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METHOD OF FAN SOUND MODE STRUCTURE DETERMINATION COMPUTER PROGRAM USER'S MANUAL MOD/.L CALCULATION PROGRAM

by

G. F. Pickett, R. A. Wells and R. A. Love

August 1977

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METHOD OF FAN SOUND MODE STRUCTURE DETERMINATION COMPUTER PROGRAM USER'S MANUAL MODAL CALCULATION PROGRAM

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by

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1.0 SUMMARY

This computer user's manual describes the operation and the essential features of the Modal Calculation Program, the second of two programs developed under the Method of Fan Sound Structure Determination Program, NAS3-20047. Jointly the two programs are used to determine the coherent modal structures of inlet sound fields. The purpose of the Modal Calculation Program P to calculate the amplitude and phase of modal structures by means of acoustic pressure measurements obtained from microphoes placed at selected locations within the fan inlet duct. These locations are determined by the first of the two programs. In addition, the Modal Calculation Program also calculates the first-order errors in the modal coefficients that are due to tolerances in microphone location coordinates and inaccuracies in the acoustic pressure measurements.

2.0 INTRODUCTION

New fan designs for modern high bypass ratio commercial engines utilize blade-vane interaction theory to the extent possible for contolling the propaga ion of interaction noise. Currently, this theory defines the modes that can propagate, but has not been developed to the extent that it can reliably predict the strengths of the propagating modes.

Further noise reduction could be achieved if the propagating modal structure were quantified. Once the modal structure were defined, an analytical system for acoustic-treatment design could be utilized to optimize treatment for a given modal structure, to produce more efficient schemes. In addition, the modal structure could be employed to verify developing theories of fan noise generation. To provide this capability by means of measured data the Method of Fan Sound Mode Structure Determination Program (NAS3-20047) was undertaken. The method would be utilized until a valid fan noise generation model on a model basis becomes available.

The theory upon which fan spinning mode theory is founded was presented in 1961 by Tyler and Sofrin (ref. 1), following extensive analytical and experimental studies. Later, Sofrin and McCann (ref. 2) derived the general form of a coherent acoustic wave in an infinitely long cylindrical duct which extended the theory to include effects of axial flow. This equation expresses the coherent acoustic pressure at locations in the duct as a function of the amplitude and phase of the propagating modes comprising the sound field. These purely coherent signals, which are due to the contributions of the constituent modes, are extracted from the overall signal by enhancement techniques adapted at Pratt & Whitney Aircraft – the advantages of utilizing signal enhancement is discussed by Posey in reference 3. Both the analytical expression derived for a general coherent acoustic wave and a signal enhancement technique form the basis for developing a method to determine fan sound mode structures. The method, in principle, is capable of determining the amplitude and phase of all modes that can propagate at a given frequency. In practice, the number of modes that can be determined is limited by the storage capacity and the running time of the computer and by measurement and location accuracy.

The method for determining fan sound mode structure (ref. 4) requires two computer programs: a Microphone Location Program (MLP) and a Modal Calculation Program (MCP). This User's Manual describes the MCP; the MLP is presented in a companion Manual.

The MLP identifies microphone locations in the duct for measuring acoustic pressures for input to the MCP that will insure a numerically stable solution. The MCP calculates modal structures from acoustic pressure measurements and calculates coefficients that can be used to determine the sensitivity of the modal calculation procedure to first-order errors in acoustic pressure measurements and microphone placement.

In the following sections, the algorithm for the modal calculations and the program elements – such as subroutines, functional elements, and principal element interrelationships – are discussed. A description of the input parameters is included. The output format is also described and illustrated by a sample case. Finally, a listing of the program code is provided in Appendix B.

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3.0 PROGRAM DESCRIPTION

3.1 ALGORITHM

The Modal Calculation Program is an algorithm for calculating the modal structure from input data compusing acoustic pressure measurements and a finite set of modes. The general form of any coherent acoustic wave in an infinitely long cylinderical duct having uniform axial flow can be written as the real part of

 $P(x, r, \theta; t) = \sum A_{m, \mu} E(k_{m\mu}^{\sigma}r) e^{i [kx X_n + m\theta_n - \omega t + \Phi_{m, \mu}]}$ Finite Set of Modes

and

$$Kx = \frac{Mx (\omega/c) \pm \sqrt{(\omega/c)^2 - (1 - Mx^2) k \frac{\sigma}{m\mu}^2}}{1 - M_x^2}$$

where the notation is consistent with reference 1.

Equation 1 can be written in matrix form where the measured pressures are obtained from microphone locations identified by the MLP. The equation system is solved in the usual manner by matrix inversion. The output from this procedure is the amplitude and phase of the coherent acoustic duct modes comprising the inlet sound field.

The input to the program consists of: the sound field in the duct comprising N acoustic duct modes, the geometric parameters (e. g. duct radius, hub-tip ratio), test parameters (e. g. frequency, axial Mach number, speed of sound), and measured acoustic pressure amplitude and phase at locations identified by the MLP. The characteristic numbers that include the eigen value k' ${}^{\sigma}_{m, \mu}$, the axial wave number kx, and the value of the eigen function E ($k^{\sigma}_{m, \mu}r$) are calculated.

In addition, this equation requires the input of acoustic pressure measurements, the number of which exactly equal the number of specific modes. A set of equations can then be established with the number of equations equaling the number of acoustic measurements. This set was written in matrix form with the matrix coefficients a function of the particular modes comprising the sound field and the microphone locations.

If the determinant of the equation system is non-zero, a set of independent equations exists. This equation system in principle can be inverted in the usual way to solve for the unknown amplitude and phase of the particular modes comprising the sound field. A Gaussian elimination procedure is used to reduce the equation system to a triangularized matrix for solution of the complex modal coefficients. The overall pressure at any location in the duct can be calculated from the information in the modal structure.

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Once the modal structure has been determined, a set of influence coefficients (ref. 4) is calculated. These coefficients can be used to determine the errors in modal amplitudes and phases that are the results of first-order inaccuracies in measured pressures and the tolerances in microphone placement.

As an option, the MCP can also calculate the resultant sound field at any specified duct location based on ~ _iven modal structure. This modal structure is supplied by the user either arbitrarily or as output from an analytical prediction deck.

3.2 PROGRAM OVERVIEW

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The Modal Calculation Program comprises six major sections which are utilized in part or whole to accomplish the objectives of the two possible modes of operation. These six major sections are:

- 1) Input The input of all data is by the NAMELIST specification, and the internal parameters are initiated for program execution.
- 2) Characteristic Number Calculation The characteristic numbers $K'_{m,\mu}^{\sigma}$ and $Q_{m,\mu}^{\sigma}$ are calculated using the procedure described in Appendix A.
- Mode Amplitude and Phase Calculation The coherent acoustic wave equation system,.
 e.g. (1), in an infinitely long cylinderical duct with uniform axial flow is solved using a Gaussian elimination procedure for the modal amplitude and phase.
- 4) Sensitivity Coefficient Calculation Standard deviations due to the first-order independent errors in the measurement of both the acoustic pressures and the microphone coordinates are obtained for the error in the modal amplitudes and phases.
- 5) Overall Pressure Calculation Resultant pressure amplitude and phase are calculated at the desired prediction locations using the amplitude and phase of the constituent modes comprising the sound field.
- 6) Output All results from the program calculations are printed.

The interrelationships between the six major sections and their utility for each option is illustrated in Figure 1. As input, both options require a specific mode group, inlet geometry, and test condition to calculate characteristic numbers. One option, "A", requires additional input in the form of acoustic pressure signals at selected duct locations to calculate the modal structure comprising the sound field. Additionally, influence coefficients, which are functions of the modal structure, are calculated. The other option, "B", requires that the modal structure be specified as input. In both options, the amplitude and phase of the constituent modes are utilized to calculate the overall acoustic pressure at any duct location. The results from both options are printed by the output section.

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3.3 PROGRAM SUBROUTINES AND FUNCTIONS DESCRIPTION

The subroutines and functions used in the six program sections presented in Section 3.2 are listed below; the purpose of each subroutine or function is described. Also as appropriate, principal-element diagrams of the more complicated sections are presented and discussed.

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Input Section

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The NAMELIST format is used to input data for execution of the computer program. This form of input is described in Section 3.4.1. The input variable names are listed in Section 3.4.2, including a description of their purpose. All input is read into the program by the following subroutine:

INPUT – This subroutine inputs data for each case and sets up the necessary internal parameters.

Characteristic Number Calculation Section

Expressions are derived in Appendix A for solving two simultaneous equations that define the characteristic numbers $k''_{m\mu}$ and $Q''_{m\mu}$. A principal-element diagram is presented in Figure 2 to illustrate the functional elements that lead to a determination of these numbers. Initially, the order of the Bessel functions is determined from the circumferential order of a particular mode. The J_m and Y_m Bessel functions are evaluated, as appropriate, depending on the value of the duct hub-tip ratio. Finally, the characteristic numbers are calculated by solving the simultaneous equations comprising the Bessel functions. The subroutines and functions utilized in this section are:

KQCAL		This subroutine calculates the characteristic numbers $K'_{m\mu}^{\sigma}$ and $Q_{m\mu}^{\sigma}$.
KMUCAL	-	This subroutine is used by KQCAL to calculate the characteristic number $k' \frac{\sigma}{m \mu}$.
EMUCAL		This subroutine calculates characteristic E-function values for a particular radial value, $\dot{r}' - r/b$.
FALZIP	-	This function solves for a root of a given function using a combination of false position and bisection techniques
BESLI	—	This function is used by KMUCAL to calculate values of $K''_{m\mu}$ for the equation which defines the system of differential equations.
		$\frac{d}{dr'} [J_m (K'_{m\mu})] + Q_{m\mu} \frac{d}{dr'} [Y_m (K'_{m\mu})] = 0$
		$\frac{d}{dr'} \left[J_m \left(\sigma K_{m\mu}^{'\sigma} \right) \right] + Q_{m\mu}^{\sigma} \frac{d}{dr'} \left[Y_m (\sigma K_{m\mu}^{'\sigma}) \right] = 0$
		for a hub-tip ratio not equal to zero.
BESL2		This function is used by KMUCAL to calculate values of $K_{m\mu}^{'\sigma}$ for the equation which defines the above system of differential equations for a hub-tip ratio equal to zero.
BESJ	-	This subroutine calculates values of the Bessel function of the first kind.
BESY	_	This subroutine calculates values of the Bessel function of the second kind



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Mode Amplitude and Phase Calculation

The modal amplitude and phase are solved by matrix inversion techniques from data that includes pressure measurements at selected microphone locations. The equations that define the matrix coefficients and a description of the procedure for fan sound mode determination was presented in Section 3.1 - Algorithm. To illustrate the functional elements that lead to a solution of the modal coefficients, a principal-element diagram is presented in Figure 3. Initially, the matrix coefficients, which are functions of the particular modes comprising the sound field and the microphone locations, are calculated. This equation system is solved by a Gaussian elimination method for the modal coefficients. The mode amplitude and phase are then extracted from these complex pressure vectors. The subroutines used in the calculation procedure are:

SOLVE -- This subroutine set ups and using SIMECQ solves the acoustic wave equation matrix for the modal amplitude and phase.
 SIMECQ -- This subroutine solves a N x N system of simultaneous equations having complex coefficients, using a Gaussian elimination method.

Sensitivity Coefficient Calculation

The Sensitivity Coefficient Calculation procedure is illustrated in the principal-element diagram presented in Figure 4.

An important element in this procedure is the calculation of influence coefficients, which reflect the sensitivity of mode amplitude and phase calculations to first-order errors in pressure measurements and microphone placement – the derivation of the influence coefficient is provided in reference 4, Section 3.4.

Because the inverse-matrix element is a common term in each expression, the procedure is initiated by calculating the inverse matrix. The influence coefficients are calculated next as a function of the modal structure and pressure measurements. The specific error in the modal amplitude and phase due to one of the five possible measurement errors is calculated from the product of the error in the measured quality and the root-sum-square of the influence coefficients. Finally, the error in a particular mode amplitude and phase is obtained as the combined effect of each measurement error.

The subroutines utilized in the Sensitivity Coefficient Calculation procedure are:

SENSTY – This subroutine calculates the standard deviations of the modal amplitude and phase for errors associated with pressure measurement and microphone location.

INVERT - This subroutine inverts a complex N x N matrix.



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Overall Pressure Calculation

The overall pressure at any location in the duct is obtained from the modal structure. The procedure for overall pressure calculation is illustrated in the principal-element diagram shown in Figure 5. The procedure summarizes the pressure contribution of each mode at a location in a duct defined by the user. The resultant amplitude and phase are then extracted from the complex pressure vector. Since this calculation is performed in the MAIN routine there are no subroutines or functions to list.

Output Section

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 The output format and the variables from the Modal Calculation Program are discussed in Section 3.5.1 and a sample case for three propagating modes is providing in Section 3.5.2. Both Sections 3.5.1 and 3.5.2 address the two possible modes of operation that can be executed with the program. Results from the computations are printed by the subroutines listed below after all angles are converted to within the range of 0° to 360°.

PRINT – This subroutine prints input and resultant values.

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ANGPOS – This subroutine converts negative angles to positive angles in the range 0° to 360° for printing.





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3.4 INPUT DESCRIPTION

3.4.1 Input Format

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The NAMELIST format is used to input data into the Modal Calculation Program and consists of a list of parameter names grouped under an identifying name: &INDATA. The parameter names correspond to variables – single variables and matrix elements – used in the program. These variables are set by specifying both the parameter name and its value. A feature of this type of input is that all associated parameters need not be specified. Any parameter not specified in the input retains its value from the preceeding case or the default value if the input is for the first case.

NAMELIST input for each case is identified by the characters &INDATA in Columns 2-7 of the first input card. Beginning in Column 9, parameters may be set using the format:

Parameter Name = Constant

The constant may be either a real or integer value and must be followed immediately by a comma. Parameter names, assigned values, or necessary commas must not extend beyond Column 72; and names of values cannot be continued on a subsequent card. Embedded blanks are not permitted in either the parameter name or constant value. Parameter names and their associated values may be specified in any order. The characters & END signify the end of the input for a particular case. If additional cards are required, parameters names must begin in Column 2.

A sample of this form of input for three microphones is presented in Figure 6.

3.4.2 Input Parameters

A sign convention was adopted for assigning positive or negative values to the input parameters. Any input parameter not addressed in this discussion is a positive value. The sign convention is formulated with respect to a cylindrical coordinate system that is consistent with the derivation of the coherent acoustic wave propagation model. Its unit vectors are designated by the directions: axial - x, circumferential - θ , radial - r.

A constant radius, annular duct is aligned with respect to this coordinate system in such a way that the positive axial unit vector is in a direction opposite to the flow. Thus, the Mach number of a uniform axial flow is always designated by a negative value to denote the axial flow rate in the negative axial direction. A positive circumferential unit vector projects in the direction that the rotor spins, and a negative vector projects in the counterrotating direction. Finally, the radial axis projects perpendicular to the centerline of the duct; thus, radial values are positive.

Each mode is characterized by three parameters which represent the circumferential and radial pressure distribution and its propagation direction. A specific mode is uniquely defined by the parenthetical notation (M, μ) . The M defines a periodic circumferential pressure distribution with M number of lobes. Positive integers represent a corotating M-circumferential lobe pattern with respect to the rotor direction, and negative M integers refer to counterrotating modes. The radial mode index μ corresponds to the radial pressure distribution. These values are always non-negative integer numbers with high integer values indicating large pressure variations with respect to the radius.

The modal propagation direction in an inlet or discharge duct can be either an incident wave propagating from the fan or a reflected wave propagating towards the fan. Wave propagation in \cdot moving medium is similarly effected by the flow rate for modes that are propagating with or against the flow direction. Hence, the input variable IDIR designates wave propagation with respect to the flow direction. Positive values denote waves propagating in the opposite direction with respect to the flow such as incident waves in the inlet duct and reflected waves in the discharge duct. Modes that propagate in the same direction as the flow are designated by a negative value for the input parameter IDIR.

A: signing of values to the input parameters will now be considered.

Since a determinative equation system is required, the number of mode indices, wave direction indicators, microphone coordinates, and measured pressures must be equal. When option B is utilized, the number of mode indices, wave direction indicators, and modal amplitude and phase values must correlate. These input parameters are listed in several tables at the end of this section. Each parameter has a corresponding description that is sufficient for assigning a value to these input parameters. However, assigning a value to the coefficient parameters for the standard deviation in measurement errors is not as straight forward as the previous parameters. The following discussion is provided to assist the user when assigning values to these variables.

The deviation coefficients for microphone location errors the tolerances in the three coordinates: axial - x, radial - r, and circumferential $-\theta$. These errors are related to the tolerance of a measurement – such as a micromenter – for determining the location of a microphone. Specifically, a user can estimate the microphone location standard deviation by assuming a high confiden – level – such as ninety-five percent – to be associated with the number of significant digits used to define the pressure measuring coordinates. The standard deviation coefficients can then be computed from this information. For example, if a 95 percent confidence level is assigned to an axial measurement accuracy of 0.005 centimeter, the standard deviation (68.3 percent confidence level) is about 2.5 x 10^{-3} centimeter.

The error deviation coefficients for acoustic pressures include the two components amplitude and phase which correspond to the measured resultant pressure at any duct location. Two mechanisms can generate errors that affect the measurement of resultant pressure. One type of error is $d_{i,j}$ to both response characteristics of the measuring device and repeatability of the coherent signal. The second type of error is caused by measuring contributions from mode, not included in the calculation for determining the modal structure. A user can estimate the former pressure measurement error in a similar manner as previously presented for microphone location measurement errors. A standard deviation can be computed by assuming a high confidence level to be associated with the combined inaccuracy of both pressure amplitude calibration errors and an error attributed to the repeatability of enhanced pressure signals during a period of time. In practice, however, this category of errors is small and can be minimized by requiring reasonable experimental procedures.

The second mechan, m that can generate pressure measurement errors was not encountered in the previous category of location measurement errors. Ideally, the contribution from modes that are unlikely to control the duct sound field will not hinder the determination of fan sound mode structures. In practice, however, these modes have to be anticipated and their impact quantified if a meaningful standard deviation for the modal coefficients is to be calculated. This mechanism, which can be perceived as a measured pressure error, is difficult to assess prior to an experimental program. A general expression for this standard deviation is presented in Appendix E of reference 4. The actual value for the standard deviation used as input to the modal calculation program should be obtained from that general expression.

A description of the input variables for operating the Modal Calculation Program is provided in Tables I, II, and III: Table I – General Parameters; Table II – Test Geometry and Condition Parameters; Table III–Error Deviation Coefficient Parameters. Under the column heading "Variable Type": th letter "R" indicates that the number is real and contains a decimal point; the letter "I" indicates the number is an integer and does not have a decimal point. "Default Values" are also delineated and indicate the value of the parameter that is internally initialized prior to the program execution. Parameters not specified in the input for the first case retain this value. Although the default values are expressed in units of the English System, the computer program can be executed with data in any consistent system of units.

3.5 OUTPUT DESCRIPTION

3.5.1 Output Format

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The output from the Modal Calculation Program is organized into four sections: Input Variables, Modal Amplitude and Phase Calculation, Sensitivity Coefficient Calculation, and Characteristic E-Function Values. All four sections are included as output when either option is requested by the input. The printout for a sample case is provided in Appendix C to illustrate the output format.

The Input Variable Section includes the value of the various parameters supplied by the user. The parameters that define the modal structure – the circumferential and radial order, and the wave-direction indicator – are listed. The reference pressure for converting the modal amplitude and resultant amplitude to decibels is also output in this section. The test geometry and conditions subsection lists various parameters that define the fan duct geometry and operating conditions observed during the experimental program. These parameters include the duct radius, duct hub-tip ratio, axial Mach number, and frequency.

The Modal Amplitude and Phase Calculation section includes both parameters that were provided by the user and the results from the calculation procedure. In this section, the user obtains the modal amplitude in units of pressure and decibels and the modal phase in units

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TABLE I

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GENERAL INPUT PARAMETERS

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Input Name	Variable Type	Default Value	Description
LOCM	1	2	Number of microphones or modes. (Less than or equal to fifty).
LOCP	l	2	Number of prediction locations. (Less than or equal to fifty).
IEMU	1	0	Print indicator for characteristic E-function value.
			0 = No print 1 = Print
PREF	R	2.9 x 10 ^{~9}	Reference pressure to convert pressure to decibels.
X0 ^{a)}	R	0.0	Axial coordinate of the reference location.
THO ^{a)}	R	0.0	Circumferential coordinate of the reference location. (degrees)
M(1) M(2) M(3)	I	-2 -2 0	Circumferential mode index. (Input NLOC values)
•		•	
M(50)		0	
MUS(1) MUS(2) MUS(3)	I	0 1 0	Radial mode index. (Input NLOC values)
MUS(50)		0	
IDIR(1) IDIR(2) IDIR(3)	1	1 1 0	Mode propagation direction indicator. (Input NLOC values) 1 = opposite flow direction 1 = with flow direction
IDIR(50)		0	

Note a): Final character is a zero.

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TABLE II

Input Variable Name Type		Default ^(a) Value	Description						
HTR	R	0.44	Hub-tip ratio.						
OR	R	5.0	Outer radius of duct.						
EMX	R	0.07	Axial Mach number (always positive).						
FRQ	R	3100.	Test frequency (Hertz)						
SPEED	R	13566.	Speed of sound						
X(1) X(2) X(3)	R	9.568 6.582 0.0	Axial coordinates of the measurement microphone locations. (Input LOC value)						
X(50)		0.0							
R(1) R(2) R(3)	R	5.0 5.0 0.0	Radial coordinates of the measurement microphone locations. (Input NLOC value)						
R(50)		0.0							
THM(1) THM(2) THM(3)	R	0.0 0.0 0.0	Circumferential coordinates of the measurement microphone locations (degrees). (Input NLOC value)						
THM(50)		00							
ы АМ(1) ВЕ ГАМ(2) ВЕТАМ(3)	R	0.03136 0.02097 0.0	Pressure amplitude at the measurement microphone locations. (Input NLOC value)						
		•							
BETAM(50)		0.0							

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TEST GEOMETRY AND CONDITION INPUT PARAMETERS

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Input Name	Variable Type	Default ^(a) Value	Description						
PSIM(1) PSIM(2) PSIM(3)	R	97.8 215.6 0.0	Pressure phase at the measurement micro- phone locations (degrees). (Input NLOC values)						
· · ·									
PSIM(50)		0.L							
PX(1) PX(2)	R	5.788 2.513	Axial coordinates of the prediction micro- phone locations. (Input LOCP values)						
Υλ(3)		0.0							
PX(50)		0.0							
PR(1) PR(2) PR(3)	R	5.0 5.0 0.0	Radial coordinates of the prediction micro- phone locations. (Input LOCP values)						
		•							
PR(50)		0.0							
THP(1) THP(2) THP(3)	R	0.0 0.0	Circumferential coordinates of the prediction microphone locations (degrees). (Input LOCP values)						
		•							
THP(50)		0.0							
ІСНК	I	0	Mode amplitude and phase indicator.						
			0 = Calculated from measured pressure 1 = Input values						
AM(1) AM(2) AM(3)	R	0.0 0.0 0.0	Mode amplitude. (If ICHK = 1, input NLOC values)						
•									
AM(50)		0.0							

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TABLE II (Cont'd.)

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Input Name	Variable Type	Default ^(a) Value	Description
PHI(1) PHI(2) PHI(3)	R	0.0 0.0 0.0	Mode phase (degrees). (If ICHK = 1, input NLOC values)
• •		•	
PHI(50)		0.0	

Note: (a) Default values shown in table are in units of the English System. The program, however, is designed to be executed with data in any consistent system of units.

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TABLE III

ERROR DEVIATION COEFFICIENT INPUT PARAMETERS

Input Name	Variable Type	Default Value	Description
SIGX	R	0.0	Standard deviation of the axial coordinate error.
SIGR	R	0.0	Standard deviation of the radial coordinate error.
SIGT	R	0.0	Standard deviation of the circumferential coordinate error (degrees).
SIGB	R	0.0	Standard deviation of the pressure amplitude error.
SIGP	R	0.0	Standard deviation of the pressure phase error (degrees).

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of degrees. The corresponding mode indices, axial wave number in units of degrees-perlength, and eigen value $k_{m\mu}^{\sigma}$ are delineated.

Additional input parameters listed in this section include the reference location usually corresponding to the fan face where the modal phases are calculated. Coordinates of the input measurement locations and resultant prediction locations are listed adjacent to the respective acoustic pressure values. The input pressure values are supplied by the user in pressure units for the amplitude and degrees for the phase. The resultant pressure is calculated by the program and output is provided in units of decibels for the amplitude and degrees for the phase.

The Sensitivity Coefficient Calculation portion of the output comprises a number of sections, the primary output of which is the total normalized amplitude and the total phase deviation for each mode. These expressions represent the modal amplitude and phase error caused by a specified set of independant errors associated with the measurement of acoustic pressure and the tolerance of pressure measuring coordinates. The amplitude standard deviation of a specific mode is expressed as both the normalized quantity with respect to the mode amplitude and the mode amplitude error in decibels. The total phase deviation is expressed in degrees for each mode.

The contribution to the total amplitude and phase deviation assuming zero errors for the other error sources is provided under the heading "Normalized Standard Deviation Components". The amplitude deviation was normalized with respect to the mode amplitude. The total phase deviation in degrees for each error source is also provided under the heading. When these values are root-sum-squared, the previous expression for the total modal deviation is obtained. A user will benefit from the error deviation components by identifying which of the errors is controlling the total modal error.

The standard deviation components are also normalized with respect to their respective error. These parameters – referred to as the root-sum-square of the influence coefficients – enhance the combined variance of the influence coefficients at each microphone location. Thus, these parameters are the previous standard deviation components with respect to a unit measurement error in pressures or microphone coordinates. The root-sum-square of the influence coefficients is a convenient expression for assessing the probability of successfully tracking modes. A future user could examine these parameters to determine if the accuracy of experimental measurements made during an earlier test is sufficient to provide a desired confidence level in the mode amplitude and phase.

The influence coefficients are the partial derivatives of the mode amplitude and phase with respect to an error at each pressure measurement location that provides input for calculating the modal coefficients. These expressions allow a future user to evaluate the effect of non-uniform errors at the microphone locations. For example, an amplitude measurement error may be known to be significantly larger at one microphone location (e.g., inaccurate calibration). The user could then evaluate the impact of this error on the overall modal structure calculation.

The final section, Characteristic E-Functions, includes the value of E-functions, $E(k_{m\mu}^{\sigma} r)$, at the measurement and prediction locations corresponding to each mode. This final section is provided as output only if it has been requested by the user.

3.5.2 Sample Cases

Two cases are presented in the sample printout, to illustrate the two options: 1) calculating mode amplitude and phase values from acoustic pressure signals and 2) specifying these values either arbitrarily or as output from an analytical prediction deck. These sample cases demonstrate the execution of each option with data listed in Figure 6. The length units in the printout are in centimeters; the time units, in seconds; the force units, in dynes.

The first sample case illustrates the option of calculating the mode amplitude and phase for a situation where three modes are propagating in a half-meter diameter annular duct. Three coherent acoustic pressure amplitude and phase values are specified at three microphone locations on the duct wall. These acoustic signals are at a frequency of 6200-Hertz, and are used to determine the modal structure of the (-4,0), (-4,1) and (-4,2) modes.

