STUDIES IN CHEMICAL IONIZATION MASS SPECTROMETRY

UNIVERSITY OF UTAH

MARCH 1975

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Prepared for
AIR FORCE MATERIALS LABORATORY
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio 45433

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These research efforts have involved studies in chemical ionization mass spectrometry which have led to improved instrumentation, techniques and methodology for trace analysis. Much of the work has emphasized instrumental developments. These have included the development of high pressure ion sources for chemical ionization studies with a high resolution mass spectrometer, the development of super pressure (20 torr) ion sources for exploring maximum sensitivity of chemical ionization mass spectrometry, and, most recently, the

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development of combined gas chromatography-electron impact-chemical ionization mass spectrometry using a dual source, dual-beam mass spectrometer. This report describes some applications of the latter instrument plus the computer software developed for accumulation of data and data reduction.

FOREWORD

This technical report has been reviewed and is approved for publication.

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SECTION I

INTRODUCTION

This document reports a continuation of research efforts described in previous technical reports by the author, AFML-TR-70-65, "High Resolution Chemical Ionization Mass Spectroscopy" (May, 1970), AFML-TR-71-98, Studies in Chemical Ionization Mass Spectroscopy" (June, 1971), and AFML-TR-73-63, "An Improved Chemical Ionization Mass Spectroscopy System" (March, 1973).

Briefly these research efforts have involved studies in chemical ionization mass spectrometry which have lead to improved instrumentation, techniques and methodology for trace analysis. Much of the work has emphasized instrumental developments. These have included the development of high pressure ion sources for chemical ionization studies with a high resolution mass spectrometer, the development of super pressure (20 torr) ion sources for exploring maximum sensitivity of chemical ionization mass spectrometry, and, most recently, the development of combined gas chromatography-electron impact-chemical ionization mass spectrometry using a dual source, dual-beam mass spectrometer. This report describes some applications of the latter instrument plus the computer software developed for accumulation of data and data reduction.

Chemical ionization mass spectroscopy is a new technique for chemical analysis which uses a series of ion molecule reactions to develop the characteristic ion spectrum from which the unknown substance is identified. The sequence of ion molecule reactions responsible for generating the spectrum are carried out under controlled conditions inside a high pressure ion source operated in such a manner that ions undergo thousands of collisions before effusing from the ion source into the mass analyzer region. A reagent gas is

chosen for these experiments which generate a simple ion spectrum--a small number of ions, or in some cases, a single ionic species--which constitutes the reagent ions for the generation of CI spectra. These ions are so chosen that they are unreactive with the reagent gas but react with high efficiency with substances under investigation. The choice of reagent gas and the concomitant choice of reagent ions produces a useful control of the ionization processes which can be made selective for molecules with high proton or electron affinities. Through choice of reagent gas the type of chemical reaction and exothermicity of reaction are both controlled, usually resulting in chemically specific and selective, high sensitivity ionization.

Research carried out in these laboratories and elsewhere suggests that there are two general areas of application for this new technique in which chemical ionization mass spectrometry is likely to prove particularly useful for the identification of unknown compounds. The area which has received most attention to date is the tailoring of a reagent ion to a particular problem. In this approach a great deal of background information is usually available concerning the mixture of substances involved, and it is possible to choose a reagent ion which will identify the particular molecular weights and functional groups of the molecule in question. A relatively newer approach which is addressed in this report is the broad application of chemical ionization mass spectrometry as an alternative ionization means for generating mass spectra for a large variety of molecules. Here much less attention is paid to generating chemical ionization spectra under precisely controlled conditions and to the selection of particularly suitable reagent gases. Rather attention is given to the fact that the basic physics and chemistry of chemical ionization is quite different from that of electron impact mass spectrometry; therefore this

alternative ionization means constitutes an independent analytical method. This approach is particularly powerful when used in conjunction with conventional electron impact mass spectrometry and gas chromatography. The combination of these three analytical perspectives for the same molecule generates a tremendous amount of information for the unknown molecule whose identity is sought. Several examples are given illustrating the usefulness of this approach.

As indicated in previous reports chemical ionization mass spectrometry appears to be substantially more sensitive for many compounds than electron impact mass spectrometry. The consequence of this fact is that bleeding of column substrate material from gas chromatography columns into the ion source of a mass spectrometer constitutes a rather more severe limitation for CIMS than for conventional GCMS. For this reason we have given some attention to the development and characterization of porous polymers as GC agents in conjunction with CIMS. We have also used high boiling silicone polymers and have explored briefly the use of molecular sieves and other solid absorbtion type packing materials for gas solid chromatography. This work is reported briefly.

It is also important to make use of gas chromatography retention time as another parameter characterizing molecular structure. The most convenient form in which this information may be discussed is the use of normalized Kovats retention indicies. We discuss this technique and report some data obtained for particular examples of compounds.

A corollary of this approach to analytical mass spectrometry is the necessity for having on-line data reduction capability to accommodate the enormous amount of information generated in a relatively short time by the combined GC-EI CI mass spectrometer.

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A third phase of this effort has been concerned with the development of suitable software for data reduction using combined GC-MS techniques. As of this date a single beam has been used for the recording of data either by electron impact or chemical ionization mass spectrometry. In the near future we anticipate that a double beam capability will be established. The interface which has been used in this work and the hardware implementation of the computerized mass spectrometry capability has been described in the earlier report, AFML-TR-73-63. The general program and the computer-operator dialogue of the present operating system is described in Section IV. The expansion of the program to include dual beam data reduction is relatively straightforward.

This report constitutes a progress report on our continuing effort to develop an analytical system involving computerized GC-CI-EI mass spectrometry. Although Air Force sponsorship has been terminated the ongoing effort will be reported in the scientific literature.

SECTION II

INSTRUMENTAL DEVELOPMENTS

Two mass spectrometers--a Varian-MAT CH-7 medium resolution magnetic
sector instrument and an AEI MS-30 dual-beam double-focusing instrument
with Nier-Johnson geometry--have been substantially modified for chemical
ionization studies. These instruments will be described briefly.

A. <u>Varian-MAT CH-7 Spectrometer</u>. We illustrate in Figs. 1,2, and 3
a new chemical ionization mass spectrometer system which has been designed to
provide maximum flexibility for investigating high pressure ion source phenomena.
Figure 1 illustrates schematically the fairly elaborate electron gun and ion
gun optics. A cathode lens followed by an Einzel lens forms an intermediate
and final image of the filament which slightly demagnifies the image of the
electron emitter and injects electrons into the ionization source. A power
supply adjustable up to 3.1 KV with respect to the ion source injects the
electrons at high energy so that they will penetrate the high pressure gas
sufficiently to generate an ion plasma in the central region of the source
which is favorable for ion extraction. Note the tunnel construction of the
electron entrance aperture which provides a reasonably large opening for
admitting more than 10 microamps of electrons while presenting the pumping
characteristics of a tube rather than an orifice of the same diameter. At the
same time the fact that the filament is separated from the ion source chamber
by a distance of some 8 centimeters produces good thermal isolation so that
the temperature of the ion source is independent of the temperature of the
cathode.

The ion acceleration optics are identical in basic design to the electron
gun and also produce a demagnified image of the ion beam exiting the source
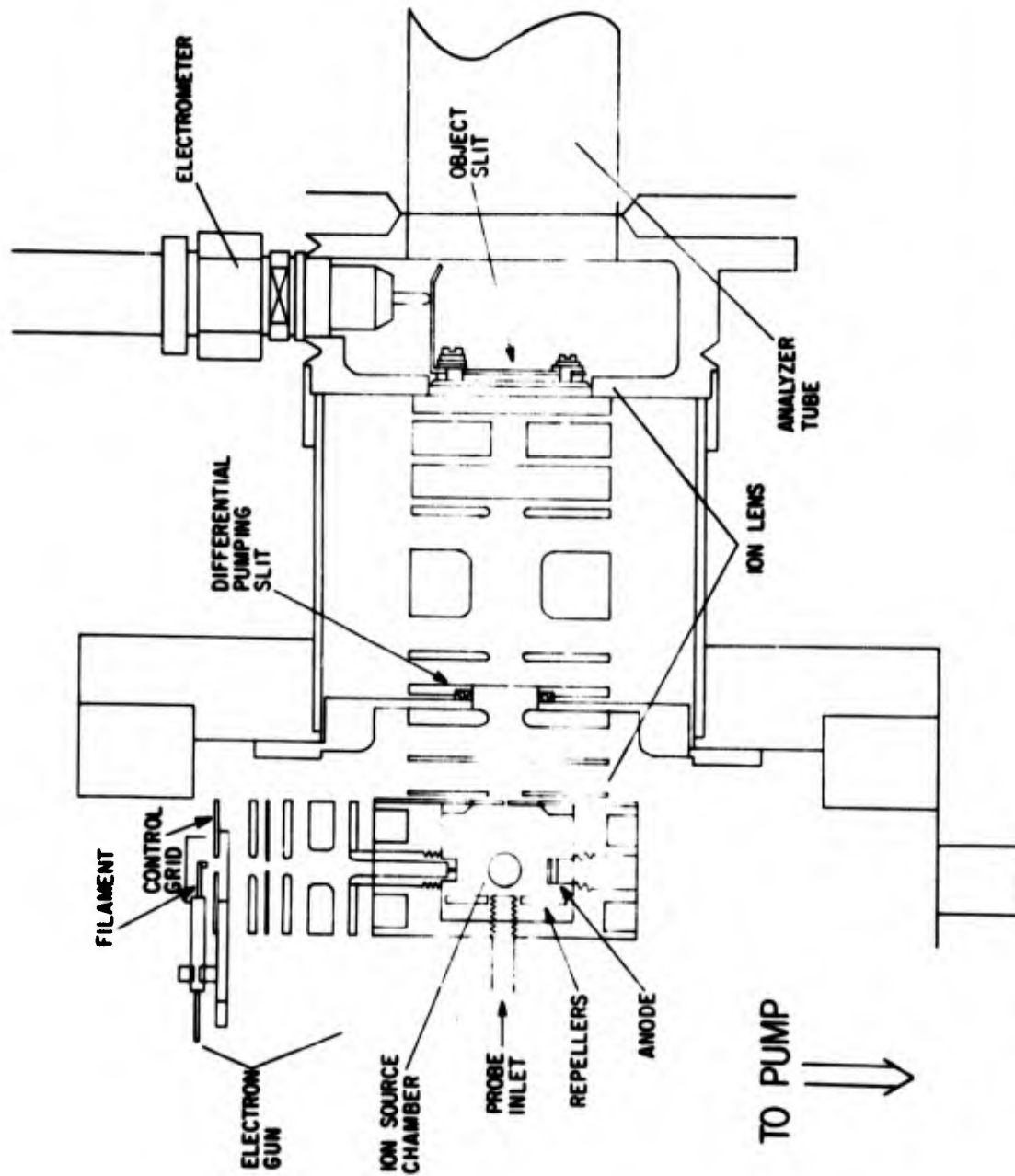
Fig. 1. Schematic of high pressure ion source, electron gun, and strong-focusing optics of CH-7 mass spectrometer.

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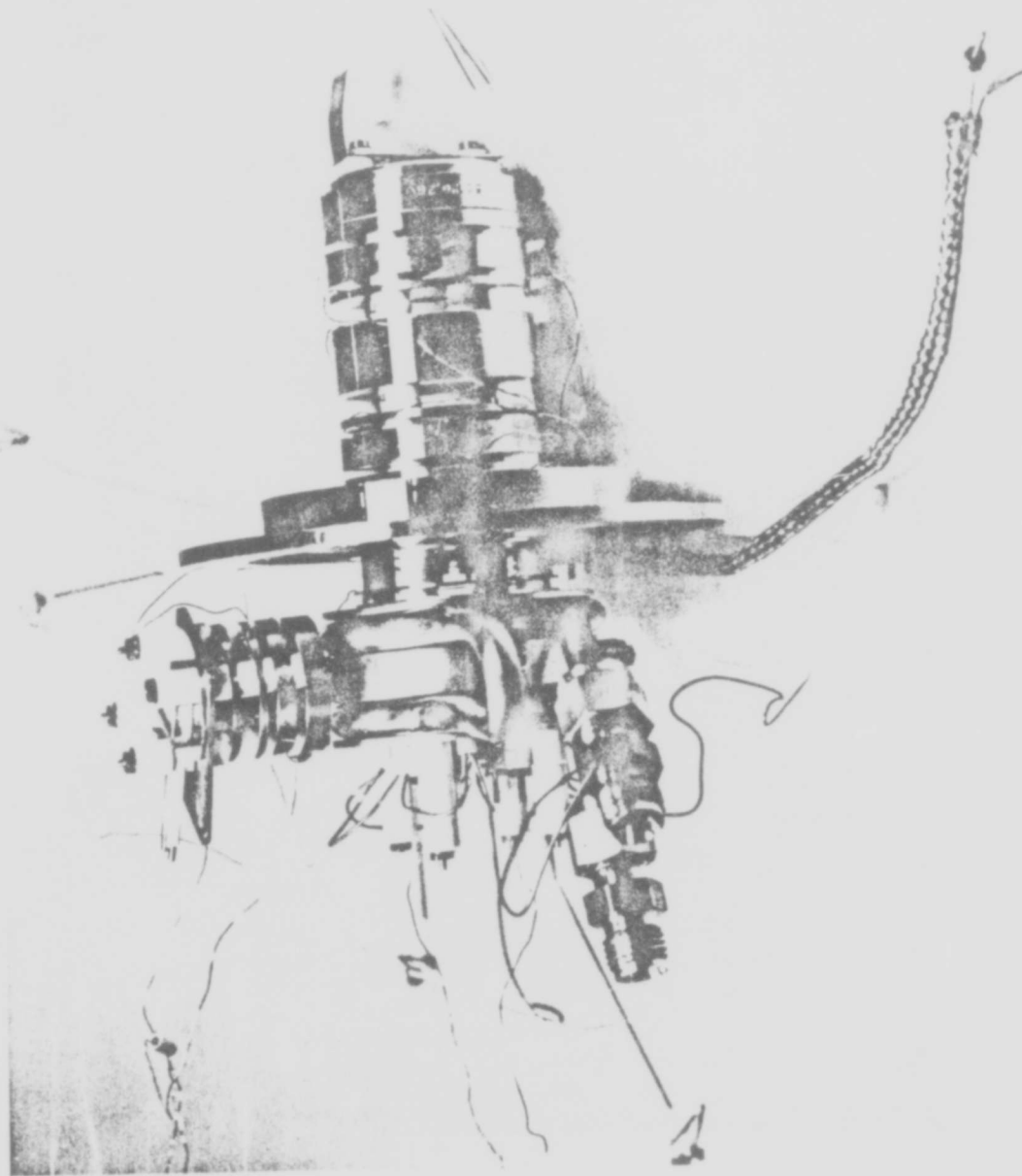
Figure 2. CH-7 Ion Source

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Figure 3.   CH-7

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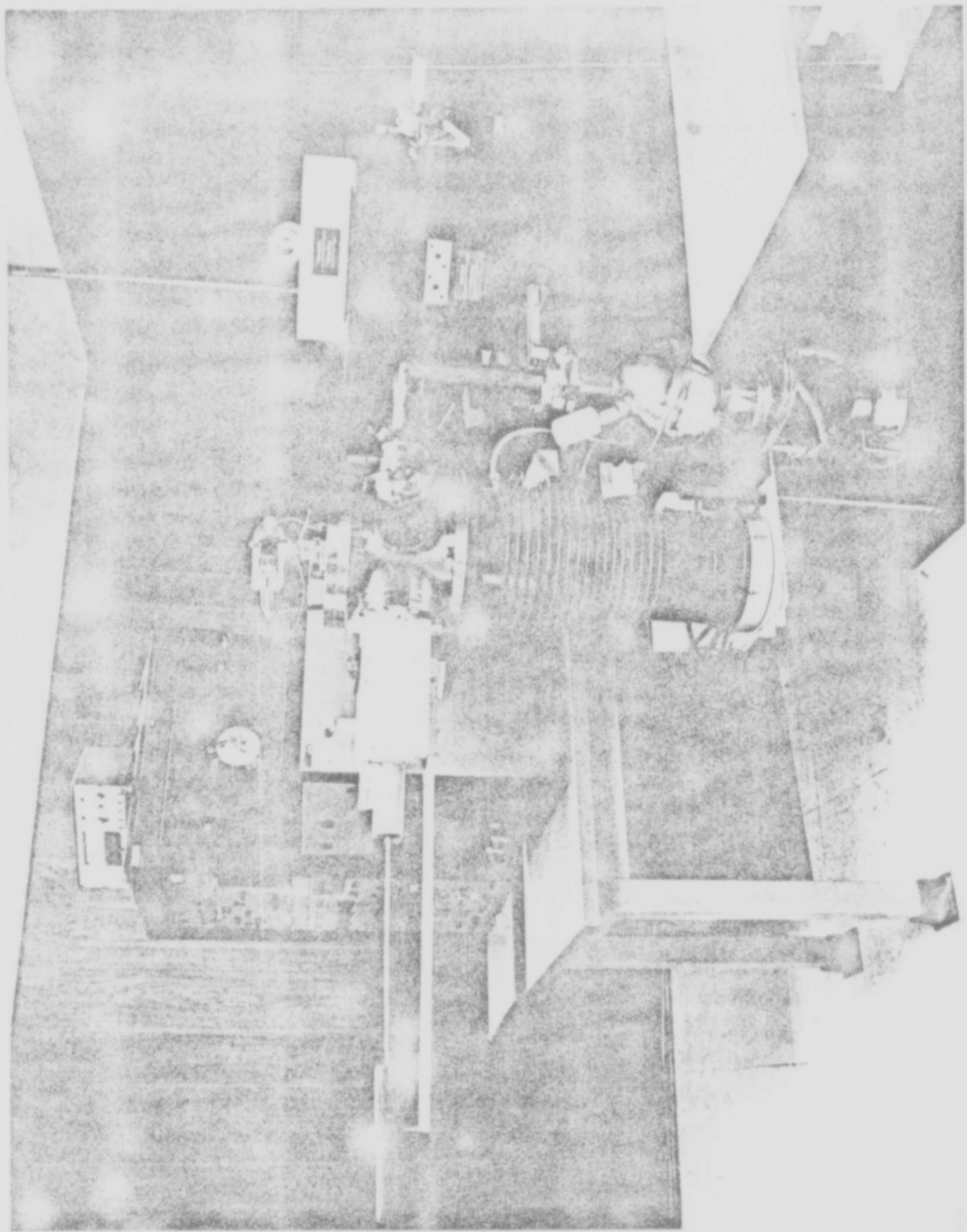
chamber on the object slit of the mass spectrometer itself. An additional Einzel lens perpendicular to the plane of the main optical path (the main lens is y-direction focusing, with the x-direction defined as the direction of ion travel, and the z-direction defined as parallel to the magnetic field) provides z-focusing to minimize ion losses in the vertical plane. The main purpose of the strong focusing acceleration optics is to maximize ion transmission through the mass analyzer. Actual measurements indicate some 55 percent of the ions effusing from the ion source are transmitted through the entire optical system.

Direct access to the source chamber is provided by three additional holes bored into the source block. All of these holes are threaded connections so that gas-tightness is extremely good. One of these couples a gas chromatograph directly into the ion source of the spectrometer without any intervening enrichment interface. A second port provides direct access for any sampling system desired by the experimenter. At present this is attached to an MKS Baratron and a Wallace and Tiernan direct reading absolute manometer for precise pressure measurement. The third port is used for the introduction of samples by means of a solids probe and for the introduction of reagent gas. Because gas flow is over the tip of the probe and into the source the solids probe may be inserted within the source chamber or withdrawn to a distance of 1.5 centimeters from the source block while remaining within the vacuum seal of the inlet probe assembly.

Also attached to the source block shown in the photograph of Figure 2 is a stainless steel coil which passes through the vacuum housing to the exterior of the instrument. This coil is used for circulation of cryogenic fluids and has been used to chill the source block below a hundred degrees Kelvin. A series of heater inserts can be used to heat the block to at least 800°K.

Because of the good thermal isolation of the filament of the electron gun assembly, one can operate the system indefinitely anywhere between the temperature extremes cited.

Figure 2 is a photograph of the actual source, while Figure 3 is a photograph of the Varian-MAT CH-7 mass spectrometer with the ion source assembly and source pumping system installed. The source pump is an NRC VHS-6 diffusion pump with a rated pumping capacity of 2400 liters/second directly at the source housing itself. The analyzer tube of the mass spectrometer is pumped by a 2-inch oil diffusion pump and liquid nitrogen trap system attached to the analyzer tube about 14 centimeters away from the differential pumping slit of the instrument. The very high differential pumping achieved permits us to operate at pressure up to 10 torr within the ion source while maintaining an anlyzer tube pressure in the 10^{-6} torr region. The intrinsic resolving power $\frac{M}{\Delta M}$ of greater than 5,000 of the instrument has been maintained in the chemical ionization configuration and the scan circuitry has been modified to permit us to examine molecules of molecular weight up to 6800.

We have also modified the ion detector circuitry of the mass spectrometer for pulse-counting operation. For this purpose we have installed on EMI 9604 venetian blind electron multiplier, a pulse amplifier and discriminator, and a scaler. This permits both positive ion and negative ion measurements with digital read-out of the detected signal. With the addition of a pulse generator to gate the electron beam and a multi-channel scaler as the ion detect element, we can measure the arrival time distribution of each ion species as a function of time after the initial ions are generated within the ion source. Collectively these modifications will permit us to measure the distribution of primary ions, reagent ions and product ions as a function of time and, consequently, as

a function of the number of collisions which the average ion has undergone. The time evolution of the high pressure mass spectrum displays directly the approach to equilibrium of the ion distribution. This means of data presentation is especially useful for ion equilibrium studies.

   D. __AEI MS-30 Dual Beam Double-Focusing Mass Spectrometer.__ Considerable interest is attached to the examination of molecules by both electron impact and chemical ionization mass spectrometry.[1] The AEI MS-30 dual beam double-focusing instrument is the obvious choice for this aspect of analytical mass spectrometry. The fact that two independent but identical ion paths exist in the instrument suggested to us the construction of a dual ion source which will provide several different combinations of mass spectra--viz., (1) simultaneous electron impact and chemical ionization spectra using a low energy reagent gas such as isobutane (t-$C_4H_9^+$ reagent ion); (2) simultaneous electron impact and chemical ionization spectra using a high energy reagent ion such as hydrogen (H_3^+) or methane (CH_5^+ and $C_2H_5^+$ reagent ions); (3) simultaneous CI spectra in both sources using high energy and low energy reagent ions; (4) simultaneous chemical ionization and electron impact spectra using a charge transfer reagent gas such as argon, neon or nitrogen and (5) combination of charge transfer and proton transfer reagent gases to give simultaneous CI spectra for which the basic ionization process is fundamentally different.

   The first configuration in which we have utilized the dual source mass spectrometer includes a gas chromatograph and enrichment device indicated schematically in Fig. 4. As indicated in the figure the carrier gas for the gas chromatograph may be the chemical ionization reagent gas chosen for the particular experiment; alternatively reagent switching (described later) may

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GC OUTLET

SILICONE MEMBRANE
SEPARATOR

VENT ⊗ 3-WAY VALVE

SHUT-OFF VALVES ⊗

REAGENT GAS

CI   EI

SOURCES
↓
TO MASS ANALYZER
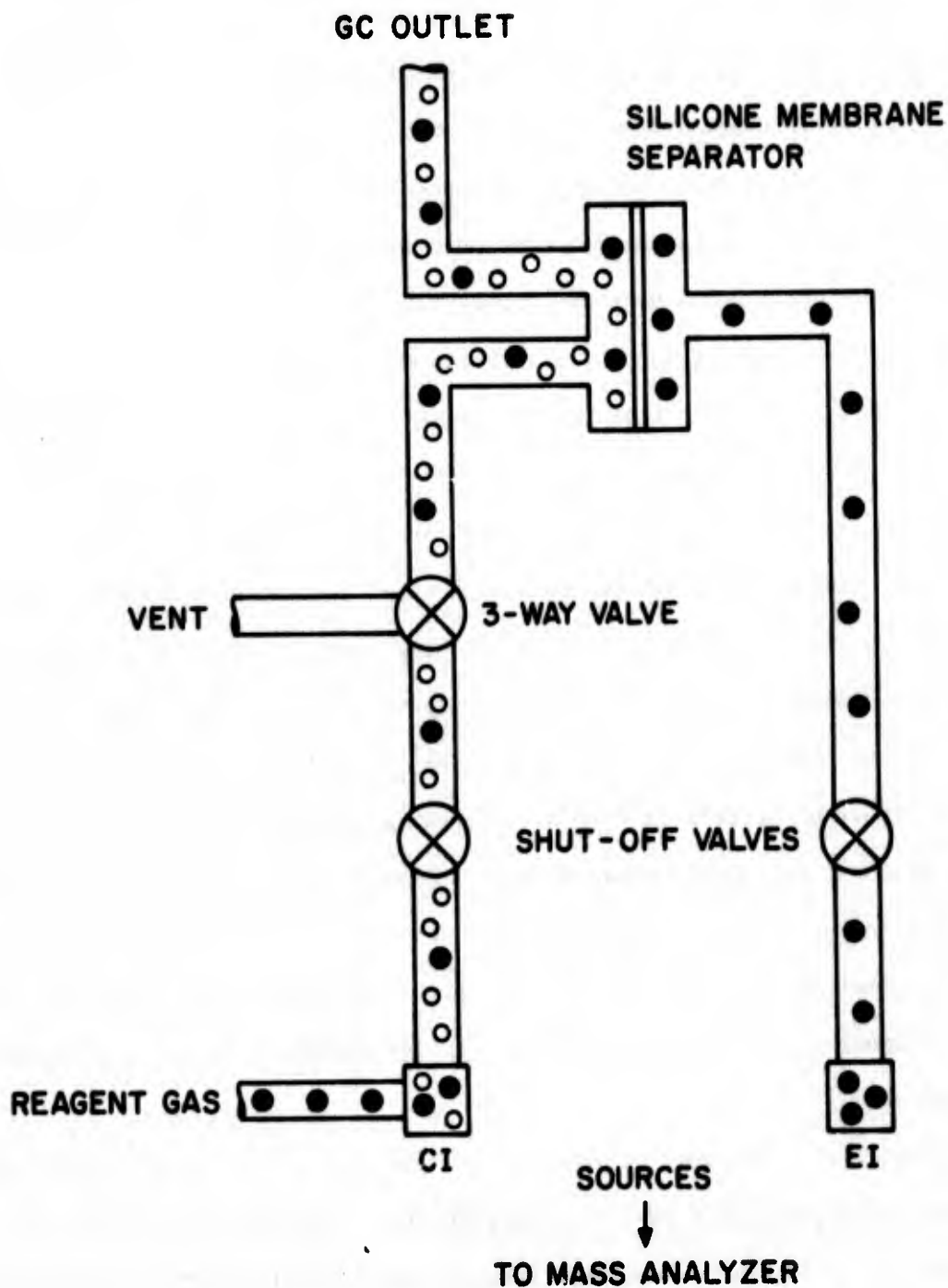
Figure 4 . Schematic of gas chromatographic splitter and
          dual beam electron impact and chemical ionization
          ion sources.

be used to generate reagent ions. The enricher shown utilizes a 0.001 inch nominal thickness silicon rubber membrane of 3 cm^2 cross-sectional area to remove 5-50% of the fractionated sample from the GC effluent, plus a minimum amount of the carrier gas, which are then admitted to the electron impact ion source. Most of the carrier gas and a portion of the unknown substance eluted from the gas chromatograph are pumped into the chemical ionization ion source where a characteristic chemical ionization spectrum is generated by a sequence of ion molecule reactions. The enriched sample is passed at reduced pressure into the electron impact source. Using this method, therefore, chemical ionization and electron impact mass spectra are generated for the same molecule essentially simultaneously.

The dual ion sources of the mass spectrometer are shown in Figure 5. The acceleration optics are similar to those described earlier for the CH-7 instrument. A cathode lens, two Einzel lenses, horizontal and vertical deflectors, and z-focus lenses present a focused intermediate image to the source electric sectors of the spectrometer.[2] Sufficient control of ion beam properties and sufficient degrees of freedom are provided by this arrangement to present an optimized ion beam at the object slits of the spectrometer. Ion focusing, transmission, and detection are then accomplished by the otherwise standard MS-30 instrument.

As described earlier the physical processes by which the mass spectrum is developed are fundamentally different for electron impact and chemical ionization. Consequently the simultaneously generated mass spectra constitute independent analyses of the same sample. It has been pointed out Jurs, Isenhour, Kowalski and Reilley[3] that these circumstances amplify greatly the probability for successful identification of an unknown whenever an authentic sample is

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not available for comparison or when limitations on spectral quality exist. This hypothesis will be explored in future research utilizing computerized interpretation of mass spectral data. The rapid, simultaneous acquisition of CI and EI mass spectra will also facilitate rational judgment concerning the relative merits of the two approaches to analytical mass spectrometry for various classes of compounds.

SECTION III

EXPLORATORY STUDIES OF NEW ANALYTICAL CHEMISTRY TECHNIQUES

A. Total Effluent Gas Chromatography--Chemical Ionization Mass Specrotmetry.

Since the first combination of gas chromatography and mass spectrometry by Holmes and Morrel in 1957,[4] there has been an unending search for better and more efficient separators. What is desired is efficient and complete transfer of the eluted G.C. peak into the mass spectrometer while effectively removing all the carrier gas. The parallel development of chemical ionization mass spectrometry has provided high pressure ion sources equipped with sufficiently powerful roughing and diffusion pumps to sustain low pressures in the mass analyzer. These chemical ionization sources are continuously being filled with a reagent gas and it seems only natural that this reagent gas could also be used as the carrier gas for transport of compounds through a column in gas-liquid chromatography. By directly coupling the G.C. to the mass spectrometer it is evident that problems intrinsic to the separator of compound selectivity and mass discrimination are avoided. If the carrier gas is selected carefully then full advantage can be taken of simplified chemical ionization spectra of the eluted peaks.

In this work we have developed the technique of directly coupled GC-MS-chemical ionization (GC/CIMS) and demonstrated its utility for analyzing selected compounds. Particular attention has been given to the utilization of gas-solid chromatography with its inherent advantage of zero column bleed. Applications of gas-solid chromatography have been limited previously by the conflicting requirements of low sample loadings necessary for high column efficiency and low sensitivity of detectors for compounds for which GSC is a useful separation technique. This sensitivity problem is overcome using the highly sensitive chemical ionization mass spectrometer.

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A Varian model 2700 gas chromatograph was coupled to the CH-7 spectrometer described earlier. It was modified by the inclusion of a 1 inch piece of narrow bore glass tubing followed by 2 feet of narrow bore stainless steel tubing between the exit of the column and the ion source. This assembly isolates the GC from the source high voltage, while the capillary tubing maintains a high pressure in the glass insulator to prevent electrical discharge. Typically, columns were 1 to 8 feet long and 1/8" to 1/4" O.D. Flow rates were normally 30-40 atm cc/min for H_2 carrier gas. This resulted in a source pressure of approximately 1 torr. The complete inlet is illustrated schematically in Fig. 5.

In most applications of GC-MS, an electrometer attached to the total ion current monitor slit generates a "normal" GC chart record. Whenever chemical ionization is involved, this total ion mode cannot be used, since each product ion is formed at the expense of a reagent ion. In order to obtain a GC/CIMS chromatogram, the spectrometer is rapidly and repeatedly scanned over a desired mass range throughout the entire chromatographic run. The computer continuously stores the mass and intensity of the peaks obtained during a scan. During the back scan of the mass spectrometer, the computer sums the intensities of all peaks for that scan and subtracts the sum of reagent ion peaks and plots this corrected total ion intensity on a cathode ray tube display unit. The result is a reconstructed real time chromatogram. Fig. 6 shows the sequential display of a chromatogram of a series of light unsaturated hydrocarbons eluted on a one foot Porapak Q column operated at 150°C with a flow of 30 atm ml/min of H_2. After the GC run is completed, the mass spectrum for any of these chromatographic peaks is available from disk and may be plotted, listed, or displayed on the CRT.
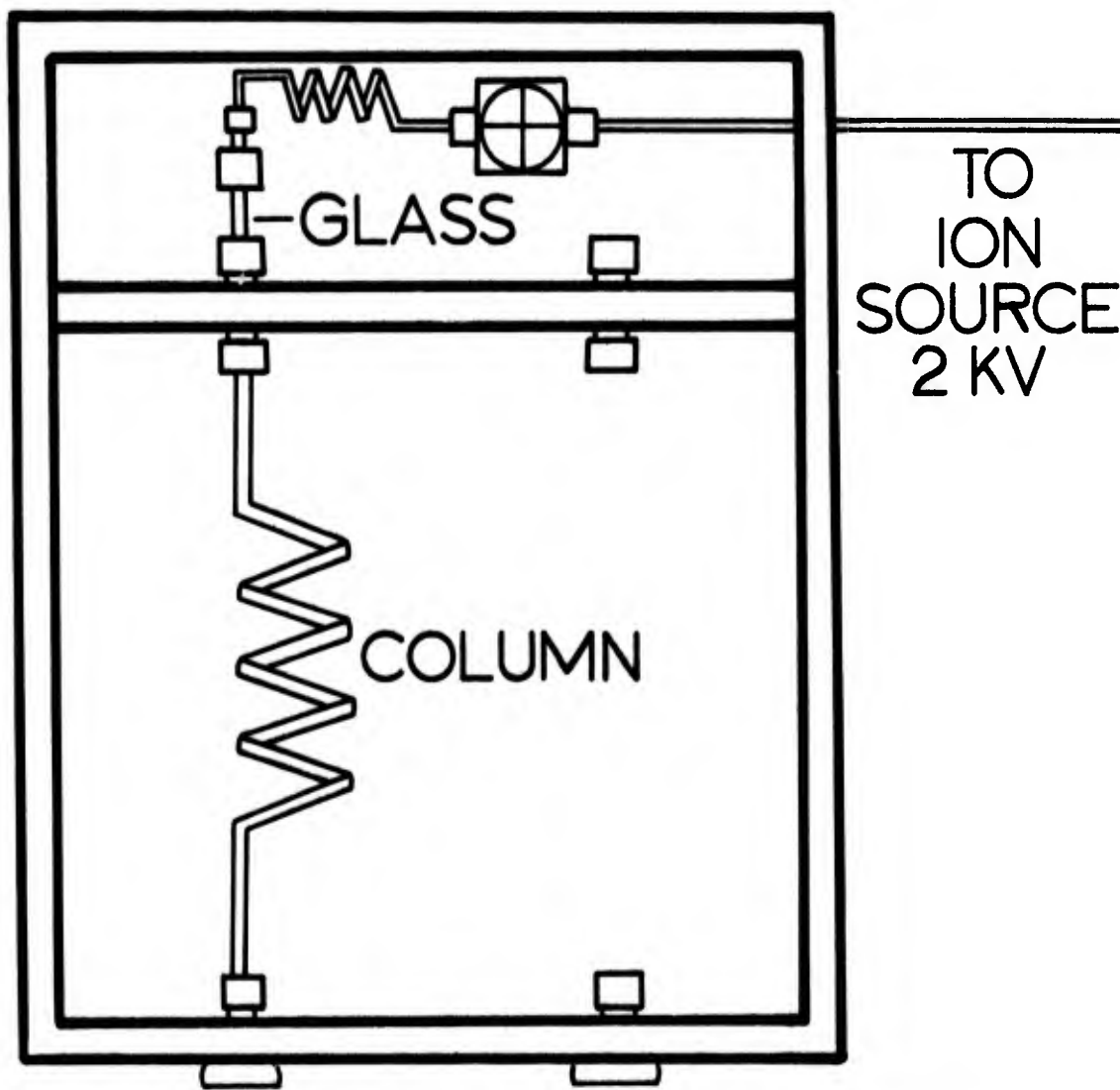
Figure 5.   Schematic of GC Interface for CH-7 Mass Spectrometer

Figure 6. Sequences of CRT Trace for Real Time Chromatogram.

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One application of this technique is an extension of the work of Taylor et al.[5] in which the amount of chromium in blood was determined by forming the volatile trifluoroacetylacetonate (tfa) chelate of chromium and analyzing the resulting mixture by GC/EIMS. In this work, an in-situ-formed polyurethane column[6] was used which gives excellent separation of the chelate from any interfering contaminants. Fig. 7 shows a sample chromatogram for $Cr(tfa)_3$ with monitoring of the mass 512 (m+1) peak. If there is any doubt as to whether the peak in question is $Cr(tfa)_3$ it is only necessary to scan over the peak as it elutes and observe the characteristic chromium isotope ratios (Fig. 8). In this example, H_2 was used as both carrier gas and reagent gas; reaction of H_3^+ with $Cr(tfa)_3$ gives mainly molecular ion with little fragmentation (Fig. 9). This may be contrasted with the EI spectrum shown in Fig. 10. The major peak is m/q 358 peak (M-tfa), but extensive fragmentation is evident. This reduction in fragmentation using chemical ionization should result in greater ultimate sensitivity of GC/CIMS over the electron impact method.

We have also applied this technique to light gas analysis and, in particular, to the analysis of carbon monoxide in nitrogen. This has been a difficult analysis for mass spectrometers since the two gases have the same nominal molecular mass; this has required high resolution to quantitate them. However, the separation of nitrogen and carbon monoxide by GC is very easily accomplished using a molecular sieve column. It is nevertheless still difficult to analyze for CO in N_2 with normal GC/MS techniques since the separators which use differential solubility (silicone membrane) usually show low solubilities for these gases and separators based on a diffusion principle (jet separator) usually discriminate against low molecular weight gases.

Fig. 11 illustrates the application of total effluent GC-CIMS to this

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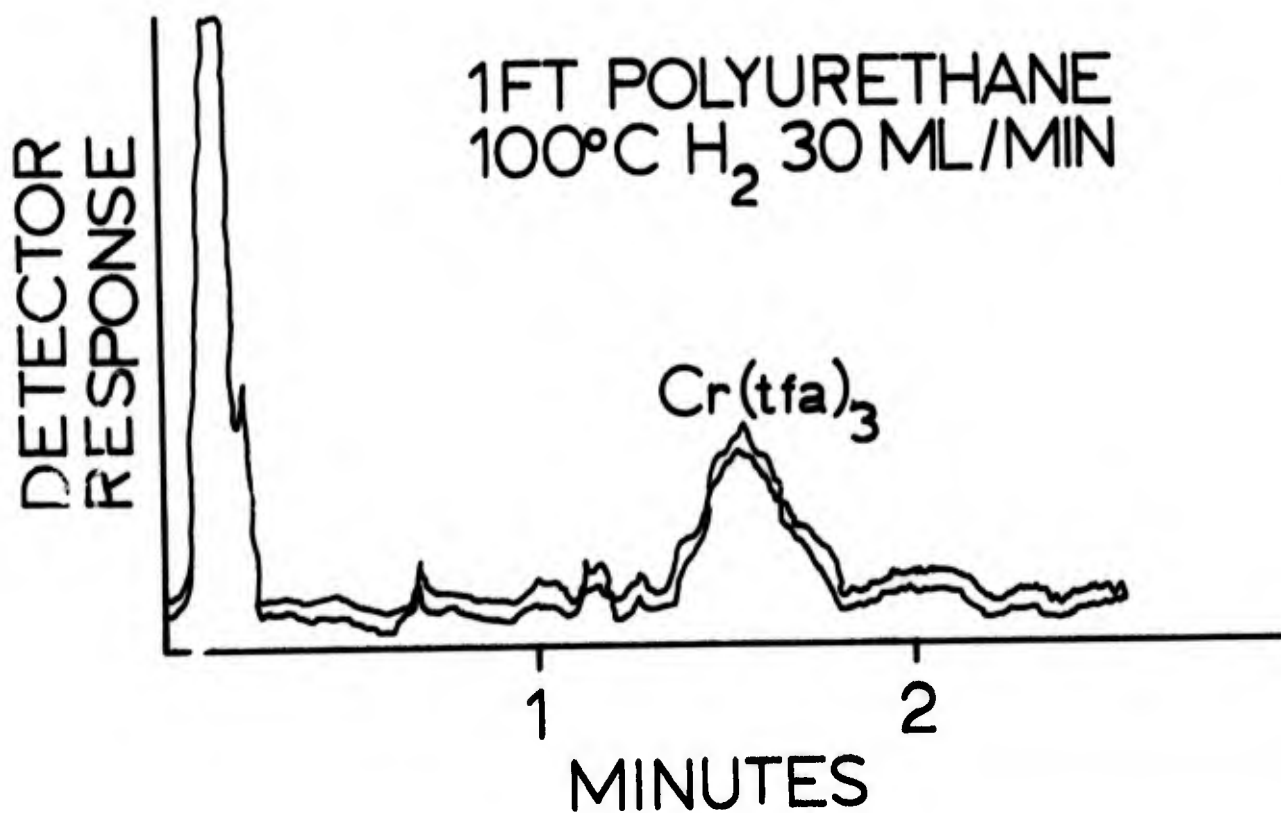
Figure 7. Detector Trace for Cr (tfa)₃ by GC-CIMS
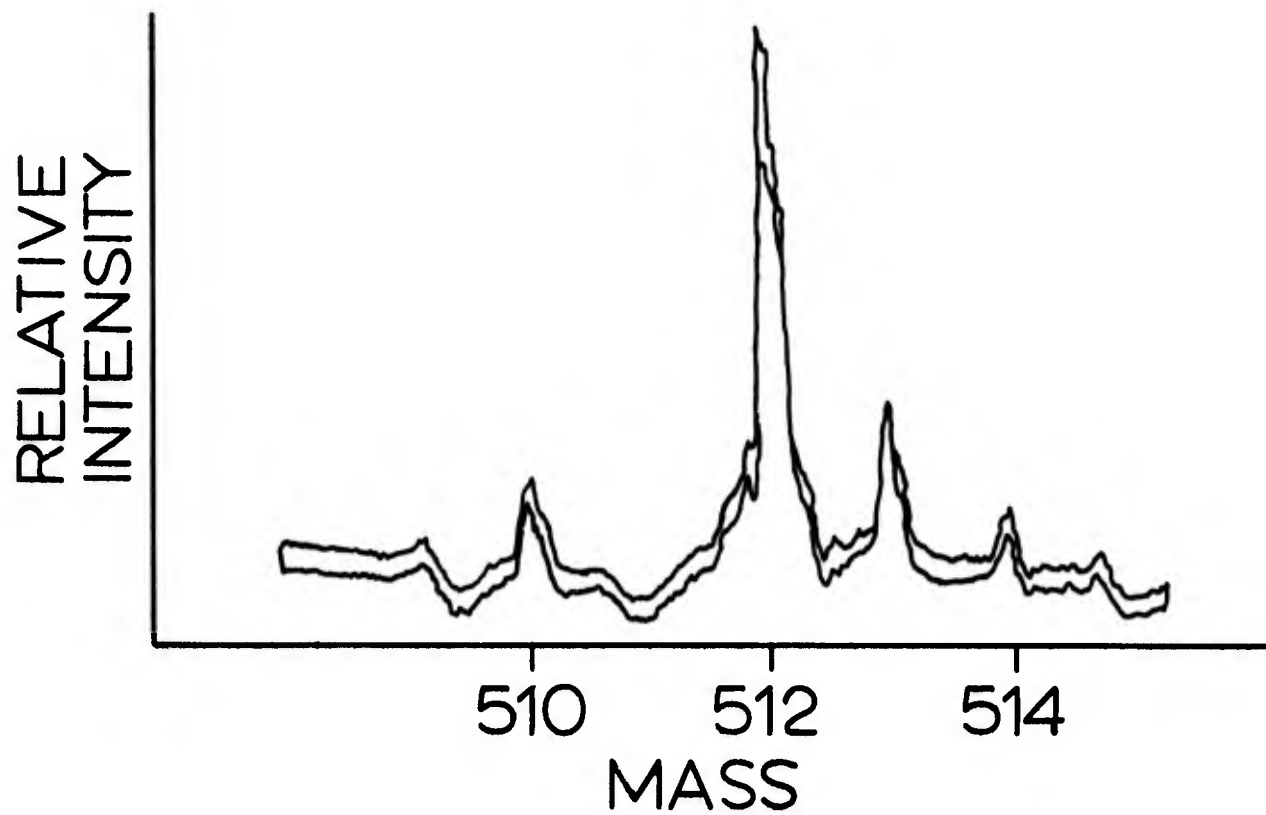
Figure 8. Mass Scan at Maximum of GC-CIMS peak.
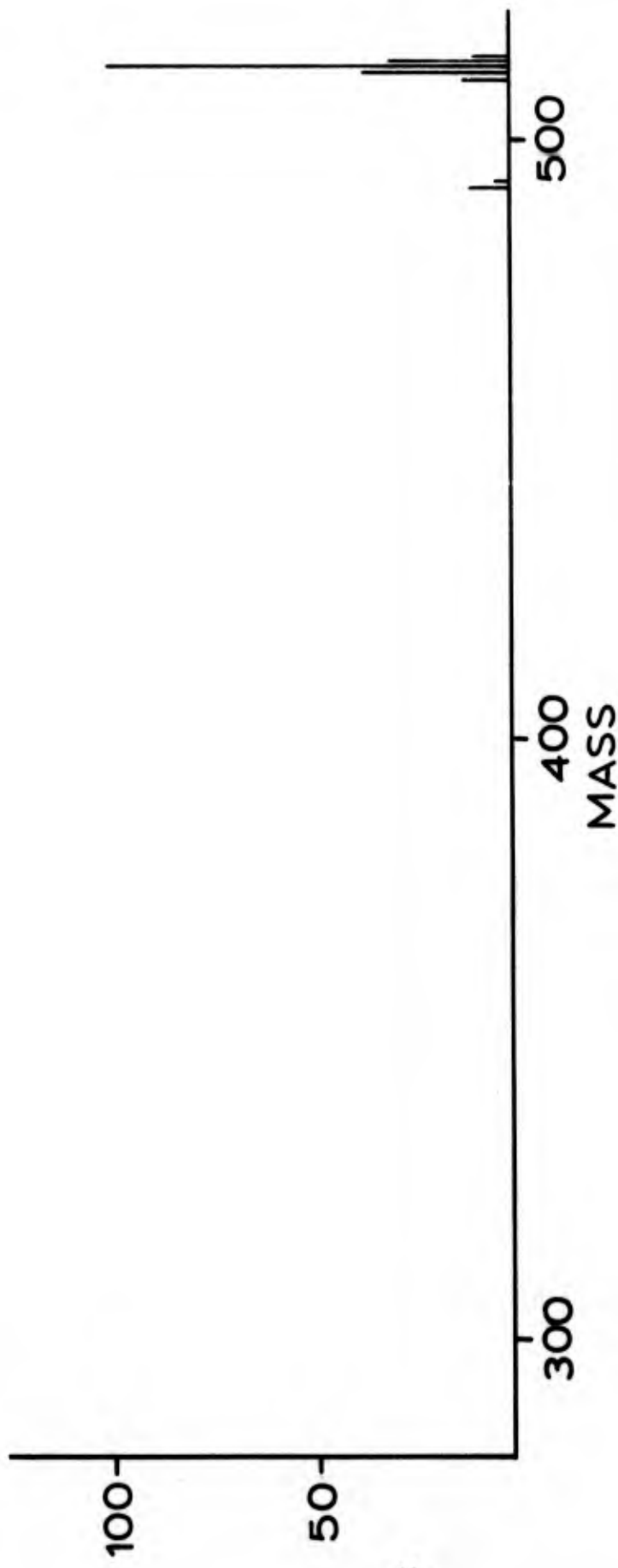
Figure 9. CI Mass Spectrum of Cr (tfa)₃

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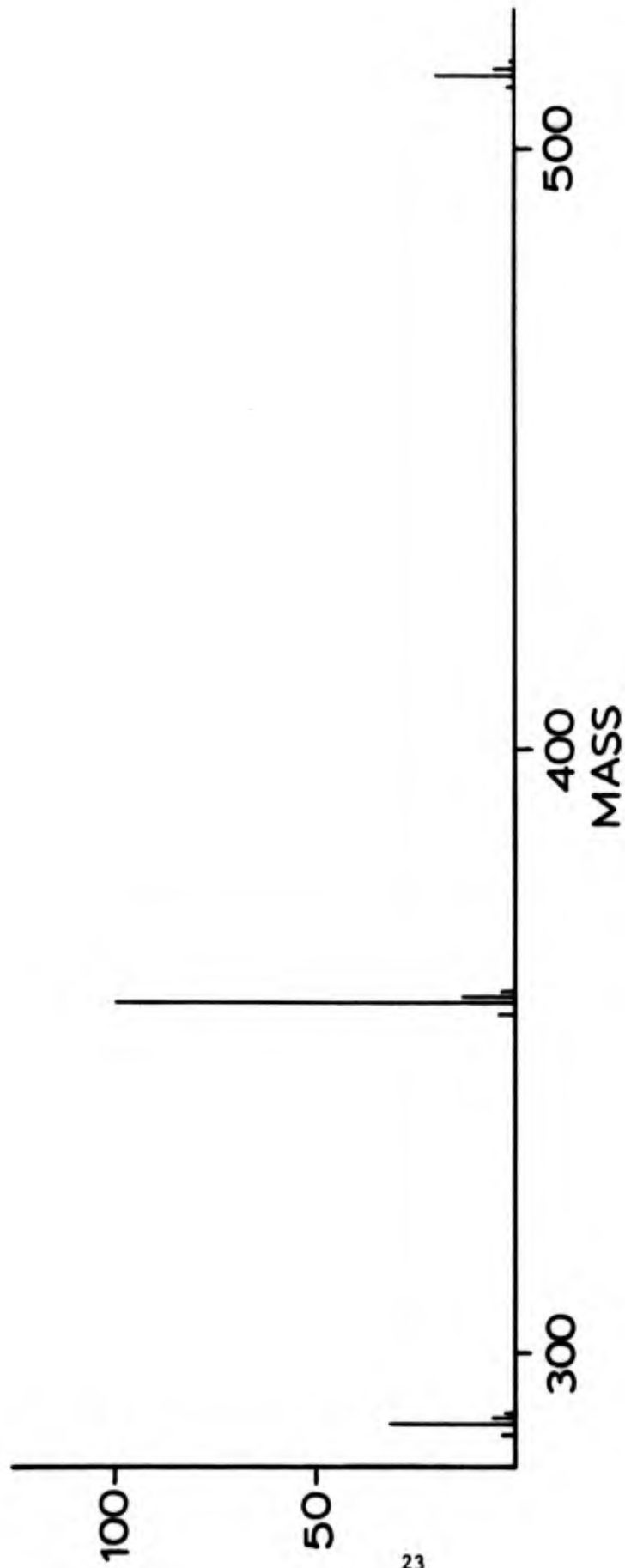
Figure 10. EI Mass Spectrum of Cr (tfa)₃
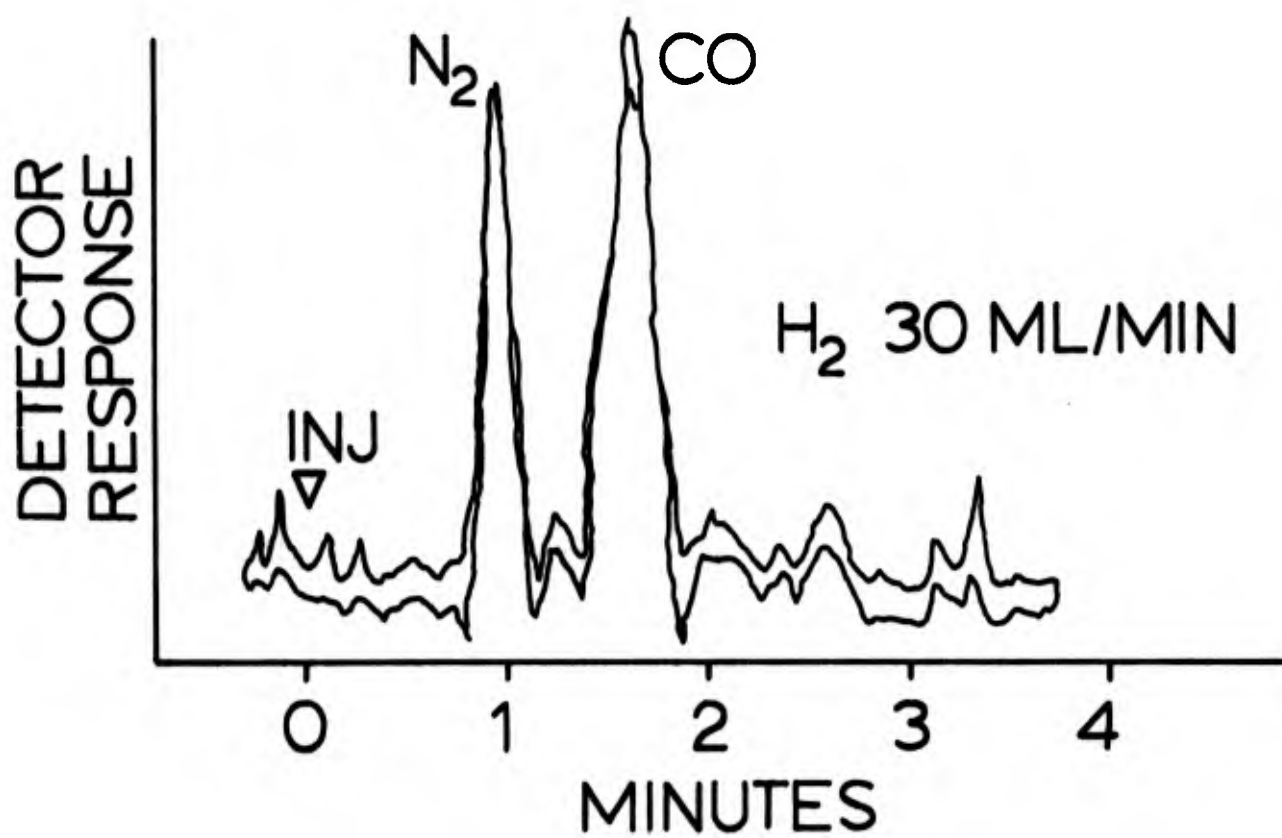
Figure 11. Dectector Trace for N_2, an CO Mixture by GC-CIMS.

problem. An 8 foot molecular sieve 5A column with H_2 as carrier gas and a flow rate of 40 atm cc/min. was used to separate the light gases. As with the $Cr(tfa)_3$ work, a single peak-mass 29 (COH^+ and N_2H^+)-was monitored to obtain the chromatogram.

