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USER'S GUIDE FOR AN OPTICAL CONSTRAST SEEKER MONTE CARLO TERMINAL HOMING SIMULATION

S. L. O'Hanian, et al

Army Missile Research, Development and Engineering Laboratory
Redstone Arsenal, Alabama

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USER'S GUIDE FOR AN OPTICAL CONTRAST SEEKER MONTE CARLO TERMINAL HOMING SIMULATION

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US Army Missile Command
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This report documents the development and incorporation of a stochastic Optical Contrast Seeker Model into the existent Monte Carlo point target terminal homing 6-DOF simulation program. In addition the basic pitch and yaw seeker platform dynamics, parameter target size, seeker breaklock, seeker blind range, transport log, and helicopter induced launch transients are included. Platform imperfections such as mass unbalance and rate gyro drifts were modeled. Each data point generated by the simulation is obtained from the statistical reduction of approximately 25 individual runs (depending on number of breaklocks),

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20. ABSTRACT (continued)

each of which has new random starting and within run variations. The runs are reduced by parametric or nonparametric means, depending on the normality of the miss distance points, to yield the miss bias (mean) and the circular error probability (GEP).

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1.0 INTRODUCTION

A stochastic simulation model of an Optical Contrast Seeker (OCS) was developed and incorporated into the existent Monte Carlo point target, laser guided, terminal homing 6-DOF simulation program described in reference 2. Two OCS simulation subroutines were developed: (1) a subroutine consisting of high and low frequency poles, and (2) a simplification of the first consisting of only low frequency poles. The non-essential high frequency poles of the OCS model were eliminated to reduce computer run time. This simplified subroutine is, in general, sufficient; however, either subroutine may be used by setting the appropriate flag.

The 6-DOF simulation program was modified to include a two-dimensional target and helicopter vibrations. The target dimensions are required for study of the OCS breaklock and blind-range phenomena. The helicopter vibrations were added to describe the missile launch transients.

The updated 6-DOF simulation program may continue to be run as either a stochastic or deterministic program. In the stochastic mode, the program executes a specified number of runs*, computes miss distance coordinates from each run, and then determines the CEP and other statistical parameters from the set of miss distances. Each run of the run set is made based on both initialization error conditions (mass unbalance, etc.) and time varying error conditions (wind, etc.) that are randomly generated from input error probability distributions. In the absence of statistical input data, the operation of the 6-DOF program reverts to that of the deterministic version of the program.

Because of the addition of the two OCS subroutines and associated 6-DOF program modifications, the computer program listing contained in this document supersedes the listings found in references 1 and 2. However, the deterministic program model description and input/output formats found in reference 1 and the stochastic program description and input/output formats found in reference 2 are still valid.

---

*A run is defined as the numerical integration of a missile trajectory from launch to target plane intercept.

2.0 FUNCTIONAL DESCRIPTION

Figures 2.1 and 2.2 are the block diagram representations of the OCS simulation model, Model S2. Figure 2.1 represents the pitch channel and Figure 2.2 represents the yaw channel. The transfer functions given in these block diagrams were transformed by use of the M-method into state variable format for solution by numerical integration. A new seeker subroutine (S2) was developed to control the integration of these state variables and to perform other calculations pertinent to the OCS.

Because of the modular concept of the 6-DOF simulation program, interfacing the new subroutine required minimal effort, particularly since the input and output variables of this seeker subroutine were identical to those of the laser seeker subroutine, S1. The one exception to this was the missile-body-to-seeker-gimbal coordinate transformation matrix, since the OCS seeker mounting has been rotated 90 degrees from that of the laser seeker. This necessitated a new matrix for transformation of the line-of-sight vector (LOS) from missile body coordinates (the basic program coordinate system) to the seeker gimbal coordinate system.

Figures 2.3 and 2.4 are the block diagrams of the simplified model, Model S3, containing only the low frequency components with the high frequency blocks replaced by their appropriate gains. This simplification, in effect, neglects the small amplitude high frequency oscillations of the system which are superimposed on the more significant, lower frequency dynamics. The simplification evolved as a consequence of the very long computation time required when running Model S2. The high frequencies of 314 and 1000 rad/sec of Model S2 require a numerical integration step size of .5 millisec, while Model S3 is integrated accurately at a step size of 12.5 millisec. This translates directly into a factor of 25 difference in run time, and there is no significant loss of accuracy when using Model S3. In comparison runs that were made, less than three percent differences in miss distance and CEP were observed.

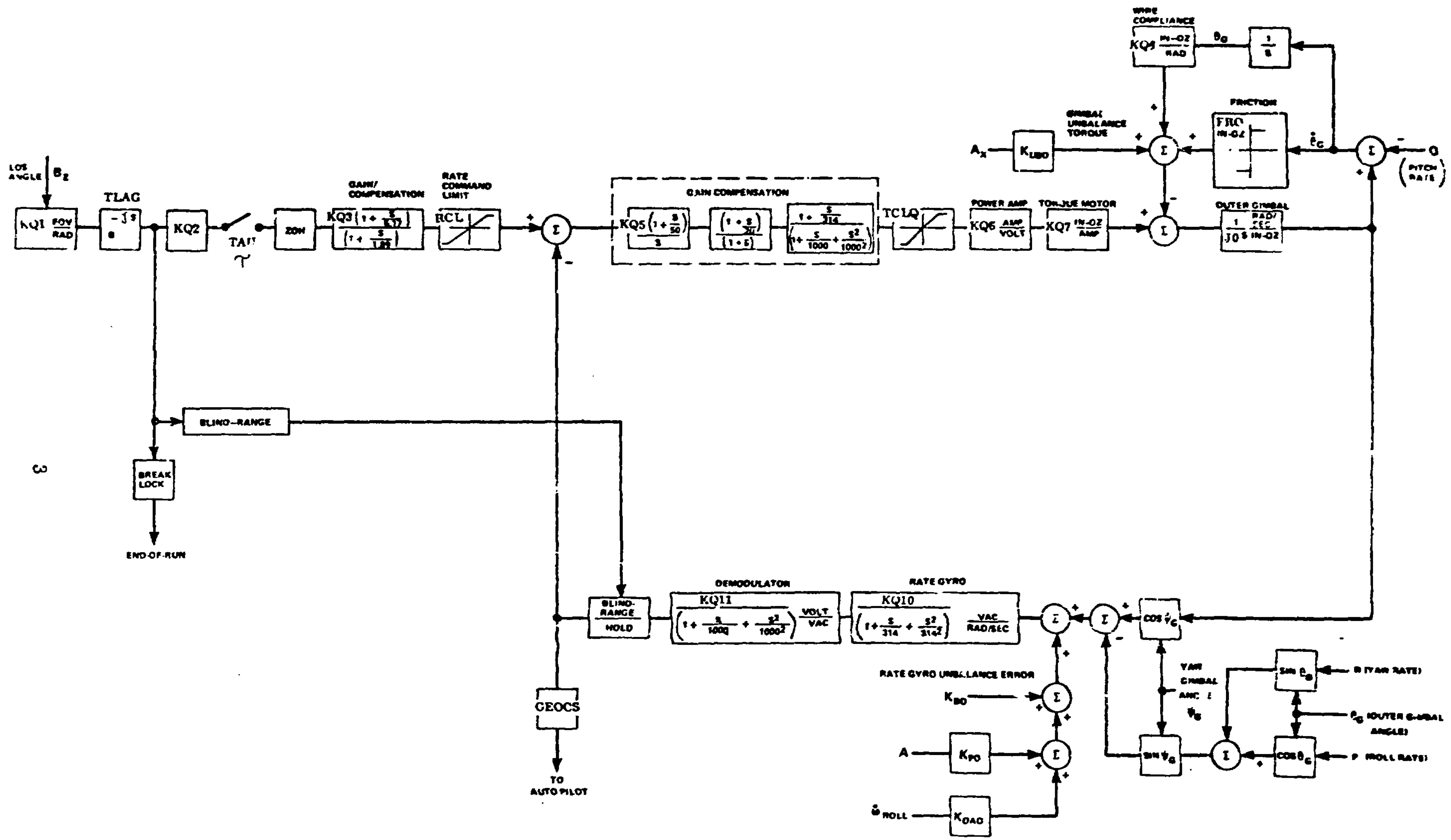


FIGURE 2.1. OCS Simulation Model (S2) - Pitch Channel

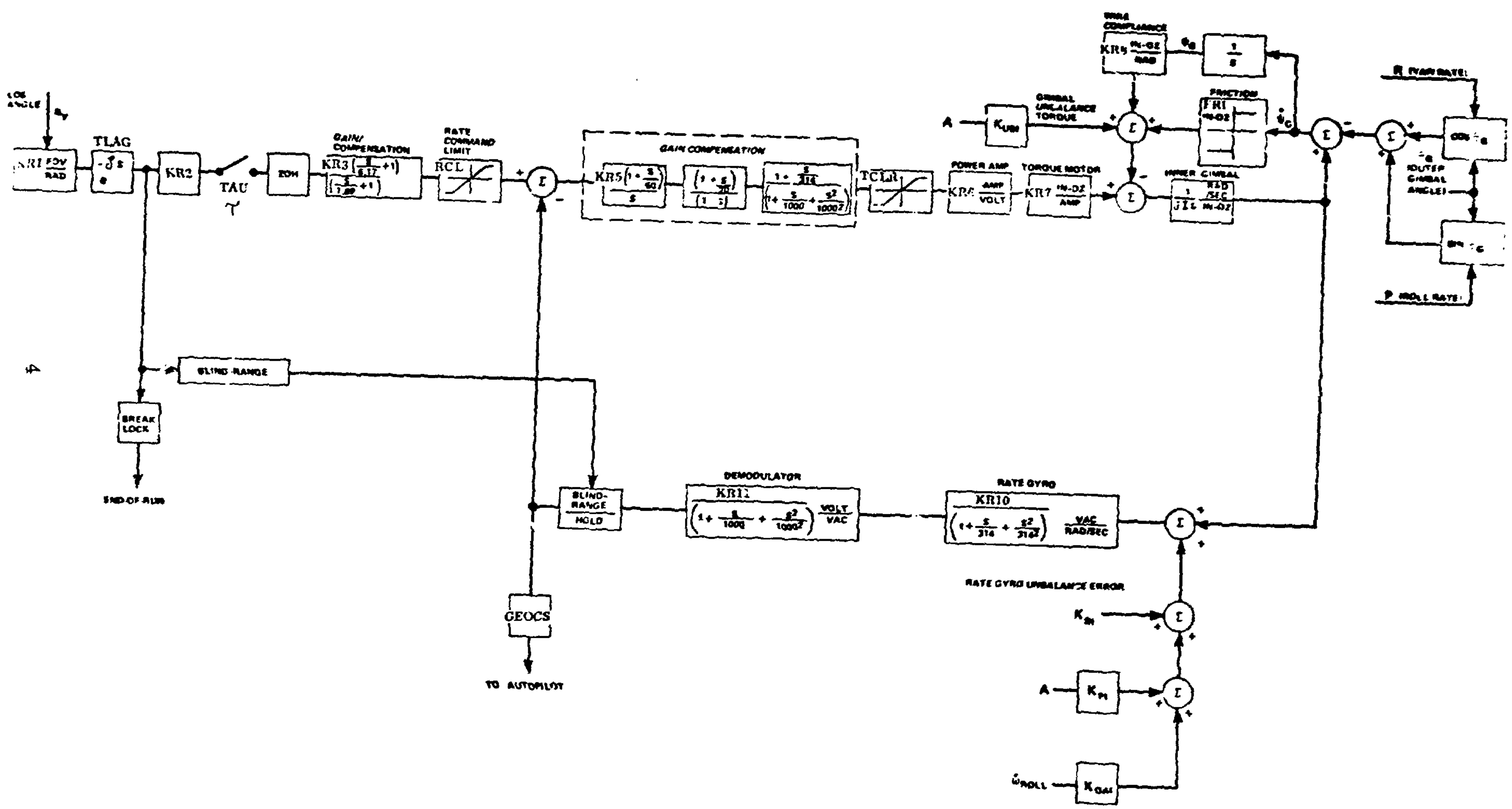


FIGURE 2.2. OCS Simulation Model (S2) - Yaw Channel

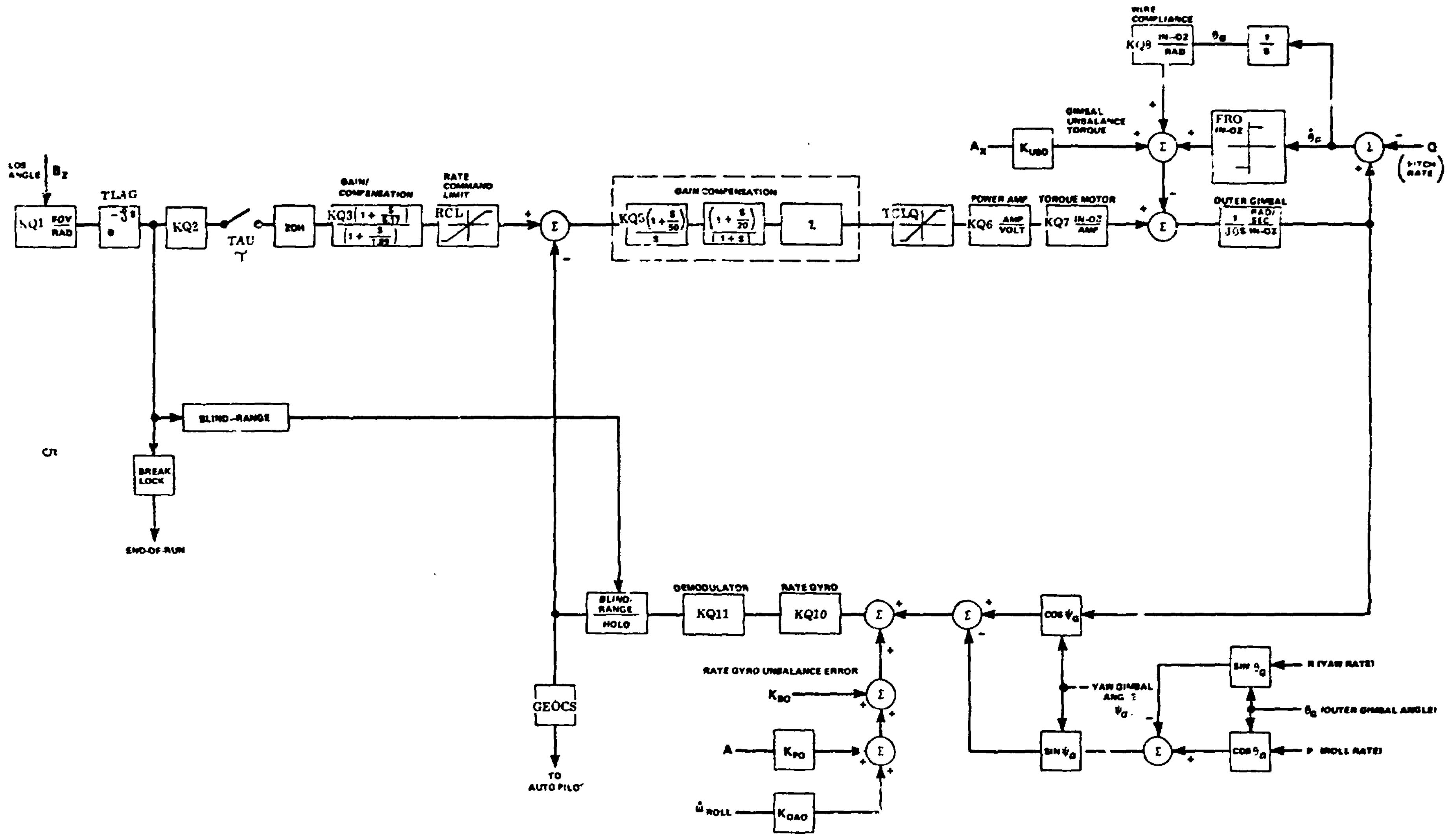


FIGURE 2.3. Simplified OCS Model (S3) - Pitch Channel

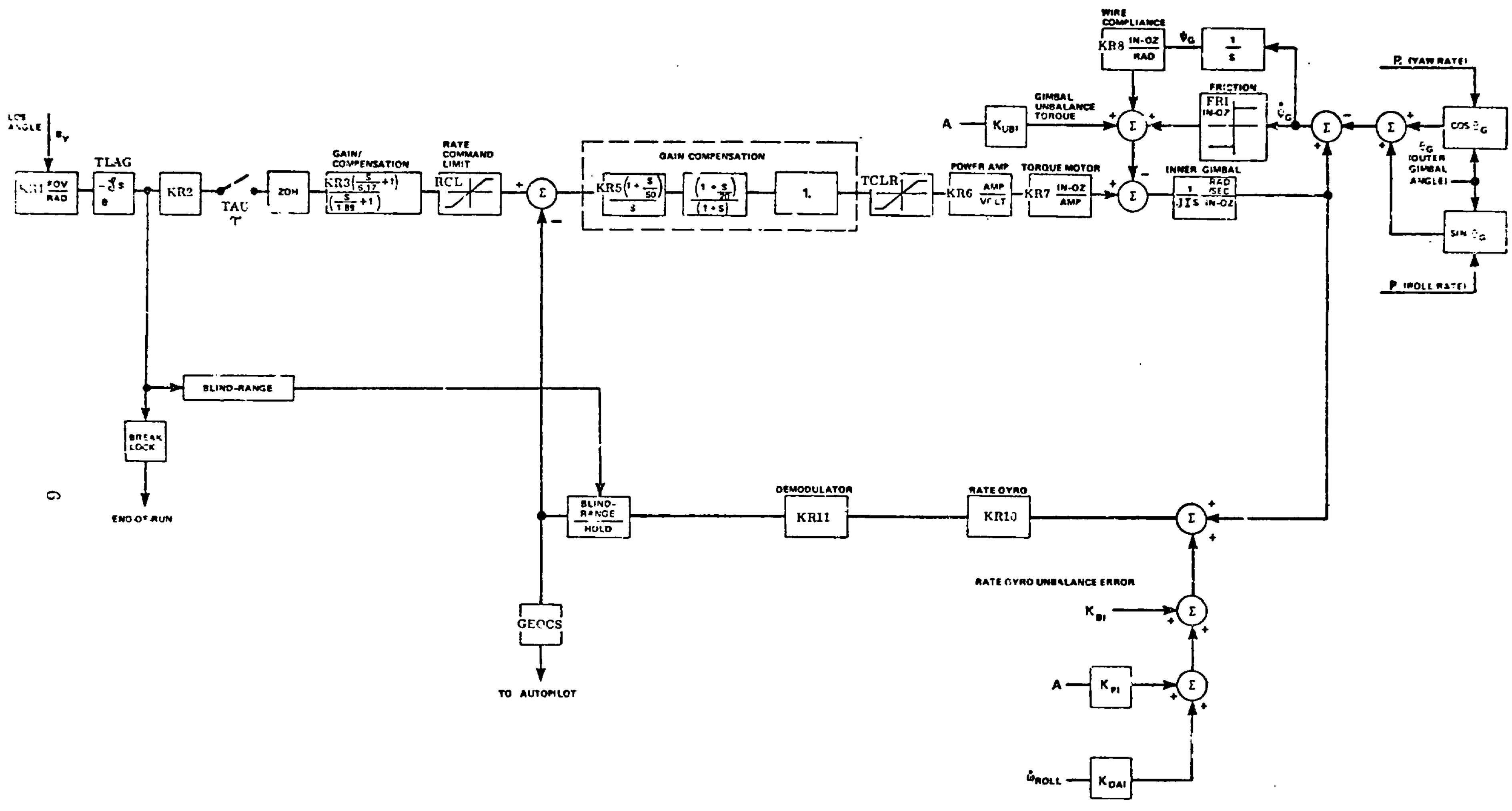


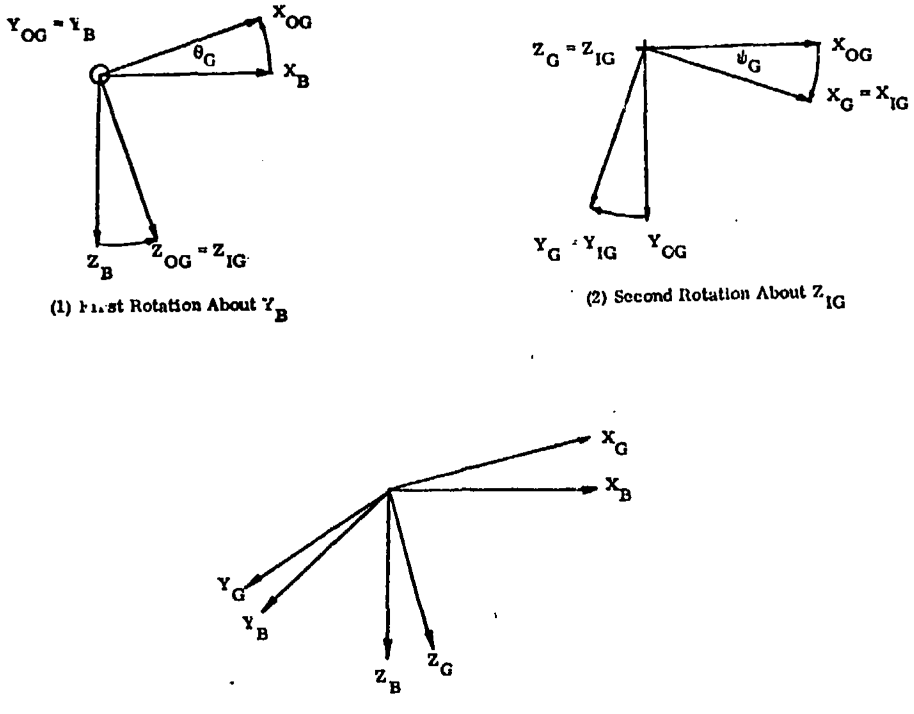
FIGURE 2.4. Simplified OCS Model (S3) - Yaw Channel

2.1 Transformation Matrix

The seeker gimbal coordinate system (X_G, Y_G, Z_G) is given in Figure 2.5 with respect to the missile body coordinate system (X_B, Y_B, Z_B). The order of rotation is (1) a rotation about Y_B through the outer gimbal angle θ_G, then (2) a rotation about Z_G through the inner gimbal angle Ψ_G.

The missile body-to-seeker gimbal coordinate system transformation matrix for this rotation sequence is:

$$[M]_G = \begin{bmatrix} (\cos\theta_G \cos\psi_G) & \sin\psi_G & (-\cos\psi_G \sin\theta_G) \\ (-\cos\theta_G \sin\psi_G) & \cos\psi_G & (\sin\psi_G \sin\theta_G) \\ \sin\theta_G & 0 & \cos\theta_G \end{bmatrix} \qquad \text{Eq. 2.1}$$



(1) First Rotation About Y_B

(2) Second Rotation About Z_{IG}

(3) Missile Body/Gimbal Coordinate System

FIGURE 2.5. Coordinate Rotation

2.2 OCS Support Models

In addition to incorporation of the pitch and yaw axis OCS models into the 6-DOF program, other critical parameter models unique to the OCS were added. These parameter models are listed below and described in the following sections:

- Gimbal friction
- Target size
- Seeker breaklock
- Seeker blind range
- Transport lag
- Helicopter induced launch transients

2.2.1 Gimbal Friction Model

Gimbal friction couples the missile angular rates to the OCS platform and may cause system degradation. Gimbal bearing pre-load and the gimbal torque motor are the main contributors of this friction which is primarily stiction (static) and coulomb. Coulomb friction is defined as a constant frictional drag which opposes motion but has a magnitude that is independent of velocity. A slight distinction must be made between stiction and coulomb friction because, in general, the force required to initiate motion (overcome stiction) is somewhat greater than the coulomb friction. When the stiction level is identical to the coulomb friction and the system starts at rest, any applied force to the gimbal less than this value must be identically opposed so that no motion is initiated. Thus, the idealized coulomb friction model, $T_F = T_C \, \mathrm{sgn}(\dot{\theta}_G)$, can create a physically impossible situation where the friction model supplies energy to the system. As mentioned previously, the missile rates (r. ually, accelerations or torques) are directly coupled to the platform through the effects of friction, although the coupling is limited in magnitude by the friction level.

Figure 2.6 is a block diagram representation of the pitch gimbal friction model. The opposing friction, T_F, is a function of the coulomb friction, T_C; the net torque, T_N; and the relative gimbal rate, $\dot{\theta}_G$. (Stiction is assumed identical to the coulomb magnitude.) The missile angular acceleration, $\dot{Q}$, is coupled to the platform through the function f_2 which is magnitude limited. The complete mathematical description is:

For $|\dot{\theta}_G| \leq \Delta$, where Δ is a computational dead zone and the system is considered at rest,

$$T_F = T_N \operatorname{Sat}(T_C) \qquad \text{Eq. 2.2}$$

$$\dot{Q}_A = \dot{Q} \operatorname{Sat} \frac{T_F + T_C \operatorname{Sgn}(\dot{Q})}{J}, \text{ where J is gimbal inertia.} \qquad \text{Eq. 2.3}$$

For $|\dot{\theta}_G| > \Delta$

$$T_F = T_C \operatorname{Sgn}(\dot{\theta}_G) \qquad \text{Eq. 2.4}$$

$$\dot{Q}_A = 0 \quad \text{where } \dot{Q}_A \triangleq f_2 (T_C, T_N, \dot{Q}, \dot{\theta}_G)\, \dot{Q} \qquad \text{Eq. 2.5}$$

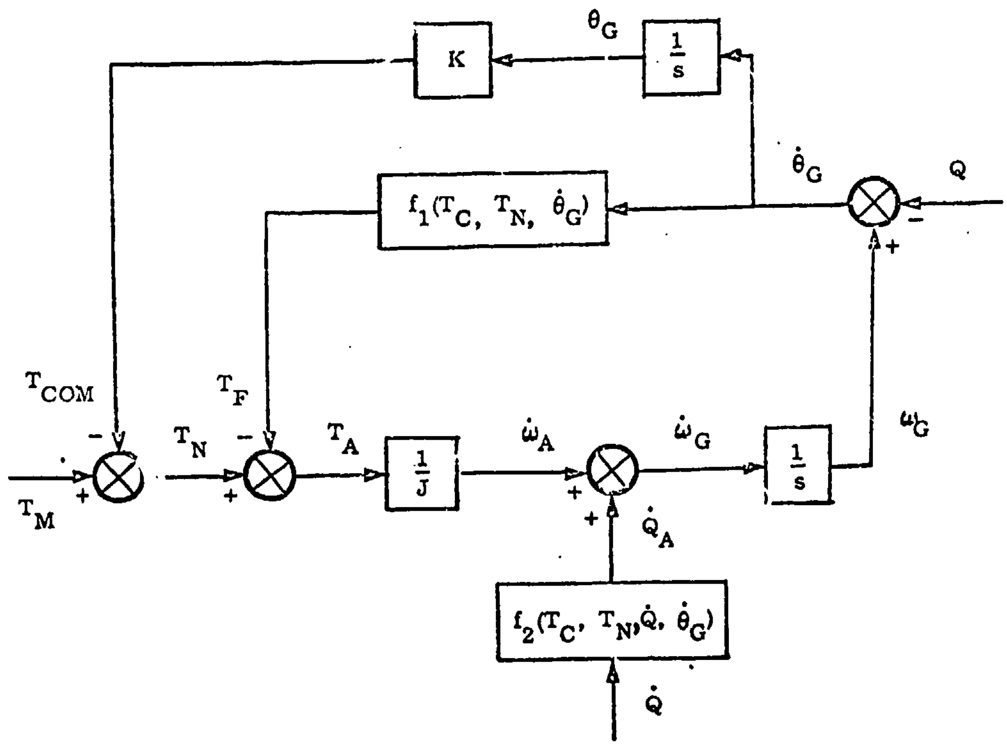


FIGURE 2.6. GIMBAL FRICTION MODEL

Figure 2.7 is a time history of the torque motor output. For this illustration, $\dot{\theta}_G$ is initially zero and θ_G is positive. To initiate motion, the torque motor had to exceed the coulomb friction level and the wire compliance torque. Figure 2.8 shows the missile acceleration, $\dot{Q}$, and the gimbal acceleration, $\dot{\omega}_G$. Observe that the gimbal angular acceleration tracks the missile angular acceleration until the torque motor exceeded the breakaway torque level.

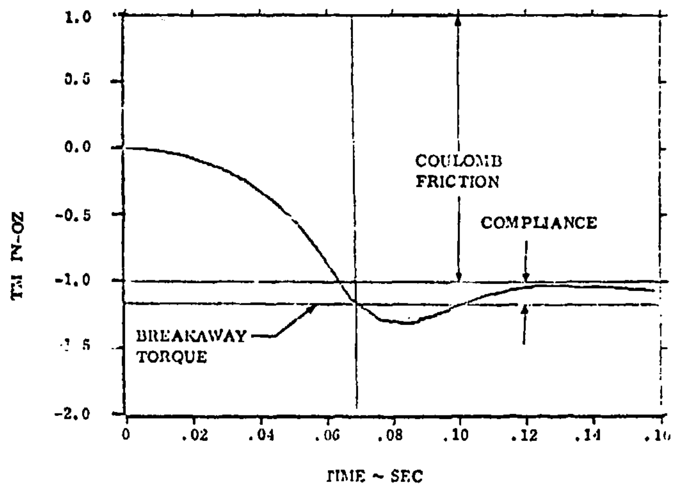


Figure 2.7. Pitch Channel Torque Motor Output

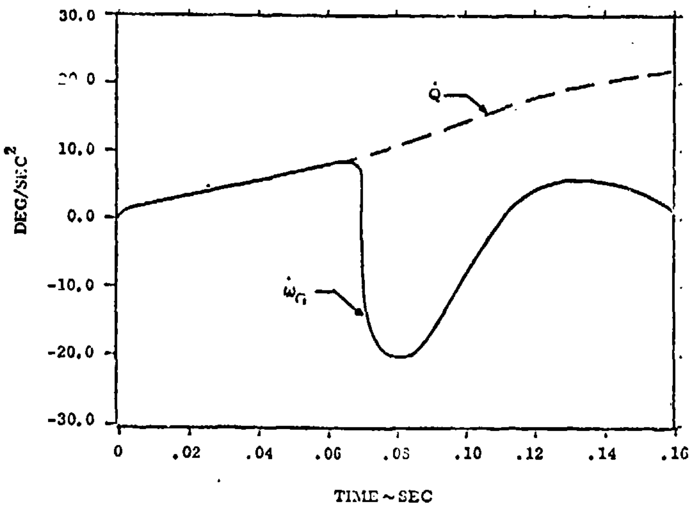


Figure 2.8. Missile Pitch and OCS Outer Gimbal Inertial Angular Acceleration

2.2.2 Target Model

A two dimensional target model was incorporated into the program for the purpose of computing seeker breaklock (Section 2.2.3) and blind range (Section 2.2.4). The dimensionality of the target does not affect any other missile or seeker parameter.

The target model is defined by the shaded area in Figure 2.9 and due to the dimensionality is restricted to be normal to the line-of-sight of the missile. The outer rectangle represents the seeker field-of-view (FOV) and the intersection of the dashed lines the instantaneous seeker aimpoint. The top and bottom of the target are always parallel to the raster lines of the vidicon screen of the seeker. Thus, for this elementary model, if the seeker rolls, the target rolls. The line-of-sight vector intersects the target at its geometric center.

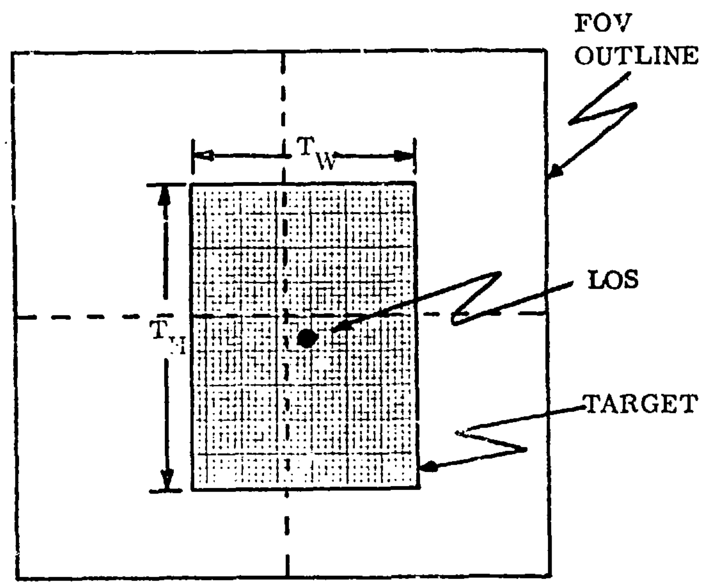


FIGURE 2.9. Target Model

2.2.3 Seeker Breaklock

Seeker breaklock (loss of target image) is assumed* to occur when seeker aimpoint shifts more than 50 percent of target height or width during one sample period, τ. Seeker aimpoint is defined as the projection of seeker boresight onto the target plane. Figure 2.10 illustrates the geometry of the breaklock parameter, aimpoint shift.

S_T is the total amount of seeker aimpoint shift over the sample period τ. S_H and S_W are the components of S_T that parallel target height T_H and width T_W, respectively. If S_H becomes greater than .5 T_H or if S_W becomes greater than .5 T_W, it is assumed that breaklock has occurred. When breaklock does occur, the simulation run is terminated because breaklock causes loss of the missile as far as homing in on the target is concerned.

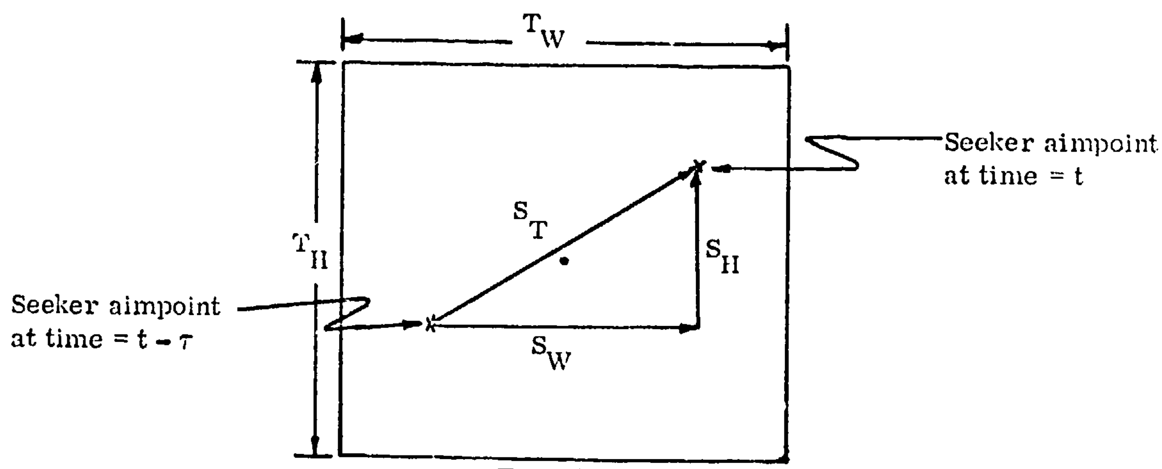


FIGURE 2.10. Seeker Aimpoint Shift

*This assumption is valid for a target-to-range ratio as low as .001.

In the simulation program, breaklock is determined from the angles subtended by the target sides/slant range and aimpoint shift/slant range. Thus, for pitch, the angle*

$$\theta_{TH} = \tan^{-1}[(T_H/2)/R] \qquad \text{Eq. 2.6}$$

and the angle

$$\Delta_Z = (\beta_{Z_t} - \beta_{Z_{t-\tau}}) \qquad \text{Eq. 2.7}$$

are compared at the end of each sample period, τ. If Δ_Z becomes greater than θ_{TH}, breaklock conditions are met.

The variables in the above equation are defined as:

- R – slant range
- θ_{TH} – angle subtended by slant range and one half the target height
- $\beta_{Z_{t-\tau}}$ – angle subtended by pitch plane component of LOS (S_H) and seeker boresight, one sample period back in time
- β_{Z_t} – angle subtended by pitch plane component of LOS (S_H) and seeker boresight, at the current time
- Δ_Z – angular shift of aimpoint over one sample period

When breaklock is encountered, the message below is printed out and the run is terminated. The time (seconds), range (feet from target), and the channel in which breaklock occurs is output.

```
*****************************************************************************
BREAK LOCK CONDITION AT TIME =     .73 RANGE =    9715.04 IN PITCH
*****************************************************************************
```

An example of seeker aimpoint shift is given in Figure 2.11. This figure contains a time history of seeker aimpoint shift for a 1 kilometer deterministic trajectory. No errors (such as gimbal mass unbalance, launch transients, rate gyro drift, etc.) were present when this run was made. The sample period was 16.7 millisec. The breaklock point (50 percent of

*Comparable calculations are made in the yaw plane to determine if breaklock occurs there.

target) currently in use in the simulation program is illustrated in the figure. If any of the spikes on the curve had reached the 50 percent point, the trajectory would have been terminated. As noted for this particular example, the maximum boresight shift was about ten percent.

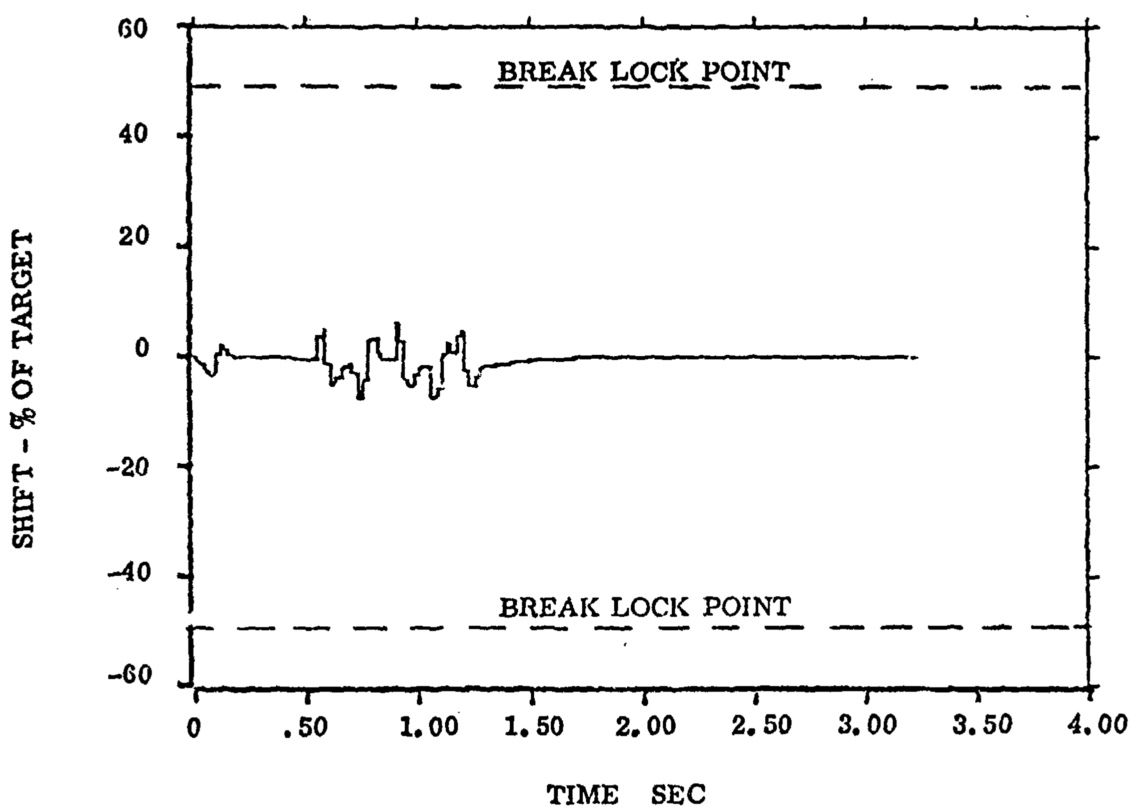


FIGURE 2.11. Seeker Breaklock Time History

2.2.4 Seeker Blind Range

Seeker blind-range is defined as the distance from the target when the target image occupies 70-80 percent of the tracker vidicon field-of-view (FOV). The actual blind-range limit is adjustable and is currently preset for 70 percent FOV.

To determine if a blind-range condition occurs, gating functions are established to check the target edges with respect to the 70 percent FOV lines as shown in Figure 2.12. However, with this implementation, blind-range is a function of the LOS angle, as well as target growth. Figure 2.13 is a time history of target edge in one axis with respect to the vidicon FOV. The general shape of the curve is due to target growth while the perturbations are caused by the LOS angle variations. The program monitors all four edges at each integration step to determine if any one edge has reached the blind-range limit. Nominally, this limit is set at 70 percent FOV, but is a program variable that may be input at any desired value. When the blind-range limit has been reached, the seeker rate gyro's output signals to the autopilot are held at their present value. Thus, the missile no longer responds to commands generated by the seeker, but instead, flies into the target with the autopilot signals set at the blind-range value. In Figure 2.13, blind-range occurred at 3.01 seconds. When blind-range occurs, the following message is printed out:

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
CCS BLIND RANGE SIGNAL HOLD AT TIME  =   3.01  RANGE =         225.00
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

Time is in seconds of flight and range is in feet from target.

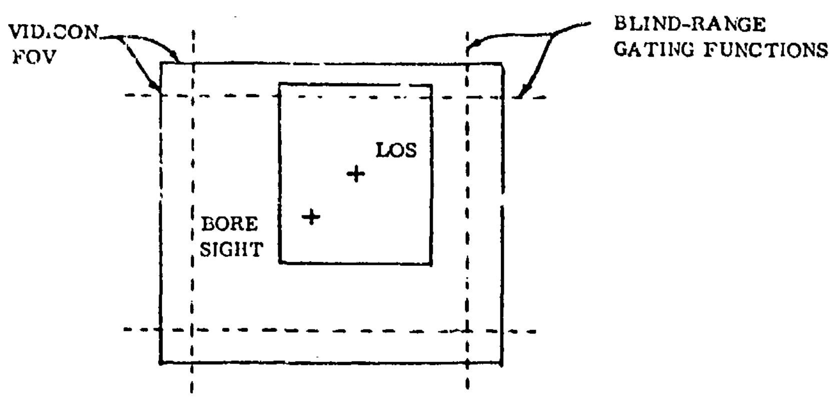


FIGURE 2.12. Blind-Range Due to LOS and Target Growth

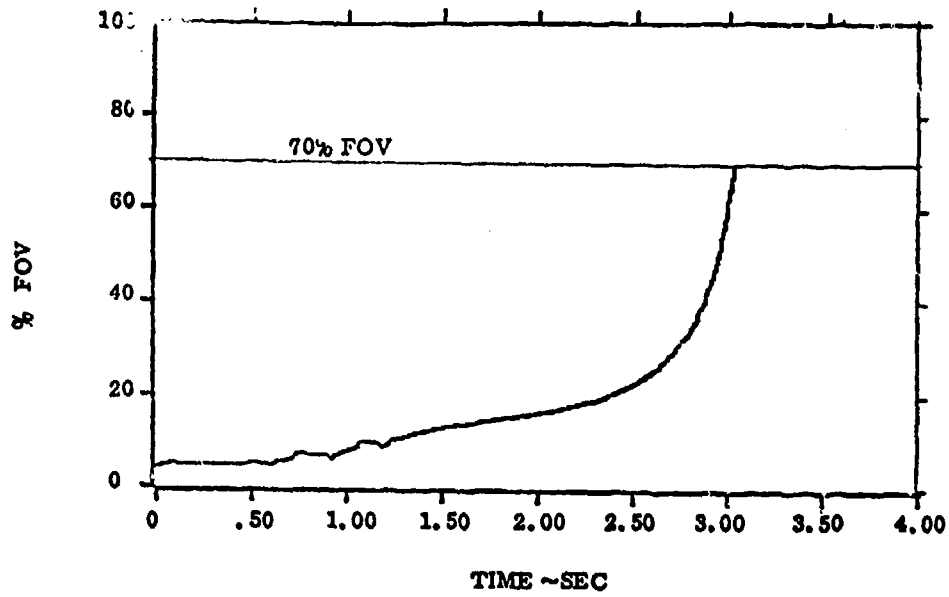


FIGURE 2.13. Target Image Growth in Seeker FOV

2.2.5 Transport Lag Implementation

The exponential, $e^{-\zeta s}$, in the second block of each of the block diagrams of Figures 2.1, 2.2, 2.3, and 2.4 represents a transport lag in the camera of the OCS. The actual phenomena that this term models is unknown at the present; however, it closely approximates the effects required to match OCS subsystem test data. Implementation of this lag was accomplished as follows:

- The last six time points of the LOS angle (BZ and BY) are stored in a storage array.
- A table look up function interpolates linearly within the stored values to return the values of BZ and BY at the lag time (TIME - TLAG).
- The interpolated values of the LOS angles are then used by the OCS model as the target position for guidance calculations.

2.2.6 Launch Transients

Missile pitch, yaw, and roll launch transients caused by helicopter vibration and launcher rail/missile shoe interaction were modeled because these transients could severely affect the condition of seeker breaklock. Typical launch transient data from which the models were developed are given in reference 3. Examination of this data reveals that pitch and yaw characteristics are similar. Thus, pitch and yaw perturbations are simulated from similar transient models. Roll transients are presented as plots of roll angle versus time. Roll transients appear to exhibit different characteristics from those of pitch and yaw, thus roll is modeled separately. An example of the plots as presented in reference 3 is given in Figure 2.14.

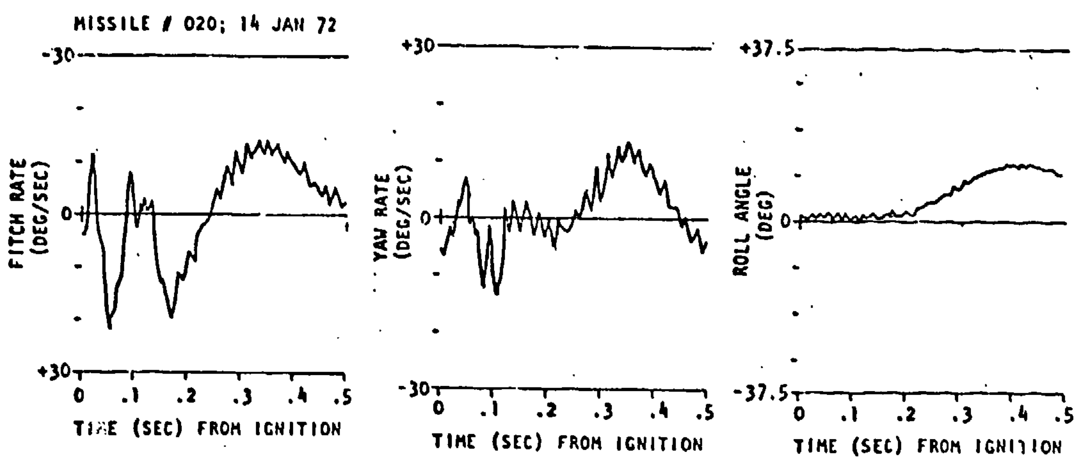


FIGURE 2.14. Typical Launch Transients

In addition to the data of reference 3, telemetry data relating to pitch and yaw, in the form of undocumented strip charts for pitch and yaw rates and a power spectral density (PSD) plot of rate-gyro output in pitch, were available to aid in model development. These telemetry data were taken from a captive flight test of the anti-tank missile mounted on a helicopter launcher. A reproduction of the PSD is shown in Figure 2.15.

2.2.6.1 Pitch, Yaw, and Roll Models

2.2.6.1.1 Pitch Model

In modeling the pitch launch transients, the helicopter vibration was assumed to be a pitching moment applied to the launch rail and coupled to the missile through the rail shoes. Since the power spectral density (PSD) of the pitch rate gyro output, Figure 2.15, has distinct frequencies; the pitching moment was modeled as a harmonic forcing function and is applied until the rear shoe exits the launch rail (tip-off point). The forcing function is defined as:

$$F(t) = A_m \cdot \epsilon^{A_e t} \cdot \sum_{i=1}^{n} A_i \sin(\omega_i t + \Phi_i) \qquad \text{Eq. 2.8}$$

where

ω_i - frequency ($2\pi f_i$)

Φ_i - phase angles initialized randomly from a 0 to 2π uniform distribution

A_i - peak amplitudes

A_e - time constant which spreads the PSD about the discrete frequencies

A_m - scale factor

The relationships between the peak amplitudes, A_i, were determined by comparing the peak amplitudes of the PSD at the desired frequencies. However, these values are the pitch rate densities in $(rad/sec)^2/hz$ and need to be related to the equivalent autocorrelation values. Since the autocorrelation function, R(0) is related to the PSD by

$$R(0) = \int_{-\infty}^{\infty} PSD\,(f)\,df$$

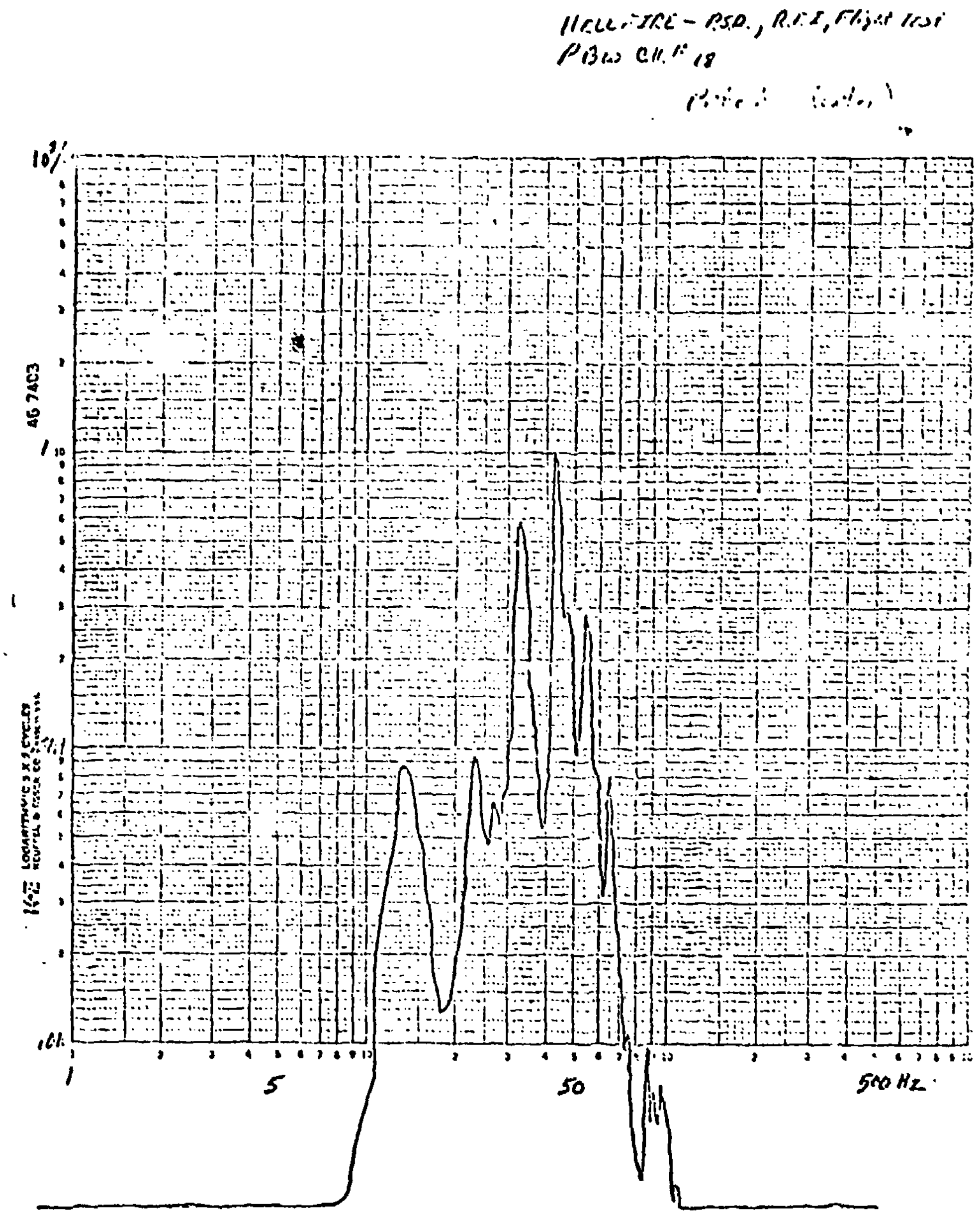


FIGURE 2.15. Power Spectral Density of Rate Gyro Output-Helicopter Mounted Captive Flight Test

It can be shown that with an ideal bandpass filter of bandwidth, BW, we can relate the autocorrelation values, A_i, to the PSD values, B_i, by

$$A_i^2 = BW \cdot B_i$$

Using the first four (n = 4) predominant frequencies of the PSD given in Figure 2.15

$$f_i = \{11, 22, 33, 44\}$$

and their peak values

$$B_i = \{.085, 0.10, 0.56, 1.0\}$$

the autocorrelation values are calculated with BW = 500 hz as

$$A_i = \{6.5, 6.7, 16.7, 22.4\}$$

Using the time constant, $A_e = -1$, to spread the spectral densities about each frequency, the scale factor, A_m, was determined by calculating* the autocorrelation function, Figure 2.16, of the simulation rate gyro output signal and comparing it to the telemetry PSD, Figure 2.15. A reasonable match was obtained with all the telemetry data with

$$A_m(\text{pitch}) = 10 \text{ FT-LBS}$$

and

$$A_i = \{1, 4, 12, 26\}.$$

Example time histories of F(t), the pitch rate, and the rate gyro output are shown in Figure 2.17, 2.18, and 2.19, respectively. The missile was constrained to the launch rail for these runs.

An example of a pitch rate time history of the missile (not constrained to the rail) for the first one-half second of flight is given in Figure 2.20. Front shoe exit time is .086 seconds and rear shoe exit time (tip-off time) is .112 seconds.

2.2.6.1.2. Yaw Model

The pitching moment forcing function and coefficients were assumed applicable for yaw. The peak amplitude, A_m, of yaw moment was determined in similar manner as pitch. A_m (yaw) was adjusted to give a reasonable match between the peak-to-peak yaw rates of the simulation program and the peak-to-peak rates given in reference 3. An example of a yaw rate time

---

* The autocorrelation function was calculated with the Time Series Analysis Program (TSAP), Reference 4.

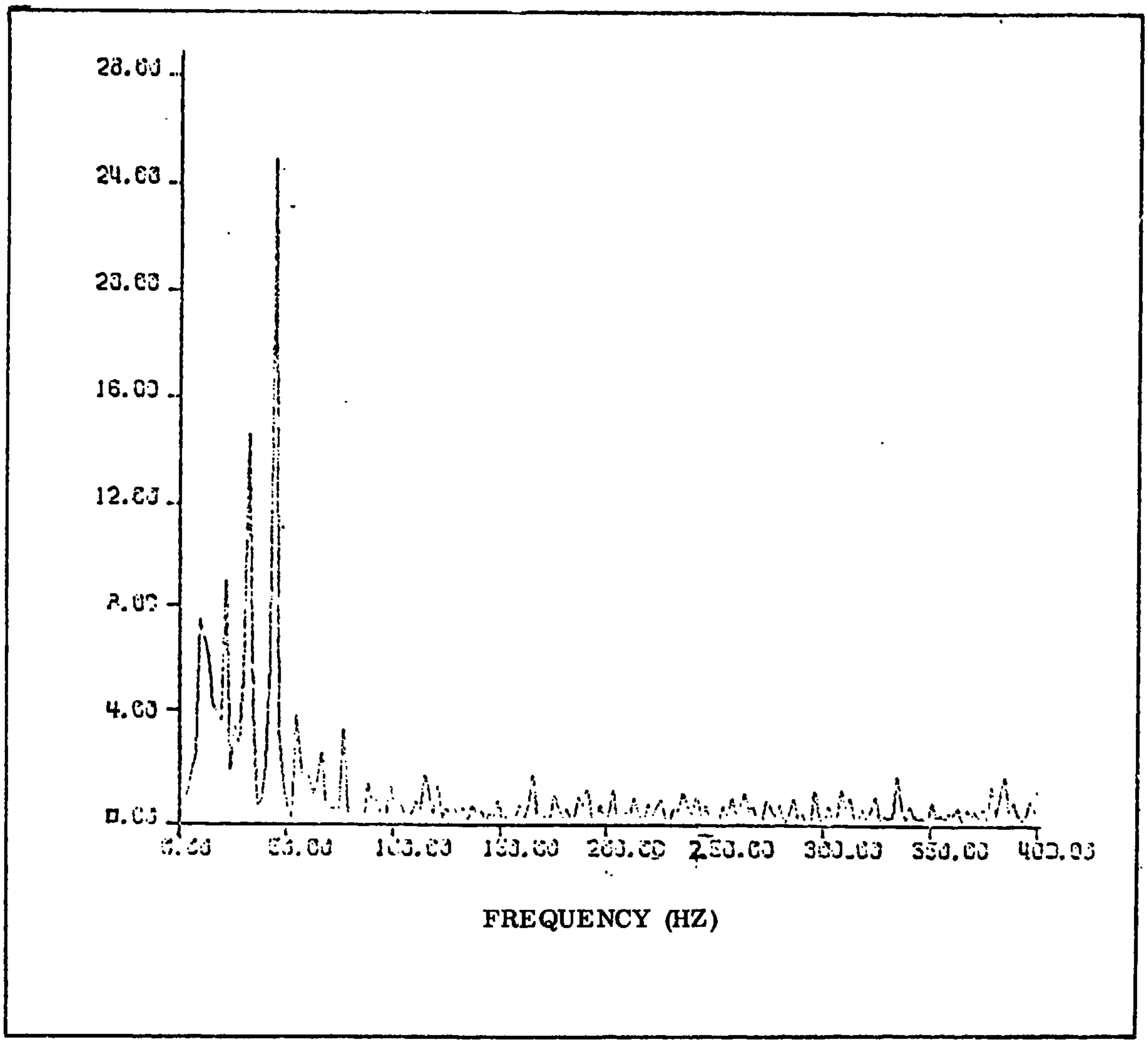


Figure 2.16. Autocorrelation Function of Rate Gyro Output - Simulation Model

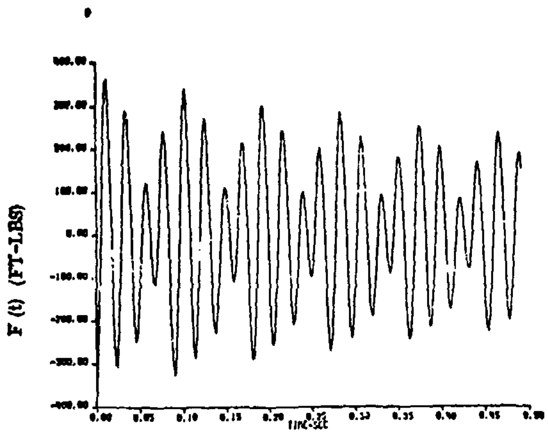


FIGURE 2. 17. Moment Forcing Function Time History

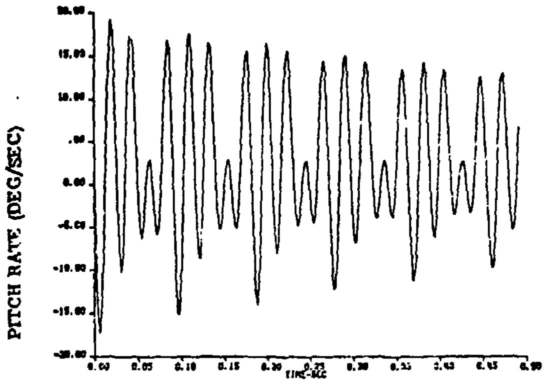


FIGURE 2.18. Pitch Rate Time History

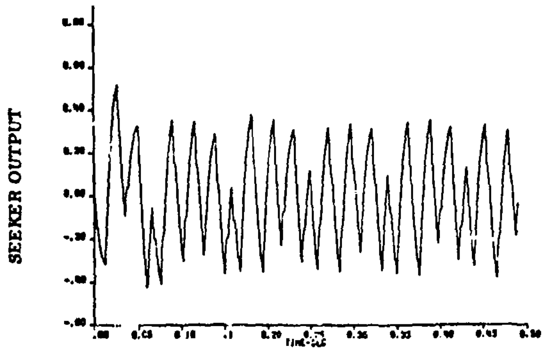


FIGURE 2.19. Output to Autopilot Time History

history is given in Figure 2.21. The best value obtained for the yaw rate amplitude coefficient was:

$$A_m \text{ (yaw)} = 4 \text{ FT-LBS.}$$

2.2.6.1.3. Pitch and Yaw Rate Initialization

As long as the missile is on the launch rail and the pitch and yaw moments are being applied, the pitch and yaw rates are directly proportional to the integral of F(t). Integrating F(t) results in the following equation, H(t).

$$H(t) = A_m \cdot \epsilon^{A_e t} \cdot \sum_{i=1}^{n} \left\{ \frac{A_i}{A_e^2 + \omega_i^2} \cdot [A_e \sin(\omega_i t + \Phi_i) - \omega_i \cos(\omega_i t + \Phi_i)] \right\} \qquad \text{Eq. 2.9}$$

The proportionality constants for pitch and yaw are the moments of inertia about the appropriate rotational axes. Thus,

$$\omega_Q = \frac{H(t)_Q}{I_Y} \qquad \text{Eq. 2.10}$$

$$\omega_R = \frac{H(t)_R}{I_Z} . \qquad \text{Eq. 2.11}$$

where

$H(t)_Q$ - refers to the pitch rate equation
$H(t)_R$ - refers to the yaw rate equation
I_Y - moment of inertia about Y axis
I_Z - moment of inertia about Z axis

Equations 2.10 and 2.11 are solved at time = 0 to determine the correct initial values of pitch and yaw rate so that the time functions of pitch and yaw are in phase with the moment time function F(t). (This is equivalent to solving for the constant of integration of a differential equation.) Pitch and yaw rates are not determined by Eq. 2.10 and 2.11 except for initialization. Instead, the forcing function F(t) is numerically integrated along with all other differential equations in the program.

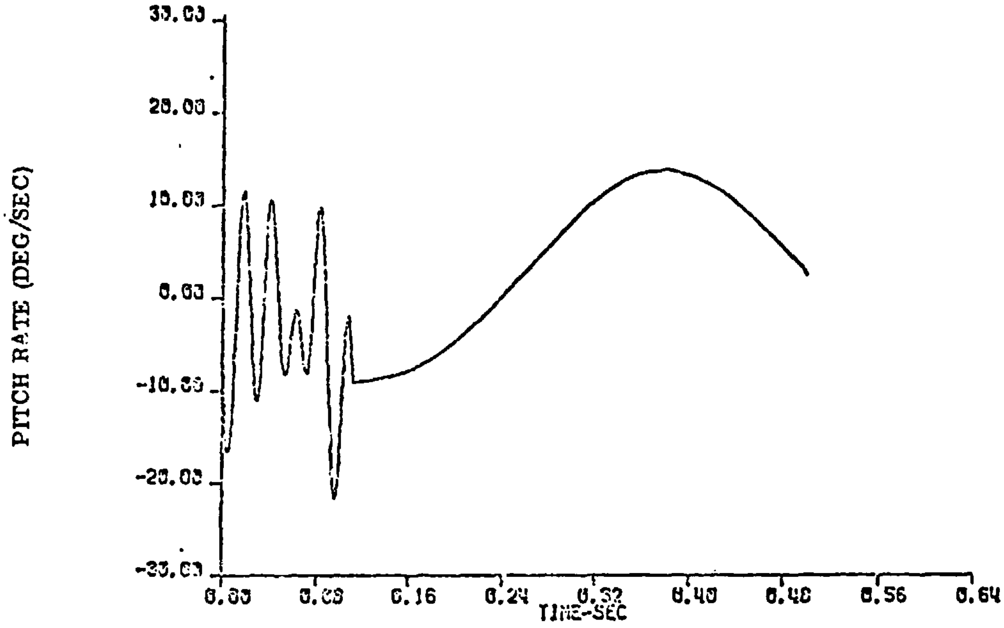


FIGURE 2.20. Simulation Model Pitch Launch Transient

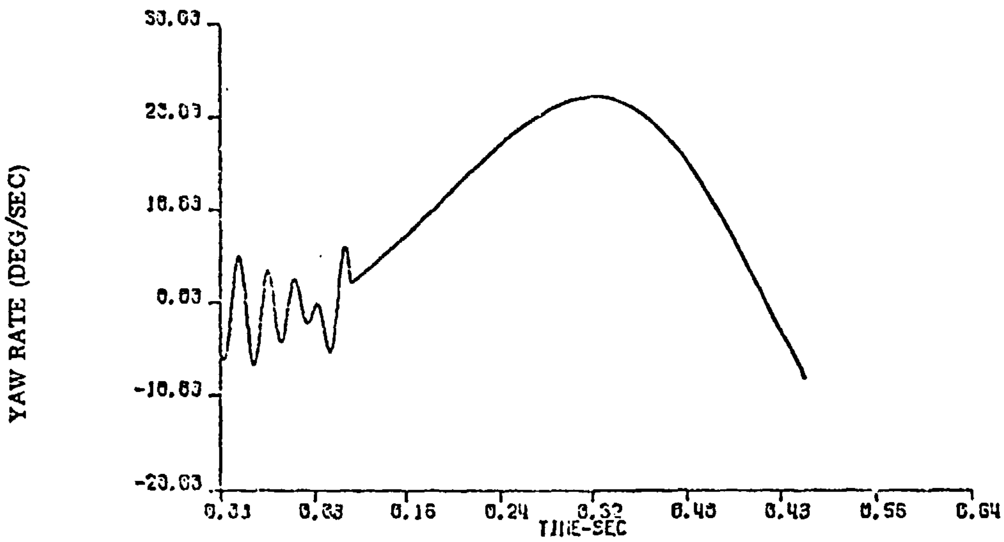


FIGURE 2.21. Simulation Model Yaw Launch Transient

2.2.6.1.4 Roll Model

Roll transients were modeled based solely on the data given in reference 3. No additional data on roll was available. All roll data plotted in reference 3 is given in roll angle; however, as with pitch and yaw, the roll transient was modeled as a roll moment. A roll moment model was developed that produced roll angles that matched typical roll angle characteristics as given in the reference. *

Examination of the slopes of the plots of reference 3 reveal that for all practical purposes, roll rate is zero until the front shoe exits the launch rail. Roll rate then begins to build up until a maximum roll angle is reached between .3 and .4 seconds. Once off the rail, roll angle varies about a mean value established when the autopilot gyros were uncaged. The oscillation about this mean is caused by the roll stabilization system.

The roll transient model developed assumes a zero roll rate and a zero roll acceleration (zero) moment applied) until front shoe exits the launch rail, as shown in Figure 2.22. Following front shoe exit, a roll moment (F_{MX}) is computed based on the difference between front and rear shoe exit times (Δt) and the desired rear shoe exit roll rate (tip-off roll rate, ω_{PTO}), or:

$$F_{MX} = (\omega_{PTO} \cdot I_X)/\Delta t \qquad \text{Eq. 2.12}$$

where I_X is the moment of inertia about the longitudinal axis and ω_{PTO} is specified by the user. The exit time difference (Δt) is .026 sec for this missile simulation.

The roll moment (F_{MX}) is applied to the missile from the time of front shoe exit to the time of rear shoe exit. Integration of the roll acceleration due to F_{MX} results in the tip-off roll rate ω_{PTO}. Immediately following rear shoe exit, all transient models are zeroed out and the simulation reverts to 6-DOF guided flight. An example roll angle time history resulting from this model is shown in Figure 2.23.

---

* Modeling of roll transients is critical because of the interaction between seeker breaklock and roll acceleration. Seeker breaklock is influenced by roll acceleration through the roll coupling term of the seeker rate gyro output axis. This output axis is directed along the roll axis of the missile.

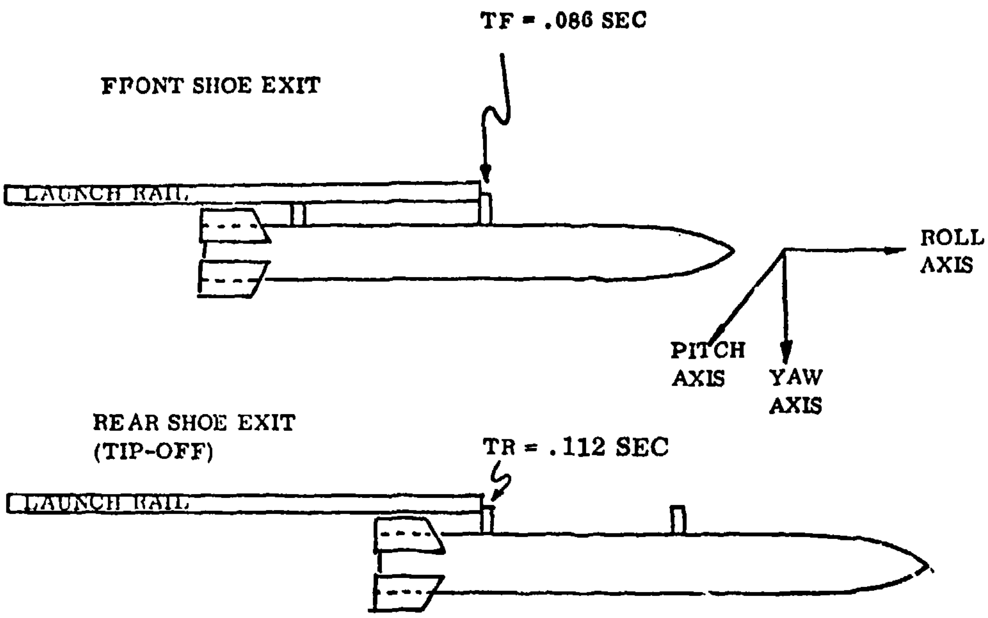


FIGURE 2.22. Launcher/Missile Configuration

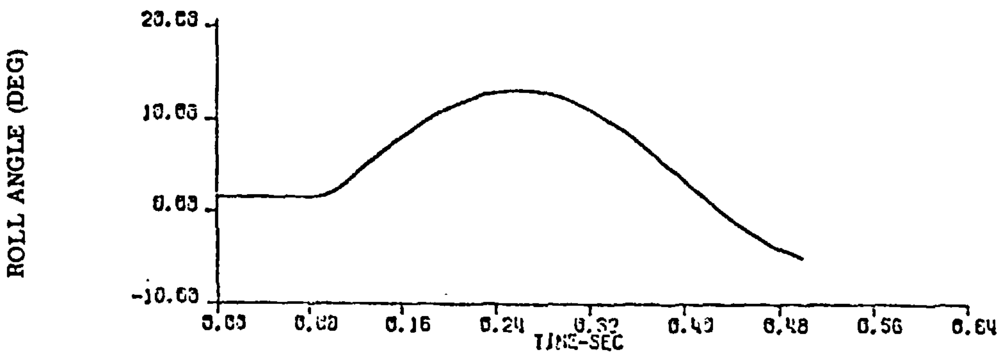


FIGURE 2.23. Simulation Model Roll Launch Transient

2.3 Input Variable Description

2.3.1 OCS Input Variable Description

The following list identifies all variables of the OCS seeker subroutines (S2 and S3) that can be input by 3-cards.* Variable names beginning with K are the gains shown in the block diagrams of Figures 2.1 and 2.2. Variable names beginning with W are the frequency components given in Figures 2.1 and 2.2. The frequency variable names themselves do not appear in the figures. Instead, actual frequency values are shown. However, these variables may still be input by 3-cards. The variable name and its position in the block diagram can be correlated by the frequency values tabulated below in the second column.

FORTRAN SYMBOL	SYMBOL USED IN TEXT	C INDEX	DEFINITION
KQ1	KQ1	545	
KQ2	KQ2	547	
KQ3	KQ3	549	
KQ5	KQ5	551	
KQ6	KQ6	553	PITCH CHANNEL GAINS
KQ7	KQ7	555	
KQ8	KQ8	557	
KQ10	KQ10	559	
KQ11	KQ11	561	
KQ12	KQ12	563	
KR1	KR1	546	
KR2	KR2	548	
KR3	KR3	550	
KR5	KR5	552	
KR6	KR6	554	YAW CHANNEL GAINS
KR7	KR7	556	
KR8	KR8	558	
KR10	KR10	560	
KR11	KR11	562	
KR12	KR12	564	

Input description continued on next page.

* See reference 1 for definition and use of 3-cards.

FORTRAN SYMBOL	SYMBOL USED IN TEXT	C INDEX	DEFINITION
WTQ1	6.17	573	
WTQ2	1.89	575	
WGQ1	50.	577	
WGQ3	20.	581	
WGQ4	1.	583	PITCH CHANNEL FREQUENCIES
WGQ5	314.	585	
WGQ6	1000.	587	
WRQ2	314.	591	
WRQ4	1000.	595	
WTR1	6.17	574	
WTR2	1.89	576	
WGR1	50.	578	
WGR3	20.	582	
WGR4	1.	584	YAW CHANNEL FREQUENCIES
WGR5	314.	586	
WGR6	1000.	588	
WRR2	314.	592	
WRR4	1000.	596	
RCL	RCL	597	Rate command limit in pitch and yaw
TCLQ	TCLQ	598	Torque command limit in pitch
TCLR	TCLR	599	Torque command limit in yaw
JI	JI	565	Moment of inertia of inner gimbal
JO	JO	566	Moment inertia of outer gimbal
GEOCS	GEOCS	497	Rate gyro gain to autopilot, pitch and yaw
FRI	FRI	567	Inner gimbal friction coefficient (in-oz)
FRO	FRO	568	Outer gimbal friction coefficient (in-oz)
FFOV	FFOV	604	Blind range decimal percent field of view
TARHT	T_H	601	Target height (ft)
TARWD	T_W	602	Target width (ft)
TAU	τ	600	Seeker sample period (sec)
TLAG	ζ	606	OCS transport lag (sec)

2.3.2 Launch Transient Input Variable Descrip'ion

A new subroutine, LTRAN, was added that contains the pitch and yaw moment forcing function, F(t), and the pitch and yaw initialization function, H(t). This subroutine is called by subroutine A3I for initialization of the rates and by subroutine A2 to compute the time varying rates.

The roll transient model is also initialized in subroutine A3I. Subroutine A2 contains the logic for integration of the roll acceleration computed in A3I.

The following list identifies all variables of the launch transient models that are input by 3-cards.

FORTRAN SYMBOL	SYMBOL USED IN TEXT	C INDEX	DEFINITION
WPTO	ω_{PTO}	1738	Tip-off roll rate (deg/sec)
AMP2	A_m	1742	Peak amplitude of pitch moment forcing function (ft/lbs)
AMP1	A_m	1746	Peak amplitude of yaw moment forcing function (ft/lbs)
VIB		626	Launch transient vibration flag (pitch and yaw only) 0 - no vibration 1 - run with vibration

3.0 RANDOM ERROR SOURCES

Initial condition random error sources specified as probability distributions unique to the OCS or impacting the operation of the OCS are listed below and described in the following sections.

1. Seeker Platform Mass Unbalance
   - Outer gimbal
   - Inner gimbal
2. Seeker Rate Gyro Errors
   - Drift
   - Mass Unbalance
   - Output axis/missile roll coupling
3. Launch Transient-Rate Distributions
   - Pitch and yaw rate
   - Roll rate

3.1 Error Source Distribution

3.1.1 Seeker Platform Mass Unbalance

Error randomization of seeker platform mass unbalance was added to the simulation program for both inner and outer gimbals of the seeker head. Missile acceleration normal to the gimbal plane acts on this mass unbalance to create a torque that attempts to rotate the seeker head, thus generating an error signal. The seeker torque motor must then compensate for this error.

Figure 3.24 illustrates the mass unbalance geometry of the outer gimbal ring. The centroid of mass unbalance is assumed to have an equal likelihood of lying at any point in the gimbal plane, while the mass unbalance magnitude (K_{UBO}) distribution must be specified by the user. Since mass unbalance magnitude includes the moment arm as well as the normalized force acting on the moment arm, the actual radius on which the mass unbalance lies is unimportant, except as to whether the resulting torque causes a clockwise or counter-clockwise rotation about the gimbal axis. Thus, following the selection of the mass unbalance magnitude from a specified distribution, the sign of the mass unbalance is selected from the uniform distribution shown in Figure 3.25. The torque acting about the outer gimbal axis is then:

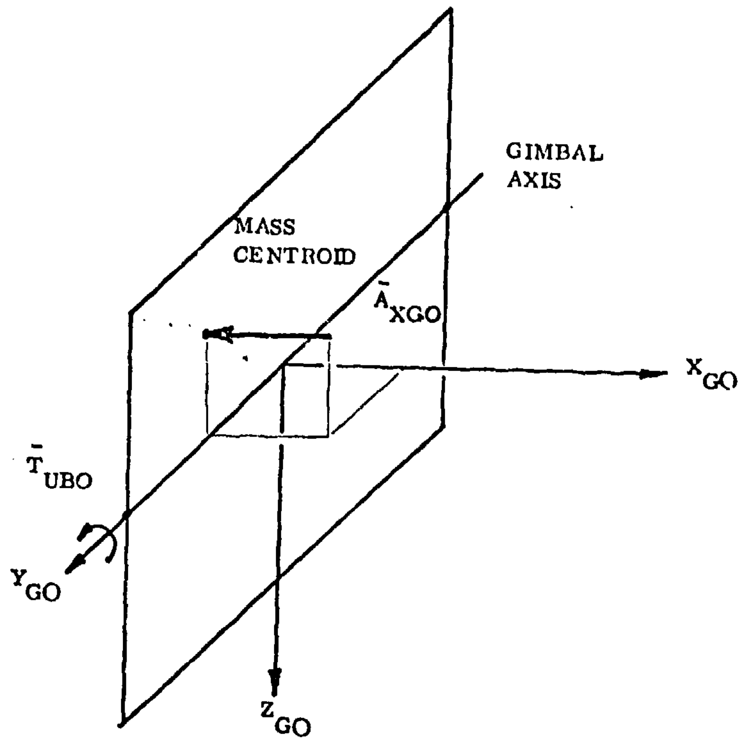


FIGURE 3.24. Seeker Outer Gimbal Mass Unbalance

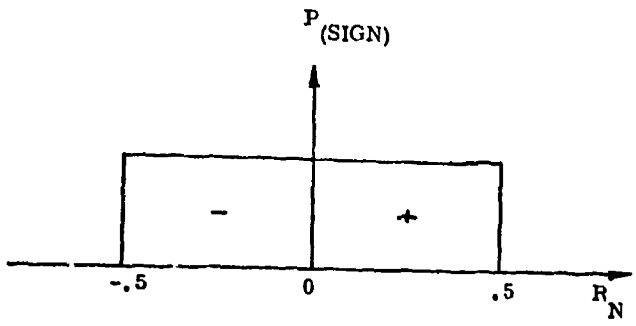


FIGURE 3.25. Probability Distribution of Mass Unbalance Sign

$$\bar{T}_{UBO} = A_{XGO} \cdot K_{UBO} \cdot SGN(RN) \qquad \text{Eq. 2.13}$$

The total acceleration,

$$\bar{A}_T = [A_{XB}, A_{YB}, A_{ZB}] \qquad \text{Eq. 2.14}$$

acting on the missile is resolved through the outer gimbal angle (θ_G) to get the acceleration component (A_{XGO}) normal to the gimbal plane. Thus, from Figure 3.26,

$$A_{XGO} = A_{XB} \cos \theta_G - A_{ZB} \sin \theta_G. \qquad \text{Eq. 2.15}$$

Since the outer gimbal rotates about the y-axis (Y_B) of the missile, only the acceleration components along missile x-axis (X_B) and z-axis (Z_B) act on the gimbal plane.

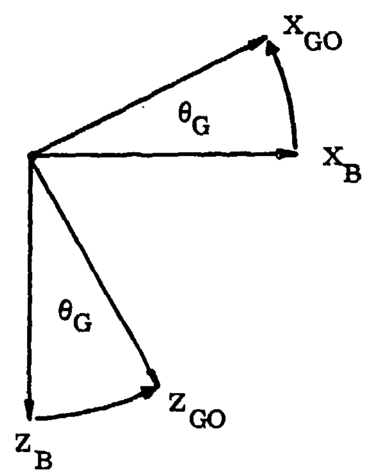


FIGURE 3.26. Gimbal Rotation About Missile Y-Axis

The inner gimbal mass unbalance centroid is somewhat more complex to locate because the inner gimbal mass is more complex in shape as shown in Figure 3.27.

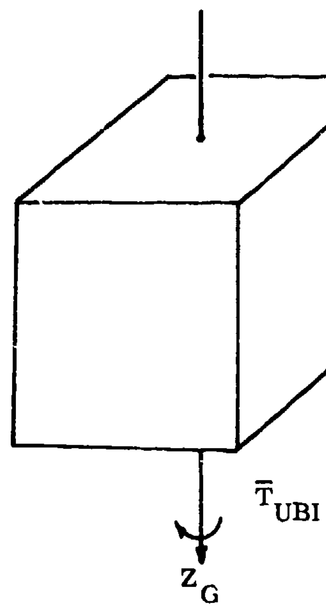


FIGURE 3.27. Inner Gimbal Mass

As with the outer gimbal, the distribution of the mass unbalance magnitude (K_{UBI}) is user specified, while the plane in which the centroid lies is assumed to have an equal likelihood of being oriented at any angle (χ), as shown in Figure 3.28. The angle χ is selected from the uniform distribution shown in Figure 3.29. The resulting torque acting about the inner gimbal axis is then,

$$\bar{T}_{UBI} = K_{UBI} (A_{YG} \cos \chi - A_{XG} \sin \chi) \qquad \text{Eq. 2.16}$$

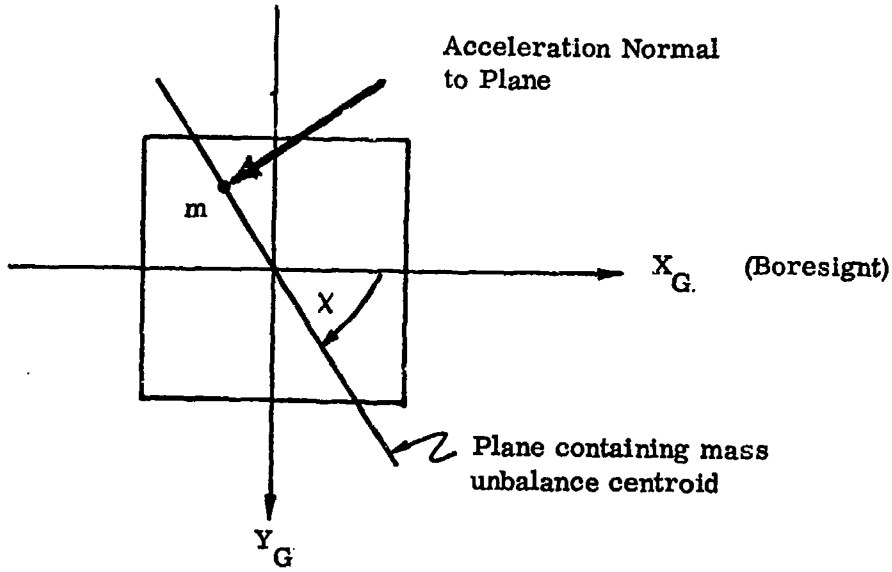


FIGURE 3.28. Inner Gimbal View Looking Down the Z-Axis

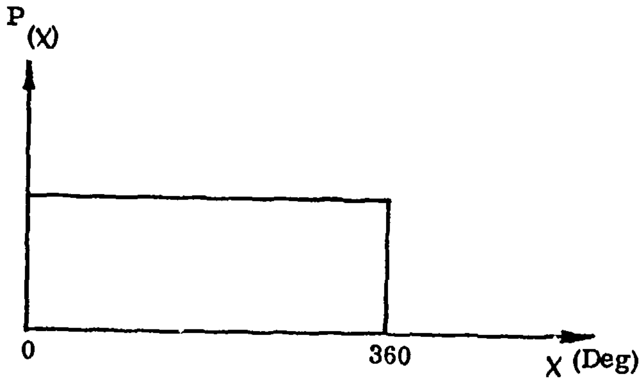


FIGURE 3.29. Probability Distribution of Mass Unbalance Radial Position

The acceleration components (A_{YG} and A_{XG}) in the inner gimbal coordinate system are determined by transforming the total acceleration ($\bar{A}_T$) through the gimbal angles (θ_G and Ψ_G), thus

$$\begin{bmatrix} A_{XG} \\ A_{YG} \\ A_{ZG} \end{bmatrix} = [M]_G \begin{bmatrix} A_{XB} \\ A_{YB} \\ A_{ZB} \end{bmatrix} \qquad \text{Eq. 2.17}$$

The transformation matrix $[M]_G$ is derived in Section 2.1.

Mass unbalance magnitude distributions are normalized with respect to acceleration. Thus, mass unbalance has the units of IN-OZ per g of acceleration. All acceleration components seen in the proceeding equations are also normalized.

3.1.2 Seeker Rate Gyro Errors

The seeker rate gyros can produce errors that perturb and bias the tracker rate loops and degrade the performance of the OCS seeker. Therefore, the primary errors sources of these rate gyros were included in the simulation program for study. Gyro errors (or more correctly, gyro error torques) can arise from a variety of different sources and are usually expressed as equivalent gyro drift rates.

Constant gyro drift rates result from uncompensated bias torques, L_ϵ, and their magnitude is usually a measure of the gyro quality. Acceleration sensitivity is primarily a function of the mass unbalance about the gyro output axis, i.e., the center of mass not coincident with the output axis. Linear accelerations, A, normal to the output axis produce gyro drift rates proportional to the acceleration.

The last gyro error source to be considered is a characteristic due to the inertia of the gyro float assembly. Angular accelerations about the output axis, $\dot{\omega}_{OA}$, cause gyro pick-off angle errors, which in turn torque the gyro through the electronic caging loop resulting in a gyro drift rate. Thus, the total gyro error rate is

$$\omega_\epsilon = \frac{L_\epsilon}{H} + \frac{P}{H} A + \frac{J_{OA}}{H} \dot{\omega}_{OA} \qquad \text{Eq. 2.19}$$

where H is the angular momentum of the rotor, P is the pendulosity, and J_{OA} is the moment of inertia of the floated assembly about its output axis.

The OCS platform has two stabilizing rate gyros mounted to sense inertial rates in the pitch and yaw axes. These rate gyros are so mounted that their output axes are aligned with the platform roll axis. Therefore, from Eq. 2.19, the error rate for the pitch gyro is

$$\omega_{\epsilon O} = K_{BO} + K_{PO} A + K_{OAO} \dot{\omega}_{ROLL} \qquad \text{Eq. 2.20}$$

and for the yaw gyro

$$\omega_{\epsilon I} = K_{BI} + K_{PI} A + K_{OAI} \dot{\omega}_{ROLL} \, . \qquad \text{Eq. 2.21}$$

The coefficients in Eqs. 2.20 and 2.21 are user specified by their distribution functions. Since the gyro pendulosity, K_P, has an equal likelihood of occurring anywhere about the gyro output axis, its location is picked from a uniform distribution prior to each run.

3.2 Probability Distribution Input Description

3.2.1 OCS Monte Carlo Input Variables

The variables associated with the Monte Carlo seeker models are given below. The mean values of these variables are input by 3-cards and the probability distributions are input by 8-cards.**

Program Variable Name of Error Source	C Index of Error Source	Program Module Calling MCARLO	MCARLO Flag*		Definition
			Name	Index	
KUO	611	S2I		611	Outer gimbal mass unbalance (in-oz/g)
KUI	612	S2I		612	Inner gimbal mass unbalance (in-oz/g)
KBO	613	S2I		613	Outer gimbal drift rate (deg/sec)
KBI	614	S2I		614	Inner gimbal drift rate (deg/sec)
KPO	615	S2I		615	Outer gimbal pendulosity coefficient (deg/sec/g)
KPI	616	S2I		616	Inner gimbal drift rate (deg/sec/g)
KOAO	617	S2I		617	Outer gimbal output axis/ roll coupling coefficient (sec)
KOAI	618	S2I		618	Inner gimbal output axis/ roll coupling coefficient (sec)

*MCARLO is flagged by the C-Index of this variable in the calling module.

When MCARLO is flagged by this C-Index, a random number will be returned from MCARLO for the error source in the first column.

** See reference 2 for definition of 8-cards.

3.2.2 Launch Transient Monte Carlo Input Variables

The variables associated with the Monte Carlo launch transient models are given below. An 8-card is used to select any one of these models (roll, pitch or yaw) as a Monte Carlo variable. Roll is the only one of the three that requires specification of a probability distribution on the 8-card. The pitch and yaw models do require 8-cards; however, the probability distribution input fields are left blank because pitch and yaw are randomized indirectly, as explained in Section 2.2.6.

A mean value of roll rate (WPTO) is input by 3-card. Mean values of pitch and yaw rate are not input, because the mean and distribution of these two variables are determined from solution of the forcing function, F(t), Eq. 2.8. However, the peak amplitude of pitch (AMP2) and yaw (AMP1) moment (due to helicopter vibration) must be input by 3-card. In addition, the flag, VIB, defined in Section 2.3.2 must be input equal to 1.

Program Variable Name of Error Source	C Index of Error Source	Program Module Calling MCARLO	MCARLO Flag*		Definition
			Name	Index	
WPTO	1738	A3I, A2		1738	Mean tip-off roll rate (deg/sec)
AMP2	1742	A3I, A2		1742	Peak amplitude of pitching moment forcing function (ft/lbs)
AMP1	1746	A3I, A2		1746	Peak amplitude of yawing moment forcing function (ft/lbs)

*MCARLO is flagged by the C-Index of this variable in the calling module.

When MCARLO is flagged by this C-Index, a random number will be returned from MCARLO for the error source in the first column.

3.2.3 Pitch and Yaw Randomization Independent of Launch Transient Model

Pitch and yaw tip-off rates may be randomized from an input probability distribution by inputting the C-indices of pitch and yaw rate on an 8-card. This capability was added as an option to directly randomize as opposed to indirectly randomizing pitch and yaw rates as mentioned above. Use of this option will generate instantaneous changes in pitch and yaw rate at time of rear shoe rail exit. This option was added primarily to allow randomization of pitch and yaw rates for launch from a tower or ground vehicle in which there are no launcher vibrations. However, this option can be exercised simultaneously with the vibration model above. Roll rate randomization described above applies equally to helicopter or ground launchers.

Program Variable Name of Error Source	C Index of Error Source	Program Module Calling MCARLO	MCARLO Flag*		Definition
			Name	Index	
WQ	1743	A2		1743	Pitch rate (deg/sec)
WR	1747	A2		1747	Yaw rate (deg/sec)

*MCARLO is flagged by the C-Index of this variable in the calling module.

When MCARLO is flagged by this C-Index, a random number will be returned from MCARLO for the error source in the first column.

4.0 COMPUTER PROGRAM DESCRIPTIONS

4.1 New Subroutines

The basic structure of the 6-DOF Monte Carlo program remains unchanged. Modifications and minor alterations were made to incorporate the OSC subroutines and all related models. Four new subroutines were created and minor changes in other subroutines were made to interface the new subroutines with existing program structure. The new subroutines added are:

1. LTRAN - pitch and yaw helicopter vibration subroutine containing Eq. 2.8, the moment forcing function, and Eq. 2.9, the rate initialization function.
2. S2I - OCS initialization subroutine. This subroutine initializes values for both OCS models, S2 and S3. (S2I contains an entry point, S3I, that initializes variables pertinent to S3.)
3. S2 - The derived OCS model subroutine, which contains both high and low frequency components.
4. S3 - The simplified OCS model subroutine, consisting of only the low frequency components.

Input variables for the OCS model and all related models are defined following the sections that describe those particular models.

Seeker subroutine selection is made by use of the 2-cards* Care must be exercised when changing 2-cards, because, as explained in reference 1, the order in which 2-cards are input determines the order in which all missile and environment subroutines are called.

4.2 Monte Carlo Runs With Breaklock

Flights that breaklock are terminated when breaklock occurs. This, of course, impacts the Monte Carlo operation of the simulation program. Dropping the run from the run set reduces the number of miss distance values that will be used to compute statistical information such as mean, standard deviation and CEP; and this in turn reduces the confidence level of the statistical data. To alleviate this degradation in confidence level, additional runs are

*See reference 1 for definition of 2-cards.

automatically added to a run set to make up for runs terminated due to breaklock. However, a limit of five additional runs is built into the program to avoid ad infinitum runs (or until computer run time limit is reached) due to the occurrence of a very large percentage of breaklock flights.

At the completion of a run set, and prior to printing out CEP data, the number of breaklock flights occurring, the total number of run attempts made, and the ratio of these two is printed out in the format shown below.

```
*BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK*
*BREAKLOCK*                                                                                          *BREAKLOCK*
*BREAKLOCK*  ----------------------------------------------------------------------------------------  *BREAKLOCK*
*BREAKLOCK*   THIS RUN SET HAD   17 BREAKLOCK FLIGHTS OUT OF   30 GIVING A PROPORTION OF  .5667       *BREAKLOCK*
*BREAKLOCK*  ----------------------------------------------------------------------------------------  *BREAKLOCK*
*BREAKLOCK*                                                                                          *BREAKLOCK*
*BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK**BREAKLOCK*
```

4.3 Sample Run

An example of a Monte Carlo run set and a CEP circle utilizing the OCS model is given in the following pages. The example consists of four runs out of a 25 run set that went into the CEP calculation.