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The output for this sample case reveals that the amplitudes of the above modes are 137.4, 142.8, and 138.5 decibels, a spectively; the modal phases are, respectively, 126.9, 160.0, and 229.2 degrees. Once the modal structure has been determined, the resultant sound field can be calculated at other duct locations. The resultant amplitude and phase – expressed in the same units as the modal coefficients – are requested at three microphone coordinates. The resultant amplitude at these locations are, respectively, 121.1, 115.7, and 115.1 decibels. The resultant phases are, respectively, 90.1, 357.8, and 67.2 degrees.

The sensitivity coefficient calculation portion of the program calculates the accuracy of the mode amplitude and phase values based on inaccuracies in the measured acoustic pressures and the microphone coordinates. Errors in the five measured quantities are expressed as standard deviations with zero mean. For this sample case they are axial - $2x 10^{-3}$ cm, radial - $2x 10^{-3}$ cm, circumferential - $2x 10^{-2}$ degree, amplitude - 25 dynes, and phase - 1.5 degrees. The combined effects of the error source deviations multiplied by the influence coefficients yields the modal amplitude and phase deviation. These calculated values for the (-4, 0), (-4, 1), and (-4, 2) modes are, respectively, 0.89, 0.84, and 0.87 decibel for the modal amplitude and 3.6, 2.5, and 1.7 degrees for the modal phase.

The second sample case illustrates the option to input the amplitudes and phases for the propagating modes to calculate the resultant acoustic pressure at specified locations. This case is similar to the first sample case because the (-4, 0), (-4, 1), and -4, 2) modes are propagating at 6200-Hertz in a half-meter diameter annular duct. The amplitude of all the modes is 121.9 decibels and the phases of these modes are, respectively, 325, 250, and 100 degrees. Output from the Modal Calculation Program comprises the resultant sound field at three microphone locations. The value of the resultant sound field is 115.8, 120.0, and 120.0 decibels for the resultant amplitude and 36.4, 345.0, and 298.2 degrees for the resultant phase. PRATT & WHITNEY AIRCRAFT W DAMA

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UTILITY COMPANY NEW COMPANY NE	ADDRESS	a i s a 1 a 9 hoboji di shalis heli si a hobobi (zdzi zar sizer zarsiobihiz i sta i si se si sheka					E= 3, 94, 82=25. 5 MX= -0. 1 F 89 -6200.				1 A A (12) = 2 2 2 . 7 . 12 5 . 9 . 84. 10	[r-h(l)]=322]. 7. [3] S. [4. [3] S. 2. 2. 7. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1. 1.	(1):00 300 300 300 300 300 300 300 300 300		P (11) = 2399. 9. 169. 6. 15. 9.	6x=00002 . 21-13=0. 302 . 21 GT=0. 02 . 5 163=		(11) 2 CO. 2 CO. 2 CO. 2 CO.	11/1)=32 5(~2.a) _00()	(1) = 0 = 1 4. 9.7 6. 241, 966	(A)-25 7 25 25												
AFORW MISHEV 122 UTILITY C(MALVST ADDRESS	وطولات بعادت معدنا تطلمان مزهجا مهجا معجا معجد المعجد الماره المرابعا ودابه مالمان ملعان مالمال والمرام والمرام	(IL MOMPA NL 0 C = 3, L 0 C P = 3, T E M U = 1, PP E F = 2, E -				HT RED , 441 8 8 - 25 . LEMX 0. 1 F 8 9 - 6200 0 . SOE				2 ET A A CIL) = 2 2 2 . 7 . 12 E. 19. 84. 10	* ETT-ICLANESPERTEN (13 SLIGH, 13 G2) 20 21 1 1 1 1	PL(1):0 (13.525 20.30)	2014)-251125.425	rwP (1) = 239. 9. 169. 6. 15. 9.	526x=00002 21-13=0. do2 12 67=0.02 5163=		1 1 1 1 2 2 0 1 2 5 0 1 2 S 0 1	PWIT/11)= 3215. 2. 0. 2.00.	Pix (1) = D . 1 4. 9.7 6. 24. 9 66	2 R (1 1 - 2 5 7 2 5 . 2 5 2 5												
MATCOM 3115 HEV 5.2 UTILITY CO	ANALVST ADDRESS	1. 2 i 1 a 1 a 1 a 2 a 2 a 2 a 2 a 2 a 2 a 2 a	REMONTA NE DES LOCOSE, EENUSI SERUSE EES E				HTE= 0, 94, 38 = 251, 5 MX= -01. 1. FRG=62000. 30E		R.C.1)=2, -1, 2, 5, 2, 2, 5, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,	THI (4)=01.0.101.11	RELANCIN = 2228: 7 126. 9.84. 10.	PERMICUN-3221. P. (BISI 9. (252. 20. 1)	Pr/(1)2.525.20.1300	28(1)525(1)25.425.425	THP (1) = 239. 7.109.6.15.9	526x=00002 21-13=0. do2 12 67=0.02 5163=	& 5 2 0 0 1 10 1 1 CH & 2 1	AM(11) - 2 50. 250. 250.	PHIL/1)= 3215. 2. 0. 2.00.	Pix (1) = 0 . 1/4 . 9.7 6. 241 9 6 6	PR(L): 25 . 25 . 25												

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Figure 5 Sample Input Form for Three Microphones

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3.6 MACHINE REQUIREMENTS

The Modal Calculation Program can be compiled, linkage edited, and executed in 512 bytes of core storage.

The following mathematical functions and procedure are required:

CMPLX	-	Expresses two real arguments in complex form.
CABS	-	Modulus of a complex argument.
CEXP	-	Exponentiation of a complex argument.
AIMAG	•	Obtain imaginary part of a complex argument.
REAL	-	Obtain real part of a complex argument.
FLØAT	-	Conversion from integer to real.
IFIX		Conversion from real to integer.
ABS	-	Absolute value of a real number.
IABS	-	Absolute value of an integer.
SQRT	-	Square root of a real value.
MAXO	-	Obtain maximum value of input integers.
ALØG	-	Natural logarithim of a real positive argument.
SIN	-	Sine of a real argument.
CØS	-	Cosine of a real argument.
ATAN2	•	Arc tangent of two real arguments.

3.7 RESOURCE ESTIMATES

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The central-processor-unit (CPU) time required to process a particular case depends on the number of modes input which determines the size of the matrix to be inverted. The average esti ... ate of CPU time per mode is 0.15 second.

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APPENDIX A

Calculation of the Characteristic Numbers

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The characteristic numbers $K_{m \mu}^{\prime \sigma}$ and $Q_{m \mu}^{\sigma}$ are defined to be the paired roots of the simultaneous equations

$$\left[\frac{d}{dr'} J_{m}(K'm\mu r') + Q_{m\mu} \frac{d}{dr'} Y_{m}(K'm\mu r')\right]_{r'=1} = 0$$
(1)

$$\left[\frac{d}{dr'} J_{m} \left(\sigma K_{m\mu}^{\prime \sigma} r'\right) + Q_{m\mu}^{\sigma} \frac{d}{dr'} Y_{m} \left(\sigma K_{m\mu}^{\prime \sigma} r'\right)\right]_{r'=1} = 0$$
 (2)

For a given circumferential mode number, m, radial order, μ , and hub/tip ratio, σ , (where σ is not equal to zero); J_m and Y_m are the Bessel functions of the first and second kinds of order m.

The following relations are used in the formulation of a solution

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$$\frac{d}{dr'} J_m(x) = J'_m(x) \frac{dx}{dr'}$$
(3)

$$\frac{d}{dr'} Y_m(x) = Y'_m(x) \frac{dx}{dr'}$$
(4)

$$J_{m+1}(x) = \frac{2m}{x} J_m(x) - J_{m-1}(x)$$
(5)

$$J_{m}'(x) = \frac{1}{2} [J_{m-1}(x) - J_{m+1}(x)]$$

$$= \frac{1}{2} [J_{m-1}(x) - \frac{2m}{x} J_{m}(x) + J_{m-1}(x)]$$

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$$= J_{m-1}(x) - \frac{m}{x} J_m(x)$$

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$$Y'_{m}(x) = \frac{2}{\pi x J_{m}(x)} + J'_{m}(x) \frac{Y_{m}(x)}{J_{m}(x)}$$

$$= \frac{2}{\pi x J_{m}(x)} + [J_{m-1}(x) - \frac{m}{x} J_{m}(x)] \frac{Y_{m}(x)}{J_{m}(x)}$$
(7)

Letting K = $K'_{m\mu}^{\sigma}$ and Q = $Q_{m\mu}^{\sigma}$, and evaluating at r' = 1; (1) and (2) become

$$J'_{m}$$
 (K) K + Q Y'_{m} (K) K = 0 (8)

$$\mathbf{J}'_{\mathbf{m}} (\sigma \mathbf{K}) \sigma \mathbf{K} + \mathbf{Q} \mathbf{Y}'_{\mathbf{m}} (\sigma \mathbf{K}) \sigma \mathbf{K} = 0$$
(9)

From (8), Q =
$$-\frac{J'_m(K)K}{Y'_m(K)K}$$
 substituting into (9) yields

$$I'_{m}(\sigma K) \sigma K - \frac{J'_{m}(K) K}{Y'_{m}(K) K} Y'_{m}(\sigma K) \sigma K = 0$$
(10)

Let
$$f(K) = J'_m(\sigma K) Y'_m(K) \sigma K^2 - J'_m(K) Y'_m(\sigma K) \sigma K^2 = 0$$
 (11)

Using the expressions in (5), (6), (7), and (11) then:

Į.

$$f(K) = \sigma K^{2} \left[J_{m-1} \left(\sigma K \right) - \frac{m}{\sigma K} J_{m} \left(\sigma K \right) \right] \left\{ \frac{2}{\pi K J_{m}(K)} + \left[J_{m-1}(K) - \frac{m}{K} J_{m}(K) \right] \frac{Y_{m}(K)}{J_{m}(K)} \right\}$$
$$\sigma K^{2} \left[J_{m-1} \left(K \right) - \frac{m}{K} J_{m}(K) \right] \left\{ \frac{2}{\pi \sigma K J_{m}(\sigma K)} + \left[J_{m-1} \left(\sigma K \right) - \frac{m}{\sigma K} J_{m}(\sigma K) \right] \frac{Y_{m}(\sigma K)}{J_{m}(\sigma K)} \right\} = 0 (12)$$

$$f(K) = \sigma K^{2} \left\{ \frac{2 \left[J_{m-1}(\sigma K) - \frac{m}{\sigma K} J_{m}(\sigma K) \right]}{\pi K J_{m}(K)} - \frac{2 \left[J_{m-1}(K) - \frac{m}{K} J_{m}(K) \right]}{\pi \sigma K J_{m}(J K)} + \frac{1}{\pi \sigma K J_{m}(J K)} \right\}$$

$$\left[J_{m-1}(K) \cdot \frac{m}{K} J_{m}(K)\right] \left[J_{m-1}(\sigma K) - \frac{m}{\sigma K} J_{m}(\sigma K)\right] \left[\frac{Y_{m}(K)}{J_{m}(K)} - \frac{Y_{m}(\sigma K)}{J_{m}(\sigma K)}\right] = 0$$
(13)

,1

2	0
	x
-	•

Equation (13) is evaluated for values of $\widetilde{K}_i = M + 3(i-1)$; i = 1, 2, 3, ... until $f(\widetilde{K}_j)$ $f(\widetilde{K}_j - 1) < 0$ for some j. A procedure employing a combination of false position and bisection techniques is then used to obtain a value of $K'_{m\mu}$ in the interval $[\widetilde{K}_{j-1}, \widetilde{K}_j]$. Having calculated a value of $K = K'_{m\mu}$, the corresponding value of $Q = Q'_{m\mu}$ can be calculated. Combining (8) and (9) yields.

$$[J'_{m}(K) + J'_{m}(\sigma K)\sigma] K + Q [Y'_{m}(K) + Y'_{m}(\sigma K)\sigma] K = 0$$
(14)

from which

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$$Q = -\frac{J'_{m}(K) + J'_{m}(\sigma K)\sigma}{Y'_{m}(K) + Y'_{m}(\sigma K)\sigma}$$
(15)

For $\sigma = 0$, $Q_{m\mu}^{\sigma} = 0$ and $K_{m\mu}^{\prime \sigma} = 0$ is defined to be the root of

$$\left[\frac{d}{dr'} J_{m} \left(\frac{K'\sigma}{m\mu}r'\right)\right]_{r'=1} = 0$$
(16)

Letting
$$K = K'_{m\mu}^{o}$$
, and evaluating at $r' = 1$, (16) becomes

If
$$f(K) = J_m'(K) K = 0$$
, then (6) yields (17)

$$f(K) = [J_{m-1}(K) - \frac{m}{K} J_m(K)] K = 0$$
(18)

Equation (18) is evaluated for values of $\widetilde{K}_i = m + 3(i-1)$; i = 1, 2, 3, ... until $f(\widetilde{K}_j) f(\widetilde{K}_{j-1}) < 0$ for some value of j. A procedure employing a combination of false position and bisection

techniques is then used to obtain a value of $K'_{m\mu}$ in the interval (\tilde{K}_{j-1}, K_j) .

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APPENDIX B

MODAL CALCULATION PROGRAM

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P S	RATT & WHITNEY AIRCRAFT DIVISION VER C.PANLIB.L4 9.0	07/25/77 12.50.00
+	+WRITE PRINT-TA9902	
Ċ	DATA SET T89902 AT LEVEL 024 AS DE 06/22/77	
ē	DATA SET T89902 AT LEVEL OLA AS DE 02/01/77	60001
č		00002
ē	THIS PROGRAM CALCULATES MODAL AMPLITUDE AND PHASE	00003
Ē		00004
č	· .	00005
-	COMMIN /PREDIT/ XP(50), RP(50), THETAP(50)	00006
	CCMM(N /APHIMU/ AMU(50), PHIMU(50), ICHECK	00007
	COMMON ZREECONZ REEPRS	0000#
	CONM(A) /EMUS/ EMU(50.50). EMUP(50.50). EMUPRM(50.50). IEMPRT	00009
	CUMMON /CNSTNT/ NMEAS, NPRED, NMUDES, SIGMA, B. MX. FREQ. A.	00010
	1 OHEGA	00011
	COMMON /KQMU/ KHU(50), QMU(50)	00012
	COMMEN /MODES/ MODE(50), MU(50), INAVE(50)	00013
	CUMMUN /ANGLES/ DEGRAD, RADDEG	00014
	COMMON /DUTPUT/ AMPR(50), PHASER(50)	00015
	COMMON /WAVENO/ KX(50)	00016
	COMMON /REFS/ XREF, RREF, THREF	00017
	REAL KMU, MX	60018
	CLMPLEX NX; EXPNT; SUM1; Q(50,50)	00019
	DIMENSION EMUDUM(50)	00020
C		60021
C	INPUT DATA FOR THIS CASE	00022
C	•	00023
	20 CALL INPUT (IEND)	00024
_	IF(1END .GT. 0) GO TO 9999	00025
Č		00026
C	CALCULATE THE CHARACTERISTIC NUMBERS KNU AND QNU FOR EACH SET OF	00027
C	CIRCUMFERENTIAL MODE NUMBER AND RADIAL ORDER	00023
C		00029
~		00030
5		00031
ř	CALCULATE ANIAL WAVE NUMBER	00032
C		00033
		00034
	DO 40 TEL NMODES	00035
	RADICL = FLOW ++ 2 - ANACH @ (KNU(1) / R) ++ 2	00037
	IF(RADICL) 25. 30. 30	00038
	25 KX(1) = CHPLX(-HX + FLOW / ANACH, INAVE(1) +	00039
	1 SORT(ABS(RADICL)) / AMACH)	60040
	GO TO 40	00041
	30 KX(I) = CMPLX((-MX + FLOW + IWAVE(I) + SQRT(RADICL))	/00042
	1 AMACH, 0-0)	00043
	40 CONTINUE	00044
C		00045
C	IF THIS IS A CHECK RUN, AMU AND PHIMU HAVE BEEN IMPUT. THUS THERE IS	00046
C	NO NEED TO CALCULATE THEM.	00047
C		00048
	1F(ICHECK •GT• 0) 60 TO 60	00049
C		00050
С	SET UP AND SOLVE THE EQUATION SYSTEM ASSOCIATED WITH THE MEASUREMENT	00051

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                                                                VER
                                                                           07/25/77
SC.PANLIB.L4
                                                                           12.50.00
                                                                9-0
   LOCATIONS
                                                                            00052
Ć
                                                                            00053
      CALL SOLVE
                                                                            00054
                                                                            00055
C
  CALCULATE SENSITIVITY COEFFICIENTS
C
                                                                            00056
C
                                                                            00057
      CALL SENSTY! Q. NMODES )
                                                                            00058
C
                                                                            00059
C
  CALCULATE SUM OF MODAL AMPLITUDES AND PHASES FOR EACH PREDICTION
                                                                            00060
                                                                            00061
C
   LOCATION
C
                                                                            00062
   60 DO 120 J=1,NPRED
                                                                            00063
      RPR1ME
                   = RP(J) / B
                                                                            00064
                                                                            00065
C
  CALCULATE CHARACTERISTIC E-FUNCTIONS FOR RPRIME
C
                                                                            00066
                                                                            00067
C
      CALL EMUCAL( RPRIME, EMUP(1, J), EMUDUM, 0 )
                                                                            00063
C
                                                                            00069
      DXP
                    = XP(J) - XREF
                                                                            00070
                    = THETAP(J) - THREF
      DTHETP
                                                                            00071
      SUM1
                    = CMPLX(0., 0.)
                                                                            60072
      DG 100 I=1,NMODES
                                                                            00073
                    = CMPLX1 G.O, REAL( KX(I) ) + DXP + MODE(I) + DTHETP 00074
      EXPNT
                      • PHIMU(I) )
     1
                                                                            00075
                    = AHU(I) • EHUP(I,J) • CEXP( EXPNT ) • EXP( -DXP •
      SUH1
                                                                            00076
     1
                      AIMAG( KX(I) ) ) + SUM1
                                                                            00077
                                                                            00078
  100 CONTINUE
C
                                                                            00079
      AMPR (J)
                    = CABS( SUN1 )
                                                                            00080
      PHASER(J)
                    = ATAN2( AINAG( SUM) ), REAL( SUM1 ) )
                                                                            00081
  120 CONTINUE
                                                                            00082
C
                                                                            00083
  PRINT RESULTS OF THIS CASE
C
                                                                            00064
                                                                   •
                                                                            00065
C
      CALL PRINT
                                                                            00056
C
                                                                            00087
C RECYCLE FOR NEXT CASE
                                                                            88000
C
                                                                            00089
                                         60 TO 20
                                                                            00090
 9999 STOP
                                                                            00091
      END
                                                                            00092
      SUBROUTINE ANGPOS( ANGLE, NUMBER )
                                                                            00093
C
                                                                            00094
  THIS SUBROUTINE CONVERTS NEGATIVE ANGLES TO CORRESPONDING POSITIVE
C
                                                                            00095
C
   ANGLES
                                                                            00096
C
                                                                            00047
      DIMENSION ANGLE(1)
                                                                            00098
      DATA DEGREE / 360. /
                                                                            00049
                                                                            00100
£
      DO BO I=1,NUMBER
                                                                            00101
      IF( ANGLE(1) )
                                         20, 80, 80
                                                                            00102
   20 DD 40 J=1,10
                                                                            00103
      DELTA
                    = J • DEGREE
                                                                            00104
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	IF(ANGLE()) + DELTA)	40, 60, 60		00105
	40 CONTINUE				00106
	60 ANGLE(1)	= DELTA + A	NGLE(I)		00107
	80 CONTINUE				00108
9	999 RETURN		;		00109
	ENU		•		00110
	FUNCTION BE	SLICX)			00111
C					00112
C	THIS FUNCTION C	ALCULATES VAL	UES OF THE EQUATION DEFIN	ING THE SYSTEM	OF00113
C	DIFFERENTIAL E	QUATIONS FOR	A NON-ZERO HUB/TIP RATIO		00114
C					00115
	COMMEN /BES	ISL/ ISIGN, JS	IGN, DELKHU, TOL, M, PI		00116
	COMMON /CNS	STNT/ DUM1(3),	SIGMA, DUM2(5)		00117
C					00118
	X1	= X • SIGMA			00119
	CALL BESJI	X1, M-JSIGN,	EMJM1, TOL, IERI)		00120
	CALL BESJI	X1, N , EMJXI	, TOL, JERZ J	•	00121
	CALL BESJ	X, M, EMJ, TU	Ly IER3)		00122
	CALL BESJE	X, M-JSIGN, E	MJP1, TOL, IER4)		00123
	CALL BESYT	X, M, EMYX, 1	ERS J		00124
-	CALL BESY(XI, M, EMYXI,	IERO J		00125
C	P		61 CH & FM 1M1		00126
	ENJMI	= 7210M + 1	SIGN V ENJAL		00127
	EMJXI			•	60120
	EMJ EMJOJ		FJ Flow & Emand		00127
	EMJPL	= J216N = 1	JIGN - ENJET		60131
	ENTA				00132
r	CHIVI	- 13104 - C			00133
Ŀ	A1		M & ISTCH / Y1 1 & FM IX1		00134
	A 2		M B JSTCH / Y 1 B FMJ		66135
	43	= 2, # A1 /			00136
	44		(PT • X1 • FMJX1)	,	00137
	A5) (ENYX / ENJ - ENYX1 / E	MJX1)	00138
C					00139
•	BESL1	= X1 + X +	(A3 - A4 • A5)		00140
	KETURN				00141
	END				00142
	FUNCTION B	ESL2(X)			00143
C					00144
Ċ	THIS FUNCTION O	CALCULATES VAL	UES OF THE EQUATION DEFIN	ING THE SYSTEM	OF00145
C	DIFFERENTIAL	EQUATIONS FOR	A HUB/TIP RATIO OF ZERO		00146
C				•	60147
	COMMUN /BES	SSL/ ISIGN, JS	IGN, DELKMU, TOL, M, PI		00148
	COMMON /CN:	STNT/ DUM1(3).	SIGMA, DUM2(5)		00149
С	_	-	• •		00150
	CALL BESJI	X, M-JSIGN, E	MJM1, TOL, IER1)		00151
	CALL BESJI	X, M, ENJ, TO)L, IER2)		00152
С					00153
	EMJM1	= JSIGN • I	SIGN - EMJMI		00154
	EMJ	= 151GN + E			00155
	BESLZ	= X = FUJN]	- 4 - 19194 - 549		00120
	KETUKN				00121

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                                                                                                    010876
                                                                                   12.50.00
       END
                                                                                    00155
       SUBROUTINE BESJI X. N. BJ. D. IER 1
                                                                                    00159
C
                                                                                    00160
  THIS SUBROUTINE CALCULATES THE J BESSEL FUNCTION FOR A GIVEN ARGUMENT,00161 X, AND UKDER N. THIS SUBROUTINE WAS TAKEN FROM THE IBM SCIENTIFIC 00162
ն
Շ
C
   SUBROUTINE PACKAGE
                                                                                    00163
C
                                                                                    00164
       BJ
                      = 0.0
                                                                                    00165
       1F( N .GE. 0 )
                                             GO TO 20
                                                                                    00166
C
                                                                                    00167
C
  ERROR - NEGATIVE ORDER. SET ERROR INDICATOR TO 1 AND RETURN
                                                                                    00168
C
                                                                                    00169
       JER
                      × 1
                                                                                    00170
                                             GO TO 9999
                                                                                    00171
   20 IF( X )
                                             40, 30, 60
GO TO 40
                                                                                    00172
   30 IF( N .GT. 0 )
                                                                                    00173
       BJ
                      = 1.0
                                                                                    00174
                                             GO 10 9999
                                                                                    00175
                                                                                    00176
  ERROR - ARGUMENT ZERO OF NEGATIVE. SET ERROR INDICATOR TO 2 AND RETURNOO177
C
C
                                                                                    00178
   40 IER
                      * 2
                                                                                    00179
                                             GO TO 9999
                                                                                    00180
                                                                                    00181
C
  CALCULATE MAXIMUM DRDER NUMBER THAT CAN BE PROCESSED FOR X.
                                                                                    00182
    IF X .LE. 15, N MUST BE LESS THAN 20 + 10+X - X++2/3.
IF X .GT. 15, N MUST BE LESS THAN 90 + X/2
C
                                                                                    00183
C
                                                                                    00184
£.
                                                                                    00185
                      80; 80; 100
= 20, + 10. ● X - X ** 2 / 3.
   60 IF( X - 15. )
                                                                                    00186
   90 NTEST
                                                                                    00187
                                             60 TO 120
                                                                                    00133
                      = 90.
  100 NTEST
                             ٠
                               X / 2.
                                                                                    00189
  120 JFI N .LT. NTEST )
                                             GO TO 140 '
                                                                                    00190
C
                                                                                    00191
C
  ERROR - ORDER RANGE COMPARED TO X IS NOT CORRECT. SET ERROR INDICATOR 00192
۵
   TO 4 AND RETURN.
                                                                                    00193
Ĉ
                                                                                    00194
       IER
                                                                                    00195
                                             GO TO 9999
                                                                                    00196
  140 IER
                      = 0
                                                                                    00197
                                                                                    00198
       NI
                        N
                           + 1
       BPREV
                      = 0.0
                                                                                    00199
                                                                                    00200
С
  COMPUTE STARTING VALUE OF M
                                                                                    00201
C
C
                                                                                    00202
                                                                                    00203
       1F( X ~ 5. )
                                             160, 180, 180
  160 MA
                                                                                    00204
                          + 6.
                                             GO TO 200
                                                                                    00205
  180 MA
                                                                                    00206
                      = 1.4 * X + 60. / X
  200 MB
                        N + IFIX( X ) /
                                             + 2
                                                                                    00207
                      .
                                           4
       MZERO
                      = MAXO( MA, MB )
                                                                                    00208
C
                                                                                    00209
C SET UPPER LIMIT OF M
                                                                                    00210
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VER PRATT & WHITNEY AIRCRAFT DIVISION 07/25/77 SC.PANLIB.L4 9.0 12.50.00 00211 C MMAX = NTEST 00212 00213 220 DO 320 M=MZERO, MMAX, 3 C 00214 Ċ SET F(M), F(M-1) 00215 00216 FML = 1.0E-28 00217 00218 FM = 0.0 ALPHA = 0.0 00219 JT = 1 00220 IF((M / 2) • 2 .EQ. M) 00221 1- = TL 00222 M2 = M - 2 DO 280 K=1,M2 00223 MK = M - K00224 BMK = 2. • FLOAT(NK) • FH1 / X - FH 00225 FM = FH1 00226 FM1 = BMK 00227 1FI MK N 1 260, 240, 260 00228 240 BJ = BMK 00229 260 JT 00230 TL- = s = 1 + JT00231 ALPHA 00232 ALPHA + BMK • 00233 280 CONTINUE C 06234 BMK 00235 = 2. + FH1 / X - FM IF(N .EQ. 0) 00236 B.J = BMK = ALPHA + BMK ALPHA 00237 BJ = BJ / ALPHA 00238 IF(ABS(BJ - BPREV) - ABS(D + BJ)) 00239 9999, 9999, 300 300 BPREV = BJ 00240 320 CONTINUE ú0241 00242 C C ERROR - REQUIRED TOLERANCE NOT OBTAINED. SET ERROR INDICATOR TO 3 AND 00243 C RETURN 00244 Č 00245 IER = 3 00246 9999 RETURN 00247 --END 00245 SUBROUTINE BESY(X, N, BY, IER) 00249 C 00250 C THIS SUBROUTINE CALCULATES THE Y BESSEL FUNCTION FOR A GIVEN ARGUMENT, G0251 C X, ANG URDER N. THIS SUBROUTINE WAS TAKEN FROM THE IBM SCIENTIFIC 00252 C C SUBROUT INE PACKAGE 00253 00254 1ER = 0 00255 IF(N .GE. 0) GO TO 20 00256 00257 C C ERROR - NEGATIVE ORDER. SET ERROR INDICATOR TO 1 AND RETURN 0025B C 00259 IER a 1 00260 GO TO 9999 60261 20 IF(X) 40, 40, 60 00262 C 00263