B. Dual Beam Electron Impact/Chemical Ionization Mass Spectrometry.

As described earlier and shown schematically in Figure 4, the modified AEI MS-30 mass spectrometer has been placed in operation as a GC-EI-CI mass spectrometer system. One possible means of sample introduction is to use reagent gas as the GC carrier gas in an analogous manner to that described in Section III A. An improved system illustrated in Figure 4 was devised to utilize low molecular weight carrier gases such as H_2, D_2 and He in order to standardize GC retention volumes for reference compounds on columns which were conditioned and calibrated on conventional flame ionization detector gas chromatographs. Reagent ions are generated by adding 3-10% of reagent gas as shown in Figure 4 using the technique we describe as "reagent switching." This may be illustrated by considering a mixture of gases consisting of 97 percent hydrogen, 3 percent methane, and 0.001 percent added sample. The initial ionization and ion molecule reactions generate the reagent ion H_3^+ which may react with the added methane or with the sample gas according to the following reaction sequence:

$$H_3^+ + CH_4 \rightarrow CH_5^+ + H_2 \tag{1}$$

$$H_3^+ + M \rightarrow MH^{+**} + H_2 \tag{2}$$

$$CH_5^+ + M \rightarrow MH^{+*} + CH_4 \tag{3}$$
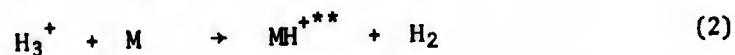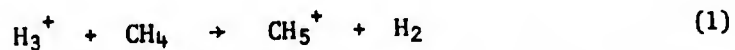
If we assume that the rate coefficients for these ion molecule reactions are comparable, then the relative probability of reactions (1) and (2) is governed by the relative concentrations of CH_4 and M. Obviously, therefore, the only

reaction of H_3^+ which need be considered is the formation of the protonated methane reagent ion, CH_5^+. Essentially quantitative conversion of H_3^+ to CH_5^+ will therefore occur, and the chemical ionization reactions of the sample molecule will be the reactions of CH_5^+ in eq. (3) rather than H_3^+ in eq. (2).

Thus we may use kinetic control of reagent ion identity as a means for rapidly switching from one reagent ion to another without the long term tailing effect associated with switching carrier gases. Using hydrogen as a carrier gas for the GC/chemical ionization mass spectrometer it should be possible first to record the chemical ionization spectrum characteristic of hydrogen, then inject a small amount of methane and record the CI spectrum characteristic of CH_5^+ reagent ions, switch to isobutane and use $t-C_4H_9^+$ reagent ions, etc. We have also demonstrated that 10% CH_4:90% He mixtures generate CI spectra pragmatically indistinguishable from pure methane reagent gas spectra. In this case scattered electrons and charge transfer processes are jointly responsible for generating the CI reagent ions.

Using the system we have initiated the generation of a library of EI-CI mass spectra obtained simultaneously for pure compounds fractionated by GC. Table I lists the spectra generated in our initial experiments, chosen to explore rapidly the merits of simultaneous generation of both kinds of mass spectra.

Figs. 12 and 13 illustrate the superiority of CI for identification of alkanes. Nonane is a typical medium molecular weight alkane which fragments so extensively under electron impact that it cannot be identified on the basis of its EI mass spectrum. However, the well-established hydride transfer reaction generates a characteristic M-1 peak giving the molecular weight directly.

TABLE I

Selection of Compounds Examined by GC-EI CIMS

a. NORMAL HYDROCARBONS

1. Pentane
2. Hexane
3. Heptane
4. Octane
5. Nonane

b. ESTERS

1. Ethyl acetate
2. Amyl acetate

c. NITRILES

1. Acetonitrile
2. Propionitrile
3. Butryonitrile
4. Acrylonitrile
5. Benzonitrile

d. AMINES

1. n-Propyl amine
2. n-Butyl amine
3. n-Pentyl amine
4. iso-Propyl amine
5. iso-Butyl amine
6. iso-Pentyl amine

e. ALDEHYDES

1. Propanal
2. Butanol
3. Pentanol

f. KETONES

1. Acetone
2. Methyl ethyl ketone
3. Methyl isopropyl ketone
4. Methyl-t-Butyl-ketone
5. disopropyl ketone

g. AROMATICS

1. Benzene
2. Toluene
3. Xylene's

h. ALKENES

1. Pentene
2. Hexene
3. Heptene
4. Octene
5. Nonene

i. ALCOHOLS

1. Methanol
2. Ethanol
3. Propanol
4. Butanol
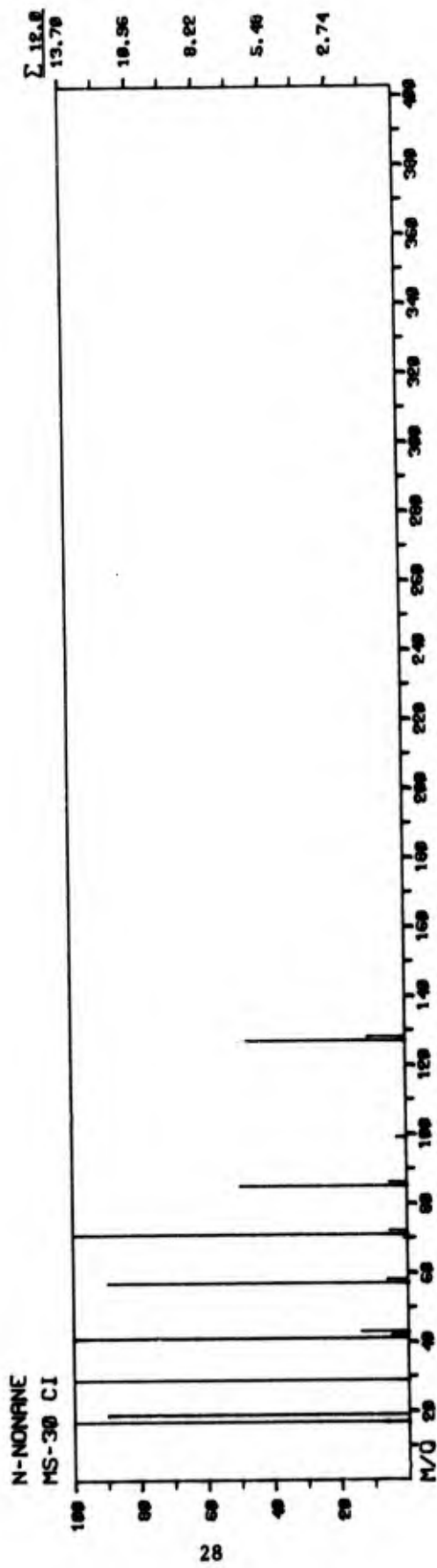
Figure 12. CI Mass Spectrum of n-C_9H_{20}

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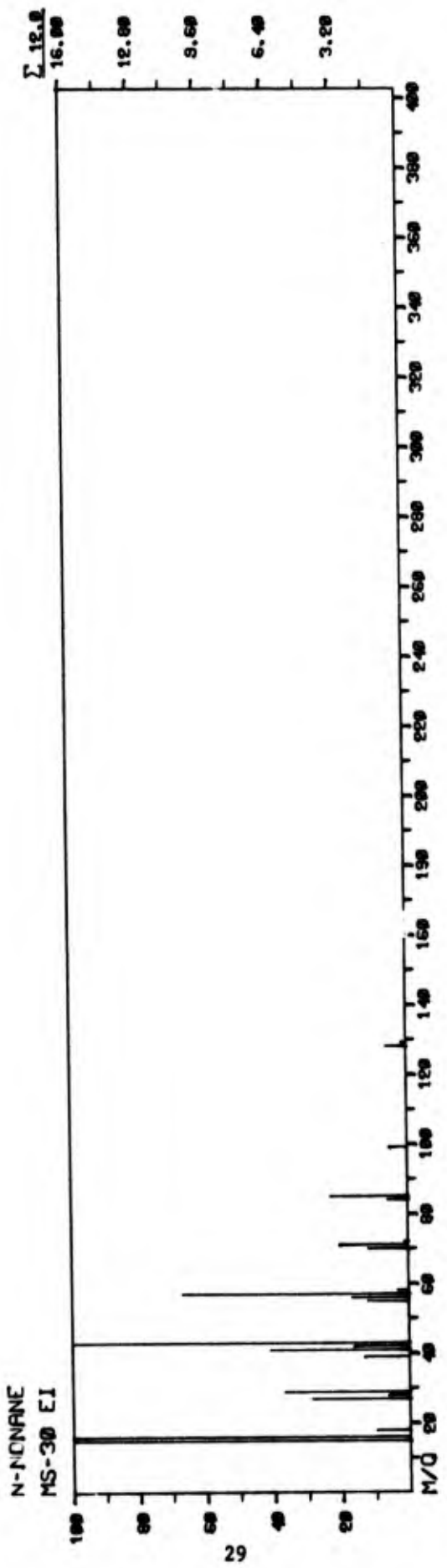
Figure 13. EI Mass Spectrum of $n-C_9H_{20}$

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Further random scission of the chain gives the homologous series of alkyl ions.

Figures 14 and 15 illustrate the complimentary features of obtaining EI and CI mass spectra simultaneously. Figure 14 is the total ion current trace for a synthetic mixture of alkenes. It is completely equivalent to a gas chromatogram developed in the usual manner. This trace also provides a cross comparison between results taken from the MS-30 and the CH-7 mass spectrometer systems using TIC monitoring as described previously.

Figure 15 shows the simultaneously generated electron impact and chemical ionization spectra corresponding to peak 2 of the chromatogram of Figure 14. The lower part of the figure displays the chemical ionization mass spectrum for the component 1-heptene. Under the chosen ion source conditions, the CI spectrum gives the characteristic doublet M-1 and M+1 at m/q 97 and 99 respectively. The molecular weight is thus m/q 98, identifying this compound as a heptene isomer. Peaks indicated by X in Figure 15 are the characteristic reagent ions of the methane plasma: CH_5^+ (m/q 17), $C_2H_5^+$ (m/q 29), and $C_3H_5^+$ (m/q 41). A trace quantity of water, representing a partial pressure of the order of 10^{-9} torr, is readily identified by the large peak H_3O^+ (m/q 19).

The upper part of Figure 15 with upward deflection of the galvanometers records the simultaneously-developed electron impact spectrum which is also readily identified as belonging to 1-heptene. The base peak for the spectrum is $C_3H_5^+$ (m/q 41), followed closely by the $C_4H_8^+$ peak (m/q 56). The remaining fragment ions are readily identified as characteristic of the electron impact cracking pattern of 1-heptene. Superposed on the 1-heptene spectrum is the electron impact spectrum of methane carrier gas consisting primarily of the ions CH_4^+ (m/q 16) and CH_3^+ (m/q 15). The water vapor noted as a substantial

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Figure 14. Total ion current chromatogram for synthetic mixture of alkenes.

8'UC-98 100°C
30ml/min. HELIUM

TIME (minutes)

PEAK 2   1-HEPTENE

EI

CI/CH₄
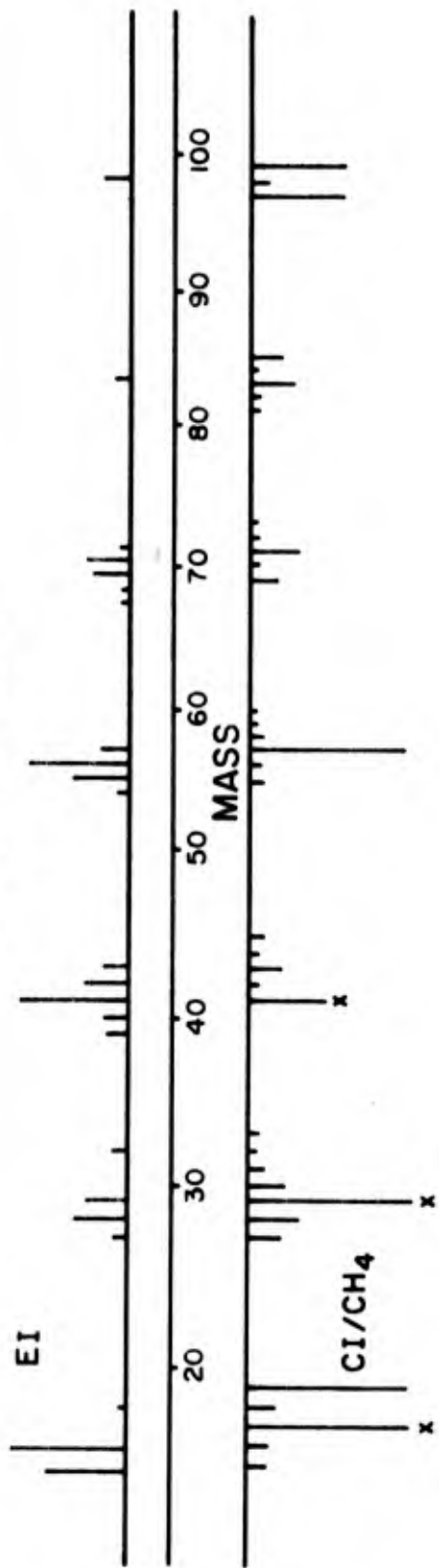
MASS

Figure 15 . EI/CI spectra of Heptene.

component of the chemical ionization spectrum is not detected in the electron impact spectrum. The enhanced sensitivity of CI mass spectroscopy is readily apparent for this simple example. For the synthetic mixture described in these figures the molecules in question are readily identified by both chemical ionization and electron impact mass spectra. For the general case of totally unknown compounds the ability to cross-correlate the fingerprint mass spectral data for the compound in question will enhance greatly our capability for identifying unknowns.

An analogous experiment for a synthetic mixture of amines is illustrated in Figs. 16 and 17. Electron impact spectra of amines are often not readily interpreted; their spectra are temperature sensitive, they fragment easily, and many times there is no parent ion. Fig. 16 shows the total ion current trace for a series of amines. Fig. 17 shows the EI/CI trace for peak 1, which was isopropyl amine (M.W. 59). Note the highest peak on the EI side was m/q 58, which might be erroneously assumed to be the molecular ion. However, the CI spectrum shows the protonated molecular ion to be m/q 60. This even m/q for the protonated molecular ion suggests that molecule contains an odd number of nitrogens. The M-1 peak in the CI spectra (m/q 58) suggested a primary amine of molecular weight 59,. Thus it is a propyl amine. Since n-propyl amine shows a small peak and no 58 peak under EI conditons, the EI spectrum tells us that it is isopropyl amine.

The application of dual beam EI-CI mass spectrometry to poylmer pyrolysis is illustrated in Figs. 18-20. Fig. 18 is a mass chromatogram of the pyrolysis of Kerimid-601. a straight-chain polymide polymer. A 5' X 1/8'' column containing Chromosorb 103 was temperature programmed from 50 to 200° at 10°C/min. from which the sample was eluted into both EI and CI sources, using the separator

33
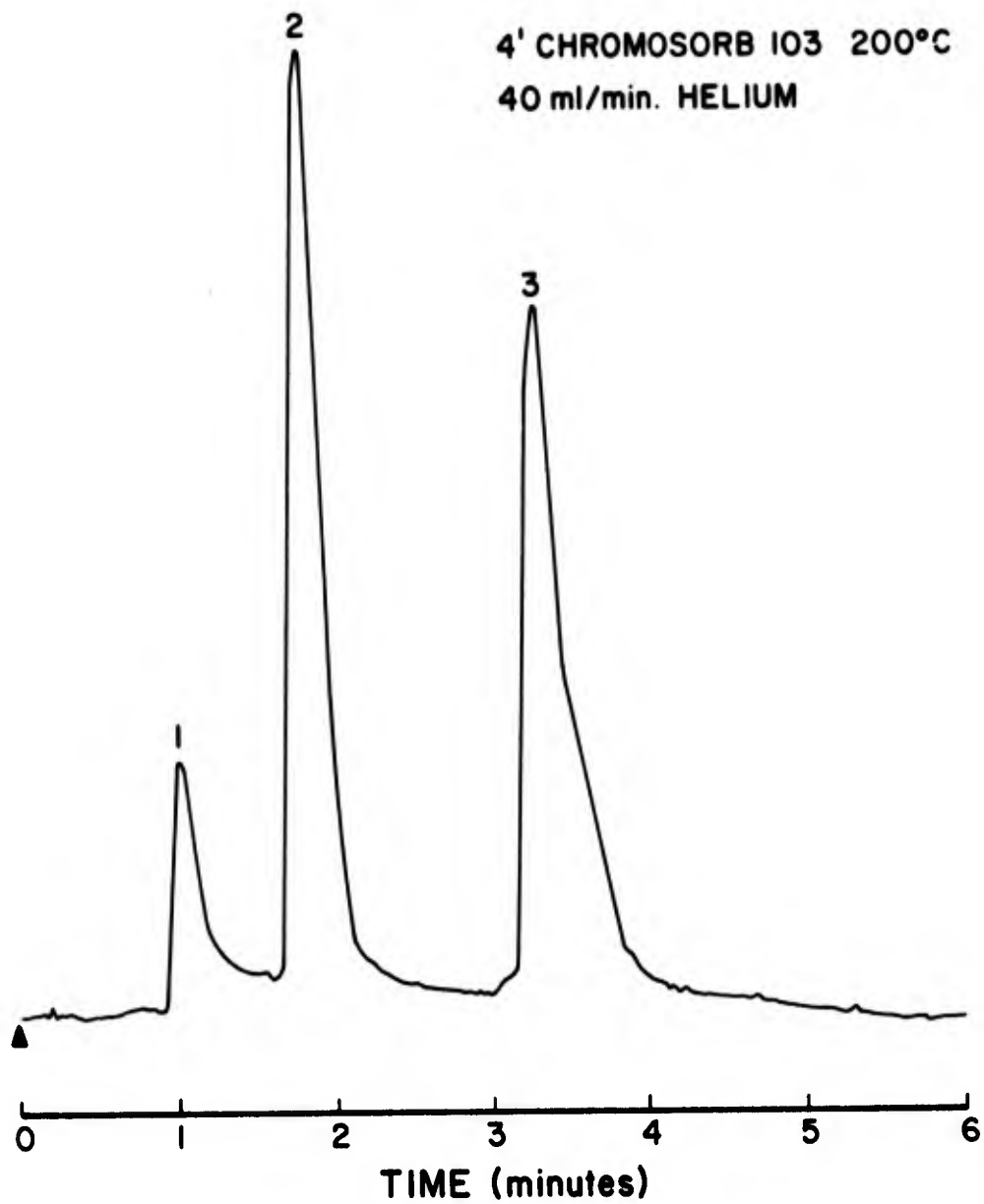
Figure 16. Total ion trace for a series of amine.

PEAK I   ISOPROPYL AMINE

EI

CI-CH₄
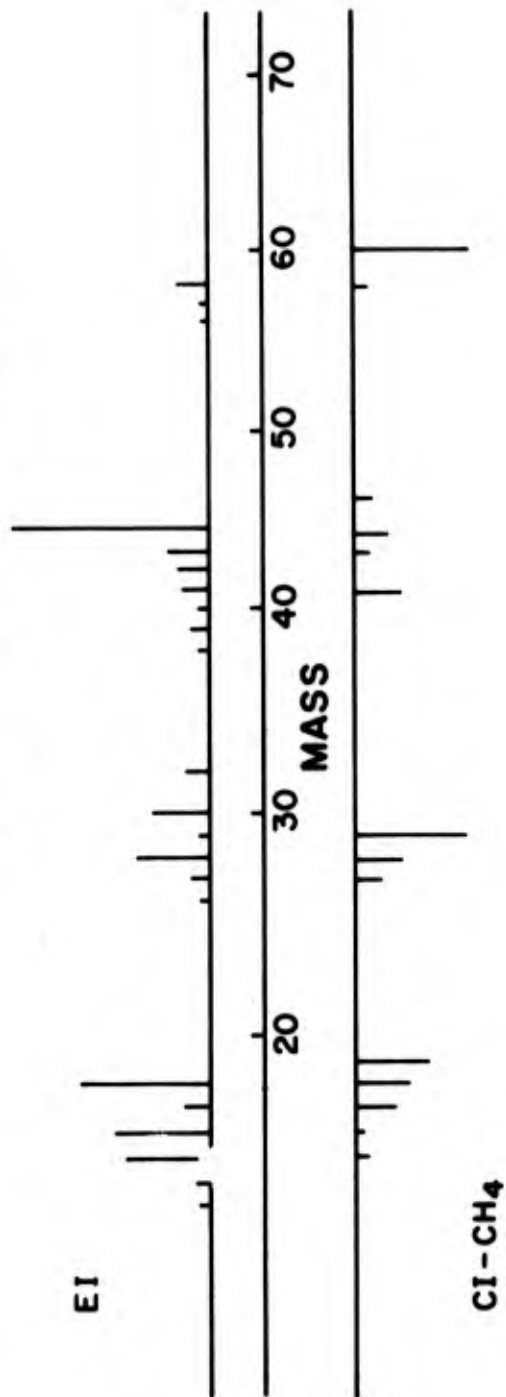
MASS

Figure 17 . EI/CI trace for isopropyl amine.

35
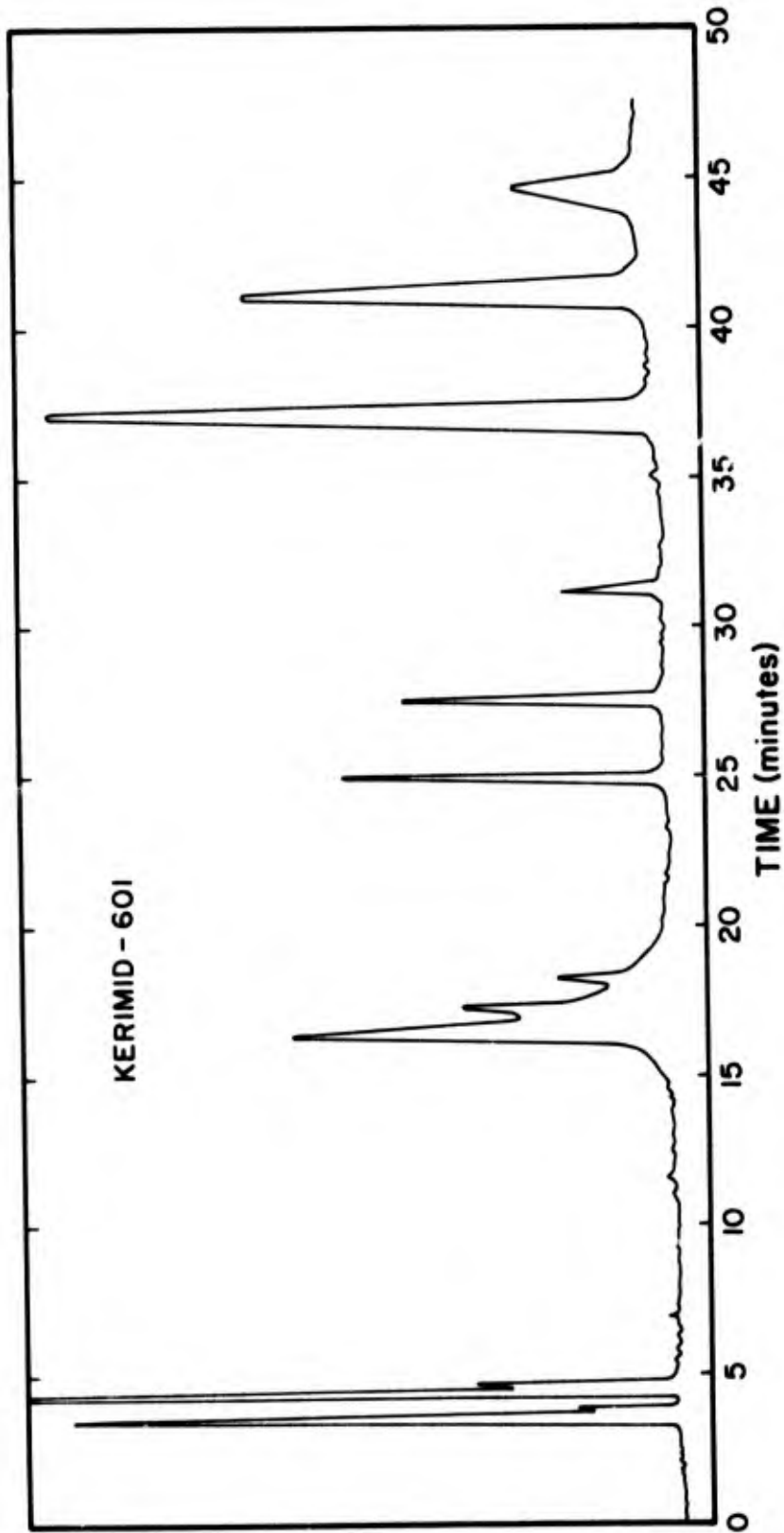
Figure 18 . Mass chromatogram of pyrolysis products of Kerimid–601.
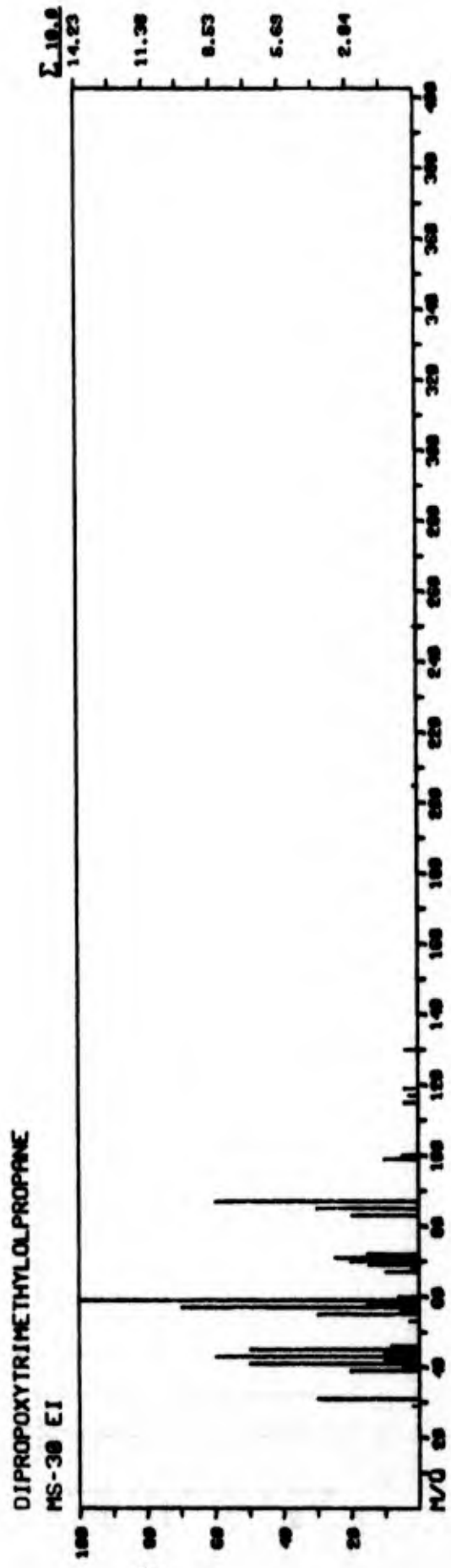
Figure 19. EI Mass Spectrum of peak 10 from Keramid 601 Pyrolysis.

DIPROPOXYTRIMETHYLOLPROPANE

MS-30 CI
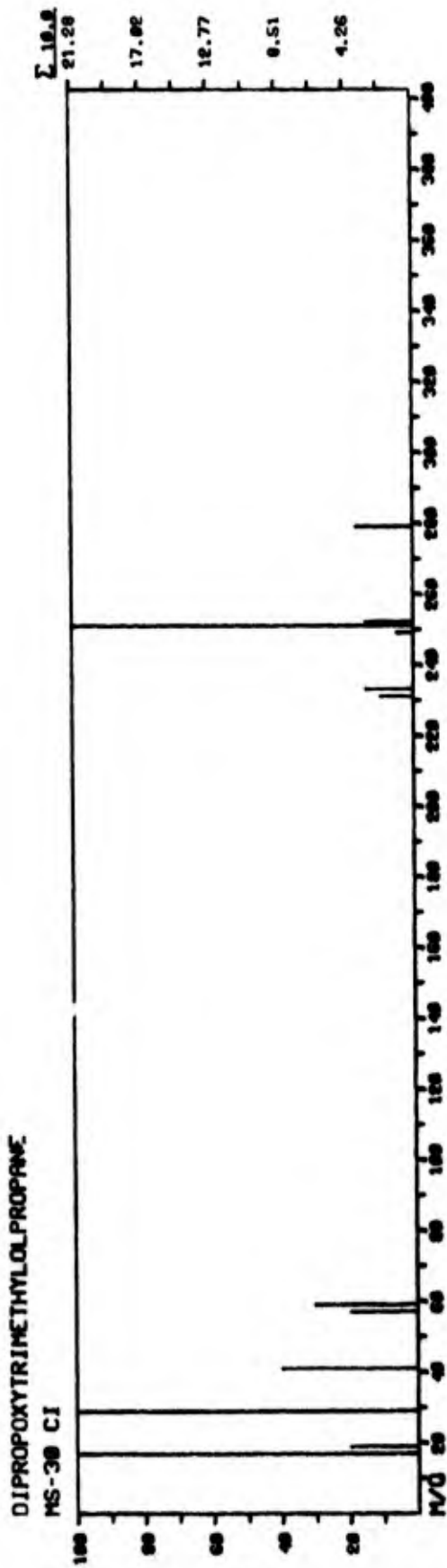
Figure 20. CI Mass Spectrum of peak 10 from Keramid 601 Pyrolysis.

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of Figure 4.   A total of 12 peaks were eluted from the column after a pyrolysis of 20 seconds at 1000°C.   Methane was used as the CI reagent gas.

Identification of most of the products formed in the pyrolysis by GC/MS, as described previously, was straightforward.   However, the EI mass spectrum of peak number 10, shown in Figure 19, was not directly interpretable.   The great abundance of m/q 93 and 103 and the unusual loss of 10 mass units between them suggested that either the molecular ion was not present in the mass spectrum or that more than one compound was eluting from the column with identical retention indices.   The simultaneously generated CI spectrum, shown in Figure 20, was very helpful in resolving this problem.   The ions at mass 17 (CH_5^+), 19 (H_3O^+), 29 ($C_2H_5^+$) and 41 ($C_3H_5^+$) were generated by the methane reagent gas (which contains a trace amount of water) under CI conditions and should be ignored.   The simple spectra that remain and comparison with the complimentary CI spectrum, suggests that m/q 94 and 104 are the most likely protonated molecular ions.   It therefore appears that chromatographic peak number 10 is actually a mixture of two compounds with molecular weights of 93 and 103, respectively. The combination of an odd mass molecular ion in the EI spectrum and the simultaneous appearance of an M+1 ion in the CI spectrum is indicative of compounds containing an odd number of nitrogen atoms.   The high degree of aromaticity and nitrogen content in the Kerimid-601 polymer suggested that two likely products of thermal degradation are aniline and benzonitrile.   Duplicate GC-MS runs of a mixture of aniline and benzonitrile produced EI and CI mass spectra and retention indices, that were identical to the unknown structure, confirming this hypothesis.

C. Resolution of Complex Mixtures. The combination of gas chromatography-mass spectrometry has come into widespread use in the identification of components of complex mixtures. In most cases the mass spectometer is utilized for qualitative analysis while the characteristic retention times of the components on the column are often ignored. However these retention volumes--best expressed as retention indices as defined by Kovats[7]--offer considerable qualitative information which nicely compliments the mass spectral data. If retention indices for the eluted compounds are determined on two columns of different polarity, the indices themselves give a great deal of structural information.[8] Also the extensive tables of retention index data can be used for compound identification or proper column selection for a particular separation.[9]

One application of this technique in our laboratory has involved analysis of the pyrolysis products from a variety of polymers using the GC-EI and CI-MS computer combination. The polymers are typically pyrolyzed in the injection part of the gas chromatograph with the products separated on one of many possible columns. The effluent is examined by a rapidly scanning mass spectrometer with masses and intensities taken and stored by the computer. In order to establish the retention indices for the pyrolysis-products a mixture of hydrocarbons of appropriate range is injected onto the same column used to separate the pyrolysis products. Care is taken to ensure identical chromatographic conditons for both the pyrolysis run and standard run. The standard hydrocarbon mixture retention volumes are then used to assign retention indices to all eluted compounds.

In order to utilize both the mass spectral and retention index data for all eluted peaks, a conversations library search program similar to that of Heller[10] has been developed and is reported in the Appendix. The data base consists of 200 compounds which have been observed in the pyrolysis of polymers.

As additional compounds are postulated their mass spectral and retention data are added to the file.

In utilizing the search program, the operator can search the data on either mass spectral parameters such as base peak and molecular ion, or on retention indices for a variety of columns. The error limits on the searched parameter can be set as narrow or as broad as desired. After searching, the number of compounds having the searched parameter within the selected error limits is printed out. If another parameter is then selected, then only the compounds fitting all the previous criteria are searched. In this way one is constantly scanning the number of possible compounds in the library which might be related to the unknown peak. If no possible candidates are found, one can re-sort the search program and vary the search order or error limits in order to find a possible match.

The retention indices that are obtained are obviously of value only in relation to the effectiveness of the column used for the separation. If the column develops adsorption sites, significant changes in retention index data will occur, thus making good qualitative identification very difficult. In a similar manner the mass spectral data for an eluted peak are only of value if it can be distinguished from the background resulting from column bleed. Thus if mass spectral peaks resulting from the column bleed are mixed with the mass spectral peaks of the eluted compound, qualitative analysis will be very difficult.

In order to avoid many of these problems, we have found many porous polymer supports which are now available,[11],[12] to be especially useful. These include the Poropaks, the Chromosorb Century Series, and others such as

Tenax. A particular advantage in using these supports is the fact that there is no liquid phase and thus no column bleed to interfere with the mass spectral data. This is especially important for high sensitivity CIMS. Further, since the porous polymer is also the solid support, there are no active sites from the support which can cause changes in retention volumes. Also for many of these porous polymers (i.e. Johns-Manville Chromasorb Century Series) the retention indices for a variety of compounds are used as a quality factor in the production of the resin.[13] Thus a column packed with polymer from entirely different batches will give the same retention indices. It should also be pointed out that columns packed with this support have high efficiencies (typically 600-800 plates per foot in this laboratory).

Since these porous polymers have no liquid phase they can be operated at sub-ambient temperatures without freezing the liquid phase. What this means in practical terms is that the same column which separates the isomers of xylene at high temperatures can separate N_2 from CO at sub-ambient temperatures. Thus one column has an extensively wide utility range. By using these porous polymer columns we are able to pack efficient, no-bleed columns with good retention index reproducibility from column to column.

Since a mass spectrometer can distinguish hydrocarbons from other compounds, a rapid scanning mass spectrometer coupled to a gas chromatograph and a computer can be used to single out the normal hydrocarbons used to define the retention index scale which are co-injected with the unknown compounds. Thus technique has been successfully applied by several labs[14],[15] in which the operator tells the computer approximately where to find the eluted hydrocarbon standards. The computer then searches the appropriate portions of the chromatograms and determines the centroid of the hydrocarbon peak. The

hydrocarbon identity is confirmed by an algorithm which ensures that all peaks characteristic of the hydrocarbon have the same variation of intensity with time. Using the information around the assigned centroid, provided by both the operator and the centroid algorithm, the computer calculates and assigns a retention index to all eluted peaks. In subsequent search programs the retention index and mass spectral data are parameters used in peak identification.

One of the drawbacks in using this system is that it requires appreciable operator interaction to specify the hydrocarbon peaks. This results from the fact that most hydrocarbon mass spectra are very similar, possessing large $\frac{m}{q}$ 43 and 57 peaks and small (less than 5% above undecane) molecular ions to aid in carbon number assignment. With the MS-30[16] peak identification is no longer a serious problem. As a normal hydrocarbon is eluted, the EI spectrum gives the characteristic hydrocarbon peaks. In addition the CI spectrum includes an intense M-1 peak which results from hydride abstraction. Thus the CI spectrum can be used to identify the carbon number of the standard hydrocarbon and thus aid in its identification. Once the first few hydrocarbon standards have been found, then all succeeding hydrocarbons can be more easily located from the approximately logarithmic relationship between retention volume and carbon number for isothermal GC runs. This logarithmic relationship can also be used to ensure that the first few peaks assigned as hydrocarbons were assigned correctly.

With the accurate determination of the retention volumes of the hydrocarbon peaks the computer can then assign a retention index scale to the reconstructed chromatogram. Thus all eluted peaks are assigned a retention index. With the expansion of the library to include chemical ionization mass spectral data the conversational search program could utilize the CI parameters to obtain

greater ease and accuracy in the identification of unknown compounds.

An example of the application of this technique is shown in Fig. 21. This chromatogram resulted from the injection port pyrolysis of 2mg of rigid urethane foam. In order to have the retention index compounds produced at the same time as the urethane foam pyrolysis products, a small amount (~1mg) of normal tetracosane was added to the foam. The pyrolysis products of the tetracosane are the entire series of C_1-C_{23} 1-normal alkenes which can act as a secondary set of retention index reference standards. For this particular column the ΔI for normal alkanes and 1-alkenes is so slight that the alkenes can be used directly for retention index calculations.

The normal alkenes used to assign retention indices were readily determined using their characteristic chemical ionization mass spectra. Little confusion should result from copyrolysis of the urethane foam and the hydrocarbon since their higher molecular weight thermolysis products are significantly different.

Using the alkenes to assign retention indices the starred peak in Figure 21 was given a retention index of 1825. Its electron impact and chemical ionization mass spectra are shown in Figure 22. The electron impact mass spectrum is uninformative since it shows a base peak of 59 and no high intensity high mass peaks, as might be expected for a compound with a retention index of 1825. In contrast the chemical ionization mass spectrum shows a very strong M+1 ion at mass 251 suggesting a molecular weight of 250.

When the original urethane is considered, this mass 250 compound could result from either of two sources. The foam is prepared by reacting 4,4'-diphenylmethane-diisocyanate (M.W. 250) with a polyetherpolyol prepared by propoxylating trimethyolpropane. The diproxy derivitive of the trimethyolopropane also has a molecular weight of 250. However, now the electron impact mass spectrum of the iso-cyanate should show the 250 mass peak as the base peak. This suggests that the compound

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Figure 21. GC Trace of CO-pyrolysis run of Polyurethane Foam.
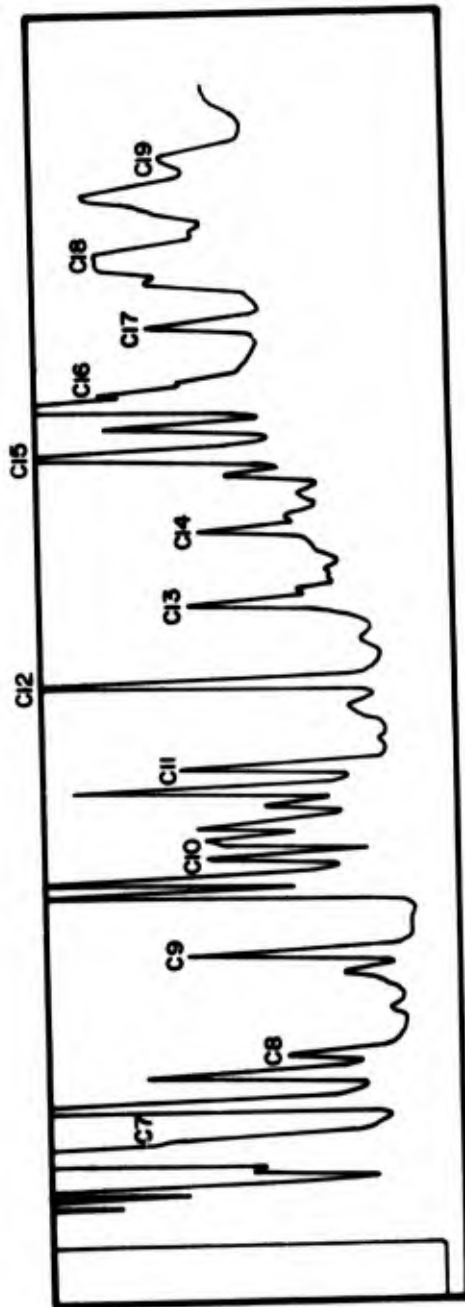
Figure 22. EI and CI Mass Spectrum of MW 250 Compound form Polyurethane Pyrolysis.

is a dipropoxytrimethylpropane polyether. This conclusion is supported by the

59 base peak in the EI spectra which is characteristic of ethers.

When a reference table of retention indices for this particular column is

checked the isocyanate is found to have a retention index of 2263 while the

dipropoxypolyol had a retention index of 1825. thus the mass spectral

and retention data confirm the identification of the compound as the dipropoxy-

trimethylpropane polyether.

SECTION IV

COMPUTER SOFTWARE OPERATING SYSTEM

The MS-30/CH-7 Mass Spectral Data Gathering System is a comprehensive system of modular computer programs which provide a real-time data acquisition, storage and retrieval capability for the AEI MS-30 mass spectrometer and the MAT CH-7 mass spectrometer. Magnetic field strength and ion intensity data are gathered automatically via hardware interfaces and stored in a systematic way on a removable medium RK-11 disc which is part of the DEC-PDP-11-20 computer system. In this section we provide a description of how the system is operated from the computer side. No attention is paid to the intricacies of how one operates the spectrometers except for those minor operation details which affect the computer.

The Data Gathering System is organized to provide several levels of interaction depending on the needs of the user. For lack of better labels, (also, the program is organized this way) these levels are called LEVEL $\emptyset$ through LEVEL N interactions. The remainder of this document will consist of a description of the various user actions which can be accomplished at these levels.

The computer program which executes these instructions interactively is included as Appendix B.

A. <u>Loading the Monitor</u>

Before running the Data Gathering System, several actions must be taken to initialize the system. The first action is the loading of the resident monitor. The following steps are necessary to accomplish this task:

1. Mount the proper disc pack on the RK-11 disc drive. This is done using the following steps:

   a. Put the "Load/Run" switch on the front of the disc drive in the "Load" position.

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b. Wait for the disc drive to stop, the interlock to drop, and the "Load" light to come on.

c. Open the door on the disc drive by pulling down from the top.

d. Remove the disc pack currently mounted by pulling it straight back.

e. Mount the proper data gathering pack on the disc drive.

f. Close the door.

g. Put the "Load/Run" switch to the "Run" position.

h. Turn off the "Write Lock" light by pressing the light.

i. Wait for the "Ready" light to come on. (The interlock is automatically raised.)

2. Turn the "Off/Local/Line" switch on the system teletype to the "Line" position.

3. Put the "Halt/Enable" switch on the system console to the "Halt" position. (Down position.)

4. Put all of the numbered switches on the system console to the down position.

5. Put numbered switches 6, 9, 10, 12, 13, 14 and 15 to the up position.

6. Depress the "Load Address" switch. (Switch is spring loaded and will return automatically to the "Up" position when pressure is released.)

7. Repeat Step 4.

8. Put numbered switches 1, 2, 8, 9, 10, 11, 12, 13, 14 and 15 to the up position.

9. Put the "Halt/Enable" switch to the "Enable" position. (Up position.)

10. Depress the "Start" switch. (Also spring loaded.)

At this point the resident monitor is loaded into memory and begins executing. This is indicated by the monitor typing on the system teletype (or display) the following:

<u>DOS V008A</u>

<u>DA 01-JAN-72</u>

<u>TI 00:00:00</u>

<u>$</u>   49

The $ in the above typeout indicates that the monitor is expecting a response from the user. Each time the system responds with a $, it is expecting a user/monitor intereaction. In the above typeout and henceforth in this document, automatic typeouts are "underlined" and other inputs by the user are not. Hopefully, this helps indicate "who is doing what."

B. <u>LEVEL Ø Interactions</u>

LEVEL Ø interactions are those actions between the user and the resident monitor which invoke execution of the Data Gathering System. The following sequence of interactions will invoke execution of the system provided only that it resides on the system disc.

1. Identify yourself to the monitor by logging in. This is accomplished by typing the following:

<u>$</u> LOG   XXX,YYY <CR>

where XXX,YYY is the user identification code (UIC) assigned to you by systems personnel (if you don't have one, get one) and <CR> is a "carriage return."

2. Set the Date and Time parameters by typing the following:

<u>$</u> DATE   Ø3-NOV-73 <CR>

<u>$</u> TIME   13:51:32 <CR>

where the proper date and time are inserted in place of Ø3-NOV-73 and 13:51:32 in the above type-ins. (Notice that time is based on a 24-hour clock.)

3. Invoke execution of the Data Gathering System by typing the following:

<u>$</u> RUN PEAKS <CR>

The system will then load the Data Gathering System into memory and begin executing it. This is indicated by the message:

C. LEVEL 1 Interactions

Several types of interaction must be accomplished either by the user or automatically by the computer during initialization of the data gathering system. These interactions will be known as LEVEL 1 Interactions. Three different situations must be taken into account by these kinds of interactions First, the situation where the system has never been run on a particular disc must be handled. This situation occurs whenever a new disc is used or when an old disc is reinitialized via a "system generation." Obviously, in this situation it is not possible to have any relevant information stored in data areas on disc which can be used by the data gathering system to update its relevant parameters. Thus, whenever this situation is encountered the system must take positive action to initialize the data areas for future use. This is commonly known as a "cold start" situation and is common to all systems initialization situations. Since it is not usually the case that one starts from a cold start, this is treated as an abnormal case requiring user intervention. This is the purpose of the "COLD START" question at the beginning of system execution. If the system is being "COLD STARTED" the user should respond with a "YES <CR>" to this question. The system will then respond:

CONFIRM

and the user should respond with:

OK <CR>

(The "CONFIRM" question is used to provide some "forgiveness" for inadvertent positive responses.) The system will then appear to hang for approximately 5 minutes. During this time it is actually setting all data areas on the disc to zero and initialyzing the various parameters associated with locations where the

various types of data are to be stored on the disc. It should be noted that any data previously existing on the disc is completely destroyed; therefore, great care should be exercised to verify that no important data is lost by this action. At the conclusion of the "COLD START" sequence the system will type:

<div align="center">COMMAND MODE</div>

Any other response to the "COLD START" question will cause the system to assume that data exists on the disc which is to be retained. In this case, the system automatically initialyzes its parameters to retain existing data and store new data in available free data areas. Thus, it immediately responds with:

<div align="center">COMMAND MODE</div>

It should be noted that the system will never return to the "COLD START" phase unless it is reloaded from disc. In all likelihood, the system will "crash" if a new disc is used and a negative response to "COLD START" is given. Thus, new discs must be subjected to the "Cold Start" routine.

D. LEVEL 2 Interactions

Beginning with the "COMMAND MODE" question, the major processors of the system become available to the user. Most users will never need to go to any higher level. There are two different modes of operation available for inter-action at this level. These are "COMMAND MODE" and "SKIPPING MODE." If the user responds with a "YES <CR>" to the "COMMAND MODE" question the system enters Command Mode. Any other response cause Skipping Mode to be entered. In Command Mode the user is able to input various two letter commands which invoke execution of the various LEVEL 2 processors. A list of the various commands and the corresponding processor which is entered is as follows:

COMMAND	PROCESSOR
OF	Offset Calibration

MF	MFI A/D Converter Zero
AD	DEC A/D Converter Zero
DA	Acquire Data
SC	Scope Chromatogram Display
CC	Calcomp Chromatogram Display
CS	Calcomp Spectrum Display
RO	Raw Data Lineprinter Output
SD	Save Raw Data
MO	Change Mode
NB	Notebook Information Input
CN	Control (Systems Programmer Only)
HE	Help Output
EX	Exit

Each of these processors is discussed in detail later in this document. When the system enters Command Mode, it types a "%" to indicate that the command interpreter has been invoked. Each time the command interpreter is expecting an input command, a "%" is typed. The user is then expected to enter one of the above commands followed by a "Carriage Return." If a legal command is entered, the system immediately begins executing the corresponding processor. If an illegal command is entered, the system responds with a "?" and returns to the beginning of the command interpreter. In general, commands can be entered in any order since no processor within LEVEL 2 depends on any other LEVEL 2 processor. Obviously, certain sequences of commands make more sense than others since the purpose of the system is to gather data from the mass spectrometers. A typical sequence of commands is as follows (interactions with each of the various processors are omitted and a sequence of . . . is used to mark where these would occur):

COMMAND MODE YES <CR>

% MF <CR>

MFI A/D ZERO

. . .

. . .

↑ Z

% AD <CR>

DEC A/D ZERO

. . .

. . .

↑ Z

% NB <CR>

NOTEBOOK INFORMATION

. . .

. . .

↑ Z

% DA <CR>

DATA ACQUISITION

. . .

. . .

↑ Z

% SC <CR>

CHROMATOGRAM SCOPE DISPLAY

. . .

. . .

↑ Z

% SD

SAVE DATA

. . .   54

$\uparrow$ Z

% EX

EXIT

$

The above sequence of commands would cause the A/D Converters to be calibrated,
pertinent information concerning the data to be stored on disc, data to be
taken from the spectrometer and stored on disc, a total ion current versus
scan number plot to be displayed on the graphics display, the raw data to be
retrieved from the disc and written on DEC TAPE and an exit to the monitor
to be performed. Notice in the above sequence of commands that as each
processor is entered, it identified itself with a title. Also, each processor
exits back to command mode after typing "$\uparrow$ Z". Under some conditions, the
processor automatically exits while under other conditions, the user must
force an exit by typing "$\uparrow$ Z" (Control Z, typed by depressing the "CNTRL" key
on the teletype and typing "Z"). The automatic exit is taken whenever it is
possible for the processor to know when to exit (i.e., whenever there exists
a fixed termination criterion). For those cases where this is not true, the
processor continues to execute until the user causes an exit. For example,
the MFI A/D ZERO routine continues to sample the output of the MFI (Magnetic
Field Integrating) A/D convertor and display the results until the user requests
an exit by typing an "$\uparrow$ Z" thereby allowing the user time to adjust the
trimpots on the converter hardware to obtain zero output for zero input.

If Skipping Mode is entered, the system sequentially outputs questions
about whether a particular processor is to be entered. A user response of
YES <CR> causes that processor to be entered. Any other response cause the
next question to be output. For example, the same sequence of events as was
accomplished previously in the Command Mode example could be accomplished using

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SKIPPING MODE as follows:

<u>COMMAND MODE</u> NO <CR>

<u>OFFSET CALIBRATION</u> NO <CR>

<u>NOTEBOOK INFORMATION</u> NO <CR>

<u>DEC A/D ZERO</u> NO <CR>

<u>MFI A/D ZERO</u> YES <CR>

. . .

. . .

↑ Z

<u>OFFSET CALIBRATION</u> NO <CR>

<u>NOTEBOOK INFORMATION</u> NO <CR>

<u>DEC A/D ZERO</u> YES <CR>

. . .

. . .

↑ Z

<u>OFFSET CALIBRATION</u> NO <CR>

<u>NOTEBOOK INFORMATION</u> YES <CR>

. . .

. . .

↑ Z

<u>OFFSET CALIBRATION</u> NO <CR>

<u>NOTEBOOK INFORMATION</u> NO <CR>

<u>DEC A/D ZERO</u> NO <CR>

<u>MFI A/D ZERO</u> NO <CR>

<u>DATA ACQUISITION</u> YES <CR>

. . .

. . .

↑ Z

OFFSET CALIBRATION   NO   <CR>

NOTEBOOK INFORMATION   NO   <CR>

DEC A/D ZERO   NO   <CR>

MFI A/D ZERO   NO   <CR>

DATA ACQUISITION   NO   <CR>

CHROMATOGRAM SCOPE DISPLAY   YES   <CR>

. . .

. . .

↑ Z

OFFSET CALIBRATION   NO   <CR>

NOTEBOOK INFORMATION   NO   <CR>

DEC A/D ZERO   NO   <CR>

MFI A/D ZERO   NC   <CR>

DATA ACQUISITION   NO   <CR>

CHROMATOGRAM SCOPE DISPLAY   NO   <CR>

CHROMATOGRAM CALCOMP DISPLAY   NO   <CR>

SPECTRUM CALCOMP DISPLAY   NO   <CR>

LINEPRINTER OUTPUT   NO   <CR>

SAVE DATA   YES   <CR>

. . .

. . .