INPUT DATA

1	OUFT 2.3	3-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
1	STCL 2.3	4-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	G2-WINDS	23-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	G3-HE	24-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	G5-HE	25-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	A1-HE	2-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	A3-HE	4-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	A2-HE	3-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	D1-HE	17-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	D2-HE	19-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	G3	30-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	C1-HE(LO-FQ)	7-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
2	C4-HE	10-0	-0.00	-0.	-0.		-0.0000	-0-0.0000
3	T	2100-0	-0.00	0.		.10000000E+01	-0.0000	-0-0.0000
3	TF	2101-0	-0.00	.15000000E+02	-0.		-0.0000	-0-0.0000
3	PPP	2103-0	-0.00	.32500000E-01	-0.		-0.0000	-0-0.0000
3	REPPLT	2105-0	-0.00	.10000000E+01	-0.		-0.0000	-0-0.0000
3	PTLESS	2107-0	-0.00	.40000000E+01	-0.		-0.0000	-0-0.0000
3	PLOTNO	2109-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	DDC	2113-0	-0.00	.60000000E+01	-0.		-0.0000	-0-0.0000
3	DPP	2113-0	-0.00	.10000000E+01	-0.		-0.0000	-0-0.0000
3	UPP	2115-0	-0.00	.40000000E+01	-0.		-0.0000	-0-0.0000
3	HMIN	2562-0	-0.00	.25000000E-02	-0.		-0.0000	-0-0.0000
3	DER(1)	2564-0	-0.00	.50000000E-02	-0.		-0.0000	-0-0.0000
3	HMAX	2563-0	-0.00	.50000000E-02	-0.		-0.0000	-0-0.0000
3	OPTN2	3502-0	-0.00	.20000000E+01	-0.		-0.0000	-0-0.0000
3	OPTN4	3504-0	-0.00	.10000000E+01	-0.		-0.0000	-0-0.0000
3	OPTN6	3506-0	-0.00	.10000000E+01	-0.		-0.0000	-0-0.0000
3	VWXE	100-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	VWYE	101-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	VWZE	102-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	VMACH	204-0	-0.00	.10000000E+00		.10000000E+01	-0.0000	-0-0.0000
3	RHZRO	209-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	BALPHA	367-0	-0.00	0.		.10000000E+01	-0.0000	-0-0.0000
3	BALPHY	368-0	-0.00	0.		.10000000E+01	-0.0000	-0-0.0000
3	BTHTG	427-0	-0.00	0.		.10000000E+01	-0.0000	-0-0.0000
3	BPSIG	431-0	-0.00	0.		.10000000E+01	-0.0000	-0-0.0000
3	WF	442-0	-0.00	.40000000E+03	-0.		-0.0000	-0-0.0000
3	BF	443-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	HOB	444-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	RLOCK	445-0	-0.00	.32810000E+05	-0.		-0.0000	-0-0.0000
3	DT	446-0	-0.00	.50000000E-01	-0.		-0.0000	-0-0.0000
3	DOB	447-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	CFOVZ	448-0	-0.00	.20000000E+02	-0.		-0.0000	-0-0.0000
3	CFOVY	449-0	-0.00	.20000000E+02	-0.		-0.0000	-0-0.0000
3	GSX	450-0	-0.00	.10000000E+02	-0.		-0.0000	-0-0.0000
3	SEPS	451-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	SWP	452-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	RBK	453-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	GEO	454-0	-0.00	.10000000E+02	-0.		-0.0000	-0-0.0000
3	OPTNSK	455-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	GS	456-0	-0.00	.50000000E+01	-0.		-0.0000	-0-0.0000
3	WSL	457-0	-0.00	.50000000E+01	-0.		-0.0000	-0-0.0000
3	WSN	458-0	-0.00	.10000000E+03	-0.		-0.0000	-0-0.0000
3	WSN	458-0	-0.00	.50000000E+02	-0.		-0.0000	-0-0.0000
3	HL2	459-0	-0.00	.30000000E+02	-0.		-0.0000	-0-0.0000
3	WL2	459-0	-0.00	.15000000E+02	-0.		-0.0000	-0-0.0000
3	TDY	160-0	-0.00	0.	-0.		-0.0000	-0-0.0000
3	GBIAS	161-0	-0.00	.10000000E+01	-0.		-0.0000	-0-0.0000
3	SH	162-0	-0.00	.40000000E+01	-0.		-0.0000	-0-0.0000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]

3	AN1	364-0	-0.00	.1500000E+02	-0.	-0.0000	-0-0.0000
3	AL	365-0	-0.00	.1500000E+01	-0.	-0.0000	-0-0.0000
3	ALXX1	365-0	-0.00	.3500000E+02	-0.	-0.0000	-0-0.0000
3	ALXX2	367-0	-0.00	.3500000E+02	-0.	-0.0000	-0-0.0000
3	ALJK1	868-0	-0.00	.3000000E+02	-0.	-0.0000	-0-0.0000
3	ALJK2	369-0	-0.00	.3000000E+02	-0.	-0.0000	-0-0.0000
3	AJK	370-0	-0.00	.1300000E+02	-0.	-0.0000	-0-0.0000
3	AXX	371-0	-0.00	.1750000E+03	-0.	-0.0000	-0-0.0000
3	DXX	372-0	-0.00	.6500000E+00	-0.	-0.0000	-0-0.0000
3	AJK	73-0	-0.00	.1750000E+03	-0.	-0.0000	-0-0.0000
3	DJK	74-0	-0.00	.6500000E+00	-0.	-0.0000	-0-0.0000
3	GXX	375-0	-0.00	.3700000E+00	-0.	-0.0000	-0-0.0000
3	GJK	375-0	-0.00	.2500000E+01	-0.	-0.0000	-0-0.0000
3	RES	377-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	DBIAS	378-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	RBIAS	479-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	AXX	390-0	-0.00	.1800000E+02	-0.	-0.0000	-0-0.0000
3	OPTACT	1140-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	CR	1145-0	-0.00	.1000000E+02	-0.	-0.0000	-0-0.0000
3	ADCL	1147-0	-0.00	.2400000E+03	-0.	-0.0000	-0-0.0000
3	W1	1148-0	-0.00	.6000000E+01	-0.	-0.0000	-0-0.0000
3	ZN	1149-0	-0.00	.1000000E+01	-0.	-0.0000	-0-0.0000
3	G1	1151-0	-0.00	.7200000E+03	-0.	-0.0000	-0-0.0000
3	BH	1152-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	WN	1153-0	-0.00	.1600000E+03	-0.	-0.0000	-0-0.0000
3	G2	1154-0	-0.00	.1000000E+01	-0.	-0.0000	-0-0.0000
3	BOP	1231-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3	BOQ	1232-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3	BOR	1233-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3	RFAREA	1305-0	-0.00	.1963000E+00	-0.	-0.0000	-0-0.0000
3	RFLGTH	1307-0	-0.00	.5000000E+00	-0.	-0.0000	-0-0.0000
3	RLUG	1315-0	-0.00	.2320000E+01	-0.	-0.0000	-0-0.0000
3	RAIL	1317-0	-0.00	.3500000E+01	-0.	-0.0000	-0-0.0000
3	AGV	1330-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	QNALGN	1403-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	QBURN	1405-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3	DISP	1414-0	-0.00	.1965000E+03	-0.	-0.0000	-0-0.0000
3	DWT	1415-0	-0.00	.5760000E+02	-0.	-0.0000	-0-0.0000
3	DWP	1416-0	-0.00	.1500000E+02	-0.	-0.0000	-0-0.0000
3	RDCGO	1417-0	-0.00	-.7500000E-01	-0.	-0.0000	-0-0.0000
3	RDCGF	1418-0	-0.00	.2670000E+00	-0.	-0.0000	-0-0.0000
3	FMIXF	1419-0	-0.00	.5700000E-01	-0.	-0.0000	-0-0.0000
3	FMIYF	1420-0	-0.00	.4600000E+01	-0.	-0.0000	-0-0.0000
3	RLCGO	1421-0	-0.00	.1430000E+01	-0.	-0.0000	-0-0.0000
3	AGRAV	1627-0	-0.00	.3217400E+02	-0.	-0.0000	-0-0.0000
3	XE	1515-0	-0.00	-.6560000E+04	.1000000E+01	-0.0000	-0-0.0000
3	ZE	1523-0	-0.00	-.1000000E+03	.1000000E+01	-0.0000	-0-0.0000
3	OPTARG	1539-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	P	1739-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3	Q	1743-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3	R	1747-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3	BTHTO	1753-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	BPSIO	1754-0	-0.00	0.	-0.	-0.0000	-0-0.0000
3	STEP	2110-0	-0.00	.2000000E+01	-0.	-0.0000	-0-0.0000
3	ST	460-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3	PPP	2105-0	-0.00	.1000000E-01	-0.	-0.0000	-0-0.0000
3	PPNT	2104-0	-0.00	0.	.1000000E+01	-0.0000	-0-0.0000
3		2664-0	-0.00	.1250000E-01	.1000000E+01	-0.0000	-0-0.0000
3	TF	2101-0	-0.00	.2500000E+02	-0.	-0.0000	-0-0.0000
3	HSL	457-0	-0.00	.3000000E+01	-0.	-0.0000	-0-0.0000
3	HSL	457-0	-0.00	.1000000E+02	-0.	-0.0000	-0-0.0000
3	XE	1515-0	-0.00	-.6560000E+04	.1000000E+01	-0.0000	-0-0.0000
3	XL	1513-0	-0.00	-.3280000E+04	.1000000E+01	-0.0000	-0-0.0000
3	KO1	545-0	-0.00	.1430000E+02	-0.	-0.0000	-0-0.0000
3	KR1	546-0	-0.00	.1430000E+02	-0.	-0.0000	-0-0.0000

3	KR2	549-0	-0.00	.5100000E+01	-0.	-0.0000	-0-0.0000
3	KQ3	549-0	-0.00	.3330000E+01	-0.	-0.0000	-0-0.0000
3	KR3	550-0	-0.00	.3330000E+01	-0.	-0.0000	-0-0.0000
3	KQ5	551-0	-0.00	.9980000E+03	-0.	-0.0000	-0-0.0000
3	KR5	552-0	-0.00	.5240000E+03	-0.	-0.0000	-0-0.0000
3	KQ6	553-0	-0.00	.3020000E+00	-0.	-0.0000	-0-0.0000
3	KR6	554-0	-0.00	.3020000E+00	-0.	-0.0000	-0-0.0000
3	KQ7	555-0	-0.00	.8700000E+01	-0.	-0.0000	-0-0.0000
3	KR7	556-0	-0.00	.8700000E+01	-0.	-0.0000	-0-0.0000
3	KQ8	557-0	-0.00	.4900000E+01	-0.	-0.0000	-0-0.0000
3	KR8	558-0	-0.00	.4400000E+01	-0.	-0.0000	-0-0.0000
3	KQ10	559-0	-0.00	.2680000E+01	-0.	-0.0000	-0-0.0000
3	KR10	560-0	-0.00	.2680000E+01	-0.	-0.0000	-0-0.0000
3	KQ11	561-0	-0.00	.9500000E+01	-0.	-0.0000	-0-0.0000
3	KR11	562-0	-0.00	.9500000E+01	-0.	-0.0000	-0-0.0000
3	KQ12	563-0	-0.00	.1000000E+01	-0.	-0.0000	-0-0.0000
3	KR12	564-0	-0.00	.1000000E+01	-0.	-0.0000	-0-0.0000
3	WTQ1	573-0	-0.00	.6170000E+01	-0.	-0.0000	-0-0.0000
3	WTR1	574-0	-0.00	.6170000E+01	-0.	-0.0000	-0-0.0000
3	WTQ2	575-0	-0.00	.1890000E+01	-0.	-0.0000	-0-0.0000
3	WTR2	576-0	-0.00	.1890000E+01	-0.	-0.0000	-0-0.0000
3	WGQ1	577-0	-0.00	.5000000E+02	-0.	-0.0000	-0-0.0000
3	WGR1	578-0	-0.00	.5000000E+02	-0.	-0.0000	-0-0.0000
3	WGQ3	581-0	-0.00	.2000000E+02	-0.	-0.0000	-0-0.0000
3	WGR3	582-0	-0.00	.2000000E+02	-0.	-0.0000	-0-0.0000
3	WGQ4	583-0	-0.00	.1000000E+01	-0.	-0.0000	-0-0.0000
3	WGR4	584-0	-0.00	.1000000E+01	-0.	-0.0000	-0-0.0000
3	WGQ5	585-0	-0.00	.3140000E+03	-0.	-0.0000	-0-0.0000
3	WGR5	586-0	-0.00	.3140000E+03	-0.	-0.0000	-0-0.0000
3	WGQ6	587-0	-0.00	.1000000E+04	-0.	-0.0000	-0-0.0000
3	WGR6	588-0	-0.00	.1000000E+04	-0.	-0.0000	-0-0.0000
3	WRQ2	591-0	-0.00	.3140000E+03	-0.	-0.0000	-0-0.0000
3	WRR2	592-0	-0.00	.3140000E+03	-0.	-0.0000	-0-0.0000
3	WRQ4	595-0	-0.00	.1000000E+04	-0.	-0.0000	-0-0.0000
3	WRR4	595-0	-0.00	.1000000E+04	-0.	-0.0000	-0-0.0000
3	TCL	597-0	-0.00	.1500000E+01	-0.	-0.0000	-0-0.0000
3	TCLQ	598-0	-0.00	.4970000E+01	-0.	-0.0000	-0-0.0000
3	TCLR	599-0	-0.00	.3100000E+01	-0.	-0.0000	-0-0.0000
3	JI	565-0	-0.00	.3500000E+00	-0.	-0.0000	-0-0.0000
3	JO	566-0	-0.00	.6580000E+00	-0.	-0.0000	-0-0.0000
3	GEOCS	497-0	-0.00	.1500000E+01	-0.	-0.0000	-0-0.0000
3	FRI	567-0	-0.00	.7000000E+00	-0.	-0.0000	-0-0.0000
3	FRO	569-0	-0.00	.1500000E+01	-0.	-0.0000	-0-0.0000
3	FFOV (ODS)	560-0	-0.00	.7300000E+00	-0.	-0.0000	-0-0.0000
3	TARHT	501-0	-0.00	.1350000E+02	-0.	-0.0000	-0-0.0000
3	TARWD	502-0	-0.00	.1050000E+02	-0.	-0.0000	-0-0.0000
3	DER1	2364-0	-0.00	.8350000E-02	.1000000E+11	-0.0000	-0-0.0000
3	TAU	500-0	-0.00	.1670000E-01	-0.	-0.0000	-0-0.0000
3	RNSTRT	3511-0	-0.00	.7700000E+02	-0.	-0.0000	-0-0.0000
8	GYRO DRIFT P1	1764-0	-0.00	.1525000E+00	-.3000000E+11	3.0000	-0-0.0000
8	GYRO DRIFT Q1	1765-0	-0.00	.5350000E-01	-.3000000E+11	3.0000	-0-0.0000
8	GYRO DRIFT P2	1766-0	-0.00	.1525000E+00	-.3000000E+11	3.0000	-0-0.0000
8	GYRO DRIFT R2	1767-0	-0.00	.5350000E-01	-.3000000E+11	3.0000	-0-0.0000
3	BPSIW	51-0	-0.00	0.	.1000000E+11	-0.0000	-0-0.0000
3	VWTE	52-0	-0.00	0.	.1000000E+11	-0.0000	-0-0.0000
8	STEADY WND VWTE	52-0	-0.00	.2800000E+02	-.3000000E+11	3.0000	-0-0.0000
8	STEADY WND BPSIW	51 1	-0.00	.1000000E+01	0.	360.0000	-0-0.0000
8	FIN ELECB	1247 1	-0.00	.5700000E+00	-.1000000E+11	1.0000	-0-0.0000
8	FIN ELECQB	1248 1	-0.00	.5700000E+00	-.1000000E+11	1.0000	-0-0.0000
8	FIN ELECRB	1249 1	-0.00	.5700000E+00	-.1000000E+11	1.0000	-0-0.0000
8	FIN MECHB	1250 1	-0.00	.3800000E+00	-.1000000E+11	1.0000	-0-0.0000
8	FIN MECHQB	1251 1	-0.00	.3800000E+00	-.1000000E+11	1.0000	-0-0.0000
8	FIN MECHRB	1252 1	-0.00	.3800000E+00	-.1000000E+11	1.0000	-0-0.0000
3	QNALGN	1403-0	-0.00	.1000000E+01	-0.	-0.0000	-0-0.0000
8	THRST X-OFFSET	1313 1	-0.00	.4200000E-02	-.1000000E+11	1.0000	-0-0.0000

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8	THRST Z-OFFSET	1315 1	-0.00	.4200000E-02	-.1000000E+01	1.0000	-0-0.0000
8	THRST BALPHT	1401 1	-0.00	.2500000E+00	-.1000000E+01	1.0000	-0-0.0000
8	THRST BPHIT	1402 1	-0.00	.2500000E+00	-.1000000E+01	1.0000	-0-0.0000
8	AUTOPILOT GYRO	360 1	-0.00	.3000000E+01	-.1000000E+01	1.0000	-0-0.0000
8	AUTOPILOT GYRO	361 1	-0.00	.3000000E+01	-.1000000E+01	1.0000	-0-0.0000
8	AUTOPILOT GYRO	362 1	-0.00	.3000000E+01	-.1000000E+01	1.0000	-0-0.0000
8	EULER ANG BPSIO	1754 1	-0.00	.1000000E+01	-.3000000E+01	3.0000	-0-0.0000
8	EULER ANG BTHTO	1753 1	-0.00	.1000000E+01	-.3000000E+01	3.0000	-0-0.0000
8	EULER ANG BPHIO	1752 1	-0.00	.1000000E+01	-.3000000E+01	3.0000	-0-0.0000
8	OUTER UNBAL	511-0	-0.00	.1570000E-01	-.3000000E+01	3.0000	-0-0.0000
8	INNER UNBAL	512-0	-0.00	.1670000E-01	-.3000000E+01	3.0000	-0-0.0000
3	TIPOFF HP MEAN	1733-0	-0.00	.2000000E+02	.1000000E+01	-0.0000	-0-0.0000
3	ZE	1523-0	-0.00	-.6000000E+03	.1000000E+01	-0.0000	-0-0.0000
3	VMHTE	1574-0	-0.00	.1300000E+03	.1000000E+01	-0.0000	-0-0.0000
3	FLAG	603-0	-0.00	.1000000E-01	-0.	-0.0000	-0-0.0000
3	TLAG	606-0	-0.00	0.	-0.	-0.0000	-0-0.0000
8	TIP OFF ROLL RATE	1733-0	-0.00	.2000000E+02	-.3000000E+01	3.0000	-0-0.0000
8	FMZ AMPL(LAUNCH)	1745-0	-0.00	.1400000E+01	-.3000000E+01	3.0000	-0-0.0000
8	FMY AMPL(LAUNCH)	1742-0	-0.00	.1000000E+01	-.3000000E+01	3.0000	-0-0.0000
3	FMZ MEAN (LAUNCH)	1745-0	-0.00	.8000000E+02	.1000000E+01	-0.0000	-0-0.0000
3	FMY MEAN (LAUNCH)	1742-0	-0.00	.2000000E+03	.1000000E+01	-0.0000	-0-0.0000
3	KOAO	617-0	-0.00	.8700000E-03	.1000000E+01	-0.0000	-0-0.0000
3	KOAI	613-0	-0.00	.8700000E-03	.1000000E+01	-0.0000	-0-0.0000
8	KOAO	617-0	-0.00	.3000000E-04	-.3000000E+01	3.0000	-0-0.0000
8	KOAI	613-0	-0.00	.3000000E-04	-.3000000E+01	3.0000	-0-0.0000
3	KUI	612-0	-0.00	.5500000E-01	.1000000E+01	-0.0000	-0-0.0000
3	KUO	611-0	-0.00	.5000000E-01	.1000000E+01	-0.0000	-0-0.0000
3	XE	1515-0	-0.00	-.1300000E+05	.1000000E+01	-0.0000	-0-0.0000
3	BTHTO	1753-0	-0.00	-.2000000E+01	.1000000E+01	-0.0000	-0-0.0000
3	BTHTO	1753-0	-0.00	-.8530000E+01	.1000000E+01	-0.0000	-0-0.0000
3	XE	1515-0	-0.00	-.4000000E+04	.1000000E+01	-0.0000	-0-0.0000
3	BTHTO	1753-0	-0.00	-.4900000E+01	.1000000E+01	-0.0000	-0-0.0000
3	XE	1515-0	-0.00	-.7000000E+04	.1000000E+01	-0.0000	-0-0.0000
3	HELICOPTER VIB	525-0	-0.00	.1000000E+01	-0.	-0.0000	-0-0.0000
6		-0-0	-0.00	-0.	-0.	-0.0000	-0-0.0000

MONTE CARLO INITIAL CONDITIONS

C-INDEX	MC-VALUE	MEAN	DISTRIBUTION	LOWER BOUND	UPPER BOUND
52	8.1288072	0.0000000	NORMAL	-3.000	3.000
51	236.561	0.000	UNIFORM	0.000	350.000
1247	-.180	0.000	UNIFORM	-1.000	1.000
1248	.378	0.000	UNIFORM	-1.000	1.000
1249	-.329	0.000	UNIFORM	-1.000	1.000
1250	-.174	0.000	UNIFORM	-1.000	1.000
1251	-.377	0.000	UNIFORM	-1.000	1.000
1252	.281	0.000	UNIFORM	-1.000	1.000
1313	-.004	0.000	UNIFORM	-1.000	1.000
1314	-.004	0.000	UNIFORM	-1.000	1.000
1315	-.003	0.000	UNIFORM	-1.000	1.000
1401	.071	0.000	UNIFORM	-1.000	1.000
1402	-.230	0.000	UNIFORM	-1.000	1.000
1733	8.1197569	20.0000000	NORMAL	-3.000	3.000
1764	.0045006	0.0000000	NORMAL	-3.000	3.000
1765	-.0691272	0.0000000	NORMAL	-3.000	3.000
1766	.0805035	0.0000000	NORMAL	-3.000	3.000
1767	.0445368	0.0000000	NORMAL	-3.000	3.000
360	1.775	0.000	UNIFORM	-1.000	1.000
361	-.597	0.000	UNIFORM	-1.000	1.000
362	-.924	0.000	UNIFORM	-1.000	1.000
1754	.858	0.000	UNIFORM	-3.000	3.000
1753	-4.706	-4.900	UNIFORM	-3.000	3.000
1752	1.380	0.000	UNIFORM	-3.000	3.000
611	.0885407	.0500000	NORMAL	-3.000	3.000
612	.0379133	.0500000	NORMAL	-3.000	3.000
617	.0008617	.0008700	NORMAL	-3.000	3.000

```
TIME=      .002:000   STEP SIZE=      2.0000000E-03

    FRONT LUG CLEARS RAIL      T =  8.60E-02      REL VEL =  2.11E+02      PITCH MOMENT = -5.45E+01
                                         RANGO  = 3.5848
                                                             TIPOFF RATES--ROLL =     8.1 PITCH =    -4.3 YAW =    -3.1

        REAR LUG CLEARS RAIL     T =     .1120REL VEL =  232.929    RAIL FORCE =    -40.63
                                         RANGO  = 5.9739
TIME=      .112:000   STEP SIZE=      8.3500000E-03

BURNOUT TIME=  3.0011 SEC.

*****************************************************************************************************
OCS BLIND RANGE SIGNAL HOLD AT TIME =  6.21  RANGE =      329.79
*****************************************************************************************************

                                                                 ***MAX BREAKLOCK VALUE =     .28337  IN  PITCH

                                                                 ***MAX BREAKLOCK VALUE =     .27224  IN  YAW

RUN NUMBER =  1

 MISS DISTANCE =    4.7314125E+00

 FLIGHT  TIME  =    6.5360395E+00

       ROELX =  -6.7331478E-01        ROELY =    4.5156575E-01        ROELZ =    4.6795396E+00

                                      RYFP   =   4.5454347E-01        RZFP   =    4.7296209E+00
   BZ        **************
   BY        **************
```

INPUT DATA

6 -0-0 -0.00 -0. -0. -0.0000 -0-0.0000

MONTE CARLO INITIAL CONDITIONS

C-INDEX	MC-VALUE	MEAN	DISTRIBUTION	LOWER BOUND	UPPER BOUND
52	2.9129063	0.0000000	NORMAL	-3.000	3.000
51	163.976	0.000	UNIFORM	0.000	350.000
1247	-.074	0.000	UNIFORM	-1.000	1.000
1248	-.020	0.000	UNIFORM	-1.000	1.000
1249	-.403	0.000	UNIFORM	-1.000	1.000
1250	-.315	0.000	UNIFORM	-1.000	1.000
1251	-.180	0.000	UNIFORM	-1.000	1.000
1252	-.229	0.000	UNIFORM	-1.000	1.000
1313	-.003	0.000	UNIFORM	-1.000	1.000
1314	-.001	0.000	UNIFORM	-1.000	1.000
1315	.502	0.000	UNIFORM	-1.000	1.000
1401	-.152	0.000	UNIFORM	-1.000	1.000
1402	.004	0.000	UNIFORM	-1.000	1.000
1733	38.2631228	20.0000000	NORMAL	-3.000	3.000
1764	.0383014	0.0000000	NORMAL	-3.000	3.000
1765	.0738540	0.0000000	NORMAL	-3.000	3.000
1766	-.0695206	0.0000000	NORMAL	-3.000	3.000
1767	-.1013949	0.0000000	NORMAL	-3.000	3.000
360	-2.606	0.000	UNIFORM	-1.000	1.000
361	1.096	0.000	UNIFORM	-1.000	1.000
362	.713	0.000	UNIFORM	-1.000	1.000
1754	.389	0.000	UNIFORM	-3.000	3.000
1753	-3.681	-4.900	UNIFORM	-3.000	3.000
1752	1.190	0.000	UNIFORM	-3.000	3.000
611	.0418523	.0500000	NORMAL	-3.000	3.000
612	.0615168	.0500000	NORMAL	-3.000	3.000
617	.0008060	.0003700	NORMAL	-3.000	3.000
618	.0008466	.0008700	NORMAL	-3.000	3.000

TIME= .0020000 STEP SIZE= 2.0000000E-03

FRONT LUG CLEARS RAIL T = 8.60E-02 REL VEL = 2.11E+02 PITCH MOMENT = -5.48E+01
RANGO = 3.5829
TIPOFF RATES--ROLL = 38.3 PITCH = -21.5 YAW = -1.9

REAR LUG CLEARS RAIL T = .1120REL VEL = 232.875 RAIL FORCE = -41.32
RANGO = 5.9769
TIME= .1120000 STEP SIZE= 8.3500000E-03

BURNOUT TIME= 3.0011 SEC.

****

OCS BLIND RANGE SIGNAL HOLD AT TIME = 6.24 RANGE = 305.73

****

+++MAX BREAKLOCK VALUE = .38339 IN PITCH

+++MAX BREAKLOCK VALUE = -.34518 IN YAW

RUN NUMBER = 2

MISS DISTANCE = 3.8427765E+00

FLIGHT TIME = 6.5467267E+00

RDELX = -5.7209481E-01 RDELY = 5.4297058E-01 RDELZ = 3.7595870E+00

```
RYFP  =  5.3245114E-01        RZFP  =  3.8057098E+00

INPUT DATA

6          -0-0 -0.00 -0.        -0.        -0.0000   -0-0.0000
```

MONTE CARLO INITIAL CONDITIONS

C-INDEX	MC-VALUE	MEAN	DISTRIBUTION	LOWER BOUND	UPPER BOUND
52	50.1629962	0.0000000	NORMAL	-3.000	3.000
51	248.545	0.000	UNIFORM	0.000	350.000
1247	.193	0.000	UNIFORM	-1.000	1.000
1248	.066	0.000	UNIFORM	-1.000	1.000
1249	-.118	0.000	UNIFORM	-1.000	1.000
1250	-.261	0.000	UNIFORM	-1.000	1.000
1251	-.089	0.000	UNIFORM	-1.000	1.000
1252	.163	0.000	UNIFORM	-1.000	1.000
1313	.003	0.000	UNIFORM	-1.000	1.000
1314	.003	0.000	UNIFORM	-1.000	1.000
1315	.003	0.000	UNIFORM	-1.000	1.000
1401	.105	0.000	UNIFORM	-1.000	1.000
1402	-.156	0.000	UNIFORM	-1.000	1.000
1738	43.3415734	20.0000000	NORMAL	-3.000	3.000
1764	.0046708	0.0000000	NORMAL	-3.000	3.000
1765	-.0206029	0.0000000	NORMAL	-3.000	3.000
1766	-.0677724	0.0000000	NORMAL	-3.000	3.000
1767	.0243741	0.0000000	NORMAL	-3.000	3.000
360	.538	0.000	UNIFORM	-1.000	1.000
361	2.257	0.000	UNIFORM	-1.000	1.000
362	.675	0.000	UNIFORM	-1.000	1.000
1754	.855	0.000	UNIFORM	-3.000	3.000
1753	-3.641	-4.900	UNIFORM	-3.000	3.000
1752	-2.797	0.000	UNIFORM	-3.000	3.000
611	.0685639	.0500000	NORMAL	-3.000	3.000
612	.0585906	.0500000	NORMAL	-3.000	3.000
617	.0003758	.0008700	NORMAL	-3.000	3.000
618	.0008565	.0008700	NORMAL	-3.000	3.000

```
TIME=     .0020000   STEP  SIZE=      2.0000000E-03

    FRONT LUG CLEARS RAIL      T =  8.60E-02     REL VEL =  2.11E+02     PITCH MOMENT = -6.40E+01
                               RANGO  = 3.5828
                                             TIPOFF RATES--ROLL = . 43.4 PITCH =  -22.0 YAW =     4.2

         REAR LUG CLEARS RAIL     T =    .1120REL VEL =  232.375   RAIL FORCE =   -49.56
                               RANGO  = 5.9768
TIME=       .1120000   STEP SIZE=      8.3500000E-03

BURNOUT TIME=  3.0011 SEC.

**************************************************************************************************
OCS BLIND RANGE SIGNAL HOLD AT TIME =  6.16  RANGE =     305.94
**************************************************************************************************

                                                  +++MAX BREAKLOCK VALUE =    .36408   IN  PITCH

                                                  +++MAX BREAKLOCK VALUE =    .22601   IN  YAW

RUN NUMBER  =  3

 MISS DISTANCE =    3.9798668E+00

 FLIGHT  TIME  =   6.0384555E+00

       RDELX =  -6.5284603E-01       RDELY =  5.2700033E-01       RDELZ =  3.8901170E+00
```

RYFP = 4.9703574E-01 RZFP = 3.9487081E+00

INPUT DATA

6 -0-0 -0.00 -0. -0. -0.0000 -0-0.0000

MONTE CARLO INITIAL CONDITIONS

C-INDEX	MC-VALUE	MEAN	DISTRIBUTION	LOWER BOUND	UPPER BOUND
52	-30.7594857	0.0000000	NORMAL	-3.000	3.000
51	20.578	0.000	UNIFORM	0.000	360.000
1247	.352	0.000	UNIFORM	-1.000	1.000
1248	-.510	0.000	UNIFORM	-1.000	1.000
1249	-.195	0.000	UNIFORM	-1.000	1.000
1250	.223	0.000	UNIFORM	-1.000	1.000
1251	-.073	0.000	UNIFORM	-1.000	1.000
1252	-.150	0.000	UNIFORM	-1.000	1.000
1313	-.042	0.000	UNIFORM	-1.000	1.000
1314	.001	0.000	UNIFORM	-1.000	1.000
1315	.003	0.000	UNIFORM	-1.000	1.000
1401	-.120	0.000	UNIFORM	-1.000	1.000
1402	-.048	0.000	UNIFORM	-1.000	1.000
1738	42.4128024	20.0000000	NORMAL	-3.000	3.000
1764	.1296747	0.0000000	NORMAL	-3.000	3.000
1765	.0250585	0.0000000	NORMAL	-3.000	3.000
1766	-.0722943	0.0000000	NORMAL	-3.000	3.000
1767	-.0855807	0.0000000	NORMAL	-3.000	3.000
360	.311	0.000	UNIFORM	-1.000	1.000
361	-2.630	0.000	UNIFORM	-1.000	1.000
362	2.884	0.000	UNIFORM	-1.000	1.000
1754	.386	0.000	UNIFORM	-3.000	3.000
1753	-2.857	-4.900	UNIFORM	-3.000	3.000
1752	-2.346	0.000	UNIFORM	-3.000	3.000
611	.0693596	.0500000	NORMAL	-3.000	3.000
612	.0739063	.0500000	NORMAL	-3.000	3.000
617	.0003564	.0003700	NORMAL	-3.000	3.000
610	.0008411	.0008700	NORMAL	-3.000	3.000

TIME= .0020000 STEP SIZE= 2.0000000E-03

FRONT LUG CLEARS RAIL T = 8.60E-02 REL VEL = 2.11E+02 PITCH MOMENT = -5.02E+01

RANGO = 3.5812

TIPOFF RATES--ROLL = 42.3 PITCH = -16.8 YAW = 1.6

REAR LUG CLEARS RAIL T = .1120REL VEL = 232.525 RAIL FORCE = -35.63

RANGO = 5.9740

TIME= .1120000 STEP SIZE= 8.3500000E-03

BURNOUT TIME= 3.0011 SEC.

****

OCS BLIND RANGE SIGNAL HOLD AT TIME = 6.44 RANGE = 318.98

****

+++MAX BREAKLOCK VALUE = .35363 IN PITCH

+++MAX BREAKLOCK VALUE = .27758 IN YAW

RUN NUMBER = 4

MISS DISTANCE = 4.4172301E+00

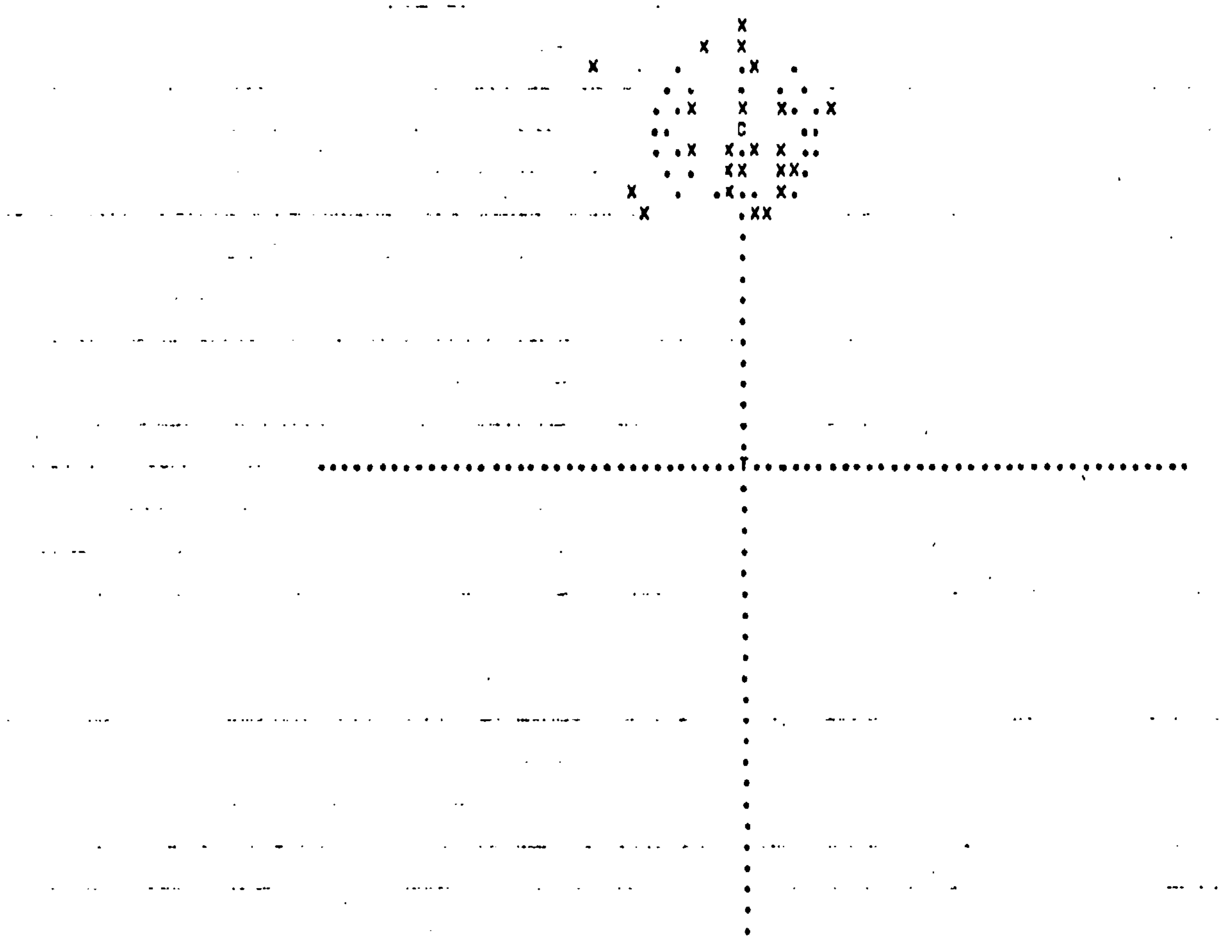
FLIGHT TIME = 6.7754873E+00

RDELX = -5.1998689E-01 RDELY = -6.1444841E-01 RDELZ = 4.3329670E+00

CEP CENTROID AT (-.069,4.449) DISTANCE FROM TARGET CENTER= 4.450

CEP CONFIDENCE CIRCLE FOR LAMBDA = 0.00

POINTS X
CEP CIRCLE ......
CIRCLE CENTROID C
TGT CENTER T
99 PER CENT CONFIDENCE CIRCLE ......



CEP CENTROID=(-.063, 4.449) DIST. FROM TGT CENTER= 4.450 CEP= .857
THE 99 PER CENT CONFIDENCE CIRCLE RADIUS IS 1.118

5.0 COMMENTS

5.1 Integration Synchronization With Sample Period

Numerical integration must be synchronized with sample period* (τ @ ZOH) in order to insure accurate integration. Logic is built into the seeker subroutines to insure that integration and sample period are synchronized. This is accomplished by:

$$\Delta t = \tau / [\mathrm{AINT}(\tau / \Delta t_{INPUT})]$$

where

- τ — sample period (SEC).
- Δt_{INPUT} — input integration stepsize (SEC).
- AINT(X) — computer center library function that integerizes the argument (X).
- Δt — computer integration stepsize that the program will use.

The above function will always compute an integration stepsize that is equal to or greater than the input stepsize. Since there is an upper bound on the stepsize that can be used to integrate the differential equations in this simulation program, there is the possibility that a stepsize larger than the upper bound will be computed. (Upper bound is approximately 12.5 millisec, with the exception of the OCS seeker model S2 which has an upper bound of approximately .5 millisec). Therefore, one should insure that a reasonable stepsize is input and verify that a reasonable stepsize is computed. For example, if the sample period is 16.7 millisecs, then a stepsize of 8.35 millisecs or less must be input to insure that the computed stepsize is 12.5 millisecs or less.

* A discussion of errors caused by numerical integration of sample data is given in Reference 5.

REFERENCES

1. "An Engineering and Programming Guide For a Six Degree of Freedom, Terminal Homing Simulation Program," TR RG-73-22, dated 10 October 1973.

2. "User's Guide For a Monte Carlo Point Target Terminal Homing Simulation Program," TR RG-74-37, dated 20 May 1974.

3. "Terminal Homing Engineering Flight Test T7 and MT7 Missile Launch Transients Data Reduction and Summary," TR RG-75-12, dated 29 August 1974.

4. "TSAP (Time Series Analysis Program): A Monte Carlo Support Module," Computer Sciences Corporation, dated 19 April 1974.

5. "Laser Guided Close Air Support Weapons Systems Effectiveness Measures," Computer Sciences Corporation, dated 28 September 1973.

APPENDIX

Monte Carlo 6-DOF Program Listing

A FORTRAN IV listing of the Monte Carlo 6-DOF Program that is operational on the MICOM CDC 6600 computer, SCOPE 3.4 operating system, is given in the following pages.

```
      PROGRAM MAIN(INPUT,OUTPUT,FILE,TAPE14,TAPE5=FILE,TAPE6=OUTPUT)     MCSIX    2
C                                                                        MCSIX    3
C*****DIMODS TO BE USED WITH FORTRAN AMRK INTEGRATION ROUTINE            MCSIX    4
C                                                                        MCSIX    5
      COMMON C(3830),GRAPH                                               MCSIX    6
      COMMON/CEPASS/X(100),Y(100)                                        MCSIX    7
      EQUIVALENCE (C(2567),HMIN  ), (C(2663),HMAX  ), (C(2664),JER   ),  MCSIX    8
     C            (C(2561),N     ), (C(2562),IPL   ), (C(2965),VAR   ),  MCSIX    9
     C            (C(2000),T     ), (C(2011),KSTEP ), (C(2010),STEP  ),  MCSIX   10
     C            (C(2012),LSTEP ), (C(2008),PLOTNO), (C(2009),NOPLOT),  MCSIX   11
     C            (C(2023),OPOINT), (C(2025),TIME  ), (C(2325),VLABLE),  MCSIX   12
     C            (C(3167),NOOUT ), (C(2022),OPTN10), (C(2006),REPPLT),  MCSIX   13
     C            (C(2865),EU    ), (C(2765),EL    ), (C(2007),PTLESS)   MCSIX   14
      EQUIVALENCE               (C(1971),RITE  ), (C(1972),RKUTTA)       MCSIX   15
      EQUIVALENCE (C(1973),KASE  ), (C(1974),NJ    ), (C(1975),NPT   )   MCSIX   16
      EQUIVALENCE (C(3512),ISGCT),(C(3721),ITCT),(C(3511),RNSTRT)        MCSIX   17
      EQUIVALENCE (C( 21),IBVNSW)                                        MCSIX   18
      EQUIVALENCE (C( 22), IPLOT)                                        MCSIX   19
      EQUIVALENCE (C( 23),KLAMBD)                                        MCSIX   20
      EQUIVALENCE (C( 24), KSSIG)                                        MCSIX   21
      EQUIVALENCE (C( 25),CEPSIG)                                        MCSIX   22
      EQUIVALENCE (C(300),RMISS)                                         MCSIX   23
      DIMENSION RMISST(100)                                              MCSIX   24
      EQUIVALENCE (C(1000),RMISST)                                       MCSIX   25
      EQUIVALENCE (C(301),      L)                                       MCSIX   26
      EQUIVALENCE (C(302),   RYF)                                        MCSIX   27
      EQUIVALENCE(C(19),PSIZE)                                           MCSIX   28
      EQUIVALENCE (C(303),   RZF)                                        MCSIX   29
      EQUIVALENCE (C( 31), CEP)                                          MCSIX   30
      EQUIVALENCE (C(3525),  NCASE), (C( 625),     IBL)                  MCSIX   31
      EQUIVALENCE (C( 623),    DERSV)                                    LAG      1
      REAL KSSIG                                                         MCSIX   32
      INTEGER CEPSIG                                                     MCSIX   33
      DIMENSION CEPSIG(5)                                                MCSIX   34
      DIMENSION GRAPH(1,1),TIME(300)                                     MCSIX   35
      DIMENSION   VLABLE(2,15)    , IPL(100)        , DER(101)           MCSIX   36
      DIMENSION   VAR(101)        , EL(100)         , EJ(100)            MCSIX   37
      EQUIVALENCE (C(1980),RN    )                                       MCSIX   38
      EQUIVALENCE (C(1981),RNT   )                                       MCSIX   39
      EQUIVALENCE (C(1382),PLOTN4)                                       MCSIX   40
      EQUIVALENCE (C(1383),PLOTN2)                                       MCSIX   41
      EQUIVALENCE (C(1384),NPLOT )                                       MCSIX   42
      INTEGER OPOINT                                                     MCSIX   43
      INTEGER OPT                                                        MCSIX   44
      EXTERNAL AUXSUB                                                    MCSIX   45
      ISGCT=0                                                            MCSIX   46
      ITCT=0                                                             MCSIX   47
      MODE=-1                                                            MCSIX   48
      ITSNGX=0                                                           MCSIX   49
C                                                                        MCSIX   50
C                                                                        MCSIX   51
C                   THIS CALL TO SUBROUTINE RANNUM IS TO PERMIT USE OF   MCSIX   52
C                   DIFFERENT RANDOM NUMBER GENERATOR STARTERS (IRNST).  MCSIX   53
C                   IF SUBROUTINE NORMAL IS CALLED WITHOUT FIRST CALLING MCSIX   54
C                   RANNUM, THE RANDOM NUMBER SEQUENCE WILL ALWAYS       MCSIX   55
C                   BE STARTED WITH THE SAME NUMBER (ENTERED AS A DATA   MCSIX   56
C                   STATEMENT IN SUBROUTINE NORMAL), WHICH WILL RESULT   MCSIX   57
```

```
C               IN THE SAME SEQUENCE ALWAYS BEING GENERATED.           MCSIX   58
            L = 1                                                      MCSIX   59
            NP = 0                                                     MCSIX   60
            CALL COUNTV                                                MCSIX   61
       1000 CALL ZERO                                                  MCSIX   62
       1001 IF(PLOTN3.LE.0.)GOTO7                                      MCSIX   63
            IF(REPPLT.GT.0.)GOTO7                                      MCSIX   64
C                                                                      MCSIX   65
C                             REPPLT = 0.  USE NEW NO.4,7 (DISCARD OLD)  MCSIX   66
C                                      1.  USE OLD PLUS THOSE ADDED    MCSIX   67
C                                     -1.  USE NEW NO. 7 (DISCARD OLD) MCSIX   68
            IF (REPPLT.GT.-1.0) NOOUT = 0                              MCSIX   69
            NPLOT=0                                                    MCSIX   70
          7 CALL OINPT1                                                MCSIX   71
          8 CONTINUE                                                   MCSIX   72
            CALL RANNUM(1.,RNSTRT,DUM)                                 MCSIX   73
            IF(ISGCT.GT.0) CALL MCARLO (DUM, -1, IDUM)                 MCSIX   74
            C(1976) = 1.                                               MCSIX   75
            KASE=0                                                     MCSIX   76
            LSTEP = STEP                                               MCSIX   77
            NPLOT4=PLOTN4                                              MCSIX   78
            NPLOT2=PLOTN2                                              MCSIX   79
            NOPLOT=PLOTNO                                              MCSIX   80
       1002 CALL  SUBL1                                                MCSIX   81
       1003 CALL  AUXI                                                 MCSIX   82
       1004 CALL  SUBL2                                                MCSIX   83
       1005 CONTINUE                                                   MCSIX   84
            DER(101)=DER(1)                                            MCSIX   85
            IF(DER(1).GT.DERSV) DER(1)=DERSV                           LAG      2
            C(1976)=1.                                                 MCSIX   87
       1006 CALL   AUXSUB                                              MCSIX   88
       1007 NJ=N-1                                                     MCSIX   89
            CALL AMRK(AUXSUB)                                          MCSIX   90
       1008 CONTINUE                                                   MCSIX   91
       1009 CALL  SUBL3                                                MCSIX   92
            IF ( KSTEP .EQ. 1 ) GO TO 1007                             MCSIX   93
C                                                                      MCSIX   94
C                                                                      MCSIX   95
C                                                                      MCSIX   96
C                                                                      MCSIX   97
C                                                                      MCSIX   98
C                                                                      MCSIX   99
C*****************SAVE MISS DISTANCE FOR EACH RUN OF THE MONTE CARLO    MCSIX  100
C                  RUN SET*********************************************  MCSIX  101
C                                                                      MCSIX  102
C                                                                      MCSIX  103
C                                                                      MCSIX  104
            IF(LCEP.NE.1) GO TO 20                                     MCSIX  105
            LCEP=0                                                     MCSIX  106
            NP = NP + 1                                                MCSIX  107
            X(NP) = RYF                                                MCSIX  108
            Y(NP) = RZF                                                MCSIX  109
            RMISST(NP) = RMISS                                         MCSIX  110
            GO TO 21                                                   MCSIX  111
         20 CONTINUE                                                   MCSIX  112
            WRITE(6,805)                                               MCSIX  113
        805 FORMAT(1H0,///)                                            MCSIX  114
```

PROGRAM MAIN 74/74 OPT=1 FTN 4.2+75067 05/05/75 16.16.28. PAGE 3

```
      WRITE(6,22) L
   22 FORMAT(1H0,11X,26H*$*$*$ WARNING RUN NUMBER ,I3,
     2      37H DID NOT INTERSECT TARGET PLANE*$*$*$,/,
     3      //,26X,38H$*$*THIS RUN DROPPED FROM DATA SET*$*$)
      WRITE(6,805)
   21 CONTINUE
      L = L + 1
C
C
C
C
C
      CALL S8
      CALL PROCES
      IF (OPTN10 .GT. 0.) CALL DUMPO
      CALL RESET
      IF(LSTEP.EQ.5.OR.LSTEP.EQ.7.OR.NOPLOT.EQ.0)GOTO5
      CALL TIMEV(DELT)
      WRITE(6,96)DELT
   96 FORMAT(1H ,17HSTART PLOTTING ATF14.7)
      LESSPT=PTLESS
      OPOINT=OPOINT-LESSPT
      CALL PLOT4(GRAPH,OPOINT,VLABLE,TIME,NPLOT4,NPLOT2,NOPLOT)
      CALL PLOT2(GRAPH,OPOINT,VLABLE,TIME,NPLOT4,NPLOT2,NOPLOT)
      CALL PLOTN(GRAPH,OPOINT,VLABLE,TIME,NPLOT4,NPLOT2,NOPLOT)
      CALL TIMEV(DELT)
      WRITE(6,97)DELT
   97 FORMAT(1H ,18HPLOTTING ENDED AT F14.7)
    5 GO TO (1000,1001,1002,1003,1004,1005,1006,1007,1008,1009,1010),
     1 LSTEP
 1010 CONTINUE
C
C
C
C
C
C************MONTE CARLO AND CEP LOGIC FOLLOWS**************************
C
C
C
      IF(NP.LT.NCASE.AND.L.LE.(NCASE+5))WRITE(6,807)
      IF(NP.LT.NCASE.AND.L.LE.(NCASE+5))GO TO 8
  807 FORMAT(1H1,3(/),*      THIS RUN ADDED DUE TO BREAKLOCK*,3(/))
      J =0
      WRITE(6,800)
  800 FORMAT(1H1, 96X,10HY-MISS    ,10HZ-MISS    ,10HMISS DIST /,
     1    6X,123H-----------------------------------------------------------
     2-----------------------------------------------------------------
     3--)
      DO 801 I=1,NP
      J = J +1
      WRITE(6,802) X(I),Y(I),RMISS(I)
  802 FORMAT( 6X,10H1        ,10H1        ,10H1        ,10H1
     1,10H1        ,10H1        ,10H1        ,10H1        ,10H1
     2    ,1H1,F9.5,2H 1,F9.5,2H 1,F8.5,2H 1)
      WRITE(6,803)
  803 FORMAT( 6X,123H-----------------------------------------------------
```

```
      2-------------------------------------------------------------- MCSIX
      3-------)                                                       MCSIX
       IF(J.GT.30) WRITE (6,800)                                      MCSIX
       IF(J.GT.30) J = 0                                              MCSIX
   801 CONTINUE                                                       MCSIX
       IF(IBL.LE.0) GO TO 804                                         MCSIX
       L=L-1                                                          MCSIX
       XIBL=IBL                                                       MCSIX
       XL=L                                                           MCSIX
       RATIO=XIBL/XL                                                  MCSIX
       WRITE(6,806) IBL,L,RATIO                                       MCSIX
   806 FORMAT(1H1,15(/),1X,10(11H*BREAKLOCK*),                        MCSIX
     .        /,1X,11H*BREAKLOCK*,88X,11H*BREAKLOCK*,                 MCSIX
     .        /,1X,11H*BREAKLOCK*,88X,11H*BREAKLOCK*,                 MCSIX
     .        /,1X,11H*BREAKLOCK*,3X,*THIS RUN SET HAD *I4,* BREAKLOCK FL MCSIX
     .IGHTS OUT OF *I4,* GIVING A PROPORTION OF *F6.4,4X,11H*BREAKLOCK*, MCSIX
     .        /,1X,11H*BREAKLOCK*,88X,11H*BREAKLOCK*,                 MCSIX
     .        /,1X,11H*BREAKLOCK*,88X,11H*BREAKLOCK*,                 MCSIX
     .        /1X,10(11H*BREAKLOCK*))                                 MCSIX
   804 CONTINUE                                                       MCSIX
       CALL CEPAS(NP,ISVNSW,IPLOT,XLAMBD,KSSIG,CEPSIG,PSIZE)          MCSIX
  4668 CONTINUE                                                       MCSIX
       CALL EXIT                                                      MCSIX
       STOP                                                           MCSIX
       END                                                            MCSIX
```

```
            PROGRAM MAIN        74/74   OPT=1                         FTN 4.2+75067     05/05/75  16.16.20.     PAGE    5

       SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE      REFERENCES
 10214  MAIN            1

 VARIABLES      SN  TYPE              RELOCATION
     0  C           REAL       ARRAY   / /      REFS        5      21*7     2*14     3*15     3*16      17      18
                                                           19        20        21       22       24       25      26      27
                                                           28        29      2*30       31       38       39      40      41
                                                           42   DEFINED        75       97
    30  CEPSIG      INTEGER    ARRAY   / /      REFS       21        33        34      192
 10752  DELT        REAL                        REFS      132       133       140      141
  5147  DER         REAL       ARRAY   / /      REFS        7        36        85       86  DEFINED       85      86
  1156  DERSV       REAL               / /      REFS       31      2*86
 10746  DUM         REAL                        REFS       73        74
  5314  EL          REAL       ARRAY   / /      REFS        7        37
  5460  EU          REAL       ARRAY   / /      REFS        7        37
  7366  GRAPH       REAL       ARRAY   / /      REFS        5        35       137      138      139
  5146  HMAX        REAL               / /      REFS        7
  5145  HMIN        REAL               / /      REFS        7
 10755  I           INTEGER                     REFS    3*166   DEFINED       154
  1160  IBL         INTEGER            / /      REFS       30       177       179      182
    24  IBVNSW      INTEGER            / /      REFS       17       192
 10747  IDUM      * INTEGER                     REFS       74
  5001  IPL         INTEGER    ARRAY   / /      REFS        7        36
    25  IPLOT       INTEGER            / /      REFS       18       132
  6667  ISGCT       INTEGER            / /      REFS       16        74   DEFINED       46
  7210  ITCT        INTEGER            / /      REFS       16   DEFINED        47
 10744  ITSNUX    * INTEGER                  DEFINED       49
 10754  J           INTEGER                     REFS      165       174       175  DEFINED      158      135     175
  3664  KASE        INTEGER            / /      REFS       15   DEFINED        76
    27  KSSIG       REAL               / /      REFS       20        32       192
  3732  KSTEP       INTEGER            / /      REFS        7        33
   454  L           INTEGER            / /      REFS       25       115       121      155      156      178     186
                                                          182   DEFINED        59      121      178
    36  LCEP        INTEGER            / /      REFS       29       105   DEFINED      186
 10753  LESSPT      INTEGER                     REFS      136   DEFINED       135
  3733  LSTEP       INTEGER            / /      REFS        7     2*131       143  DEFINED       77
 10743  MODE      * INTEGER                  DEFINED       48
  5000  N           INTEGER            / /      REFS        7        89
  7360  NCASE       INTEGER            / /      REFS       30     2*155     2*156
  3665  NJ          INTEGER            / /      REFS       15   DEFINED        89
  6136  NOOUT       INTEGER            / /      REFS        7   DEFINED        69
  3730  NOPLOT      INTEGER            / /      REFS        7       131       137      138      139
                                             DEFINED       80
 10745  NP          INTEGER                     REFS      107       108       109      110      155      156     164
                                                          192   DEFINED        60      107
  3677  NPLOT       INTEGER            / /      REFS       42   DEFINED        70
 10751  NPLOT2      INTEGER                     REFS      137       138       139  DEFINED       79
 10750  NPLOT4      INTEGER                     REFS      137       138       139  DEFINED       78
  3666  NPT         INTEGER            / /      REFS       15
  3746  OPOINT      INTEGER            / /      REFS        7        43       136      137      138      139
                                             DEFINED      136
 10742  OPT       * INTEGER   *UNDEF            REFS       44
  3745  OPTN10      REAL               / /      REFS        7       129
  3727  PLOTNO      REAL               / /      REFS        7        53        80
  3676  PLOTN2      REAL               / /      REFS       41        79
```

```
VARIABLES    SN  TYPE             RELOCATION
  3675  PLOTN4   REAL                 / /      REFS     40     78
    22  PSIZE    REAL                 / /      REFS     27    192
  3726  PTLESS   REAL                 / /      REFS      7    135
 10760  RATIO    REAL                          REFS    152   DEFINED   181
  3725  REPPLT   REAL                 / /      REFS      7     64     69
  3662  RITE     REAL                 / /      REFS     14
  3663  RKUTTA   REAL                 / /      REFS     14
   453  RMISS    REAL                 / /      REFS     22    110
  1747  RMISST   REAL      ARRAY      / /      REFS     23     24    156   DEFINED   118
  3673  RN       REAL                 / /      REFS     38
  6666  RNSTRT   REAL                 / /      REFS     16     73
  3674  RNT      REAL                 / /      REFS     39
   455  RYF      REAL                 / /      REFS     26    108
   456  RZF      REAL                 / /      REFS     28    109
  3731  STEP     REAL                 / /      REFS      7     77
  3717  T        REAL                 / /      REFS      7
  3750  TIME     REAL      ARRAY      / /      REFS      7     35    137    138    139
  5624  VAR      REAL      ARRAY      / /      REFS      7     37
  4424  VLABLE   REAL      ARRAY      / /      REFS      7     36    137    138    139
     0  X        REAL      ARRAY    CEPASS     REFS      6    166   DEFINED   108
 10756  XIBL     REAL                          REFS    151   DEFINED   179
 10757  XL       REAL                          REFS    151   DEFINED   180
    26  XLAMBD   REAL                 / /      REFS     19    192
   144  Y        REAL      ARRAY    CEPASS     REFS      6    166   DEFINED   109

FILE NAMES       MODE
  4102  FILE
     0  INPUT
  2641  OUTPUT
  6143  TAPE14
  4102  TAPE5
  2041  TAPE6        FMT                WRITES   113    115    119    133    141    155    159    166
                                          173    174    192

EXTERNALS        TYPE   ARGS     REFERENCES
        AMRK              1          90
        AUXI              6          82
        AUXSUB            0          45     88     90
        CEPAS             7         192
        COUNTV            0          61
        DUMPO             0         123
        EXIT              6         194
        MCARLO            3          74
        OINPI1            6          71
        PLOTN             7         133
        PLOT2             7         133
        PLOT4             7         137
        PROCES            6         129
        RANNUM            3          73
        RESET             0         130
        SUBL1             6          61
        SUBL2             0          83
        SUBL3             0          92
        S8                6         127
        TIMEV             1         132    140
        ZERO              0          62
```

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PROGRAM MAIN          74/74   OPT=1                                  FTN 4.2+73067      05/05/75  16.16.28.     PAGE    7

STATEMENT LABELS                  DEF LINE   REFERENCES
 10347    5                          143        131
 10233    7                           71         63       64
 10234    8                           72        155
 10303   20                          112        105
 10311   21                          120        111
 10512   22       FMT                115        115
 10537   96       FMT                134        133
 10547   97       FMT                142        141
 10571  800       FMT                160        153      174
     0  801                          176        164
 10622  802       FMT                167        165
 10646  803       FMT                171        171
 10437  804                          191        177
 10564  805       FMT                114        113      119
 10676  806       FMT                183        182
 10557  807       FMT                157        155
 10223 1000                           62        143
 10224 1001                           63        143
 10253 1002                           81        143
 10254 1003                           82        143
 10255 1004                           83        143
 10256 1005                           84        143
 10264 1006                           88        143
 10265 1007                           89         93       143
 10270 1008                           91        143
 10270 1009                           92        143
 10366 1010                          145        143
     0 4668        INACTIVE          193

 OOPS  LABEL   INDEX    FROM-TO    LENGTH   PROPERTIES
 10404  801    * I      164 176     248                   EXT REFS

COMMON BLOCKS   LENGTH    MEMBERS - BIAS NAME(LENGTH)
 / /             3831              0 C      (3830)          3830 GRAPH  (1)
 CEPASS           200              0 X      (100)            100 Y      (100)

EQUIV CLASSES   LENGTH    MEMBERS - BIAS NAME(LENGTH)
C        C       3831             18 PSIZE  (1)              20 IBVNSN (1)             21 IPLOT  (1)
                                  22 XLA48) (1)              23 KSSIG  (1)             24 CEPSIG (6)
                                  30 LCEP   (1)             239 RMISS  (1)            300 L      (1)
                                 301 RYF    (1)             302 RZF    (1)            622 DERSV  (1)
                                 524 IBL    (1)             999 RMISST (100)         1970 RITE   (1)
                                1971 RKUTTA (1)            1972 KASE   (1)           1973 NJ     (1)
                                1974 NPT    (1)            1973 RN     (1)           1980 RNT    (1)
                                1981 PLOTN4 (1)            1982 PLOTN2 (1)           1983 NPLOT  (1)
                                1999 T      (1)            2005 REPPLT (1)           2006 PTLESS (1)
                                2007 PLOTNO (1)            2008 NOPLOT (1)           2009 STEP   (1)
                                2010 KSTEP  (1)            2011 LSTEP  (1)           2021 OPTN10 (1)
                                2022 OPOINT (1)            2024 TIME   (303)         2324 VLABLE (30)
                                2560 N      (1)            2561 IPL    (100)         2661 HMIN   (1)
                                2662 HMAX   (1)            2663 DER    (101)         2764 EL     (100)
                                2864 EU     (100)          2964 VAR    (101)         3166 NOOUT  (1)
                                3510 KNSTRT (1)            3511 ISSCT  (1)           3720 ITCT   (1)
                                3824 NCASE  (1)
```

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PROGRAM MAIN        74/74   OPT=1                    FTN 4.2+75067      05/05/75  16.16.20.       PAGE    8

STATISTICS
  PROGRAM LENGTH                  555B     365
  BUFFER LENGTH                 10204B    4228
  CM LABELED COMMON LENGTH        310B     200
  CM BLANK COMMON LENGTH         7367B    3831
```

```
      BLOCK DATA                                                        MCSIX 197
      COMMON                                                            MCSIX 198
     */NC1/NC1(2)      /NC2/NC2(4)      /NC3/NC3(4)      /NC5/NC5(4)    MCSIX 199
     */CA1/VM1(6)      /CA2/BA2(6),VM2(6)                               MCSIX 200
     */CA3/BA3(7),VM3(3)      /CA5/BA5(7),VM5(3)                        MCSIX 201
      COMMON /CMOF/CMO (6)   /CA4/VM4(6)                                MCSIX 202
     */CZPF/CZP(35)    /CZ2F/CZ2(35)    /CMPF/CMP(35)    /CM2F/CM2(35)  MCSIX 203
     */CY4F/CY4(36)    /CN4F/CN4(35)    /CL4F/CL4(21)    /CL2F/CL2(21)  MCSIX 204
     */CZDF/CZD1(35)                    /CMDF/CMD1(35)                  MCSIX 205
     */CM3F/CM3(36)    /CLPF/CLP(36)    /CLDF/CLD1(21)                  MCSIX 206
     */CXOF/CXO(6)                                                      MCSIX 207
      DATA NC1/5,3/                                                     MCSIX 208
      DATA NC2/6,6,0,0/                                                 MCSIX 209
      DATA NC3/7,5,0,0/                                                 MCSIX 210
      DATA NC5/7,3,0,0/                                                 MCSIX 211
      DATA VM1/0.3,0.8,0.9,1.1,1.4,2.0/                                 MCSIX 212
      DATA VM2/0.3,0.7,0.9,1.1,1.4,2.0/                                 MCSIX 213
      DATA VM3/ .5, .85, .95,1.05,1.25/                                 MCSIX 214
      DATA VM4/ .5, .85, .95,1.05,1.25,2./                              MCSIX 215
      DATA VM5/ .5, .95, 1.25/                                          MCSIX 216
      DATA BA2/ 0., 4., 8.,12.,16.,20./                                 MCSIX 217
      DATA BA3/ 0., 2., 4., 8.,12.,16.,20./                             MCSIX 218
      DATA BA5/ 0., 2., 4., 8., 12.,16.,20./                            MCSIX 219
      DATA CXO/.33,.30,.38,.71,.84,.97/                                 MCSIX 220
      DATA CMO /                                                        MCSIX 221
     *                                                                  MCSIX 222
      DATA CZP/                                                         MCSIX 223
     *                                                                  MCSIX 224
     *                                                                  MCSIX 225
     *                                                                  MCSIX 226
     *                                                                  MCSIX 227
     *                                                                  MCSIX 228
      DATA CMP/                                                         MCSIX 229
     *                                                                  MCSIX 230
     *                                                                  MCSIX 231
     *                                                                  MCSIX 232
     *                                                                  MCSIX 233
     *                                                                  MCSIX 234
      DATA CZD1/                                                        MCSIX 235
     *                                                                  MCSIX 236
     *                                                                  MCSIX 237
     *                                                                  MCSIX 238
     *                                                                  MCSIX 239
     *                                                                  MCSIX 240
      DATA CMD1/                                                        MCSIX 241
     *                                                                  MCSIX 242
     *                                                                  MCSIX 243
     *                                                                  MCSIX 244
     *                                                                  MCSIX 245
     *                                                                  MCSIX 246
      DATA CLD1/                                                        MCSIX 247
     *                                                                  MCSIX 248
     *                                                                  MCSIX 249
     *                                                                  MCSIX 250
      DATA CY4/                                                         MCSIX 251
     *                                                                  MCSIX 252
     *                                                                  MCSIX 253
```

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BLOCK DATA          74/74  OPT=1                FTN 4.2+75067      05/05/75  16.16.23.      PAGE   2

      *                                                              MCSIX     254
      *                                                              MCSIX     255
      *                                                              MCSIX     256
      *                                                              MCSIX     257
       DATA CN4/                                                     MCSIX     258
      *                                                              MCSIX     259
      *                                                              MCSIX     260
      *                                                              MCSIX     261
      *                                                              MCSIX     262
      *                                                              MCSIX     263
      *                                                              MCSIX     264
       DATA CL4/                                                     MCSIX     265
      *                                                              MCSIX     266
      *                                                              MCSIX     267
      *                                                              MCSIX     268
       DATA CL2/                                                     MCSIX     269
      *                                                              MCSIX     270
      *                                                              MCSIX     271
      *                                                              MCSIX     272
       DATA CZ2/                                                     MCSIX     273
      *                                                              MCSIX     274
      *                                                              MCSIX     275
      *                                                              MCSIX     276
      *                                                              MCSIX     277
      *                                                              MCSIX     278
       DATA CM2/                                                     MCSIX     279
      *                                                              MCSIX     280
      *                                                              MCSIX     281
      *                                                              MCSIX     282
      *                                                              MCSIX     283
      *                                                              MCSIX     284
       DATA CMQ/                                                     MCSIX     285
      *                                                              MCSIX     286
      *                                                              MCSIX     287
      *                                                              MCSIX     288
      *                                                              MCSIX     289
      *                                                              MCSIX     290
      *                                                              MCSIX     291
       DATA CLP/                                                     MCSIX     292
      *                                                              MCSIX     293
      *                                                              MCSIX     294
      *                                                              MCSIX     295
      *                                                              MCSIX     296
      *                                                              MCSIX     297
      *                                                              MCSIX     298
                                                                     MCSIX     299
```

```
BLOCK DATA             74/74    OPT=1                    FTN 4.2+75067      05/05/75  16.16.23.       PAGE     3

        SYMBOLIC REFERENCE MAP (R=3)

VARIABLES        SN  TYPE            RELOCATION
      0  BA2         REAL        ARRAY    CA2           REFS          2   DEFINED       21
      0  BA3         REAL        ARRAY    CA3           REFS          2   DEFINED       22
      0  BA5         REAL        ARRAY    CA5           REFS          2   DEFINED       23
      0  CLD1        REAL        ARRAY    CLDF          REFS          6   DEFINED       51
      0  CLP         REAL        ARRAY    CLPF          REFS          6   DEFINED       36
      0  CL2         REAL        ARRAY    CL2F          REFS          6   DEFINED       73
      0  CL4         REAL        ARRAY    CL4F          REFS          6   DEFINED       69
      0  CMD1        REAL        ARRAY    CMDF          REFS          6   DEFINED       45
      0  CMO         REAL        ARRAY    CMOF          REFS          6   DEFINED       25
      0  CMP         REAL        ARRAY    CMPF          REFS          6   DEFINED       33
      0  CMQ         REAL        ARRAY    CMQF          REFS          6   DEFINED       89
      0  CM2         REAL        ARRAY    CM2F          REFS          6   DEFINED       83
      0  CN4         REAL        ARRAY    CN4F          REFS          6   DEFINED       52
      0  CXO         REAL        ARRAY    CXOF          REFS          6   DEFINED       24
      0  CY4         REAL        ARRAY    CY4F          REFS          6   DEFINED       55
      0  CZD1        REAL        ARRAY    CZDF          REFS          6   DEFINED       39
      0  CZP         REAL        ARRAY    CZPF          REFS          6   DEFINED       27
      0  CZ2         REAL        ARRAY    CZ2F          REFS          6   DEFINED       77
      0  NC1         INTEGER     ARRAY    NC1           REFS          2   DEFINED       12
      0  NC2         INTEGER     ARRAY    NC2           REFS          2   DEFINED       13
      0  NC3         INTEGER     ARRAY    NC3           REFS          2   DEFINED       14
      0  NC5         INTEGER     ARRAY    NC5           REFS          2   DEFINED       15
      0  VM1         REAL        ARRAY    CA1           REFS          2   DEFINED       16
      6  VM2         REAL        ARRAY    CA2           REFS          2   DEFINED       17
      7  VM3         REAL        ARRAY    CA3           REFS          2   DEFINED       18
      0  VM4         REAL        ARRAY    CA4           REFS          6   DEFINED       19
      7  VM5         REAL        ARRAY    CA5           REFS          2   DEFINED       20

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
         NC1          2              0 NC1    (2)
         NC2          4              0 NC2    (4)
         NC3          4              0 NC3    (4)
         NC5          4              0 NC5    (4)
         CA1          6              0 VM1    (6)
         CA2         12              0 BA2    (6)                  6 VM2    (5)
         CA3         12              0 BA3    (7)                  7 VM3    (5)
         CA5         10              0 BA5    (7)                  7 VM5    (3)
         CMOF         6              0 CMO    (6)
         CA4          6              0 VM4    (6)
         CZPF        35              0 CZP    (35)
         CZ2F        35              0 CZ2    (35)
         CMPF        35              0 CMP    (35)
         CM2F        35              0 CM2    (35)
         CY4F        36              0 CY4    (36)
         CN4F        36              0 CN4    (36)
         CL4F        21              0 CL4    (21)
         CL2F        21              0 CL2    (21)
         CZDF        35              0 CZD1   (35)
         CMDF        35              0 CMD1   (35)
         CMQF        36              0 CMQ    (36)
         CLPF        36              0 CLP    (36)
         CLDF        21              0 CLD1   (21)
         CXOF         6              0 CXO    (6)
```

```
        BLOCK DATA            74/74   OPT=1                        FTN 4.2+75067    05/05/75  16.16.23.     PAGE    6

  STATISTICS
    PROGRAM LENGTH            03       0
    CM LABELED COMMON LENGTH  7513     489
```

```
      SUBROUTINE MCARLO(RNSTRT,MODE,ITSNDX)
      COMMON C(3830)                                                    MCARLO   2
      EQUIVALENCE (C(  60),    RLW)                                     MCARLO   3
      EQUIVALENCE (C(1551),     RX)                                     MCARLO   4
      EQUIVALENCE (C(1571),     RY)                                     MCARLO   5
      EQUIVALENCE (C(2000),      T)                                     MCARLO   6
      EQUIVALENCE (C(1564),YMC)                                         MCARLO   7
      EQUIVALENCE (C(1565),YMC2)                                        MCARLO   8
      EQUIVALENCE (C(1574),ZMC)                                         MCARLO   9
      EQUIVALENCE (C(1575),ZMC2)                                        MCARLO  10
      EQUIVALENCE (C(2564),     DT)                                     MCARLO  11
      EQUIVALENCE (C(2765),    NTM)                                     MCARLO  12
      EQUIVALENCE (C(2775),     TM)                                     MCARLO  13
      EQUIVALENCE (C(2785),  TRMS2)                                     MCARLO  14
      EQUIVALENCE (C(2795),   TRMS)                                     MCARLO  15
      EQUIVALENCE (C(2305),    TMU)                                     MCARLO  16
      EQUIVALENCE (C(2815),    TVM)                                     MCARLO  17
      EQUIVALENCE (C(2825),   TSIG)                                     MCARLO  18
      EQUIVALENCE (C(3513),  ISSCT)                                     MCARLO  19
      EQUIVALENCE (C(3514),  SIGMA)                                     MCARLO  20
      EQUIVALENCE (C(3554),  SIGLB)                                     MCARLO  21
      EQUIVALENCE (C(3594),  SIGUB)                                     MCARLO  22
      EQUIVALENCE (C(3634),  ISNDX)                                     MCARLO  23
      EQUIVALENCE (C(3674),  IDIST)                                     MCARLO  24
      EQUIVALENCE (C(3511),RANSTT)                                      MCARLO  25
      EQUIVALENCE (C(3721),   ITCT)                                     MCARLO  26
      EQUIVALENCE (C(3723), TSGMA)                                      MCARLO  27
      EQUIVALENCE (C(3733),    TLB)                                     MCARLO  28
      EQUIVALENCE (C(3743),    TUB)                                     MCARLO  29
      EQUIVALENCE (C(3753), ITNDX)                                      MCARLO  30
      EQUIVALENCE (C(3763),ITDIST)                                      MCARLO  31
      EQUIVALENCE (C(3773),  TSPER)                                     MCARLO  32
      EQUIVALENCE (C(3783),TYPPER)                                      MCARLO  33
      EQUIVALENCE (C(3793),  TPSIG)                                     MCARLO  34
      EQUIVALENCE (C(3813),ITNDX2)                                      MCARLO  35
      EQUIVALENCE (C(3803),  TNXST)                                     MCARLO  36
      DIMENSION SIGMA(40),SIGLB(40),SIGUB(40),ISNDX(40),IDIST(40)       MCARLO  37
      DIMENSION TSGMA(10),TLB(10),TUB(10),ITNDX(10),ITDIST(10),         MCARLO  38
     *TSPER(10),TYPPER(10),TPSIG(10),ITNDX2(10),TNXST(10)               MCARLO  39
      DIMENSION SVC(40),SVST(40),IDISTT(7)                              MCARLO  40
      DIMENSION INIT(40)                                                MCARLO  41
      DIMENSION NTM(10), TM(10), TRMS2(10), TRMS(10), TMU(10), TVM(10), MCARLO  42
     1 TSIG(10)                                                         MCARLO  43
      DATA CFERTY/10HR         /                                        MCARLO  44
      DATA INIT/40*0/                                                   MCARLO  45
      DATA CCEF1/13.0537351/                                            MCARLO  46
      DATA COEF2/165.4366343/                                           MCARLO  47
      DATA COEF3/23.10344032/                                           MCARLO  48
      DATA LTCT/0/                                                      MCARLO  49
      DATA (IDISTT(IA),IA=1,7)/6HNORMAL,7HUNIFORM,7H2-ORDER,7H2-ORDER,7H MCARLO  50
     *1-ORDER,7H2-ORDER,7H2-ORDER/                                      MCARLO  51
      RNSTRT = RANSTT                                                   MCARLO  52
      I = ITSNDX                                                        MCARLO  53
      IF(MODE.GE.2) GO TO 300                                           MCARLO  54
      IF(MODE.NE.-1) GO TO 81                                           MCARLO  55
      WRITE(6,2100)                                                     MCARLO  56
      WRITE(6,2103)                                                     MCARLO  57
```

```
      GO TO 1000                                                       MCARLO    59
   81 CONTINUE                                                         MCARLO    60
C                                                                      MCARLO    61
C            MONTE-CARLO INITIAL CONDITIONS.  USE UNIFORM              MCARLO    62
C            DISTRIBUTION FOR I TH  CONDITION IF IDIST(I)=1,           MCARLO    63
C            AND USE NORMAL DISTRIBUTION IF IDIST(I)=0.                MCARLO    64
C                                                                      MCARLO    65
C                                                                      MCARLO    66
C            SAVE MEAN VALUES OF INITIAL CONDITIONS TO BE MONTE        MCARLO    67
C            CARLO D.  IN SVC(I), AND SAVE TIME SERIES MEAN            MCARLO    68
C            VALUES (FOR CONSTANT MEANS) IN SVCT(I).                   MCARLO    69
C                                                                      MCARLO    70
C                                                                      MCARLO    71
      IF(MODE.EQ.INIT(I)) GO TO 80                                     MCARLO    72
      JU = ISNDX(I)                                                    MCARLO    73
      SVC(I) = C(JU)                                                   MCARLO    74
      INIT(I) = 1                                                      MCARLO    75
   80 CONTINUE                                                         MCARLO    76
      IF(IDIST(I).NE.1) GO TO 100                                      MCARLO    77
      CALL RANNUM (1., RNSTRT, RX)                                     MCARLO    78
      JU = ISNDX(I)                                                    MCARLO    79
      C(JU) = SVC(I) + (RX*(SIGUB(I) - SIGLB(I)) + SIGLB(I))*SIGMA(I)  MCARLO    80
      GO TO 1                                                          MCARLO    81
  100 IF(IDIST(I).NE.0) GO TO 101                                      MCARLO    82
      XL = SIGLB(I)                                                    MCARLO    83
      SGMA=SIGMA(I)                                                    MCARLO    84
      XU = SIGUB(I)                                                    MCARLO    85
      JU = ISNDX(I)                                                    MCARLO    86
      XMU=SVC(I)                                                       MCARLO    87
      CALL NORM(RX,XL,XU,XMU,SGMA,RNSTRT)                              MCARLO    88
      C(JU)=RX                                                         MCARLO    89
      GO TO 1                                                          MCARLO    90
  101 JU= ISNDX(I)                                                     MCARLO    91
      WRITE(6,5000)JU,IDIST(I)                                         MCARLO    92
    1 CONTINUE                                                         MCARLO    93
      IF(IDIST(I).NE.1) GO TO 737                                      MCARLO    94
      WRITE(6,2101) JU, C(JU), SVC(I), SIGLB(I), SIGUB(I)              MCARLO    95
      GO TO 13                                                         MCARLO    96
  737 WRITE(6,2105) JU, C(JU), SVC(I), SIGLB(I), SIGUB(I)              MCARLO    97
   13 CONTINUE                                                         MCARLO    98
 5000 FORMAT(1X,61HTHE INITIAL CONDITION MONTE CARLO DIST. PARAMETER FOR MCARLO  99
     * C-INDEX,1X,I5,1X,12HWAS INPUT AS,1X,I5,1X,30H...ONLY 0 AND 1 ARE MCARLO  100
     *RECOGNIZED)                                                      MCARLO   101
C                                                                      MCARLO   102
C                                                                      MCARLO   103
C            WRITE OUT MONTE CARLO INITIAL CONDITIONS.                 MCARLO   104
C                                                                      MCARLO   105
C                                                                      MCARLO   106
 2100 FORMAT(30X,30HMONTE CARLO INITIAL CONDITIONS/)                   MCARLO   107
 2103 FORMAT(25X,7HC-INDEX,5X,8HMC-VALUE,5X,4HMEAN,5X,12HDISTRIBUTION,5X MCARLO 108
     *,11HLOWER BOUND,5X,11HUPPER BOUND)                               MCARLO   109
 2101 FORMAT(25X,I5,8X,F8.3,3X,F8.3,6X,7HUNIFORM,9X,F8.3,7X,F8.3)      MCARLO   110
 2105 FORMAT(25X,I5,8X,F11.7,1X,F11.7,1X,7H NORMAL,10X,F8.3,7X,F8.3)   OLAY       1
C                                                                      MCARLO   112
      GO TO 1000                                                       MCARLO   113
C                                                                      MCARLO   114
C                                                                      MCARLO   115
```

```
      GO TO 1000                                                        MCARLO   59
   81 CONTINUE                                                          MCARLO   60
C                                                                       MCARLO   61
C                   MONTE CARLO INITIAL CONDITIONS.  USE UNIFORM        MCARLO   62
C                   DISTRIBUTION FOR I TH  CONDITION IF IDIST(I)=1,     MCARLO   63
C                   AND USE NORMAL DISTRIBUTION IF IDIST(I)=0.          MCARLO   64
C                                                                       MCARLO   65
C                                                                       MCARLO   66
C                   SAVE MEAN VALUES OF INITIAL CONDITIONS TO BE MONTE  MCARLO   67
C                   CARLO D    IN SVC(I), AND SAVE TIME SERIES MEAN     MCARLO   68
C                   VALUES (FOR CONSTANT MEANS) IN SVCT(I).             MCARLO   69
C                                                                       MCARLO   70
C                                                                       MCARLO   71
      IF(MODE.EQ.INIT(I)) GO TO 80                                      MCARLO   72
      JU = ISNDX(I)                                                     MCARLO   73
      SVC(I) = C(JU)                                                    MCARLO   74
      INIT(I) = 1                                                       MCARLO   75
   80 CONTINUE                                                          MCARLO   76
      IF(IDIST(I).NE.1) GO TO 100                                       MCARLO   77
      CALL RANNUM (1.,-RNSTRT, RX)                                      MCARLO   78
      JU = ISNDX(I)                                                     MCARLO   79
      C(JU) = SVC(I) + (RX*(SIGUB(I) - SIGLB(I)) + SIGLB(I))*SIGMA(I)   MCARLO   80
      GO TO 1                                                           MCARLO   81
  100 IF(IDIST(I).NE.0) GO TO 101                                       MCARLO   82
      XL = SIGLB(I)                                                     MCARLO   83
      SGMA=SIGMA(I)                                                     MCARLO   84
      XU = SIGUB(I)                                                     MCARLO   85
      JU = ISNDX(I)                                                     MCARLO   86
      XMU=SVC(I)                                                        MCARLO   87
      CALL NOR4(RX,XL,XU,XMU,SGMA,RNSTRT)                               MCARLO   88
      C(JU)=RX                                                          MCARLO   89
      GO TO 1                                                           MCARLO   90
  101 JU= ISNDX(I)                                                      MCARLO   91
      WRITE(6,5000)JU,IDIST(I)                                          MCARLO   92
    1 CONTINUE                                                          MCARLO   93
      IF(IDIST(I).NE.1) GO TO 737                                       MCARLO   94
      WRITE(6,2101) JU, C(JU), SVC(I), SIGLB(I), SIGUB(I)               MCARLO   95
      GO TO 13                                                          MCARLO   96
  737 WRITE(6,2105) JU, C(JU), SVC(I), SIGLB(I), SIGUB(I)               MCARLO   97
   13 CONTINUE                                                          MCARLO   98
 5000 FORMAT(1X,61HTHE INITIAL CONDITION MONTE CARLO DIST. PARAMETER FOR MCARLO   99
     * C-INDEX,1X,I5,1X,12HWAS INPUT AS,1X,I6,1X,30H...ONLY 0 AND 1 ARE MCARLO  100
     *RECOGNIZED)                                                       MCARLO  101
C                                                                       MCARLO  102
C                                                                       MCARLO  103
C                   WRITE-OUT MONTE CARLO INITIAL CONDITIONS.           MCARLO  104
C                                                                       MCARLO  105
C                                                                       MCARLO  106
 2100 FORMAT(30X,30HMONTE CARLO INITIAL CONDITIONS/)                    MCARLO  107
 2103 FORMAT(25X,7HC-INDEX,5X,8HMC-VALUE,5X,4HMEAN,5X,12HDISTRIBUTION,5X MCARLO  108
     *,11HLOWER BOUND,5X,11HUPPER BOUND)                                MCARLO  109
 2101 FORMAT(25X,I5,8X,F8.3,3X,F8.3,6X,7HUNIFORM,9X,F5.3,7X,F5.3)       MCARLO  110
 2105 FORMAT(25X,I5,8X,F11.7,1X,F11.7,1X,7H NORMAL,10X,F8.3,7X,F8.3)    OLAY      1
C                                                                       MCARLO  112
      GO TO 1000                                                        MCARLO  113
C                                                                       MCARLO  114
C                                                                       MCARLO  115
```

SUBROUTINE MCARLO 74/74 OPT=1 FTN 4.2+75067 05/05/75 16.16.27. PAGE 3

```
C
C                   TEST FLIGHT TIME AGAINST NEXT SAMPLE TIME FOR
C                   EACH TIME SERIES ERROR SOURCE.  FOR THOSE TIME
C                   SERIES ERROR SOURCES HAVING A NEXT SAMPLING TIME,
C                   TNXST(I), LESS THAN OR EQUAL TO THE SIMULATION
C                   TIME, I, DETERMINE THE TIME SERIES ERROR SOURCE
C                   MONTE CARLO VALUE.
C
C
  306 IF(LTCT.LE.3) GO TO 1000
      IF(MODE.EQ.4) TNKST(I) = 0.
      IF(C(1976).LE.0.) GO TO 1000
      IF(C(2000).LT.TNXST(ITSNDX)) GO TO 1000
      IB= ITSNDX
      ITT=ITDIST(IB) +1
C
C
C                   DETERMINE IF THE TIME SERIES PERIOD IS DETERMINISTIC
C                   (TYPPER(IB).GT.0) OR STOCHASTIC (TYPPER(IB).EQ.0).
C
C
      IF(TYPPER(IB).GT.0.) GO TO 311
C
C
C                   INCREMENT THE IB TH  TIME SERIES ERROR SOURCE BY
C                   THE VALUE OF THE DETERMINISTIC PERIOD, TSPER(IB)
C
C
      TNXST(IB)=C(2000)+ TSPER(IB)
      GO TO 312
  311 XMU=TNXST(IB)+ TSPER(IB)
      XL=TNXST(IB)
      XU=XMU+TSPER(IB)
      SGMA=TSSIG(IB)
      CALL NORM(RX,XL,XU,XMU,SGMA,RNSTRT)
C
C
C                   INCREMENT THE IB TH  TIME SERIES ERROR SOURCE BY
C                   A NORMALLY DISTRIBUTED RANDOM VALUE, WHERE THE
C                   RANDOM VALUEIS BOUNDED TO  LIE BETWEEN ZERO AND
C                   TWICE THE PERIOD MEAN VALUE, TSPER(IB).
C
C
      TNXST(IB)=RX
  312 CONTINUE
      JU=ITNDX(IB)
      JW=ITNDX2(IB)
      IF(MODE.EQ.4) SVCT(I) = C(JJ)
      XMU=SVCT(IB)
      IF(JU.NE.JW) XMU=C(JJ)
      XL=TLB(IB)
      XU=TUB(IB)
      SGMA=TSGMA(IB)
 1306 IF(ITDIST(IB).LE.0) GO TO 1307
      GO TO (304,305,340,350,380,380),ITDIST(IB)
C
 1307 CONTINUE
```

```
C
C                 DETERMINE THE NORMALLY DISTRIBUTED IB TH  ERROR
C                 SOURCE MONTE CARLO VALUE.
C
C
      CALL NORM(RX,XL,XU,XMU,SGMA,RNSTRT)
      C(JH)=RX
      GO TO 309
C
  304 CONTINUE
C
C                 DETERMINE THE UNIFORMALY DISTRIBUTED IB TH  ERROR
C                 SOURCE MONTE CARLO VALUE.
C
C
      CALL RANNJM (1.,RNSTRT, RX)
      ZMU=SVCT(IB)
      IF(JU.NE.JH) ZMU=C(JU)
      C(JH) = SVCT(IB) + (RX*(TJB(IB) - TLB(IB)) + TLB(IB)) *TSGMA(IB)
      GO TO 309
C
C
C                 DETERMINE THE CORRELATED NORMAL IB TH   ERROR SOURCE
C                 MONTE CALRLO VALUE.
C
C
  305 IF(MODE.NE.4) GO TO 330
      GO TO 1000
  330 CALL NORM(RX,-3.,3.,0.,1.,RNSTRT)
      YMC = TMU(IB)
      YMC2 = TRMS(IB)
      GO TO 309
  340 IF(MODE.NE.4) GO TO 341
      GO TO 1000
  341 CALL NORM(RY,-3.,3.,0.,1.,RNSTRT)
      ZMC = TMU(IB)
      ZMC2 = TRMS(IB)
      GO TO 309
  350 IF(MODE.NE.4) GO TO 351
      NTM(IB) = 0
      TM(IB) = 0.
      TRMS2(IB) = 0.
      GO TO 1000
  351 CALL NORM (RL4,-3.,3.,0.,1.,RNSTRT)
  309 CONTINUE
      NTM(IB) = NTM(IB) + 1
      TM(IB) = TM(IB) + C(JU)
      TRMS2(IB) = (TRMS2(IB) + C(JU)*C(JU))
C
C     CALCULATE TIME SERIES ROOT MEAN SQUARE
C
      TRMS(IB) = SQRT(TRMS2(IB)/NTM(IB))
C
C     CALCULATE TIME SERIES MEAN VALUES
C
      TMU(IB) = TM(IB)/NTM(IB)
      GO TO 1000
```

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      SUBROUTINE MCARLO      74/74    OPT=1                    FTN 4.2+75867     05/05/75  16.16.27.      PAGE     5

                    ENTRY MCARLX                                                          MCARLO     230
  230               WRITE(6,7443)                                                         MCARLO     231
                    DO 1001 I3=1,ITCT                                                     MCARLO     232
              C                                                                           MCARLO     233
              C     CALCULATE TIME SERIES VARIANCE                                        MCARLO     234
              C                                                                           MCARLO     235
  235               TVM(IB) = TRMS(IB)*TRMS(IB) - TMU(IB)*TMU(IB)                         MCARLO     236
              C                                                                           MCARLO     237
              C     CALCULATE TIME SERIES STANDARD DEVIATION                              MCARLO     238
              C                                                                           MCARLO     239
                    TSIG(IB) = SQRT(TVM(IB))                                              MCARLO     240
  240         C                                                                           MCARLO     241
                    WRITE(6,7443) ITNDX(IB),TMU(IB),TVM(IB),TSIG(IB),TRMS(I3)             MCARLO     242
               1001 CONTINUE                                                              MCARLO     243
               7440 FORMAT(30X,30HMONTE CARLO TIME SERIES VALUES//,                       MCARLO     244
                  1 26X,7HC-INDEX,5X,4HMEAN,8X,8HVARIANCE,4X,7HSTD DEV,5X,3HRMS/)         MCARLO     245
  245          7443 FORMAT(25X,I5,8X,F8.3,4X,F8.3,4X,F8.3,4X,F8.3)                        MCARLO     246
                    GO TO 1000                                                            MCARLO     247
                380 WRITE(6,8821)ITDIST(IB)                                               MCARLO     248
               8821 FORMAT(1X,23HUNRECOGNIZED DISTRIBUTION NO.,1X,I6,1X,7HENTERED)        MCARLO     249
               1000 RETURN                                                                MCARLO     250
  250               END                                                                   MCARLO     251
```

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      SUBROUTINE MCARLO      74/74    OPT=1                    FTN 4.2+75857     05/05/75  16.16.27.      PAGE     6

  CARD NR. SEVERITY  DETAILS   DIAGNOSIS OF PROBLEM

    235       I       ITCT     THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
    239       I       ITCT     THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
```

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SUBROUTINE MCARLO      74/74    OPT=1                    FTN 4.2+75067      05/05/75  16.16.27.     PAGE   7

          SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS        DEF LINE      REFERENCES
    3  MCARLO           1
  306  MCARLX         229          249

VARIABLES         SN  TYPE           RELOCATION
    0  C              REAL      ARRAY   / /        REFS         2        3        4        5        6        7        8
                                                            9       10       11       12       13       14       15       16
                                                           17       18       19       20       21       22       23       24
                                                           25       26       27       28       29       30       31       32
                                                           33       34       35       36       73       94       96      126
                                                          127      143      152      164      189      218    2*219
                                                   DEFINED         79       88      178      190
  410  COEF1        * REAL                         DEFINED         46
  411  COEF2        * REAL                         DEFINED         47
  412  COEF3        * REAL                         DEFINED         48
  407  CPERTY       * REAL                         DEFINED         44
 5147  DT             REAL                / /      REFS            11
  573  I              INTEGER                      REFS            71       72       73       74       76       78     5*79
                                                           81       82       83       84       85       86       90       91
                                                           93     3*94     3*96      125      162  DEFINED       53
  601  IB             INTEGER                      REFS           129      136    2*143    2*145      146      147      148
                                                          158      160      151      153      165      166      157      168
                                                          169      158    5*190      201      202      207      208      211
                                                          212      213    2*217    2*218    2*219    3*223    3*227    5*235
                                                        2*239    5*241      247  DEFINED      128      231
 7131  IDIST          INTEGER   ARRAY   / /        REFS            24       37       76       81       91       93
  725  IDISTT         INTEGER   ARRAY              REFS            40  DEFINED       50
  734  INIT           INTEGER   ARRAY              REFS            41       71  DEFINED       45       74
 6667  ISGCT          INTEGER           / /        REFS            19
 7061  ISNDX          INTEGER   ARRAY   / /        REFS            23       37       72       78       85       90
 7210  ITCT           INTEGER           / /        REFS            26      124      231
 7262  ITDIST         INTEGER   ARRAY   / /        REFS            31       38      129      168      159      247
 7250  ITNDX          INTEGER   ARRAY   / /        REFS            30       74      160      241
 7344  ITNDX2         INTEGER   ARRAY   / /        REFS            35       38      151
    0  ITSNDX         INTEGER           F.P.       REFS            53      127      128  DEFINED        1
  662  ITT          * INTEGER                      DEFINED        129
  574  JU             INTEGER                      REFS            73       79       88       91     2*94     2*96      162
                                                        2*164    2*189      218    2*219  DEFINED       72       78       85
                                                           90      150
  603  JW             INTEGER                      REFS           164      178      189      190  DEFINED      161
  413  LTCT         * INTEGER                      DEFINED         49
    0  MODE           INTEGER           F.P.       REFS            54       55       71      125      162      198      284
                                                          210  DEFINED        1
 5314  NTM            INTEGER   ARRAY   / /        REFS            12       42      217      223      227
                                                   DEFINED        211      217
 6666  RANSTT         REAL              / /        REFS            25       52
   73  RLW            REAL              / /        REFS             3      215
    0  RNSTRT         REAL              F.P.       REFS            77       87      149      177      187      208      286
                                                          215  DEFINED        1       52
 3030  RX             REAL              / /        REFS             4       77       79       87       88      149      158
                                                          177      178      187      198      208
 3042  RY             REAL              / /        REFS             5      206
  576  SGMA           REAL                         REFS            57      149      177  DEFINED       83      148      167
 6741  SIGLB          REAL      ARRAY   / /        REFS            21       37     2*79       82       94       96
 6671  SIGMA          REAL      ARRAY   / /        REFS            20       37       79       83
```

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        SUBROUTINE MCARLO        74/74    OPT=1                          FTN 4.2+75067     05/05/75  16.16.27.     PAGE     8

VARIABLES     SN   TYPE              RELOCATION
  7011  SIGUB      REAL        ARRAY    / /       REFS        22      37      79      84      94      96
   605  SVC        REAL        ARRAY              REFS        40      79      56      94      96
                                                 DEFINED      73
   655  SVCT       REAL        ARRAY              REFS        40     163     188     190   DEFINED   162
  3717  T          REAL                 / /       REFS         6
  7224  TLB        REAL        ARRAY    / /       REFS        28      38     165    2*198
  5326  TM         REAL        ARRAY    / /       REFS        13      42     218     227   DEFINED   212     218
  5364  TMU        REAL        ARRAY    / /       REFS        16      42     201     207    2*235    241
                                                 DEFINED     227
  7332  TNXST      REAL        ARRAY    / /       REFS        36      38     127     145     146
                                                 DEFINED     125     143     158
  7320  TPSIG      REAL        ARRAY    / /       REFS        34      38     146
  5352  TRMS       REAL        ARRAY    / /       REFS        15      42     202     208    2*235    241
                                                 DEFINED     223
  5340  TRMS2      REAL        ARRAY    / /       REFS        14      42     219     223   DEFINED   213     219
  7212  TSGMA      REAL        ARRAY    / /       REFS        27      38     167     190
  5410  TSIG       REAL        ARRAY    / /       REFS        18      42     241   DEFINED   239
  7274  TSPER      REAL        ARRAY    / /       REFS        32      38     143     145     147
  7236  TUB        REAL        ARRAY    / /       REFS        29      38     156     190
  5376  TVM        REAL        ARRAY    / /       REFS        17      42     239     241   DEFINED   235
  7306  TYPPER     REAL        ARRAY    / /       REFS        33      38     136
   575  XL         REAL                           REFS        87     149     177   DEFINED    82     146     165
   600  XMU        REAL                           REFS        87     147     149     177   DEFINED    86     145
                                                  163        164
   577  XU         REAL                           REFS        87     149     177   DEFINED    94     147     166
  3033  YMC        REAL                 / /       REFS         7   DEFINED   201
  3034  YMC2       REAL                 / /       REFS         8   DEFINED   202
  3045  ZMC        REAL                 / /       REFS         9   DEFINED   207
  3046  ZMC2       REAL                 / /       REFS        10   DEFINED   208
   604  ZMU        REAL                          DEFINED     188     189

FILE NAMES         MODE
        TAPE6      FMT                  WRITES       56      57      91      94      96   .  230     241     247

EXTERNALS          TYPE    ARGS       REFERENCES
        NORM                6            87       149     177     200     236     215
        RANNUM              3            77       187
        SQRT       REAL     1 LIBRARY   223       239

STATEMENT LABELS              DEF LINE   REFERENCES
    71  1                        92         91       89
   116  13                       97         95
    30  60                       75         71
    21  81                       59         55
    45  100                      81         75
    63  101                      90         81
   117  300                     124         54
   215  304                     181        163
   234  305                     198        163
   270  309                     216        173       191     233     289
   137  311                     145        136
   152  312                     159        144
   237  330                     200        193
   246  340                     204        169
   251  341                     235        204
   260  350                     210        169
   265  351                     215        213
```

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          SUBROUTINE MCARLO      74/74    OPT=1                     FTN 4.2+75057      05/05/75  16.16.27.        PAGE    9

 STATEMENT LABELS                DEF LINE   REFERENCES
    342  380                       247       2*169
    105  737                        95          93
    346  1000                      249          59      112      124      126      127      199      205      214      228
                                               245
      0  1001                      242         231
      0  1306       INACTIVE       168
    207  1307                      171         165
    465  2100    FMT               105          55
    504  2101    FMT               109          94
    472  2103    FMT               107          57
    512  2105    FMT               110          95
    447  5000    FMT                98          91
    534  7440    FMT               243         233
    547  7443    FMT               245         241
    560  8821    FMT               248         247

 LOOPS  LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES
   320  1001   * IB       231 242      22B                   EXT REFS

 COMMON BLOCKS   LENGTH    MEMBERS - BIAS NAME(LENGTH)
     / /         3830            0 C       (3830)

 EQUIV CLASSES   LENGTH    MEMBERS - BIAS NAME(LENGTH)
 C       C        3830          53 RLH    (1)              1550 RX      (1)          1563 YMC     (1)
                              1564 YMC2   (1)              1570 RY      (1)          1573 ZMC     (1)
                              1574 ZMC2   (1)              1933 T       (1)          2663 DT      (1)
                              2764 NTM    (10)             2774 TM      (10)         2784 TRMS2   (10)
                              2794 TRMS   (10)             2804 TMJ     (10)         2814 TVM     (10)
                              2824 ISIG   (10)             3510 RANSTT  (1)          3511 ISGCT   (1)
                              3513 SIGMA  (40)             3553 SIGLB   (40)         3593 SIGUB   (40)
                              3633 ISNDX  (40)             3673 IDIST   (40)         3720 ITCT    (1)
                              3722 ISGMA  (10)             3732 TLB     (10)         3742 TUB     (10)
                              3752 ITNDX  (10)             3762 ITDIST  (10)         3772 TSPER   (10)
                              3782 TYPPER (10)             3792 TPSIG   (10)         3802 TNXST   (10)
                              3812 ITNDX2 (10)

 STATISTICS
   PROGRAM LENGTH                10148     516
   CM BLANK COMMON LENGTH        73663    3830
```

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SUBROUTINE CEPAS        74/74    OPT=1                    FTN 4.2+75067     05/05/75  16.16.32.        PAGE    1