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PRATT & WHITNEY AIRCRAFT DIVISION 07/25/77 VER SC.PANLIB.L4 12.50.00 9.0 C ERROR - ARGUMENT ZERO OR NEGATIVE. SET ERROR INDICATOR TO 2 AND RETURNO0264 00265 40 IER = 2 00266 60 TO 9999 00267 C 00268 С BRANCH IF X IS LESS THAN OR EQUAL TO 4. 00269 C 00270 60 IF(X - 4.) 100, 100, 80 00271 00272 CALCULATE YO AND YI FOR X GREATER THAN 4. 00273 C 00274 80 T1 = 4. / X 00275 - T1 ≠ T1 TZ 00276 = { { { { { { { { { { { { { { { -.000037043 € T2 + .0000173565 } € T2 -PO 00277 .0000487613) # T2 + .00017343) + T2 - .001753062 00278 1 2) * T2 + .3989423 00279 (.0000032312 # T2 - .0000142078) + T2 + 00 t 00280 .0000342468) # T2 - .0000869791) # T2 + .0004564324) # T2 - .01246694 (((() .0000042414 # T2 - .070020092) # T2 # 1 00281 2 00282 P1 00283 1 .0000580759) + T2 - .000223203) + T2 + 00284 .002921826) + T2 + .3989423 ((((-.0000036594 + T2 + .00001622) + T2 -2 00285 91 00286 .0000398708) # T2 # .0001064741) # T2 -.00063904) # T2 + .03740084 1 00287 2 00288 . = 2. / SQRT(X) 00289 B = A + T1 00290 = X - .7553982 C 00291 = A + P0 + SIN(C) + B + Q0 + COS(C) = -A + P1 + COS(C) + B + Q1 + SIN(C) YO 00292 71 00293 60 TO 160 00294 00295 C CALCULATE YO AND Y1 FOR X LESS THAN OR EQUAL TO 4 00296 C 00297 100 XX = .5 * X 00298 X2 = XX + XX 00299 T ** ALOG(XX) + .5772157 00300 SUN .0.0 00301 TERM ** T 00302 YO . . 00303 DO 120 L=1,15 00304 IF1 L .NE. 1) SUM = 1. / FLOAT(L-1) + SUM 00305 FL . L 00306 TS = T - SUN 00307 TERM - (-X2 * TERM / (FL ** 2)) * (1. - 1. / (FL 00308 1 TS]] 00309 YO TERM + YO 00310 120 CONTINUE 00311 TERM = XX + (T - .5) 00312 .0.0 SUN 00313 P TERM ¥1 00314 00 140 L=2,16 00315 SUN = 1. / FLOAT/ L-1) + SLM 00316

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PRATT & WHITNEY AIRCRAFT DIVISION
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SC-PANLIB.L4
                                                                     9.0
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       FL
                      a
                                                                                  00317
       FL1
                      = FL - 1.
                                                                                  00318
       TS
                       T - SUN
                      .
                                                                                  00319
       TERM
                      = ( -X2 • TERM / ( FL • FL1 ) ) • ( ( TS -
                                                                      .5 / FL ) 00320
                        / ( TS + .5 / FL1 ) )
                                                                                  00321
       ¥1
                      = TERM + Y1
                                                                                  00322
  140 CONTINUE
                                                                                  00323
       P12
                     = .6366198
                                                                                  00324
                     = PI2 + Y0
= PI2 + ( Y1 - 1. / X )
       YO
                                                                                  00325
       ¥1
                                                                                  00326
                                                                                  00327
  CHECK IF ONLY YO OR YI IS DESIRED
C
                                                                                  00328
                                                                                  00329
  160 IF( N .GT. 1 )
                                            GO TO 180
                                                                                  00330
C
                                                                                  00331
C
  RETURN YO OR Y1 AS REQUIRED
                                                                                  00332
C
                                                                                  00333
       AY
                     Y0
                                                                                  00334
       FI N .EQ. 1 )
                                            BY = ¥1
                                                                                  00335
                                            CU TO 9999
                                                                                  00336
                                                                                  00337
Ċ
  PERFORM RECURRENCE OPERATIONS TO FIND YN(X)
                                                                                  00338
C
                                                                                  00339
  180 YA
                     = YO
                                                                                  00340
       YB
                     = Y1
                                                                                  00341
                     = 1
                                                                                  00342
  200 T = FLOAT( 2+K ) / X
                                                                                  00343
       YC.
                     = T + YB - YA
                                                                                  00344
       IF( ABS( YC ) - 1.0E70 )
                                            240, 240, 220
                                                                                  00345
C
                                                                                  CO346
  ERROR - BY HAS EXCEEDED MAGNITUDE OF 10++70. SET ERROR INDICATOR TO 3 00347
C
C
   AND RETURN
                                                                                  00348
L
                                                                                  00349
  220 1ER
                     - 3
                                                                                  00350
                                            GD TO 9999
                                                                                  00351
                     = 1 + K
  240 K
                                                                                  00352
       IF( K .EQ. N )
                                            GD TO 260
                                                                                  60353
       YA
                     = YB
                                                                                  00354
       YB
                     = YC
                                                                                  00355
                                            GO TO 200
                                                                                 00356
  260 BY
                     = YC
                                                                                  00357
 9999 RETURN
                                                                                  00358
       € ND
                                                                                  00359
       BLOCK DATA
                                                                                 00360
       CUMMON /DFAULT/ LOCM, LOCP, HTR, DR, EMX, FRQ, XO, RO,
THO, X1501, R1501, THM(50), BETAM(50), PSIM(50),
                                                                                 00361
      1
                                                                                 00362
                         PX(50), PR(50), THP(50), N(50), NUS(50),
IDIR(50), PREF, AN(50), PHI(50), ICHK,
     2
                                                                                 00363
     3
                                                                                  00364
                         SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED
                                                                                 00365
      4
C
C
                                                                                  00366
  CONSTANT DEFAULT VALUES
                                                                                  00367
C
                                                                                 00368
C
     LOCH
             - NUMBER OF MEASUREMENT LOCATIONS
                                                                                 00369
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PRATT & WHITNEY AIRCRAFT DIVISION VER 07/25/77 12.50.00 SC.PANLIB.L4 9.0 - NUMBER OF PREDICTION LOCATIONS 00370 LOCP - HUB / TIP HATID - CUTER RADIUS 00371 C C HTR 00372 GR 00373 C - AXIAL MACH NUMBER EMX C - TEST FREQUENCY 00374 FRU C SPEED - SPEED OF SOUND 00375 00376 C DATA LOCH / 2 /, LUCP / 2 /, HTR / 0.44 /, DR / 5.0 /, EMX / -u.07 /, FRQ / 3100. /, SPEED / 13566.24 / 00377 1 60378 66379 C REFERENCE LOCATION VALUES 00390 C C 00381 - AXIAL CUMPUNENT OF REFERENCE LOCATION XO 00382 C RO - RADIAL CUMPUNENT OF REFERENCE LOCATION 00383 - ANGULAR COMPUNENT OF REFERENCE LOCATION (DEG) TH0 00364 Ċ 66385 DATA X0 / 0.0 /, R0 / 0.0 /, TH0 / 0.0 / 00356 C 00367 MEASUREMENT LOCATION VALUES 00368 Ċ 60389 - AXIAL COMPONENT OF MEASUREMENT LOCATION 00390 С С С - RADIAL COMPONENT OF MEASUREMENT LOCATION 00391 R - ANGULAR COMPONENT OF MEASUREMENT LOCATION (DEG) THM 0039A Ċ BETAN - AMPLITUDE OF MEASURED VALUE 00393 C - PHASE ANGLE OF MEASURED VALUE (DEG) 00394 PSIM C 00345 UATA X / 9.508, 6.582, 48+0.0 /, R / 2+5.0, 48+0.0 /, THM / 50+0.0 /, ULTAM / 0.03136, 0.05097, 48+0.0 /, 60396 00397 1 2 PS1M / 97.8, 215.6, 48+0.0 / 06398 **UU379** PREDICTION LOCATION VALUES Ċ 01400 C 0-+01 - AXIAL COMPONENT OF PREDICTION LOCATION PX. 00402 C PR - RADIAL COMPONENT OF PREDICTION DOCATION 00403 - ANGULAR COMPONENT OF PREDICTION LOCATION (DEG) C C THP 00464 00465 DATA PX / 5.788, 2.513, 48+0.0 /, PR / 2+5.0, 48+0.0 /, 00406 1 THP / 50+0.0 / 00407 00408 C NODE VALUES С 00409 C 00410 Ĉ - CIRCUMFERENTIAL MODE NUMBER 00411 NUS - RADIAL ORDER 00412 C 1016 - INCIDENT OR REFLECTED WAVE INDICATOR 00413 C 00414 DATA M / -2; -2; 48+0 /, MUS / 0; 1; 48+0 /, IDIR / 1; 1; 48+0 / 60415 C 00416 REFERENCE CONSTANTS Ċ 60417 C 60410 C PREF - REFERENCE PRESSURE 00419 C 00420 DATA PREF / 2.9E-9 / 00421 C 00/ 22

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                                                                  VER
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C RESULTANT AMPLITUDE AND PHASE VALUES
                                                                              00423
£
                                                                              00424
             - AMPLITUDE
                                                                              00425
C
     AM
Ċ
                                                                              00426
     PHI
             - PHASE ANGLE (DEG)
C
     ICHK
             - CHECK CASE INDICATOR
                                                                              00427
C
                                                                              00428
      DATA AN / 50+0.0 /, PHI / 50+0.0 /, ICHK / 0 /
                                                                              60429
                                                                              00430
C
C BESSEL FUNCTION VALUES
                                                                              00431
                                                                              00432
C
      COMMON /BESSL/ DUM2(2), DELKMU, TOL, MM, PI
                                                                              00433
      DATA UELKMU / 3. /, TOL / .0001 /, PI / 3.141593 /
                                                                              00434
C
                                                                              60435
C ANGULAR CONVERSION FACTORS
                                                                              00436
                                                                              00437
C
     DEGRAD - DEGREES TO RADIANS
                                                                              60438
C
C
     RAUDEG - RADIANS TO DEGREES
                                                                              00439
C
                                                                              00440
      COMMON /ANGLES/ DEGRAD+ RADDEG
                                                                              00441
      UATA DEGRAD / .0174533 /, RADDEG / 57.29578 /
                                                                              60442
C
                                                                              00443
                                                                              00444
C
C ERROR DEVIATION COEFFICIENTS
                                                                              00445
                                                                              00446
C
С
     SIGX
             - AXIAL COEFFICIENT
                                                                              60447
C
     SIGR
             - RADIAL CUEFFICIENT
                                                                              00448
C
     SIGT
             - ANGULAR COEFFICIENT
                                                                              00449
C
     8112
             - AMPLITUDE COEFFICIENT
                                                                              00450
C
     SIGP
             - PHASE CUEFFICIENT
                                                                              00451
C
                                                                              00452
      DATA SIGX / 0.0 /, SIGR / 0.0 /, SIGT / 0.0 /, SIGP / 0.0 /,
                                                                              60453
     1
            SIG8 / 0.0 /
                                                                              00454
      t ND
                                                                              00455
      SUBROUTINE EMUCALI RPRIME, ENU, ENUPRM, IDERIV )
                                                                              00456
C
                                                                              00457
C THIS SUBROUTINE CALCULATES NHODES CHARACTERISTIC E-FUNCTION VALUES FOR00458
   A PARTICULAR RADIAL VALUE, RPRIME.
C
                                                                              06459
٤.
                                                                              00460
      DIMENSION EMU(1), EMUPRM(1)
                                                                              00461
       CUMMEN /ENSINT/ NMEAS, NPRED, NMODES, DUM1(6)
                                                                              60462
      COMMON /KQMU/ KMU(50), QMU(50)
CUMMUN /MUDES/ MODE(50), UUM2(100)
CCMMON /bessl/ Isign, Jsign, DelkMU, Tol, M, PI
                                                                              00463
                                                                              00464
                                                                              00465
      REAL KMU, JPRIME
                                                                              00466
C
                                                                              00467
C
                                                                              Ú0468
      DO 40 I=1.NMODES
                                                                              00469
       M
                    = IABS( MODE(I) )
                                                                              00470
       IFE M .NE. O J
                                          GO TO 10
                                                                              00471
       ISIGN
                    .
                      1
                                                                              00472
       JS1GN
                     = -1
                                                                              00473
                                          GO TO 20
                                                                              00474
   10 ISIGN
                    = MODE(I) / M
                                                                              00475
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PRATT & WHITNEY AIRCRAFT DIVISION VER 07/25/77 9.0 12.50.00 SC.PANLIB.L4 **JSIGN** = ISIGN 00476 IF( 151GN .GE. 0 ) 60 TO 20 00477 00478 C Ċ NEGATIVE MODE NUMBER. IF EVEN, SIGN OF BESSEL FUNCTION WILL BE +1. IF 00479 ODD. SIGN OF GESSEL FUNCTION WILL BE -1. 00480 C C 06481 IFE ( M / 2 ) • 2 .EQ. M ) ISIGN = 100482 20 CONST = KMU(I) • RPRIME 00483 00484 CALCULATE BESSEL FUNCTIONS OF FIRST AND SECOND KIND FOR KNULLIARPRIME 00465 C 00486 CALL BESJE CONST, M, EMJ, TOL, JER1 ) 00467 CALL BESYI CONST, M. ENY, IER2 ) 00468 CALL BESJI CONST, M-JSIGN, EMM1, TOL, IER3 ) 00489 = ISIGN . JSIGN . EMMI 00490 ENHL EMJ = ISIGN • EMJ 00491 = ISIGN + EMY EMY C0492 00493 C CALCULATE CHARACTERISTIC E-FUNCTION 00494 00495 EMU(I) = EMJ + GMU(I) • ENY 00496 IFI IDERIV .LE. 0 ) 60 TO 40 00497 30, 25, 30 IF( KMU(I) ) 00498 00499 С (0,0) CASE. SET DERIVATIVE TO 0.0 00500 00501 25 EMUPRM(1) = 0.0 00502 GO TO 40 00503 00504 C CALCULATE DERIVATIVE OF CHARACTERISTIC E-FUNCTION 00505 ſ 00506 **30 JPRIME** = EMM1 - MODE(I) • EMJ / CONST 00507 YPRIME = 2. / ( PI • CONST • EMJ ) + JPRIME • EMY / EMJ 00508 = KMU(I) + ( JPRIME + QMU(I) + YPRIME ) EMUPRMII 00509 40 CONTINUE 00510 9999 RETURN 00511 END 00512 FUNCTION FALZIP (FUNCT, AL, BR, TOL, ROOT, ITER, YY) 00513 C 00514 C CURRESPUNDS TO OLD VERSION (FALSIE) ARGUMENT LIST AS FOLLOWS (THIS IS 00515 FOR INTERNAL PURPOSES UNLY. IN USE THE TWO ARE INTERCHANGEABLED. 00516 C C 00517 C FUNCTION FALSIE (AXR. XXL, XXR, TOL, ROOT, ITER, YY) 00518 C 00519 C 00520 THIS RUUTINE USES A COMBINATION OF FALSE POSITION AND DISECTION C 00521 TECHNIQUES TO SOLVE FUR A ROOT ("ROUT") OF A GIVEN FUNCTION C 00522 ("FUNCT") WHICH HAS ONE ARGUMENT (THE INDEPENDENT VARIABLE). C 00523 C 60524 C \*AL, BR\* DEFINES THE INTERVAL TO BE SEARCHED. 00525 С 00526 C THE VALU. RETURNED BY THE FUNCTION IS FALZIP. FUNCT(FALZIP) = ROOT 00527 00528