↑ Z

OFFSET CALIBRATION   NO   <CR>

NOTEBOOK INFORMATION   NO   <CR>

DEC A/D ZERO   NO   <CR>

MFI A/D ZERO   NO   <CR>

```
DATA ACQUISITION   NO   <CR>

CHROMATOGRAM SCOPE DISPLAY   NO   <CR>

CHROMATOGRAM CALCOMP DISPLAY   NO   <CR>

SPECTRUM CALCOMP DISPLAY   NO   <CR>

LINEPRINTER OUTPUT   NO   <CR>

SAVE DATA   NO   <CR>

CONTROL   NO   <CR>

HELP   NO   <CR>

EXIT   YES   <CR>

      £
```

The reason for providing both modes of operation is to facilitate use of the
system by a wide range of users. As can be seen in the previous example, Skipping
Mode has two disadvantages which are implicit in the sequential access method.
First, some positive user response is required for each question. This is
somewhat alleviated by the fact that any response other than YES <CR> is interpretted
to be a negative response. Therefore it is not necessary to type anything
other than a <CR>. Thus, in the above example, all instances of NO <CR>
could be replaced with a <CR>. This makes skipping down through the commands
much faster and thus not so inconvenient. The other problem with sequential
access is the question of where to return in the access list at the completion
of a processor. In the above example it is evident that ↑ Z causes a return
to the beginning of the list. Another return is provided in this mode by a
↑ N. ↑ N causes a return to the next sequential question. Thus, when it
was desired to go from the "Chromatogram Scope Display" processor to the "Save
Data" processor, a ↑ N termination would have eliminated the need to respond
to the five questions preceding the "Chromatogram" question and that question

itself. Thus, the interactive sequence for this procedure actually is as
follows:

                    . . .

                    . . .

            CHROMATOGRAM SCOPE DISPLAY YES <CR>

                    . . .

                    . . .

            ↑ N

            CHROMATOGRAM CALCOMP DISPLAY NO <CR>

            SPECTRUM CALCOMP DISPLAY NO <CR>

            LINEPRINTER OUTPUT NO <CR>

            SAVE DATA YES <CR>

                    . . .

            ETC.

COMMAND MODE is provided for those users who make extensive use of the system
and need or desire maxiumum speed. It has the inherent disadvantage that the
user must either memorize or have at hand a long list of somewhat mnemonic
commands. SKIPPING MODE is provided for occasional users who have no need
to memorize a command list.

E. LEVEL 3 Interactions:

    In the previous section, direct interactions with the various processors
were deliberatly omitted from the examples to maintain clarity. Before discussing
these interactions in detail it is instructive to consider part of the fundamental
strategy used in the system. There are three different kinds of data stored by
the system. These are spectral data, total ion current data, and information
type data. Two different types of spectral data can be stored--namely, raw

data, which consist of magnetic field strength and ion intensity data, and reduced spectral data, which consist of mass number (to 1/100th of a mass unit) and ion intensity data. As far as the user is concerned, these two different kinds of spectra are the same except that the original raw data cannot be reconstructed from the reduced data. Total ion current data consists of an ordered list of the sum of the ion intensities for each particular scan of the spectrometer. Mathematically, total ion current is defined as follows:

$$TIC_J = \sum_{i=1}^{N_i} I_i$$

where I_i is the intensity of the i-th peak in the j-th scan and there are N_J peaks in the j-th scan. Information type data consists of answers to relevant questions asked by the computer prior to data acquisition. Each of these three forms of data is stored in a distinct area on the system disc pack. Access to these areas is accomplished via a directory (which is located at a fixed place on the disc) which consists of a list of identification parameters along with the appropriate disc addresses for the above-mentioned data. In most senses, the directory is similar to a table of contents (or index) to a book; that is, it contains pointers to relevant information within the three data areas mentioned above.

Interactions with each processor is different because of the differences in objectives; therefore each will be described briefly. First, let us consider the "NOTEBOOK INFORMATION" processor. As its name indicates, the "NOTEBOOK INFORMATION" processor is intended to allow entry of data similar to that which would be entered in a laboratory notebook by a conscientious experimenter during the process of conducting an experiment. The processor sequentially interrogates the system operator regarding a whole sequence of relevant parameters for a mass spectral experiment. The operator is expected to reply

to each interrogation with a character string not longer than seventy-two characters which indicates in some way the value of that parameter. The following is a typical example of the interactions required by that processor (assume that the system is in command mode):

% NB

NOTEBOOK INFORMATION

PAPER TAPE OUT   YE

MASS SPECTRAL INFORMATION

1-DATE: 23-DEC-74

2-TIME: 00:08:59

3-OPERATOR: DS

4-SAMPLE NAME: A5, 610-8

5-INSTRUMENT: MS-3Ø

6-RUN TYPE: EPA

7-CHARGES: JHF

8-INSTRUMENT SETTINGS:

A-MASS RANGE: 10-600

B-FILTER SETTING:

C-SCAN RATE: 10

D-SOURCE PRESSURE:

E-GAIN:

F-RESOLUTION: 1000

G-ACCELLERATING POTENTIAL: 4KV

H-EI OR CI: CI

I-REAGENT GAS: MET

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9-SAMPLE PARAMETERS:

A-TYPE: SOLID

B-AMOUNT:

C-INLET METHOD: PROBE

D-SOURCE TEMPERATURE: 200

E-MOLECULAR FORMULA:

F-MOLECULAR WEIGHT: 173.17

G-COMMENT:

10-G/C PARAMETERS:

11-COMPUTER PARAMETERS:

A-SAMPLING RATE: 140

B-INTENSITY THRESHOLD: 5

C-LOW MASS THRESHOLD: 51

D-HIGH MASS THRESHOLD: 600

E-CENTERING METHOD:

F-COMMENT:

12-COMPUTER ASSIGNMENTS:

A-RUN NUMBER: 000001

B-UIC: 000401

C-SCAN NUMBER: 000001

D-SCAN DISC ADDRESS: 006000

E-TIC DISC ADDRESS: 005050

F-INFORMATION DISC ADDRESS: 005400

%

As can be seen in this example, even the null response is accepted by the
processor. Obviously, the null response conveys very little information. Many
times mass spectral experiments involve identical instrument and computer
parameters; therefore a "default" set of parameters is included in the "Note-
book Information" processor along with a way of invoking one or several of
these defaults easily. As can be seen in the above example, the interrogations
are split into three distinct levels. The highest level is numbers 1 through
12, the second level is lettered A through H and the third level is again
numbered much in the fashion of a topic outline. Two levels of defaults are
provided. The first is the single interrogation default. It is invoked by
the user responding to an interrogation by typing a ↑D character. This causes
the processor to fill in the default value for that particular response and
then to proceed to the next sequential interrogation. The second level is the
so-called "high-level" default. It is invoked by typing a ↑A character and
causes the processor to fill in default values for the current interrogation
and all succeeding interrogations until an interrogation on the highest level
is encountered. Thus, whole sections of the processor can be defaulted by a
single response. The following is a list of the current defaults (where <null>
is the "null" response):

        1-DATE: 27-DEC-74

        2-TIME: 00:02:42

        3-OPERATOR: <null>

        4-SAMPLE NAME: <null>

        5-INSTRUMENT: MS-30

        6-RUN TIME: <null>

        7-CHARGES: <null>

        8-INSTRUMENT SETTINGS:

A-MASS RANGE: 10-600 AMU

B-FILTER SETTING: OPEN

C-SCAN RATE: 10 SEC/DECADE

D-SOURCE PRESSURE: <null>

E-GAIN: <null>

F-RESOLUTION: 1000

G-ACCELLERATING POTENTIAL: 4 KV

H-EI OR CI: EI

9-SAMPLE PARAMETERS:

A-TYPE: SOLID

B-AMOUNT: <null>

C-INLET METHOD: PROBE

D-SOURCE TEMPERATURE: <null>

E-MOLECULAR FORMULA: <null>

F-MOLECULAR WEIGHT: <null>

G-COMMENT: <null>

10-G/C PARAMETERS:

11-COMPUTER PARAMETERS:

A-SAMPLING RATE: 140 MICROSECONDS

B-INTENSITY THRESHOLD: 5

C-LOW MASS THRESHOLD: <null>

D-HIGH MASS THRESHOLD: <null>

E-CENTERING METHOD: <null>

F-COMMENT: <null>

The second processor we will consider is the "INTENSITY A/D ZERO" processor. The purpose of this processor is to provide the necessary information to allow the user to adjust the collector sensitivity output voltage on the spectrometer to an average value of zero. This is a necessary adjustment because of the strategy of thresholding used in the peak detection portion of the data acquisition software. The following is a typical example of the output from the "A/D ZERO" processor:

% AD

DEC A-D ZERO

000004

000004

000004

000004   Initial Offset of
            Collector Sensitivity Voltage

000004

000004

000004

000004

000004

000004

000004

000003

000002

000001   Adjustment of Voltage Occurs

000001

000000

000000 ⌉

000000 ⌋

$$\underline{000000}$$

$$\underline{000000}$$

$$\underline{000000}$$

$$\underline{000000}$$ Final Value Reached

$$\underline{000000}$$

$$\underline{000000}$$

$$\underline{000000}$$

$$\underline{000000}$$

$$\underline{000000}$$

↑V

Each value shown in the above example is the average of 1000 intensity A/D samples. The final value sought is zero so as to minimize the sensitivity of the peak detection algorithm to additive noise.

The third and probably most important processor available is the "Data Acquisition" processor. It provides the necessary interrupt-driven code to acquire and store on disc mass spectra in the form of raw magnetic field and raw intensity values. As an integral part of the processor, both peak detection and peak integration is performed, thereby yielding an ordered pair of numbers corresponding to the peak intensity and the magnetic field of the centroid of the detected peak. Figure 23 shows a hypothetical mass spectral peak and the relevant samples and results.

The integrated peak intensity for a peak such as is shown in Figure 23 given by:

$$I_r = \sum_{I=1}^{n} I_i$$

where n is the total number of samples across the peak waveform, I_i are the

66
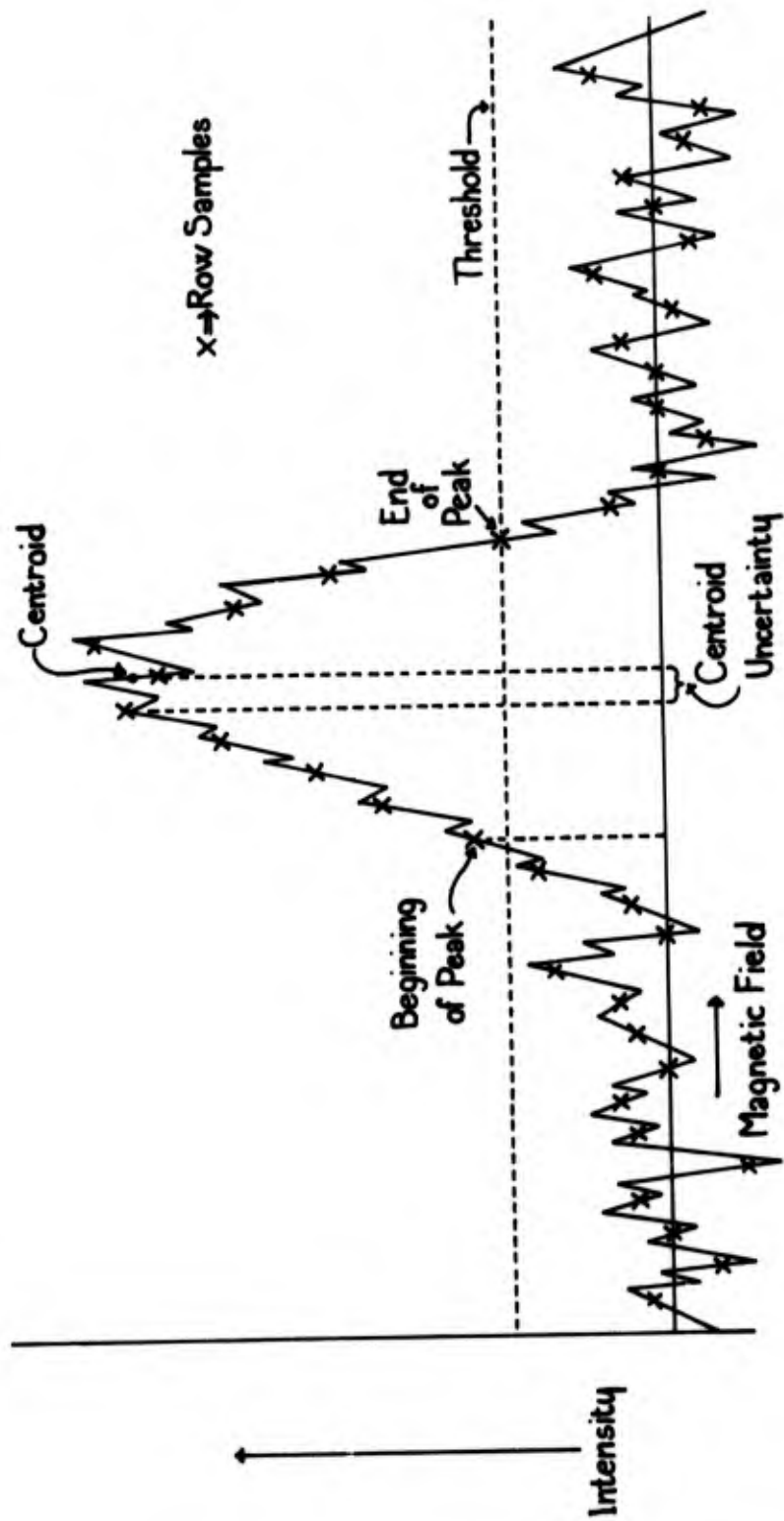
Figure 23. Hypothetical Mass Peak Sent to computer by Interface.

individual intensity samples and I_T is the resultant integrated intensity. An index to the magnetic field sample nearest to the actual centroid of the peak is given by:

$$m = \sum_{i=1}^{n} \cdot \sum_{i=1}^{i} 1_i \Big/ \sum_{i=1}^{n} 1_i$$

where m is the index of the nearest sample and the outer sum in the numerator is the sum of the partial sums. This formula follows directly from the basic planar figure centroid equations. Table 2 shows the results of applying these formulas to the hypothetical peak of Fig. 22.

Table 2. Calculation of Centroid

Sample No.	M	1	1	1		
0	16	6	6	6		
1	17	9	15	21		
2	18	11	26	47		
3	19	13	39	86	n =	10
4	20	16	55	141	1_T =	112
5	21	15	70	221	m =	5
6	22	16	86	307	M_m =	21
7	23	13	99	406		
8	24	8	107	513		
9	25	5	112	625		

With a little thought one sees that the centroid index formula is independent of which direction the sum is done to within one sample uncertainty. Other parameters which are calculated by the "Data Acquistion" processor include the number of peaks in each scan, the total intensity of each scan, etc. An example of the output from the processor is as follows:

```
% DA
DATA ACQUISITION

SCAN PEAKS     TIC     SCAN PEAKS     TIC     SCAN PEAKS     TIC
   01 00007 0000001672 00002 00010 0000002539 00003 00008 0000002054
   04 00007 0000001756 00005 00008 0000002121 00006 00005 0000001765
   07 00005 0000001764 00008 00007 0000001983 00009 00006 0000001925
   10 00006 0000001832 00011 00005 0000001784 00012 00006 0000001897
   13 00006 0000002019 00014 DONE
```

The last processor which will be included in this section is the "Mass Assignment" processor.
This processor takes as input the results from the "Data Acquisition" processor and yields as
output a table of correspondence between masses and intensities. A typical example of the
output of this processor is shown below:

```
RUN  NUMBER:                        5
UIC:                              401
SCAN  NUMBER:                       4

NUMBER  OF  PEAKS:                   44
TOTAL  ION  CURRENT:             52948.
MAXIMUM  INTENSITY:             17705.
```

PEAK	NOMINAL MASS	PREDICTED MASS	MISS	ABSOLUTE INTENSITY	RELATIVE INTENSITY	PERCENT TIC
1	14. 000	13. 923	-0. 07717	1604.	9. 060	3. 029
2	15. 000	14. 939	-0. 06137	132.	0. 746	0. 249
3	16. 000	15. 908	-0. 09242	486.	2. 745	0. 918
4	17. 000	16. 914	-0. 08550	852.	4. 812	1. 609
5	18. 000	17. 911	-0. 08943	3697.	20. 881	6. 982
6	20. 000	19. 902	-0. 09778	117.	0. 661	0. 221
7	26. 000	25. 906	-0. 09426	103.	0. 582	0. 195
8	27. 000	26. 915	-0. 08536	235.	1. 327	0. 444
9	28. 000	27. 890	-0. 11005	17705.	100. 000	33. 438
10	29. 000	28. 885	-0. 11456	433.	2. 446	0. 818
11	29. 000	28. 921	-0. 07885	125.	0. 706	0. 236
12	31. 000	30. 884	-0. 11553	621.	3. 507	1. 173
13	32. 000	31. 880	-0. 12049	9823.	55. 482	18. 552
14	36. 000	35. 849	-0. 15113	159.	0. 898	0. 300
15	40. 000	39. 818	-0. 18228	265.	1. 497	0. 500
16	44. 000	43. 858	-0. 14177	264.	1. 491	0. 499
17	51. 000	50. 851	-0. 14897	739.	4. 174	1. 396
18	69. 000	68. 830	-0. 17030	7483.	42. 265	14. 133
19	70. 000	69. 830	-0. 17016	96.	0. 542	0. 181
20	93. 000	92. 811	-0. 18939	265.	1. 497	0. 500
21	100. 000	99. 802	-0. 19796	450.	2. 542	0. 850
22	101. 000	100. 808	-0. 19235	87.	0. 491	0. 164
23	113. 000	112. 797	-0. 20298	154.	0. 870	0. 291
24	119. 000	118. 779	-0. 22102	1520.	8. 585	2. 871
25	131. 000	130. 768	-0. 23230	1330.	7. 512	2. 512
26	143. 000	142. 757	-0. 24319	148.	0. 836	0. 280
27	151. 000	150. 761	-0. 23947	112.	0. 633	0. 212
28	155. 000	154. 748	-0. 25223	110.	0. 621	0. 208
29	162. 000	161. 746	-0. 25446	132.	0. 746	0. 249
30	163. 000	162. 751	-0. 24864	95.	0. 537	0. 179
31	169. 000	168. 734	-0. 26575	790.	4. 462	1. 492
32	181. 000	180. 728	-0. 27199	716.	4. 044	1. 352
33	193. 000	192. 728	-0. 27176	151.	0. 853	0. 285
34	205. 000	204. 721	-0. 27931	92.	0. 520	0. 174
35	219. 000	218. 697	-0. 30315	251.	1. 418	0. 474
36	231. 000	230. 702	-0. 29813	402.	2. 271	0. 759
37	243. 000	242. 687	-0. 31314	225.	1. 271	0. 425
38	255. 000	254. 694	-0. 30586	91.	0. 514	0. 172
39	269. 000	268. 674	-0. 32596	103.	0. 582	0. 195
40	281. 000	280. 671	-0. 32919	237.	1. 339	0. 448
41	293. 000	292. 650	-0. 35022	190.	1. 073	0. 359
42	331. 000	330. 656	-0. 34360	117.	0. 661	0. 221
43	343. 000	342. 657	-0. 34311	144.	0. 813	0. 272
44	381. 000	380. 649	-0. 35120	97.	0. 548	0. 183

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Appendix

Kovats Searching Program (KSEARCH)

Introduction

The Kovats Search Program has been devised around the retention indicies data base combined with the molecular weight, base mass spectral peak and response factors for some 200 compounds. In using the program, one can search any or all of the parameters listed above in any combination. Error limits on the values chosen for searching can be as broad or as narrow as desired.

Using the Program

PRN? KSEARCH

Calls the program and loads the data into memory. The computer will immediately respond with:

TYPE OPTION...-1=INSTRUCTIONS

This command allows one to select which type of data will be searched. If you are unsure of the option number you wish to use, type -1 and the following will appear:

INSTRUCTIONS ARE:

0=RESET; 1=TC-RF; 2=FID-RF; 3=MW; 4=LGPK; 5=C101; 6=PPQ;
7=C103; 8=OV-1; 9=DEX; 10=OV17; 11=C-20M; 12=DEGS; 13=MISC

Each of these options is defined as follows:

0=RESET

As you search, the number of possible hits is continually being reduced by previous searches. For example, if on the first search you asked for all compounds with molecular weight 58 you would have 20 possible hits. On the second search, if you asked for all compounds with RI of 1000 on C-103, the program would look for compounds with RI 1000 on C-103 and having molecular weight 58 and so on thru successive searches. If you desire to start over with the entire file than type 0 for option. The computer will immediately respond with TYPE OPTION again at which time you could initialize a new search.

1=TC-RF

Searches for a particular Response factor for the TC detector. The response factor in this case is defined as (actual area) X (RF) = true area.

2=FID-RF

Similar as above except uses response factors for flame detector.

3=MW

Searches for a particular molecular weight.

4=LGPK

Searches for a particular mass spectral base peak.

5=C101, 6=PPQ, 7=C103, 8=OV-1, 9=DEX, 10=OV17, 11=C-20M, 12=DEGS, 13=MISC

Searches for the retention index for the particular liquid phase or solid support listed.

After the option number has been typed in, the computer will respond with:

TYPE VALUE AND DEV.

The value you type in will have the deviation added and subtracted from it giving the boundaries of tolerable values to be accepted in the search.

The computer will next respond with:

20 HITS...PRINT

This indicates that it found 20 compounds with the type of data requested falling within the error limits. If you wish to print out the hits, type Y to which the computer will respond with:

PENTANAL	716
TETRACHLOROMETHANE	720
.	.
.	.
.	.
PROPYL	735

The first column is the name of the compound and the second column is the searched value for that compound.

After the hits have been listed or after an N or <CD> has been typed for the previous question, the computer will respond with:

ANOTHER SEARCH?

A Y will return you to the OPTION question. If you wish to search from the complete file rather than the file limited by the previous searches, type 0 for RESET. All the other options operate as described previously.

An N or <CD> will stop the program in a normal termination.

PEAKS   MACRO VR05A 01-JAN-72 00:09
TABLE OF CONTENTS

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```
1                           . TITLE   PEAKS
2                           . SBTTL   GLOBALS, REGISTERS,  AND DEFINITIONS
3                           . GLOBL   SCANS, INITIL
4                           . GLOBL   IMCR, MCR
5                           . GLOBL   MBUF, SIZE
6                           . GLOBL   GETSPC
7                           . GLOBL   BNUM, BBUF, GETCHM, INTSCA, PTSNUM
8                           . GLOBL   STRING
9                           . GLOBL   SDIRER
10                          . GLOBL   ERLOC, PLTSWT
11                          . GLOBL   THENUM
12                          . GLOBL   FLAGG, PLTCH1, XY4, PLTSPC, DSKXYZ, PLTCHR, PDSC, HUND
13                          . GLOBL   LENGTH, FMAX
14                          . GLOBL   EQBUFL, AR3, DIRBUF, DIRA, COREAD, FLD, TYPE1, STRT
15                          . GLOBL   OTABL, PTABL, QTABL, RTABL, LFLDM, MQQ, ACSPEC, AR2
16                          . GLOBL   TICBUF, EQBUF, STUFF, INCHSM, TITLES, NTABL, MTABL
17                          . GLOBL   SWITCH, SSNUM, ADCC, MFI, DSKIN, CNTRLB
18                          . GLOBL   GETCOR, CNTLC, JMOREC, STRING
19                          . GLOBL   BDA, TDA, SCALIT, INST1, INST2
20                          . GLOBL   ABLOK, TICA, INFAD
21                          . GLOBL   FIXLP
22                          . GLOBL   INFADR
23                          . GLOBL   M30, M10
24                          . GLOBL   SETINC, CHROMA
25                          . GLOBL   BLANK, INPUT, DSKIN, YE, R33
26                          . GLOBL   RAWREC, U1X, IBUF, DATAB, IMOREC, TICFLG
27                          . GLOBL   ANOTM, ADMES
28                          . GLOBL   NUM
29                          . GLOBL   LPF, PPF, MS30F
30                          . GLOBL   BLNK                                          74
31                          . GLOBL   NBOKRE
32                          . GLOBL   OCRLF
33                          . GLOBL   SPACEC
34                          . GLOBL   TRA.
35                          . GLOBL   DPSCN
36                          . GLOBL   TRNUM, TUIC, TSNUM, PKSNM, RAWSAV
37                          . GLOBL   INTMU
38                          . GLOBL PEAKS
39                          . GLOBL   TLNK, DSKOUT
40                          . GLOBL   TICC, RSAV, RRSTR, TTYI, TTYO
41                          . GLOBL   BLOK
42                          . GLOBL   RNUM, UIC, SNUM
43       000015            CR=15
44       000011            BB=11
45       000012            LF=12
46       000064            PRTVEC=64
47                         ; PROGRAM PEAKS:   2-OCT, 1972 - MASS SPECTRUM MEASUREMENT
48                         ; CLOCK DRIVEN VERSION
49                         ; WITH MAGNETIC FIELD INTEGRATOR IMPLEMENTED
50               ; ***************************************************************
51               ; ***************************************************************
52               ;         THIS PROGRAM USES THE ALGORITHM:
53               ;         N( C )=N( I )+1-( SUM SUM I/SUM I )
54               ;
55               ;         TO FIND THE CENTROID OF THE PEAK
56               ; REGISTER ASSIGNMENT:
57               ; RO  POINTER TO FORTRAN STACK FOR PEAK DATA
```

```
58                  ;R1  SUM INTENSITY
59                  ;R2  SUM OF SUM I
60                  ;R3  HIGH ORDER SUM OF SUM I
61                  ;R4  FIELD STACK
62                  ;R5  POINT COUNTER
63                  ;R6 STACK POINTER
64                  ;BIT ASSIGNMENT MFI (THROUGH @#DROUT)
65                  ;0 MX ADDRESS 0-1
66                  ;1 MX ADDRESS 2
67                  ;2 MX ADDRESS 4
68                  ;3 MX ADDRESS 8
69                  ;4 ENABLE ADDRESS SELECTOR
70                  ;5 ENABLE MX ADDRESS INC (DT)
71                  ;6 ENAGLE LOAD MX ADDRESS (NDR)
72                  ;7 PEN LIFT FOR PLOT PACKAGE (TO BE IMPLEMENTED LATER)
73                  ;8 CLEAR ACCUMULATOR (FIELD),CLR TIME COUNTERS (NDR)
74                  ;9 ENABLE LOAD MF, TIME BUFFER  (NDR)
75                  ;10 ENABLE TIME BASE
76                  ;11 ENABLE CLR INTERUPT
77                  ;12 NOT ASSIGNED
78                  ;13 "
79                  ;14 "
80                  ;15 CRT BLANKING (TO BE IMPLEMENTED LATER)
81                  ;****************************************************
82                  ;****************************************************
83                          .MCALL  .LOOK,.ALLOC
84                          .MCALL  .D2BIN
85                          .MCALL  .CVTDT
86                          .MCALL  .O2BIN
87                          .MCALL  .PARAM,.DATE,.TIME,.GTUIC,.INIT,.RLSE,.WAIT,.TRAN
88                          .MCALL  .WRITE,.OPENO,.CLOSE
89                          .MCALL  .BIN2O,.RADPK,.BIN2D
90                          .MCALL  STRGO,PUSH,POP,POPTST,TT,IO,DSKO,DSKI,EMT442
91                          .MCALL  RESUL,DIVD,MULT,MULTDV,LOGSHT,POPR
92                          .MCALL  CONVER
93                          .MCALL  GETPR,CLREM,GETIPR
94                          .MCALL  PARAD,.PARTY,.PAREA,.PARDR
95 00000                    .PARAD
96 00000                    .PARTY
97 00000                    .PAREA
98 00000                    .PARDR
99      172554              PLTR=172554
100     177546              CLK=177546
101 0000                    .PARAM
102     000016              UN=16
```

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```
1                       .SBTTL   FLD BUFFER AND INTERACTIVE MESSAGES
2          000000'      .CSECT
3 000000 000000 FLD:    .WORD    0
4 000002    040 QUE0:   .ASCIZ   / OFFSET CALIBRATION /
5 000027    040 QUE01:  .ASCIZ   / NOT SCANNING /
6 000046        QUE1:
7 000046    040         .ASCIZ   / COMMAND MODE /
8 000065    040 QUE4:   .ASCIZ   / NOTEBOOK INFORMATION /
9 000114    040 QUE5:   .ASCIZ   / CONTROL /
10 00126   117 TYPE1:   .ASCII   /ONE-SHOT/
11 00136   015         .BYTE    CR,LF
12 00140   104 TYPE2:   .ASCII   /DIRECT-PROBE/
13 00154   015         .BYTE    CR,LF
14 00156   107 TYPE3:   .ASCII   /GAS-LIQUID-CHROMATOGRAPH/
15 00206   015         .BYTE    CR,LF
16 00210   124 TYPE4:   .ASCIZ   /THERMO-CHEMICAL/
17 00230   120 INST3:   .ASCII   /PERKIN-ELMER/
18 00244   015         .BYTE    CR,LF
19 00246   115 INST1:   .ASCII   /MS-30/
20 00253   015         .BYTE    CR,LF
21 00255   103 INST2.   .ASCII   /CH-7/
22 00261   040         .BYTE    40
23 00262   040 UICERM:  .ASCIZ   / BAD UIC/<CR><LF>
24 00275   040 HELPM:   .ASCII   / YOU ARE ABOUT TO RECEIVE THE/
25 00332   040         .ASCII   / CONTENTS OF/<O>
26 00347   040 MHELPM:  .ASCIZ   / ^O WILL ABORT THE PRINTOUT/<CR><LF>
27 00405   040 HELPOA:  .ASCIZ   / TYPE YES FOR MORE HELP /
28 00436   040 HELPOB:  .ASCIZ   / HELP ROUTINE /
29 00455   040 HELPOM:  .ASCIZ   / HELPOO. DOC/<CR><LF>
30 00473   040 HELP1M:  .ASCIZ   / HELP10. DOC/<CR><LF>
31 00511   040 HELP2M:  .ASCIZ   / HELP20. DOC/<CR><LF>
32 00527   040 HARDJM:  .ASCIZ   / HARD JUMP /
33 00543   040 ADDRES:  .ASCIZ   / ADDRESS /
34 00555   040 OUTRAM:  .ASCIZ   / OUTPUT RAW DATA TO DECTAPE /
35 00612   040 LENGTM:  .ASCIZ   / PLOT LENGTH /
36 00630   040 FMAXM:   .ASCIZ   / FIELD MAX /
37 00644   040 TITLES:  .ASCIZ   / TITLES /
38 00655   040 MS30FM:  .ASCIZ   / MS-30 FLAG /
39 00672   040 DEVIC:   .ASCIZ   / DATA OUTPUT DEVICE /
40 00717   040 ABLOKM:  .ASCIZ   / ABLOK VALUE /
41 00735   040 OTICM:   .ASCIZ   / TIC POINTER OFFSET IN WORDS /
42 00773   040 DIRPM:   .ASCIZ   / DIRECTORY POINTER OFFSET IN WORDS /
43 01037   040 RAWCHR:  .ASCIZ   / RAW CHROMATOGRAM OUT /
44 01066   040 RAWOUT:  .ASCIZ   / SAVE RAW DATA/
45 01105   040 DIRLOK:  .ASCIZ   / DIRECTORY LISTING /
46 01131   040 DDATA:   .ASCIZ   / REAL TIME DATA DIRECTORY CONTENTS /<CR><LF>
47 01177   040 ENTRIS:  .ASCIZ   / NUMBER OF ENTRIES /
48 01223   040 BDAM:    .ASCIZ   / LOWEST AVAILABLE DISC ADDRESS /
49 01263   040 TDAM:    .ASCIZ   / HIGHEST AVAILABLE DISC ADDRESS /
50 01324   040 TICM:    .ASCIZ   / TOTAL ION CURRENT DISC ADDRESS /
51 01365   040 BLOKM:   .ASCIZ   / BLOK VALUE /
52 01402   040 UICM:    .ASCIZ   / FALL THRU UIC /
53 01422   040 SNUMM:   .ASCIZ   / FALL THRU SCAN # /
54 01445   040 RNUMM:   .ASCIZ   / FALL THRU RUN # /
55 01467   040 DLM:     .ASCIZ   / DIRECTORY LENGTH ON DISC /
56 01522   040 DADM:    .ASCIZ   / DIRECTORY DISC ADDRESS /
57 01553   040 SETPAR:  .ASCIZ   / SET PARAMETERS /
```

```
58 01574    040 REINIT: .ASCIZ  / REINITIALIZATION /
59 01617    040 COLD:   .ASCIZ  / COLD START /
50 01634    040 ZEROM:  .ASCIZ  / ZERO THE DISC /
51 01654    040 WAVEFM: .ASCIZ  / SCOPE DISPLAY OF PEAK WAVEFORM /
62 01715    040 PKNUM:  .ASCIZ  / PEAK NUMBER /
53 01733    040 PTSNUM: .ASCIZ  / NUMBER OF POINTS /
64 01756    040 MASSAM: .ASCIZ  / ASSIGN MASSES /
65 01776    040 INTSCA: .ASCIZ  / INTENSITY SCALE /
66 02020    040 CHROM:  .ASCIZ  / SCOPE DISPLAY OF SELECTED CHROMATOGRAM/
67 02070    040 CCHROM: .ASCIZ  / CALCOMP PLOT OF SELECTED CHROMATOGRAM /
68 02140    040 CCSPEC: .ASCIZ  / CALCOMP PLOT OF SELECTED SPECTRUM /
69 02204    040 FMMS30: .ASCIZ  / MAXIMUM FIELD MS-30 /
70 02232    040 FMCH7:  .ASCIZ  / MAXIMUM FIELD CH-7 /
71 02257    040 LFLDM:  .ASCIZ  / OUT OF RANGE FIELD /
72 02304    040 ADCZ:   .ASCIZ  / DEC A-D ZERO /
73 02323    040 MFIZ:   .ASCIZ  # MFI A-D ZERO #
74 02342    040 PCONT:  .ASCIZ  / NUMBER OF SCANS FOR CHROMATOGRAM /
75 02405    040 DUMB:   .ASCIZ  / CONTROL ROUTINE ERROR ABORT!/
76 02443    040 ZELAM:  .ASCIZ  / LOW ADDRESS FOR DISC ZEROING /
77 02502    040 ZEHAM:  .ASCIZ  / HIGH ADDRESS FOR DISC ZEROING /
78 02542    040 ACQM:   .ASCIZ  / DATA ACQUISITION /
79 02565    040 MOREM:  .ASCIZ  / MORE COMMANDS /
80 02605    040 INFAM:  .ASCIZ  / INFORMATION BLOCK ADDRESS /
81 02641    040 PEPSC:  .ASCIZ  / MINIMUM NUMBER OF SAMPLES PER PEAK /
82 02706    040 INTMUL: .ASCIZ  / INTENSITY MULTIPLIER /
83 02735    040 SCPMAM: .ASCIZ  / MAX Y SCOPE DEFLECTION /
84 02766    040 INTT:   .ASCIZ  / INTENSITY THRESHOLD /
85 03014    040 MASL:   .ASCIZ  / HIGH ORDER FIELD FOR LOW MASS THRESHOLD /
86 03066    040 MASH:   .ASCIZ  / HIGH ORDER FIELD FOR HIGH MASS THRESHOLD /
87 03141    040 CORM:   .ASCIZ  / CORE IMAGE DISC ADDRESS /
88 03173    040 DPSCNM: .ASCIZ  / SCOPE DIVISIONS PER SCAN /
89 03226    040 PDSCM:  .ASCIZ  / PLOTTER DIVISIONS PER SCAN /
90 03263    040 LSIZEM: .ASCIZ  / AXIS LABEL CHARACTER SIZE /
91 03317    040 LOFFSM: .ASCIZ  / AXIS LABEL OFFSET /
92 03343    040 LSPACE: .ASCIZ  / CHARACTER SPACING /
93 03367    040 ATICS:  .ASCIZ  / AXIS TIC LENGTH /
94 03411    040 TITLE:  .ASCII  / MS-30 CH-7 MASS SPECTRAL DATA SYSTEM/<CR><LF>
95 03460    040         .ASCIZ  / VERSION V-001/<CR><LF><CR><LF>
96 03503    040 LBS:    .ASCIZ  / % /
97 03507    040 YTICS:  .ASCIZ  / Y TIC DISTANCE /
98 03530    040 REFRM:  .ASCIZ  / NUMBER OF SCOPE REFRESHES /
99 03564    125 UOFUM:  .ASCIZ  /UNIVERSITY OF UTAH/
100 3607    104 CHEMM:  .ASCIZ  /DEPARTMENT OF CHEMISTRY/
101 3637    115 MSPECM: .ASCIZ  /MASS SPECTROMETRY CENTER/
102 3670    111 INSTM:  .ASCIZ  /INSTRUMENT: /
103 3705    117 OPERM:  .ASCIZ  /OPERATOR: /
104 3720    122 RUNTM:  .ASCIZ  /RUN TYPE: /
105 3733    104 DATEM:  .ASCIZ  /DATE: /
106 3742    124 TIMEM:  .ASCIZ  /TIME: /
107 3751    114 INCHSM: .ASCIZ  /LINEAR INCHES: /
108 3771    103 COSTM:  .ASCIZ  /COST: $/
109 4001    122 RNUMN:  .ASCIZ  /RUN NUMBER: /
110 4016    125 UICN:   .ASCIZ  /UIC: /
111 4024    123 SNUMN:  .ASCIZ  /SCAN NUMBER: /
112 4042    104 DISCN:  .ASCIZ  /DISC ADDRESS: /
113 4061    000 SNUMNE: .BYTE   0
114                     .EVEN
```

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```
115                       . EVEN
116 4062 003637'MTABL:    . WORD    MSPECM, CHEMM, UOFUM
117 4070 000031 NTABL:    . WORD    INSTM-MSPECM, MSPECM-CHEMM, CHEMM-UOFUM
118 4076 003670'OTABL:    . WORD    INSTM, OPERM, RUNTM, DATEM, TIMEM, INCHSM, COSTM
119 4114 000015 PTABL:    . WORD    OPERM-INSTM, RUNTM-OPERM, DATEM-RUNTM, TIMEM-DATEM
120 4124 000007           . WORD    INCHSM-TIMEM, COSTM-INCHSM, RNUMN-COSTM
121 4132 004001'QTABL:    . WORD    RNUMN, UICN, SNUMN, DISCN
122 4142 000015 RTABL:    . WORD    UICN-RNUMN, SNUMN-UICN, DISCN-SNUMN, SNUMNE-DISCN
```

```
 1                      .SBTTL    START-UP ROUTINE (OVERLAYED)
 2                      .EVEN
 3                      .GLOBL   CCMASS
 4                      .GLOBL   DSKTLP
 5            ;*******************************************************************
 6            ;          START UP MODULE
 7            ;          PURPOSE:
 8            ;                  TO PROVIDE FOR NORMAL START UP OF REAL TIME SOFTWARE
 9            ;                  FOR BOTH THE COLD START CASE AND THE RESTART CASE.   TWO
10            ;                  MODES OF CONTROL ARE PROVIDED; NAMELY, "SKIPPING MODE"
11            ;                  AND "COMMAND MODE".   SKIPPING MODE SEQUENTIALLY CYCLES
12            ;                  THRU A LIST OF CONTROL DECISIONS THAT THE INTERACTIVE
13            ;                  USER MAY WISH TO EXCERCISE.   POSITIVE RESPONSES ARE
14            ;                  INDICATED BY THE USER TYPING "YE".   ANY OTHER RESPONSE
15            ;                  IS INTERPRETTED AS A NEGATIVE RESPONSE.
16            ;          RELEVANT MNEUMONICS:
17            ;                  TRPVEC==>TRAP INSTRUCTION INTERRUPT VECTOR
18            ;                  TRPSTA==>TRAP INSTRUCTION VECTOR PLUS TWO
19            ;                  SWITCH==>DEFAULT MAPPING SWITCH
20            ;                  TRPHDL==>THE TRAP INSTRUCTION RECEIVING ROUTINE
21            ;                  INTENT==>DYNAMIC INTENSITY THRESHOLD
22            ;                  INTEDF==>DEFAULT INTENSITY THRESHOLD
23            ;                  DCNTR==>MODULO FOR DIRECTORY UPDATE
24            ;                  TCXTR==>MODULO FOR TIC UPDATE
25            ;                  DBADIR==>DISC BASE ADDRESS OF THE DIRECTORY
26            ;                  DIRBUF==>CORE BUFFER FOR KEEPING DIRECTORY BLOCK
27            ;                  DIRA==>CURRENT DIRECTORY DISC ADDRESS
28            ;                  TICA==>CURRENT TIC DISC ADDRESS
29            ;                  RNUM==>CURRENT RUN #
30            ;                  BLOK==>CURRENT DISC ADDRESS FOR ACTUAL DATA
31            ;                  DIRP==>DYNAMIC POINTER TO CORE ADDRESS OF NEXT DIRECTORY ENTRY
32            ;                  ABLOK==>ANOTHER COPY OF BLOK
33            ;                  DBADD==>DIRECTORY BASE ADDRESS
34            ;                  SETINC==>ROUTINE TO SET UP INREMENTS FOR SCOPE
35            ;                  TICBUF==>CORE BUFFER FOR TIC
36            ;                  TICF==>TEST FOR TOTAL ION CURRENT BUFFER FULL ROUTINE
37            ;                  BACKOF==>DELETE WIERD DIRECTORY ENTRIES ROUTINE
38            ;                  GETZE==>FIND OUT WHAT THE OFFSET IS ROUTINE
39            ;          RELEVANT MACROS:
40            ;                  DSKI==>TRAN MODE DISC INPUT MACRO
41            ;                  DIVD==>EAE DOUBLE PRECISION INTEGER DIVIDE MACRO
42            ;                  PUSH==>SYSTEM STACK PUSHING MACRO
43            ;                  MULT==>EAE MULTIPLY MACRO
44            ;                  POPR==>AUTO INCREMENT REGISTER MACRO
45            ;                  DSKO==>TRAN MODE DISC OUTPUT ROUTINE
46            ;                  CLREM==>CLEAR ITS ARGUMENTS MACRO
47            ;*******************************************************************
48 04152 000000 BLKHED: .WORD    0
49       004222'         .=.+46
50 04222        STRT1:   STRGO    #TITLE          ;OUTPUT THE TITLE MESSAGE
51 04232        STRTT:   TTYIO    #COLD           ;FOR A FRESH DISC MUST INITIALYZE HERE
52 04254 001002         BNE      1$              ;NOT A FRESH DISC SO DONT BOTHER
53 04256 000167         JMP      COLDR           ;GO DO THE STUFF BEFORE YOU CRASH
54 04262        1$:
55 04262 012700         MOV      #BLKHED,R0      ;A PLACE TO PUT STUFF
56 04266 012767         MOV      #STRT,JMOREC    ;JMOREC IS WHERE ~V GOES
57 04274 016767         MOV      INFAD,INFADR    ;SET UP INFORMATION DISC ADDRESS
```

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START-UP ROUTINE (OVERLAYED)

```
58 04302 012767          MOV     #STRT, IMOREC       ; IMOREC IS WHERE ^Z GOES
59 04310                 .DATE                       ; GET THE DATE FOR POSTERITY
60 04316 012620          MOV     (SP)+,(RO)+         ; PUT IT IN THE BLKHED/V
61 04320                 .TIME                       ; THE TIME MIGHT BE NICE TO KNOW ALSO
62 04326                 POP     (RO)+,(RO)+         ; JAM IT OUT THERE TOO
63 04332                 .GTUIC                      ; FIND OUT WHO THIS SLEAZER IS
64 04340 011667          MOV     (SP),UIC            ; PUT HIM IN AS THE DEFAULT
65 04344 012620          MOV     (SP)+,(RO)+         ; AND IN THE BLKHED
66 04346 012767          MOV     #24,DPSCN           ; SCOPE DIVISIONS PER SCAN
67 04354 004567          JSR     R5,INITIL           ; GO DO THE REAL INITIALIZATION STUFF
68 04360 004567          JSR     R5,GETCOR           ; GO SEE HOW MUCH CORE IS AVAILABLE FOR PEAK PROFILES
69 04364                 DSKO    @#MQ,COREAD,#FLD    ; OUTPUT THE CURRENT CORE IMAGE TO DISC
70 04404                 DSKO    #1,INFAD,#BLKHED    ; OUTPUT THE CRAP
71 04424 012767 STRT:    MOV     #9,.KBSAV           ; SOME BODY MUST NEED A 9.
72 04432 004567          JSR     R5,TICF             ; FIX UP TICP
73 04436 012702          MOV     #QUES,R2            ; SET UP TO DO INTERACTION IN SKIPPING MODE
74 04442 012767          MOV     #STRT,IMOREC        ; JUST IN CASE SOMEBODY SCREWS WITH IMOREC
75 04450 005267          INC     INFO                ; TELL THE DATA TAKER THAT WEVE BEEN HERE
76 04454                 CLREM   FLAGG,FLAGG+2,R3    ; ZERO THOSE GUYS
77 04466 005067 MQUES:   CLR     WAVFLG              ; CLEAR WAVEFORM FLAG
78 04472                 TTYIO   (R2)+               ; OTHERWISE ENTER SKIPPING MODE
79 04512 001504          BEQ     AJMP                ; YES MEANS GO THERE
80 04514          MMQUES:
81 04514 005723          TST     (R3)+               ; OTHERWISE SKIP TO NEXT QUESTION
82 04516 020327          CMP     R3,#CMTABE-CMTABL-2 ; ALL DONE YET?
83 04522 002761          BLT     MQUES               ; LESS THAN MEANS NOT DONE YET
84 04524 000167          JMP     STRT                ; START OVER
85 04530          FMATCH:
86 04530                 POP     BLKHED,BLKHED+2     ; GET THE TABLE ADDRESS FROM CALLER/V
87 04540 004567          JSR     R5,RSAV             ; SAVE THE WORLD
88 04544 005000 3$:      CLR     RO                  ; THIS IS GOING TO COUNT HOW FAR
89 04546 016701          MOV     BLKHED+2,R1         ; ADDRESS OF COMMAND TABLE
90 04552 012102          MOV     (R1)+,R2            ; FIRST ENTRY IS NUMBER OF ENTRIES
91 04554                 TTYIO   #LBS                ; GET A COMMAND
92 04576 026721 2$:      CMP     IBUF,(R1)+          ; DOES IT MATCH
93 04602 001410          BEQ     1$                  ; THEN WE CAN RETURN WITH IT
94 04604 005720          TST     (RO)+               ; ADD 2 TO THE POINTER
95 04606 005302          DEC     R2                  ; HAVE WE LOOKED AT ALL COMMANDS YET
96 04610 003372          BGT     2$                  ; GREATER THAN MEANS NO
97 04612                 STRGO   #CERR               ; OUTPUT COMMAND ERROR MESSAGE
98 04622 000750          BR      3$                  ; AND LOOP FOR DUMMYS
99 04624 010067 1$:      MOV     RO,BLKHED+2         ; SAVE FOR LATER
100 4630 004567          JSR     R5,RRSTR            ; RESTORE THE WORLD
101 4634                 PUSH    BLKHED+2,BLKHED     ; SET UP STACK FOR RETURN
102 4644 000207          RTS     PC                  ; AMF
103 4646          CMODE:  PUSH    #CMTABL             ; COMMAND MODE TABLE ADDRESS
104 4652 004767          JSR     PC,FMATCH           ; GET A LEGAL COMMAND AND GO TO TABLE
105 4656                 POP     R3                  ; GET THE MATCHING POINTER/V
106 4660 005723          TST     (R3)+
107 4662                 STRGO   QUES(R3)            ; OUTPUT THE IDENTIFIER
108 4672 004567          JSR     R5,OCRLF            ; FOLLOWED BY A CARRIAGE RETURN LINE FEED
109 4676 012767          MOV     #CMODE,IMOREC       ; COME BACK HERE FOR MORE COMMANDS
110 4704 012767          MOV     #CMODE,JMOREC       ; DITTO
111 4712 000173          JMP     @QUESR(R3)          ; GO DO THE COMMAND
112 4716    117 OOKK:    .ASCII  /OK/                ; CONFIRM CODE FOR SYSTEMS CATS
113 4720 000167 DEFALT:  JMP     STRT
114 4724          AJMP:
```

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```
115 4724 010267          MOV     R2,AR2          ;SAVE R2 FOR RETURN VIA ^N
116 4730 010367          MOV     R3,AR3          ;DITTO FOR R3
117 4734 012767          MOV     #MMQUES,JMOREC  ;RETURN ADDRESS
118 4742 000173          JMP     @QUESR(R3)      ;GO DO THE ACTUAL PROCESSOR
119 4746 000167 MODEC:   JMP     STRT
120 4752        HELP0:   STRGO   #HELPM
121 4762                 STRGO   #HELPOM
122 4772                 STRGO   #MHELPM
123 5002                 PUSH    #HELPOM+1
124 5006 004767          JSR     PC,DSKTLP
125 5012                 TTYIO   #HELPOA
126 5034 001020          BNE     1$
127 5036                 STRGO   #HELPM,#HELP1M
128 5056                 STRGO   #MHELPM
129 5066                 PUSH    #HELP1M+1
130 5072 004767          JSR     PC,DSKTLP
131 5076        1$:
132 5076 000177          JMP     @IMOREC
```

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```
 1  005102 000000 PLTSWT:  .WORD   0
 2  005104          OFSETR: TTYIO   #QUE01          ;ASK THE NOT SCANNING QUESTION
 3  005126 001366           BNE     OFSETR          ;LOOOP UNTIL YES
 4  005130 004767           JSR     PC,GETZE        ;GO GET THE OFFSET
 5  005134 066767           ADD     OFFSET,INTENT   ;ADD UP THE STUFF
 6  005142                   .BIN2O  #EQBUF,OFFSET   ;BINARY TO OCTAL ASCII IT
 7  005160                   STRGO   #EQBUF          ;OUTPUT IT FOR INFORMATION ETC.
 8  005170 004567           JSR     R5,OCRLF        ;FOLLOWED BY A <CR>&<LF>
 9  005174 052767           BIS     #1,SWITCH       ;FLIB THE SWITCH
10  05202 000177            JMP     @JMOREC         ;BEAT IT OUT OF HERE
```

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```
 1                          . SBTTL   SOFT DISPLAY CHROMATOGRAM ROUTINE(OVERLAYED)
 2 005206          GETCHM:
 3 005206 004567          JSR       R5, THENUM
 4 005212 004567          JSR       R5, TICC
 5 005216 000406          BR        . +16
 6 005220 005626'STABL:   . WORD    TRNUM, TUIC, TSNUM, TICBUF, IBUF, ERLOC
 7 005234 005367          DEC       ERLOC
 8 005240 001001          BNE       STICER
 9 005242 000205          RTS       R5
10 05244          STICER:  STRGO     #BADTIC, #BADDIR
11 05264 005067          CLR       TICBUF
12 05270 005726 EROUTL:   TST       ( SP )+
13 05272 000177          JMP       @IMOREC
14 05276          THENUM:
15 05276 012767          MOV       #STRT, IMOREC
16 05304 012700          MOV       #QTABL, RO
17 05310 012701          MOV       #STABL, R1
18 05314          1$:
19 05314                  TTYIO     ( RO )+
20 05334                  . D2BIN   #IBUF
21 05346                  POPTST    @( R1 )+
22 05352                  TTYIO     ( RO )+
23 05372 126727          CMPB      IBUF, #15
24 05400 001005          BNE       4$
25 05402                  . GTUIC
26 05410                  POP       @( R1 )+
27 05412 000440          BR        5$
28 05414 012703 4$:       MOV       #IBUF, R3
29 05420 122723 3$:       CMPB      #54, ( R3 )+
30 05424 001411          BEQ       2$
31 05426 020327          CMP       R3, #IBUF+3
32 05432 101772          BLOS      3$
33 05434                  STRGO     #UICERM
34 05444 (""177          JMP       @IMOREC
35 05450          2$:      . D2BIN   #IBUF
36 05462 005211          INC       ( R1 )
37 05464 112671          MOVB      ( SP )+, @( R1 )
38 05470 005311          DEC       ( R1 )
39 05472 005726          TST       ( SP )+
40 05474                  . D2BIN   R3
41 05504 112671          MOVB      ( SP )+, @( R1 )
42 05510 005726          TST       ( SP )+
43 05512 '''5721          TST       ( R1 )+
44 05514          5$:      TTYIO     ( RO )+
45 05534                  . D2BIN   #IBUF
46 05546                  POP       @( R1 )+
47 05550 016767          MOV       TSNUM, SSNUM
48 05556 042767          BIC       #2, SWITCH
49 05564 127627          CMPB      @( SP ), #55
50 05572 001013          BNE       6$
51 05574 052767          BIS       #2, SWITCH
52 05602 '''5216          INC       ( SP )
53 05604                  . D2BIN   ( SP )
54 05614                  POPTST    SSNUM
55 05622 005726 6$:       TST       ( SP )+
56 05624 000205          RTS       R5
57 05626 000000 TRNUM:    . WORD    0
```

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```
58 05630 000000 TUIC:    . WORD   0
59 05632 000000 TSNUM:   . WORD   0
60 05634 000000 ERLOC:   . WORD   0
61 05636 000000 TICFLG:  . WORD   0
62 05640 000000 SSNUM:   . WORD   0
63 05642 000000 IMOREC:  . WORD   0
64 05644 000000 PPF:     . WORD   0
65 05646         ACHROM:
66 05646 004567          JSR      R5, GETCHM
67 05652 005067          CLR      TICFLG
68 05656 012767          MOV      #ACHROM, IMOREC
69 05664 000167          JMP      OUTCH1
```

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```
1                               SBTTL   SOFT    PLOT CHROMATOGRAM ROUTINE(OVERLAYED)
2 005670           BCHROM:
3 005670 004567                 JSR     R5,GETCHM
4 005674 005067                 CLR     TICFLG
5 005700 012767                 MOV     #BCHROM,IMOREC
6 005706 000167                 JMP     PLTCH1
```

```
1                        SBTTL   SOFT PLOT SPECTRUM ROUTINE(OVERLAYED)
2 005712          ACSPEC:
3 005712 004567           JSR     R5,GETSPC
4 005716 005067           CLR     TICFLG
5 005722 012767           MOV     #ACSPEC,IMOREC
6 005730 000167           JMP     XY4
7 005734          GETSPC:
8 005734 004567           JSR     R5,THENUM
9 005740 004567 GTSPC1:   JSR     R5,SCANS
10 05744 000407           BR      .+20
11 05746 005626'          .WORD   TRNUM,TUIC,TSNUM,DATAB,PKSNM,IBUF,ERLOC
12 05764 005367           DEC     ERLOC
13 05770 001001           BNE     SDIRER
14 05772 000205           RTS     R5
15 05774          SDIRER:  STRGO   #BADSCN,#BADDIR
16 06014 005067           CLR     DATAB
17 06020 000167           JMP     EROUTL
18 06024 000000 PKSNM:    .WORD   0
```