      SUBROUTINE CEPAS(NP,IBVNSW,IPLOT,XLAMBD,KSSIG,CEPSIG,PSIZE)      MCARLO  252
      COMMON/CEPASS/X(100),Y(100)                                       MCARLO  253
      DIMENSION           CEPSIG(6)                                     MCARLO  254
      DIMENSION CRIT(100)                                               MCARLO  255
      REAL KSSIG                                                        MCARLO  256
      INTEGER CEPSIG                                                    MCARLO  257
      WRITE(6,2003)                                                     SOMETH    9
 2003 FORMAT(1H1,39HCEPAS PARAMETER CONTROL CARD INPUT DATA  )          SOMETH   10
      WRITE(6,2004)NP,IBVNSW,IPLOT,XLAMBD,KSSIG,(CEPSIG(JJ),JJ=1,5)     MCARLO  258
      WRITE(6,2005)                                                     SOMETH   11
 2005 FORMAT(1X,31HINPUT MISS DISTANCE COORDINATES///)                  SOMETH   12
 2004 FORMAT(1X,3I6,2(1X,F10.3),5I6)                                    MCARLO  259
      DO 5 I=1,5
      IF(CEPSIG(I).GT.0) GO TO 5                                        MCARLO  261
      CEPSIG(I)= -1                                                     MCARLO  262
    5 CONTINUE                                                          MCARLO  263
      NUC=(NF - 1) / 15                                                 MCARLO  264
      NUC=NUC+1                                                         MCARLO  265
      WRITE(6,2000)                                                     MCARLO  266
 2000 FORMAT(1X,2HX=)                                                   MCARLO  267
      WRITE(6,2001)(X(I),I=1,NP)                                        MCARLO  268
 2001 FORMAT(10(2X,F7.3))                                               MCARLO  269
      WRITE(6,2002)                                                     MCARLO  270
 2002 FORMAT(1X,2HY=)                                                   MCARLO  271
      WRITE(6,2001)(Y(I),I=1,NP)                                        MCARLO  272
      CALL CEPP (X,Y,NP,KSSIG,XLAMBD,IBVNSW,CEPSIG,IPLOT,PSIZE)         MCARLO  273
      RETURN                                                            MCARLO  274
      END                                                               MCARLO  275
```

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SUBROUTINE CEPAS      74/74   OPT=1                              FTN 4.2+75057     05/05/75  16.16.32.     PAGE   2

        SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE     REFERENCES
      3  CEPAS          1        27

VARIABLES      SN   TYPE               RELOCATION
      0  CEPSIG     INTEGER     ARRAY     F.P.      REFS          3        6        9       14       26
                                                    DEFINED       1       15
    161  CRIT       REAL       *UNDEF               REFS          4
    157  I          INTEGER                         REFS         14       15       21       25   DEFINED    13    21
                                                    23
      0  IBVNSW     INTEGER               F.P.      REFS          9       26   DEFINED       1
      0  IPLOT      INTEGER               F.P.      REFS          9       26   DEFINED       1
    156  JJ         INTEGER                         REFS          9  DEFINED        9
      0  KSSIG      REAL                  F.P.      REFS          5        9       26   DEFINED      1
      0  NP         INTEGER               F.P.      REFS          9       17       21       25       26
                                                    DEFINED       1
    160  NUG        INTEGER                         REFS         18  DEFINED       17       18
      0  PSIZE      REAL                  F.P.      REFS         26  DEFINED        1
      0  X          REAL        ARRAY     CEPASS    REFS          2       21       26
      0  XLAMBD     REAL                  F.P.      REFS          9       26   DEFINED       1
    144  Y          REAL        ARRAY     CEPASS    REFS          2       25       26

FILE NAMES         MODE
   TAPE6           FMT                 WRITES         7        9       10       19       21       23       25

EXTERNALS          TYPE    ARGS        REFERENCES
   CEPP                      9            26

STATEMENT LABELS               DEF LINE    REFERENCES
     17   5                        16         13       14
    134  2000    FMT               20         13
    142  2001    FMT               22         21       25
    150  2002    FMT               24         23
     75  2003    FMT                8          7
    125  2004    FMT               12          3
    117  2005    FMT               11         11

LOOPS   LABEL    INDEX      FROM-TO     LENGTH     PROPERTIES
   15   5        I          13 16        38        INSTACK

COMMON BLOCKS    LENGTH    MEMBERS - BIAS NAME(LENGTH)
   CEPASS         200            0 X       (100)         100 Y       (100)

STATISTICS
   PROGRAM LENGTH                3253       213
   CM LABELED COMMON LENGTH      3101       200
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      SUBROUTINE CEPP(X,Y,NP,KSSIG,XLAMBD,IBVNSW,CEPSIG,IPLOT,PSIZE)    MCARLO 276
      REAL KSSIG                                                        MCARLO 277
      INTEGER CEPSIG                                                    MCARLO 278
      DIMENSION ZXX(100),ZYY(100)                                       MCARLO 279
      DIMENSION TITLE1(5),TITLE2(5)                                     MCARLO 280
      DIMENSION ICHI(6)                                                 MCARLO 281
      DIMENSION CHI2(6,50)                                              MCARLO 282
      DIMENSION X(100),Y(100),SORTX(100),DIST(100),CEPSIG(6),ICONREF(6),MCARLO 283
     * RCONF1(5),RCONF2(5)                                              MCARLO 284
      DATA ISKSW/0/                                                     MCARLO 285
      DATA (CHI2(1,I),I=1,50)/0.0201,0.297,0.872,1.65,2.56,3.57,4.66,   MCARLO 286
     *5.81,7.01,8.25,9.54,10.9,12.2,13.6,15.0,16.4,17.8,19.2,20.7,22.2, MCARLO 287
     *23.7,25.1,26.7,28.2,29.7,31.2,32.8,34.3,35.9,37.5,39.1,40.6,42.2, MCARLO 288
     *43.8,45.4,47.1,48.7,50.3,51.9,53.5,55.2,56.8,58.5,60.1,61.8,63.4, MCARLO 289
     *65.1,66.7,68.4,70.1/                                              MCARLO 290
      DATA (CHI2(2,I),I=1,50)/0.103,0.711,1.64,2.73,3.94,5.23,6.57,     MCARLO 291
     *7.96,9.39,10.9,12.3,13.8,15.4,16.9,18.5,20.1,21.7,23.3,24.9,26.5, MCARLO 292
     *28.1,29.8,31.4,33.1,34.8,36.4,38.1,39.8,41.5,43.2,44.9,46.6,48.3, MCARLO 293
     *50.0,51.7,53.5,55.2,56.9,58.7,60.4,62.1,63.9,65.6,67.4,69.1,70.9, MCARLO 294
     *72.6,74.4,76.2,77.9/                                              MCARLO 295
      DATA (CHI2(3,I),I=1,50)/0.211,1.06,2.20,3.49,4.87,6.3,7.79,9.31,  MCARLO 296
     *10.9,12.4,14.0,15.7,17.3,18.9,20.6,22.3,24.0,25.6,27.3,29.1,      MCARLO 297
     *30.8,32.5,34.2,35.9,37.7,39.4,41.2,42.9,44.7,46.5,48.2,50.0,51.8, MCARLO 298
     *53.5,55.3,57.1,58.9,60.7,62.5,64.3,66.1,67.9,69.7,71.5,73.3,75.1, MCARLO 299
     *76.9,78.7,80.5,82.4/                                              MCARLO 300
      DATA (CHI2(4,I),I=1,50)/0.446,1.65,3.07,4.59,6.18,7.81,9.47,11.2, MCARLO 301
     *12.9,14.6,16.3,18.1,19.8,21.6,23.4,25.1,26.9,28.7,30.5,32.3,34.2, MCARLO 302
     *36.0,37.8,39.6,41.4,43.3,45.1,47.0,48.8,50.6,52.5,54.3,56.2,58.0, MCARLO 303
     *59.9,61.8,63.6,65.5,67.3,69.2,71.1,72.9,74.8,76.7,78.6,80.4,82.3, MCARLO 304
     *84.2,86.1,87.9/                                                   MCARLO 305
      DATA (CHI2(5,I),I=1,50)/0.713,2.19,3.83,5.53,7.27,9.03,10.8,12.6, MCARLO 306
     *14.4,16.3,18.1,19.9,21.8,23.6,25.5,27.4,29.2,31.1,33.0,34.9,36.8, MCARLO 307
     *38.6,40.5,42.4,44.3,46.2,48.1,50.0,51.9,53.8,55.7,57.6,59.5,61.4, MCARLO 308
     *63.3,65.3,67.2,69.1,71.0,72.9,74.8,76.8,78.7,80.6,82.5,84.4,86.4, MCARLO 309
     *88.3,90.2,92.1/                                                   MCARLO 310
      DATA (TITLE1(I),I=1,6)/6HCEP CO,6HNFIDEN,6HCE CIR,6HCLE FO,       MCARLO 311
     1         6HR LAMB,6HDA =  /                                       MCARLO 312
      DATA (TITLE2(I),I=1,6)/6HCEP CO,6HNFIDEN,6HCE CIR,6HCLE FO,       MCARLO 313
     1         6HR LAMB,6HDA =  /                                       MCARLO 314
      DATA ICONREF/99,95,90,80,70/                                      MCARLO 315
      DATA SORTX/100*(0.)/                                              MCARLO 316
C                                                                       MCARLO 317
C    * * *    X= ARRAY OF X-COMPONENT OF MISS DISTANCES                 MCARLO 318
C    * * *    Y= ARRAY OF Y-COMPONENT OF MISS DISTANCES                 MCARLO 319
C    * * *    NP= NUMBER OF POINTS                                      MCARLO 320
C    * * *    KSSIG= SIGNIFICANCE LEVEL FOR K-S TEST DESIRED -- SET     MCARLO 321
C             NEGATIVE IF NO K-S TEST DESIRED                           MCARLO 322
C    * * *    XLAMBD= (PROGRAM   ) / (MISSILE CEP) --                   MCARLO 323
C             SET TO ZERO IF NO ESTIMATE OF PROGRAM CEP IS MADE         MCARLO 324
C    * * *    IBVNSW=1 IF DESIRE TO USE BIVARIATE NORMAL ASSUMPTION     MCARLO 325
C             REGARDLESS OF OUTCOME OF K-S TEST ---  SET NOT = 1 TO USE MCARLO 326
C             BIVARIATE NORMAL ONLY IF K-S TEST DOES NOT REJECT         MCARLO 327
C             ASSUMPTION OF NORMALITY.  IF NOT =1, AND DATA FAILS K-S TEST MCARLO 328
C             FOR NORMALITY, CEP WILL BE                                MCARLO 329
C             CALCULATED AS THE RADIUS, R, OF A CIRCLE CONTAINING       MCARLO 330
C             ONE-HALF OF THE SAMPLE POINTS.                            MCARLO 331
C    * * *    CEPSIG= SIGNIFICANCE LEVELS AT WHICH CEP CONFIDENCE       MCARLO 332
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C          INTERVAL(S) PRINT IS DESIRED.   PRELOAD TO NEGATIVE NUMBERS  MCARLO
C          IN CALLING PROGRAM BEFORE ENTERING DESIRED CONFIDENCE LEVELS MCARLO
C          ENTER AS AN INTEGER (IN PERCENT) -- EG., IF DESIRE           MCARLO
C          R(0.99), R(0.90), AND R(0.70), ENTER (FOR EXAMPLE)           MCARLO
C          CEPSIG(1=90, CEPSIG(2)=99, AND CEP(3)=70.  NO ORDER          MCARLO
C          NEEDS TO BE OBSERVED.                                        MCARLO
C    * * * IPLOT= 1 FOR PLOTS OF CEP(S) AND POINTS, NOT =1 OTHERWISE    MCARLO
C                                                                       MCARLO
      KSSIG=0.05                                                        MCARLO
      NCONF=0                                                           MCARLO
      EPSLN=.00001                                                      MCARLO
 8950 CONTINUE                                                          MCARLO
      WRITE(6,1019)                                                     MCARLO
 1019 FORMAT(1H1)                                                       MCARLO
      IF(NP.LE.0) GO TO 300                                             MCARLO
C                                                                       MCARLO
C    * * * CALCULATE SAMPLE SIGMA-X, SIGMA-Y, X-MEAN, AND Y-MEAN        MCARLO
C                                                                       MCARLO
      SUMX2=0.                                                          MCARLO
      SUMY2=0.                                                          MCARLO
      XBAR=0.                                                           MCARLO
      YBAR=0.                                                           MCARLO
      DO 1 I=1,NP                                                       MCARLO
      SUMX2=SUMX2 + X(I)**2                                             MCARLO
      SUMY2=SUMY2 + Y(I)**2                                             MCARLO
      XBAR=XBAR + X(I)                                                  MCARLO
    1 YBAR = YBAR + Y(I)                                                MCARLO
      XBAR = XBAR / NP                                                  MCARLO
      YBAR = YBAR / NP                                                  MCARLO
      SXHAT2=(SUMX2 - (XBAR**2)*NP)/(NP - 1)                            MCARLO
      SYHAT2 = (SUMY2 - (YBAR**2)*NP)/(NP-1)                            MCARLO
      SXHAT= SQRT(SXHAT2)                                               MCARLO
      SYHAT = SQRT(SYHAT2)                                              MCARLO
C                                                                       MCARLO
C                                                                       MCARLO
C    * * * KOLOMOGOROV-SMIRNOV TEST FOR NORMALITY                       MCARLO
C                                                                       MCARLO
C    * * * CHECK X                                                      MCARLO
C                                                                       MCARLO
C                                                                       MCARLO
      NI=0                                                              MCARLO
      CALL KSTEST(X,NP,KSSIG,SBAR,SXHAT,NI)                             MCARLO
      NIX=NI                                                            MCARLO
C                                                                       MCARLO
C    * * * CHECK Y                                                      MCARLO
C                                                                       MCARLO
      CALL KSTEST(Y,NP,KSSIG,YBAR,SYHAT,NI)                             MCARLO
      NIY=NI                                                            MCARLO
      IF(NIX.GT.0) WRITE(6,1001)KSSIG                                   MCARLO
 1001 FORMAT(1X,53HX-COMPONENT OF MISS DISTANCE FAIL K-S TEST FOR NORMAL MCARLO
     *ITY AT ,F10.5,2X,18HSIGNIFICANCE LEVEL)                           MCARLO
      WRITE(6,1073)                                                     MCARLO
      WRITE(6,1078)                                                     MCARLO
      IF(NIY.GT.0) WRITE(6,1002)KSSIG                                   MCARLO
 1002 FORMAT(1X,53HY-COMPONENT OF MISS DISTANCE FAIL K-S TEST FOR NORMAL MCARLO
     *ITY AT ,F10.5,2X,18HSIGNIFICANCE LEVEL)                           MCARLO
      IF(IBVNSW.EQ.1) GO TO 450                                         MCARLO
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      IF(NIX.GT.0.OR.NIY.GT.0) GO TO 400                                  MCARLO 390
C                                                                         MCARLO 391
C  * * *  DETERMINE CONSTANT XK FOR ELLIPTICAL TO CEP CONVERSION          MCARLO 392
C                                                                         MCARLO 393
  450 SSMIN=AMIN1(SXHAT,SYHAT)                                            MCARLO 394
      SSMAX=AMAX1(SXHAT,SYHAT)                                            MCARLO 395
      RATIOX=SSMIN/SSMAX                                                  MCARLO 396
      IF(RATIOX.GE.0.3) GO TO 102                                         MCARLO 397
      XK=0.9938*RATIOX**2 - 0.0495*RATIOX + 0.675                         MCARLO 398
  103 CEP=XK*SSMAX                                                        MCARLO 399
      GO TO 121                                                           MCARLO 400
  102 CEP=0.615*SSMIN + 0.562*SSMAX                                       MCARLO 401
C                                                                         MCARLO 402
C  * * *  CALCULATE CONFIDENCE INTERVALS                                  MCARLO 403
C                                                                         MCARLO 404
      IF(NP.GT.1) GO TO 545                                               MCARLO 405
      WRITE(6,1073)                                                       MCARLO 406
      WRITE(6,1078)                                                       MCARLO 407
      WRITE(6,1112) NP                                                    MCARLO 408
 1112 FORMAT(1X,64HNO CONFIDENCE INTERVALS CALCULATED BECAUSE NUMBER OF   MCARLO 409
     *POINTS, NP=,I6,14HIS LESS THAN 2)                                   MCARLO 410
      GO TO 528                                                           MCARLO 411
  545 CONTINUE                                                            MCARLO 412
  121 NCONF=0                                                             MCARLO 413
      IF(CEPSIG(1).LE.0) GO TO 528                                        MCARLO 414
      DO 4 I=1,5                                                          MCARLO 415
      ICHI(I)=-1                                                          MCARLO 416
      IF(CEPSIG(I).LE.0) GO TO 4                                          MCARLO 417
      NCONF=NCONF + 1                                                     MCARLO 418
      IF(CEPSIG(I).EQ.99) ICHI(I)=1                                       MCARLO 419
      IF(CEPSIG(I).EQ.95) ICHI(I)=2                                       MCARLO 420
      IF(CEPSIG(I).EQ.90) ICHI(I)=3                                       MCARLO 421
      IF(CEPSIG(I).EQ.80) ICHI(I)=4                                       MCARLO 422
      IF(CEPSIG(I).EQ.70) ICHI(I)=5                                       MCARLO 423
      IF(ICHI(I).GT.0) GO TO 44                                           MCARLO 424
      WRITE(6,1007)CEPSIG(I)                                              MCARLO 425
      NCONF=NCONF - 1                                                     MCARLO 426
   44 IF(CEPSIG(I+1).LE.0) GO TO 526                                      MCARLO 427
    4 CONTINUE                                                            MCARLO 428
 1007 FORMAT(1X,23HCONFIDENCE LEVEL OF ,I4,2X,28HENTERED WHICH IS NOT TA  MCARLO 429
     *BLED,2X,31HNO CONFIDENCE INTERVAL COMPUTED)                         MCARLO 430
  526 CEPS=CEP                                                            MCARLO 431
      NU=2*(NP - 1)                                                       MCARLO 432
      NUS=NU                                                              MCARLO 433
      NU=NU/2                                                             MCARLO 434
      IF(NCONF.LE.0) GO TO 528                                            MCARLO 435
      DO 5 I=1,NCONF                                                      MCARLO 436
      J=ICHI(I)                                                           MCARLO 437
    5 RCONF1(I)=CEP*SQRT(NUS/CHI2(J,NU))                                  MCARLO 438
      IF(XLAMBD.LT.EPS_N) GO TO 528                                       MCARLO 439
  257 CEPS=CEP/SQRT(1+XLAMBD**2)                                          MCARLO 440
      IF(NCONF.LE.0) GO TO 528                                            MCARLO 441
      DO 6 I=1,NCONF                                                      MCARLO 442
      J=ICHI(I)                                                           MCARLO 443
    6 RCONF2(I)=RCONF1(I)/SQRT(1+(XLAMBD**2)*(1 - CHI2(J,NU)/NUS))        MCARLO 444
      WRITE(6,1073)                                                       MCARLO 445
  528 WRITE(6,1013)CEP,NP                                                 MCARLO 446
```

```
 1010 FORMAT(1X,10HJOINT CEP=,F7.3,2X,18HFOR THE FOLLOWING ,I4,1X,6HPOIN
     *TS)
      DO 8 I=1,NP
      DX=SQRT((X(I) - XBAR)**2 + (Y(I) - YBAR)**2)
    8 WRITE(6,1011)X(I),Y(I),DX
 1011 FORMAT(10X,1H(,F5.2,1H,,F5.2,1H),5X,10HMISS DIST=,F5.2)
      IF(NCONF.LE.0) GO TO 529
C
C
C
      WRITE(6,1078)
      WRITE(6,1078)
      WRITE(6,1012)
 1012 FORMAT(1X,30HCONFIDENCE INTERVAL(S) FOR JOINT CEP/)
      WRITE(6,1499)
 1499 FORMAT(42X,10H(PER CENT))
      WRITE(6,1013)(ICONREF(JJ),JJ=1,NCONF)
 1013 FORMAT(1X,21HCONFIDENCE LEVELS --,5(5X,I6))
      WRITE(6,1014)
 1014 FORMAT(21X,5(5X,6H------))
      WRITE(6,1015)(RCONF1(JJ),JJ=1,NCONF)
 1015 FORMAT(21X,5(5X,F5.2))
      WRITE(6,1500)
 1500 FORMAT(40X,4H(FT))
  529 IF(XLAMBD.LT.EPSLN) GO TO 500
      WRITE(6,1078)
      WRITE(6,1078)
 1078 FORMAT(130X)
      WRITE(6,1016)CEPS,XLAMBD
 1016 FORMAT(1X,12HMISSILE CEP=,F7.3,26H ASSUMING  SIMULATION CEP=,F6.2,
     *1X,21HTIMES THE MISSILE CEP)
  539 CONTINUE
      IF(NCONF.LE.0) GO TO 500
      WRITE(6,1078)
      WRITE(6,1078)
      WRITE(6,1017)
 1017 FORMAT(1X,33HCONFIDENCE INTERVAL(S) FOR MISSILE CEP/)
      WRITE(6,1499)
      WRITE(6,1013)(ICONREF(JJ),JJ=1,NCONF)
      WRITE(6,1014)
      WRITE(6,1015)(RCONF2(JJ),JJ=1,NCONF)
      WRITE(6,1500)
      GO TO 500
C
C
C
C
  530 CONTINUE
C
C
C    * * *    K-S TEST FOR NORMALITY WAS NEGATIVE, CALCULATE CEP AS THE
C             RADIUS OF A CIRCLE CONTAINING 50 PERCENT OF THE SAMPLE POINT
C
C
C
  400 DO 2 I=1,NP
    2 DIST(I)=SQRT((X(I)-XBAR)**2+(Y(I)-YBAR)**2)
```

```
C
C * * *  SORT DISTANCES IN INCREASING ORDER
C
      ND=NP
      ISV=0
      NS=0
  402 COMPR = 10**6
      DO 3 I=1,ND
      IF(DIST(I).GE.COMPR) GO TO 3
      ISV=I
      COMPR=DIST(I)
    3 CONTINUE
      NS=NS+1
      SORTX(NS)=COMPR
      DIST(ISV)=DIST(ND)
      ND=ND-1
      IF(ND.GT.1) GO TO 402
      NS=NS+1
      SORTX(NS)=DIST(1)
C
C * * *  DETERMINE IF NUMBER OF POINTS,NP, IS EVEN OR ODD
C
      ND=NP/2
      NS=NP-2*ND
      IF(NS.EQ.0) GO TO 403
C
C * * *  NUMBER OF POINTS IS EVEN.  SET CEP TO A DISTANCE WHICH IS
C
C        HALFWAY BETWEEN THE INTERIOR POINT CLOSEST TO THE 50 PER-
C        CENT CIRCLE AND THE EXTERIOR POINT CLOSEST TO THE 50 PER-
C        CENT CIRCLE.
C
      CEP=(SORTX(ND)+SORTX(ND+1))/2.
      GO TO 404
C
C * * *  NUMBER OF POINTS IS ODD.  SET CEP TO THE MEDIAN DISTANCE.
C
  403 CEP=SORTX(ND+1)
  404 WRITE(6,1004)CEP
 1004 FORMAT(1X,4HCEP=,F10.5,2X,67HDATA FAILED K-S NORMALITY TEST -- NO
     *CONFIDENCE INTERVAL CALCULATED)
      GO TO 500
  300 WRITE(6,1000)
 1000 FORMAT(1X,42HSUBROUTINE CEP ENTERED WITH NO. POINTS = 0)
      GO TO 520
C
C * * *  PLOT CEP(S), CONFIDENCE INTERVALS, AND POINTS
C
  500 DX=SQRT(XBAR**2 + YBAR**2)
      WRITE(6,1078)
      WRITE(6,1073)
      WRITE(6,1113)XBAR,YBAR,DX
 1113 FORMAT(1X,17HCEP CENTROID AT (,F5.3,1H,,F5.3,1H),10X,28HDISTANCE F
     *ROM TARGET CENTER=,F5.3)
      IF(IFLOT.EQ.0) GO TO 520
      IF(NCONF.LE.0) GO TO 501
      DO 27 KOCH=1,NCONF
```

```
      SUBROUTINE CEPP        74/74    OPT=1                        FTN 4.2+75067      05/05/75  16.16.33.      PAGE   6

                   JU=ICHI(KOCH)
                   DO 556 KMN=1,NP                                                      MCARLO    561
                   ZXX(KMN)=X(KMN)                                                      MCARLO    562
             556   ZYY(KMN)=Y(KMN)                                                      MCARLO    563
     290           CALL FPLOT(ZXX,ZYY,NP,CEP,ICONREF(JU),RCONF1(KOCH),TITLE1,XBAR,      MCARLO    564
                  *YBAR,0.,PSIZE)                                                       MCARLO    565
                   IF(XLAMBD.LT.EPS_N) GO TO 27                                         MCARLO    566
                   DO 557 KMN=1,NP                                                      MCARLO    567
                   ZXX(KMN)=X(KMN)                                                      MCARLO    568
     295     557   ZYY(KMN)=Y(KMN)                                                      MCARLO    569
                   CALL FPLOT(ZXX,ZYY,NP,CEPS,ICONREF(JU),RCONF2(KOCH),TITLE2,XBAR,     MCARLO    570
                  *YBAR,XLAMBD,PSIZE)                                                   MCARLO    571
              27   CONTINUE                                                             MCARLO    572
                   GO TO 520                                                            MCARLO    573
     300     501   CALL FPLOT(X,Y,NP,CEP,0.0.,TITLE1,XBAR,YBAR,0.,PSIZE)                MCARLO    574
             520   CONTINUE                                                             MCARLO    575
                   RETURN                                                               MCARLO    576
                   END                                                                  MCARLO    577
                                                                                        MCARLO    578

      SUBROUTINE CEPP        74/74    OPT=1                        FTN 4.2+75067      05/05/75  16.16.33.      PAGE   7

   CARD NR. SEVERITY  DETAILS    DIAGNOSIS OF PROBLEM

      40      I                  DATA VARIABLE LIST EXCEEDS ITEM LIST, EXCESS VARIABLES NOT INITIALIZED.
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        SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE     REFERENCES
     3  CEPP           1         302

VARIABLES       SN  TYPE            RELOCATION
  1317  CEP         REAL                        REFS      156     163     165     171     257     298     308
                                             DEFINED      124     126     251     266
  1320  CEPS        REAL                        REFS      200     296  DEFINED    156     165
     0  CEPSIG      INTEGER      ARRAY    F.P.  REFS        3       8     139     142     144     145     146
                                                 147      148     150     152  DEFINED      1
  1667  CHI2        REAL         ARRAY          REFS        7     153     159  DEFINED     11      16      21
                                                  26       31
  1331  COMPR       REAL                        REFS      237     242  DEFINED    235     239
  2507  DIST        REAL         ARRAY          REFS        8     237     239     243     247
                                             DEFINED      228     243
  1324  DX          REAL                        REFS      176     280  DEFINED    175     277
  1275  EPSLN       REAL                        REFS      154     136     232  DEFINED     68
  1302  I           INTEGER                     REFS       51      82      83      84     141     142   2*144
                                               2*145    2*146   2*147   2*148     149     150     152     162
                                                 163      158   2*159   2*175   2*176   3*228     237     238
                                                 239  DEFINED      80     140     161     167     174     227
                                                 236
     0  IBVNSM      INTEGER               F.P.  REFS      114  DEFINED      1
  1661  ICHI        INTEGER      ARRAY          REFS        6     149     152     168     286
                                             DEFINED      141     144     145     146     147     148
  2653  ICONREF     INTEGER      ARRAY          REFS        8     188     210     296     296
                                             DEFINED       40
     0  IPLOT       INTEGER               F.P.  REFS      283  DEFINED      1
   663  ISKSM     * INTEGER                  DEFINED       10
  1327  ISV         INTEGER                     REFS      243  DEFINED    233     238
  1323  J           INTEGER                     REFS      153     169  DEFINED    162     168
  1325  JJ          INTEGER                     REFS      188     192     210     212  DEFINED    188     192
                                                 210      212
  1333  JU          INTEGER                     REFS      230     296  DEFINED    286
  1334  KMN         INTEGER                     REFS    2*288   2*289   2*294   2*295  DEFINED    287     293
  1332  KOCH        INTEGER                     REFS      296     290     296  DEFINED    285
     0  KSSIG       REAL                  F.P.  REFS        2      99     104     106     111
                                             DEFINED        1      66
  1274  NCONF       INTEGER                     REFS      143     151     160     161     166     157     178
                                                 188      192     204     210     212     284     285
                                             DEFINED       57     138     143     151
  1326  ND          INTEGER                     REFS      236     243     244     245     252   2*261     260
                                             DEFINED      232     244     251
  1307  NI          INTEGER                     REFS       99     100     104     105  DEFINED     98
  1311  NIX         INTEGER                     REFS      106     115  DEFINED    100
  1312  NIY         INTEGER                     REFS      111     115  DEFINED    105
     0  NP          INTEGER               F.P.  REFS       72      80      85      86    2*87    2*88      99
                                                 104      130     133     157     171     174     227     232
                                                 251      252     287     298     293     296     308
                                             DEFINED        1
  1330  NS          INTEGER                     REFS      241     242     246     247     253
                                             DEFINED      234     241     246     252
  1321  NU          INTEGER                     REFS      158     159     153     169  DEFINED    157     159
  1322  NUS         INTEGER                     REFS      153     169  DEFINED    158
     0  PSIZE       REAL                  F.P.  REFS      230     296     300  DEFINED      1
  1315  RATIOX      REAL                        REFS      122   2*123  DEFINED    121
```

```
VARIABLES     SN  TYPE            RELOCATION
  2661  RCONF1      REAL      ARRAY               REFS      8     169     132     290   DEFINED    153
  2667  RCONF2      REAL      ARRAY               REFS      8     212     296  DEFINED     169
  1310  SBAR     *  REAL                          REFS     39
  2343  SORTX       REAL      ARRAY               REFS      8   2*261     256  DEFINED      41     242     247
  1314  SSMAX       REAL                          REFS    121     124     126  DEFINED     120
  1313  SSMIN       REAL                          REFS    121     126  DEFINED     119
  1276  SUMX2       REAL                          REFS     81      87  DEFINED      76      81
  1277  SUMY2       REAL                          REFS     82      88  DEFINED      77      82
  1305  SXHAT       REAL                          REFS     99     119     120  DEFINED      89
  1303  SXHAT2      REAL                          REFS     89  DEFINED      87
  1306  SYHAT       REAL                          REFS    104     119     120  DEFINED      98
  1304  SYHAT2      REAL                          REFS     90  DEFINED      88
  1645  TITLE1      REAL      ARRAY               REFS      5     290     300  DEFINED      36
  1653  TITLE2      REAL      ARRAY               REFS      5     296  DEFINED      38
     0  X           REAL      ARRAY    F.P.       REFS      8      81      83      99     175     175     228
                                                   288    234     300  DEFINED       1
  1300  XBAR        REAL                          REFS     83      85      87     175     228     277     280
                                                   296    236     300  DEFINED      78      83      85
  1316  XK .        REAL                          REFS    124  DEFINED     123
     0  XLAMBD      REAL               F.P.       REFS    154     165     169     196     200     292     296
                                               DEFINED      1
     0  Y           REAL      ARRAY    F.P.       REF.      5      82      84     104     175     176     228
                                                   289    235     300  DEFINED       1
  1301  YBAR        REAL                          REFS     84      86      88     104     175     228     277
                                                   280    230     296     300  DEFINED      79      84      86
  1335  ZXX         REAL      ARRAY               REFS      4     290     296  DEFINED     288     234
  1501  ZYY         REAL      ARRAY               REFS      4     230     236  DEFINED     289     295

FILE NAMES      MODE
        TAPE6   FMT                     WRITES     70     136     109     110     111     131     132     133
                                           153    175     171     176     182     183     184     186     188
                                           193    192     194     197     198     200     205     206     207
                                           203    210     211     212     213     267     271     278     279
                                           280

EXTERNALS           TYPE   ARGS        REFERENCES
        KSTEST               6             93    104
        PPLOT               11            293    296     300
        SQRT        REAL     1 LIBRARY     83     90     163     155     169     175     228     277

INLINE FUNCTIONS    TYPE   ARGS       DEF LINE  REFERENCES
        AMAX1       REAL     6 INTRIN             120
        AMIN1       REAL     6 INTRIN             119

STATEMENT LABELS                 DEF LINE   REFERENCES
     0  1                           84        83
     0  2                          229       227
   454  3                          243       235    237
   222  4                          153       141    142
     0  5                          163       161
     0  6                          169       167
     0  8                          176       174
   565  27                         298       285    292
   217  44                         152       143
   132  102                        126       122
     0  103           INACTIVE     124
   146  121                        138       125
```

```
STATEMENT LABELS                DEF LINE  REFERENCES
    0  257        INACTIVE      165
  502  300                      271      72
  423  400                      227     115
  442  402                      235     245
  475  403                      266     253
  477  404                      267     262
  116  450                      119     114
  505  500                      277     196     204     214     278
  570  501                      300     284
  577  520                      301     273     203     239
  225  526                      156     152
  277  528                      171     135     139     150     164     156
  357  529                      195     178
    0  530        INACTIVE      213
    0  539        INACTIVE      203
  146  545                      137     133
    0  557                      295     233
    0  558                      289     287
 1225 1000     FMT              272     271
  675 1001     FMT              107     106
  722 1002     FMT              112     111
 1210 1004     FMT              268     267
  766 1007     FMT              154     153
 1611 1010     FMT              172     171
 1626 1011     FMT              177     175
 1645 1012     FMT              185     184
 1665 1013     FMT              189     183     210
 1675 1014     FMT              191     193     211
 1104 1015     FMT              193     192     212
 1132 1016     FMT              201     203
 1155 1017     FMT              205     207
  667 1019     FMT               71      73
 1123 1078     FMT              193     103     110     131     132     178     182     183     197     198
                                        205     206     278     279
  747 1112     FMT              134     133
 1247 1113     FMT              231     293
 1056 1499     FMT              187     185     209
 1112 1500     FMT              195     194     213
    0 8950        INACTIVE       69

LOOPS LABEL  INDEX    FROM-TO   LENGTH  PROPERTIES
   34    1     I       80  84     78    INSTACK
  152    4   * I      140 153    53B                EXT REFS  EXITS
  235    5   * I      161 163    12B                EXT REFS
  260    6   * I      167 169    15B                EXT REFS
  302    8   * I      174 176    22B                EXT REFS
  424    2   * I      227 228    13B                EXT REFS
  451    3   * I      236 240     5B    INSTACK
  522   27   * KOCH   285 298    46B                EXT REFS  NOT INNER
  530  558     KMN    287 283     3B    INSTACK
  551  557     KMN    293 295     3B    INSTACK

STATISTICS
  PROGRAM LENGTH                27243   1492
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```
STATEMENT LABELS              DEF LINE  REFERENCES
   0  257       INACTIVE        165
 502  300                       271       72
 423  400                       227      115
 442  402                       235      245
 475  403                       266      253
 477  404                       267      262
 116  450                       113      114
 505  500                       277      195     204     214     270
 570  501                       300      284
 577  520                       301      273     283     239
 225  526                       155      152
 277  528                       171      135     139     150     164     156
 357  529                       195      178
   0  530       INACTIVE        219
   0  539       INACTIVE        203
 146  545                       137      133
   0  557                       295      233
   0  558                       283      287
1225 1000   FMT                 272      271
 675 1001   FMT                 107      106
 722 1002   FMT                 112      111
1210 1004   FMT                 268      267
 766 1007   FMT                 154      151
1011 1010   FMT                 172      171
1026 1011   FMT                 177      175
1045 1012   FMT                 185      184
1065 1013   FMT                 189      183     210
1075 1014   FMT                 191      193     211
1104 1015   FMT                 193      192     212
1132 1016   FMT                 231      203
1155 1017   FMT                 208      207
 667 1019   FMT                  71       73
1123 1078   FMT                 193      103     110     131     132     170     182     183     137     198
                                         205     206     278     279
 747 1112   FMT                 134      133
1247 1113   FMT                 281      233
1056 1499   FMT                 187      185     209
1112 1500   FMT                 195      194     213
   0 8950       INACTIVE         69

LOOPS  LABEL    INDEX     FROM-TO    LENGTH   PROPERTIES
  34    1       I         80 84        73     INSTACK
 152    4     * I        146 153      53B              EXT REFS  EXITS
 235    5     * I        161 163      12B              EXT REFS
 260    6     * I        167 169      15B              EXT REFS
 302    8     * I        174 176      22B              EXT REFS
 424    2     * I        227 226      13B              EXT REFS
 451    3     * I        236 240       5B     INSTACK
 522   27     * KOCH     285 298      46B              EXT REFS  NOT INNER
 530  558       KMN      287 289       3B     INSTACK
 551  557       KMK      293 295       3B     INSTACK

STATISTICS
  PROGRAM LENGTH                27243  1492
```

```
SUBROUTINE NORM        74/74   OPT=1                    FTN 4.2+75067      05/05/75  16.16.49.       PAGE    1

              SUBROUTINE NORM(RX,XL,XU,XMU,SGMA,RNSTRT)                       MCARLO    579
              XLL=XMU+SGMA*XL                                                 MCARLO    580
              XUU=XMU + SGMA*XU                                               MCARLO    581
              CALL NORMAL(RX,XLL,XUU,XMU,SGMA,RNSTRT)                         MCARLO    582
    5         RETURN                                                          MCARLO    583
              END                                                             MCARLO    584


SUBROUTINE NORM        74/74   OPT=1                    FTN 4.2+75067      05/05/75  16.16.49.       PAGE    2

       SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    3  NORM           1              5

VARIABLES       SN   TYPE            RELOCATION
      0  RNSTRT      REAL                 F.P.      REFS     4   DEFINED     1
      0  RX          REAL                 F.P.      REFS     4   DEFINED     1
      0  SGMA        REAL                 F.P.      REFS     2       3       4   DEFINED     1
      0  XL          REAL                 F.P.      REFS     2   DEFINED     1
     30  XLL         REAL                           REFS     4   DEFINED     2
      0  XMU         REAL                 F.P.      REFS     2       3       4   DEFINED     1
      0  XU          REAL                 F.P.      REFS     3   DEFINED     1
     31  XUU         REAL                           REFS     4   DEFINED     3

EXTERNALS              TYPE   ARGS      REFERENCES
      NORMAL                    6           4

STATISTICS
  PROGRAM LENGTH                 32B     26
```

```
      SUBROUTINE KSTEST(Y,NP,KSSIG,XBAR,SXMAT,NI)                        MCARLO   585
      DIMENSION Y(100),CRIT(100),ISNIGF(100)                             MCARLO   586
      REAL KSSIG                                                         MCARLO   587
      DATA NZT/3/                                                        MCARLO   588
      DATA NUM/0/                                                        MCARLO   589
      DATA CRIT /375.,842.,708.,624.,565.,521.,486.,457.,432.,410.,391., MCARLO   590
     A          375.,361.,349.,338.,328.,318.,309.,301.,294.,289.,284., MCARLO   591
     B          280.,275.,270.,264.,258.,252.,248.,242.,238.,236.,234., MCARLO   592
     C          232.,230.,227.,224.,221.,218.,215.,212.,210.,207.,205., MCARLO   593
     D          203.,200.,198.,196.,194.,192.,50*192./                  MCARLO   594
      NV=NP                                                              MCARLO   595
      NI=0                                                               MCARLO   596
      RSNIG=KSSIG                                                        MCARLO   597
      NZT=5                                                              MCARLO   598
 3011 CONTINUE                                                           MCARLO   599
      NSG=0                                                              MCARLO   600
  500 FORMAT(I2)                                                         MCARLO   601
      NUM=NUM+1                                                          MCARLO   602
  527 RNV=NV                                                             MCARLO   603
      YMAX=Y(1)                                                          MCARLO   604
      YS2=Y(1)**2                                                        MCARLO   605
      YMIN=Y(1)                                                          MCARLO   606
      YSUM=Y(1)                                                          MCARLO   607
      DO 1 I=2,NV                                                        MCARLO   608
      IF(YMAX-Y(I))100,100,101                                           MCARLO   609
  100 YMAX=Y(I)                                                          MCARLO   610
  101 IF(YMIN-Y(I))106,105,102                                           MCARLO   611
  102 YMIN=Y(I)                                                          MCARLO   612
  106 YSUM=YSUM+Y(I)                                                     MCARLO   613
    1 YS2=YS2+Y(I)**2                                                    MCARLO   614
      RNV1=RNV-1                                                         MCARLO   615
      S2=(YS2-(YSUM**2)/RNV1/RNV1                                        MCARLO   616
      S=SQRT(S2)                                                         MCARLO   617
      YMEAN=YSUM/RNV                                                     MCARLO   618
      WRITE(6,563)NUM                                                    MCARLO   619
  563 FORMAT(1X,8HCASE NO.=,I4/)                                         MCARLO   620
      WRITE(6,517)YMEAN,S                                                MCARLO   621
  517 FORMAT(11X,5HMEAN=,F10.4,8HSTD DEV=,F10.4)                         MCARLO   622
      NSTEPS = NV/5                                                      MCARLO   623
      SSTEP=(YMAX-YMIN)/NSTEPS                                           MCARLO   624
      B1=YMIN-SSTEP                                                      MCARLO   625
      NCUM=0                                                             MCARLO   626
      UMAX=0.                                                            MCARLO   627
      WRITE(6,4331)NSTEPS,YMIN,YMAX                                      MCARLO   628
 4331 FORMAT(1X,7HNSTEPS=,I6,2X,5HYMIN=,F6.3,1X,5HYMAX=,F6.3)            MCARLO   629
      DO 2 I=1,NSTEPS                                                    MCARLO   630
      B1=B1+SSTEP                                                        MCARLO   631
  124 OBS=B1+SSTEP/0.5                                                   MCARLO   632
  125 B2=B1+SSTEP                                                        MCARLO   633
      IF(I.EQ.NSTEPS) B2=B2+0.00001                                      MCARLO   634
      NN=0                                                               MCARLO   635
      DO 2 J=1,NV                                                        MCARLO   636
      IF(Y(J)-B1)3,103,103                                               MCARLO   637
  103 IF(Y(J)-B2)104,3,3                                                 MCARLO   638
  104 NN=NN+1                                                            MCARLO   639
      NCUM=NCUM+1                                                        MCARLO   640
    3 CONTINUE                                                           MCARLO   641
```

SUBROUTINE KSTEST   74/74   OPT=1   FTN 4.2+75067   05/05/75 16.16.58.   PAGE 2

```
      RNCJM=NCUM
      RELCUM=RNCJM/RNV
      YMINUSM=OBS-YMEAN
      Z=YMINUSM/S
      CALL ZTABLE(Z,FREQ,NZT)
      D=ABS(FREQ-RELCUM)
      IF(D-DMAX)120,120,121
  121 DMAX=D
  120 CONTINUE
    2 CONTINUE
      CRITTT = CRIT(NV)/1000.
      WRITE(6,5123)DMAX,CRITTT
 5123 FORMAT(1X,5HDMAX=,F10.7,2X,13HCRITICAL VAL=,F10.7)
      IF(DMAX-CRITTT)566,568,568
  568 NSG=NSG+1
  516 CONTINUE
      NI=1
  566 CONTINUE
      RETURN
      END
```

```
SUBROUTINE KSTEST      74/74   OPT=1                     FTN 4.2+75057      05/05/75  16.16.58.      PAGE    3

      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE      REFERENCES
      3   KSTEST        1            75

VARIABLES        SN   TYPE          RELOCATION
    250   B1          REAL                               REFS        47       48      49        53      DEFINED      41       47
    254   B2          REAL                               REFS        50       54   DEFINED      49       58
    266   CRIT        REAL          ARRAY                REFS         2       68   DEFINED       6
    265   CRITTT      REAL                               REFS        69       71   DEFINED      68
    264   D           REAL                               REFS        54       65   DEFINED      63
    252   DMAX        REAL                               REFS        64       59      71     DEFINED      43       65
    263   FREQ        REAL                               REFS        62       63
    241   I           INTEGER                            REFS        25       26      27        28       29       30       50
                                                      DEFINED        24       46
    432   ISNIGF      INTEGER   *UNDEF                   REFS         2
    256   J           INTEGER                            REFS        53       54   DEFINED      52
      0   KSSIG       REAL                   F.P.        REFS         3       13   DEFINED       1
    251   NCUM        INTEGER                            REFS        56       58   DEFINED      42       56
      0   NI          INTEGER                F.P.     DEFINED         1       12      74
    255   NN          INTEGER                            REFS        55   DEFINED     51        55
      0   NP          INTEGER                F.P.        REFS        11   DEFINED      1
    233   NSG         INTEGER                            REFS        72   DEFINED     16        72
    246   NSTEPS      INTEGER                            REFS        40       44      46        50    DEFINED     39
    153   NUM         INTEGER                            REFS        18       35   DEFINED       5       18
    231   NV          INTEGER                            REFS        19       24      39        52       68
                                                      DEFINED        11
    152   NZT         INTEGER                            REFS        62   DEFINED      4        14
    253   OBS         REAL                               REFS        50   DEFINED     48
    260   RELCUM      REAL                               REFS        63   DEFINED     59
    257   RNCUM       REAL                               REFS        59   DEFINED     58
    234   RNV         REAL                               REFS        31       32      34        59    DEFINED     19
    242   RNV1        REAL                               REFS        32   DEFINED     31
    232   RSMIG    *  REAL                            DEFINED        13
    244   S           REAL                               REFS        37       51   DEFINED      33
    247   SSTEP       REAL                               REFS        41       47      48        49    DEFINED     40
      0   SXHAT       REAL      *UNUSED      F.P      DEFINED         1
    243   S2          REAL                               REFS        33   DEFINED     32
      0   XBAR        REAL      *UNUSED      F.P.     DEFINED         1
      0   Y           REAL          ARRAY    F.P.        REFS         2       20      21        22       23       25       26
                                                             27      28       29      30        53       54
                                                      DEFINED         1
    235   YMAX        REAL                               REFS        25       40      44     DEFINED     20       26
    245   YMEAN       REAL                               REFS        37       50   DEFINED      34
    237   YMIN        REAL                               REFS        27       40      41        44     DEFINED     22       28
    261   YMINUSN     REAL                               REFS        51   DEFINED     60
    240   YSUM        REAL                               REFS        29       32      34     DEFINED     23       29
    236   YS2         REAL                               REFS        30       32   DEFINED      21       30
    262   Z           REAL                               REFS        62   DEFINED     51

 FILE NAMES        MODE
      TAPE6        FMT                        WRITES         35       37      44        59

EXTERNALS            TYPE    ARGS       REFERENCES
      SQRT           REAL      1 LIBRARY       33
      ZTABLE                   3               62
```

```
SUBROUTINE KSTEST      74/74    OPT=1                      FTN 4.2+75057    05/05/75  16.16.50.    PAGE    4

INLINE FUNCTIONS   TYPE   ARGS          DEF LINE   REFERENCES
     ABS           REAL     1  INTRIN                  63

STATEMENT LABELS                 DEF LINE   REFERENCES
     0   1                          30         24
     0   2                          67         45        52
   111   3                          57         53        2*54
     0   100          INACTIVE      26        2*25
    30   101                        27         25
     0   102          INACTIVE      28         27
     0   103          INACTIVE      54        2*53
     0   104          INACTIVE      55         54
    33   106                        29        2*27
   127   120                        65        2*54
     0   121          INACTIVE      65         64
     0   124          INACTIVE      48
     0   125          INACTIVE      43
   154   500     FMT   NO REFS      17
     0   516          INACTIVE      73
   172   517     FMT                38         37
     0   527          INACTIVE      13
   162   563     FMT                36         35
   145   566                        75         71
     0   568          INACTIVE      72        2*71
     0   3011         INACTIVE      15
   265   4331    FMT                45         44
   220   6123    FMT                70         63

LOOPS  LABEL    INDEX      FROM-TO    LENGTH    PROPERTIES
  25    1         I         24 30      128       OPT
  66    2       * I         46 67      463                  EXT REFS  NOT INNER
 101    2       * J         52 67      318                  EXT REFS

STATISTICS
  PROGRAM LENGTH               5763    382
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```
      SUBROUTINE ZTABLE(Z,FREQ,NZT)                                    MCARLO   662
      DIMENSION ZCUM(385)                                              MCARLO   663
      DATA (ZCUM(I),I=1,108)                                           MCARLO   664
     1          /0000.,0040.,0080.,0120.,0160.,0199.,0239.,0279.,0319.,MCARLO   665
     A           0359.,0398.,0438.,0478.,0517.,0557.,0596.,0636.,0675.,MCARLO   666
     B           0714.,0753.,0793.,0832.,0871.,0910.,0948.,0987.,1026.,MCARLO   667
     C           1064.,1103.,1141.,1179.,1217.,1255.,1293.,1331.,1368.,MCARLO   668
     D           1406.,1443.,1480.,1517.,1554.,1591.,1682.,1664.,1700.,MCARLO   669
     E           1736.,1772.,1808.,1844.,1879.,1915.,1950.,1985.,2019.,MCARLO   670
     F           2054.,2088.,2123.,2157.,2190.,2224.,2257.,2291.,2324.,MCARLO   671
     G           2357.,2389.,2422.,2452.,2486.,2517.,2549.,2580.,2611.,MCARLO   672
     H           2642.,2673.,2704.,2734.,2764.,2794.,2823.,2852.,2881.,MCARLO   673
     I           2910.,2939.,2967.,2995.,3023.,3351.,3078.,3106.,3133.,MCARLO   674
     J           3159.,3186.,3212.,3238.,3264.,3289.,3315.,3340.,3365.,MCARLO   675
     K           3389.,3413.,3138.,3461.,3485.,3508.,3531.,3554.,3577./MCARLO   676
      DATA (ZCUM(I),I=109,216)                                         MCARLO   677
     2          /3599.,3621.,3643.,3665.,3686.,3708.,3729.,3749.,3770.,MCARLO   678
     A           3790.,3810.,3830.,3849.,3869.,3888.,3907.,3925.,3944.,MCARLO   679
     B           3962.,3980.,3997.,4015.,4032.,4049.,4066.,4082.,4099.,MCARLO   680
     C           4115.,4131.,4147.,4162.,4177.,4192.,4207.,4222.,4236.,MCARLO   681
     D           4251.,4265.,4279.,4292.,4306.,4319.,4332.,4345.,4357.,MCARLO   682
     E           4370.,4382.,4394.,4406.,4418.,4429.,4441.,4452.,4463.,MCARLO   683
     F           4474.,4484.,4495.,4505.,4515.,4525.,4535.,4545.,4554.,MCARLO   684
     G           4564.,4573.,4582.,4591.,4599.,4608.,4616.,4625.,4633.,MCARLO   685
     H           4641.,4649.,4656.,4664.,4671.,4678.,4686.,4693.,4699.,MCARLO   686
     I           4706.,4713.,4719.,4726.,4732.,4738.,4744.,4750.,4756.,MCARLO   687
     J           4761.,4767.,4772.,4778.,4783.,4788.,4793.,4798.,4803.,MCARLO   688
     K           4808.,4812.,4817.,4821.,4826.,4830.,4834.,4838.,4842./MCARLO   689
      DATA (ZCUM(I),I=217,385)                                         MCARLO   690
     3          /4846.,4850.,4854.,4857.,4861.,4864.,4868.,4871.,4875.,MCARLO   691
     A           4878.,4881.,4884.,4887.,4890.,4893.,4896.,4898.,4901.,MCARLO   692
     B           4904.,4906.,4909.,4911.,4913.,4916.,4918.,4920.,4922.,MCARLO   693
     C           4925.,4927.,4929.,4931.,4932.,4934.,4936.,4938.,4940.,MCARLO   694
     D           4941.,4943.,4945.,4946.,4948.,4949.,4951.,4952.,4953.,MCARLO   695
     E           4955.,4956.,4957.,4959.,4960.,4961.,4962.,4963.,4964.,MCARLO   696
     F           4965.,4966.,4967.,4968.,4969.,4970.,4971.,4972.,4973.,MCARLO   697
     G           4974.,4974.,4975.,4976.,4977.,4977.,4978.,4979.,4979.,MCARLO   698
     H           4980.,4981.,4981.,4982.,4982.,4983.,4984.,4984.,4985.,MCARLO   699
     I           4985.,4985.,4986.,4987.,4987.,4987.,4988.,4988.,4989.,MCARLO   700
     J           4989.,4989.,4990.,4990.,75*4990./                     MCARLO   701
  107 ABSZ=ABS(Z)                                                      MCARLO   702
      EPSLN1=-0.005                                                    MCARLO   703
      EPSLN2=0.005                                                     MCARLO   704
      IF(Z-EPSLN1)110,111,111                                          MCARLO   705
  111 IF(Z-EPSLN2)112,112,110                                          MCARLO   706
  112 FREQ=0.5                                                         MCARLO   707
      GO TO 200                                                        MCARLO   708
  110 ABSZ=100.*ABSZ                                                   MCARLO   709
      IZ=ABSZ                                                          MCARLO   710
      RZ=IZ                                                            MCARLO   711
      RZ=RZ+0.5                                                        MCARLO   712
      IF(ABSZ-RZ)101,101,102                                           MCARLO   713
  102 IZ=IZ+1                                                          MCARLO   714
  101 IF(IZ-310)103,104,104                                            MCARLO   715
  104 FREQ=1.                                                          MCARLO   716
      GO TO 203                                                        MCARLO   717
  103 IZ=IZ+1                                                          MCARLO   718
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SUBROUTINE ZTABLE     74/74  OPT=1                    FTN 4.2+75067    05/05/75  16.16.54.     PAGE   2

                   FREQ = ZCUM(IZ)/10000.                                        MCARLO   719
                   IF(Z-0.)105,105,106                                           MCARLO   720
   60          105 FREQ=0.5-FREQ                                                 MCARLO   721
                   GO TO 200                                                     MCARLO   722
               106 FREQ=FREQ+0.5                                                 MCARLO   723
               200 RETURN                                                        MCARLO   724
                   END                                                           MCARLO   725


SUBROUTINE ZTABLE     74/74  OPT=1                    FTN 4.2+75067    05/05/75  16.16.54.     PAGE   3

      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE     REFERENCES
     3  ZTABLE         1          63

 VARIABLES      SN   TYPE            RELOCATION
     55  ABSZ        REAL                           REFS      48      49      52   DEFINED      41       48
     56  EPSLN1      REAL                           REFS      44  DEFINED     42
     57  EPSLN2      REAL                           REFS      45  DEFINED     43
      0  FREQ        REAL                 F.P.      REFS      50      62  DEFINED        1       46       55      58
                                                    60        52
     60  IZ          INTEGER                        REFS      50      53      54        57      58
                                                 DEFINED      49      53      57
      0  NZT         INTEGER  *UNUSED     F.P.   DEFINED       1
     61  RZ          REAL                           REFS      51      52   DEFINED      50       51
      0  Z           REAL                 F.P.      REFS      41      44      45        59   DEFINED       1
     62  ZCUM        REAL       ARRAY               REFS       2      58   DEFINED       3       16       29

 INLINE FUNCTIONS    TYPE    ARGS      DEF LINE  REFERENCES
        ABS          REAL      1   INTRIN         41

 STATEMENT LABELS               DEF LINE   REFERENCES
     26  101                       54       2*52
      0  102          INACTIVE     53        52
     33  103                       57        54
      0  104          INACTIVE     55       2*54
      0  105          INACTIVE     60       2*59
     43  106                       62        59
      0  107          INACTIVE     41
     16  110                       48        44        45
      0  111          INACTIVE     45       2*44
      0  112          INACTIVE     46       2*45
     46  200                       63        47        56        51

 STATISTICS
   PROGRAM LENGTH                 663B      435
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```
      SUBROUTINE PPLOT(X,Y,NP,CEP,ICHI,RCCNF,TITLE,XBAR,YBAR,XLAMBD,    MCARLO   726
     1                 PSIZE)                                           MCARLO   727
      DIMENSION X(100),Y(100),TITLE(6),SORTY(100),SORTX(100),PLINE(22)  MCARLO   728
      DIMENSION MSKK(2)                                                 MCARLO   729
      DATA POINTS/7HX      /                                            MCARLO   730
      DATA CEPX/7H......./                                              MCARLO   731
      DATA CONFC/7H......./                                             MCARLO   732
      DATA EPSLN/0.00001/                                               MCARLO   733
      DATA (PLINE(I),I=1,22)/22*(7H       )/                            MCARLO   734
      DATA FF/7HXXXXXXX/                                                MCARLO   735
      DATA CPR/7H......./                                               MCARLO   736
      DATA RCR/7H......./                                               MCARLO   737
      DATA TGT/7HTTTTTTT/                                               MCARLO   738
      DATA CPCEN/7HCCCCCCC/                                             MCARLO   739
      DATA BLNKK/7H       /                                             MCARLO   740
      DATA (MSKK(I),I=1,10)/77000000000000000003,00770000000000000003,  MCARLO   741
     *00007700000000000003,00000077000000000003,00000000770000000003,   MCARLO   742
     *00000000007700000003,00000000000077000003,00000000000000770000?,  MCARLO   743
     *00000000000000007703,00000000000000000077B/                       MCARLO   744
      ICIRSW=0                                                          MCARLO   745
      ITGTSW=0                                                          MCARLO   746
      YCEP=CEP                                                          MCARLO   747
      YRCNF=RCONF                                                       MCARLO   748
      WRITE(6,1000)                                                     MCARLO   749
 1000 FORMAT(1H1)                                                       MCARLO   750
      WRITE(6,1001) (TITLE(I),I=1,6),XLAMBD                             MCARLO   751
 1001 FORMAT(45X,6A5,F4.2)                                              MCARLO   752
      WRITE(6,1003)                                                     MCARLO   753
      WRITE(6,1002)POINTS                                               MCARLO   754
      WRITE(6,1072)CEPX                                                 MCARLO   755
      CPCCC=CPCE..A.MSKK(4).O.BLNKK.A..N.MSKK(4)                        MCARLO   756
      WRITE(6,1492)CPCCC                                                MCARLO   757
 1492 FORMAT(6X,16HCIRCLE CENTROID ,A7)                                 MCARLO   758
      CPCCC=TGT.A.MSKK(4).O.BLNKK.A..N.MSKK(4)                          MCARLO   759
      WRITE(6,1493)CPCCC                                                MCARLO   760
 1493 FORMAT(6X,13HTEST CENTER,A7)                                      MCARLO   761
 1002 FORMAT(6X,9HPOINTS   ,A6)                                         MCARLO   762
 1003 FORMAT(130X)                                                      MCARLO   763
 1072 FORMAT(6X,10HCEP CIRCLE,3X,A6)                                    MCARLO   764
      IF(ICHI.LE.0) GO TO 100                                           MCARLO   765
      WRITE(6,1073)ICHI,CONFC                                           MCARLO   766
  100 CONTINUE                                                          MCARLO   767
      DO 1 I=1,3                                                        MCARLO   768
    1 WRITE(6,1003)                                                     MCARLO   769
 1073 FORMAT(1X,I4,1X,26HPER CENT CONFIDENCE CIRCLE,3X,A6)              MCARLO   770
      ND=NP                                                             MCARLO   771
      NS=0                                                              MCARLO   772
      XMIN=1.*(10**6)                                                   MCARLO   773
      XMAX=1.*(-10**6)                                                  MCARLO   774
  103 YMAX=1.*(-10**6)                                                  MCARLO   775
      DO 2 I=1,ND                                                       MCARLO   776
      IF(Y(I).LE.YMAX) GO TO 101                                        MCARLO   777
      YMAX = Y(I)                                                       MCARLO   778
      IY=I                                                              MCARLO   779
  101 IF(ND.NE.NP) GO TO 2                                              MCARLO   780
      IF(X(I).GT.XMAX) XMAX=X(I)                                        MCARLO   781
      IF(X(I).LT.XMIN) XMIN=X(I)                                        MCARLO   782
```

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SUBROUTINE PPLOT        74/74    OPT=1                    FTN 4.2+75067        05/05/75  16.16.36         PAGE    2

              2 CONTINUE                                                   MCARLO   783
                NS=NS+1                                                    MCARLO   784
                SORTY(NS)=Y(IY)                                            MCARLO   785
                Y(IY)=Y(ND)                                                MCARLO   786
                SORTX(NS)=X(IY)                                            MCARLO   787
                X(IY)=X(ND)                                                MCARLO   788
                ND=ND-1                                                    MCARLO   789
                IF(ND.GT.1) GO TO 103                                      MCARLO   790
                NS=NS+1                                                    MCARLO   791
                SORTY(NS)=Y(1)                                             MCARLO   792
                SORTX(NS)=X(1)                                             MCARLO   793
                XMAXA = ABS(XMAX)                                          MCARLO   794
                XMINA=ABS(XMIN)                                            MCARLO   795
                XDEVM=AMAX1(XMAXA,XMINA)                                   MCARLO   796
                YMAXA=ABS(SORTY(1))                                        MCARLO   797
                YMINA=ABS(SORTY(NP))                                       MCARLO   798
                YDEVM=AMAX1(YMAXA,YMINA)                                   MCARLO   799
            106 XCIR=ABS(XBAR) + AMAX1(CEP,RCONF)                          MCARLO   800
                YCIR=ABS(YBAR)   + AMAX1(CEP,RCONF)                        MCARLO   801
            110 TSPRD=AMAX1(XDEVM,YDEVM,XCIR,YCIR)                         MCARLO   802
                IF(PSIZE.GT.0.) TSPRD=PSIZE/2.                             MCARLO   803
                SCAL=TSPRD/21.                                             MCARLO   804
                SCAL2=SCAL/2.                                              MCARLO   805
                HSPRD=TSPRD                                                MCARLO   806
                HSCAL=HSPRD/35.                                            MCARLO   807
                CCIRTP=YBAR + CEP                                          MCARLO   808
                CCIRBT=YBAR - CEP                                          MCARLO   809
                RCIRTP=YBAR + RCONF                                        MCARLO   810
                RCIRBT=YBAR - RCONF                                        MCARLO   811
                IF(RCONF.LT.CEP)RCIRTP=-100000.                            MCARLO   812
                YCEP = CCIRTP + SCAL                                       MCARLO   813
                YRCNF = RCIRTP + SCAL                                      MCARLO   814
                ICSW = 0                                                   MCARLO   815
                TU = TSPRD + SCAL                                          MCARLO   816
                NJ=1                                                       MCARLO   817
                CALL XLOC(0.,HSPRD,IND,INDX)                               MCARLO   818
                IXHO=IND                                                   MCARLO   819
                IXNDX = INDX                                               MCARLO   820
                DO 15 I=1,44                                               MCARLO   821
                TU=TU - SCAL                                               MCARLO   822
                PLINE(IXHO)= RCR.A.MSKK(IXNDX).O.PLINE(IXHO).A..N.MSKK(IXNDX)  MCARLO   823
                IF(0..LT.TU.OR.ITGTSW.GT.0) GO TO 2222                     MCARLO   824
                DO 2223 IOP=7,16                                           MCARLO   825
           2223 PLINE(IOP)=RCR                                             MCARLO   826
           2222 CONTINUE                                                   MCARLO   827
                IF(CCIRTP.LT.TU.OR.TU.LT.CCIRBT) GO TO 5180                MCARLO   828
                YCEP=YCEP - SCAL                                           MCARLO   829
                ARGG=CEP**2 - YCEP**2 + 2*YCEP*YBAR - YBAR**2              MCARLO   830
                IF(ARGG.LT.0) GO TO 5180                                   MCARLO   831
                RAD=SQRT(ARGG)                                             MCARLO   832
                GO TO 5181                                                 MCARLO   833
           5180 CONTINUE                                                   MCARLO   834
                IF(CCIRTP.LT.TU) GO TO 205                                 MCARLO   835
                IF(ABS(TU - CCIRBT).GT.SCAL2) GO TO 205                    MCARLO   836
                RAD=0.                                                     MCARLO   837
           5181 CONTINUE                                                   MCARLO   838
                XXL=XBAR - RAD                                             MCARLO   839
```

```
      CALL XLOC(XXL,HSPRD,IND,INDX)
      PLINE(IND)=CPR.A.MSKK(INDX).O.PLINE(IND).A..N.MSKK(INDX)
      XXU=XBAR + RAD
      CALL XLOC(XXU,HSPRD,IND,INDX)
      PLINE(IND)=CPR.A.MSKK(INDX).O.PLINE(IND).A..N.MSKK(INDX)
  205 IF(RCIRTP.LT.TU.OR.TU.LT.RCIRBT) GO TO 5190
      YRCNF=YRCNF - SCAL
      ARRCNF=RCONF**2 - YRCNF**2 + 2*YRCNF*YBAR - YBAR**2
      IF(ARRCNF.LT.0) GO TO 5190
      RAD=SQRT(ARRCNF)
      GO TO 5191
 5190 CONTINUE
      IF(RCIRTP.LT.TU) GO TO 207
      IF(ABS(TU - RCIRBT).GT.SCAL2) GO TO 207
      RAD=0.
 5191 CONTINUE
      XXL=XBAR - RAD
      CALL XLOC(XXL,HSPRD,IND,INDX)
      PLINE(IND)=RCR.A.MSKK(INDX).O.PLINE(IND).A..N.MSKK(INDX)
      XXU=XBAR + RAD
      CALL XLOC(XXU,HSPRD,IND,INDX)
      PLINE(IND)=RCR.A.MSKK(INDX).O.PLINE(IND).A..N.MSKK(INDX)
  207 IF(ICSW.GT.0) GO TO 210
      IF(YBAR.LT.TU) GO TO 210
      ICSW=1
      CALL XLOC(XBAR,HSPRD,IND,INDX)
      PLINE(IND)=CPCEN.A.MSKK(INDX).O.PLINE(IND).A..N.MSKK(INDX)
  210 IF(0..LT.TU.OR.ITGTSW.GT.0) GO TO 213
      ITGTSW=1
      CALL XLOC(0.,HSPRD,IND,INDX)
      PLINE(IND)=TGT.A.MSKK(INDX).O.PLINE(IND).A..N.MSKK(INDX)
  213 JQ=0
      IF(NJ.GT.NP) GO TO 202
      DO 16 K=NJ,NP
      IF(SORTY(K).LT.TU) GO TO 201
      JQ=JQ+1
      CALL XLOC(SORTX(K),HSPRD,IND,INDX)
      PLINE(IND)=PP.A.MSKK(INDX).O.PLINE(IND).A..N.MSKK(INDX)
   16 CONTINUE
  201 NJ=NJ+JQ
  202 WRITE(6,1022)(PLINE(KUG),KUG=3,19)
 1022 FORMAT(1X,16A7,A5)
      DO 33 KUG=1,19
   33 PLINE(KUG)=BLNKK
   15 CONTINUE
      WRITE(6,1003)
      DX=SQRT(XBAR**2+YBAR**2)
      WRITE(6,1021)XBAR,YBAR,DX,CEP
 1021 FORMAT(1X,14HCEP CENTROID=(,F6.3,1H,,F6.3,1H),10X,22HDIST. FROM TG
     *T CENTER=,F6.3,10X,4HCEP=,F6.3)
      WRITE(6,1175)ICHI,RCONF
 1175 FORMAT(1X,4HTHE ,I4,1X,37HPER CENT CONFIDENCE CIRCLE RADIUS IS ,F6
     *.3)
      RETURN
      END
```

```
         SUBROUTINE PPLOT        74/74    OPT=1                    FTN 4.2+73057      05/05/75  16.16.56.       PAGE     4

         SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE      REFERENCES
       3  PPLOT        1          168

 VARIABLES         SN  TYPE            RELOCATION
     722  ARGG         REAL                              REFS        106       107    DEFINED     105
     726  ARRCNF       REAL                              REFS        123       124    DEFINED     122
     477  BLNKK        REAL                              REFS         31        34        158    DEFINED        15
     707  CCIRBT       REAL                              REFS        103       111    DEFINED      84
     766  CCIRTP       REAL                              REFS         88       103        110    DEFINED        83
       0  CEP          REAL                  F.P.        REFS         22        75         76        83        84        87       105
                                                          162     DEFINED         1
     467  CEPX         REAL                              REFS         30    DEFINED          6
     470  CONFC        REAL                              REFS         41    DEFINED          7
     662  CPCCC        REAL                              REFS         32        35    DEFINED        31        34
     476  CPCEN        REAL                              REFS         31       141    DEFINED        14
     473  CPR          REAL                              REFS        116       119    DEFINED        11
     732  DX           REAL                              REFS        152    DEFINED        151
     471  EPSLN     *  REAL                              DEFINED       8
     705  HSCAL     *  REAL                              DEFINED      92
     704  HSPRD        REAL                              REFS         82        93        115       118       132       135       148
                                                          144        131    DEFINED         81
     661  I            INTEGER                           REFS         26        52         53        54      2*56      2*57
                                                         DEFINED      26        43         51        96
       0  ICH          INTEGER               F.P.        REFS         40        41        155    DEFINED         1
     655  ICIRSW    *  INTEGER                           DEFINED      20
     712  ICSW         INTEGER                           REFS        137    DEFINED         90       139
     716  INDX         INTEGER                           REFS         33        35        115     2*116       118     2*113       132
                                                         2*133       135     2*136        140     2*141       144     2*145       151
                                                         2*152
     721  IOP          INTEGER                           REFS        101    DEFINED        100
     656  ITGTSW       INTEGER                           REFS         39       142    DEFINED        21       143
     715  IND          INTEGER                           REFS         33        94        115     2*116       118     2*113       132
                                                         2*133       135     2*136        140     2*141       144     2*143       151
                                                         2*152
     720  IXNDX        INTEGER                           REFS       2*98    DEFINED         95
     717  IXND         INTEGER                           REFS       2*98    DEFINED         94
     670  IY           INTEGER                           REFS         50        61         62        63    DEFINED        54
     727  JQ           INTEGER                           REFS        150       154    DEFINED       146       150
     730  K            INTEGER                           REFS        149       151    DEFINED       148
     731  KUG          INTEGER                           REFS        155       158    DEFINED       155       157
    1271  MSKK         INTEGER         ARRAY             REFS          4      2*31       2*34      2*98     2*115     2*119     2*133
                                                         2*136     2*141     2*145      2*152    DEFINED        16
     663  ND           INTEGER                           REFS         51        55         51        63        64        65
                                                         DEFINED      46        64
     714  NJ           INTEGER                           REFS        147       148        154    DEFINED        92       154
       0  NP           INTEGER               F.P.        REFS         46        55         73       147       148
                                                         DEFINED       1
     664  NS           INTEGER                           REFS         59        60         52        66        57        58
                                                         DEFINED      47        59         56
    1243  PLINE        REAL            ARRAY             REFS          3        98        116       119       133       136       141
                                                          145        152       155    DEFINED         9        98       1?1       110
                                                          119        133       136        141       145       152       158
     466  POINTS       REAL                              REFS         29    DEFINED          5
     472  PP           REAL                              REFS        152    DEFINED         10
       0  PSIZE        REAL                  F.P.        REFS       2*78    DEFINED          1
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        SUBROUTINE PPLOT       74/74    OPT=1                                     FTN 4.2+75087     05/05/75  15.16.56.      PAGE    5

VARIABLES     SN  TYPE              RELOCATION
  723  RAD        REAL                                REFS      114      117      131      134   DEFINED      187      112
                                                        124      129
  711  RCIRBT     REAL                                REFS      120      120   DEFINED       86
  710  RCIRTP     REAL                                REFS       59      120      127   DEFINED       85       57
    0  RCONF      REAL                      F.P.      REFS       23       75       76       85       86       87      122
                                                        165  DEFINED        1
  474  RCR        REAL                                REFS       98      101      133      136   DEFINED       12
  702  SCAL       REAL                                REFS       80       88       89       91       97      104      121
                                                    DEFINED       79
  703  SCAL2      REAL                                REFS      111      128  DEFINED       80
 1077  SORTX      REAL       ARRAY                    REFS        3      151  DEFINED       62       68
  733  SORTY      REAL       ARRAY                    REFS        3       72       73      149   DEFINED       58       67
  [illegible]  TGT        REAL                                REFS       34      145  DEFINED       13
  [illegible]  TITLE      REAL       ARRAY          F.P.      REFS        3       26  DEFINED        1
  701  TSPRD      REAL                                REFS       79       81       91   DEFINED       77       78
  713  TU         REAL                                REFS       97       99    2*103      110      111    2*120      122
                                                        128      138      142      149   DEFINED       91       97
    0  X          REAL       ARRAY          F.P.      REFS        3     2*56     2*57       62       63       68
                                                    DEFINED        1       63
    0  XBAR       REAL                      F.P.      REFS       75      114      117      131      134      148      161
                                                        162  DEFINED        1
  677  XCIR       REAL                                REFS       77  DEFINED       75
  673  XDEVM      REAL                                REFS       77  DEFINED       71
    0  XLAMBD     REAL                      F.P.      REFS       26  DEFINED        1
  666  XMAX       REAL                                REFS       56       59  DEFINED       49       56
  671  XMAXA      REAL                                REFS       71  DEFINED       59
  665  XMIN       REAL                                REFS       57       70  DEFINED       48       57
  672  XMINA      REAL                                REFS       71  DEFINED       70
  724  XXL        REAL                                REFS      115      132  DEFINED      114      131
  725  XXU        REAL                                REFS      118      135  DEFINED      117      134
    0  Y          REAL       ARRAY          F.P.      REFS        3       52       53       60       61       67
                                                    DEFINED        1       51
    0  YBAR       REAL                      F.P.      REFS       76       83       84       85       86    2*105    2*122
                                                        138      151      152  DEFINED        1
  657  YCEP       REAL                                REFS      104    2*105  DEFINED       22       58      104
  700  YCIR       REAL                                REFS       77  DEFINED       76
  676  YDEVM      REAL                                REFS       77  DEFINED       74
  667  YMAX       REAL                                REFS       52  DEFINED       50       53
  674  YMAXA      REAL                                REFS       74  DEFINED       72
  675  YMINA      REAL                                REFS       74  DEFINED       73
  660  YRCNF      REAL                                REFS      121    2*122  DEFINED       23       89      121

FILE NAMES        MODE
        TAPE6     FMT                     WRITES       24       26       28       29       30       32       35       41
                                                 44      155      158      162      165

EXTERNALS          TYPE    ARGS      REFERENCES
        SQRT       REAL     1 LIBRARY     107      124      151
        XLOC                4              93      115      118      132      135      140      144      131

INLINE FUNCTIONS   TYPE    ARGS       DEF LINE  REFERENCES
        ABS        REAL     1  INTRIN       69       70       72       73       75       76      111      128
        AMAX1      REAL     0  INTRIN       71       74       75       76       77

STATEMENT LABELS             DEF LINE    REFERENCES
    0  1                        44           43
  102  2                                     51       55
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SUBROUTINE PPLOT      74/74    OPT=1                      FTN 4.2+73867      05/15/75  16.16.56.      PAGE    6

STATEMENT LABELS                   DEF LINE  REFERENCES
    0  15                             159       95
    0  16                             153      149
    0  33                             158      157
   41  100                             42       48
   74  101                             55       52
   56  103                             30       63
    0  106         INACTIVE            75
    0  110         INACTIVE            77
  416  201                            134      143
  423  202                            155      147
  300  205                            120      113      111
  345  207                            137      127      128
  361  210                            142      137      138
  373  213                            145      142
  583  1000     FMT                    25       24
  512  1001     FMT                    27       25
  547  1002     FMT                    37       23
  552  1003     FMT                    38       23       46       150
  617  1021     FMT                   163      162
  602  1022     FMT                   156      153
  554  1072     FMT                    39       38
  570  1073     FMT                    43       41
  636  1175     FMT                   165      165
  534  1492     FMT                    33       32
  544  1493     FMT                    36       35
  233  2222                           102       93
    0  2223                           101      103
  251  5180                           109      103      106
  260  5161                           113      108
  316  5190                           126      123      123
  325  5191                           138      125

LOOPS  LABEL    INDEX      FROM-TO    LENGTH    PROPERTIES
   42  1        * I         43 44       5B               EXT REFS
   70  2        * I         51 58      153         OPT
  217  15       * I         96 159    2118               EXT REFS  NOT INNER
  231  2223       IOP      100 101      28       INSTACK
  400  16       * K        148 153     168               EXT REFS  EXITS
  424  33         KUG      157 158      23       INSTACK

STATISTICS
  PROGRAM LENGTH                     13153     717
```

```
SUBROUTINE XLOC        74/74    OPT=1                    FTN 4.2+75057      05/05/75  16.17.04.      PAGE   1

            SUBROUTINE XLOC(XVAL,HSPRO,IND,INDX)                                         MCARLO     895
            XD=ABS(-HSPRO + XVAL)                                                        MCARLO     896
            XR=XD/(2.*HSPRO)                                                             MCARLO     897
            RK=XR*70.                                                                    MCARLO     898
            KK=RK                                                                        MCARLO     899
            RKK=KK                                                                       MCARLO     900
            RMDR=RK-RKK                                                                  MCARLO     901
            IF(RMDR.GE.1.5) KK=KK+1                                                      MCARLO     902
            KK1=KK - 1                                                                   MCARLO     903
            IND=KK1/7                                                                    MCARLO     904
            INDX=KK - 7*IND                                                              MCARLO     905
            IND=IND + 7                                                                  MCARLO     906
            RETURN                                                                       MCARLO     907
            END                                                                          MCARLO     908
```

```
SUBROUTINE XLOC        74/74    OPT=1                    FTN 4.2+75057      05/05/75  16.17.04.      PAGE   2

      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
    3  XLOC           1           13

VARIABLES      SN    TYPE           RELOCATION
    0  HSPRO         REAL                 F.P.      REFS         2       3    DEFINED      1
    0  INDX          INTEGER              F.P.      DEFINED      1      11
    0  IND           INTEGER              F.P.      REFS        11      12    DEFINED      1      10      12
   37  KK            INTEGER                        REFS         6       8          9     11   DEFINED     5      8
   42  KK1           INTEGER                        REFS        10    DEFINED       9
   36  RK            REAL                           REFS         5       7    DEFINED      4
   40  RKK           REAL                           REFS         7    DEFINED       6
   41  RMDR          REAL                           REFS         8    DEFINED       7
   34  XD            REAL                           REFS         3    DEFINED       2
   35  XR            REAL                           REFS         4    DEFINED       3
    0  XVAL          REAL                 F.P.      REFS         2    DEFINED       1

INLINE FUNCTIONS     TYPE     ARGS        DEF LINE     REFERENCES
        ABS          REAL       1  INTRIN                  2

STATISTICS
  PROGRAM LENGTH                  433      35
```

```
SUBROUTINE G2          74/74   OPT=1                    FTN 4.2+75067     05/05/75  16.17.35.     PAGE   1

      SUBROUTINE G2
C ** MONTE CARLO WINDS **
      COMMON C(3630)
      EQUIVALENCE (C(3753),ITNDX)
      EQUIVALENCE (C(3721),ITCT)
      EQUIVALENCE (C(  52),  VWTE)
      EQUIVALENCE (C(  54),  SIGU)
      EQUIVALENCE (C(  56),   BLU)
      EQUIVALENCE (C(  58),  WNDWD)
      EQUIVALENCE (C(  59),  SLWD)
      EQUIVALENCE (C(  60),   RLW)
      EQUIVALENCE (C(  62),   SLW)
      EQUIVALENCE (C(  65),CBPSIW)
      EQUIVALENCE (C(  65),SBPSIW)
      EQUIVALENCE (C(  69), GSIGU)
      EQUIVALENCE (C(  70), GVWTE)
      EQUIVALENCE (C( 100),  VWXE)
      EQUIVALENCE (C( 101),  VWYE)
      EQUIVALENCE (C( 102),  VWZE)
      EQUIVALENCE (C(1503),   VXE)
      EQUIVALENCE (C(1507),   VYE)
      EQUIVALENCE (C(1511),   VZE)
      DIMENSION ITNDX(10)
      DATA RNSTRT /0./
      ICK = 0
      DO 500 IOL = 1,ITCT
      ITSNDX = IOL
C
C  MONTE CARLO WIND GUSTS TIME SERIES
      IF(ITNDX(IOL).NE.70) GO TO 502
      UBAR = 0.
      IF(VWTE.NE.0.) UBAR = ABS((VXE*VWXE + VYE*VWYE + VZE*VWZE)/VWTE)
      CALL MCARLO(DUM, 2, ITSNDX)
      WNDW02 = UBAR/BLU + WNDWD
      GLW = GSIGU*SQRT(WNDW02)
      SLWD = RLW - WNDW02*SLW
      GVWTE = VWTE + GLW*SLW
      ICK = 1
  502 CONTINUE
  500 CONTINUE
      IF(ICK.EQ.0) GO TO 503
      VWXE = - GVWTE*CBPSIW
      VWYE = - GVWTE*SBPSIW
  503 CONTINUE
C
      RETURN
      END
```

```
SUBROUTINE G2        74/74   OPT=1                    FTN 4.2+75067     05/05/75  16.17.05.     PAGE    2

     SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE      REFERENCES
     1   G2            1            46

 VARIABLES      SN  TYPE             RELOCATION
    67   BLU        REAL                 / /        REFS        8       34
     0   C          REAL         ARRAY   / /        REFS        3        4        5        6        7        8        9
                                                      10       11       12       13       14       15       16       17
                                                      18       19       20       21       22
   100   CBPSIN     REAL                 / /        REFS       13       42
    60   DUM      * REAL                            REFS       33
    62   GLW        REAL                            REFS       37   DEFINED       35
   104   GSIGU      REAL                 / /        REFS       15       35
   105   SVHTE      REAL                 / /        REFS       16       42       43   DEFINED       37
    54   ICP        INTEGER                         REFS       41   DEFINED       25       38
    55   IOL        INTEGER                         REFS       27       30   DEFINED       26
  7210   ITCT       INTEGER              / /        REFS        5       26
  7250   ITNDX      INTEGER      ARRAY   / /        REFS        4       23       30
    56   ITSNDX     INTEGER                         REFS       33   DEFINED       27
    73   RLW        REAL                 / /        REFS       11       36
    52   RNSTRT   * REAL                         DEFINED       24
   101   SBPSIN     REAL                 / /        REFS       14       43
    65   SIGU       REAL                 / /        REFS        7
    75   SLW        REAL                 / /        REFS       12       36       37
    72   SLWO       REAL                 / /        REFS       10   DEFINED       36
    57   UBAR       REAL                            REFS       34   DEFINED       31       32
    63   VHTE       REAL                 / /        REFS        6     2*32       37
   143   VWXE       REAL                 / /        REFS       17       32   DEFINED       42
   144   VWYE       REAL                 / /        REFS       18       32   DEFINED       43
   145   VWZE       REAL                 / /        REFS       19       32
  3102   VXE        REAL                 / /        REFS       20       32
  3106   VYE        REAL                 / /        REFS       21       32
  3112   VZE        REAL                 / /        REFS       22       32
    71   WNDWO      REAL                 / /        REFS        9       34
    61   WNDWO2     REAL                            REFS       35       36   DEFINED       34

 EXTERNALS            TYPE    ARGS         REFERENCES
      MCARLO                   3               33
      SQRT            REAL     1 LIBRARY       35

 INLINE FUNCTIONS     TYPE    ARGS         DEF LINE   REFERENCES
      ABS             REAL     1  INTRIN                 32

 STATEMENT LABELS                 DEF LINE   REFERENCES
      0  500                          40        25
     36  502                          39        31
     45  503                          44        41

 LOOPS  LABEL    INDEX      FROM-TO     LENGTH     PROPERTIES
     4   500   * IOL        26 40        35B                   EXT REFS

 COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
       / /         3836                 0 C        (3830)
```

```
      SUBROUTINE G2          74/74   OPT=1                    FTN 4.2+75067      05/05/75  16.17.05.      PAGE    3

  EQUIV CLASSES   LENGTH    MEMBERS - BIAS NAME(LENGTH)
  C       C        383C           51 VWTE    (1)              53 SIGU    (1)              55 BLU     (1)
                                  57 WHDWO   (1)              58 SLWO    (1)              59 RLW     (1)
                                  61 S_W     (1)              64 CBPSIN  (1)              65 SBPSIN  (1)
                                  68 GSIGU   (1)              63 GVWTE   (1)              99 VWXE    (1)
                                 100 VWYE    (1)             101 VWZE    (1)            1602 VXE     (1)
                                1506 VYE     (1)            1613 VZE     (1)            3720 ITCT    (1)
                                3752 ITNDX   (10)

  STATISTICS
    PROGRAM LENGTH            633      51
    CM BLANK COMMON LENGTH  73663    3830
```

```
      SUBROUTINE G2I
C**WIND AND GUSTS MODULE
      COMMON C(3830)
C**INPUT DATA
      EQUIVALENCE(C(2000),I)
      EQUIVALENCE (C(  50),OPTNW )
      EQUIVALENCE (C(  51),BPSIW )
      EQUIVALENCE (C(  52),VWTE  )
C**OUTPUT DATA
      EQUIVALENCE (C( 100),VWXE  )
      EQUIVALENCE (C( 101),VWYE  )
      EQUIVALENCE (C( 102),VWZE  )
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(  54),  SIGU)
      EQUIVALENCE (C(  55),   BLU)
      EQUIVALENCE (C(  58), WNOWO)
      EQUIVALENCE (C(  59),  SLWO)
      EQUIVALENCE (C(  60),   RLW)
      EQUIVALENCE (C(  62),   SLW)
      EQUIVALENCE (C(  65),CBPSIW)
      EQUIVALENCE (C(  66),SBPSIW)
      EQUIVALENCE (C(  58), VWTEM)
      EQUIVALENCE (C(  59), GSIGU)
      EQUIVALENCE (C(2561),     N)
      EQUIVALENCE (C(2562),   IPL)
      EQUIVALENCE (C(3634), ISNOX)
      EQUIVALENCE (C(3512), I3512)
      EQUIVALENCE (C(3753), ITNDX)
      EQUIVALENCE (C(3771),  ITCT)
      DIMENSION IPL(100), ISNOX(40), ITNDX(10)
C
      VWTEM=VWTE
C MONTE CARLO STEADY STATE WIND COMPONENT
      DO 500 I = 1, I3512
      IDO = 1
      IF(ISNOX(I).EQ.51) CALL MCARLO (DUM, 1, IDO)
      IF(ISNOX(I).EQ.52) CALL MCARLO (DUM, 1, IDO)
  500 CONTINUE
C
      VWTE = ABS(VWTE)
      SLW = 0.
C
C MONTE CARLO  INITIAL VALUE OF TIME SERIES WIND GUSTS
      DO 501 I = 1,ITCT
      IDO = 1
      IF(ITNDX(I).NE.70) GO TO 501
      CALL MCARLO ( DUM,4,IDO)
      WNOWO = 1.
      IF(VWTE.EQ.0.) GO TO 505
      SIGU = VWTE/2.9
      GO TO 506
  505 CONTINUE
      VWTE = 2.9 * SIGU
  506 CONTINUE
      GSIGU = SIGU*SQRT(1.89/C(2654))
      BLU = -12.1*SIGU + 475.
      IF(VWTEM/VWTE.GT..1) WNOWO = VWTE/VWTEM
```

```
        SUBROUTINE G2I          74/74    OPT=1                    FTN 4.2+75067      05/05/75  16.17.06.       PAGE    2

                   IPL(N) = 59                                                 G2          106
                   N = N + 1                                                   G2          107
             501   CONTINUE                                                    G2          108
C                                                                              G2          109
                   CBPSIN = COSD(BPSIN)                                        G2          110
                   SBPSIN = SIND(BPSIN)                                        G2          111
                   VNXE = - VNTE*CBPSIN                                        G2          112
                   VNYE = - VNTE*SBPSIN                                        G2          113
                   VNZE = 0.                                                   G2          114
                   RETURN                                                      G2          115
                   END                                                         G2          116

        SUBROUTINE G2I          74/74    OPT=1                    FTN 4.2+75067      05/05/75  16.17.06.       PAGE    3

CARD NR. SEVERITY  DETAILS    DIAGNOSIS OF PROBLEM

   58       I       ITCT      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
```

```
SUBROUTINE G2I        74/74    OPT=1                          FTN 4.2+75057     05/15/75  15.17.36.     PAGE    4

SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS        DEF LINE      REFERENCES
    1   G2I            1             67

VARIABLES      SN   TYPE           RELOCATION
   67   BLU         REAL                  / /      REFS       15    DEFINED    56
   62   BPSIM       REAL                  / /      REFS        7       52      53
    0   C           REAL        ARRAY     / /      REFS        3        5       6       7       8      10      11
                                                   12         14       15      16      17      18      19      28
                                                   21         22       23      24      25      26      27      28
                                                   29         55
  100   CBPSIN      REAL                  / /      REFS       20       64    DEFINED    62
  115   DUM         REAL                           REFS       36       37      47
  104   GSIGU       REAL                  / /      REFS       23    DEFINED    55
  113   I           INTEGER                        REFS       35       36      37      45      45
                                                 DEFINED      34       44
  114   IDO         INTEGER                        REFS       36       37      47    DEFINED    35      35
 5001   IPL         INTEGER     ARRAY     / /      REFS       25       30    DEFINED    58
 7061   ISNDX       INTEGER     ARRAY     / /      REFS       26       30      36      37
 7210   ITCT        INTEGER               / /      REFS       29       44
 7250   ITNDX       INTEGER     ARRAY     / /      REFS       28       30      46
 6667   I3512       INTEGER               / /      REFS       27       34
 5000   N           INTEGER               / /      REFS       24       38      59    DEFINED    59
   61   OPTNM       REAL                  / /      REFS        6
   73   RLW         REAL                  / /      REFS       18
  101   SBPSIN      REAL                  / /      REFS       21       65    DEFINED    63
   65   SIGU        REAL                  / /      REFS       14       53      55      56    DEFINED    50
   75   SLW         REAL                  / /      REFS       19    DEFINED    41
   72   SLWG        REAL                  / /      REFS       17
 3717   T           REAL                  / /      REFS        5
   63   VWTE        REAL                  / /      REFS        8       32      40      49      50    2*57     64
                                                   65    DEFINED       40      53
  103   VWTEM       REAL                  / /      REFS       22     2*57    DEFINED    32
  143   VWXE        REAL                  / /      REFS       10    DEFINED    64
  144   VWYE        REAL                  / /      REFS       11    DEFINED    65
  145   VWZE        REAL                  / /      REFS       12    DEFINED    66
   71   WNOHO       REAL                  / /      REFS       16    DEFINED    48      57

EXTERNALS          TYPE   ARGS          REFERENCES
        COSO       REAL     1               62
        MCARLO              3               35       37       47
        SIND       REAL     1               63
        SQRT       REAL     1 LIBRARY       55

INLINE FUNCTIONS   TYPE   ARGS        DEF LINE   REFERENCES
        ABS        REAL     1  INTRIN                40

STATEMENT LABELS                DEF LINE    REFERENCES
      0  500                       38          34
     55  501                       60          44       46
     36  505                       52          43
     40  506                       54          51

LOOPS   LABEL    INDEX        FROM-TO      LENGTH     PROPERTIES
    5    500       * I         34 38         14B                  EXT REFS
   24    501       * I         44 60         34B                  EXT REFS
```

```
SUBROUTINE G2I          74/74  OPT=1                    FTN 4.2+75067     05/05/75  16.17.86.      PAGE    5

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
  / /            383C                    C     (3830)

EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
C       C        3836                49 OPTNW   (1)        50 BPSIN   (1)        51 VWTE    (1)
                                     53 SIGJ    (1)        55 BLJ     (1)        57 WNDWD   (1)
                                     59 SLWD    (1)        59 RLW     (1)        61 SLW     (1)
                                     64 CBPSIN  (1)        65 SBPSIN  (1)        67 VWTEM   (1)
                                     68 GSIGU   (1)        99 VWXE    (1)       100 VWYE    (1)
                                    101 VWZE    (1)      1939 T       (1)      2560 N       (1)
                                   2561 IPL     (100)    3511 I3512   (1)      3633 ISNDX   (40)
                                   3720 ITST    (1)      3752 ITNDX   (10)

STATISTICS
  PROGRAM LENGTH                 1163     78
  CM BLANK COMMON LENGTH        73663   3830
```

```
SUBROUTINE G3          74/74    OPT=1                    FTN 4.2+75057      05/05/75  16.17.08.     PAGE    1

      SUBROUTINE G3                                                        G3       2
C**AIR DATA MODULE G3                                                      G3       3
      COMMON C(3830)                                                       G3       4
C**INPUT DATA                                                              G3       5
      EQUIVALENCE (C(1208),RHZRO )                                         G3       6
C**INPUTS FROM OTHER MODULES                                               G3       7
      EQUIVALENCE (C(0100),VWXE  )                                         G3       8
      EQUIVALENCE (C(0101),VWYE  )                                         G3       9
      EQUIVALENCE (C(0102),VWZE  )                                         G3      10
      EQUIVALENCE (C(1603),VXE   )                                         G3      11
      EQUIVALENCE (C(1607),VYE   )                                         G3      12
      EQUIVALENCE (C(1611),VZE   )                                         G3      13
      EQUIVALENCE (C(1623),RZE   )                                         G3      14
C**INPUTS FROM MAIN PROGRAM                                                G3      15
C**STATE VARIABLE OUTPUTS                                                  G3      16
C**NONE                                                                    G3      17
C**OTHER OUTPUTS                                                           G3      18
      EQUIVALENCE (C(0200),VMWXE )                                         G3      19
      EQUIVALENCE (C(0201),VMWYE )                                         G3      20
      EQUIVALENCE (C(0202),VMWZE )                                         G3      21
      EQUIVALENCE (C(0203),PDYNMC)                                         G3      22
      EQUIVALENCE (C(0204),VMACH )                                         G3      23
      EQUIVALENCE (C(0205),DRHO  )                                         G3      24
      EQUIVALENCE (C(0206),VSOUND)                                         G3      25
      EQUIVALENCE (C(0207),VAIRSP)                                         G3      26
      EQUIVALENCE (C(0209),RH    )                                         G3      27
C**CALCULATE PRESENT ALTITUDE                                              G3      28
      RH= -RZE+RHZRO                                                       G3      29
C**CALCULATE MISSILE VELOCITY WRT AIR MASS IN EARTH AXES                   G3      30
      VMWXE = VXE-VWXE                                                     G3      31
      VMWYE = VYE-VWYE                                                     G3      32
      VMWZE = VZE-VWZE                                                     G3      33
      VAIRSP = SQRT(VMWXE*VMWXE+VMWYE*VMWYE+VMWZE*VMWZE)                   G3      34
C**AIR DENSITY, SPEED OF SOUND, DYNAMIC PRESSURE, AND MACH                 G3      35
      DRHO=(.076475)/(1.+.3325E-04*RH+RH*RH*RH*RH*.02315E-12)              G3      36
      VSOUND = -.00392*RH+1117.3                                           G3      37
      PDYNMC = (DRHO*VAIRSP*VAIRSP)/64.344                                 G3      38
      VMACH = VAIRSP/VSOUND                                                G3      [illegible]
      RETURN                                                               G3      40
      END                                                                  G3      41
```

```
SUBROUTINE G3          74/74   OPT=1                FTN 4.2+75057     05/05/75  16.17.08.      PAGE    2

          SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE     REFERENCES
    1  G3                1      * 39

VARIABLES        SN  TYPE          RELOCATION
    0  C              REAL     ARRAY    / /          REFS      3      5      7      8      9     10     11
                                                       12     13     18     19     20     21     22     23
                                                       24     25     26
  314  DRHO           REAL              / /          REFS     23     37  DEFINED    35
  312  PDYNMC         REAL              / /          REFS     21  DEFINED    37
  320  RH             REAL              / /          REFS     26   4*35     36  DEFINED    28
  317  RHZRO          REAL              / /          REFS      5     28
 3126  RZE            REAL              / /          REFS     13     28
  316  VAIRSP         REAL              / /          REFS     25   2*37     38  DEFINED    33
  313  VMACH          REAL              / /          REFS     22  DEFINED    38
  307  VMWXE          REAL              / /          REFS     18   2*33  DEFINED    30
  310  VMWYE          REAL              / /          REFS     19   2*33  DEFINED    31
  311  VMWZE          REAL              / /          REFS     20   2*33  DEFINED    32
  315  VSOUND         REAL              / /          REFS     24     38  DEFINED    36
  143  VWXE           REAL              / /          REFS      7     30
  144  VWYE           REAL              / /          REFS      8     31
  145  VWZE           REAL              / /          REFS      9     32
 3102  VXE            REAL              / /          REFS     10     30
 3106  VYE            REAL              / /          REFS     11     31
 3112  VZE            REAL              / /          REFS     12     32

EXTERNALS           TYPE   ARGS         REFERENCES
       SQRT         REAL     1 LIBRARY      33

COMMON BLOCKS    LENGTH    MEMBERS - BIAS NAME(LENGTH)
      / /         3830               0      (3830)

EQUIV CLASSES    LENGTH    MEMBERS - BIAS NAME(LENGTH)
C       C         3830          99 VWXE    (1)          100 VWYE    (1)          101 VWZE    (1)
                               199 VMWXE   (1)          200 VMWYE   (1)          201 VMWZE   (1)
                               202 PDYNMC  (1)          203 VMACH   (1)          204 DRHO    (1)
                               205 VSOUND  (1)          206 VAIRSP  (1)          207 RHZRO   (1)
                               208 RH      (1)         1602 VXE     (1)         1606 VYE     (1)
                              1610 VZE     (1)         1622 RZE     (1)