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                                                                 9.0
                                                                            12.50.00
   THE SEARCH CONTINUES UNTIL TWO SUBSEQUENT GUESSES ARE WITHIN "TOL"
                                                                             00529
C
     OF EACH OTHER, OR UNTIL "ITER" ITERATIONS HAVE TAKEN PLACE.
                                                                             00530
                                                                             00531
C
C
   "YY" IS RETURNED AS FUNCT(FALZIP), AND SHOULD BE CLOSE TO "ROOT".
                                                                             00532
C
                                                                             00533
   THE TECHNIQUE WAS ADAPTED FROM AN ALGOL SUBROUTINE APPEARING IN THE
C
                                                                             00534
     COMPUTER JUURNAL 12 (1969) --- "EIGENVALUES OF A+X = LAMBDA+6+X
                                                                             00535
ĉ
     WITH EAND SYMMETRIC & AND B. BY G. PETERS + J.H. WILKINSON
C
                                                                             00536
C
                                                                             00537
      EXTERNAL FUNCT
                                                                             00538
      REAL INTERP
                                                                             00539
C
                                                                             00540
C
   J IS COUNT OF ITERATIONS.
                                                                             00541
    1 J = 0
                                                                             00542
      A = AL
                                                                             00543
      6 = 6K
                                                                             00544
C
                                                                             00545
   EVALUATE FUNCTION AT LEFT (A) AND RIGHT (B) BRACKETS.
C.
                                                                             00546
      AF = FUNCT (A)
                                                                             00547
      BF = FUNCT (B)
                                                                             00548
                                                                             00549
Ĺ
   THE FULLOWING (THROUGH STATEMENT 3) DETERMINES IF THE FUNCTION IS OF 00550
C
C
     UPPOSITE SIGN AT THE ENDPOINTS GIVEN.
                                                                             00551
      1SW = 1
                                                                             00552
      1+ (bF - RUOT) 2, 75, 3
                                                                             00553
    2 15W = -1
                                                                             00554
    3 IF (IAF - ROUT) + 15W) 50, 50, 55
                                                                             00555
                                                                             00556
C
   STATEMENT 5 INCREMENTS THE COUNTER J; FIRST TIME THROUGH GO TO 50.
                                                                             00557
    5 J = J + 1
                                                                             00558
C
                                                                             00559
   IF LEFT BRACKET HAS 'SAME' FUNCTION VALUE AS RIGHT, USE BISECTION.
DTH=RWISE, SET UP INTERPULATED POINT FOR POSSIBLE USE.
C
                                                                             00560
С
                                                                             00561
      IF (ABS((AF - BF)/BF) - 1.E-5) 10, 10, 15
                                                                             00562
   10 INTERP = BISECT
                                                                             00563
      GO TO 20
                                                                             00564
   15 INTERP = (A+bF - B+AF + (B-A)+ROOT) / (BF-AF)
                                                                             00565
C
                                                                             00566
C
   IF WITHIN A TOLERANCE OF THE BRACKET B, MOVE THE INTERPOLATED POINT
                                                                             00567
C
     UNE TULERANCE AWAY.
                                                                             00568
   20 1F (IAUS(INTERP-U)/AUS(INTERP+B)) -2.+TOL) 22,23,23
                                                                             00569
   22 INTERP = B + (C - B) / ABS (C - B) • TOL
                                                                             00570
C
                                                                             00571
£
   SET A=B (B IS ALWAYS THE POINT WITH SMALLEST (ABS) VALUE OF FUNCTION.00572
   23 A = B
                                                                             00573
      AF = BF
                                                                             00574
C
                                                                             00575
   USE POINT CLOSEST TO B (INTERP OR BISECT) AS NEW B AND EVALUATE BF.
£.
                                                                             00576
      IF ((INTERP - BISECT) . (B - INTERP)) 30, 25, 25
                                                                             00577
   25 B = INTERP
                                                                             00578
      GO TU 35
                                                                             00579
   30 6 . BISECT
                                                                             00580
   35 HF = FUNCT(B)
                                                                             605#1
                                                                               .
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| BFHR = BF - ROOT         00582           C         IF CF IS UN THE SAME SIDE OF THE ROOT AS BF, LET POINT C = POINT A.         00584           40 IF (ICL - ROOT) = BHRR) 55, 75, 50         00586         00586           50 C = A         00586         00586           C IF CF IS CLOSER (ABS) TO ROOT THAN BF, SWITCH POINTS B AND C.         00586           C IF CF IS CLOSER (ABS) TO ROOT THAN BF, SWITCH POINTS B AND C.         00586           C IF ANY CASE, B AND C ARE THE TWO BRACKETS. ALSO BF IS CLOSER TO THEO0590         00591           S IF (ABS18F - ROOT) - ABS(CF - ROOT)] 60, 60, 57         00591           S IF (ABS18F - ROOT) - ABS(CF - ROOT)] 60, 60, 57         00593           A = B         00596           B = C         00596           C = A         00597           C S ET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60         00506           C B ACK IF ITERATIUM COUNT DDESN*T EXCLED MAXIMUM.         06601           60 BISECT = 16 * C1 /2.         00559           C II LASS(BISECT-B)/ADS(BISECT+B)) -2.*TOL) 75,65,65         06603           61 II - ITERATIUM COUNT DDESN*T EXCLED MAXIMUM.         06601           100 FORMAT (10007),40,6F,C,CF         00606           100 FORMAT (10007),40,6F,C,CF         00606           100 FORMAT (10007),40,6F,C,CF         00601                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | PRATT & WHITNEY AIRCRAFT DIVISION VI<br>SC.PANLIB.L4 9         | ER 07/25/7<br>.0 12.50.0 | 17 |
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| C 00083<br>C IF CF IS ON THE SAME SIDE OF THE ROOT AS BF, LET POINT C = POINT A. 00364<br>O IF (ICF - ROOT) • WHAR) 55, 75, 50<br>SO C = A<br>C C F = AF<br>C O00667<br>C IF CF IS CLOSER (ABS) TO ROOT THAN BF, SWITCH POINTS B AND C. 00367<br>C RUOT THAN CF IS.<br>SO IF CF IS CLOSER (ABS) TO ROOT THAN BF, SWITCH POINTS B AND C. 00397<br>SO IF (ABS18F - ROOT) - ABS(CF - ROOT)) 60, 60, 57<br>SO A = B<br>A = B<br>C C O00568<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE SENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE SENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE SENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE SENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE SENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF CLOSE SENDUGH, FINISH UP. OTHERWISE 60<br>C SET UP BISECTION POINT. IF ALZIP, AFTER*, 14, * ITERATIONS* // OCOOD<br>C JAX, 'BRACKET 1 = ', GIS.8, SX, 'FUNCTION = ', GIS.8/<br>C SET UP B<br>C SET UP B<br>C SET UP BISECTION POINT FALSER<br>C SET UP SAF<br>C SET UP S | BFMK = BF - ROOT                                               | 00582                    |    |
| C IF CF IS CM THE SAME SIDE OF THE ROOT AS BF, LET POINT C = POINT A. 00584<br>40 IF (ICF - ROOT) • BHRR) 55, 75, 50 00565<br>50 C = A 00566<br>C IF CF IS CLOSER (ABS) TO ROOT THAN BF, SMITCH POINTS B AND C. 00586<br>C IF CF IS CLOSER (ABS) TO ROOT THAN BF, SMITCH POINTS B AND C. 00597<br>C NUCT THAN CF IS. 00591<br>55 IF (ASSIBF - ROOT) - ABS(CF - ROOT)) 60, 60, 57 00592<br>57 A = B 00595<br>B = C 00595<br>B = C 00595<br>C = A 00595<br>C SET UP BISECTION POINT. IF CLOSE ENOUGH, FINISH UP. 0THERWISE 60 00509<br>C SET UP BISECTION POINT. IF CLOSE ENOUGH, FINISH UP. 0THERWISE 60 00509<br>C SET UP BISECTION POINT. IF CLOSE ENOUGH, FINISH UP. 0THERWISE 60 00509<br>C SET UP BISECTION POINT. IF CLOSE ENOUGH, FINISH UP. 0THERWISE 60 00509<br>C IF (IA - 11ER) 5, 70, 70<br>70 WRITEL6, 100014, B, B, C, CF<br>1000 FURMAT 11H0/// 30X, *1N FALZIP, AFTER*, 14, * 1TERATIONS* // 00060<br>1 100, FURMAT 11H0/// 30X, *1N FALZIP, AFTER*, 14, * 1TERATIONS* // 00605<br>1 0000 FURMAT 11H0/// 30X, *1N FALZIP, AFTER*, 14, * 1TERATIONS* // 00606<br>1 100, FURMAT 11H0/// 30X, *1N FALZIP, AFTER*, 14, * 1TERATIONS* // 00606<br>1 100, FURMAT 11H0/// 30X, *1N FALZIP, AFTER*, 14, * 1TERATIONS* // 00606<br>1 100, FURMAT 11H0/// 30X, *1N FALZIP, AFTER*, 14, * 1TERATIONS* // 00606<br>1 100, FURMAT 11H0/// 30X, *1N FALZIP, AFTER*, 14, * 1TERATIONS* // 00606<br>1 100, FURMAT 11H0/// 30X, *1N FALZIP, AFTER*, 14, * 1TERATIONS* // 00606<br>1 Y = UF<br>7 FALZIP = B 00<br>1 Y = UF<br>7 FALZIP = B 00<br>1 Y = UF<br>8 ONLY = 0 F 00011, A, AF, B, BF<br>1000 FORMAT 1000**********************************                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | C                                                              | 00583                    |    |
| 40 IF (I(F - RODT) ● BFHR1 55, 75, 50       00585         50 C = A       00586         C F = AF       00586         C IF CF IS CLOSER (ABS) TO ROOT THAN BF, SWITCH POINTS B AND C.       00586         C IF CF IS CLOSER (ABS) TO ROOT THAN BF, SWITCH POINTS B AND C.       00586         C RUDT THAN CF IS.       00591         55 IF (ABS(BF - ROOT) - ABS(CF - ROOT)) 60, 60, 57       00593         AF = BF       00596         B = C       00597         C F = AF       00596         C SET UP BISECTION POINT. IF CLOSE ENDUCH, FINISH UP. OTHERWISE 60       00596         C SET UP BISECTION POINT. IF CLOSE ENDUCH, FINISH UP. OTHERWISE 60       00596         C BACK IF ITERATION COUNT DOESN'T EXCLED MAXIMUM.       00662         O BIS(I = B + C) / 2.       000546       00546         C IA (ABS(B)SECT+B)) -2.*TOL) 75,65,65       00602         D WAITHER, JO, 70, 70       00644       00642         T (ABS(B)SECT-B)/ABS(B)SECT+B)) -2.*TOL) 75,65,65       00605         1000 FUNAT (HOV// JOX, 'IN FALZIP, AFTER*, 14, * ITERATIONS' // 00606       00644         1001 FUNAT (HEA, JOR, 70       70       00644         70 WRITE(6,1000JA,B45FC,CF       00545       00644         1004 FUNAT (HOV// JOX, 'IN FALZIP, AFTER*, 14, * ITERATIONS' // 00606       00644                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | C IF CF IS UN THE SAME SIDE OF THE ROOT AS BF, LET POINT C = 1 | POINT A. 00584           |    |
| 50 C = A       00586         C F = AF       00586         C IF CF IS CLOSER (ABS) TO ROOT THAN BF, SWITCH POINTS B AND C.       00587         C NUT THAN CF IS.       00591         55 IF (AMSIGF - ROOT) - ABSICF - ROOT)) 60, 60, 57       00592         55 IF (AMSIGF - ROOT) - ABSICF - ROOT)) 60, 60, 57       00592         56 F       00596         6 F       00596         6 F       00596         7 A = B       00596         8 F C       00596         0 C = A       00597         C C = A       00596         C SET UP BISECTION POINT. IF CLOSE ENDUCH, FINISH UP. OTHERWISE 60       00600         C MACK IF ITERATION COUNT DOESN*T EXCLED MAXIMUM.       00662         60 BISECT = IB + CI / 2.       00591         C I (ASSIGET=BJARSIBISECT+BJ) -2.*TOL 1 75,65,65       00609         1 100, 'bBACKET 1 = ', 615.6, 5X, 'FUNCTION = ', 615.6/       006047         1 100, 'bBACKET 1 = ', 615.6, 5X, 'FUNCTION = ', 615.6/       006047         1 100, 'bBACKET 1 = ', 615.6, 5X, 'FUNCTION = ', 615.6/       006047         1 100, 'bBACKET 1 = ', 615.6, 5X, 'FUNCTION = ', 615.6/       006047         1 100, 'bBACKET 1 = ', 615.6, 5X, 'FUNCTION = ', 615.6/       006047         1 100, 'bBACKET 1 = ', 615.6, 5X, 'FUNCTION = ', 615.6/       006047                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 40 1F ((CF - ROOT) • BEMR) 55, 75, 50                          | 00585                    |    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 50 C = A                                                       | 00586                    |    |
| C 1F CF IS CLOSER (ABS) TO ROOT THAN BF, SWITCH POINTS B AND C. 00589<br>C 1M ANY CASE, B ANU C ARE THE TWO BRACKETS. ALSO BF IS CLOSER TO THEODS90<br>NUOT THAN CF IS. 00591<br>55 1F (ABS(18F - ROOT) - ABS(CF - ROOT)) 60, 60, 57 00592<br>57 A = B 00593<br>AF = BF 000000000000000000000000000000000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | LF = AF                                                        | 00587                    |    |
| C 1F CF IS CLOSER (ABS) TO ROOT THAN BF, SUITCH POINTS B AND C. 00589<br>( RUDT THAN CF IS. 00591<br>S5 IF (ABS18F - ROOT) - ABS(CF - ROOT)) 60, 60, 57 00592<br>( AF = bF 00592<br>AF = bF 00593<br>AF = bF 00595<br>bF = CF 00595<br>C = A 00597<br>C = AF 00597<br>C = AF 00597<br>C = AF 00597<br>C = AF 00599<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE GO 00609<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE GO 00600<br>C bACK IF ITERATION COUNT DOESN'T EXCLED NAXIMUM. 06661<br>C 00 815K1 = (B + C) / 2, 70 00<br>C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE GO 00600<br>C bACK IF ITERATION COUNT DOESN'T EXCLED NAXIMUM. 06661<br>C 00 815K1 = (B + C) / 2, 70 00<br>C WRITE(6,1000)J, BBF, L, CF 00605<br>1000 FURMAT (1HU// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00605<br>2 10X, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 06603<br>3 5X, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 06603<br>C 100, FURMAT (1HU// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00605<br>C 100, FURMAT (1HU// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00605<br>C 100, FURMAT (1HU// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00605<br>C 100, FURMAT (1HU// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00606<br>C 1 10X, 'BRACKET 2 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 06607<br>C 100, FURMAT (1HU// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00606<br>C 1 10X, 'BRACKET 2 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 06616<br>100, FURMA (1HU// 30X, 'INFALZIP, 'ROOT GIVEN (=', G15.8, ') DIDN''T FALL BETOCHT<br>NEED VALUES OF FUNCTION AT BRACKETS GIVENNO'' FALL BETOCHT<br>NEED VALUES OF FUNCTION AT BRACKETS GIVENNO'' G15.8 / 00618<br>C 10X, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8 / 00616<br>100, FURMA (1'O**IN FALZIP, 'ROOT GIVEN (=', G15.8, ') DIDN''T FALL BETOCHT<br>NEED VALUES OF FUNCTION AT BRACKETS GIVENNO'' FOR THE EXECUTION OF A CASE<br>OO622<br>C THIS SUBROUTINE INPUT THE DATA REQUIRED FOR THE EXECUTION OF A CASE<br>OO622<br>C COMMON /DFAULT/ LOCM, LOCP, MTR, OR, ENX, FRO, XO, RO, 00622<br>C COMMON /DFAULT/ LOCM, LOCP, MTR, OR, ENX, FRO, XO, RO, 00622<br>C C                                                        | C                                                              | 00568                    |    |
| C IN ANY CASE, B AND C ARE THE TWO BRACKETS. ALSO BF IS CLOSER TO THEOGSO<br>ROT THAN CF IS.<br>55 IF (ABSIBF - ROOT) - ABSICF - ROOT) 60, 60, 57<br>6 = 0<br>6 = 0<br>7 A = B<br>6 = 0<br>6 = 0<br>6 = 0<br>7 A = B<br>7 A = B<br>7 A = B<br>8 = 0<br>6 = 0<br>7 A = B<br>8 = 0<br>7 A = B<br>8 = 0<br>7 A = B<br>8 = 0<br>7 CF = AF<br>7 D BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>7 OGSO<br>7 CF = AF<br>7 D BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>7 OGSO<br>7 CF = AF<br>7 OGSO<br>7 CF = AF<br>7 OGSO<br>7 D RAILECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>7 OGSO<br>7 D RAILECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE 60<br>7 OGSO<br>7 D RAILECT-BD/ABSIBISECT+BJ) -2.*TOL 1 75,65,65<br>7 OG603<br>7 D RAILECOJA, BAST, CF<br>7 D RAILECOJA, BAST, CF<br>1000 FUMAT (1H0/// 30X, '1N FALZIP, AFIER', 14, ' ITERATIONS' // 00605<br>1000 FUMAT (1H0/// 30X, '1N FALZIP, AFIER', 14, ' ITERATIONS' // 00606<br>1 10X, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 00607<br>7 D RAILIN = B<br>7 S FALZIP = B<br>7 S FALZIP = A<br>7 OGAT 1 '00000000000000000000000000000000000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | C IF CF IS CLOSER (ABS) TO ROOT THAN BE, SWITCH POINTS B AND   | C. 00584                 |    |
| C RUUT THAN CF IS. 00091<br>55 IF (AMS18F - RODT) - ABS(CF - RODT)) 60, 60, 57 00592<br>57 A = B<br>6 A = DF 00592<br>6 C 00595<br>6 C = A 00596<br>C = A 00597<br>C = A 00599<br>C = A 0000 - A A - A - A - A - A - A - A -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | C IN ANY CASE, B AND C ARE THE TWO BRACKETS. ALSO BE IS CLO    | SER TO THEOOSYO          |    |
| 35 1F (ABS(BF - RUUT) - ABS(LF - RUUT)) 60, 60, 57       00592         37 A = B       00593         AF = BF       00593         B = C       00593         C = A       00593         C = A       00593         C SET UP BISECTION POINT. IF CLOSE ENOUGH, FINISH UP. OTHERMISE 60       00602         B AK IF ITERATION COUNT DOESN*T EXCEED MAXIMUM.       00662         C SET UP BISECT-D/ABS(BISECT+B)) -2.*TOL ) 75,65,65       06603         60 BISE(I = (B + C) / 2.       00602         1 (ABS(BEET-B)/ABS(BISECT+B)) -2.*TOL ) 75,65,65       06603         100 FORMAT (IHU/// 30X, *IN FALZIP, AFTER*, 14, *ITERATIONS* // 00606       00604         100 FORMAT (IHU/// 30X, *IN FALZIP, AFTER*, 14, *ITERATIONS* // 00606       00604         100 FORMAT (IHU/// 30X, *IN FALZIP, AFTER*, 14, *ITERATIONS* // 00606       00607         2 10X, *BRACKET 1 = *, 615.8, 5X, *FUNCTION = *, 615.8/       00601         3 5X, *URACKET 1 MAS RETURNED AS RESULT.*)       006012         75 FALZIP = B       00613         90 FALZIP = A       00613         91 FALZIP = A       00613         92 FUNCTION AT BRACKETS GIVEN (=*, 615.8, *) DIDN**T FALL BET00617         1 INFEN VALUES OF FUNCTION AT BRACKETS GIVEN****/       00618         2 10X, *BRACKET 2 = *, 615.8, 5X, *FUNCTION = *, 615.8 /       00612                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | C RUUT THAN CF IS.                                             | 00591                    |    |
| > A = B       00593         A = BF       00594         B = C       00595         B = C       00596         C = A       00597         C = A F       00597         C = A F       00599         C = B = C       00599         C = A F       00599         C = B = C = A F       00599         C = B = C = B + C + Z = C = C = C = C = C = C = C = C = C =                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 55 IF (AUS(UF - RUUT) - AUS(CF - RUUT)) 60, 60, 57             | 00572                    |    |
| AF = DF       00595         B = C       00595         bF = CF       00595         C = A       00597         C SET UP BISECTION POINT. IF CLOSE ENDUCH, FINISH UP. OTHERWISE 60       00600         C MACK IF ITERATION COUNT DDESN*T EXCLED MAXIMUM.       00602         60 BISE(I = (B + C) / 2.       00596         C I (AUSIBISECT-B)/ABSIBISECT+B)) -2.*TOL ) 75,65,65       00600         60 BISE(I = (B + C) / 2.       00605         1000 FURMAT (1HU/// 30X, *IN FALZIP, AFIER*, 14, * ITERATIONS* // 00606       00607         1000 FURMAT (1HU/// 30X, *IN FALZIP, AFIER*, 14, * ITERATIONS* // 00606       00607         1000 FURMAT (1HU/// 30X, *IN FALZIP, AFIER*, 14, * ITERATIONS* // 00606       00607         2 UX, *BRACKET 1 = *, GIS.8, 5X, *FUNCTION = *, GIS.8/ 00607       00601         3 5x, *URACKET 1 = *, GIS.8, 5X, *FUNCTION = *, GIS.8/ 00607       00611         Y = upF       00612       00612         80 FALZIP = B       00612       00612         YY = upF       00613       00612         RETURN       00612       00614         RETURN       00612       00613         100 FORMAT (*0***IN FALZIP, ROT GIVEN (=*, GIS.8, *) DIDN**T FALL BET00617         I HEN VALUES OF FUVCTION AT BRACKETS GIVEN=**/       00612         100, x*0RACKET 1 = *, G                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                | 00593                    |    |
| bF = C       00596         C = A       00597         CF = AF       00597         C SET UP BISECTION POINT. IF CLOSE ENOUGH, FINISH UP. OTHERWISE 60       00597         C BACK IF ITERATION COUNT DDESN*T EXCLED MAXIMUM.       00601         00 BISECT = (B + C) / 2.       00602         11 (ABSIDISECT-DAPASIGISECT+B)) -2.*TOL) 75,65,65       00602         00 BISECT = (B + C) / 2.       00604         10 BISECT = (B + C) / 2.       00604         11 (ABSIDISECT-BLASSIGISECT+B)) -2.*TOL) 75,65,65       00607         11 (ABSIDISECT = (CF)       00604         1000 FUNHAT (1100/// 30X, '1N FALZIP, AFTER*, 14, * ITERATIONS* // 00607       00604         1000 FUNHAT (1100/// 30X, '1N FALZIP, AFTER*, 14, * ITERATIONS* // 00606       00604         11 (DX, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 00607       00607         2 10X, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 00607       00618         Y = DF       00611       00612         RETURN       00613       00614         NY = AF       00614       00615         1100 FORMAT (100FRODT,A, AF, B, BF       00616         1100 FORMAT (100FRODT,A, AF, B, SK, 'FUNCTION = ', G15.8, ') DIDN*'T FALL BETO(0618         2 10X, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8 / 00618         3 10X, 'BRACKET 1 = ', G15.8,                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Ar = Dr<br>L = C                                               | 00574                    |    |
| $ \begin{array}{llllllllllllllllllllllllllllllllllll$                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                | 00546                    |    |
| CF = AF<br>C 00599<br>C 00599<br>C SET UP BISECTION POINT. IF CLOSE ENDUCH, FINISH UP. OTHERWISE GO 00600<br>UBACK IF ITERATION COUNT DDESN*T EXCEED MAXIMUM. 06601<br>60 BISECT = (B + C) / 2. 00662<br>11 (ABSIBISECT=b)/ABSIGISECT+B)) -2.*TOL ) 75,65,65<br>06603<br>05 IF (J - ITER) 5, 70, 70<br>1000 FUNHAT (INU/// 30X, 'IN FALZIP, AFTER*, 14, 'ITERATIONS* // 00604<br>1000 FUNHAT (INU/// 30X, 'IN FALZIP, AFTER*, 14, 'ITERATIONS* // 00607<br>1000 FUNHAT (INU/// 30X, 'IN FALZIP, AFTER*, 14, 'ITERATIONS* // 00607<br>1000 FUNHAT (INU/// 30X, 'IN FALZIP, AFTER*, 14, 'ITERATIONS* // 00607<br>2 UDX, 'BRACKET 1 = ', GIS.8, 5X, 'FUNCTION = ', GIS.8/ 06607<br>2 UDX, 'BRACKET 1 = ', GIS.8, 5X, 'FUNCTION = ', GIS.8/ 06607<br>3 SX, 'BRACKET 1 HAS RETURNED AS RESULT.*') 006009<br>75 FALZIP = B 00611<br>NY = 0F 00611<br>BO FALZIP = A 00613<br>3 Y = AF 00616<br>1000 FORMAT ('0**IN FALZIP, ROOT GIVEN (=', GIS.8, ') DIDN*T FALL BETONGT<br>INEEN VALUES OF FUNCTION AT BRACKETS GIVEN44*Y/ 06618<br>2 IUX, 'BRACKET 2 = ', GIS.8, 5X, 'FUNCTION = ', GIS.8 / 06619<br>3 IOX, 'BRACKET 2 = ', GIS.8, 5X, 'FUNCTION = ', GIS.8 / 06620<br>4 40X, 'TERMINATING RUN' ) 00620<br>5 TUP<br>END 00622<br>C THIS SUBROUTINE INPUT( TEND ) 06624<br>1 100, X(501, R(501, THM (501, BETAMISO), PSIN(50), 00626<br>1 100, X(501, R(501, THM (501, BETAMISO), PSIN(50), 00626<br>1 100, TASID, PREF, AND, SIGH, SIGH, SIGH, SIGH, A, FREQ, A, 00633<br>1 00745                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | DF - CF<br>C = A                                               | 00597                    |    |
| C SET UP BISECTION POINT. IF CLOSE ENDUCH, FINISH UP. OTHERWISE GO 00599<br>C SET UP BISECTION COUNT DESN*T EXCLED MAXIMUM.<br>G BALL = (B + C) / 2.<br>IF (IABS(BISECT-B)/ABS(BISECT+B)) -2.*TOL) 75,65,65<br>G IAC MAXIMIN, 00604<br>1000 FURMAT (IHU/// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00605<br>1000 FURMAT (IHU/// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00607<br>2 LUX, 'BRACKET 1 = ', GIS.8, 5X, 'FUNCTION = ', GIS.8/ 00609<br>3 SX, 'BRACKET 2 = ', GIS.8, 5X, 'FUNCTION = ', GIS.8/ 00609<br>75 FALZIP = B<br>G FALZIP = B<br>G FALZIP = A<br>G FALZIP = A<br>G FALZIP = A<br>I UX, 'BRACKET 1 = ', GIS.8, 5X, 'FUNCTION = ', GIS.8/ 00610<br>YY = UF<br>RETURN<br>B FALZIP = A<br>G FALZIP = C<br>G FUNCTION AT BRACKETS GIVEN***/<br>G FALZIP = C<br>G FUNCTION AT BRACKET S = ', GIS.8, 'D DIDN**T FALL BETONGAT<br>INFEN VALUES OF FUNCTION AT BRACKETS GIVEN***/<br>G FALZIP = C<br>G FUNCTION AT BRACKET S = ', GIS.8 / 00618<br>C THIS SUBRCUTINE INPUT( IEND )<br>C COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, NOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO,<br>G COMMON /CNSTNT/ NMFAS, NIRED, NUDES, SIGHA, B, MX, FREQ, A,<br>G COMMON /CNSTNT/ NMFAS, NIRED, NUDES, SIGHA, B, MX, FREQ, A,<br>G COMMON /CNSTNT/ NMFAS, NIRED, NUDES, SIGHA, B, MX, FREQ, A,<br>G COMMON /CNSTNT/ NMFAS, NIRED, NUDES, SIGHA, B, MX, FREQ, A,<br>G COMMON /CNSTNT/ NMFAS, NIRED, NUDES, SIGHA, B, MX, FREQ, A,<br>G COMMON /CNSTNT/ NMFAS, NIRED, NUDES, SIGHA, B, MX, FREQ, A,<br>G COMMON /CNSTNT/ NMFAS, NIRED, NUDES, SIGHA, B, MX, FREQ                                                 | CF = AF                                                        | 00595                    |    |
| C SET UP BISECTION POINT. IF CLOSE ENDUGH, FINISH UP. OTHERWISE GO<br>DACK IF ITERATION COUNT DDESN'T EXCLED MAXIMUM.<br>GG600<br>C BACK IF ITERATION COUNT DDESN'T EXCLED MAXIMUM.<br>GG602<br>IF (IABS(BISECT-B)/ABS(BISECT+B)) -2.*TOL) 75,65,65<br>GG603<br>65 IF (J - ITER) 5, 70, 70<br>70 WRITE(6,1000)J,BF;L;Cf<br>1000 FURMAT (IHG/// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00606<br>1000 FURMAT (IHG/// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00606<br>1000 FURMAT (IHG/// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00606<br>1 UUX, 'URACKET 1 = ', GIS.6, 5X, 'FUNCTION = ', GIS.6/ 00607<br>2 UUX, 'URACKET 1 = ', GIS.6, 5X, 'FUNCTION = ', GIS.6/ 00607<br>75 FALZIP = B<br>00610<br>YY = UF<br>RETURN<br>00614<br>RETURN<br>00615<br>1000 FORMAT ('00+*IN FALZIP, RODT GIVEN (=', GIS.8, ') DIDN''T FALL BETONGIT<br>IMEEN VALUES OF FUNCTION AT BRACKETS GIVEN***/ 00618<br>2 UUX, 'URACKET 1 = ', GIS.6, 5X, 'FUNCTION = ', GIS.8 / 00619<br>3 10X, 'URACKET 1 = ', GIS.6, 5X, 'FUNCTION = ', GIS.8 / 00618<br>C GG625<br>C THIS SUBROUTINE INPUT( TEND )<br>C COMMUN /DFAULT/ LOCM, LOCP, HTR, OR, EMX, FRQ, XO, RO, 00628<br>1 UTA, YER, SIGR, SIGT, SIGH, SIGH, B, MX, FREQ, A, 00633<br>1 UWEAA<br>C ONHON /CRSTNT/ NMFAS, NIRED, NHOLES, SIGHA, B, MX, FREQ, A, 00633<br>1 UWEAA<br>C ONHON /CNSTNT/ NMFAS, NIRED, NHOLES, SIGHA, B, MX, FREQ, A, 00633<br>1 UWEAA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | C C                                                            | 00599                    |    |
| C       BACK IF ITERATION COUNT DOESN*T EXCEED MAXIMUM.       G0601         60 BISE(T = (B + C) / 2.       IF (ABSIBISECT = b)ABSIBISECT+B)) -2.*TOL) 75,65,65       G0603         65 IF (J = ITER) 5, 70, 70       00604         70 WRITEL6, 1000]J,B,BF,L,CF       00605         1000 FUKMAT (HU/// 30X, *IN FALZIP, AFTER*, 14, *ITERATIONS* // 00606       00604         1 UX, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8/ 00607       00604         2 UX, *BRACKET 1 = *, G15.6, 5X, *FUNCTION = *, G15.8/ 00607       00607         3 5X, *URACKET 1 WAS RETURNED AS RESULT.*)       00601         75 FALZIP = B       00611         80 FALZIP = A       00613         90 FALZIP = A       00616         1000 FURMAT (*00**IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN*T FALL BETONCIT         1000 FORMAT (*00*A, AF, B, BF       00618         91 JUX, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00618         1000 FORMAT (*00*A, AF, B, BF       00616         1100 FORMAT (*00*A, AF, B, BF       00618         2 100, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00618       00618         2 100, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00624       00621         3 100, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00624       00622         4 400, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00624       00622                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | C SET UP BISECTION POINT. IF CLOSE ENDUGH. FINISH UP. OTHER    | WISE 60 00600            |    |
| 60 BISELT = (B + C) / 2.       00662         1F (IABS(BISECT-B)/ABS(BISECT+B)) -2.*TOL) 75,65,65       00603         65 IF (J - ITER) 5, 70, 70       00604         70 WRITEL6,1000J,B,BF,C,CF       00605         1000 FURMAT (IHU/// 30X, *IN FALZIP, AFTER*, 14, * ITERATIONS* // 00607       00605         1 UX, *BRACKET 1 = *, GIS.8, 5X, *FUNCTION = *, GIS.8/ 00607       00604         2 LUX, *BRACKET 2 = *, GIS.6, 5X, *FUNCTION = *, GIS.8/ 00607       00601         75 FALZIP = B       00611         YY = UF       00612         80 FALZIP = A       00613         YY = UF       00614         RETURN       00615         80 FALZIP = A       00618         YY = AF       00618         100 + ORMAT (*0**IN FALZIP, ROOT GIVEN (=*, GIS.8, *) DIDN**T FALL BETORGIT         INEEN VALUES UF FUNCTION AT BRACKETS GIVEN****/       00618         2 LUX, *BRACKET 1 = *, GIS.8, 5X, *FUNCTION = *, GIS.8 / 00620       00621         3 10X, *BRACKET 2 = *, GIS.8, 5X, *FUNCTION = *, GIS.8 / 00620       00622         4 40X, *TERMINATING RUN* )       00622       00622         5 TUP       6025       6       00622         6 THIS SUBROUTINE INPUT( TEND )       00622       00622         6 TUP       1000, X1501, R(501, THM(501, BETAM1501, PSIM1501, 00622                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | C BACK IF ITERATION COUNT DDESN'T EXCEED MAXIMUM.              | 00601                    |    |
| <pre>1+ ((ABS(B)SECT-B)/ABS(B)SECT+B)) -2.*TOL) 75,65,65 06603 65 IF (J - 1TER) 5, 70, 70 00604 70 WRITE(6,1000)J,B,BF,LCF 00605 1000 FUKMAT (1H0/// 30X, *IN FALZIP, AFTER*, 14, * ITERATIONS* // 00606 1 10X, *BRACKET 1 = *, 615.8, 5X, *FUNCTION = *, 615.8/ 00607 2 10X, *BRACKET 1 = *, 615.6, 5X, *FUNCTION = *, 615.8/ 00607 75 FALZIP = B 00611 YY = UF 00611 RETURN 00612 80 FALZIP = A 00613 YY = AF 006614 100 + 0RMA1 (*0++1N FALZIP, ROT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, ROT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, ROT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, ROT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) DIDN**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) ODOA**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) ODOA**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) ODOA**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) ODOA**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) ODOA**T FALL BET00617 100 + 0RMA1 (*0++1N FALZIP, KOT GIVEN (=*, G15.8, *) ODOA**T FALL BET00617 2 00622 C C C C C C C C C C C C C C C C C C C</pre>                                                                                                                                                                                                                                                                                                                  | 60 BISE(T = (B + C) / 2.                                       | 00662                    |    |
| 65       IF (1) - 1TER) 5, 70, 70       00604         70       WRITEL6,1000]J,B,BF,L,CF       00605         1000       FUHAT (1H0// 30X, '1N FALZIP, AFTER', 14, 'ITERATIONS' // 00607       00605         1       UX, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 00607         2       UX, 'BRACKET 2 * ', G15.6, 5X, 'FUNCTION = ', G15.8/ 00607         3       5X, 'BRACKET 1 MAS RETURNED AS RESULT.')       006010         75       FALZIP = B       00613         97       FALZIP = A       00613         90       FALZIP = A       00614         90       FALZIP = A       00615         90       FALZIP = A       00616         9100       FALZIP = A       00616         9100       FALZIP = A       00616         9100       FALZIP, ROOT GIVEN (=', G15.8, ') DIDN*T FALL BETONET         91       FALZIP, ROOT GIVEN (=', G15.8, ') DIDN*T FALL BETONET         92       10X, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8 / 00618         91       10X, 'BRACKET 2 = ', G15.8, 5X, 'FUNCTION = ', G15.8 / 00621         91       004, 'ERHINATING RUN')       00622         91       10X, 'BRACKET 2 = ', G15.8, 5X, 'FUNCTION = ', G15.8 / 00624       00622         91       00622       00622       00622                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 1F ((ABS(B)SECT-B)/ABS(BISECT+B)) -2.+TOL) 75,65,65            | 00603                    |    |
| 70       WRITEL6, 1000J, B, BF, L, CF       00605         1000       FURMAT (1Hu/// 30X, *1N FALZIP, AFTER*, 14, *1TERATIONS* // 00606         1       102, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8/ 00607         2       10X, *BRACKET 2 = *, G15.6, 5X, *FUNCTION = *, G15.8/ 00607         2       10X, *BRACKET 1 WAS RETURNED AS RESULT.*)       00609         75       FALZIP = B       00610         YY = UF       00611         RETURN       00612         80       FALZIP = A       00613         YY = AF       00614         RETURN       00616         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETOCH:T         100 CRMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 65 IF (J - ITER) 5, 70, 70                                     | 00604                    |    |
| 1000 FUKMAT (1HU/// 30X, 'IN FALZIP, AFTER', 14, 'ITERATIONS' // 00607<br>1 10X, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8/ 00607<br>2 10X, 'BRACKET 2 = ', G15.6, 5X, 'FUNCTION = ', G15.8/ 00607<br>3 5X, 'BRACKET 1 WAS RETURNED AS RESULT.') 00607<br>75 FALZIP = B 00601<br>YY = UF 00601<br>RETURN 00612<br>80 FALZIP = A 00613<br>YY = AF 0004 GIVEN (=', G15.8, ') DIDN''T FALL BETORGIT<br>INCEN VALUES UF FUNCTION AT BRACKETS GIVEN 4=*, G15.8, ') DIDN''T FALL BETORGIT<br>INCEN VALUES UF FUNCTION AT BRACKETS GIVEN 4=*, G15.8, ') DIDN''T FALL BETORGIT<br>100, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8 / 00618<br>100, 'BRACKET 1 = ', G15.8, 5X, 'FUNCTION = ', G15.8 / 00620<br>4 40X, 'TERMINATING RUN' ) 00621<br>STUP<br>END 00622<br>COMMON /DFAULT/ LOCM, LOCP, HTR, GR, EMX, FRQ, XO, RO, 00628<br>1 01X, 'DFAULT/ LOCM, LOCP, HTR, GR, EMX, FRQ, XO, RO, 00628<br>1 01X, 'SIG, SIGT, SIGT, SIGH, SIGH, B, MX, FREU, A, 00633<br>1 01X, 'SIG, SIGT, SIGH, SIGH, B, MX, FREU, A, 00631<br>1 01X, SIGR, SIGT, SIGH, SIGH, B, MX, FREU, A, 00631<br>1 01X, SIGR, SIGT, SIGH, SIGH, B, MX, FREU, A, 00633<br>1 01X, 'NTT, NHTAS, NPRED, NNUDES, SIGHA, B, MX, FREU, A, 00634<br>1 00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 70 WRITE(6,1000)J,B,BF,L,CF                                    | 00605                    |    |
| 1       1 UX, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8/       00607         2       1 UX, *BRACKET 2 = *, G15.8, 5X, *FUNCTION = *, G15.8/       GG408         3       5X, *BRACKET 1 WAS RETURNED AS RESULT.*)       00607         75       FALZIP = B       00610         YY = bF       00611         RETURN       00613         90       FALZIP = A       00613         YY = AF       00614         RETURN       00615         85       WRITE(6,1100)ROOT,A, AF, B, BF       00616         100 + ORMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETORAT7       10616         1100 + ORMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETORAT7       10618         2       10X, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 /       00618         2       10X, *BRACKET 2 = *, G15.8, 5X, *FUNCTION = *, G15.8 /       00620         4       40X, *TERMINATING RUN* )       00621         3       10X, *BRACKET 2 = *, G15.8, 5X, *FUNCTION = *, G15.8 /       00622         4       40X, *TERMINATING RUN* )       00622         5       SUBROUTINE INPUT( TEND )       60624         C       00627       00627         C       00628       00627         C       00627                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1000 FURMAT (1HU/// 30X, "IN FALZIP, AFTER", 14, " ITERATIONS  | • // 00606               |    |
| 2 10X, "BRACKET 2 = ", G15-6, 5X, "FUNCTION = ", G15-8/ GG66B<br>3 5X, "URACKET 1 WAS RETURNED AS RESULT.") 00600<br>75 FALZIP = B 00600<br>YY = UF 000611<br>RETURN 00613<br>YY = AF 00614<br>RETURN 00616<br>1000 FORMAT ("O++IN FALZIP, ROOT GIVEN (=", G15-8, ") DIDN**T FALL BETORAT7<br>IMEEN VALUES UF FUNCTION AT BRACKETS GIVEN+***/ 00618<br>2 10X, "BRACKET 1 = ", G15-8, 5X, "FUNCTION = ", G15-8 / 00620<br>4 40X, "TERMINATING RUN" ) 00622<br>5 TUP 00622<br>COMMON /DFAULT/ LOCM, LOCP, HTR, DR, EMX, FRQ, XO, RO, 00628<br>1 THO, X150), R150), R150, M150, NUS(50), 00629<br>1 THO, X150), R150, THP150, M150, NUS(50), 00630<br>3 107(SNT/ NH-AS, NFRED, NUODES, SIGHA, B, MX, FREQ, A, 00633<br>1 UMESA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1 10x, *bRACKET 1 = *, G15.8, 5x, *FUNCTION = *, G15.8         | / 00607                  |    |
| 3       5X, "BRACKET I WAS RETURNED AS RESULT.")       000607         75 FALZIP = B       00610         YY = UF       00611         80 FALZIP = A       00613         YY = AF       00614         RETURN       00615         85 WRITEL6,1100JR00T,A,AF,B,BF       00616         1100 FORMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETORAT         1100 FORMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETORAT         1100 FORMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETORAT         1100 FORMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETORAT         1100 FORMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) OD618         2 10X, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00620         4       40X, *TERMINATING RUN* )         3 10X, *BRACKET 2 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00621         5 TUP       00621         5 TUP       00622         4       40X, *TERMINATING RUN* )         5 SUBROUTINE INPUT( TEND )       00623         5 C TH1S SUBROUTINE INPUTS THE DATA REQUIRED FOR THE EXECUTION OF A CASE (00626         C       00627         2       PX (50), R150, TH* (50), BETAMI50), PSIM(50), 00628         1       TH0, X (50), R150, TH* (50), MIS0), MUS150), 00628         2       PX (50), PR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2 1ux, "BRACKET 2 = ", G15.8, 5X, "FUNCTION = ", G15.8         | 80300                    |    |
| 75 FALTIP = 8       00610         YY = 0F       00611         RETURN       00612         80 FALTIP = A       00613         YY = AF       00616         100 FORMAT 1*0++1N FALTIP, ROOT GIVEN (=*, GI5.8, *) DIDN**T FALL BET00617         IMEEN VALUES OF FUNCTION AT BRACKETS GIVEN++***/       00618         2 10X, *DRACKET 1 = *, GI5.8, 5X, *FUNCTION = *, GI5.8 / 00620         4 40X, *DERACKET 2 = *, GI5.8, 5X, *FUNCTION = *, GI5.8 / 00621         3 10X, *DRACKET 2 = *, GI5.8, 5X, *FUNCTION = *, GI5.8 / 00621         STUP       00622         END       00623         SUBROUTINE INPUT( TEND )       G0625         C       COMMUN /DFAULT/ LOCM, LOCP, MTR, OR, EMX, FRQ, XO, RO, 00628         1       THO, X(50), R(50), THM150), BETAM150), PSIM150), 00629         2       PX150), PR (50), THP150), MI50), MUS150), 00630         3       101R(50), PREF, AM150), PH1(50), 1CHK, 60631         4       SIGX, SIGR, SIGT, SIGH, SIGP, IEMU, SPEED       60632         1       UMELA       00633                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3 5X, "URACKET I WAS RETURNED AS RESULT.")                     | 00809                    |    |
| VY = 0F       00611         RETURN       00612         80 FALZIP = A       00613         YY = AF       00614         RETURN       00616         1100 FORMAT (*0**IN FALZIP, ROOT GIVEN (=*, GI5.8, *) DIDN**T FALL BETONATT       00618         1100 FORMAT (*0**IN FALZIP, ROOT GIVEN (=*, GI5.8, *) DIDN**T FALL BETONATT       00619         1100 FORMAT (*0**IN FALZIP, ROOT GIVEN (=*, GI5.8, *) DIDN**T FALL BETONATT       00619         1100 FORMAT (*0**IN FALZIP, ROOT GIVEN (=*, GI5.8, *) DIDN**T FALL BETONATT       00619         1100 FORMAT (*0**IN FALZIP, ROOT GIVEN (=*, GI5.8, *) DIDN**T FALL BETONATT       00618         2 1000, *BRACKET 1 = *, GI5.8, 50, *FUNCTION = *, GI5.8 / 06619       00621         3 1000, *BRACKET 2 = *, GI5.8, 50, *FUNCTION = *, GI5.8 / 06620       00621         4 4000, *TERMINATING RUN* )       00621         STUP       00622         END       00623         SUBROUTINE INPUT( TEND )       00624         C       00625         C       00626         C       00627         COMMON /DFAULT/ LOCM, LOCP, HTR, OR, ENX, FRQ, XO, RO, 00628         1       TH0, X(50), R(50), THM(50), MUS(50), 00639         2       PX(50), PREF, AM(50), PHI(50), RUS(50), 00631         3       1011R(50), PREF, AM(50), PHI(50), ICHK, 00631 </td <td>/&gt; FALLIP = B</td> <td>00810</td> <td></td>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | /> FALLIP = B                                                  | 00810                    |    |
| B0 FAL/1P = A       00613         YY = AF       00616         RETURN       00615         B5 WRITE(6,1100)RODT,A,AF,B,BF       00616         100 + 0RMA1 (*0***IN FAL/IP, RODT GIVEN (=*, G15.8, *) DIDN**T FALL BETORAT       00618         2 10X, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00620       00621         3 10X, *BRACKET 2 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00620       00622         4 40X, *TERMINATING RUN* )       00623         STUP       00624         END       00627         C       00627         C       00627         C       00628         1       THO, X(50), R(50), THM (50), BETAM(50), PSIM(50), 00624         2       PX(50), PK(50), THM(50), BETAM(50), PSIM(50), 00630         3       101R(50), PREF, AM(50), PH(50), MUS(50), 00630         3       101R(50), PREF, AM(50), PH(50), ICMK, 60631         4       S16X, S1GR, S1GT, S1GB, S1GHA, B, MX, FREU, A, 00633         1       UMEGA       00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TT                         | 00612                    |    |
| 00       Filler       00013         YY = AF       00016         RETURN       00616         1100 FORMAT (*0***IN FALZIP, ROOT GIVEN (=*, GI5.8, *) DIDN**T FALL BETORGI7         IwEEN VALUES OF FUNCTION AT BRACKETS GIVEN****/       00618         2       10X, *BRACKET 1 = *, GI5.8, 5X, *FUNCTION = *, GI5.8 /       00620         4       40X, *BRACKET 2 = *, GI5.8, 5X, *FUNCTION = *, GI5.8 /       00621         3       10X, *BRACKET 2 = *, GI5.8, 5X, *FUNCTION = *, GI5.8 /       00620         4       40X, *TERMINATING RUN*)       00621         STUP       00622       00623         SUBROUTINE INPUT( TEND )       00624         C       C       COMMUN /DFAULT/ LOCM* LOCP* HTR, OR, EMX* FRQ, XO, RO, 00628         1       TH0, X(50), R(50), THM(50), BETAN(50), PSIM(50), 00629       00621         2       PX(50), PR(50), THM(50), MUS(50)*, 00630       00627         C       COMMUN /DFAULT/ LOCM* LOCP* HTR, OR, EMX* FRQ, XO, RO, 00628       00627         1       TH0, X(50), R(50), THM(50), BETAN(50)*, PSIM(50)*, 00630       00632         3       101R(50)*, PREF*, AM(50)*, PH(50)*, MUS(50)*, 00630       00631         4       SIGX*, SIGR*, SIGT, SIGB*, SIGH*, EMU*, SPEED       00632         2       PX(50)*, PREF*, AM(50)*, PH(50)*, 1CMK*, FREQ*, A, 00633                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                | 00613                    |    |
| RETURN       07615         85 WRITE(6,1100)RODT,A,AF,B,BF       00616         1100 FORMAT (*0+++IN FALZIP, ROOT GIVEN (=*,G15.8,*) DIDN**T FALL BETOR617       06618         2 10X, *BRACKET 1 = *,G15.8,5X, *FUNCTION = *,G15.8 /       00619         3 10X, *BRACKET 1 = *,G15.8,5X, *FUNCTION = *,G15.8 /       00620         4 40X, *BRACKET 2 = *,G15.8,5X, *FUNCTION = *,G15.8 /       00621         5TUP       00623         SUBROUTINE INPUT( TEND )       00624         C       00625         C THIS SUBROUTINE INPUTS THE DATA REQUIRED FOR THE EXECUTION OF A CASE 00626         1       TH0,X(50), R(50), THM(50), BETAM(50), PSIM(50), 00629         2       PX(50), PK (50), THP(50), M(50), MUS(50), 00639         3       101R(50), PREF, AM(50), PH1(50), ICMK, 60631         4       SIGX, SIGR, SIGT, SIGH, SIGP, IEMU, SPEED 00632         COMMON /CNSTNT/ NM+AS, NPRED, NMUDES, SIGMA, B, MX, FREU, A, 00633         1       UMEGA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | VV z AF                                                        | 1 00614                  |    |
| 85       WRITE(6,1100)ROOT,A,AF,B,BF       00616         1100       FORMAT (*0***IN FALZIP, ROOT GIVEN (=*, GI5.8, *) DIDN**T FALL BETORAIT         1NEEN VALUES OF FUNCTION AT BRACKETS GIVEN****/       00618         2       10X, *DRACKET 1 = *, GI5.8, 5X, *FUNCTION = *, GI5.8 /       00619         3       10X, *DRACKET 2 = *, GI5.8, 5X, *FUNCTION = *, GI5.8 /       00620         4       40X, *TERMINATING RUN*)       00621         5TUP       00622       00623         END       00624       00623         SUBROUTINE INPUT( TEND )       00624         C       00627         COMMUN /DFAULT/ LOCM, LOCP, HTR, OR, EMX, FRO, XO, RO,       00628         1       THO, X(50), R(50), THM(50), BETAM(50), PSIM(50), 00624         2       PX(50), PR(50), THP(50), M(50), MUS(50), 00624         2       PX(50), PREF, AM(50), PH(50), M(50), MUS(50), 00624         3       101R(50), PREF, AM(50), PH(50), ICMK, 60631         4       SIGX, SIGR, SIGT, SIGHA, B, MX, FREQ, A, 00633         1       UMEGA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | RETURN                                                         | 09615                    |    |
| 1100 FORMAT (*0***IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**T FALL BETORGIT         1NEEN VALUES OF FUNCTION AT BRACKETS GIVEN****/       60618         2 10X, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 /       60619         3 10X, *BRACKET 2 = *, G15.8, 5X, *FUNCTION = *, G15.8 /       60620         4 40X, *TERMINATING RUN*)       00621         5TUP       00622         END       00623         SUBROUTINE INPUT( TEND )       60624         C       00625         C THIS SUBROUTINE INPUT( TEND )       60626         C       00627         COMMON /DFAULT/ LOCM, LOCP, HTR, OR, EMX, FRO, XO, RO,       00628         1       THO, X(50), R(50), THM(50), BETAM(50), PSIM(50), 00624         2       PX (50), PR (50), THP(50), M(50), MUS (50), 00628         1       THO, X(50), PREF, AM (50), PSIM(50), 00628         3       101R (50), PREF, AM (50), PSIM(50), 00628         4       S1GX, S1GR, S1GT, SIGH, S1GH, S1GH, G0631         4       S1GX, S1GR, S1GT, SIGH, S1GH, MX, FREU, A, 00633         1       UMEGA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 85 WRITE 16.1100)R00T.A.AF.B.BF                                | 00616                    |    |
| INEEN VALUES OF FUNCTION AT BRACKETS GIVEN****/       60618         2       16X, *BRACKET 1 = *, 615.8, 5X, *FUNCTION = *, 615.8 /       66619         3       10X, *BRACKET 2 = *, 615.8, 5X, *FUNCTION = *, 615.8 /       60620         4       40X, *TERMINATING RUN*)       00621         5TUP       60623         END       00624         SUBROUTINE INPUT( TEND )       60626         C       60627         C       60628         C       60627         C       60626         C       60627         C       60628         C       60624         C       60625         C       60626         C       60627         C       60628         C       60627         C       60628         C       60626         C       60627         C       60628         1       THO, X(50), RTF, OR, EMX, FRO, XO, RO, 00628         1       THO, X(50), R(50), THM(50), BETAM(50), PSIM(50), 00629         2       PX(50), PR(50), THP(50), MISO), MUS(50), 00630         3       101R(50), PREF, AM(50), PH(50), ICHK, 60631         4       SIGX, SIGR, SIGT, SIGH, SIGH, IEMU, SPE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1100 FORMAT (*0+++IN FALZIP, ROOT GIVEN (=*, G15.8, *) DIDN**  | T FALL BETOOGIT          |    |
| 2 10X, *BRACKET 1 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 06619<br>3 10X, *BRACKET 2 = *, G15.8, 5X, *FUNCTION = *, G15.8 / 00620<br>4 40X, *TERMINATING RUN*)<br>5TUP<br>END<br>5UDROUTINE INPUT( TEND )<br>C<br>C<br>COMMON /DFAULT/ LOCM, LOCP, HTR, OR, EMX, FRQ, XO, RO, 0628<br>1 THO, X(50), R(50), THM(50), BETAM(50), PSIM(50), 00628<br>1 THO, X(50), R(50), THM(50), MUS(50), 00630<br>3 101R(50), PREF, AM(50), PHI(50), ICHK, 60631<br>4 SIGX, SIGR, SIGT, SIGH, SIGP, IEMU, SPEED 60633<br>1 UMEGA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | IWEEN VALUES OF FUNCTION AT BRACKETS GIVEN****/                | 00618                    |    |
| 3       10x, *BRACAET 2 = *, G15.8, 5X, *FUNCTION = *, G15.8 /       00620         4       40x, *TERMINATING RUN*)       00621         STUP       00622         END       00623         SUBROUTINE INPUT( TEND )       00625         C       00625         C       00627         C       00628         1       TH0, X(50), REQUIRED FOR THE EXECUTION OF A CASE         00627       00628         1       TH0, X(50), RESOL, THM(50), BETAMISOL, PSIM(50), 00629         2       PX(50), PK (50), THP(50), MISOL, MUS(50), 00630         3       101R(50), PREF, AM(50), PH1(50), ICHK, 60631         4       SIGX, SIGR, SIGT, SIGHA, B, MX, FREQ, A, 00633         1       UMEGA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 2 10X, "BRACKET 1 = ", G15.8, 5X, "FUNCTION = ", G15.8         | / 06619                  |    |
| 4       40x, *TERMINATING RUN*)       00621         STUP       00622         ENU       00623         SUBROUTINE INPUT(TEND)       00624         C       60625         C       C         C       COMMUN /DFAULT/ LOCM* LDCP* HTR, OR, EMX* FRQ, X0* R0*       00628         1       THO, X(50), R(50), THMI50), BETAM(50), PSIM(50), 00628       00629         2       PX(50), PR(50), THMI50), MISO), MUS(50)*       00630         3       101R(50)* PREF, AM(50), PHI(50)*, 1CHK*       60631         4       SIGX* SIGR* SIGT* SIGB* SIGP* IEMU* SPEED       60632         COMMON /CNSTNT/ NH+AS* NPRED, NMUDES* SIGMA* B* MX* FREU* A*       00633                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 3 10X, "BRACKET 2 = ", G15.B, 5X, "FUNCTION = ", G15.8         | / 00620                  |    |
| STUP       00622         END       00623         SUBROUTINE INPUT(TEND)       00624         C       00625         C       00626         C       00627         COMMON /DFAULT/ LOCM+ LDCP+ HTR, OR, EMX+ FRQ, X0, R0, 00628       00627         C       00628         1       THO, X(50), R(50), THM150), BETAM(50), PSIM(50), 00629         2       PX(50), PR(50), THM150), MUS(50), 00630         3       101R(50), PREF, AM(50), PHI(50), 1CHK, 60631         4       SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED       00632         COMMON /CNSTNT/ NH+AS, NPRED, NMUDES, SIGMA, B, MX+ FREQ, A, 00633       00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 4 40X, "TERMINATING RUN" }                                     | 00621                    |    |
| END       00623         SUBROUTINE INPUT( TEND )       60624         C       60625         C THIS SUBROUTINE INPUTS THE DATA REQUIRED FOR THE EXECUTION OF A CASE       60625         C       00623         C CMMUN /DFAULT/ LOCM+ LDCP+ HTR, OR, EMX+ FRQ, X0, R0,       00627         C CMMUN /DFAULT/ LOCM+ LDCP+ HTR, OR, EMX+ FRQ, X0, R0,       00628         1       THO, X(50), R(50), THM150), BETAM(50), PSIM(50),       00628         2       PX(50), PR(50), THP150), M(50), MUS(50),       00630         3       101R(50), PREF, AM(50), PH1(50), ICMX,       60631         4       SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED       60632         COMMON /CNSTNT/ NH+AS, NPRED, NMUDES, SIGMA, B, MX+ FREQ, A,       00633         1       UMEGA       00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | STUP                                                           | 00622                    |    |
| SUBROUTINE INPUT( TEND )         60624           C         G0625           C THIS SUBROUTINE INPUTS THE DATA REQUIRED FOR THE EXECUTION OF A CASE         60626           C         COMMON /DFAULT/ LOCM, LDCP, HTR, OR, EMX, FRQ, XO, RO,         00627           1         THO, X(50), R(50), THM150), BETAM(50), PSIM(50),         00628           2         PX150), PR(50), THM150), MISO), MUS(50),         00630           3         101R(50), PREF, AM(50), PH1(50), ICMK,         60631           4         SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED         60632           COMMON /CNSTNT/ NH+AS, NPRED, NMUDES, SIGMA, B, MX, FREQ, A,         00633           1         UMEGA         00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ENU                                                            | 00623                    |    |
| C       G0825         G THIS SUBROUTINE INPUTS THE DATA REQUIRED FOR THE EXECUTION OF A CASE       G0626         C       COMMON /DFAULT/ LOCM, LDCP, HTR, OR, EMX, FRQ, XO, RO,       00627         1       THO, X(50), R(50), THM(50), BETAM(50), PSIM(50),       00628         2       PX(50), PR(50), THP(50), M(50), MUS(50),       00630         3       IDIR(50), PREF, AM(50), PHI(50), ICMK,       G0631         4       SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED       G0632         COMMON /CNSTNT/ NH+AS, NPRED, NMUDES, SIGMA, B, MX, FREQ, A,       G0633         1       UMEGA       G0633                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | SUBROUTINE INPUT( TEND )                                       | 00624                    |    |
| C       THIS SUBRUUTINE INPUTS THE DATA REQUIRED FOR THE EXECUTION OF A CASE       00628         C       00621       00621         C       00623       00624         1       THO, X(50), R(50), THM(50), BETAM(50), PSIM(50), 00629       00629         2       PX(50), PR(50), THP(50), M(50), MUS(50), 00630       00630         3       101R(50), PREF, AM(50), PHI(50), ICHK, 00631       00632         4       SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED       00633         1       UMEGA       00633                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                | 60625                    |    |
| COMMUN /DFAULT/ LOCM, LDCP, HTR, OR, EMX, FRQ, XO, RO,       00628         1       THO, X(50), R(50), THM(50), BETAM(50), PSIM(50),       00629         2       PX(50), PR(50), THP(50), M(50), MUS(50),       00630         3       101R(50), PREF, AM(50), PHI(50), ICMK,       60631         4       SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED       60632         COMMON /CNSTNT/ NH+AS, NPRED, NMUDES, SIGMA, B, MX, FREQ, A,       00633         1       UMEGA       00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | C INTO SUBRUUTINE INPUTS THE DATA REQUIRED FUR THE EXECUTION O | FALASE UUDZO             |    |
| 1       THO, X(50), R(50), THM(50), BETAM(50), PSIM(50), 00629         2       PX(50), PR(50), THP(50), M(50), MUS(50), 00630         3       101R(50), PREF, AM(50), PHI(50), ICHK, 00631         4       SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED       00632         COMMON /CNSTNT/ NH+AS, NPRED, NMUDES, SIGMA, B, MX, FREQ, A, 00633       00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                | 00627                    |    |
| 2         PX (50), PR (50), THP(50), M(50), MUS (50),         00630           3         101R (50), PREF, AM (50), PH (50), ICHK,         60631           4         SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED         00632           COMMON /CNSTNT/ NH+AS, NPRED, NMUDES, SIGMA, B, MX, FREQ, A, 00633         00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | LUMMUM /UFAULI/ LULMA LULMA MIKA UKA EMAA PRUA XUA KUA<br>1    | SIN(50], 00628           |    |
| 3101R(50), PREF, AN(50), PHI50), 1CHK,006314SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED00632COMMON /CNSTNT/ NHEAS, NFRED, NMUDES, SIGMA, B, MX, FREQ, A,006331UMEGA00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 2 DX(50), DV/501, TUD/601, W/601, M/61601,                     | 00027<br>00627           |    |
| 4 SIGX, SIGR, SIGT, SIGB, SIGP, IEMU, SPEED 00632<br>COMMON /CNSTNT/ NM+AS, NPRED, NMUDES, SIGMA, B, MX, FREQ, A, 00633<br>1 UMEGA 00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3 1018(50), PREF, AN(50), PH(50), 1040                         | 66631                    |    |
| COMMON /CNSTNT/ NHEAS, NPRED, NHUDES, SIGMA, B. MX. FREU. A. 00633<br>1 UMEGA 00434                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 4 SIGX. SIGR. SIGT. SIGB. SIGP. IEMU. SPEE                     | D 00632                  |    |
| 1 UMEGA 00634                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | COMMON /CNSTNT/ NHEAS, NPRED, NHODES, SIGHA, B. MX. FRED       | A. 00633                 |    |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1 UMEGA                                                        | 00634                    |    |