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```
 1                          .SBTTL  SOFT     DATA OUTPUT ROUTINE(OVERLAYED)
 2                  .GLOBL  IOSWT
 3                  .GLOBL  CLOSM
 4 006026 004567 ACRAW:   JSR     R5,GETSPC
 5 006032 005067          CLR     TICFLG
 6 006036 016767          MOV     IMOREC,IMSAV
 7 006044 012767          MOV     #ACRAW1,IMOREC
 8 006052 000167          JMP     U1X
 9 006056 005267 ACRAW1:  INC     TSNUM
10 06062 026767           CMP     TSNUM,SSNUM
11 06070 003004           BGT     1$
12 06072 004567           JSR     R5,GTSPC1
13 06076 000167           JMP     U1X
14 06102 016767 1$:       MOV     IMSAV,IMOREC
15 06110 052767           BIS     #1,IOSWT
16 06116 004567           JSR     R5,CLOSM
17 06122 042767           BIC     #1,IOSWT
18 06130 000736           BR      ACRAW
19 06132 000000 IOSWT:    .WORD   0
20 06134 000000 IMSAV:    .WORD   0
```

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```
1                          .SBTTL  SOFT MASS ASSIGNMENT ROUTINE
2                          .GLOBL  START
3  006136  004567 MASSES:  JSR     R5,START
4  006142  000775          BR      MASSES
```

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```
1                         . SBTTL   DISPLAY CHROMATOGRAM ROUTINE(OVERLAYED)
2 006144 012767 OUTCHR:   MOV      #1,TICFLG
3 006152         OUTCH1:
4 006152 004567           JSR      R5,STUFF
5 006156 104460 2$:       TRAP     60
6 006160 105737           TSTB     @#TKS
7 006164 100374           BPL      2$
3 006166 123727           CMPB     @#TKB,#32
9 006174 001363           BNE      OUTCHR
10 06176 112737           MOVB     #101,@#TKS
11 06204                  PUSH     #8.,(SP)
12 06212 004767           JSR      PC,SETINC
13 06216 '""'177          JMP      @IMOREC
14 06222         LDISC:   TTYIO    #ADMES
15 06244                  EMT442
16 06256                  POPTST   MQQ
17 06264                  DSKI     #1,MQQ,#TICBUF
18 06304         STUFF:
19 06304                  STRGO    #PCONT
20 06314                  CONVER   TICBUF,#EQBUF
21 06332 004567           JSR      R5,OUTEQ
22 06336 004567           JSR      R5,BLANK
23 06342 004567           JSR      R5,INPUT
24 06346                  PUSH     #4,(SP)
25 06354 004767           JSR      PC,SETINC
26 06360 005037           CLR      @#TKS
27 06364 126727           CMPB     IBUF,#15
28 06372 001417           BEQ      3$
29 06374 005767           TST      TICFLG
30 06400 001415           BEQ      5$
31 06402 126727           CMPB     IBUF,#7
32 06410 001704           BEQ      LDISC
33 06412         4$:
34 06412                  EMT442
35 06424                  POPTST   TICBUF
36 06432         3$:
37 06432 000205           RTS      R5
38 06434 126727 5$:       CMPB     IBUF,#7
39 06442 001363           BNE      4$
40 06444 005726           TST      (SP)+
41 06446 000177           JMP      @IMOREC
```

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```
 1                         .SBTTL   START-UP CONTROL ROUTINE (OVERLAYED)
 2 006452        JMPI:
 3 006452 010267          MOV      R2,AR2
 4 006456 012767          MOV      #TPLAC,JMOREC
 5 006464 000172          JMP      @MSSR(R2)
 6 006470        CNTRL:
 7 006470                 TTYIO    #CNFRM
 8 006512 012767          MOV      #TPLAC,RETURN
 9 006520 026767          CMP      OOKK,IBUF
10 06526 001036           BNE      BKKJMP
11 06530 005002 MOREC:    CLR      R2
12 06532 012767           MOV      #MOREC,IMOREC
13 06540        ALOC:
14 06540                  TTYIO    MSS(R2)
15 06562 026767           CMP      IBUF,YE
16 06570 001730           BEQ      JMPI
17 06572        TPLAC:
18 06572 126727           CMPB     IBUF,#32
19 06600 001413           BEQ      JBKK
20 06602 005722           TST      (R2)+
21 06604 020227           CMP      R2,#34.
22 06610 001353           BNE      ALOC
23 06612                  STRGO    #DUMB
24 06622 104060           EMT      60
25 06624 000167 BKKJMP:   JMP      STRT
26 06630 000167 JBKK:     JMP      PEAKS
27 06634        CMODE1:   PUSH     #CNTABL
28 06640 004767           JSR      PC,FMATCH
29 06644                  POP      R3
30 06646 005723           TST      (R3)+
31 06650                  STRGO    MSS(R3)
32 06660 004567           JSR      R5,OCRLF
33 06664 012767           MOV      #CMODE1,IMOREC
34 06672 012767           MOV      #CMODE1,JMOREC
35 06700 000173           JMP      @MSSR(R3)
```

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```
 1                           SBTTL   RAWCHROMATOGRAM OUTPUT ROUTINE
 2 006704          RAWCHO:
 3 006704 000177           JMP     @IMOREC
 4                         .SBTTL  DIRECTORY INSPECTION ROUTINE(OVERLAYED)
 5 006710 012767 DIROUT:   MOV     #1,LPF
 6 006716 005067           CLR     PPF
 7 006722 ...4567          JSR     R5,FIXLP
 3 006726                  DSKI    #1,DBADIR,DATAB
 9 006746                  DIVD    DATAB,,#44
10 06762 005737           TST     @#AC
11 06766 001402           BEQ     1$
12 06770 005237           INC     @#MQ
13 06774 ...13767 1$:      MOV     @#MQ,NBLOCK
14 07002                  DSKI    @#MQ,DBADIR,DATAB
15 07022                  STRGO   #DDATA
16 07032                  STRGO   #ENTRIS
17 07042                  .BIN2D  #EQBUF,DATAB
18 07060                  STRGO   #EQBUF
19 07070 000177           JMP     @IMOREC
```

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```
 1                          .SBTTL   DISC ZERO ROUTINE (OVERLAYED)
 2 007074        DSKZER:
 3 007074                   TTYIO    #ZEHAM
 4 '"'7116                  EMT442
 5 007130                   POPTST   R1
 6 007134                   TTYIO    #ZELAM
 7 '07156                   EMT442
 8 007170                   POPTST   RO
 9 007174                   TTYIO    #CNFRM
10 07216 026767             CMP      IBUF,OOKK
11 07224 001323             BNE      DSKZER
12 C7226        BIGZE:
13 0722^ 012702             MOV      #512.,R2
14 07232 062702             ADD      #DIRBUF,R2
15 07236 005042 2$:         CLR      -(R2)
16 07240 020227             CMP      R2,#DIRBUF
17 07244 001374             BNE      2$
18 07246 020001             CMP      RO,R1
19 07250 003311             BGT      DSKZER
2" 07252 16'001             SUB      RO,R1
21 07254        1$:
22 07254                    DSKO     #1,RO,#DIRBUF
23 07272 005200             INC      RO
24 07274 005301             DEC      R1
25 07276 001366             BNE      1$
26 07300 000177             JMP      @IMOREC
27                          .GLOBL   BLANKF
28 07304        BLANKF:     POP      F1,F2,TICAA
29 07320 004567             JSR      R5,RSAV
30 07324 016700             MOV      F2,RO
31 07330 016701             MOV      TICAA,R1
32 07334 112721 1$:         MOVB     #40,(R1)+
33 07340 005300             DEC      RO
34 07342 003374             BGT      1$
35 07344 004567             JSR      R5,RRSTR
36 07350                    PUSH     F1
37 07354 000207             RTS      PC
38 07356 000177             JMP      @IMOREC
```

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```
1                           . SBTTL   COLD START ROUTINE (OVERLAYED)
2 007362          COLDR:
3 007362                    TTYIO    #CNFRM
4 007404 026767            CMP      IBUF, OOKK
5 007412 001145            BNE      VBOB
6 007414                   . INIT    #PKSLNK
7 007422                   . LOOK    #PKSLNK, #PKSFIL, 1
8 007436 ''32766           BIT      #200, 4( SP )
9 007444 001010            BNE      1$
10 07446                   . ALLOC   #PKSLNK, #PKSFIL, #20230
11 07464 '''5726           TST      ( SP )+
12 07466          1$:      . RLSE    #PKSLNK
13 07474 062706            ADD      #6, SP
14 07500 012767            MOV      #VJOE, IMOREC
15 07506 016700            MOV      DBADIR, R0
16 07512 016701            MOV      COREAD, R1
17 07516 005301            DEC      R1
18 07520 000167            JMP      BIGZE
19 07524          VJOE:
20 07524 ''04567           JSR      R5, GETCOR
21 07530                   DSKO     @#MQ, COREAD, #FLD
22 07550          3$:
23 07550 016767            MOV      DBADD, BLOK
24 07556 016767            MOV      BLOK, ABLOK
25 07564                   DSKI     #1, DIRA, #DIRBUF
26 07604 012702            MOV      #DIRBUF, R2
27 07610 012722            MOV      #1, ( R2 )+
28 07614                   CLREM    ( R2 )+, ( R2 )+, ( R2 )+
29 07622                   POPR     R2, DBADD, DBATIC, DBADD, DBATIC
30 07642 010267            MOV      R2, DIRP
31 07646 005022 1$:        CLR      ( R2 )+
32 07650 020227            CMP      R2, #D.RBUF+506.
33 07654 103774            BLO      1$
34 07656 012767            MOV      #TICBUF+14. , TICP
35 07664 012767            MOV      #1, DIRL
36 07672 016767            MOV      DBADIR, DIRA
37 07700 016767            MOV      DBATIC, TICA
38 07706                   DSKO     #1, DIRA, #DIRBUF
39 07726          VBOB:
40 07726 000167            JMP      STRTT
41 07732          EQPUT:   CONVER   @WHERE( R2 ), #EQBUF
42 07750          OUTEQ:
43 07750                   STRGO    #EQBUF
44 07760 000205            RTS      R5
45 07762 000177 REINIR:    JMP      @IMOREC
46 07766 000000            . WORD    0
47 07770 000000 PKSLNK:    . WORD    0
48 07772 014474            . RAD50   /DAT/
49 07774 000001            . WORD    1
50 07776 015270            . RAD50   /DK/
51 10000 000000            . WORD    0, 13
52 10004 050573 PKSFIL:    . RAD50   /MAS/
53 10006 074503            . RAD50   /SPC/
54 10010 014474            . RAD50   /DAT/
55 10012 000401            . WORD    401, 377
```

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```
1                       . SBTTL   SETPARAMETERS ROUTINE ( OVERLAYED )
2 010016 005002 SETPAT:  CLR      R2
3 010020          3$:    STRGO    PARA( R2 )
4 010030 004567         JSR      R5, EQPUT
5 010034 004567         JSR      R5, BLANK
6 010040 004567         JSR      R5, INPUT
7 010044 126727         CMPB     IBUF, #32
8 010052 001472         BEQ      4$
9 010054 126727         CMPB     IBUF, #15
10 10062 001410         BEQ      2$
11 10064                EMT442
12 10076                POPTST   @WHERE( R2 )
13 10104 005722 2$:     TST      ( R2 )+
14 10106 020227         CMP      R2, #64.
15 10112 001342         BNE      3$
16 10114 126727         CMPB     IBUF, #15
17 10122 001416         BEQ      1$
18 10124 126727         CMPB     IBUF, #32
19 10132 001442         BEQ      4$
20 10134 006367         ASL      DIRP
21 10140 062767         ADD      #DIRBUF, DIRP
22 10146 006367         ASL      TICP
23 10152 062767         ADD      #TICBUF, TICP
24 10160          1$:
25 10160                TTYIO    PARA( R2 )
26 10202 126727         CMPB     IBUF, #32
27 10210 001413         BEQ      4$
28 10212 126727         CMPB     IBUF, #15
29 10220 001407         BEQ      4$
30 10222                . RADPK   #IBUF
31 10232                POPTST   TLNK+6
32 10240 000167 4$:     JMP      MOREC
```

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```
1                              .SBTTL  HARD      TRANSFER OF CONTROL ROUTINE(OVERLAYED)
2 ··10244           HARDJ:     TTYIO   #ADDRES
3 010266                       .O2BIN  #IBUF
4 ·l10300                      POPTST  #EQBUF
5 010306                       TTYIO   #CNFRM
6 010330 026767                CMP     IBUF,OOKK
7 010336 001342                BNE     HARDJ
8 010340 000177                JMP     @EQBUF
```

```
 1                           . SBTTL  LOOKUP TABLES FOR START-UP (OVERLAYED)
 2 010344 000046'MSS:        . WORD   QUE1.COLD.REINIT.SETPAR
 3 010354 000527'            . WORD   HARDJM
 4 010356 013570'            . WORD   RAWDAT
 5 010360 015715'            . WORD   DSKLM.ACQM
 6 010364 001037'            . WORD   RAWCHR.DIRLOK
 7 010370 001634'            . WORD   ZEROM
 8 010372 002020'            . WORD   CHROM
 9 010374 002140'            . WORD   CCSPEC
10 10376 002070'             . WORD   CCHROM.ADCZ.MFIZ
11 10404 002565'             . WORD   MOREM
12 10406 006634'MSSR:        . WORD   CMODE1.COLDR.REINIR.SETPAT
13 10416 010244'             . WORD   HARDJ
14 10420 000000G             . WORD   RAWREC
15 10422 015756'             . WORD   DSKLOK.PEAKS
16 10426 006704'             . WORD   RAWCHO.DIROUT
17 10432 007074'             . WORD   DSKZER
18 10434 006144'             . WORD   OUTCHR
19 10436 000000G             . WORD   PLTSPC
20 10440 000000G             . WORD   PLTCHR.ADCC.MFI
21 10446 006530'             . WORD   MOREC
22 10450         PARA:
23 10450 011020'             . WORD   SWITMG
24 10452 003173'             . WORD   DPSCNM.REFRM.INTMUL.PDSCM
25 10462 002735'             . WORD   SCPMAM
26 10464 001365'             . WORD   BLOKM.ABLOKM
27 10470 003263'             . WORD   LSIZEM.LOFFSM.LSPACE.ATICS.YTICS
28 10502 000612'             . WORD   LENGTM.FMAXM.MS3OFM
29 10510 002766'             . WORD   INTT.MASL.MASH.CORM.PEPSC
30 10522 001324'             . WORD   TICM
31 10524 001223'             . WORD   BDAM.TDAM
32 10530 001522'             . WORD   DADM.DLM.RNUMM.SNUMM.UICM.INFAM
33 10544 000735'             . WORD   OTICM
34 10546 000773'             . WORD   DIRPM
35 10550 000672'             WORD    DEVIC
36 10552         WHERE:
37 10552 025744'             . WORD   SWITCH
38 10554 000000G             . WORD   DPSCN.REFRS.INTMU.PDSC
39 10564 025724'             . WORD   SCPMAX
40 10566 026020'             . WORD   BLOK.ABLOK
41 10572 000000G             . WORD   SIZE.M10.SPACEC.M30.HUND
42 10604 000000G             . WORD   LENGTH.FMAX.MS3OF
43 10612 025732'             . WORD   INTENT.MASLOW.MASHI.COREAD.PEPSCN
44 10624 025722'             . WORD   TICA
45 10626 000000G             . WORD   BDA.TDA
46 10632 025770'             . WORD   DIRA.DIRL.RNUM.SNUM.UIC
47 10644 025740'             . WORD   INFAD
48 10646 025706'             . WORD   TICP
49 10650 025712'             . WORD   DIRP
50 10652 000021 CNTABL: . WORD  17.
51 10654    103             . ASCII  /CORISPHJRODLDARCDODZSCCSCCADMFMCHE/
52 10716 000041 PATABL: . WORD  33.
53 10720    104             . ASCII  /DSRFIMPDYMBLABLSLOLPATYTLEFMMSITMLCIDPTIBDTD/
54 10774    104             . ASCII  /DILDRHSNUIIATPDPDVHE/
55 11020    040 SWITMG: . ASCIZ  / OPTION SWITCH CONTENTS /
56                           . EVEN
```

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```
1                     .SBTTL   SCANS ROUTINE
2                 ; ****************************************************************
3                 ;    CALL SCANS( RNUM, UIC, SCANN, BUFR, N, TIC, ERR )
4                 ;    RNUM=RUN #
5                 ;    UIC=USER ID CODE
6                 ;    SCANN=SCAN #
7                 ;    BUFR=8 BLOCK BUFFER
8                 ;    N=TOTAL NUMBER OF PEAKS
9                 ;    TIC=TOTAL ION CURRENT
10                ;    ERR=ERROR CODE   1=OK    2=BAD RUN #    3=BAD UIC
11                ;                          4=BAD SCAN #
12                ; ****************************************************************
13 11052         SCANS:
14 11052 004567          JSR     R5, RSAV
15 11056 005725          TST     ( R5 )+
16 11060                 GETIPR  R5, R0, R1, R2
17 11066                 GETPR   R5, R3, R4, TICAA, ERRA
18 11102                 CLREM   F1, F2
19 11112 012767          MOV     #1, SCNTIC
20 11120 004567          JSR     R5, GETADD         ; GO GET THE DISC ADDRESS
21 11124 005700          TST     R0                 ; IS IT ON DISC
22 11126 001402          BEQ     ERRO               ; NOPE SO TROUBLE
23 11130 004567          JSR     R5, GETDAT         ; GO GET THE DATA
24 11134         ERRO:
25 11134 004567          JSR     R5, RRSTR
26 11140 000205          RTS     R5                 ; LET LEONARD HAVE IT
27 11142         GETADD:
28 11142 012777          MOV     #1, @ERRA
29 11150 016767          MOV     DBADIR, DIRLK
30 11156                 DSKI    #1, DBADIR, R3     ; GET THE DIRECTORY
31 11174 011367          MOV     ( R3 ), ENTRY      ; THE FIRST ENTRY IS THE # OF ENTRIES
32 11200 010367          MOV     R3, R3SAV          ; SAVE THE BASE ADDRESS FOR LATER
33 11204                 DIVD    ( R3 ), , #44, NBLOCK
34 11224 005737          TST     @#AC
35 11230 001402          BEQ     1$
36 11232 005267          INC     NBLOCK
37 11236 026727 1$:      CMP     NBLOCK, #2
38 11244 002403          BLT     2$
39 11246 012767          MOV     #44, ENTRY
40 11254         2$:
41 11254 005723          TST     ( R3 )+            ; FIRST ENTRY ADDRESS
42 11256 021300 MORE:    CMP     ( R3 ), R0         ; DOES THE RUN # MATCH?
43 11260 001035          BNE     NOPE               ; WRONG RUN #
44 11262 005267          INC     F1                 ; FOUND AT LEAST ONE GOOD RUN #
45 11266 026301          CMP     2( R3 ), R1        ; DOES THE UIC MATCH?
46 11272 001030          BNE     NOPE               ; BAD UIC
47 11274 005267          INC     F2                 ; AT LEAST ONE GOOD UIC
48 11300 026302          CMP     4( R3 ), R2        ; DOES THE SCANN # MATCH?
49 11304 001023          BNE     NOPE               ; BAD SCAN #
50 11306 005767          TST     SCNTIC             ; SCAN OR TICC ENTRY?
51 11312 001413          BEQ     TICADR             ; TIC ADDRESSES
52 11314 016301          MOV     6( R3 ), R1        ; EUREKA!!!! BEGINNING DISC ADDRESS
53
54 11320 016302          MOV     10. ( R3 ), R2     ; ENDING DISC ADDRESS+1
55 11324         REST:
56 11324 160102          SUB     R1, R2             ; THE # OF BLOCKS
57 11326 010200          MOV     R2, R0             ; NO ERROR
```

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```
58 11330 010167          MOV     R1, DSKXYZ
59 11334 016703 HOME:    MOV     R3SAV, R3       ;RESTORE R3 TO BASE ADDRESS
60 11340 000205          RTS     R5              ;DONE
61 11342 016301 TICADR:  MOV     8.(R3),R1       ;BEGINNING DISC ADDRESS
62 11346 016302          MOV     12.(R3),R2      ;ENDING DISC ADDRESS+1
63 11352 000764          BR      REST            ;GO DO THE REST
64 11354 005367 NOPE:    DEC     ENTRY           ;LOOKED AT ALL OF THE ENTRIES?
65 11360 001423          BEQ     ERROR           ;YUP AND DIDNT FIND IT
66 11362 062703          ADD     #14.,R3         ;MOVE DOWN TO A NEW ENTRY
67 11366 000733          BR      MORE            ;LOOP AND LOOK AGAIN
68 11370         GETDAT:
69 11370                 DSKI    R0,R1,R3        ;GET THE DATA
70 11402 016377          MOV     8.(R3),@TICAA   ;RETURN THE TOTOAL ION CURRENT
71 11410 016314          MOV     10.(R3),(R4)    ;RETURN THE TOTAL # OF PEAKS
72 11414 000205          RTS     R5              ;THAT TAKES CARE OF THAT
73 11416 000000 NBLOCK:  .WORD   0
74 11420 000000 DIRLK:   .WORD   0
75 11422 000000 TICAA:   .WORD   0
76 11424 000000 F1:      .WORD   0
77 11426 000000 F2:      .WORD   0
78 11430         ERROR:
79 11430 005367          DEC     NBLOCK
80 11434 003417          BLE     1$
81 11436 005267          INC     DIRLK
82 11442 016703          MOV     R3SAV,R3
83 11446                 DSKI    #1,DIRLK,R3
84 11464 012367          MOV     (R3)+,ENTRY
85 11470 000167          JMP     MORE
86 11474         1$:
87 11474 005767          TST     F1              ;BAD RUN #???
88 11500 001410          BEQ     BADR            ;YUP
89 11502 005767          TST     F2              ;BAD UIC
90 11506 001411          BEQ     BADU            ;YUP
91 11510 012777          MOV     #4,@ERRA        ;BAD SCAN #
92 11516 005000 OUTH:    CLR     R0              ;AN ERROR WAS IN FACT DETECTED
93 11520 000205          RTS     R5
94 11522 012777 BADR:    MOV     #2,@ERRA        ;BAD RUN
95 11530 000772          BR      OUTH
96 11532 012777 BADU:    MOV     #3,@ERRA        ;BAD UIC
97 11540 000766          BR      OUTH
```

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```
 1                     SBTTL   TOTAL ION CURRENT ROUTINE
 2                ;*************************************************************
 3                ;        CALL TICC( RNUM, UIC, SNUM, BUFR, N, ERR )
 4                ;        RNUM=RUN #
 5                ;        UIC=USER ID CODE
 6                ;        SNUM=BEGINNIG SCAN Z#
 7                ;        BUFR=DATA BUFFER( AT LEAST TWO BLOCKS )
 8                ;        N=# OF TOTAL POINTS
 9                ;        ERR=ERROR LOCATION SAME AS SCANNS
10                ;*************************************************************
11 11542 004567 TICC:   JSR     R5, RSAV ; SAVE THE REGISTERS
12 11546 005725         TST     ( R5 )+
13 11550               GETIPR   R5, R0, R1, R2
14 11556               GETPR    R5, R3, R4, ERRA
15 11566               CLREM    F1, F2
16 11576 004567         JSR     R5, GETTIC      ; GET THE ADDRESSES
17 11602 005200         INC     R0              ; IS IT ON DISC
18 11604 001402         BEQ     NODATA          ; NOPE
19 11606 004567         JSR     R5, TICDAT      ; GET THE DATA
20 11612 004567 NODATA: JSR     R5, RRSTR       ; RESTORE THE REGISTERS
21 11616 000205         RTS     R5              ; GO HOME
22 11620 005067 GETTIC: CLR     SCNTIC          ; TIC DATA WANTED
23 11624 004567         JSR     R5, GETADD      ;
24 11630 000205         RTS     R5              ;
25 11632         TICDAT:
26 11632               DSKI     R0, R1, R3      ; GET THE DATA
27 11644 011314         MOV     ( R3 ), @R4     ; # OF POINTS
28 11646 000205         RTS     R5              ;
29 11650 000000 SCNTIC: WORD    0
```

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```
 1                              . SBTTL  PEAKS ENTRY POINT
 2                              . GLOBL  PWANT
 3 011652 000167 SRT:          JMP     STRT
 4 011656 000000 ADERCT: . WORD   O
 5 011660 000000 KBSAV:  . WORD   0, 0
 6 011664 000000 PNUM:   . WORD   O
 7 011666         PEAKS:
 8 011666                       STRGO   #TITL
 9 011676                       PUSH    #140, #WT
10 11706          BKK:
11 11706  ·05767               TST     ADERCT
12 11712 001421                BEQ     2$
13 11714                       . BIN2D  #MBUF, ADERCT
14 11732                       STRGO   #ADERM
15 11742                       STRGO   #MBUF
16 11752 004567                JSR     R5, OCRLF
17 11756          2$:
18 11756 005767                TST     OVRCNT          ; ANY OVERFLOWS?
19 11762 0·1417                BEQ     3$              ; NOPE
20 11764                       . BIN2D  #MBUF, OVRCNT   ; SO FIX FOR OUTPUT
21 12002                       STRGO   #OVRMSG
22 12012                       STRGO   #MBUF
23 12022          3$:
24 12022                       CLREM   R0, @#CLK, ADERCT, OVRCNT
25 12040 012700                MOV     #DATAB, R0      ; STARTING ADDRESS OF DATA BUFFER
26 12044 ·1·067                MOV     R0, FDATA       ; SAVE FOR LATER
27 12050                       . BIN2D  #MBUF, SNUM
28 12066                       STRGO   #MBUF
29 12076                       STRGO   #SPACE
30 12106 005367                DEC     KBSAV
31 12112 003005                BGT     1$
32 12114 004567                JSR     R5, OCRLF
33 12120 012767                MOV     #9. , KBSAV
34 12126          1$:
35 12126 004567                JSR     R5, FIXBUF      ; GO SET UP BUFFER HEADERS
36 12132          WT1:
37 12132 012737                MOV #4400, @#DROUT                 ; CLR INTERUPT, ACCUMULATORS
38 12140                       CLREM   NUM, TIC, FLAG, @#TKS, TIC+2
39 12164 012767                MOV     #-82. , PNUM
40 12172 012701                MOV     #110, R1
41 12176                       POPR    R1, #SCAN, #300, #OFF, #340
42 12216 012737                MOV #140, @#DR         ; ENABLE INTERUPTS A, B ON DR11
43 12224 012737                MOV #CLEAN, @#ADVEC    ; SET A-D INTERUPT VECTOR TEMPORARY
44 12232 012737                MOV     #300, @#ADVEC+2  ; PRIORITY 6
45 12240 005737                TST @#ADBUF             ; MAKE SURE ITS READY
46 12244 000002                RTI
47 12246          WT:
48 12246 012737                MOV     #140, @#177776
49 12254 005767                TST     WAVFLG
50 12260 001037                BNE     2$
51 12262 104460                TRAP    60
52 12264 105737 3$:            TSTB    @#TKS
53 12270 100366                BPL     WT
54 12272 113767                MOVB    @#TKB, TKBB
55 12300 142767                BICB    #200, TKBB
56 12306 126727                CMPB    TKBB, #4
57 12314 001406                BEQ     1$
```

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```
58 12316 126727              CMPB     TKBB,#3
59 12324 001350              BNE      WT
60 12326 000167              JMP      CNTLC
61 12332 012737 1$:          MOV      #CLEAN,@#ADVEC
62 12340 012737              MOV      #CLEAN,@#11'
63 12346 012737              MOV      #CLEAN,@#114
64 12354 000167              JMP      DONE
65 12360 005767 2$:          TST      PWANT
66 12364 001337              BNE      3$
67 12366 104462              TRAP     62
68 12370 000735              BR       3$
69 12372 000000 TKBB:        .WORD    0
70 12374 012737 SCAN:        MOV #4000,@#DROUT        ;CLR INTERUPT
71 12402 005267              INC FLAG                 ;TELL THE WORLD YOU'VE SCANNED
72 12406 012737              MOV #2000,@#DROUT        ;      ENABLE TIME BASE
73 12414 012737              MOV #102,@#ADCSR         ;ENABLE A.D.C. CLOCKED MODE AND INTERUPT
74 12422 005767              TST      MS30F           ;MS 30?
75 12426 001011              BNE      1$
76 12430 052737              BIS      #10,@#ADCSR      ;GAIN OF 2 FOR THE 30
77 12436 052767              BIS      #10,SWITCH       ;DIVIDE BY N
78 12444 012767              MOV      #7,INTENT        ;UP THE THRESHOLD
79 12452         1$:
80 12452         NEXT:       CLREM    R1,R2,R3,R5
81 12462 012704              MOV #FLD,R4              ;SET UP FIELD STACK
82 12466 012737              MOV #DATA,@#ADVEC        ;SET VECTOR TO TAKE DATA
83 12474 000002 SAMPLE       RTI
84 12476         DATA:
85 12476 005737              TST      @#ADCSR          ;A/D ERROR?
86 12502 100002              BPL      10$              ;PLUS MEANS NO
87 12504 005267              INC      ADERCT           ;COUNT IT
88 12510 013767 10$:         MOV      @#ADBUF,INTNOW   ;GET THE INTEENSITY DATA
89 12516 026767              CMP      INTNOW,INTENT    ;ABOVE THRESHOLD
90 12524 100402              BMI      11$
91 12526 000167              JMP      SAVE
92 12532 005705 11$:         TST R5                   ; ANY POINTS YET?
93 12534 001757              BEQ SAMPLE
94 12536 020567              CMP R5,PEPSCN            ;LESS THAN TEN ENTRIES?
95 12542 100005              BPL      X111
96 12544         X44:
97 12544                     PUSH     #140,#NEXT
98 12554 000002              RTI
99 12556         X111:
100 2556 005367              DEC      OFFCNT           ;COMPLETELY OFF YET?
101 2562 003344              BGT      SAMPLE           ;NOT YET
102                                                   ;HMM---MUST HAVE SOME DATA
103 2564 012737              MOV #CLEAN,@#ADVEC       ;THEREFORE DONT BOTHER ME
104 2572 005767              TST      WAVFLG
105 2576 001402              BEQ      8$
106 2600 104462              TRAP     62
107 2602 000760              BR       X44
108 2604         8$:
109 2604 032767              BIT      #1,SWITCH
110 2612 001426              BEQ      5$
111 2614                     MULT     R5,OFFSET
112 2626 163701              SUB      @#MQ,R1
113 2632 010537              MOV      R5,@#MQ
114 2636 005237              INC      @#MQ
```

101

```
115 2642 010537         MOV     R5,@#MUL
116 2646 012737         MOV     #2,@#DIV
117 2654 016737         MOV     OFFSET,@#MUL
118 2662 163702         SUB     @#MQ,R2
119 2666 005603         SBC     R3
120 2670        5$.
121 2670 010110         MOV     R1,(R0) ;*****DONT DIVIDE INTENSITY BY N****
122 2672 032767         BIT     #10,SWITCH
123 2700 001013         BNE     6$
124 2702 010137         MOV     R1,@#MQ
125 2706 005037         CLR     @#AC
126 2712 012737         MOV     #4,@#MUL
127 2720 010537         MOV     R5,@#DIV
128 2724 013710         MOV     @#MQ,(R0)
129 2730 062067 6$:     ADD     (R0)+,TIC
130 2734 005567         ADC     TIC+2
131 2740                DIVD    R2,R3,R1
132 2754 032767         BIT     #20,SWITCH
133 2762 001401         BEQ     7$
134 2764                POPR    R0,R5
135 2766        7$:
136 2766 163705         SUB @#MQ,R5                 ;WHICH DATA SET IS CENTER?
137                                                  ;(LESS ONE BY FORMULA)
138 2772                MULT    R5,#6,R5
139 3010 062705         ADD #FLD,R5                 ;CALCULATE OFFSET---(SET 1=FLD+0
140 3014 005725         TST     (R5)+
141                                                  ; WE GET BACK OUR 1)
142 3016                POPR    R0,(R5)+,(R5)+
143 3022 020027         CMP     R0,#DATAB+2048.
144 3026 101161         BHI     DOVERF
145 3030 032767         BIT     #4,SWITCH
146 3036 001432         BEQ     X333
147 3040 005767         TST     MS30F
148 3044 001443         BEQ     X456
149 3046 026760         CMP     MASLOW,-2(R0)
150 3054 003007         BGT     X567
151 3056 005767         TST     MASHI
152 3062 001420         BEQ     X333
153 3064 026760         CMP     MASHI,-2(R0)
154 3072 003014         BGT     X333
155 3074 005460 X567:   NEG     -6(R0)
156 3100 066067         ADD     -6(R0),TIC
157 3106 005567         ADC     TIC+2
158 3112 062767         ADD     #-1,TIC+2
159 3120 005460         NEG     -6(R0)
160 3124        X333:
161 3124 005267         INC NUM                     ;ANOTHER PEAK
162 3130 005267         INC     PNUM
163 3134 002603         BLT     X44
164 3136 062700         ADD     #20.,R0
165 3142 012767         MOV     #-82.,PNUM
166 3150 000167         JMP     X44
167 3154 005767 X456:   TST     MASLOW
168 3160 001761         BEQ     X333
169 3162 026760         CMP     MASLOW,-2(R0)
170 3170 002741         BLT     X567
171 3172 026760         CMP     MASHI,-2(R0)
```

102

```
172 3200 003751          BLE     X333
173 3202 000734          BR      X567
174 3204 066701 SAVE:    ADD  INTNOW,R1        ; SUM I
175 3210 102423          BVS     1$             ; OVERFLOW?
176 3212 016767 2$:      MOV     OFFTHR,OFFCNT  ; FOR COMING OFF THIS PEAK
177 3220 005205          INC R5                 ; GOT ONE MORE POINT
178 3222 012737          MOV     #3171,@#DROUT  ; ******HARDWARE GLITCH!!!!!!!!
179 3230                 POPR    R4,INTNOW,@#DRIN,@#DRIN
180 3244 020427          CMP     R4,#SRT
181 3250 101054          BHI     OVERFL
182 3252 060102          ADD R1,R2              ; SUM OF SUM
183 3254 005503          ADC R3                 ; SUM OF SUM HIGH ORDER
184 3256 000002          RTI
185
186 3260 005267 1$:      INC     OVRCNT         ; INDICATE ANOTHER OVERFLOW
187 3264 000752          BR      2$             ; AND CONTINUE
188 3266 005737 CLEAN:   TST @#ADBUF
189 3272 000002          RTI
190
191 3274 005004 BLANK:   CLR     R4
192 3276 012704          MOV     #IBUF,R4
193 3302 016724 LOOP3:   MOV     BLNK,(R4)+
194 3306 022704          CMP     #IBUFE,R4
195 3312 101373          BHI     LOOP3
196 3314 000205          RTS     R5
197 3316        INPUT:   PUSH    #IBUF,#IBUFE
198 3326 004567          JSR     R5,TTYI
199 3332 000205          RTS     R5
200 3334 000003 OFFTHR: .WORD    3
201 3336 000003 OFFCNT: .WORD    3
202 3340 000000 OVRCNT: .WORD    0
203 3342 000000 INTNOW: .WORD    0
204 3344    040 OVRMSG: .ASCIZ   / INTENSITY OVERFLOW /
205                     .EVEN
```

103

```
 1                          . SBTTL   STACK OVERFLOW ROUTINE
 2 013372          DOVERF:  STRGO    #MDATAM
 3 013402          OVERFL:  STRGO    #FLOWM
 4 013412 000167            JMP      CNTLC
 5 013416     106 FLOWM:    . ASCII  /FIELD STACK OVERFLOW.  TOO MANY SAMPLES PER PEAK. /
 6 013476     015          . BYTE CR, LF
 7 013500     105          . ASCII  /EITHER SCANNING TOO SLOW OR BAD ZEROING. /
 8 013550     015          . BYTE    CR, LF, 0
 9 013553     104 MDATAM:  . ASCIZ  /DATA BUFFER /
10 13570     040 RAWDAT:  . ASCIZ  / RAW DATA OUT /
11 13607     015 ADERM.   . BYTE    CR, LF
12 13611     101          . ASCIZ  . A/D ERROR COUNT .
13                        . EVEN
```

104

```
1                          . SBTTL  PEAK WAVEFORM ROUTINE
2 013632 012767 WAVER:  MOV    #1. WAVFLG
3 013640                   TTYIO  #PKNUM
4 013662                   . D2BIN #IBUF
5 013674                   POPTST PWANT
6 013702 000167         JMP    PEAKS
7 013706 000000 WAVFLG: . WORD  0
```

105

```
1                               . SBTTL   END OF SCAN ROUTINE
2 013710 005037 OFF:    CLR @#ADCSR
3 013714 012737         .       MOV #4000, @#DROUT                   ; CLEAR INTERUPT B
4 013722 012737'                MOV     #CLEAN, @#ADVEC  ; IN CASE THERES AN INTERRUPT WAITING
5 013730 005767                 TST FLAG                     ; DID YOU SCAN OR COME IN IN THE MIDDLE?
6 013734 003010                 BGT 2$
7 013736 012737                 MOV     #140, @#177776
8 013744                        PUSH    #140, #WT1
9 013754 000002                 RTI
10 13756 005037 2$:     CLR @#DR                             . SHUT UP, YOU HAD YOUR CHANCE
11 13762 005767                 TST     WAVFLG
12 13766 001402                 BEQ     5$
13 13770 000167                 JMP     X494
14 13774          5$:
15 13774                        . BIN2D  #MBUF, NUM
16 14012                        STRGO   #MBUF
17 14022                        STRGO   #SPACE
18 14032 005367                 DEC     KBSAV
19 14036                        . BIN2D  #MBUF, TIC+2
20 14054                        STRGO   #MBUF
21 14064                        . BIN2D  #MBUF, TIC
22 14102                        STRGO   #MBUF
23 14112                        STRGO   #SPACE
24 14122 005367          ..     DEC     KBSAV
25 14126 003005                 BGT     4$
26 14130 004567                 JSR     R5, OCRLF
27 14134 012767                 MOV     #9. , KBSAV
28 14142          4$:
29 14142 016767                 MOV     NUM, DATAB+6
30 14150 016767                 MOV     TIC, DATAB+8.
31 14156 016767                 MOV     MS30F, DATAB+10.
32 14164 016705                 MOV     FDATA, R5        ;
33 14170 160005                 SUB     R0, R5           ;
34 14172 005405                 NEG     R5
35 14174                        DIVD    R5, , #512. , MQQ, ACC
36 14222 012767                 MOV     #512. , PPP          ; BYTES FOR A FULL BLOCK
37 14230 005767                 TST     ACC
38 14234 001405                 BEQ     3$               ; NO EXTRA BLOCK
39 14236 005267                 INC     MQQ
40 14242 016767                 MOV     ACC, PPP
41 14250 016767 3$:     MOV     MQQ, BNUM
42 14256 016767                 MOV     MQQ, DATAB+12.
43 14264 016767                 MOV     PPP, DATAB+14.
44 14272 016777                 MOV     TIC, @TICP
45 14300 062767                 ADD     #2, TICP
46 14306 016777                 MOV     TIC+2, @TICP
47 14314 016767                 MOV     INFADR, DATAB+16.
48 14322 062767                 ADD     #2, TICP
49 14330 005267                 INC     TICBUF
50 14334 004567                 JSR     R5, TICFUL
51 14340                        DSKO    BNUM, BLOK, FDATA
52 14360 016700                 MOV     DIRP, R0
53 14364                        POPR    R0, RNUM, UIC, SNUM, BLOK, TICA
54 14410 066767                 ADD     BNUM, BLOK       ; THE NUMBER OF BLOCKS THIS TIME
55 14416                        POPR    R0, BLOK, TICA
56 14426 010067                 MOV     R0, DIRP
57 14432 005267                 INC     DIRBUF
```

106

```
58 14436 004567         JSR     R5, DIRFUL
59 14442 012737 X494:   MOV     #140, @#177776
60 14450 005267         INC     SNUM
61 14454                PUSH    #140, #BKK
62 14464 000002         RTI
63 14466 026727 DIRFUL: CMP     DIRP, #DIRBUF+504.
64 14474 103453         BLO     1$
65 14476                DSKO    #1, DIRA, #DIRBUF
66 14516 012700         MOV     #DIRBUF, R0
67 14522                DSKI    #1, DBADIR, R0
68 14540 062767         ADD     #4, DIRBUF
69 14546 012767         MOV     #10. , DCNTR
70 14554                DSKO    #1, DBADIR, R0
71 14572 005020 2$:     CLR     (R0)+
72 14574 020027         CMP     R0, #DIRBUF+504.
73 14600 103774         BLO     2$
74 14602 005267         INC     DIRA
75 14606 012767         MOV     #DIRBUF+2, DIRP
76 14614 005067         CLR     DIRBUF
77 14620 005267         INC     DIRL
78 14624 005367 1$:     DEC     DCNTR
79 14630 ***3036        BGT     3$
80 14632                DSKO    #1, DIRA, #DIRBUF
81 14652 012767         MOV     #10. , DCNTR
82 14660                DSKI    #1, DBADIR, #BBUF
83 14700 062767         ADD     #10. , BBUF
84 14706                DSKO    #1, DBADIR, #BBUF
85 14726 000205 3$:     RTS     R5
86 14730 005367 TICFUL: DEC     TCXTR
87 14734 ***3013        BGT     2$
88 14736                DSKO    #1, TICA, #TICBUF
89 14756 012767         MOV     #10. , TCXTR
90 14764        2$:
91 14764 026727         CMP     TICP, #TICBUF+508.
92 14772 002417         BLT     1$
93 14774                DSKO    #1, TICA, #TICBUF
94 15014 005267         INC     TICA
95 15020 012767         MOV     #10. , TCXTR
96 15026 004567         JSR     R5, TICF
97 15032 000205 1$:     RTS     R5
98 15034 012701 FIXBUF: MOV     #-4. , R1
99 15040 010002         MOV     R0, R2
100 5042        1$:     POPR    R2, RNUM, UIC, SNUM
101 5056 005012         CLR     (R2)
102 5060 062702         ADD     #506. , R2
103 5064 005201         INC     R1
104 5066 002765         BLT     1$
105 5070 062700         ADD     #18. , R0
106 5074 000205         RTS     R5
107 5076    040 SPACE:  . BYTE   40, 0
```

107

```
 1                         .SBTTL   END OF RUN ROUTINE
 2 015100 000002 RTI:      RTI
 3 015102          DONE:
 4 015102           PUSH    @#60,@#64
 5 015112 012737    MOV     #RTI,@#60
 5 015120 012737    MOV     #RTI,@#64
 7 015126 012737    MOV     #100,@#177560
 8 015134 012737    MOV     #100,@#177564
 9 015142           POP     @#64,@#60
10 15152            DSKO    #1,TICA,#TICBUF
11 15172 005267     INC     TICA
12 15176            DSKO    #1,DIRA,#DIRBUF
13 15216 016700     MOV     DIRBUF,R0
14 15222            DSKI    #1,DBADIR,#DIRBUF
15 15242            DIVD    DIRBUF,,#44
16 15256 163767     SUB     @#AC,DIRBUF
17 15264 060067     ADD     R0,DIRBUF
18 15270            DSKO    #1,DBADIR,#DIRBUF
19 15310            DSKI    #1,DIRA,#DIRBUF
20 15330            STRGO   #DONN
21 15340            TTYIO   #RAWDAT
22 15362 001002     BNE     1$
23 15364 004567     JSR     R5,THINGS          ;GO OUTPUT THE STUFF
24 15370       1$:
25 15370 016767     MOV     BLOK,ABLOK
26 15376 005267     INC     RNUM
27 15402 012767     MOV     #1,SNUM
28 15410 005067     CLR     TICBUF
29 15414 000167     JMP     CNTRLB
```

108

```
 1                          . SBTTL   DISC LOOKUP ROUTINE
 2 015420     040 BADSCN: . ASCIZ    / SCAN/
 3 015426     040 BADTIC: . ASCIZ    / TIC/
 4 015433     040 BADDIR: . ASCIZ    / DIRECTORY LOOKUP ERROR/<CR><LF>
 5 015465     040 CNFRM:  . ASCIZ    / CONFIRM /
 6 015477     040 SEQBK:  . ASCIZ    / NON-SEQUENTIAL BLOCK? /
 7 015527     040 OSETM:  . ASCIZ    / WORD TO BE CHANGED? /
 8 015555     040 CONTSM: . ASCIZ    / CONTENTS? /
 9 015571     040 CHANN:  . ASCIZ    / MORE CHANGES? /
10 15611      040 BACKM:  . ASCIZ    / OUTPUT CHANGED BLOCK? /
11 15641      040 ADMES:  . ASCIZ    / DISC ADDRESS? /
12 15661      040 ANOTM:  . ASCIZ    / ANOTHER BLOCK? /
13 15702      040 CHANM:  . ASCIZ    / CHANGES? /
14 15715      040 DSKLM:  . ASCIZ    / LOOK AT DISC? /
15 15735      040 CERR:   . ASCIZ    / COMMAND ERROR /
16                         . EVEN
17 15756             DSKLOK:
18 15756 004567            JSR      R5, RSAV
19 15762                   TTYIO    #ADMES
20 16004                   EMT442
21 16016                   POPTST   MQQ
22 16024        5$:
23 16024                   DSKI     #1, MQQ, #BBUF
24 16044 ··4567            JSR      R5, OUTOUT
25 16050                   TTYIO    #CHANM
26 16072 001114            BNE      6$
27 16074 ·05000 4$:        CLR      R0
28 16076        2$:
29 16076                   TTYIO    CHANK R0 )
30 16120 020027            CMP      R0, #4
31 16124 001422            BEQ      1$
32 16126                   EMT442
33 16140                   POPTST   CHANK R0 )
34 16146 020027 3$:        CMP      R0, #4
35 16152 001407            BEQ      1$
36 16154 062700            ADD      #2, R0
37 16160 000746            BR       2$
38 16162 016760            MOV      IBUF, CHANK R0 )
39 16170 000766            BR       3$
40 16172        1$:
41 16172 005367            DEC      CHANW
42 16176 006367            ASL      CHANW
43 16202 062767            ADD      #BBUF, CHANW
44 16210 016777            MOV      CHANW+2, @CHANW
45 16216 026767            CMP      IBUF, YE
46 16224 ··01723           BEQ      4$
47 16226                   TTYIO    #BACKM
48 16250 001025            BNE      6$
49 16252                   TTYIO    #CNFRM
50 16274 026767            CMP      IBUF, OOKK
51 16302 001225            BNE      DSKLOK
52 16304                   DSKO     #1, MQQ, #BBUF
53 16324        6$:
54 16324                   TTYIO    #ANOTM
55 16346 ··1020            BNE      OUTRR
56 16350                   TTYIO    #SEQBK
57 16372 001404            BEQ      DSKLO
```

109

```
58 16374 005267           INC     MQQ
59 16400 000167           JMP     5$
60 16404 000167 DSKLO:    JMP     DSKLOK
61 16410        OUTRR:
62 16410 004567           JSR     R5, RRSTR
63 16414 000177           JMP     @RETURN
64 16420 000000 RETURN:  . WORD   0
```

```
 1                          . SBTTL   PARAMETERS AND DATA BUFFERS
 2                          . GLOBL   WAVER
 3                          . GLOBL   TICBUF, TICA, DIRBUF, DIRP, TICFUL, DIRFUL
 4 016422    104 DONN:      . ASCII   /DONE/
 5 016426    015           . BYTE    CR, LF, 0
 6                          . EVEN
 7 016432 000000 DIRBUF:   . WORD    0
 8         017434'         . = . +512.
 9 017434 000000 BBUF:     . WORD    0
10         020436'         . = . +512.
11 20436 000000 TICBUF:    . WORD    0
12         021440'         . = . +512.
13 21440 000000 IBUF:      . WORD    0, 0, 0
14         021652'         . = . +132.
15         021652'   IBUFE=.
16                          . EVEN
17 21652 000000 DATAB:     . WORD    0
18         025654'         . = . +2048.
19 25654 000000 MBUF:      . WORD    0, 0, 0, 0, 0
20 25666    015           . BYTE    CR, LF, 0
21 25671    000 MBUFE:     . BYTE    0
22                          . EVEN
23 25672           EQBUF:
24 25672 000000              . WORD    0, 0, 0
25 25700    040              . BYTE    40, 40, 0
26 25703    015              . BYTE    CR, LF
27         025705'   EQBUFL=.
28                          . EVEN
29 25706 000001 TICP:      . WORD    1
30 25710 000000 R3SAV:     . WORD    0
31 25712 000007 DIRP:      . WORD    7
32 25714 005050 DBATIC:    . WORD    5050
33 25716 006000 DBADD:     . WORD    6000
34 25720 005000 DBADIR:    . WORD    5000
35 25722 005050 TICA:      . WORD    5050
36 25724 002000 SCPMAX:    . WORD    2000
37 25726 000011 PEPSCN:    . WORD    9.
38 25730 000000 OFFSET:    . WORD    0
39 25732 000004 INTENT:    . WORD    4
40 25734 000000 MASLOW:    . WORD    0
41 25736 000000 MASHI:     . WORD    0
42 25740 005400 INFAD:     . WORD    5400
43 25742 005400 INFADR:    . WORD    5400
44 25744 000010 SWITCH:    . WORD    10
45 25746    040 BLNK:      . ASCII   /  /
46 25750 000000 FLAG:      0
47 25752 000000 NUM:       0
48 25754 000030 REFRS:     . WORD    30
49 25756 000000 FDATA:     . WORD    0
50 25760 000000 BNUM:      . WORD    0
51 25762 000000 INFO:      . WORD    0
52 25764 000000 STOR:      . WORD    0
53 25766 010600 COREAD:    . WORD    10600
54 25770 005000 DIRA:      . WORD    5000
55 25772 000000 ERRA:      . WORD    0
56 25774 000001 DIRL:      . WORD    1
57 25776 000000 ENTRY:     . WORD    0
```

111

```
58 26000 000000 TIC:    . WORD   0, 0
59 26004 000000 MQQ:    . WORD   0
60 26006 000000 ACC:    . WORD   0
61 26010 000000 PPP:    . WORD   0
62 26012 000001 RNUM:   . WORD   1
63 26014 000001 SNUM:   . WORD   1
64 26016 000025 UIC:    . WORD   25
65 26020 006000 BLOK:   . WORD   6000
66 26022 006000 ABLOK:  . WORD   6000
67 26024 004424'JMOREC: . WORD   STRT
68 26026 000000 AR2:    . WORD   0
69 26030 000000 AR3:    . WORD   0
70 26032 000012 DCNTR:  . WORD   10.
71 26034 000005 TCXTR:  . WORD   5
72 26036 000000 CNTR:   . WORD   0
73 26040 000046'QUES:   . WORD   QUE1, QUE0
74 26044 026344'        . WORD   MODECM
75 26046 000065'        . WORD   QUE4
76 26050 002304'        . WORD   ADCZ, MFIZ
77 26054 002542'        . WORD   ACQM, MASSAM, CHROM, CCHROM, CCSPEC, IMCR, CCMASQ, RAWDAT, RAWOUT
78 26076 001654'        . WORD   WAVEFM
79 26100 000436'        . WORD   HELPOB, QUE5
80 26104 004646'QUESR:  . WORD   CMODE, OFSETR, MODEC, NBOKRE
81 26114 000000G        . WORD   ADCC, MFI
82 26120 011666'        . WORD   PEAKS, MASSES, ACHROM, BCHROM, ACSPEC, MCR, CCMASS, ACRAW, RAWSAV
83 26142 013632'        . WORD   WAVER
84 26144 004752'        . WORD   HELPO, CNTRL
85                      ;*********************************************************
86                      ;         IMPORTANT NOTE:
87                      ;               THE FOLLOWING COMMAND TABLE MUST BE IN EXACTLY
88                      ;               THE SAME ORDER AS THE PROCESSOR RECEIVING TABLE
89                      ;               QUESR.   FAILURE TO MAINTAIN THIS RELATIONSHIP
90                      ;               WILL RESULT IN LOSS OF SYNC IN COMMAND MODE.
91                      ;*********************************************************
92 26150 000021 CMTABL: . WORD   17.
93 26152    117         . ASCII  /OF/    ;OFFSET CALIBRATION
94 26154    115         . ASCII  /MO/    ;MODE CHANGE
95 26156    116         . ASCII  /NB/    ;NOTEBOOK INFORMATION
96 26160    101         . ASCII  /AD/    ;DEC AD ZERO
97 26162    115         . ASCII  /MF/    ;MFI ZERO
98 26164    104         . ASCII  /DA/    ;ACQUIRE DATA
99 26166    101         . ASCII  /AM/    ;ASSIGN MASSES
100 6170    123         . ASCII  /SC/    ;SCOPE CHROMATOGRAM
101 6172    103         . ASCII  /CC/    ;CALCOMP CHROMATOGRAM
102 6174    103         . ASCII  /CS/    ;CALCOMP SPECTRUM
103 6176    123         . ASCII  /SM/    ;MASS CHROMATOGRAM SCOPE
104 6200    103         . ASCII  /CM/    ;MASS CHROMATOGRAM CALCOMP
105 6202    122         . ASCII  /RO/    ;RAW DATA OUT
106 6204    123         . ASCII  /SD/    ;SAVE DATA
107 6206    101         . ASCII  /AP/    ;PEAK WAVEFORM DISPLAY
108 6210    110         . ASCII  /HE/    ;HELP
109 6212    103         . ASCII  /CN/    ;CONTROL
110 6214 000000 CMTABE: . WORD   0       ;TABLE END
111 6216    015 TITL:   . BYTE   15, 12
112      000003         . REPT   3
113                     . ASCII  / SCAN PEAKS      TIC   /
114                     . ENDM
```

```
115 6325    015         . BYTE    15, 12, 0
116                     . EVEN
117 6330 015527´CHAN:   . WORD    OSETM, CONTSM, CHANN
118 6336 000000 CHANW:  . WORD    0, 0, 0
119 6344    040 MODECM: . ASCIZ   / MODE CHANGE TO SKIPPING MODE /
120 6403    040 CCMASQ: . ASCIZ   / CALCOMP PLOT OF SELECTED MASS CHROMATOGRAM /
121                     . EVEN
```

```
 1                          . SBTTL    THINGS ROUTINE
 2 026460          THINGS:  . BIN20    #BUF, BLOK
 3 026476 016767            MOV       BLOK, BNUM
 4 026504 166767            SUB       ABLOK, BNUM
 5 026512 016767            MOV       BNUM, CNTR
 6 026520 005467            NEG       CNTR
 7 026524                   . BIN20    #BUF1, BNUM
 8 026542                   STRGO     #MS1
 9 026552 005767 1$:        TST       CNTR
10 26556 001417             BEQ       RTSR5
11 26560                    DSKI      #1, ABLOK, #BBUF
12 26600 005267             INC       ABLOK
13 26604 005267             INC       CNTR
14 26610 004567             JSR       R5, OUTOUT
15 26614 000756             BR        1$
16 26616 000205 RTSR5:      RTS       R5
```