STATISTICS
  PROGRAM LENGTH            403      32
  CM BLANK COMMON LENGTH  73663    3830
```

```
      SUBROUTINE G5                                              G5         2
C**COORDINATE CONVERSION MODULE                                  G5         3
      COMMON C(3830)                                             G5         4
C                                                                G5         5
C**INPUTS FROM OTHER MODULES                                     G5         6
      EQUIVALENCE (C(0200),VMHXE )                               G5         7
      EQUIVALENCE (C(0201),VMHYE )                               G5         8
      EQUIVALENCE (C(0202),VMHZE )                               G5         9
      EQUIVALENCE (C(0207),VAIRSP)                               G5        10
      EQUIVALENCE (C(1317),RAIL  )                               G5        11
      EQUIVALENCE (C(1405),QBURN )                               G5        12
      EQUIVALENCE (C(1603),VXE   )                               G5        13
      EQUIVALENCE (C(1607),VYE   )                               G5        14
      EQUIVALENCE (C(1611),VZE   )                               G5        15
      EQUIVALENCE (C(1615),RXE   )                               G5        16
      EQUIVALENCE (C(1619),RYE   )                               G5        17
      EQUIVALENCE (C(1623),RZE   )                               G5        18
      EQUIVALENCE (C(1635),RDELX )                               G5        19
      EQUIVALENCE (C(1636),RDELY )                               G5        20
      EQUIVALENCE (C(1637),RDELZ )                               G5        21
      EQUIVALENCE (C(1651),RTXE  )                               G5        22
      EQUIVALENCE (C(1655),RTYE  )                               G5        23
      EQUIVALENCE (C(1659),RTZE  )                               G5        24
      EQUIVALENCE (C(1668),RXO   )                               G5        25
      EQUIVALENCE (C(1669),RYO   )                               G5        26
      EQUIVALENCE (C(1670),RZO   )                               G5        27
      EQUIVALENCE (C(1571),VXO   )                               G5        28
      EQUIVALENCE (C(1572),VYO   )                               G5        29
      EQUIVALENCE (C(1673),VZO   )                               G5        30
      EQUIVALENCE (C(1580),RSJYMC)                               G5        31
      EQUIVALENCE (C(1581),RSJZMC)                               G5        32
      EQUIVALENCE (C(1582),RSPOTX)                               G5        33
      EQUIVALENCE (C(1583),RSPOTY)                               G5        34
      EQUIVALENCE (C(1584),RSPOTZ)                               G5        35
      EQUIVALENCE (C(3753), ITNDX)                               G5        36
      EQUIVALENCE (C(3721), ITCT)                                G5        37
      EQUIVALENCE (C(1560), SXPDD)                               G5        38
      EQUIVALENCE (C(1561),    RX)                               G5        39
      EQUIVALENCE (C(1562),GSPOTY)                               G5        40
      EQUIVALENCE (C(1563),  SXPD)                               G5        41
      EQUIVALENCE (C(1566),   SXP)                               G5        42
      EQUIVALENCE (C(1570), SYPDD)                               G5        43
      EQUIVALENCE (C(1571),    RY)                               G5        44
      EQUIVALENCE (C(1572),GSPOTZ)                               G5        45
      EQUIVALENCE (C(1573),  SYPD)                               G5        46
      EQUIVALENCE (C(1576),   SYP)                               G5        47
      EQUIVALENCE (C(1579),  ZETA)                               G5        48
      EQUIVALENCE (C(1580),    WJ)                               G5        49
      DIMENSION ITNDX(10)                                        G5        50
      EQUIVALENCE (C(1703),CFA11 )                               G5        51
      EQUIVALENCE (C(1707),CFA12 )                               G5        52
      EQUIVALENCE (C(1711),CFA13 )                               G5        53
      EQUIVALENCE (C(1715),CFA21 )                               G5        54
      EQUIVALENCE (C(1719),CFA22 )                               G5        55
      EQUIVALENCE (C(1723),CFA23 )                               G5        56
      EQUIVALENCE (C(1727),CFA31 )                               G5        57
      EQUIVALENCE (C(1731),CFA32 )                               G5        58
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      EQUIVALENCE (C(1735),CFA33 )                        G5        59
      EQUIVALENCE (C(1751),CRAD  )                        G5        60
      EQUIVALENCE (C(1768),   XB01)                       G5        61
      EQUIVALENCE (C(1769),   YB01)                       G5        62
      EQUIVALENCE (C(1770),   ZB01)                       G5        63
      EQUIVALENCE (C(1771),   XB02)                       G5        64
      EQUIVALENCE (C(1772),   YB02)                       G5        65
      EQUIVALENCE (C(1773),   ZB02)                       G5        66
      EQUIVALENCE (C(1764),    P1)                        G5        67
      EQUIVALENCE (C(1765),    Q1)                        G5        68
      EQUIVALENCE (C(1755),    P2)                        G5        69
      EQUIVALENCE (C(1767),    R2)                        G5        70
      EQUIVALENCE (C(1751),   A011)                       G5        71
      EQUIVALENCE (C(1752),   A012)                       G5        72
      EQUIVALENCE (C(1763),   A013)                       G5        73
      EQUIVALENCE (C(1755),A021  )                        G5        74
      EQUIVALENCE (C(1756),A022  )                        G5        75
      EQUIVALENCE (C(1757),A023  )                        G5        76
      EQUIVALENCE (C(1758),A031  )                        G5        77
      EQUIVALENCE (C(1759),A032  )                        G5        78
      EQUIVALENCE (C(1760),A033  )                        G5        79
      EQUIVALENCE (C(2000),T     )                        G5        80
C                                                         G5        81
C**OTHER OUTPUTS                                          G5        82
      EQUIVALENCE (C(0350),BTHT  )                        G5        83
      EQUIVALENCE (C(0351),BPSI  )                        G5        84
      EQUIVALENCE (C(0352),BPHI  )                        G5        85
      EQUIVALENCE (C(0353),BPH1  )                        G5        86
      EQUIVALENCE (C(0354),BTH2  )                        G5        87
      EQUIVALENCE (C(0355),BPS1  )                        G5        88
      EQUIVALENCE (C(0356),VTOTE )                        G5        89
      EQUIVALENCE (C(0357),BGAMH )                        G5        90
      EQUIVALENCE (C(0358),BGAMV )                        G5        91
      EQUIVALENCE (C(0363),ETHLV )                        G5        92
      EQUIVALENCE (C(0364),BFSLV )                        G5        93
      EQUIVALENCE (C(0365),BLAMV )                        G5        94
      EQUIVALENCE (C(0366),BLAMH )                        G5        95
      EQUIVALENCE (C(0367),BALPHA)                        G5        96
      EQUIVALENCE (C(0368),BALPHY)                        G5        97
      EQUIVALENCE (C(0369),RALPHP)                        G5        98
      EQUIVALENCE (C(0370),BPHIP )                        G5        99
      EQUIVALENCE (C(0371),RANGE )                        G5       100
      EQUIVALENCE (C(0372),RXBA  )                        G5       101
      EQUIVALENCE (C(0373),RYBA  )                        G5       102
      EQUIVALENCE (C(0374),RZBA  )                        G5       103
      EQUIVALENCE (C(0380),RANGO )                        G5       104
      EQUIVALENCE (C(0390),RXL   )                        G5       105
      EQUIVALENCE (C(0391),RYL   )                        G5       106
      EQUIVALENCE (C(0392),RZL   )                        G5       107
      EQUIVALENCE (C(0393),BPH2  )                        G5       108
C                                                         G5       109
C**CALCULATION OF HEADING, PITCH, ROLL EULER ANGLES IN DEGREES G5   110
      BPHI = ATAND(CFA23,CFA33)                           G5       111
      BTHT = ATAND(-CFA13,SQRT(CFA11*CFA11+CFA12*CFA12))  G5       112
      BPSI = ATAND(CFA12,CFA11)                           G5       113
C                                                         G5       114
C**FREE GYRO MODELS (INITIAL GIMBAL ANGLES ARE ZERO)      G5       115
```

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      C
      C** AUTO-PILOT-DRIFT-RATES
            DXB01 = -Q1*YB01/CRAD
            DYB01 = (Q1*XB01 - P1*ZB01)/CRAD
            DZB01 = P1*YB01/CRAD
            DXB02 = -R2*ZB02/CRAD
            DYB02 = -P2*ZB02/CRAD
            DZB02 = (P2*YB02 - R2*XB02)/CRAD
      C
            XB01 = DXB01*T
            YB01 = 1. + DYB01*T
            ZB01 = DZB01*T
            XB02 = DXB02*T
            YB02 = DYB02*T
            ZB02 = 1. + DZB02*T
            B11 = A011*CFA11 + A012*CFA12 + A013*CFA13
            B12 = A011*CFA21 + A012*CFA22 + A013*CFA23
            B13 = A011*CFA31 + A012*CFA32 + A013*CFA33
            B21 = A021*CFA11 + A022*CFA12 + A023*CFA13
            B22 = A021*CFA21 + A022*CFA22 + A023*CFA23
            B23 = A021*CFA31 + A022*CFA32 + A023*CFA33
            B31 = A031*CFA11 + A032*CFA12 + A033*CFA13
            B32 = A031*CFA21 + A032*CFA22 + A033*CFA23
            B33 = A031*CFA31 + A032*CFA32 + A033*CFA33
            XB1 = B11*XB01 + B21*YB01 + B31*ZB01
            YB1 = B12*XB01 + B22*YB01 + B32*ZB01
            ZB1 = B13*XB01 + B23*YB01 + B33*ZB01
            XB2 = B11*XB02 + B21*YB02 + B31*ZB02
            YB2 = B12*XB02 + B22*YB02 + B32*ZB02
            ZB2 = B13*XB02 + B23*YB02 + B33*ZB02
            BPH1 = ATAND (ZB1,YB1)
            BPS1 = ATAND (-XB1,YB1/COSD(BPH1))
            BTH2 = ATAND (XB2,ZB2)
            BPH2 = ATAND (-YB2,ZB2/COSD(BTH2))
      C
      C**CALCULATION OF TOTAL VELOCITY
            VTOTE = SQRT(VXE*VXE+VYE*VYE+VZE*VZE)
            RDELX = RTXE-RXE
            RDELY = RTYE-RYE
            RDELZ = RTZE-RZE
      C
            IF(C(1976).LE.0.) GO TO 20
            RXL = RXE - RXO - VXO*T
            RYL = RYE - RYO - VYO*T
            RZL = RZE - RZO - VZO*T
            RANGO = SQRT(RXL**2 + RYL**2 + RZL**2)
            VXL = VXE - VXO
            VYL = VYE - VYO
            VZL = VZE - VZO
         20 CONTINUE
      C
      C**TRANSFORM MISSILE LOS FROM EARTH TO BODY AXES
      C
      C LINE OF SIGHT OF LASER SPOT WITH MONTE CARLO SPOT JITTER INCLUDED
      C
            DO 500 I = 1, IIST
            IDO = I
```

```
      IF(ITNDX(I).NE.1500) GO TO 501
      RSJYMC =-GSPOTY*SXP
      CALL MCARLO (DUM,2,IDO)
      SXPDD = W0*W0*(RX-2.*ZETA*SXPD/W0 - SXP)
  501 IF(ITNDX(I).NE.1501) GO TO 500
      RSJZMC = GSPOTZ*SYP
      CALL MCARLO (DUM,2,IDO)
      SYPDD =-W0*W0*(RY --2.*ZETA*SYPD/W0 - SYP)
  500 CONTINUE
      RSPOTX = RDELX
      RSPOTY = RDELY + RSJYMC
      RSPOTZ = RDELZ + RSJZMC
      RXBA = RSPOTX*CFA11 + RSPOTY*CFA12 + RSPOTZ*CFA13
      RYBA = RSPOTX*CFA21 + RSPOTY*CFA22 + RSPOTZ*CFA23
      RZBA = RSPOTX*CFA31 + RSPOTY*CFA32 + RSPOTZ*CFA33
C
      UVP1 =  VXE*RDELX+VYE*RDELY
      UVP2 = RDELX*RDELX+RDELY*RDELY
      UVP3 = VZE*RDELZ
      UVP4 = SQRT(UVP2)
      RANGE = SQRT(UVP2+RDELZ**2)
C**VERTICAL AND HORIZONTAL LINE-OF-SIGHT ANGLES (EARTH AXES)
C
      BLAMH = ATAND(-RDELY,RDELX)
      BLAMV = ATAND(-RDELZ,UVP4)
C
C**VERTICAL AND HORIZONTAL PROPORTIONAL NAVIGATION ANGLES
      IF(VTOTE.LE.10.) GO TO 30
      VXP=(UVP1+UVP3)/RANGE
      VYP = ( VYE*RDELX-VXE*RDELY)/UVP4
      VZP = (VZE*UVP2-RDELZ*UVP1)/(RANGE*UVP4)
      BTHLV = ATAND(VZP,VXP)
      BPSLV  = ATAND(VYP,VXP)
C
      BGAMV = ATAND(-VZE,SQRT(VXE*VXE+VYE*VYE))
      BGAMH = ATAND(VYE,VXE)
C
C**VELOCITY WRT AIR IN BODY AXES
      VMHU = CFA11*VMHXE+CFA12*VMHYE+CFA13*VMHZE
      VMHV = CFA21*VMHXE+CFA22*VMHYE+CFA23*VMHZE
      VMHW = CFA31*VMHXE+CFA32*VMHYE+CFA33*VMHZE
C
C**VERTICAL AND HORIZONTAL ANGLES OF ATTACK
      IF (QBURN.LE.0. .AND. RANGO.LE.RAIL) GO TO 30
      BALPHA = ATAND(VMHW,VMHU)
      BALPHY = ATAND(VMHV,VMHU)
C
C**ALPHA PRIME AND PHI PRIME (WIND TUNNEL AXES)
      IF ((BALPHA-BALPHY).EQ.0.) GO TO 30
      BPHIP = ATAND(BALPHY,BALPHA)
   30 BALPHP=SQRT(BALPHA**2+BALPHY**2)
      RETURN
      END
```

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     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
   1  G5              1            223

VARIABLES      SN   TYPE              RELOCATION
  3340  A011        REAL                    / /       REFS      70       130       131       132
  3341  A012        REAL                    / /       REFS      71       130       131       132
  3342  A013        REAL                    / /       REFS      72       130       131       132
  3332  A021        REAL                    / /       REFS      73       133       134       135
  3333  A022        REAL                    / /       REFS      74       133       134       135
  3334  A023        REAL                    / /       REFS      75       133       134       135
  3335  A031        REAL                    / /       REFS      76       136       137       138
  3336  A032        REAL                    / /       REFS      77       136       137       138
  3337  A033        REAL                    / /       REFS      78       136       137       138
   556  BALPHA      REAL                    / /       REFS      95       220       221       222   DEFINED    216
   560  BALPHP      REAL                    / /       REFS      97   DEFINED       222
   557  BALPHY      REAL                    / /       REFS      96       220       221       222   DEFINED    217
   544  BGAMH       REAL                    / /       REFS      89   DEFINED       207
   545  BGAMV       REAL                    / /       REFS      90   DEFINED       206
   555  BLAMH       REAL                    / /       REFS      94   DEFINED       195
   554  BLAMV       REAL                    / /       REFS      93   DEFINED       136
   537  BPHI        REAL                    / /       REFS      84   DEFINED       110
   561  BPHIP       REAL                    / /       REFS      98   DEFINED       221
   540  BPH1        REAL                    / /       REFS      85       146   DEFINED       145
   610  BPH2        REAL                    / /       REFS     117   DEFINED       148
   536  BPSI        REAL                    / /       REFS      83   DEFINED       112
   553  BPSLV       REAL                    / /       REFS      92   DEFINED       204
   542  BPS1        REAL                    / /       REFS      87   DEFINED       146
   552  BTHLV       REAL                    / /       REFS      91   DEFINED       203
   535  BTHT        REAL                    / /       REFS      82   DEFINED       111
   541  BTH2        REAL                    / /       REFS      86       148   DEFINED       147
   534  B11         REAL                              REFS     139       142   DEFINED       130
   535  B12         REAL                              REFS     140       143   DEFINED       131
   536  B13         REAL                              REFS     141       144   DEFINED       132
   537  B21         REAL                              REFS     139       142   DEFINED       133
   540  B22         REAL                              REFS     140       143   DEFINED       134
   541  B23         REAL                              REFS     141       144   DEFINED       135
   542  B31         REAL                              REFS     139       142   DEFINED       136
   543  B32         REAL                              REFS     140       143   DEFINED       137
   544  B33         REAL                              REFS     141       144   DEFINED       138
     0  C           REAL        ARRAY       / /       REFS       3         6         7         8         9        10        11
                                                        12      13        14        15        16        17        18        19
                                                        20      21        22        23        24        25        26        27
                                                        28      29        30        31        32        33        34        35
                                                        36      37        38        39        40        41        42        43
                                                        44      45        46        47        48        50        51        52
                                                        53      54        55        56        57        58        59        60
                                                        61      62        63        64        65        66        67        68
                                                        69      70        71        72        73        74        75        76
                                                        77      78        79        82        83        84        85        86
                                                        87      88        89        90        91        92        93        94
                                                        95      96        97        98        99       100       101       102
                                                       103     104       105       106       107       156
  3246  CFA11       REAL                    / /       REFS      50     2*111       112       130       133       136       184
                                                       216
  3252  CFA12       REAL                    / /       REFS      51     2*111       112       130       133       136       184
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SUBROUTINE 65        74/74   OPT=1                          FTN 4.2+75067   05/05/75  16.17.10.   PAGE    6

VARIABLES   SN  TYPE          RELOCATION
                                                 210
  3256  CFA13   REAL              / /           REFS     52    111    130    133    136    184    210
  3262  CFA21   REAL              / /           REFS     53    131    134    137    185    211
  3266  CFA22   REAL              / /           REFS     54    131    134    137    185    211
  3272  CFA23   REAL              / /           REFS     55    110    131    134    137    185    211
  3276  CFA31   REAL              / /           REFS     56    132    135    138    186    212
  3302  CFA32   REAL              / /           REFS     57    132    135    138    186    212
  3306  CFA33   REAL              / /           REFS     58    110    132    135    138    186    212
  3326  CRAD    REAL              / /           REFS     59    117    118    119    120    121    122
   560  DUM     REAL                            REFS    174    178
   526  DXB01   REAL                            REFS    124  DEFINED  117
   531  DXB02   REAL                            REFS    127  DEFINED  120
   527  DYB01   REAL                            REFS    125  DEFINED  118
   532  DYBC2   REAL                            REFS    128  DEFINED  121
   530  DZB01   REAL                            REFS    126  DEFINED  119
   533  DZB02   REAL                            REFS    129  DEFINED  122
  3031  GSPOTY  REAL              / /           REFS     39    173
  3043  GSPOTZ  REAL              / /           REFS     44    177
   556  I       INTEGER                         REFS    171    172    176  DEFINED  170
   557  IDO     INTEGER                         REFS    174    178  DEFINED  171
  7210  ITCT    INTEGER           / /           REFS     36    170
  7250  ITNDX   INTEGER   ARRAY   / /           REFS     35     49    172    176
  3343  P1      REAL              / /           REFS     56    118    119
  3345  P2      REAL              / /           REFS     58    121    122
  2574  QBURN   REAL              / /           REFS     11    215
  3344  Q1      REAL              / /           REFS     67    117    118
  2444  RAIL    REAL              / /           REFS     10    215
   562  RANGE   REAL              / /           REFS     99    200    202  DEFINED  192
   573  RANGO   REAL              / /           REFS    103    215  DEFINED  160
  3142  RDELX   REAL              / /           REFS     18    181    188  2*189    195    201
                                            DEFINED    152
  3143  RDELY   REAL              / /           REFS     19    182    198  2*189    195    201
                                            DEFINED    153
  3144  RDELZ   REAL              / /           REFS     20    183    190    192    196    202
                                            DEFINED    154
  3217  RSJYMC  REAL              / /           REFS     30    182  DEFINED  173
  3220  RSJZMC  REAL              / /           REFS     31    183  DEFINED  177
  3221  RSPOTX  REAL              / /           REFS     32    184    185    186  DEFINED  181
  3222  RSPOTY  REAL              / /           REFS     33    184    185    186  DEFINED  182
  3223  RSPOTZ  REAL              / /           REFS     34    184    185    186  DEFINED  183
  3162  RTXE    REAL              / /           REFS     21    152
  3166  RTYE    REAL              / /           REFS     22    153
  3172  RTZE    REAL              / /           REFS     23    154
  3030  RX      REAL              / /           REFS     38    175
   563  RXBA    REAL              / /           REFS    100  DEFINED  184
  3116  RXE     REAL              / /           REFS     15    152    157
   605  RXL     REAL              / /           REFS    104    160  DEFINED  157
  3203  RXO     REAL              / /           REFS     24    157
  3042  RY      REAL              / /           REFS     43    179
   564  RYBA    REAL              / /           REFS    101  DEFINED  185
  3122  RYE     REAL              / /           REFS     16    153    158
   606  RYL     REAL              / /           REFS    105    160  DEFINED  158
  3204  RYO     REAL              / /           REFS     25    158
   565  RZBA    REAL              / /           REFS    102  DEFINED  186
  3126  RZE     REAL              / /           REFS     17    154    159
   607  RZL     REAL              / /           REFS    106    160  DEFINED  159
  3205  RZO     REAL              / /           REFS     26    159
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VARIABLES    SN  TYPE           RELOCATION
  3346  R2       REAL              / /      REFS      59      120      122
  3035  SXP      REAL              / /      REFS      41      173      175
  3032  SXPD     REAL              / /      REFS      40      175
  3027  SXPDD    REAL              / /      REFS      37    DEFINED    175
  3047  SYP      REAL              / /      REFS      46      177      179
  3044  SYPD     REAL              / /      REFS      45      179
  3041  SYPDD    REAL              / /      REFS      42    DEFINED    179
  3717  T        REAL              / /      REFS      79      124      125      126      127      128      129
                                             157     158      159
   561  UVP1     REAL                       REFS     200      202    DEFINED    188
   562  UVP2     REAL                       REFS     191      192      202    DEFINED    189
   563  UVP3     REAL                       REFS     230    DEFINED    130
   564  UVP4     REAL                       REFS     196      201      202    DEFINED    191
   316  VAIRSP   REAL              / /      REFS       9
   570  VMWU     REAL                       REFS     216      217    DEFINED    210
   571  VMWV     REAL                       REFS     217    DEFINED    211
   572  VMWW     REAL                       REFS     216    DEFINED    212
   307  VMWXE    REAL              / /      REFS       6      210      211      212
   310  VMWYE    REAL              / /      REFS       7      210      211      212
   311  VMWZE    REAL              / /      REFS       8      210      211      212
   543  VTOTE    REAL              / /      REFS      88      199    DEFINED    151
  3102  VXE      REAL              / /      REFS      12     2*151     151      188      201     2*206     207
   553  VXL    * REAL                    DEFINED     161
  3205  VXO      REAL              / /      REFS      27      157      151
   565  VXP      REAL                       REFS     203      204    DEFINED    200
  3106  VYE      REAL              / /      REFS      13     2*151     152      188      201     2*206     207
   554  VYL    * REAL                    DEFINED     152
  3207  VYO      REAL              / /      REFS      28      158      152
   566  VYP      REAL                       REFS     204    DEFINED    201
  3112  VZE      REAL              / /      REFS      14     2*151     163      190      202      206
   555  VZL    * REAL                    DEFINED     153
  3210  VZO      REAL              / /      REFS      29      159      153
   567  VZP      REAL                       REFS     203    DEFINED    202
  3053  WO       REAL              / /      REFS      48     3*175    3*179
  3347  XB01     REAL              / /      REFS      50      118      139      140      141
                                         DEFINED     124
  3352  XB02     REAL              / /      REFS      53      122      142      143      144
                                         DEFINED     127
   545  XB1      REAL                       REFS     146    DEFINED    139
   550  XB2      REAL                       REFS     147    DEFINED    142
  3350  YB01     REAL              / /      REFS      51      117      119      139      140      141
                                         DEFINED     125
  3353  YB02     REAL              / /      REFS      54      122      142      143      144
                                         DEFINED     128
   546  YB1      REAL                       REFS     145      146    DEFINED    140
   551  YB2      REAL                       REFS     148    DEFINED    143
  3351  ZB01     REAL              / /      REFS      52      118      139      140      141
                                         DEFINED     126
  3354  ZB02     REAL              / /      REFS      55      120      121      142      143      144
                                         DEFINED     129
   547  ZB1      REAL                       REFS     145    DEFINED    141
   552  ZB2      REAL                       REFS     147      148    DEFINED    144
  3052  ZETA     REAL              / /      REFS      47      175      179

EXTERNALS        TYPE    ARGS       REFERENCES
      ATAND      REAL      2          113      111      112      145      146      147      148      195      198
                                      203      204      206      207      216      217      221
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SUBROUTINE GS        74/74   OPT=1                        FTN 4.2+75067      05/05/75  16.17.10.      PAGE   8

EXTERNALS     TYPE   ARGS        REFERENCES
   CUSD       REAL    1           146      148
   MCARLO             3           174      178
   SQRT       REAL    1 LIBRARY   111      151      160      191      192      206      222

STATEMENT LABELS              DEF LINE   REFERENCES
   243  20                      164       155
   435  30                      222       193      215      220
   275  500                     130       170      176
   261  501                     176       172

LOOPS  LABEL   INDEX      FROM-TO     LENGTH     PROPERTIES
  244   500     I         170 180      348                  EXT REFS

COMMON-BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
   / /          3830                 0 C      (3830)

EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
  C      C      3830          199 VMHXE   (1)        200 VMAYE   (1)        201 VMHZE   (1)
                              205 VAIRSP  (1)        349 BTHT    (1)        350 BPSI    (1)
                              351 BPHI    (1)        352 BPH1    (1)        353 BTH2    (1)
                              354 BPS1    (1)        355 VTOTE   (1)        356 BGAMH   (1)
                              357 BGAMV   (1)        362 BTHLV   (1)        363 BPSLV   (1)
                              364 BLAMV   (1)        365 BLAMH   (1)        366 BALPHA  (1)
                              367 BALPHY  (1)        368 BALPHP  (1)        369 BPHIP   (1)
                              370 RANGE   (1)        371 RX3A    (1)        372 RYBA    (1)
                              373 RZBA    (1)        373 RANGO   (1)        389 RXL     (1)
                              390 RYL     (1)        391 RZL     (1)        392 BPH2    (1)
                             1315 RAIL    (1)       1404 GBURN   (1)       1559 SXPOD   (1)
                             1560 RX      (1)       1551 GSPOTY  (1)       1562 SXPD    (1)
                             1565 SXP     (1)       1569 SYPOD   (1)       1570 RY      (1)
                             1571 GSPOTZ  (1)       1572 SYPD    (1)       1575 SYP     (1)
                             1578 ZETA    (1)       1579 HO      (1)       1602 VXE     (1)
                             1505 VYE     (1)       1610 VZE     (1)       1614 RXE     (1)
                             1618 RYE     (1)       1622 RZE     (1)       1634 RDELX   (1)
                             1635 RDELY   (1)       1636 RDELZ   (1)       1650 RTXE    (1)
                             1654 RTYE    (1)       1658 RTZE    (1)       1667 RXO     (1)
                             1668 RYO     (1)       1659 RZO     (1)       1670 VXO     (1)
                             1671 VYO     (1)       1672 VZO     (1)       1679 RSJYMC  (1)
                             1680 RSJZMD  (1)       1681 RSPOTX  (1)       1682 RSPOTY  (1)
                             1683 RSPOTZ  (1)       1702 CFA11   (1)       1706 CFA12   (1)
                             1710 CFA13   (1)       1714 CFA21   (1)       1718 CFA22   (1)
                             1722 CFA23   (1)       1725 CFA31   (1)       1730 CFA32   (1)
                             1734 CFA33   (1)       1750 CRAD    (1)       1754 A021    (1)
                             1755 A022    (1)       1756 A023    (1)       1757 A031    (1)
                             1758 A032    (1)       1759 A033    (1)       1760 A011    (1)
                             1761 A012    (1)       1762 A013    (1)       1763 P1      (1)
                             1764 Q1      (1)       1765 P2      (1)       1766 R2      (1)
                             1767 X301    (1)       1768 Y301    (1)       1769 Z801    (1)
                             1770 X302    (1)       1771 Y802    (1)       1772 Z802    (1)
                             1993 F       (1)       3720 ITCT    (1)       3752 ITNOX   (10)

STATISTICS
  PROGRAM LENGTH              5733      379
  CM BLANK COMMON LENGTH     73653     3830
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```
      SUBROUTINE A1
      COMMON C(3830)
C
C**TABLE LOOKUP FOR AERO COEF
      COMMON
     */NC1/NC1(2)      /NC2/NC2(4)      /NC3/NC3(4)      /NC5/NC5(4)
     */CA1/CA1(6)      /CA2/CA2(12)     /CA3/CA3(12)     /CA5/CA5(10)
     */CZPF/CZPF(35)   /CZ2F/CZ2F(35)   /CMPF/CMPF(35)   /CM2F/CM2F(35)
     */CY4F/CY4F(36)   /CN4F/CN4F(36)   /CL4F/CL4F(21)   /CL2F/CL2F(21)
     */CZDF/CZDF(35)                    /CMDF/CMDF(35)
     */CMQF/CMQF(36)   /CLPF/CLPF(36)   /CLDF/CLDF(21)
     */CXDF/CXDF(6)
      COMMON  /CMDF/CMDF(6)   /CA4/CA4(6)
C
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(0204),VMACH )
      EQUIVALENCE (C(0367),BALPHA)
      EQUIVALENCE (C(0368),BALPHY)
      EQUIVALENCE (C(0369),BALPHP)
      EQUIVALENCE (C(0370),BPHIP )
      EQUIVALENCE (C(1103),BDELT1)
      EQUIVALENCE (C(1107),BDELT2)
      EQUIVALENCE (C(1111),BDELT3)
      EQUIVALENCE (C(1113),BDELT4)
      EQUIVALENCE (C(1551),OPTM  )
      EQUIVALENCE (C(1555),UDL1  )
      EQUIVALENCE (C(1556),UDL2  )
      EQUIVALENCE (C(1557),UDL3  )
      EQUIVALENCE (C(1558),UDL4  )
C
C**INPUTS FROM MAIN PROGRAM
      EQUIVALENCE (C(2000),T     )
      EQUIVALENCE (C(2020),LCONV)
C
C**OUTPUT TO MODULES
      EQUIVALENCE (C(1200),OPTHNG)
      EQUIVALENCE (C(1203),CX    )
      EQUIVALENCE (C(1204),CY    )
      EQUIVALENCE (C(1205),CZ    )
      EQUIVALENCE (C(1206),CLP   )
      EQUIVALENCE (C(1207),CMQ   )
      EQUIVALENCE (C(1208),CNR   )
      EQUIVALENCE (C(1209),CL    )
      EQUIVALENCE (C(1210),CM    )
      EQUIVALENCE (C(1211),CN    )
C
C**OTHER OUTPUTS
      EQUIVALENCE (C(1212),CXO   )
      EQUIVALENCE (C(1213),CZO   )
      EQUIVALENCE (C(1214),DCZ2  )
      EQUIVALENCE (C(1215),CZOQ  )
      EQUIVALENCE (C(1216),CZOR  )
      EQUIVALENCE (C(1217),DCY4  )
      EQUIVALENCE (C(1218),CMO   )
      EQUIVALENCE (C(1219),DCM2  )
      EQUIVALENCE (C(1220),CMOQ  )
      EQUIVALENCE (C(1221),CMOR  )
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      EQUIVALENCE (C(1222),OCN4  )                          A1      59
      EQUIVALENCE (C(1223),OCL1  )                          A1      60
      EQUIVALENCE (C(1224),OCL4  )                          A1      61
      EQUIVALENCE (C(1225),CLOP  )                          A1      62
      EQUIVALENCE (C(1226),VM    )                          A1      63
      EQUIVALENCE (C(1227),BAP   )                          A1      64
      EQUIVALENCE (C(1228),BDL   )                          A1      65
      EQUIVALENCE (C(1229),BDM   )                          A1      66
      EQUIVALENCE (C(1230),BDN   )                          A1      67
      EQUIVALENCE (C(1231),BDP   )                          A1      68
      EQUIVALENCE (C(1232),BDQ   )                          A1      69
      EQUIVALENCE (C(1233),BDR   )                          A1      70
      EQUIVALENCE (C(1236),CH1   )                          A1      71
      EQUIVALENCE (C(1237),CH2   )                          A1      72
      EQUIVALENCE (C(1238),CH3   )                          A1      73
      EQUIVALENCE (C(1239),CH4   )                          A1      74
      EQUIVALENCE (C(1240),CH11  )                          A1      75
      EQUIVALENCE (C(1241),CH21  )                          A1      76
      EQUIVALENCE (C(1242),CH31  )                          A1      77
      EQUIVALENCE (C(1243),CH41  )                          A1      78
      DIMENSION NOCLD(2), DCLDVM(3), OCLDOF(3), OCLDAF(3)   A1      79
      EQUIVALENCE (C(1234), DCLDO)                          A1      80
      EQUIVALENCE (C(1235), DCLDA)                          A1      81
      DATA NOCLD /3,3 /                                     A1      82
      DATA DCLDVM / .500,.350, 1.250/                       A1      83
      DATA OCLDOF /.000,-.0013,.0010/                       A1      84
      DATA DCLDAF /.0015,.0023,.0010/                       A1      85
C                                                           A1      86
      DATA IA,IB,IC,ID,IE,IF /7,6,8,5,8,3/                  A1      87
C     MULTIPLE ANGLE FORMULAE AND ABSOLUTE VALUES OF ANGLE OF ATTACK A1 88
      USPHI = SIND(BPHIP)                                   A1      89
      UCPHI = COSD(BPHIP)                                   A1      90
      US2PHI = SIND(2.*BPHIP)                               A1      91
      US4PHI = SIND(4.*BPHIP)                               A1      92
      US2PH2 = US2PHI**2                                    A1      93
C                                                           A1      94
C**LIMIT TABLE ARGUMENTS                                    A1      95
      BDP = (-BDELT1-BDELT2+BDELT3+BDELT4)/4.               A1      96
      BDQ = ( BDELT1+BDELT2+BDELT3+BDELT4)/4.               A1      97
      BDR = (-BDELT1+BDELT2-BDELT3+BDELT4)/4.               A1      98
      IF (OPTM .LE. 0.) GO TO 15                            A1      99
      BDP = (-UDL1-UDL2+UDL3+UDL4)/4.                       A1     100
      BDQ = (+UDL1+UDL2+UDL3+UDL4)/4.                       A1     101
      BDR = (-UDL1+UDL2-UDL3+UDL4)/4.                       A1     102
   15 CONTINUE                                              A1     103
      BDL = AMAX1(10.,ABS(BDP))                             A1     104
      BDM = AMAX1(10.,ABS(BDQ))                             A1     105
      BDN = AMAX1(10.,ABS(BDR))                             A1     106
      BAP = BALPHP                                          A1     107
      UAL = ABS(BALPHA)                                     A1     108
      UBT = ABS(BALPHY)                                     A1     109
      VM = VMACH                                            A1     110
      IF (BAP.GT.20.)BAP=20.                                A1     111
      IF (UAL.GT.20.)UAL=20.                                A1     112
      IF (UBT.GT.20.)UBT=20.                                A1     113
      IF (VM.GT.1.25) VM = 1.25                             A1     114
      IF (VM.LT.0.5) VM = .5                                A1     115
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      C
      C**TABLE LOOKUP FOR AERO COEF
         IF (T.GT.0. .AND. T.LE.UT) GO TO 1000
         UT = T
         CALL TABLE(    VM,CA1,CXOF,NC1,XF,4HCXO ,CXO )
         CALL TABLE(    VM,CA4,CMOF,NC1,XF,4HCMO ,CMO )
         XF=0.
         CALL TABL2(BAP,VM,CA3,CZPF,NC3,XF,4HCZO ,CZO )
         CALL TABL2(BAP,VM,CA3,CMPF,NC3,XF,4HCMO ,CMO )
         CALL TABL2(BAP,VM,CA3,CM2F,NC3,XF,4HDCM2,DCM2)
         CALL TABL2(BAP,VM,CA3,CZOF,NC3,XF,4HCZOQ,CZOQ)
         CZOR = CZOQ
         CALL TABL2(BAP,VM,CA3,CMOF,NC3,XF,4HCMOQ,CMOQ)
         CMOR = CMOQ
         CALL TABL2(BAP,VM,CA3,CZ2F,NC3,XF,4HDCZ2,DCZ2)
         XF=0.
         CALL TABL2(BAP,VM,CA2,CY4F,NC2,XF,4HDCY4,DCY4)
         CALL TABL2(BAP,VM,CA2,CN4F,NC2,XF,4HDCN4,DCN4)
         CALL TABL2(BAP,VM,CA2,CLPF,NC2,XF,4HCLP ,CLP )
         XF=0.
         CALL TABL2(UAL,VM,CA2,CMQF,NC2,XF,4HCMQ ,CMQ )
         XF=0.
         CALL TABL2(UBT,VM,CA2,CMQF,NC2,XF,4HCNR ,CNR )
         XF=0.
         CALL TABL2(BAP,VM,CA5,CLOF,NC5,XF,4HCLOP,CLOP)
         CALL TABL2(BAP,VM,CA5,CL4F,NC5,XF,4HDCL4,DCL4)
         CALL TABL2(BAP,VM,CA5,CL2F,NC5,XF,4HDCL2,DCL2)
         CALL TABLE(    VM,DCLDVM,DCLDOF,NDCLD,XF,4H    ,DCLDO)
         CALL TABLE(    VM,DCLDVM,DCLDAF,NDCLD,XF,4H    ,DCLDA)
         CMO = CMO - CMO
 1000 CONTINUE
      C
      C**AERO COEF WIND AXIS
         CZP = CZO + DCZ2*US2PH2 + CZOQ*UCPHI*BDQ - CZDR*USPHI*BDR
         CMP = CMO + DCM2*US2PH2 + CMOQ*UCPHI*BDQ - CMDR*USPHI*BDR
         CNP =       DCN4*US4PHI + CMOQ*USPHI*BDQ + CMDR*UCPHI*BDR
         CYP =       DCY4*US4PHI + CZOQ*USPHI*BDQ + CZDR*UCPHI*BDR
      C
      C** TRANSFORMATION FROM WIND TO BODY AXIS
         CX = CXO
         CL = DCL2*US2PHI+ DCL4*US4PHI + CLOP*BDP
         CY =  CYP*UCPHI - CZP*USPHI
         CZ = -CYP*USPHI - CZP*UCPHI
         CN =  CNP*UCPHI - CMP*USPHI
         CM =  CNP*USPHI + CMP*UCPHI + CMO
         DUM = SIN(.31416*BALPHP)
         DCLDR = DCLDO - DCLDA*DUM*COSD(BPHIP)
         DCLDQ =       -DCLDA*DUM*SIND(BPHIP)
         CL = CL + DCLDR*BDR + DCLDQ*BDQ
         RETURN
         END
```

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        SUBROUTINE A1         74/74  OPT=1                      FTN 4.2+75067      05/05/75  16.17.17.     PAGE    4

        SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS      DEF LINE    REFERENCES
      1  A1             1         164

  VARIABLES       SN   TYPE              RELOCATION
     556  BALPHA       REAL                  / /          REFS      17      107
     560  BALPHP       REAL                  / /          REFS      19      106     160
     557  BALPHY       REAL                  / /          REFS      18      108
    2312  BAP          REAL                  / /          REFS      53      110     122     123     124     125     127
                                                           129     131      132     133     139     140     141
                                                       DEFINED     106      110
    2116  BDELT1       REAL                  / /          REFS      21       95
    2122  BDELT2       REAL                  / /          REFS      22       95      96      97
    2126  BDELT3       REAL                  / /          REFS      23       95      96      97
    2132  BDELT4       REAL                  / /          REFS      24       95      96      97
    2313  BDL          REAL                  / /          REFS      64   DEFINED     103
    2314  BDM          REAL                  / /          REFS      65   DEFINED     104
    2315  BDN          REAL                  / /          REFS      66   DEFINED     105
    2316  BDP          REAL                  / /          REFS      67      103     155  DEFINED      95      99
    2317  BDQ          REAL                  / /          REFS      68      104     148     149     150     151     163
                                                       DEFINED      96      100
    2320  BDR          REAL                  / /          REFS      59      105     148     149     150     151     163
                                                       DEFINED      97      101
     561  BPHIP        REAL                  / /          REFS      20       88      89      90      91     151     162
       0  C            REAL    ARRAY         / /          REFS       2       16      17      18      19      20      21
                                                            22      23       24      25      26      27      28      29
                                                            32      33       36      37      38      39      40      41
                                                            42      43       44      45      48      49      50      51
                                                            52      53       54      55      56      57      58      59
                                                            60      61       62      63      64      65      66      67
                                                            68      69       70      71      72      73      74      75
                                                            75      77       79      80
       0  CA1          REAL    ARRAY      CA1             REFS       5      119
       0  CA2          REAL    ARRAY      CA2             REFS       5      131     132     133     135     137
       0  CA3          REAL    ARRAY      CA3             REFS       5      122     123     124     125     127     129
       0  CA4          REAL    ARRAY      CA4             REFS      13      120
       0  CA5          REAL    ARRAY      CA5             REFS       5      139     140     141
    2323  CH1          REAL                  / /          REFS      70
    2327  CH11         REAL                  / /          REFS      74
    2324  CH2          REAL                  / /          REFS      71
    2330  CH21         REAL                  / /          REFS      75
    2325  CH3          REAL                  / /          REFS      72
    2331  CH31         REAL                  / /          REFS      76
    2326  CH4          REAL                  / /          REFS      73
    2332  CH41         REAL                  / /          REFS      77
    2270  CL           REAL                  / /          REFS      43      163  DEFINED     155     153
       0  CLDF         REAL    ARRAY      CLDF            REFS       5      139
    2310  CLDP         REAL                  / /          REFS      51      139     155
    2265  CLP          REAL                  / /          REFS      40      133
       0  CLPF         REAL    ARRAY      CLPF            REFS       5      133
       0  CL2F         REAL    ARRAY      CL2F            REFS       5      141
       0  CL4F         REAL    ARRAY      CL4F            REFS       5      140
    2271  CM           REAL                  / /          REFS      44  DEFINED     159
       0  CMDF         REAL    ARRAY      CMDF            REFS       5      127
    2303  CMDQ         REAL                  / /          REFS      56      127     128     149     150
    2304  CMDR         REAL                  / /          REFS      57      149     150  DEFINED     128
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SUBROUTINE A1        74/74  OPT=1                    FTN 4.2+75067    05/05/75 16.17.17.    PAGE   5

VARIABLES   SN  TYPE            RELOCATION
  2301  CMO     REAL                / /        REFS      54     123      144      149   DEFINED   144
     0  CMOF    REAL       ARRAY    CMOF       REFS      13     120
   560  CMP     REAL                           REFS     158     159   DEFINED     149
     0  CMPF    REAL       ARRAY    CMPF       REFS       5     123
  2266  CMQ     REAL                / /        REFS      41     135
     0  CMQF    REAL       ARRAY    CMQF       REFS       5     135      137
   555  CMO     REAL                           REFS     120     144      159
     0  CM2F    REAL       ARRAY    CM2F       REFS       5     124
  2272  CN      REAL                / /        REFS      45   DEFINED    158
   561  CNP     REAL                           REFS     158     159   DEFINED     150
  2267  CNR     REAL                / /        REFS      42     137
     3  CN4F    REAL       ARRAY    CN4F       REFS       5     132
  2262  CX      REAL                / /        REFS      37   DEFINED    154
  2273  CXO     REAL                / /        REFS      48     119      154
     0  CXOF    REAL       ARRAY    CXOF       REFS       5     119
  2263  CY      REAL                / /        REFS      38   DEFINED    156
   562  CYP     REAL                           REFS     156     157   DEFINED     151
     0  CY4F    REAL       ARRAY    CY4F       REFS       5     131
  2264  CZ      REAL                / /        REFS      39   DEFINED    157
     0  CZOF    REAL       ARRAY    CZOF       REFS       5     125
  2276  CZDQ    REAL                / /        REFS      51     125      126      148      151
  2277  CZOR    REAL                / /        REFS      52     148      151   DEFINED     126
  2274  CZO     REAL                / /        REFS      49     122      145
   557  CZP     REAL                           REFS     156     157   DEFINED     148
     0  CZPF    REAL       ARRAY    CZPF       REFS       5     122
     0  CZ2F    REAL       ARRAY    CZ2F       REFS       5     129
  2322  DCLOA   REAL                / /        REFS      80     143      151      162
   576  DCLOAF  REAL       ARRAY               REFS      78     143   DEFINED      84
  2321  DCLOO   REAL                / /        REFS      79     142      161
   573  DCLOOF  REAL       ARRAY               REFS      78     142   DEFINED      83
   565  DCLOQ   REAL                           REFS     163   DEFINED    162
   564  DCLDR   REAL                           REFS     153   DEFINED    151
   570  DCLOVM  REAL       ARRAY               REFS      78     142      143   DEFINED     82
  2306  DCL1    REAL                / /        REFS      59
   556  DCL2    REAL                           REFS     141     155
  2307  DCL4    REAL                / /        REFS      50     140      155
  2302  DCM2    REAL                / /        REFS      55     124      149
  2305  DCN4    REAL                / /        REFS      58     132      150
  2300  DCY4    REAL                / /        REFS      53     131      151
  2275  DCZ2    REAL                / /        REFS      50     129      148
   563  DUM     REAL                           REFS     161     162   DEFINED     160
   526  IA    * INTEGER                     DEFINED      86
   527  IB    * INTEGER                     DEFINED      86
   530  IC    * INTEGER                     DEFINED      86
   531  ID    * INTEGER                     DEFINED      86
   532  IE    * INTEGER                     DEFINED      86
   533  IF    * INTEGER                     DEFINED      86
  3743  LCONV   INTEGER             / /        REFS      33
     0  NC1     INTEGER    ARRAY    NC1        REFS       5     119      120
     0  NC2     INTEGER    ARRAY    NC2        REFS       5     131      132      133      135      137
     0  NC3     INTEGER    ARRAY    NC3        REFS       5     122      123      124      125      127      129
     0  NC5     INTEGER    ARRAY    NC5        REFS       5     139      140      141
   566  NOCLD   INTEGER    ARRAY               REFS      78     142      143   DEFINED      81
  2257  OPTHNG  REAL                / /        REFS      36
  3616  OPTM    REAL                / /        REFS      25      98
  3717  T       REAL                / /        REFS      32     117      118
   551  UAL     REAL                           REFS     111     135   DEFINED  [illegible]
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          SUBROUTINE A1            74/74   OPT=1                              FTN 4.2+75067      05/05/75  16.17.17.        PAGE    6

VARIABLES        SN   TYPE              RELOCATION
     552  UBT         REAL                               REFS      112       137   DEFINED      108      112
     545  UCPHI       REAL                               REFS      148       149      150       151      156      157      158
                                                                DEFINED       89
    3022  UDL1        REAL               / /             REFS                 99      100       101
    3023  UDL2        REAL               / /             REFS                 99      100       101
    3024  UDL3        REAL               / /             REFS       28        99      100       101
    3025  UDL4        REAL               / /             REFS       29        99      100       101
     544  USPHI       REAL                               REFS      148       149      150       151      156      157      158
                                                          159  DEFINED        88
     546  US2PHI      REAL                               REFS       92       155   DEFINED       90
     550  US2PH2      REAL                               REFS      148       149   DEFINED       92
     547  US4PHI      REAL                               REFS      150       151      155   DEFINED       91
     553  UT          REAL                               REFS      117   DEFINED      118
    2311  VM          REAL               / /             REFS       52       113      114       119      120      122      123
                                                          124      125       127      129       131      132      133      135
                                                          137      139       140      141       142      143
                                                      DEFINED      109       113      114
     313  VMACH       REAL               / /             REFS       16       109
     554  XF          REAL                               REFS      119       120      122       123      124      125      127
                                                          129      131       132      133       135      137      139      140
                                                          141      142       143   DEFINED      121      130      134      136
                                                          136

EXTERNALS          TYPE    ARGS        REFERENCES
         COSD      REAL     1              89         161
         SIN       REAL     1 LIBRARY     161
         SIND      REAL     1              83          90        91       162
         TABLE              7             113         120       142       143
         TABL2              8             122         123       124       125       127      129      131      132      133
                                          135         137       139       140       141

INLINE FUNCTIONS   TYPE    ARGS        DEF LINE  REFERENCES
         ABS       REAL     1  INTRIN             103       104       105       107      108
         AMAX1     REAL     2  INTRIN             103       104       105

STATEMENT LABELS                       DEF LINE   REFERENCES
    45  15                               102         99
   165  1000                             145        117

COMMON BLOCKS   LENGTH       MEMBERS - BIAS NAME(LENGTH)
         / /      3830                 0 C      (3830)
         NC1         2                 0 NC1    (2)
         NC2         4                 0 NC2    (4)
         NC3         4                 0 NC3    (4)
         NC5         4                 0 NC5    (4)
         CA1         6                 0 CA1    (6)
         CA2        12                 0 CA2    (12)
         CA3        12                 0 CA3    (12)
         CA5        10                 0 CA5    (10)
         CZPF       35                 0 CZPF   (35)
         CZ2F       35                 0 CZ2F   (35)
         CMPF       35                 0 CMPF   (35)
         CM2F       35                 0 CM2F   (35)
         CY4F       36                 0 CY4F   (36)
         CN4F       36                 0 CN4F   (36)
         CL4F       21                 0 CL4F   (21)
         CL2F       21                 0 CL2F   (21)
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   SUBROUTINE A1          74/74    OPT=1                        FTN 4.2+75067     05/05/75  16.17.17.     PAGE    7

 COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
       CZDF         35                0 CZDF    (35)
       CMDF         35                0 CMDF    (35)
       CMQF         36                0 CMQF    (36)
       CLPF         36                0 CLPF    (36)
       CLUF         21                0 CLDF    (21)
       CXOF          6                0 CXOF    (6)
       CNOF          6                0 CNOF    (6)
       CA4           6                0 CA4     (6)

 EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
 C     C           3830             203 VMACH   (1)        365 BALPHA  (1)        367 BALPHY  (1)
                                    368 BALPHP  (1)        369 BPHIP   (1)       1102 BDELT1  (1)
                                   1105 BDELT2  (1)       1110 BDELT3  (1)       1114 BDELT4  (1)
                                   1199 UPTHNG  (1)       1202 CX      (1)       1203 CY      (1)
                                   1204 CZ      (1)       1205 CLP     (1)       1206 CMQ     (1)
                                   1207 CNR     (1)       1208 CL      (1)       1209 CM      (1)
                                   1210 CN      (1)       1211 CXO     (1)       1212 CZO     (1)
                                   1213 UCZ2    (1)       1214 CZDQ    (1)       1215 CZDR    (1)
                                   1216 UCY4    (1)       1217 CMO     (1)       1218 DCM2    (1)
                                   1219 UMOQ    (1)       1220 CMDR    (1)       1221 DCN4    (1)
                                   1222 UCL1    (1)       1223 DCL4    (1)       1224 CLOP    (1)
                                   1225 VM      (1)       1226 BAP     (1)       1227 BDL     (1)
                                   1228 BDM     (1)       1229 BDN     (1)       1230 BDP     (1)
                                   1231 BDQ     (1)       1232 BDR     (1)       1233 DCLDO   (1)
                                   1234 UCLDA   (1)       1235 CH1     (1)       1236 CH2     (1)
                                   1237 CH3     (1)       1238 CH4     (1)       1239 CH11    (1)
                                   1240 CH21    (1)       1241 CH31    (1)       1242 CH41    (1)
                                   1553 UPTM    (1)       1554 UDL1    (1)       1555 UDL2    (1)
                                   1556 UDL3    (1)       1557 UDL4    (1)       1939 T       (1)
                                   2319 LCONV   (1)

 STATISTICS
   PROGRAM LENGTH              6453      421
   CM LABELED COMMON LENGTH    7313      489
   CM BLANK COMMON LENGTH     73668     3830
```

```
      SUBROUTINE A3I
C***INITIALIZATION FOR ENGINE MODULE
      COMMON C(3830)
      DIMENSION IPL(100), ISNOX(43)
      EQUIVALENCE (C(3634), ISNDX), (C(3512), I3512)
      EQUIVALENCE (C( 357),BALPHA)
      EQUIVALENCE (C( 358),BALPHY)
      EQUIVALENCE (C( 370),BPHIP )
      EQUIVALENCE (C(1303),RDELCG)
      EQUIVALENCE (C(1320),FMXTH )
      EQUIVALENCE (C(1321),FMYTH )
      EQUIVALENCE (C(1322),FMZTH )
      EQUIVALENCE (C(1405),QBURN )
      EQUIVALENCE (C(1411),FTHX  )
      EQUIVALENCE (C(1412),FTHY  )
      EQUIVALENCE (C(1413),FTHZ  )
      EQUIVALENCE (C(1415),DWT   )
      EQUIVALENCE (C(1418),RDCGF )
      EQUIVALENCE (C(1419),FMIXF )
      EQUIVALENCE (C(1420),FMIYF )
      EQUIVALENCE (C(1528),DMASS )
      EQUIVALENCE (C(1739),WP    )
      EQUIVALENCE (C(1743),WQ    )
      EQUIVALENCE (C(1747),WR    )
      EQUIVALENCE (C(1748),FMIX  )
      EQUIVALENCE (C(1749),FMIY  )
      EQUIVALENCE (C(1750),FMIZ  )
      EQUIVALENCE (C(2000),     T)
      EQUIVALENCE (C(2551),N     )
      EQUIVALENCE (C(2552),IPL   )
      EQUIVALENCE (C(1751),     CRAD)
      EQUIVALENCE (C( 525),     VI3)
      EQUIVALENCE (C(1737),     FMX), (C(1741),     FMY), (C(1745), FMZ)
      DATA IFLG1,IFLG2/0,0/
      IPL(N  ) = 1496
      N = N+1
      C(1499) = 0.
C
      IF (QBURN .GT. 0.) GO TO 10
      CRAD=57.295778
      FMX=0.        $ FMY=0.         $ FMZ=0.
      WP = 0.
      WQ = 0.
      WR = 0.
      BALPHA = 0.
      BALPHY = 0.
      BPHIP = 0.
C
C MONTECARLO THRUST DIRECTION ERRORS
C
      DO 5 I = 1, I3512
      IDD = I
      IF(ISNDX(I).EQ.1313) CALL MCARLO (DUM, 1, IDD)
      IF(ISNDX(I).EQ.1314) CALL MCARLO (DUM, 1, IDD)
      IF(ISNDX(I).EQ.1315) CALL MCARLO (DUM, 1, IDD)
      IF(ISNDX(I).EQ.1401) CALL MCARLO (DUM, 1, IDD)
      IF(ISNDX(I).EQ.1402) CALL MCARLO (DUM, 1, IDD)
```

```
C**MONTE CARLO TIPOFF ROLL,PITCH AND YAW RATES
      IF(ISNDX(I).EQ.1738)CALL MCARLO(DUM,1,IDO)
      IF(ISNDX(I).EQ.1745)IFLG2=0
      IF(ISNDX(I).EQ.1742)IFLG1=0
    5 CONTINUE
C
      IF(VIB.LE.0.)GO TO 6
      CALL LTRAN(T,DELT,D(1746),DUM,WR0,IFLG2,1)
      CALL LTRAN(T,DELT,D(1742),DUM,WQ0,IFLG1,2)
      WQ=WQ0/FMIYF         *CRAD
      WR=WR0/FMIYF         *CRAD
    6 CONTINUE
      IFLG1=1       $ IFLG2=1
C
      RETURN
   10 CONTINUE
      FIHRST=0.
      FTHX=0.
      FTHY=0.
      FTHZ=0.
      FMXTH=0.
      FMYTH=0.
      FMZTH=0.
      DMASS = DWT/32.174
      RDELCG = RDCGF
      FMIX = FMIXF
      FMIY = FMIYF
      FMIZ = FMIYF
      RETURN
      END
```

```
        SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS     DEF LINE     REFERENCES
     1  A3I            1          72       85

 VARIABLES        SN    TYPE            RELOCATION
   556  BALPHA          REAL                  / /          REFS       6    DEFINED      45
   557  BALPHY          REAL                  / /          REFS       7    DEFINED      46
   561  BPHIP           REAL                  / /          REFS       8    DEFINED      47
     0  C               REAL       ARRAY      / /          REFS       3        2*5       6       7       8       9      10
                                                                     11       12        13      14      15      16      17      18
                                                                     19       20        21      22      23      24      25      26
                                                                     27       28        29      30      31      32      3*33    65
                                                                     65    DEFINED      37
  3326  CRAD            REAL                  / /          REFS      31       57        58   DEFINED      48
   146  DELT            REAL                               REFS      55       56
  3133  DMASS           REAL                  / /          REFS      21    DEFINED      81
   145  DUM             REAL                               REFS      53       54        55      56      57      59      65
                                                                     65
  2606  DMT             REAL                  / /          REFS      17       81
  3323  FMIX            REAL                  / /          REFS      25    DEFINED      83
  2612  FMIXF           REAL                  / /          REFS      19       83
  3324  FMIY            REAL                  / /          REFS      26    DEFINED      84
  2613  FMIYF           REAL                  / /          REFS      20       57        58      84      85
  3325  FMIZ            REAL                  / /          REFS      27    DEFINED      85
  3310  FMX             REAL                  / /          REFS      33    DEFINED      41
  2447  FMXTH           REAL                  / /          REFS      10    DEFINED      78
  3314  FMY             REAL                  / /          REFS      33    DEFINED      41
  2450  FMYTH           REAL                  / /          REFS      11    DEFINED      79
  3320  FMZ             REAL                  / /          REFS      33    DEFINED      41
  2451  FMZTH           REAL                  / /          REFS      12    DEFINED      80
   151  FTHRST    *     REAL                           DEFINED       74
  2602  FTHX            REAL                  / /          REFS      14    DEFINED      75
  2603  FTHY            REAL                  / /          REFS      15    DEFINED      76
  2604  FTHZ            REAL                  / /          REFS      16    DEFINED      77
   143  I               INTEGER                            REFS      52       53        54      55      56      57      59
                                                                     60       51   DEFINED      51
   144  IDO             INTEGER                            REFS      53       54        55      56      57      59
                                                         DEFINED     52
   135  IFLG1           INTEGER                            REFS      56    DEFINED      34      61      70
   136  IFLG2           INTEGER                            REFS      65    DEFINED      34      66      70
  5601  IPL             INTEGER    ARRAY      / /          REFS       4       30   DEFINED      35
  7061  ISNOX           INTEGER    ARRAY      / /          REFS       4        5        53      54      55      56      57
                                                                     59       50        61
  6667  I3512           INTEGER               / /          REFS       5       51
  5663  N               INTEGER               / /          REFS      29       35        36   DEFINED      36
  2574  QBURN           REAL                  / /          REFS      13       39
  2611  RDCGF           REAL                  / /          REFS      18       82
  2433  RDELCG          REAL                  / /          REFS       9    DEFINED      82
  3717  T               REAL                  / /          REFS      28       65        66
  1161  VIB             REAL                  / /          REFS      32       56
  3312  WP              REAL                  / /          REFS      22    DEFINED      42
  3316  WQ              REAL                  / /          REFS      23    DEFINED      43      67
   150  WQ0             REAL                               REFS      56       57
  3322  WR              REAL                  / /          REFS      24    DEFINED      44      68
   147  WR0             REAL                               REFS      55       58
```

```
EXTERNALS        TYPE   ARGS     REFERENCES
   LTRAN                 7          55       66
   MCARLO                3          53       54       55       56       57       59

STATEMENT LABELS           DEF LINE   REFERENCES
    0  5                      62         51
   74  6                      69         64
   76  10                     73         33

LOOPS  LABEL    INDEX      FROM-TO    LENGTH    PROPERTIES
   16  5          I        51 62       448               EXT REFS

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
   //           3830              0 C      (3830)

EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
 C       C      3830         366 BALPHA  (1)      357 BALPHY  (1)      369 BPHIP   (1)
                             625 VIB     (1)     1307 RDELCG  (1)     1319 FMXTH   (1)
                            1320 FMYTH   (1)     1321 FMZTH   (1)     1404 QBURN   (1)
                            1410 FTHX    (1)     1411 FTHY    (1)     1412 FTHZ    (1)
                            1414 DNT     (1)     1417 RDCGF   (1)     1418 FMIXF   (1)
                            1413 FMIYF   (1)     1627 DMASS   (1)     1736 FMX     (1)
                            1738 WP      (1)     1740 FMY     (1)     1742 WQ      (1)
                            1744 FMZ     (1)     1745 WR      (1)     1747 FMIX    (1)
                            1748 FMIY    (1)     1749 FMIZ    (1)     1750 CRAD    (1)
                            1393 I       (1)     2560 N       (1)     2561 IPL     (180)
                            3511 13512   (1)     3533 ISNDX   (40)

STATISTICS
  PROGRAM LENGTH                1523     106
  CM BLANK COMMON LENGTH       73668    3830
```

```
      SUBROUTINE A3
C**ENGINE MODULE
      COMMON C(3830)
C
C
C** INPUT DATA
      EQUIVALENCE (C(1313),RFXCG )
      EQUIVALENCE (C(1314),RFYCG )
      EQUIVALENCE (C(1315),RFZCG )
      EQUIVALENCE (C(1401),BALPHT)
      EQUIVALENCE (C(1402),BPHIT )
      EQUIVALENCE (C(1403),QNALGN)
      EQUIVALENCE (C(1404),PCFTH )
      EQUIVALENCE (C(1405),QBURN )
      EQUIVALENCE (C(1414),CISP  )
      EQUIVALENCE (C(1415),DWT   )
      EQUIVALENCE (C(1416),DWP   )
      EQUIVALENCE (C(1417),RDCGO )
      EQUIVALENCE (C(1418),RDCGF )
      EQUIVALENCE (C(1419),FMIXF )
      EQUIVALENCE (C(1420),FMIYF )
      EQUIVALENCE (C(1421),RLCGO )
C
C** INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(2000),T     )
C
C** OUTPUTS
      EQUIVALENCE (C(1308),RDELCG)
      EQUIVALENCE (C(1320),FMXTH )
      EQUIVALENCE (C(1321),FMYTH )
      EQUIVALENCE (C(1322),FMZTH )
      EQUIVALENCE (C(1409),UDWP  )
      EQUIVALENCE (C(1410),FTHRST)
      EQUIVALENCE (C(1411),FTHX  )
      EQUIVALENCE (C(1412),FTHY  )
      EQUIVALENCE (C(1413),FTHZ  )
      EQUIVALENCE (C(1422),RLCG  )
      EQUIVALENCE (C(1628),DMASS )
      EQUIVALENCE (C(1748),FMIX  )
      EQUIVALENCE (C(1749),FMIY  )
      EQUIVALENCE (C(1750),FMIZ  )
C
C**STATE VARIABLES AND THEIR DERIVATIVES
      EQUIVALENCE (C(1496),UIMPD )
      EQUIVALENCE (C(1499),UIMP  )
C**LOOK UP TABLE FOR THRUST
      DIMENSION NTH(2), THA(10), THF(10)
      DATA NTH/10,0/
      DATA THA/   0., .125, .250, .750,1.500,1.625,1.750, 2.00, 3.,100./
      DATA THF/2300.,1750.,1650.,1600.,1400.,1250., 600., 300., 0., 0./
C
      IF (QBURN.GT.0.) RETURN
      CALL TABLE(T,THA,THF,NTH,XF,6HFTHRST,FTHRST)
C
      IF (QNALGN) 20,20,10
   10 USINA=SIND(BALPHT)
      FTHX=FTHRST*COSD(BALPHT)
```

SUBROUTINE A3   74/74   OPT=1   FTN 4.2+75057   05/05/75 16.17.23.   PAGE   2

```
      FTHY=-FTHRST*USINA*SIND(BPHIT)                                    A3     146
      FTHZ=FTHRST*USINA*COSD(BPHIT)                                     A3     147
      FMXTH = -FTHY*RFZCG + FTHZ*RFYCG                                  A3     148
      FMYTH = -FTHX*RFZCG + FTHZ*RFXCG                                  A3     149
      FMZTH = -FTHX*RFYCG - FTHY*RFXCG                                  A3     150
      GO TO 30                                                          A3     151
   20 FTHX=FTHRST                                                       A3     152
      FTHY=0.                                                           A3     153
      FTHZ=0.                                                           A3     154
      FMXTH=0.                                                          A3     155
      FMYTH=0.                                                          A3     156
      FMZTH=0.                                                          A3     157
   30 CONTINUE                                                          A3     158
C                                                                       A3     159
      UIMPD = FTHRST                                                    A3     160
      UDWP = UIMP/CISP                                                  A3     161
C                                                                       A3     162
      DMASS = (DWT+DWP-UDWP)/32.174                                     A3     163
      RDELCG = RDCGO - (RDCGO - RDCGF)*UDWP/DWP                         A3     164
C                                                                       A3     165
      FMIX=FMIXF*(DWT+DWP-UDWP)/DWT                                     A3     166
      FMIY=FMIYF*(DWT+DWP-UDWP)/DWT                                     A3     167
      FMIZ = FMIY                                                       A3     168
      RLCG = RLCGO + RDELCG                                             A3     169
      IF (FTHRST .GT. 0.) RETURN                                        A3     170
C                                                                       A3     171
      WRITE (6,100) T                                                   A3     172
  100 FORMAT (//14H BURNOUT TIME=,F8.4,5H SEC.)                         A3     173
      QBURN=1.0                                                         A3     174
      RETURN                                                            A3     175
      END                                                               A3     176
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        SUBROUTINE A3          74/74    OPT=1                     FTN 4.2+75067      05/05/75  16.17.23.      PAGE      3

        SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS     DEF LINE      REFERENCES
     1   A3             1          52       82       87

 VARIABLES       SN   TYPE              RELOCATION
   2570  BALPHT        REAL                   / /       REFS      10       56       57
   2571  BPHIT         REAL                   / /       REFS      11       58       59
      0  C             REAL          ARRAY    / /       REFS       3        7        8        9       10       11       12
                                                                  13       14       15       16       17       18       19       20
                                                                  21       22       25       28       29       30       31       32
                                                                  33       34       35       36       37       38       39       40
                                                                  41       44       45
   2605  CISP          REAL                   / /       REFS      15       73
   3133  DMASS         REAL                   / /       REFS      38  DEFINED       75
   2607  DWP           REAL                   / /       REFS      17       75       76       78       79
   2606  DWT           REAL                   / /       REFS      16       75     2*78     2*79
   3323  FMIX          REAL                   / /       REFS      39  DEFINED       78
   2612  FMIXF         REAL                   / /       REFS      20       78
   3324  FMIY          REAL                   / /       REFS      40       80  DEFINED       79
   2613  FMIYF         REAL                   / /       REFS      21       79
   3325  FMIZ          REAL                   / /       REFS      41  DEFINED       80
   2447  FMXTH         REAL                   / /       REFS      29  DEFINED       50       67
   2450  FMYTH         REAL                   / /       REFS      30  DEFINED       61       68
   2451  FMZTH         REAL                   / /       REFS      31  DEFINED       62       69
   2601  FTHRST        REAL                   / /       REFS      33       53       57       58       59       54       72
                                                          82
   2602  FTHX          REAL                   / /       REFS      34       61       62  DEFINED       57       54
   2603  FTHY          REAL                   / /       REFS      35       60       62  DEFINED       58       65
   2604  FTHZ          REAL                   / /       REFS      36       60       61  DEFINED       59       66
    114  NTH           INTEGER       ARRAY              REFS      47       53  DEFINED       48
   2573  PCFTH         REAL                   / /       REFS      13
   2574  QBURN         REAL                   / /       REFS      14       52  DEFINED       86
   2572  QNALGN        REAL                   / /       REFS      12       55
   2611  ROCGF         REAL                   / /       REFS      19       76
   2610  ROCGO         REAL                   / /       REFS      18     2*76
   2433  RDELCG        REAL                   / /       REFS      28       81  DEFINED       76
   2440  RFXCG         REAL                   / /       REFS       7       61       62
   2441  RFYCG         REAL                   / /       REFS       8       60       62
   2442  RFZCG         REAL                   / /       REFS       9       50       61
   2615  RLCG          REAL                   / /       REFS      37  DEFINED       81
   2614  RLCGO         REAL                   / /       REFS      22       81
   3717  T             REAL                   / /       REFS      25       53       84
    116  THA           REAL          ARRAY              REFS      47       53  DEFINED       49
    130  THF           REAL          ARRAY              REFS      47       53  DEFINED       50
   2600  UDWP          REAL                   / /       REFS      32       75       76       78       79
                                                     DEFINED      73
   2732  UIMP          REAL                   / /       REFS      45       73
   2727  UIMPD         REAL                   / /       REFS      44  DEFINED       72
    113  USINA         REAL                             REFS      58       59  DEFINED       56
    112  XF          * REAL                             REFS      53

 FILE NAMES        MODE
      TAPE6        FMT                  WRITES       84
```

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      SUBROUTINE A3         74/74  OPT=1                       FTN 4.2+75067      05/05/75  16.17.23.       PAGE    4

 EXTERNALS          TYPE   ARGS       REFERENCES
       COSD         REAL     1             57         59
       SIND         REAL     1             55         58
       TABLE                 7             53

 STATEMENT LABELS              DEF LINE    REFERENCES
     0  10          INACTIVE      56          53
    33  20                        64          2*55
    37  30                        70          63
   103  100      FMT              85          84

 COMMON BLOCKS     LENGTH      MEMBERS - BIAS NAME(LENGTH)
       //          3830                  0 C        (3830)

 EQUIV CLASSES     LENGTH      MEMBERS - BIAS NAME(LENGTH)
 C       C         3830            1307 RDELCG  (1)          1312 RFXCG   (1)          1313 RFYCG   (1)
                                   1314 RFZCG   (1)          1319 FMXTH   (1)          1320 FMYTH   (1)
                                   1321 FMZTH   (1)          1400 BALPHT  (1)          1401 BPHIT   (1)
                                   1402 QNALGV  (1)          1403 PCFTH   (1)          1404 QBURN   (1)
                                   1408 UDHP    (1)          1409 FTHRST  (1)          1410 FTHX    (1)
                                   1411 FTHY    (1)          1412 FTHZ    (1)          1413 CISP    (1)
                                   1414 UWT     (1)          1415 DWP     (1)          1416 RDCGD   (1)
                                   1417 RDCGF   (1)          1418 FMIXF   (1)          1419 FMIYF   (1)
                                   1420 RLCGD   (1)          1421 RLCG    (1)          1495 UIMPD   (1)
                                   1498 UIMP    (1)          1627 DMASS   (1)          1747 FMIX    (1)
                                   1748 FMIY    (1)          1749 FMIZ    (1)          1999 T       (1)

 STATISTICS
   PROGRAM LENGTH                  1443    100
   CM BLANK COMMON LENGTH         73663   3830
```

```
      SUBROUTINE A2                                                       A2        2
C**AERO-FORCE AND MOMENT MODULE   BODY AXES                               A2        3
      COMMON C(3830)                                                      A2        4
  101 FORMAT(1H0,4X,21HFRONT LUG CLEARS RAIL,5X,3HT =,1PE10.2,5X,         A2        5
     *        9HREL VEL =,1PE10.2,5X,14HPITCH MOMENT =,1PE10.2)           A2        6
C                                                                         A2        7
C**INPUT DATA                                                             A2        8
      EQUIVALENCE (C(1306),RFAREA)                                        A2        9
      EQUIVALENCE (C(1307),RFLGTH)                                        A2       10
      EQUIVALENCE (C(1316),RLUG  )                                        A2       11
      EQUIVALENCE (C(1317),RAIL  )                                        A2       12
      EQUIVALENCE (C(1742),   AMP2),  (C(1746),   AMP1)                   A2       13
      EQUIVALENCE (C(1332),CPHAS )                                        A2       14
      EQUIVALENCE (C(1405),QBURN )                                        A2       15
      EQUIVALENCE (C(1627),AGRAV )                                        A2       16
C                                                                         A2       17
C**INPUTS FROM OTHER MODULES                                              A2       18
      DIMENSION ISNDX(40)                                                 A2       19
      EQUIVALENCE (C(3534),   ISNDX(),   (C(3512),   I3512)               A2       20
      EQUIVALENCE (C(0203),PDYNMC)                                        A2       21
      EQUIVALENCE (C( 204),VMACH )                                        A2       22
      EQUIVALENCE (C(0207),VAIRSP)                                        A2       23
      EQUIVALENCE (C( 350),BTHT  )                                        A2       24
      EQUIVALENCE (C( 380),RANGO )                                        A2       25
      EQUIVALENCE (C(1203),CX    )                                        A2       26
      EQUIVALENCE (C(1204),CY    )                                        A2       27
      EQUIVALENCE (C(1205),CZ    )                                        A2       28
      EQUIVALENCE (C(1206),CLP   )                                        A2       29
      EQUIVALENCE (C(1207),CMQ   )                                        A2       30
      EQUIVALENCE (C(1208),CNR   )                                        A2       31
      EQUIVALENCE (C(1209),CL    )                                        A2       32
      EQUIVALENCE (C(1210),CM    )                                        A2       33
      EQUIVALENCE (C(1211),CN    )                                        A2       34
      EQUIVALENCE (C(1236),CH1   )                                        A2       35
      EQUIVALENCE (C(1237),CH2   )                                        A2       36
      EQUIVALENCE (C(1238),CH3   )                                        A2       37
      EQUIVALENCE (C(1239),CH4   )                                        A2       38
      EQUIVALENCE (C(1320),FMXTH )                                        A2       39
      EQUIVALENCE (C(1321),FMYTH )                                        A2       40
      EQUIVALENCE (C(1322),FMZTH )                                        A2       41
      EQUIVALENCE (C(1411),FTHX  )                                        A2       42
      EQUIVALENCE (C(1412),FTHY  )                                        A2       43
      EQUIVALENCE (C(1413),FTHZ  )                                        A2       44
      EQUIVALENCE (C(1422),RLCG  )                                        A2       45
      EQUIVALENCE (C(1723),CFA23 )                                        A2       46
      EQUIVALENCE (C(1735),CFA33 )                                        A2       47
      EQUIVALENCE (C(1739),WP    )                                        A2       48
      EQUIVALENCE (C(1743),WQ    )                                        A2       49
      EQUIVALENCE (C(1737),     FMX),  (C(1741),    FMY), (C(1745), FMZ)  A2       50
      EQUIVALENCE (C(1747),WR    )                                        A2       51
      EQUIVALENCE (C(1749),    FMI()                                      A2       52
      EQUIVALENCE (C(1738),    WPT))                                      A2       53
      EQUIVALENCE (C(1751),    CRA))                                      A2       54
      EQUIVALENCE (C( 525),     VI))                                      A2       55
      EQUIVALENCE (C(2000),T     )                                        A2       56
      EQUIVALENCE  (C(1972),RKUTTA)                                       A2       57
      EQUIVALENCE (C(1375),NPT)                                           A2       58
```

```
      C
      C**OUTPUTS
            EQUIVALENCE (C(13001),FXBA  )
            EQUIVALENCE (C(13011),FYBA  )
            EQUIVALENCE (C(13021),FZBA  )
            EQUIVALENCE (C(13031),FMXBA )
            EQUIVALENCE (C(13041),FMYBA )
            EQUIVALENCE (C(13051),FMZBA )
            EQUIVALENCE (C(13081),ROELCG)
            EQUIVALENCE (C(16281),DMASS )
            EQUIVALENCE (C(17481),FMIX  )
            EQUIVALENCE (C(17491),FMIY  )
            EQUIVALENCE (C(17501),FMIZ  )
      C
      C**OTHER OUTPUTS
            EQUIVALENCE (C(13091),FMH1  )
            EQUIVALENCE (C(13101),FMH2  )
            EQUIVALENCE (C(13111),FMH3  )
            EQUIVALENCE (C(13121),FMH4  )
            EQUIVALENCE (C(13231),FMXLUG)
            EQUIVALENCE (C(13241),FMYLUG)
            EQUIVALENCE (C(13251),FMZLUG)
            EQUIVALENCE (C(35041),OPTN4)
      C
      C**FORCE VECTOR COMPONENTS
            UQS = PDYNMC*RFAREA
            UQSL = UQS*RFLGTH
      C
            FXBA=UQS*(-CX)+FTHX
            FYBA=UQS*CY+FTHY
            FZBA=UQS*CZ+FTHZ
      C
      C** AERO MOMENTS   (NOTE FACTOR OF 2.0 IN DAMPING COEFFICIENT)
            UL2V = 0
            IF (VAIRSP .GT. 0.) UL2V = RFLGTH/(2.*VAIRSP)
            FMXBA = (CL + CLP*UL2V*WP)  * UQSL               + FMXTH
            FMYBA = (CM + CMQ*UL2V*WQ)  * UQSL + FZBA*ROELCG + FMYTH
            FMZBA = (CN + CNR*UL2V*WR)  * UQSL - FYBA*ROELCG + FMZTH
      C
      C** CALCULATE HINGE MOMENTS
            FMH1 = CH1*UQSL
            FMH2 = CH2*UQSL
            FMH3 = CH3*UQSL
            FMH4 = CH4*UQSL
      C
      C**MOMENTS AND FORCES DUE TO LUGS
            IF ( (OPTN4 .GT. 0.).AND.(RANGO .LE. RAIL+RLUG) ) GO TO 70
            UFZL2=FZLUG
            FYLUG = 0.
            FZLUG = 0.
            FMXLUG = 0.
            FMYLUG = 0.
            FMZLUG = 0.
            IF (FLG2 .GT.0.) GO TO 74
            FMX=0.       $      FMY=0.      $      FMZ=0.
            DO 6 I=1,I3512
            IDO=I
```

```
      SUBROUTINE A2          74/74    OPT=1                          FTN 4.2+75067      05/05/75  16.17.26.        PAGE    3

      IF(ISNDX(I).EQ.1743)CALL MCARLO(DUM,1,IDO)
      IF(ISNDX(I).EQ.1747)CALL MCARLO(DUM,1,IDO)
    6 CONTINUE
      C(13) = 1.
      WRITE(6,104)WP,WQ,WR
  104 FORMAT(1H ,30X,*TIPOFF RATES--ROLL = *F6.1,* PITCH = *F6.1,
     . * YAW = *F6.1)
      FLG2 = 1.
      WRITE(6,102) T,VAIRS?,UFZL2
      WRITE(6,103) RANGO
  103 FORMAT(32X,9HRANGO  = ,F6.4)
  102 FORMAT (1H0,36H          REAR LUG CLEARS RAIL    T = ,F8.4,
     *  10HREL VEL = ,F8.3,16H   RAIL FORCE = ,F8.2)
      GO TO 74
   70 IF (RANGO .LE. RAIL) GO TO 72
      RZDD=0.
      FYLUG = -(FYBA + DMASS*AGRA/*CFA23 +  FMZBA*
     *        RLCG*DMASS/FMIZ)/(1. + DMASS*RLCG*RLCG/FMIZ)
      FZLUG = -(FZBA + DMASS*AGRA/*(CFA33-RZDD) +  FMYBA*
     *        RLCG*DMASS/FMIY)/(1. + DMASS*RLCG*RLCG/FMIY)
      FMXLUG = - FMXBA
      FMYLUG = -FZLUG*RLCG
      FMZLUG = FYLUG*RLCG
      IF (FLG1 .GT. 0.) GO TO 74
      FLG1 = 1.
      WRITE(6,101) T, VAIRSP, FMYLUG
      WRITE(6,103) RANGO
C
C
C
C
C
C                    WPTO--MONTE CARLO VALUE OF TIPOFF ROLL RATE
C                    DTLUG---TIME INCREMENT BETWEEN FIRST LUG AND
C                            LAST LUG DROP OFF TIME(TIPOFF ROLL RATE
C                            OCCURS AT LAST LUG)
C                    FMX---ROLL MOMENT THAT GENERATES  TIPOFF ROLL RATE
      DTLUG=.026
      FMX=WPTO*FMIX/CRAD/DTLUG
    5 CONTINUE
C
C
C
C
      GO TO 74
   72 CONTINUE
      RZDD=0.
      FYLUG = -(FYBA + DMASS*AGRA/*CFA23)
      FZLUG = -(FZBA + DMASS*AGRA/*(CFA33-RZDD))
      FMXLUG = - FMXBA
      FMYLUG = - FMYBA
      FMZLUG = - FMZBA
      FLG1 = 0.
      FLG2=0.
   74 CONTINUE
C**TOTAL FORCE AND MOMENTS
      FYBA = FYBA + FYLUG
```

```
SUBROUTINE A2           74/74    OPT=1                    FTN 4.2+75067      05/05/75  16.17.26.      PAGE    4
              FZBA = FZBA + FZLUG
              FMXBA = FMXBA + FMXLUG                                    A2       173
              FMYBA = FMYBA + FMYLUG                                    A2       174
              FMZBA = FMZBA + FMZLUG                                    A2       175
        C                                                               A2       176
        C**LAUNCH TRANSIENTS MOMENTS (1-YAW,2-PITCH,3-ROLL MOMENTS)      A2       177
        C                                                               A2       178
              IF(FLG2.GT.0.)GO TO 75                                    A2       179
              IF(VIB.LE.0.)GO TO 75                                     A2       180
              CALL LTRAN(T,DELT,AMP2,FMY,WR0,1,2)                       A2       181
              CALL LTRAN(T,DELT,AMP1,FMZ,WR0,1,1)                       A2       182
        75    CONTINUE                                                  A2       183
              FMXBA=FMXBA+FMX                                           A2       184
              FMYBA=FMYBA+FMY                                           A2       185
              FMZBA=FMZBA+FMZ                                           A2       186
        C                                                               A2       187
              RETURN                                                    A2       188
              END                                                       A2       189
                                                                        A2       190
```

```
      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE    REFERENCES
    1  A2              1         188

 VARIABLES     SN   TYPE          RELOCATION
  3132  AGRAV       REAL              / /    REFS    15    131    133    162    163
  3321  AMP1        REAL              / /    REFS    12    182
  3315  AMP2        REAL              / /    REFS    12    181
   535  BTHT        REAL              / /    REFS    23
     0  C           REAL   ARRAY      / /    REFS     3      8      9     10     11    2*12    13
                                                14    15   2*19     20     21     22     23     24
                                                25    26     27     28     29     30     31     32
                                                33    34     35     36     37     38     39     40
                                                41    42     43     44     45     46     47     48
                                              3*49    50     51     52     53     54     55     56
                                                57    50     51     52     63     64     65     66
                                                67    68     69     70     73     74     75     78
                                                77    78     79     80  DEFINED   118
   327  23          REAL              / /    REFS    45    131    152
  3306  33          REAL              / /    REFS    46    133    163
  2323  CH1         REAL              / /    REFS    34     98
  2324  CH2         REAL              / /    REFS    35     99
  2325  CH3         REAL              / /    REFS    36    100
  2326  CH4         REAL              / /    REFS    37    101
  2270  CL          REAL              / /    REFS    31     93
  2265  CLP         REAL              / /    REFS    28     93
  2271  CM          REAL              / /    REFS    32     94
  2266  CMQ         REAL              / /    REFS    29     94
  2272  CN          REAL              / /    REFS    33     95
  2267  CNR         REAL              / /    REFS    30     95
  2463  CPHAS       REAL              / /    REFS    13
  3326  CRAD        REAL              / /    REFS    53    153
  2262  CX          REAL              / /    REFS    25     86
  2263  CY          REAL              / /    REFS    26     87
  2264  CZ          REAL              / /    REFS    27     88
   363  DELT        REAL                     REFS   131    182
  3133  DMASS       REAL              / /    REFS    57   3*131  3*133    162    163
   362  DTLUG       REAL                     REFS   153  DEFINED   152
   357  DUM         REAL                     REFS   115    116
   361  FLG1        REAL                     REFS   138  DEFINED   139    167
   354  FLG2        REAL                     REFS   111    179  DEFINED   122    158
  2434  FMH1        REAL              / /    REFS    73  DEFINED    98
  2435  FMH2        REAL              / /    REFS    74  DEFINED    99
  2436  FMH3        REAL              / /    REFS    75  DEFINED   100
  2437  FMH4        REAL              / /    REFS    76  DEFINED   101
  3323  FMIX        REAL              / /    REFS    51     58    153
  3324  FMIY        REAL              / /    REFS    59   2*133
  3325  FMIZ        REAL              / /    REFS    70   2*131
  3310  FMX         REAL              / /    REFS    49    184  DEFINED   112    153
  2426  FMXBA       REAL              / /    REFS    53    135    154    173    154
                                          DEFINED    93    173    184
  2452  FMXLUG      REAL              / /    REFS    77    173  DEFINED   108    135    164
  2447  FMXTH       REAL              / /    REFS    38     93
  3314  FMY         REAL              / /    REFS    49    181    185  DEFINED   112
  2427  FMYBA       REAL              / /    REFS    64    133    165    174    185
                                          DEFINED    94    174    185
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          SUBROUTINE A2          74/74   OPT=1                     FTN 4.2+75057      05/05/75  16.17.26.      PAGE     6

 VARIABLES     SN  TYPE              RELOCATION
   2453  FMYLUG    REAL                    / /      REFS        78      140      174   DEFINED      109      136      165
   2450  FMYTH     REAL                    / /      REFS        39       94
   3320  FMZ       REAL                    / /      REFS        49      182      156   DEFINED      112
   2430  FMZBA     REAL                    / /      REFS        65      131      166      175      186
                                                 DEFINED        95      175      186
   2454  FMZLUG    REAL                    / /      REFS        79      175   DEFINED      110      137      156
   2451  FMZTH     REAL                    / /      REFS        40       95
   2602  FTHX      REAL                    / /      REFS        41       86
   2603  FTHY      REAL                    / /      REFS        42       87
   2604  FTHZ      REAL                    / /      REFS        43       88
   2423  FXBA      REAL                    / /      REFS        60   DEFINED       86
   2424  FYBA      REAL                    / /      REFS        51       95      131      162      171
                                                 DEFINED        87      171
    353  FYLUG     REAL                             REFS       137      171   DEFINED      106      131      162
   2425  FZBA      REAL                    / /      REFS        52       94      133      163      172
                                                 DEFINED        88      172
    352  FZLUG     REAL                             REFS       105      136      172   DEFINED      107      133      163
    355  I         INTEGER                          REFS       114      115      116   DEFINED      113
    356  IDO       INTEGER                          REFS       115      116   DEFINED      114
   7661  ISNDX     INTEGER   ARRAY         / /      REFS        18       19      115      116
   6667  I3512     INTEGER                 / /      REFS        19      113
   3666  NPT       INTEGER                 / /      REFS        57
   6657  OPTN4     REAL                    / /      REFS        50      104
    312  POYNMC    REAL                    / /      REFS        20       83
   2574  QBURN     REAL                    / /      REFS        14
   2444  RAIL      REAL                    / /      REFS        11      104      129
    573  RANGO     REAL                    / /      REFS        24      104      124      129      141
   2433  RUELCG    REAL                    / /      REFS        66       94       95
   2431  RFAREA    REAL                    / /      REFS         8       83
   2432  RFLGTH    REAL                    / /      REFS         9       94       32
   3663  RKUTTA    REAL                    / /      REFS        56
   2615  RLCG      REAL                    / /      REFS        44    3*131    3*133      136      137
   2443  RLUG      REAL                    / /      REFS        10      104
    360  RZDO      REAL                             REFS       133      153   DEFINED      130      151
   3717  T         REAL                    / /      REFS        55      123      140      181      182
    351  UFZL2     REAL                             REFS       123   DEFINED      105
    350  UL2V      REAL                             REFS        93       94       95   DEFINED       91       92
    346  UQS       REAL                             REFS        84       86       87       88   DEFINED       93
    347  UQSL      REAL                             REFS        93       94       95       98       99      108      181
                                                 DEFINED        84
    316  VAIRSP    REAL                    / /      REFS        22     2*92      123      140
   1161  VIB       REAL                    / /      REFS        54      150
    313  VMACH     REAL                    / /      REFS        21
   3312  WP        REAL                    / /      REFS        47       93      119
   3311  WPTO      REAL                    / /      REFS        52      153
   3316  WQ        REAL                    / /      REFS        48       94      119
    364  WQ0     * REAL                             REFS       151
   3322  WR        REAL                    / /      REFS        50       95      119
    365  WR0     * REAL                             REFS       152

 FILE NAMES        MODE
         TAPE6     FMT                     WRITES      119      123      124      140      141

 EXTERNALS         TYPE    ARGS      REFERENCES
         LTRAN               7          181      182
         MCARLO              3          115      116
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SUBROUTINE A2        74/74   OPT=1                     FTN 4.2+75067     05/05/75  16.17.26.     PAGE   7

STATEMENT LABELS                 DEF LINE   REFERENCES
    0  5            INACTIVE       154
    0  6                           117       113
  113  70                          129       104
  156  72                          160       123
  174  74                          159       111       128       138       159
  214  75                          183       173       180
  246  101    FMT                    4       143
  315  102    FMT                  125       123
  312  103    FMT                  125       124       141
  267  104    FMT                  120       113

LOOPS   LABEL   INDEX    FROM-TO   LENGTH   PROPERTIES
   66   6       * I      113 117    14B                   EXT REFS

COMMON BLOCKS   LENGTH   MEMBERS - BIAS NAME(LENGTH)
   //           3830             0 C       (3830)

EQUIV CLASSES   LENGTH   MEMBERS - BIAS NAME(LENGTH)
C       C        3830       202 POYNMO  (1)        203 VMACH   (1)       206 VAIRSP  (1)
                            349 STRT    (1)        379 RANGO   (1)       625 VIB     (1)
                           1202 CX      (1)       1203 CY      (1)      1204 CZ      (1)
                           1205 CLP     (1)       1206 CMQ     (1)      1207 CNR     (1)
                           1208 CL      (1)       1209 CM      (1)      1210 CN      (1)
                           1235 CH1     (1)       1236 CH2     (1)      1237 CH3     (1)
                           1238 CH4     (1)       1299 FX3A    (1)      1300 FYBA    (1)
                           1301 FZ3A    (1)       1302 FMXBA   (1)      1303 FMYBA   (1)
                           1304 FMZBA   (1)       1305 RFAREA  (1)      1306 RFLGTH  (1)
                           1307 XDELCG  (1)       1308 FMX1    (1)      1309 FMX2    (1)
                           1310 FMX3    (1)       1311 FMX4    (1)      1315 RLUG    (1)
                           1316 RAIL    (1)       1319 FMXTH   (1)      1320 FMYTH   (1)
                           1321 FMZTH   (1)       1322 FMXLUG  (1)      1323 FMYLUG  (1)
                           1324 FMZLUG  (1)       1331 CPHAS   (1)      1404 QBURN   (1)
                           1410 FTHX    (1)       1411 FTHY    (1)      1412 FTHZ    (1)
                           1421 RLCG    (1)       1625 AGRAV   (1)      1627 DMASS   (1)
                           1722 CFA23   (1)       1734 CFA33   (1)      1736 FMX     (1)
                           1737 NPTO    (1)       1738 HP      (1)      1740 FMY     (1)
                           1741 AMP2    (1)       1742 HQ      (1)      1744 FMZ     (1)
                           1745 AMP1    (1)       1746 HR      (1)      1747 FMIX    (1)
                           1748 FMIY    (1)       1749 FMIZ    (1)      1750 CRAG    (1)
                           1971 RKUTTA  (1)       1974 NPT     (1)      1999 T       (1)
                           3503 OPTN4   (1)       3511 I3512   (1)      3633 ISNDX   (40)

STATISTICS
  PROGRAM LENGTH                  3663   246
  CM BLANK COMMON LENGTH         73663  3830
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```
      SUBROUTINE LTRAN(T,DELT,AMP,Y,YC,IFLG,K)
      DIMENSION A(5,3),PHI(5,3),W(5,3)
      DATA IMAX,AE/4,-1./
      DATA (A(I,1),I=1,5)/1.,4.,12.,26.,0./
      DATA (A(I,2),I=1,5)/1.,4.,12.,26.,0./
      DATA (A(I,3),I=1,5)/1.,4.,12.,26.,0./
      IF(IFLG.GT.0)GO TO 17
      ZC=0.
      W1=5.28*11.
      DO 1 I=1,IMAX
      CALL RANNUM(0.,RNSTRT,RN)
      PHI(I,K)=3.14*RN
      W(I,K)=I*W1
C ZC IS INTEGRATION CONSTANT FOR Z
      B=W(I,K)*T+PHI(I,K)
      ZC=ZC+ A(I,K)*(AE*SIN(B)-W(I,K)*COS(B))/(AE**2+W(I,K)**2)
    1 CONTINUE
      YC=AMP*EXP(AE*T)*ZC
   17 CONTINUE
      Z=0.
      DO 2 I=1,IMAX
      Z=Z+A(I,K)*SIN(W(I,K)*T+PHI(I,K))
    2 CONTINUE
      Y=AMP*EXP(AE*T)*Z
      RETURN
      END
```

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SUBROUTINE LTRAN        74/74    OPT=1                    FTN 4.2+75057      05/05/75  16.17.30.       PAGE     2

        SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
      3  LTRAN        1           25

VARIABLES     SN    TYPE              RELOCATION
   116  A          REAL       ARRAY                   REFS       2      16      22   DEFINED     4      5      6
   101  AE         REAL                               REFS    2*16      18      24   DEFINED     3
     0  AMP        REAL                  F.P.         REFS      18      24  DEFINED        1
   114  B          REAL                               REFS    2*16 DEFINED      15
     0  DELT       REAL       *UNUSED    F.P.      DEFINED       1
   111  I          INTEGER                            REFS      12    2*13    2*15    3*16   3*22
                                                   DEFINED      10      21
     0  IFLG       INTEGER               F.P.         REFS       7 DEFINED       1
   100  IMAX       INTEGER                            REFS      10      21 DEFINED       3
     0  K          INTEGER               F.P.         REFS      12      13    2*15    3*16   3*22
                                                   DEFINED       1
   135  PHI        REAL       ARRAY                   REFS       2      15      22   DEFINED    12
   113  RN         REAL                               REFS      11      12
   112  RNSTRT  *  REAL                               REFS      11
     0  T          REAL                  F.P.         REFS      15      18      22      24   DEFINED     1
   154  W          REAL       ARRAY                   REFS       2      15    2*16      22   DEFINED    13
   110  W1         REAL                               REFS      13 DEFINED       9
     0  Y          REAL                  F.P.      DEFINED       1      24
     0  YC         REAL                  F.P.      DEFINED       1      18
   115  Z          REAL                               REFS      22      24 DEFINED      20     22
   107  ZC         REAL                               REFS      16      18 DEFINED       8     16

EXTERNALS          TYPE    ARGS         REFERENCES
        COS        REAL    1 LIBRARY      15
        EXP        REAL    1 LIBRARY      15        24
        RANNUM             3              11
        SIN        REAL    1 LIBRARY      16        22

STATEMENT LABELS                 DEF LINE    REFERENCES
     0  1                           17          13
     0  2                           23          21
    47  17                          19           7

LOOPS   LABEL     INDEX      FROM-TO     LENGTH    PROPERTIES
   12   1          * I        16 17        30B                EXT REFS
   51   2          * I        21 23        15B                EXT REFS

STATISTICS
  PROGRAM LENGTH                 173B        123
```

```
      SUBROUTINE D1I                                                    D1     2
C**   TRANSLATIONAL DYNAMICS INITIALIZATION MODULE FOR D1               D1     3
      COMMON C(3830)                                                    D1     4
      EQUIVALENCE (C(2551),N     )                                      D1     5
      EQUIVALENCE (C(2562),IPL   )                                      D1     6
      DIMENSION IPL(100), ISNDX(4)), ITNDX(10)                          D1     7
      EQUIVALENCE (C(3634), ISNDX), (C(3512), I3512)                    D1     8
C                                                                       D1     9
C**   INPUT DATA                                                        D1    10
      EQUIVALENCE (C( 100),VHXE  )                                      D1    11
      EQUIVALENCE (C( 101),VHYE  )                                      D1    12
      EQUIVALENCE (C( 102),VHZE  )                                      D1    13
      EQUIVALENCE (C( 204),VMACH )                                      D1    14
      EQUIVALENCE (C( 357),BALPHA)                                      D1    15
      EQUIVALENCE (C( 368),BALPHY)                                      D1    16
      EQUIVALENCE (C( 427),BTHTG )                                      D1    17
      EQUIVALENCE (C( 431),BPSIG )                                      D1    18
      EQUIVALENCE (C(1533),OPTARG)                                      D1    19
      EQUIVALENCE (C(1665),BLOSV )                                      D1    20
      EQUIVALENCE (C(1657),RSLANT)                                      D1    21
      EQUIVALENCE (C(1574),VMHTE )                                      D1    22
      EQUIVALENCE (C(1751),CRAD  )                                      D1    23
      EQUIVALENCE (C(3502),OPTN2 )                                      D1    24
      EQUIVALENCE (C(3504),OPTN4 )                                      D1    25
      EQUIVALENCE (C(3535),OPTN6 )                                      D1    26
C                                                                       D1    27
C**   OUTPUT TO MODULES                                                 D1    28
      EQUIVALENCE (C(1615),RXE   )                                      D1    29
      EQUIVALENCE (C(1619),RYE   )                                      D1    30
      EQUIVALENCE (C(1623),RZE   )                                      D1    31
      EQUIVALENCE (C(1603),VXE   )                                      D1    32
      EQUIVALENCE (C(1607),VYE   )                                      D1    33
      EQUIVALENCE (C(1511),VZE   )                                      D1    34
      EQUIVALENCE (C(1651),RTXE  )                                      D1    35
      EQUIVALENCE (C(1655),RTYE  )                                      D1    36
      EQUIVALENCE (C(1559),RTZE  )                                      D1    37
      EQUIVALENCE (C(1558),RXO   )                                      D1    38
      EQUIVALENCE (C(1553),RYO   )                                      D1    39
      EQUIVALENCE (C(1570),RZO   )                                      D1    40
      EQUIVALENCE (C(1571),VXO   )                                      D1    41
      EQUIVALENCE (C(1572),VYO   )                                      D1    42
      EQUIVALENCE (C(1573),VZO   )                                      D1    43
      EQUIVALENCE (C(1752),BPHIO )                                      D1    44
      EQUIVALENCE (C(1753),BTHTO )                                      D1    45
      EQUIVALENCE (C(1754),BPSIO )                                      D1    46
      EQUIVALENCE (C(1555),RHZRO )                                      D1    47
      EQUIVALENCE (C(1635), ROELX)                                      D1    48
      EQUIVALENCE (C(1536), ROELY)                                      D1    49
      EQUIVALENCE (C(1537), ROELZ)                                      D1    50
      EQUIVALENCE (C(1580),RSJYMC)                                      D1    51
      EQUIVALENCE (C(1581),RSJZMC)                                      D1    52
      EQUIVALENCE (C(3753),ITNDX), (C(3721),ITGT)                       D1    53
      EQUIVALENCE (C(1761),  A011)                                      D1    54
      EQUIVALENCE (C(1762),  A012)                                      D1    55
      EQUIVALENCE (C(1763),  A013)                                      D1    56
      EQUIVALENCE (C(1755),  A021)                                      D1    57
      EQUIVALENCE (C(1756),  A022)                                      D1    58
```

```
      EQUIVALENCE (C(1757),  A023)
      EQUIVALENCE (C(1758),  A031)
      EQUIVALENCE (C(1759),  A032)
      EQUIVALENCE (C(1750),  A033)
      EQUIVALENCE (C(1764),    P1)
      EQUIVALENCE (C(1765),    Q1)
      EQUIVALENCE (C(1766),    P2)
      EQUIVALENCE (C(1767),    R2)
      EQUIVALENCE (C(1768),  X801)
      EQUIVALENCE (C(1769),  Y801)
      EQUIVALENCE (C(1770),  Z801)
      EQUIVALENCE (C(1771),  X802)
      EQUIVALENCE (C(1772),  Y802)
      EQUIVALENCE (C(1773),  Z802)
      EQUIVALENCE (C( 350),BPH1ER)
      EQUIVALENCE (C( 351),BTH2ER)
      EQUIVALENCE (C( 362),BPS1ER)
      EQUIVALENCE (C(1562),GSPOTY)
      EQUIVALENCE (C(1572),GSPOTZ)
      EQUIVALENCE (C(1581),SIGSPOT)
      EQUIVALENCE (C(1579),   ZETA)
      EQUIVALENCE (C(1580),     W))
C
C
C* ZERO OUT SPOT JITTER MAX/MIN STORAGE LOCATIONS THAT ARE SAVED IN OUTP
      C(1567) = 0.
      C(1568) = 0.
      C(1577) = 0.
      C(1578) = 0.
C  PRINTED FROM MODULE-C4
      W0 = 3.94
      ZETA = .745
C
C SPOT JITTER MONTE CARLO INITIAL VALUES
C
      RSJYMC = 0.
      RSJZMC = 0.
      DO 500 IOL=1,ITCT
      ITSNDX = IOL
      IF(ITNDX(IOL).NE.1560) GO TO 502
      IPL(N)=1560
      IPL(N+1)=1563
      N=N+2
      IF(SIGSPOT.NE.0.)
     1 GSPOTY = .707*SIGSPOT/SQRT(W0/4./ZETA * C(2664))
      CALL MCARLO(RNSTRT,4,ITSNDX)
  502 IF(ITNDX(IOL).NE.1581) GO TO 500
      IPL(N)=1570
      IPL(N+1)=1573
      N=N+2
      IF(SIGSPOT.NE.0.)
     1 GSPOTZ = .707*SIGSPOT/SQRT(W0/4./ZETA * C(2664))
      CALL MCARLO(RNSTRT,4,ITSNDX)
  500 CONTINUE
C
      IPL(N) = 1630
      IPL(N+1) = 1634
```

```
      IPL(N+2) = 1608
      IPL(N+3) = 1612
      IPL(N+4) = 1616
      IPL(N+5) = 1620
      IPL(N+6) = 1640
      IPL(N+7) = 1644
      IPL(N+8) = 1648
      IPL(N+9) = 1652
      IPL(N+10) = 1656
      N = N+11
      C( 363) = 0.
      C( 364) = 0.
      CRAD = 57.295778
C
      IF (OPTN2.LE.0.) RETURN
      IF (OPTARG.LE. 0.) N = N-5
C
C**CALCULATE MISSILE PARAMETER INITIAL CONDITIONS
      RYE=0.
      RTZE = 0.
      RTYE = 0.
      RTXE = 0.
      BPHIO = 0.
      XB01 = 0.
      YB01 = 1.
      ZB01 = 0.
      XB02 = 0.
      YB02 = 0.
      ZB02 = 1.
C
C***  MONTE CARLO AUTOPILOT GYRO DRIFT RATES
      P1 = 0.
      Q1 = 0.
      P2 = 0.
      R2 = 0.
      DO 503 I = 1,I3512
      IDO = I
      IF(ISNDX(I).EQ.1764) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.1765) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.1766) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.1767) CALL MCARLO (DUM, 1, IDO)
  503 CONTINUE
C
C
C*** AUTOPILOT GYRO BIAS ERRORS
C
      BPHIER = 0.
      BTHZER = 0.
      BPSIER = 0.
      DO 11 I = 1, I3512
      IDO = I
      IF(ISNDX(I).EQ.550) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.561) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.552) CALL MCARLO (DUM, 1, IDO)
   11 CONTINUE
C
C** INITIALIZE MATRIX COEF FOR AUTOPILOT GYRO MODELS
```

```
      C
            USPHI1 = SIND(BPHIO + BPHIER)
            UCPHI1 = COSD(BPHIO + BPHIER)
            USTHT2 = SIND(BTHTO + BTH2ER)
            UCTHT2 = COSD(BTHTO + BTH2ER)
            USPSI1 = SIND(BPSIO + BPSIER)
            UCPSI1 = COSD(BPSIO + BPSIER)
            A011 = UCPSI1*UCTHT2
            A012 = USPSI1*UCTHT2
            A013 = -USTHT2
            A021 = -USPSI1*UCPHI1 + UCPSI1*USTHT2*USPHI1
            A022 = UCPSI1*UCPHI1 + USPSI1*USTHT2*USPHI1
            A023 = UCTHT2*USPHI1
            A031 = UCPSI1*USTHT2*UCPHI1 + USPSI1*USPHI1
            A032 = USPSI1*USTHT2*UCPHI1 - UCPSI1*USPHI1
            A033 = UCTHT2*UCPHI1
      C
      C
      C MISSILE INITIAL ATTITUDE ERRORS
      C
            DO 5 I = 1, I3512
            IDO = -1
            IF(ISNDX(I).EQ.1752) CALL MCARLO (DUM, 1, IDO)
            IF(ISNDX(I).EQ.1753) CALL MCARLO (DUM, 1, IDO)
            IF(ISNDX(I).EQ.1754) CALL MCARLO (DUM, 1, IDO)
          5 CONTINUE
      C
            IF (OPTN2.GT.1.0) GO TO 10
            RXE=-RSLANT*COSD(BLOSV)
            RZE=RSLANT*SIND(BLOSV)
            GO TO 20
         10 RSLANT = SQRT(RZE**2 + RXE**2)
         20 RH = RHZRO - RZE
      C
            IF (OPTN4 .GT. 0.) GO TO 30
            BPSIO = CRAD*ASIN(SIND(BPSIO)*RSLANT/RXE)
            CPSIO  = COSD(BPSIO)
            TTHTG = SIND(BTHTG)/COSD(BTHTG)
            BTHTO = ATAND((-RZE/RXE - TTHTG*CPSIO),(CPSIO - TTHTG*RZE/RXE))
            GO TO 40
         30 CONTINUE
            IF (OPTN4 .GT. 1.) GO TO 40
            UST = SIND(BTHTO)
            USP = SIND(BPSIO)
            UCP = COSD(BPSIO)
            UCT = COSD(BTHTO)
            UCPH = COSD(BPHIO)
            USPH = SIND(BPHIO)
            RXBA = -RXE*UCP*UCT + RZE*UST
            RYBA = -RXE*(UCP*UST*USPH - USP*UCPH) - RZE*UCT*USPH
            RZBA = -RXE*(UCP*UST*UCPH + USP*USPH) - RZE*UCT*UCPH
            BTHTG = ATAND(-RZBA,RXBA)
            BPSIG = ATAND( RYBA,(RXBA*COSD(BTHTG)-RZBA*SIND(BTHTG)))
         40 CONTINUE
      C
         24 VSOUND = 1117.3 - .00392*RH
            IF (OPTN5 .LE. 0.) VWHTE = /MACH*VSOUND
```

```
      SUBROUTINE D1I         74/74   OPT=1                        FTN 4.2+75067     05/05/75  16.17.31.     PAGE    5

            VMNXY = VMNTE*COSD(BALPHA - BTHTO)                                          01      230
  230     C                                                                             01      231
            VXE = VMXE + VMNXY*COSD(BALPHY + BPSIO)                                     01      232
            VYE = VMYE + VMNXY*SIND(BALPHY + BPSIO)                                     01      233
            VZE = VMZE + VMNTE*SIND(BALPHA - BTHTO)                                     01      234
          C                                                                             01      235
  235       RXO = RXE                                                                   01      236
            RYO = RYE                                                                   01      237
            RZO = RZE                                                                   01      238
            VXO = VXE                                                                   01      239
            VYO = VYE                                                                   01      240
  240       VZO = VZE                                                                   01      241
            RDELX = RTXE - RXE                                                          01      242
            RDELY = RTYE - RYE                                                          01      243
            RDELZ = RTZE - RZE                                                          01      244
            RETURN                                                                      01      245
  245       END                                                                         01      246

      SUBROUTINE D1I         74/74   OPT=1                        FTN 4.2+75067     05/05/75  16.17.31.     PAGE    6

CARD NR. SEVERITY  DETAILS    DIAGNOSIS OF PROBLEM

    98      I       ITCT      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
    99      I       ITCT      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
   105      I       ITCT      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
   106      I       ITCT      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
```