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| PRATT<br>SC.PAI | & WHITNEY   | Y AIRCRAFT DIVISION VER 9.0                                  | 07/25/77<br>12.50.00 |
|-----------------|-------------|--------------------------------------------------------------|----------------------|
|                 | COMMON /    | REFS/ XREF, RREF, THREF                                      | 00635                |
|                 | COMMON /    | NEASUR/ XM(50), RM(50), TH <b>ETAN(50), BETA(50), PSI</b> (5 | 0) 00636             |
|                 | CONNON /F   | PREUCT/ XP150), RP150), THETAP150)                           | 00637                |
|                 | CLIMMLN /P  | HULES/ HOUE (50), MU(50), IWAVE (50)                         | 00638                |
|                 | CCHAGN /E   | bessel oumits, PI                                            | 00639                |
|                 | COMMUN ZR   | REFCUNZ REFPRS                                               | 00640                |
|                 | COMMON /    | ANGLES/ DEGRAD, RADDEG                                       | 00641                |
|                 | CUMMUM /    | APHIMUZ AMUISO), PHIMUISOJ, ICHECK                           |                      |
|                 | CONTUN ZE   | LAUSS ERU(DUSDUS ERUFIDUSDUS ERUFANIDUSDUS ER                | 243501 60444         |
| -               |             | JUEA<br>DAIVIEN 2104998 2104968 2104918 2104908 2104968 004  |                      |
| r '             | •           | 1024                                                         | 00646                |
| •               | MANELIST    | AINDATAZ LUCH, LUCP, HTP, OR, FMX, FRO, XO,                  | 00647                |
|                 |             | THUS X. R. THUS RETARS PSING PX. PR. THP.                    | M- 00648             |
|                 |             | MUS. 101R. PREF. VREF. AN. PHI. ICHK.                        | 00549                |
|                 | 5           | SIGX. SIGR. SIGT. SIGB. SIGP. IEMU. SPEED                    | 00650                |
| -               | REAL MX.    | LAEF                                                         | 00651                |
| C               | ···- · · •  |                                                              | 00652                |
| C               |             |                                                              | 00653                |
|                 | 1 END       | = 0                                                          | 00654                |
|                 | READ (5, IN | NDATA, END=9998)                                             | 00655                |
| C               |             |                                                              | 00656                |
| C SET           | UP INTERN   | VAL PARAMETERS                                               | 00657                |
| C               |             |                                                              | 00658                |
|                 | NMEAS       | = LOCM                                                       | 00659                |
|                 | NPRED       |                                                              |                      |
|                 | NHUDES      | = LUCM                                                       | 00001                |
|                 | 210HV       | - FWA<br>- WIV                                               | 00002                |
|                 | 5460        | - ENA<br># 500                                               | 00665                |
|                 | BEEPES      |                                                              | 00665                |
|                 | ICHECK      | * JCHK                                                       | 00666                |
|                 | XREF        | = X0                                                         | <sup>1</sup> i 60667 |
|                 | KREF        | = RG                                                         | 00668                |
|                 | THREF       | = THO + DEGRAD                                               | 00669                |
|                 | B           | = OR                                                         | 60670                |
|                 | A           | = SPEED                                                      | 00671                |
|                 | ILMPRT      | = ILMU                                                       | 00672                |
|                 | SIGMAX      | = SIGX                                                       | 00673                |
|                 | SIGMAR      | = SIGR                                                       | 00674                |
|                 | SIGNAT      | = SIGT                                                       | 00675                |
|                 | SIGMAB      | SIGB                                                         | 00676                |
| •               | SIGMAP      | = 51GP                                                       | 00677                |
| L               | DO 30 1-1   | • • • • • • • •                                              | 00079                |
|                 | AN(1)       | - ¥11)                                                       | 00017<br>AAAAA       |
|                 | AU111       | - ~~17<br>= 841)                                             | 00000                |
|                 | THE TANET   | THATIS OF DEGRAD                                             | 00662                |
|                 |             | E PSIMIIA E DECRAD                                           | 00683                |
|                 | BEIACIN     | R BETAN(I)                                                   | 00694                |
| 20              | CONTINUE    |                                                              | 00685                |
| د               |             |                                                              | 00686                |
| -               | DD 46 1=1   | 1,NPRED                                                      | 00687                |
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PRATT & WHITNEY AIRCRAFT DIVISION
                                                                 VER
                                                                            07/25/77
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SC.PANLIB.L4
                                                                  9.0
      XP(1)
                      PX(I)
                                                      1
                                                                             88900
                                                                             00689
      RP(1)
                    = PR(1)
                                                                             00690
      THETAP(I)
                    = THP(1) + DEGRAD
                                                                             00691
   40 CONTINUE
                                                                             00692
C
      DO 60 I=1,NMODES
                                                                             00693
                    = H(I)
                                                                             00694
      MODE(1)
                                                                             00695
                    - MUS(I)
      MULTI
      IWAVE(1)
                                                                             00696
                    = 101R(1)
      AMU(I)
                    # AM(1)
                                                                             00697
      PHIMU(I)
                    = PHI(I) . DEGRAD
                                                                             00698
                                                                             00649
   60 CONTINUE
C
                                                                             00700
                                                                              00701
      UD 80 J=1,20
      DU 80 1=1,20
                                                                             00702
                    = 0.0
                                                                             00703
      ENU(I.J)
      ENUP(1,J)
                    = 0.0
                                                                             00704
                                               1.1
      ENUPRH(1,J)
                                                                             00705
                    • 0.0
   80 CONTINUE
                                                                             00706
                                                                              00707
C
  CALCULATE KADIAN FREQUENCY
                                                                             60708
C
                                                                             06709
C
      UMEGA
                    = 2. • PI + FREQ
                                                                             00710
C
                                                                             00711
C
                                                                              00712
  SET INDICATOR FOR ERROR SOURCE STANDARD DEVIATIONS
                                                                              00713
C
                                                                             00714
C
                                                                             00715
      IFE SIGMAX }
                                          200, 100, 200
  100 IFE SIGMAR )
                                          200, 120, 200
                                                                             00716
                                          200, 140, 200
200, 160, 200
  120 IFE SIGMAT )
                                                                             00717
                                                                             00718
  140 IFE SIGMAB
                  1
  160 IFE SIGNAP
                                          200, 180, 200
                                                                              00719
                  )
  160 10EV
                                                                             00720
                    = 0
                                          GO TO 9999
                                                                              00721
  200 ILEV
                    = 1
                                                                              00722
                                          GO TO 9999
                                                                             00723
                                                                             00724
C
C END OF DATA SET
                                                                              00725
                                                                              00726
C
 9998 1END
                                                                              00727
                    = 1
 9999 RETURN
                                                                              00728
                                                                              00729
      END
      SUBROUTINE KNUCALI VALUE, DELTA, KMU, RIGHT )
                                                                              00730
                                                                             00731
£
C THIS SUBROUTINE CALCULATES THE CHARACTERISTIC NUMBER, KNU
                                                                             00732
                                                                             00733
C
      EXTERNAL BESL1, BESL2
                                                                              00734
      COMMUN /CNSTNT/ DUM1(3), SIGMA, DUM2(5)
                                                                              00735
      REAL KMU, LEFT
                                                                              00736
   30 IPLUS
                    = 0
                                                                             00737
      IMINUS
                    = 0
                                                                             00738
   35 IF( SIGMA )
                                          50, 40, 50
                                                                             00739
C
                                                                              00740
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PRATT & WHITNEY AIRCRAFT DIVISION VER 07/25/77 9.0 12.50.00 SC.PANLIB.L4 00741 40 KM = BESL2( VALUE ) 00742 60 10 60 00743 50 KNU BESLIG VALUE ) 00744 C 00745 60 IF( KHU ) 80, 65, 70 00746 65 RIGHT = VALUE 00747 60 10 130 00748 **70 1PLUS** a 1 00749 GO TO 90 00750 **80 IMINUS** = 1 C 00751 DETERMINE IF LEFT AND RIGHT BRACKETS HAVE BEEN FOUND. 00752 C Ē 00753 90 IF( IPLUS .EQ. 1 .AND. IMINUS .EQ. 1 ) GO TO 100 00754 00755 C 00756 C BRACKETS NOT FOUND. RECYLE. C 00757 00758 VALUSV - VALUE 00759 VALUE = DELTA + VALUE 60 TO 35 00760 00761 C BRACKETS FOUND, CALCULATE KMU 00762 C 00763 100 LEFT = VALUSV 00764 00765 R 1GHT -VALUE IFE SIGMA 1 110, 120, 110 00766 LEFT, RIGHT, .001, 0.0, 50, YY ) GO TO 130 00767 110 KMU = FALZIPE BESLI. 00768 LEFT, RIGHT, .001, 0.0, 50, YY ) 120 KMU = FALZIPE BESL2, 00769 130 RETURN 00770 00771 ENU SUURDUTINE KOCAL 00772 . 00773 C C THIS SUBROUTINE CALCULATES THE CHARACTERISTIC NUMBERS KNU AND QNU 00774 00775 C. COHMON /MODES/ MODE(50), MU(50), IWAVE(50) 00776 COMMON /KUMU/ KMU(50), QMU(50) 00777 COMMON /BESSL/ ISIGN, JSIGN, DELKMU, TOL, N, PI 00778 COMMEN /CNSTNT/ DURI(2), NMODES, SIGNA, DUM2(5) 00779 REAL KHU, KMUPRM 00780 С 00781 DO 100 I=1,NMODES 00752 C 00783 C CALCULATE ORDER FOR BESSEL FUNCTION EVALUATION 00784 00785 C = IABS( MODE(I) ) 66786 IF( M .NE. 0 ) 66 TO 10 00787 ISIGN = 1 00755 JSIGN -1 00789 BRAKTL 00790 = -1 60 TO 20 00791 10 ISIGN = MODE(I) / M 00792 = ISIGN 00793 **JSIGN** 