114

```
 1                          . SBTTL  BLOCK TYPEOUT ROUTINE
 2 026620           OUTOUT:
 3 026620 004567         JSR     R5,RSAV
 4 026624 012704         MOV     #-16.,R4
 5 026630 012700         MOV     #-258.,R0
 6 026634 005001         CLR     R1
 7 026636 012703         MOV     #2,R3
 8 026642 005002         CLR     R2
 9 026644           L1:   PUSH    BBUF(R1),#OBUF
10 26654 060316         ADD     R3,(SP)
11 26656 012746         MOV     #5,-(SP)
12 26662 104042         EMT     42
13 26664 005202         INC     R2
14 26666 020227         CMP     R2,#6
15 26672 001406         BEQ     IO
16 26674 062703         ADD     #8.,R3
17 26700 005721 L2:     TST     (R1)+
18 26702 005200         INC     R0
19 26704 001413         BEQ     OUTR
20 26706 000756         BR      L1
21 26710           IO:   STRGO   #OBUFB
22 26720 004567         JSR     R5,WWAIT
23 26724 005002         CLR     R2
24 26726 012703         MOV     #2,R3
25 26732 000762         BR      L2
26 26734           OUTR:
27 26734 004567         JSR     R5,RRSTR
28 26740 000205         RTS     R5
29 26742    040 WAITM:  . ASCIZ  / CONTINUE /
30       026755'        WAITME=.
31                      . EVEN
32 26756 005204 WWAIT:  INC     R4
33 26760 ···1014        BNE     NOWA
34 26762 012704         MOV     #-16.,R4
35 26766               TTYIO   #WAITM
36 27010 001001         BNE     UNUSAL
37 27012 000205 NOWA:   RTS     R5
38 27014 012605 UNUSAL: MOV     (SP)+,R5
39 27016 004567         JSR     R5,RRSTR
40 27022 000205         RTS     R5
41 27024    110 MS1:    . ASCII  /HIGHEST BLOCK=  /
42 27044 000000 BUF:    . WORD   0,0,0
43 27052    040         . BYTE   40,40,40
44 27055    124 MS2:    . ASCII  /TOTAL BLOCKS= /
45 27073    000 BUF1:   . BYTE   0,0,0,0,0,0
46 27101    015         . BYTE   CR,LF,0
47                      . EVEN
48 27104           OBUFB:
49 27104    040 OBUF:   . BYTE   40,40
50 27106 000000         . WORD   0,0,0
51 27114    040         . BYTE   40,40
52 27116 000000         . WORD   0,0,0
53 27124    040         . BYTE   40,40
54 27126 000000         . WORD   0,0,0
55 27134    040         . BYTE   40,40
56 27136 000000         . WORD   0,0,0
57 27144    040         . BYTE   40,40
```

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```
58 27146 000000      . WORD    0,0,0
59 27154    040      . BYTE    40,40
60 27156 000000      . WORD    0,0,0
61 27164    015      . BYTE    CR,LF,0
62       027167'     OBUFE=.
63                   . EVEN
```

```
1                          . SBTTL   INITILIZATION ROUTINE
2                          . GLOBL   TRPHDL
3       000034             TRPVEC=34
4       000036             TRPSTA=36
5                  ;*********************************************************************
6                  ;        INITIALIZATION MODULE
7                  ;        PURPOSE:
8                  ;                TO PROVIDE AUTOMATIC INITIALIZATION OF THE REAL-TIME
9                  ;                DATA ACQUISITION SOFTWARE FOR ALL ORDINARY CASES.   AS
10                 ;                SUCH IT DOES NOT EVEN PRETEND TO HANDLE EXTRAORDINARY
11                 ;                SITUATIONS; PARTICULARLY, WHEN UNFORSEEN EVENTS HAVE CAUSED
12                 ;                CORRUPTION OF THE DATA STRUCTURE ON DISC.   ALSO, UNFORSEEN
13                 ;                EVENTS UNFORTUNATELY MAY INCLUDE CERTAIN OBSCURE BUGS WHICH
14                 ;                HAVE NOT YET BEEN KICKED OUT OF THE SOFTWARE.
15                 ;
16                 ;        RELEVANT MNEUMONICS:
17                 ;                TRPVEC==>TRAP INSTRUCTION INTERRUPT VECTOR
18                 ;                TRPSTA==>TRAP INSTRUCTION VECTOR PLUS TWO
19                 ;                SWITCH==>DEFAULT MAPPING SWITCH
20                 ;                TRPHDL==>THE TRAP INSTRUCTION RECEIVING ROUTINE
21                 ;                INTENT==>DYNAMIC INTENSITY THRESHOLD
22                 ;                INTEDF==>DEFAULT INTENSITY THRESHOLD
23                 ;                DCNTR==>MODULO FOR DIRECTORY UPDATE
24                 ;                TCXTR==>MODULO FOR TIC UPDATE
25                 ;                DBADIR==>DISC BASE ADDRESS OF THE DIRECTORY
26                 ;                DIRBUF==>CORE BUFFER FOR KEEPING DIRECTORY BLOCK
27                 ;                DIRA==>CURRENT DIRECTORY DISC ADDRESS
28                 ;                TICA==>CURRENT TIC DISC ADDRESS
29                 ;                RNUM==>CURRENT RUN #                                              117
30                 ;                BLOK==>CURRENT DISC ADDRESS FOR ACTUAL DATA
31                 ;                DIRP==>DYNAMIC POINTER TO CORE ADDRESS OF NEXT DIRECTORY ENTRY
32                 ;                ABLOK==>ANOTHER COPY OF BLOK
33                 ;                DBADD==>DIRECTORY BASE ADDRESS
34                 ;                SETINC==>ROUTINE TO SET UP INREMENTS FOR SCOPE
35                 ;                TICBUF==>CORE BUFFER FOR TIC
36                 ;                TICF==>TEST FOR TOTAL ION CURRENT BUFFER FULL ROUTINE
37                 ;                BACKOF==>DELETE WIERD DIRECTORY ENTRIES ROUTINE
38                 ;                GETZE==>FIND OUT WHAT THE OFFSET IS ROUTINE
39                 ;        RELEVANT MACROS:
40                 ;                DSKI==>TRAN MODE DISC INPUT MACRO
41                 ;                DIVD==>EAE DOUBLE PRECISION INTEGER DIVIDE MACRO
42                 ;                PUSH==>SYSTEM STACK PUSHING MACRO
43                 ;                MULT==>EAE MULTIPLY MACRO
44                 ;                POPR==>AUTO INCREMENT REGISTER MACRO
45                 ;                DSKO==>TRAN MODE DISC OUTPUT ROUTINE
46                 ;                CLREM==>CLEAR ITS ARGUMENTS MACRO
47                 ;*********************************************************************
48 27170          INITIL:
49 27170 005067            CLR       ADERCT          ;A/D ERROR COUNT THIS SCAN
50 27174 012767            MOV       #14,SWITCH      ;NO DIVIDE BY N
51 27202 012737            MOV       #TRPHDL,@#TRPVEC     ;SET UP TRAP VECTOR FOR SCOPE ROUTINES
52 27210 005037            CLR       @#TRPSTA             ;MORE TRAP VECTOR STUFF
53 27214 012767            MOV       #10.,DCNTR      ;A CARRIAGE RETURN LINE FEED AFTER EVERY 10 SCAN NUMBERS
54 27222 012767            MOV       #5,TCXTR        ;TIC UPDATE AFTER EVERY 5 SCANS
55 27230            DSKI     #1,DBADIR,#DIRBUF       ;INPUT THE FIRST DIRECTORY BLOCK
56 27250            DIVD     DIRBJF,,#44             ;FORTY FOUR OCTAL ENTRIES PER DIRECTORY BLOCK
57 27264            PUSH     @#AC,@#MQ               ;MQ HAS NUMBER OF BLOCKS AND AC HAS REMAINDER
```

```
58 27274 016767        MOV      DBADIR, DIRA    ;BASE ADDRESS OF THE DIRECTORY FOR CALCULATION
59 27302 062667        ADD      (SP)+, DIRA     ;OF THE BLOCK ADDRESS OF LATEST DIRECTORY BLOCK
60 27306 005716        TST      (SP)            ;IF REMAINDER IS ZERO WE BACKUP A BLOCK
61 27310 003025        BGT      1$              ;OTHERWISE WE NEED TO CALCULATE THE OFFSET INTO THIS BLOCK
62 27312 005367        DEC      DIRA            ;BACK OFF ONE BLOCK
63 27316               DSKI     #1, DIRA, #DIRBUF ;AND INPUT THE BLOCK
64 27336 016767        MOV      DIRBUF+502., TICA    ;WE KNOW EXACTLY WHERE TO GO IN THIS BLOCK
65 27344 016767        MOV      DIRBUF+490., RNUM    ;SO GRAB THE RELEVANT STUFF
66 27352 016767        MOV      DIRBUF+500., BLOK    ;AND RUN
67 27360 005267        INC      DIRA            ;AND SWITCH BLOCKS AGAIN
68 27364          1$:
69 27364               DSKI     #1, DIRA, #DIRBUF ;WILL THE REAL DIRECTORY BLOCK PLEASE ENTER CORE
70 27404 026716        CMP      DIRBUF, (SP)    ;IS THE DIRECTORY CORRECT?
71 27410 002532        BLT      BACKOF          ;IF NOT TRY TO FIX IT
72 27412               MULT     DIRBUF, #14., R4  ;FOURTEEN BYTES PER ENTRY
73 27432 005724        TST      (R4)+
74 27434 010467        MOV      R4, DIRP
75 27440 062767        ADD      #DIRBUF, DIRP
76 27446 005726        TST      (SP)+
77 27450 003411        BLE      2$
78 27452 016467        MOV      DIRBUF-4(R4), BLOK
79 27460 016467        MOV      DIRBUF-2(R4), TICA
80 27466 016467        MOV      DIRBUF-14.(R4), RNUM
81 27474 016767 2$:    MOV      BLOK, ABLOK
82 27502 026767        CMP      BLOK, DBADD
83 27510 002472        BLT      BACKOF
84 27512 005267        INC      RNUM
85 27516 012767        MOV      #1, SNUM
86 27524               PUSH     #8., (SP)
87 27532 004767        JSR      PC, SETINC                                  118
88 27536               TTYIO    #MASL
89 27560               .02BIN   #IBUF
90 27572               POPTST   MASLOW
91 27600               TTYIO    #MASH
92 27622               .02BIN   #IBUF
93 27634               POPTST   MASHI
94 27642 012701 TICF:  MOV      #TICBUF, R1
95 27646 005021        CLR      (R1)+
96 27650               POPR     R1, RNUM, UIC, SNUM
97 27664 005011        CLR      (R1)
98 27666 012767        MOV      #TICBUF+14., TICP
99 27674 000205        RTS      R5
100 7676          BACKOF: DSKI   #1, DBADIR, #DIRBUF
101 7716 005367        DEC      DIRBUF
102 7722               DSKO     #1, DBADIR, #DIRBUF
103 7742 000167        JMP      INITIL
104 7746          GETZE:
105 7746 004567        JSR      R5, RSAV
106 7752               CLREM    R0, R1, R2
107 7760 005037 3$:    CLR      @#ADCSR
108 7764 105737 1$:    TSTB     @#ADCSR
109 7770 100375        BPL      1$
110 7772 063700        ADD      @#ADBUF, R0
111 7776 005501        ADC      R1
112 0000 005202        INC      R2
113 0002 012703        MOV      #100., R3
114 0006 005303 2$:    DEC      R3
```

```
115 0010 100376         BPL      2$
116 0012 020227         CMP      R2, #1000.
117 0016 ·····2760      BLT      3$
118 0020               DIVD     R0, R1, #1000 , OFFSET
119 0044 004567         JSR      R5, RRSTR
120 0050 000207         RTS      PC
```

1   004222'   . END   STRT1

ABLOK	026022RG	ABLOKM	000717R	AC	= 177302
ACC	026006R	ACHROM	005646R	ACQM	002542R
ACRAW	006026R	ACRAW1	006056R	ACSPEC	005712RG
ADBUF	= 176772	ADCC	= ****** G	ADCSR	= 176770
ADCZ	002304R	ADDRES	000543R	ADERCT	011656R
ADERM	013607R	ADMES	015641RG	ADPRI	= 000132
ADVEC	= 000130	AJUMP	004724R	ALOC	006540R
ANOTM	015661RG	AR2	026026RG	AR3	026030RG
ASH	= 177316	ATICS	003367R	BACKM	015611R
BACKOF	027676R	BADDIR	015433R	BADR	011522R
BADSCN	015420R	BADTIC	015426R	BADU	011532R
BB	= 000011	BBUF	017434RG	BCHROM	005670R
BDA	= ****** G	BDAM	001223R	BIGZE	007226R
BKK	011706R	BKKJMP	006624R	BLANK	013274RG
BLANKF	007304RG	BLKHED	004152R	BLNK	025746RG
BLOK	026020RG	BLOKM	001365R	BNUM	025760RG
BUF	027044R	BUF1	027073R	CCHROM	002070R
CCMASQ	026403R	CCMASS	= ****** G	CCSPEC	002140R
CERR	015735R	CHAN	026330R	CHANM	015702R
CHANN	015571R	CHANW	026336R	CHEMM	003607R
CHROM	002020R	CHROMA	= ****** G	CLEAN	013266R
CLK	= 177546	CLOSM	= ****** G	CMODE	004646R
CMODE1	006634R	CMTABE	026214R	CMTABL	026150R
CNFRM	015465R	CNTABL	010652R	CNTLC	= ****** G
CNTR	026036R	CNTRL	006470R	CNTRLB	= ****** G
COLD	001617R	COLDR	007362R	CONTSM	015555R
COREAD	025766RG	CORM	003141R	COSTM	003771R
CR	= 000015	DADM	001522R	DATA	012476R
DATAB	021652RG	DATEM	003733R	DBADD	025716R
DBADIR	025720R	DBATIC	025714R	DCNTR	026032R
DDATA	001131R	DEFALT	004720R	DEVIC	000672R
DIRA	025770RG	DIRBUF	016432RG	DIRFUL	014466RG
DIRL	025774R	DIRLK	011420R	DIRLOK	001105R
DIROUT	006710R	DIRP	025712RG	DIRPM	000773R
DISCN	004042R	DIV	= 177300	DLM	001467R
DONE	015102R	DONN	016422R	DOVERF	013372R
DPSCN	= ****** G	DPSCNM	003173R	DR	= 165000
DRIN	= 165004	DROUT	= 165002	DSKIN	= ****** G
DSKLM	015715R	DSKLO	016404R	DSKLOK	015756R
DSKOUT	= ****** G	DSKTLP	= ****** G	DSKXYZ	= ****** G
DSKZER	007074R	DUMB	002405R	EAENOR	= 177312
EAESC	= 177310	EAESR	= 177311	ENTRIS	001177R
ENTRY	025776R	EQBUF	025672RG	EQBUFL	= 025705RG
EQPUT	007732R	ERLOC	005634RG	EROUTL	005270R
ERRA	025772R	ERRO	011134R	ERROR	011430R
FDATA	025756R	FIXBUF	015034R	FIXLP	= ****** G
FLAG	025750R	FLAGG	= ****** G	FLD	000000RG
FLOWM	013416R	FMATCH	004530R	FMAX	= ****** G
FMAXM	000630R	FMCH7	002232R	FMMS30	002204R
F1	011424R	F2	011426R	GETADD	011142R
GETCHM	005206RG	GETCOR	= ****** G	GETDAT	011370R
GETSPC	005734RG	GETTIC	011620R	GETZE	027746R
GTSPC1	005740R	HARDJ	010244R	HARDJM	000527R
HELPM	000275R	HELPO	004752R	HELPOA	000405R
HELPOB	000436R	HELPOM	000455R	HELP1M	000473R
HELP2M	000511R	HOME	011334R	HUND	= ****** G
IBUF	021440RG	IBUFE	= 021652R	IMCR	= ****** G

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SYMBOL TABLE

IMOREC 005642RG	IMSAV 006134R	INCHSM 003751RG
INFAD 025740RG	INFADR 025742RG	INFAM 002605R
INFO 025762R	INITIL 027170RG	INPUT 013316RG
INSTM 003670R	INST1 000246RG	INST2 000255RG
INST3 000230R	INTENT 025732R	INTMU = ****** G
INTMUL 002706R	INTNOW 013342R	INTSCA 001776RG
INTT 002766R	IO 026710R	IOSWT 006132RG
JBKK 006630R	JMOREC 026024RG	JMPI 006452R
KBSAV 011660R	LBS 003503R	LDISC 006222R
LENGTH= ****** G	LENGTM 000612R	LF = 000012
LFLDM 002257RG	LOFFSM 003317R	LOOP3 013302R
LPF = ****** G	LSH = 177314	LSIZEM 003263R
LSPACE 003343R	L1 026644R	L2 026700R
MASH 003066R	MASHI 025736R	MASL 003014R
MASLOW 025734R	MASSAM 001756R	MASSES 006136R
MBUF 025654RG	MBUFE 025671R	MCR = ****** G
MDATAM 013553R	MFI = ****** G	MFIZ 002323R
MHELPM 000347R	MMQUES 004514R	MODEC 004746R
MODECM 026344R	MORE 011256R	MOREC 006530R
MOREM 002565R	MQ = 177304	MQQ 026004RG
MQUES 004466R	MSPECM 003637R	MSS 010344R
MSSR 010406R	MS1 027024R	MS2 027055R
MS30F = ****** G	MS30FM 000655R	MTABL 004062RG
MUL = 177306	M10 = ****** G	M30 = ****** G
NBLOCK 011416R	NBOKRE= ****** G	NEXT 012452R
NODATA 011612R	NOPE 011354R	NOWA 027012R
NTABL 004070RG	NUM 025752RG	OBUF 027104R
OBUFB 027104R	OBUFE = 027167R	OCRLF = ****** G
OFF 013710R	OFFCNT 013336R	OFFSET 025730R
OFFTHR 013334R	OFSETR 005104R	OOKK 004716R
OPERM 003705R	OSETM 015527R	OTABL 004076RG
OTICM 000735R	OUTCHR 006144R	OUTCH1 006152R
OUTEQ 007750R	OUTH 011516R	OUTOUT 026620R
OUTR 026734R	OUTRAM 000555R	OUTRR 016410R
OVERFL 013402R	OVRCNT 013340R	OVRMSG 013344R
PARA 010450R	PATABL 010716R	PC =%000007
PCONT 002342R	PDSC = ****** G	PDSCM 003226R
PEAKS 011666RG	PEPSC 002641R	PEPSCN 025726R
PKNUM 001715R	PKSFIL 010004R	PKSLNK 007770R
PKSNM 006024RG	PLTCHR= ****** G	PLTCH1= ****** G
PLTR = 172554	PLTSPC= ****** G	PLTSWT 005102RG
PNUM 011664R	PPF 005644RG	PPP 026010R
PRTVEC= 000064	PSW = 177776	PTABL 004114RG
PTSNUM 001733RG	PWANT = ****** G	QTABI 004132RG
QUES 026040R	QUESR 026104R	QUE0 000002R
QUE01 000027R	QUE1 000046R	QUE4 000065R
QUE5 000114R	RAWCHO 006704R	RAWCHR 001037R
RAWDAT 013570R	RAWOUT 001066R	RAWREC= ****** G
RAWSAV= ****** G	REFRM 003530R	REFRS 025754R
REINIR 007762R	REINIT 001574R	REST 011324R
RETURN 016420R	RNUM 026012RG	RNUMM 001445R
RNUMN 004001R	RRSTR = ****** G	RSAV = ****** G
RTABL 004142RG	RTI 015100R	RTSR5 026616R
RUNTM 003720R	R0 =%000000	R1 =%000001
R2 =%000002	R3 =%000003	R3SAV 025710R
R33 = ****** G	R4 =%000004	R5 =%000005
R6 =%000006	R7 =%000007	SAMPLE 012474R

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```
SAVE    013204R        SCALIT= ****** G      SCAN    012374R
SCANS   011052RG       SCNTIC  011650R       SCPMAM  002735R
SCPMAX  025724R        SDIRER  005774RG      SEQBK   015477R
SETINC= ****** G       SETPAR  001553R       SETPAT  010016R
SIZE  = ****** G       SNUM    026014RG      SNUMM   001422R
SNUMN   004024R        SNUMNE  004061R       SP     =%000006
SPACE   015076R        SPACEC= ****** G      SRT     011652R
SSNUM   005640RG       STABL   005220R       START = ****** G
STICER  005244R        STOR    025764R       STRING= ****** G
STRT    004424RG       STRTT   004232R       STRT1   004222R
STUFF   006304RG       SWITCH  025744RG      SWITMG  011020R
SWR   = 177570         TCXTR   026034R       TDA   = ****** G
TDAM    001263R        THENUM  005276RG      THINGS  026460R
TIC     026000R        TICA    025722RG      TICAA   011422R
TICADR  011342R        TICBUF  020436RG      TICC    011542RG
TICDAT  011632R        TICF    027642R       TICFLG  005636RG
TICFUL  014730RG       TICM    001324R       TICP    025706R
TIMEM   003742R        TITL    026216R       TITLE   003411R
TITLES  000644RG       TKB   = 177562        TKBB    012372R
TKS   = 177560         TLNK  = ****** G      TPB   = 177566
TPLAC   006572R        TPS   = 177564        TRA.  = ****** G
TRNUM   005626RG       TRPHDL= ****** G      TRPSTA= 000036
TRPVEC= 000034         TSNUM   005632RG      TTYI  = ****** G
TTYO  = ****** G       TUIC    005630RG      TYPE1   000126RG
TYPE2   000140R        TYPE3   000156R       TYPE4   000210R
UIC     026016RG       UICERM  000262R       UICM    001402R
UICN    004016R        UN    = 000016        UNUSAL  027014R
UOFUM   003564R        U1X   = ****** G      VBOB    007726R
VJOE    007524R        WAITM   026742R       WAITME= 026755R
WAVEFM  001654R        WAVER   013632RG      WAVFLG  013706R
WHERE   010552R        WT      012246R       WT1     012132R
WWAIT   026756R        XY4   = ****** G      X111    012556R
X333    013124R        X44     012544R       X456    013154R
X494    014442R        X567    013074R       YE    = ****** G
YTICS   003507R        ZEHAM   002502R       ZELAM   002443R
/EPOM   001834R          SYM = 000027
   ABS.  000000      000
         030052      001
```

ERRORS DETECTED: 0
FREE CORE: 12144. WORDS
,LP:/NL:BEX/CRF<APKS1

CROSS REFERENCE TABLE   S-1

```
ABLOK    1- 20#   14- 24@   17- 40    24- 25@   26- 66#   27-  4    27- 11
         27- 12@   29- 81@
ABLOKM   2- 40#   17- 26
AC       1- 97#   12-  9#   12- 10    18- 33#   18- 34    20-111#   20-125@
         20-131#@  20-138#   23- 35#   24- 15#   24- 16    29- 56#   29- 57
         29- 72#   29-118#@
ACC      23- 35@   23- 37    23- 40    26- 60#
ACHROM   5- 65#    5- 68    26- 82
ACQM     2- 78#   17-  5    26- 77
ACRAW    8-  4#    8- 18    26- 82
ACRAW1   8-  7     8-  9#
ACSPEC   1- 15#    7-  2#    7-  5     26- 82
ADBUF    1- 95#   20- 45    20- 88    20-188    29-110
ADCC     1- 17#   17- 20    26- 81
ADCSR    1- 95#   20- 73@   20- 76@   20- 85    23-  2@   29-107@   29-108
ADCZ     2- 72#   17- 10    26- 76
ADDRES   2- 33#   16-  2
ADERCT   20-  4#   20- 11    20- 13    20- 24@   20- 87@   29- 49@
ADERM    20- 14   21- 11#
ADMES    1- 27#   10- 14    25- 11#   25- 19
ADPRI    1- 95#
ADVEC    1- 95#   20- 43@   20- 44@   20- 61@   20- 82@   20-103@   23-  4@
AJUMP    3- 79     3-114#
ALOC     11- 13#   11- 22
ANOTM    1- 27#   25- 12#   25- 54
AR2      1- 15#    3-115@   11-  3@   26- 68#
AR3      1- 14#    3-116@   26- 69#
ASH      1- 97#   12-  9#   18- 33#   20-111#   20-131#   20-138#   23- 35#
         24- 15#   29- 56#   29- 72#   29-118#
ATICS    2- 93#   17- 27
BACKM    25- 10#   25- 47
BACKOF   29- 71   29- 83    29-100#
BADDIR   5- 10     7- 15    25-  4#
BADR     18- 88   18- 94#
BADSCN   7- 15    25-  2#
BADTIC   5- 10    25-  3#
BADU     18- 90   18- 96#
BB       1- 44#
BBUF     1-  7#   23- 82    23- 83@   23- 84    25- 23    25- 43    25- 52
         26-  9#   27- 11    28-  9
BCHROM   6-  2#    6-  5    26- 82
BDA      1- 19#   17- 45
BDAM     2- 48#   17- 31
BIGZE    13- 12#   14- 18
BKK      20- 10#   23- 61
BKKJMP   11- 10   11- 25#
BLANK    1- 25#   10- 22    15-  5    20-191#
BLANKF   13- 27#   13- 28#
BLKHED   3- 48#    3- 55     3- 70     3- 86@    3- 89     3- 99@    3-101
BLNK     1- 30#   20-193    26- 45#
BLOK     1- 41#   14- 23@   14- 24    17- 40    23- 51    23- 53    23- 54@
         23- 55   24- 25    26- 65#   27-  2    27-  3    29- 66@   29- 78@
         29- 81   29- 82
BLOKM    2- 51#   17- 26
BNUM     1-  7#   23- 41@   23- 51    23- 54    26- 50#   27-  3@   27-  4@
         27-  5   27-  7
BUF      27-  2   23- 42#
BUF1     27-  7   28- 45#
```

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CROSS REFERENCE TABLE   S-2

```
CCHROM    2- 67#   17- 10    26- 77
CCMASQ    26- 77   26-120#
CCMASS    3-  3#   26- 82
CCSPEC    2- 68#   17-  9    26- 77
CERR      3- 97    25- 15#
CHAN      25- 29   26-117#
CHANM     25- 13#  25- 25
CHANN     25-  9#  26-117
CHANW     25- 33@  25- 38@   25- 41@   25- 42@   25- 43@   25- 44@   26-118#
CHEMM     2-100#   2-116     2-117
CHROM     2- 66#   17-  8    26- 77
CHROMA    1- 24#
CLEAN     20- 43   20- 61    20- 62    20- 63    20-103    20-188#   23-  4
CLK       1-100#   20- 24@
CLOSM     8-  3#   8- 16
CMODE     3-103#   3-109     3-110     26- 80
CMODE1    11- 27#  11- 33    11- 34    17- 12
CMTABE    3- 82    26-110#
CMTABL    3- 82    3-103     26- 92#
CNFRM     11-  7   13-  9    14-  3    16-  5    25-  5#   25- 49
CNTABL    11- 27   17- 50#
CNTLC     1- 18#   20- 60    21-  4
CNTR      26- 72#  27-  5@   27-  6@   27-  9    27- 13@
CNTRL     11-  6#  26- 84
CNTRLB    1- 17#   24- 29
COLD      2- 59#   3- 51     17-  2
COLDR     3- 53    14-  2#   17- 12
CONTSM    25-  8#  26-117
COREAD    1- 14#   3- 69     14- 16    14- 21    17- 43    26- 53#
CORM      2- 87#   17- 29
COSTM     2-108#   2-118     2-120
CR        1- 43#   2- 11     2- 13     2- 15     2- 18     2- 20     2- 23
          2- 26    2- 29     2- 30     2- 31     2- 46     2- 94     2- 95
          21-  6   21-  8    21- 11    25-  4    26-  5    26- 20    26- 26
          28- 46   28- 61
DADM      2- 56#   17- 32
DATA      20- 82   20- 84#
DATAB     1- 26#   7- 11     7- 16@    12-  8    12-  9    12- 14    12- 17
          20- 25   20-143    23- 29@   23- 30@   23- 31@   23- 42@   23- 43@
          23- 47@  26- 17#
DATEM     2-105#   2-118     2-119
DBADD     14- 23   14- 29    26- 33#   29- 82
DBADIR    12-  8   12- 14    14- 15    14- 36    18- 29    18- 30    23- 67
          23- 70   23- 82    23- 84    24- 14    24- 18    26- 34#   29- 55
          29- 58   29-100    29-102
DBATIC    14- 29   14- 37    26- 32#
DCNTR     23- 69@  23- 78@   23- 81@   26- 70#   29- 53@
DDATA     2- 46#   12- 15
DEFALT    3-113#
DEVIC     2- 39#   17- 35
DIRA      1- 14#   14- 25    14- 36@   14- 38    17- 46    23- 65    23- 74@
          23- 80   24- 12    24- 19    26- 54#   29- 58@   29- 59@   29- 62@
          29- 63   29- 67@   29- 69
DIRBUF    1- 14#   13- 14    13- 16    13- 22    14- 25    14- 26    14- 32
          14- 38   15- 21    23- 57@   23- 43    23- 65    23- 66    23- 68@
          23- 72   23- 75    23- 76@   23- 80    24- 12    24- 13    24- 14
          24- 15   24- 16@   24- 17@   24- 18    24- 19    26-  3#   26-  7#
          29- 55   29- 56    29- 63    29- 64    29- 65    29- 66    29- 69
```

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CROSS REFERENCE TABLE   S-3

```
            29- 70    29- 72    29- 75    29- 78    29- 79    29- 80    29-100
            29-101@   29-102
DIRFUL   23- 58    23- 63#   26-  3#
DIRL     14- 35@   17- 46    23- 77@   26- 56#
DIRLK    18- 29@   18- 74#   18- 81@   18- 83
DIRLOK    2- 45#   17-  6
DIROUT   12-  5#   17- 16
DIRP     14- 30@   15- 20@   15- 21@   17- 49    23- 52    23- 56@   23- 63
         23- 75@   26-  3#   26- 31#   29- 74@   29- 75@
DIRPM     2- 42#   17- 34
DISCN     2-112#    2-121     2-122
DIV       1- 97#   12-  9#@  18- 33#@  20-111#   20-116@   20-127@   20-131#@
         20-138#   23- 35#@  24- 15#@  29- 56#@  29- 72#   29-118#@
DLM       2- 55#   17- 32
DONE     20- 64    24-  3#
DONN     24- 20    26-  4#
DOVERF   20-144    21-  2#
DPSCN     1- 35#    3- 66@   17- 38
DPSCNM    2- 88#   17- 24
DR        1- 98#   20- 42@   23- 10@
DRIN      1- 98#   20-179
DROUT     1- 98#   20- 37@   20- 70@   20- 72@   20-178@   23-  3@
DSKIN     1- 17#    1- 25#   10- 17#   12-  8#   12- 14#   14- 25#   18- 30#
         18- 69#   18- 83#   19- 26#   23- 67#   23- 82#   24- 14#   24- 19#
         25- 23#   27- 11#   29- 55#   29- 63#   29- 69#   29-100#
DSKLM    17-  5    25- 14#
DSKLO    25- 57    25- 60#
DSKLOK   17- 15    25- 17#   25- 51    25- 60
DSKOUT    1- 39#    3- 69#    3- 70#   13- 22#   14- 21#   14- 38#   23- 51#
         23- 65#   23- 70#   23- 80#   23- 84#   23- 88#   23- 93#   24- 10#
         24- 12#   24- 18#   25- 52#   29-102#
DSKTLP    3-  4#    3-124     3-130
DSKXYZ    1- 12#   18- 58@
DSKZER   13-  2#   13- 11    13- 19    17- 17
DUMB      2- 75#   11- 23
EAENOR    1- 97#   12-  9#   18- 33#   20-111#   20-131#   20-138#   23- 35#
         24- 15#   29- 56#   29- 72#   29-118#
EAESC     1- 97#   12-  9#   18- 33#   20-111#   20-131#   20-138#   23- 35#
         24- 15#   29- 56#   29- 72#   29-118#
EAESR     1- 97#   12-  9#   18- 33#   20-111#   20-131#   20-138#   23- 35#
         24- 15#   29- 56#   29- 72#   29-118#
ENTRIS    2- 47#   12- 16
ENTRY    18- 31@   18- 39@   18- 64@   18- 84@   26- 57#
EQBUF     1- 16#    4-  6     4-  7    10- 20    12- 17    12- 18    14- 41
         14- 43    16-  4@   16-  8    26- 23#
EQBUFL    1- 14#   26- 27#
EQPUT    14- 41#   15-  4
ERLOC     1- 10#    5-  6     5-  7@    5- 60#    7- 11     7- 12@
EROUTL    5- 12#    7- 17
ERRA     18- 17@   18- 28@   18- 91@   18- 94@   18- 96@   19- 14@   26- 55#
ERRO     18- 22    18- 24#
ERROR    18- 65    18- 78#
FDATA    20- 26@   23- 32    23- 51    26- 49#
FIXBUF   20- 35    23- 98#
FIXLP     1- 21#   12-  7
FLAG     20- 38@   20- 71@   23-  5    26- 46#
FLAGG     1- 12#    3- 76@
FLD       1- 14#    2-  3#    3- 69    14- 21    20- 81    20-139
```

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CROSS REFERENCE TABLE    S-4

FLOWM     21-  3    21-  5#
FMATCH     3- 85#    3-104    11- 28
FMAX       1- 13#   17- 42
FMAXM      2- 36#   17- 28
FMCH7      2- 70#
FMMS30     2- 69#
F1        13- 28@   13- 36    18- 18@   18- 44@   18- 76#   18- 87    19- 15@
F2        13- 28@   13- 30    18- 18@   18- 47@   18- 77#   18- 89    19- 15@
GETADD    18- 20    18- 27#   19- 23
GETCHM     1-  7#    5-  2#    5- 66     6-  3
GETCJR     1- 18#    3- 68    14- 20
GETDAT    18- 23    18- 68#
GETSPC     1-  6#    7-  3     7-  7#    8-  4
GETTIC    19- 16    19- 22#
GETZE      4-  4    29-104#
GTSPC1     7-  9#    8- 12
HARDJ     16-  2#   16-  7    17- 13
HARDJM     2- 32#   17-  3
HELPM      2- 24#    3-120     3-127
HELPO      3-120#   26- 84
HELPOA     2- 27#    3-125
HELPOB     2- 28#   26- 79
HELPOM     2- 29#    3-121     3-123
HELP1M     2- 30#    3-127     3-129
HELP2M     2- 31#
HOME      18- 59#
HUND       1- 12#   17- 41
IBUF       1- 26#    3- 51#    3- 78#    3- 91#    3- 92     3-125#    4-  2#
           5-  6     5- 19#    5- 20     5- 22#    5- 23     5- 28     5- 31
           5- 35     5- 44#    5- 45     7- 11    10- 14#   10- 15    10- 27
          10- 31    10- 34    10- 38    11-  7#   11-  9    11- 14#   11- 15
          11- 18    13-  3#   13-  4    13-  6#   13-  7    13-  9#   13- 10
          14-  3#   14-  4    15-  7    15-  9    15- 11    15- 16    15- 18
          15- 25#   15- 26    15- 28    15- 30    16-  2#   16-  3    16-  5#
          16-  6    20-192    20-197    22-  3#   22-  4    24- 21#   25- 19#
          25- 20    25- 25#   25- 29#   25- 32    25- 38    25- 45    25- 47#
          25- 49#   25- 50    25- 54#   25- 56#   26- 13#   28- 35#   29- 88#
          29- 89    29- 91#   29- 92
IBUFE     20-194    20-197    26- 15#
IMCR       1-  4#   26- 77
IMOREC     1- 26#    3- 58@    3- 74@    3-109@    3-132     5- 13     5- 15@
           5- 34     5- 63#    5- 68@    6-  5@    7-  5@    8-  6     8-  7@
           8- 14@   10- 13    10- 41    11- 12@   11- 33@   12-  3    12- 19
          13- 26    13- 38    14- 14@   14- 45
IMSAV      8-  6@    8- 14     8- 20#
INCHSM     1- 16#    2-107#    2-118     2-120
INFAD      1- 20#    3- 57    3- 70    17- 47    26- 42#
INFADR     1- 22#    3- 57@   23- 47    26- 43#
INFAM      2- 80#   17- 32
INFO       3- 75@   26- 51#
INITIL     1-  3#    3- 67    29- 48#   29-103
INPUT      1- 25#    3- 51#    3- 78#    3- 91#    3-125#    4-  2#    5- 19#
           5- 22#    5- 44#   10- 14#   10- 23    11-  7#   11- 14#   13-  3#
          13-  6#   13-  9#   14-  3#   15-  6    15- 25#   16-  2#   16-  5#
          20-197#   22-  3#   24- 21#   25- 19#   25- 25#   25- 29#   25- 47#
          25- 49#   25- 54#   25- 56#   28- 35#   29- 88#   29- 91#
INSTM      2-102#    2-117     2-118     2-119
INST1      1- 19#    2- 19#
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INST2     1- 19#     2- 21#
INST3     2- 17#
INTENT    4-  5@    17- 43     20- 78@   20- 89    26- 37#
INTMU     1- 37#    17- 38
INTMUL    2- 82#    17- 24
INTNOW   20- 88@    20- 89    20-174    20-179    20-203#
INTSCA    1-  7#     2- 65#
INTT      2- 84#    17- 29
IO       28- 15     28- 21#
IOSWT     8-  2#     8- 15@    8- 17@    8- 19#
JBKK     11- 19     11- 26#
JMOREC    1- 18#     3- 56@    3-110@    3-117@    4- 10     11-  4@   11- 34@
         26- 67#
JMPI     11-  2#    11- 16
KBSAV     3- 71@    20-  5#    20- 30@   20- 33@   23- 18@   23- 24@   23- 27@
LBS       2- 96#     3- 91
LDISC    10- 14#    10- 32
LENGTH    1- 13#    17- 42
LENGTM    2- 35#    17- 28
LF        1- 45#     2- 11     2- 13     2- 15     2- 18     2- 20     2- 23
          2- 26     2- 29     2- 30     2- 31     2- 46     2- 94     2- 95
         21-  6     21-  8    21- 11    25-  4    26-  5    26- 20    26- 26
         28- 46     28- 61
LFLDM     1- 15#     2- 71#
LOFFSM    2- 91#    17- 27
LOOP3    20-193#    20-195
LPF       1- 29#    12-  5@
LSH       1- 97#    12-  9#    18- 33#   20-111#   20-131#   20-138#   23- 35#
         24- 15#    29- 56#   29- 72#   29-118#
LSIZEM    2- 90#    17- 27
LSPACE    2- 92#    17- 27
L1       28-  9#    28- 20
L2       28- 17#    28- 25
MASH      2- 86#    17- 29    29- 91
MASHI    17- 43     20-151    20-153    20-171    26- 41#   29- 93@
MASL      2- 85#    17- 29    29- 88
MASLOW   17- 43     20-149    20-167    20-169    26- 40#   29- 90@
MASSAM    2- 64#    26- 77
MASSES    9-  3#     9-  4    26- 82
MBUF      1-  5#    20- 13    20- 15    20- 20    20- 22    20- 27    20- 28
         23- 15     23- 16    23- 19    23- 20    23- 21    23- 22    26- 19#
MBUFE    26- 21#
MCR       1-  4#    26- 82
MDATAM   21-  2     21-  9#
MFI       1- 17#    17- 20    26- 81
MFIZ      2- 73#    17- 10    26- 76
MHELPM    2- 26#     3-122     3-128
MMQUES    3- 80#     3-117
MODEC     3-119#    26- 80
MODECM   26- 74     26-119#
MORE     18- 42#    18- 67    18- 85
MOREC    11- 11#    11- 12    15- 32    17- 21
MOREM     2- 79#    17- 11
MQ        1- 97#     3- 69    12-  9#@  12- 12@   12- 13    12- 14    14- 21
         18- 33#@  20-111#@  20-112    20-113@   20-114@   20-118    20-124@
         20-128    20-131#@  20-136    20-138#@  23- 35#@  24- 15#@  29- 56#@
         29- 57     29- 72#@  29-118#@
MQQ       1- 15#    10- 16@   10- 17    23- 35@   23- 39@   23- 41    23- 42
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          25- 21¢   25- 23    25- 52    25- 58@   26- 59#
MQUES      3- 77#    3- 83
MSPECM     2-101#    2-116     2-117
MSS       11- 14    11- 31    17-  2#
MSSR      11-  5    11- 35    17- 12#
MS1       27-  8    28- 41#
MS2       28- 44#
MS30F      1- 29#   17- 42    20- 74    20-147    23- 31
MS30FM     2- 38#   17- 28
MTABL      1- 16#    2-116#
MUL        1- 97#   12-  9#   18- 33#   20-111#@  20-115@   20-117@   20-126@
          20-131#   20-138#@  23- 35#   24- 15#   29- 56#   29- 72#@  29-118#
M10        1- 23#   17- 41
M30        1- 23#   17- 41
NBLOCK    12- 13@   18- 33@   18- 36@   18- 37    18- 73#   18- 79@
NBOKRE     1- 31#   26- 80
NEXT      20- 80@   20- 97
NODATA    19- 18    19- 20#
NOPE      18- 43    18- 46    18- 49    18- 64#
NOWA      28- 33    28- 37#
NTABL      1- 16#    2-117#
NUM        1- 28#   20- 38@   20-161@   23- 15    23- 29    26- 47#
OBUF      28-  9    28- 49#
OBUFB     28- 21    28- 48#
OBUFE     28- 62#
OCRLF      1- 32#    3-108     4-  8    11- 32    20- 16    20- 32    23- 26
OFF       20- 41    23-  2#
OFFCNT    20-100@   20-176@   20-201#
OFFSET     4-  5     4-  6    20-111    20-117    26- 38#   29-118@
OFFTHR    20-176    20-200#
OFSETR     4-  2#    4-  3    26- 80
OOKK       3-112#   11-  9    13- 10    14-  4    16-  6    25- 50
OPERM      2-103#    2-118     2-119
OSETM     25-  7#   26-117
OTABL      1- 15#    2-118#
OTICM      2- 41#   17- 33
OUTCHR    10-  2#   10-  9    17- 18
OUTCH1     5- 69    10-  3#
OUTEQ     10- 21    14- 42#
OUTH      18- 92#   18- 95    18- 97
OUTOUT    25- 24    27- 14    28-  2#
OUTR      28- 19    28- 26#
OUTRAM     2- 34#
OUTRR     25- 55    25- 61#
OVERFL    20-181    21-  3#
OVRCNT    20- 18    20- 20    20- 24@   20-186@   20-202#
OVRMSG    20- 21    20-204#
PARA      15-  3    15- 25    17- 22#
PATABL    17- 52#
PC         1-101#    3-102@    3-104@    3-124@    3-130@    4-  4@   10- 12@
          10- 25@   11- 28@   13- 37@   29- 87@   29-120@
PCONT      2- 74#   10- 19
PDSC       1- 12#   17- 38
PDSCM      2- 89#   17- 24
PEAKS      1- 38#   11- 26    17- 15    20-  7#   22-  6    26- 82
PEPSC      2- 81#   17- 29
PEPSCN    17- 43    20- 94    26- 37#
PKNUM      2- 62#   22-  3
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```
PKSFIL   14-  7     14- 10     14- 52#
PKSLNK   14-  6     14-  7     14- 10     14- 12    14- 47#
PKSNM     1- 36#     7- 11      7- 18#
PLTCHR    1- 12#    17- 20
PLTCH1    1- 12#     6-  6
PLTR      1- 99#
PLTSPC    1- 12#    17- 19
PLTSWT    1- 10#     4-  1#
PNUM     20-  6#    20- 39@    20-162@   20-165@
PPF       1- 29#     5- 64#    12-  6@
PPP      23- 36@    23- 40@    23- 43    26- 61#
PRTVEC    1- 46#     1- 96#
PSW       1-101#
PTABL     1- 15#     2-119#
PTSNUM    1-  7#     2- 63#
PWANT    20-  2#    20- 65     22-  5@
QTABL     1- 15#     2-121#     5- 16
QUES      3- 73      3-107     26- 73#
QUESR     3-111      3-118     26- 80#
QUE0      2-  4#    26- 73
QUE01     2-  5#     4-  2
QUE1      2-  6#    17-  2     26- 73
QUE4      2-  8#    26- 75
QUE5      2-  9#    26- 79
RAWCH0   12-  2#    17- 16
RAWCHR    2- 43#    17-  6
RAWDAT   17-  4     21- 10#    24- 21    26- 77
RAWOUT    2- 44#    26- 77
RAWREC    1- 26#    17- 14
RAWSAV    1- 36#    26- 82
REFRM     2- 98#    17- 24
REFRS    17- 38     26- 48#
REINIR   14- 45#    17- 12
REINIT    2- 58#    17-  2
REST     18- 55#    18- 63
RETURN   11-  8@    25- 63     25- 64#
RNUM      1- 42#    17- 46     23- 53    23-100    24- 26@   26- 62#   29- 65@
         29- 80@    29- 84@    29- 96
RNUMM     2- 54#    17- 32
RNUMN     2-109#     2-120      2-121     2-122
RRSTR     1- 40#     3-100     13- 35    18- 25    19- 20    25- 62    28- 27
         28- 39     29-119
RSAV      1- 40#     3- 87     13- 29    18- 14    19- 11    25- 18    28-  3
         29-105
RTABL     1- 15#     2-122#
RTI      24-  2#    24-  5     24-  6
RTSR5    27- 10     27- 16#
RUNTM     2-104#     2-118      2-119
R0        1-101#     3- 55@     3- 60@    3- 62@    3- 65@    3- 88@    3- 94
          3- 99      5- 16@     5- 19     5- 22     5- 44    13-  8@   13- 18
         13- 20     13- 22     13- 23@   13- 30@   13- 33@   14- 15@   18- 16@
         18- 21     18- 42     18- 57@   18- 69    18- 92@   19- 13@   19- 17@
         19- 26     20- 24@    20- 25@   20- 26    20-121@   20-128@   20-129
         20-134@    20-142@    20-143    20-149    20-153    20-155@   20-156
         20-159@    20-164@    20-169    20-171    23- 33    23- 52@   23- 53@
         23- 55@    23- 56     23- 66@   23- 67    23- 70    23- 71@   23- 72
         23- 99     23-105@    24- 13@   24- 17    25- 27@   25- 29    25- 30
         25- 33@    25- 34     25- 36@   25- 38@   28-  5@   28- 18@   29-106@
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```
        29-110@  29-118
R1      1-101#    3- 89@    3- 90     3- 92     5- 17@    5- 21@    5- 26@
        5- 36@    5- 37@    5- 38@    5- 41@    5- 43     5- 46@   13-  5@
       13- 18    13- 20@   13- 24@   13- 31@   13- 32@   14- 16@   14- 17@
       18- 16@   18- 45    18- 52@   18- 56    18- 58    18- 61@   18- 69
       19- 13@   19- 26    20- 40@   20- 41@   20- 80@   20-112@   20-121
       20-124    20-131    20-174@   20-182    23- 98@   23-103@   28-  6@
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       29-111@   29-118
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       13- 15@   13- 16    14- 26@   14- 27@   14- 28@   14- 29@   14- 30
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       15- 14    15- 25    18- 16@   18- 48    18- 54@   18- 56@   18- 57
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       23-100@   23-101@   23-102@   28-  8@   28- 13@   28- 14    28- 23@
       29-106@   29-112@   29-116
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        3-111     3-116     3-118     5- 28@    5- 29     5- 31     5- 40
       11- 29@   11- 30    11- 31    11- 35    18- 17@   18- 30    18- 31
       18- 32    18- 33    18- 41    18- 42    18- 45    18- 48    18- 52
       18- 54    18- 59@   18- 61    18- 62    18- 66@   18- 69    18- 70
       18- 71    18- 82@   18- 83    18- 84    19- 14@   19- 26    19- 27
       20- 80@   20-119@   20-131    20-133@   28-  7@   28- 10    28- 16@
       28- 24@   29-113@   29-114@
R3SAV  18- 32@   18- 59    18- 82    26- 30#
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R4      1-101#   18- 17@   18- 71@   19- 14@   19- 27@   20- 81@   20-179@
       20-180    20-191@   20-192@   20-193@   20-194    28-  4@   28- 32@
       28- 34@   29- 72@   29- 73    29- 74    29- 78    29- 79    29- 80
R5      1-101#    3- 50@    3- 51@    3- 67@    3- 68@    3- 69@    3- 70@
        3- 72@    3- 78@    3- 87@    3- 91@    3- 97@    3-100@    3-107@
        3-108@    3-120@    3-121@    3-122@    3-125@    3-127@    3-128@
        4-  2@    4-  7@    4-  8@    5-  3@    5-  4@    5-  9@    5- 10@
        5- 19@    5- 22@    5- 33@    5- 44@    5- 56@    5- 66@    6-  3@
        7-  3@    7-  8@    7-  9@    7- 14@    7- 15@    8-  4@    8- 12@
        8- 16@    9-  3@   10-  4@   10- 14@   10- 17@   10- 19@   10- 21@
       10- 22@   10- 23@   10- 37@   11-  7@   11- 14@   11- 23@   11- 31@
       11- 32@   12-  7@   12-  8@   12- 14@   12- 15@   12- 16@   12- 18@
       13-  3@   13-  6@   13-  9@   13- 22@   13- 29@   13- 35@   14-  3@
       14- 20@   14- 21@   14- 25@   14- 38@   14- 43@   14- 44@   15-  3@
       15-  4@   15-  5@   15-  6@   15- 25@   16-  2@   16-  5@   18- 14@
       18- 15    18- 16    18- 17    18- 20@   18- 23@   18- 25@   18- 26@
       18- 30@   18- 60@   18- 69@   18- 72@   18- 83@   18- 93@   19- 11@
       19- 12    19- 13    19- 14    19- 16@   19- 19@   19- 20@   19- 21@
       19- 23@   19- 24@   19- 26@   19- 28@   20-  8@   20- 14@   20- 15@
       20- 16@   20- 21@   20- 22@   20- 28@   20- 29@   20- 32@   20- 35@
       20- 80@   20- 92    20- 94    20-111    20-113    20-115    20-127
       20-134    20-136@   20-138@   20-139@   20-140    20-142    20-177@
       20-196@   20-198@   20-199@   21-  2@   21-  3@   22-  3@   23- 16@
       23- 17@   23- 20@   23- 22@   23- 23@   23- 26@   23- 32@   23- 33@
       23- 34@   23- 35    23- 50@   23- 51@   23- 58@   23- 65@   23- 67@
       23- 70@   23- 80@   23- 82@   23- 84@   23- 85@   23- 88@   23- 93@
       23- 96@   23- 97@   23-106@   24- 10@   24- 12@   24- 14@   24- 18@
       24- 19@   24- 20@   24- 21@   24- 23@   25- 18@   25- 19@   25- 23@
       25- 24@   25- 25@   25- 29@   25- 47@   25- 49@   25- 52@   25- 54@
       25- 56@   25- 62@   27-  8@   27- 11@   27- 14@   27- 16@   28-  3@
       28- 21@   28- 22@   28- 27@   28- 28@   28- 35@   28- 37@   28- 38@
```

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              28- 39@   28- 40@   29- 55@   29- 63@   29- 69@   29- 88@   29- 91@
              29- 99@   29-100@   29-102@   29-105@   29-119@
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R7            1-101#
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              3- 63@    3- 64     3- 65     3- 69@    3- 70@    3- 78@    3- 86
              3- 91@    3- 97@    3-101@    3-103@    3-105     3-107@    3-120@
              3-121@    3-122@    3-123@    3-125@    3-127@    3-128@    3-129@
              4-  2@    4-  6#@   4-  7@    5- 10@    5- 12     5- 19@    5- 20#@
              5- 21     5- 22@    5- 25@    5- 26     5- 33@    5- 35#@   5- 37
              5- 39     5- 40#@   5- 41     5- 42     5- 44@    5- 45#@   5- 46
              5- 49     5- 52@    5- 53#@   5- 54     5- 55     7- 15@    10- 11@
              10- 14@   10- 15@   10- 16    10- 17@   10- 19@   10- 20@   10- 24@
              10- 34@   10- 35    10- 40    11-  7@   11- 14@   11- 23@   11- 27@
              11- 29    11- 31@   12-  8@   12- 14@   12- 15@   12- 16@   12- 17#@
              12- 18@   13-  3@   13-  4@   13-  5     13-  6@   13-  7@   13-  8
              13-  9@   13- 22@   13- 28    13- 36@   14-  3@   14-  6#@  14-  7#@
              14-  8     14- 10#@  14- 11    14- 12#@  14- 13@   14- 21@   14- 25@
              14- 38@   14- 41@   14- 43@   15-  3@   15- 11@   15- 12    15- 25@
              15- 30#@  15- 31    16-  2@   16-  3#@  16-  4     16-  5@   18- 30@
              18- 69@   18- 83@   19- 26@   20-  8@   20-  9@   20- 13#@  20- 14@
              20- 15@   20- 20#@  20- 21@   20- 22@   20- 27#@  20- 28@   20- 29@
              20- 97@   20-197@   21-  2@   21-  3@   22-  3@   22-  4#@   22-  5
              23-  8@   23- 15#@  23- 16@   23- 17@   23- 19#@  23- ?0@   23- 21#@
              23- 22@   23- 23@   23- 51@   23- 61@   23- 65@   23- 67#   23- 70@
              23- 80@   23- 82@   23- 84@   23- 88@   23- 93@   24-  4@   24-  9
              24- 10@   24- 12@   24- 14@   24- 18@   24- 19@   24- 20@   24- 21@
              25- 19@   25- 20@   25- 21     25- 23@   25- 25@   25- 29@   25- 32@
              25- 33    25- 47@   25- 49@   25- 52@   25- 54@   25- 56@   27-  2#@
              27-  7#@  27-  8@   27- 11@   28-  9@   28- 10@   28- 11@   28- 21@
              28- 35@   28- 38    29- 55@   29- 57@   29- 59    29- 60    29- 63@
              29- 69@   29- 70    29- 76    29- 86@   29- 88@   29- 89#@  29- 90
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         4-   2#    4-   7#    5- 10#    5- 19#    5- 22#    5- 33#    5- 44#
         7- 15#   10- 14#   10- 19#   11-   7#   11- 14#   11- 23#   11- 31#
        12- 15#   12- 16#   12- 18#   13-   3#   13-   6#   13-   9#   14-   3#
        14- 43#   15-   3#   15- 25#   16-   2#   16-   5#   20-   8#   20- 14#
        20- 15#   20- 21#   20- 22#   20- 28#   20- 29#   21-   2#   21-   3#
        22-   3#   23- 16#   23- 17#   23- 20#   23- 22#   23- 23#   24- 20#
        24- 21#   25- 19#   25- 25#   25- 29#   25- 47#   25- 49#   25- 54#
        25- 56#   27-   8#   28- 21#   28- 35#   29- 88#   29- 91#
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        23- 48@   23- 91    26- 29#   29- 98@
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          5- 22#     5- 44#    10- 14#    11-  7#    11- 14#    11- 15     13-  3#
         13-  6#    13-  9#    14-  3#    15- 25#    16-  2#    16-  5#    22-  3#
         24- 21#    25- 19#    25- 25#    25- 29#    25- 45     25- 47#    25- 49#
         25- 54#    25- 56#    28- 35#    29- 88#    29- 91#
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         26- 15     26- 18#    26- 27     28- 30     28- 62
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         14-  6#    14-  7#    14- 10#    14- 12#    15- 30#    16-  3#    20- 13#
         20- 20#    20- 27#    22-  4#    23- 15#    23- 19#    23- 21#    27-  2#
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        10- 11   10- 15#   10- 17#   10- 20#   10- 24    10- 34#   11- 27
        12-  8#  12- 14#   13-  4#   13-  7#   13- 22#   13- 36    14- 21#
        14- 25#  14- 38#   14- 41#   15- 11#   18- 30#   18- 69#   18- 83#
        19- 26#  20-  9    20- 97    20-197    23-  8    23- 51#   23- 61
        23- 65#  23- 67#   23- 70#   23- 80#   23- 82#   23- 84#   23- 88#
        23- 93#  24-  4    24- 10#   24- 12#   24- 14#   24- 18#   24- 19#
        25- 20#  25- 23#   25- 32#   25- 52#   27- 11#   28-  9    29- 55#
        29- 57   29- 63#   29- 69#   29- 86    29-100#   29-102#
RESUL    1- 91#   12-  9#   18- 33#   20-111#   20-131#   20-138#   23- 35#
        24- 15#  29- 56#   29- 72#   29-118#
STRGO    1- 90#    3- 50     3- 51#    3- 78#    3- 91#    3- 97     3-107
         3-120    3-121     3-122     3-125#    3-127     3-128     4-  2#
         4-  7    5- 10     5- 19#    5- 22#    5- 33     5- 44#    7- 15
        10- 14#  10- 19    11-  7#   11- 14#   11- 23    11- 31    12- 15
        12- 16   12- 18    13-  3#   13-  6#   13-  9#   14-  3#   14- 43
        15-  3   15- 25#   16-  2#   16-  5#   20-  8    20- 14    20- 15
        20- 21   20- 22    20- 28    20- 29    21-  2    21-  3    22-  3#
        23- 16   23- 17    23- 20    23- 22    23- 23    24- 20    24- 21#
        25- 19#  25- 25#   25- 29#   25- 47#   25- 49#   25- 54#   25- 56#
        27-  8   28- 21    28- 35#   29- 88#   29- 91#
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         5- 22    5- 44    10- 14    11-  7    11- 14    13-  3    13-  6
        13-  9   14-  3    15- 25    16-  2    16-  5    22-  3    24- 21
        25- 19   25- 25    25- 29    25- 47    25- 49    25- 54    25- 56
        28- 35   29- 88    29- 91
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.AMODE   4-  6#    5- 20#    5- 35#    5- 40#    5- 45#    5- 53#   12- 17#
        14-  6#  14-  7#   14- 10#   14- 12#   15- 30#   16-  3#   20- 13#
        20- 20#  20- 27#   22-  4#   23- 15#   23- 19#   23- 21#   27-  2#
        27-  7#  29- 89#   29- 92#
.BIN2D   1- 89#   12- 17    20- 13    20- 20    20- 27    23- 15    23- 19
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. PARDR    1- 94#    1- 98
. PAREA    1- 94#    1- 97    12-  9#   18- 33#   20-111#   20-131#   20-138#
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. PARTY    1- 94#    1- 96
. RADPK    1- 89#   15- 30
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4                               . GLOBL  TTYLOK
5                               . MCALL  EMT442, LOGSHT, MULT, MULTDV, POPR, RESUL, STRGO, TTYIO
6                               . GLOBL  SCANS, INITIL
7                               . GLOBL  MBUF, SIZE
8                               . GLOBL  IMCR, MCR
9                               . GLOBL  STRING
10                              . GLOBL  FLAGG, PLTCH1, XY4, PLTSPC, DSKXYZ, PLTCHR, PDSC, HUND
11                              . GLOBL  LENGTH, FMAX
12                              . GLOBL  TICBUF, EQBUF, STUFF, INCHSM, TITLES, NTABL, MTABL
13                              . GLOBL  OTABL, PTABL, LFLDM, MQQ, QTABL, RTABL, ACSPEC, AR2
14                              . GLOBL  AR3, DIRBUF, DIRA, COREAD, FLD, TYPE1, STRT
15                              . GLOBL  EQBUFL
16                              . GLOBL  SWITCH, SSNUM, ADCC, MFI, DSKIN, CNTRLB, CNTRLP, CNTLZZ
17                              . GLOBL  GETCOR, OUTUP, CNTLC, CNTRLV, JMOREC, STRING
18                              . GLOBL  BDA, TDA, SCALIT, BLANKF, INST1, INST2
19                              . GLOBL  ABLOK, TICA, INFAD
20                              . GLOBL  FIXLP
21                              . GLOBL  INFADR
22                              . GLOBL  X, Y
23                              . GLOBL  M30, ONEE, ZERO, M10
24                              . GLOBL  SET, PLT, ORIGIN
25                              . GLOBL  SETINC, CHROMA
26                              . GLOBL  FIN
27                              . GLOBL  BLANK, INPUT, DSKIN, YE, R5SAV, R33
28                              . GLOBL  SYMBOL, ISYMBL, XSTORE, YSTORE
29                              . GLOBL  RAWREC, U1X, GETPKS, IBUF, DATAB, IMOREC, TICFLG
30                              . GLOBL  A13LUT, ANOTM, ADMES
31                              . GLOBL  NUM
32                              . GLOBL  LPF, PPF, MS30F, GCFLG
33                              . GLOBL  PPMM
4                               . GLOBL  BLNK
35                              . GLOBL  LPMM
36                              . GLOBL  ALUT
37                              . GLOBL  NBOKRE
38                              . GLOBL  FRLUT, OCRLF
39                              . GLOBL  SPACEC
40                              . GLOBL  FIX
41                              . GLOBL  R00, R10, R20, R30, R40, R50
42                              . GLOBL  TRA.
43                              . GLOBL  DPSCN
44                              . GLOBL  LININC
45                              . GLOBL  INTMU
46                              . GLOBL  PEAKS
47                              . GLOBL  TLNK, DSKOUT
48                              . GLOBL  TICC, RSAV, RRSTR, TTYI, TTYO
49                              . GLOBL  BLOK
50                              . GLOBL  RNUM, UIC, SNUM
51      000015                  CR=15
52      000011                  BB=11
53      000012                  LF=12
54      000064                  PRTVEC=64
55                              . MCALL  . LOOK, . ALLOC
56                              . MCALL  . D2BIN
57                              . MCALL  . CVTDT
```