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        SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS     DEF LINE     REFERENCES
     1  D1I              1       129       244

 VARIABLES      SN  TYPE          RELOCATION
   3340  A011       REAL                   / /        REFS      53   DEFINED     179
   3341  A012       REAL                   / /        REFS      54   DEFINED     180
   3342  A013       REAL                   / /        REFS      55   DEFINED     181
   3332  A021       REAL                   / /        REFS      56   DEFINED     182
   3333  A022       REAL                   / /        REFS      57   DEFINED     183
   3334  A023       REAL                   / /        REFS      58   DEFINED     184
   3335  A031       REAL                   / /        REFS      59   DEFINED     185
   3336  A032       REAL                   / /        REFS      60   DEFINED     186
   3337  A033       REAL                   / /        REFS      61   DEFINED     197
    556  BALPHA     REAL                   / /        REFS      14       229     233
    557  BALPHY     REAL                   / /        REFS      15       231     232
   3201  BLOSV      REAL                   / /        REFS      19       200     201
   3327  BPHIO      REAL                   / /        REFS      43       173     174     218     219
                                                  DEFINED     137
    547  BPHIER     REAL                   / /        REFS      72       173     174  DEFINED     161
    656  BPSIG      REAL                   / /        REFS      17       207  DEFINED     224
   3331  BPSIO      REAL                   / /        REFS      45       177     178     208     215     216     231
                                                      232  DEFINED     207
    551  BPSIER     REAL                   / /        REFS      74       177     178  DEFINED     153
    652  BTHTG      REAL                   / /        REFS      16     2*209   2*224  DEFINED     223
   3330  BTHTO      REAL                   / /        REFS      44       175     176     214     217     229     233
                                                  DEFINED     210
    550  BTH2ER     REAL                   / /        REFS      73       175     176  DEFINED     152
      0  C          REAL          ARRAY    / /        REFS       3         4       5     2*7      10      11      12
                                                       13      14        15      16      17      18      19      20
                                                       21      22        23      24      25      28      29      30
                                                       31      32        33      34      35      36      37      38
                                                       39      40        41      42      43      44      45      46
                                                       47      48        49      50      51    2*52      53      54
                                                       55      56        57      58      59      60      61      62
                                                       63      64        65      66      67      68      69      70
                                                       71      72        73      74      75      76      77      78
                                                       79     101       108  DEFINED      83      84      85      86
                                                      125     126
    537  CPSIC      REAL                              REFS   2*210   DEFINED     208
   3326  CRAD       REAL                   / /        REFS      22       207  DEFINED     127
    527  DJN        REAL                              REFS     152       153     154     155     166     157     168
                                                      194     195       196
   3031  GSPOTY     REAL                   / /        REFS      75   DEFINED     101
   3043  GSPOTZ     REAL                   / /        REFS      76   DEFINED     108
    525  I          INTEGER                           REFS     151       152     153     154     155     165     168
                                                      167     158       193     134     195     196
                                                  DEFINED     150       154     192
    526  IDO        INTEGER                           REFS     152       153     154     155     166     157     168
                                                      194     195       196  DEFINED     151     165     193
    522  IOL        INTEGER                           REFS      96        97     104  DEFINED      95
   5601  IPL        INTEGER       ARRAY    / /        REFS       5         6  DEFINED      98      99     105     106
                                                      113     114       115     116     117     118     119     120
                                                      121     122       1??
   7061  ISNOX      INTEGER       ARRAY    / /        REFS       6         ?     152     153     154     155     166
                                                      167     158       194     195     196
```

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VARIABLES   SN   TYPE          RELOCATION
   7210  ITCT     INTEGER            / /        REFS      52     95
   7250  ITNDX    INTEGER    ARRAY   / /        REFS       6     52       97      104
    523  ITSNDX   INTEGER                       REFS     183    110   DEFINED      96
   6667  I3512    INTEGER            / /        REFS       7    150      154      192
   5600  N        INTEGER            / /        REFS       4     98       99      100      105      106      107
                                                 113     114    115      116      117      118      119      120
                                                 121     122    123      124      130   DEFINED     100      107
                                                 124     130
   3146  OPTARG   REAL               / /        REFS      18    130
   6655  OPTN2    REAL               / /        REFS      23    129      139
   6657  OPTN4    REAL               / /        REFS      24    206      213
   6661  OPTN6    REAL               / /        REFS      25    228
   3343  P1       REAL               / /        REFS      62  DEFINED    146
   3345  P2       REAL               / /        REFS      64  DEFINED    148
   3344  Q1       REAL               / /        REFS      63  DEFINED    147
   3142  RDELX    REAL               / /        REFS      47  DEFINED    241
   3143  RDELY    REAL               / /        REFS      48  DEFINED    242
   3144  RDELZ    REAL               / /        REFS      49  DEFINED    243
    536  RH       REAL                          REFS     227  DEFINED    204
   3200  RHZRO    REAL               / /        REFS      46    204
    524  RNSTRT   REAL                          REFS     103    110
   3217  RSJYHC   REAL               / /        REFS      50  DEFINED     93
   3220  RSJZHC   REAL               / /        REFS      51  DEFINED     94
   3262  RSLANT   REAL               / /        REFS      20    200      201      207   DEFINED     203
   3162  RTXE     REAL               / /        REFS      34    241   DEFINED     136
   3166  RTYE     REAL               / /        REFS      35    242   DEFINED     135
   3172  RTZE     REAL               / /        REFS      36    243   DEFINED     134
    547  RXBA     REAL                          REFS     223    224   DEFINED     220
   3116  RXE      REAL               / /        REFS      28    203      207    2*210      220      221      222
                                                 235     241  DEFINED    200
   3203  RXO      REAL               / /        REFS      37  DEFINED    235
    550  RYBA     REAL                          REFS     224  DEFINED    221
   3122  RYE      REAL               / /        REFS      29    236      242   DEFINED     133
   3204  RYO      REAL               / /        REFS      38  DEFINED    236
    551  RZBA     REAL                          REFS     223    224   DEFINED     222
   3126  RZE      REAL               / /        REFS      30    203      204    2*210      220      221      222
                                                 237     243  DEFINED    201
   3205  RZO      REAL               / /        REFS      39  DEFINED    237
   3346  R2       REAL               / /        REFS      65  DEFINED    149
   3054  SIGSPOT  REAL               / /        REFS      77  2*101    2*108
    540  TTHTG    REAL                          REFS   2*210  DEFINED    209
    543  UCP      REAL                          REFS     220    221      222   DEFINED     216
    545  UCPH     REAL                          REFS     221  2*222  DEFINED     218
    531  UCPHI1   REAL                          REFS     182    183      185      186      187
                                             DEFINED     174
    535  UCPSI1   REAL                          REFS     179    182      183      185      186
                                             DEFINED     178
    544  UCT      REAL                          REFS     220    221      222   DEFINED     217
    533  UCTHT2   REAL                          REFS     179    180      184      187   DEFINED     176
    542  USP      REAL                          REFS     221    222   DEFINED     215
    546  USPH     REAL                          REFS   2*221    222   DEFINED     219
    530  USPHI1   REAL                          REFS     182    183      184      185      185
                                             DEFINED     173
    534  USPSI1   REAL                          REFS     180    182      183      185      186
                                             DEFINED     177
    541  UST      REAL                          REFS     220    221      222   DEFINED     214
    532  USTHT2   REAL                          REFS     181    182      183      185      186
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SUBROUTINE DII         74/74  OPT=1                                   FTN 4.2+75067      05/05/75  16.17.31.      PAGE    9

VARIABLES     SN   TYPE            RELOCATION
                                                DEFINED      175
   313   VMACH     REAL                 / /     REFS          13      228
  3211   VMWTE     REAL                 / /     REFS          21      229       233      DEFINED    228
   553   VMWXY     REAL                         REFS         231      232      DEFINED     229
   552   VSOUND    REAL                         REFS         228     DEFINED    227
   143   VWXE      REAL                 / /     REFS          10      231
   144   VWYE      REAL                 / /     REFS          11      232
   145   VWZE      REAL                 / /     REFS          12      233
  3102   VXE       REAL                 / /     REFS          31      238      DEFINED     231
  3206   VXO       REAL                 / /     REFS          40     DEFINED    238
  3106   VYE       REAL                 / /     REFS          32      239      DEFINED     232
  3207   VYO       REAL                 / /     REFS          41     DEFINED    239
  3112   VZE       REAL                 / /     REFS          33      240      DEFINED     233
  3210   VZO       REAL                 / /     REFS          42     DEFINED    240
  3053   WO        REAL                 / /     REFS          79      101       138      DEFINED     88
  3347   XB01      REAL                 / /     REFS          66     DEFINED    138
  3352   XB02      REAL                 / /     REFS          69     DEFINED    141
  3350   YB01      REAL                 / /     REFS          67     DEFINED    139
  3353   YB02      REAL                 / /     REFS          70     DEFINED    142
  3351   ZB01      REAL                 / /     REFS          68     DEFINED    140
  3354   ZB02      REAL                 / /     REFS          71     DEFINED    143
  3052   ZETA      REAL                 / /     REFS          78      101       138      DEFINED     89

EXTERNALS          TYPE    ARGS        REFERENCES
         ASIN      REAL    1 LIBRARY   207
         ATAND     REAL    2           213      223      224
         COSD      REAL    1           174      176      178      200      208      209      216      217      218
                                       224      229      231
         MCARLO            3           103      110      152      153      154      155      166      157      168
                                       194      195      196
         SIND      REAL    1           173      175      177      201      207      209      214      215      219
                                       224      232      233
         SQRT      REAL    1 LIBRARY   101      108      203

STATEMENT LABELS               DEF LINE    REFERENCES
     0   5                       197         192
   267   10                      203         199
     0   11                      159         164
   273   20                      204         202
     0   24        INACTIVE      227
   322   30                      212         205
   375   40                      225         211       213
    51   500                     111          95       104
    31   502                     104          97
     0   503                     156         153

LOOPS   LABEL     INDEX      FROM-TO      LENGTH     PROPERTIES
   11   500       * IOL       95 111       438B           EXT REFS
  117   503       * I        150 156       248            EXT REFS
  146   11        * I        164 169       208            EXT REFS
  237   5         * I        192 137       20B            EXT REFS

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
  / /             3830                   0 C     (3830)
```

```
EQUIV-CLASSES   LENGTH   MEMBERS - BIAS NAME(LENGTH)
C      C        3830           99 VMXE    (1)          100 VMYE    (1)          101 VMZE    (1)
                              203 VMACH   (1)          359 BPH1ER  (1)          360 BTH2ER  (1)
                              361 BPS1ER  (1)          365 BA_PHA  (1)          367 BALPHY  (1)
                              426 BTHTG   (1)          430 BPSIG   (1)         1561 GSPOTY  (1)
                             1571 GSPOTZ  (1)         1578 ZETA    (1)         1579 WO      (1)
                             1580 SIGSPOT (1)         1602 VXE     (1)         1606 VYE     (1)
                             1610 VZE     (1)         1614 RXE     (1)         1618 RYE     (1)
                             1622 RZE     (1)         1634 RDELX   (1)         1635 RDELY   (1)
                             1636 RDELZ   (1)         1635 OPTARG  (1)         1650 RTXE    (1)
                             1654 RTYE    (1)         1658 RTZE    (1)         1664 RHZRO   (1)
                             1665 DLOSV   (1)         1666 RS_ANT  (1)         1667 RX0     (1)
                             1668 RY0     (1)         1669 RZ0     (1)         1670 VX0     (1)
                             1671 VY0     (1)         1672 VZ0     (1)         1673 VMNTE   (1)
                             1679 RSJYMC  (1)         1680 RSJZMC  (1)         1750 CRAD    (1)
                             1751 BPHIO   (1)         1752 BTHTO   (1)         1753 BPSIO   (1)
                             1754 A021    (1)         1755 A022    (1)         1756 A023    (1)
                             1757 A031    (1)         1758 A032    (1)         1759 A033    (1)
                             1760 A011    (1)         1761 A012    (1)         1762 A013    (1)
                             1763 P1      (1)         1764 Q1      (1)         1765 P2      (1)
                             1766 Q2      (1)         1767 X301    (1)         1768 Y801    (1)
                             1769 Z301    (1)         1770 X802    (1)         1771 Y802    (1)
                             1772 Z302    (1)         2550 N       (1)         2561 IPL     (100)
                             3501 OPTN2   (1)         3503 OPTN4   (1)         3505 OPTN5   (1)
                             3511 ISCI2   (1)         3633 ISNOX   (40)        3720 ITCT    (1)
                             3752 ITNDX   (10)

STATISTICS
  PROGRAM LENGTH                5543        364
  CM BLANK COMMON LENGTH       73653       3830
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      SUBROUTINE D1                                               D1     247
C**TRANSLATIONAL DYNAMICS MODULE                                  D1     248
      COMMON C(3830)                                              D1     249
C                                                                 D1     250
C**INPUT DATA                                                     D1     251
      EQUIVALENCE (C(1527),AGRAV )                                D1     252
      EQUIVALENCE (C(1528),DMASS )                                D1     253
      EQUIVALENCE (C(1629),ATHRST)                                D1     254
      EQUIVALENCE (C(1530),ATURNT)                                D1     255
      EQUIVALENCE (C(1531),BGAMT )                                D1     256
      EQUIVALENCE (C(1539),OPTARG)                                D1     257
      EQUIVALENCE (C(1581),ADIVE )                                D1     258
      EQUIVALENCE (C(1751),CRAD  )                                D1     259
C                                                                 D1     260
C**INPUTS FROM OTHER MODULES                                      D1     261
      EQUIVALENCE (C(1300),FXBA  )                                D1     262
      EQUIVALENCE (C(1301),FYBA  )                                D1     263
      EQUIVALENCE (C(1302),FZBA  )                                D1     264
      EQUIVALENCE (C(1703),CFA11 )                                D1     265
      EQUIVALENCE (C(1707),CFA12 )                                D1     266
      EQUIVALENCE (C(1711),CFA13 )                                D1     267
      EQUIVALENCE (C(1715),CFA21 )                                D1     268
      EQUIVALENCE (C(1719),CFA22 )                                D1     269
      EQUIVALENCE (C(1723),CFA23 )                                D1     270
      EQUIVALENCE (C(1727),CFA31 )                                D1     271
      EQUIVALENCE (C(1731),CFA32 )                                D1     272
      EQUIVALENCE (C(1735),CFA33 )                                D1     273
      EQUIVALENCE (C(2000),T     )                                D1     274
C                                                                 D1     275
C**STATE VARIABLE OUTPUTS                                         D1     276
      EQUIVALENCE (C(1600),VXED  )                                D1     277
      EQUIVALENCE (C(1603),VXE   )                                D1     278
      EQUIVALENCE (C(1604),VYED  )                                D1     279
      EQUIVALENCE (C(1607),VYE   )                                D1     280
      EQUIVALENCE (C(1608),VZED  )                                D1     281
      EQUIVALENCE (C(1611),VZE   )                                D1     282
      EQUIVALENCE (C(1612),RXED  )                                D1     283
      EQUIVALENCE (C(1615),RXE   )                                D1     284
      EQUIVALENCE (C(1616),RYED  )                                D1     285
      EQUIVALENCE (C(1619),RYE   )                                D1     286
      EQUIVALENCE (C(1620),RZED  )                                D1     287
      EQUIVALENCE (C(1623),RZE   )                                D1     288
      EQUIVALENCE (C(1640),VTARGD)                                D1     289
      EQUIVALENCE (C(1643),VTARG )                                D1     290
      EQUIVALENCE (C(1644),BPSITD)                                D1     291
      EQUIVALENCE (C(1647),BPSIT )                                D1     292
      EQUIVALENCE (C(1648),RTXED )                                D1     293
      EQUIVALENCE (C(1651),RTXE  )                                D1     294
      EQUIVALENCE (C(1652),RTYED )                                D1     295
      EQUIVALENCE (C(1655),RTYE  )                                D1     296
      EQUIVALENCE (C(1656),RTZED )                                D1     297
      EQUIVALENCE (C(1659),RTZE  )                                D1     298
C                                                                 D1     299
C**OTHER OUTPUTS                                                  D1     300
      EQUIVALENCE (C(1624),AXBA  )                                D1     301
      EQUIVALENCE (C(1625),AYBA  )                                D1     302
      EQUIVALENCE (C(1626),AZBA  )                                D1     303
```

```
      EQUIVALENCE (C(1532),VDELX )
      EQUIVALENCE (C(1533),VDELY )
      EQUIVALENCE (C(1534),VDELZ )
      EQUIVALENCE (C(1535),RDELX )
      EQUIVALENCE (C(1536),RDELY )
      EQUIVALENCE (C(1537),RDELZ )
      EQUIVALENCE (C(1538),VCLSNG)
      EQUIVALENCE (C(1660),VTXE  )
      EQUIVALENCE (C(1661),VTYE  )
      EQUIVALENCE (C(1662),VTZE  )
      EQUIVALENCE (C(1663),VDXB  )
      EQUIVALENCE (C(1664),VDYB  )
      EQUIVALENCE (C(1665),VDZB  )
      EQUIVALENCE (C(1575),ANGX  )
      EQUIVALENCE (C(1577),ANGY  )
      EQUIVALENCE (C(1578),ANGZ  )
      EQUIVALENCE (C( 371),RANGE  )
C
C**ADD AERO AND THRUST FORCES TO GET TOTAL ACCELERATION IN BODY AXES
      AXBA = FXBA/DMASS
      AYBA = FYBA/DMASS
      AZBA = FZBA/DMASS
C
C**RESOLVE FROM BODY TO EARTH AXES
      AXE = CFA11*AXBA+CFA21*AYBA+CFA31*AZBA
      AYE = CFA12*AXBA+CFA22*AYBA+CFA32*AZBA
      AZE = CFA13*AXBA+CFA23*AYBA+CFA33*AZBA
C
C**INTEGRATE ACCELERATIONS
      VXED = AXE
      VYED = AYE
      VZED = AZE + AGRAV
C
C**CALCULATE TOTAL MISSILE ACCELERATION IN BODY AXES
      VDXB = CFA11*VXED + CFA12*VYED + CFA13*VZED
      VDYB = CFA21*VXED + CFA22*VYED + CFA23*VZED
      VDZB = CFA31*VXED + CFA32*VYED + CFA33*VZED
      ANGX = VDXB/32.174
      ANGY = VDYB/32.174
      ANGZ = VDZB/32.174
C
C**INTEGRATE VELOCITIES TO EARTH AXES  POSITION
   10 RXED = VXE
      RYED = VYE
      RZED = VZE
C
C**TARGET MOTION
      IF (OPTARG .LE. 0.) RETURN
      VTARGD = ATHRST*AGRAV
      BPSITD= 0.
      IF (VTARG.GT.0.) BPSITD= ATURNT*AGRAV*CRAD/VTARG
C
      VTXE = VTARG*COSD(BGAMT)*COSD(BPSIT)
      VTYE = VTARG*COSD(BGAMT)*SIND(BPSIT)
      VTZE = VTARG*SIND(BGAMT)
C
      RTXED = VTXE
```

```
115         RTYED = VTYE
            RTZED = VTZE
      C
            VDELX = VTXE-VXE
            VDELY = VTYE-VYE
120         VDELZ = VTZE-VZE
      C
            VCLSNG = (RDELX*VDELX+RDELY*VDELY+RDELZ*VDELZ)/RANGE
            RETURN
            END
```

```
      SUBROUTINE D1          74/74  OPT=1                              FTN 4.2+75067      05/05/75  16.17.37.       PAGE    4

         SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE     REFERENCES
     1  D1             1        105      123

 VARIABLES      SN  TYPE          RELOCATION
   3220  ADIVE      REAL                / /         REFS          12
   3132  AGRAV      REAL                / /         REFS           6        89       106       108
   3213  ANGX       REAL                / /         REFS          71   DEFINED        95
   3214  ANGY       REAL                / /         REFS          72   DEFINED        96
   3215  ANGZ       REAL                / /         REFS          73   DEFINED        97
   3134  ATHRST     REAL                / /         REFS           8       106
   3135  ATURNT     REAL                / /         REFS           9       108
   3127  AXBA       REAL                / /         REFS          55        82        83        84   DEFINED        77
    130  AXE        REAL                            REFS          37   DEFINED        82
   3130  AYBA       REAL                / /         REFS          56        82        83        34   DEFINED        78
    131  AYE        REAL                            REFS          58   DEFINED        83
   3131  AZBA       REAL                / /         REFS          57        82        83        84   DEFINED        79
    132  AZE        REAL                            REFS          59   DEFINED        94
   3136  BGAMT      REAL                / /         REFS          10       110       111       112
   3156  BPSIT      REAL                / /         REFS          46       110       111
   3153  BPSITD     REAL                / /         REFS          45   DEFINED       107       108
      0  C          REAL         ARRAY  / /         REFS           3         6         7         8         9        10        11
                                                      12          13        16        17        18        19        20        21
                                                      22          23        24        25        26        27        28        31
                                                      32          33        34        35        36        37        38        39
                                                      40          41        42        43        44        45        46        47
                                                      48          49        50        51        52        55        56        57
                                                      58          59        60        61        62        63        64        65
                                                      66          67        68        69        70        71        72        73
                                                      74
   3246  CFA11      REAL                / /         REFS          19        82        92
   3252  CFA12      REAL                / /         REFS          20        83        92
   3256  CFA13      REAL                / /         REFS          21        84        92
   3262  CFA21      REAL                / /         REFS          22        82        93
   3266  CFA22      REAL                / /         REFS          23        83        93
   3272  CFA23      REAL                / /         REFS          24        84        93
   3276  CFA31      REAL                / /         REFS          25        82        94
   3302  CFA32      REAL                / /         REFS          26        83        94
   3306  CFA33      REAL                / /         REFS          27        84        94
   3326  CRAD       REAL                / /         REFS          13       108
   3133  DMASS      REAL                / /         REFS           7        77        78        79
   2423  FXBA       REAL                / /         REFS          16        77
   2424  FYBA       REAL                / /         REFS          17        78
   2425  FZBA       REAL                / /         REFS          18        79
   3146  OPTARG     REAL                / /         REFS          11       105
    562  RANGE      REAL                / /         REFS          74       122
   3142  RDELX      REAL                / /         REFS          61       122
   3143  RDELY      REAL                / /         REFS          62       122
   3144  RDELZ      REAL                / /         REFS          63       122
   3162  RTXE       REAL                / /         REFS          48
   3157  RTXED      REAL                / /         REFS          47   DEFINED       114
   3166  RTYE       REAL                / /         REFS          50
   3163  RTYED      REAL                / /         REFS          49   DEFINED       115
   3172  RTZE       REAL                / /         REFS          52
   3167  RTZED      REAL                / /         REFS          51   DEFINED       116
   3116  RXE        REAL                / /         REFS          38
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VARIABLES    SN  TYPE          RELOCATION
  3113  RXED     REAL              / /     REFS      37   DEFINED     100
  3122  RYE      REAL              / /     REFS      40
  3117  RYED     REAL              / /     REFS      39   DEFINED     101
  3126  RZE      REAL              / /     REFS      42
  3123  RZED     REAL              / /     REFS      41   DEFINED     102
  3717  T        REAL              / /     REFS      28
  3145  VCLSNG   REAL              / /     REFS      64   DEFINED     122
  3137  VDELX    REAL              / /     REFS      58       122  DEFINED   118
  3140  VDELY    REAL              / /     REFS      59       122  DEFINED   119
  3141  VDELZ    REAL              / /     REFS      60       122  DEFINED   120
  3176  VDXB     REAL              / /     REFS      68        95  DEFINED    92
  3177  VDYB     REAL              / /     REFS      69        96  DEFINED    93
  3200  VDZB     REAL              / /     REFS      70        97  DEFINED    94
  3152  VTARG    REAL              / /     REFS      44     2*108      110   111    112
  3147  VTARGD   REAL              / /     REFS      43   DEFINED      106
  3173  VTXE     REAL              / /     REFS      55       114      118  DEFINED   110
  3174  VTYE     REAL              / /     REFS      56       115      119  DEFINED   111
  3175  VTZE     REAL              / /     REFS      57       116      120  DEFINED   112
  3102  VXE      REAL              / /     REFS      32       100      118
  3077  VXED     REAL              / /     REFS      31        92       93    94  DEFINED   87
  3106  VYE      REAL              / /     REFS      34       101      119
  3103  VYED     REAL              / /     REFS      33        92       93    94  DEFINED   88
  3112  VZE      REAL              / /     REFS      36       102      120
  3107  VZED     REAL              / /     REFS      35        92       93    94  DEFINED   89

EXTERNALS        TYPE   ARGS       REFERENCES
       COSD      REAL     1        2*110      111
       SIND      REAL     1          111      112

STATEMENT LABELS            DEF LINE   REFERENCES
     0  10         INACTIVE    100

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
     / /          3830             0 C         (3830)

EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
C     C          3830          370 RANGE  (1)        1299 FXBA   (1)        1300 FYBA   (1)
                              1301 FZBA   (1)        1599 VXED   (1)        1602 VXE    (1)
                              1603 VYED   (1)        1605 VYE    (1)        1607 VZED   (1)
                              1610 VZE    (1)        1611 RXED   (1)        1614 RXE    (1)
                              1615 RYED   (1)        1618 RYE    (1)        1619 RZED   (1)
                              1622 RZE    (1)        1623 AXBA   (1)        1624 AYBA   (1)
                              1625 AZBA   (1)        1626 AGRAV  (1)        1627 DMASS  (1)
                              1628 ATHRST (1)        1629 ATJRNT (1)        1630 BGAMT  (1)
                              1631 VDELX  (1)        1632 VDELY  (1)        1633 VDELZ  (1)
                              1634 RDELX  (1)        1635 RDELY  (1)        1636 RDELZ  (1)
                              1637 VCLSNG (1)        1638 OPTARG (1)        1639 VTARGD (1)
                              1642 VTARG  (1)        1643 BPSITO (1)        1646 BPSIT  (1)
                              1647 RTXED  (1)        1650 RTXE   (1)        1651 RTYED  (1)
                              1654 RTYE   (1)        1655 RTZED  (1)        1658 RTZE   (1)
                              1659 VTXE   (1)        1660 VTYE   (1)        1661 VTZE   (1)
                              1662 VDXB   (1)        1663 VDYB   (1)        1664 VDZB   (1)
                              1675 ANGX   (1)        1676 ANGY   (1)        1677 ANGZ   (1)
                              1680 ADIVE  (1)        1702 CFA11  (1)        1706 CFA12  (1)
                              1710 CFA13  (1)        1714 CFA21  (1)        1718 CFA22  (1)
                              1722 CFA23  (1)        1726 CFA31  (1)        1730 CFA32  (1)
                              1734 CFA33  (1)        1750 CRAD   (1)        1999 T      (1)
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SUBROUTINE D1          74/74   OPT=1                FTN 4.2+75067     05/35/75  16.17.37.    PAGE    5

STATISTICS
  PROGRAM LENGTH                   1333      91
  CM BLANK COMMON LENGTH          73663    3830
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      SUBROUTINE O2I                                                      01     371
C**ROTATIONAL DYNAMICS INITIALIZATION MODULE O2IEUL                       01     372
      COMMON C(3530)                                                      01     373
      DIMENSION IPL (100)                                                 01     374
C**INPUT DATA                                                             01     375
      EQUIVALENCE (C(1752),BPHIO )                                        01     376
      EQUIVALENCE (C(1753),BTHTO )                                        01     377
      EQUIVALENCE (C(1754),BPSIO )                                        01     378
C**INPUTS FROM MAIN PROGRAM                                                01     379
      EQUIVALENCE (C(2561),N     )                                        01     380
      EQUIVALENCE (C(2562),IPL   )                                        01     381
C**STATE VARIABLE OUTPUTS                                                  01     382
      EQUIVALENCE (C(1703),CFA11 )                                        01     383
      EQUIVALENCE (C(1707),CFA12 )                                        01     384
      EQUIVALENCE (C(1711),CFA13 )                                        01     385
      EQUIVALENCE (C(1715),CFA21 )                                        01     386
      EQUIVALENCE (C(1719),CFA22 )                                        01     387
      EQUIVALENCE (C(1723),CFA23 )                                        01     388
      EQUIVALENCE (C(1727),CFA31 )                                        01     389
      EQUIVALENCE (C(1731),CFA32 )                                        01     390
      EQUIVALENCE (C(1735),CFA33 )                                        01     391
C**OTHER OUTPUTS                                                          01     392
      EQUIVALENCE (C(1755),A021  )                                        01     393
      EQUIVALENCE (C(1756),A022  )                                        01     394
      EQUIVALENCE (C(1757),A023  )                                        01     395
      EQUIVALENCE (C(1758),A031  )                                        01     396
      EQUIVALENCE (C(1759),A032  )                                        01     397
      EQUIVALENCE (C(1760),A033  )                                        01     398
C**INITIAL CALCULATION OF EULER ANGLE MATRIX OF DIRECTION COSINES (CFA)   01     399
      USPHI = SIND(BPHIO)                                                 01     400
      UCPHI = COSD(BPHIO)                                                 01     401
      USTHT = SIND(BTHTO)                                                 01     402
      UCTHT = COSD(BTHTO)                                                 01     403
      USPSI = SIND(BPSIO)                                                 01     404
      UCPSI = COSD(BPSIO)                                                 01     405
      CFA11 = UCPSI*UCTHT                                                 01     406
      CFA12 = USPSI*UCTHT                                                 01     407
      CFA13 = -USTHT                                                      01     408
      CFA21 = -USPSI*UCPHI+UCPSI*USTHT*USPHI                              01     409
      CFA22 = UCPSI*UCPHI+USPSI*USTHT*USPHI                               01     410
      CFA23 = UCTHT*USPHI                                                 01     411
      CFA31 = UCPSI*USTHT*UCPHI+USPSI*USPHI                               01     412
      CFA32 = USPSI*USTHT*UCPHI-UCPSI*USPHI                               01     413
      CFA33 = UCTHT*UCPHI                                                 01     414
C                                                                         01     415
C**INITIALIZE MATRIX COEF FOR FREE GYRO MODEL(S)                          01     416
C                                                                         01     417
C**INTEGRATED PARAMATER LIST (IPL) FOR WPO,WQO,WRO,AND CFAO               01     418
      IPL(N) = 1700                                                       01     419
      IPL(N+1) = 1704                                                     01     420
      IPL(N+2) = 1708                                                     01     421
      IPL(N+3) = 1712                                                     01     422
      IPL(N+4) = 1716                                                     01     423
      IPL(N+5) = 1720                                                     01     424
      IPL(N+6) = 1724                                                     01     425
      IPL(N+7) = 1728                                                     01     426
      IPL(N+8) = 1732                                                     01     427
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                 IPL(N+9) = 1736                              01      428
  60             IPL(N+10) = 1740                             01      429
                 IPL(N+11) = 1744                             01      430
                 N = N+12                                     01      431
                 RETURN                                       01      432
                 END                                          01      433
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      SUBROUTINE D2I          74/74   OPT=1                        FTN 4.2+75067     05/05/75  16.17.40.     PAGE   3

         SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE      REFERENCES
     1  D2I              1           62

 VARIABLES        SN  TYPE            RELOCATION
     3332  A021       REAL                  / /        REFS        23
     3333  A022       REAL                  / /        REFS        24
     3334  A023       REAL                  / /        REFS        25
     3335  A031       REAL                  / /        REFS        26
     3336  A032       REAL                  / /        REFS        27
     3337  A033       REAL                  / /        REFS        28
     3327  BPHIO      REAL                  / /        REFS         6        30        31
     3331  BPSIO      REAL                  / /        REFS         8        34        35
     3330  BTHTO      REAL                  / /        REFS         7        32        33
        0  C          REAL        ARRAY     / /        REFS         3         6         7         8        10        11        13
                                                          14       15        16        17        18        19        20        21
                                                          23       24        25        26        27        28
     3246  CFA11      REAL                  / /        REFS        13   DEFINED        36
     3252  CFA12      REAL                  / /        REFS        14   DEFINED        37
     3256  CFA13      REAL                  / /        REFS        15   DEFINED        38
     3262  CFA21      REAL                  / /        REFS        16   DEFINED        39
     3266  CFA22      REAL                  / /        REFS        17   DEFINED        40
     3272  CFA23      REAL                  / /        REFS        18   DEFINED        41
     3276  CFA31      REAL                  / /        REFS        19   DEFINED        42
     3302  CFA32      REAL                  / /        REFS        20   DEFINED        43
     3306  CFA33      REAL                  / /        REFS        21   DEFINED        44
     5001  IFL        INTEGER     ARRAY     / /        REFS         4        11   DEFINED        49        50        51        52
                                                          53       54        55        56        57        58        59        60
     5000  N          INTEGER               / /        REFS        10        49        50        51        52        53        54
                                                          55       56        57        58        59        60        61
                                                     DEFINED       61
       73  UCPHI      REAL                             REFS        39        40        42        43        44
                                                     DEFINED       31
       77  UCPSI      REAL                             REFS        36        39        40        42        43
                                                     DEFINED       35
       75  UCTHT      REAL                             REFS        36        37        41        44   DEFINED        33
       72  USPHI      REAL                             REFS        39        40        41        42        43
                                                     DEFINED       30
       76  USPSI      REAL                             REFS        37        39        40        42        43
                                                     DEFINED       34
       74  USTHT      REAL                             REFS        38        39        40        42        43
                                                     DEFINED       32

 EXTERNALS            TYPE    ARGS        REFERENCES
           COSD       REAL      1            31        33        35
           SIND       REAL      1            31        32        34

 COMMON BLOCKS      LENGTH       MEMBERS - BIAS NAME(LENGTH)
       / /            3830               0  C       (3830)

 EQUIV-CLASSES      LENGTH       MEMBERS - BIAS NAME(LENGTH)
 C        C           3830         1702 CFA11   (1)          1706 CFA12   (1)          1710 CFA13   (1)
                                   1714 CFA21   (1)          1718 CFA22   (1)          1722 CFA23   (1)
                                   1726 CFA31   (1)          1730 CFA32   (1)          1734 CFA33   (1)
                                   1751 BPHIO   (1)          1752 BTHTO   (1)          1753 BPSIO   (1)
                                   1754 A021    (1)          1755 A022    (1)          1756 A023    (1)
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        SUBROUTINE D2I         74/74   OPT=1                            FTN 4.2+75067      05/15/75  16.17.40.        PAGE     4

   EQUIV CLASSES    LENGTH       MEMBERS - BIAS NAME(LENGTH)
                                   1757 A031    (1)               1758 A032    (1)              1759 A033    (1)
                                   2550 N       (1)               2551 IPL     (100)

   STATISTICS
     PROGRAM LENGTH                1003        64
     CM BLANK COMMON LENGTH       73663      3930
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```
      SUBROUTINE D2
C**   ROTATIONAL DYNAMICS MODULE
      COMMON C(3530)
C
C**DATA INPUTS
      EQUIVALENCE (C(1748),FMIX )
      EQUIVALENCE (C(1749),FMIY )
      EQUIVALENCE (C(1750),FMIZ )
      EQUIVALENCE (C(1751),CRAD )
      EQUIVALENCE (C(4503),OPTN3)
C
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(1303),FMXBA )
      EQUIVALENCE (C(1304),FMYBA )
      EQUIVALENCE (C(1305),FMZBA )
C
C**STATE VARIABLE OUTPUTS
      EQUIVALENCE (C(1700),CFA11D)
      EQUIVALENCE (C(1703),CFA11 )
      EQUIVALENCE (C(1704),CFA12D)
      EQUIVALENCE (C(1707),CFA12 )
      EQUIVALENCE (C(1708),CFA13D)
      EQUIVALENCE (C(1711),CFA13 )
      EQUIVALENCE (C(1712),CFA21D)
      EQUIVALENCE (C(1715),CFA21 )
      EQUIVALENCE (C(1716),CFA22D)
      EQUIVALENCE (C(1719),CFA22 )
      EQUIVALENCE (C(1720),CFA23D)
      EQUIVALENCE (C(1723),CFA23 )
      EQUIVALENCE (C(1724),CFA31D)
      EQUIVALENCE (C(1727),CFA31 )
      EQUIVALENCE (C(1728),CFA32D)
      EQUIVALENCE (C(1731),CFA32 )
      EQUIVALENCE (C(1732),CFA33D)
      EQUIVALENCE (C(1735),CFA33 )
      EQUIVALENCE (C(1736),WPD   )
      EQUIVALENCE (C(1739),WP    )
      EQUIVALENCE (C(1740),WQD   )
      EQUIVALENCE (C(1743),WQ    )
      EQUIVALENCE (C(1744),WRD   )
      EQUIVALENCE (C(1747),WR    )
C
C**INTEGRATE BODY ANGULAR RATES
      IF (OPTN3.GT.0.) GO TO 55
      WPD = CRAD*FMXBA/FMIX
   55 WQD = (CRAD*FMYBA+(FMIZ-FMIX)*WP*WR/CRAD)/FMIY
   65 WRD = (CRAD*FMZBA+(FMIX-FMIY)*WP*WQ/CRAD)/FMIZ
C
C**INTEGRATE ATTITUDE DIRECTION COSINES
   49 CFA11D=(CFA21*WR-CFA31*WQ)/CRAD
      CFA12D=(CFA22*WR-CFA32*WQ)/CRAD
      CFA13D=(CFA23*WR-CFA33*WQ)/CRAD
      CFA21D = (CFA31*WP-CFA11*WR)/CRAD
      CFA22D = (CFA32*WP-CFA12*WR)/CRAD
      CFA23D = (CFA33*WP-CFA13*WR)/CRAD
      CFA31D = (CFA11*WQ-CFA21*WP)/CRAD
      CFA32D = (CFA12*WQ-CFA22*WP)/CRAD
```

```
      CFA33D = (CFA13*W2-CFA23*WP)/CRAD                                 02        59
      RETURN                                                            02        60
60    END                                                               02        61
```

```
SUBROUTINE D2          74/74   OPT=1                          FTN 4.2+75067     05/35/75  16.17.42.       PAGE    3

      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS     DEF LINE     REFERENCES
    1  D2             1           59

 VARIABLES      SN   TYPE          RELOCATION
     0  C            REAL       ARRAY   / /      REFS      3      6      7      8      9     10     13
                                                   14     15     18     19     20     21     22     23
                                                   24     25     26     27     28     29     30     31
                                                   32     33     34     35     36     37     38     39
                                                   40     41
  3246  CFA11        REAL               / /      REFS     19     53     56
  3243  CFA11D       REAL               / /      REFS     18  DEFINED   50
  3252  CFA12        REAL               / /      REFS     21     54     57
  3247  CFA12D       REAL               / /      REFS     20  DEFINED   51
  3256  CFA13        REAL               / /      REFS     23     55     58
  3253  CFA13D       REAL               / /      REFS     22  DEFINED   52
  3262  CFA21        REAL               / /      REFS     25     50     56
  3257  CFA21D       REAL               / /      REFS     24  DEFINED   53
  3266  CFA22        REAL               / /      REFS     27     51     57
  3263  CFA22D       REAL               / /      REFS     26  DEFINED   54
  3272  CFA23        REAL               / /      REFS     29     52     58
  3267  CFA23D       REAL               / /      REFS     28  DEFINED   55
  3276  CFA31        REAL               / /      REFS     31     50     53
  3273  CFA31D       REAL               / /      REFS     30  DEFINED   56
  3302  CFA32        REAL               / /      REFS     33     51     54
  3277  CFA32D       REAL               / /      REFS     32  DEFINED   57
  3306  CFA33        REAL               / /      REFS     35     52     55
  3303  CFA33D       REAL               / /      REFS     34  DEFINED   58
  3326  CRAD         REAL               / /      REFS      9     45    2*45   2*47    50     51     52
                                                   53     54     55     56     57     58
  3323  FMIX         REAL               / /      REFS      6     45     46     47
  3324  FMIY         REAL               / /      REFS      7     46     47
  3325  FMIZ         REAL               / /      REFS      8     46     47
  2426  FMXBA        REAL               / /      REFS     13     45
  2427  FMYBA        REAL               / /      REFS     14     46
  2430  FMZBA        REAL               / /      REFS     15     47
  6656  OPTN3        REAL               / /      REFS     10     44
  3312  WP           REAL               / /      REFS     37     46     47     53     54     55     56
                                                   57     58
  3307  WPD          REAL               / /      REFS     36  DEFINED   45
  3316  WQ           REAL               / /      REFS     39     47     50     51     52     56     57
                                                   58
  3313  WQD          REAL               / /      REFS     38  DEFINED   46
  3322  WR           REAL               / /      REFS     41     46     50     51     52     53     54
                                                   55
  3317  WRD          REAL               / /      REFS     40  DEFINED   47

 STATEMENT LABELS              DEF LINE   REFERENCES
     0  49         INACTIVE       50
     6  55                        46         44
     0  65         INACTIVE       47

 COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
   / /            3836           0 C       (3830)
```

```
SUBROUTINE D2          74/74    OPT=1                    FTN 4.2+75057      05/15/75  16.17.42.      PAGE    4

EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
C        C       3830        1302 FMXBA   (1)       1303 FMYBA   (1)       1304 FMZBA   (1)
                             1699 CFA11D  (1)       1702 CFA11   (1)       1703 CFA12D  (1)
                             1706 CFA12   (1)       1707 CFA13D  (1)       1710 CFA13   (1)
                             1711 CFA21D  (1)       1714 CFA21   (1)       1715 CFA22D  (1)
                             1718 CFA22   (1)       1719 CFA23D  (1)       1722 CFA23   (1)
                             1723 CFA31D  (1)       1726 CFA31   (1)       1727 CFA32D  (1)
                             1730 CFA32   (1)       1731 CFA33D  (1)       1734 CFA33   (1)
                             1735 WPD     (1)       1738 WP      (1)       1739 WQD     (1)
                             1742 WQ      (1)       1743 WRD     (1)       1746 WR      (1)
                             1747 FMIX    (1)       1748 FMIY    (1)       1749 FMIZ    (1)
                             1750 GRAD    (1)       3502 OPTN3   (1)

STATISTICS
  PROGRAM LENGTH                643      52
  CM BLANK COMMON LENGTH      73663    3830
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SUBROUTINE S1I        74/74    OPT=1                    FTN 4.2+75067     05/15/75  16.17.45.     PAGE    1

      SUBROUTINE S1I                                                    S1       2
C**SEEKER INIT.MODULE                                                   S1       3
      COMMON C(3830)                                                    S1       4
      DIMENSION IZ(50), IY(50), ISNDX(40)                               S1       5
      EQUIVALENCE (C(3634), ISNDX), (C(3512), I3512)                    S1       6
      EQUIVALENCE (C( 470), BTGERR)                                     S1       7
      EQUIVALENCE (C( 471), BPGERR)                                     S1       8
      EQUIVALENCE (C( 465),  SOY)                                       S1       9
      EQUIVALENCE (C( 466),  SOZ)                                       S1      10
    1 FORMAT(5X,2HBZ,6X,4(I13,I11)/(13X,4(I13,I11)))                    S1      11
    2 FORMAT(5X,2HBY,6X,4(I13,I11)/(13X,4(I13,I11)))                    S1      12
      EQUIVALENCE (C(11),BY)                                            S1      13
      EQUIVALENCE (C(12),BZ)                                            S1      14
      EQUIVALENCE(C(2011),KSTEP)                                        S1      15
      EQUIVALENCE(C(500),IZ)                                            S1      16
      EQUIVALENCE(C(550),IY)                                            S1      17
      DIMENSION IPL(100)                                                S1      18
      EQUIVALENCE (C(452),SWP)                                          S1      19
      EQUIVALENCE(C(0411),WLQ)                                          S1      20
      EQUIVALENCE(C(0415),WLR)                                          S1      21
      EQUIVALENCE (C(0419),WLQS)                                        S1      22
      EQUIVALENCE (C(0423),WLRS)                                        S1      23
      EQUIVALENCE (C(0427),BTHTG)                                       S1      24
      EQUIVALENCE (C(0431),BPSIG)                                       S1      25
      EQUIVALENCE (C(2561),N)                                           S1      26
      EQUIVALENCE (C(2562),IPL)                                         S1      27
      EQUIVALENCE (C(4504),OPTN4)                                       S1      28
      EQUIVALENCE (C( 523),   DERIV)                                    LAG      3
      IPL(N)=424                                                        S1      29
      IPL(N+1)=423                                                      S1      30
      IPL(N+2)=403                                                      S1      31
      IPL(N+3)=412                                                      S1      32
      IPL(N+4)=415                                                      S1      33
      IPL(N+5)=423                                                      S1      34
      N=N+6                                                             S1      35
      C(411)=0.                                                         S1      36
      C(415)=0.                                                         S1      37
      C(419)=0.                                                         S1      38
      C(423)=0.                                                         S1      39
      BY=0.                                                             S1      40
      BZ=0.                                                             S1      41
      SOY = 0.                                                          S1      42
      SOZ = 0.                                                          S1      43
      DO 10 I = 1, I3512                                                S1      44
      IDO = I                                                           S1      45
C                                                                       S1      46
C MONTE CARLO SEEKER OUTPUT STARTING VALUES                             S1      47
C                                                                       S1      48
      IF(ISNDX(I).EQ.11) CALL MCARLO (DUM, 1, IDO)                      S1      49
      IF(ISNDX(I).EQ.12) CALL MCARLO (DUM, 1, IDO)                      S1      50
      IF(ISNDX(I).EQ.450) CALL MCARLO (DUM, 1, IDO)                     S1      51
      IF(ABS(BY).GT.0. ) BY = SIGN(1.,BY)                               S1      52
      IF(ABS(BZ).GT.0. ) BZ = SIGN(1.,BZ)                               S1      53
C                                                                       S1      54
C  MONTE CARLO SEEKER POINTING ERROR                                    S1      55
C                                                                       S1      56
      IF(ISNDX(I).EQ.470) CALL MCARLO (DUM, 1, IDO)                     S1      57
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      IF(ISNDX(I).EQ.471) CALL MCARLO (DUM, 1, IDO)               S1    58
C                                                                  S1    59
C ** MONTECARLO SEEKER DRIFT                                       S1    60
      IF(ISNDX(I).EQ.465) CALL MCARLO (DUM, 1, IDO)               S1    61
      IF(ISNDX(I).EQ.466) CALL MCARLO (DUM, 1, IDO)               S1    62
C                                                                  S1    63
   10 CONTINUE                                                     S1    64
      BTHTG = BTHTG + BTGERR                                       S1    65
      BPSIG = BPSIG + BPGERR                                       S1    66
C                                                                  S1    67
      WLQS=SWP*(BTHTG-BPSIG)                                       S1    68
      WLQ=SWP*(BTHTG-BPSIG)                                        S1    69
      WLR=SWP*(BTHTG+BPSIG)                                        S1    70
      WLRS=SWP*(BTHTG+BPSIG)                                       S1    71
      C(13) = -1.                                                  S1    72
      DERSV=.002                                                   LAG    4
      C(461)=0.                                                    S1    73
      C(462)=0.                                                    S1    74
      C(463)=0.                                                    S1    75
      C(464)=0.                                                    S1    76
      IF(OPTN4.GT.1.) GO TO 30                                     S1    77
      C(461)=1.                                                    S1    78
      C(462)=1.                                                    S1    79
      C(463)=1.                                                    S1    80
      C(464)=1.                                                    S1    81
   30 CONTINUE                                                     S1    82
      NI=1                                                         S1    83
      MI=1                                                         S1    84
      SET=0.                                                       S1    85
      DO 200 I=1,50                                                S1    86
      IZ(I)=0                                                      S1    87
  200 IY(I)=0                                                      S1    88
      RETURN                                                       S1    89
      ENTRY QD                                                     S1    90
      IF(SET.GT.0.) RETURN                                         S1    91
      IF(NI.GT.50) RETURN                                          S1    92
      IF(MI.LE.10) GO TO 100                                       S1    93
      NI=NI+1                                                      S1    94
      MI=1                                                         S1    95
  100 IZ(NI)=IZ(NI)+INT(BZ+2.)*10**(10-MI)                        S1    96
      IY(NI)=IY(NI)+INT(BY+2.)*10**(10-MI)                        S1    97
      MI=MI+1                                                      S1    98
      RETURN                                                       S1    99
      ENTRY S8                                                     S1   100
      IF(SET.GT.0..OR.KSTEP.NE.2) RETURN                           S1   101
      SET=1.                                                       S1   102
      WRITE(6,1) (IZ(I),I=1,NI)                                    S1   103
      WRITE(6,2) (IY(I),I=1,NI)                                    S1   104
      RETURN                                                       S1   105
      END                                                          S1   106
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SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS    DEF LINE    REFERENCES
  126  QU           31        92        93       106
    1  S1I           1        30
  160  S8          101       102       105

VARIABLES     SN  TYPE            RELOCATION
  726  BPGERR     REAL                  / /     REFS       7      56
  656  BPSIG      REAL                  / /     REFS      24      66      68      69      70      71
                                                DEFINED   56
  725  BTGERR     REAL                  / /     REFS       6      65
  652  BTHTG      REAL                  / /     REFS      23      65      68      69      70      71
                                                DEFINED   65
   12  BY         REAL                  / /     REFS      12    2*52      98  DEFINED     40      52
   13  BZ         REAL                  / /     REFS      13    2*53      37  DEFINED     41      53
    0  C          REAL       ARRAY      / /     REFS       3     2*5       6       7       8       9      12
                                                  13      14      15      16      18      19      20      21
                                                  22      23      24      25      26      27      28
                                                DEFINED   36      37      38      39      72      74      75
                                                  75      77      79      80      81      82
 1156  DERSV      REAL                  / /     REFS      28  DEFINED     73
  244  DUM        REAL                          REFS      49      50      51      57      58      61      62
  242  I          INTEGER                       REFS      45      49      50      51      57      58      61
                                                  62      88      89     104     105  DEFINED     44      87
                                                 104     105
  243  IDO        INTEGER                       REFS      49      50      51      57      58      61      62
                                                DEFINED   45
 5001  IPL        INTEGER    ARRAY      / /     REFS      17      26  DEFINED     29      30      31      32
                                                  33      34
 7061  ISNDX      INTEGER    ARRAY      / /     REFS       4       5      49      50      51      57      58
                                                  61      62
 1211  IY         INTEGER    ARRAY      / /     REFS       4      15      98     105  DEFINED     89      98
 1127  IZ         INTEGER    ARRAY      / /     REFS       4      15      97     104  DEFINED     88      97
 6667  I3512      INTEGER               / /     REFS       5      44
 3732  KSTEP      INTEGER               / /     REFS      14     102
  246  MI         INTEGER                       REFS      34      97      99      99  DEFINED     85      96
                                                  99
 5000  N          INTEGER               / /     REFS      25      29      30      31      32      33      34
                                                  35  DEFINED     35
  245  NI         INTEGER                       REFS      33      95    2*97    2*98     104     105
                                                DEFINED   94      95
 6657  OPTN4      REAL                  / /     REFS      27      78
  720  SDY        REAL                  / /     REFS       8  DEFINED     42
  721  SDZ        REAL                  / /     REFS       9  DEFINED     43
  247  SET        REAL                          REFS      32     102  DEFINED     86     103
  703  SWP        REAL                  / /     REFS      18      58      69      70      71
  632  WLQ        REAL                  / /     REFS      19  DEFINED     69
  642  WLQS       REAL                  / /     REFS      21  DEFINED     68
  636  WLR        REAL                  / /     REFS      20  DEFINED     70
  646  WLRS       REAL                  / /     REFS      22  DEFINED     71

FILE NAMES        MODE
     TAPE6        FMT                         WRITES     104     105
```

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        SUBROUTINE SII          74/74    OPT=1                    FTN 4.2+75067     05/05/75  16.17.45.     PAGE   4

EXTERNALS          TYPE   ARGS      REFERENCES
      MCARLO                3           43        50       51       57       58       61       62

 INLINE FUNCTIONS    TYPE    ARGS         DEF LINE  REFERENCES
      ABS            REAL      1  INTRIN               52       53
      INT            INTEGER   1  INTRIN               97       98
      SIGN           REAL      2  INTRIN               52       53

STATEMENT LABELS                DEF LINE   REFERENCES
   213  1        FMT               10        104
   220  2        FMT               11        105
     0  10                         64         44
   116  30                         83         78
   140  100                        97         94
     0  200                        89         87

LOOPS  LABEL      INDEX      FROM-TO     LENGTH     PROPERTIES
   22  10       * I          44 64        523                      EXT REFS
  123  200        I          87 89         28       INSTACK

COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
   / /            3830              0 C      (3830)

 EQUIV CLASSES    LENGTH     MEMBERS - BIAS NAME(LENGTH)
G        C          3836              10 BY      (1)          11 BZ      (1)          410 WLQ    (1)
                                     414 WLR     (1)         418 WLAS    (1)          422 WLRS   (1)
                                     425 BTHTG   (1)         430 BPSIG   (1)          451 SHP    (1)
                                     464 SDY     (1)         465 SDZ     (1)          469 BTGERR (1)
                                     473 BPSERR  (1)         599 IZ      (50)         622 DERSV  (1)
                                     649 IY      (50)       2010 KSTCP   (1)         2550 N      (1)
                                    2561 IPL     (100)      3583 OPTN4   (1)         3511 I3512  (1)
                                    3633 ISNDX   (40)

 STATISTICS
   PROGRAM LENGTH                   2503      168
   CM BLANK COMMON LENGTH          73663     3830
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      SUBROUTINE S1                                                  S1     107
C**SEEKER MODULE                                                     S1     108
C                                                                    S1     109
      COMMON C(3330)                                                 S1     110
      EQUIVALENCE (C(2000),T      )                                  S1     111
  101 FORMAT (30H    TARGET ACQUISITION    T = ,F8.4,                S1     112
     *       10H   EPS Z = ,1PE11.3,10H   EPS Y = ,1PE11.3)          S1     113
  102 FORMAT (30H      PITCH PLANE TRACK   T = ,F8.4,                S1     114
     *       10H   EPS Z = ,1PE11.3,10H   EPS Y = ,1PE11.3)          S1     115
  103 FORMAT (30H        YAW   PLANE TRACK   T = ,F8.4,              S1     116
     *       10H   EPS Z = ,1PE11.3,10H   EPS Y = ,1PE11.3)          S1     117
C                                                                    S1     118
C**INPUT DATA                                                        S1     119
      EQUIVALENCE (C( 443),RLOCK )                                   S1     120
      EQUIVALENCE (C( 445),DT    )                                   S1     121
      EQUIVALENCE (C( 447),BOB   )                                   S1     122
      EQUIVALENCE (C( 448),CFOVZ )                                   S1     123
      EQUIVALENCE (C( 449),CFOVY )                                   S1     124
      EQUIVALENCE (C( 450),GSX   )                                   S1     125
      EQUIVALENCE (C( 451),SEPS  )                                   S1     126
      EQUIVALENCE (C( 452),SWP   )                                   S1     127
      EQUIVALENCE (C( 453),RBK   )                                   S1     128
      EQUIVALENCE (C( 454),GEO   )                                   S1     129
      EQUIVALENCE (C( 455),OPTNSK)                                   S1     130
      EQUIVALENCE (C(0456),GS    )                                   S1     131
      EQUIVALENCE (C(0457),WSL   )                                   S1     132
      EQUIVALENCE (C(0458),WSN   )                                   S1     133
      EQUIVALENCE (C(0459),WLZ   )                                   S1     134
C                                                                    S1     135
      EQUIVALENCE (C( 460),ST    )                                   S1     136
      EQUIVALENCE (C( 461),CAGE  )                                   S1     137
      EQUIVALENCE (C( 462),TKRZ  )                                   S1     138
      EQUIVALENCE (C( 463),TKRY  )                                   S1     139
      EQUIVALENCE (C( 464),TRKZY )                                   S1     140
C                                                                    S1     141
C**INPUTS FROM OTHER MODULES                                         S1     142
      EQUIVALENCE (C(0371),RANGE )                                   S1     143
      EQUIVALENCE (C(0372),RXBA  )                                   S1     144
      EQUIVALENCE (C(0373),RYBA  )                                   S1     145
      EQUIVALENCE (C(0374),RZBA  )                                   S1     146
      EQUIVALENCE (C(1739),WP    )                                   S1     147
      EQUIVALENCE (C(1743),WQ    )                                   S1     148
      EQUIVALENCE (C(1747),WR    )                                   S1     149
C                                                                    S1     150
C**STATE VARIABLE OUTPUTS                                            S1     151
      EQUIVALENCE (C(0408),WLQD  )                                   S1     152
      EQUIVALENCE (C(0411),WLQ   )                                   S1     153
      EQUIVALENCE (C(0412),WLRD  )                                   S1     154
      EQUIVALENCE (C(0415),WLR   )                                   S1     155
      EQUIVALENCE (C(0416),WLQSD )                                   S1     156
      EQUIVALENCE (C(0419),WLQS  )                                   S1     157
      EQUIVALENCE (C(0420),WLRSD )                                   S1     158
      EQUIVALENCE (C(0423),WLRS  )                                   S1     159
      EQUIVALENCE (C(0424),BTHTGD)                                   S1     160
      EQUIVALENCE (C(0427),BTHTG )                                   S1     161
      EQUIVALENCE (C(0428),BPSIGD)                                   S1     162
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      C                                                              S1       164
      C**OTHER-OUTPUTS                                               S1       165
            EQUIVALENCE (C(11),BY)                                   S1       166
            EQUIVALENCE (C(12),BZ)                                   S1       167
            EQUIVALENCE (C(0403),WLAMQ )                             S1       168
            EQUIVALENCE (C(0407),WLAMR )                             S1       169
            EQUIVALENCE (C(0435),BEPSZ )                             S1       170
            EQUIVALENCE (C(0436),BEPSY )                             S1       171
            EQUIVALENCE (C(0437),WZ    )                             S1       172
            EQUIVALENCE (C(0438),WY    )                             S1       173
            EQUIVALENCE (C(0439),BGDEFL)                             S1       174
            EQUIVALENCE (C( 465),   SDY)                             S1       175
            EQUIVALENCE (C( 465),   SDZ)                             S1       176
      C                                                              S1       177
      C**DIRECTION COSINES FOR BODY TO PLATFORM TRANSFORMATION       S1       178
            BTACT = BTHTG                                            S1       179
            BPACT = BPSIG                                            S1       180
            UCT=COSD(BTACT)                                          S1       181
            UST=SIND(BTACT)                                          S1       182
            UCP=COSD(BPACT)                                          S1       183
            USP=SIND(BPACT)                                          S1       184
            UB11 = UCT*UCP                                           S1       185
            UB12 = UCT*USP                                           S1       186
            UB13 =-UST                                               S1       187
            UB21 =-USP                                               S1       188
            UB22 = UCP                                               S1       189
            UB23 = 0.                                                S1       190
            UB31 = UST*UCP                                           S1       191
            UB32 = UST*USP                                           S1       192
            UB33 = UCT                                               S1       193
      C                                                              S1       194
      C** CALCULATE TOTAL DEFLECTION OF GIMBALS                      S1       195
            BGDEFL=SQRT(BTHTG**2+BPSIG**2)                           S1       196
      C                                                              S1       197
      C**TRANSFORM LOS FROM BODY TO GIMBAL AXES                      S1       198
            RXG = UB11*RXBA+UB12*RYBA+UB13*RZBA                      S1       199
            RYG = UB21*RXBA+UB22*RYBA+UB23*RZBA                      S1       200
            RZG = UB31*RXBA+UB32*RYBA+UB33*RZBA                      S1       201
      C                                                              S1       202
      C**LOS ERRORS IN PLATFORM COORDINATES                          S1       203
            BEPSZ = ATAND(-RZG,RXG)                                  S1       204
            BEPSY = ATAND( RYG,RXG)                                  S1       205
      C                                                              S1       206
      C**SEEKER OUTPUT SIGNALS                                       S1       207
            IF (OPTNSK.LE.0.) GO TO 80                               S1       208
      C                                                              S1       209
      C**VIDICON TRACKER                                             S1       210
            IF (RANGE .LT. R3K) RETURN                               S1       211
            WLAMQ = GEO*BEPSZ                                        S1       212
            WLAMR = GEO*BEPSY                                        S1       213
            GO TO 30                                                 S1       214
      C                                                              S1       215
      C**QUADRENT TRACKER                                            S1       216
         80 CONTINUE                                                 S1       217
            IF(C(1975).LE.0.) GO TO 82                               S1       218
            IF(T.LT.(ST-.000001)) GO TO 82                           S1       219
            IF(C(13).LE.0.) GO TO 820                                S1       220
```

```
      C(13) = -1.
      ST = T
      C(2664) = DT / AINT(DT / C(2764))
  820 CONTINUE
      ST = ST + DT
      IF (RANGE .GT. RLOCK) GO TO 81
      CZ = 2.*BEPSZ/CFOVZ
      CY = 2.*BEPSY/CFOVY
      IF (CZ**2 .GT. 1.-CY**2) GO TO 81
      BZ = SIGN(1.,BEPSZ)
      BY = SIGN(1.,BEPSY)
      TKDB = BDB/2.*(RANGE/32810.)**2
      IF (ABS(BEPSZ).LT.TKDB) BZ = 0.
      IF (ABS(BEPSY).LT.TKDB) BY = 0.
      CALL GD
      IF (CAGE .GT. 0.) GO TO 82
      UZ = BZ
      UY = BY
      CAGE = 1.
      WRITE(6,101) T, BEPSZ, BEPSY
      GO TO 82
   81 BZ = 0.
      BY = 0.
C**SEEKER COMPENSATION
   82 WLAMQ = BZ*GS
      WLAMR = BY*GS
      WQP = WLAMQ
      WRP = WLAMR
      IF (WSL .LE. 0.) GO TO 83
      WLQD = WLAMQ
      WLRD = WLAMR
      WLQD = WLQD + SEPS
      WLRD = WLRD + SEPS
      WQP = WLQD/WSL + WLQ
      WRP = WLRD/WSL + WLR
      WLAMQ = WQP
      WLAMR = WRP
      IF (WSN .LE. 0.) GO TO 83
      WLQSD = WSN*(WQP - WLQS)
      WLRSD = WSN*(WRP - WLRS)
      WQP = WLQSD/WL2 + WLQS
      WRP = WLRSD/WL2 + WLRS
C**SEEKER SWITCHING LOGIC
   83 IF (CAGE .LE. 0.) GO TO 30
C  PITCH PLANE
   16 IF (TKRZ .GT. 0.) GO TO 20
      IF (BZ*UZ .GE. 0.) GO TO 12
      TKRZ = 1.
      WRITE(6,102) T, BEPSZ, BEPSY
      GO TO 20
   12 WLAMQ = BZ*GSX
      WQP = WLAMQ
      WLQD = 0.
      WLQSD = 0.
      UZ = BZ
C  YAW PLANE
   20 IF (TKRY .GT. 0.) GO TO 30
```

```
      IF (BY*UY .GE. 0.) GO TO 22                                       S1     278
      TKRY = 1.                                                         S1     279
      WRITE(5,103) T, BEPSZ, BEPSY                                      S1     280
      GO TO 30                                                          S1     281
   22 WLAMR = BY*GSX                                                    S1     282
      WRP = WLAMR                                                       S1     283
      WLRD = 0.                                                         S1     284
      WLRSD = 0.                                                        S1     285
      UY = BY                                                           S1     286
   36 CONTINUE                                                          S1     287
C                                                                       S1     288
C**MISSILE BODY RATES IN GIMBAL AXES                                    S1     289
      WZ = UB31*WP+UB32*WQ+UB33*WR                                      S1     290
      WY = UB21*WP+UB22*WQ+UB23*WR                                      S1     291
C                                                                       S1     292
C**GIMBAL COUPLING                                                      S1     293
      UZK = SKP*(-BTHIG + .1*BPSIG)                                     S1     294
      UYK = SKP*(-BPSIG - .1*BTHIG)                                     S1     295
      UZK = UZK + SDZ                                                   S1     296
      UYK = UYK + SDY                                                   S1     297
C                                                                       S1     298
C**GIMBAL ANGLE DERIVATIVES                                             S1     299
      BTHIGD = WQP + UZK - WY                                           S1     300
      BPSIGD = WRP + UYK - WZ/UB33                                      S1     301
C                                                                       S1     302
      IF (CAGE .GT. 0.) RETURN                                          S1     303
      WLAMQ = 0.                                                        S1     304
      WLAMR = 0.                                                        S1     305
      WLQD = 0.                                                         S1     306
      WLRD = 0.                                                         S1     307
      WLQSD = 0.                                                        S1     308
      WLRSD = 0.                                                        S1     309
      BTHIGD = 0.                                                       S1     310
      BPSIGD = 0.                                                       S1     311
      RETURN                                                            S1     312
      END                                                               S1     313
C**HELFIRE AUTOPILOT INITIATION MODULE                                  S1     314
C**HIGH FREQ. MODEL                                                     S1     315
```

```
      SUBROUTINE S1          74/74   OPT=1                                        FTN 4.2+75067      05/05/75  16.17.47.     PAGE   5

          SYMBOLIC REFERENCE MAP (R=2)

 ENTRY POINTS     DEF LINE     REFERENCES
     1  S1             1        105     137     206

 VARIABLES        SN  TYPE              RELOCATION
     676  BOB         REAL                  / /      REFS       16       126
     663  BEPSY       REAL                  / /      REFS       65       107      122      125      128      134      163
                                                       174  DEFINED       99
     662  BEPSZ       REAL                  / /      REFS       64       106      121      124      127      134      163
                                                       174  DEFINED       98
     666  BGDEFL      REAL                  / /      REFS       58   DEFINED       90
     364  BPACT       REAL                           REFS       77        78  DEFINED       74
     656  BPSIG       REAL                  / /      REFS       57        74       90      188      189
     653  BPSIGD      REAL                  / /      REFS       56   DEFINED      195      205
     363  BTACT       REAL                           REFS       75        76  DEFINED       73
     652  BTHTG       REAL                  / /      REFS       55        73       90      188      189
     647  BTHTGD      REAL                  / /      REFS        4   DEFINED      194      204
      12  BY          REAL                  / /      REFS       60       132      140      172      176      180
                                                  DEFINED      125       128      137
      13  BZ          REAL                  / /      REFS       61       131      139      161      165      159
                                                  DEFINED      124       127      136
       0  C           REAL      ARRAY       / /      REFS        4         5       14       15       16       17       18
                                                        19      20        21       22       23       24       25       26
                                                        27      28        30       31       32       33       34       37
                                                        38      39        40       41       42       43       46       47
                                                        48      49        50       51       52       53       54       55
                                                        55      57        60       61       62       63       64       65
                                                        66      67        68       69       70      112      114      114
                                                  DEFINED      115       117
     714  CAGE        REAL                  / /      REFS       31       130      158      197  DEFINED      133
     700  CFOVY       REAL                  / /      REFS       18       122
     677  CFOVZ       REAL                  / /      REFS       17       121
     406  CY          REAL                           REFS      123   DEFINED      122
     405  CZ          REAL                           REFS      123   DEFINED      121
     675  DT          REAL                  / /      REFS       15     2*117      119
     705  GEO         REAL                  / /      REFS       23       106      107
     707  GS          REAL                  / /      REFS       25       139      140
     701  GSX         REAL                  / /      REFS       19       165      176
     706  OPTNSK      REAL                  / /      REFS       24       102
     562  RANGE       REAL                  / /      REFS       37       105      120      126
     704  RBK         REAL                  / /      REFS       22       105
     674  RLOCK       REAL                  / /      REFS       14       120
     563  RXBA        REAL                  / /      REFS       38        93       94       95
     402  RXG         REAL                           REFS       98        99  DEFINED       93
     564  RYBA        REAL                  / /      REFS       39        93       94       95
     403  RYG         REAL                           REFS       99   DEFINED       94
     565  RZBA        REAL                  / /      REFS       40        93       34       95
     404  RZG         REAL                           REFS       98   DEFINED       95
     720  SDY         REAL                  / /      REFS       69       191
     721  SDZ         REAL                  / /      REFS       70       190
     702  SEPS        REAL                  / /      REFS       20       146      147
     713  ST          REAL                  / /      REFS       30       113      119  DEFINED      116      119
     703  SWP         REAL                  / /      REFS       21       186      189
    3717  T           REAL                  / /      REFS        5       113      116      134      163      174
     407  TKDB        REAL                           REFS      127       128  DEFINED      126
     716  TKRY        REAL                  / /      REFS       33       171  DEFINED      173
```

```
VARIABLES     SN   TYPE          RELOCATION
   715  TKRZ      REAL               / /        REFS     32     160   DEFINED    162
   717  TRKZY     REAL               / /        REFS     34
   371  UB11      REAL                          REFS     33   DEFINED     79
   372  UB12      REAL                          REFS     33   DEFINED     80
   373  UB13      REAL                          REFS     33   DEFINED     81
   374  UB21      REAL                          REFS     34     185   DEFINED     82
   375  UB22      REAL                          REFS     34     185   DEFINED     83
   376  UB23      REAL                          REFS     34     185   DEFINED     84
   377  UB31      REAL                          REFS     35     184   DEFINED     85
   400  UB32      REAL                          REFS     35     184   DEFINED     86
   401  UB33      REAL                          REFS     35     184     195   DEFINED     87
   367  UCP       REAL                          REFS     79      83      85   DEFINED     77
   365  UCT       REAL                          REFS     79      80      87   DEFINED     75
   370  USP       REAL                          REFS     50      82      86   DEFINED     78
   366  UST       REAL                          REFS     51      85      86   DEFINED     76
   411  UY        REAL                          REFS    172   DEFINED    132     180
   415  UYK       REAL                          REFS    131     195   DEFINED    189     191
   410  UZ        REAL                          REFS    151   DEFINED    131     169
   414  UZK       REAL                          REFS    130     194   DEFINED    188     130
   622  WLANQ     REAL               / /        REFS     52     141     144     166   DEFINED    186     139
                                                 150    165     196
   626  WLANR     REAL               / /        REFS     53     142     145     177   DEFINED    187     140
                                                 151    176     139
   632  WLQ       REAL               / /        REFS     47     148
   627  WLQD      REAL               / /        REFS     46     146     148   DEFINED    144     146     167
                                                 200
   642  WLQS      REAL               / /        REFS     51     153     155
   637  WLQSD     REAL               / /        REFS     50     155   DEFINED    153     158     202
   636  WLR       REAL               / /        REFS     49     149
   633  WLRD      REAL               / /        REFS     48     147     149   DEFINED    145     147     178
                                                 201
   646  WLRS      REAL               / /        REFS     53     154     156
   643  WLRSD     REAL               / /        REFS     52     156   DEFINED    154     179     203
   712  WL2       REAL               / /        REFS     28     155     156
  3312  WP        REAL               / /        REFS     41     184     185
  3316  WQ        REAL               / /        REFS     42     184     185
   412  WQP       REAL                          REFS    150     153     134   DEFINED    141     148     155
                                                 166
  3322  WR        REAL               / /        REFS     43     184     185
   413  WRP       REAL                          REFS    151     154     195   DEFINED    142     149     156
                                                 177
   710  WSL       REAL               / /        REFS     26     143     148     149
   711  WSN       REAL               / /        REFS     27     152     153     154
   665  WY        REAL               / /        REFS     57     194   DEFINED    185
   664  WZ        REAL               / /        REFS     56     195   DEFINED    184

 FILE NAMES       MODE
      TAPE6       FMT                   WRITES     134     153     174

 EXTERNALS         TYPE   ARGS         REFERENCES
      ATAND        REAL     2              93      93
      COSD         REAL     1              75      77
      QG                    6             123
      SIND         REAL     1              75      76
      SQRT         REAL     1 LIBRARY      93
```

```
INLINE FUNCTIONS   TYPE   ARGS         DEF LINE  REFERENCES
     ABS           REAL     1  INTRIN              127      128
     AINT          REAL     1  INTRIN              117
     SIGN          REAL     2  INTRIN              124      125

STATEMENT LABELS              DEF LINE   REFERENCES
      0   10         INACTIVE    160
    202   12                     165      151
    207   20                     171      153      164
    217   22                     175      172
    224   30                     181      108      158      171      175
     61   80                     111      102
    135   81                     135      121      123
    137   82                     139      112      113      130      135
    171   83                     158      143      152
    274  101      FMT              5      134
    306  102      FMT              8      163
    320  103      FMT             10      174
     74  820                     118      114

COMMON BLOCKS   LENGTH   MEMBERS - BIAS NAME(LENGTH)
   / /           3830         0 C      (3830)

EQUIV CLASSES   LENGTH   MEMBERS - BIAS NAME(LENGTH)
 C       C       3830        10 BY      (1)       11 BZ      (1)      370 RANGE   (1)
                            371 RX3A    (1)      372 RY3A    (1)      373 RZ3A    (1)
                            402 W_AMQ   (1)      405 WLAMR   (1)      407 WLQD    (1)
                            410 WLQ     (1)      411 WLRD    (1)      414 WLR     (1)
                            415 WLQSD   (1)      418 WLQS    (1)      419 WLRSD   (1)
                            422 WLRS    (1)      423 BTHTGD  (1)      426 BTHTG   (1)
                            427 BPSIGD  (1)      430 BPSIG   (1)      434 BEPSZ   (1)
                            435 BEPSY   (1)      436 WZ      (1)      437 WY      (1)
                            438 BGDEF   (1)      444 RLOCK   (1)      445 DT      (1)
                            446 BD3     (1)      447 CFOVZ   (1)      448 CFOVY   (1)
                            449 GSX     (1)      450 SEPS    (1)      451 SWP     (1)
                            452 KBK     (1)      453 GEO     (1)      454 OPTNSK  (1)
                            455 GS      (1)      455 WS      (1)      457 WSN     (1)
                            458 W_2     (1)      459 ST      (1)      460 CAGE    (1)
                            461 TKRZ    (1)      462 TKRY    (1)      463 TKRZY   (1)
                            464 SDY     (1)      465 SDZ     (1)     1738 WP      (1)
                           1742 WQ      (1)     1746 WR      (1)     1999 T       (1)

STATISTICS
  PROGRAM LENGTH               4168      270
  CM BLANK COMMON LENGTH      73668B    3830
```

```
      SUBROUTINE C1I                                          C1       2
      COMMON C(3830)                                          C1       3
      DIMENSION IPL(10))                                      C1       4
      EQUIVALENCE (C(2561),N    )                             C1       5
      EQUIVALENCE (C(2562),IPL   )                            C1       6
C                                                             C1       7
      IPL(N  ) = 800                                          C1       8
      IPL(N+1) = 804                                          C1       9
      IPL(N+2) = 808                                          C1      10
      IPL(N+3) = 812                                          C1      11
      IPL(N+4) = 816                                          C1      12
      IPL(N+5) = 820                                          C1      13
      IPL(N+6) = 824                                          C1      14
      IPL(N+7) = 828                                          C1      15
      IPL(N+8) = 832                                          C1      16
      IPL(N+9) = 836                                          C1      17
      IPL(N+10) = 840                                         C1      18
      IPL(N+11) = 844                                         C1      19
      IPL(N+12) = 848                                         C1      20
      IPL(N+13) = 852                                         C1      21
      N = N+14                                                C1      22
      C(803) = 0.                                             C1      23
      C(807) = 0.                                             C1      24
      C(811) = 0.                                             C1      25
      C(815) = 0.                                             C1      26
      C(819) = 0.                                             C1      27
      C(823) = 0.                                             C1      28
      C(827) = 0.                                             C1      29
      C(831) = 0.                                             C1      30
      C(835) = 0.                                             C1      31
      C(839) = 0.                                             C1      32
      C(843) = 0.                                             C1      33
      C(847) = 0.                                             C1      34
      C(851) = 0.                                             C1      35
      C(855) = 0.                                             C1      36
      C( 811) = C( 878) + C (851)                             C1      37
      C( 823) = C( 879)                                       C1      38
      C( 831) =-C(1233)                                       C1      39
      C( 847) =-C( 831)                                       C1      40
      C( 839) = C( 831)                                       C1      41
      IF (C(877) .LE. 0.) RETURN                              C1      42
      IPL(N  ) = 901                                          C1      43
      IPL(N+1) = 905                                          C1      44
      IPL(N+2) = 909                                          C1      45
      C( 904) = 0.                                            C1      46
      C( 908) = 0.                                            C1      47
      C( 912) = 0.                                            C1      48
      RETURN                                                  C1      49
      END                                                     C1      50
C**HELFIRE AUTOPILOT MODULE                                   C1      51
C**HIGH FREQ MODEL (USE DER = .0025)                           C1      52
```

```
         SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS      DEF LINE     REFERENCES
       1  C1I             1           41      45

  VARIABLES      SN  TYPE             RELOCATION
       0  C          REAL        ARRAY    / /          REFS      2        4        5      2*36      37       38       39
                                                         40     41  DEFINED       22       23       24       25       26
                                                         27     28       29       30       31       32       33       34
                                                         35     36       37       38       39       40       45       46
                                                         47
    5001  IPL        INTEGER     ARRAY    / /          REFS      3        5  DEFINED        7        8        9       10
                                                         11     12       13       14       15       16       17       18
                                                         19     20       42       43       44
    5000  N          INTEGER              / /          REFS      4        7        8        9       10       11       12
                                                         13     14       15       16       17       18       19       20
                                                         21     42       43       44  DEFINED       21

  COMMON BLOCKS    LENGTH     MEMBERS - BIAS NAME(LENGTH)
      / /           3830               0 C       (3830)

  EQUIV-CLASSES    LENGTH     MEMBERS - BIAS NAME(LENGTH)
  C       C         3830            2560 N      (1)             2551 IPL     (10)

  STATISTICS
    PROGRAM LENGTH                  553      45
    CM BLANK COMMON LENGTH        73663    3830
```

```
      SUBROUTINE C1                                   C1      53
      COMMON C(3830)                                  C1      54
      DIMENSION BDELTC(4),VAR(101)                    C1      55
C                                                     C1      56
C**INPUT DATA                                          C1      57
      EQUIVALENCE (C( 850),TDY   )                    C1      58
      EQUIVALENCE (C( 851),GBIAS )                    C1      59
      EQUIVALENCE (C( 852),GN    )                    C1      60
      EQUIVALENCE (C( 853),WN2   )                    C1      61
      EQUIVALENCE (C( 854),WN1   )                    C1      62
      EQUIVALENCE (C( 855),WL    )                    C1      63
      EQUIVALENCE (C( 856),WLXX1 )                    C1      64
      EQUIVALENCE (C( 857),WLXX2 )                    C1      65
      EQUIVALENCE (C( 858),WLJK1 )                    C1      66
      EQUIVALENCE (C( 859),WLJK2 )                    C1      67
      EQUIVALENCE (C( 870),HJK   )                    C1      68
      EQUIVALENCE (C( 871),HXX   )                    C1      69
      EQUIVALENCE (C( 872),DXX   )                    C1      70
      EQUIVALENCE (C( 873),WJK   )                    C1      71
      EQUIVALENCE (C( 874),DJK   )                    C1      72
      EQUIVALENCE (C( 875),GXX   )                    C1      73
      EQUIVALENCE (C( 876),GJK   )                    C1      74
      EQUIVALENCE (C( 877),RES   )                    C1      75
      EQUIVALENCE (C( 878),QBIAS )                    C1      76
      EQUIVALENCE (C( 879),RBIAS )                    C1      77
      EQUIVALENCE (C( 880),WXX   )                    C1      78
C                                                     C1      79
C**INPUTS FROM OTHER MODULES                           C1      80
      EQUIVALENCE (C(  77),SPHI  )                    C1      81
      EQUIVALENCE (C(  87),STHT  )                    C1      82
      EQUIVALENCE (C(  97),SPSI  )                    C1      83
      EQUIVALENCE (C( 353),BPHI  )                    C1      84
      EQUIVALENCE (C( 354),BTHZ  )                    C1      85
      EQUIVALENCE (C( 355),BPSI  )                    C1      86
      EQUIVALENCE (C( 403),WLAMQ )                    C1      87
      EQUIVALENCE (C( 407),WLAMR )                    C1      88
      EQUIVALENCE (C( 451),CAGE  )                    C1      89
      EQUIVALENCE (C( 452),TKRZ  )                    C1      90
      EQUIVALENCE (C( 453),TKRY  )                    C1      91
      EQUIVALENCE (C(1551),DTH   )                    C1      92
      EQUIVALENCE (C(1552),UPHI  )                    C1      93
      EQUIVALENCE (C(1553),UPSI  )                    C1      94
      EQUIVALENCE (C(1554),UTHT  )                    C1      95
C                                                     C1      96
C**INPUTS FROM MAIN PROGRAM                            C1      97
      EQUIVALENCE (C(2000),T     )                    C1      98
C                                                     C1      99
C** STATE-VARIABLE OUTPUTS                             C1     100
      EQUIVALENCE (C( 800),WLQSDD)                    C1     101
      EQUIVALENCE (C( 803),WLQSP )                    C1     102
      EQUIVALENCE (C( 804),WLQSD )                    C1     103
      EQUIVALENCE (C( 807),WLQS  )                    C1     104
      EQUIVALENCE (C( 808),WLQSSD)                    C1     105
      EQUIVALENCE (C( 811),WLQSS )                    C1     106
      EQUIVALENCE (C( 812),WLRSDD)                    C1     107
      EQUIVALENCE (C( 815),WLRSP )                    C1     108
      EQUIVALENCE (C( 816),WLRSD )                    C1     109
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```
      EQUIVALENCE (C( 819),WLRS  )
      EQUIVALENCE (C( 820),WLRSSD)
      EQUIVALENCE (C( 823),WLRSS )
      EQUIVALENCE (C( 824),BLQSSD)
      EQUIVALENCE (C( 827),BLQSS )
      EQUIVALENCE (C( 828),BLRSSD)
      EQUIVALENCE (C( 831),BLRSS )
      EQUIVALENCE (C( 832),BJJSDD)
      EQUIVALENCE (C( 835),BJJSP )
      EQUIVALENCE (C( 836),BJJSD )
      EQUIVALENCE (C( 839),BJJS  )
      EQUIVALENCE (C( 840),BKKSDD)
      EQUIVALENCE (C( 843),BKKSP )
      EQUIVALENCE (C( 844),BKKSD )
      EQUIVALENCE (C( 847),BKKS  )
      EQUIVALENCE (C( 848),BXXSDD)
      EQUIVALENCE (C( 851),BXXSP )
      EQUIVALENCE (C( 852),BXXSD )
      EQUIVALENCE (C( 855),BXXS  )
      EQUIVALENCE (C( 900),WNS   )
      EQUIVALENCE (C( 901),SNTH  )
      EQUIVALENCE (C( 904),STHP  )
      EQUIVALENCE (C( 905),SNPS  )
      EQUIVALENCE (C( 908),SPSP  )
      EQUIVALENCE (C( 909),SNPH  )
      EQUIVALENCE (C( 912),SPHP  )
C
C**OUTPUTS
      EQUIVALENCE (C( 856),BDELTC)
C
CM*OTHER OUTPUTS
      EQUIVALENCE (C( 880),BXX   )
      EQUIVALENCE (C( 881),BJJ   )
      EQUIVALENCE (C( 882),BKK   )
      EQUIVALENCE (C( 883),BXXSS )
      EQUIVALENCE (C( 884),BJJSS )
      EQUIVALENCE (C( 885),BKKSS )
      EQUIVALENCE (C( 886),BTHTS )
      EQUIVALENCE (C( 887),BPSIS )
C
C**GUIDANCE SIGNAL SHAPING
C**GUIDANCE SWITCHING
      WLQSD = WLQSP
      WLRSD = WLRSP
      WLQSDD = WN2*(WN2*(WLAMQ - WLQS) - 2.*WLQSD)
      WLRSDD = WN2*(WY2*(WLAMR - WLRS) - 2.*WLRSD)
      WQC = GN*(WLQSD/WL+WLQS) + GBIAS
      WRC = GN*(WLRSD/WL+WLRS) + RBIAS
      IF (TKRZ.GT.0. .AND. T.GT.TDY) GO TO 4
      WLQSDD = 0.
      WQC = QBIAS + GBIAS
      IF (CAGE.GT.0. .AND. T.GT.TDY) WQC = WLAMQ + GBIAS
    4 IF (TKRY .GT. 0.) GO TO 5
      WLRSDD = 0.
      WRC = RBIAS
      IF (CAGE .GT. 0.) WRC = WLAMR
    5 CONTINUE
```