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PRATT & WHITNEY AIRCRAFT DIVISION
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SC.PANLIB.L4
                                                                                    00794
       BRAK TL
                      • M
       1+( ISIGN .GE. 0 )
                                             60 TO 20 / /
                                                                                    00795
                                                                                    00796
1.
L NEGATIVE ORDER. IF EVEN, SIGN OF BESSEL FUNCTION WILL BE +1. IF ODD,
                                                                                    00797
   SIGN OF BESSEL FUNCTION WILL BE -1.
                                                                                    00798
C
                                                                                    00799
C
       IF( ( M / 2 ) + 2 .EQ. M )
                                             ISIGN = 1
                                                                                    00400
                                                                                    10800
C
   20 NUMMUS
                      = MU(I) + 1
                                                                                    00802
                                                                                    00803
C
C CALCULATE CHARACTERISTIC NUMBER KMU CORRESPONDING TO HODE(1) AND MU(1)00604
   THE VALUE OF KMU WILL BE THE MU(1)+1 ROOT OF THE EQUATION DEFINING
                                                                                    00805
C
   THE SYSTEM OF SIMULTANEOUS EQUATIONS
                                                                                    00806
C
                                                                                    06807
                                                                                    00808
       KHUPRH
                      = 0.0
                                                                                    00869
       DO 40 J=1.NUMMUS
       1FI M .EQ. 0 .AND. J .EQ. 1 ) GO TO 40
                                                                                    00810
       CALL KHUCALI BRAKTL, DELKMU, KMUPRM, BRAKTR )
                                                                                    00811
                                                                                    00812
       HRAKTL
                      = BRAKTR
   40 CONTINUE
                                                                                    00813
       KNU(I)
                      = KMUPRM
                                                                                    00814
                                                                                    00915
C CALLULATE CHARACTERISTIC NUMBER ONU CORRESPONDING TO MODE(I) AND MU(1)00816
   IF THE HUB/TIP RATIO IS ZERO, SET ONU TO ZERO AND CONTINUE
                                                                                    00817
C
c
                                                                                    00818
                                                                                    00819
       IF( SIGHA )
                                             60, 60, 80
   60 4MU(1)
                      = 0.0
                                                                                    00620
                                             GO TO 100
                                                                                    00921
   80 1F( KMU(1) )
                                             90, 60, 90
                                                                                    00822
   90 CALL BESJ( KMUPRN, M-JSIGN, EMM1, TOL, IER )
EMM1 = ISIGN + JSIGN + EMM1
                                                                                    00823
                                                                                    00624
       CALL BESJI KHUPRH, M, ENJ, TOL, IER2 )
                                                                                    00825
       CALL BESY4 KMUPRM, M, EMY, IER3 )
ENJ = ISIGN + EMJ
                                                                                    00826
                                                                                    00927
                      = ISIGN * EMY
                                                                                    00828
       EMY
       CALL BESY! KMUPRH, M-JSICN, EYM1, 1ER4 )
                                                                                    00829
       EVHI
                      = 1SIGN + JSIGN + EYM1
                                                                                     00630
                      = EMH1 - ( M + JSTGN + ENJ ) / KNUPRM
= EYM1 - ( M + JSIGN + EMY ) / KNUPRM
                                                                                    60831
       00632
       ь
                      = SIGNA + KMUPRN
                                                                                    00933
       SIGMAK
       CALL BESJI SIGMAR, M-JSIGN, EMMI, TOL, JERS )
                                                                                    00834
       CALL BESJ( SIGMAK, M, EMJ, TUL, IER6 )
Call Besy( SIGMAK, M, EMY, IER7 )
                                                                                    00835
                                                                                    00636
       CALL BESY! SIGMAK, M-JSICN, EYM1, IERB )
                                                                                    00837
                      = ISIGN + JSIGN + EMMI
= ISIGN + JSIGN + EYMI
       EMM1
                                                                                    00638
       EYMĪ
                                                                                    00839
                      = ISIGN * EHJ
                                                                                    00840
       ENJ
       EMY
                      = 151GN + EMY
                                                                                    00841
                      = LHM1 - ( M + JSIGN + EMJ ) / SIGMAK
= EYM1 - ( M + JSIGN + EMY ) / SIGMAK
= - ( A + C + SIGMA ) / ( B + D + SIGMA )
                                                                                    00842
       C
                                                                                    00843
       n
       QMU(1)
                                                                                    00644
  100 CONTINUE
                                                                                    00845
 9999 RETURN
                                                                                    00846
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PRATT & WHITNEY AIRCRAFT DIVISION

| SC.PANLIB.L4                                                      | 7.0            | 12.50.00 |
|-------------------------------------------------------------------|----------------|----------|
| ENO                                                               |                | 00547    |
| SUBROUTINE PRINT                                                  |                | 00848    |
| C                                                                 |                | 00849    |
| C THIS SUBROUTINE PRINTS INPUT AND CALCULATED VALUES              |                | 00850    |
| C                                                                 | •              | 00851    |
| COMMON /CNSTNT/ NMEAS, NPRED, NMODES, SIGMA, B, MX,               | FREQ, A,       | 00652    |
| 1 OMEGA                                                           |                | 00853    |
| COMMON /REFS/ XREF, RREF, THREF                                   |                | 00854    |
| COMMON /MEASUR/ XM(50), RM(50), THETAM(50), BETA(50)              | ), PSI(50)     | 00855    |
| COMMUN /PREDCT/ XP(50), RP(50), THETAP(50)                        |                | 00856    |
| CCMMLN /HOUES/ HOUE(50), HU(50), IWAVE(50)                        |                | 00857    |
| CGHHGN /EMUS/ EMU(50,50), EMUP(50,50), EMUPRM(50,5                | io), IEMPRT    | 00858    |
| COMMON /ANGLES/ DEGRAD, RADDEG                                    |                | 00559    |
| COMMON /OUTPUT/ AMPR(50), PHASER(50)                              |                | 00860    |
| CUMMUN /REFCON/ REFPRS                                            |                | 00861    |
| COMMON /WAVENU/ KX150)                                            |                | 00862    |
| COMMON /KUNU/ KNU(50), CHU(50)                                    |                | 00863    |
| CONFILM FARMINGF ARGEDUIG PHINGEDUIG ILMELK                       |                |          |
| COMMUN ADAIVIES SIGUARD SIGUARD SIGUADD SIGU                      | 141.1 97844134 | 00014    |
| COMMON ADED CHMA ADACHMAEAA DENCHMAEAA ADACHMAEAA                 |                | 00000    |
| CUMPUN / DERJUM/ ARNJUN(JU/) / RRNJUN(JU/) AANJUN(JU/)            | PARSUNISUIT    | 00869    |
|                                                                   | - 0430413011   | 00866    |
| COMMON ZDERIVSZ DAMORN(56,50), DAMENS(50,50), DPHDRN              | 1150-501-      | 00670    |
| BOHRNET DERTES DEHENRITSOUSDE DEMENSIONS DE DEMENSIONS            | (50.50)        | 00871    |
| 2 DPHDXN(50.50), DPHXNS(50.50), DANDTH                            | 450-501-       | 00872    |
| 3 DAMINS (50, 50), DPHOIN (50, 50), DPHINS                        | (50.50).       | 00873    |
| 4 DAMDEN(50,50), DAMENS(50,50), DPHDEN                            | (150-50) -     | 00874    |
| 5 DPHBNS(50,50), UAMUPN(50,50), DAMPNS                            | (50.50).       | 00675    |
| 6 DPHDPN(50,50), UPHPNS(50,50)                                    |                | 00876    |
| CONMON /MCOMP/ XALOMP(50), RACOMP(50), TACOMP(50),                | BACOMP(50).    | 00977    |
| 1 PACOMP(50), XPCOMP(50), RPCOMP(50),                             | TPCOMP(50),    | 00678    |
| 2 BPCOMP(50), PPLOMP(50)                                          | , -            | 00879    |
| DIMENSION AMUDB(50), DEVUB(50)                                    | •              | 00880    |
| COMPLEX KX                                                        |                | 00881    |
| REAL NHU, MX                                                      |                | 00882    |
| C                                                                 |                | 00983    |
| C CONVERT INTERNAL UNITS TO OUTPUT UNITS                          |                | 00884    |
| C .                                                               |                | 00885    |
| THREF RADDEG + THREF                                              |                | 00686    |
| C                                                                 |                | 00887    |
| DO 20 I=1,NMEAS                                                   |                | 00888    |
| THETANII) = RADDEG + THETANII)                                    |                | 00669    |
| PS1(1) = RADDEG = PS1(1)                                          |                | 00890    |
| ZO CUNTINUE                                                       |                | 00891    |
|                                                                   |                | 00845    |
| UU ZO IFIANKEU<br>Thetanith                                       |                | 00893    |
| INCIATILI - RAUDES - INCIATILI<br>Rullerili - Raudes - Rulessoiti |                | 00894    |
| THADERIAL = 70, # ALTERIAL ADDITAL ADDITAL                        |                | 00893    |
| ARTRIII = 200 + ALUGIUI ARTRIII / REFPRS }                        |                | 00370    |
|                                                                   |                | 00697    |
| U 00 20 I-1.840055                                                |                | 00878    |
| nn 20 1-10UUNC3                                                   |                | 00834    |

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VER 07/25/77 PRATT & WHITNEY AIRCRAFT DIVISION 9.0 12-50-00 SC.PANLIB.L4 00900 KX(I) = RADDEG • KX(I) **30 CONTINUE** 00901 00902 C 00903 DO 35 I=1,NMODES PHIMU(I) RADDEG ● PHIMU(I) 00904 AMUD8(1) = 20. • ALOGIOI AMU(I) / REFPRS ) 00905 00906 **35 CONTINUE** C 00907 IFI IDEV .LE. 0 ) 00908 60 TO 50 DU 40 1=1,NMODES 00909 DEVUB(I) ≈ 20. ● ALOG10( 1. + SIGAM(I) / AMU(I) ) 00910 40 LONT INUE 00911 00912 C DU 45 I=1.NMODES 00913 DIVSOR = 1. / AMU(1) 00914 = DIVSOR • SQRT( XACOMP(I) ) 00915 XACUMP(1) = DIVSOR \* SQRT( RACOMP(1) ) RACUMPEL 00916 TACOMP(1) = DIVSOR • SURT( TACOMP(I) ) 00917 = DIVSOR • SORT( BACOMP(I) ) 00918 BACOMP(I) = UIVSOR + SQRT( PACOMP(I) ) PACOMP(1) 00919 = SURT( XPCOMP(1) ) XPCOMP(1) 00920 = SURT( RPCUMP(I) ) = SURT( TPCOMP(I) ) RPCOMP(I) 00921 00922 TPCUMP(I) BPLUMF(1) = SURT( BPCOMP(I) ) 00423 PPCUMP(1) = SURT( PPCOMP(1) ) 00924 00925 45 CONTINUE C 00926 50 00 55 1=1,NMODES 00927 DIVSOR 00928 = 1.0 / AMU(1)= DIVSOR • SURTI ARNSUMII) ) \* DIVSOR • SURTI AXNSUMII) ) AKNSUMIII 00929 00430 AXIISUM(1) = DIVSOR • SQRT( ATNSUM(I) ) = DIVSOR • SQRT( ABNSUM(I) ) ATRISUMED) 06931 ALNSUME11 00432 = DIVSOR • SUPT( APNSUM(I) ) APNSUM(1) 00433 = SURT( PRNSUM(I) ) 00934 PRNSUM(1) PXHSUN(1) = SORTE PXNSUM(1) ) 00935 = SURT( PTNSUM(I) ) = SURT( PBNSUM(I) ) PINSUM(1) 00936 00937 PENSUM(1) PPNSUM(I) = SORT( PPNSUM(I) ) 00938 55 CONTINUE 00939 00940 C C CONVERT ANY NEGATIVE ANGLES TO PUSITIVE ANGLES FOR PRINTING 00941 00942 C CALL ANGPOST PHIMU, NMODES ) 00943 CALL ANGPOST PHASER, NPRED ) 00944 00945 **C PRINT INPUT VARIABLES** 00946 00947 WRITE(6,9000) 00945 9000 FORMATE 1H1, T45, \*\*\*\* MODAL CALCULATION COMPUTER PROGRAM \*\*\*\* 100949 WRITE 16,9001) NMEAS, NPRED, NMODES 9001 FURMATE //, T56, '... INPUT VARIABLES ...', //, T5, 'NUMBER DF MEAU0951 1SUREMENT LUCATIONS = ', 12, T51, 'NUMBER OF PREDICTION LOCATIONS ±00952

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07/25/77 PRATT & WHITNEY AIRCRAFT DIVISION VER SC.PANLIB.L4 12.50.00 9.0 2 % 12, 196, "NUMBER OF (MODE, NU) SETS = ", 12 ) 00953 00954 WRITE(6,9002) 9002 FURMAT( //, 1X, "... INPUT MODES ...", //, T5, "MODE", T14, 00955 1"CIRCUMFERENTIAL", T34, "RADIAL", T47, "WAVE", /, T16, "MODE NUMBEO0956 2R', T34, 'ORDER', T45, 'INDICATOR' ) 00957 00958 UD 60 1=1, NMODES WRITE(6,9003) I, MODE(I), MU(I), IWAVE(I) Ũ0959 9003 FORMAT( 5x, 12, 11x, 14, 13x, 12, 11x, 12) 00960 00961 60 CUNTINUE 00962 PRINT REFERENCE VALUES 00963 £. C 00964 WRITE(6,9004) REFPRS 00965 9004 FURMATE ///, 1X, ... REFERENCE VALUES ...., //, T5, \*REFERENCE PR00966 1ESSURE = ", E9.4 ) 00967 00968 C PRINT TEST GEOMETRY AND CONDITIONS 00969 00970 00971 WRITE(6,9005) SIGMA, B. MX, FREQ, A, DMEGA 9005 FCRMAT( ///, 1X, \*... TEST ( EDMETRY AND CONDITIONS ...., //, T5, 009/2 1 HUB / TIP RATIO = ', F8.3, T42, 'OUTER RADIUS OF DUCT = ', F8.2, 00973 2184, "AXIAL MACH NUMBER = ", F8.2, /, T5, "FREQUENCY = ", F8.2, 00974 3T42, "SPEED OF SOUND = ", F8.2, T84, "F. DIAN FREQUENCY = ٠. 00975 00976 4F10.2 ) 00977 00978 C PRINT CALCULATED NODAL AMPLITUDES AND PHASES 00479 WRITE(6,9000) 00980 00991 WRITE (6,9006) 9006 FORMAT( //, T45, \*... HODAL AMPLITUDE AND PHASE CALCULATION ...., 00982 1//, 1X, \*... CALCULATED MODAL AMPLITUDES AND PHASES ...., //, T5, 00983 2\*MULE\*, T12, \*CIRCUMFERENTIAL\*, T30, \*RADIAL\*, T41, \*WAVE\*, T47, 00984 32(AX, \*AMPLITUDE\*), T84, \*PHASE\*, T98, \*ATAI WAVE NUMBER\*, //00985 32(6X, "AMPLITUDE"), T84, "PHASE", T98, "AXIAL WAVE NUMBER", 00985 4T125, \*KMU\*, /, T14, \*MODE NUMBER\*, T30, \*ORDER\*, T39, \*INDICATOR\*00986 5, Y53, \*(PRESSURE)\*, T71, \*(DB)\*, T82, \*(DEGREES)\*, T98, \*REAL\*, 00997 67109, "IMAGINARY", / ) 00988 DU 80 1=1, NHOUES 00989 WRITE(6,9007) 1, MODE(1), MU(1), IWAVE(1), AMU(1), AMUDB(1), 00990 PHIMULI), KX(I), KMU(I) 00991 1 9007 FORMATE 5X, 12, 4X, 14, 11X, 12, 8X, 12, 5K, E12.6, 3X, E12.6, 00992 00993 14(3X,F10.4) } 00994 80 CONTINUE 00995 C C PRINT REFERENCE LOCATION VALUES 00996 00997 C WRITE(6,9008) XREF, RREF, THREF 00998 9008 FORMAT ///, 1X, \*... REFERENCE LOCATION ..... // TIO, \*X\*, T27, 00999 1\*R\*, T42, "THETA", //, 4X, E12.6, 2(5X,E12.6) ) 01000 01001 01002 PRINT MEASUREMENT LOCATION VALUES 01003 IF( ICHECK .GT. 0 ) GO TO 110 01004 01005 WRITE(6,9009)

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| PRATT & WHITNEY AIRCRAFT DIVISION<br>SC.PANLIB.L4                                                      | VER<br>9.0   | 07/25/77<br>12.50.00 |
|--------------------------------------------------------------------------------------------------------|--------------|----------------------|
| 9009 FORMATI ///. 1X. " MEASUREMENT LOCATIONS". /                                                      | /. T5. *L00  | A001001              |
| IN*. T23. "X". T40. "R". T55. "THETA". T70. "ANPLITU                                                   | DE . TB9.    | 01007                |
| 2"PHASE", /, T6, "NUMBER", T73, "(B)", T89, "(PSI)",                                                   | 7)           | 01005                |
| DO 100 1=1.NMEAS                                                                                       |              | 01009                |
| WRITE(6,9010) I, XM(I), RM(I), THETAM(I), BETA(I),                                                     | PSI(I)       | 01010                |
| 9010 FCKMATI 7X, 12, 3X, 3(5X, F12.6), 5X, E12.6, 5X, F12                                              | .6)          | 01011                |
| 100 CUNTINUE                                                                                           |              | 01012                |
| C                                                                                                      |              | 01013                |
| C PRINT PREDICTION LOCATION VALUES                                                                     |              | 01014                |
| C                                                                                                      |              | 01015                |
| 110 WRITE(6,9011)                                                                                      |              | 01016                |
| 9011 FLRMATE ///, IX, " PREDICTION LOCATIONS ", //                                                     | , T5, *LOC/  | TION01017            |
| 1*, T23, *X*, T40, *R*, T55, *THETA*, T70, *AMPLITUD                                                   | E', 189,     | 01018                |
| 2"PHASE", /, 76, "NUMBER", 769, "(RESULTANT)", 786,                                                    | • (RESULTAN) | <b>[]*,</b> 01019    |
| 3/ )                                                                                                   |              | 01020                |
| DO 120 I=1.NPRED                                                                                       |              | 01021                |
| WRITE(6,9010) I, XP(I), RP(I), THETAP(I), AMPR(I),                                                     | PHASER(I)    | 01022                |
| 120 CONTINUE                                                                                           |              | 01023                |
| C                                                                                                      | _            | 01024                |
| C PRINT SENSITIVITY CALCULATION VALUES IF NOT A CHECK CAS                                              | E            | 01025                |
|                                                                                                        |              | 01026                |
| IFI ICHECK .GT. 0 ) 60 TO 250                                                                          |              | 01027                |
| WKIIE[0,9000]                                                                                          |              | 01028                |
| WELLELOGYULZI<br>DONA ECHMATZZZZ 145 8 CENELTINITY COLLETCIENT CALCH                                   |              |                      |
| TEL TORN IS ON SENSITIVIT CULFFICIENT CALLU                                                            | CALTON       | 01030                |
|                                                                                                        |              | 01031                |
| C BRINT FRUIR COMPLE STANDARD DEVIATION VALUES                                                         |              | 01033                |
| C FRINT ERROR STURGE STANDARD DEVIATION VALUES                                                         |              | 01034                |
| WRITELA. 40131 SIGNAY, SIGNAR, SIGNAT, SIGNAR, SIGNA                                                   | D            | 01035                |
| 9013 FORMATE ///. 1X. P ERNOR SOURCE STANDARD DEVIATE                                                  |              | //• 01036            |
| 117. *SIGMA X*. T24. *SIGMA R*. T39. *SIGMA THETA*.                                                    | 158. SIGN    | 8*.01037             |
| 2174. "SIGHA PSI". /. 4X. E12.6. 4(5X.E12.6) )                                                         |              | 01038                |
|                                                                                                        | •            | 01039                |
| C PRINT MUDAL STANDARD DEVIATIONS                                                                      |              | 01040                |
| C                                                                                                      |              | 01041                |
| WRITE(6,9014)                                                                                          |              | 01042                |
| 5014 FORMATE ///, 1X, NORMALIZED STANDARD DEVIATION                                                    | S DUE TO A   | LL ER01043           |
| 1ROB SUURCES 1, 1/, T5,                                                                                |              | 01044                |
| 1 HOUE', 112, "CIRCUMFERENTIAL", T30, "RADIAL", T41,                                                   | "XAVE", T    | 52, 01045            |
| 2*NORMALIZED AMPLYTUDE*, TRO, *AMPLITUDE*, T105,                                                       |              | 01046                |
| 3"PHASE", /, T14, "MODE NUMBER", T30, "ORDER", T39,                                                    |              | 01047                |
| 4"INDICATOR", 157, "DEVIATION", 160, "DEVIATION", 11                                                   | 03, 'DEVIA'  | FION*01048           |
| 5, /, 183, '(D8)', 1103, '(DEGREES)', / )                                                              |              | 01049                |
| DO 140 1=10NMODES                                                                                      | 1 DEMORAT    | 01050                |
| MUTITIOSANTSI TA MODELLAS MOLTA INVALITA ZIVYMCLI<br>MUTITIOSANTSI TA MODELLAS MOLTA INVALITA ZIVYMCLI | 18 DEADR(1)  | 01051                |
| 0016 KUMATI KU 10 GU 14, 110 10 GU 17 10 21110                                                         | E17 41 1     | 01052                |
| TUE FURNALL DAY ICY TAY IMY ILAY ICY DAY ICY IAY SULLAY                                                | [12.0] ]     | 01055                |
|                                                                                                        |              | 01034                |
| C PRINT MODAL STANDARD DEVIATION COMPONENTS                                                            |              | 01022                |
| C                                                                                                      |              | 01050                |
| WRITE(6.90)6)                                                                                          |              | 01058                |
| ······································                                                                 |              | V1V/0                |