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```
58                          . MCALL    . O2BIN
59                          . MCALL    . PARAM, . DATE, . TIME, . GTUIC, . INIT, . RLSE, . WAIT, . TRAN
60                          . MCALL    . WRITE, . OPENO, . CLOSE
61                          . MCALL    . BIN2O, . RADPK, . BIN2D
62                          . MCALL    . PARAD, . PARTY, . PAREA, . PARDR
63  101000                 . PARAD
64  00000                  . PARTY
65  00000                  . PAREA
66  00000                  . PARDR
67       172554            PLTR=172554
68       177546            CLK=177546
69  00000                  . PARAM
70       000016            UN=16
```

141

```
 1                      . GLOBL  IAXIS
 2                      . SBTTL  DISC TO LINEPRINTER TRANSFER ROUTINE
 3                      . GLOBL  DSKTLP
 4                      . MCALL  . INIT,.OPENI,.OPENO,.READ,.WRITE,.WAIT,.CLOSE
 5                      . MCALL  . RLSE
 6             ;**************************************************************
 7             ;          DISC TO LINEPRINTER I/O ROUTINE
 8             ;          P. C.  ABEGGLEN
 9             ;          12 DEC 73
10             ;          CALLING SEQUENCE:
11             ;                    PUSH    #FILNAM
12             ;                    JSR     PC,DSKLP
13             ;          WHERE:
14             ;                    #FILNAM=ADDRESS OF ASCII FILENAME.EXTENSION
15             ;          NOTE:
16             ;                    THIS ROUTINE DOES A BRUTE FORCE TRANSFER
17             ;                    OF FORMATTED ASCII NORMAL TEXT FROM A DISC
18             ;                    FILE TO THE LINEPRINTER.   IT ASSUMES THAT
19             ;                    THE FILE IS DELIMITED BY AN OCTAL '37 WHICH
20             ;                    IS THE UNIT SEPERATOR CHARACTER GENERATED BY
21             ;                    THE CONTROL-SHIFT-O KEY ON THE TELETYPE.
22             ;                    OPERATOR ABORT IS ACCOMPLISHED BY TYPING
23             ;                    A CONTROL-O( ^O ).
24             ;**************************************************************
25 00000 000000         . WORD   0
26 00002 000000 DSKLKK: . WORD   0
27 00004 015167         . RAD50  /DIO/
28 00006 000001         . WORD   1
29 00010 015270         . RAD50  /DK/
30 00012 000000         . WORD   0
31 00014 000000 LPLKK:  . WORD   0
32 00016 046617         . RAD50  /LPO/
33 00020 000001         . WORD   1
34 00022 046600         . RAD50  /LP/
35 00024 000000         . WORD   0,0
36 00030 000000 DSKFL:  . WORD   0,0,0,401,0,0,0
37 00046 000000 LPFL:   . WORD   0,0,0,401,0
38 00060 000204 LHDR:   . WORD   132.,4,0,DATAB
39 00070        DSKTLP: POP     PCSAV,LPFL
40 00100                . INIT   #DSKLKK
41 00106                . INIT   #LPLKK
42 00114 042737         BIC     #100,@#TKS
43 00122 004567         JSR     R5,RSAV
44 00126 012700         MOV     #DSKFL,R0
45 00132                PUSH    LPFL
46 00136 005046         CLR     -(SP)
47 00140 104042         EMT     42
48 00142 103004         BCC     1$
49 00144                POP     (R0)+
50 00146 012700         MOV     #DSKFL+4,R0
51 00152 000404         BR      3$
52 00154        1$:     POP     (R0)+
53 00156 005046         CLR     -(SP)
54 00160 104042         EMT     42
55 00162                POP     (R0)+
56 00164 005216 3$:     INC     (SP)
57 00166 005046         CLR     -(SP)
```

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```
58 00170 104042           EMT      42
59 00172                  POPTST   (R0)
60 00176 ''12700          MOV      #DSKFL,R0
61 00202                  .OPENI   #DSKLKK,R0
62 00220 ''12700          MOV      #LPFL,R0
63 00224                  .OPENO   #LPLKK,R0
64 00242          5$:     .READ    #DSKLKK,#LHDR
65 00254 105737           TSTB     @#TKS
66 00260 100004           BPL      4$
67 00262 123727           CMPB     @#TKB,#17
68 00270 0''1417          BEQ      CLOUT
69 00272          4$:     .WAIT    #DSKLKK
70 00300                  .WRITE   #LPLKK,#LHDR
71 00312                  .WAIT    #LPLKK
72 00320 126727           CMPB     DATAB,#37
73 00326 001345           BNE      5$
74 00330      CLOUT:      .CLOSE   #DSKLKK
75 00336                  .CLOSE   #LPLKK
76 00344                  .RLSE    #DSKLKK
77 00352                  .RLSE    #LPLKK
78 00360 052737           BIS      #100,@#TKS
79 00366 004567           JSR      R5,RRSTR
80 00372                  PUSH     PCSAV
81 00376 000207           RTS      PC
82 00400 000000 PCSAV:    .WORD    0
```

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```
1                       . SBTTL   MASS SPECTRUM PLOT ROUTINE
2                       . GLOBL   PLTMAS, PLTSWT, SBTTLS
3                       ;*******************************************************
4                       ;        MASS SPECTRUM PLOT ROUTINE
5                       ;        P. C. ABEGGLEN
6                       ;        13-DEC-73
7                       ;*******************************************************
8 000402 004567 PLTMAS: JSR     R5, STUP        ; SET UP THE PLOTTER
9 000406 005067        CLR     XCL             ; CLEAR LAST X COORDINATE SAVER
10 00412 032767        BIT     #1, PLTSWT      ; TEST THE SUBTITLE SWITCH
11 00420 001402        BEQ     1$              ; CLEAR MEANS NO SUBTITLES
12 00422 004567        JSR     R5, SBTTLS      ; GO PLOT THE SUBTITLES
13 00426 004567 1$:    JSR     R5, GETYMA      ; GET MAXIMUM Y COORDINATE
14 00432 024040        CMP     -(R0), -(R0)    ; BACK OFF TO HIGHEST MASS
15 00434 005710        TST     (R0)            ; NEGATIVE OR ZERO IS BAD
16 00436 003006        BGT     2$              ; GREATER THAN IS GOOD
17 00440               STRGO   #BMASS          ; PRINT BAD MESSAGE
18 00450 000177        JMP     @IMOREC         ; AND LEAVE
19 00454 016703 2$:    MOV     DATAB+6, R3     ; GET THE PEAK COUNT
20 00460               MULT    (R0), MASINC, XMAX       ; MAX X COORDINATE
21 00500 012700        MOV     #DATAB+18., R0           ; FIRST MASS
22 00504        3$:    MULTDV  (R0)+, TWO5, YMAX, YC    ; NORMALIZE TO FULL WIDTH
23 00532               MULT    (R0)+, MASINC, XC        ; X COORDINATE THIS MASS
24 00552 004567        JSR     R5, PLTIT                ; GO PLOT IT
25 00556 005303        DEC     R3              ; DONE YET?
26 00560 003351        BGT     3$              ; NOPE SO LOOP
27 00562 004567        JSR     R5, ANAXIS      ; MAKE AN AXIS
28 00566 000177        JMP     @IMOREC         ; AND SPLIT
29 00572 004567 PLTIT: JSR     R5, PLT         ; CALL THE PLOTTER DRIVER
30 00576 000403        BR      . +10           ; FOR FORTRN
31 00600 010666'       . WORD  XC, ZERO, ZERO  ; (XC, 0, PENUP)
32 00606 004567        JSR     R5, PLT         ; DRIVER AGAIN
33 00612 000403        BR      . +10           ;
34 00614 010666'       . WORD  XC, YC, ONEE    ; (XC, YC, PENDOWN)
35 00622               PUSH    #OUT10          ; ABORT ADDRESS
36 00626 004767        JSR     PC, TTYLOK      ; SEE IF WANT AN ABORT
37 00632 026767        CMP     XC, XCL         ; SAME AS AT LAST ENTRY?
38 00640 001404        BEQ     OUT14           ; IF SO WARN SOMEBODY
39 00642 016767        MOV     XC, XCL         ; SAVE FOR NEXT ENTRY
40 00650 000205 OUT10: RTS     R5              ; AND EXIT
41 00652        OUT14: STRGO   #MPEAK          ; MULTIPLE PEAK MESSAGE
42 00662 162767        SUB     #7, XC          ; GOING TO PLOT A TINY X
43 00670 162767        SUB     #7, YC          ; TO MARK THE MULTIPLE PEAK
44 00676 004567        JSR     R5, ISYMBL      ; USING THE SYMBOL ROUTINE
45 00702 000406        BR      . +16           ;
46 00704 010666'       . WORD  XC, YC, TTWO, ANX, ZERO, ONEE
47 00720 000205        RTS     R5              ; AND SCRAM
48 00722        ANAXIS: PUSH   #OUT11   ; ABORT ADDRESS
49 00726 004767        JSR     PC, TTYLOK      ; LOOK
50 00732 004567        JSR     R5, IAXIS       ; CALL AXIS BUILDER
51 00736 000407        BR      . +20           ;
52 00740 000000G       . WORD  ZERO, XMAX, ZERO, TWO5, MASINC, HUND, SIZE
53 00756 004567        JSR     R5, CCDONE      ; CALCOMP DONE ROUTINE
54 00762 000205 OUT11: RTS     R5              ; AND THATS THAT
55 00764 012700 GETYMA: MOV    #DATAB+18., R0  ; ADDRESS OF FIRST INTENSITY
56 00770 005001        CLR     R1
57 00772 016702        MOV     DATAB+6, R2     ; NUMBER OF PEAKS
```

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```
58 00776 022001 1$:    CMP    (RO)+,R1        ;BIGGEST SO FAR?
59 01000 003402        BLE    2$              ;NO MEANS BRANCH
60 01002 016001        MOV    -2(RO),R1       ;GRAB IT
61 01006 022020 2$:    CMP    (RO)+,(RO)+     ;BUMP TO NEXT INTENSITY
62 01010 005302        DEC    R2              ;DONE YET?
63 01012 003371        BGT    1$              ;POSITIVE MEANS NO
64 01014 010167        MOV    R1,YMAX         ;PUT BIGGEST IN YMAX
65 01020 001002        BNE    3$              ;ZERO IS TROUBLE
66 01022 005267        INC    YMAX            ;SO MAKE IT ONE
67 01026 000205 3$:    RTS    R5              ;AND SCRAM
68 01030 000000 MWANT: .WORD  0               ;MASS WANTED LOCATION
69 01032    040 BMASS: .ASCIZ / MAXIMUM MASS EITHER NEGATIVE OR ZERO /<CR><LF>
70 01103    040 MPEAK: .ASCIZ / MULTIPLE PEAK /<CR><LF>
71 01125    040 IMCR:  .ASCIZ / MASS CHROMATOGRAM ROUTINE /
72 01161    040 MASSM: .ASCIZ / MASS WANTED /
73                     .EVEN
```

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```
 1                          .SBTTL   MASS CHROMATOGRAM ROUTINE
 2                          .MCALL   .D2BIN
 3                  ;********************************************************
 4                  ;        MASS CHROMATOGAM ROUTINE
 5                  ;        P.C  ABEGGLEN
 6                  ;        DEC. 10,1973
 7                  ;********************************************************
 8                          .GLOBL   MCR,STRING,TTYI,SCANS,GETPKS,TSNUM,SSNUM
 9                          .GLOBL   DATAB,TICBUF IMOREC,CNTLC,THENUM,SDIRER
1''                         .MCALL   .PARTY
11 01200                    .PARTY
12                          .GLOBL   TRNUM,TUIC,TSNUM,IBUF,PKSNM,ERLOC
13 01200          MCR:
14 01200 004567            JSR      R5,OCRLF
15 01204 004567            JSR      R5,THENUM
16 01210                   TTYIO    #MASSM
17 01232                   D2BIN    #IBUF
18 01244                   POPTST   MWANT
19 01252 012700            MOV      #TICBUF+14.,RO
20 01256 005020 1$:        CLR      (RO)+
21 01260 020027            CMP      RO,#TICBUF+512.
22 01264 100774            BMI      1$
23 01266 012700            MOV      #TICBUF+14.,RO
24 01272 005067            CLR      TICBUF
25 01276 004567 7$:        JSR      R5,SCANS
26 01302 000407            BR       .+20
27 01304 0000000G          .WORD    TRNUM,TUIC,TSNUM,DATAB,PKSNM,IBUF,ERLOC
28 01322 005367            DEC      ERLOC
29 01326 001402            BEQ      2$
30 01330 000167            JMP      SDIRER
31 01334 004567 2$:        JSR      R5,GETPKS
32 01340 012701            MOV      #DATAB+20.,R1
33 01344 021167 5$:        CMP      (R1),MWANT
34 01350 003006            BGT      3$
35 01352 001420            BEQ      4$
36 01354 062701 8$:        ADD      #6,R1
37 01360 005367            DEC      DATAB+6
38 01364 003367            BGT      5$
39 01366 026767 3$:        CMP      TSNUM,SSNUM
40 01374 002012            BGE      6$
41 01376 005267            INC      TSNUM
42 01402 005267            INC      TICBUF
43 01406 005720            TST      (RO)+
44 01410 104460            TRAP     60
45 01412 000731            BR       7$
46 01414 066110 4$:        ADD      -2(R1),(RO)
47 01420 000755            BR       8$
48 01422 104460 6$:        TRAP     60
49 01424                   PUSH     #OUT12
50 01430 004767            JSR      PC,TTYLOK
51 01434 000772            BR       6$
52 01436 000177 OUT12:     JMP      @IMOREC
```

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```
 1
 2                  .SBTTL   CALCOMP MASS CHROMATOGRAM ROUTINE
 3                  .GLOBL   GETCHM,CCMASS,BBUF,INTMU
 4                  .MCALL   PSHJPC
 5
 6                  ;***************************************************************
 7
 8                  ;        CALCOMP MASS CHROMATOGRAM ROUTINE
 9
10                  ;        P. C. AGEGGLEN
11
12                  ;        24-JAN-74
13
14                  ;***************************************************************
15
16 01442 000000 DBUF:   .WORD 0                 ;DIFFERENCE BUFFER
17         003444'      .=.+1024.
18 03444 000000 RBUF:   .WORD 0                 ;MASS BUFFER
19         005446'      .=.+1024.
20 05446        BLK0:   POP     R00,R10,R20     ;RETURN,END+2,START
21 05462 004567        JSR     R5,RSAV         ;SAVE REGISTERS
22 05466 016700        MOV     R20,R0          ;GET START
23 05472 016701        MOV     R10,R1          ;GET END +2
24 05476 005020 1$:    CLR     (R0)+           ;CLEAR IT
25 05500 020001        CMP     R0,R1           ;DONE YET
26 05502 100775        BMI     1$              ;LOOP ON NO
27 05504 004567        JSR     R5,RRSTR        ;RESTORE REGISTERS
28 05510               PUSH    R00             ;RETURN PC
29 05514 000207        RTS     PC              ;RETURN
30 05516 004567 SCANSC: JSR    R5,SCANS        ;CALL LOOKUP ROUTINE
31 05522 000407        BR      .+20            ;FORTRAN RETURN
32 05524 000000G       .WORD   TRNUM,TUIC,TSNUM,DATAB,PKSNM,IBUF,ERLOC
33 05542 005367        DEC     ERLOC           ;ERROR?
34 05546 001403        BEQ     1$              ;ZERO MEANS NO
35 05550 005726        TST     (SP)+           ;POP RETURN
36 05552 000167        JMP     SDIRER          ;SCAN DIRECOTRY ERROR
37 05556 004567 1$:    JSR     R5,GETPKS       ;COMPRESS BUFFER
38 05562 000207        RTS     PC              ;RETURN
39 05564        CCMASS: PSHJPC  BLK0,#DBUF,#DBUF+1024.   ;ZERO DBUF
40 05600               PSHJPC  BLK0,#RBUF,#RBUF+1024.   ;ZERO RBUF
41 05614 004767        JSR     PC,ASK          ;ASK SOME QUESTIONS
42 05620 004567        JSR     R5,GETCHM       ;GET CHROMATOGRAM
43 05624 012700        MOV     #DBUF+14.,R0    ;DIFFENCE STARTING ADDRESS
44 05630 012701        MOV     #RBUF+14.,R1    ;MASS PROFILE SA
45 05634 012702        MOV     #BBUF+14.,R2    ;TIC PROFILE SA
46 05640 012703        MOV     #TICBUF+12.,R3  ;TIC BA-2
47 05644 005067        CLR     RBUF
48 05650 004767 1$:    JSR     PC,SCANSC       ;GET A SCAN
49 05654 012704        MOV     #DATAB+20.,R4   ;SCAN POINTER
50 05660 021467 2$:    CMP     (R4),MWANT      ;DO WE WANT THIS ONE
51 05664 003006        BGT     3$              ;NOPE AND WE ARE PASSED IT
52 05666 001421        BEQ     4$              ;YES SO GO GRAP IT
53 05670 062704 5$:    ADD     #6,R4           ;MOVE TO NEXT MASS
54 05674 005367        DEC     DATAB+6         ;FINISHED WITH THIS SCAN?
55 05700 003367        BGT     2$              ;LOOP ON NO
56 05702 026767 3$:    CMP     TSNUM,SSNUM     ;ALL SCANS?
57 05710 002026        BGE     6$              ;YES
```

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```
58 05712 005267          INC     TSNUM           ; BUMP SCAN #
59 05716 005267          INC     RBUF            ; BUMP COUNTER
60 05722 005720          TST     (R0)+           ; BUMP DIFFERENCE POINTER
61 05724 005721          TST     (R1)+           ; BUMP MASS POINTER
62 05726 005722          TST     (R2)+           ; BUMP TIC POINTER
63 05730 000747          BR      1$              ; LOOP FOR NEXT SCAN
64 05732 016405 4$:      MOV     -2(R4),R5       ; GRAB INTENSITY
65 05736 060511          ADD     R5,(R1)         ; ADD INTO MASS PROFILE
66 05740 005711          TST     (R1)            ; THIS MASS ALREADY?
67 05742 001007          BNE     7$              ; YUP
68 05744 006367          ASL     TSNUM           ; 2 BYTES/WORD
69
70 05750 016312          MOV     TSNUM(R3),(R2)  ; GET TOTAL ION CURRENT
71 05754 011210          MOV     (R2),(R0)       ; PUT IT
72 05756 006267          ASR     TSNUM           ; BACK TO NORMAL
73 05762 160512 7$:      SUB     R5,(R2)         ; DIFFERENCE IT
74 05764 000731          BR      1$              ; CONTINUE
75
76                       ; *******************************************************************
77
78                       ; NOW    BBUF HAS TIC PROFILE
79
80                       ;        DBUF HAS DIFFERENCE PROFILE
81
82                       ;        RBUF HAS MASS PROFILE
83
84                       ; *******************************************************************
85
86 05766 016767 6$:      MOV     RBUF,BBUF       ; COUNTER FOR TIC
87 05774 016767          MOV     RBUF,DBUF       ; DIFFENCE
88 06002                 PSHJPC  PROFIL,#RBUF,#0,#800.        ; MASS PROFILE
89 06022                 PSHJPC  PROFIL,#DBUF,#820.,#1620.    ; DIFFERENCE PROFILE
90 06042                 PSHJPC  PROFIL,#BBUF,#1640.,#2440.   ; TIC PROFILE
91 06062 004567          JSR     R5,CCDONE       ; FINISH OFFPLOT
92 06066 004767          JSR     PC,TTYLOK       ; LOOK AT TTY
93 06072 000177          JMP     @IMOREC         ; GO HOME
94 06076 004567 ASK:     JSR     R5,OCRLF        ; <CR><LF>
95 06102 004567          JSR     R5,THENUM       ; GET NUMBERS
96 06106                 TTYIO   #MASSM          ; MASS WANTED
97 06130                 .D2BIN  #IBUF           ; CONVERT
98 06142                 POPTST  MWANT           ; GRAB RESULT
99 06150 000207          RTS     PC              ; RETURN
100 6152        PROFIL:  POP     PCSAV,R00,R10,R20           ; RETURN,TOP,BOTTOM,BUFFER
101 6172 004567          JSR     R5,RSAV         ; SAVE WORLD
102 6176 004767          JSR     PC,NEWORG       ; SET ORIGIN
103 6202                 PSHJPC  MAXIT,R20       ; GET MAX Y
104 6212 016701          MOV     R10,R1          ; TOP
105 6216 166701          SUB     R00,R1          ; DELTA Y
106 6222 010167          MOV     R1,R30          ; FOR IAXIS
107 6226 016702          MOV     R20,R2          ; BUFFER ADDRESS
108 6232 005067          CLR     XC              ; STARTING X
109 6236        1$:      MULTDV  14.(R2),R1,R0,YC  ; SCALE Y
110 6262 005722          TST     (R2)+           ; BUMP INDEX
111 6264 066767          ADD     PDSC,XC         ; UPDATE X
112 6272 004567          JSR     R5,PLT          ; PLOT IT
113 6276 000403          BR      .+10
114 6300 010666          .WORD   XC,YC,ONEE                  ; ARGS
```

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```
115 6306 005377          DEC     @R20              ; DOWN COUNT
116 6312 003351          BGT     1$                ; LOOP TILL DONE
117 6314 004567          JSR     R5, IAXIS         ; DRAW AXIS
118 6320 000407          BR      .+20
119 6322 000000G         . WORD  ZERO, XC, ZERO, R30, PDSC, EIGHTY, SIZE
120 6340 005467          NEG     R10               ; BACK TO OLD ORIGIN
121 6344 004767          JSR     PC, NEWORG        ; CALL IT
122 6350 004567          JSR     R5, RRSTR         ; RESTORE WORLD
123 6354                 PUSH    PCSAV             ; RETURN PC
124 6360 000207          RTS     PC                ; GO HOME
125 6362 004567 NEWORG:  JSR     R5, PLT           ; GO TO NEW ORIGIN
126 6366 000403          BR      .+10              ; FORTRAN
127 6370 007136'         . WORD  R10, ZERO, ZERO   ; ARGS
128 6376 004567          JSR     R5, ORIGIN        ; ORIGIN MARK
129 6402 000207          RTS     PC                ; RETURN
130 6404         MAXIT:  POP     R40, R2           ; GET ADDRESS
131 6412 011001          MOV     (R0), R1          ; GET COUNT
132 6414 062702          ADD     #14., R2          ; UPDATE POINTER
133 6420 005000          CLR     R0                ; YMAX
134 6422 022200 1$:      CMP     (R2)+, R0         ; BIGGER?
135 6424 003402          BLE     2$                ; NOPE
136 6426 016200          MOV     -2(R2), R0        ; UPDATE YMAX
137 6432 005301 2$:      DEC     R1                ; DONE YET?
138 6434 003372          BGT     1$                ; LOOP ON POSITIVE
139 6436                 PUSH    R40               ; PC
140 6442 000207          RTS     PC                ; RETURN
141 6444 000120 EIGHTY:  . WORD  80.
142 6446 000000 PWANT.   . WORD  0
143 6450 000000 COUNTR:  . WORD  0
144 6452 000000 ADDRES:  . WORD  0
```

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```
                            . SBTTL   TRAP HANDLER
 1                          . GLOBL   TRPHDL, TRAPH
 2
 3  006454 011667 TRPHDL:   MOV      ( SP ), ATMP
 4  006460 162767           SUB      #2, ATMP
 5  006466 017767           MOV      @ATMP, ATMP
 6  006474 042767           BIC      #177700, ATMP
 7  006502 026767           CMP      ATMP, THIGH
 8  006510 003030           BGT      TEROR
 9  006512 026767           CMP      ATMP, TLOW
10  06520 002424            BLT      TEROR
11  06522 162767            SUB      #60, ATMP
12  06530 006367            ASL      ATMP
13  06534 062767            ADD      #TLIST, ATMP
14  06542 017767            MOV      @ATMP, ATMP
15  06550 000177            JMP      @ATMP
16  06554 000000 ATMP:      . WORD   0
17  06556 006616'TLIST:     . WORD   CHROMR, SCALIT, WAVEM, SHIFTM
18  06566 000060 TLOW       . WORD   60
19  06570 000063 THIGH:     . WORD   63
20  06572 000167 TEROR:     JMP      TRAPH
21  06576 104060            EMT      60
22  06600     040 TERORM    . ASCII  / TRAP ERROR/
23  06613     015           . BYTE   15, 12, 0
24                          . EVEN
25  06616 012767 CHROMR:    MOV      #TICBUF, COUNTR
26  06624 012767            MOV      #TICBUF+14. , ADDRES
27  06632 104461            TRAP     61
28  06634                   PUSH     TICBUF, #TICBUF+14.
29  06644 004767            JSR      PC, CHROMA
30  06650 000002            RTI
31  06652          SCALIT:
32  06652 017767            MOV      @COUNTR, R00
33  06660 016767            MOV      ADDRES, R30
34  06666 016767            MOV      R30, R31
35  06674 062767            ADD      #2, R31
36  06702                   CLREM    R10, R11
37  06712 026777 2$:        CMP      R11, @R31
38  06720 003013            BGT      1$
39  06722 002404            BLT      9$
40  06724 026777            CMP      R10, @R30
41  06732 002006            BGE      1$
42  06734 017767 9$:        MOV      @R31, R11
43  06742 017767            MOV      @R30, R10
44  06750          1$:
45  06750 062767            ADD      #4, R30
46  06756 062767            ADD      #4, R31
47  06764 005367            DEC      R00
48  06770 003350            BGT      2$
49  06772 005067            CLR      INTMU
50  06776 005767 7$:        TST      R11
51  07002 001410            BEQ      6$
52  07004 000241            CLC
53  07006 006067            ROR      R11
54  07012 006067            ROR      R10
55  07016 005367            DEC      INTMU
56  07022 000765            BR       7$
57  07024 026767 6$:        CMP      R10, SCPMAX
```

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```
58 07032 003015           BGT    4$
59 07034 005767           TST    R10
60 07040 001423           BEQ    3$
61 07042 002423           BLT    8$
62 07044 006367 5$:       ASL    R10
63 07050 026767           CMP    R10,SCPMAX
64 07056 003014           BGT    3$
65 07060 005267           INC    INTMU
66 07064 000767           BR     5$
67 07066 026767 4$:       CMP    R10,SCPMAX
68 07074 003405           BLE    3$
69 07076 006267           ASR    R10
70 07102 005367           DEC    INTMU
71 07106 000767           BR     4$
72 07110         3$:
73 07110 000002           RTI
74 07112 000241 8$:       CLC
75 07114 006067           ROR    R10
76 07120 005367           DEC    INTMU
77 07124 000747           BR     5$
78                        .GLOBL R11
79 07126 000000 R11:      .WORD  0
80 07130 000000 R31:      .WORD  0
81 07132 002000 SCPMAX:   .WORD  2000
82 07134 000000 R00:      .WORD  0
83 07136 000000 R10:      .WORD  0
84 07140 000000 R20:      .WORD  0
85 07142 000000 R30:      .WORD  0
86 07144 000000 PCOUNT:   .WORD  0
87 07146 000000 R40:      .WORD  0
88 07150 000000 R50:      .WORD  0
```

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```
1                          . GLOBL   DPSCN, YKURV, PTSNUM, EQBUF, INTSCA, PWANT
2 007152 005767 WAVEM:     TST      PWANT
3 007156 001512            BEQ      1$
4 007160 005367            DEC      PWANT
5 007164 001401            BEQ      2$
6 007166 000002            RTI
7 007170 052737 2$:        BIS      #340, @#177776
8 007176 010567            MOV      R5, R50               ; SAVE R5
9 007202 012767            MOV      #BBUF, R40            ; TEMPORARY BUFFER
10 07210 012767            MOV      #FLD, R30             ; INTENSITY BUFFER
11 07216 017777 3$:        MOV      @R30, @R40           ; GET INTENSITIES
12 07224 062767            ADD      #2, R40               ; BUMP POINTER
13 07232 062767            ADD      #6, R30               ; 6 BYTES/ENTRY
14 07240 005367            DEC      R50                   ; COUNTER
15 07244 003364            BGT      3$                    ; LOOP ON POSITIVE
16 07246 010567            MOV      R5, PCOUNT            ; COUNTER FOR DISPLAY
17 07252 042737            BIC      #340, @#177776        ; CLEAR PRIORITY FOR INTERRUPT
18 07260 012767            MOV      #PCOUNT, COUNTR       ; SET UP FOR SCALING
19 07266 012767            MOV      #BBUF, ADDRES         ; TEMPORARY BUFFER ADDRESS
20 07274 104461            TRAP     61                    ; GET SCALE FACTOR
21 07.76 1..4463           TRAP     63                    ; ONLY NEED TO SHIFT EM ONCE
22 07300                   . BIN2D   #EQBUF, PCOUNT        ; ASCII THE POINT COUNT
23 07316                   STRGO    #PTSNUM               ; OUTPUT IT TO TTY
24 07326                   STRGO    #EQBUF                ; DITTO
25 07336 (..4567           JSR      R5, OCRLF             ; <CR><LF>
26 07342                   . BIN2D   #EQBUF, INTMU         ; SHIFT COUNT
27 07360                   STRGO    #INTSCA               ; MESSAGE TO TTY
28 07370                   STRGO    #EQBUF                ; COUNT
29 07400 004567            JSR      R5, OCRLF             ; <CR><LF>
30 07404        1$:        PUSH     #BBUF, PCOUNT, DPSCN      ; ARGS FOR YKURV
31 07420 004767            JSR      PC, YKURV
32 07424 000002            RTI
33 07426 017767 SHIFTM:    MOV      @COUNTR, R00          ; HOW MANY
34 07434 016767            MOV      ADDRES, R10           ; POINTER
35 07442        1$:        LOGSHT   @R10, , INTMU, @R10       ; SHIFT EM TO SCALE
36 07470 062767            ADD      #2, R10               ; BUMP POINTER
37 07476 005367            DEC      R00                   ; DONE YET
38 07502 003357            BGT      1$                    ; NOPE
39 07504 000002            RTI
```

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```
1                         .SBTTL   MFI A/D ZERO ROUTINE(OVERLAYED)
2 007506       OUTIT:  .BIN2O   #EQBUF,@#MQ
3 007524               STRGO    #EQBUF
4 007534 004567        JSR      R5,OCRLF
5 007540 105737        TSTB     @#TKS
6 007544 000207        RTS      PC
7 007546 012703 WTRR:  MOV      #-100,R3
8 007552 005203 1$:    INC      R3
9 007554 100776        BMI      1$
10 07556 000207        RTS      PC
11 07560 012700 MFI:   MOV #DATA, R0              ;DATA BUFFER
12 07564 012701        MOV #LINE, R1
13 07570 042737        BIC      #100,@#TKS
14 07576 012702        MOV      #72.,R2
15 07602 112721 2$:    MOVB     #40,(R1)+
16 07606 005302        DEC      R2
17 07610 003374        BGT      2$
18 07612 012737        MOV #4400,@#DROUT                  ;CLEAR DR11
19 07620 012737        MOV #DATAIN, @#ADVEC               ;SET UP INTERUPT
20 07626 012737        MOV #340, @#ADVEC+2                ;PRIORITY
21 07634 005037        CLR @#177546                       ;TURN OFF CLOCK
22 07640 105737 1$:    TSTB @#ADBUF                       ;READY IT
23 07644 112737        MOVB #102, @#ADCSR                 ;INTERUPT ENABLE
24 07652 005001        CLR R1                             ;COUNTER
25 07654 012737        MOV #2000, @#DROUT                 ;TIME BASE
26 07662 000001        WAIT
27 07664               PUSH     #MFI
28 07670 004767        JSR      PC,TTYLOK
29 07674 000761        BR 1$
30 07676 105037 ERR:   CLRB     @#ADCSR
31 07702               STRGO    #ERRM
32 07712 000002        RTI
33 07714 005737 DATAIN: TST     @#ADCSR               ;ERROR SET
34 07720 100766        BMI      ERR
35 07722 105737        TSTB     @#ADBUF
36 07726 105037        CLRB     @#ADCSR
37 07732 005002        CLR      R2
38 07734 013703        MOV @#177570, R3                   ;GET SWITCHES
39 07740 001412        BEQ 1$                             ;NO SWITCHES
40 07742 020327        CMP      R3,#177406
41 07746 001003        BNE      4$
42 07750 052702 5$:    BIS      #3171,R2
43 07754 000404        BR       1$
44 07756 032703 4$:    BIT      #40000,R3
45 07762 001372        BNE      5$
46 07764 050302        BIS R3, R2                         ;SET BITS
47 07766 010237 1$:    MOV R2,@#DROUT   ;DOIT
48 07772 013720        MOV @#DRIN, (R0)+                  ;L F
49
50 07776 013720        MOV @#DRIN, (R0)+                  ;H F
51 10002 013720        MOV @#DRIN, (R0)+          ;L T
52 10006 013720        MOV @#DRIN, (R0)+                  ;H  T
53 10012 012703        MOV #DATA, R3
54 10016 162320        SUB (R3 )+, (R0)+                  ;D L F
55 10020 162320        SUB (R3 )+, (R0)+                  ;D H F
56 10022 162320        SUB (R3 )+, (R0)+                  ;D L T
57 10024 162320        SUB (R3 )+, (R0)+                  ;D H T
```

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```
58 10026 032737          BIT #100000, @#177570       ;15 SUPPRESS PRINT OUT
59 10034 001030          BNE 2$
60 10036 010300          MOV    R3,R0
61 10040 005420          NEG    (R0)+
62 10042 005420          NEG    (R0)+
63 10044 005420          NEG    (R0)+
64 10046 005420          NEG    (R0)+
65 10050 012700          MOV #DATA, R0
66 10054 ''12704         MOV #LINE, R4
67 10060 012702          MOV #8., R2
68 10064       3$:       BIN2O R4, (R0)+
69 10076 062704          ADD #8., R4
70 10102 005302          DEC R2
71 10104 003367          BGT 3$
72 10106                 STRGO #LINE
73 10116 012700 2$:      MOV #DATA, R0
74
75 10122 012023          MOV (R0)+, (R3)+
76 10124 012023          MOV (R0)+, (R3)+
77 10126 012023          MOV (R0)+, (R3)+
78 10130 012023          MOV (R0)+, (R3)+
79 10132 012700          MOV    #DATA,R0
80 10136 000002          RTI
81 10140 000000 LINE:    .WORD 0
82       010250'         . = +70.
83 10250    015          .BYTE CR, LF, 0
84 10253    105 ERRM:    .ASCIZ /ERROR/<CR><LF>
85                       .EVEN
86 10264 000000 DATA:    .WORD 0, 0, 0, 0, 0, 0, 0, 0
```

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```
 1                          .SBTTL  DEC A/D ZERO ROUTINE
 2 010304          ADCC:
 3 010304 005037          CLR     @#TKS
 4 010310          3$:     CLREM   R0,R2,R1
 5 010316 012737 2$:       MOV     #1,@#ADCSR
 6 010324 105737 1$:       TSTB    @#ADCSR
 7 010330 100375          BPL     1$
 8 010332 013703          MOV     @#ADBUF,R3
 9 010336 060300          ADD     R3,R0
10 10340 005501           ADC     R1
11 10342 005703           TST     R3
12 10344 100002           BPL     4$
13 10346 062701           ADD     #-1,R1
14 10352          4$:
15 10352 005202           INC     R2
16 10354 004767           JSR     PC,WTRR
17 10360 ··20227          CMP     R2,#1000.
18 10364 002754           BLT     2$
19 10366                  DIVD    R0,R1,R2
20 10402 004767           JSR     PC,OUTIT
21 10406                  PUSH    #ADCC
22 10412 004767           JSR     PC,TTYLOK
23 10416 000732           BR      ADCC
```

```
                               . SBTTL   CALCOMP PLOT CHROMATOGRAM ROUTINE (OVERLAYED)
1
2 010420           PLTCHR:
3 010420 012767    MOV      #1, TICFLG
4 010426           PLTCH1:
5 010426 004567    JSR      R5, STUP
6 010432 004567    JSR      R5, STUFF
7 010436           POP      R33, R44
8 010446           CLREM    XC, YMAX
9 010456 016701    MOV      TICBUF, R1
10 10462 012700    MOV      #TICBUF+14. , R0
11 10466 022067 2$:  CMP      (R0)+, YMAX
12 10472 003403    BLE      1$
13 10474 016067    MOV      -2(R0), YMAX
14 10502 005301 1$:  DEC      R1
15 10504 003370    BGT      2$
16 10506 016767    MOV      TICBUF, R44
17 10514 012767    MOV      #TICBUF+14. , R33
18 10522           MTIC:    MULTDV   @R33, TWO5, YMAX, YC
19 10552 062767    ADD      #2, R33
20 10560 066767    ADD      PDSC, XC
21 10566 004567    JSR      R5, PLT
22 10572 000403    BR       . +10
23 10574 010666'   . WORD    XC, YC, ONEE
24 10602 005367    DEC      R44
25 10606 003345    BGT      MTIC
26 10610 004567    JSR      R5, IAXIS
27 10614 000407    BR       . +20
28 10616 000000G   . WORD    ZERO, XC, ZERO, TWO5, PDSC, HUND, SIZE
29 10634 004567    JSR      R5, CCDONE
30 10640 000177    JMP      @IMOREC
31 10644 004704 TWO5:  . WORD    2500.
32 10646 005670 THREG:  . WORD    3000.
33 10650 000003 SIZE:  . WORD    3
34 10652 000144 P100:  . WORD    100.
35 10654 000372 HUND:  . WORD    250.
36 10656 000000 R44:  . WORD    0
37 10660 000000 R33:  . WORD    0
38 10662 000000 YC:  . WORD    0
39 10664 000050 PDSC:  . WORD    50
40 10666 000000 XC:  . WORD    0
41 10670 000000 YMAX:  . WORD    0
42 10672 000010 EIGHT:  . WORD    8.
43 10674 002734 ONE5:  . WORD    1500.
44 10676           HOWMNY:  STRGO    #INCHSM
45 10706           DIVD     LININC, LININC+2, #254. , LININC, LININC+2
46 10744           . BIN2O   #EQBUF, LININC
47 10762           STRGO    #EQBUF
48 10772           . BIN2O   #EQBUF, LININC+2
49 11010           STRGO    #EQBUF
50 11020 004567    JSR      R5, OCRLF
51 11024 000205    RTS      R5
52 11026 004567 CCDONE:  JSR      R5, FIN
53 11032 004567    JSR      R5, HOWMNY
54 11036 004567    JSR      R5, PLT
55 11042 000403    BR       . +10
56 11044 0000000   . WORD    ZERO, P100, ZERO
57 11052 004567    JSR      R5, ORIGIN
```

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```
58 11056 000205          RTS     R5
59 11060         STUP:
60 11060 004567          JSR     R5, SET
61 11064 004567          JSR     R5, PLT
62 11070 000403          BR      . +10
63 11072 000000G         . WORD  ZERO, P100, ZERO
64 11100 004567          JSR     R5, ORIGIN
65 11104                 TTYIO   #TITLES
66 11126 001042          BNE     1$
67 11130 004567          JSR     R5, PLTMES
68 11134 000000G         . WORD  MTABL, NTABL, 0, 2000. , 8. , 84.
69 11150 004567          JSR     R5, PLTMES
70 11154 000000G         . WORD  OTABL, PTABL, 50. , 1750. , 4, 42.
71 11170 004767          JSR     PC, BUIQWA
72 11174 004567          JSR     R5, PLTMES
73 11200 011406'         . WORD  `TABL, UTABL, 538. , 1750. , 4, 42.
74 11214 004567          JSR     R5, PLT
75 11220 000403          BR      . +10
76 11222 010674'         . WORD  ONE5, P100, ZERO
77 11230 004567          JSR     R5, ORIGIN
78 11234         1$:
79 11234 000205          RTS     R5
80 11236         PLTMES:
81 11236 011567          MOV     ( R5 ), XC
82 11242 013567          MOV     @( R5 )+, 6$
83 11246 011567          MOV     ( R5 ), 7$
84 11252 012567          MOV     ( R5 )+, R33
85 11256 166567          SUB     -4( R5 ), R33
86 11264 006267          ASR     R33
87 11270 010567          MOV     R5, 9$
88 11274 005725          TST     ( R5 )+
89 11276 012567          MOV     ( R5 )+, R44
90 11302 010567          MOV     R5, 8$
91 11306 005725          TST     ( R5 )+
92 11310         5$:
93 11310 004567          JSR     R5, ISYMBL
94 11314 000406          BR      . +16
95 11316 000000 9$:      . WORD  0, R44
96 11322 000000 8$:      . WORD  0
97 11324 000000 6$:      . WORD  0, ZERO
98 11330 000000 7$:      . WORD  0
99 11332 062767          ADD     #2, XC
100 1340 017767          MOV     @XC, 6$
101 1346 062767          ADD     #2, 7$
102 1354 161567          SUB     ( R5 ), R44
103 1360 005367          DEC     R33
104 1364 003351          BGT     5$
105 1366 005725          TST     ( R5 )+
106 1370 000205          RTS     R5
107 1372 000000 MS30F:   . WORD  0
108 1374 000123 MASINC:  . WORD  83.
109 1376 000000 XMAX:    . WORD  0
110 1400 000000 XDIV:    . WORD  0
111 1402 003100 FMAX:    . WORD  1600.
112 1404 000000 XCL:     . WORD  0
113 1406 011432'TTABL:   . WORD  QWAA, QWAA+6, QWAA+12. , QWAA+18. , QWAA+27.
114 1420 000006 UTABL:   . WORD  6, 6, 6, 9. , 8.
```

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```
115 1432      115 QWAA:    . ASCII  /MS-30 PCA    EI-GLC06AUG /
116 1462      040          . ASCII  /             /
117                        . EVEN
118 1476          BUIQWA:  PUSH     #QWAA, #44
119 1506 004767            JSR      PC, BLANKF
120 1512 012700            MOV      #QWAA, R0
121 1516 105767            TSTB     DATAB+10.
122 1522 001407            BEQ      2$
123 1524 012701            MOV      #INST2, R1
124 1530 112120 3$:        MOVB     ( R1 )+, ( R0 )+
125 1532 020127            CMP      R1, #INST2+6
126 1536 100774            BMI      3$
127 1540 000406            BR       4$
128 1542 012701 2$:        MOV      #INST1, R1
129 1546 112120 5$:        MOVB     ( R1 )+, ( R0 )+
130 1550 020127            CMP      R1, #INST1+6
131 1554 100774            BMI      5$
132 1556        4$:        . BIN20  R0, DATAB+2
133 1572 062700            ADD      #6, R0
134 1576 062700            ADD      #6, R0
135 1602                   . CVTDT  #0, R0
136 1612 062700            ADD      #9. , R0
137 1616                   . CVTDT  #1, R0
138 1626 000207            RTS      PC
```