```
      WLQSSD = WN1*(WQC - WLQSS)                                           C1   167
      WLRSSD = WN1*(WRC - WLRSS)                                           C1   168
      BLQSSD = WLQSS                                                       C1   169
      BLRSSD = WLRSS                                                       C1   170
C                                                                          C1   171
C**RATE GYRO DYNAMICS AND LIMITING                                         C1   172
      BTHTS = -BTH2                                                        C1   173
      BPSIS = -BPS1                                                        C1   174
      BXX   = -BPH1                                                        C1   175
      IF (RES .LE. 0.) GO TO 10                                            C1   176
      SNTH = WNS*(STHT - STHP)                                             C1   177
      SNPS = WNS*(SPSI - SPSP)                                             C1   178
      SNPH = WNS*(SPHI - SPHP)                                             C1   179
      BTHTS = -RES*AINT(BTH2/RES) + SNTH                                   C1   180
      BPSIS = -RES*AINT(BPS1/RES) + SNPS                                   C1   181
      BXX   = -RES*AINT(BPH1/RES) + SNPH                                   C1   182
   10 CONTINUE                                                             C1   183
      IF (OFTN .LE. 0.) GO TO 15                                           C1   184
      BTHTS = UTHT                                                         C1   185
      BPSIS = UPSI                                                         C1   186
      BXX   = UPHI                                                         C1   187
      BTH2 = -BTH2                                                         C1   188
      BPS1 = -BPS1                                                         C1   189
      BPH1 = -BPH1                                                         C1   190
   15 CONTINUE                                                             C1   191
C                                                                          C1   192
C**SUMMATION OF RATE DAMPING AND GUIDANCE SIGNALS AND THEIR DERIVATIVES    C1   193
      BJJ =-(BLRSS-BPSIS) - (BLQSS-BTHTS)                                  C1   194
      BKK =-(BLRSS-BPSIS) - (BLQSS-BTHTS)                                  C1   195
C                                                                          C1   196
C**GUIDANCE SIGNAL SHAPING AND LIMITING                                    C1   197
      BXXSD = BXXSP                                                        C1   198
      BJJSD = BJJSP                                                        C1   199
      BKKSD = BKKSP                                                        C1   200
      BXXSDD = WXX*(WXX*(BXX - BXXS) - 2.*DXX*BXXSD)                       C1   201
      BJJSDD = WJK*(WJK*(BJJ - BJJS) - 2.*DJK*BJJSD)                       C1   202
      BKKSDD = WJK*(WJK*(BKK - BKKS) - 2.*DJK*BKKSD)                       C1   203
      BXXSS = GXX*((BXXSDD + (WLXX1+WLXX2)*BXXSD)/(WLXX1*WLXX2) + BXXS)    C1   204
      BJJSS = GJK*((BJJSDD + (WLJK1+WLJK2)*BJJSD)/(WLJK1*WLJK2) + BJJS)    C1   205
      BKKSS = GJK*((BKKSDD + (WLJK1+WLJK2)*BKKSD)/(WLJK1*WLJK2) + BKKS)    C1   206
      IF (ABS(BJJSS) .GT. HJK) BJJSS = SIGN(HJK,BJJSS)                     C1   207
      IF (ABS(BKKSS) .GT. HJK) BKKSS = SIGN(HJK,BKKSS)                     C1   208
      IF (ABS(BXXSS) .GT. HXX) BXXSS = SIGN(HXX,BXXSS)                     C1   209
C                                                                          C1   210
C**COMMANDS TO ACTUATORS                                                   C1   211
      BDELTC(1) = BJJSS + BXXSS                                            C1   212
      BDELTC(2) = BKKSS + BXXSS                                            C1   213
      BDELTC(3) = BJJSS - BXXSS                                            C1   214
      BDELTC(4) = BKKSS - BXXSS                                            C1   215
      RETURN                                                               C1   216
      END                                                                  C1   217
```

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        SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS    DEF LINE    REFERENCES
     1   C1           1          154

 VARIABLES     SN  TYPE           RELOCATION
   1527  BDELTC    REAL       ARRAY   / /         REFS      3      86  DEFINED    160       161       162     163
   1560  BJJ       REAL               / /         REFS     90     150  DEFINED    142
   1566  BJJS      REAL               / /         REFS     58     150      153
   1503  BJJSD     REAL               / /         REFS     67     150      153  DEFINED       147
   1477  BJJSDD    REAL               / /         REFS     65     153  DEFINED    150
   1502  BJJSP     REAL               / /         REFS     66     147
   1563  BJJSS     REAL               / /         REFS     93   2*155      150      162  DEFINED       153     155
   1561  BKK       REAL               / /         REFS     91     151  DEFINED    143
   1516  BKKS      REAL               / /         REFS     72     151      154
   1513  BKKSD     REAL               / /         REFS     71     151      154  DEFINED       148
   1507  BKKSDD    REAL               / /         REFS     69     154  DEFINED    151
   1512  BKKSP     REAL               / /         REFS     70     148
   1564  BKKSS     REAL               / /         REFS     94   2*156      151      163  DEFINED       154     156
   1472  BLQSS     REAL               / /         REFS     62     142      143
   1467  BLQSSD    REAL               / /         REFS     51  DEFINED     117
   1476  BLRSS     REAL               / /         REFS     64     142      143
   1473  BLRSSD    REAL               / /         REFS     53  DEFINED     118
    540  BPHI      REAL               / /         REFS     32     123      130      138  DEFINED       138
   1566  BPSIS     REAL               / /         REFS     36     142      143  DEFINED    122       129     134
    542  BPSI      REAL               / /         REFS     34     122      129      137  DEFINED       137
   1565  BTHTS     REAL               / /         REFS     35     142      143  DEFINED    121       128     133
    541  BTH2      REAL               / /         REFS     33     121      128      136  DEFINED       136
   1557  BXX       REAL               / /         REFS     59     149  DEFINED    123       130       135
   1526  BXXS      REAL               / /         REFS     76     149      152
   1523  BXXSD     REAL               / /         REFS     75     149      152  DEFINED    146
   1517  BXXSDD    REAL               / /         REFS     73     152  DEFINED    149
   1522  BXXSP     REAL               / /         REFS     74     146
   1562  BXXSS     REAL               / /         REFS     92   2*157      160      161       162       163
                                               DEFINED    132     157
      0  C         REAL       ARRAY   / /         REFS      2       6        7        8         9        10      11
                                                    12     13      14       15       16        17        18      19
                                                    20     21      22       23       24        25        26      29
                                                    30     31      32       33       34        35        36      37
                                                    38     39      40       41       42        43        46      49
                                                    50     51      52       53       54        55        56      57
                                                    58     59      60       61       62        63        64      65
                                                    66     67      68       69       70        71        72      73
                                                    74     75      76       77       78        79        80      81
                                                    82     83      86       89       90        91        92      93
                                                    94     95      96
    714  CAGE      REAL               / /         REFS     37     109      113
   1551  DJK       REAL               / /         REFS     20     150      151
   1547  DXX       REAL               / /         REFS     18     149
   1534  GBIAS     REAL               / /         REFS      7     104      108      109
   1553  GJK       REAL               / /         REFS     22     153      154
   1535  GN        REAL               / /         REFS      8     104      105
   1552  GXX       REAL               / /         REFS     21     152
   1545  HJK       REAL               / /         REFS     16   2*155    2*156
   1571  HXX       REAL               / /         REFS     26   2*157
   3616  OPTM      REAL               / /         REFS     40     132
   1555  QBIAS     REAL               / /         REFS     24     108
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SUBROUTINE G1          74/74   OPT=1                          FTN 4.2+75067       05/05/75  16.17.53.        PAGE     5

VARIABLES      SN  TYPE           RELOCATION
  1556  RBIAS     REAL             / /        REFS     25       105      112
  1554  RES       REAL             / /        REFS     23       124      2*128     2*129     2*130
  1614  SNPH      REAL             / /        REFS     32       130     DEFINED    127
  1616  SNPS      REAL             / /        REFS     80       129     DEFINED    126
  1604  SNTH      REAL             / /        REFS     78       128     DEFINED    125
   114  SPHI      REAL             / /        REFS     29       127
  1617  SPHP      REAL             / /        REFS     53       127
   140  SPSI      REAL             / /        REFS     31       126
  1613  SPSP      REAL             / /        REFS     81       126
  1607  STHP      REAL             / /        REFS     79       125
   126  STHT      REAL             / /        REFS     30       125
  3717  T         REAL             / /        REFS     46       106      139
  1533  TOT       REAL             / /        REFS      6       106      109
   716  TKRY      REAL             / /        REFS     39       110
   715  TKRZ      REAL             / /        REFS     38       106
  3017  UPHI      REAL             / /        REFS     41       135
  3020  UPSI      REAL             / /        REFS     42       134
  3021  UTHT      REAL             / /        REFS     43       133
   211  VAR       REAL    *UNDEF              REFS      3
  1550  WJK       REAL             / /        REFS     19      2*150     2*151
  1540  WL        REAL             / /        REFS     11       104      105
   622  WLAMQ     REAL             / /        REFS     35       102      109
   626  WLAMR     REAL             / /        REFS     36       103      113
  1543  WLJK1     REAL             / /        REFS     14      2*153     2*154
  1544  WLJK2     REAL             / /        REFS     15      2*153     2*154
  1446  WLQS      REAL             / /        REFS     52       102      104
  1443  WLQSD     REAL             / /        REFS     51       102      104     DEFINED    108
  1437  WLQSDD    REAL             / /        REFS     49     DEFINED    102      107
  1442  WLQSP     REAL             / /        REFS     50       100
  1452  WLQSS     REAL             / /        REFS     54       115      117
  1447  WLQSSD    REAL             / /        REFS     53     DEFINED    115
  1462  WLRS      REAL             / /        REFS     58       103      105
  1457  WLRSD     REAL             / /        REFS     57       103      105     DEFINED    101
  1453  WLRSDD    REAL             / /        REFS     55     DEFINED    103      111
  1456  WLRSP     REAL             / /        REFS     56       131
  1466  WLRSS     REAL             / /        REFS     60       116      118
  1463  WLRSSD    REAL             / /        REFS     59     DEFINED    116
  1541  WLXX1     REAL             / /        REFS     12      2*152
  1542  WLXX2     REAL             / /        REFS     13      2*152
  1603  WNS       REAL             / /        REFS     77       125      126      127
  1537  WN1       REAL             / /        REFS     10       115      116
  1536  WN2       REAL             / /        REFS      9      2*102     2*103
   207  WQC       REAL                        REFS    115     DEFINED    104      108      109
   210  WRC       REAL                        REFS    116     DEFINED    105      112      113
  1546  WXX       REAL             / /        REFS     17      2*149

INLINE FUNCTIONS   TYPE   ARGS       DEF LINE  REFERENCES
       ABS         REAL    1  INTRIN            155     156      157
       AINT        REAL    1  INTRIN            128     129      130
       SIGN        REAL    2  INTRIN            155     156      157

STATEMENT LABELS                DEF LINE  REFERENCES
    33   4                        110        105
    42   5                        114        113
    77  10                        131        124
   110  15                        139        132
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    SUBROUTINE C1         74/74   OPT=1                          FTN 4.2+75067      05/15/75  16.17.53.       PAGE    6

 COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
     / /          3830                 0 C      (3830)

 EQUIV CLASSES   LENGTH      MEMBERS - BIAS NAME(LENGTH)
 C       C        3830               75 SPHI    (1)          85 STHT    (1)          96 SPSI    (1)
                                    352 BPH1    (1)         353 BTH2    (1)         354 BPSI    (1)
                                    402 WLAMQ   (1)         405 WLAMR   (1)         460 CAGE    (1)
                                    461 TKRZ*   (1)         462 TKRY    (1)         799 WLQSDD  (1)
                                    802 WLQSP   (1)         803 WLQSD   (1)         806 WLQS    (1)
                                    807 WLQSSD  (1)         810 WLQSS   (1)         811 WLRSDD  (1)
                                    814 WLRSP   (1)         815 WLRSD   (1)         818 WLRS    (1)
                                    819 WLRSSD  (1)         822 WLRSS   (1)         823 BLQSSD  (1)
                                    825 BLQSS   (1)         827 BLRSSD  (1)         830 BLRSS   (1)
                                    831 BJJSDD  (1)         834 BJJSP   (1)         835 BJJSD   (1)
                                    838 BJJS    (1)         839 BKKSDD  (1)         842 BKKSP   (1)
                                    843 BKKSD   (1)         846 BKKS    (1)         847 BXXSDD  (1)
                                    850 BKXSP   (1)         851 BKKSD   (1)         854 BXXS    (1)
                                    855 BJELTZ  (4)         859 TDY     (1)         860 GBIAS   (1)
                                    861 GN      (1)         862 WN2     (1)         863 WN1     (1)
                                    864 WL      (1)         865 WLKK1   (1)         866 WLXX2   (1)
                                    867 WLJK1   (1)         868 WLJK2   (1)         869 WJK     (1)
                                    870 WXX     (1)         871 DXX     (1)         872 WJK     (1)
                                    873 DJK     (1)         874 GXX     (1)         875 GJK     (1)
                                    876 RES     (1)         877 QBIAS   (1)         878 RBIAS   (1)
                                    879 BKX     (1)         880 BJJ     (1)         881 BKK     (1)
                                    882 BXXSS   (1)         883 BJJSS   (1)         884 BKKSS   (1)
                                    885 BTHTS   (1)         886 BPSIS   (1)         889 WXX     (1)
                                    893 WNS     (1)         900 SNTH    (1)         903 STHP    (1)
                                    904 SNPS    (1)         907 SPSP    (1)         908 SNPH    (1)
                                    911 SPHP    (1)        1550 OPTM    (1)        1551 UPHI    (1)
                                   1552 UPSI    (1)        1553 UTHT    (1)        1999 T       (1)

 STATISTICS
   PROGRAM LENGTH                3563      238
   CM BLANK COMMON LENGTH       73663     3830
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      SUBROUTINE C2I                                          C2       2
C**HELFIRE AUTOPILOT INITIATION MODULE                        C2       3
C**LOW  FREQ. MODEL                                           C2       4
      COMMON C(3830)                                          C2       5
      DIMENSION IPL(100)                                      C2       6
      EQUIVALENCE (C(2561),N      )                           C2       7
      EQUIVALENCE (C(2552),IPL    )                           C2       8
C                                                             C2       9
      IPL(N  ) = 800                                          C2      10
      IPL(N+1) = 804                                          C2      11
      IPL(N+2) = 808                                          C2      12
      IPL(N+3) = 812                                          C2      13
      IPL(N+4) = 815                                          C2      14
      IPL(N+5) = 820                                          C2      15
      IPL(N+6) = 824                                          C2      16
      IPL(N+7) = 828                                          C2      17
      N = N+8                                                 C2      18
      C(2662) = .305                                          C2      19
      C(2663) = .005                                          C2      20
      C(2664) = .305                                          C2      21
      C(803) = 0.                                             C2      22
      C(807) = 0.                                             C2      23
      C(811) = 0.                                             C2      24
      C(815) = 0.                                             C2      25
      C(819) = 0.                                             C2      26
      C(823) = 0.                                             C2      27
      C(827) = 0.                                             C2      28
      C(831) = 0.                                             C2      29
      C( 811) = C( 861)                                       C2      30
      IF (C( 462) .GT. 0.) RETURN                             C2      31
      C( 811) = C( 978) + C( 861)                             C2      32
      C( 823) = C( 879)                                       C2      33
      RETURN                                                  C2      34
      END                                                     C2      35
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SUBROUTINE C2I        74/74  OPT=1                 FTN 4.2+75067    05/05/75  16.23.42.       PAGE    2

      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS       DEF LINE     REFERENCES
      1  C2I            1          30      33

 VARIABLES      SN  TYPE         RELOCATION
     0  C           REAL         ARRAY   / /        REFS        4       6       7       29      30     2*31     32
                                                    DEFINED    18      19      20       21      22      23      24
                                                      25       26      27      28       29      31      32
  5001  IPL         INTEGER      ARRAY   / /        REFS        5       7    DEFINED     9      10      11      12
                                                      13       14      15      16
  5000  N           INTEGER *            / /        REFS        6       9      10       11      12      13      14
                                                      15       16      17    DEFINED    17

 COMMON BLOCKS  LENGTH     MEMBERS - BIAS NAME(LENGTH)
    / /          3830                 0 C      (3830)

 EQUIV CLASSES  LENGTH     MEMBERS - BIAS NAME(LENGTH)
  C      C       3830               2560 N     (1)                2561 IPL    (100)

 STATISTICS
   PROGRAM LENGTH                  36B     30
   CM BLANK COMMON LENGTH        7366B   3830
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      SUBROUTINE C2                                                     C2        35
C**HELFIRE AUTOPILOT MODULE                                             C2        37
C**LOW  FREQ MODEL (USE DER = .005)                                     C2        38
      COMMON C(3830)                                                    C2        39
      DIMENSION BDELTC(4),VAR(101)                                      C2        40
C                                                                       C2        41
C**INPUT DATA                                                           C2        42
      EQUIVALENCE (C( 860),TOY   )                                      C2        43
      EQUIVALENCE (C( 861),GBIAS )                                      C2        44
      EQUIVALENCE (C( 862),GN    )                                      C2        45
      EQUIVALENCE (C( 863),WN2   )                                      C2        46
      EQUIVALENCE (C( 864),WN1   )                                      C2        47
      EQUIVALENCE (C( 865),WL    )                                      C2        48
      EQUIVALENCE (C( 866),WLXX1 )                                      C2        49
      EQUIVALENCE (C( 867),WLXX2 )                                      C2        50
      EQUIVALENCE (C( 868),WLJK1 )                                      C2        51
      EQUIVALENCE (C( 869),WLJK2 )                                      C2        52
      EQUIVALENCE (C( 870),HJK   )                                      C2        53
      EQUIVALENCE (C( 875),GXX   )                                      C2        54
      EQUIVALENCE (C( 875),GJK   )                                      C2        55
      EQUIVALENCE (C( 878),QBIAS )                                      C2        56
      EQUIVALENCE (C( 879),RBIAS )                                      C2        57
      EQUIVALENCE (C(3504),OPTN4 )                                      C2        58
C                                                                       C2        59
C**INPUTS FROM OTHER MODULES                                            C2        60
      EQUIVALENCE (C( 353),BPH1  )                                      C2        61
      EQUIVALENCE (C( 354),BTH2  )                                      C2        62
      EQUIVALENCE (C( 355),BPSI  )                                      C2        63
      EQUIVALENCE (C( 393),BPH2  )                                      C2        64
      EQUIVALENCE (C( 403),WLAM2 )                                      C2        65
      EQUIVALENCE (C( 407),WLAMR )                                      C2        66
      EQUIVALENCE (C( 461), AGE  )                                      C2        67
      EQUIVALENCE (C( 462),TKRZ  )                                      C2        68
      EQUIVALENCE (C( 463),TKRY  )                                      C2        69
      EQUIVALENCE (C(1733),WP    )                                      C2        70
      EQUIVALENCE (C(1743),WQ    )                                      C2        71
      EQUIVALENCE (C(1747),WR    )                                      C2        72
      EQUIVALENCE (C(1735),WPD   )                                      C2        73
      EQUIVALENCE (C(1740),WQD   )                                      C2        74
      EQUIVALENCE (C(1744),WRD   )                                      C2        75
C                                                                       C2        76
C**INPUTS FROM MAIN PROGRAM                                             C2        77
      EQUIVALENCE (C(2000),T     )                                      C2        78
C                                                                       C2        79
C** STATE VARIABLE OUTPUTS                                              C2        80
      EQUIVALENCE (C( 800),WLQSDD)                                      C2        81
      EQUIVALENCE (C( 803),WLQSP )                                      C2        82
      EQUIVALENCE (C( 804),WLQSD )                                      C2        83
      EQUIVALENCE (C( 807),WLQS  )                                      C2        84
      EQUIVALENCE (C( 808),WLQSSD)                                      C2        85
      EQUIVALENCE (C( 811),WLQSS )                                      C2        86
      EQUIVALENCE (C( 812),WLRSDD)                                      C2        87
      EQUIVALENCE (C( 815),WLRSP )                                      C2        88
      EQUIVALENCE (C( 816),WLRSD )                                      C2        89
      EQUIVALENCE (C( 819),WLRS  )                                      C2        90
      EQUIVALENCE (C( 820),WLRSSD)                                      C2        91
      EQUIVALENCE (C( 823),WLRSS )                                      C2        92
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      EQUIVALENCE (C( 824),BLQSSD)                                C2      93
      EQUIVALENCE (C( 827),BLQSS )                                C2      94
      EQUIVALENCE (C( 829),BLRSSD)                                C2      95
      EQUIVALENCE (C( 831),BLRSS )                                C2      96
C                                                                 C2      97
C**OUTPUTS                                                        C2      98
      EQUIVALENCE (C( 855),BDELTC)                                C2      99
C                                                                 C2     100
C**OTHER OUTPUTS                                                  C2     101
      EQUIVALENCE (C( 880),BXXS  )                                C2     102
      EQUIVALENCE (C( 881),BJJS  )                                C2     103
      EQUIVALENCE (C( 882),BKKS  )                                C2     104
      EQUIVALENCE (C( 883),BXXSS )                                C2     105
      EQUIVALENCE (C( 884),BJJSS )                                C2     106
      EQUIVALENCE (C( 885),BKKSS )                                C2     107
      EQUIVALENCE (C(830),WPERR)                                  C2     108
      EQUIVALENCE (C(831),WPTIME)                                 C2     109
C                                                                 C2     110
      IF(T .LT. WPTIME) WP=WP+WPERR                               C2     111
C**GUIDANCE SIGNAL SHAPING                                         C2     112
      WLQSD = WLQSP                                               C2     113
      WLRSD = WLRSP                                               C2     114
      WLQSDD = WN2*(WN2*(WLAMQ - WLQS) - 2.*WLQSD)                C2     115
      WLRSDD = WN2*(WN2*(WLAMR - WLRS) - 2.*WLRSD)                C2     116
      WQC = GN*(WLQSD/WL+WLQS) + GBIAS                            C2     117
      WRC = GN*(WLRSD/WL+WLRS)                                    C2     118
C**GUIDANCE SWITCHING                                             C2     119
      IF (OPTN4 .LE. 1.) GO TO 5                                  C2     120
      IF (TKRZ.GT.0. .AND. T.GT.TDY) GO TO 4                      C2     121
      WLQSDD = 0.                                                 C2     122
      WQC = QBIAS + GBIAS                                         C2     123
      IF (CAGE.GT.0. .AND. T.GT.TDY) WQC = WLAMQ + GBIAS          C2     124
    4 IF (TKRY .GT. 0.) GO TO 5                                   C2     125
      WLRSDD = 0.                                                 C2     126
      WRC = RBIAS                                                 C2     127
      IF (CAGE .GT. 0.) WRC = WLAMR                               C2     128
    5 CONTINUE                                                    C2     129
      WLQSSD = WN1*(WQC - WLQSS)                                  C2     130
      WLRSSD = WN1*(WRC - WLRSS)                                  C2     131
      BLQSSD = WLQSS                                              C2     132
      BLRSSD = WLRSS                                              C2     133
C                                                                 C2     134
C**RATE GYRO DYNAMICS AND LIMITING                                C2     135
      CTH2 = COSD(BTH2)                                           C2     136
      STH2 = SIND(BTH2)                                           C2     137
      SPH1 = SIND(BPH1)                                           C2     138
      CPH1 = COSD(BPH1)                                           C2     139
      TPH2 = SIND(PH2)/COSD(PH2)                                  C2     140
      TPS1 = SIND(PS1)/COSD(PS1)                                  C2     141
      BTH    = -BTH2                                              C2     142
      BXXS   = -BPH1                                              C2     143
      BPS    = -BPS1                                              C2     144
      BTHD   = -(-WQ   -(CTH2*WR   + STH2*WP  )*TPH2)             C2     145
      BTHDD  = -(-WQD  -(CTH2*WRD  + STH2*WPD)*TPH2)              C2     146
      BXXSD  = -(-WP   -(SPH1*WR   + CPH1*WP  )*TPS1)             C2     147
      BXXSDD = -(-WPD  -(SPH1*WRD  + CPH1*WPD)*TPS1)              C2     148
      BPSD   = -(      - SPH1*WR   (       *WP )                  C2     149
```

```
      BPSDD = -(      - CPH1*WRD + SPH1*WPD)                    C2     150
C                                                               C2     151
C**SUMMATION OF RATE DAMPING AND GUIDANCE SIGNALS AND THEIR DERIVATIVES  C2  152
      BJJS   =  (BLRSS -BPS  ) - (BLQSS -BTH  )                 C2     153
      BJJSD  =  (WLRSS -BPSD ) - (WLQSS -BTHD )                 C2     154
      BJJSDD =  (WLRSSD-BPSDD) - (WLQSSD-BTHDD)                 C2     155
      BKKS   = -(BLRSS -BPS  ) - (BLQSS -BTH  )                 C2     156
      BKKSD  = -(WLRSS -BPSD ) - (WLQSS -BTHD )                 C2     157
      BKKSDD = -(WLRSSD-BPSDD) - (WLQSSD-BTHDD)                 C2     158
C                                                               C2     159
C**GUIDANCE SIGNAL SHAPING AND LIMITING                         C2     160
      BXXSS = GXX*((BXXSDD + (WLX(1+WLXX2)*BXXSD)/(WLXX1*WLXX2) + BXXS)  C2  161
      BJJSS = GJK*((BJJSDD + (WLJK1+WLJK2)*BJJSD)/(WLJK1*WLJK2) + BJJS)  C2  162
      BKKSS = GJK*((BKKSDD + (WLJK1+WLJK2)*BKKSD)/(WLJK1*WLJK2) + BKKS)  C2  163
      IF (ABS(BJJSS) .GT. HJK) BJJSS = SIGN(HJK,BJJSS)          C2     164
      IF (ABS(BKKSS) .GT. HJK) BKKSS = SIGN(HJK,BKKSS)          C2     165
C                                                               C2     166
C**COMMANDS TO ACTUATORS                                        C2     167
      BDELTC(1) = BJJSS + BXXSS                                 C2     168
      BDELTC(2) = BKKSS + BXXSS                                 C2     169
      BDELTC(3) = BJJSS - BXXSS                                 C2     170
      BDELTC(4) = BKKSS - BXXSS                                 C2     171
      RETURN                                                    C2     172
      END                                                       C2     173
C** INITIALIZATION MODULE FOR HELFIRE  SIMPLIFIED ACTUATOR       C2     174
C****** NON - LINEAR MODEL ******                               C2     175
C                                                               C2     176
```

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SUBROUTINE C2          74/74   OPT=1                         FTN 4.2+73067     05/05/75  16.23.43.     PAGE    4

         SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS     DEF LINE     REFERENCES
    1  C2               1        137

 VARIABLES         SN  TYPE          RELOCATION
   1527  BDELTC        REAL      ARRAY     / /     REFS      5      54  DEFINED    133    134    135    136
   1560  BJJS          REAL                / /     REFS     58     127  DEFINED    118
    251  BJJSD         REAL                        REFS    127  DEFINED     119
    252  BJJSDD        REAL                        REFS    127  DEFINED     120
   1563  BJJSS         REAL                / /     REFS     71   2*129      133    135  DEFINED    127    129
   1561  BKKS          REAL                / /     REFS     59     128  DEFINED    121
    253  BKKSD         REAL                        REFS    128  DEFINED     122
    254  BKKSDD        REAL                        REFS    128  DEFINED     123
   1564  BKKSS         REAL                / /     REFS     72   2*130      134    136  DEFINED    128    130
   1472  BLQSS         REAL                / /     REFS     59     118      121
   1467  BLQSSD        REAL                / /     REFS     58  DEFINED      97
   1476  BLRSS         REAL                / /     REFS     51     118      121
   1473  BLRSSD        REAL                / /     REFS     60  DEFINED      98
    540  BPH1          REAL                / /     REFS     26     103      104    108
    610  BPH2          REAL                / /     REFS     29
    242  BPS           REAL                        REFS    118     121  DEFINED    109
    247  BPSD          REAL                        REFS    119     122  DEFINED    114
    250  BPSDD         REAL                        REFS    120     123  DEFINED    115
    542  BPS1          REAL                / /     REFS     28     109
    241  BTH           REAL                        REFS    118     121  DEFINED    107
    243  BTHD          REAL                        REFS    119     122  DEFINED    110
    244  BTHDD         REAL                        REFS    120     123  DEFINED    111
    541  BTH2          REAL                / /     REFS     27     101      102    107
   1557  BXXS          REAL                / /     REFS     67     126  DEFINED    108
    245  BXXSD         REAL                        REFS    126  DEFINED     112
    246  BXXSDD        REAL                        REFS    126  DEFINED     113
   1562  BXXSS         REAL                / /     REFS     70     133      134    135    136
                                                DEFINED    126
      0  C             REAL      ARRAY     / /     REFS      4       8        9     10     11     12     13
                                                        14      15      16       17     18     19     20     21
                                                        22      23      26       27     28     29     30     31
                                                        32      33      34       35     36     37     38     39
                                                        40      43      46       47     48     49     50     51
                                                        52      53      54       55     56     57     58     59
                                                        60      61      64       67     68     69     70     71
                                                        72      73      74
    714  CAGE          REAL                / /     REFS     32      89       93
    234  CPH1          REAL                        REFS    112     113      114    115  DEFINED    104
    231  CTH2          REAL                        REFS    110     111  DEFINED    101
   1534  GBIAS         REAL                / /     REFS      9      82       88     89
   1553  GJK           REAL                / /     REFS     20     127      128
   1535  GN            REAL                / /     REFS     10      82       83
   1552  GXX           REAL                / /     REFS     19     126
   1545  HJK           REAL                / /     REFS     18   2*129    2*130
   6657  OPTN4         REAL                / /     REFS     23      85
    236  PH2           REAL                        REFS  2*105
    240  PS1           REAL                        REFS  2*106
   1555  QBIAS         REAL                / /     REFS     21      88
   1556  RBIAS         REAL                / /     REFS     22      92
    233  SPH1          REAL                        REFS    112     113      114    115  DEFINED    133
    232  STH2          REAL                        REFS    110     111  DEFINED    102
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      SUBROUTINE C2          74/74    OPT=1                          FTN 4.2+75067     05/05/75  16.23.43.     PAGE    5

 VARIABLES       SN  TYPE             RELOCATION
    3717  T          REAL                 / /         REFS     43      76      86      89
    1533  TOY        REAL                 / /         REFS      8      86      89
     716  TKRY       REAL                 / /         REFS     34      90
     715  TKRZ       REAL                 / /         REFS     33      86
     235  TPH2       REAL                             REFS    110     111  DEFINED    105
     237  TPS1       REAL                             REFS    112     113  DEFINED    106
     255  VAR        REAL       *UNDEF                REFS      5
    1540  WL         REAL                 / /         REFS     13      82      83
     622  WLAMQ      REAL                 / /         REFS     30      80      82
     626  WLAMR      REAL                 / /         REFS     31      81      93
    1543  WLJK1      REAL                 / /         REFS     16   2*127   2*128
    1544  WLJK2      REAL                 / /         REFS     17   2*127   2*128
    1446  WLQS       REAL                 / /         REFS     49      80      82
    1443  WLQSD      REAL                 / /         REFS     48      80      92  DEFINED     78
    1437  WLQSDD     REAL                 / /         REFS     46  DEFINED     80     87
    1442  WLQSP      REAL                 / /         REFS     47      78
    1452  WLQSS      REAL                 / /         REFS     51      95      97     119     122
    1447  WLQSSD     REAL                 / /         REFS     50     120     123  DEFINED     95
    1462  WLRS       REAL                 / /         REFS     55      81      83
    1457  WLRSD      REAL                 / /         REFS     54      81      83  DEFINED     79
    1453  WLRSDD     REAL                 / /         REFS     52  DEFINED     81     91
    1456  WLRSP      REAL                 / /         REFS     53      79
    1466  WLRSS      REAL                 / /         REFS     57      96      98     119     122
    1463  WLRSSD     REAL                 / /         REFS     56     120     123  DEFINED     96
    1541  WLXX1      REAL                 / /         REFS     14   2*126
    1542  WLXX2      REAL                 / /         REFS     15   2*126
    1537  WN1        REAL                 / /         REFS     12      95      96
    1536  WN2        REAL                 / /         REFS     11    2*80    2*81
    3312  WP         REAL                 / /         REFS     35      76     110   2*112     114
                                                   DEFINED     76
    3307  WPO        REAL                 / /         REFS     38     111   2*113     115
    1571  WPERR      REAL                 / /         REFS     73      76
    1572  WPTIME     REAL                 / /         REFS     74      76
    3316  WQ         REAL                 / /         REFS     36     110
     227  WQC        REAL                             REFS     95  DEFINED     82      86      89
    3313  WQD        REAL                 / /         REFS     39     111
    3322  WR         REAL                 / /         REFS     37     110     112     114
     230  WRC        REAL                             REFS     96  DEFINED     83      92      93
    3317  WRD        REAL                 / /         REFS     40     111     113     115

 EXTERNALS           TYPE    ARGS       REFERENCES
          COSD       REAL     1            101     104     105     106
          SIND       REAL     1            102     103     105     106

 INLINE FUNCTIONS    TYPE    ARGS       DEF LINE  REFERENCES
          ABS        REAL     1  INTRIN              129     130
          SIGN       REAL     2  INTRIN              129     130

 STATEMENT LABELS              DEF LINE   REFERENCES
      41   4                      90         85
      50   5                      94         85      90

 COMMON BLOCKS    LENGTH     MEMBERS - BIAS NAME(LENGTH)
      / /          3830              0 C        (3830)
```

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SUBROUTINE C2          74/74   OPT=1                       FTN 4.2+75067      05/15/75  16.23.43.     PAGE    5

EQUIV CLASSES    LENGTH    MEMBERS - BIAS NAME(LENGTH)
C         C        3830         352 BPH1     (1)        353 BT42     (1)        354 BPS1     (1)
                                392 BPH2     (1)        402 WLAMQ    (1)        406 WLAMR    (1)
                                460 CAGE     (1)        451 TKRZ     (1)        462 TKRY     (1)
                                799 WLQSD    (1)        802 WLQSP    (1)        803 WLQSD    (1)
                                805 WLQS     (1)        807 WLQSSD   (1)        810 WLQSS    (1)
                                811 WLRSD    (1)        814 WLRSP    (1)        815 WLRSD    (1)
                                818 WLRS     (1)        819 WLRSSD   (1)        822 WLRSS    (1)
                                823 BLQSSD   (1)        825 BLQSS    (1)        827 BLRSSD   (1)
                                830 BLRSS    (1)        855 BDELTC   (4)        859 TDY      (1)
                                850 BBIAS    (1)        861 GN       (1)        862 WN2      (1)
                                863 WN1      (1)        864 WL       (1)        865 WLXX1    (1)
                                865 WLXX2    (1)        867 WLJK1    (1)        868 WLJK2    (1)
                                869 WJK      (1)        874 GXK      (1)        875 GJK      (1)
                                877 QBIAS    (1)        878 RBIAS    (1)        879 BXKS     (1)
                                880 BJJS     (1)        881 BKKS     (1)        882 BXKSS    (1)
                                883 BJJSS    (1)        884 BKKSS    (1)        889 WPERR    (1)
                                890 WPTIME   (1)       1735 WPD      (1)       1738 WP       (1)
                               1739 WQD      (1)       1742 WQ       (1)       1743 WRD      (1)
                               1746 WR       (1)       1939 T        (1)       3503 OPTN4    (1)

STATISTICS
  PROGRAM LENGTH                4223    274
  CM BLANK COMMON LENGTH       73663   3830
```

```
      SUBROUTINE C4I                                          C4      2
      COMMON C(3830)                                          C4      3
      DIMENSION IPL(100), ISNOX(4))                           C4      4
      EQUIVALENCE (C(3534), ISNOX), (C(3512), I3512)          C4      5
      DIMENSION BDELT(4)                                      C4      6
      EQUIVALENCE (C(1103),BDELT1)                            C4      7
      EQUIVALENCE (C(1107),BDELT2)                            C4      8
      EQUIVALENCE (C(1111),BDELT3)                            C4      9
      EQUIVALENCE (C(1115),BDELT4)                            C4     10
      EQUIVALENCE (C(1247),FELECB )                           C4     11
      EQUIVALENCE (C(1248),FELECQ3)                           C4     12
      EQUIVALENCE (C(1249),FELECR3)                           C4     13
      EQUIVALENCE (C(1250),FMECHB )                           C4     14
      EQUIVALENCE (C(1251),FMECHQ3)                           C4     15
      EQUIVALENCE (C(1252),FMECHR3)                           C4     16
      EQUIVALENCE (C(1254), DELT3)                            C4     17
      EQUIVALENCE (C(1255),DELTQB)                            C4     18
      EQUIVALENCE (C(1255),DELTRB)                            C4     19
      EQUIVALENCE (C(1143),OPTACT)                            C4     20
      EQUIVALENCE (C(1231),BDP    )                           C4     21
      EQUIVALENCE (C(1232),BDQ    )                           C4     22
      EQUIVALENCE (C(1233),BDR    )                           C4     23
      EQUIVALENCE (C(2551),N      )                           C4     24
      EQUIVALENCE (C(2552),IPL    )                           C4     25
      IPL(N) = 1100                                           C4     26
      IPL(N+1) = 1104                                         C4     27
      IPL(N+2) = 1108                                         C4     28
      IPL(N+3) = 1112                                         C4     29
      N = N+4                                                 C4     30
      IF (OPTACT .LE. 0.) RETURN                              C4     31
      IPL(N  ) = 1159                                         C4     32
      IPL(N+1) = 1167                                         C4     33
      IPL(N+2) = 1174                                         C4     34
      IPL(N+3) = 1181                                         C4     35
      IPL(N+4) = 1153                                         C4     36
      IPL(N+5) = 1170                                         C4     37
      IPL(N+6) = 1177                                         C4     38
      IPL(N+7) = 1184                                         C4     39
      N = N+8                                                 C4     40
      C(1163) = 0.                                            C4     41
      C(1170) = 0.                                            C4     42
      C(1177) = 0.                                            C4     43
      C(1184) = 0.                                            C4     44
      C(1166) = 0.                                            C4     45
      C(1173) = 0.                                            C4     46
      C(1180) = 0.                                            C4     47
      C(1187) = 0.                                            C4     48
      IPL(N  ) = 1116                                         C4     49
      IPL(N+1) = 1120                                         C4     50
      IPL(N+2) = 1124                                         C4     51
      IPL(N+3) = 1128                                         C4     52
      N = N+4                                                 C4     53
      C(1119) = 0.                                            C4     54
      C(1123) = 0.                                            C4     55
      C(1127) = 0.                                            C4     56
      C(1131) = 0.                                            C4     57
      RETURN                                                  C4     58
```

```
C
      ENTRY A1I
C
C MONTE CARLO FIN MISALIGNMENT ERRORS
C
      FELECB  = 0.
      FELECQB = 0.
      FELECRB = 0.
      FMECHB  = 0.
      FMECHQB = 0.
      FMECHRB = 0.
      DO 10 I = 1, I3512
      IDO = I
      IF(ISNDX(I).EQ.1250) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.1251) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.1252) CALL MCARLO (DUM, 1, IDO)
C MONTE CARLO FIN OFFSET (MODULE C4I AND C4)
      IF(ISNDX(I).EQ.1247) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.1248) CALL MCARLO (DUM, 1, IDO)
      IF(ISNDX(I).EQ.1249) CALL MCARLO (DUM, 1, IDO)
      DELTB  = FELECB  + FMECHB
      DELTQB = FELECQB + FMECHQB
      DELTRB = FELECRB + FMECHQB
   10 CONTINUE
      BDELT1 = -BDP + BDQ - BDR
      BDELT2 = -BDP + BDQ + BDR
      BDELT3 =  BDP + BDQ - BDR
      BDELT4 =  BDP + BDQ + BDR
      BDELT1 = BDELT1 - DELTB + DELTQB - DELTRB
      BDELT2 = BDELT2 - DELTB + DELTQB + DELTRB
      BDELT3 = BDELT3 + DELTB + DELTQB - DELTRB
      BDELT4 = BDELT4 + DELTB + DELTQB + DELTRB
      RETURN
      END
C**  HELFIRE SIMPLIFIED ACTUATOR MODEL
C****** NON - LINEAR MODEL ******
C
```

```
        SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE     REFERENCES
   50  A1I           59          30
    1  C4I            1          30        57

VARIABLES      SN  TYPE          RELOCATION
  150  BDELT       REAL        *UNDEF            REFS       5
 2116  BDELT1      REAL                  / /     REFS       6      86   DEFINED    82     86
 2122  BDELT2      REAL                  / /     REFS       7      87   DEFINED    83     87
 2126  BDELT3      REAL                  / /     REFS       8      88   DEFINED    84     88
 2132  BDELT4      REAL                  / /     REFS       9      89   DEFINED    85     89
 2316  BDP         REAL                  / /     REFS      20      82     83       84     85
 2317  BDQ         REAL                  / /     REFS      21      82     83       84     85
 2320  BDR         REAL                  / /     REFS      22      82     83       84     85
    0  C           REAL        ARRAY     / /     REFS       2     2*4      6        7      8     9     10
                                                   11      12      13     14       15     16    17     18
                                                   19      20      21     22       23     24
                                              DEFINED      40      41     42       43     44    45     48
                                                   47      53      54     55       56
 2345  DELTB       REAL                  / /     REFS      16      86     87       88     89
                                              DEFINED      78
 2346  DELTQB      REAL                  / /     REFS      17      86     87       88     89
                                              DEFINED      79
 2347  DELTRB      REAL                  / /     REFS      18      86     87       88     89
                                              DEFINED      80
  147  DUM         REAL                          REFS      71      72     73       75     76    77
 2336  FELECB      REAL                  / /     REFS      10      78   DEFINED    63
 2337  FELECQB     REAL                  / /     REFS      11      79   DEFINED    64
 2340  FELECRB     REAL                  / /     REFS      12      80   DEFINED    65
 2341  FMECHB      REAL                  / /     REFS      13      78   DEFINED    66
 2342  FMECHQB     REAL                  / /     REFS      14      79     80     DEFINED  67
 2343  FMECHRB     REAL                  / /     REFS      15   DEFINED   68
  145  I           INTEGER                       REFS      70      71     72       73     75    76     77
                                              DEFINED      69
  146  IDO         INTEGER                       REFS      71      72     73       75     76    77
                                              DEFINED      70
 5601  IPL         INTEGER     ARRAY     / /     REFS       3      24   DEFINED    25     26    27     28
                                                   31      32      33     34       35     36    37     38
                                                   48      49      50     51
 7661  ISNDX       INTEGER     ARRAY     / /     REFS       3       4     71       72     73    75     76
                                                   77
 6667  I35.2       INTEGER               / /     REFS       4      59
 5600  N           INTEGER               / /     REFS      23      25     26       27     28    29     31
                                                   32      33      34     35       36     37    38     39
                                                   48      49      50     51       52   DEFINED 29     39
                                                   52
 2163  OPTACT      REAL                  / /     REFS      19      30

EXTERNALS          TYPE   ARGS       REFERENCES
      MCARLO               3           71      72      73      75     76       77

STATEMENT LABELS             DEF LINE    REFERENCES
     0  10                      81          53
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```
SUBROUTINE C4I          74/74  OPT=1                         FTN 4.2+75067      05/05/75  16.23.47.      PAGE    4

LOOPS  LABEL  INDEX     FROM-TO    LENGTH    PROPERTIES
  60   10     * I        69 61      42B                   EXT REFS

COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
  / /.           3830                0 C      (3830)

EQUIV CLASSES   LENGTH      MEMBERS - BIAS NAME(LENGTH)
C       C        3830          1102 BDELT1 (1)         1106 BDELT2 (1)          1110 BDELT3 (1)
                               1114 BDELT4 (1)         1133 OPTACT (1)          1230 BOP    (1)
                               1231 BDQ    (1)         1232 BDR    (1)          1246 FELECB (1)
                               1247 FELECQB(1)         1245 FELECRB(1)          1249 FMECHB (1)
                               1250 FMECHQB(1)         1251 FMECHRB(1)          1253 DELTB  (1)
                               1254 DELTQB (1)         1255 DELTRB (1)          2560 N      (1)
                               2561 LPL    (100)       3511 I3512  (1)          3633 ISNDX  (48)

STATISTICS
  PROGRAM LENGTH               1543     105
  CM BLANK COMMON LENGTH      73663    3830
```

```
      SUBROUTINE C4
C
      COMMON C(3830)
      DIMENSION BDELTO(4),BDELT(4),BDELTC(4),VAR(101)
      DIMENSION WDS(4), WDSD(4),  WDSDD(4), BDS(4), BDSD(4)
      DIMENSION IPL(101)
      DIMENSION NC2(2), CB2(6), CHDF(6)
C
C**INPUT DATA
      EQUIVALENCE (C(1140),OPTACT)
      EQUIVALENCE (C(1145),CR    )
      EQUIVALENCE (C(1146),BDELM )
      EQUIVALENCE (C(1147),HDEL  )
      EQUIVALENCE (C(1148),H1    )
      EQUIVALENCE (C(1149),ZN    )
      EQUIVALENCE (C(1150),FMHD  )
      EQUIVALENCE (C(1151),G1    )
      EQUIVALENCE (C(1152),BH    )
      EQUIVALENCE (C(1153),WN    )
      EQUIVALENCE (C(1154),G2    )
      EQUIVALENCE (C(1155),H1    )
      EQUIVALENCE (C(1156),H2    )
      EQUIVALENCE (C(1305),RFAREA)
      EQUIVALENCE (C(1307),RFLGTH)
C
C**INPUTS FROM OTHER MODULES
      EQUIVALENCE (C(0203),PDYNMC)
      EQUIVALENCE (C( 204),VMACH )
      EQUIVALENCE (C( 855),BDELTC)
      EQUIVALENCE (C(1254), DELTB)
      EQUIVALENCE (C(1255),DELTQB)
      EQUIVALENCE (C(1256),DELTRB)
      EQUIVALENCE (C(1309),FMH1  )
      EQUIVALENCE (C(1310),FMH2  )
      EQUIVALENCE (C(1311),FMH3  )
      EQUIVALENCE (C(1312),FMH4  )
C
C**INPUTS FROM MAIN PROGRAM
      EQUIVALENCE (C(2000),T     )
      EQUIVALENCE (C(2013),DOC   )
      EQUIVALENCE (C(2561),N     )
      EQUIVALENCE (C(2562),IPL   )
C
      DATA NC2/6,0/
      DATA  CB2/ .00,  .40,  .80,  .95, 1.05, 1.40/
      DATA CHDF/.0013,.0014,.0018,.0022,.0032,.0023/
C**STATE VARIABLE OUTPUTS
      BDELTC(1) = BDELTC(1) - DELTB + DELT2B - DELTRB
      BDELTC(2) = BDELTC(2) - DELTB + DELT2B + DELTRB
      BDELTC(3) = BDELTC(3) + DELTB + DELT2B - DELTRB
      BDELTC(4) = BDELTC(4) + DELTB + DELT2B + DELTRB
      BDELT(1)=C(1103)
      BDELT(2)=C(1107)
      BDELT(3)=C(1111)
      BDELT(4)=C(1115)
      WDSD (1) = C(1163)
      WDSD (2) = C(1178)
```

```
      WDSD (3) = C(1177)
      WDSD (4) = C(1184)
      WDS  (1) = C(1166)
      WDS  (2) = C(1173)
      WDS  (3) = C(1180)
      WDS  (4) = C(1187)
      BDS(1) = C(1119)
      BDS(2) = C(1123)
      BDS(3) = C(1127)
      BDS(4) = C(1131)
C
C**ACTUATOR DYNAMICS
      XF=0.
      CHD=FINTP1(JMACH,CB2,CHDF,NC2,XF,3HCHD)
      DO 30  I=1,4
      UQS = FDYNMC*RFAREA
      UQSL = UQS*RFLGTH
      FMHD = CHD*UQSL*12.
      H1 = HLEL
      H2 = H1*2.
      IF (I.GE.2 .AND. I.LE.3) GO TO 5
      H2 = H1
      H1 = H1*2.
    5 CONTINUE
      A1 =        (BDELTC(I)  - BDELT(I))
      A1S= A1 - SIGN(B4,A1)
      IF(ABS(A1) .LE. B4) A1S= 0.
      A2 = G1/GR*A1S
      IF(A2 .LT. -H2) A2 = -H2
      IF(A2 .GT.  H1) A2 =  H1
      BDSD(I) = W1*(A2 - BDS(I))
      BDE = BDS(I) - G2*FMHD*BDELT(I)
      WDSDD(I) = WN*(WN*(BDE - WDS(I)) - 2.*ZN*WDSD(I))
      BDELTD(I) = WDSD(I)/A1 + WDS(I)
      IF (OFTACT .LE. 0.)
     * BDELTD(I) = (A2 - G2*FMHD*BDELT(I))/(1.+G2*FM4J/W1)
C** RATE LIMIT
C**SURFACE POSITION LIMITER
      IF((ABS(BDELT(I)).GT.19.).AND.(BDELTD(I)*BDELT(I).GT.0.))BDELTD(I)
     *=0.
   30 CONTINUE
C
      C(1103) = BDELT(1)
      C(1107) = BDELT(2)
      C(1111) = BDELT(3)
      C(1115) = BDELT(4)
C
C**OUTPUT DERIVATIVES OF STATE VARIABLES TO INTEGRATION
      C(1100) = BDELTD(1)
      C(1104) = BDELTD(2)
      C(1108) = BDELTD(3)
      C(1112) = BDELTD(4)
      C(1160) = WDSDD(1)
      C(1167) = WDSDD(2)
      C(1174) = WDSDD(3)
      C(1181) = WDSDD(4)
      C(1116) = BDSD(1)
```

```
  115           C(1120) = BOSD(2)                                C4       210
                C(1124) = BOSD(3)                                C4       211
                C(1128) = BOSD(4)                                C4       212
        C                                                        C4       213
                RETURN                                           C4       214
  120           END                                              C4       215
```

```
      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS     DEF LINE    REFERENCES
    1   C4            1          119

VARIABLES     SN   TYPE          RELOCATION
   211  A1         REAL                         REFS     2*83      84    DEFINED      82
   212  A1S        REAL                         REFS       55  DEFINED       83       84
   213  A2         REAL                         REFS       86      87       86       92  DEFINED       85       88
                                                  87
   214  BDE        REAL                         REFS       90  DEFINED       89
  2171  BDELH      REAL                /  /     REFS       12
   221  BDELT      REAL       ARRAY             REFS        4      82       89       92     2*96      100      101
                                                 102      103  DEFINED       52       53       54       55
  1527  BDELTC     REAL       ARRAY    ,  /     REFS        4      29       48       49       50       51       82
                                               DEFINED     48      49       50       51
   215  BDELTD     REAL       ARRAY             REFS        4      96      106      107      108      109
                                               DEFINED     91      92       96
   406  BDS        REAL       ARRAY             REFS        5      88       89  DEFINED       54       65       66
                                                  67
   412  BDSD       REAL       ARRAY             REFS        5     114      115      116      117
                                               DEFINED     88
  2177  BH         REAL                /  /     REFS       18      83       84
     0  C          REAL       ARRAY    /  /     REFS        3      10       11       12       13       14       15
                                                  16       17      18       19       20       21       22       23
                                                  24       27      28       29       30       31       32       33
                                                  34       35      36       39       40       41       42       52
                                                  53       54      55       56       57       58       59       60
                                                  61       62      63       64       65       66       67
                                               DEFINED    100     101      102      103      106      107      108
                                                 109      110     111      112      113      114      115      116
                                                 117
   420  CB2        REAL       ARRAY             REFS        7      71  DEFINED       45
   205  CHD        REAL                         REFS       75  DEFINED       71
   426  CHDF       REAL       ARRAY             REFS        7      71  DEFINED       46
  2170  CR         REAL                /  /     REFS       11      85
  2345  DELTB      REAL                /  /     REFS       30      48       49       50       51
  2346  DELTQB     REAL                /  /     REFS       31      48       49       50       51
  2347  DELTRB     REAL                /  /     REFS       32      48       49       50       51
  3734  DOC        REAL                /  /     REFS       40
  2175  FMHJ       REAL                /  /     REFS       16      89     2*92  DEFINED       75
  2434  FMH1       REAL                /  /     REFS       33
  2435  FMH2       REAL                /  /     REFS       34
  2436  FMH3       REAL                /  /     REFS       35
  2437  FMH4       REAL                /  /     REFS       36
  2176  G1         REAL                /  /     REFS       17      85
  2201  G2         REAL                /  /     REFS       20      89     2*92
  2172  HDEL       REAL                /  /     REFS       13      76
  2202  H1         REAL                /  /     REFS       21      77       79       80     2*87
                                               DEFINED     76      80
  2203  H2         REAL                /  /     REFS       22    2*86  DEFINED       77       79
   206  I          INTEGER                      REFS     2*78    2*82     2*88     2*89     3*93     3*91     2*92
                                                 4*95  DEFINED     72
  5001  IPL        INTEGER    ARRAY    /  /     REFS        6      42
  5000  N          INTEGER             /  /     REFS       41
   416  NC2        INTEGER    ARRAY             REFS        7      71  DEFINED       44
  2163  OPTACT     REAL                /  /     REFS       10      92
```

```
VARIABLES     SN   TYPE              RELOCATION
  312  POYNMC      REAL                  / /          REFS      27      73
 2431  RFAREA      REAL                  / /          REFS      23      73
 2432  RFLGTH      REAL                  / /          REFS      24      74
 3717  T           REAL                  / /          REFS      39
  207  UQS         REAL                                REFS      74   DEFINED     73
  210  UQSL        REAL                                REFS      75   DEFINED     74
  225  VAR         REAL        *UNDEF                  REFS       4
  313  VMACH       REAL                  / /          REFS      28      71
  372  WOS         REAL         ARRAY                  REFS       5      90     91   DEFINED    50     61     62
                                                          63
  376  WOSD        REAL         ARRAY                  REFS       5      90     91   DEFINED    56     57     58
                                                          59
  402  WOSDD       REAL         ARRAY                  REFS       5     110    111     112    113
                                                    DEFINED      90
 2200  WN          REAL                  / /          REFS      19    2*90
 2173  W1          REAL                  / /          REFS      14      88     91      92
  204  XF          REAL                                REFS      71   DEFINED     70
 2174  ZN          REAL                  / /          REFS      15      90

EXTERNALS          TYPE    ARGS          REFERENCES
       FINTP1      REAL      6               71

INLINE FUNCTIONS   TYPE    ARGS         DEF LINE   REFERENCES
       ABS         REAL      1   INTRIN                 84         96
       SIGN        REAL      2   INTRIN                 83

STATEMENT LABELS             DEF LINE    REFERENCES
   73  5                         81          78
    0  30                        98          72

LOOPS  LABEL    INDEX      FROM-TO     LENGTH    PROPERTIES
   55  30     * I           72 98        65B       OPT

COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
     / /         3830                 0 C     (3830)

EQUIV CLASSES    LENGTH      MEMBERS - BIAS NAME(LENGTH)
 C        C      3830              202 POYNMC  (1)          203 VMACH   (1)            855 BDELTC  (4)
                                  1139 OPTACT  (1)         1144 CP      (1)           1145 BDELW   (1)
                                  1146 WDEL    (1)         1147 W1      (1)           1148 ZN      (1)
                                  1149 FWMD    (1)         1150 G1      (1)           1151 BH      (1)
                                  1152 WN      (1)         1153 G2      (1)           1154 H1      (1)
                                  1155 H2      (1)         1253 DELTB   (1)           1254 DELTQB  (1)
                                  1255 DELTR3  (1)         1305 RFAREA  (1)           1306 RFLGTH  (1)
                                  1308 FMH1    (1)         1309 FMH2    (1)           1310 FMH3    (1)
                                  1311 FMH4    (1)         1939 T       (1)           2012 DOC     (1)
                                  2560 N       (1)         2561 IP      (101)

STATISTICS
  PROGRAM LENGTH                 4363      286
  CM BLANK COMMON LENGTH        73663     3830
```

```
      SUBROUTINE G4                                                   G4        2
C*************************************************************        G4        3
C** THIS IS A SUBROUTINE (NOT A MODULE) CALLED BY STAGE 3 **          G4        4
C** STOPS PROGRAM AND COMPUTES MISS DISTANCE               **          G4        5
C*************************************************************        G4        6
      COMMON C(3830)                                                  G4        7
  100 FORMAT(1H0,17H MISS DISTANCE = ,1PE15.7/                        G4        8
     *        1H0,17H FLIGHT  TIME  = ,1PE15.7)                       G4        9
  200 FORMAT(1H0, 9X,8HRDELX = ,1PE15.7, 8X,8HRDELY = ,1PE15.7,       G4       10
     *       8X,8HRDELZ = ,1PE15.7)                                   G4       11
  300 FORMAT(1H0,40X,8HRYFP  = ,1PE15.7, 8X,8HRZFP  = ,1PE15.7)       G4       12
      EQUIVALENCE (C( 357),BGAMH )                                    G4       13
     *,           (C( 358),BGAMV )                                    G4       14
     *,           (C( 371),RANGE )                                    G4       15
     *,           (C(1535),RDELX )                                    G4       16
     *,           (C(1536),RDELY )                                    G4       17
     *,           (C(1537),RDELZ )                                    G4       18
      EQUIVALENCE (C(2000),T     )                                    G4       19
      EQUIVALENCE (C(1564),YMC)                                       G4       20
      EQUIVALENCE (C(1565),YMC2)                                      G4       21
      EQUIVALENCE (C(1574),ZMC)                                       G4       22
      EQUIVALENCE (C(1575),ZMC2)                                      G4       23
     *,           (C(2020),LCONV )                                    G4       24
      EQUIVALENCE (C( 300),RMISS )                                    G4       25
     $,           (C(301),         )                                  G4       26
     *,           (C( 302),RYF   )                                    G4       27
     *,           (C( 303),RZF   )                                    G4       28
      EQUIVALENCE (C( 31), LCEP)                                      G4       29
      EQUIVALENCE (C(3721),    ITC( )                                 DLAY     24
      LCEP = 0                                                        G4       30
      IF (RANGE .GT. 500.) GO TO 20                                   G4       31
      UC13 =-SIND(BGAMV)                                              G4       32
      UC33 = COSD(BGAMV)                                              G4       33
      UC21 =-SIND(BGAMH)                                              G4       34
      UC22 = COSD(BGAMH)                                              G4       35
      UC11 =  UC22*UC33                                               G4       36
      UC12 = -UC21*UC33                                               G4       37
      UC31 = -UC22*UC13                                               G4       38
      UC32 =  UC21*UC13                                               G4       39
      RXFP =  UC11*RDELX + UC12*RDELY + UC13*RDELZ                    G4       40
      RYFP =  UC21*RDELX + UC22*RDELY                                 G4       41
      RZFP =  UC31*RDELX + UC32*RDELY + UC33*RDELZ                    G4       42
      IF (RXFP .GT. 0.) GO TO 10                                      G4       43
      PCT = UXFP/(RXFP - UXFP)                                        G4       44
      RDX = UDELX - PCT*(RDELX - UDELX)                               G4       45
      RDY = UDELY - PCT*(RDELY - UDELY)                               G4       46
      RDZ = UDELZ - PCT*(RDELZ - UDELZ)                               G4       47
      RYF = UYFP - PCT*(RYFP - UYFP)                                  G4       48
      RZF = UZFP - PCT*(RZFP - UZFP)                                  G4       49
      TZERO = UT - PCT*(T - UT)                                       G4       50
      RMISS = SQRT(RYF**2 + RZF**2)                                   G4       51
      PITCH=10H PITCH                                                 DLAY     25
      YAW=10H YAW                                                     DLAY     26
      WRITE(6,600)C(630),PITCH                                        DLAY     27
      WRITE(6,600)C(631),YAW                                          DLAY     28
  600 FORMAT(1H0,50X,*+++MAX BREAKLOCK VALUE =*F10.5,*  IN *A10)      DLAY     29
      WRITE(6,400) L                                                  G4       53
```

```
  400 FORMAT(1H0,13HRUN NJMBER = ,I2)                                G4      54
      IF(ITCT.LE.3)GO TO 33                                          DLAY    30
      CALL MCARLX(DUM,2,RNSTRT)                                      DLAY    31
      WRITE(6,500) C(1557), C(1561), C(1577), C(1578)                G4      55
      XMCSPOT = SQRT(YMC2*YMC2 + ZMC2*ZMC2)                          G4      56
      WRITE(6,2555)YMC,YMC2                                          G4      57
      WRITE(6,2556)ZMC,ZMC2,XMCSPOT                                  G4      58
   30 CONTINUE                                                       DLAY    32
  500 FORMAT(1H0,11X,13HMAX SPOT Y = ,F6.2,14H MIN SPOT Y = , F6.2/  G4      59
     1       12X,13HMAX SPOT Z = ,F6.2,14H MIN SPOT Z = ,F6.2//      G4      60
     2 )                                                             G4      61
 2555 FORMAT(1H0,11X,25HSAMPLE SPOT JITTER Y-MEAN=,F10.5,6X,12HMEAN SQUA G4  62
     1RE=,F10.5)                                                     G4      63
 2556 FORMAT(1H0,11X,25HSAMPLE SPOT JITTER Z-MEAN=,F10.5,6X,12HMEAN SQUA G4  64
     1RE=,F10.5,6X,18HSPOT RADIAL RMS = ,F10.5)                      G4      65
      WRITE(6,100) RMISS, TZERO                                      G4      66
      WRITE(6,200) RDX, ROY, ROZ                                     G4      67
      WRITE(6,300) RYF, RZF                                          G4      68
      LCONV = 2                                                      G4      69
      LCEP = 1                                                       G4      70
      RETURN                                                         G4      71
   16 UT = -T                                                        G4      72
      UDELX = RDELX                                                  G4      73
      UDELY = RDELY                                                  G4      74
      UDELZ = RDELZ                                                  G4      75
      UXFP = -RXFP                                                   G4      76
      UYFP = RYFP                                                    G4      77
      UZFP =-RZFP                                                    G4      78
      RETURN                                                         G4      79
   20 IF (RDELZ .LT. 0.) LCONV = 2                                   G4      80
      RETURN                                                         G4      81
      END                                                            G4      82
```

```
SUBROUTINE G4           74/74    OPT=1                    FTN 4.2+75067     05/05/75  16.23.53.      PAGE   3

     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS    DEF LINE     REFERENCES
    1  G4           1          78      85      88

VARIABLES       SN  TYPE          RELOCATION
   544  BGAMH       REAL                  / /       REFS      12        34        35
   545  BGAMV       REAL                  / /       REFS      12        32        33
     0  C           REAL         ARRAY    / /       REFS       6      6*12        18        19        20        21      2*22
                                                          4*24        28        29        54        55      4*61
   371  DUM       * REAL                            REFS      60
  7210  IICT        INTEGER               / /       REFS      29        59
   454  L           INTEGER               / /       REFS      24        57
    36  LCEP        INTEGER               / /       REFS      28   DEFINED        30        77
  3743  LCONV       INTEGER               / /       REFS      22   DEFINED        76        87
   353  PCI         REAL                            REFS      45        46        47        48        49        50
                                                 DEFINED      44
   367  PITCH       REAL                            REFS      54   DEFINED        52
   562  RANGE       REAL                  / /       REFS      12        31
  3142  RDELX       REAL                  / /       REFS      12        40        41        42        45        80
  3143  RDELY       REAL                  / /       REFS      12        40        41        42        46        81
  3144  RDELZ       REAL                  / /       REFS      12        40        42        47        82        87
   355  RDX         REAL                            REFS      74   DEFINED        45
   357  RDY         REAL                            REFS      74   DEFINED        46
   361  RDZ         REAL                            REFS      74   DEFINED        47
   453  RMISS       REAL                  / /       REFS      24        73   DEFINED        51
   372  RNSTRT    * REAL                            REFS      50
   350  RXFP        REAL                            REFS      43        44        83   DEFINED        40
   455  RYF         REAL                  / /       REFS      24        51        75   DEFINED        48
   351  RYFP        REAL                            REFS      48        84   DEFINED        41
   456  RZF         REAL                  / /       REFS      24        51        75   DEFINED        49
   352  RZFP        REAL                            REFS      49        85   DEFINED        42
  3717  T           REAL                  / /       REFS      18        50        79
   365  TZERO       REAL                            REFS      73   DEFINED        50
   344  UC11        REAL                            REFS      40   DEFINED        36
   345  UC12        REAL                            REFS      40   DEFINED        37
   340  UC13        REAL                            REFS      38        39        40   DEFINED        32
   342  UC21        REAL                            REFS      37        39        41   DEFINED        34
   343  UC22        REAL                            REFS      36        38        41   DEFINED        35
   346  UC31        REAL                            REFS      42   DEFINED        38
   347  UC32        REAL                            REFS      42   DEFINED        39
   341  UC33        REAL                            REFS      36        37        42   DEFINED        33
   356  UDELX       REAL                            REFS    2*45   DEFINED        80
   360  UDELY       REAL                            REFS    2*46   DEFINED        81
   362  UDELZ       REAL                            REFS    2*47   DEFINED        82
   366  UT          REAL                            REFS    2*50   DEFINED        79
   354  UXFP        REAL                            REFS    2*44   DEFINED        83
   363  UYFP        REAL                            REFS    2*48   DEFINED        84
   364  UZFP        REAL                            REFS    2*49   DEFINED        85
   373  XMCSPOT     REAL                            REFS      64   DEFINED        62
   370  YAW         REAL                            REFS      55   DEFINED        53
  3033  YMC         REAL                  / /       REFS      19        63
  3634  YMC2        REAL                  / /       REFS      20      2*62        63
  3645  ZMC         REAL                  / /       REFS      21        64
  3646  ZMC2        REAL                  / /       REFS      22      2*62        64
```

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SUBROUTINE G4          74/74   OPT=1                          FTN 4.2+75067      05/05/75  16.23.53.      PAGE    3

       SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS    DEF LINE     REFERENCES
     1  G4           1          78      85      88

 VARIABLES      SN  TYPE           RELOCATION
   544  BGAMH       REAL                 / /        REFS    12     34     35
   545  BGAMV       REAL                 / /        REFS    12     32     33
     0  C           REAL        ARRAY    / /        REFS     6    6*12    18      19      20      21     2*22
                                                           4*24    28     29     54      55     4*61
   371  DUM      *  REAL                            REFS    60
  7210  ITCT        INTEGER              / /        REFS    29     59
   454  L           INTEGER              / /        REFS    24     57
    36  LCEP        INTEGER              / /        REFS    2P  DEFINED   30      77
  3743  LCONV       INTEGER              / /        REFS    22  DEFINED   76      87
   353  PCT         REAL                            REFS    45     46     47      48      49      50
                                                 DEFINED    44
   367  PITCH       REAL                            REFS    54  DEFINED   52
   562  RANGE       REAL                 / /        REFS    12     31
  3142  RDELX       REAL                 / /        REFS    12     40     41      42      45      80
  3143  RDELY       REAL                 / /        REFS    12     40     41      42      46      81
  3144  RDELZ       REAL                 / /        REFS    12     40     42      47      82      87
   355  RDX         REAL                            REFS    74  DEFINED   45
   357  RDY         REAL                            REFS    74  DEFINED   46
   361  RDZ         REAL                            REFS    74  DEFINED   47
   453  RMISS       REAL                 / /        REFS    24     73  DEFINED    51
   372  RNSTRT   *  REAL                            REFS    50
   350  RXFP        REAL                            REFS    43     44     83   DEFINED    40
   455  RYF         REAL                 / /        REFS    24     51     75   DEFINED    48
   351  RYFP        REAL                            REFS    48     64  DEFINED    41
   456  RZF         REAL                 / /        REFS    24     51     75   DEFINED    49
   352  RZFP        REAL                            REFS    49     85  DEFINED    42
  3717  T           REAL                 / /        REFS    18     50     79
   365  TZERO       REAL                            REFS    73  DEFINED   50
   344  UC11        REAL                            REFS    40  DEFINED   36
   345  UC12        REAL                            REFS    40  DEFINED   37
   340  UC13        REAL                            REFS    38     39     40   DEFINED    32
   342  UC21        REAL                            REFS    37     39     41   DEFINED    34
   343  UC22        REAL                            REFS    36     38     41   DEFINED    35
   346  UC31        REAL                            REFS    42  DEFINED   38
   347  UC32        REAL                            REFS    42  DEFINED   39
   341  UC33        REAL                            REFS    36     37     42   DEFINED    73
   356  UDELX       REAL                            REFS  2*45  DEFINED   80
   360  UDELY       REAL                            REFS  2*46  DEFINED   81
   362  UDELZ       REAL                            REFS  2*47  DEFINED   92
   366  UT          REAL                            REFS  2*50  DEFINED   79
   354  UXFP        REAL                            REFS  2*44  DEFINED   83
   363  UYFP        REAL                            REFS  2*48  DEFINED   84
   364  UZFP        REAL                            REFS  2*49  DEFINED   85
   373  XMCSPOT     REAL                            REFS    64  DEFINED   52
   370  YAW         REAL                            REFS    55  DEFINED   53
  3033  YMC         REAL                 / /        REFS    19     63
  3634  YMC2        REAL                 / /        REFS    20   2*62     63
  3645  ZMC         REAL                 / /        REFS    21     64
  3646  ZMC2        REAL                 / /        REFS    22   2*62     64
```

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SUBROUTINE G4          74/74  OPT=1                    FTN 4.2+75057    05/05/75  16.23.53.     PAGE    4

FILE NAMES      MODE
     TAPE6      FMT               WRITES     54     55     57     61     63     64     73     74
                                    75

EXTERNALS            TYPE   ARGS        REFERENCES
     COSD            REAL    1               33     35
     MCARLX                  3               63
     SIND            REAL    1               32     34
     SQRT            REAL    1  LIBRARY      51     62

STATEMENT LABELS            DEF LINE    REFERENCES
   127   10                    79            43
   141   20                    67            31
   116   30                    55            59
   155   100      FMT           7            73
   165   200      FMT           9            74
   175   300      FMT          11            75
   230   400      FMT          58            57
   256   500      FMT          66            61
   215   600      FMT          55            54     55
   271   2555     FMT          59            63
   301   2556     FMT          71            64

COMMON BLOCKS    LENGTH     MEMBERS - BIAS NAME(LENGTH)
     //          3830                 0 C       (3830)

EQUIV CLASSES    LENGTH     MEMBERS - BIAS NAME(LENGTH)
     C           3830          33 LCEP     (1)     233 RMISS   (1)     300 L       (1)
                              301 RYF      (1)     302 RZF     (1)     356 BGAMM   (1)
                              357 BGAMV    (1)     370 RANGE   (1)    1563 YMC     (1)
                             1564 YMC2     (1)    1573 ZMC     (1)    1574 ZMC2    (1)
                             1634 RDELX    (1)    1635 RDELY   (1)    1636 RDELZ   (1)
                             1993 I        (1)    2019 LCONV   (1)    3720 ITCT    (1)

STATISTICS
   PROGRAM LENGTH             3743     252
   CM BLANK COMMON LENGTH    73663    3830
```

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      SUBROUTINE AMRK           74/74    OPT=1                        FTN 4.2+75067      05/05/75  16.23.36.      PAGE    1

                 SUBROUTINE AMRK(AUXSUB)                                         AMRK      2
                 COMMON C(3830)                                                  AMRK      3
                 DIMENSION CSAV(100), IPL(100)                                   AMRK      4
                 REAL K1(100), K2(100), K3(100), K4(100)                         AMRK      5
   5             EQUIVALENCE (C(2000),    T)                                     AMRK      6
                 EQUIVALENCE (C(2664), DELT)                                     AMRK      7
                 EQUIVALENCE (C(2561),    NJ)                                    AMRK      8
                 EQUIVALENCE (C(2562),   IPL)                                    AMRK      9
                 EQUIVALENCE (C(1275), XNORK)                                    AMRK     10
  10             XNORK = -1.                                                     AMRK     11
                 DO 1 I = 1,NJ                                                   AMRK     12
                 J = IPL(I)                                                      AMRK     13
           C                                                                     AMRK     14
           C****STORE INITIAL VALUES                                             AMRK     15
  15             CSAV(I) = C(J+3)                                                AMRK     16
           C                                                                     AMRK     17
           C*** COMPUTE K1                                                       AMRK     18
                 K1(I) = DELT*C(J)                                               AMRK     19
               1 C(J+3) = CSAV(I) + .5*K1(I)                                     AMRK     20
  20             T = T + .5*DELT                                                 AMRK     21
                 CALL AUXSUB                                                     AMRK     22
           C                                                                     AMRK     23
           C*** COMPUTE K2                                                       AMRK     24
                 DO 2 I = 1,NJ                                                   AMRK     25
  25             J = IPL(I)                                                      AMRK     26
                 K2(I) = DELT*C(J)                                               AMRK     27
               2 C(J+3) = CSAV(I) + .5*K2(I)                                     AMRK     28
                 CALL AUXSUB                                                     AMRK     29
           C                                                                     AMRK     30
  30       C*** COMPUTE K3                                                       AMRK     31
                 DO 3 I = 1,NJ                                                   AMRK     32
                 J = IPL(I)                                                      AMRK     33
                 K3(I) = DELT*C(J)                                               AMRK     34
               3 C(J+3) = CSAV(I) + K3(I)                                        AMRK     35
  35             T = T + .5*DELT                                                 AMRK     36
                 CALL AUXSUB                                                     AMRK     37
           C                                                                     AMRK     38
           C*** COMPUTE K4                                                       AMRK     39
                 DO 4 I = 1, NJ                                                  AMRK     40
  40             J = IPL(I)                                                      AMRK     41
                 K4(I) = DELT*C(J)                                               AMRK     42
               4 C(J+3) = CSAV(I) +(K1(I) + 2.*(K2(I) + K3(I)) + K4(I))/6.       AMRK     43
                 XNORK = 1.                                                      AMRK     44
                 CALL AUXSUB                                                     AMRK     45
  45             RETURN                                                          AMRK     46
                 END                                                             AMRK     47

      SUBROUTINE AMRK           74/74    OPT=1                        FTN 4.2+75057      05/05/75  16.23.36.      PAGE    2

 CARD NR. SEVERITY  DETAILS   DIAGNOSIS OF PROBLEM

      19      I       NJ      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
      27      I       NJ      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
      34      I       NJ      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
      42      I       NJ      THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
```

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         SUBROUTINE AMRK       74/74    OPT=1                       FTN 4.2+75067     05/05/75  16.23.56.      PAGE    3

           SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS       DEF LINE       REFERENCES
     3   AMRK           1             45

 VARIABLES      SN    TYPE          RELOCATION
     0   C            REAL          ARRAY    / /          REFS          2          5          6          7          8          9         15
                                                                18         26         30         41    DEFINED         19         27         34
                                                                42
   114   CSAV         REAL          ARRAY                 REFS          3         19         27         34         42
                                                          DEFINED      15
  5147   DELT         REAL                   / /          REFS          6         18         20         26         33         35         41
   112   I            INTEGER                             REFS         12         15         18       2*19         25         26       2*27
                                                                32         33       2*34         40         41       5*42
                                                          DEFINED      11         24         31         39
  5001   IPL          INTEGER       ARRAY    / /          REFS          3          8         12         25         32         40
   113   J            INTEGER                             REFS         15         18         19         26         27         33         34
                                                                41         42    DEFINED         12         25         32         40
   260   K1           REAL          ARRAY                 REFS          4         19         42    DEFINED         18
   424   K2           REAL          ARRAY                 REFS          4         27         42    DEFINED         26
   570   K3           REAL          ARRAY                 REFS          4         34         42    DEFINED         33
   734   K4           REAL          ARRAY                 REFS          4         42    DEFINED         41
  5000   NJ           INTEGER                / /          REFS          7         11         24         31         39
  3717   T            REAL                   / /          REFS          5         20         35    DEFINED         20         35
  3667   XNORK        REAL                   / /          REFS          9    DEFINED         10         43

 EXTERNALS            TYPE     ARGS         REFERENCES
       AUXSUB                    6   F.P.        21         28         36         44

 STATEMENT LABELS                 DEF LINE    REFERENCES
     0  1                           13          11
     0  2                           27          24
     0  3                           34          31
     0  4                           42          33

 LOOPS  LABEL      INDEX      FROM-TO      LENGTH      PROPERTIES
    23   1          I          11 13         6B         INSTACK
    41   2          I          24 27         5B         INSTACK
    54   3          I          3* 34         5B         INSTACK
    70   4          I          39 42        11B         OPT

 COMMON BLOCKS    LENGTH       MEMBERS - BIAS NAME(LENGTH)
     / /           3830                  0 C       (3830)

 EQUIV CLASSES    LENGTH       MEMBERS - BIAS NAME(LENGTH)
 C         C       3830          1375 XNORK   (1)          1939 T       (1)          2560 NJ       (1)
                                 2561 IPL     (100)        2663 DELT    (1)

 STATISTICS
    PROGRAM LENGTH                 11053     581
    CM BLANK COMMON LENGTH         73663    3830
```

```
      SUBROUTINE AUXI                                                    AMRK  48
      COMMON C(3830)                                                     AMRK  49
      EQUIVALENCE (C(2361),NOMOD ), (C(2362),XMOJNO), (C(2561),N    )    AMRK  50
      DIMENSION  XMODNO(39)                                              AMRK  51
      N = 1                                                              AMRK  52
      DO 1 I=1,NOMOD                                                     AMRK  53
      L =XMODNO(I)                                                       AMRK  54
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23 AMRK  55
     1     ,24,25,26,27,28,29,30,31,32,33,34,35,36,37),L                 AMRK  56
    2 CALL  A1I                                                          AMRK  57
      GO TO 1                                                            AMRK  58
    3 CALL  A2I                                                          AMRK  59
      GO TO 1                                                            AMRK  60
    4 CALL  A3I                                                          AMRK  61
      GO TO 1                                                            AMRK  62
    5 CALL  A4I                                                          AMRK  63
      GO TO 1                                                            AMRK  64
    6 CALL  A5I                                                          AMRK  65
      GO TO 1                                                            AMRK  66
    7 CALL  C1I                                                          AMRK  67
      GO TO 1                                                            AMRK  68
    8 CALL  C2I                                                          AMRK  69
      GO TO 1                                                            AMRK  70
    9 CALL  C3I                                                          AMRK  71
      GO TO 1                                                            AMRK  72
   10 CALL  C4I                                                          AMRK  73
      GO TO 1                                                            AMRK  74
   11 CALL  C5I                                                          AMRK  75
      GO TO 1                                                            AMRK  76
   12 CALL  C6I                                                          AMRK  77
      GO TO 1                                                            AMRK  78
   13 CALL  C7I                                                          AMRK  79
      GO TO 1                                                            AMRK  80
   14 CALL  C8I                                                          AMRK  81
      GO TO 1                                                            AMRK  82
   15 CALL  C9I                                                          AMRK  83
      GO TO 1                                                            AMRK  84
   16 CALL  C10I                                                         AMRK  85
      GO TO 1                                                            AMRK  86
   17 CALL  D1I                                                          AMRK  87
      GO TO 1                                                            AMRK  88
   18 CALL  D2I                                                          AMRK  89
      GO TO 1                                                            AMRK  90
   19 CALL  D3I                                                          AMRK  91
      GO TO 1                                                            AMRK  92
   20 CALL  D4I                                                          AMRK  93
      GO TO 1                                                            AMRK  94
   21 CALL  D5I                                                          AMRK  95
      GO TO 1                                                            AMRK  96
   22 CALL  G1I                                                          AMRK  97
      GO TO 1                                                            AMRK  98
   23 CALL  G2I                                                          AMRK  99
      GO TO 1                                                            AMRK 100
   24 CALL  G3I                                                          AMRK 101
      GO TO 1                                                            AMRK 102
   25 CALL  G4I                                                          AMRK 103
      GO TO 1                                                            AMRK 104
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      26 CALL G5I                                          AMRK   105
         GO TO 1                                           AMRK   106
      27 CALL G6I                                          AMRK   107
         GO TO 1                                           AMRK   108
      28 CALL S1I                                          AMRK   109
         GO TO 1                                           AMRK   110
      29 CALL S2I                                          AMRK   111
         GO TO 1                                           AMRK   112
      30 CALL S3I                                          AMRK   113
         GO TO 1                                           AMRK   114
      31 CALL S4I                                          AMRK   115
         GO TO 1                                           AMRK   116
      32 CALL S5I                                          AMRK   117
         GO TO 1                                           AMRK   118
      33 CALL S6I                                          AMRK   119
         GO TO 1                                           AMRK   120
      34 CALL S7I                                          AMRK   121
         GO TO 1                                           AMRK   122
      35 CALL S8I                                          AMRK   123
         GO TO 1                                           AMRK   124
      36 CALL S9I                                          AMRK   125
         GO TO 1                                           AMRK   126
      37 CALL S10I                                         AMRK   127
       1 CONTINUE                                          AMRK   128
         RETURN                                            AMRK   129
         END                                               AMRK   130
```

```
SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE     REFERENCES
    1   AUXI          1            82

VARIABLES        SN   TYPE              RELOCATION
      0   C           REAL         ARRAY    / /          REFS       2      3*3
    171   I           INTEGER                            REFS       7    DEFINED       6
    172   L           INTEGER                            REFS       8    DEFINED       7
   5000   N           INTEGER                   / /      REFS       3    DEFINED       5
   4470   NOMOD       INTEGER                   / /      REFS       3       5
   4471   XMODNO      REAL         ARRAY        / /      REFS       3       4          7

EXTERNALS              TYPE     ARGS          REFERENCES
        A1I                       0              10
        A2I                       0              12
        A3I                       0              14
        A4I                       0              15
        A5I                       0              13
        C1I                       0              21
        C10I                      0              39
        C2I                       0              22
        C3I                       0              24
        C4I                       0              25
        C5I                       0              23
        C6I                       0              31
        C7I                       0              32
        C8I                       0              34
        C9I                       0              35
        D1I                       0              41
        D2I                       0              42
        D3I                       0              44
        D4I                       0              45
        D5I                       0              43
        G1I                       0              51
        G2I                       0              52
        G3I                       0              54
        G4I                       0              55
        G5I                       0              53
        G6I                       0              61
        S1I                       0              62
        S10I                      0              81
        S2I                       0              64
        S3I                       0              65
        S4I                       0              63
        S5I                       0              71
        S6I                       0              72
        S7I                       0              74
        S8I                       0              75
        S9I                       0              73

STATEMENT LABELS          DEF LINE   REFERENCES
    166   1                   81        5      8     11     13     15     17     19     21     23
                                       25     27     29     31     33     35     37     39     41
                                       43     45     47     49     51     53     55     57     59
                                       61     63     65     57     69     71     73     75     77
                                       73
```

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        SUBROUTINE AUXI        74/74    OPT=1                    FTN 4.2+75057      05/05/75  16.23.37.     PAGE    4

 STATEMENT LABELS                  DEF LINE   REFERENCES
     57   2                           10         8
     61   3                           12         3
     63   4                           14         3
     65   5                           16         3
     67   6                           18         3
     71   7                           20         3
     73   8                           22         3
     75   9                           24         3
     77  10                           26         3
    101  11                           28         3
    103  12                           30         3
    105  13                           32         3
    107  14                           34         3
    111  15                           36         3
    113  16                           38         3
    115  17                           40         3
    117  18                           42         3
    121  19                           44         3
    123  20                           46         3
    125  21                           48         3
    127  22                           50         3
    131  23                           52         3
    133  24                           54         8
    135  25                           56         3
    137  26                           58         3
    141  27                           60         3
    143  28                           62         3
    145  29                           64         3
    147  30                           66         3
    151  31                           68         3
    153  32                           70         3
    155  33                           72         3
    157  34                           74         3
    161  35                           76         3
    163  36                           78         3
    165  37                           80         3

  LOOPS  LABEL    INDEX      FROM-TO     LENGTH    PROPERTIES
     4   1         * I        6 81        165B             EXT REFS

 COMMON BLOCKS    LENGTH     MEMBERS - BIAS NAME(LENGTH)
     //            3830                0 C        (3830)

 EQUIV CLASSES    LENGTH     MEMBERS - BIAS NAME(LENGTH)
 C       C         3830         2363 NOMOD   (1)            2351 XMODND (99)          2560 N       (1)

 STATISTICS
   PROGRAM LENGTH                 1233     123
   CM BLANK COMMON LENGTH        73663    3830
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```
      SUBROUTINE AUXSUB                                                 AMRK     131
      COMMON C(3830)                                                    AMRK     132
      EQUIVALENCE (C(2000),T     ), (C(2361),NOMOD ), (C(2362),XMODNO)  AMRK     133
      EQUIVALENCE (C(2561),N     ), (C(2562),IPL   ), (C(2664),DER   )  AMRK     134
      EQUIVALENCE (C(2965),VAR   )                                      AMRK     135
      EQUIVALENCE (C(2320),LCONV)                                       AMRK     136
      DIMENSION   DER(101)        , VAR(101)        , IPL(100)          AMRK     137
      DIMENSION   XMODNO(99)                                            AMRK     138
      EXTERNAL A1                                                       AMRK     139
      EXTERNAL A2                                                       AMRK     140
      EXTERNAL A3                                                       AMRK     141
      DO 1 I=1,NOMOD                                                    AMRK     142
      IF(LCONV.EQ.2)RETURN                                              AMRK     143
      L =XMODNO(I)                                                      AMRK     144
      GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,  AMRK     145
     123,24,25,26,27,28,29,30,31,32,33,34,35,36,37),L                   AMRK     146
    2 CALL A1                                                           AMRK     147
      GO TO 1                                                           AMRK     148
    3 CALL A2                                                           AMRK     149
      GO TO 1                                                           AMRK     150
    4 CALL A3                                                           AMRK     151
      GO TO 1                                                           AMRK     152
    5 CALL A4                                                           AMRK     153
      GO TO 1                                                           AMRK     154
    6 CALL A5                                                           AMRK     155
      GO TO 1                                                           AMRK     156
    7 CALL C1                                                           AMRK     157
      GO TO 1                                                           AMRK     158
    8 CALL C2                                                           AMRK     159
      GO TO 1                                                           AMRK     160
    9 CALL C3                                                           AMRK     161
      GO TO 1                                                           AMRK     162
   10 CALL C4                                                           AMRK     163
      GO TO 1                                                           AMRK     164
   11 CALL C5                                                           AMRK     165
      GO TO 1                                                           AMRK     166
   12 CALL C6                                                           AMRK     167
      GO TO 1                                                           AMRK     168
   13 CALL C7                                                           AMRK     169
      GO TO 1                                                           AMRK     170
   14 CALL C8                                                           AMRK     171
      GO TO 1                                                           AMRK     172
   15 CALL C9                                                           AMRK     173
      GO TO 1                                                           AMRK     174
   16 CALL C10                                                          AMRK     175
      GO TO 1                                                           AMRK     176
   17 CALL D1                                                           AMRK     177
      GO TO 1                                                           AMRK     178
   18 CALL D2                                                           AMRK     179
      GO TO 1                                                           AMRK     180
   19 CALL D3                                                           AMRK     181
      GO TO 1                                                           AMRK     182
   20 CALL D4                                                           AMRK     183
      GO TO 1                                                           AMRK     184
   21 CALL D5                                                           AMRK     185
      GO TO 1                                                           AMRK     186
   22 CALL G1                                                           AMRK     187
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            GO TO 1                                   AMRK     188
      23    CALL G2                                   AMRK     189
            GO TO 1                                   AMRK     190
      24    CALL G3                                   AMRK     191
            GO TO 1                                   AMRK     192
      25    CALL G4                                   AMRK     193
            GO TO 1                                   AMRK     194
      26    CALL G5                                   AMRK     195
            GO TO 1                                   AMRK     196
      27    CALL G6                                   AMRK     197
            GO TO 1                                   AMRK     198
      28    CALL S1                                   AMRK     199
            GO TO 1                                   AMRK     200
      29    CALL S2                                   AMRK     201
            GO TO 1                                   AMRK     202
      30    CALL S3                                   AMRK     203
            GO TO 1                                   AMRK     204
      31    CALL S4                                   AMRK     205
            GO TO 1                                   AMRK     206
      32    CALL S5                                   AMRK     207
            GO TO 1                                   AMRK     208
      33    CALL S6                                   AMRK     209
            GO TO 1                                   AMRK     210
      34    CALL S7                                   AMRK     211
            GO TO 1                                   AMRK     212
      35    CALL S8                                   AMRK     213
            GO TO 1                                   AMRK     214
      36    CALL S9                                   AMRK     215
            GO TO 1                                   AMRK     216
      37    CALL S10                                  AMRK     217
       1    CONTINUE                                  AMRK     218
            RETURN                                    AMRK     219
            END                                       AMRK     220
```

```
        SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE     REFERENCES
   1  AUXSUB         1           13      83

VARIABLES     SN  TYPE            RELOCATION
      0  C         REAL        ARRAY   / /         REFS      2      3*3     3*4     5     6
   5147  DER       REAL        ARRAY   / /         REFS      4      7
    172  I         INTEGER                         REFS     14   DEFINED    12
   5061  IPL       INTEGER     ARRAY   / /         REFS      4      7
    173  L         INTEGER                         REFS     15   DEFINED    14
   3743  LCONV     INTEGER             / /         REFS      6     13
   5000  N         INTEGER             / /         REFS      4
   4470  NOMOD     INTEGER             / /         REFS      3     12
   3717  T         REAL                / /         REFS      3
   5624  VAR       REAL        ARRAY   / /         REFS      5      7
   4471  XMODNO    REAL        ARRAY   / /         REFS      3      8      14

EXTERNALS          TYPE    ARGS        REFERENCES
         A1                  0             9     17
         A2                  0            13     19
         A3                  0            11     21
         A4                  0            23
         A5                  0            25
         C1                  0            27
         C10                 0            45
         C2                  0            29
         C3                  0            31
         C4                  0            33
         C5                  0            35
         C6                  0            37
         C7                  0            39
         C8                  0            41
         C9                  0            43
         D1                  0            47
         D2                  0            49
         D3                  0            51
         D4                  0            53
         D5                  0            55
         G1                  0            57
         G2                  0            59
         G3                  0            61
         G4                  0            63
         G5                  0            65
         G6                  0            67
         S1                  0            69
         S10                 0            87
         S2                  0            71
         S3                  0            73
         S4                  0            75
         S5                  0            77
         S6                  0            79
         S7                  0            81
         S8                  0            83
         S9                  0            85
```

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SUBROUTINE AUXSJB        74/74   OPT=1                 FTN 4.2+75067      05/05/75  16.23.59.        PAGE    4

STATEMENT LABELS                 DEF LINE    REFERENCES
  167  1                           88         12    15    18    20    22    24    26    28    30
                                              32    34    36    38    40    42    44    46    48
                                              50    52    54    56    58    60    62    64    66
                                              68    70    72    74    76    78    80    82    84
                                              86
   60  2                           17         15
   62  3                           19         15
   64  4                           21         15
   66  5                           23         15
   70  6                           25         15
   72  7                           27         15
   74  8                           29         15
   76  9                           31         15
  100 10                           33         15
  102 11                           35         15
  104 12                           37         15
  106 13                           39         15
  110 14                           41         15
  112 15                           43         15
  114 16                           45         15
  116 17                           47         15
  120 18                           49         15
  122 19                           51         15
  124 20                           53         15
  126 21                           55         15
  130 22                           57         15
  132 23                           59         15
  134 24                           61         15
  136 25                           63         15
  140 26                           65         15
  142 27                           67         15
  144 28                           69         15
  146 29                           71         15
  150 30                           73         15
  152 31                           75         15
  154 32                           77         15
  156 33                           79         15
  160 34                           81         15
  162 35                           83         15
  164 36                           85         15
  166 37                           87         15

LOOPS  LABEL    INDEX      FROM-TO     LENGTH     PROPERTIES
   3    1        * I        12 88       1678          EXT REFS   EXITS

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
   / /            3830               0 C      (3830)

EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
   C     C        3830          1399 I       (1)         2019 LOONV  (1)        2360 NOMOD  (1)
                                2361 XMOOND  (99)        2560 N      (1)        2561 IPL    (100)
                                2663 OER     (131)       2964 VAR    (101)

STATISTICS
  PROGRAM LENGTH                1743     124
  CM BLANK COMMON LENGTH       73663    3830
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```
SUBROUTINE DUMPJ        74/74   OPT=1                     FTN 4.2+75067     05/05/75  16.24.01.     PAGE    1

                        SUBROUTINE DUMPJ
                        COMMON C(3830)                                                     EXEC      2
                        DO 100 I=1, 1500, 7                                                EXEC      3
                        N = 0                                                              EXEC      4
     5                  DO 200 J=1, 7                                                      EXEC      5
                        K = I + J - 1                                                      EXEC      6
                    200 IF (ABS(C(K)) .GT. 1.E-10) N = 1                                   EXEC      7
                    100 IF (N .GT. 0) WRITE(6,300)                                         EXEC      8
                       *    I,C(I),C(I+1),C(I+2),C(I+3),C(I+4),C(I+5),C(I+6)               EXEC      9
    10              300 FORMAT(1H ,I5,1P7E15.7)                                            EXEC     10
                        RETURN                                                             EXEC     11
                        END                                                                EXEC     12
                                                                                           EXEC     13

SUBROUTINE DUMPJ        74/74   OPT=1                     FTN 4.2+75067     05/05/75  16.24.01.     PAGE    2

      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE     REFERENCES
     1 DUMPO         1            11

VARIABLES      SN   TYPE            RELOCATION
     0 C            REAL       ARRAY    / /
    57 I            INTEGER                        REFS       2        7        7*8
    61 J            INTEGER                        REFS       6       8*8    DEFINED     3
    62 K            INTEGER                        REFS       6    DEFINED       5
    60 N            INTEGER                        REFS       7    DEFINED       6
                                                   REFS       8    DEFINED       4        7

FILE NAMES       MODE
     TAPE6       FMT                   WRITES      8

INLINE FUNCTIONS    TYPE    ARGS        DEF LINE   REFERENCES
     ABS            REAL       1  INTRIN                7

STATEMENT LABELS                 DEF LINE     REFERENCES
     0  100                           9            3
     0  200                           7            5
    53  300       FMT                10            8

LOOPS   LABEL    INDEX    FROM-TO    LENGTH    PROPERTIES
     3   100      * I       3  8       35B                   EXT REFS   NOT INNER
    11   200      * J       5  7       7B      INSTACK

COMMON BLOCKS    LENGTH    MEMBERS - BIAS NAME(LENGTH)
    / /           3830              0  C     (3830)

STATISTICS
    PROGRAM LENGTH                  63B       51
    CM BLANK COMMON LENGTH        7366B     3830
```

```
      SUBROUTINE OINPT1                                                 EXEC     14
C     BASIC INPUT SUBROUTINE OINPT1                                     EXEC     15
      COMMON C(3830)                                                    EXEC     16
      EQUIVALENCE (C(3219),ONAME1), (C(3268),ONAME2), (C(3318),ONAME3), EXEC     17
C                 (C(3328),ONAME4), (C(2361),NOMOD ), (C(2362),MODNO ), EXEC     18
C                 (C(3440),NORNDM), (C(3441),RNDMNO), (C(3167),NODUT ), EXEC     19
C                 (C(3168),OUTNO ), (C(2461),NOSUB ), (C(2462),SUBNO ), EXEC     20
     *(C(3339),NOSTAT),                                                 EXEC     21
C                 (C(3338),LOSTAT), (C(3340),STATNO), (C(3066),NOLIST), EXEC     22
C                 (C(3057),LISTNO), (C(3117),VALUE ), (C(2008),PLOTNO), EXEC     23
C                 (C(2009),NOPLOT), (C(2325),VLABLE), (C,K)             EXEC     24
      EQUIVALENCE (C(2010),  STEP)                                      EXEC     25
      EQUIVALENCE (C(1984),NPLOT )                                      EXEC     26
      EQUIVALENCE (C(1985),OUTPLT)                                      EXEC     27
      EQUIVALENCE (C(3512),ISGCT),(C(3514),SIGMA),(C(3554),SIGLB),      EXEC     28
     *(C(3594),SIGUB),(C(3634),ISNDX),(C(3574),IDIST),(C(3511),RNSTRT)  EXEC     29
      EQUIVALENCE(C(3721),ITCT),(C(3723),TSGMA),(C(3733),TLB),          EXEC     30
     *(C(3743),TUB),(C(3753),ITNDX),(C(3763),ITDIST),(C(3773),TSPER),   EXEC     31
     *(C(3783),TYPPER),(C(3793),TPSIG),(C(3803),TNXST),(C(3813),ITNDX2) EXEC     32
      EQUIVALENCE (C( 21),IBVNSW)                                       EXEC     33
      EQUIVALENCE (C( 22), IPLOT)                                       EXEC     34
      EQUIVALENCE (C(19),PSIZE)                                         EXEC     35
      EQUIVALENCE (C( 23),KLAMBD)                                       EXEC     36
      EQUIVALENCE (C( 24), KSSIG)                                       EXEC     37
      EQUIVALENCE (C( 25),DEPSIG)                                       EXEC     38
      EQUIVALENCE (C(3825),  NCASE)                                     BREAK    93
      DIMENSION ONAME3(10),ONAME4(10)                                   EXEC     39
      DIMENSION LISTNO(50),  VALUE(50)                                  EXEC     40
      DIMENSION SUBNO(99),IR(4),VR(4)                                   EXEC     41
      DIMENSION RNDMNO(50)                                              EXEC     42
      DIMENSION ALPHA(3),ONAME1(50),ONAME2(50),OUTNO(50) ,MODNO(99)     EXEC     43
      DIMENSION K(3510)                                                 EXEC     44
      DIMENSION STATNO (100)                                            EXEC     45
      DIMENSION VLABLE(2,15)                                            EXEC     46
      DIMENSION OUTPLT(15)                                              EXEC     47
      DIMENSION SIGMA(40),SIGLB(40),SIGUB(40),ISNDX(40),IDIST(40)       EXEC     48
      DIMENSION TSGMA(10),TLB(10),TUB(10),ITNDX(10),ITDIST(10),         EXEC     49
     *TSPER(10),TYPPER(10),TPSIG(10),ITNDX2(10),TNXST(10)               EXEC     50
      DIMENSION DEPSIG(5)                                               EXEC     51
      INTEGER DEPSIG                                                    EXEC     52
      REAL KSSIG                                                        EXEC     53
      REAL MODNO                                                        EXEC     54
      INTEGER OUTNO                                                     EXEC     55
      INTEGER RNDMNO                                                    EXEC     56
      INTEGER STATNO                                                    EXEC     57
      INTEGER OUTPLT                                                    EXEC     58
      DATA CFERTY/10HR         /                                        EXEC     59
      DATA SSS/10HS          /                                          EXEC     60
      JAR = 0                                                           EXEC     61
      WRITE(6,31)                                                       EXEC     62
   31 FORMAT(1H1IKPUT DATA/)                                            EXEC     63
    1 READ(5,2)IR(1),(ALPHA(JC),JC=1,3),IR(2),IR(3),TPER,TPSGMA,        EXEC     64
     *VR(1),VR(2),VR(3),IR(4),VR(4)                                     EXEC     65
      IF(EOF(5)) 50,55                                                  EXEC     66
   55 CONTINUE                                                          EXEC     67
      WRITE(6,30)IR(1),(ALPHA(JC),JC=1,3),IR(2),IR(3),TPER,TPSGMA,      EXEC     68
     *VR(1),VR(2),VR(3),                                                EXEC     69
```

```
     *IR(4),VR(4)
   30 FORMAT(1X,I2,3A6,I5,I2,A1,F3.2,2E15.7,F10.4,I5,F7.4)
    2 FORMAT(I2,3A6,I5,I1,A1,F3.2,2E15.7,F10.4,I5,F5.2)
    7 IF( IR(1) .NE. 1 ) GO TO 3
      NOSUB = NOSUB + 1
      SUBNO(NOSUB) = IR(2)
      GO TO 1
    3 IF( IR(1) .NE. 2 ) GO TO 4
      NOMOD = NOMOD + 1
      MODNO(NOMOD) = IR(2)
      GO TO 1
    4 IF(IR(1) .NE. 3) GO TO 5
      L = IR(2)
      S(L) = VR(1)
      IF (VR(2) .EQ. 0.) GO TO 1
      NOLIST = NOLIST + 1
      LISTNO(NOLIST) = L
      VALUE(NOLIST) = VR(1)
      GO TO 1
    5 IF(IR(1) .NE. 4) GO TO 6
      NOOUT = NOOUT + 1
      IF (NOOUT.GT.50) GO TO 1
      ONAME1(NOOUT)=ALPHA(2)
      ONAME2(NOOUT) = ALPHA(3)
      OUTNO(NOOUT) = IR(2)
      GO TO 1
    6 IF (IR(1) .NE. 5) GO TO 16
      IF (VR(1) .EQ. 0.) GO TO 17
      LOSTAT = LOSTAT + 1
   17 NOSTAT = NOSTAT + 1
      STATNO(NOSTAT) = IR(2)
      ONAME3(NOSTAT)=ALPHA(2)
      ONAME4(NOSTAT)=ALPHA(3)
      GO TO 1
   16 IF (IR(1).NE.7) GO TO 19
      NPLOT=NPLOT+1
      IF (NPLOT.GT.15) GO TO 1
      DO 20 I=1,2
   20 VLABLE (I,NPLOT)=ALPHA(I+1)
      OUTPLT(NPLOT)=IR(2)
      GO TO 1
   19 IF(IR(1).NE.8) GO TO 18
      IF(TFER.EQ.SSS) GO TO 194
      IF(VR(4).GT.0.) GO TO 192
      IF(IR(3).NE.0.AND.IR(3).NE.1) GO TO 193
      ISGCT=ISGCT+1
      SIGMA(ISGCT)=VR(1)
      SIGLB(ISGCT)=VR(2)
      SIGUB(ISGCT)=VR(3)
      ISNDX(ISGCT)=IR(2)
      IDIST(ISGCT)=IR(3)
      GO TO 1
   18 IF(IR(1).NE.9) GO TO 191
      STEP = 11.
      READ(5,8)NP,I3VNSW,IPLOT,XLAMBD,KSSIG,(CEPSIS(I),I=1,5),PSIZE
    8 FORMAT(3I4,2F10.3,5I2,E15.7)
      GO TO 1
```

```
SUBROUTINE DINPT1        74/74   OPT=1                    FTN 4.2+75067   05/05/75  16.24.82.    PAGE   3

      192 IF(IR(3).GT.5) GO TO 193                                          EXEC     127
          ITCT=ITCT+1                                                       EXEC     128
          TSGMA(ITCT)=VR(1)                                                 EXEC     129
          TLB(ITCT)=VR(2)                                                   EXEC     130
          TUB(ITCT)=VR(3)                                                   EXEC     131
          ITNDX2(ITCT)=IR(2)                                                EXEC     132
          IF(IR(4).GT.0) ITNDX2(ITCT)=IR(4)                                 EXEC     133
          ITNDX(ITCT)=IR(2)                                                 EXEC     134
          ITDIST(ITCT)=IR(3)                                                EXEC     135
          TSPER(ITCT)=VR(4)                                                 EXEC     136
          TPSIG(ITCT)=TPSGMA                                                EXEC     137
          TYPPER(ITCT)=0.                                                   EXEC     138
          IF(TPER.EQ.CPER(T)) TYPPER(ITCT)=1.                               EXEC     139
          GO TO 1                                                           EXEC     140
      194 RNSTRT=VR(1)                                                      EXEC     141
          GO TO 1                                                           EXEC     142
      193 WRITE(6,5518)                                                     EXEC     143
     5518 FORMAT(1X,59HUNDEFINED DISTRIBUTION TYPE NUMBER ENTERED - CARD REJ EXEC     144
         *ECTED)                                                            EXEC     145
          WRITE(6,30)IR(1),(ALPHA(JC),JC=1,3),IR(2),IR(3),TPER,TPSGMA,      EXEC     146
         *VR(1),VR(2),VR(3),                                                EXEC     147
         *IR(4),VR(4)                                                       EXEC     148
          GO TO 1                                                           EXEC     149
      191 CONTINUE                                                          BREAK     94
          NCASE=NCASE+1                                                     BREAK     95
          IF(IR(2).EQ.0)RETURN                                              BREAK     96
          N = IR(2)                                                         EXEC     151
          DO 12 I = 1, N                                                    EXEC     152
          READ (5,13) J,Y,MAND,MIER,SIGNO,BETA                              EXEC     153
          WRITE (6,13) J,Y,MAND,MIER,SIGNO,BETA                             EXEC     154
       13 FORMAT (I5,F5.0,2(3X,O12),2E15.6)                                 EXEC     155
          NORNDM = NORNDM + 1                                               EXEC     156
          RNDMNO(I) = J                                                     EXEC     157
          C(J) = Y                                                          EXEC     158
          K(J+1) = MAND                                                     EXEC     159
          K(J+2) = MIER                                                     EXEC     160
          C(J+3) = SIGNO                                                    EXEC     161
       12 C(J+4) = BETA                                                     EXEC     162
          RETURN                                                            EXEC     163
       50 STOP                                                              EXEC     164
          END                                                               EXEC     165

SUBROUTINE DINPT1        74/74   OPT=1                    FTN 4.2+75067   05/05/75  16.24.82.    PAGE   4

CARD NR. SEVERITY DETAILS  DIAGNOSIS OF PROBLEM

     60    I       33 CD 60 FIELD WIDTH OF A CONVERSION DESCRIPTOR SHOULD BE AS LARGE AS THE MINIMUM SPECIFIED FOR THAT DESCRIPTOR.
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      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS    DEF LINE     REFERENCES
     1  OINPT1         1        140        153

 VARIABLES    SN   TYPE             RELOCATION
   445  ALPHA      REAL       ARRAY                     REFS      31      56      80      81      89      38      96
                                                         134  DEFINED     52
   434  BETA       REAL                                 REFS     144     152  DEFINED     143
     0  C          REAL       ARRAY     / /             REFS       3    22*4      12      13      14    7*13   11*17
                                                          20      21      22      23      24      25      26
                                                     DEFINED      71    -148     151     152
    30  CEPSIG     INTEGER    ARRAY     / /             REFS      25      39      40  DEFINED    112
   233  CPERTY     REAL                                 REFS     127  DEFINED     47
   424  I          INTEGER                              REFS    2*96     112     147  DEFINED     95     112     142
    24  IBVNSW     INTEGER              / /             REFS      20  DEFINED    112
  7131  IDIST      INTEGER    ARRAY     / /             REFS      15      36  DEFINED    108
    25  IPLOT      INTEGER              / /             REFS      21  DEFINED    112
   435  IR         INTEGER    ARRAY                     REFS      29    4*56      61      63      65      67      69
                                                          70      77      82      84      88      92      97      99
                                                       2*102     107     108     110     115     120   2*121     122
                                                         123   4*134     140     141  DEFINED   4*52
  6667  ISGCT      INTEGER              / /             REFS      15     103     104     105     106     107     108
                                                     DEFINED     103
  7061  ISNOX      INTEGER    ARRAY     / /             REFS      15      36  DEFINED    107
  7210  ITCT       INTEGER              / /             REFS      17     116     117     118     119     120     121
                                                         122     123     124     125     126     127
                                                     DEFINED     116
  7262  ITDIST     INTEGER    ARRAY     / /             REFS      17      37  DEFINED    123
  7250  ITNOX      INTEGER    ARRAY     / /             REFS      17      37  DEFINED    122
  7344  ITNOX2     INTEGER    ARRAY     / /             REFS      17      37  DEFINED    120     121
   427  J          INTEGER                              REFS     144     147     148     149     150     151     152
                                                     DEFINED     143
   417  JAR      * INTEGER                           DEFINED      49
   420  JC         INTEGER                              REFS      52      56     134  DEFINED     52      56     134
     0  K          INTEGER    ARRAY     / /             REFS       4      32  DEFINED    149     150
    27  KSSIG      REAL                 / /             REFS      24      41  DEFINED    112
   423  L          INTEGER                              REFS      71      74  DEFINED     70
  5772  LISTNO     INTEGER    ARRAY     / /             REFS       4      28  DEFINED     74
  6411  LOSTAT     INTEGER              / /             REFS       4      86  DEFINED     86
   431  MANO       INTEGER                              REFS     144     149  DEFINED    143
   432  MIER       INTEGER                              REFS     144     150  DEFINED    143
  4471  MODNO      REAL       ARRAY     / /             REFS       4      31      42  DEFINED     67
   426  N          INTEGER                              REFS     142  DEFINED    141
  7360  NCASE      INTEGER              / /             REFS      26     139  DEFINED    139
  5771  NOLIST     INTEGER              / /             REFS       4      73      74      75  DEFINED     73
  4470  NOMOD      INTEGER              / /             REFS       4      66      67  DEFINED     66
  6136  NOOUT      INTEGER              / /             REFS       4      78      79      80      81      82
                                                     DEFINED      78
  3730  NOPLOT     INTEGER              / /             REFS       4
  6557  NORNOM     INTEGER              / /             REFS       4     146  DEFINED    146
  6412  NOSTAT     INTEGER              / /             REFS       4      87      88      89      90
                                                     DEFINED      87
  4634  NOSUB      INTEGER              / /             REFS       4      62      63  DEFINED     62
   425  NP       * INTEGER                           DEFINED     112
  3677  NPLOT      INTEGER              / /             REFS      13      93      94      96      97
                                                     DEFINED      93
```