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PRATT & WHITNEY AIRCRAFT DIVISION
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 9016 FORMATI ///, 1X, •... NORMALIZED STANDARD DEVIATION COMPONENTS (ER01059
1Rok source deviation times RMS sum of Normalized influence coeffic01060
      21ENTS) ....* )
                                                                                   01061
       WRITE(6,9017)
                                                                                   01062
 9017 FURMATI //, T5, MODE*, T26, AMPLITUDE DUE TO ERROR IN*, T92,
1*PHASE DUE TO ERROR IN*, /, T15, *X*, T27, *R*, T37, *THETA*,
2751, *8*, T62, *PSI*, T79, *X*, T91, *R*, T101, *THETA*, T115,
                                                                                   01063
                                                                                   01064
                                                                                   01065
      3'6", T126, "PSI", / )
                                                                                   01066
       DU LOU I=1, NHOUES
                                                                                   01067
       WRITE(6,9018) 1. XACOMP(I), RACOMP(I), TACOMP(I), BACOMP(I),
                                                                                   01068
                       PACOMPILI, XPCOMPILI, RPCOMPILI, TPCOMPILI,
                                                                                   01069
                       BPCOMP(I), PPCOMP(I)
                                                                                   01070
      2
 9018 FURMATE 5%, 12, 5(1%,E11.4), 4%, 5(1%,E11.4) 1
                                                                                   01071
  160 CUNTINUE
                                                                                   01072
C
                                                                                   01073
C PRINT INFLUENCE COEFFICIENTS
                                                                                   61074
                                                                                   01075
C
  180 WRITE(6,9019)
                                                                                   01076
 9019 FORMATE ///, 1X, ..., RMS SUM OF NORMALIZED INFLUENCE COEFFICIENTS01077
      1 .... )
                                                                                   01078
       WRITLI6, 9017)
                                                                                   01079
       DO 200 I=1,NAGDES
                                                                                   01080
       WRITE(6,9019) I, AXNSUM(I), ARNSUM(I), ATNSUM(I), ABNSUM(I),
                                                                                   01081
                       APNSUM(I), PXNSUM(I), PRNSUM(I), PTNSUM(I),
                                                                                   01082
      1
                       PBNSUM(I), PPNSUM(I)
                                                                                   01083
      2
  200 CONTINUE
                                                                                   01084
C
                                                                                   01085
  PRINT PARTIAL DERIVATIVES
                                                                                   01086
C
Ċ
                                                                                   01087
       WR1TE16,90201
                                                                                   01035
 9020 FORMATE ///, 1%, "... INFLUENCE COEFFICIENTS (PARTIAL DERIVATIVES 01089
      1) .... )
                                                                                   01090
                                                                                   01091
       DO 240 I=1,NMEAS
       WRITE(6,9021) 1
                                                                                   01092
 9021 FORMATE //, T45, "INFLUENCE COEFFICIENTS FOR NEASUREMENT LOCATION 01093
      1 , 12 )
                                                                                   01094
       WRITE(6,9017)
                                                                                   01095
       CO 226 J=1.NMODES
                                                                                   01096
       WRITE(6,9018) J. DAMDXN(I,J), DAMDRN(I,J), DAMDTN(I,J),
                                                                                   01097
                       DAMDBN(I,J), DANDPN(I,J), DPHDXN(I,J),
                                                                                   01098
      1
                       DPHDRN(I,J), DPHDTN(I,J), DPHDBN(I,J),
                                                                                   01099
      2
                                                                                   01100
                       DPHOPM (I.J)
      3
  220 CONTINUE
                                                                                   01101
  240 CONTINUE
                                                                                   01102
C
                                                                                   01103
C PRINT CHARACTERISTIC E-FUNCTION VALUES IF REQUESTED
                                                                                   01104
C
                                                                                   01105
  250 IFI JEMPRT .LE. 0 )
                                             60 TO 9999
                                                                                   01106
       WRITE(6, 9000)
                                                                                   01107
       WRITE16.90221
                                                                                   01108
 9022 FURMATE //, T23, *... CHARACTERISTIC E-FUNCTION VALUES FOR MODAL A01109
      IMPLITUDE AND PHASE CALCULATIONS .... 1
                                                                                   01110
       WRIT2(6, 9023) ( I, I=1, NHODES )
                                                                                    01111
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 9023 FORMAT( ///, 1X, *... MEASUREMENT LOCATIONS ...*, //, 1X, *LOCATIO01112
1N*, 168, *HODES*, //, 8X, 15(6X,12), / ) 01113
                                                                                 01114
      DO 260 J=1,NMEAS
                                                                                 01115
      WRITE(6,9024) J. ( EMULI, J). I=1. NHODES )
 9024 FURMATI 4X, 12, 5X, 15(12, F7.3) )
                                                                                 01116
                                                                                 01117
  260 CONTINUE
                                                                                 01118
      WRITL(6,9025) ( 1,1=1,NMODES )
 9025 FLKMAT( ///, 1X, *... PREDICTION LOCATIONS ....*, //, 1X, *LOCATIONO1119
1*, T68, *MODES*, //, 9X, 15(6X,12), / ) 01120
                                                                                 01121
      DO 280 J=1.NPRED
                                                                                 01125
       WRITE(0,9024) J. ( EMUP(1, J), 1=1, NMODES )
                                                                                 01123
  280 CONTINUE
                                                                                 01124
 9999 RETURN
                                                                                 01125
       END
       SUBRUUTINE SIMEQCI A. C. NA. NB. SNGUL )
                                                                                 01126
                                                                                 01127
C
C THIS SUBRUUTINE SOLVES A NA X NA SYSTEM OF SIMULTANEOUS EQUATIONS
                                                                                 01128
                                                                                 01129
   HAVING CUMPLEX COEFFICIENTS USING GAUSSIAN ELIMINATION METHOD.
C
                                                                                 01130
C
                                                                                 01131
       COMPLEX A(50,1), C(1), SAVE, ZERO
                                                                                  01132
       DATA ZERD / (0.0,0.0) /
                                                                                 01133
C
                                                                                 01134
       SMALL
                     ....
                                                                                 01135
       60 240 1=1,NA
                                                                                 01136
C
  FIND MAXIMUM ELEMENT IN JTH COLUMN, ROWS I+1 TO NA
                                                                                 01137
С
                                                                                  01138
                                                                                  01139
                       1 + 1
                                                                                  01140
                                            20, 100, 20
       IFE I - NA D
                                                                                  01141
                     = CABS( A(I+I) )
   20 VALMX
                                                                                  01142
       MZ
                      .
                       1
                                                                                  01143
       DO 60 KZ=JZ,NA
                                                                           ,
                                                                                  01144
                      = CABSE AIKZ.I) )
       R
                                                                                  01145
       IFI VALMX - B )
                                            40, 40, 60
                                                                                  01146
   #0 VALMX
                     = 6
                                                                                  01147
       MZ
                      = KZ
                                                                                  01148
   60 CONTINUE
                                                                                  01149
C
  INTERCHANGE ROW CONTAINING MAXIMUM WITH ITH ROW
                                                                                  01150
С
                                                                                  01151
C
                                                                                  62152
       LU BO IK=1,NB
                                                                                  01153
                      = A(1, IK)
       SAVE
                                                                                  01154
       A(1.1K)
                      = A(MZ, IK)
                                                                                  01155
                      = SAVE
       A(MZ .IK)
                                                                                  01156
   80 LONTINUE
                                                                                  01157
                                                                                  01158
C NORMALIZE 1TH ROW
                                                                                  21159
C
                                            160, 120, 160
160, 140, 160
                                                                                  01160
   100 IF( REAL( A(1,1) ) )
                                                                                  01161
   120 IFE AIMAGE ALL, I) ) )
                                                                                  01162
C
                                                                                  01163
  ERNOR - COEFFICIENT MATRIX IS SINGULAR
С
                                                                                  01164
C
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|--------|---------------|-------------------------|-------------------------------|-------------------------------------------|----------------------|
|        | 140           | SNGUL                   | = 1.0                         |                                           | 01165                |
|        |               |                         |                               | 60 TO 9999                                | 01166                |
|        | 160           | DU 220 LZ=JZ            | NB                            | · ·                                       | 01167                |
|        |               | A(I,LZ)                 | _= A(I,LZ) / A(I              | ,1)                                       | 01168                |
|        |               | IF( JZ - NB             | <b>)</b>                      | 180, 260, 260                             | 01169                |
|        | 180           | 00 200 NZ=JZ            | •NA                           |                                           | 01170                |
|        | 200           | A(NZ +LZ)               | $= A(MZ_{1}LZ) - A(MZ_{1}LZ)$ | $(Z_{1}I) = A(I_{1}LZ)$                   | 01171                |
|        | 200           | CONTINUE                |                               |                                           | 01172                |
|        | 240           | CONTINUE                |                               | ,                                         | 01173                |
| r      | 240           | CONTINUE                |                               |                                           | 01174                |
| ř      | SOL           |                         | TENTS                         |                                           | 01175                |
| ř      | 3011          |                         | LIENIS                        |                                           | 01176                |
| ~      | 260           | DO 280 MZEL             | MA                            |                                           | 01177                |
|        | £00           | C (M7 )                 | - 7500                        |                                           | 01178                |
|        | 280           | CONTINUE                | - 2280                        |                                           | 01179                |
|        | 200           | C (NA )                 | - AINL-MAL                    |                                           | 01180                |
|        |               | NC                      | = NA $=$ 3                    |                                           | 01101                |
|        |               | 11                      | = 1                           |                                           | 01102                |
|        |               | DO 320 IZ=1.            |                               |                                           | 01184                |
|        |               | KK                      | = NA                          |                                           | 01195                |
|        |               | LZ                      | = NA - IZ                     |                                           | 01186                |
|        |               | CILZ)                   | = AILZ,NB)                    |                                           | 01167                |
|        |               | DU 300 N=1,1            | 1                             |                                           | 01188                |
|        |               | C(LZ)                   | = C(LZ) ··· C(KK)             | AILZ,KK)                                  | 01189                |
|        |               | KK                      | = KK - 1                      |                                           | 01190                |
|        | 300           | CUNT INUE               |                               |                                           | 01191                |
|        |               | 11                      | = 11 + 1                      |                                           | 01192                |
|        | 320           | CONT INUE               |                               |                                           | 01193                |
| •      | 9999          | RETURN                  |                               |                                           | 01194                |
|        |               | END                     |                               |                                           | 01195                |
| -      |               | SUPROUTINE 20           | JLVE                          | •                                         | 01196                |
| č      | -             |                         |                               |                                           | 01197                |
| 2      | 1412          | SUBKUUTINE S            | SETS UP AND SULVE             | S THE EQUATION SYSTEM ASSOCIATED          | 4ITH01198            |
| 2      | REA           | SOKEMENT LUCI           | ATTOM PARAMETERS              |                                           | 01199                |
| Ľ      |               |                         | / DUM3/61 DT                  |                                           | 01200                |
|        |               | COMMON /DESSE           | /                             |                                           | 01201                |
|        |               | CONNEN ZNEASI           | R/ XM1501, RM150              | NKEF<br>1), THETAMISON, BETAISON, BETISON | 01202                |
|        |               | CUMMON ZMODES           | MODE (50) - 010               | 1 ( 100 )                                 | 01203                |
|        |               | CLAMIN /EMUS            | EHU(50.50) E                  | HUP(50,50), FRUPPH(50,50), TENDAT         | 01204                |
|        |               | COMMUN ZAPHIN           | U/ AMU(50). PHIM              | W(50) ICHECK                              | 01204                |
|        |               | COMMON /CNSTN           | T/ NMEAS. NPRED.              | NMODES, SIGMA, B. DUN2(A)                 | 01208                |
|        |               | COMMEN ZWAVEN           | 0/ KX(50)                     |                                           | 01208                |
|        |               | COMMON /LMATE           | X/ EQ1(50,51)                 |                                           | 01209                |
|        |               | COMMON /DVIA1           | E/ DUM4(155), 10              | EV                                        | 01210                |
|        |               | CEMPLEX KX. E           | XPNT, EQ1, EQ(50              | 51), ANSWER (50)                          | 01211                |
| C      |               |                         |                               |                                           | 01212                |
| C      | SET           | UP COEFFICIEN           | IT MATRIX                     |                                           | 01213                |
| C      |               |                         |                               |                                           | 01214                |
|        |               | UU 40 I±1,NME           | A5                            |                                           | 01215                |
|        |               | DX CD                   | = XM(I) - XREF                |                                           | 01216                |
|        |               | UK                      | = KM(1) - RREF                |                                           | 01217                |
|        |               |                         |                               |                                           |                      |

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PRATT & WHITNEY AIRCRAFT DIVISION
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SC.PANLIB.L4
      DTHE TA
                    - THETANII) - THREE
                                                                             01218
C
                                                                             01219
C CALCULATE CHARACTERISTIC E-FUNCTION VALUES AND DERIVATIVES FOR RPRIME 0122C
                                                                             01721
C
   10 RPRIME
                    « DR / B
                                                                             01222
      CALL EMUCALI RPRIME, EMU(1,1), EMUPRM(1,1), 1)
                                                                             01223
С
                                                                             01224
   15 DU 26 J=1. NHODES
                                                                             01225
                    = CMPLX( 0.0, REAL( KX(J) ) + DX + NODE(J) + DTHETA 101226
      EXPNT
                    = EHU(J,I) + CEXP( EXPNT ) + EXP( -DX +
                                                                             01227
      EQ(1,J)
                      AIMAGE KX(J) ) )
                                                                             01225
     1
      EQ1(1,J)
                    - E4(I,J)
                                                                             01229
   20 CONTINUE
                                                                             01230
                                                                             01231
£
C SET UP RIGHT HAND SIDE
                                                                             01232
                                                                             01233
£
      LU(1,NHODES+1) = BETA(I) @ CEXPI CMPLX( 0.0, PSI(I) ) )
                                                                             01234
      EQ1(I,NMODES+1) = EQ(1,NMODES+1)
                                                                             01235
   40 CUNTINUE
                                                                             01236
C
                                                                             01237
 SOLVE EQUATION SYSTEM
                                                                             01236
C
C
                                                                             01239
      CALL SIMEQCI EQ. ANSWER, NMEAS, NMODES+1, SNGULR )
                                                                             01240
      IFI SNGULR 1
                                                                             01241
                                          60, 80, 60
C
                                                                             01242
C ERROR - SINGULAR MATRIX. TERMINATE EXECUTION
                                                                             01243
                                                                             01244
                    - NHODES + 1
                                                                             01245
   60 NH1
      WEITE(6,1000) [ [ EQ1(I,J),J=1,NM1 ],I=1,NMEAS ]
                                                                             01246
 1000 FURMATE //, 5%, "COEFFICIENT MATRIX IS SINGULAR", 1 /, 1%,
                                                                             01247
                                                                             01248
     110613.6 ) )
                                          STOP
                                                                             01249
                                                                             01250
C
C CALCULATE AMPLITUDE AND PHASE VALUES
                                                                             01251
C
                                                                             01252
   80 LO 100 1=1,NMODES
                                                                             01253
                    = CABS( ANSWER(I) )
                                                                             01254
      AMU(1)
      PHIMU(1)
                    = ATAN2( AIMAG( ANSWER(I) ), REAL( ANSWER(I) ) )
                                                                             01 255
  100 CONTINUE
                                                                             01.56
C
                                                                             01257
 9999 RETURN
                                                                             01258
                                                                             01259
      I ND
      SUBROUTINE SENSITY Q. NOIM D
                                                                             01260
                                                                             01261
  THIS SUBROUTINE CALCULATES THE SENSITIVITY COEFFICIENTS ASSOCIATED
C
                                                                             01262
C
   WITH THE EQUATION SYSTEM
                                                                             01263
£
                                                                             01264
      UIMENSION EMUAVG(50,50), IROW(50), ICOL(50)
                                                                             01265
      CLMPLEX KX, EQ1, TERM, ZERO, SUM, QINDIM, NDIM), DET
                                                                             01266
      REAL MU
                                                                             01267
      CUMNUN /DERIVS/ DAMDRN(50,50), DAMRNS(50,50), DPHDRN(50,50),
DPHRNS(50,50), DAMDXN(50,50), DAMXNS(50,50),
                                                                             01268
                                                                             01269
     1
                       DPHDXN(50,50), DPHXNS(50,50), DAMDTN(50,50),
     2
                                                                             01270
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     3
                      DAMINS(50,50), DPHDIN(50,50), DPHINS(50,50),
                                                                          01271
                      DAMDBN(50,50), DAMBNS(50,50), DPHOBN(50,50),
                                                                          01272
     4
                      DPHENS(50,50), DAMUPN(50,50), DAMPNS(50,50),
     5
                                                                          01273
                      DPHDPN(50,50), DPHPNS(50,50)
                                                                          01274
     6
      COMMON /DERSUM/ ARNSUM(50), PRNSUM(50), AXNSUM(50), PANSUM(50).
                                                                          01275
                      ATNSUM(50), PTNSUM(50), ABNSUM(50), PBNSUM(50),
                                                                          01276
     1
     2
                      APNSUM(50), PPNSUM(50)
                                                                          01277
                      XALUHPISO), RACOHPISO), TACOMPISOJ, BACOMPISOJ,
      COMMON /NCOMP/
                                                                          01278
                      PALONP(50), XPCUNP(50), RPCOMP(50), TPCOMP(50).
     1
                                                                          01279
                      BPEGHP(50), PPELMP(50)
                                                                          01280
     2
      COMMON /DVIATE/ SICMAX, SIGMAR, SIGMAT, SIGMAB, SIGMAP, SIGAN(50),01281
                      SILIM(50), SIGAHC(50), IDEV
                                                                          01262
     1
      CONMON /LNSTNT/ NHEAS, NPRED, NHODES, SIGMA, 8, DUMI(4)
                                                                          01293
      COMMON /MEASUR/ DUN2(150), BETA(50), PSI(50)
                                                                          01284
      COMMON ZAPHINUZ AMU(50), PHIMU(50)
                                                                          01285
      COMMON ZEMUSZ
                      EMU(50,50), EMUP(50,50), EMUPRM(50,50), IEMPRT
                                                                          01286
      COMMON TREFLUNT REFPRS
                                                                          01287
      COMMUN /ANGLES/ GEGRAD, RADDEG
                                                                          01286
                     KMU(50), QMU(50)
      COMMON /KNHU/
                                                                          01299
      CUMMUN /WAVENU/ KK1501
                                                                          01290
      COMMUN /LMATRX/ EQ1(50,51)
                                                                           01291
      COMMON PHOLESP MODE (50), MU(50)
                                                                          01292
      DATA ZERO / (0.0,0.0) /
                                                                          01293
                                                                          01294
 CALCULATE INVERSE OF MEASUREMENT LOCATION MATRIX
                                                                          01295
C
                                                                          01296
      60 10 J=1,NU1M
                                                                          01297
      00 16 1-1.NUIM
                                                                          01298
                   = £01(1,J)
                                                                           01299
      4(1.J)
   10 CONTINUE
                                                                          01300
      CALL INVERTE Q. NDIM. DET. IROW. ICOL )
                                                                          01301
                                                                          01302
C CALCULATE AVERAGE CHARACTERISTIC E-FUNCTION VALUES
                                                                          01303
                                                                          01304
      DO 40 J=1,NHODES
                                                                          01305
      00 20 1=1,NMEAS
                                                                          01306
      EMUAVG(I.J) = KNUIJ) + ENUPRN(J,I) / ( ENUIJ,I) + B
                                                                          01307
   20 CONTINUE
                                                                          01308
   40 CUNTINUE
                                                                          01309
C
                                                                           01316
  CALCULATE DERIVATIVES WITH RESPECT TO A
                                                                          01311
C
C
                                                                          01312
                                                                          01313
      00 100 K=1,NMEAS
                   = ZERO
                                                                          01314
      SUM
      UD 60 J=1.NMOULS
                                                                          01315
                   = ENUAVG(K, J) + EQ1(K, J) + ANU(J) +
      SUH
                                                                          01316
     1
                     CEXPI CMPLXI 0., PHIMU(J) ) ) + SUM
                                                                          01317
   60 CONTINUE
                                                                          01318
      DO BO L=1.NMODES
                                                                          01319
                   = Q(L,K) + SUN + CEXP( CMPLX( 0., -PHIMU(L) ) )
                                                                          01320
      TERM
      LANDRNIK .LJ
                   = - REALI TERM )
                                                                          01321
      DAHRNSIK,L) = DAHLRNIK,L) ++ 2
                                                                          01322
      UPHDRN(K,L) = - AIMAG( TERM / AMU(L) ) * RADDEG
                                                                          01323
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      UPHRNS(K.L) = DPHDRN(K.L) ++ 2
                                                                             01324
   80 CONTINUE
                                                                             01325
  100 CONTINUE
                                                                             01326
£
                                                                             01327
C CALCULATE DERIVATIVES WITH RESPECT TO X
                                                                             01328
C
                                                                             01329
                                                                             01330
      UU 160 K=1, NMEAS
                    = ZERO
                                                                             01331
      SUM
      DO 120 J=1.NMUDES
                                                                             01332
      SUN
                    = EQI(K,J) + KX(J) + ANU(J) + CEXP( CNPLX( 0.,
                                                                             01333
     1
                      PHINU(J) ) + SUM
                                                                             01334
  120 CONTINUE
                                                                             01335
      DU 140 L=1,NMODES
                                                                             01336
      TERM
                    = Q(L,K) + SUN + CEXP( CNPLX( 0., -PHIMU(L) ) )
                                                                             01337
                    = AIMAGI TERM )
      DANUXN (K.L.)
                                                                             01338
      DAHXNS(K,L)
                    = DAMUXNIK,L) ++ 2
                                                                             01339
                    = - REAL( TERM / AMU(L) ) * RADDEG
= DPHUXN(K,L) ** 2
      DFHUXN(K.L)
                                                                             01340
      UPHXNS(K,L)
                                                                             01341
  140 CONTINUE
                                                                             01342
  160 CONTINUE
                                                                             01343
£
                                                                             01344
C CALCULATE DERIVATIVES WITH RESPECT TO THETA
                                                                             01345
C
                                                                             01346
      DU 220 K=1,NMEAS
                                                                             01347
                                                                             01348
      SUM
                    = ZERU
      UO 180 J=1.NMUDES
                                                                             01349
                    = EQ1(K,J) + MODE(J) + ANU(J) +
      SUN
                                                                             01350
     1
                      CEXPI CMPLXI 0., PHIMU(J) ) ) + SUN
                                                                             01351
  180 CONTINUE
                                                                             01352
      DU 200 L=1,NHUDES
                                                                             01353
                    = Q(L,K) * SUM * CEXP( CMPLX( 0., -PHIMU(L) ) )
= AIMAG( TERM ) / RADDEG
      TERM
                                                                             01354
      LAND TN (K .L )
                                                                             01355
      DAMINS(K,L)
                    = DAMDIN(K,L) ++ 2
                                                                             01356
                    = -REAL( TERM / AMU(L) )
      DPHDTN(K.L)
                                                                             01357
      DPHINS(K.L.)
                    = UPHDTN(K,L) ++ 2
                                                                             01358
  200 CUNTINUE
                                                                             01359
  220 CONTINUE
                                                                             01360
C
                                                                              01361
C CALCULATE DERIVATIVES WITH RESPECT TO BN
                                                                             01362
C
                                                                             01363
      UU 260 L=1,NMODES
                                                                             01364
      DU 240 K=1.NMEAS
                                                                             01365
       TEKM
                    = Q(L,K) + CEXP( CMPLX( D., PSI(K) - PHIMU(L) ) )
                                                                             01366
      DAMDEN (K.L.)
                    = REAL( TERM )
                                                                              01367
      DAMENS IK . L.)
                    = DAMOBN(K.L) ** 2
                                                                             01369
                    = AIMAGI TERM / AMUIL) ) * RADDEG
      DPHUEN(K.L)
                                                                             01369
      DPHDNS(K.L) = DPHDBN(K.L) ++ 2
                                                                             01370
  240 CONTINUE
                                                                             01371
  260 CONTINUE
                                                                              01372
C
                                                                              01373
Ċ
  CALCULATE DERIVATIVES WITH RESPECT TO PSI
                                                                             01374
C
                                                                             01375
      DU 300 L=1,NMODES
                                                                              01376
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N. .PANE 18.L4
                                                                           01377
      00 280 K=1,NMEAS
                    = Q(L,K) = BFTA(K) = CEXP( CMPLX( 0., PSJ(K) -
                                                                           01378
      TERM
                                                                           01379
                      PHINU(L) ) )
     1
                    = - AIMAGI TERM ) / RADDEG
                                                                            01380
      UANUPN(K,L)
                    = DAHGPN(K,L) ++ 2
                                                                           01381
      UAMPNS(K,L)
      UPHDPN(K.L)
                   = REAL( TERM / ANUIL) )
                                                                           01382
                                                                           01353
                    = DPHDPN(K,L) ++ 2
      DPHPNS(K.L)
                                                                           01384
  280 CONTINUE
                                                                           01385
  300 CONTINUE
                                                                            01386
C CALCULATE SUMS OF DERIVATIVES
                                                                            01387
                                                                            01368
C
      DO 340 J=1,NMODES
                                                                           01359
                                                                           01390
      SUMM
                   = 0.0
                                                                           01391
      00 320 1=1,NMEAS
                    = DAMRNS(I,J) + SUMM
                                                                            01392
      SUMM
                                                                            01393
  320 CONTINUE
      ARNSUMEJE
                    = SUMM
                                                                            01394
                                                                            01395
  340 CONTINUE
                                                                           01396
C
      DO 360 J=1.NHODES
                                                                           01397
                                                                            01398
      SIMM
                   3 0-0
                                                                           01399
      LO 360 I=1.NMEAS
                                                                            01400
      SUNH
                   = DPHRNS(1,J) + SUMM
                                                                           01401
  360 CONTINUE
      FRNSUMIJ
                    = SUMM
                                                                           01402
                                                                            01403
  380 CONTINUE
                                                                            01404
C
      UO 420 J=1,NMUDES
                                                                            01405
                                                                            01406
                   = 0.0
      SUHH
                                                                            61407
      DO 400 1=1,NMCAS
                    = DAMXNS(I,J) + SUMM
                                                                           01408
      SUHH
                                                                           01409
  400 CLNTINUE
                                                                            01410
      AXNSUM(J)
                    = SUMM
  420 CENTINUE
                                                                            01411
                                                                            01412
C
      DU 460 J=1,NMODES
                                                                            01413
                                                                            01414
      SUMM
                    = 0.0
                                                                            01415
      00 440 I=1,NMEAS
      SUMM
                    = DPHXNS(I,J) + SUNM
                                                                            01416
                                                                            01417
  440 CONTINUE
                                                                            01418
      PXNSUM(J)
                    = SUMM
  460 CONTINUE
                                                                            01419
C
                                                                            01420
      LO 500 J=1+NMODES
                                                                            01421
      SUMM
                   = 0.0
                                                                            01422
                                                                            01423
      DC 480 1=1,NMEAS
      SUMM
                    = DANINS(I,J) + SUMM
                                                                            01424
                                                                            01425
  480 CUNTINUE
      AINSUN(J)
                                                                            01426
                    = SUMM
  500 CONTLINUE
                                                                            01427
                                                                            01428
C
      DU 540 J=1,NMODES
                                                                            01429
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                                                                 9.0
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      SUMM
                    = 0.0
                                                                             01430
      DO 520 I=1.NHEAS
                                                                             01431
      SUMA
                    = DPHTNS(I,J) • SUMM
                                                                             01432
  520 CONTINUE
                                                                             01433
      PINSUN(J)
                    = SLIMM
                                                                             01434
  540 CONTINUE
                                                                             01435
C
                                                                             01436
      LO 560 J=1.NHODES
                                                                             01437
                    = 0.0
      SUHM
                                                                             01438
      DD 560 I=1.NHEAS
                                                                             01439
      SUNM
                    = DAMENS(1,J) + SUMM
                                                                             01440
  560 CONTINUE
                                                                             01441
      ABNSUMEJ)
                    = SUMM
                                                                             01442
  580 CONTINUE
                                                                             01443
C
                                                                             01444
      DO 620 J=1,NMUDES
                                                                             01445
      SUMM
                    = 0.0
                                                                             01446
      DO 600 I=1,NMEAS
                                                                             01447
      SUMM
                    = DPHBNS(I,J) + SUMM
                                                                             01448
  600 CONTINUE
                                                                             01449
      PENSUMEJE
                    = SUMM
                                                                             01450
  620 CONTINUE
                                                                             01451
C
                                                                             01452
      DO 660 J=1.NMODES
                                                                             01453
      SUMM
                    = 0.0
                                                                             01454
      DU 640 1=1.NMEAS
                                                                             01455
      SUMM
                    = DAMPNS(1,J) + SUMM
                                                                             01456
  640 CENTINUE
                                                                             01457
      APNSUM(J)
                    = SUMM
                                                                             01458
  660 CONTINUE
                                                                             01459
C
                                                                             01460
      LO 700 J=1.NHODES
                                                                             01461
                                                                             01462
                    = 0.0
      SUMM
      DO 680 I=1, NMEAS
                                                                             01463
                    = DPHPNS(I,J) + SUMM
      SUMM
                                                                             01464
  680 CONTINUE
                                                                             01465
      PPNSUM(J)
                    = SUMM
                                                                             01466
  700 CONTINUE
                                                                             01467
C
                                                                             01468
C
  CALCULATE COEFFICIENTS OF DEVIATION FOR EACH MUDE IF REQUESTED
                                                                             01469
Ċ
                                                                             01470
      IFI IDEV .EQ. 0 )
                                         GO TO 9999
                                                                             01471
                    = SIGMAR ++
                                                                             01472
      SIGR
                                 2
                    * SIGNAX ** 2
      SIGX
                                                                             01473
      SIGT
                    = SIGMAT ++
                                 2
                                                                             01474
                    = SIGMAB ++ 2
                                                                             01475
      SIGB
                    - SIGMAP ++ 2
      SIGP
                                                                             01476
                                                                             01477
C
C
  CALCULATE COMPONENTS OF MODAL STANDARD DEVIATIONS
                                                                             01475
C
                                                                             01479
      DO 720 I=1,NMODES
                                                                             01460
      XACUMP(1)
                                                                             01481
                    = AXNSUM(I) + SIGX
      RACOMP(1)
                    = ARNSUM(I) + SIGR
                                                                             01482
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                                                                                01483
      TACOMP(1)
                     .
                       ATNSUM(I) + SIGT
      BACOMP(I)
                     = AGNSUM(I) + SIGB
                                                                                01484
                                                                                01485
                     = APNSUN(I) + SIGP
      PACOMP(1)
  720 CONTINUE
                                                                                01466
      DO 740 I=1,NMODES
                                                                                01487
      XPLOMP(1)
                     = PXNSUM(I) * SIGX
                                                                                01488
                                                                                01489
      RPCOMP(I)
                     = PRNSUM(I) + SIGR
      TPCOMP(1)
                     = - INSUM(I) + SIGT
                                                                                01490
                                                                                01491
      SPCUMP(1)
                     = PBNSUM(I) + SIGB
                                                                                01492
      PPCUMP(I)
                     = PPNSUN(1) + SIGP
  740 CONTINUE
                                                                                01493
                                                                                01494
      60 760 1=1, NMODES
                                                                                01495
                     = SURT( XACOMP(I) + RACOMP(I) + TACOMP(I) +
      SIGAM(I)
     1
                       BACUMP(1) + PACOMP(1) )
                                                                                01496
                       SURT( XPCUMP(1) + RPCOMP(1) + TPCOMP(1) +
BPCOMP(1) + PPCOMP(1) )
                                                                                01497
      SIGTN(1)
                     *
                                                                                01499
     1
      SIGAMC(1)
                     = SIGAM(I) / AMU(1)
                                                                                01499
                                                                                01500
  760 CONTINUE
                                                                                01501
C
 9999 RETURN
                                                                                01502
                                                                                01503
      END
                                                                                01504
       SUBROUTINE INVERTI A. N. D. L. N. J
                                                                                01505
C
 THIS SUBROUTINE INVERTS A COMPLEX MATRIX. THIS PROCEDURE WAS ADAPTED
FROM THE IBM SCIENTIFIC SUBROUTINE PACKAGE
                                                                                01506
С
                                                                                01507
С
                                                                                01508
C
      DIHENSION L(1), M(1)
                                                                                01509
      COMPLEX A(1), BIGA, HOLD, D, ONE, ZERO
                                                                                01510
                                                                                01511
      DATA ZERD / (0.0,0.0) /, UNE / (1.0,0.0) /
                                                                                01512
C
C SEARCH FUR THE LARGEST ELEMENT
                                                                                01513
                                                                                01514
£
       D
                     = ONE
                                                                                01515
                                                                                01516
                     = -N
      NK
       DO 380 K=1.N
                                                                                01517
                                                                                01518
       NK
                     = N
                         + NK
                                                                                01519
       LEKY
                     .
                       ×.
                                                                                01520
      H (K)
                     = K
       KK.
                     = K + NK
                                                                                01521
       BIGA
                     = A{KK}
                                                                                01522
                                                                                01523
       DO 60 J=K,N
                     = N + ( J - 1 )
                                                                                01524
       1 Z
       DO 60 I=K.N
                                                                                01525
                                                                                01526
                     = IZ + I
       11
   20 1FI CABSE BIGA ) - CABSE A(IJ) ) ) 40, 60, 60
                                                                                01527
   40 BIGA
                     = A(IJ)
                                                                                01525
                                                                                01529
       L(K)
                     = I
                                                                                01530
       MEKI
                     .
                       .1
                                                                                01531
   60 CONTINUE
                                                                                01532
C
C INTERCHANGE ROWS
                                                                                01533
                                                                                01534
C
                     = L(K)
                                                                                01535
       J
                                           ORIGINAL PAGE In
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OF POOR QUALITY