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```
1                            .SBTTL  CALCOMP PLOT SPECTRUM ROUTINE(OVERLAYED)
2 011630          COMPRS:
3 011630                     DIVD    R1,,#82.
4 011642 005737             TST     @#AC
5 011646 001402             BEQ     1$
6 011650 005237             INC     @#MQ
7 011654 012703 1$:         MOV     #DATAB+510.,R3
8 011660 012704             MOV     #DATAB+512.,R4
9 011664 062704 5$:         ADD     #18.,R4
10 11670 005337             DEC     @#MQ
11 11674 003410             BLE     3$
12 11676 012702 2$:         MOV     #82.,R2
13 11702          4$:
14 11702                     POPR    R3,(R4)+,(R4)+,(R4)+
15 11710 005302             DEC     R2
16 11712 003373             BGT     4$
17 11714 000763             BR      5$
18 11716          3$.
19 11716 010102             MOV     R1,R2
20 11720 010167             MOV     R1,R44
21 11724 000205             RTS     R5
22 11726          GETPKS:
23 11726 012700             MOV     #DATAB+18.,R0
24 11732 016701             MOV     DATAB+6,R1
25 11736 004567             JSR     R5,COMPRS
26 11742 ...3205             RTS     R5
27 11744          ERFLD:     STRGO   #LFLDM
28 11754                     .BIN2D  #MBUF,-2(R0)
29 11772                     STRGO   #MBUF
30 12002 000177             JMP     @IMOREC
31 12006 004567 PLTSPC:     JSR     R5,STUP
32 12012 012767             MOV     #1,TICFLG
33 12020          XY4:
34 12020 005767             TST     TICFLG
35 12024 ...1434            BEQ     7$
36 12026                     TTYIO   #ADMES
37 12050                     EMT442
38 12062                     POPTST  MQQ
39 12070 016767             MOV     MQQ,DSKXYZ
40 12076                     DSKI    #1,MQQ,#DATAB
41 12116          7$:
42 12116                     TTYIO   #TITLES
43 12140 001002             BNE     5$
44 12142 004567             JSR     R5,SBTTLS
45 12146          5$:
46 12146 005067             CLR     YMAX
47 12152 004567             JSR     R5,GETPKS
48 12156 022067 XY2:        CMP     (R0)+,YMAX
49 12162 003403             BLE     XY1
50 12164 016067             MOV     -2(R0),YMAX
51 12172 022020 XY1:        CMP     (R0)+,(R0)+
52 12174 005301             DEC     R1
53 12176 ...3367            BGT     XY2
54 12200                     MULTDV  FMAX,FMAX,LENGTH,XDIV
55 12230 001002             BNE     3$
56 12232 000167             JMP     BXDIV
57 12236          3$:
```

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```
58 12236 005740        TST      -(R0)
59 12240 001002        BNE      1$
60 12242 000167        JMP      ERFLD
61 12246          1$:
62 12246               LOGSHT   (R0),,#4,R2
63 12270               LOGSHT   -(R0),,#-12.
64 12306 053702        BIS      @#MQ,R2
65 12312               MULTDV   R2,R2,XDIV,XMAX
66 12336 100002        BPL      2$
67 12340 000167        JMP      BXMAX
68 12344          2$:
69 12344 012767        MOV      #DATAB+18.,R33
70 12352 012767        MOV      #1,XCL
71 12360      XY3:     MULTDV   @R33,TWO5,YMAX,YC
72 12410 062767        ADD      #2,R33
73 12416               LOGSHT   @R33,,#-12.,R2
74 12442 062767        ADD      #2,R33
75 12450               LOGSHT   @R33,,#4
76 12470 053702        BIS      @#MQ,R2
77 12474               MULTDV   R2,R2,XDIV,XC
78 12520 100002        BPL      4$
79 12522 000167        JMP      BADXC
80 12526          4$:
81 12526 004567        JSR      R5,PLT
82 12532 000403        BR       .+10
83 12534 010666        .WORD    XC,ZERO,ZERO
84 12542 004567        JSR      R5,PLT
85 12546 000403        BR       .+10
86 12550 010666        .WORD    XC,YC,ONEE
87 12556 005267        INC      XC
88 12562 026767        CMP      XC,XCL
89 12570 001033        BNE      XY5
90 12572 016767        MOV      XC,X
91 12600 016767        MOV      YC,Y
92 12606 162767        SUB      #7,X
93 12614 162767        SUB      #7.,Y
94 12622 004567        JSR      R5,ISYMBL
95 12626 000406        BR       .+16
96 12630 000000G       .WORD    X,Y,TTWO,ANX,ZERO,ONEE
97 12644 004567        JSR      R5,PLT
98 12650 000403        BR       .+10
99 12652 010666        .WORD    XC,YC,ZERO
100 2660 004567 XY5:   JSR      R5,PLT
101 2664 000403        BR       .+10
102 2666 010666        .WORD    XC,YC,ONEE
103 2674 004567        JSR      R5,PLT
104 2700 000403        BR       .+10
105 2702 010666        .WORD    XC,ZERO,ONEE
106 2710 016767        MOV      XC,XCL
107 2716 062767        ADD      #2,R33
108 2724 005367        DEC      R44
109 2730 003213        BGT      XY3
110 2732 004567        JSR      R5,IAXIS
111 2736 000407        BR       .+20
112 2740 000000G       .WORD    ZERO,XMAX,ZERO,TWO5,MASINC,HUND,SIZE
113 2756 004567        JSR      R5,CCDONE
114 2762 005767        TST      TICFLG
```

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```
115 2766 001402         BEQ     1$
116 2770 000167         JMP     XY4
117 2774 000167 1$:     JMP     ACSPEC
118 3000 000000 DSKXYZ: .WORD   0
119 3002 000002 TTWO:   .WORD   2
120 3004        BXMAX:  STRGO   #BXMAXM
121 3014        ANOUTL: .BIN20  #MBUF,XMAX
122 3032        STRGO   #MBUF
123 3042 000177         JMP     @IMOREC
124 3046        BADXC:  STRGO   #BADXCM
125 3056 016767         MOV     XC,XMAX
126 3064 000753         BR      ANOUTL
127 3066        BXDIV:  STRGO   #BXDIVM
128 3076 016767         MOV     XDIV,XMAX
129 3104 000743         BR      ANOUTL
130 3106 002342 LENGTH: .WORD   1250.
131 3110    040 BXMAXM: .ASCIZ  / BAD XMAX /
132 3123    040 BXDIVM: .ASCIZ  / BAD XDIV /
133 3136    040 BADXCM: .ASCIZ  / BAD XC /
134 3147    130 ANX:    .ASCII  /X/
135                     .EVEN
136 3150 004567 SBTTLS: JSR     R5,PLTMES
137 3154 0000000        .WORD   QTABL,RTABL,100.,2400.,4,42.
138 3170 012700         MOV     #QWAA,R0
139 3174 005001         CLR     R1
140 3176        6$:     .BIN20  R0,DATAB(R1)
141 3212 005721         TST     (R1)+
142 3214 062700         ADD     #6,R0
143 3220 020127         CMP     R1,#6
144 3224 '"'2764         BLT     6$
145 3226                .BIN20  #QWAA+18.,DSKXYZ
146 3244 004567         JSR     R5,PLTMES
147 3250 011406'        .WORD   TTABL,UTABL,488.,2400.,4,42.
148 3264 000205         RTS     R5
```

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```
 1                          SBTTL   TELETYPE I/O ROUTINE
 2                  ;*********************************************************
 3                  ;          TELETYPE INPUT/OUTPUT ROUTINE
 4                  ;          LINEPRINTER OUTPUT ROUTINE
 5                  ;          BY:      P. C. ABEGGLEN
 6                  ;          OCT. 25, 1972
 7                  ;          CALLING SEQUENCE:
 8                  ;                   INPUT
 9                  ;                            MOV     #MSG,-(SP)
10                  ;                            MOV     #MSGEND,-(SP)
11                  ;                            JSR     R5,TTYI
12                  ;                   OUTPUT
13                  ;                            MOV     #MSG,-(SP)
14                  ;                            MOV     #MSGEND,-(SP)
15                  ;                            JSR     R5,TTYO
16                  ;          OUTPUT(ASCIZ STRING MUST BE TERMINATED WITH NULL)
17                  ;                            MOV     #MSG,-(SP)
18                  ;                            JSR     R5,STRING
19                  ;          NOTE:
20                  ;          TWO SPECIAL EXITS FROM TTYI ARE PROVIDED.
21                  ;          ONE IS TAKEN TO A USER DEFINED LABEL CALLED
22                  ;          "STRT" IN THE EVENT OF A "CONTROL-B" BEING
23                  ;          INPUT AND THE OTHER IS TAKEN TO A A
24                  ;          LABEL CALLED "BKK" IN THE EVENT OF A "CONTROL-P
25                  ;          BEING INPUT.   IF THE "STRING" ENTRY POINT TO
26                  ;          THE TELETYPE OUTPUT ROUTINE IS USED, CARE MUST
27                  ;          BE TAKEN TO INSURE THAT THE STRING TO BE OUTPUT
28                  ;          IS @#ACTUALLY TERMINATED BY A NULL CHARE#ACTER.
29                  ;          OTHERWISE, THE OUTPUT MAY NEVER TERMINATE .
30                  ;          MSG=STARTING ADDRESS OF BUFFER HEADER
31                  ;          MSGEND=ENDING ADDRESS OF MESSAGE+1
32                  ;*********************************************************
33       177514    LPS=177514
34       177516    LPB=LPS+2
35 13266    CMMN:
36 13266 010067       MOV     R0,R0SAV          ;SAVE R0
37 13272 010167       MOV     R1,R1SAV          ;R1
38 13276             POP     TKSSAV,R5SAV,R0,R1
39 13312 160100       SUB     R1,R0             ;BYTE COUNT-1
40 13314 010167       MOV     R1,TTYSA
41 13320 016745       MOV     TKSSAV,-(SP)      ;R5 B@#ACK
42 13324 005067       CLR     RUBFLG            ;NO RUBOUTS YET
43 13330 000205       RTS     R5                ;RETURN
44 13332 105737 NO1:  TSTB    @#TPS             ;READY
45 13336 100375       BPL     NO1               ;NOPE
46 13340 013767       MOV     @#TPS,TPSSAV      ;SAV @#TPS
47 13346 005037       CLR     @#TPS
48 13352 005767       TST     LPFG
49 13356 001010       BNE     2$
50 13360 105737 1$:   TSTB    @#LPS
51 13364 100375       BPL     1$
52 13366 013767       MOV     @#LPS,LPSSAV      ;SAVE LINE PRINTER STATUS
53 13374 005037       CLR     @#LPS             ;TURN OFF THE INTERRUPT
54 13400 000205 2$:   RTS     R5                ;RETURN
55 13402 005267 STRING: INC   RUBFLG            ;SET FLAG FOR NULL TERMINATOR
56 13406 010067       MOV     R0,R0SAV
57 13412 010167       MOV     R1,R1SAV
```

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```
58 13416              POP     R5SAV, R1
59 13424 005000      CLR     R0
60 13426 004567      JSR     R5, NO1
61 13432 000404      BR      NO2
62 13434 004567 TTYO:  JSR     R5, CMMN        ; GO GET THINGS
63 13440 004567      JSR     R5, NO1         ; @#TPS ETC.
64 13444        NO2:
65 13444 121127      CMPB    (R1), #37
66 13450 003444      BLE     OCNTRL
67 13452        CARCNT:
68 13452 005767      TST     LPFG
69 13456 001003      BNE     LPOK
70 13460 005737      TST     @#LPS
71 13464 100476      BMI     LPERRR
72 13466 004767 LPOK:  JSR     PC, OUTCHR
73 13472 105721      TSTB    (R1)+
74 13474        CAR1:
75 13474 005767      TST     RUBFLG          ; LOOKING FOR NULL'S
76 13500 001047      BNE     NULLTR          ; TRAP TO NULL LOOKER FORRER!
77 13502 005300      DEC     R0              ; DOWN COUNTER
78 13504 001357      BNE     NO2             ; GO AROUND
79 13506 105737 NO3:   TSTB    @#TPS           ; LAST ONE OUT
80 13512 100375      BPL     NO3             ; NOPE
81 13514 013767      MOV     @#PRTVEC, RTIS  ; GOING TO GET AN INTERRUPT HERE
82 13522 012737      MOV     #RTI, @#PRTVEC  ; SO FIX IT
83 13530 016737      MOV     TPSSAV, @#TPS   ; RESTORE @#TPS
84 13536 016700      MOV     R0SAV, R0       ; R0
85 13542 016701      MOV     R1SAV, R1       ; R1
86 13546 016746      MOV     R5SAV, -(SP)    ; PREVIOUS R5
87 13552 016737      MOV     RTIS, @#PRTVEC
88 13560 000205      RTS     R5              ; GO HOME
89 13562 121127 OCNTRL: CMPB    (R1), #15
90 13566 003003      BGT     1$
91 13570 121127      CMPB    (R1), #11
92 13574 002326      BGE     CARCNT
93 13576 004567 1$:    JSR     R5, OUTUP
94 13602 152711      BISB    #100, (R1)
95 13606 004767      JSR     PC, OUTCHR
96 13612 142721      BICB    #100, (R1)+
97 13616 000726      BR      CAR1
98 13620 105711 NULLTR: TSTB    (R1)
99 13622 001731      BEQ     NO3
100 3624 000707      BR      NO2
101 3626 005767 OUTCHR: TST     LPFG
102 3632 001005      BNE     1$
103 3634 105737 2$:    TSTB    @#LPS
104 3640 100375      BPL     2$
105 3642 111137      MOVB    (R1), @#LPB
106 3646 105737 1$:    TSTB    @#TPS
107 3652 100375      BPL     1$
108 3654 111137      MOVB    (R1), @#TPB
109 3660 000207      RTS     PC
110 3662        LPERRR: PUSH    LPFG
111 3666 005267      INC     LPFG
112 3672        STRGO    #LPRM
113 3702        TTYIO    #TODO
114 3724 001403      BEQ     1$
```

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```
115 3726 005726           TST      ( SP )+
116 3730 000167           JMP      LPOK
117 3734          1$:     POP      LPFG
118 3740 000167           JMP      CARCNT
119 3744 000000 LPFG:     . WORD   0
120 3746 000000 LPSSAV:   . WORD   0
121 3750    040 LPRM:     . ASCIZ  / LINE PRINTER ERROR /<15><12>
122 3777    040 TODO:     . ASCIZ  / CONTINUE WITH LINE PRINTER IO /
123                       . EVEN
124 4040 000000 ROSAV:    . WORD   0
125 4042 000000 TTY2:     . WORD   0
126 4044 000000 R1SAV:    . WORD   0
127 4046 000000 R5SAV:    . WORD   0
128 4050 000002 RTI:      RTI
129 4052 000000 TTYSA:    . WORD   0
130 4054 000000 RTIS:     . WORD   0
131 4056 000000 TKSSAV:   . WORD   0
132 4060 000000 TPSSAV:   . WORD   0
133 4062 000000 RUBFLG:   . WORD   0
134 4064 012701 FIXVEC:   MOV      #RTI, R1
135 4070 010137           MOV      R1, @#ADVEC
136 4074 010137           MOV      R1, @#110
.37 4100 010137           MOV      R1, @#114
138 4104 052737           BIS      #100, @#TPS
139 4112 052737           BIS      #100, @#TKS
140 4120 000207           RTS      PC
141 4122 004567 CNTRLV:   JSR      R5, OUTUP
142 4126 012701           MOV      #ACV, R1
143 4132 004767           JSR      PC, OUTCHR
144 4136 004567           JSR      R5, OCRLF
145 4142 016702           MOV      AR2, R2
146 4146 016703           MOV      AR3, R3
147 4152 000177           JMP      @JMOREC
148 4156    126 ACV:      . BYTE   126
149 4157    103 ACC:      . BYTE   103
150 4160    015 BCR:      . BYTE   15
151 4161    012 ALF:      . BYTE   12
152 4162    102 ACB:      . BYTE   102
153 4163    120 ACP:      . BYTE   120
154 4164    132 ACZ:      . BYTE   132
155 4165    134 ASL:      . BYTE   134
156 4166    136 AUP:      . BYTE   136
157                       . EVEN
158 4170 004567 CNTLC:    JSR      R5, OUTUP        ; READY FOR OUTPUT
159 4174 012701           MOV      #ACC, R1
160 4200 004767           JSR      PC, OUTCHR
161 4204 004567           JSR      R5, OCRLF        ; OUTPUT CARRAIGE RETURN AND LINE F
162 4210 004767           JSR      PC, FIXVEC
163 4214 104060           EMT      60               ; GO B@#ACK TO THE MONITOR
164 4216         OCRLF:   PUSH     R1
165 4220 012701           MOV      #BCR, R1
166 4224 004767           JSR      PC, OUTCHR
167 4230 005201           INC      R1
168 4232 004767           JSR      PC, OUTCHR
169 4236            POP      R1
170 4240 000205           RTS      R5
171 4242 004567 TTYI:     JSR      R5, CMMN         ; GO GET THINGS
```

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```
172 4246 004567          JSR     R5,NO1          ;GO DO @#TPS
173 4252 013767          MOV     @#TKS,TKSSAV     ;SAVE @#TKS
174 4260 042767          BIC     #4200,TKSSAV     ;TURN OFF BUSY & DONE
175 4266 142737          BICB    #100,@#TKS       ;TURN OFF INTERRUPT
176 4274 105737 NO5:     TSTB    @#TKS            ;DONE SET
177 4300 100375          BPL     NO5              ;NOPE
178 4302 113711          MOVB    @#TKB,(R1)       ;INPUT A CHAR.
179 4306 142711          BICB    #200,(R1)        ;CLEAR EIGTH BIT
180 4312 121127          CMPB    (R1),#177        ;RUBOUT
181 4316 001471          BEQ     RUBOUT           ;YUP
182 4320 005767          TST     RUBFLG           ;PREVIOUS RUBOUT
183 4324 001047          BNE     YESS             ;YUP
184 4326        YESB:
185 4326 005067          CLR     RUBFLG           ;FIX RUBOUT FLAG
186 4332                 PUSH    #OUT13
187 4336 004767          JSR     PC,TTYLO1
188 4342        OUT13:
189 4342 121127          CMPB    (R1),#37
190 4346 003422          BLE     ACNTRL
191 4350        ACR:
192 4350 004767          JSR     PC,OUTCHR
193 4354        ACR1:
194 4354 122127          CMPB    (R1)+,#15        ;CARRIAGE RETURN
195 4360 001402          BEQ     EXIT             ;YUP
196 4362 005300          DEC     R0               ;BUFFER FULL
197 4364 001343          BNE     NO5              ;NOPE
198 4366 012701 EXIT:    MOV     #ALF,R1
199 4372 004767          JSR     PC,OUTCHR
200 4376 105737          TSTB    @#TKS            ;CLEAR DONE
201 4402 016737          MOV     TKSSAV,@#TKS     ;RESTORE @#TKS
202 4410 000167          JMP     NO3              ;GO HOME
203 4414 121127 ACNTRL:  CMPB    (R1),#15
204 4420 001753          BEQ     ACR
205 4422 004567          JSR     R5,OUTUP
206 4426 152711          BISB    #100,(R1)
207 4432 004767          JSR     PC,OUTCHR
208 4436 142711          BICB    #100,(R1)
209 4442 000744          BR      ACR1
210 4444 004567 YESS:    JSR     R5,OSLAS         ;OUTPUT A SLASH
211 4450 000726          BR      YESB             ;GO BACK
212 4452 004567 YEST:    JSR     R5,OSLAS         ;OUTSLASH
213 4456 005267          INC     RUBFLG           ;ANOTHER RUBOUT
214 4462 000416          BR      YESC             ;RETURN
215 4464 016701 CNTLU:   MOV     TTYSA,R1         ;BASE ADDRESS
216 4470 005067          CLR     RUBFLG           ;DONT NEED SLASH
217 4474 004567          JSR     R5,OCRLF         ;CR&LF
218 4500 000675          BR      NO5              ;GO START OVER
219 4502 005301 RUBOUT:  DEC     R1               ;BACKOFF POINTER
220 4504 020167          CMP     R1,TTYSA         ;OUT OF THE BUFFER
221 4510 002765          BLT     CNTLU            ;BEGINNING OF THE BUFFER
222 4512 005767          TST     RUBFLG           ;FIRST RUBOUT
223 4516 001755          BEQ     YEST             ;YUP
224 4520        YESC:
225 4520 004767          JSR     PC,OUTCHR
226 4524 000663          BR      NO5              ;REINPUT IT
227 4526 004567 CNTRLB:  JSR     R5,OUTUP
228 4532 012701          MOV     #ACB,R1
```

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```
229 4536 004767           JSR    PC, OUTCHR
230 4542 004567           JSR    R5, OCRLF
231 4546 004567           JSR    R5, GETCOR
232 4552                  DSKI   @#MQ, COREAD, #FLD
233 4572 004767           JSR    PC, FIXVEC
234 4576 126727           CMPB   TYPE1, #117
235 4604 001405           BEQ    1$
236 4606                  STRGO  #IMAGE
237 4616 104060           EMT    60
238 4620           1$:
239 4620 004567           JSR    R5, OCRLF
240 4624 000167           JMP    STRT
241 4630 004567 CNTRLP:   JSR    R5, OUTUP
242 4634 012701           MOV    #ACP, R1
243 4640 004767           JSR    PC, OUTCHR
244 4644 004567           JSR    R5, OCRLF
245 4650 004767           JSR    PC, FIXVEC
246 4654 000167           JMP    PEAKS
247 4660 004567 CNTLZZ:   JSR    R5, OUTUP
248 4664 012701           MOV    #ACR, R1
249 4670 004767           JSR    PC, OUTCHR
250 4674 126727           CMPB   TYPE1, #117
251 4702 001412           BEQ    1$
252 4704 004567           JSR    R5, GETCOR
253 4710                  DSKI   @#MQ, COREAD, #FLD
254 4730           1$:
255 4730 004567           JSR    R5, OCRLF
256 4734 000177           JMP    @IMOREC
257 4740        OSLAS:    PUSH   R1
258 4742 012701           MOV    #ASL, R1
259 4746 004767           JSR    PC, OUTCHR
260 4752                  POP    R1
261 4754 000205           RTS    R5                ; RETURN
262 4756        GETCOR:
263 4756 012737           MOV    #PEAKS, @#MQ
264 4764 162737           SUB    #FLD, @#MQ
265 4772 012737           MOV    #512., @#DIV
266 5000 005737           TST    @#AC
267 5004 001402           BEQ    NOPI
268 5006 005237           INC    @#MQ
269 5012 000205 NOPI:     RTS    R5
270 5014        OUTUP:    PUSH   R1
271 5016 012701           MOV    #AUP, R1
272 5022 004767           JSR    PC, OUTCHR
273 5026                  POP    R1
274 5030 000205           RTS    R5
275 5032    040 IMAGE:    .ASCIZ / NO CORE IMAGE/<CR><LF>
276                       .EVEN
```

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```
1                      .SBTTL   LOOK AT THE TTY ROUTINE
2                  ;*********************************************************
3                  ;        TTY CONTROL CHARACTER INPUT DECODING ROUTINE
4                  ;        P. C. ABEGGLEN
5                  ;        27-DEC-73
6                  ;*********************************************************
7  015054 105737 TTYLOK: TSTB   @#TKS           ; DONE SET?
8  015060 100075         BPL    OUT15           ; NO MEANS NO USE WAITING AROUND
9  015062 010067 TTYLO1: MOV    RO, ROSAVR      ; SAVE RO FOR POSTERITY
10 15066 142737         BICB   #100, @#TKS     ; TURN OFF THAT MISERABLE INTERRUPT
11 15074                POP    PCS, KMOREC     ; GET THE STUFF OFF OF THE STACK
12 15104 113700         MOVB   @#TKB, RO       ; GRAB A BYTE FROM TTY
13 15110 142700         BICB   #200, RO        ; GET RID OF PARITY FOR MAXIMUM UTILITY
14 15114 120027         CMPB   RO, #37         ; IS IT A CONTROL CHARACTER?
15 15120 003043         BGT    2$              ; NO MEANS SPLIT
16 15122 120027         CMPB   RO, #1          ; ^A?
17 15126 001002         BNE    3$              ; SKIP ON NOT EQUALS
18 15130 000167         JMP    CNTRLA          ; ^A RECEIVING ROUTINE
19 15134 120027 3$:     CMPB   RO, #2          ; ^B?
20 15140 001002         BNE    4$              ; SKPNE
21 15142 000167         JMP    CNTRLB          ; ^B RECEIVER
22 15146 120027 4$:     CMPB   RO, #3          ; ^C?
23 15152 001002         BNE    5$              ; SKPNE
24 15154 000167         JMP    CNTLC           ; GO TO MONITOR
25 15160 120027 5$:     CMPB   RO, #17         ; ^N?
26 15164 001002         BNE    6$              ; SKPNE
27 15166 000167         JMP    CNTRLV          ; SAME AS ^V RIGHT NOW
28 15172 120027 6$:     CMPB   RO, #20         ; ^P?
29 15176 001002         BNE    7$              ; BE CAREFUL WITH THIS ONE
30 15200 000167         JMP    CNTRLP          ; IT GOES TO A DANGEROUS PLACE
31 15204 120027 7$:     CMPB   RO, #26         ; ^V
32 15210 001002         BNE    8$              ; SKPNE
33 15212 000167         JMP    CNTRLV          ; ^V RECEIVER
34 15216 120027 8$:     CMPB   RO, #32         ; ^Z?
35 15222 001002         BNE    2$              ; NO MATCH IN SKIP CHAIN
36 15224 000167         JMP    CNTLZZ          ; GO TO IMOREC
37 15230 016700 2$:     MOV    ROSAVR, RO      ; RESTORE RO
38 15234                PUSH   PCS             ; PUT BACK PC
39 15240 000207         RTS    PC
40 15242        CNTRLA:
41 15242 000177         JMP    @KMOREC         ; DO IT
42 15246 000000 PCS:    .WORD  0
43 15250 000000 KMOREC: .WORD  0
44 15252 000000 ROSAVR: .WORD  0
45 15254        OUT15:  POP    (SP)            ; DUMP ARG
46 15256 000207         RTS    PC
```

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```
 1                      . SBTTL   DISC I/O ROUTINE
 2               ; ***************************************************************
 3               ;           DISC INPUT/OUTPUT ROUTINE
 4               ;           BY P. C. ABEGGLEN
 5               ;           NOV. 22, 1972
 6               ;           CALLING SEQUENCE:
 7               ;               INPUT
 8               ;                           MOV     BLKCNT, -( SP )
 9               ;                           MOV     BLKNUM, -( SP )
10               ;                           MOV     #BLK, -( SP )
11               ;                           JSR     R5, DSKIN
12               ;               OUTPUT
13               ;                           MOV     BLKCNT, -( SP )
14               ;                           MOV     BLKNUM, -( SP )
15               ;                           MOV     #BLK, -( SP )
16               ;                           JSR     R5, DSKOUT
17               ;           NOTE:
18               ;                   THIS ROUTINE DOES TRANSFER MODE I/O WITH NO
19               ;                   ADDRESS CHECKING PERFORMED.   IT CONTAINS ITS OWN
20               ;                   LINK BLOCK AND TRANSFER BLOCK.
21               ;                   BLKNUM= ABSOLUTE BLOCK #
22               ;                   #BLK=STARTING ADDRESS OF BLOCK BUFFER
23               ;                   BLKCNT=# OF BLOCKS TO BE TRANSFERRED
24               ; --  --
25               ; ***************************************************************
26 15260   040 CALLED: . ASCIZ   / CALLED FROM LOC. /
27 15303   040 ORANGM: . ASCIZ   / OUT OF RANGE DISC ADDRESS /
28                      . EVEN
29 15340 004770 BDA:   . WORD    4770
30 15342 010700 TDA:   . WORD    10700
31 15344 012767 DSKIN: MOV       #4, TBLK+6          ; READ CODE
32 15352 000403        BR        CMNN               ; GO AROUND
33 15354 012767 DSKOUT: MOV      #2, TBLK+6          ; WRITE CODE
34 15362 010067 CMNN:  MOV       R0, ROSAV
35 15366        POP    TTY2, TBLK+2, TBLK, R0
36 15404 026727 CMP    TBLK+6, #4          ; IN OR OUT
37 15412 001410 BEQ    NOCHEK              ; INPUT ANYTHING
38 15414 026767 CMP    TBLK, BDA           ; BELOW LOWER BOUND
39 15422 002452 BLT    ORANG               ; YUP
40 15424 026767 CMP    TBLK, TDA           ; ABOVE UPPER BOUND
41 15432 003046 BGT    ORANG               ; YUP
42 15434        NOCHEK:
43 15434 010146        MOV       R1, -( SP )
44 15436 012701        MOV       #TLNK, R1
45 15442 005300 LPP:   DEC       R0
46 15444 012767        MOV       #256. , TBLK+4
47 15452 005067        CLR       TBLK+10            ; NOT TRANSFERRED WORD
48 15456 005767        TST       TCNTR
49 15462 001402        BEQ       TRR
50 15464                . INIT   R1
51 15470        TRR:    . TRAN   R1, #TBLK
52 15500                . WAIT   R1
53 15504 ...5067        CLR       TCNTR
54 15510 000402         BR       TRX
55 15512                . RLSE   R1
56 15516 005267 TRX:   INC       TBLK
57 15522 062767        ADD       #512. , TBLK+2
```

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```
58 15530 005700          TST     R0
59 15532 001343          BNE     LPP
60 15534 016700          MOV     R0SAV, R0
61 15540 012601          MOV     (SP)+, R1
62 15542 016746          MOV     TTY2, -(SP)        ;RESTORE PREVIOUS R5
63 15546 000205          RTS     R5                 ;GO HOME
64 1555 '       ORANG:   STRGO   #ORANGM
65 15560                 .BIN20  #EQBUF, TBLK
66 15576                 PUSH    #EQBUF, #EQBUFL
67 15606 +*14567         JSR     R5, TTY0
68 15612                 STRGO   #CALLED
69 15622                 .BIN20  #EQBUF, R5
70 15636                 PUSH    #EQBUF, #EQBUFL
71 15646 004567          JSR     R5, TTY0
72 15652 104060          EMT     60                 ;FATAL ERROR
73 15654 000001 TCNTR:   .WORD   1
74 15656 000000          .WORD   0
75 15660 000000 TLNK:    .WORD   0
76 15662 016003          .RAD50  /DSK/
77 15664    001          .BYTE   1,0
78 15666 015270          .RAD50  /DK/
79 15670 000000 TBLK:    .WORD   0,0
80 15674 000400          .WORD   400,0,0
81 15702 005300 DBUG:    DEC R0
82 15704 000000          HALT
83 15706 000656          BR LPP+2
84 15710    131 YE:      .ASCII  /YE/
85 15712 000000 FLAGG:   .WORD   0,0
```

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```
 1                      SBTTL   REGISTER SAVE/RESTORE ROUTINE
 2              ;***********************************************************
 3              ;           REGISTER SAVE/RESTORE ROUTINE
 4              ;           BY:   P. C. ABEGGLEN
 5              ;           OCT. 30, 1972
 6              ;           CALLING SEQUENCE:
 7              ;                   SAVE
 8              ;                         JSR      R5, RSAV
 9              ;                   RESTORE
10              ;                         JSR      R5, RRSTR
11              ;           NOTE:
12              ;                   NAMES MUST BE DECLARED GLOBAL IF NOT CONCATE-
13              ;                   NATED TO SOURCE.
14              ;***********************************************************
15 15716       RSAV:
16 15716 011667         MOV     ( SP ), TEMP
17 15722               PUSH    R4, R3, R2, R1, R0, R5
18 15736 016705         MOV     TEMP, R5
19 15742 012607         MOV     ( SP )+, PC
20 15744       RRSTR:
21 15744 005726         TST     ( SP )+
22 15746               POP     R0, R1, R2, R3, R4
23 15760 000205         RTS     R5               ;GO HOME WITH EVERYTHING
24 15762 000000 TEMP:   . WORD   0
25       000001'        . END
```

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ABLOK =	****** G	AC =	177302	ACB	014162R
ACC	014157R	ACNTRL	014414R	ACP	014163R
ACR	014350R	ACR1	014354R	ACSPEC=	****** G
ACV	014156R	ACZ	014164R	ADBUF =	176772
ADCC	010304RG	ADCSR =	176770	ADDRES	006452R
ADMES =	****** G	ADPRI =	000132	ADVEC =	000130
ALF	014161R	ALUT =	****** G	ANAXIS	000722R
ANOTM =	****** G	ANOUTL	013014R	ANX	013147R
AR2 =	****** G	AR3 =	****** G	ASH =	177316
ASK	006076R	ASL	014165R	ATMP	006554R
AUP	014166R	A13LUT=	****** G	BADXC	013046R
BADXCM	013136R	BB =	000011	BBUF =	****** G
BCR	014160R	BDA	015340RG	BLANK =	****** G
BLANKF=	****** G	BLKO	005446R	BLNK =	****** G
BLOK =	****** G	BMASS	001032R	BUIQWA	011476R
BXDIV	013066R	BXDIVM	013123R	BXMAX	013004R
BXMAXM	013110R	CALLED	015260R	CARCNT	013452R
CAR1	013474R	CCDONE	011026R	CCMASS	005564RG
CHROMA=	****** G	CHROMR	006616R	CLK =	177546
CLOUT	000330R	CMMN	013266R	CMNN	015362R
CNTLC	014170RG	CNTLU	014464R	CNTLZZ	014660RG
CNTRLA	015242R	CNTRLB	014526R	CNTRLP	014630RG
CNTRLV	014122RG	COMPRS	011630R	COREAD=	****** G
COUNTR	006450R	CR =	000015	DATA	010264R
DATAB =	****** G	DATAIN	007714R	DBUF	001442R
DBUG	015702R	DIRA =	****** G	DIRBUF=	****** G
DIV =	177300	DPSCN =	****** G	DR =	165000
DRIN =	165004	DROUT =	165002	DSKFL	000030R
DSKIN	015344RG	DSKLKK	000002R	DSKOUT	015354RG
DSKTLP	000070RG	DSKXYZ	013000RG	EAENOR=	177312
EAESC =	177310	EAESR =	177311	EIGHT	010672R
EIGHTY	006444R	EQBUF =	****** G	EQBUFL=	****** G
ERFLD	011744R	ERLOC =	****** G	ERR	007676R
ERRM	010253R	EXIT	014366R	FIN =	****** G
FIX =	****** G	FIXLP =	****** G	FIXVEC	014064R
FLAGG	015712RG	FLD =	****** G	FMAX	011402RG
FRLUT =	****** G	GCFLG =	****** G	GETCHM=	****** G
GETCOR	014756RG	GETPKS	011726RG	GETYMA	000764R
HOWMNY	010676R	HUND	010654RG	IAXIS =	****** G
IBUF =	****** G	IMAGE	015032R	IMCR	001125RG
IMOREC=	****** G	INCHSM=	****** G	INFAD =	****** G
INFADR=	****** G	INITIL=	****** G	INPUT =	****** G
INST1 =	****** G	INST2 =	****** G	INTMU =	****** G
INTSCA=	******/ G	ISYMBL=	****** G	JMOREC=	****** G
KMOREC	015250R	LENGTH	013106RG	LF =	000012
LFLDM =	****** G	LHDR	000060R	LINE	010140R
LININC=	****** G	LPB =	177516	LPERRR	013662R
LPF =	****** G	LPFG	013744R	LPFL	000046R
LPLKK	000014R	LPMM =	****** G	LPOK	013466R
LPP	015442R	LPRM	013750R	LPS =	177514
LPSSAV	013746R	LSH =	177314	MASINC	011374R
MASSM	001161R	MAXIT	006404R	MBUF =	****** G
MCR	001200RG	MFI	007560RG	MPEAK	001103R
MQ =	177304	MQQ =	****** G	MS30F	011372RG
MTABL =	****** G	MTIC	010522R	MUL =	177306
MWANT	001030R	M10 =	****** G	M30 =	****** G
NBOKRE=	****** G	NEWORG	006362R	NOCHEK	015434R

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NOPI	015012R	NO1	013332R	NO2	013444R
NO3	013506R	NO5	014274R	NTABL =	****** G
NULLTR	013620R	NUM =	****** G	OCNTRL	013562R
OCRLF	014216RG	ONEE =	****** G	ONE5	010674R
ORANG	015550R	ORANGM	015303R	ORIGIN=	****** G
OSLAS	014740R	OTABL =	****** G	OUTCHR	013626R
OUTIT	007506R	OUTUP	015014RG	OUT10	000650R
OUT11	000762R	OUT12	001436R	OUT13	014342R
OUT14	000652R	OUT15	015254R	PC	=%000007
PCOUNT	007144R	PCS	015246R	PCSAV	000400R
PDSC	010664RG	PEAKS =	****** G	PKSNM =	****** G
PLT =	****** G	PLTCHR	010420RG	PLTCH1	010426RG
PLTIT	000572R	PLTMAS	000402R	PLTMES	011236R
PLTR =	172554	PLTSPC	012006RG	PLTSWT=	****** G
PPF =	****** G	PPMM =	****** G	PROFIL	006152R
PRTVEC=	000064	PSW =	177776	PTABL =	****** G
PTSNUM=	****** G	PWANT	006446RG	P100	010652R
QTABL =	****** G	QWAA	011432R	RAWREC=	****** G
RBUF	003444R	RNUM =	****** G	RRSTR	015744RG
RSAV	015716RG	RTABL =	****** G	RTI	014050R
RTIS	014054R	RUBFLG	014062R	RUBOUT	014502R
R0	=%000000	ROSAV	014040R	ROSAVR	015252R
R00	007134RG	R1	=%000001	R1SAV	014044R
R10	007136RG	R11	007126RG	R2	=%000002
R20	007140RG	R3	=%000003	R30	007142RG
R31	007130R	R33	010660RG	R4	=%000004
R40	007146RG	R44	010656R	R5	=%000005
R5SAV	014046RG	R50	007150RG	R6	=%000006
R7	=%000007	SBTTLS	013150RG	SCALIT	006652RG
SCANS =	****** G	SCANSC	005516R	SCPMAX	007132R
SDIRER=	****** G	SET =	****** G	SETINC=	****** G
SHIFTM	007426R	SIZE	010650RG	SNUM =	****** G
SP	=%000006	SPACEC=	****** G	SSNUM =	****** G
STRING	013402RG	STRT =	****** G	STUFF =	****** G
STUP	011060R	SWITCH=	****** G	SWR =	177570
SYMBOL=	****** G	TBLK	015670R	TCNTR	015654R
TDA	015342RG	TEMP	015762R	TEROR	006572R
TERORM	006600R	THENUM=	****** G	THIGH	006570R
THREG	010646R	TICA =	****** G	TICBUF=	****** G
TICC =	****** G	TICFLG=	****** G	TITLES=	****** G
TKB =	177562	TKS =	177560	TKSSAV	014056R
TLIST	006556R	TLNK	015660RG	TLOW	006566R
TODO	013777R	TPB =	177566	TPS =	177564
TPSSAV	014060R	TRAPH =	****** G	TRA. =	****** G
TRNUM =	****** G	TRPHDL	006454RG	TRR	015470R
TRX	015516R	TSNUM =	****** G	TTABL	011406R
TTWO	013002R	TTYI	014242RG	TTYLOK	015054RG
TTYLO1	015062R	TTYO	013434RG	TTYSA	014052R
TTY2	014042R	TUIC =	****** G	TWO5	010644R
1YPE1 =	****** G	UIC =	****** G	UN =	000016
UTABL	011420R	U1X =	****** G	WAVEM	007152R
WTRR	007546R	X =	****** G	XC	010666R
XCL	011404R	XDIV	011400R	XMAX	011376R
XSTORE=	****** G	XY1	012172R	XY2	012156R
XY3	012360R	XY4	012020RG	XY5	012660R
Y =	****** G	YC	010662R	YE	015710RG
YESB	014326R	YESC	014520R	YESS	014444R

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SYMBOL TABLE

YEST   014452R   YKURV = ****** G   YMAX   010670R
YSTORE= ****** G   ZERO = ****** G   . SYM = 000027

. ABS.   0(**"00   000
         015764   001

ERRORS DETECTED: 0
FREE CORE: 12516. WORDS
, LP: /NL: BEX/CRF<IOPAK

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CROSS REFERENCE TABLE   S-1

```
ABLOK      1- 19#
AC         1- 65#    3- 20#    3- 22#    3- 23#    5-109#    7- 35#@  9- 19#@
           10- 18#   10- 45#@  11- 3#    11- 4     11- 54#   11- 62#@ 11- 63#@
           11- 65#   11- 71#   11- 73#@  11- 75#@  11- 77#   12-266
ACB        12-152#   12-228
ACC        12-149#   12-159
ACNTRL     12-190    12-203#
ACP        12-153#   12-242
ACR        12-191#   12-204    12-248
ACR1       12-193#   12-209
ACSPEC     1- 13#    11-117
ACV        12-142    12-148#
ACZ        12-154#
ADBUF      1- 63#    8- 22     8- 35     9- 8
ADCC       1- 16#    9- 2#     9- 21     9- 23
ADCSR      1- 63#    8- 23@    8- 30@    8- 33     8- 36@   9- 5@   9- 6
ADDRES     5-144#    6- 26@    6- 33     7- 19@    7- 34
ADMES      1- 30#    11- 36
ADPRI      1- 63#
ADVEC      1- 63#    8- 19@    8- 20@    12-135@
ALF        12-151#   12-198
ALUT       1- 36#
ANAXIS     3- 27     3- 48#
ANOTM      1- 30#
ANOUTL     11-121#   11-126    11-129
ANX        3- 46     11- 96    11-134#
AR2        1- 13#    12-145
AR3        1- 14#    12-146
ASH        1- 65#    3- 20#    3- 22#    3- 23#    5-109#    7- 35#   9- 19#
           10- 18#   10- 45#   11- 3#    11- 54#   11- 62#   11- 63#  11- 65#
           11- 71#   11- 73#   11- 75#   11- 77#
ASK        5- 41     5- 94#
ASL        12-155#   12-258
ATMP       6- 3@     6- 4@     6- 5@     6- 6@     6- 7      6- 9    6- 11@
           6- 12@    6- 13@    6- 14@    6- 15     6- 16#
AUP        12-156#   12-271
A13LUT     1- 30#
BADXC      11- 79    11-124#
BADXCM     11-124    11-133#
BB         1- 52#
BBUF       5- 3#     5- 45     5- 86@    5- 90     7- 9      7- 19    7- 30
BCR        12-150#   12-165
BDA        1- 18#    14- 29#   14- 38
BLANK      1- 27#
BLANKF     1- 18#    10-119
BLKO       5- 20#    5- 39     5- 40
BLNK       1- 34#
BLOK       1- 49#
BMASS      3- 17     3- 69#
BUIQWA     10- 71    10-118#
BXDIV      11- 56    11-127#
BXDIVM     11-127    11-132#
BXMAX      11- 67    11-120#
BXMAXM     11-120    11-131#
CALLED     14- 26#   14- 68
CARCNT     12- 67#   12- 92    12-118
CAR1       12- 74#   12- 97
CCDONE     3- 53     5- 91     10- 29    10- 52#   11-113
```

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CROSS REFERENCE TABLE   S-2

```
CCMASS   5-  3#    5- 39#
CHROMA   1- 25#    6- 29
CHROMR   6- 17     6- 25#
CLK      1- 68#
CLOUT    2- 68     2- 74#
CMMN     12- 35#   12- 62    12-171
CMNN     14- 32    14- 34#
CNTLC    1- 17#    4-  9#    12-158#   13- 24
CNTLU    12-215#   12-221
CNTLZZ   1- 16#    12-247#   13- 36
CNTRLA   13- 18    13- 40#
CNTRLB   1- 16#    12-227#   13- 21
CNTRLP   1- 16#    12-241#   13- 30
CNTRLV   1- 17#    12-141#   13- 27    13- 33
COMPRS   11-  2#   11- 25
COREAD   1- 14#    12-232    12-253
COUNTR   5-143#    6- 25@    6- 32     7- 18@    7- 33
CR       1- 51#    3- 69     3- 70     8- 83     8- 84     12-275
DATA     8- 11     8- 53     8- 65     8- 73     8- 79     8- 86#
DATAB    1- 29#    2- 38     2- 72     3- 19     3- 21     3- 55     3- 57
         4-  9#    4- 27     4- 32     4- 37@    5- 32     5- 49     5- 54@
         10-121    10-132    11-  7    11-  8    11- 23    11- 24    11- 40
         11- 69    11-140
DATAIN   8- 19     8- 33#
DBUF     5- 16#    5- 39     5- 43     5- 87@    5- 89
DBUG     14- 81#
DIRA     1- 14#
DIRBUF   1- 14#
DIV      1- 65#    3- 20#    3- 22#@   3- 23#    5-109#@   7- 35#    9- 19#@
         10- 18#@  10- 45#@  11-  3#@  11- 54#@  11- 62#   11- 63#   11- 65#@
         11- 71#@  11- 73#   11- 75#   11- 77#@  12-265@
DPSCN    1- 43#    7-  1#    7- 30
DR       1- 66#
DRIN     1- 66#    8- 48     8- 50     8- 51     8- 52
DROUT    1- 66#    8- 18@    8- 25@    8- 47@
DSKFL    2- 36#    2- 44     2- 50     2- 60
DSKIN    1- 16#    1- 27#    11- 40#   12-232#   12-253#   14- 31#
DSKLKK   2- 26#    2- 40     2- 61     2- 64     2- 69     2- 74     2- 76
DSKOUT   1- 47#    14- 33#
DSKTLP   2-  3#    2- 39#
DSKXYZ   1- 10#    11- 39@   11-118#   11-145
EAENOR   1- 65#    3- 20#    3- 22#    3- 23#    5-109#    7- 35#    9- 19#
         10- 18#   10- 45#   11-  3#   11- 54#   11- 62#   11- 63#   11- 65#
         11- 71#   11- 73#   11- 75#   11- 77#
EAESC    1- 65#    3- 20#    3- 22#    3- 23#    5-109#    7- 35#    9- 19#
         10- 18#   10- 45#   11-  3#   11- 54#   11- 62#   11- 63#   11- 65#
         11- 71#   11- 73#   11- 75#   11- 77#
EAESR    1- 65#    3- 20#    3- 22#    3- 23#    5-109#    7- 35#    9- 19#
         10- 18#   10- 45#   11-  3#   11- 54#   11- 62#   11- 63#   11- 65#
         11- 71#   11- 73#   11- 75#   11- 77#
EIGHT    10- 42#
EIGHTY   5-119     5-141#
EQBUF    1- 12#    7-  1#    7- 22     7- 24     7- 26     7- 28     8-  2
         8-  3     10- 46    10- 47    10- 48    10- 49    14- 65    14- 66
         14- 69    14- 70
EQBUFL   1- 15#    14- 66    14- 70
ERFLD    11- 27#   11- 60
ERLOC    4- 12#    4- 27     4- 28@    5- 32     5- 33@
```