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SUBROUTINE OINPT1        74/74    OPT=1                           FTN 4.2+75067      05/05/75  16.24.82.        PAGE     6

VARIABLES      SN   TYPE              RELOCATION
  6221  ONAME1      REAL        ARRAY     / /         REFS        4        31    DEFINED       80
  6303  ONAME2      REAL        ARRAY     / /         REFS        4        31    DEFINED       81
  6365  ONAME3      REAL        ARRAY     / /         REFS        4        27    DEFINED       89
  6377  ONAME4      REAL        ARRAY     / /         REFS        4        27    DEFINED       90
  6137  OUTNO       INTEGER     ARRAY     / /         REFS        4        31         43    DEFINED      82
  3700  OUTPLT      INTEGER     ARRAY     / /         REFS       14        35         46    DEFINED      97
  3727  PLOTNO      REAL                  / /         REFS        4
    22  PSIZE       REAL                  / /         REFS       22   DEFINED        112
  6560  RNDMNO      INTEGER     ARRAY     / /         REFS        4        30         44    DEFINED     147
  6666  CHSTRT      REAL                  / /         REFS       15   DEFINED        129
  6741  SLGLB       REAL        ARRAY     / /         REFS       15        36    DEFINED      105
  6671  SIGMA       REAL        ARRAY     / /         REFS       15        36    DEFINED      104
   433  SIGNO       REAL                              REFS      144       151    DEFINED      143
  7611  SIGUB       REAL        ARRAY     / /         REFS       15        36    DEFINED      106
   234  SSS         REAL                              REFS      130   DEFINED         46
  6413  STATNO      INTEGER     ARRAY     / /         REFS        4        33         45    DEFINED      88
  3731  STEP        REAL                  / /         REFS       12   DEFINED        111
  4635  SUBNO       REAL        ARRAY     / /         REFS        4        29    DEFINED       63
  7224  TLB         REAL        ARRAY     / /         REFS       17        37    DEFINED      118
  7332  TNXST       REAL        ARRAY     / /         REFS       17        37
   421  TPER        REAL                              REFS       56       100        127       134    DEFINED      52
   422  TPSGMA      REAL                              REFS       56       125        134    DEFINED      52
  7320  TPSIG       REAL        ARRAY     / /         REFS       17        37    DEFINED      125
  7212  TSGMA       REAL        ARRAY     / /         REFS       17        37    DEFINED      117
  7274  TSPER       REAL        ARRAY     / /         REFS       17        37    DEFINED      124
  7236  TUB         REAL        ARRAY     / /         REFS       17        37    DEFINED      119
  7306  TYPPER      REAL        ARRAY     / /         REFS       17        37    DEFINED      126      127
  6654  VALUE       REAL        ARRAY     / /         REFS        4        28    DEFINED       75
  4424  VLABLE      REAL        ARRAY     / /         REFS        4        34    DEFINED       96
   441  VR          REAL        ARRAY                 REFS       29      4*56         71        72       75       85      101
                                                      104       105       106        117       118      119      124      129
                                                      4*134   DEFINED     4*52
    26  XLAMBD      REAL                  / /         REFS       23   DEFINED        112
   430  Y           REAL                              REFS      144       148    DEFINED      143

FILE NAMES          MODE
        TAPE5       FMT                    READS       52       112       143
        TAPE6       FMT                    WRITES      50        56       131        134      144

EXTERNALS           TYPE    ARGS          REFERENCES
        EOF         REAL     1               54

STATEMENT LABELS                  DEF LINE    REFERENCES
     5   1                           52          64        68        72        76         79       83       31       94      98
                                                109       114       128       130        137
   306   2       FMT                 60          52
    20   3                           65          61
    25   4                           69          65
    42   5                           77          69
    54   6                           84          77
     0   7          INACTIVE         61
   327   8       FMT                113         112
     0  12                          132         142
   407  13       FMT                145         143       144
    70  16                           92          84
    61  17                           87          85
   131  18                          110          93
```

```
STATEMENT LABELS              DEF LINE    REFERENCES
  105  19                        99          32
    0  20                        95          95
  300  30       FMT              59          55     134
  240  31       FMT              51          53
  230  50                       154          54
    0  55        INACTIVE        55          54
  201  191                      138         113
  137  192                      115         101
  174  193                      131         102     115
  172  194                      129         100
  336  5518     FMT             132         131

LOOPS  LABEL   INDEX    FROM-TO    LENGTH    PROPERTIES
  100   20       I       95 96        23      INSTACK
  206   12     * I      142 152      218                   EXT REFS

COMMON BLOCKS   LENGTH    MEMBERS - BIAS NAME(LENGTH)
   / /          3830                   0 C      (3830)

EQUIV CLASSES   LENGTH    MEMBERS - BIAS NAME(LENGTH)
C       C       3830                   0 K      (3510)
                                      21 JPLOT  (1)        19 PSIZE  (1)       20 IBVNSW (1)
                                      24 CEPSIG (6)        22 XLAM3D (1)       23 KSSIG  (1)
                                    2007 PLOTND (1)      1983 NPLOT  (1)     1984 OUTPLT (15)
                                    2324 VLABLE (30)     2008 NOPLOT (1)     2009 STEP   (1)
                                    2460 NOSUB  (1)      2360 NOMOG  (1)     2361 MODNO  (99)
                                    3066 LISTNO (50)     2461 SUBNO  (99)    3065 NOLIST (1)
                                    3167 OUTNO  (50)     3116 VALUE  (50)    3166 NOOUT  (1)
                                    3317 ONAME3 (10)     3217 ONAME1 (50)    3267 ONAME2 (50)
                                    3338 NOSTAT (1)      3327 ONAME4 (10)    3337 LOSTAT (1)
                                    3441 RNDMNO (50)     3339 STATNO (100)   3439 NORNDM (1)
                                    3513 SIGMA  (40)     3510 RNSTRT (1)     3511 ISGCT  (1)
                                    3633 ISNDX  (40)     3553 SIGLB  (40)    3593 SIGUB  (40)
                                    3722 FSGMA  (10)     3673 IDIST  (40)    3720 ITCT   (1)
                                    3752 LTNDX  (10)     3732 TLB    (10)    3742 TUB    (10)
                                    3762 IYPPER (10)     3762 ITDIST (10)    3772 TSPER  (10)
                                    3812 ITNDX2 (10)     3792 TPSIG  (10)    3802 TNXST  (10)
                                                         3824 NCASE  (1)

STATISTICS
  PROGRAM LENGTH              4503    296
  CM BLANK COMMON LENGTH     73663   3830
```

```
      SUBROUTINE OUPT2        74/74    OPT=1                    FTN 4.2+75067     05/05/75  16.24.35.     PAGE    1

                    SUBROUTINE OUPT2                                                                EXEC     165
             C      OUTPUT INITIALIZITION SUBROUTINE OUPT2                                          EXEC     167
                    COMMON C(3830),GRAPH                                                            EXEC     168
                    EQUIVALENCE (C(2017),OTCNT ), (C(3167),NOOUT ), (C(2016),PGCNT ),               EXEC     169
        5       C              (C(2014),ITCNT ), (C(2003),PCNT  ), (C(2015),DP    ),                EXEC     170
                C              (C(2018),TAPE  ), (C(2019),TAPEND), (C(2013),DOC   ),                EXEC     171
                C              (C(2000),T     ), (C(2021),KCONV ), (C(2025),TIME  ),                EXEC     172
                C              (C(2005),PLOTNO), (C(2009),NOPLOT), (C(3168),OUTNO ),                EXEC     173
                C              (C(2004),PPNT  ), (C(2023),OPOINT)                                   EXEC     174
       10           DIMENSION GRAPH(1,1),TIME(300),OUTNO(50)                                        EXEC     175
                    INTEGER     PGCNT , OTCNT , OUTNO , OPOINT                                      EXEC     176
                    EQUIVALENCE (C(1985),OUTPLT)                                                    EXEC     177
                    INTEGER OUTPLT                                                                  EXEC     178
                    DIMENSION OUTPLT(15)                                                            EXEC     179
       15           KCONV=0                                                                         EXEC     180
                    ITCNT = DOC + 1.0                                                               EXEC     181
                    PCNT = T-0.000001                                                               EXEC     182
                    PGCNT = 1                                                                       EXEC     183
                    OTCNT = (NOOUT + 4)/5                                                           EXEC     184
       20           IF ( ITCNT .GE. 7) GO TO 2                                                      EXEC     185
                    ITCNT = ITCNT + 1                                                               EXEC     186
                    CALL LUMPO                                                                      EXEC     187
             C                                                                                      EXEC     188
                  2 TIME(1)=T                                                                       EXEC     189
       25           OPOINT =1                                                                       EXEC     190
                    DO 10 J=1,NOPLOT                                                                EXEC     191
                    K=OUTPLT(J)                                                                     EXEC     192
                 10 GRAPH(1,J)=C(K)                                                                 EXEC     193
                    RETURN                                                                          EXEC     194
       30           END                                                                             EXEC     195

      SUBROUTINE OUPT2        74/74    OPT=1                    FTN 4.2+75067     05/05/75  16.24.35.     PAGE    2

CARD NR. SEVERITY  DETAILS   DIAGNOSIS OF PROBLEM

      28    I      NOPLOT    THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
```

```
SUBROUTINE OUPT2      74/74   OPT=1                          FTN 4.2+.067     05/05/75  16.24.05.     PAGE   3

      SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS     DEF LINE     REFERENCES
        1 OUPT2         1           29

  VARIABLES     SN  TYPE            RELOCATION
        0 C           REAL        ARRAY    / /         REFS       3     17*4       12       28
     3736 CPP         REAL                 / /         REFS       4
     3734 DOC         REAL                 / /         REFS       4       16
     3740 DTCNT       INTEGER              / /         REFS       4       11    DEFINED     19
     7366 GRAPH       REAL        ARRAY    / /         REFS       3       10    DEFINED     28
     3735 ITCNT       INTEGER              / /         REFS       4       20       21    DEFINED     16       21
       33 J           INTEGER                          REFS      27       28    DEFINED     26
       34 K           INTEGER                          REFS      28    DEFINED     27
     3744 KCONV       INTEGER              / /         REFS       4    DEFINED     15
     6136 NOOUT       INTEGER              / /         REFS       4       19
     3730 NOPLOT      INTEGER              / /         REFS       4       26
     3746 OPOINT      INTEGER              / /         REFS       4       11    DEFINED     25
     6137 OUTNO       INTEGER     ARRAY    / /         REFS       4       10       11
     3700 OUTPLT      INTEGER     ARRAY    / /         REFS      12       13       14       27
     3722 PCNT        REAL                 / /         REFS       4    DEFINED     17
     3737 PGCNT       INTEGER              / /         REFS       4       11    DEFINED     18
     3727 PLOTNO      REAL                 / /         REFS       4
     3723 PPNT        REAL                 / /         REFS       4
     3717 T           REAL                 / /         REFS       4       17       24
     3741 TAPE        REAL                 / /         REFS       4
     3742 TAPEND      REAL                 / /         REFS       4
     3750 TIME        REAL        ARRAY    / /         REFS       4       10    DEFINED     24

  EXTERNALS           TYPE   ARGS       REFERENCES
      DUMPO                    0            22

  STATEMENT LABELS             DEF LINE    REFERENCES
       20 2                       24           23
        0 10                      28           25

  LOOPS  LABEL    INDEX     FROM-TO     LENGTH    PROPERTIES
     26  10       J         26 28        3B       INSTACK

  COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
        / /         3831          0 C        (3630)          3630 GRAPH  (1)

  EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
  C       C         3831        1984 OUTPLT  (15)            1999 T       (1)          2002 PCNT    (1)
                                2003 PPNT    (1)             2007 PLOTNO  (1)          2008 NOPLOT  (1)
                                2012 DOC     (1)             2013 ITCNT   (1)          2014 CPP     (1)
                                2015 PGCNT   (1)             2016 DTCNT   (1)          2017 TAPE    (1)
                                2018 TAPEND  (1)             2020 KCONV   (1)          2022 OPOINT  (1)
                                2024 TIME    (300)           3166 NOOUT   (1)          3167 OUTNO   (58)

  STATISTICS
    PROGRAM LENGTH                 353       29
    CM BLANK COMMON LENGTH       73673     3831
```

```
      SUBROUTINE OUPT3
C     OUTPUT-SUBROUTINE-OUPT3
      COMMON C(3830),GRAPH
      EQUIVALENCE (C(3168),OUTNO ), (C(3218),ONAME1), (C(3268),ONAME2),
     C            (C(2017),DTCNT ), (C(3167),NOOUT ), (C(2016),PGCNT ),
     C            (C(2014),ITCNT ), (C(2003),PCNT  ), (C(2015),CPP   ),
     C            (C(2000),T     ), (C(2664),DER   ), (C(2018),TAPE  ),
     C            (C(2019),TAPENO), (C(2008),PLOTNO), (C(2009),NOPLOT),
     C            (C(2005),PPP   ), (C(2004),PPNT  ), (C(2025),TIME  ),
     C            (C(2023),OPOINT)
      EQUIVALENCE (C(1985),OUTPLT)
      DIMENSION B(50),OUTNO(50),ONAME1(50),ONAME2(50)
      DIMENSION TIME(300),GRAPH(1,1)
      DIMENSION OUTPLT(15)
      INTEGER DTCNT,PGCNT,OUTNO
      INTEGER OPOINT
      INTEGER OUTPLT
C
C** SAVE SPOT JITTER MAX/MIN VALUES
      IF(C(1680).GT.C(1567)) C(1557) = C(1680)
      IF(C(1680).LT.C(1568)) C(1558) = C(1580)
      IF(C(1681).GT.C(1577)) C(1577) = C(1581)
      IF(C(1681).LT.C(1578)) C(1578) = C(1581)
C
      IF (ITCNT. GT. 6) GO TO 7
      ITCNT = ITCNT + 1
      CALL DUMPO
      PGCNT = -1
C
    7 IF (DER. EQ. DER1) GO TO 8
      DER1 = DER
      WRITE(6,20)T,DER
   20 FORMAT(1H ,5HTIME=F1+.7,2X,10HSTEP SIZE=1PE19.7)
    8 IF (T .LT. PCNT)GOTO15
    9 PCNT = PCNT + CPP
      IF (PGCNT. NE. 1) GO TO 3
      IF(NOOUT.LE.1) GO TO 3
    1 WRITE(6,2) (ONAME1(I),ONAME2(I), I=1,NOOUT)
    2 FORMAT (1H1,3X,4HTIME,5X,5(7X,2A6)//(20X,2A6,7X,2A6,7X,2A6,7X,
     12A6,7X,2A6)/)
      PGCNT = 2*DTCNT + 4
    3 IF(PGCNT .GE. 86) GO TO 1
      DO 4 I = 1,NOOUT
      J = OUTNO(I)
    4 B(I) = C(J)
      IF(NOOUT.LE.1) GO TO 15
      WRITE (6,5) T,(B(I), I = 1,NOOUT)
    5 FORMAT (///,F14.7,1P5E19.7/(14X,1P5E19.7))
      PGCNT = PGCNT + DTCNT + 4
   15 IF(T.LT.PPNT.OR.NOPLOT.EQ.0) RETURN
      PPNT=PPNT+PPP
      KPOINT =OPOINT +1
      IF (KPOINT-300) 16,13,18
   13 WRITE (6,14)
   14 FORMAT (//71H ****  WARNING-PLOTTING ARRAY FILLED-ONLY FIRST 300 P
     -OINTS PLOTTED ****,//)
   16 OPOINT=KPOINT
```

```
SUBROUTINE OUPT3      74/74   OPT=1                FTN 4.2+75067     05/05/75  16.24.06.    PAGE   2

                   TIME (OPOINT)=T                                         EXEC      253
                   DO 10 J=1,NOPLOT                                        EXEC      254
     60            K=OUTFLT(J)                                             EXEC      255
                10 GRAPH(OPOINT ,J)=C(K)                                   EXEC      256
                18 RETURN                                                  EXEC      257
                   END                                                     EXEC      258
```



```
SUBROUTINE OUPT3      74/74   OPT=1                FTN 4.2+75067     05/05/75  16.24.06.    PAGE   3

CARD NR. SEVERITY  DETAILS   DIAGNOSIS OF PROBLEM

     61      I     NOPLOT    THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.
```

```
        SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS      DEF LINE     REFERENCES
      1  OUPT3          1          50       62

  VARIABLES        SN  TYPE             RELOCATION
     207  B            REAL      ARRAY             REFS       12       47   DEFINED       45
       0  C            REAL      ARRAY    / /      REFS        3     19*4        11     3*20     3*21     3*22     3*23
                                                     45       51  DEFINED        20       21       22       23
    3736  CPP          REAL               / /      REFS        4       35
    5147  DER          REAL               / /      REFS        6       30        31       32
     202  DER1         REAL                        REFS       30  DEFINED        31
    3740  DTCNT        INTEGER            / /      REFS        4       15        41       49
    7366  GRAPH        REAL      ARRAY    / /      REFS        3       13   DEFINED       61
     203  I            INTEGER                     REFS     2*38       44        45       47   DEFINED       38       43
                                                     47
    3735  ITCNT        INTEGER            / /      REFS        4       25        26  DEFINED       26
     204  J            INTEGER                     REFS       45       60        51  DEFINED       44       59
     206  K            INTEGER                     REFS       51  DEFINED        60
     205  KPOINT       INTEGER                     REFS       53       57   DEFINED       52
    6136  NODUT        INTEGER            / /      REFS        4       37        38       43       46       47
    3730  NOPLOT       INTEGER            / /      REFS        4       50        59
    6221  ONAME1       REAL      ARRAY    / /      REFS        4       12        38
    6303  ONAME2       REAL      ARRAY    / /      REFS        4       12        38
    3746  OPOINT       INTEGER            / /      REFS        4       16        52       58       61
                                                DEFINED       57
    6137  OUTNO        INTEGER   ARRAY    / /      REFS        4       12        15       44
    3700  OUTPLT       INTEGER   ARRAY    / /      REFS       11       14        17       60
    3722  PCNT         REAL               / /      REFS        4       34        35  DEFINED       35
    3737  PGCNT        INTEGER            / /      REFS        4       15        36       42       49
                                                DEFINED       28       41        49
    3727  PLOTNO       REAL               / /      REFS        4
    3723  PPNT         REAL               / /      REFS        4       50        51  DEFINED       51
    3724  PPP          REAL               / /      REFS        4       51
    3717  T            REAL               / /      REFS        4       32        34       47       50       58
    3741  TAPE         REAL               / /      REFS        4
    3742  TAPEND       REAL               / /      REFS        4
    3750  TIME         REAL      ARRAY    / /      REFS        4       13   DEFINED       58

  FILE NAMES       MODE
        TAPE6      FMT                    WRITES       32       38       47       54

  EXTERNALS              TYPE   ARGS          REFERENCES
        DUMPO                     6               27

  STATEMENT LABELS                DEF LINE    REFERENCES
      36  1                         38           42
     145  2         FMT             39           38
      54  3                         42           35       37
       0  4                         45           43
     161  5         FMT             48           47
      23  7                         30           25
      27  8                         34           33
       0  9           INACTIVE      35
       0  10                        61           53
       0  13          INACTIVE      54           53
     171  14        FMT             55           54
```

```
        SUBROUTINE OUPT3      74/74  OPT=1                    FTN 4.2+75067     05/05/75  16.24.86.      PAGE   5

  STATEMENT LABELS              DEF LINE   REFERENCES
     77  15                        50         34       46
    112  16                        57         53
    123  18                        62         53
    131  20      FMT               33         32

  LOOPS  LABEL   INDEX     FROM-TO     LENGTH    PROPERTIES
     41          * I        38          10B                  EXT REFS
     61    4       I        43-45       3B      INSTACK
    120   10       J        59 61       3B      INSTACK

  COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
      //          3831             0 C        (3830)          3830 GRAPH   (1)

  EQUIV CLASSES   LENGTH    MEMBERS - BIAS NAME(LENGTH)
  C       C        3831          1384 OUTPLT  (15)          1999 T       (1)        2002 PCNT    (1)
                                 2303 PPNT    (1)           2004 PPP     (1)        2007 PLOTNO  (1)
                                 2308 NOPLOT  (1)           2013 ITCNT   (1)        2014 CPP     (1)
                                 2315 PSCNT   (1)           2016 DTCNT   (1)        2017 TAPE    (1)
                                 2018 TAPEND  (1)           2022 OPOINT  (1)        2024 TIME    (300)
                                 2663 CER     (1)           3165 NOOUT   (1)        3167 OUTNO   (50)
                                 3217 ONAME1  (50)          3267 ONAME2  (50)

  STATISTICS
    PROGRAM LENGTH                2713    185
    CM BLANK COMMON LENGTH       73673   3831
```

```
SUBROUTINE ZERO          74/74   OPT=1                    FTN 4.2+75067       05/05/75  16.24.88.     PAGE   1

                         SUBROUTINE ZERO                                              EXEC    259
                         COMMON C(3830)                                               EXEC    260
                         EQUIVALENCE (C(1384),NPLOT )                                 EXEC    261
                         EQUIVALENCE (C(2323),OPOINT)                                 EXEC    262
                         EQUIVALENCE (C(2361),NOMOD )                                 EXEC    263
                         EQUIVALENCE (C(2461),NOSUB )                                 EXEC    264
                         EQUIVALENCE (C(3066),NOLIST)                                 EXEC    265
                         EQUIVALENCE (C(3167),NOOUT )                                 EXEC    266
                         EQUIVALENCE (C(3338),LOSTAT)                                 EXEC    267
                         EQUIVALENCE (C(3339),NOSTAT)                                 EXEC    268
                         EQUIVALENCE (C(3440),NORNDM)                                 EXEC    269
                         INTEGER OPOINT                                               EXEC    270
                         LOSTAT = 0                                                   EXEC    271
                         NOSTAT = 0                                                   EXEC    272
                         NOSUB = 0                                                    EXEC    273
                         NOMOD = 0                                                    EXEC    274
                         NOOUT = 0                                                    EXEC    275
                         NORNDM = 0                                                   EXEC    276
                         NOLIST = 0                                                   EXEC    277
                         OPOINT=0                                                     EXEC    278
                         NPLOT=0                                                      EXEC    279
                         RETURN                                                       EXEC    280
                         END                                                          EXEC    281

SUBROUTINE ZERO          74/74   OPT=1                    FTN 4.2+75067       05/05/75  16.24.88.     PAGE   2

     SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE     REFERENCES
     1  ZERO           1           22

 VARIABLES     SN   TYPE            RELOCATION
   0  C             REAL        ARRAY     / /         REFS      2          3          4          5          6          7          8
                                                          9     10         11
  6411  LOSTAT      INTEGER               / /         REFS      9      DEFINED     13
  5771  NOLIST      INTEGER               / /         REFS      7      DEFINED     19
  4470  NOMOD       INTEGER               / /         REFS      5      DEFINED     16
  5136  NOOUT       INTEGER               / /         REFS      8      DEFINED     17
  6557  NORNDM      INTEGER               / /         REFS     11      DEFINED     18
  6412  NOSTAT      INTEGER               / /         REFS     10      DEFINED     14
  4634  NOSUB       INTEGER               / /         REFS      6      DEFINED     15
  3677  NPLOT       INTEGER               / /         REFS      3      DEFINED     21
  3746  OPOINT      INTEGER               / /         REFS      4         12     DEFINED     20

 COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
     / /          3830                  0 C      (3830)

 EQUIV CLASSES   LENGTH      MEMBERS - BIAS NAME(LENGTH)
 C       C        3830          1383 NPLOT  (1)        2022 OPOINT (1)        2360 NOMOD  (1)
                                2460 NOSUB  (1)        3065 NOLIST (1)        3166 NOOUT  (1)
                                3337 LOSTAT (1)        3338 NOSTAT (1)        3439 NORNDM (1)

 STATISTICS
   PROGRAM LENGTH                 103        8
   CM BLANK COMMON LENGTH       73663     3830
```

```
SUBROUTINE SUBL1        74/74   OPT=1                    FTN 4.2+75057     05/05/75  16.24.09.     PAGE    1

          SUBROUTINE    SUBL1                                         EXEC    282
          COMMON C(3830)                                              EXEC    283
          EQUIVALENCE (C(2461),NOSUB ), (C(2462),SUBNO )              EXEC    284
          DIMENSION   SUBNO(99)                                       EXEC    285
          DO 1 I = 1, NOSUB                                           EXEC    286
          J = SUBNO(I)                                                EXEC    287
          GO TO ( 1, 2, 3, 4, 5, 6, 7, 8, 9 ), J                      EXEC    288
        2 CALL INPT1                                                  EXEC    289
          GO TO 1                                                     EXEC    290
        3 CALL OUPT1                                                  EXEC    291
          GO TO 1                                                     EXEC    292
        4 CALL STGE1                                                  EXEC    293
          GO TO 1                                                     EXEC    294
        5 CALL CNTR1                                                  EXEC    295
          GO TO 1                                                     EXEC    296
        6 CALL RNU1                                                   EXEC    297
          GO TO 1                                                     EXEC    298
        7 CALL AUXA1                                                  EXEC    299
          GO TO 1                                                     EXEC    300
        8 CALL AUXB1                                                  EXEC    301
          GO TO 1                                                     EXEC    302
        9 CALL AUXC1                                                  EXEC    303
        1 CONTINUE                                                    EXEC    304
          RETURN                                                      EXEC    305
          END                                                         EXEC    306
```

```
SUBROUTINE SUBL1        74/74   OPT=1                              FTN 4.2+75057      05/05/75  16.24.09.       PAGE    2

        SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE      REFERENCES
      1  SUBL1           1            24

 VARIABLES      SN   TYPE            RELOCATION
      0  C           REAL        ARRAY    / /            REFS      2      2*3
     44  I           INTEGER                             REFS      6   DEFINED      5
     45  J           INTEGER                             REFS      7   DEFINED      6
   4634  NOSUB       INTEGER              / /            REFS      3      5
   4635  SUBNO       REAL        ARRAY    / /            REFS      3      4         6

 EXTERNALS              TYPE    ARGS       REFERENCES
            AUXA1                 0            18
            AUXB1                 0            20
            AUXC1                 0            22
            CNTR1                 0            14
            INPT1                 0             3
            OUPT1                 0            11
            RNDM1                 0            15
            STGE1                 0            12

 STATEMENT LABELS                DEF LINE   REFERENCES
     41  1                          23          5      7      9     11     13     15     17     19     21
     22  2                           8          7
     24  3                          10          7
     26  4                          12          7
     30  5                          14          7
     32  6                          15          7
     34  7                          18          7
     36  8                          20          7
     40  9                          22          7

 LOOPS  LABEL    INDEX     FROM-TO     LENGTH     PROPERTIES
     3  1        * I        5 23        413                 EXT REFS

 COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
       / /         3830               0 C        (3830)

 EQUIV CLASSES    LENGTH      MEMBERS - BIAS NAME(LENGTH)
 C        C        3830        2460 NOSUB   (1)                2461 SUBNO   (99)

 STATISTICS
   PROGRAM LENGTH                463       38
   CM BLANK COMMON LENGTH      73663     3830
```

SUBROUTINE SUBL2 74/74 OPT=1 FTN 4.2+75057 05/15/75 16.24.18. PAGE 1

```
      SUBROUTINE   SUBL2                                          EXEC   307
                                                                  EXEC   308
      COMMON C(3830)                                              EXEC   309
      EQUIVALENCE (C(2461),NOSUB ), (C(2462),SUBNO )              EXEC   310
      DIMENSION   SUBNO(93)                                       EXEC   311
      DO 1 I = 1, NOSUB                                           EXEC   312
      J = SUBNO(I)                                                EXEC   313
      GO TO ( 1, 2, 3, 4, 5, 6, 7, 8, 9 ), J                      EXEC   314
    2 CALL INPT2                                                  EXEC   315
      GO TO 1                                                     EXEC   316
    3 CALL OUPT2                                                  EXEC   317
      GO TO 1                                                     EXEC   318
    4 CALL STGE2                                                  EXEC   319
      GO TO 1                                                     EXEC   320
    5 CALL CNTR2                                                  EXEC   321
      GO TO 1                                                     EXEC   322
    6 CALL RNDM2                                                  EXEC   323
      GO TO 1                                                     EXEC   324
    7 CALL AUXA2                                                  EXEC   325
      GO TO 1                                                     EXEC   326
    8 CALL AUXB2                                                  EXEC   327
      GO TO 1                                                     EXEC   328
    9 CALL AUXC2                                                  EXEC   329
    1 CONTINUE                                                    EXEC   330
      RETURN                                                      EXEC   331
      END                                                         EXEC   332
```

```
SUBROUTINE SUBL2        74/74   OPT=1                    FTN 4.2+75067     05/05/75  16.24.10.     PAGE   2

     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE    REFERENCES
   1  SUBL2          1          25

VARIABLES     SN   TYPE          RELOCATION
    0  C           REAL      ARRAY   / /       REFS      3     2*4
   44  I           INTEGER                     REFS      7     DEFINED     6
   45  J           INTEGER                     REFS      8     DEFINED     7
       NOSUB       INTEGER           / /       REFS      4       6
   4   SUBNO       REAL      ARRAY   / /       REFS      4       5         7

EXTERNALS         TYPE    ARGS      REFERENCES
   AUXA2                   0           19
   AUXB2                   0           21
   AUXC2                   0           23
   CNTR2                   0           15
   INPT2                   0            9
   OUPT2                   0           11
   RNDM2                   0           17
   STGE2                   0           13

STATEMENT LABELS               DEF LINE    REFERENCES
   41  1                          24          5     8     10     12     14     16     18     20     22
   22  2                           9          5
   24  3                          11          5
   26  4                          13          5
   30  5                          15          5
   32  6                          17          5
   34  7                          19          3
   36  8                          21          3
   40  9                          23          8

LOOPS  LABEL    INDEX      FROM-TO     LENGTH    PROPERTIES
  3     1       * I         6 24        41B             EXT REFS

COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
   / /          3830             0 C       (3830)

EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
C        C       3830          2+63 NOSUB  (1)            2461 SUBNO  (99)

STATISTICS
  PROGRAM LENGTH                 45B      38
  CM BLANK COMMON LENGTH       7366B    3830
```

```
SUBROUTINE SUBL3        74/74    OPT=1                    FTN 4.2+75057     05/15/75 - 16.24.11.    PAGE    4

      SUBROUTINE   SUB_3
      COMMON C(3830)                                                   EXEC      333
      EQUIVALENCE (C(2,61),NOSUB ), (C(2462),SUBNO )                   EXEC      334
      DIMENSION  SUBNO(99)                                             EXEC      335
      DO 1 I = 1, NOSUB                                                EXEC      336
      J = SUBNO(I)                                                     EXEC      337
      GO TO ( 1, 2, 3, 4, 5, 6, 7, 8, 9 ), J                           EXEC      338
    2 CALL INPT3                                                       EXEC      339
      GO TO 1                                                          EXEC      340
    3 CALL OUPT3                                                       EXEC      341
      GO TO 1                                                          EXEC      342
    4 CALL STEE3                                                       EXEC      343
      GO TO 1                                                          EXEC      344
    5 CALL CNTR3                                                       EXEC      345
      GO TO 1                                                          EXEC      346
    6 CALL RNDM3                                                       EXEC      347
      GO TO 1                                                          EXEC      348
    7 CALL AUXA3                                                       EXEC      349
      GO TO 1                                                          EXEC      350
    8 CALL AUXB3                                                       EXEC      351
      GO TO 1                                                          EXEC      352
    9 CALL AUXC3                                                       EXEC      353
    1 CONTINUE                                                         EXEC      354
      RETURN                                                           EXEC      355
      END                                                              EXEC      356
                                                                       EXEC      357
```

```
SUBROUTINE SUBL3      74/74   OPT=1                      FTN 4.2+75067      05/05/75  16.24.11.      PAGE    2

     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE     REFERENCES
     1   SUBL3        1           24

VARIABLES      SN  TYPE              RELOCATION
     0  C          REAL        ARRAY    / /            REFS       2       2*3
    44  I          INTEGER                             REFS       6     DEFINED      5
    45  J          INTEGER                             REFS       7     DEFINED      6
  4634  NOSUB      INTEGER                  / /        REFS       3       5
  4635  SUBNO      REAL        ARRAY    / /            REFS       3       4          6

EXTERNALS            TYPE    ARGS        REFERENCES
        AUXA3                   0            18
        AUXB3                   0            20
        AUXC3                   0            22
        CNTR3                   0            14
        INPT3                   0             9
        OUPT3                   0            13
        RNDM3                   0            15
        STGE3                   0            12

STATEMENT LABELS                DEF LINE   REFERENCES
    41  1                          23        5       7       9      11      13      15      17      19      21
    22  2                           8        7
    24  3                          10        7
    26  4                          12        7
    30  5                          14        7
    32  6                          15        7
    34  7                          18        7
    36  8                          20        7
    40  9                          22        7

LOOPS  LABEL    INDEX      FROM-TO    LENGTH    PROPERTIES
  3    1      * I           5 23       41B              EXT REFS

COMMON BLOCKS    LENGTH     MEMBERS - BIAS NAME(LENGTH)
      / /         3830           0 C       (3830)

EQUIV CLASSES    LENGTH     MEMBERS - BIAS NAME(LENGTH)
 C     C          3830          2460 NOSUB   (1)            2461 SUBNO   (99)

STATISTICS
  PROGRAM LENGTH                 463     38
  CM BLANK COMMON LENGTH       73660   3830
```

```
      SUBROUTINE STGE2        74/74    OPT=1                      FTN 4.2+75067     05/05/75  16.24.12.      PAGE     1

                    SUBROUTINE STGE2
                    COMMON C(3830)                                                     EXEC      358
                    EQUIVALENCE (C(2011),KSTEP ), (C(2020),LCONV ), (C(2021),KCONV )   EXEC      359
                    KCONV = 0                                                          EXEC      360
   5                LCONV = 0                                                          EXEC      361
                    KSTEP = 1                                                          EXEC      362
                    RETURN                                                             EXEC      363
                    END                                                                EXEC      364
                                                                                       EXEC      365

      SUBROUTINE STGE2        74/74    OPT=1                      FTN 4.2+75067     05/05/75  16.24.12.      PAGE     2

        SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE     REFERENCES
     1   STGE2         1           7

 VARIABLES       SN   TYPE           RELOCATION
     0   C            REAL       ARRAY   / /
  3744   KCONV        INTEGER            / /          REFS       2      3*3
  3732   KSTEP        INTEGER            / /          REFS       3   DEFINED       4
  3743   LCONV        INTEGER            / /          REFS       3   DEFINED       6
                                                      REFS       3   DEFINED       5

 COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
   / /             3830                   0 C       (3830)

 EQUIV CLASSES    LENGTH      MEMBERS - BIAS NAME(LENGTH)
   C      C        3830           2010 KSTEP  (1)           2019 LCONV   (1)           2020 KCONV   (1)

 STATISTICS
   PROGRAM LENGTH                    53       5
   CM BLANK COMMON LENGTH         73668    3830
```

```
      SUBROUTINE STGE3                                            EXEC    366
      COMMON C(3630)                                              EXEC    367
      EQUIVALENCE (C(2000),T     ), (C(2001),TF    ), (C(2003),PCNT  )  EXEC 368
      EQUIVALENCE (C(2010),STEP  ), (C(2011),KSTEP ), (C(2020),LCONV )  EXEC 369
      EQUIVALENCE (C(2021),KCONV ), (C(2561),N     ), (C(2662),HMIN  )  EXEC 370
      EQUIVALENCE (C(2663),HMAX  ), (C(2664),DER   ), (C(2765),EL    )  EXEC 371
      EQUIVALENCE (C(2865),EU    ), (C(2965),VAR   )                    EXEC 372
      EQUIVALENCE (C(1973),KASE  ), (C(1974),NJ    ), (C(1975),NPT   )  EXEC 373
      DIMENSION   DER(101)        , VAR(101)       , EL(100)            EXEC 374
      EXTERNAL AUXSJB                                             EXEC    375
      CALL G4                                                     EXEC    376
      IF (ABS(T-TF) .LE. 0.01 ) GO TO 20                          EXEC    377
      IF ( (TF-T) .LT. 0.) GO TO 10                               EXEC    378
      IF (LCONV .EQ. 2) GO TO 20                                  EXEC    379
      IF (LCONV .EQ. 1) GO TO 10                                  EXEC    380
      IF(DER(1) .LT. 0.) DER(1)=-DER(1)*.5                        EXEC    381
      RETURN                                                      EXEC    382
   10 IF(DER(1) .GT. 0.) DER(1)=-DER(1)*.5                        EXEC    383
      KCONV = KCONV + 1                                           EXEC    384
      IF(KCONV .GE. 10) GO TO 20                                  EXEC    385
      RETURN                                                      EXEC    386
   20 PCNT = 1.0                                                  EXEC    387
      IF(STEP .EQ.11.)GOTO 40                                     EXEC    388
      PREDER = DER(1)                                             EXEC    389
      DER(1) = 0.                                                 EXEC    390
      NJ=N-1                                                      EXEC    391
      NPT=0                                                       EXEC    392
      CALL AMRK(AUXSUB)                                           EXEC    393
      DER(1) = PREDER                                             EXEC    394
   40 CALL OUPT3                                                  EXEC    395
      KSTEP = 2                                                   EXEC    396
      RETURN                                                      EXEC    397
      END                                                         EXEC    398
```

```
SUBROUTINE STGE3        74/74   OPT=1                      FTN 4.2+75067     05/05/75  16.24.13.      PAGE   2

        SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE      REFERENCES
     1   STGE3          1             17       21      32

VARIABLES       SN   TYPE            RELOCATION
     0   C           REAL        ARRAY      / /         REFS        2      3*3      3*4      3*5      3*5      2*7      3*8
  5147   DER         REAL        ARRAY      / /         REFS        6        9     2*16     2*18       24
                                                        DEFINED    16       18       25       29
  5314   EL          REAL        ARRAY      / /         REFS        6        9
  5460   EU          REAL                   / /         REFS        7
  5146   HMAX        REAL                   / /         REFS        6
  5145   HMIN        REAL                   / /         REFS        5
  3664   KASE        INTEGER                / /         REFS        8
  3744   KCONV       INTEGER                / /         REFS        5       19       20  DEFINED       19
  3732   KSTEP       INTEGER                / /         REFS        4  DEFINED       31
  3743   LCONV       INTEGER                / /         REFS        4       14       15
  5000   N           INTEGER                / /         REFS        5       26
  3665   NJ          INTEGER                / /         REFS        8  DEFINED       26
  3666   NPT         INTEGER                / /         REFS        8  DEFINED       27
  3722   PCNT        REAL                   / /         REFS        3  DEFINED       22
    52   PREDER      REAL                               REFS       29  DEFINED       24
  3731   STEP        REAL                   / /         REFS        4       23
  3717   T           REAL                   / /         REFS        3       12       13
  3720   TF          REAL                   / /         REFS        3       12       13
  5624   VAR         REAL        ARRAY      / /         REFS        7        9

EXTERNALS            TYPE   ARGS        REFERENCES
     AMRK                    1             29
     AUXSUB                  0             10      28
     G4                      0             11
     OUPT3                   0             33

INLINE FUNCTIONS     TYPE   ARGS        DEF LINE   REFERENCES
     ABS             REAL    1  INTRIN              12

 STATEMENT LABELS                     DEF LINE   REFERENCES
    20  10                               18         13       15
    26  20                               22         12       14       20
    41  40                               30         23

COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
     / /         3830                  0 C     (3830)

EQUIV CLASSES   LENGTH      MEMBERS - BIAS NAME(LENGTH)
  C       C      3830             1972 KASE    (1)        1973 NJ      (1)        1974 NPT     (1)
                                  1999 T       (1)        2000 TF      (1)        2002 PCNT    (1)
                                  2003 STEP    (1)        2010 KSTEP   (1)        2019 LCONV   (1)
                                  2020 KCONV   (1)        2560 N       (1)        2661 HMIN    (1)
                                  2662 HMAX    (1)        2663 DER   (101)        2764 EL    (100)
                                  2864 EU      (1)        2964 VAR   (101)

STATISTICS
  PROGRAM LENGTH                     533      43
  CM BLANK COMMON LENGTH           73663    3830
```

```
SUBROUTINE RESET      74/74  OPT=1                FTN 4.2+75067    05/05/75  16.24.14.     PAGE   1

                    SUBROUTINE RESET                                                  EXEC     399
                    COMMON C(3830)                                                    EXEC     400
                    EQUIVALENCE (C(3066),NOLIST), (C(3067),LISTNO), (C(3117),VALUE )  EXEC     401
                    DIMENSION  LISTNO(50),   VALUE(50)                                EXEC     402
     5              IF (NOLIST .EQ. 0) RETURN                                         EXEC     403
                    DO 1 I = 1, NOLIST                                                EXEC     404
                    J = LISTNO(I)                                                     EXEC     405
                  1 C(J) = VALUE(I)                                                   EXEC     406
                    RETURN                                                            EXEC     407
    10              END                                                               EXEC     408

SUBROUTINE RESET      74/ .  OPT=1                FTN 4.2+75067    05/05/75  16.24.14.     PAGE   2

 CARD NR. SEVERITY  DETAILS   DIAGNOSIS OF PROBLEM

      8     I       NOLIST   THIS STATEMENT MAY REDEFINE A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.

SUBROUTINE RESET      74/74  OPT=1                FTN 4.2+75067    05/05/75  16.24.14.     PAGE   3

         SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS     DEF LINE     REFERENCES
     1  RESET        1            5       3

 VARIABLES     SN   TYPE            RELOCATION
     0  C           REAL       ARRAY    / /          REFS      2        3*3   DEFINED      8
    11  I           INTEGER                          REFS      7        8     DEFINED      6
    12  J           INTEGER                          REFS      8    DEFINED        7
  5772  LISTNO      INTEGER    ARRAY    / /          REFS      3        4          7
  5771  NOLIST      INTEGER             / /          REFS      3        5          6
  6054  VALUE       REAL       ARRAY    / /          REFS      3        4          8

 STATEMENT LABELS              DEF LINE    REFERENCES
     0  1                         8           5

 LOOPS  LABEL    INDEX      FROM-TO     LENGTH     PROPERTIES
     6  1          I          6 8         3B        INSTACK

 COMMON BLOCKS   LENGTH      MEMBERS - BIAS NAME(LENGTH)
     / /          3830                 0 C       (3830)

 EQUIV CLASSES   LENGTH      MEMBERS - BIAS NAME(LENGTH)
 C          C     3830            3065 NOLIST  (1)          3066 LISTNO (50)            3116 VALUE  (50)

 STATISTICS
   PROGRAM LENGTH                  133         11
   CM BLANK COMMON LENGTH        73663       3830
```

```
      SUBROUTINE TABLE      74/74  OPT=1                    FTN 4.2+75067     05/05/75  16.24.15.      PAGE    1

                   SUBROUTINE TABLE (X,XI,YI,NX,XK,XLABEL,Y)                                  EXEC    409
                   DIMENSION XLABEL (2)                                                       EXEC    410
                   XK = 0.                                                                    EXEC    411
                   Y = FINTP1 (X,XI,YI,NX,XK,XLABEL)                                          EXEC    412
      5            RETURN                                                                     EXEC    413
                   END                                                                        EXEC    414

      SUBROUTINE TABLE      74/74  OPT=1                    FTN 4.2+75067     05/05/75  16.24.15.      PAGE    2

          SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS       DEF LINE      REFERENCES
      3  TABLE           1              5

  VARIABLES       SN  TYPE             RELOCATION
      0  NX           INTEGER               F.P.        REFS      4   DEFINED     1
      0  X            REAL                  F.P.        REFS      4   DEFINED     1
      0  XI           REAL                  F.P.        REFS      4   DEFINED     1
      0  XK           REAL                  F.P.        REFS      4   DEFINED     1
      0  XLABEL       REAL       ARRAY      F.P.        REFS      2        4   DEFINED     1    3
      0  Y            REAL                  F.P.        DEFINED   1        4               1
      0  YI           REAL                  F.P.        REFS      4   DEFINED     1

  EXTERNALS            TYPE    ARGS         REFERENCES
      FINTP1           REAL      6              4

  STATISTICS
    PROGRAM LENGTH                  30B      24
```

```
SUBROUTINE TABL2        74/74    OPT=1                  FTN 4.2+75067      05/05/75  16.24.16.        PAGE    1

                   SUBROUTINE TABL2(X,Y,XYI,ZI,NXY,XINTER,XLABEL,Z)                           EXEC     415
                   DIMENSION XLABEL(2)                                                        EXEC     416
                   DIMENSION XYI(2),NXY(2)                                                    EXEC     417
                   Z =   FINTP2 (X,Y,XYI,XYI(NXY+1),ZI,NXY,NXY(2),NXY,XINTER,XLABEL)          EXEC     418
      5            RETURN                                                                     EXEC     419
                   END                                                                        EXEC     420

SUBROUTINE TABL2        74/74    OPT=1                  FTN 4.2+75067      05/05/75  16.24.16.        PAGE    2

      SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE     REFERENCES
    3  TABL2        1             5

VARIABLES      SN   TYPE             RELOCATION
    0  NXY          INTEGER  ARRAY   F.P.       REFS      3      4*4   DEFINED      1
    0  X            REAL             F.P.       REFS      4   DEFINED      1
    0  XINTER       REAL             F.P.       REFS      4   DEFINED      1
    0  XLABEL       REAL     ARRAY   F.P.       REFS      2        4   DEFINED      1
    0  XYI          REAL     ARRAY   F.P.       REFS      3      2*4   DEFINED      1
    0  Y            REAL             F.P.       REFS      4   DEFINED      1
    0  Z            REAL             F.P.    DEFINED      1        4
    0  ZI           REAL             F.P.       REFS      4   DEFINED      1

EXTERNALS        TYPE   ARGS       REFERENCES
      FINTP2     REAL    10            4

STATISTICS
  PROGRAM LENGTH                403      32
```

```
      SUBROUTINE TABL3        74/74    OPT=1                    FTN 4.2+75067     05/35/75  16.24.17.     PAGE    1

                    SUBROUTINE TABL3(X,Y,Z,XYZI,WI,NXYZ,XINTER,XLABEL,W)          EXEC     421
                    DIMENSION XLABEL(2)                                           EXEC     422
                    DIMENSION XYZI(1),NXYZ(1)                                     EXEC     423
                    NZI= NXYZ(1) + NXYZ(2) + 1                                    EXEC     424
     5              XINTER = 0.                                                   EXEC     425
                    W  =   FINTP3 (X,Y,Z,XYZI,XYZI(NXYZ+1),XYZI(NZI), WI,NXYZ(3),  EXEC     426
                   C   NXYZ(2),NXYZ,XINTER,XLABEL)                                EXEC     427
                    RETURN                                                        EXEC     428
                    END                                                           EXEC     429

      SUBROUTINE TABL3        74/74    OPT=1                    FTN 4.2+75067     05/35/75  16.24.17.     PAGE    2

       SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS      DEF LINE      REFERENCES
      3  TABL3          1              8

  VARIABLES      SN   TYPE            RELOCATION
       0  NXYZ        INTEGER    ARRAY     F.P.       REFS        3       2*4      4*6   DEFINED      1
      47  NZI         INTEGER                         REFS        6    DEFINED       4
       0  W           REAL                 F.P.     DEFINED       1         6
       0  WI          REAL                 F.P.       REFS        6    DEFINED       1
       0  X           REAL                 F.P.       REFS        6    DEFINED       1
       0  XINTER      REAL                 F.P.       REFS        6    DEFINED       1        5
       0  XLABEL      REAL       ARRAY     F.P.       REFS        2         5    DEFINED       1
       0  XYZI        REAL       ARRAY     F.P.       REFS        3       3*6    DEFINED       1
       0  Y           REAL                 F.P.       REFS        6    DEFINED       1
       0  Z           REAL                 F.P.       REFS        6    DEFINED       1

  EXTERNALS           TYPE   ARGS        REFERENCES
       FINTP3         REAL    12              5

  STATISTICS
    PROGRAM LENGTH                  50B       40
```

```
FUNCTION FINTP1      74/74   OPT=1                    FTN 4.2+75067    05/05/75  16.24.18.    PAGE   1

      FUNCTION FINTP1(X,XI,YI,N,F,XL)                                            EXEC   430
      DIMENSION XI(N), YI(N) , XL(2)                                             EXEC   431
      IF(F .GT. 0.)GO TO 30                                                      EXEC   432
      DO 10 I=2, N                                                               EXEC   433
      IF(X .LE. XI(I)) GO TO 20                                                  EXEC   434
   10 CONTINUE                                                                   EXEC   435
      I = N                                                                      EXEC   436
   20 PCT = (X-XI(I-1))/(XI(I)-XI(I-1))                                          EXEC   437
      F = 1.                                                                     EXEC   438
   30 FINTP1 = YI(I-1) + PCT*(YI(I)-YI(I-1))                                     EXEC   439
      RETURN                                                                     EXEC   440
      END                                                                        EXEC   441


FUNCTION FINTP1      74/74   OPT=1                    FTN 4.2+75067    05/05/75  16.24.18.    PAGE   2

    SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS     DEF LINE     REFERENCES
     4  FINTP1        1             11

 VARIABLES     SN   TYPE            RELOCATION
     0  F           REAL                  F.P.       REFS       3   DEFINED      1        9
    40  FINTP1      REAL                          DEFINED      10
    41  I           INTEGER                          REFS       5       3*8     3*10   DEFINED     4      7
     0  N           INTEGER               F.P.       REFS     2*2         4        7   DEFINED     1
    42  PCT         REAL                             REFS      10   DEFINED        8
     0  X           REAL                  F.P.       REFS       5         8  DEFINED         1
     0  XI          REAL        ARRAY     F.P.       REFS       2         5      3*8   DEFINED     1
     0  XL          REAL        ARRAY     F.P.       REFS       2   DEFINED        1
     0  YI          REAL        ARRAY     F.P.       REFS       2      3*10  DEFINED         1

 STATEMENT LABELS           DEF LINE   REFERENCES
     0  10                      5          4
    22  20                      8          5
    31  30                     10          3

 LOOPS  LABEL    INDEX       FROM-TO    LENGTH    PROPERTIES
    15  10       * I          4  6        3B      INSTACK     EXITS

 STATISTICS
   PROGRAM LENGTH               43B       35
```

```
FUNCTION FINTP2        74/74    OPT=1                          FTN 4.2+75057     05/05/75  16.24.19.      PAGE   1

                    FUNCTION FINTP2(X,Y,XI,YI,ZI,NXD,NY,NX,F,XL)              EXEC    442
                    DIMENSION XI(1),YI(1), ZI(NXD,1), T(2), XL(2)             EXEC    443
                    IF(F .GT. 0.) GO TO 30                                    EXEC    444
                    DO 10 I=2, NY                                             EXEC    445
                    IF(Y .LE. YI(I)) GO TO 20                                 EXEC    446
                 10 CONTINUE                                                  EXEC    447
                    I = NY                                                    EXEC    448
                 20 PCT = (Y-YI(I-1))/(YI(I)-YI(I-1))                         EXEC    449
                 30 DO 40 J=1,2                                               EXEC    450
                    L = I + J - 2                                             EXEC    451
                 40 T(J) = FINTP1(X,XI,ZI(1,L),NX,F,XL)                       EXEC    452
                    FINTP2 = T(1) + PCT*(T(2)-T(1))                           EXEC    453
                    RETURN                                                    EXEC    454
                    END                                                       EXEC    455

FUNCTION FINTP2        74/74    OPT=1                          FTN 4.2+75057     05/05/75  16.24.19.      PAGE   2

     SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS     DEF LINE     REFERENCES
     4  FINTP2         1           13

  VARIABLES     SN  TYPE              RELOCATION
      0  F          REAL                      F.P.     REFS        3      11     DEFINED      1
     71  FINTP2     REAL                               DEFINED    12
     72  I          INTEGER                            REFS        5     3*8        10     DEFINED      4      7
     74  J          INTEGER                            REFS       10      11     DEFINED      9
     75  L          INTEGER                            REFS       11   DEFINED      10
      0  NX         INTEGER                   F.P.     REFS       11   DEFINED       1
      0  NXD        INTEGER                   F.P.     REFS        2   DEFINED       1
      0  NY         INTEGER                   F.P.     REFS        4       7     DEFINED      1
     73  PCT        REAL                               REFS       12   DEFINED       8
     76  T          REAL          ARRAY                REFS        2    3*12     DEFINED     11
      0  X          REAL                      F.P.     REFS       11   DEFINED       1
      0  XI         REAL          ARRAY       F.P.     REFS        2      11     DEFINED      1
      0  XL         REAL          ARRAY       F.P.     REFS        2      11     DEFINED      1
      0  Y          REAL                      F.P.     REFS        5       8     DEFINED      1
      0  YI         REAL          ARRAY       F.P.     REFS        2       5        3*8     DEFINED      1
      0  ZI         REAL          ARRAY       F.P.     REFS        2      11     DEFINED      1

  EXTERNALS         TYPE   ARGS       REFERENCES
     FINTP1         REAL     6           11

  STATEMENT LABELS                DEF LINE   REFERENCES
      0  10                           5          4
     26  20                           8          5
     33  30                           9          3
      0  40                          11          9

  LOOPS   LABEL    INDEX     FROM-TO     LENGTH     PROPERTIES
     21    10       * I        4  6        38B      INSTACK      EXITS
     34    40       * J        9 11       203                  EXT REFS

  STATISTICS
    PROGRAM LENGTH               100B       64
```

```
FUNCTION-FINTP3        74/74   OPT=1                    FTN-4.2+75067      5/05/75  16.24.20.       PAGE    1

                      FUNCTION FINTP3(X,Y,Z,XI,YI,ZI,WI,NZ,NY,NX,F,XL)                  EXEC     456
                      DIMENSION XI(1), YI(1), ZI(1), WI(NX,NY,1), T(2), XL(2)           EXEC     457
                      DO 10 I=2, NZ                                                     EXEC     458
                      IF(Z .LE. ZI(I)) GO TO 20                                         EXEC     459
     5             10 CONTINUE                                                          EXEC     460
                      I = NZ                                                            EXEC     461
                   20 PCT = (Z-ZI(I-1))/(ZI(I)-ZI(I-1))                                 EXEC     462
                   30 DO 40 J=1,2                                                       EXEC     463
                      L = I + J - 2                                                     EXEC     464
    10             40 T(J) = FINTP2(X,Y,XI,YI,WI(1,1,L),NX,NY,NX,F,XL)                  EXEC     465
                      FINTP3 = T(1) + PCT*(T(2)-T(1))                                   EXEC     466
                      RETURN                                                            EXEC     467
                      END                                                               EXEC     468

FUNCTION FINTP3        74/74   OPT=1                    FTN 4.2+75067      05/05/75  16.24.20.      PAGE    2

     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS      DEF LINE      REFERENCES
     4  FINTP3         1             12

VARIABLES      SN   TYPE          RELOCATION
     0  F           REAL                   F.P.    REFS        10    DEFINED      1
   101  FINTP3      REAL                          DEFINED      11
   102  I           INTEGER                        REFS         4     3*7         9    DEFINED      3        5
   104  J           INTEGER                        REFS         9      10   DEFINED       8
   105  L           INTEGER                        REFS        10    DEFINED      9
     0  NX          INTEGER                F.P.    REFS         2     2*10  DEFINED       1
     0  NY          INTEGER                F.P.    REFS         2      10   DEFINED       1
     0  NZ          INTEGER                F.P.    REFS         3       6   DEFINED       1
   103  PCT         REAL                           REFS        11    DEFINED      7
   106  T           REAL         ARRAY             REFS         2     3*11  DEFINED      10
     0  WI          REAL         ARRAY     F.P.    REFS         2      10   DEFINED       1
     0  X           REAL                   F.P.    REFS        10    DEFINED      1
     0  XI          REAL         ARRAY     F.P.    REFS         2      10   DEFINED       1
     0  XL          REAL         ARRAY     F.P.    REFS         2      10   DEFINED       1
     0  Y           REAL                   F.P.    REFS        10    DEFINED      1
     0  YI          REAL         ARRAY     F.P.    REFS         2      10   DEFINED       1
     0  Z           REAL                   F.P.    REFS         4       7   DEFINED       1
     0  ZI          REAL         ARRAY     F.P.    REFS         2       4     3*7  DEFINED      1

EXTERNALS         TYPE    ARGS      REFERENCES
     FINTP2       REAL     10           10

STATEMENT LABELS                  DEF LINE    REFERENCES
     0  10                            5            3
    25  20                            7            4
     0  30          INACTIVE          8
     0  40                           10            3

LOOPS   LABEL    INDEX     FROM-TO    LENGTH    PROPERTIES
   20    10      * I         3 5        3B      INSTACK    EXITS
   33    40      * J         8 10      25B                 EXT REFS

STATISTICS
  PROGRAM LENGTH                 110B       72
```

SUBROUTINE PLOT4   74/74   OPT=1   FTN 4.2+75067   05/15/75 16.24.21.   PAGE 1

```
      SUBROUTINE PLOT4 (GRAPH,NP,YL,T,NPLOT4,NPLOT2,NOPLOT)
C**PLOT SUBROUTINE
      DIMENSION GRAPH(1,1),YL(2,4),T(300)
      DIMENSION IXP(4),IYP(4),MRKPT(4)
      DATA (MRKPT(I),I=1,4)/42,16,38,63/
      DATA IXP/4,29,4,28/
      DATA IYP/776,776,411,411/
      IF (NPLOT4.EQ.0) RETURN
      KK = 1
      XM1 = GRAPH(1,1)
      YM1 = GRAPH(1,2)
      XT1 = GRAPH(1,3)
      YT1 = GRAPH(1,4)
      XM2 = XM1
      YM2 = YM1
      XT2 = XT1
      YT2 = YT1
      DO 1 I=1,NP
      XM1 = AMIN1(GRAPH(I,1),XM1)
      YM1 = AMIN1(GRAPH(I,2),YM1)
      XT1 = AMIN1(GRAPH(I,3),XT1)
      YT1 = AMIN1(GRAPH(I,4),YT1)
      XM2 = AMAX1(GRAPH(I,1),XM2)
      YM2 = AMAX1(GRAPH(I,2),YM2)
      XT2 = AMAX1(GRAPH(I,3),XT2)
    1 YT2 = AMAX1(GRAPH(I,4),YT2)
      XMIN = AMIN1(XM1,XT1)
      YMIN = AMIN1(YM1,YT1)
      XMAX = AMAX1(XM2,XT2)
      YMAX = AMAX1(YM2,YT2)
      DELX = ABS(XMAX-XMIN)
      DELY = ABS(YMAX-YMIN)
      DEL = AMAX1(DELX,DELY)
      X1 = XMIN
      Y1 = YMIN-(DEL-DELY)/2.
      X2 = X1+DEL
      Y2 = Y1+DEL
      CALL CAMRAV (9)
      CALL DXDYV(1,X1,X2,DX,N,I,NK,25.,IER2)
      CALL DXDYV(2,Y2,Y1,DY,M,J,NK,25.,IER2)
      CALL SETMIV (24,0,24,24)
      CALL GRID1V(KK,X1,X2,Y2,Y1,DX,DY,N,M,I,J,NX,NY)
      DO 2 J=1,3,2
      K = J+1
      UTIME = 0.
      IX1 = NXV(GRAPH(1,J) )
      IY1 = NYV(GRAPH(1,K) )
      DO 2 IJ=2,NP
      IX2 = NXV(GRAPH(IJ,J))
      IY2 = NYV(GRAPH(IJ,K))
      IF(T(IJ)-(.5+UTIME)) 7,3,3
    3 UTIME = T(IJ)
      CALL POINTV(IX2,IY2,-17,2)
    7 IF(J-2) 4,5,5
    5 CALL POINTV(IX2,IY2,0,2)
      GO TO 6
    4 CALL LINEV(IX1,IY1,IX2,IY2)
```

```
    6 IX1 = IX2                                                          EXEC   526
    2 IY1 = IY2                                                          EXEC   527
      CALL FRINTV(12,YL(1,1)    ,524,12)                                 EXEC   528
      CALL APRNTV(0,-14,12,YL(1,2)    ,12,524)                           EXEC   529
      RETURN                                                             EXEC   530
C                                                                        EXEC   531
      ENTRY PLOT2                                                        EXEC   532
      IF (NPLOT2.EQ.0) RETURN                                            EXEC   533
      JX= NPLOT4+1                                                       EXEC   534
      JY1= JX+1                                                          EXEC   535
      JYN= NPLOT4+NPLOT2                                                 EXEC   536
      X1= GRAPH(1,JX)                                                    EXEC   537
      X2= X1                                                             EXEC   538
      DO 110 I=2,NP                                                      EXEC   539
      X1= AMIN1 (GRAPH(I,JX),X1)                                         EXEC   540
  110 X2= AMAX1 (GRAPH(I,JX),X2)                                         EXEC   541
      Y1= GRAPH(1,JY1)                                                   EXEC   542
      Y2= Y1                                                             EXEC   543
      DO 120 JY=JY1,JYN                                                  EXEC   544
      DO 120 I=1,NP                                                      EXEC   545
      Y1= AMIN1 (GRAPH(I,JY),Y1)                                         EXEC   546
  120 Y2= AMAX1 (GRAPH(I,JY),Y2)                                         EXEC   547
      CALL CAMRAV (9)                                                    EXEC   548
      CALL DXDYV (1,X1,X2,DX,N,I,NX,14.0,IERR)                           EXEC   549
      CALL DXDYV (2,Y1,Y2,DY,M,J,NY,14.0,IERR)                           EXEC   550
      CALL SETMIV (35,24,24,24)                                          EXEC   551
      CALL GRIDIV (1,X1,X2,Y1,Y2,DX,DY,N,M,I,J,-3,-3)                    EXEC   552
      IMARK= 1                                                           EXEC   553
      DO 140 JY=JY1,JYN                                                  EXEC   554
      IX1= NXV (GRAPH(1,JX))                                             EXEC   555
      IY1= NYV (GRAPH(1,JY))                                             EXEC   556
C                                                                        EXEC   557
      DO 130 IJ=2,NP                                                     EXEC   558
      IX2= NXV (GRAPH(IJ,JX))                                            EXEC   559
      IY2= NYV (GRAPH(IJ,JY))                                            EXEC   560
      CALL LINEV (IX1,IY1,IX2,IY2)                                       EXEC   561
      CALL LINEV (IX1,IY1,IX2,IY2)                                       EXEC   562
      IX1= IX2                                                           EXEC   563
  130 IY1= IY2                                                           EXEC   564
      IF (IMARK.GT.4) GO TO 140                                          EXEC   565
      CALL APLOTV (NP,GRAPH(1,JX),GRAPH(1,JY),20,20,1,MRKPT(IMARK),IRR)  EXEC   566
  140 IMARK= IMARK + 1                                                   EXEC   567
      CALL PRINTV (12,     YL(1,JX),458,8)                               EXEC   568
      I=1                                                                EXEC   569
      DO 150 JY=JY1,JYN                                                  EXEC   570
      IF (I.GT.4) GO TO 150                                              EXEC   571
      IYQ= IYP(I) + 29                                                   EXEC   572
      CALL PLOTV (IXP(I),IYQ,MRKPT(I))                                   EXEC   573
      CALL APRNTV (0,-14,12,    Y (1,JY),IXP(I),IYP(I))                  EXEC   574
  150 I= I+1                                                             EXEC   575
      RETURN                                                             EXEC   576
C                                                                        EXEC   577
      ENTRY PLOTN                                                        EXEC   578
      NPLOT3=NOPLOT-NPLOT2-NPLOT4                                        EXEC   579
      IF (NPLOT3.LE.0) RETURN                                            EXEC   580
      DO 160 NM=1,NPLOT3                                                 EXEC   581
      JY=NPLOT4+NPLOT2+NM                                                EXEC   582
```

```
      IX=MOD(NM,3)
      IF(IX .EQ. 0)IX=3                                          EXEC   583
      II=712-344*(IX-1)                                          EXEC   584
      JJ=28+344*(IX-1)                                           EXEC   585
      KK=1                                                       EXEC   586
      IF(IX .GT. 1)KK=2                                          EXEC   587
      X1=T(1)                                                    EXEC   588
      X2=T(NF)                                                   EXEC   589
      Y1=GRAPH(1,JY)                                             EXEC   590
      Y2=Y1                                                      EXEC   591
      DO 50 I=1,NP                                               EXEC   592
      Y1=AMIN1(GRAPH(I,JY),Y1)                                   EXEC   593
   50 Y2=AMAX1(GRAPH(I,JY),Y2)                                   EXEC   594
      CALL CAMRAV(9)                                             EXEC   595
      CALL DXDYV(1,X1,X2,DX,N,I,NX,14.,IERR)                     EXEC   596
      CALL DXDYV(2,Y1,Y2,DY,M,J,NY,14.,IERR)                     EXEC   597
      CALL SETMIV(24,0,II,JJ)                                    EXEC   598
      CALLGRIDIV(KK,X1,X2,Y1,Y2,DX,DY,N,M,I,J,NX,-3)             EXEC   599
      IX1=NXV(X1)                                                EXEC   600
      IY1=NYV(GRAPH(1,JY))                                       EXEC   601
      DO 55 IJ=2,NP                                              EXEC   602
      IX2=NXV(T(IJ))                                             EXEC   603
      IY2=NYV(GRAPH(IJ,JY))                                      EXEC   604
      CALL LINEV(IX1,IY1,IX2,IY2)                                EXEC   605
      IY1=IY2                                                    EXEC   606
   55 IX1=IX2                                                    EXEC   607
      CALL PRINTV (-11,10HTIME (SEC),468,696-344*(IX-1))         EXEC   608
  100 CALL APRNTV (0,-14,12,   Y (1,JY),4,890-344*(IX-1))        EXEC   609
      RETURN                                                     EXEC   610
      END                                                        EXEC   611
                                                                 EXEC   612
```

```
     SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE     REFERENCES
   411  PLOTN          110          112     143
   214  PLOT2           64           65     109
     3  PLOT4            1            8      62

 VARIABLES      SN  TYPE          RELOCATION
  1055  DEL         REAL                          REFS     35    36    37  DEFINED    33
  1053  DELX        REAL                          REFS     33  DEFINED   31
  1054  DELY        REAL                          REFS     33    35  DEFINED    32
  1062  DX          REAL                          REFS     39    42    81    84   129   132
  1066  DY          REAL                          REFS     40    42    82    84   130   132
     0  GRAPH       REAL        ARRAY     F.P.    REFS      3    10    11    12    13    19    20
                                                   21      22    23    24    25    26    46    47
                                                   49      50    59    72    73    74    78    79
                                                   87      88    91    92  2*98   123   126   127
                                                  134     137  DEFINED  1
  1046  I           INTEGER                       REFS     19    20    21    22    23    24    25
                                                   26      39    42    72    73    78    79    81
                                                   84     103   104 2*105 2*106   107   126   127
                                                  129     132  DEFINED  18    71    77   101   107
                                                  125
  1065  IERR        INTEGER                       REFS     39    40    81    82   129   130
  1113  II          INTEGER                       REFS    131  DEFINED   117
  1076  IJ          INTEGER                       REFS     49    50    51    52    91    92   138
                                                  137  DEFINED    48    90   135
  1165  IMARK       INTEGER                       REFS     97    98    99  DEFINED  85    99
  1106  IRR       * INTEGER                       REFS     98
  1112  IX          INTEGER                       REFS    116   117   118   120   141   142
                                              DEFINED     115   116
  1115  IXP         INTEGER     ARRAY             REFS      4   105   106  DEFINED   6
  1074  IX1         INTEGER                       REFS     57    93    94   138  DEFINED    46    58
                                                   87      95   133   140
  1077  IX2         INTEGER                       REFS     53    55    57    58    93    94    95
                                                  138     140  DEFINED  49    91   136
  1121  IYP         INTEGER     ARRAY             REFS      4   104   106  DEFINED   7
  1107  IYQ         INTEGER                       REFS    135  DEFINED   104
  1075  IY1         INTEGER                       REFS     57    93    94   138  DEFINED    47    59
                                                   88      96   134   139
  1100  IY2         INTEGER                       REFS     53    55    57    59    93    94    96
                                                  138     139  DEFINED  50    92   137
  1070  J           INTEGER                       REFS     40    42    44    46    49    54    82
                                                   84     130   132  DEFINED    43
  1114  JJ          INTEGER                       REFS    131  DEFINED   118
  1101  JX          INTEGER                       REFS     57    69    72    73    87    91    98
                                                  100  DEFINED    56
  1104  JY          INTEGER                       REFS     78    79    88    92    98   106   123
                                                  126     127   134   137   142  DEFINED    76    86
                                                  102     114
  1103  JYN         INTEGER                       REFS     76    56   102  DEFINED    68
  1102  JY1         INTEGER                       REFS     74    76    86   102  DEFINED    67
  1072  K           INTEGER                       REFS     47    50  DEFINED    44
  1035  KK          INTEGER                       REFS     42   132  DEFINED     9   119   120
  1067  M           INTEGER                       REFS     40    42    82    84   130   132
  1125  MRKPT       INTEGER     ARRAY             REFS      4    98   105  DEFINED     5
```

```
VARIABLES   SN  TYPE        RELOCATION
 1111  NM      INTEGER                         REFS     114    115   DEFINED   113
    0  NOPLOT  INTEGER               F.P.      REFS     111  DEFINED     1
    0  NP      INTEGER               F.P.      REFS      18     46      71        77        98       98      122
                                               125      135  DEFINED     1
    0  NPLOT2  INTEGER               F.P.      REFS      65     68     111       114   DEFINED        1
 1110  NPLOT3  INTEGER                         REFS     112    113   DEFINED     111
    0  NPLOT4  INTEGER               F.P.      REFS       8     56      68       111       114
                                               DEFINED    1
 1064  NX      INTEGER                         REFS      39     42      81       129       132
 1071  NY      INTEGER                         REFS      40     42      82       130
    0  T       REAL        ARRAY     F.P.      REFS       3     51      52       121       122      136
                                               DEFINED    1
 1073  UTIME   REAL                            REFS      51  DEFINED    45        52
 1051  XMAX    REAL                            REFS      31  DEFINED    29
 1047  XMIN    REAL                            REFS      31     34   DEFINED      27
 1036  XM1     REAL                            REFS      14     19      27   DEFINED        10       19
 1042  XM2     REAL                            REFS      23     29   DEFINED      14        23
 1040  XT1     REAL                            REFS      16     21      27   DEFINED        12       21
 1044  XT2     REAL                            REFS      25     29   DEFINED      16        25
 1056  X1      REAL                            REFS      36     39      42        70        72       51       84
                                               123      132    133   DEFINED      34        59       72      121
 1060  X2      REAL                            REFS      39     42      73        61        84      129      132
                                               DEFINED   36     70      73       122
    0  YL      REAL        ARRAY     F.P.      REFS       3     60      61       100       106      142
                                               DEFINED    1
 1052  YMAX    REAL                            REFS      32  DEFINED    30
 1050  YMIN    REAL                            REFS      32     35   DEFINED      28
 1037  YM1     REAL                            REFS      15     20      28   DEFINED        11       20
 1043  YM2     REAL                            REFS      24     30   DEFINED      15        24
 1041  YT1     REAL                            REFS      17     22      28   DEFINED        13       22
 1045  YT2     REAL                            REFS      26     30   DEFINED      17        26
 1057  Y1      REAL                            REFS      37     40      42        75        78       82       84
                                               124      126    130     132   DEFINED        35       74       78
                                               123      126
 1061  Y2      REAL                            REFS      40     42      79        82        84      127      130
                                               132  DEFINED     37      75        79       124      127

EXTERNALS          TYPE    ARGS       REFERENCES
       APLOTV               8           93
       APRNTV               6           61     106    142
       CAMRAV               1           35      80    128
       DXDYV                9           39      40     51     82     129     130
       GRIDIV              13           42      84    132
       LINEV                4           57      93     94    138
       NXV         INTEGER  1           45      49     57     91     133     136
       NYV         INTEGER  1           47      50     88     92     134     137
       PLOTV                3          105
       POINTV               4           53      55
       PRINTV               4           63     100    141
       SETMIV               4           41      83    131

INLINE FUNCTIONS   TYPE    ARGS       DEF LINE  REFERENCES
       ABS         REAL     1  INTRIN             31     32
       AMAX1       REAL     6  INTRIN             23     24     25     26     29     30     33     73
                                                  79    127
       AMIN1       REAL     0  INTRIN             19     20     21     22     27     28     72     78
                                                 126
```

```
INLINE FUNCTIONS   TYPE     ARGS        DEF LINE  REFERENCES
     MOD           INTEGER   2  INTRIN             115

STATEMENT LABELS                DEF LINE   REFERENCES
      0  1                        26        19
      0  2                        39        43       48
      0  3          INACTIVE      52        2*51
    171  4                        57        54
      0  5          INACTIVE      55        2*54
    173  6                        55        55
    164  7                        54        51
      0  50                      127       125
      0  55                      140       135
      0  100                     142       113
      0  110                      73        71
      0  120                      79        75       77
      0  130                      35        31
    350  140                      99        85       97
    403  150                     107       102      103

LOOPS  LABEL   INDEX    FROM-TO   LENGTH   PROPERTIES
   36  1        I       16 26     23B      OPT
  126  2      * J       43 53     55B               EXT REFS  NOT INNER
  142  2      * IJ      48 59     37B               EXT REFS
  237  110      I       71 73     5B       INSTACK
  250  120    * JY      76 79     13B               NOT INNER
  254  120      I       77 79     5B       INSTACK
  301  140    * JY      86 99     53B               EXT REFS  NOT INNER
  313  130    * IJ      90 95     24B               EXT REFS
  363  150    * JY     102 107    24B               EXT REFS
  426  100    * NM     113 142    117B              EXT REFS  NOT INNER
  455  50       I      125 127    5B       INSTACK
  504  55     * IJ     135 140    21B               EXT REFS

STATISTICS
  PROGRAM LENGTH                11603     624
```

```
      SUBROUTINE DUMMY                                            EXEC  613
C     DUMMY SUBROUTINE                                            EXEC  614
      ENTRY A2I                                                   EXEC  615
      ENTRY A4                                                    EXEC  616
      ENTRY A4I                                                   EXEC  617
      ENTRY A5                                                    EXEC  618
      ENTRY C3                                                    EXEC  619
      ENTRY C3I                                                   EXEC  620
      ENTRY C5                                                    EXEC  621
      ENTRY C5I                                                   EXEC  622
      ENTRY C6                                                    EXEC  623
      ENTRY C6I                                                   EXEC  624
      ENTRY C7                                                    EXEC  625
      ENTRY C7I                                                   EXEC  626
      ENTRY C8                                                    EXEC  627
      ENTRY C8I                                                   EXEC  628
      ENTRY C9                                                    EXEC  629
      ENTRY C9I                                                   EXEC  630
      ENTRY C10                                                   EXEC  631
      ENTRY C10I                                                  EXEC  632
      ENTRY D3                                                    EXEC  633
      ENTRY D3I                                                   EXEC  634
      ENTRY D4                                                    EXEC  635
      ENTRY D4I                                                   EXEC  636
      ENTRY D5                                                    EXEC  637
      ENTRY D5I                                                   EXEC  638
      ENTRY G1                                                    EXEC  639
      ENTRY G1I                                                   EXEC  640
      ENTRY G3I                                                   EXEC  641
      ENTRY G4I                                                   EXEC  642
      ENTRY G5I                                                   EXEC  643
      ENTRY G6                                                    EXEC  644
      ENTRY G6I                                                   EXEC  645
      ENTRY S4                                                    EXEC  646
      ENTRY S4I                                                   EXEC  647
      ENTRY S5                                                    EXEC  648
      ENTRY S5I                                                   EXEC  649
      ENTRY S6                                                    EXEC  650
      ENTRY S6I                                                   EXEC  651
      ENTRY S7                                                    EXEC  652
      ENTRY S7I                                                   EXEC  653
      ENTRY S8I                                                   EXEC  654
      ENTRY S9                                                    EXEC  655
      ENTRY S9I                                                   EXEC  656
      ENTRY S10                                                   EXEC  657
      ENTRY S10I                                                  EXEC  658
      ENTRY AUXA1                                                 EXEC  659
      ENTRY AUXA2                                                 EXEC  660
      ENTRY AUXA3                                                 EXEC  661
      ENTRY AUXB1                                                 EXEC  662
      ENTRY AUXB2                                                 EXEC  663
      ENTRY AUXB3                                                 EXEC  664
      ENTRY AUXC1                                                 EXEC  665
      ENTRY AUXC2                                                 EXEC  666
```

```
      ENTRY CNTR1                                   EXEC  668
      ENTRY CNTR2                                   EXEC  669

      SUBROUTINE DUMMY     74/74   OPT=1        FTN 4.2+75067   05/05/75  16.24.27.   PAGE  2

      ENTRY CNTR3                                   EXEC  670
      ENTRY INPT1                                   EXEC  671
      ENTRY INPT2                                   EXEC  672
      ENTRY INPT3                                   EXEC  673
      ENTRY OUPT1                                   EXEC  674
      ENTRY PROCES                                  EXEC  675
      ENTRY RNDM1                                   EXEC  676
      ENTRY RNDM2                                   EXEC  677
      ENTRY RNDM3                                   EXEC  678
      ENTRY STGE1                                   EXEC  679
      ENTRY KIKSET                                  EXEC  680
      ENTRY COUNTV                                  EXEC  681
      ENTRY TIMEV                                   EXEC  682
      ENTRY WRITE                                   EXEC  683
      RETURN                                        EXEC  684
      END                                           EXEC  685
```

SYMBOLIC REFERENCE MAP (R=3)

```
ENTRY POINTS     DEF LINE    REFERENCES
  1  AUXA1          47
  1  AUXA2          48
  1  AUXA3          49
  1  AUXB1          50
  1  AUXB2          51
  1  AUXB3          52
  1  AUXC1          53
  1  AUXC2          54
  1  AUXC3          55
  1  A2I             3
  1  A4              4
  1  A4I             5
  1  A5              6
  1  CNTR1          56
  1  CNTR2          57
  1  CNTR3          58
  1  COUNTV         69
  1  C10            19
  1  C10I           20
  1  C3              7
  1  C3I             8
  1  C5              9
  1  C5I            10
  1  C6             11
  1  C6I            12
  1  C7             13
  1  C7I            14
  1  C8             15
  1  C8I            16
  1  C9             17
  1  C9I            18
  1  DUMMY           1
  1  D3             21
  1  D3I            22
  1  D4             23
  1  D4I            24
  1  D5             25
  1  D5I            26
  1  G1             27
  1  G1I            28
  1  G3I            29
  1  G4I            30
  1  G5I            31
  1  G6             32
  1  G6I            33
  1  INPT1          59
```

```
      1  INPT2           60
      1  INPT3           61
      1  KIKSET          68
      1  OUPT1           62
      1  PROCES          63
      1  RNOM1           ?
      1  RNOM2           6?
      1  RNOM3           66

     SUBROUTINE DUMMY      74/74    OPT=1                       FTN 4.2+75067      05/05/75  16.24.27.      PAGE    4

 ENTRY POINTS      DEF LINE      REFERENCES
      1  STGE1           67
      1  S10             45
      1  S10I            46
      1  S4              34
      1  S4I             35
      1  S5              36
      1  S5I             37
      1  S6              38
      1  S6I             39
      1  S7              40
      1  S7I             41
      1  S8I             42
      1  S9              43
      1  S9I             44
      1  TIMEV           70
      1  WRITE           71           72

 STATISTICS
   PROGRAM LENGTH                     38       3
```

```
      SUBROUTINE TERROR      74/74    OPT=1                        FTN 4.2+75057      05/05/75  16.24.28.      PAGE    1

                      SUBROUTINE TERROR (XLABEL)                                                EXEC     686
                C**   FOR USE WITH CODIM2, FCN2, FCN3                                           EXEC     687
                C                                                                               EXEC     688
                      COMMON C(3830)                                                            EXEC     689
       5              EQUIVALENCE (C(2020),LCONV)                                               EXEC     690
                      WRITE (6,10) XLABEL                                                       EXEC     691
                10    FORMAT ( 43H0        NO AERO POINTS SPECIFIED FOR ARG , 5X,               EXEC     692
                     C      7HTABLE  ,A6 )                                                      EXEC     693
                      CALL EXIT                                                                 EXEC     694
      10              END                                                                       EXEC     695

      SUBROUTINE TERROR      74/74    OPT=1                        FTN 4.2+75057      05/05/75  16.24.28.      PAGE    2

      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE     REFERENCES
      3  TERROR        1           10

 VARIABLES      SN   TYPE           RELOCATION
      0  C           REAL       ARRAY   / /          REFS       4       5
   3743  LCONV       INTEGER            / /          REFS       5
      0  XLABEL      REAL               F.P.         REFS       6    DEFINED      1

 FILE NAMES          MODE
        TAPE6        FMT                      WRITES        5

 EXTERNALS               TYPE   ARGS         REFERENCES
        EXIT                      0               3

 STATEMENT LABELS                   DEF LINE     REFERENCES
     15  10        FMT                  7              5

 COMMON BLOCKS     LENGTH      MEMBERS - BIAS NAME(LENGTH)
       / /          3830                     0 C        (3830)

 EQUIV CLASSES     LENGTH      MEMBERS - BIAS NAME(LENGTH)
 C      C           3830              2019 LCONV    (1)

 STATISTICS
   PROGRAM LENGTH                       253        21
   CM BLANK COMMON LENGTH             73668      3830
```

```
SUBROUTINE AERROR        74/74   OPT=1                      FTN 4.2+75057      05/05/75  16.24.29.     PAGE   1

                    SUBROUTINE AERROR (XLABEL)                                          EXEC    695
                    COMMON C(3830)                                                      EXEC    697
                    EQUIVALENCE (C(2020),LCONV)                                         EXEC    698
                    WRITE (6,20) XLABEL                                                 EXEC    699
                 20 FORMAT  ( 43H0         OUT OF AERO TABLE ARGUMENT ARRAY , 5X,       EXEC    700
                  C    7HTABLE  ,A6 )                                                   EXEC    701
                    DO 40 I=1202,1251,7                                                 EXEC    702
                 40 WRITE(6,30) C(I),C(I+1),C(I+2),C(I+3),C(I+4),C(I+5),C(I+6)          EXEC    703
                 30 FORMAT(1H ,7E15.7)                                                  EXEC    704
                    WRITE (6,30) C(2000),C(367),C(368),C(204),C(369),C(370),C(1117),    EXEC    705
                  C C(1118),C(1119),C(1120)                                             EXEC    706
                    LCONV=2                                                             EXEC    707
                    RETURN                                                              EXEC    708
                    END                                                                 EXEC    709

SUBROUTINE AERROR        74/74   OPT=1                      FTN 4.2+75057      05/05/75  16.24.29.     PAGE   2

      SYMBOLIC REFERENCE MAP (R=3)

 ENTRY POINTS      DEF LINE     REFERENCES
     3  AERROR        1           13

 VARIABLES      SN   TYPE            RELOCATION
     0  C            REAL       ARRAY    / /         REFS       2         3        7*8     10*10
   100  I            INTEGER                         REFS      7*8    DEFINED       7
  3743  LCONV        INTEGER             / /         REFS       3     DEFINED      12
     0  XLABEL       REAL                F.P.        REFS       4     DEFINED       1

 FILE NAMES           MODE
      TAPE6           FMT                   WRITES        4          8          10

 STATEMENT LABELS              DEF LINE    REFERENCES
    36   20        FMT            5          4
    60   30        FMT            9          3        10
     0   40                       8          7

 LOOPS   LABEL    INDEX     FROM-TO     LENGTH     PROPERTIES
   10     40      * I         7 8        17B                     EXT REFS

 COMMON BLOCKS    LENGTH      MEMBERS - BIAS NAME(LENGTH)
      / /          3830                 0 C      (3830)

 EQUIV CLASSES    LENGTH      MEMBERS - BIAS NAME(LENGTH)
 C       C         3830             2019 LCONV  (1)

 STATISTICS
   PROGRAM LENGTH                   1013      65
   CM BLANK COMMON LENGTH          73660    3830
```

```
FUNCTION SINO        74/74   OPT=1                      FTN 4.2+75057    05/05/75  16.24.38.     PAGE    1

                  FUNCTION SIND (X)
                  SIND=-SIN (X/57.29578)                                          EXEC     710
                  RETURN                                                          EXEC     711
                  END                                                             EXEC     712
                                                                                  EXEC     713

FUNCTION SIND        74/74   OPT=1                      FTN 4.2+75057    05/05/75  16.24.38.     PAGE    2

     SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS       DEF LINE      REFERENCES
   4  SIND            1             3

VARIABLES      SN  TYPE           RELOCATION
   12  SIND        REAL
    0  X           REAL                 F.P.        DEFINED      2
                                                     REFS         2   DEFINED     1

EXTERNALS          TYPE    ARGS      REFERENCES
     SIN           REAL      1 LIBRARY       2

STATISTICS
  PROGRAM LENGTH               13B      11
```

```
FUNCTION COSD       74/74  OPT=1                    FTN 4.2+75067     05/05/75  16.24.30.      PAGE    1

                          FUNCTION COSD (X)                                              EXEC    714
                          COSD=-COS-(X/57.29578)                                         EXEC    715
                          RETURN                                                         EXEC    716
                          END                                                            EXEC    717

FUNCTION COSD       74/74  OPT=1                    FTN 4.2+75067     05/05/75  16.24.30.      PAGE    2

    SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS     DEF LINE     REFERENCES
     4  COSD          1            3

VARIABLES     SN   TYPE          RELOCATION
    12  COSD       REAL                          DEFINED      2
     0  X          REAL              F.P.        REFS         2   DEFINED      1

EXTERNALS          TYPE    ARGS        REFERENCES
        COS        REAL      1 LIBRARY      2

STATISTICS
  PROGRAM LENGTH              133     11
```

```
FUNCTION ATAND      74/74   OPT=1                FTN 4.2+75067     05/05/75  15.24.31.     PAGE   1

          FUNCTION ATAND (Y,X)
          ATAND= 57.29578*ATAN2 (Y,X)                                  EXEC    718
          RETURN                                                       EXEC    719
          END                                                          EXEC    720
                                                                       EXEC    721

FUNCTION ATAND      74/74   OPT=1                FTN 4.2+75057     05/05/75  16.24.31.     PAGE   2

       SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS      DEF LINE      REFERENCES
      4  ATAND           1             3

  VARIABLES    SN   TYPE            RELOCATION
     13  ATAND      REAL                           DEFINED     2
      0  X          REAL                F.P.       REFS        2   DEFINED     1
      0  Y          REAL                F.P.       REFS        2   DEFINED     1

  EXTERNALS          TYPE   ARGS           REFERENCES
        ATAN2        REAL      2 LIBRARY        2

  STATISTICS
    PROGRAM LENGTH              14B       12
```

```
      SUBROUTINE S2I
      COMMON C(3830)
C
C **OCS SEEKER INITIALIZATION MODULE**
C
C
C**HIGH FREQUENCY SEEKER
      REAL KQ1,KQ2,KQ3,KQ4,KQ5,KQ6,KQ7,KQ8,KQ9,KQ10,KQ11,KQ12
      REAL KR1,KR2,KR3,KR4,KR5,KR6,KR7,KR8,KR9,KR10,KR11,KR12
      REAL KUO,KUI,KBO,KBI,KPO,KPI,KOAO,KOAI
      REAL JI,JO
      EQUIVALENCE (C( 545),     KQ1),  (C( 573),   WTQ1)
      EQUIVALENCE (C( 546),     KR1),  (C( 574),   WTR1)
      EQUIVALENCE (C( 547),     KQ2),  (C( 575),   WTQ2)
      EQUIVALENCE (C( 548),     KR2),  (C( 576),   WTR2)
      EQUIVALENCE (C( 549),     KQ3),  (C( 577),   WGQ1)
      EQUIVALENCE (C( 550),     KR3),  (C( 578),   WGR1)
      EQUIVALENCE (C( 551),     KQ5),  (C( 579),   WGQ2)
      EQUIVALENCE (C( 552),     KR5),  (C( 580),   WGR2)
      EQUIVALENCE (C( 553),     KQ6),  (C( 581),   WGQ3)
      EQUIVALENCE (C( 554),     KR6),  (C( 582),   WGR3)
      EQUIVALENCE (C( 555),     KQ7),  (C( 583),   WGQ4)
      EQUIVALENCE (C( 556),     KR7),  (C( 584),   WGR4)
      EQUIVALENCE (C( 557),     KQ8),  (C( 585),   WGQ5)
      EQUIVALENCE (C( 558),     KR8),  (C( 586),   WGR5)
      EQUIVALENCE (C( 559),    KQ10),  (C( 587),   WGQ6)
      EQUIVALENCE (C( 560),    KR10),  (C( 588),   WGR6)
      EQUIVALENCE (C( 561),    KQ11),  (C( 589),   WRQ1)
      EQUIVALENCE (C( 562),    KR11),  (C( 590),   WRR1)
      EQUIVALENCE (C( 563),    KQ12),  (C( 591),   WRQ2)
      EQUIVALENCE (C( 564),    KR12),  (C( 592),   WRR2)
      EQUIVALENCE (C( 565),      JI),  (C( 593),   WRQ3)
      EQUIVALENCE (C( 566),      JO),  (C( 594),   WRR3)
      EQUIVALENCE (C( 567),     FRI),  (C( 595),   WRQ4)
      EQUIVALENCE (C( 568),     FRO),  (C( 596),   WRR4)
      EQUIVALENCE (C( 569),     TUI),  (C( 597),    RCL)
      EQUIVALENCE (C( 570),     TUO),  (C( 598),   TCLQ)
      EQUIVALENCE (C( 571),    QERO),  (C( 599),   TCLR)
      EQUIVALENCE (C( 572),    RERO),  (C( 600),    TAU)
      EQUIVALENCE (C( 480),     GQ1),  (C( 482),    GQ2)
      EQUIVALENCE (C( 481),     GR1),  (C( 483),    GR2)
      EQUIVALENCE (C( 484),     GQ3),  (C( 486),    GQ4)
      EQUIVALENCE (C( 485),     GR3),  (C( 487),    GR4)
      EQUIVALENCE (C( 489),     GQ5),  (C( 491),    GQ6)
      EQUIVALENCE (C( 490),     GR5),  (C( 492),    GR6)
      EQUIVALENCE (C( 601),   TARHT),  (C( 602),  TARHO)
C**INPUTS FROM OTHER MODULES**
      EQUIVALENCE (C(1751),    CRAD)
      EQUIVALENCE (C( 371),   RANGE)
C
C**STATE VARIABLES
C
      EQUIVALENCE (C( 424),  BTHTGO),  (C( 427),  BTHTG)
      EQUIVALENCE (C( 428),  BPSIGO),  (C( 431),  BPSIG)
      EQUIVALENCE (C( 500),     DQ1),  (C( 503),     Q1)
      EQUIVALENCE (C( 501),     DR1),  (C( 504),     R1)
      EQUIVALENCE (C( 506),     DQ2),  (C( 509),     Q2)
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      EQUIVALENCE (C( 507),     DR2), (C( 510),     R2)
      EQUIVALENCE (C( 512),     DQ3), (C( 515),     Q3)
      EQUIVALENCE (C( 513),     DR3), (C( 516),     R3)
      EQUIVALENCE (C( 514),     DWD), (C( 517),     WD)
      EQUIVALENCE (C( 518),    DDQ4), (C( 521),    DQ4), (C( 524),   Q4)
      EQUIVALENCE (C( 519),    DDR4), (C( 522),    DR4), (C( 525),   R4)
      EQUIVALENCE (C( 520),     DWI), (C( 523),     WI)
      EQUIVALENCE (C( 527),    DDQ5), (C( 530),    DQ5), (C( 533),   Q5)
      EQUIVALENCE (C( 528),    DDR5), (C( 531),    DR5), (C( 534),   R5)
      EQUIVALENCE (C( 536),    DDQ6), (C( 539),    DQ6), (C( 542),   Q6)
      EQUIVALENCE (C( 537),    DDR6), (C( 540),    DR6), (C( 543),   R6)
C
C**OUTPUTS
      EQUIVALENCE (C( 603), RBLOCK), (C( 605),  IOCS)
      EQUIVALENCE (C( 608), TDELAY), (C( 609),  THTR), (C( 510), THTR)
      EQUIVALENCE (C( 525),BEPSYSV)
      EQUIVALENCE (C( 529),BEPSZSV)
      EQUIVALENCE (C( 532), TIMESV)
      EQUIVALENCE (C(2561),      N), (C(2562),   IPL)
      EQUIVALENCE (C( 523),  DERSV)
      EQUIVALENCE (C(3504),   OPTN4)
C
C**MONTE CARLO PARAMETERS
C
      EQUIVALENCE (C(3534),  ISNOX), (C(3512), I3512)
      EQUIVALENCE (C( 611),    KUD), (C( 612),   KJI)
      EQUIVALENCE (C( 613),    KBD), (C( 614),   KBI)
      EQUIVALENCE (C( 615),    KPD), (C( 616),   KPI)
      EQUIVALENCE (C( 617),   KOAD), (C( 618),  KOAI)
      EQUIVALENCE (C( 619),    UCC), (C( 620),   USC)
      EQUIVALENCE (C( 521),   UCCS), (C( 522),  USCS)
      DIMENSION IPL(100)
      DIMENSION ISNOX(40)
      IS3=0
C
C
      IF(C(2564).GT..0005)WRITE(6,112)
  112 FORMAT(1H1,15(/),10X,*INTEGRATION STEPSIZE IS GREATER THAN THE REC
     .OMMENDED VALUE FOR SEEKER MODEL S2.*/,11X,*RECOMMENDED VALUE IS .0
     $005 SEC. CHECK RESULTS FOR VALIDITY.*,10(/))
C
C
      GO TO 10
C
C
      ENTRY S3I
C**LOW FREQUENCY SEEKER
C
      IPL(N)=500
      IS3=1
      IPL(N+1)=501
      IPL(N+2)=505
      IPL(N+3)=507
      IPL(N+4)=512
      IPL(N+5)=513
      IPL(N+6)=514
      IPL(N+7)=520
```

```
      [illegible]
      IPL(N+8)=424
      IPL(N+9)=428
      N=N+10
      GO TO 20
   10 CONTINUE
      IPL(N)=500
      IPL(N+1)=501
      IPL(N+2)=506
      IPL(N+3)=507
      IPL(N+4)=512
      IPL(N+5)=513
      IPL(N+6)=514
      IPL(N+7)=513
      IPL(N+8)=513
      IPL(N+9)=520
      IPL(N+10)=521
      IPL(N+11)=522
      IPL(N+12)=527
      IPL(N+13)=528
      IPL(N+14)=530
      IPL(N+15)=531
      IPL(N+16)=536
      IPL(N+17)=537
      IPL(N+18)=539
      IPL(N+19)=540
      IPL(N+20)=424
      IPL(N+21)=428
      N=N+22
   20 CONTINUE
      DO 1 I=500,543
    1 C(I)=0.
C*****FILL TRANSPORT LAG (TLAG) ARRAYS
      C(655)=C(2030)
      DO 7 I=1,6
      C(655-I)=C(655-I)-C(2664)
      C(655+I)=0.
      C(661+I)=0.
    7 CONTINUE
      C(13)=-1.
      C(461)=0.
      C(462)=0.
      C(463)=0.
      C(464)=0.
      IF(OPTN4.GT.1.) GO TO 3
      C(461)=1.
      C(462)=1.
      C(463)=1.
      C(464)=1.
    3 CONTINUE
      TDELAY=0.     $  THTQ=0.    $   THTR=0.
      C(403)=0.     $ C(437)=0.   $ C(424)=0.      $ C(428)=0.
      C(435)=0.     $ C(436)=0.
      C(630)=0.     $ C(631)=0.
      DERSV=.002
      BEPSYSV=0.
      BEPSZSV=0.
      TUI=0.
```