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PRATT & WHITNEY AIRCRAFT DIVISION
                                                                VER
                                                                           (1/25/77
SC.PANLIB.L4
                                                                           12.50.00
                                                                9.0
      IFL J = K )
                                         120, 120, 80
                                                                            01536
   80 KI
                                                                            01537
      DO 100 I=1.N
                                                                            01538
      KI
                    = N + KI
                                                                            01539
                    HOLD
                                                                            01540
                    = KI - K + J
      JI
                                                                            01541
      A(KI)
                    = A(JI)
                                                                            01542
      AIJIJ
                    = HOLD
                                                                            01543
  100 CONTINUE
                                                                            01544
C
                                                                            01545
Ċ
 INTERCHANGE COLUMNS
                                                                            01546
                                                                            01547
  120 1
                    = H(K)
                                                                            01548
      161 1 - K 1
                                                                            01549
                                         180, 190, 140
  140 JP
                            1
                              -1)
                                                                            01550
                          1
      00 160 J=1.N
                                                                            01551
      JK
                    = NK +
                                                                            01552
                           1
      JI
                      JP + J
                    .
                                                                            01553
                    = -A(JK)
      HOLD
                                                                            01554
      A (JK)
                    = A(JI)
                                                                            01555
      A(JI)
                    = HOLD
                                                                            01556
  160 CUNTINUE
                                                                            01557
C
                                                                            0155A
C
  DIVILE COLUMN BY MINUS PIVOT ( VALUE OF PIVOT IS CONTAINED IN BIGA, )
                                                                            01559
C
                                                                            61560
                                         200, 200, 220
  180 IFI CAUST BIGA ) )
                                                                            01561
  200 D
                    ZERO
                                                                            01562
                                         60 TO 9999
                                                                            01563
  220 DO 260 I=1.N
                                                                            01564
      IF( 1 - K )
                                                                            01565
                                         240, 260, 240
  240 IK
                    = NK + I
                                                                            01566
      A11KJ
                    - A(IK) / ( -BIGA )
                                                                            01567
                                                                       •
  260 CONTINUE
                                                                            01568
C
                                                                            01569
C REDUCE MATRIX
                                                                            01570
C
                                                                            01571
      00 320 I=1.N
                                                                            01572
      IK
                    = NK + I
                                                                            01573
      HOLD
                    - A(IK)
                                                                            01574
      IJ
                    .
                      1 - M
                                                                            01575
      DO 320 J=1.N
                                                                            01576
                      IJ + N
      11
                    *
                                                                            01577
      1F( I - K )
                                         280, 320, 280
                                                                            01578
  280 IF1 J - K )
                                         300, 320, 300
                                                                            01579
  300 KJ
                    = IJ - I + K
                                                                            01580
                    - HOLD - A(KJ) + A(IJ)
      A(IJ)
                                                                            01581
  320 CONTINUE
                                                                            01582
C
                                                                            01583
C
  DIVIDE ROW BY PIVOT
                                                                            01584
C
                                                                            01585
      KJ
                    = K
                                                                            01586
                        - N
      00 360 J=1,N
                                                                            01567
                    = N + KJ
      KJ
                                                                            01555
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| PRATI<br>SC.PA | I G WHITNEY AI                                    | IRCRAFT DIVISION   |                       | VER<br>9.0 | 07/25/77<br>12.50.00 |
|----------------|---------------------------------------------------|--------------------|-----------------------|------------|----------------------|
| 340            | 1F( J - K )                                       | - A(K)) / BIGA     | 340, 340, 340         |            | 01589                |
| 340            | CONTINUE                                          |                    |                       |            | 01590                |
| c              |                                                   |                    |                       |            | 01592                |
| C CAL          | CULATE DETERN                                     | INANT              |                       |            | 01593                |
| C              |                                                   |                    |                       |            | 01594                |
|                | D                                                 | = D 🗢 BIGA         |                       |            | 01595                |
| C              | •                                                 |                    |                       |            | 01596                |
| C REP          | LACE PIVOT BY                                     | RECIPROCAL         |                       |            | 01597                |
| C              |                                                   |                    |                       |            | 01598                |
|                | A (KK )                                           | > ONE / BIGA       |                       |            | 01599                |
| 380            | CONT INUE                                         |                    |                       |            | 01600                |
|                |                                                   |                    |                       |            | 01601                |
| C P10          | AL KUW AND LU                                     | LUMN INTERCHANGE   |                       |            | 01602                |
| L              | *                                                 |                    |                       |            | 01603                |
| 400            |                                                   | - N                |                       |            | 01604                |
| 400            | N                                                 | = K = 1            |                       |            | 01605                |
| A20            | 1 K I                                             |                    | <b>4444 4444 4</b> 20 |            | 01606                |
| 44 V           | 161 1 - 4 1                                       | - LINJ             |                       |            | 01607                |
| 440            |                                                   |                    | 480, 480, 440         |            | 01609                |
| 440            | 10                                                |                    |                       |            | 01609                |
|                | D(1 440 J=1.N                                     |                    |                       |            | 01610                |
|                | 1K 400 4-194                                      | - 10 - 1           |                       |            | 01611                |
|                |                                                   |                    |                       |            | 01012                |
|                | 11                                                |                    |                       |            | 01013                |
|                | A LJK Y                                           |                    |                       | •          | 01014                |
|                | ALJI                                              |                    |                       |            | 01012                |
| 460            | CONTINUE                                          | - 11000            |                       |            | 01413                |
| 480            | J                                                 | = M(K)             |                       |            | 01017                |
|                | $\mathbf{I} \mathbf{F} (\mathbf{J} - \mathbf{K})$ |                    | 400. 400. 500         |            | 01010                |
| 500            | K1                                                | = K - N            |                       |            | 01017                |
|                | DO 520 1=1.N                                      |                    |                       | +          | 01620                |
|                | KI                                                | = N + KI           |                       |            | 01622                |
| •              | HOLD                                              | = A(K1)            |                       |            | 01623                |
|                | JI                                                | = KI - K + J       |                       |            | 01624                |
|                | A{K13                                             | = -A(JI)           | •                     |            | 01625                |
|                | A(J1)                                             | = HOLD             |                       |            | 01626                |
| 520            | CONTINUE                                          |                    |                       |            | 01627                |
|                |                                                   |                    | 60 TO 400             |            | 01628                |
| <b>4999</b>    | RETURN                                            |                    |                       |            | 01629                |
|                | END                                               |                    |                       |            | 01630                |
| *****          | ABOVE ACTION                                      | SATISFACTORILY COM | PLETED ++++           |            |                      |

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NUMBER DF (MODE, NU) SETS --0.10 36455.75 AXIAL MACH NUMBER = Radian Frequency = \*\*\* MODAL CALCULATION COMPUTER PROGRAM \*\*\* • ŝ NUMBER OF PREDICTION LOCATIONS = ... INPUT VARIABLES ... 25,00 CUTER RADIUS OF DUCT = Speed of Sound = 34345.00 WAVE INDICATOR NUMEER OF MEASUPEMENT LOCATIONS = 3 RADIAL LKDER 1 2 2 ... TEST GEOMETRY AND CONDITIONS ... REFERENCE PRESSURE = .2000E-03 0++\*0 CIRCUMFERENTIAL Mede Number -4 -4 ... REFERENCE VALUES ... HUE / TIP FATIC = FPEGULNCY = 6200.00 ... INPUT MOLES ... PICIDE 01

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|                  | NUMBEA<br>2MAG2NARY            | 000<br>000                                     |              |       |              |                  |                  | ORIGINAL PAGE IS<br>OF FOOR QUALITY          |               |                            |                                              |  |
|------------------|--------------------------------|------------------------------------------------|--------------|-------|--------------|------------------|------------------|----------------------------------------------|---------------|----------------------------|----------------------------------------------|--|
| ·                | AXTAL WAVE REAL                | 71 <b>.0845</b><br>69 <b>.0154</b><br>65 .0738 |              |       |              |                  |                  | 151<br>109<br>173                            |               | -                          | 47<br>162<br>61                              |  |
|                  | PHASE<br>(DEGREES)             | 126.9814<br>160.(302<br>229.2115               |              |       |              | •                | PHASE<br>(PSI)   | 324.6999<br>135.4000<br>252.2000             |               | PHASE<br>(RESULTAN)        | 90°097<br>357°7867<br>957°2491               |  |
|                  | AMPLITUDE<br>(Db)              | 0.137428F+03<br>0.142601E+03<br>0.138539E+03   |              |       |              |                  | AMPLITUDE<br>(B) | 0.228700E+03<br>0.128970E+03<br>0.841000E+02 | ·             | AMPLI TUDE<br>(RESUL TANT) | 0.121165F+03<br>0.115699E+03<br>0.115084E+03 |  |
|                  | AMPLITUDE<br>(PRESSURE)        | 0.148735E+04<br>0.276112E+04<br>6.169032E+04   |              |       |              |                  | THETA            | • • • •<br>• • •                             |               | ТНЕТА                      | 239,900040<br>100,606037<br>15,900006        |  |
| PHASES           | WAVE<br>Indicator              |                                                |              | THETA | 0•0          |                  | æ                | 25.00000<br>25.00000<br>25.00000             |               | ھ                          | 25.00000<br>25.00000<br>25.00000             |  |
| UDES AND         | RADIAL<br>ORDER                | 0 - N                                          |              |       |              | •                |                  | ör                                           | •             |                            |                                              |  |
| TED MODAL AMPLIT | LIRCUMFERENTIAL<br>Mode Number | 444                                            | ICE LOCATION | œ     | 6 <b>.</b> 0 | WENT LOCATIONS . | *                | 0.0<br>14.7600<br>29.96000                   | TEN LOCATIONS | ×                          | 0.0<br>13.52500<br>20.30000                  |  |
| •• CALCULA       | MODE                           | - ~ M                                          | •• KEFEREN   | ×     | 0.0          | •• MÉASURF       | LOCATION         | (V (J)                                       | •• PRENTCI    | LCCA 71 CA<br>NUMBER       | - N M                                        |  |

\*\*\* MDDAL CALCULATION COMPUTER PROGRAM \*\*\*

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|     |                      |                      |                                                   |                        |                                     | DEVIATION<br>[DEGRES]<br>0.360487E+01<br>0.244215E+01             |                         | ED INFLIENCE CLEFFICIENTS! |               | F         CUE         TO         ERROR         N           THETA         B         PSI           0.49666-01         0.34816+01         0.93116+00           0.49846-01         0.23156+01         0.93116+00           0.44846-01         0.23156+01         0.91856+00           0.44856-01         0.14026+01         0.93476+00 |  |
|-----|----------------------|----------------------|---------------------------------------------------|------------------------|-------------------------------------|-------------------------------------------------------------------|-------------------------|----------------------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|     | IPUTER PROGRAM 444   | T CALCULATION        | SIGMA PS]<br>0-150006+03                          |                        | AMPLITURE                           | UE VIATION<br>(DB)<br>0.8907966+00<br>0.842056+00<br>0.8744971+00 |                         | MES RMS SUM OF NGRMALIZ    | •             | X RHAS<br>C.P676F-01 0.8131F-04<br>0.8406F-01 0.1140E-03<br>0.6200E-01 0.7044E-03                                                                                                                                                                                                                                                  |  |
|     | DDAL CALCULATION COM | VSITIVITY COEFFICIEN | 516MA 8<br>0. 250000 +02                          | R SOURCES              | VORMALIZED AMPLITURE<br>DEVIATION   | 0+ 1079995+00<br>0- 1018005+00<br>0- 1059275+00                   | Source neviation and    |                            | -             | F51<br>00 0.1404E-01<br>00 0.6818E-02<br>00 0.29501-02                                                                                                                                                                                                                                                                             |  |
|     | I<br>•<br>•          | ••• SEI              | NS<br>SIGMA THETA<br>0.200000E-01                 | DUE TO ALL ERRO        | NAVE<br>INGICATOR                   | ***                                                               | DMFONENTS LEAROR        |                            | HITL EKKON IN | -71-03 0-10755<br>741-03 0-10755<br>731-03 0-10595                                                                                                                                                                                                                                                                                 |  |
|     |                      |                      | OURCE STANDARD DEVIATIO<br>X<br>E-O2 0.200000E-02 | ED STANDARD DEVIATIONS | RCUMFERENTIAL RADIAL<br>MUTER LADER | 0-N<br>777                                                        | D STANDAPD UEVIATION CO | AMPLI TUDI I               |               | 1-03 0.4944 -05 0.434<br>21-03 0.4944 -05 0.434<br>21-03 0.61941 -05 0.46<br>14-03 0.61941 -05 0.151                                                                                                                                                                                                                               |  |
| wh, |                      |                      |                                                   | +++ NURMAL 1           |                                     | <b>- ^ n</b>                                                      | NCRMALIZI               | MODE                       |               | 1 0 - 741<br>0 - 461<br>0 - 30, 461                                                                                                                                                                                                                                                                                                |  |

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|                               |               |              | 154                    | 0.6207E+00<br>0.6123E+00<br>0.6231E+00           |              |                | ISA                    | 0.3982E+00<br>0.4557E+00          |  |
|-------------------------------|---------------|--------------|------------------------|--------------------------------------------------|--------------|----------------|------------------------|-----------------------------------|--|
|                               |               |              | 8<br>2<br>2<br>4       | 0.1392E+00<br>0.9259E-61<br>0.5610E-01           |              |                | 8<br>N<br>N            | -0.7737E-01<br>-0.5167E-01        |  |
|                               |               |              | INE TO FRAD<br>Theta   | 0.2483E+91<br>6.2449E+01<br>0.2442E+01           |              |                | DUE TO ERRO<br>Theta   | 0. 15 \$3E + 01<br>0. 18 23E + 01 |  |
| ÷                             | •             |              | PHASE                  | 0.4066F-01<br>0.5702E-01<br>0.1025E+00           |              | DCATICN 1      | PHASE<br>R             | 0.2251E-01<br>0.4534E-01          |  |
| ITEP PROGRAM                  | CALCULATION   |              | ×                      | 0.4332E+02<br>0.4203E+02<br>0.4100E+02           |              | MEASUREMENT    | <b>X</b> .             | -0.2869E+02<br>-0.3154E+02        |  |
| CULATION COMPU                | Y COEFFICIENT |              | 184                    | 0.6646F-02<br>0.4545E-02<br>0.1967E-02           |              | EFFICIENTS FOR | P S J                  | 0.60176+01<br>0.99395+01          |  |
| <ul> <li>MODAL CAL</li> </ul> | . SENSITIVIT  | IENTS        | ROR IN<br>B            | 0.4301F-02<br>0.4063E-02<br>0.423EE-02           | IVES )       | INFLUENCE CO   | KOR JN ,<br>b          | 0.2590E+01<br>0.5571E+01          |  |
| :                             | :             | 0[++}0] 3]N+ | DF LUE TO FR<br>Thifta | 0. 7674E - 01<br>0. 141 al - 61<br>0. 7667l - 02 | TIAL DERIVAT |                | DE DUE TO ERI<br>Theta | 0. 22076+n2<br>c. 3976+03         |  |
|                               |               | ALIZED INFLU | AMPLITU<br>R           | 0.4957E-02<br>0.4275F-02<br>0.4096F-02           | ICIENTS (PAR |                | AMPLITU<br>K           | 0-27705+01<br>6-2714+01           |  |
|                               |               | SUM OF NOFM  | ×                      | 0, 3704 + 460<br>0, 23061 + 60<br>0, 15121 + 00  | LUFNCE COEFF |                | ×                      | -0-43236+03<br>-0-45576+03        |  |
|                               |               | S E E        | MCDF                   | н v б                                            | ••• INF      |                | MODE                   | - ~                               |  |

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|   |                                     | £ + 00             | 14                           | 00<br>00<br>00<br>00<br>00<br>00<br>00<br>00 |                | 51<br>86 + 00<br>46 + 00<br>76 + 00                |  |
|---|-------------------------------------|--------------------|------------------------------|----------------------------------------------|----------------|----------------------------------------------------|--|
|   |                                     | 0.414              | Ľ                            | 0.452(<br>0.370(<br>0.442]                   |                | 0.144<br>0.144                                     |  |
|   |                                     | -0.9041E-02        | 8<br>7<br>8                  | 0.8881E-01<br>0.6576E-01<br>C.4060E-01       | Z              | 6<br>0.3973E-01<br>0.373E-01<br>-0.3764E-01        |  |
|   |                                     | 0 <b>.1659E+01</b> | DUE TO ERRO<br>Theta         | 0.1808E+01<br>0.14 E0F+01<br>0.1771E+01      | nif to fag     | THETA<br>0.5940E+00<br>0.6974E+00<br>0.5706E+00    |  |
|   |                                     | 0.6339£-01         | DCATICN 2<br>PHASE           | -0.3239E-01<br>-0.1°27E-01<br>0.1¢66E-01     | DCATJCN 3      | R<br>C.9860E-02<br>-0.2707E-01<br>-0.8605E-01      |  |
|   |                                     | -0.2737E+02        | MEASUREMENT L<br>X           | -0.3014E+02<br>-0.2464E+02<br>-0.2464E+02    | MEA SUREMENT L | X<br>-0.12266+02<br>-0.1263f+02<br>-0.8542E+01     |  |
|   |                                     | 0.1065E+01         | FFICIENTS FOR<br>PSI         | 0.51676+01<br>0.71296+61<br>0.26956+01       | FFICIENTS FOR  | PSJ<br>0.26205+01<br>0.26115+01<br>0.16505+01      |  |
| • |                                     | 0.3065E+01         | INFLUENCE COE<br>Rok 1n<br>B | C.5216E+01 -<br>0.7925E+01 -<br>0.5605E+01 - | INFLUENCE CCE  | 8<br>0.26495+01<br>0.57245+01<br>0.28675+01        |  |
|   | ORIGINAL PAGE IS<br>OF POOR QUALITY | 0.4259E+01         | IDE DUE TO ER<br>Theta       | -0.2075E+02<br>-0.2052E+02<br>-0.1076E+02    | 97 CF 30       | THETA<br>-0.1132E+02<br>-6.1124E+02<br>6.652CE+01  |  |
|   |                                     | <b>∪.1885 +01</b>  | AMPLITU<br>K                 | -0.61326+01<br>-0.92176+01<br>-0.6414E+01    |                | R<br>0.315 cE +01<br>c.565 cE +01<br>c.15 c7 t +01 |  |
|   |                                     | 0.37936+02         | ×                            | 0.3253£+03<br>0.4445£+05<br>0.1588£+03       |                | x<br>0.10706+03<br>0.11165+03<br>-0.19676+03       |  |
|   | 68                                  | m                  | MCDE                         | - N 6                                        |                |                                                    |  |




|                             |       |                   |                   |               | KUMU                        | 5.2516<br>6.7800<br>12.9219                      |                 |       |     |               |                          |                                              |    |   |
|-----------------------------|-------|-------------------|-------------------|---------------|-----------------------------|--------------------------------------------------|-----------------|-------|-----|---------------|--------------------------|----------------------------------------------|----|---|
|                             |       |                   |                   |               | NUMBER<br>I MAGINARY        | 000<br>000                                       |                 |       |     |               |                          |                                              |    |   |
|                             |       |                   |                   |               | AXIAL WAVE<br>Real          | 71.0845<br>69.0154<br>65.0758                    |                 |       |     |               |                          | 266<br>266                                   |    |   |
|                             |       | ***               | NOI               |               | PHASE<br>DEGREES)           | 325.6000<br>250.0001<br>100.0000                 |                 |       |     |               | PHASE<br>(PESULTANT      | 36.4374<br>345.04374<br>298.2324             |    |   |
|                             |       | N COMPUTEL PPOGPA | NE PHASE CALCULAT |               | AMPLITUDE<br>(D8)           | 0.121936E+03<br>0.121938E+03<br>0.121938E+03     |                 |       |     |               | AMPLITUDE<br>(RESULTANT) | 0.115620E+03<br>0.120052E+03<br>0.119999E+03 |    |   |
|                             |       | HODAL CALCULATIO  | DDAL AMPLITUDE AN |               | AMPLITUDE<br>(PRESSURE)     | 0. 250000E +03<br>0. 25000E +03<br>0. 25000E +03 |                 |       |     |               | THETA                    | 000<br>000                                   |    |   |
|                             |       | *                 | Σ<br>·<br>·       | PHASES        | WAVE<br>IND ICATCR          |                                                  |                 | THETA | 0•0 |               | لا                       | 25.00000<br>25.00000<br>25.00000             |    |   |
|                             |       |                   |                   | TUDES AND     | P ADIAL<br>CKDER            | 0 - N                                            |                 |       |     | :             |                          | 00                                           |    |   |
| ORIGINAL PAG<br>OF POOR QUA | HE IS |                   |                   | D MCDAL AMPLI | CUMFERENTIAL<br>IOPE NUMBER | 414                                              | LCCATICN        | ~     | 0.0 | N LOCATIONS   | ×                        | 0.0<br>14.9760<br>29.9600                    |    |   |
|                             |       |                   |                   | ••• CALCULATE | MODE CIP                    | N M                                              | • • • REFERENCE | ×     | 0•0 | ••• PREDICTIC | LGCATION<br>NUMBER       | - N M                                        | 71 |   |
|                             |       |                   |                   |               | -                           | ç -1. 2012-1-1-1-                                |                 |       |     |               |                          | r<br>J                                       |    | ľ |



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\*\*\* MODAL CALCULATION COMPUTER PROGRAM \*\*\*

... CHARACTERISTIC E-FUNCTION VALUES FOR MODAL AMPLITUDE AND PHASE CALCULATIONS ...

MODES

... MEASUREMENT LOCATIONS ...

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1 2 3 2 0.0 0.0 0.0 3 0.0 0.0 0.0 0.0

... PREDICTION LOCATIONS ...

LOCATION

MODES

1 2 3 1 0.404 -0.315 0.233 2 0.404 -0.315 0.233 3 0.404 -0.315 0.233

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