```
      TUO=0.
      GQ1=KQ1*KQ2/CRAD
      GR1=KR1*KR2/CRAD
      GQ2=KQ3*WTQ2/ATQ1
      GR2=KR3*WTR2/ATR1
      GQ3=KQ5*WGQ6*WGQ6*WGQ4/(WGQ1*WGQ3*WGQ5)
      GR3=KR5*WGR6*WGR6*WGR4/(WGR1*WGR3*WGR5)
      GQ4=KG6*KQ7
      GR4=KR6*KR7
      GQ5=KQ10*WRQ2*WRQ2/CRAD
      GR5=KR10*WRR2*WRR2/CRAD
      GQ6=KQ11*WRQ4*WRQ4
      GR6=KR11*WRR4*WRR4
      RANGE=SQRT(C(1635)*C(1635)+C(1636)*C(1636)+C(1637)*C(1637))
      THTQ=ATAND(TARHT,RANGE)/2.
      THTR=ATAND(TARHJ,RANGE)/2.
      IOCS=-10
C
      IF(IS3.EQ.0) GO TO 6
      GQ3=KQ5*WGQ4/WGQ1/WGQ3
      GR3=KR5*WGR4/WGR1/WGR3
      GQ5=KQ10*KQ11/CRAD
      GR5=KR10*KR11/CRAD
    6 CONTINUE
C
      DO 30 I=1,I3512
      IDO=I
C
C**MONTE CARLO MASS UNBALANCE ON SEEKER GYRO
C
      IF(ISNDX(I).EQ.611)CALL MCARLO(DUM, 1, IDO)
      IF(ISNDX(I).EQ.611)CALL RANNUM(0.,RNSTRT,RN)
      KUO=SIGN(KUO,RN)
      IF(ISNDX(I).EQ.612)CALL MCARLO(DUM, 1, IDO)
      IF(ISNDX(I).EQ.612)CALL RANNUM(0.,RNSTRT,RN)
      CHI=360.*RN
C
C**MONTE CARLO SEEKER RATE GYRO ERRORS
C
      IF(ISNDX(I).EQ.613)CALL MCARLO(DUM, 1, IDO)
      IF(ISNDX(I).EQ.614)CALL MCARLO(DUM, 1, IDO)
      IF(ISNDX(I).EQ.615)CALL MCARLO(DUM, 1, IDO)
      IF(ISNDX(I).EQ.615)CALL RANNUM(0.,RNSTRT,RN)
      CHIG=360.*RN
      IF(ISNDX(I).EQ.616)CALL MCARLO(DUM, 1, IDO)
      IF(ISNDX(I).EQ.617)CALL MCARLO(DUM, 1, IDO)
      IF(ISNDX(I).EQ.618)CALL MCARLO(DUM, 1, IDO)
      UCC=COSD(CHI)
      USC=SIND(CHI)
      UCCG=COSD(CHIG)
      USCG=SIND(CHIG)
   30 CONTINUE
      RETURN
      END
```

```
        SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS     DEF LINE     REFERENCES
      1  S2I            1
     11  S3I          133         224

  VARIABLES     SN  TYPE            RELOCATION
     1015  BEPSYSV   REAL               / /      REFS      73   DEFINED    169
     1020  BEPSZSV   REAL               / /      REFS      74   DEFINED    170
      656  BPSIG     REAL               / /      REFS      54
      653  BPSICD    REAL               / /      REFS      54
      652  BTHTG     REAL               / /      REFS      53
      647  BTHTGD    REAL               / /      REFS      53
        0  C         REAL      ARRAY    / /      REFS       2     2*12    2*13    2*14    2*15    2*16    2*17
                                                     2*18    2*19     2*20    2*21    2*22    2*23    2*24    2*25
                                                     2*26    2*27     2*28    2*29    2*30    2*31    2*32    2*33
                                                     2*34    2*35     2*36    2*37    2*38    2*39    2*40    2*41
                                                     2*42    2*43     2*44    2*45    2*46    48      49      2*53
                                                     2*54    2*55     2*56    2*57    2*58    2*59    2*60    2*61
                                                     3*62    3*63     2*64    3*65    3*66    3*67    3*68    2*71
                                                     3*72    73       74      75      2*76    77      78      2*82
                                                     2*83    2*84     2*85    2*86    2*87    2*88    34      167
                                                     2*149   6*185    DEFINED 145     147     149     150     151
                                                     153     154      155     156     157     159     160     161
                                                     162     4*165    2*166   2*167
      430  CHI       REAL                        REFS     219     220   DEFINED    207
      431  CHIG      REAL                        REFS     221     222   DEFINED    215
     3326  CRAD      REAL               / /      REFS      48     173     174     181     182     193     194
     1005  DDQ4      REAL               / /      REFS      62
     1016  DDQ5      REAL               / /      REFS      55
     1027  DDQ6      REAL               / /      REFS      67
     1006  DDR4      REAL               / /      REFS      63
     1017  DDR5      REAL               / /      REFS      56
     1030  DDR6      REAL               / /      REFS      68
     1156  DERSV     REAL               / /      REFS      77   DEFINED    168
      763  DQ1       REAL               / /      REFS      55
      771  DQ2       REAL               / /      REFS      57
      777  DQ3       REAL               / /      REFS      59
     1010  DQ4       REAL               / /      REFS      62
     1021  DQ5       REAL               / /      REFS      65
     1032  DQ6       REAL               / /      REFS      67
      764  DR1       REAL               / /      REFS      56
      772  DR2       REAL               / /      REFS      58
     1000  DR3       REAL               / /      REFS      60
     1011  DR4       REAL               / /      REFS      63
     1022  DR5       REAL               / /      REFS      66
     1033  DR6       REAL               / /      REFS      68
      425  DUM       REAL                        REFS     232     205     211     212     213     216     217
                                                     218
     1007  DWI       REAL               / /      REFS      64
     1001  DWO       REAL               / /      REFS      61
     1066  FRI       REAL               / /      REFS      34
     1067  FRO       REAL               / /      REFS      35
      737  GQ1       REAL               / /      REFS      40   DEFINED    173
      741  GQ2       REAL               / /      REFS      40   DEFINED    175
      743  GQ3       REAL               / /      REFS      42   DEFINED    177     191
      745  GQ4       REAL               / /      REFS      42   DEFINED    179
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        SUBROUTINE S2I         74/74   OPT=1                               FTN 4.2+75067      05/05/75  16.24.32.      PAGE     6

 VARIABLES     SN  TYPE              RELOCATION
    750  GQ5       REAL                  / /     REFS        44    DEFINED      181       193
    752  GQ6       REAL                  / /     REFS        44    DEFINED      183
    740  GR1       REAL                  / /     REFS        41    DEFINED      174
    742  GR2       REAL                  / /     REFS        41    DEFINED      176
    744  GR3       REAL                  / /     REFS        43    DEFINED      178       192
    746  GR4       REAL                  / /     REFS        43    DEFINED      180
    751  GR5       REAL                  / /     REFS        45    DEFINED      182       194
    753  GR6       REAL                  / /     REFS        45    DEFINED      184
    423  I         INTEGER                       REFS       145      2*149      150       151       198       202       203
                                                  205       206        211      212       213       214       216       217
                                                  218   DEFINED        144      148       197
    424  IDO       INTEGER                       REFS       202        205      211       212       213       216       217
                                                  218   DEFINED        198
   1134  IOCS      INTEGER               / /     REFS        71    DEFINED      188
   5001  IPL       INTEGER   ARRAY       / /     REFS        76         89  DEFINED       106       108       109       110
                                                  111       112        113      114       115       116       120       121
                                                  122       123        124      125       126       127       128       129
                                                  130       131        132      133       134       135       136       137
                                                  138       139        140      141
   7061  ISNDX     INTEGER   ARRAY       / /     REFS        52         90      202       203       205       206       211
                                                  212       213        214      216       217       218
    422  IS3       INTEGER                       REFS       190    DEFINED       91       107
   6667  I3512     INTEGER               / /     REFS        52        197
   1064  JI        REAL                  / /     REFS        11         32
   1065  JO        REAL                  / /     REFS        11         33
   1145  KBI       REAL                  / /     REFS        10         84
   1144  KBO       REAL                  / /     REFS        10         84
   1151  KOAI      REAL                  / /     REFS        10         86
   1150  KOAO      REAL                  / /     REFS        10         86
   1147  KPI       REAL                  / /     REFS        10         85
   1146  KPO       REAL                  / /     REFS        10         85
   1040  KQ1       REAL                  / /     REFS         8         12      173
   1056  KQ10      REAL                  / /     REFS         8         26      181       193
   1060  KQ11      REAL                  / /     REFS         8         28      183       193
   1062  KQ12      REAL                  / /     REFS         8         30
   1042  KQ2       REAL                  / /     REFS         8         14      173
   1044  KQ3       REAL                  / /     REFS         8         16      175
    416  KQ4     * REAL       *UNDEF             REFS         8
   1046  KQ5       REAL                  / /     REFS         8         18      177       191
   1050  KQ6       REAL                  / /     REFS         8         20      179
   1052  KQ7       REAL                  / /     REFS         8         22      179
   1054  KQ8       REAL                  / /     REFS         8         24
    417  KQ9     * REAL       *UNDEF             REFS         8
   1041  KR1       REAL                  / /     REFS         9         13      174
   1057  KR10      REAL                  / /     REFS         9         27      182       194
   1061  KR11      REAL                  / /     REFS         9         29      184       194
   1063  KR12      REAL                  / /     REFS         9         31
   1043  KR2       REAL                  / /     REFS         9         15      174
   1045  KR3       REAL                  / /     REFS         9         17      176
    420  KR4     * REAL       *UNDEF             REFS         9
   1047  KR5       REAL                  / /     REFS         9         19      178       192
   1051  KR6       REAL                  / /     REFS         9         21      180
   1053  KR7       REAL                  / /     REFS         9         23      190
   1055  KR8       REAL                  / /     REFS         9         25
    421  KR9     * REAL       *UNDEF             REFS         9
   1143  KUI       REAL                  / /     REFS        10         83
   1142  KUO       REAL                  / /     REFS        10         83      204   DEFINED       204
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VARIABLES     SN  TYPE          RELOCATION
   5000  N        INTEGER       / /       REFS     76    106    108    109    110    111    112
                                                   113   114    115    116    117    120    121    122
                                                   123   124    125    126    127    128    129    130
                                                   131   132    133    134    135    136    137    138
                                                   139   140    141    142    DEFINED 117   142
   6657  OPTN4    REAL          / /       REFS     78    158
   1072  QERG     REAL          / /       REFS     38
    766  Q1       REAL          / /       REFS     55
    774  Q2       REAL          / /       REFS     57
   1002  Q3       REAL          / /       REFS     59
   1013  Q4       REAL          / /       REFS     62
   1024  Q5       REAL          / /       REFS     65
   1035  Q6       REAL          / /       REFS     67
    562  RANGE    REAL          / /       REFS     49    186    187    DEFINED 185
   1132  RBLOCK   REAL          / /       REFS     71
   1124  RCL      REAL          / /       REFS     36
   1073  RERG     REAL          / /       REFS     39
    427  RN       REAL                    REFS     203   204    206    207    214    215
    426  RNSTRT   REAL                    REFS     203   206    214
    767  R1       REAL          / /       REFS     56
    775  R2       REAL          / /       REFS     58
   1003  R3       REAL          / /       REFS     60
   1014  R4       REAL          / /       REFS     63
   1025  R5       REAL          / /       REFS     66
   1036  R6       REAL          / /       REFS     68
   1130  TARHT    REAL          / /       REFS     46    186
   1131  TARWD    REAL          / /       REFS     46    187
   1127  TAU      REAL          / /       REFS     39
   1125  TCLQ     REAL          / /       REFS     37
   1126  TCLR     REAL          / /       REFS     38
   1137  TDELAY   REAL          / /       REFS     72    DEFINED 164
   1140  THTQ     REAL          / /       REFS     72    DEFINED 164    186
   1141  THTR     REAL          / /       REFS     72    DEFINED 164    187
   1023  TIMESV   REAL          / /       REFS     75
   1070  TUI      REAL          / /       REFS     36    DEFINED 171
   1071  TUO      REAL          / /       REFS     37    DEFINED 172
   1152  UCC      REAL          / /       REFS     87    DEFINED 219
   1154  UCCG     REAL          / /       REFS     88    DEFINED 221
   1153  USC      REAL          / /       REFS     87    DEFINED 220
   1155  USCG     REAL          / /       REFS     88    DEFINED 222
   1100  WGQ1     REAL          / /       REFS     16    177    191
   1102  WGQ2     REAL          / /       REFS     18
   1104  WGQ3     REAL          / /       REFS     20    177    191
   1106  WGQ4     REAL          / /       REFS     22    177    191
   1110  WGQ5     REAL          / /       REFS     24    177
   1112  WGQ6     REAL          / /       REFS     26    2*177
   1101  WGR1     REAL          / /       REFS     17    178    192
   1103  WGR2     REAL          / /       REFS     19
   1105  WGR3     REAL          / /       REFS     21    178    192
   1107  WGR4     REAL          / /       REFS     23    178    192
   1111  WGR5     REAL          / /       REFS     25    178
   1113  WGR6     REAL          / /       REFS     27    2*178
   1012  WI       REAL          / /       REFS     54
   1004  WO       REAL          / /       REFS     51
   1114  WRQ1     REAL          / /       REFS     28
   1116  WRQ2     REAL          / /       REFS     30    2*181
   1120  WRQ3     REAL          / /       REFS     32
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 VARIABLES     SN  TYPE            RELOCATION
   1122  WRQ4      REAL                 / /      REFS       34     2*163
   1115  WRR1      REAL                 / /      REFS       29
   1117  WRR2      REAL                 / /      REFS       31     2*182
   1121  WRR3      REAL                 / /      REFS       33
   1123  WRR4      REAL                 / /      REFS       35     2*184
   1074  WTQ1      REAL                 / /      REFS       12      175
   1076  WTQ2      REAL                 / /      REFS       14      175
   1075  WTR1      REAL                 / /      REFS       13      176
   1077  WTR2      REAL                 / /      REFS       15      176

 FILE NAMES      MODE
      TAPE6      FMT                    WRITES      94

 EXTERNALS        TYPE    ARGS        REFERENCES
      ATAND       REAL     2             185       187
      COSD        REAL     1             219       221
      MCARLO               3             202       205      211       212       213       216       217       218
      RANNUM               3             203       206      214
      SIND        REAL     1             220       222
      SQRT        REAL     1 LIBRARY     185

 INLINE FUNCTIONS   TYPE    ARGS         DEF LINE  REFERENCES
      SIGN          REAL     2  INTRIN              204

 STATEMENT LABELS               DEF LINE    REFERENCES
      0   1                        145        144
    132   3                        163        155
    236   6                        195        190
      0   7                        152        149
     36  10                        119        100
    101  20                        143        113
      0  30                        223        197
    364 112      FMT                95         94

 LOOPS  LABEL    INDEX       FROM-TO     LENGTH    PROPERTIES
   103  1        I           144 145       28      INSTACK
   113  7      * I           148 152       7B      INSTACK
   237  30     * I           197 223      77B                  EXT REFS

 COMMON BLOCKS   LENGTH     MEMBERS - BIAS NAME(LENGTH)
    / /           3830             0 C      (3830)

 EQUIV CLASSES   LENGTH     MEMBERS - BIAS NAME(LENGTH)
 C        C       3830           370 RANGE   (1)          423 BTHTGD  (1)          426 BTHTG   (1)
                                 427 BPSIGD  (1)          430 BPSTG   (1)          479 GQ1     (1)
                                 480 GR1     (1)          481 GQ2     (1)          482 GR2     (1)
                                 483 GQ3     (1)          484 GR3     (1)          485 GQ4     (1)
                                 486 GR4     (1)          488 GQ5     (1)          489 GR5     (1)
                                 490 GQ6     (1)          491 GR6     (1)          499 DQ1     (1)
                                 500 DR1     (1)          502 Q1      (1)          503 R1      (1)
                                 505 DQ2     (1)          505 DR2     (1)          508 Q2      (1)
                                 509 R2      (1)          511 DQ3     (1)          512 DR3     (1)
                                 513 DQ0     (1)          514 Q3      (1)          515 R3      (1)
                                 516 WO      (1)          517 DDQ4    (1)          518 DDR4    (1)
                                 519 UWI     (1)          520 DQ4     (1)          521 DR4     (1)
                                 522 WI      (1)          523 Q4      (1)          524 R4      (1)
                                 525 BEPSYSV(1)           525 DDQ5    (1)          527 DDR5    (1)
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```
EQUIV CLASSES   LENGTH   MEMBERS - BIAS NAME(LENGTH)
                          528 BEPSZSV(1)       529 DQ5     (1)       530 DR5    (1)
                          531 TIMESV  (1)      532 Q5      (1)       533 R5     (1)
                          535 DDQ6    (1)      536 DDR6    (1)       538 DQ6    (1)
                          539 DR5     (1)      541 Q6      (1)       542 R6     (1)
                          544 KQ1     (1)      545 KR1     (1)       546 KQ2    (1)
                          547 KR2     (1)      548 KQ3     (1)       549 KR3    (1)
                          550 KQ5     (1)      551 KR5     (1)       552 KQ6    (1)
                          553 KR6     (1)      554 KQ7     (1)       555 KR7    (1)
                          556 KQ8     (1)      557 KR8     (1)       558 KQ10   (1)
                          559 KR10    (1)      560 KQ11    (1)       561 KR11   (1)
                          562 KQ12    (1)      563 KR12    (1)       564 JI     (1)
                          565 JO      (1)      566 FRI     (1)       567 FRO    (1)
                          568 TUI     (1)      569 TJO     (1)       570 QERG   (1)
                          571 RERG    (1)      572 WTQ1    (1)       573 WTR1   (1)
                          574 WTQ2    (1)      575 WTR2    (1)       576 WGQ1   (1)
                          577 WGR1    (1)      578 WGQ2    (1)       579 WGR2   (1)
                          580 WGQ3    (1)      581 WGR3    (1)       582 WGQ4   (1)
                          583 WGR4    (1)      584 WGQ5    (1)       585 WGR5   (1)
                          586 WGQ5    (1)      587 WGR6    (1)       588 WRQ1   (1)
                          589 WRR1    (1)      590 WRQ2    (1)       591 WRR2   (1)
                          592 WRQ3    (1)      593 WRR3    (1)       594 WRQ4   (1)
                          595 WRR4    (1)      596 RCL     (1)       597 TCLQ   (1)
                          598 TCLR    (1)      599 TAU     (1)       600 TARHT  (1)
                          601 TARHO   (1)      602 RBLOCK  (1)       60  IOCS   (1)
                          607 TDELAY  (1)      608 THTQ    (1)       609 THTR   (1)
                          610 KUD     (1)      611 KUI     (1)       612 KBD    (1)
                          613 KBI     (1)      614 KPD     (1)       615 KPI    (1)
                          616 KOAD    (1)      617 KOAI    (1)       618 UCC    (1)
                          619 USC     (1)      620 UCCG    (1)       621 USCG   (1)
                          622 UERSV   (1)     1750 CRAD    (1)      2560 N      (1)
                         2561 IPL   (100)     3503 OPTN4   (1)      3511 I3512  (1)
                         3633 ISNDX  (40)

STATISTICS
   PROGRAM LENGTH             4323     282
   CM BLANK COMMON LENGTH    73668    3830
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C                                                                       S2     230
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      EQUIVALENCE (C( 548),    KR2),  (C( 576),   WTR2)                 S2     251
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      EQUIVALENCE (C( 550),    KR3),  (C( 578),   WGR1)                 S2     253
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      EQUIVALENCE (C( 552),    KR5),  (C( 580),   WGR2)                 S2     255
      EQUIVALENCE (C( 553),    KQ6),  (C( 581),   WGQ3)                 S2     256
      EQUIVALENCE (C( 554),    KR6),  (C( 582),   WGR3)                 S2     257
      EQUIVALENCE (C( 555),    KQ7),  (C( 583),   WGQ4)                 S2     258
      EQUIVALENCE (C( 556),    KR7),  (C( 584),   WGR4)                 S2     259
      EQUIVALENCE (C( 557),    KQ8),  (C( 585),   WGQ5)                 S2     260
      EQUIVALENCE (C( 558),    KR8),  (C( 586),   WGR5)                 S2     261
      EQUIVALENCE (C( 559),   KQ10),  (C( 587),   WGQ6)                 S2     262
      EQUIVALENCE (C( 560),   KR10),  (C( 588),   WGR6)                 S2     263
      EQUIVALENCE (C( 561),   KQ11),  (C( 589),   WRQ1)                 S2     264
      EQUIVALENCE (C( 562),   KR11),  (C( 590),   WRR1)                 S2     265
      EQUIVALENCE (C( 563),   KQ12),  (C( 591),   WRQ2)                 S2     266
      EQUIVALENCE (C( 564),   KR12),  (C( 592),   WRR2)                 S2     267
      EQUIVALENCE (C( 565),     JI),  (C( 593),   WRQ3)                 S2     268
      EQUIVALENCE (C( 566),     JO),  (C( 594),   WRR3)                 S2     269
      EQUIVALENCE (C( 567),    FRI),  (C( 595),   WRQ4)                 S2     270
      EQUIVALENCE (C( 568),    FRO),  (C( 596),   WRR4)                 S2     271
      EQUIVALENCE (C( 569),    TUI),  (C( 597),    RCL)                 S2     272
      EQUIVALENCE (C( 570),    TUO),  (C( 598),   TCL2)                 S2     273
      EQUIVALENCE (C( 571),   QERS),  (C( 599),   TCL3)                 S2     274
      EQUIVALENCE (C( 572),   RERS),  (C( 600),    TAU)                 S2     275
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      EQUIVALENCE (C( 489),    GQ5),  (C( 491),    GQ6)                 S2     280
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      EQUIVALENCE (C( 603), RBLOCK),  (C( 605),   IOCS)                 S2     283
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      EQUIVALENCE (C( 501),  TARHI),  (C( 502),  TARHO)                S2   284
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      EQUIVALENCE (C( 608), TDELAY),  (C( 609),   THTI), (C( 610), THTR) S2   286
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      EQUIVALENCE (C( 373),   RYBA)                                    S2   291
      EQUIVALENCE (C( 374),   RZBA)                                    S2   292
      EQUIVALENCE (C(1739),     HP)                                    S2   293
      EQUIVALENCE (C(1743),     HQ)                                    S2   294
      EQUIVALENCE (C(1747),     HR)                                    S2   295
      EQUIVALENCE (C(1751),   CRAD)                                    S2   296
      EQUIVALENCE (C(2000),   TIME)                                    S2   297
      EQUIVALENCE (C( 371),  RANGE)                                    S2   298
      EQUIVALENCE (C(1676),   ANGX)                                    S2   299
      EQUIVALENCE (C(1577),   ANGY)                                    S2   300
      EQUIVALENCE (C(1578),   ANGZ)                                    S2   301
      EQUIVALENCE (C(1736),    HPD)                                    S2   302
      EQUIVALENCE (C(1740),    HQD)                                    S2   303
      EQUIVALENCE (C(1744),    HRD)                                    S2   304
      EQUIVALENCE (C( 550),TIMESV)                                     S2   305
      EQUIVALENCE (C( 556),   LOSZ)                                    S2   306
      EQUIVALENCE (C( 562),   LOSY)                                    S2   307
      REAL LOSZ,LOSY                                                   S2   308
      DIMENSION TIMESV(5),LOSZ(6),LOSY(6),XL(2)                        S2   309
C                                                                      S2   310
C**STATE VARIABLES                                                      S2   311
      EQUIVALENCE (C( 424), BTHTGD),  (C( 427),  BTHTG)                S2   312
      EQUIVALENCE (C( 428), BPSIGD),  (C( 431),  BPSIG)                S2   313
      EQUIVALENCE (C( 500),    DQ1),  (C( 503),     Q1)                S2   314
      EQUIVALENCE (C( 501),    DR1),  (C( 504),     R1)                S2   315
      EQUIVALENCE (C( 506),    DQ2),  (C( 509),     Q2)                S2   316
      EQUIVALENCE (C( 507),    DR2),  (C( 510),     R2)                S2   317
      EQUIVALENCE (C( 512),    DQ3),  (C( 515),     Q3)                S2   318
      EQUIVALENCE (C( 513),    DR3),  (C( 516),     R3)                S2   319
      EQUIVALENCE (C( 514),    DHO),  (C( 517),     HO)                S2   320
      EQUIVALENCE (C( 518),   DDQ4),  (C( 521),    DQ4),  (C( 524),  Q4) S2   321
      EQUIVALENCE (C( 519),   DDR4),  (C( 522),    DR4),  (C( 525),  R4) S2   322
      EQUIVALENCE (C( 520),    DHI),  (C( 523),     HI)                S2   323
      EQUIVALENCE (C( 527),   DDQ5),  (C( 530),    DQ5),  (C( 533),  Q5) S2   324
      EQUIVALENCE (C( 528),   DDR5),  (C( 531),    DR5),  (C( 534),  R5) S2   325
      EQUIVALENCE (C( 536),   DDQ6),  (C( 539),    DQ6),  (C( 542),  Q6) S2   326
      EQUIVALENCE (C( 537),   DDR6),  (C( 540),    DR6),  (C( 543),  R6) S2   327
C                                                                      S2   328
C**OTHER OUTPUTS                                                        S2   329
      EQUIVALENCE (C( 435),  BEPSZ)                                    S2   330
      EQUIVALENCE (C( 436),  BEPSY)                                    S2   331
      EQUIVALENCE (C( 403),  WLAMQ)                                    S2   332
      EQUIVALENCE (C( 407),  WLAMR)                                    S2   333
      EQUIVALENCE (C( 525),BEPSYSV)                                    S2   334
      EQUIVALENCE (C( 529),BEPSZSV)                                    S2   335
      EQUIVALENCE (C( 493),  DTHCQ),  (C( 494),  DTHCR)                S2   336
      EQUIVALENCE (C( 495), DTHRGQ),  (C( 496), DTHRGR)                S2   337
      EQUIVALENCE (C(2020),  LCONV),  (C( 625),    IBL)                S2   338
      EQUIVALENCE (C( 607),  BRLKQ)                                    S2   339
C                                                                      S2   340
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      C**MONTE CARLO PARAMETERS
      C
            EQUIVALENCE (C(3634),  ISNDK), (C(3512),  I3512)
            EQUIVALENCE (C( 611),    KUO), (C( 612),    KUI)
            EQUIVALENCE (C( 513),    KBO), (C( 614),    KBI)
            EQUIVALENCE (C( 615),    KPO), (C( 616),    KPI)
            EQUIVALENCE (C( 517),   KOAO), (C( 618),   KOAI)
            EQUIVALENCE (C( 619),    UCG), (C( 620),    USG)
            EQUIVALENCE (C( 521),   UCCG), (C( 622),   USCG)
            DATA FOV/4./
      C
      C INTEGRATION SWITCHING TEST
      C            SYNCHRONIZE INTEGRATION WITH SAMPLE SIZE
            IF(C(13).LE.0.)GO TO 1
            C(13)=-1.
            C(2664)=TAU/AINT(TAU/C(2764))
    1       CONTINUE
      C
      C**DIRECTION COSINES FOR BODY TO PLATFORM TRANSFORMATION
            UCT=COSD(BTHTG)
            UST=SIND(BTHTG)
            UCP=COSD(BPSIG)
            USP=SIND(BPSIG)
            UB11=UCT*UCP
            UB12=USP
            UB13=-UCP*UST
            UB21=-UCT*USP
            UB22=UCP
            UB23=UST*USP
            UB31=UST
            UB32=0.
            UB33=UCT
      C
      C**TRANSFORM LOS FROM BODY TO GIMBAL AXES
            RXG=UB11*RXBA+UB12*RYBA+UB13*RZBA
            RYG=UB21*RXBA+UB22*RYBA+UB23*RZBA
            RZG=UB31*RXBA+UB32*RYBA+UB33*RZBA
            IF(I3512.LE.0)GO TO 5
      C**GYRO ERRORS
      C
      C**TRANSFORM NORMALIZED ACCELERATIONS FROM BODY TO GIMBAL AXES
            ANGXG=UB11*ANGX+UB12*ANGY+UB13*ANGZ
            ANGYG=UB21*ANGX+UB22*ANGY+UB23*ANGZ
            ANGZG=UB31*ANGX+UB32*ANGY+UB33*ANGZ
            ANG=ANGZG*UCCG-ANGYG*USCG
            QERG=KBO+KPO*ANG+KOAO*WPD
            RERG=KBI+KPI*ANG+KOAI*WPD
            TUO=KUO*(ANGX*UCT-ANGZ*UST)
            TUI=KUI*(ANGYG*UCG-ANGXG*USG)
    5       CONTINUE
      C
      C**LOS ERRORS IN PLATFORM COORDINATES
            IF(C(1976).LE.0.)GO TO 32
            BEPSZ=ATAND(-RZG,RXG)
            BEPSY=ATAND( RYG,RXG)
      C**SAVE EVERY FIFTH  POINT OF BEPSZ AND BEPSY FOR TLAG
            ILAG=ILAG+1
```

```
      IF(ILAG.LT.5)GO TO 4                                          S2
      ILAG=0                                                        S2
      DO 2 L=2,6                                                    S2
      TIMESV(L-1)=TIMESV(L)                                         S2
      LOSZ(L-1)=LOSZ(L)                                             S2
      LOSY(L-1)=LOSY(L)                                             S2
    2 CONTINUE                                                      S2
    4 CONTINUE                                                      S2
      TIMESV(6)=TIME                                                S2
      LOSZ(6)=BEPSZ                                                 S2
      LOSY(6)=BEPSY                                                 S2
   32 CONTINUE                                                      S2
C                                                                   S2
C        TRACKER LOOP                                               S2
C                                                                   S2
C                                                                   S2
C**ZOH (TDELAY..TAU) AND TIME DELAY (TLAG)                          S2
      IF(TIME.LT.(TDELAY-.00001).OR.C(1976).LE.0.)GO TO 30          S2
      TDELAY=TIME+TAU                                               S2
      THTQ=ATAND(TARHT/2.,RANGE)                                    S2
      THTR=ATAND(TARHW/2.,RANGE)                                    S2
      BRLKQ=(BEPSZ-BEPSZSV)/(2.*THTQ)                               S2
      BRLKR=(BEPSY-BEPSYSV)/(2.*THTR)                               S2
      TTLAG=TIME-TLAG   $  N=6  $  F=0.                             S2
      BEPSZSV=FINTP1(     TTLAG,TIMESV,LOSZ,N,F,XL)                 S2
      BEPSYSV=FINTP1(     TTLAG,TIMESV,LOSY,N,F,XL)                 S2
      IF(ABS(BRLKQ) .LT. .5 .AND. ABS(BRLKR) .LT. .5)GO TO 30       S2
C**BREAKLOCK DETERMINATION                                          S2
      IF(IOCS.NE.-10)GO TO 30                                       S2
      IOCS=-9                                                       S2
      IBL=IBL+1                                                     S2
      LCONV=2                                                       S2
      WHICH = 10H IN PITCH                                          S2
      IF(ABS(BRLKR) .GE. .5)WHICH = 10H IN YAW                      S2
      WRITE(6,101)TIME,RANGE,WHICH                                  S2
  101 FORMAT(1H0,100(1H*)/* BREAK LOCK CONDITION AT TIME = *F5.2,   S2
     + * RANGE = *F10.2,A10,/100(1H*))                              S2
   30 CONTINUE                                                      S2
      DELAYQ=GQ1*BEPSZSV                                            S2
      DELAYR=GR1*BEPSYSV                                            S2
      DQ1=      DELAYQ-WTQ2*Q1                                      S2
      DR1=      DELAYR-WTR2*R1                                      S2
      DTHCQ=(DQ1+WTQ1*Q1)*GQ2                                       S2
      DTHCR=(DR1+WTR1*R1)*GR2                                       S2
C        RATE COMMAND LIMIT                                         S2
      IF(ABS(DTHCQ).GT.RCL)DTHCQ=SIGN(RCL,DTHCQ)                    S2
      IF(ABS(DTHCR).GT.RCL)DTHCR=SIGN(RCL,DTHCR)                    S2
C                                                                   S2
C        RATE GYRO LOOP                                             S2
C                                                                   S2
      W1Q=WO*UCP-(WP*UST-WR*UST)*JSP                                S2
      DDQ5=    (W1Q+QERG)-WRQ2*DQ5-WRQ2*WRQ2*Q5                     S2
      DDR5=     (WI+RERG)-WRR2*DR5-WRR2*WRR2*R5                     S2
      DDQ6=GG5*Q5-WRQ4*DQ6-WRQ4*WRQ4*Q6                             S2
      DDR6=GR5*R5-WRR4*DR6-WRR4*WRR4*R6                             S2
      DTHRGQ=KQ12*Q6*GQ6                                            S2
      DTHRGR=KR12*R6*GR5                                            S2
```

```
      C
      C
      C** BLIND RANGE DETERMINATION
            THTOAQ=THTQ+ABS(BEPSZ)
            THTOAR=THTR+ABS(BEPSY)
            BLNDQ=THTOAQ*2./FOV
            BLNDR=THTOAR*2./FOV
            TESTFOV=FFOV*FOV/2.
            IF(THTOAQ.LT.TESTFOV.AND.THTOAR.LT.TESTFOV) GO TO 20
            IF(IOCS.LE.1)WRITE(5,100)TIME,RANGE
      100   FORMAT(1H0,100(1H*)/* OCS BLIND RANGE SIGNAL HOLD AT TIME = *F5.2,
           + *  RANGE = *F10.2/100(1H*))
            IOCS=10
            GO TO 21
      20    CONTINUE
            WLAMQ=G6*GQ6*GEOCS
            WLAMR=R6*GR6*GEOCS
            IF(ABS(C(630)).LT.ABS(BRLKQ))C(630)=BRLKQ
            IF(ABS(C(631)).LT.ABS(BRLKR))C(631)=BRLKR
      21    CONTINUE
      C
      C        GAIN COMPENSATION
      C
            DTHTEQ=DTHCQ-DTHRGQ
            DTHTER=DTHCR-DTHRGR
            DQ2=     DTHTEQ
            DR2=     DTHTER
            DQ3=DQ2+WGQ1*Q2-WGQ4*Q3
            DR3=DR2+WGR1*R2-WGR4*R3
            DDQ4=DQ3+WGQ3*Q3-WGQ5*DQ4-WGQ6*WGQ6*Q4
            DDR4=DR3+WGR3*R3-WGR5*DR4-WGR6*WGR6*R4
      C
      C        SEEKER TORQUE MOTOR
      C
            TQ=(WGQ5*Q4+DQ4)*GQ3
            TR=(WGR5*R4+DR4)*GR3
            IF(ABS(TQ).GT.TCLQ)TQ=SIGN(TCLQ,TQ)
            IF(ABS(TR).GT.TCLR)TR=SIGN(TCLR,TR)
            TMQ=GQ4*TQ
            TMR=GR4*TR
      C
      C        SEEKER GIMBAL ANGLE RATES
      C
      C**COULOMB FRICTION MODEL
            TCOMQ=KQ8*BTHTG/CRAD
            IF(ABS(BTHTGD).LE.4.E-4)GO TO 70
            TFQ=           SIGN(FRO,BTHTGD)
            TAQ=TMQ-TFQ-TCOMQ-TJJ
            DWQ=TAQ*CRAD/JQ
            GO TO 73
      70    CONTINUE
            TFQ=TMQ-TCOMQ-TUC
            IF(ABS(TFQ).GT.FRO)TFQ=SIGN(FRO,TMQ)
            WCOQ=(TFQ+SIGN(FRO,WQD))*CRAD/JQ
            DWBAQ=WQD
            IF(ABS(WQD).GT.ABS(WCOQ))DWBAQ=WCOQ
            TAQ=TMQ-TFQ-TCOMQ-TJJ
```

```
      DWAQ=TAQ/JO*CRAD                                    S2
      DWO=DWBAQ+DWAQ                                      S2
   73 CONTINUE                                            S2
      TCOMR=KR8*BPSIG/CRAD                                S2
      IF(ABS(BPSIGD).LE.4.E-4)GO TO 80                    S2
      TFR=SIGN(FRI,BPSIGD)                                S2
      TAR=TMR-TFR-TCOMR-TJI                               S2
      DWI=TAR*CRAD/JI                                     S2
      GO TO 63                                            S2
   80 CONTINUE                                            S2
      WRES=UCT*WRD+JST*WP)                                S2
      TFR=TMR-TCOMR-TJI                                   S2
      IF(ABS(TFR).GT.FRI)TFR=SIGN(FRI,TMR)                S2
      WCOR=(TFR+SIGN(FRI,WRES))*CRAD/JI                   S2
      DWBAR=WRES                                          S2
      IF(ABS(WRES).GT.ABS(WCOR))DWBAR=WCOR                S2
      TAR=TMR-TFR-TCOMR-TUI                               S2
      DWAR=TAR/JI*CRAD                                    S2
      DWI=DWBAR+DWAR                                      S2
   83 CONTINUE                                            S2
      BTHTGL=WO-WI                                        S2
      BPSIGD=WI-(WR*JCI+WP*UST)                           S2
    3 CONTINUE                                            S2
      RETURN                                              S2
      END                                                 S2
```

```
SYMBOLIC REFERENCE MAP (R=3)

ENTRY POINTS   DEF LINE   REFERENCES
  1  S2            1        309

VARIABLES    SN  TYPE        RELOCATION
   703  ANG        REAL                    REFS    150    161  DEFINED    159
  3213  ANGX       REAL              / /   REFS     73    156      157    158    162
   700  ANGXG      REAL                    REFS    153  DEFINED    156
  3214  ANGY       REAL              / /   REFS     74    156      157    158
   701  ANGYG      REAL                    REFS    159    153  DEFINED    157
  3215  ANGZ       REAL              / /   REFS     75    156      157    158    162
   702  ANGZG      REAL                    REFS    159  DEFINED    158
   663  BEPSY      REAL              / /   REFS    105    182      194    233  DEFINED    169
  1015  BEPSYSV    REAL              / /   REFS    138    194      211  DEFINED    197
   662  BEPSZ      REAL              / /   REFS    104    181      193    232  DEFINED    168
  1020  BEPSZSV    REAL              / /   REFS    109    193      210  DEFINED    196
   720  BLNDQ    * REAL                 DEFINED    234
   721  BLNOR    * REAL                 DEFINED    235
   656  BPSIG      REAL              / /   REFS     37    136      137    289
   653  BPSIGD     REAL              / /   REFS     37    290      291  DEFINED    307
  1136  BRLKQ      REAL              / /   REFS    113    198    2*246  DEFINED    193
   706  BRLKR      REAL                    REFS    198    205    2*247  DEFINED    194
   652  BTHTG      REAL              / /   REFS     56    134      135    273
   647  BTHTGD     REAL              / /   REFS     56    274      275  DEFINED    306
     0  C          REAL      ARRAY   / /   REFS     16   2*22     2*23   2*24   2*25   2*25   2*27
                                         2*28   2*29   2*30     2*31   2*32   2*33   2*34   2*35
                                         2*36   2*37   2*38     2*39   2*40   2*41   2*42   2*43
                                         2*44   2*45   2*46     2*47   2*48   2*49   2*50   2*51
                                         2*52   2*53   2*54     2*55     56   2*57   2*58     59
                                         3*60     61     64       65     66     67     68     69
                                           70     71     72       73     74     75     76     77
                                           78     79     80       81   2*86   2*87   2*88   2*89
                                         2*90   2*91   2*92     2*93   2*94   3*95   3*95   2*97
                                         3*98   3*99  3*100    3*101    104    105    106    107
                                          108    109  2*110    2*111  2*112    113  2*117  2*118
                                        2*119  2*120  2*121    2*122  2*123    128    130    167
                                          189    246    247  DEFINED    129    130    246    247
  3326  CRAD       REAL              / /   REFS     70    273      277    282    286    289    293
                                          299    303
  1005  DDQ4       REAL              / /   REFS     95  DEFINED    258
  1016  DDQ5       REAL              / /   REFS     98  DEFINED    223
  1027  DDQ6       REAL              / /   REFS    100  DEFINED    225
  1006  DDR4       REAL              / /   REFS     96  DEFINED    259
  1017  DDR5       REAL              / /   REFS     99  DEFINED    224
  1030  DDR6       REAL              / /   REFS    101  DEFINED    226
   713  DELAYQ     REAL                    REFS    212  DEFINED    210
   714  DELAYR     REAL                    REFS    213  DEFINED    211
   763  DQ1        REAL              / /   REFS     88    214  DEFINED    212
   771  DQ2        REAL              / /   REFS     90    256  DEFINED    254
   777  DQ3        REAL              / /   REFS     92    258  DEFINED    256
  1010  DQ4        REAL              / /   REFS     95    258      263
  1021  DQ5        REAL              / /   REFS     98    223
  1032  DQ6        REAL              / /   REFS    100    225
   764  DR1        REAL              / /   REFS     89    215  DEFINED    213
   772  DR2        REAL              / /   REFS     91    257  DEFINED    255
  1000  DR3        REAL              / /   REFS     93    259  DEFINED    257
```

```
VARIABLES    SN  TYPE         RELOCATION
  1011  DR4        REAL             / /      REFS     36      259      264
  1022  DR5        REAL             / /      REFS     39      224
  1033  DR6        REAL             / /      REFS    101      226
   754  DTHCQ      REAL             / /      REFS    110    2*217      252   DEFINED    214     217
   755  DTHCR      REAL             / /      REFS    110    2*218      253   DEFINED    215     218
   756  DTHRGQ     REAL             / /      REFS    111      252  DEFINED       227
   757  DTHRGR     REAL             / /      REFS    111      253  DEFINED       228
   723  DTHTEQ     REAL                      REFS    254  DEFINED      252
   724  DTHTER     REAL                      REFS    255  DEFINED      253
   736  DWAQ       REAL                      REFS    287  DEFINED      286
   745  DWAR       REAL                      REFS    304  DEFINED      303
   735  DWBAQ      REAL                      REFS    287  DEFINED      283       284
   744  DWBAR      REAL                      REFS    304  DEFINED      300       301
  1007  DWI        REAL             / /      REFS     37  DEFINED      293       304
  1001  DWO        REAL             / /      REFS     34  DEFINED      277       287
   711  F          REAL                      REFS    136      197  DEFINED       195
  1133  FFOV       REAL             / /      REFS     59      236
   604  FOV        REAL                      REFS    234      235      236   DEFINED    124
  1066  FRI        REAL             / /      REFS     44      231    2*298       299
  1067  FRO        REAL             / /      REFS     45      275    2*281       282
   760  GEOCS      REAL             / /      REFS     56      244      245
   737  GQ1        REAL             / /      REFS     50      210
   741  GQ2        REAL             / /      REFS     50      214
   743  GQ3        REAL             / /      REFS     52      263
   745  GQ4        REAL             / /      REFS     52      257
   750  GQ5        REAL             / /      REFS     54      225
   752  GQ6        REAL             / /      REFS     54      227      244
   740  GR1        REAL             / /      REFS     51      211
   742  GR2        REAL             / /      REFS     51      215
   744  GR3        REAL             / /      REFS     53      264
   746  GR4        REAL             / /      REFS     53      268
   751  GR5        REAL             / /      REFS     55      226
   753  GR6        REAL             / /      REFS     55      228      245
  1160  IBL        INTEGER          / /      REFS    112      202  DEFINED       202
   704  ILAG       INTEGER                   REFS    171      172  DEFINED       171     173
  1134  IOCS       INTEGER          / /      REFS     57      200      238   DEFINED    201     241
  7661  ISNOX      INTEGER          / /      REFS    117
  6067  I3512      INTEGER          / /      REFS    117      152
  1064  JI         REAL             / /      REFS     20       42      293       299     303
  1065  JO         REAL             / /      REFS     20       43      277       282     286
  1145  KBI        REAL             / /      REFS     19      119      161
  1144  KBO        REAL             / /      REFS     19      119      160
  1151  KOAI       REAL             / /      REFS     19      121      161
  1150  KOAO       REAL             / /      REFS     19      121      160
  1147  KPI        REAL             / /      REFS     19      120      161
  1146  KPO        REAL             / /      REFS     19      120      160
  1040  KQ1        REAL             / /      REFS     17       22
  1056  KQ10       REAL             / /      REFS     17       36
  1060  KQ11       REAL             / /      REFS     17       38
  1062  KQ12       REAL             / /      REFS     17       40      227
  1042  KQ2        REAL             / /      REFS     17       24
  1044  KQ3        REAL             / /      REFS     17       26
   654  KQ4     *  REAL    *UNDEF            REFS     17
  1046  KQ5        REAL             / /      REFS     17       28
  1050  KQ6        REAL             / /      REFS     17       30
  1052  KQ7        REAL             / /      REFS     17       32
  1054  KQ8        REAL             / /      REFS     17       34      273
```

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VARIABLES     SN  TYPE         RELOCATION
  655  KQ9     *  REAL      *UNDEF              REFS     17
 1041  KR1        REAL                 / /      REFS     18      23
 1057  KR10       REAL                 / /      REFS     18      37
 1061  KR11       REAL                 / /      REFS     18      39
 1063  KR12       REAL                 / /      REFS     18      41      228
 1043  KR2        REAL                 / /      REFS     18      25
 1045  KR3        REAL                 / /      REFS     18      27
  656  KR4     *  REAL      *UNDEF              REFS     18
 1047  KR5        REAL                 / /      REFS     18      29
 1051  KR6        REAL                 / /      REFS     18      31
 1053  KR7        REAL                 / /      REFS     18      33
 1055  KR8        REAL                 / /      REFS     18      35      289
  657  KR9     *  REAL      *UNDEF              REFS     18
 1143  KUI        REAL                 / /      REFS     19     118      163
 1142  KUO        REAL                 / /      REFS     19     118      162
  705  L          INTEGER                       REFS   2*175  2*176   2*177   DEFINED   174
 3743  LCONV      INTEGER              / /      REFS    112   DEFINED   203
 1225  LOSY       REAL        ARRAY    / /      REFS     51      82       83     177      197
                                             DEFINED    177     182
 1217  LOSZ       REAL        ARRAY    / /      REFS     80      82       83     176      196
                                             DEFINED    176     181
  710  N          INTEGER                       REFS    136     137   DEFINED    195
 1072  QERG       REAL                 / /      REFS     48     223   DEFINED    160
  766  Q1         REAL                 / /      REFS     88     212      214
  774  Q2         REAL                 / /      REFS     90     256
 1002  Q3         REAL                 / /      REFS     92     256      258
 1013  Q4         REAL                 / /      REFS     95     258      253
 1024  Q5         REAL                 / /      REFS     98     223      225
 1035  Q6         REAL                 / /      REFS    100     225      227     244
  562  RANGE      REAL                 / /      REFS     72     191      192     206      238
 1132  RBLOCK     REAL                 / /      REFS     57
 1124  RCL        REAL                 / /      REFS     46   2*217    2*218
 1073  RERG       REAL                 / /      REFS     49     224   DEFINED    161
  563  RXBA       REAL                 / /      REFS     54     149      150     151
  675  RXG        REAL                          REFS    158     169   DEFINED    149
  564  RYBA       REAL                 / /      REFS     65     149      150     151
  676  RYG        REAL                          REFS    169   DEFINED    150
  565  RZBA       REAL                 / /      REFS     56     149      150     151
  677  RZG        REAL                          REFS    158   DEFINED    151
  767  R1         REAL                 / /      REFS     89     213      215
  775  R2         REAL                 / /      REFS     91     257
 1003  R3         REAL                 / /      REFS     93     257      259
 1014  R4         REAL                 / /      REFS     96     259      264
 1025  R5         REAL                 / /      REFS     99     224      226
 1036  R6         REAL                 / /      REFS    101     226      228     245
  733  TAQ        REAL                          REFS    277     286   DEFINED    276      285
  741  TAR        REAL                          REFS    293     303   DEFINED    292      302
 1130  TARMT      REAL                 / /      REFS     58     191
 1131  TARMO      REAL                 / /      REFS     58     192
 1127  TAU        REAL                 / /      REFS     49   2*130      190
 1125  TCLQ       REAL                 / /      REFS     47   2*265
 1126  TCLR       REAL                 / /      REFS     48   2*266
  731  TCOMQ      REAL                          REFS    276     280      285   DEFINED    273
  737  TCOMR      REAL                          REFS    292     297      302   DEFINED    289
 1137  TDELAY     REAL                 / /      REFS     50     189   DEFINED    190
  722  TESTFOV    REAL                          REFS   2*237  DEFINED    236
  732  TFQ        REAL                          REFS    276     281      282     285   DEFINED   275   288
```

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VARIABLES     SN    TYPE          RELOCATION
                                                  281
    740   TFR      REAL                           REFS     292     298     239     302   DEFINED   291     292
                                                  298
    716   THTOAQ   REAL                           REFS     234     237   DEFINED   232
    717   THTOAR   REAL                           REFS     235     237   DEFINED   233
   1140   THTQ     REAL             / /           REFS      50     193     232   DEFINED   191
   1141   THTR     REAL             / /           REFS      50     194     233   DEFINED   192
   3717   TIME     REAL             / /           REFS      71     180     189     190     195     286     238
   1211   TIMESV   REAL       ARRAY / /           REFS      79      83     175     196     197
                                               DEFINED     175     180
   1135   TLAG     REAL             / /           REFS      51     195
    727   THQ      REAL                           REFS     276     280     281     285   DEFINED   257
    730   THR      REAL                           REFS     292     297     298     302   DEFINED   268
    725   TQ       REAL                           REFS   2*265     257   DEFINED   263     265
    726   TR       REAL                           REFS   2*266     268   DEFINED   264     266
    707   TTLAG    REAL                           REFS     136     197   DEFINED   195
   1070   TUI      REAL             / /           REFS      46     292     297     302   DEFINED   163
   1071   TUO      REAL             / /           REFS      47     276     280     285   DEFINED   162
    664   UB11     REAL                           REFS     149     156   DEFINED   138
    665   UB12     REAL                           REFS     149     156   DEFINED   139
    666   UB13     REAL                           REFS     149     156   DEFINED   140
    667   UB21     REAL                           REFS     150     157   DEFINED   141
    670   UB22     REAL                           REFS     150     157   DEFINED   142
    671   UB23     REAL                           REFS     150     157   DEFINED   143
    672   UB31     REAL                           REFS     151     158   DEFINED   144
    673   UB32     REAL                           REFS     151     158   DEFINED   145
    674   UB33     REAL                           REFS     151     158   DEFINED   146
   1152   UCC      REAL             / /           REFS     122     153
   1154   UCCG     REAL             / /           REFS     123     159
    662   UCP      REAL                           REFS     138     140     142     222   DEFINED   136
    660   UCT      REAL                           REFS     138     141     146     162     222     296     307
                                               DEFINED     134
   1153   USC      REAL             / /           REFS     122     153
   1155   USCG     REAL             / /           REFS     123     159
    663   USP      REAL                           REFS     139     141     143     222   DEFINED   137
    661   UST      REAL                           REFS     140     143     144     162     222     296     307
                                               DEFINED     135
    734   WCOQ     REAL                           REFS   2*284   DEFINED   282
    743   WCOR     REAL                           REFS   2*301   DEFINED   299
   1100   WGQ1     REAL             / /           REFS      26     256
   1102   WGQ2     REAL             / /           REFS      28
   1104   WGQ3     REAL             / /           REFS      30     258
   1106   WGQ4     REAL             / /           REFS      32     256
   1110   WGQ5     REAL             / /           REFS      34     263
   1112   WGQ6     REAL             / /           REFS      36   3*258
   1101   WGR1     REAL             / /           REFS      27     257
   1103   WGR2     REAL             / /           REFS      29
   1105   WGR3     REAL             / /           REFS      31     259
   1107   WGR4     REAL             / /           REFS      33     257
   1111   WGR5     REAL             / /           REFS      35     264
   1113   WGR6     REAL             / /           REFS      37   3*259
    712   WHICH    REAL                           REFS     206   DEFINED   204     205
   1012   WI       REAL             / /           REFS      37     224     307
    622   WLAMQ    REAL             / /           REFS     106   DEFINED   244
    626   WLAMR    REAL             / /           REFS     107   DEFINED   245
   1004   WO       REAL             / /           REFS      34     222     306
   3312   WP       REAL             / /           REFS      57     222     307
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VARIABLES    SN  TYPE           RELOCATION
  3307  WPD      REAL              / /        REFS     76      160     161     296
  3316  WQ       REAL              / /        REFS     68      306
  3313  WQD      REAL              / /        REFS     77      282     283     284
  3322  WR       REAL              / /        REFS     69      222     307
  3317  WRD      REAL              / /        REFS     78      296
   742  WRES     REAL                         REFS    239      300     301  DEFINED  296
  1114  WRQ1     REAL              / /        REFS     38
  1116  WRQ2     REAL              / /        REFS     40     3*223
  1120  WRQ3     REAL              / /        REFS     42
  1122  WRQ4     REAL              / /        REFS     44     3*225
  1115  WRR1     REAL              / /        REFS     39
  1117  WRR2     REAL              / /        REFS     41     3*224
  1121  WRR3     REAL              / /        REFS     43
  1123  WRR4     REAL              / /        REFS     45     3*226
  1074  WTQ1     REAL              / /        REFS     22      214
  1076  WTQ2     REAL              / /        REFS     24      212
  1075  WTR1     REAL              / /        REFS     23      215
  1077  WTR2     REAL              / /        REFS     25      213
   715  W1Q      REAL                         REFS    223   DEFINED    222
   746  XL       REAL        ARRAY            REFS     53      196     197

FILE NAMES      MODE
      TAPE6     FMT                    WRITES     206     238

EXTERNALS        TYPE   ARGS        REFERENCES
      ATAND      REAL     2            168     169     191     192
      COSD       REAL     1            134     136
      FINTP1     REAL     6            195     197
      SIND       REAL     1            135     137

INLINE FUNCTIONS   TYPE   ARGS     DEF LINE  REFERENCES
      ABS          REAL     1      INTRIN     2*198   205    217    218    232    233   2*246   2*247
                                               265    256    274    281   2*284   290    298   2*301
      AINT         REAL     1      INTRIN      130
      SIGN         REAL     2      INTRIN      217    218    265    266    275    281    282    291
                                               298    299

STATEMENT LABELS                DEF LINE   REFERENCES
    10  1                        131        128
     0  2                        178        174
     0  3           INACTIVE     308
   135  4                        179        172
   114  5                        164        152
   325  20                       243        237
   342  21                       248        242
   216  30                       209        183     198     200
   141  32                       193        167
   435  70                       279        274
   467  73                       288        276
   504  80                       295        290
   541  83                       305        294
   632  100      FMT             239        233
   613  101      FMT             207        205

LOOPS  LABEL    INDEX    FROM-TO    LENGTH    PROPERTIES
  132  2        L        174 178      3B      INSTACK
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COMMON BLOCKS   LENGTH    MEMBERS - BIAS NAME(LENGTH)
  / /            3830        0 C       (3830)

EQUIV CLASSES   LENGTH    MEMBERS - BIAS NAME(LENGTH)
C        C       3830         370 RANGE    (1)        371 RXBA     (1)        372 RYBA     (1)
                              373 RZBA     (1)        402 WLAMQ    (1)        406 WLAMR    (1)
                              423 BTHTGQ   (1)        425 BTHTG    (1)        427 BPSIGD   (1)
                              433 BPSIG    (1)        434 BEPSZ    (1)        435 BEPSY    (1)
                              479 GQ1      (1)        480 GR1      (1)        481 GQ2      (1)
                              482 GR2      (1)        483 GQ3      (1)        484 GR3      (1)
                              485 GQ4      (1)        486 GR4      (1)        488 GQ5      (1)
                              489 GR5      (1)        490 GQ6      (1)        491 GR6      (1)
                              492 DTHGQ    (1)        493 DTHGR    (1)        494 DTHRGQ   (1)
                              495 DTHRGR   (1)        496 GEOCS    (1)        499 DQ1      (1)
                              500 DR1      (1)        502 Q1       (1)        503 R1       (1)
                              505 DQ2      (1)        506 DR2      (1)        508 Q2       (1)
                              509 R2       (1)        511 DQ3      (1)        512 DR3      (1)
                              513 DDQ3     (1)        514 Q3       (1)        515 R3       (1)
                              516 WO       (1)        517 DDQ4     (1)        518 DDR4     (1)
                              519 DWI      (1)        520 DQ4      (1)        521 DR4      (1)
                              522 WI       (1)        523 Q4       (1)        524 R4       (1)
                              525 BEPSYSV(1)          526 DDQ5     (1)        527 DDR5     (1)
                              528 BEPSZSV(1)          529 DQ5      (1)        530 DR5      (1)
                              532 Q5       (1)        533 R5       (1)        535 DDQ6     (1)
                              536 DDR6     (1)        538 DQ6      (1)        539 DR6      (1)
                              541 Q6       (1)        542 R6       (1)        544 KQ1      (1)
                              545 KR1      (1)        546 KQ2      (1)        547 KR2      (1)
                              548 KQ3      (1)        549 KR3      (1)        550 KQ5      (1)
                              551 KR5      (1)        552 KQ6      (1)        553 KR6      (1)
                              554 KQ7      (1)        555 KR7      (1)        556 KQ8      (1)
                              557 KR8      (1)        558 KQ10     (1)        559 KR10     (1)
                              560 KQ11     (1)        561 KR11     (1)        562 KQ12     (1)
                              563 KR12     (1)        564 JI       (1)        565 JO       (1)
                              566 FRI      (1)        567 FRO      (1)        568 TUI      (1)
                              569 TUO      (1)        570 QERG     (1)        571 RERG     (1)
                              572 WTQ1     (1)        573 WTR1     (1)        574 WTQ2     (1)
                              575 WTR2     (1)        576 WGQ1     (1)        577 WGR1     (1)
                              578 WGQ2     (1)        579 WGR2     (1)        580 WGQ3     (1)
                              581 WGR3     (1)        582 WGQ4     (1)        583 WGR4     (1)
                              584 WGQ5     (1)        585 WGR5     (1)        586 WGQ6     (1)
                              587 WGR6     (1)        588 WRQ1     (1)        589 WRR1     (1)
                              590 WRQ2     (1)        591 WRR2     (1)        592 WRQ3     (1)
                              593 WRR3     (1)        594 WRQ4     (1)        595 WRR4     (1)
                              596 RCL      (1)        597 TCLQ     (1)        598 TCLR     (1)
                              599 TAU      (1)        600 TARHT    (1)        601 TARWD    (1)
                              602 RBLOCK   (1)        603 FFOV     (1)        604 IDCS     (1)
                              605 FLAG     (1)        606 BRLKQ    (1)        607 TDELAY   (1)
                              608 THTQ     (1)        609 THTR     (1)        610 KUO      (1)
                              611 KUI      (1)        612 KBO      (1)        613 KBI      (1)
                              614 KPO      (1)        615 KPI      (1)        616 KOAO     (1)
                              617 KOAI     (1)        618 USS      (1)        619 USC      (1)
                              620 USCG     (1)        621 USSG     (1)        624 IBL      (1)
                              649 TIMESV   (6)        655 LOSZ     (6)        661 LOSY     (6)
                             1675 ANGX     (1)       1676 ANGY     (1)       1677 ANGZ     (1)
                             1735 WPD      (1)       1738 WP       (1)       1739 WQD      (1)
                             1742 WL       (1)       1743 WRD      (1)       1746 WR       (1)
                             1750 GRAD     (1)       1333 TIME     (1)       2019 LCONV    (1)
                             3511 13512    (1)       3633 ISNDX    (1)
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STATISTICS
  PROGRAM LENGTH              7503     488
  CM BLANK COMMON LENGTH     73663    3830
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```
      SUBROUTINE S3                                                    S3        2
C                                                                      S3        3
C ** OCS SEEKER MODULE**                                               S3        4
C                                                                      S3        5
C**LOW FREQUENCE SEEKER                                                S3        6
C                                                                      S3        7
      COMMON C(3830)                                                   S3        8
      REAL KQ1,KQ2,KQ3,KQ4,KQ5,KQ6,KQ7,KQ8,KQ9,KQ10,KQ11,KQ12          S3        9
      REAL KR1,KR2,KR3,KR4,KR5,KR6,KR7,KR8,KR9,KR10,KR11,KR12          S3       10
      REAL KUO,KUI,KBO,KBI,KPO,KPI,KOAO,KOAI                           S3       11
      REAL JI,JO                                                       S3       12
C**INPUT DATA                                                          S3       13
      EQUIVALENCE (C( 545),     KQ1),  (C( 573),   WTQ1)               S3       14
      EQUIVALENCE (C( 546),     KR1),  (C( 574),   WTR1)               S3       15
      EQUIVALENCE (C( 547),     KQ2),  (C( 575),   WTQ2)               S3       16
      EQUIVALENCE (C( 548),     KR2),  (C( 576),   WTR2)               S3       17
      EQUIVALENCE (C( 549),     KQ3),  (C( 577),   WGQ1)               S3       18
      EQUIVALENCE (C( 550),     KR3),  (C( 578),   WGR1)               S3       19
      EQUIVALENCE (C( 551),     KQ5),  (C( 579),   WGQ2)               S3       20
      EQUIVALENCE (C( 552),     KR5),  (C( 580),   WGR2)               S3       21
      EQUIVALENCE (C( 553),     KQ6),  (C( 581),   WGQ3)               S3       22
      EQUIVALENCE (C( 554),     KR6),  (C( 582),   WGR3)               S3       23
      EQUIVALENCE (C( 555),     KQ7),  (C( 583),   WGQ4)               S3       24
      EQUIVALENCE (C( 556),     KR7),  (C( 584),   WGR4)               S3       25
      EQUIVALENCE (C( 557),     KQ9),  (C( 585),   WGQ5)               S3       26
      EQUIVALENCE (C( 558),     KR9),  (C( 586),   WGR5)               S3       27
      EQUIVALENCE (C( 559),    KQ10),  (C( 587),   WGQ6)               S3       28
      EQUIVALENCE (C( 560),    KR10),  (C( 588),   WGR6)               S3       29
      EQUIVALENCE (C( 561),    KQ11),  (C( 589),   WRQ1)               S3       30
      EQUIVALENCE (C( 562),    KR11),  (C( 590),   WRR1)               S3       31
      EQUIVALENCE (C( 563),    KQ12),  (C( 591),   WRQ2)               S3       32
      EQUIVALENCE (C( 564),    KR12),  (C( 592),   WRR2)               S3       33
      EQUIVALENCE (C( 565),      JI),  (C( 593),   WRQ3)               S3       34
      EQUIVALENCE (C( 566),      JO),  (C( 594),   WRR3)               S3       35
      EQUIVALENCE (C( 567),     FRI),  (C( 595),   WRQ4)               S3       36
      EQUIVALENCE (C( 568),     FRO),  (C( 596),   WRR4)               S3       37
      EQUIVALENCE (C( 569),     TUI),  (C( 597),    RCL)               S3       38
      EQUIVALENCE (C( 570),     TUO),  (C( 598),   TCLQ)               S3       39
      EQUIVALENCE (C( 571),    QERS),  (C( 599),   TCLR)               S3       40
      EQUIVALENCE (C( 572),    RERS),  (C( 600),    TAU)               S3       41
      EQUIVALENCE (C( 480),     GQ1),  (C( 482),    GQ2)               S3       42
      EQUIVALENCE (C( 481),     GR1),  (C( 483),    GR2)               S3       43
      EQUIVALENCE (C( 484),     GQ3),  (C( 486),    GQ4)               S3       44
      EQUIVALENCE (C( 485),     GR3),  (C( 487),    GR4)               S3       45
      EQUIVALENCE (C( 489),     GQ5),  (C( 491),    GQ6)               S3       46
      EQUIVALENCE (C( 490),     GR5),  (C( 492),    GR6)               S3       47
      EQUIVALENCE (C( 501),   TARHI),  (C( 502),  TARHO)               S3       48
      EQUIVALENCE (C( 508),  TDELAY),  (C( 509),   THTQ),  (C( 510), THTR)S3    49
      EQUIVALENCE (C( 504),     FFO)                                   S3       50
      EQUIVALENCE (C( 603),  RBLOCK),  (C( 605),   IOCS)               S3       51
      EQUIVALENCE (C( 497),   GEOCS)                                   S3       52
      EQUIVALENCE (C( 596),    TLAG)                                   S3       53
C                                                                      S3       54
C**INPUTS FROM OTHER MODULES**                                         S3       55
      EQUIVALENCE (C( 372),    RXBA)                                   S3       56
      EQUIVALENCE (C( 373),    RYBA)                                   S3       57
      EQUIVALENCE (C( 374),                                            S3       58
```

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      EQUIVALENCE (C(1739),     WP)
      EQUIVALENCE (C(1743),     WQ)
      EQUIVALENCE (C(1747),     WR)
      EQUIVALENCE (C(1751),    CRAJ)
      EQUIVALENCE (C(2000),    TIME)
      EQUIVALENCE (C( 371),   RANGE)
      EQUIVALENCE (C(1676),    ANGX)
      EQUIVALENCE (C(1677),    ANGY)
      EQUIVALENCE (C(1678),    ANGZ)
      EQUIVALENCE (C(1736),     WPD)
      EQUIVALENCE (C(1740),     WQD)
      EQUIVALENCE (C(1744),     WRD)
      EQUIVALENCE (C( 650),  TIMESV)
      EQUIVALENCE (C( 656),    LOSZ)
      EQUIVALENCE (C( 662),    LOSY)
      REAL LOSZ,LOSY
      DIMENSION TIMESV(6),LOSZ(6),LOSY(6),XL(2)
C
C**STATE VARIABLES
      EQUIVALENCE (C( 424), BTHTGD),  (C( 427),  BTHTG)
      EQUIVALENCE (C( 428), BPSIGD),  (C( 431),  BPSIG)
      EQUIVALENCE (C( 500),     DQ1),  (C( 503),     Q1)
      EQUIVALENCE (C( 501),     DR1),  (C( 504),     R1)
      EQUIVALENCE (C( 506),     DQ2),  (C( 509),     Q2)
      EQUIVALENCE (C( 507),     DR2),  (C( 510),     R2)
      EQUIVALENCE (C( 512),     DQ3),  (C( 515),     Q3)
      EQUIVALENCE (C( 513),     DR3),  (C( 516),     R3)
      EQUIVALENCE (C( 514),     DWD),  (C( 517),     WD)
      EQUIVALENCE (C( 520),     DWI),  (C( 523),     WI)
C
C**OTHER OUTPUTS
      EQUIVALENCE (C( 435),   BEPSZ)
      EQUIVALENCE (C( 436),   BEPSY)
      EQUIVALENCE (C( 433),   WLAMQ)
      EQUIVALENCE (C( 407),   WLAMR)
      EQUIVALENCE (C( 525),BEPSYSV)
      EQUIVALENCE (C( 529),BEPSZSV)
      EQUIVALENCE (C( 493),   DTHCQ),  (C( 494),  DTHCR)
      EQUIVALENCE (C( 495),  DTHRGQ),  (C( 496), DTHRGR)
      EQUIVALENCE (C(2020),    LCONV),  (C( 625),   IBL)
      EQUIVALENCE (C( 507),   BRLKQ)
C
C**MONTE CARLO PARAMETERS
C
      EQUIVALENCE (C(3534),   ISNDC),  (C(3512),  I3512)
      EQUIVALENCE (C( 511),     KUJ),  (C( 512),    KJI)
      EQUIVALENCE (C( 513),     KBJ),  (C( 514),    KBI)
      EQUIVALENCE (C( 515),     KPJ),  (C( 516),    KPI)
      EQUIVALENCE (C( 517),    KOAJ),  (C( 518),   KOAI)
      EQUIVALENCE (C( 519),     UCJ),  (C( 520),    USC)
      EQUIVALENCE (C( 521),    UCCJ),  (C( 622),   USCJ)
      DATA FCV/4./
C
C INTEGRATION SWITCHING TEST
C           SYNCHRONIZE INTEGRATION WITH SAMPLE SIZE
      IF(C(13).LE.0.)GO TO 1
      C(13)=-1.
```

```
      C(2664)= TU/AINT(TAU/C(2764))
    1 CONTINUE
C
C**DIRECTION COSINES FOR BODY TO PLATFORM TRANSFORMATION
      UCT=COSD(BTHTG)
      UST=SIND(BTHTG)
      UCP=COSD(BPSIG)
      USP=SIND(BPSIG)
      UB11=UCT*UCP
      UB12=USP
      UB13=-UCP*UST
      UB21=-UCT*USP
      UB22=UCP
      UB23=UST*USP
      UB31=UST
      UB32=0.
      UB33=UCT
C
C** RANSFORM LOS FROM BODY TO GIMBAL AXES
      RXG=UB11*RXBA+UB12*RYBA+UB13*RZBA
      RYG=UB21*RXBA+UB22*RYBA+UB23*RZBA
      RZG=UB31*RXBA+UB32*RYBA+UB33*RZBA
      IF(I3512.LE.0)GO TO 5
C**GYRO ERRORS
C
C**TRANSFORM NORMALIZED ACCELERATIONS FROM BODY TO GIMBAL AXES
      ANGXG=UB11*ANGX+UB12*ANGY+UB13*ANGZ
      ANGYG=UB21*ANGX+UB22*ANGY+UB23*ANGZ
      ANGZG=UB31*ANGX+UB32*ANGY+UB33*ANGZ
      ANG=ANGZG*UCCG-ANGYG*USCG
      QERG=KEO+KPO*ANG+KOAO*WPD
      RERG=KBI+KPI*ANG+KOAI*WPD
      TUO=KUO*(ANGX*UCT-ANGZ*UST)
      TUI=KUI*(ANGYG*UCG-ANGXG*USG)
    5 CONTINUE
C
C**LOS ERRORS IN PLATFORM COORDINATES
      IF(C(1976).LE.0.)GO TO 32
      BEPSZ=ATAND(-RZG,RXG)
      BEPSY=ATAND( RYG,RXG)
C****SAVE THE PREVIOUS FIVE POINTS IN TIME OF BEPSZ AND BEPSY FOR TLAG.
      DO 2 L=2,6
      TIMESV(L-1)=TIMESV(L)
      LOSZ(L-1)=LOSZ(L)
      LOSY(L-1)=LOSY(L)
    2 CONTINUE
      TIMESV(6)=TIME
      LOSZ(6)=BEPSZ
      LOSY(6)=BEPSY
   32 CONTINUE
C
C         TRACKER-LOOP
C
C
C**ZOH (TDELAY..TAU) AND TIME DELAY (TLAG)
      IF(TIME.LT.(TDELAY-.00001).OR.C(1976).LE.0.)GO TO 30
      TDELAY=TIME+TAU
```

```
            THTQ=ATAND(TARHT/2.,RANGE)
            THTR=ATAND(TARHD/2.,RANGE)
            BRLKQ=(BEPSZ-BEPSZSV)/(2.*THTQ)
            BRLKR=(BEPSY-BEPSYSV)/(2.*THTR)
            TTLAG=TIME-TLAG   $  N=6  $  F=1.
            BEPSZSV=FINTP1(    TTLAG,TIMESV,LOSZ,N,F,XL)
            BEPSYSV=FINTP1(    TTLAG,TIMESV,LOSY,N,F,XL)
            IF(ABS(BRLKQ) .LT. .5 .AND. ABS(BRLKR) .LT. .5)GO TO 30
      C**BREAKLOCK DETERMINATION
            IF(IOCS.NE.-10)GO TO 30
            IBL=IBL+1
            LCONV=2
            IOCS=-9
            WHICH = 10H IN PITCH
            IF(ABS(BRLKR) .GE. .5)WHICH = 10H IN YAW
            WRITE(6,101)TIME,RANGE,WHICH
  101       FORMAT(1H0,100(1H*)/* BREAK LOCK CONDITION AT TIME =  *F5.2,
           + * RANGE = *F10.2,A10,/100(1H*))
   30       CONTINUE
            DELAYQ=GQ1*BEPSZSV
            DELAYR=GR1*BEPSYSV
            DQ1=    DELAYQ-WTQ2*Q1
            DR1=    DELAYR-WTR2*R1
            DTHCQ=(DQ1+WTQ1*Q1)*GQ2
            DTHCR=(DR1+WTR1*R1)*GR2
      C        RATE COMMAND LIMIT
            IF(ABS(DTHCQ).GT.RCL)DTHCQ=SIGN(RCL,DTHCQ)
            IF(ABS(DTHCR).GT.RCL)DTHCR=SIGN(RCL,DTHCR)
      C
      C        RATE GYRO LOOP
      C
            W1Q=WQ*JSP-(WP*UST-WR*UST)*JSP
            RGQ=GG5*(W1Q+QERG)
            RGR=GR5*(WI +RERG)
            DTHRGQ=KQ12*RGQ
            DTHRGR=KR12*RGR
      C
      C**BLIND RANGE DETERMINATION
            THTOAQ=THTQ+ABS(BEPSZ)
            THTOAR=THTR+ABS(BEPSY)
            BLNDQ=THTOAQ*2./FOV
            BLNDR=THTOAR*2./FOV
            TESTFOV=FFOV*FOV/2.
            IF(THTOAQ.LT.TESTFOV.AND.THTOAR.LT.TESTFOV) GO TO 20
            IF(IOCS.LE.0)WRITE(6,100)TIME,RANGE
  100       FORMAT(1H0,100(1H*)/* OCS BLIND RANGE SIGNAL HOLD AT TIME = *F5.2,
           + *  RANGE = *F10.2/100(1H*))
            IOCS=10
            GO TO 21
   20       CONTINUE
      C
      C**OUTPUT TO AUTOPILOT
            WLAMQ=GEOCS*RGQ
            WLAMR=GEOCS*RGR
            IF(ABS(C(630)).LT.ABS(BRLKQ))C(630)=BRLKQ
            IF(ABS(C(631)).LT.ABS(BRLKR))C(631)=BRLKR
   21       CONTINUE
```

.0167
.01669995
.01669

```
      C
      C         GAIN COMPENSATION
      C
            DTHTEQ=DTHCQ-DTHRSQ
            DTHTER=DTHCR-DTHRSR
            DQ2=    DTHTEQ
            DR2=    DTHTER
            DQ3=DQ2+WGQ1*Q2-WGQ4*Q3
            DR3=DR2+WGR1*R2-WGR4*R3
      C
      C         SEEKER TORQUE MOTOR
      C
            TQ=GQ3*(DQ3+WGQ3*Q3)
            TR=GR3*(DR3+WGR3*R3)
            IF(ABS(TQ).GT.TCLQ) TQ=SIGN(TCLQ,TQ)
            IF(ABS(TR).GT.TCLR) TR=SIGN(TCLR,TR)
            TMQ=GG4*TQ
            TMR=GR4*TR
      C
      C         SEEKER GIMBAL ANGLE RATES
      C
      C**COULOMB FRICTION MODEL
            TCOMQ=KQ8*BTHTG/CRAD
            IF(ABS(BTHTGD).LE.4.E-4)GO TO 70
            TFQ=                  SIGN(FRQ,BTHTGD)
            TAQ=TMQ-TFQ-TCOMQ-TUQ
            DWO=TAQ*CRAD/JO
            GO TO 73
   70       CONTINUE
            TFQ=TMQ-TCOMQ-TUQ
            IF(ABS(TFQ).GT.FRQ) TFQ=SIGN(FRQ,TMQ)
            WCOQ=(TFQ+SIGN(FRQ,WQO))*CRAD/JO
            DWBAQ=WQO
            IF(ABS(WQO).GT.ABS(WCOQ))DWBAQ=WCOQ
            TAQ=TMQ-TFQ-TCOMQ-TUQ
            DWAQ=TAQ/JO*CRAU
            DWO=DWBAQ+DWAQ
   73       CONTINUE
            TCOMR=KR8*BPSIG/CRAD
            IF(ABS(BPSIGD).LE.4.E-4)GO TO 80
            TFR=SIGN(FRI,BPSIGD)
            TAR=TMR-TFR-TCOMR-TUI
            DWI=TAR*CRAD/JI
            GO TO 83
   80       CONTINUE
            WRES=UCT*WRO+JST*WPD
            TFR=TMR-TCOMR-TUI
            IF(ABS(TFR).GT.FRI) TFR=SIGN(FRI,TMR)
            WCOR=(TFR+SIGN(FRI,WRES))*CRAD/JI
            DWBAR=WRES
            IF(ABS(WRES).GT.ABS(WCOR))DWBAR=WCOR
            TAR=TMR-TFR-TCOMR-TUI
            DWAR=TAR/JI*CRAU
            DWI=DWBAR+DWAR
   83       CONTINUE
            BTHTGD=WO-WQ
            BPSIGD=WI-(WR*UCT+WP*UST)
```

```
        3       CONTINUE                                    S3      287
                RETURN                                      S3      288
                END                                         S3      289
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      SUBROUTINE S3         74/74   OPT=1                      FTN 4.2+75057      05/05/75  16.29.41.      PAGE    7

            SYMBOLIC REFERENCE MAP (R=3)

  ENTRY POINTS     DEF LINE     REFERENCES
     1  S3              1          287

 VARIABLES     SN  TYPE          RELOCATION
    637  ANG       REAL                       REFS      145     146   DEFINED    144
   3213  ANGX      REAL                 / /   REFS       54     141     142      143     147
    634  ANGXG     REAL                       REFS      148   DEFINED   141
   3214  ANGY      REAL                 / /   REFS       65     141     142      143
    635  ANGYG     REAL                       REFS      144     148   DEFINED    142
   3215  ANGZ      REAL                 / /   REFS       66     141     142      143     147
    636  ANGZG     REAL                       REFS      144   DEFINED   143
    663  BEPSY     REAL                 / /   REFS       90     133     175      211   DEFINED    154
   1015  BEPSYSV   REAL                 / /   REFS       93     175     192    DEFINED   178
    662  BEPSZ     REAL                 / /   REFS       89     132     174      210   DEFINED    153
   1020  BEPSZSV   REAL                 / /   REFS       94     174     131    DEFINED   177
    655  BLNDQ  *  REAL                     DEFINED     212
    656  BLNDR  *  REAL                     DEFINED     213
    656  BPSIG     REAL                 / /   REFS       78     121     122      267
    653  BPSIGD    REAL                 / /   REFS       78     268     269    DEFINED   285
   1136  BRLKQ     REAL                 / /   REFS       98     179    2*226   DEFINED   174
    641  BRLKR     REAL                       REFS      179     185    2*227   DEFINED   175
    652  BTHTG     REAL                 / /   REFS       77     119     120      251
    647  BTHTGD    REAL                 / /   REFS       77     252     253    DEFINED   254
      0  C         REAL      ARRAY      / /   REFS        7    2*13    2*14     2*15    2*16    2*17    2*18
                                              2*19     2*20    2*21    2*22     2*23    2*24    2*25    2*26
                                              2*27     2*28    2*29    2*30     2*31    2*32    2*33    2*34
                                              2*35     2*36    2*37    2*38     2*39    2*40    2*41    2*42
                                              2*43     2*44    2*45    2*46     2*47    3*48     49    2*50
                                                51       52      55      56       57      58      59      60
                                                61       62      53      64       65      65      57      63
                                                69       70      71      72     2*77    2*78    2*79    2*80
                                              2*81     2*82    2*83    2*84     2*85    2*86      39      90
                                                91       92      93      94     2*95    2*96    2*97      98
                                             2*102    2*103   2*104   2*105    2*106   2*107   2*108     113
                                               115      152     170     226      227   DEFINED    114     115
                                               225      227
   3326  CRAD      REAL                 / /   REFS       51     251     255      260     264     257     271
                                               277      281
    646  DELAYQ    REAL                       REFS      133   DEFINED   131
    647  DELAYR    REAL                       REFS      134   DEFINED   132
    763  DQ1       REAL                 / /   REFS       79     195   DEFINED    193
    771  DQ2       REAL                 / /   REFS       81     236   DEFINED    234
    777  DQ3       REAL                 / /   REFS       83     241   DEFINED    236
    764  DR1       REAL                 / /   REFS       80     196   DEFINED    194
    772  DR2       REAL                 / /   REFS       82     237   DEFINED    235
   1000  DR3       REAL                 / /   REFS       84     242   DEFINED    237
    754  DTHCQ     REAL                 / /   REFS       95    2*198    232    DEFINED   195     198
    755  DTHCR     REAL                 / /   REFS       95    2*199    233    DEFINED   196     199
    756  DTHRGQ    REAL                 / /   REFS       96     232   DEFINED    206
    757  DTHRGR    REAL                 / /   REFS       96     233   DEFINED    207
    660  DTHTEQ    REAL                       REFS      234   DEFINED   232
    661  DTHTER    REAL                       REFS      235   DEFINED   233
    673  DWAQ      REAL                       REFS      265   DEFINED   264
    702  DWAR      REAL                       REFS      282   DEFINED   281
    672  DWBAQ     REAL                       REFS      265   DEFINED   261      262
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VARIABLES    SN  TYPE           RELOCATION
  701  OWBAR      REAL                    REFS   292   DEFINED   278    279
 1007  DWI        REAL           / /      REFS    96   DEFINED   271    282
 1001  DWO        REAL           / /      REFS    95   DEFINED   255    265
  644  F          REAL                    REFS   177      178  DEFINED  176
 1133  FFOV       REAL           / /      REFS    49      214
  540  FOV        REAL                    REFS   212      213    214  DEFINED  189
 1066  FRI        REAL           / /      REFS    35      269  2*276    277
 1067  FRO        REAL           / /      REFS    36      253  2*259    260
  760  GEOCS      REAL           / /      REFS    51      224    225
  737  GQ1        REAL           / /      REFS    41      191
  741  GQ2        REAL           / /      REFS    41      195
  743  GQ3        REAL           / /      REFS    43      241
  745  GQ4        REAL           / /      REFS    43      245
  750  GQ5        REAL           / /      REFS    45      284
  752  GQ6        REAL           / /      REFS    45
  740  GR1        REAL           / /      REFS    42      192
  742  GR2        REAL           / /      REFS    42      196
  744  GR3        REAL           / /      REFS    44      242
  746  GR4        REAL           / /      REFS    44      246
  751  GR5        REAL           / /      REFS    46      285
  753  GR6        REAL           / /      REFS    46
 1160  IOL        INTEGER        / /      REFS    97      182  DEFINED    182
 1134  IOCS       INTEGER        / /      REFS    50      181    216  DEFINED   184   219
 7061  ISNDX      INTEGER        / /      REFS   102
 6667  I3512      INTEGER        / /      REFS   102      137
 1064  JI         REAL           / /      REFS    11       33    271    277    281
 1065  JO         REAL           / /      REFS    11       34    255    260    264
 1145  KBI        REAL           / /      REFS    10      104    146
 1144  KBO        REAL           / /      REFS    10      104    145
 1151  KOAI       REAL           / /      REFS    10      106    146
 1150  KOAO       REAL           / /      REFS    10      106    145
 1147  KPI        REAL           / /      REFS    10      105    146
 1146  KPO        REAL           / /      REFS    10      105    145
 1040  KQ1        REAL           / /      REFS     8       13
 1056  KQ10       REAL           / /      REFS     8       27
 1060  KQ11       REAL           / /      REFS     8       29
 1062  KQ12       REAL           / /      REFS     8       31    286
 1042  KQ2        REAL           / /      REFS     8       15
 1044  KQ3        REAL           / /      REFS     8       17
  610  KQ4     *  REAL  *UNDEF            REFS     8
 1046  KQ5        REAL           / /      REFS     8       19
 1050  KQ6        REAL           / /      REFS     8       21
 1052  KQ7        REAL           / /      REFS     8       23
 1054  KQ8        REAL           / /      REFS     8       25    251
  611  KQ9     *  REAL  *UNDEF            REFS     8
 1041  KR1        REAL           / /      REFS     9       14
 1057  KR10       REAL           / /      REFS     9       28
 1061  KR11       REAL           / /      REFS     9       30
 1063  KR12       REAL           / /      REFS     9       32    287
 1043  KR2        REAL           / /      REFS     9       16
 1045  KR3        REAL           / /      REFS     9       18
  612  KR4     *  REAL  *UNDEF            REFS     9
 1047  KR5        REAL           / /      REFS     9       20
 1051  KR6        REAL           / /      REFS     9       22
 1053  KR7        REAL           / /      REFS     9       24
 1055  KR8        REAL           / /      REFS     9       25    267
  613  KR9     *  REAL  *UNDEF            REFS     9
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VARIABLES   SN  TYPE            RELOCATION
 1143  KUI       REAL                   / /    REFS        10      103      148
 1142  KUO       REAL                   / /    REFS        10      103      147
  640  L         INTEGER                       REFS     2*157    2*158    2*159   DEFINED      136
 3743  LCONV     INTEGER                / /    REFS        37  DEFINED      103
 1225  LOSY      REAL         ARRAY     / /    REFS        72       73       74       159      178
                                            DEFINED       159      163
 1217  LOSZ      REAL         ARRAY     / /    REFS        71       73       74       158      177
                                            DEFINED       158      152
  643  N         INTEGER                       REFS       177      178  DEFINED       176
 1072  QERG      REAL                   / /    REFS        39      204  DEFINED       145
  766  Q1        REAL                   / /    REFS        79      193      135
  774  Q2        REAL                   / /    REFS        81      236
 1002  Q3        REAL                   / /    REFS        83      236      241
  562  RANGE     REAL                   / /    REFS        63      172      173       187      215
 1132  RBLOCK    REAL                   / /    REFS        50
 1124  RCL       REAL                   / /    REFS        37    2*198    2*199
 1073  RERG      REAL                   / /    REFS        40      205  DEFINED       146
  651  RGQ       REAL                          REFS       236      224  DEFINED       204
  652  RGR       REAL                          REFS       237      225  DEFINED       205
  563  RXBA      REAL                   / /    REFS        55      134      135       136
  631  RXG       REAL                          REFS       153      154  DEFINED       134
  564  RYBA      REAL                   / /    REFS        56      134      135       136
  632  RYG       REAL                          REFS       154  DEFINED      135
  565  RZBA      REAL                   / /    REFS        57      134      135       136
  633  RZG       REAL                          REFS       153  DEFINED      136
  767  R1        REAL                   / /    REFS        80      194      196
  775  R2        REAL                   / /    REFS        82      237
 1003  R3        REAL                   / /    REFS        84      237      242
  670  TAQ       REAL                          REFS       255      264  DEFINED       254      263
  676  TAR       REAL                          REFS       271      281  DEFINED       270      280
 1130  TARHT     REAL                   / /    REFS        47      172
 1131  TARHD     REAL                   / /    REFS        47      173
 1127  TAU       REAL                   / /    REFS        40    2*115      171
 1125  TCLQ      REAL                   / /    REFS        38    2*243
 1126  TCLR      REAL                   / /    REFS        39    2*244
  666  TCOMQ     REAL                          REFS       254      258      263   DEFINED      251
  674  TCOMR     REAL                          REFS       270      275      280   DEFINED      267
 1137  TDELAY    REAL                   / /    REFS        48      170  DEFINED       171
  657  TESTFOV   REAL                          REFS     2*215  DEFINED      214
  667  TFQ       REAL                          REFS       254      259      260       263  DEFINED      253      258
                                               259
  675  TFR       REAL                          REFS       270      276      277       280  DEFINED      259      275
                                               276
  653  THTOAQ    REAL                          REFS       212      215  DEFINED       210
  654  THTOAR    REAL                          REFS       213      215  DEFINED       211
 1140  THTQ      REAL                   / /    REFS        48      174      210   DEFINED      172
 1141  THTR      REAL                   / /    REFS        48      175      211   DEFINED      173
 3717  TIME      REAL                   / /    REFS        62      151      170       171      176      187      216
 1211  TIMESV    REAL         ARRAY     / /    REFS        70       74      157       177      178
                                            DEFINED       157      161
 1135  TLAG      REAL                   / /    REFS        52      176
  664  TMQ       REAL                          REFS       254      258      259       263  DEFINED      245
  665  TMR       REAL                          REFS       270      275      276       280  DEFINED      246
  662  TQ        REAL                          REFS     2*243      245  DEFINED       241      243
  663  TR        REAL                          REFS     2*244      246  DEFINED       242      244
  642  TTLAG     REAL                          REFS       177      178  DEFINED       176
 1070  TUI       REAL                   / /    REFS        37      270      275       280  DEFINED      148
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SUBROUTINE S3        74/74   OPT=1                     FTN 4.2+75067      05/05/75  16.29.41.     PAGE   18

VARIABLES     SN  TYPE          RELOCATION
  1071  TUG       REAL            / /      REFS      38     254     258     263  DEFINED    147
   620  UB11      REAL                     REFS     134     141  DEFINED    123
   621  UB12      REAL                     REFS     134     141  DEFINED    124
   622  UB13      REAL                     REFS     134     141  DEFINED    125
   623  UB21      REAL                     REFS     135     142  DEFINED    126
   624  UB22      REAL                     REFS     135     142  DEFINED    127
   625  UB23      REAL                     REFS     135     142  DEFINED    128
   626  UB31      REAL                     REFS     136     143  DEFINED    129
   627  UB32      REAL                     REFS     136     143  DEFINED    130
   630  UB33      REAL                     REFS     136     143  DEFINED    131
  1152  UCC       REAL            / /      REFS     107     148
  1154  UCCG      REAL            / /      REFS     118     144
   616  UCP       REAL                     REFS     123     125     127     203  DEFINED    121
   614  UCT       REAL                     REFS     123     126     131     147     203     274     285
                                        DEFINED     119
  1153  USC       REAL            / /      REFS     107     148
  1155  USCG      REAL            / /      REFS     118     144
   617  USP       REAL                     REFS     124     126     128     203  DEFINED    122
   615  UST       REAL                     REFS     125     128     129     147     203     274     285
                                        DEFINED     120
   671  WCOQ      REAL                     REFS   2*262  DEFINED    260
   700  WCOR      REAL                     REFS   2*279  DEFINED    277
  1100  WGQ1      REAL            / /      REFS      17     236
  1102  WGQ2      REAL            / /      REFS      19
  1104  WGQ3      REAL            / /      REFS      21     241
  1106  WGQ4      REAL            / /      REFS      23     236
  1110  WGQ5      REAL            / /      REFS      25
  1112  WGQ6      REAL            / /      REFS      27
  1101  WGR1      REAL            / /      REFS      18     237
  1103  WGR2      REAL            / /      REFS      20
  1105  WGR3      REAL            / /      REFS      22     242
  1107  WGR4      REAL            / /      REFS      24     237
  1111  WGR5      REAL            / /      REFS      26
  1113  WGR6      REAL            / /      REFS      28
   645  WHICH     REAL                     REFS     157  DEFINED    185     186
  1012  WI        REAL            / /      REFS      56     205     285
   622  WLAMQ     REAL            / /      REFS      91  DEFINED    224
   626  WLAMR     REAL            / /      REFS      92  DEFINED    225
  1004  WO        REAL            / /      REFS      85     203     284
  3312  WP        REAL            / /      REFS      58     282     285
  3307  WPD       REAL            / /      REFS      67     145     146     274
  3316  WQ        REAL            / /      REFS      59     284
  3313  WQD       REAL            / /      REFS      58     260     251     262
  3322  WR        REAL            / /      REFS      50     203     285
  3317  WRD       REAL            / /      REFS      59     274
   677  WRES      REAL                     REFS     277     278     279  DEFINED    274
  1114  WRQ1      REAL            / /      REFS      29
  1116  WRQ2      REAL            / /      REFS      31
  1120  WRQ3      REAL            / /      REFS      33
  1122  WRQ4      REAL            / /      REFS      35
  1115  WRR1      REAL            / /      REFS      30
  1117  WRR2      REAL            / /      REFS      32
  1121  WRR3      REAL            / /      REFS      34
  1123  WRR4      REAL            / /      REFS      36
  1074  WTQ1      REAL            / /      REFS      13     195
  1076  WTQ2      REAL            / /      REFS      15     193
  1075  WTQ3      REAL            / /      REFS      14     196
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VARIABLES      SN  TYPE           RELOCATION
  1077  WTR2       REAL                  / /        REFS      16      194
   650  W1Q        REAL                             REFS     204   DEFINED     203
   703  XL         REAL      ARRAY                  REFS      74      177      178

FILE NAMES         MODE
         TAPE6     FMT                       WRITES      187      216

EXTERNALS          TYPE   ARGS         REFERENCES
         ATAND     REAL    2              153      154     172      173
         COSD      REAL    1              119      121
         FINTP1    REAL    6              177      178
         SIND      REAL    1              120      122

INLINE FUNCTIONS   TYPE   ARGS      DEF LINE  REFERENCES
         ABS       REAL    1  INTRIN          2*179     186     198     199     210     211    2*226   2*227
                                              243       244     252     259    2*262    258     276    2*279
         AINT      REAL    1  INTRIN          115
         SIGN      REAL    2  INTRIN          199       139     243     244     253     259     250     269
                                              276       277

STATEMENT LABELS            DEF LINE   REFERENCES
    10   1                    116        113
     0   2                    160        155
     0   3        INACTIVE    285
   114   5                    149        137
   301  20                    221        215
   314  21                    228        220
   214  30                    190        173     179     181
   136  32                    164        152
   371  70                    257        252
   423  73                    266        255
   440  80                    273        263
   475  83                    283        272
   566 100       FMT          217        215
   547 101       FMT          188        187

LOOPS  LABEL  INDEX   FROM-TO    LENGTH   PROPERTIES
  127  2      L       156 160     38      INSTACK

COMMON BLOCKS  LENGTH   MEMBERS - BIAS NAME(LENGTH)
  / /           3830              0 C     (3830)

EQUIV CLASSES  LENGTH   MEMBERS - BIAS NAME(LENGTH)
C     C        3830      370 RANGE   (1)     371 RXBA    (1)     372 RYBA    (1)
                         373 RZBA    (1)     402 WLAMQ   (1)     406 WLAMR   (1)
                         423 STHTGD  (1)     425 BTHTS   (1)     427 BPSIGD  (1)
                         430 BPSIG   (1)     434 BEPSZ   (1)     435 BEPSY   (1)
                         479 GQ1     (1)     480 GR1     (1)     481 GQ2     (1)
                         482 GR2     (1)     483 GQ3     (1)     484 GR3     (1)
                         485 GQ4     (1)     486 GR4     (1)     488 GQ5     (1)
                         489 GR5     (1)     490 GQ5     (1)     491 GR6     (1)
                         492 DTHCQ   (1)     493 DTHCR   (1)     494 DTHRGQ  (1)
                         495 DTHRGR  (1)     496 GEDCS   (1)     499 DQ1     (1)
                         500 DR1     (1)     502 Q1      (1)     503 R1      (1)
                         505 DQ2     (1)     506 DR2     (1)     508 Q2      (1)
                         509 R2      (1)     511 DQ3     (1)     512 DR3     (1)
                         513 UWD     (1)     514 Q3      (1)     515 R3      (1)
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EQUIV CLASSES   LENGTH   MEMBERS - BIAS NAME(LENGTH)
                         515 WO       (1)     519 DWI      (1)     522 WI       (1)
                         525 BEPSYSV  (1)     528 BEPSZSV  (1)     544 KQ1      (1)
                         545 KR1      (1)     546 KQ2      (1)     547 KR2      (1)
                         548 KQ3      (1)     549 KR3      (1)     550 KQ5      (1)
                         551 KR5      (1)     552 KQ6      (1)     553 KR6      (1)
                         554 KQ7      (1)     555 KR7      (1)     556 KQ8      (1)
                         557 KR8      (1)     558 KQ10     (1)     559 KR10     (1)
                         560 KQ11     (1)     561 KR11     (1)     562 KQ12     (1)
                         563 KR12     (1)     564 JI       (1)     565 JO       (1)
                         566 FRI      (1)     567 FRO      (1)     568 TUI      (1)
                         569 TUO      (1)     570 QERG     (1)     571 RERG     (1)
                         572 WTQ1     (1)     573 WTR1     (1)     574 WTQ2     (1)
                         575 WTR2     (1)     576 WGQ1     (1)     577 WGR1     (1)
                         578 WGQ2     (1)     579 WGR2     (1)     580 WGQ3     (1)
                         581 WGR3     (1)     582 WGQ4     (1)     583 WGR4     (1)
                         584 WGQ5     (1)     585 WGR5     (1)     586 WGQ6     (1)
                         587 WGR6     (1)     588 WRQ1     (1)     589 WRR1     (1)
                         590 WRQ2     (1)     591 WRR2     (1)     592 WRQ3     (1)
                         593 WRR3     (1)     594 WRQ4     (1)     595 WRR4     (1)
                         596 KCL      (1)     597 TCLQ     (1)     598 TCLR     (1)
                         599 TAU      (1)     600 TARHT    (1)     601 TARHD    (1)
                         602 KBLOCK   (1)     603 FFOV     (1)     604 IOCS     (1)
                         605 ILAG     (1)     606 BRLKQ    (1)     607 TOELAY   (1)
                         608 THTQ     (1)     609 THTR     (1)     610 KUO      (1)
                         611 KJI      (1)     612 KBO      (1)     613 KBI      (1)
                         614 KPO      (1)     615 KPI      (1)     616 KOAO     (1)
                         617 KOAI     (1)     618 USC      (1)     619 USC      (1)
                         620 USCG     (1)     621 USCG     (1)     624 IBL      (1)
                         649 TIMESV   (6)     655 LOSZ     (6)     661 LOSY     (6)
                        1675 ANGX     (1)    1676 ANGY     (1)    1677 ANGZ     (1)
                        1735 WPO      (1)    1738 WP       (1)    1739 WQO      (1)
                        1742 WQ       (1)    1743 WRO      (1)    1746 W        (1)
                        1750 CRAD     (1)    1999 TIME     (1)    2019 LCCNV    (1)
                        3511 I3512    (1)    3633 ISNDX    (1)

STATISTICS
  PROGRAM LENGTH              7053     453
  CM BLANK COMMON LENGTH     73668    3830
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