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```
ERR        8- 30#    8- 34
ERRM       8- 31     8- 84#
EXIT       12-195    12-198#
FIN        1- 26#    10- 52
FIX        1- 40#
FIXLP      1- 20#
FIXVEC     12-134#   12-162    12-233    12-245
FLAGG      1- 10#    14- 85#
FLD        1- 14#    7- 10     12-232    12-253    12-264
FMAX       1- 11#    10-111#   11- 54
FRLUT      1- 38#
GCFLG      1- 32#
GETCHM     5-  3#    5- 42
GETCOR     1- 17#    12-231    12-252    12-262#
GETPKS     1- 29#    4-  8#    4- 31     5- 37     11- 22#    11- 47
GETYMA     3- 13     3- 55#
HOWMNY     10- 44#   10- 53
HUND       1- 10#    3- 52     10- 28    10- 35#   11-112
IAXIS      2-  1#    3- 50     5-117     10- 26    11-110
IBUF       1- 29#    4- 12#    4- 16#    4- 17     4- 27     5- 32      5- 96#
           5- 97     10- 65#   11- 36#   11- 37    11- 42#   12-113#
IMAGE      12-236    12-275#
IMCR       1-  8#    3- 71#
IMOREC     1- 29#    3- 18     3- 28     4-  9#    4- 52     5- 93      10- 30
           11- 30    11-123    12-256
INCHSM     1- 12#    10- 44
INFAD      1- 19#
INFADR     1- 21#
INITIL     1-  6#
INPUT      1- 27#    4- 16#    5- 96#    10- 65#   11- 36#   11- 42#    12-113#
INST1      1- 18#    10-128    10-130
INST2      1- 18#    10-123    10-125
INTMU      1- 45#    5-  3#    6- 49@    6- 55@    6- 65@    6- 70@     6- 76@
           7- 26     7- 35
INTSCA     7-  1#    7- 27
ISYMBL     1- 28#    3- 44     10- 93    11- 94
JMOREC     1- 17#    12-147
KMOREC     13- 11@   13- 41    13- 43#
LENGTH     1- 11#    11- 54    11-130#
LF         1- 53#    3- 69     3- 70     8- 83     8- 84     12-275
LFLDM      1- 13#    11- 27
LHDR       2- 38#    2- 64     2- 70
LINE       8- 12     8- 66     8- 72     8- 81#
LININC     1- 44#    10- 45@   10- 46    10- 48
LPB        12- 34#   12-105@
LPERRR     12- 71    12-110#
LPF        1- 32#
LPFG       12- 48    12- 68    12-101    12-110    12-111@   12-117@    12-119#
LPFL       2- 37#    2- 39@    2- 45     2- 62
LPLKK      2- 31#    2- 41     2- 63     2- 70     2- 71     2- 75      2- 77
LPMM       1- 35#
LPOK       12- 69    12- 72#   12-116
LPP        14- 45#   14- 59    14- 83
LPRM       12-112    12-121#
LPS        12- 33#   12- 34    12- 50    12- 52    12- 53@   12- 70     12-103
LPSSAV     12- 52@   12-120#
LSH        1- 65#    3- 20#    3- 22#    3- 23#    5-109#    7- 35#@    9- 19#
           10- 18#   10- 45#   11-  3#   11- 54#   11- 62@@  11- 63#@   11- 65#
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```
          11- 71#    11- 73#@ 11- 75#@ 11- 77#
MASINC    3- 20      3- 23     3- 52    10-108#   11-112
MASSM     3- 72#     4- .6     5- 96
MAXIT     5-103      5-130#
MBUF      1-  7#     11- 28    11- 29   11-121    11-122
MCR       1-  8#     4-  8#    4- 13#
MFI       1- 16#     8- 11#    8- 27
MPEAK     3- 41      3- 70#
MQ        1- 65#     3- 20#@   3- 22#@  3- 23#@   5-109#@   7- 35#@   8-  2
          9- 19#@  10- 18#@  10- 45#@ 11-  3#@  11-  6@   11- 10@   11- 54#@
         11- 62#@  11- 63#@  11- 64   11- 65#@  11- 71#   11- 73#   11- 75#@
         11- 76    11- 77#@  12-232   12-253    12-263@   12-264@   12-268@
MOQ       1- 13#    11- 38@   11- 39   11- 40
MS30F     1- 32#    10-107#
MTABL     1- 12#    10- 68
MTIC     10- 18#    10- 25
MUL       1- 65#     3- 20#@   3- 22#@  3- 23#@   5-109#@   7- 35#    9- 19#
         10- 18#@  10- 45#    11-  3#   11- 54#@ 11- 62#    11- 63#   11- 65#@
         11- 71#@  11- 73#    11- 75#   11- 77#@
MWANT     3- 68#     4- 18@    4- 33    5- 50     5- 98@    .
M10       1- 23#
M30       1- 23#
NBOKRE    1- 37#
NEWORG    5-102      5-121     5-125#
NOCHEK   14- 37     14- 42#
NOPI     12-267     12-269#
NO1      12- 44#    12- 45    12- 60   12- 63    12-172
NO2      12- 61     12- 64#   12- 78   12-100
NO3      12- 79#    12- 80    12- 99   12-202
NO5      12-176#    12-177    12-197   12-218    12-226
NTABL     1- 12#    10- 68
NULLTR   12- 76     12- 98#
NUM       1- 31#
OCNTRL   12- 66     12- 89#
OCRLF     1- 38#     4- 14     5- 94    7- 25     7- 29     8-  4     10- 50
         12-144     12-161    12-164#  12-217    12-230    12-239    12-244
         12-255
ONEE      1- 23#     3- 34     3- 46    5-114    10- 23    11- 86    11- 96
         11-102     11-105
ONE5     10- 43#    10- 76
ORANG    14- 39     14- 41    14- 64#
ORANGM   14- 27#    14- 64
ORIGIN    1- 24#     5-128    10- 57   10- 64    10- 77
OSLAS    12-210     12-212    12-257#
OTABL     1- 13#    10- 70
OUTCHR   12- 72     12- 95    12-101#  12-143    12-160    12-166    12-168
         12-192     12-199    12-207   12-225    12-229    12-243    12-249
         12-259     12-272
OUTIT     8-  2#     9- 20
OUTUP     1- 17#    12- 93    12-141   12-158    12-205    12-227    12-241
         12-247     12-270#
OUT10     3- 35      3- 40#
OUT11     3- 48      3- 54#
OUT12     4- 49      4- 52#
OUT13    12-186     12-188#
OUT14     3- 38      3- 41#
OUT15    13-  8     13- 45#
PC        1- 69#     2- 81@    3- 36@   3- 49@    4- 50@    5- 29@    5- 38@
```

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```
                 5- 39@    5- 40@    5- 41@    5- 48@    5- 88@    5- 89@    5- 90@
                 5- 92@    5- 99@    5-102@    5-103@    5-121@    5-124@    5-129@
                 5-140@    6- 29@    7- 31@    8-  6@    8- 10@    8- 28@    9- 16@
                 9- 20@    9- 22@   10- 71@   10-119@   10-138@   12- 72@   12- 95@
                12-109@   12-140@   12-143@   12-160@   12-162@   12-166@   12-168@
                12-187@   12-192@   12-199@   12-207@   12-225@   12-229@   12-233@
                12-243@   12-245@   12-249@   12-259@   12-272@   13- 39@   13- 46@
                15- 19@
PCOUNT           6- 86#    7- 16@    7- 18     7- 22     7- 30
PCS             13- 11@   13- 38    13- 42#
PCSAV            2- 39@    2- 80     2- 82#    5-100@    5-123
PDSC             1- 10#    5-111     5-119    10- 20    10- 28    10- 39#
PEAKS            1- 46#   12-246    12-263
PKSNM            4- 12#    4- 27     5- 32
PLT              1- 24#    3- 29     3- 32     5-112     5-125    10- 21    10- 54
                10- 61    10- 74    11- 81    11- 84    11- 97    11-100    11-103
PLTCHR           1- 10#   10-  2@
PLTCH1           1- 10#   10-  4#
PLTIT            3- 24     3- 29#    .
PLTMAS           3-  2#    3-  8#
PLTMES          10- 67    10- 69    10- 72    10- 80#   11-136    11-146
PLTR             1- 67#
PLTSPC           1- 10#   11- 31#
PLTSWT           3-  2#    3- 10               •
PPF              1- 32#
PPMM             1- 33#
PROFIL           5- 88     5- 89     5- 90     5-100#
PRTVEC           1- 54#    1- 64#    4- 11#   12- 81    12- 82@   12- 87@
PSW              1- 69#
PTABL            1- 13#   10- 70
PTSNUM           7-  1#    7- 23
PWANT            5-142#    7-  1#    7-  2     7-  4@
P100            10- 34#   10- 56    10- 63    10- 76
QTABL            1- 13#   11-137
QWAA            10-113    10-115#   10-118    10-120    11-138    11-145
RAWREC           1- 29#
RBUF             5- 18#    5- 40     5- 44     5- 47@    5- 59@    5- 86     5- 87
                 5- 88               •
RNUM             1- 50#
RRSTR            1- 48#    2- 79     5- 27     5-122    15- 20#
RSAV             1- 48#    2- 43     5- 21     5-101    15- 15#
RTABL            1- 13#   11-137
RTI             12- 82    12-128#   12-134
RTIS            12- 81@   12- 87    12-130#
RUBFLG          12- 42@   12- 55@   12- 75    12-133#   12-182    12-185@   12-213@
                12-216@   12-222
RUBOUT          12-181    12-219@
R0               1- 69#    2- 44@    2- 49@    2- 50@    2- 52@    2- 55@    2- 59@
                 2- 60@    2- 61@    2- 62@    2- 63@    3- 14     3- 15     3- 20
                 3- 21@    3- 22     3- 23     3- 55@    3- 58     3- 60     3- 61
                 4- 19@    4- 20@    4- 21     4- 23@    4- 43     4- 46@    5- 22@
                 5- 24@    5- 25     5- 43@    5- 60     5- 71@    5-109     5-131
                 5-133@    5-134     5-136@    8- 11@    8- 48@    8- 50@    8- 51@
                 8- 52@    8- 54@    8- 55@    8- 56@    8- 57@    8- 60@    8- 61@
                 8- 62@    8- 63@    8- 64@    8- 65@    8- 68     8- 73@    8- 75
                 8- 76     8- 77     8- 78     8- 79@    9-  4@    9-  9@    9- 19
                10- 10@   10- 11    10- 13    10-120@   10-124@   10-129@   10-132
                10-133@   10-134@   10-135    10-136@   10-137    11- 23@   11- 28
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            11- 48     11- 50     11- 51     11- 58     11- 62     11- 63     11-138¢
            11-140     11-142¢    12- 36     12- 38¢    12- 39¢    12- 56     12- 59¢
            12- 77¢    12- 84¢    12-196¢    13-  9     13- 12¢    13- 13¢    13- 14
            13- 16     13- 19     13- 22     13- 25     13- 28     13- 31     13- 34
            13- 37¢    14- 34     14- 35¢    14- 45¢    14- 58     14- 60¢    14- 81¢
            15- 17     15- 22¢
ROSAV       12- 36¢    12- 56¢    12- 84     12-124#    14- 34¢    14- 60
ROSAVR      13-  9¢    13- 37     13- 44#
ROO         1- 41#     5- 20¢     5- 28      5-100¢     5-105      6- .32¢    6- 47¢
            6- 82#     7- 33¢     7- 37¢
R1          1- 69#     3- 56¢     3- 58      3- 60¢     3- 64      4- 32¢     4- 33
            4- 36¢     4- 46      5- 23¢     5- 25      5- 44¢     5- 61      5- 65¢
            5- 66      5-104¢     5-105¢     5-106      5-109      5-131¢     5-137¢
            8- 12¢     8- 15¢     8- 24¢     9-  4¢     9- 10¢     9- 13¢     9- 19
            10-  9¢    10- 14¢    10-123¢    10-124     10-125     10-128¢    10-129
            10-130     11-  3     11- 19     11- 20     11- 24¢    11- 52¢    11-139¢
            11-140     11-141     11-143     12- 37     12- 38¢    12- 39     12- 40
            12- 57     12- 58¢    12- 65     12- 73     12- 85¢    12- 89     12- 91
            12- 94¢    12- 96¢    12- 98     12-105     12-108     12-134¢    12-135
            12-136     12-137     12-142¢    12-159¢    12-164     12-165¢    12-167¢
            12-169¢    12-178¢    12-179¢    12-180     12-189     12-194     12-198¢
            12-203     12-206¢    12-208¢    12-215¢    12-219¢    12-220     12-228¢
            12-242¢    12-248¢    12-257     12-258¢    12-260¢    12-270     12-271¢
            12-273¢    14- 43     14- 44¢    14- 50     14- 51     14- 52     14- 55
            14- 61¢    15- 17     15- 22¢
R1SAV       12- 37¢    12- 57¢    12- 85     12-126#
R10         1- 41#     5- 20¢     5- 23      5-100¢     5-104      5-120¢     5-127
            6- 36¢     6- 40      6- 43¢     6- 54¢     6- 57      6- 59      6- 62¢
            6- 63      6- 67      6- 69¢     6- 75¢     6- 83#     7- 34¢     7- 35¢
            7- 36¢
R11         6- 36¢     6- 37      6- 42¢     6- 50      6- 53¢     6- 78#     6- 79#
R2          1- 69#     3- 57¢     3- 62¢     5- 45¢     5- 62      5- 70¢     5- 71
            5- 73¢     5-107¢     5-109      5-110      5-130¢     5-132¢     5-134
            5-136      8- 14¢     8- 16¢     8- 37¢     8- 42¢     8- 46¢     8- 47
            8- 67¢     8- 70¢     9-  4¢     9- 15¢     9- 17      9- 19      11- 12¢
            11- 15¢    11- 19¢    11- 62¢    11- 64¢    11- 65     11- 73¢    11- 76¢
            11- 77     12-145¢    15- 17     15- 22¢
R20         1- 41#     5- 20¢     5- 22      5-100¢     5-103      5-107      5-115¢
            6- 84#
R3          1- 69#     3- 19¢     3- 25¢     5- 46¢     5- 70      8-  7¢     8-  8¢
            8- 38¢     8- 40      8- 44      8- 46      8- 53¢     8- 54      8- 55
            8- 56      8- 57      8- 60      8- 75¢     8- 76¢     8- 77¢     8- 78¢
            9-  8¢     9-  9      9- 11      11-  7¢    11- 14¢    12-146¢    15- 17
            15- 22¢
R30         1- 41#     5-106¢     5-119      6- 33¢     6- 34      6- 40      6- 43
            6- 45¢     6- 85#     7- 10¢     7- 11      7- 13¢
R31         6- 34¢     6- 35¢     6- 37      6- 42      6- 46¢     6- 80#
R33         1- 27#     10-  7¢    10- 17¢    10- 18     10- 19¢    10- 37#    10- 84¢
            10- 85¢    10- 86¢    10-103¢    11- 69¢    11- 71     11- 72¢    11- 73
            11- 74¢    11- 75     11-107¢
R4          1- 69#     5- 49¢     5- 50      5- 53¢     5- 64      8- 66¢     8- 68
            8- 69¢     11-  8¢    11-  9¢    11- 14     15- 17     15- 22¢
R40         1- 41#     5-130¢     5-139      6- 87#     7-  9¢     7- 11¢     7- 12¢
R44         10-  7¢    10- 16¢    10- 24¢    10- 36#    10- 89¢    10- 95     10-102¢
            11- 20¢    11-108¢
R5          1- 69#     2- 43¢     2- 79¢     3-  8¢     3- 12¢     3- 13¢     3- 17¢
            3- 24¢     3- 27¢     3- 29¢     3- 32¢     3- 40¢     3- 41¢     3- 44¢
            3- 47¢     3- 50¢     3- 53¢     3- 54¢     3- 67¢     4- 14¢     4- 15¢
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             4- 16@     4- 25@     4- 31@     5- 21@     5- 27@     5- 30@     5- 37@
             5- 42@     5- 64@     5- 65      5- 73      5- 91@     5- 94@     5- 95@
             5- 96@     5-101@     5-112@     5-117@     5-122@     5-125@     5-128@
             7-  8      7- 16      7- 23@     7- 24@     7- 25@     7- 27@     7- 28@
             7- 29@     8-  3@     8-  4@     8- 31@     8- 72@     10-  5@     10-  6@
             10- 21@    10- 26@    10- 29@    10- 44@    10- 47@    10- 49@    10- 50@
             10- 51@    10- 52@    10- 53@    10- 54@    10- 57@    10- 58@    10- 60@
             10- 61@    10- 64@    10- 65@    10- 67@    10- 69@    10- 72@    10- 74@
             10- 77@    10- 79@    10- 81     10- 82     10- 83     10- 84     10- 85
             10- 87     10- 88     10- 89     10- 90     10- 91     10- 93@    10-102
             10-105     10-106@    11- 21@    11- 25@    11- 26@    11- 27@    11- 29@
             11- 31@    11- 36@    11- 40@    11- 42@    11- 44@    11- 47@    11- 81@
             11- 84@    11- 94@    11- 97@    11-100@    11-103@    11-110@    11-113@
             11-120@    11-122@    11-124@    11-127@    11-136@    11-146@    11-148@
             12- 43@    12- 54@    12- 60@    12- 62@    12- 63@    12- 88@    12- 93@
             12-112@    12-113@    12-141@    12-144@    12-158@    12-161@    12-170@
             12-171@    12-172@    12-205@    12-210@    12-212@    12-217@    12-227@
             12-230@    12-231@    12-232@    12-236@    12-239@    12-241@    12-244@
             12-247@    12-252@    12-253@    12-255@    12-261@    12-269@    12-274@
             14- 63@    14- 64@    14- 67@    14- 68@    14- 69     14- 71@    15- 17
             15- 18@    15- 23@
R5SAV        1- 27#     12- 38@    12- 58@    12- 86     12-127#
R50          1- 41#     6- 88#     7-  8@     7- 14@
R6           1- 69#
R7           1- 69#
SBTTLS       3-  2#     3- 12      11- 44     11-136#
SCALIT       1- 18#     6- 17      6- 31#
SCANS        1-  6#     4-  8#     4- 25      5- 30
SCANSC       5- 30#     5- 48
SCPMAX       6- 57      6- 63      6- 67      6- 81#
SDIRER       4-  9#     4- 30      5- 36
SET          1- 24#     10- 60
SETINC       1- 25#
SHIFTM       6- 17      7- 33#
SIZE         1-  7#     3- 52      5-119      10- 28     10- 33#    11-112
SNUM         1- 50#
SP           1- 69#     2- 39      2- 40#@    2- 41#@    2- 45@     2- 46@     2- 49
             2- 52      2- 53@     2- 55      2- 56@     2- 57@     2- 59      2- 61#@
             2- 63#@    2- 64#@    2- 69#@    2- 70#@    2- 71#@    2- 74#@    2- 75#@
             2- 76#@    2- 77#@    2- 80@     3- 17@     3- 35@     3- 41@     3- 48@
             4- 16@     4- 17#@    4- 18      4- 49@     5- 20      5- 28@     5- 35
             5- 39@     5- 40@     5- 88@     5- 89@     5- 90@     5- 96@     5- 97#@
             5- 98      5-100      5-103@     5-123@     5-130      5-139@     6-  3
             6- 28@     7- 22#@    7- 23@     7- 24@     7- 26#@    7- 27@     7- 28@
             7- 30@     8-  2#@    8-  3@     8- 27@     8- 31@     8- 68#1     8- 72@
             9- 21@     10-  7     10- 44@    10- 46#@   10- 47@    10- 48#@   10- 49@
             10- 65@    10-118@    10-132#@   10-135#@   10-137#@   11- 27@    11- 28#@
             11- 29@    11- 36@    11- 37@    11- 38     11- 40@    11- 42@    11-120@
             11-121#@   11-122@    11-124@    11-127@    11-140#@   11-145#@   12- 38
             12- 41@    12- 58     12- 86@    12-110@    12-112@    12-113@    12-115
             12-117     12-164@    12-169     12-186@    12-232@    12-236@    12-253@
             12-257@    12-260     12-270@    12-273     13- 11     13- 38@    13- 45@
             14- 35     14- 43@    14- 50#@   14- 51#@   14- 52#@   14- 55#@   14- 61
             14- 62@    14- 64@    14- 65#@   14- 66@    14- 68@    14- 69#@   14- 70
             15- 16     15- 17@    15- 19     15- 21     15- 22
SPACEC       1- 39#
SSNUM        1- 16#     4-  8#     4- 39      5- 56
STRING       1-  9#     1- 17#     3- 17#     3- 41#     4-  8#     4- 16#     5- 96#
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	7- 23#	7- 24#	7- 27#	7- 28#	8- 3#	8- 31#	8- 72#
	10- 44#	10- 47#	10- 49#	10- 65#	11- 27#	11- 29#	11- 36#
	11- 42#	11-120#	11-122#	11-124#	11-127#	12- 55#	12-112#
	12-113#	12-236#	14- 64#	14- 68#			
STRT	1- 14#	12-240					
STUFF	1- 12#	10- 6					
STUP	3- 8	10- 5	10- 59#	11- 31			
SWITCH	1- 16#						
SWR	1- 69#						
SYMBOL	1- 28#						
TBLK	14- 31@	14- 33@	14- 35@	14- 36	14- 38	14- 40	14- 46@
	14- 47@	14- 51 ..	14- 56@	14- 57@	14- 65	14- 79#	
TCNTR	14- 48	14- 53@	14- 73#				
TDA	1- 18#	14- 30#	14- 40				
TEMF	15- 16@	15- 18	15- 24#				
TEROR	6- 8	6- 10	6- 20#				
TERORM	6- 22#						
THENUM	4- 9#	4- 15	5- 95				
THIGH	6- 7	6-'19#					
THREG	10- 32#						
TICA	1- 19#						
TICBUF	1- 12#	4- 9#	4- 19	4- 21	4- 23	4- 24@	4- 42@
	5- 46	6- 25	6- 26	6- 28	10- 9	10- 10	10- 16
	10- 17						
TICC	1- 48#						
TICFLG	1- 29#	10- 3@	11- 32@	11- 34	11-114		
TITLES	1- 12#	10- 65	11- 42				
TKB	1- 64#	2- 67	4- 11#	12-178	13- 12		
TKS	1- 64#	2- 42@	2- 65	2- 78@	4- 11#	8- 5	8- 13@
	9- 3@	12-139@	12-173	12-175@	12-176	12-200	12-201@
	13- 7	13- 10@					
TKSSAV	12- 38@	12- 41	12-131#	12-173@	12-174@	12-201	
TLIST	6- 13	6- 17#					
TLNK	1- 47#	14- 44	14- 75#				
TLOW	6- 9	6- 18#					
TODO	12-113	12-122#					
TPB	1- 64#	4- 11#	12-108@				
TPS	1- 64#	4- 11#	12- 44	12- 46	12- 47@	12- 79	12- 83@
	12-106	12-138@					
TPSSAV	12- 46@	12- 83	12-132#				
TRAPH	6- 2#	6- 20					
TRA.	1- 42#						
TRNUM	4- 12#	4- 27	5- 32				
TRPHDL	6- 2#	6- 3#					
TRR	14- 49	14- 51#					
TRX	14- 54	14- 56#					
TSNUM	4- 8#	4- 12#	4- 27	4- 39	4- 41@	5- 32	5- 56
	5- 58@	5- 68@	5- 70	5- 72@			
TTABL	10- 73	10-113@	11-147				
TTWO	3- 46	11- 96	11-119#				
TTYI	1- 48#	4- 8#	12-171#				
TTYLOK	1- 4#	3- 36	3- 49	4- 50	5- 92	8- 28	9- 22
	13- 7#						
TTYLO1	12-187	13- 9#					
TTYO	1- 48#	12- 62#	14- 67	14- 71			
TTYSA	12- 40@	12-129#	12-215	12-220			
TTY2	12-125#	14- 35@	14- 62				
TUIC	4- 12#	4- 27	5- 32				

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CROSS REFERENCE TABLE   S-9

TWO5	3- 22	3- 52	10- 18	10- 28	10- 31#	11- 71	11-112
TYPE1	1- 14#	12-234	12-250				
UIC	1- 50#						
UN	1- 70#						
UTABL	10- 73	10-114#	11-147				
U1X	1- 29#						
WAVEM	6- 17	7- 2#					
WTRR	8- 7#	9- 16					
X	1- 22#	11- 90@	11- 92@	11- 96			
XC	3- 23@	3- 31	3- 34	3- 37	3- 39	3- 42@	3- 46
	5-108@	5-111@	5-114	5-119	10- 8@	10- 20@	10- 23
	10- 28	10- 40#	10- 81@	10- 99@	10-100	11- 77@	11- 83
	11- 86	11- 87@	11- 88	11- 90	11- 99	11-102	11-105
	11-106	11-125					
XCL	3- 9@	3- 37	3- 39@	10-112#	11- 70@	11- 88	11-106@
XDIV	10-110#	11- 54@	11- 65	11- 77	11-128		
XMAX	3- 20@	3- 52	10-109#	11- 65@	11-112	11-121	11-125@
	11-128@						
XSTORE	1- 28#						
XY1	11- 49	11- 51#					
XY2	11- 48#	11- 53					
XY3	11- 71#	11-109					
XY4	1- 10#	11- 33#	11-116				
XY5	11- 39	11-100#					
Y	1- 22#	11- 91@	11- 93@	11- 96			
YC	3- 22@	3- 34	3- 43@	3- 46	5-109@	5-114	10- 18@
	10- 23	10- 38#	11- 71@	11- 86	11- 91	11- 99	11-102
YE	1- 27#	4- 16#	5- 96#	10- 65#	11- 36#	11- 42#	12-113#
	14- 84#						
YESB	12-184#	12-211					
YESC	12-214	12-224#					
YESS	12-183	12-210#					
YEST	12-212#	12-223					
YKURV	7- 1#	7- 31					
YMAX	3- 22	3- 64@	3- 66@	10- 8@	10- 11	10- 13@	10- 18
	10- 41#	11- 46@	11- 48	11- 50@	11- 71		
YSTORE	1- 28#						
ZERO	1- 23#	3- 31	3- 46	3- 52	5-119	5-127	10- 28
	10- 56	10- 63	10- 76	10- 97	11- 83	11- 96	11- 99
	11-105	11-112					
	3- 30	3- 33	3- 45	3- 51	4- 26	5- 17#	5- 19#
	5- 31	5-113	5-118	5-126	8- 82#	10- 22	10- 27
	10- 55	10- 62	10- 75	10- 94	11- 82	11- 85	11- 95
	11- 98	11-101	11-104	11-111			
SYM	2- 40#	2- 41#	2- 61#	2- 63#	2- 64#	2- 69#	2- 70#
	2- 71#	2- 74#	2- 75#	2- 76#	2- 77#	4- 17#	5- 97#
	7- 22#	7- 26#	8- 2#	8- 68#	10- 46#	10- 48#	10-132#
	10-135#	10-137#	11- 28#	11-121#	11-140#	11-145#	14- 50#
	14- 51#	14- 52#	14- 55#	14- 65#	14- 69#		

CROSS REFERENCE TABLE   M-1

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CLREM     1-  3#    6- 36     9-  4     10-  8
DIVD      1-  3#    9- 19     10- 45    11-  3
DSKI      1-  3#    11- 40    12-232    12-253
DSKO      1-  3#
EMT442    1-  5#    11- 37
LOGSHT    1-  5#    7- 35     11- 62    11- 63    11- 73    11- 75
MULT      1-  5#    3- 20     3- 22     3- 23     5-109     10- 18    11- 54
          11- 65   11- 71    11- 77
MULTDV    1-  5#    3- 22     5-109     10- 18    11- 54    11- 65    11- 71
          11- 77
POP       1-  3#    2- 39     2- 49     2- 52     2- 55     5- 20     5-100
          5-130    10-  7    12- 38    12- 58    12-117    12-169    12-260
          12-273   13- 11    13- 45    14- 35    15- 22
POPR      1-  5#    11- 14
POPTST    1-  3#    2- 59     4- 18     5- 98     11- 38
PSHJPC    5-  4#    5- 39     5- 40     5- 88     5- 89     5- 90     5-103
PUSH      1-  3#    2- 45     2- 80     3- 35     3- 48     4- 49     5- 28
          5- 39#   5- 40#    5- 88#    5- 89#    5- 90#    5-103#    5-123
          5-139    6- 28     7- 30     8- 27     9- 21     10-118    11- 37#
          11- 40#  12-110    12-164    12-186    12-232#   12-253#   12-257
          12-270   13- 38    14- 66    14- 70    15- 17
RESUL     1-  5#    3- 20#    3- 22#    3- 23#    5-109#    7- 35#    9- 19#
          10- 18#  10- 45#   11-  3#   11- 54#   11- 62#   11- 63#   11- 65#
          11- 71#  11- 73#   11- 75#   11- 77#
STRGO     1-  5#    3- 17     3- 41     4- 16     5- 96#    7- 23     7- 24
          7- 27    7- 28     8-  3     8- 31     8- 72     10- 44    10- 47
          10- 49   10- 65    11- 27    11- 29    11- 36#   11- 42#   11-120
          11-122   11-124    11-127    12-112    12-113#   12-236    14- 64
          14- 68
TTYIO     1-  5#    4- 16     5- 96     10- 65    11- 36    11- 42    12-113
.ALLOC    1- 35#
.AMODE    2- 40#   2- 41#    2- 61#    2- 63#    2- 64#    2- 69#    2- 70#
          2- 71#   2- 74#    2- 75#    2- 76#    2- 77#    4- 17#    5- 97#
          7- 22#   7- 26#    8-  2#    8- 68#    10- 46#   10- 48#   10-132#
          10-135#  10-137#   11- 28#   11-121#   11-140#   11-145#   14- 50#
          14- 51#  14- 52#   14- 55#   14- 65#   14- 69#
.BIN2D    1- 61#   7- 22     7- 26     11- 28
.BIN2O    1- 61#   8-  2     8- 68     10- 46    10- 48    10-132    11-121
          11-140   11-145    14- 65    14- 69
.CLOSE    1- 60#   2-  4#    2- 74     2- 75
.CODE     2- 61#   2- 63#
.CVTDT    1- 57#   10-135    10-137
.DATE     1- 59#
.D2BIN    1- 56#   4-  2#    4- 17     5- 97
.GTUIC    1- 59#
.INIT     1- 59#   2-  4#    2- 40     2- 41     14- 50
.LOOK     1- 55#
.OPEN     2- 61#   2- 63#
.OPENI    2-  4#   2- 61
.OPENO    1- 60#   2-  4#    2- 63
.O2BIN    1- 58#
.PARAD    1- 62#   1- 63
.PARAM    1- 59#   1- 69
.PARDR    1- 62#   1- 66
.PAREA    1- 62#   1- 65     3- 20#    3- 22#    3- 23#    5-109#    7- 35#
          9- 19#   10- 18#   10- 45#   11-  3#   11- 54#   11- 62#   11- 63#
          11- 65#  11- 71#   11- 73#   11- 75#   11- 77#
.PARTY    1- 62#   1- 64     4- 10#    4- 11
```

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```
CROSS REFERENCE TABLE    M-2

. RADPK   1- 61#
. READ    2-  4#    2- 64
. RLSE    1- 59#    2-  5#    2- 76    2- 77    14- 55
. TIME    1- 59#
. TRAN    1- 59#   14- 51
. WAIT    1- 59#    2-  4#    2- 69    2- 71    14- 52
. WRITE   1- 60#    2-  4#    2- 70
```

CCLIB1 Module Real Time Data Aquisition Routine

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CCLIB1 MACRO VR05A 01-JAN-72 00:52
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```
 1                              . TITLE   CCLIB1
 2                              . SBTTL   GLOBALS, REGISTERS,  AND DEFINITIONS
 3                              . GLOBL   SCANS, INITIL
 4                              . GLOBL   STRING
 5                              . GLOBL   SET, PLT, ORIGIN
 5                              . GLOBL   X, Y
 7                              . GLOBL   M30, ONES, ZERO, M10
 8                              . GLOBL   SETINC, CHROMA
 9                              . GLOBL   FIN
10                              . GLOBL   SIZE
11                              . GLOBL   MBUF, IAXIS
12                              . GLOBL   BLANK, INPUT, DSKIN, YE, R5SAV, R33
13                              . GLOBL   SYMBOL, ISYMBL, XSTORE, YSTORE
14                              . GLOBL   RAWREC, U1X, GETPKS, IBUF, DATAB, IMOREC, TICFLG
15                              . GLOBL   A13LUT, ANOTM, ADMES
16                              . GLOBL   NUM
17                              . GLOBL   LPF, PPF, MS20F, GCFLG
18                              . GLOBL   PPMM
19                              . GLOBL   BLNK
20                              . GLOBL   LPMM
21                              . GLOBL   ALUT
22                              . GLOBL   NBOKRE
23                              . GLOBL   FRLUT, OCRLF
24                              . GLOBL   SPACEC
25                              . GLOBL   FIX
26                              . GLOBL   R00, R10, R20, R30, R40, R50
27                              . GLOBL   TRA
28                              . GLOBL   DPSCN
29                              . GLOBL   LININC
30                              . GLOBL   INTMU
31                              . GLOBL  PEAKS
32                              . GLOBL   TLNK, DSKOUT
33                              . GLOBL   TICC, RSAV, RRSTR, TTYI, TTYO
34                              . GLOBL   BLOK
35                              . GLOBL   RNUM, UIC, SNUM
36        000015               CR=15
37        000011               BB=11
38        000064               PRTVEC=64
39                              . MCALL    . D2BIN
40                              . MCALL    . CVTDT
41                              . MCALL   MULT, DIVD
42                              . MCALL    . 02BIN
43                              . MCALL    . PARAM, . DATE, . TIME, . GTUIC, . INIT, . RLSE, . WAIT, . TRAN
44                              . MCALL    . WRITE, . OPENO, . CLOSE
45                              . MCALL    . BIN20, . RADPK,  BIN2D
46                              . MCALL    . PARAD, . PARTY, . PAREA, . PARDR
47 00000                        . PARAD
48 00000                        . PARTY
49 00000                        . PAREA
50 00000                        . PARDR
51        172554               PLTR=172554
52        177546               CLK=177546
53 00000                        . PARAM
54                              . SBTTL   CALCOMP AXIS SUBROUTIINE
55 00000          IAXIS:
56 00000 004567        JSR     R5, RSAV
57 00004 016567        MOV     2( R5 ), 1$
```

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```
58 00012 004567          JSR      R5, PLT
59 00016 000403          BR       . +10
60 00020 000000 1$:      . WORD   0, ZERO, ZERO
61 00026 016567          MOV      4( R5 ), 2$
62 00034 004567          JSR      R5, PLT
63 00040 000403          BR       . +10
64 00042 000000 2$:      . WORD   0
65 00044 001316'         . WORD   ZERO, ONEE
56 00050 005775          TST      @12( R5 )
67 00054 003002          BGT      5$
58 00056 000167          JMP      S20
69 00062          5$:
70 00062                 DIVD     @4( R5 ), , @12( R5 ), ACNTR, X
71 00112 167567          SUB      @4( R5 ), X
72 00120 005467          NEG      X
73 00124                 DIVD     @2( R5 ), , @12( R5 ), , Y
74 00146 167567          SUB      @2( R5 ), Y
75 00154 005467          NEG      Y
76 00160                 MULT     @16( R5 ), #7, OFFS
77 00202 016767          MOV      OFFS, YSIZE
78 00210 006267          ASR      YSIZE
79 00214                 MULT     @16( R5 ), #5, XSIZE
80 00226 006267          ASR      XSIZE
81 00242 005467          NEG      OFFS
82 00246 066767          AND      M30, OFFS
83 00254 066767          ADD      M10, OFFS
84 00262 004567 S10:     JSR      R5, PLT
85 00266 000403          BR       . +10
86 00270 001310'         . WORD   X, ZERO, ZERO
87 00276 004567          JSR      R5, PLT
88 00302 000403          BR       . +10
89 00304 001310'         . WORD   X, M30, ONEE
90 00312 005767          TST      ACNTR
91 00316 001511          BEQ      NLBL
92 00320                 . BIN2D  #MBUF, ACNTR
93 00336 126727          CMPB     MBUF+4, #60
94 00344 001404          BEQ      LBL
95 00346 126727          CMPB     MBUF+4, #65
96 00354 001072          BNE      NLBL
97 00356 012767 LBL:     MOV      #MBUF, ADLBL
98 00364 012767          MOV      #4, NCHAR
99 00372 127727 1$:      CMPB     @ADLBL, #60
100 0400 001005          BNE      2$
101 0402 005367          DEC      NCHAR
102 0406 005267          INC      ADLBL
103 0412 000767          BR       1$
104 0414          2$:    MULT     XSIZE, NCHAR, XS
105 0436                 MULT     NCHAR, SPACEC
106 0452 066767          ADD      MQ, XS
107 0460 005267          INC      NCHAR
108 0464 166767          SUB      X, XS
109 0472 005467          NEG      XS
110 0476 004567          JSR      R5, PLT
111 0502 000403          BR       . +10
112 0504 001332'         . WORD   XS, OFFS, ZERO
113 0512 017567          MOV      @16( R5 ), SIZE
114 0520 004567          JSR      R5, ISYMBL
```

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```
115 0524 ......406      BR       .+16
116 0526 001332'       .WORD    XS,OFFS,SIZE
117 0534 000000 ADLBL:  WORD    0,ZERO,NCHAR
118 0542 005367 NLBL:   DEC      ACNTR
119 0546 167567         SUB      @12(R5),X
120 0554 026767         CMP      X,Y
121 0562 002237         BGE      S10
122 0564 016567 S20.    MOV      6(R5),2$
123 0572 004567         JSR      R5,PLT
124 0576 000403         BR       .+10
125 0600 001316'       .WORD    ZERO
126 0602 000000 2$:     .WORD    0,ZERO
127 0606 016567         MOV      10(R5),1$
128 0614 004567         JSR      R5,PLT
129 0620 000403         BR       .+10
130 0622 001316'        .WORD    ZERO
131 0624 000000 1$.    .WORD    0,ONEE
132 0630 005775         TST      @14(R5)
133 0734 003002         BGT      6$
134 06.5 000167         JMP      S40
135 0642        6$:
136 0642                DIVD     @10(R5),,@14(R5),,Y
137 0664 016767         MOV      YMUL,MUL
138 0672 016767         MOV      MQ,ACNTR
139 0700 167567         SUB      @10(R5),Y
140 0706 005467         NEG      Y
141 0712                DIVD     @6(R5),,@14(R5),,X
142 0734 167567         SUB      @6(R5),X
143 0742 016767         MOV      YSIZE,XS
144 0750 005467         NEG      X
145 0754 004567 S30:    JSR      R5,PLT
146 0760 000403         BR       .+10
147 0762 001316'        .WORD    ZERO,Y,ZERO
148 0770 004567         JSR      R5,PLT
149 0774 000403         BR       .+10
150 0776 001312'        .WORD    M30,Y,ONEE
151 1004 005767         TST      ACNTR
152 1010 001517         BEQ      15$
153 1012                MULT     @16(R5),#5,XSIZE
154 1034                .BIN2D   #MBUF,ACNTR
155 1052 012767         MOV      #MBUF,17$
156 1060 012767         MOV      #4,NCHAR
157 1066 127727 16$:    CMPB     @17$,#60
158 1074 001005         BNE      18$
159 1076 005367         DEC      NCHAR
160 1102 005267         INC      17$
161 1106 000767         BR       16$
162 1110 066767 18$:    ADD      SPACEC,XSIZE
163 1116 005267         INC      NCHAR
164 1122                MULT     NCHAR,XSIZE,XSIZE
165 1144 166767         SUB      M10,XSIZE
166 1152 166767         SUB      M30,XSIZE
167 1160 005467         NEG      XSIZE
168 1164 016767         MOV      XS,YSIZE
169 1172 166767         SUB      Y YSIZE
170 1200 005467         NEG      YSIZE
171 1204 004567         JSR      R5,PLT
```

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```
172 1210 000403              BR      .+10
173 1212 001326'             .WORD   XSIZE,YSIZE,ZERO
174 1220 004567              JSR     R5,ISYMBL
175 1224 000406              BR      .+16
176 1226 001326'             .WORD   XSIZE,YSIZE,SIZE
177 1234 000000 17$:         .WORD   0,ZERO,NCHAR
178 1242 162767              SUB     #10.,ACNTR
179 1250         15$:
180 1250 167567              SUB     @14(R5),Y
181 1256 026767              CMP     Y,X
182 1264 002233              BGE     £30
183 1266 004567 S40:         JSR     R5,PLT
184 1272 000403              BR      .+10
185 1274 001316'             .WORD   ZERO,ZERO,ZERO
186 1302 004567              JSR     R5,RRSTR
187 1306 000205              RTS     R5
188 1310 000000 X:           .WORD   0
189 1312 177754 M30:         .WORD   -20.
190 1314 000001 ONEE:        .WORD   1
191 1316 000000 ZERO:        .WORD   0
192 1320 177773 M10:         .WORD   -5
193 1322 000000 OFFS:        .WORD   0
194 1324 000000 NCHAR:       .WORD   0
195 1326 000000 XSIZE:       .WORD   0
196 1330 000000 YSIZE:       .WORD   0
197 1332 000000 XS:          .WORD   0
198 1334 000000 ACNTR:       .WORD   0
199 1336 000000 Y:           .WORD   0
200 1340 000012 YMUL:        .WORD   10.
```

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```
 1                         .SBTTL   MASS ASSIGNMENT ROUTINE
 2                         .GLOBL   STRING,IBUF,DATAB
 3                         .GLOBL   START
 4                         .MCALL   STRG0
 5              ; *****MASS ASSIGNMENT PROGRAM--STORED ON RB1 AS MASSA1.PAL*******
 6              ;   ****TEST OF FPMP-11  STORED ON RB-1 AS TEST.PAL****
 7              ; ***MODIFIED TO PERMIT EITHER OCTAL OR DECIMAL INPUT****
 8              ; ***STORED AS ECHO1.PAL ON DT26*******
 9                         .GLOBL   RSAV,RRSTR
10        177514           LPS=177514
11        177516           LPB=177516
12                         .GLOBL   TRNUM,TSNUM,TUIC,GETSPC
13                         .GLOBL   TRAPH,$ECO,$RCI,$ICO,IFIX,SCANS,$FCO,$ICI
14 01342 004567 START:     JSR     R5,GETSPC        ;GET THE DATA
15 01346 016767            MOV     DATAB+6,NP
16 01354 012701            MOV #M$2,R1
17 01360 004767            JSR PC,PMSG
18 01364 004767            JSR PC,R$DEC
19 01370 010067            MOV R0,IS
20 01374 004767            JSR PC,R$DEC
21 01400 010067            MOV R0,LO
22 01404 005067            CLR HI
23 01410 005003            CLR R3
24 01412 012767            MOV #ZTMP, PTR1
25 01420 004767            JSR PC, DOT
26 01424 104700            TRAP 300
27 01426 001400            ZTMP-.
28 01430 004567            JSR R5, STAR
29 01434 011472′           ARM
30 01436 002374′           IS
31 01440 012767            MOV #1, DF
32 01446 000167            JMP OK
33 01452 041360 MA:        .FLT2 30.
34 01456 000000 TIC:       0
35 01460 000000 ERR:       0
36 01462 016767 OK:        MOV NP, CTR1
37 01470 016767            MOV     DATAB+10,,CH7F           ;CH7 FLAG
38 01476 012701            MOV     #DATAB-2,R1              ;BUFFER ADDRESS
39 01502 005767            TST NP
40 01506 001002            BNE LOK69
41 01510 000205            RTS     R5
42 01512 000000 CH7F:      .WORD   0
43 01514 005767 LOK69:     TST     CH7F
44 01520 001002            BNE     1$
45 01522 000167            JMP     LOK68
46 01526 012767 1$:        MOV     #ARH,PTR1
47 01534 062701 LOK:       ADD #24, R1
48 01540 012767            MOV #122, CTR2
49 01546 005367 LOOK:      DEC CTR2
50 01552 005721            TST (R1)+
51 01554 012167            MOV (R1)+,LO
52 01560 012167            MOV (R1)+,HI
53 01564 005003            CLR R3
54 01566 004767            JSR PC, DOT
55 01572 005367            DEC CTR1
56 01576 001404            BEQ KOOL
57 01600 005767            TST CTR2
```

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```
58 01604 ····1753              BEQ LOK
59 01606 000757                BR LOOK
60 01610           LOK67:
61 01610 012701 KOOL:  MOV  #M$H, R1
62 01614 004767        JSR PC, PMSG
63 01620 004767        JSR PC, PCR
64 01624 012701        MOV #ARH, R1
65 01630 016702        MOV NP, R2
66 01634 004767        JSR PC, PA$1
67 01640 104600 B1:    TRAP 200
68 01642 044303        . FLT2 1. E5
69 01646 104601        TRAP 201
70 01650 000000 S0:    . WORD 0, 0
71 01654 026767        CMP IS, NP
72 01662 002536        BLT B11
73 01664 104600        TRAP 200
74 01666 140200 CM1:   . FLT2 -1.
75 01672 000535        BR BB11
76 01674 012703 LOK68:  MOV    #DATAB+12. , R3
77 01700 016737        MOV     DATAB+6, @#MQ
78 01706 012737        MOV     #6, @#MUL
79 01714 063703        ADD     @#MQ, R3
80 01720 012367        MOV     (R3)+, LO
81 01724 011367        MOV     (R3), HI
82 01730 012767        MOV     #XTMP, PTR1
83 01736 005003        CLR     R3
34 01740 004767        JSR     PC, DOT
85 01744 016737        MOV     NP, @#MQ
86 01752 012737        MOV     #4, @#MUL
87 01760 063767        ADD     @#MQ, PTR1
88 01766 162767        SUB     #4, PTR1
89 01774 062701 LOK11:  ADD #24, R1
90 02000 012767        MOV #122, CTR2
91 02006 005367 LOOK11: DEC CTR2
92 02012 104600        TRAP    200
93 02014 000000 XTMP:  . WORD   0, 0
94 02020 005721        TST (R1)+
95 02022 012167        MOV (R1)+, LO
96 02026 012167        MOV (R1)+, HI
97 02032 005003        CLR R3
98 02034 004767        JSR PC, DOT
99 02040 016703        MOV     PTR1, R3
100 2044 062703        ADD     #4, R3
101 2050 012367        MOV     (R3)+, ZTMP
102 2054 011367        MOV     (R3), ZTMP+2
103 2060 104703        TRAP    303
104 2062 000744        ZTMP-.
105 2064 104701        TRAP    301
106 2066 000740        ZTMP-.
107 2070 016703        MOV     PTR1, R3
108 2074 062703        ADD     #10, R3
109 2100 016743        MOV     ZTMP+2, -(R3)
110 2104 016743        MOV     ZTMP, -(R3)
111 2110 005367        DEC     CTR1
112 2114 001635                BEQ KOOL
113 2116 005767        TST     CTR2
114 2122 001724        BEQ LOK11
```

```
115 2124 000730           BR LOOK11
116 2126 000000 ITMP:     0
117 2130 000000 NR:       0
118 2132 000000 ST:       0
119 2134 000000 L:        0
120 2136 000000 LF:       0
121 2140 000000 NP:       0
122 2142 000000 NS:       0
123 2144 000000 SN:       . WORD 0, 0
124 2150 000000 B:        . WORD 0, 0
125 2154 000000 A:        . WORD 0, 0
126 2160 104600 B11:      TRAP 200
127 2162 040200 CP1:      . FLT2 1.
128 2166 104601 BB11:     TRAP 201
129 2170 000000 DM:       0, 0
130 2174 104601 B12:      TRAP 201
131 2176 000000 CM:       . WORD 0, 0
132 2202 005067          CLR NR
133 2206 005067          CLR    L
134 2212 004767          JSR PC, PCR
135 2216 016767 B13:     MOV IS, J
136 2224 016767          MOV    NP, ST
137 2232 006267          ASR    ST
138 2236 006267          ASR    ST
139 2242 006267          ASR    ST
140 2246 005067          CLR    NF
141 2252 004567          JSR R5, LDAR
142 2256 011472'         ARM
143 2260 002376'         J
144 2262 104407          TRAP 7
145 2264 104601          TRAP 201
146 2266 000000 C:        . WORD 0, 0
147 2272 104601          TRAP 201
148 2274 000000 BS:       . WORD 0, 0
149 2300 012767          MOV #-1, LF
150 2306 012767          MOV #-1, NS
151 2314 016767          MOV CM1, SN
152 2322 016767          MOV CM1+2, SN+2
153 2330 004767          JSR PC, B46
154 2334 166767 B2:      SUB NS, J
155 2342 026767          CMP NP, J
156 2350 002452          BLT B28
157 2352 005767          TST NF
158 2356 003045          BGT JB6
159 2360 004767          JSR PC, B58
160 2364 000414          BR RT1
161 2366 000000 DF:       0
162 2370 000000 NF:       0
163 2372 000000 RTN:      0
164 2374 000000 IS:       0
165 2376 000000 J:        0
166 2400 000000 JS:       0
167 2402 000000 AS:       . WORD 0, 0
168 2406 000000 CZO:      . FLT2 0.
169 2412 000000 SS:       . WORD 0, 0
170 2416 005767 RT1:     TST LF
171 2422 002405          BLT B21
```

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```
172 2424 012767           MOV #B2,RTN
173 2432 000167           JMP B5
174 2436 012767 B21:      MOV #RT2,RTN
175 2444 000167           JMP B4
176 2450 016767 RT2:      MOV A,AS
177 2456 016767           MOV A+2,AS+2
178 2464 004767           JSR PC,B42
179 2470 000721           BR B2
180 2472 000167 JB6:      JMP B6
181 2476 016767 B28:      MOV IS,J
182 2504 016767           MOV AS,A
183 2512 016767           MOV AS+2,A+2
184 2520 016767           MOV BS,C
185 2526 016767           MOV BS+2,C+2
186 2534 016767           MOV CP1,SN
187 2542 016767           MOV CP1+2,SN+2
188 2550 012767           MOV #1,NS
189 2556 004767           JSR PC,B46
190 2562 166767 B3:       SUB NS,J
191 2570 005767           TST J
192 2574 003736           BLE JB6
193 2576 005767           TST NF
194 2602 003333           BGT JB6
195 2604 004767           JSR PC,B58
196 2610 012767           MOV #B3,RTN
197 2616 005767           TST LF
198 2622 002402           BLT B31
199 2624 000167           JMP B5
200 2630 012767 B31:      MOV #RT3,RTN
201 2636 000403           BR B4
202 2640 004767 RT3:      JSR PC,D42
203 2644 000746           BR B3
204 2646 012767 B4:       MOV #1,LF
205 2654 004567           JSR R5,LDAR
206 2660 011472'          ARM
207 2662 002374'          IS
208 2664 104702           TRAP 302
209 2666 177302           DM-.
210 2670 004567           JSR R5,STAR
211 2674 011472'          ARM
212 2676 002376'          J
213 2700 016767           MOV CZO,SS
214 2706 016767           MOV CZO+2,SS+2
215 2714 104700           TRAP 300
216 2716 177260           CM-.
217 2720 104702           TRAP 302
218 2722 177246           DM-.
219 2724 104701           TRAP 301
220 2726 177242           DM-.
221 2730 004567           JSR R5,LDAR
222 2734 011472'          ARM
223 2736 002376'          J
224 2740 003467           BLE B48
225 2742 000417           BR B44
226 2744 104700 B42:      TRAP 300
227 2746 177222           DM-.
228 2750 002402           BLT BB42
```

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```
229  2752  104704           TRAP 304
230  2754  176712           CM1-.
231  2756  104702  BB42:    TRAP 302
232  2760  176472           MA-.
233  2762  002006           BGE BB44
234  2764  012767           MOV #0, DF
235  2772  012767           MOV #1000, NF
236  3000  000207  BB44:    RTS PC
237  3002  004567  B44:     JSR R5, LDAR
238  3006  0114722          ARM
239  3010  0023762          J
240  3012  104407           TRAP 7
241  3014  104701           TRAP 301
242  3016  177250           C-.
243  3020  104703           TRAP 303
244  3022  177126           B-.
245  3024  104601           TRAP 201
246  3026  000000  ZTMP:    .WORD 0, 0
247  3032  104700           TRAP 300
248  3034  000554           D-.
249  3036  104705           TRAP 305
250  3040  177766           ZTMP-.
251  3042  104701           TRAP 301
252  3044  177110           A-.
253  3046  004767           JSR PC, B46
254  3052  005767           TST DF
255  3056  002414           BLT D84
256  3060  000177           JMP @RTN
257  3064  016767  B46:     MOV J, JS
258  3072  016767           MOV C, B
259  3100  016767           MOV C+2, B+2
260  3106  000207           RTS PC
261  3110  004767  D84:     JSR     PC, B84
262  3114  000177           JMP     @RTN
263  3120  016767  B48:     MOV J, NF
264  3126  012701           MOV #MZRO, R1
265  3132  004767           JSR PC, PMSG
266  3136  016700           MOV     J, R0
267  3142  004767           JSR     PC, RINT
268  3146  004767           JSR PC, PCR
269  3152  000177           JMP @RTN
270  3156  005015  MZRO:    5015
271  3160    132            .ASCIZ /ZERO
272  3166  012500  STPT:    MOV (R5)+, R0
273  3170  067500           ADD @(R5), R0
274  3174  067500           ADD     @(R5), R0
275  3200  067500           ADD     @(R5), R0
276  3204  063500           ADD @(R5)+, R0
277  3206  162700           SUB #4, R0
278  3212  000207           RTS PC
279  3214  004767  LDAR:    JSR PC, STPT
280  3220  104500           TRAP 100
281  3222  000205           RTS R5
282  3224  004767  STAR:    JSR PC, STPT
283  3230  104501           TRAP 101
284  3232  000205           RTS R5
285  3234  104700  B5:      TRAP 300
```

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```
286 3236 000352              D-.
287 3240 104705              TRAP 305
288 3242 176712              A-.
289 3244 104702              TRAP 302
290 3246 177020              C-.
291 3250 104701              TRAP 301
292 3252 177554              ZTMP-.
293 3254 104704              TRAP 304
294 3256 177550              ZTMP-.
295 3260 104701              TRAP 301
296 3262 177544              ZTMP-.
297 3264 104406              TRAP 6
298 3266 104601              TRAP 201
299 3270 000000 AK:          . WORD 0, 0
300 3274 104700              TRAP 300
301 3276 177530              ZTMP-.
302 3300 104703              TRAP 303
303 3302 177766              AK-.
304 3304 104603              TRAP 203
305 3306 040000              . FLT2 . 5
306 3312 002406              BLT BB74
307 3314 104700              TRAP 300
308 3316 177752              AK-.
309 3320 104702              TRAP 302
310 3322 176640              CP1-.
311 3324 104701              TRAP 301
312 3326 177742              AK-.
313 3330 000167 BB74:        JMP B74
314 3334 016767 B51:         MOV J, NF
315 3342 000177              JMP @RTN
316 3346 016767 B52:         MOV NS, ITMP
317 3354 066767              ADD J, ITMP
318 3362 004567              JSR R5, LDAR
319 3366 011472´             ARM
320 3370 002126´             ITMP
321 3372 104701              TRAP 301
322 3374 177432              ZTMP-.
323 3376 004567              JSR R5, LDAR
324 3402 011472´             ARM
325 3404 002376´             J
326 3406 104703              TRAP 303
327 3410 177416              ZTMP-.
328 3412 104704              TRAP 304
329 3414 176530              SN-.
330 3416 002436              BLT B56
331 3420 003014              BGT B55
332 3422 005767 B54:         TST JF
333 3426 002002              BGE B53
334 3430 000167              JMP      B85
335 3434 104700 B53:         TRAP 300
336 3436 176474              ST-.
337 3440 104702              TRAP      302
338 3442 176224              CM1-.
339 3444 002733              BLT B51
340 3446 000177              JMP @RTN
341 3452 016767 B55:         MOV J, NF
342 3460 012701              MOV #MLST, R1
```

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```
343 3464 004767          JSR PC,PMSG
344 3470 004767          JSR     PC,PSP
345 3474 016700          MOV     J,R0
346 3500 004767          JSR     PC,RINT
347 3504 004767          JSR PC,PCR
348 3510 000177          JMP @RTN
349 3514 004567 B56:     JSR R5,LDAR
350 3520 011472          ARM
351 3522 002376          J
352 3524 003002          BGT     BB56
353 3526 000167          JMP B48
354 3532 104700 BB56.    TRAP 300
355 3534 000342          MD-.
356 3536 104704          TRAP 304
357 3540 000336          MD-.
358 3542 104702          TRAP 302
359 3544 176646          SS-.
360 3546 104701          TRAP 301
361 3550 176642          SS-.
362 3552 000167          JMP B44
363 3556 004567 B58:     JSR R5,LDAR
364 3562 005472          ARH
365 3564 002400          JS
366 3566 104701          TRAP 301
367 3570 177236          ZTMP-.
368 3572 004567          JSR R5,LDAR
369 3576 005472          ARH
370 3600 002376          I
371 3602 104703          TRAP 303
372 3604 177222          ZTMP-.
373 3606 104601          TRAP 201
374 3610 000000 D:       .WORD 0,0
375 3614 000207          RTS PC
376 3616 005767 B6.      TST DF
377 3622 002406          BLT B8
378 3624 001466          BEQ B7
379 3626 005767          TST NF
380 3632 003403          BLE BB6
381 3634 000167          JMP B13
382 3640 000205 B8:      RTS     R5
383 3642 062767 BB6.     ADD #1,NR
384 3650 004767          JSR PC,PCR
385 3654 104700          TRAP 300
386 3656 176312          DM-.
387 3660 104703          TRAP 303
388 3662 176314          CM-.
389 3664 104701          TRAP 301
390 3666 177140          ZTMP-.
391 3670 012701          MOV #ZTMP,R1
392 3674 004767          JSR PC,PR1
393 3700 004767          JSR PC,PSP
394 3704 012701          MOV #SS,R1
395 3710 004767          JSR PC,PR1
396 3714 004767          JSR PC,PSP
397 3720 012701          MOV #A,R1
398 3724 004767          JSR PC,PR1
399 3730 104700 B62:     TRAP 300
```

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```
400 3732 175716              SO-.
401 3734 104703              TRAP 303
402 3736 176454              SS-.
403 3740 002002              BGE BB62
404 3742 000167 J62:         JMP B13
405 3746 016767 BB62:        MOV SS,SO
406 3754 016767              MOV SS+2,SO+2
407 3762 104700              TRAP 300
408 3764 176204              DM-.
409 3766 104703              TRAP 303
410 3770 176206              CM-.
411 3772 104601              TRAP 201
412 3774 000000 DS:          .WORD 0, 0
413 4000 000760              BR J62
414 4002 005767 B7:          TST NR
415 4006 003007              BGT B71
416 4010 012701              MOV #MB0, R1
417 4014 004767              JSR PC,PMSG
418 4020 004767              JSR PC, PCR
419 4024 000205              RTS    R5
420 4026 016767 B71:         MOV DS,DM
421 4034 016767              MOV DS+2,DM+2
422 4042 012767              MOV #-1, DF
423 4050 005067              CLR NF
424 4054 004767              JSR     PC,PCR
425 4060 000167              JMP B13
426 4064 104700 B74:         TRAP 300
427 4066 176740              ZTMP-.
428 4070 104703              TRAP 303
429 4072 177176              AK-.
430 4074 104601              TRAP 201
431 4076 000000 MD:          .WORD 0,0
432 4102 104700              TRAP 300
433 4104 177164              AK-.
434 4106 004567              JSR R5,STAR
435 4112 011472'             ARM
436 4114 002376'             J
437 4116 000167              JMP      B75
438 4122 104700              TRAP 300
439 4124 177752              MD-
440 4126 002402              BLT BMD
441 4130 104704              TRAP 304
442 4132 175534              CM1-.
443 4134 104602 BMD:         TRAP 202
444 4136 037514              .FLT2 .2
445 4142 002402              BLT B75
446 4144 000167              JMP B52
447 4150 005767 B75:         TST DF
448 4154 002402              BLT B84
449 4156 000167              JMP B53
450 4162 005267 B84:         INC L
451 4166 004567              JSR     R5,LDAR
452 4172 011472'             ARM
453 4174 002376'             J
454 4176 104701              TRAP    301
455 4200 176626              ZTMP-.
456 4202 012701              MOV     #ZTMP,R1
```

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```
457 4206 ···4767          JSR PC,PRINT
458 4212 004767          JSR PC,PSP
459 4216 012701          MOV #MD,R1
460 4222 004767          JSR PC,PRMD
461 4226 022767          CMP #5,L
462 4234 002402          BLT B85
463 4236 000177          JMP @RTN
464 4242 005067 B85:     CLR L
465 4246 004767          JSR PC,PCR
466 4252 000177          JMP @RTN
467 4256 012746 PR1:     MOV #BFOUT,-(SP)
468 4262 012746          MOV #16,-(SP)
469 4266 012746          MOV #6,-(SP)
470 4272 012746          MOV #1,-(SP)
471 4276 016146          MOV 2(R1),-(SP)
472 4302 011146          MOV (R1),-(SP)
473 4304 004767          JSR PC,$ECO
474 4310 012767          MOV #0,BFOUT+16
475 4316 012701          MOV #BFOUT,R1
476 4322 004767          JSR PC,PMSG
477 4326 000207          RTS PC
478 4330 005011 R$OCT:   CLR (R1)
479 4332 004767 RBG:     JSR PC,RD$1
480 4336 120027          CMPB R0,#137
481 4342 001772          BEQ R$OCT
482 4344 120027          CMPB R0,#60
483 4350 103412          BCS ORT
484 4352 122700          CMPB #7,R0
485 4356 103407          BCS ORT
486 4360 006311          ASL (R1)
487 4362 006311          ASL (R1)
488 4364 006311          ASL (R1)
489 4366 162700          SUB #60,R0
490 4372 060011          ADD R0,@R1
491 4374 000756          BR RBG
492 4376 000207 ORT:     RTS PC
493 4400 042767 RD$1:    BIC #100,TKS
494 4406 142767          BICB #104,TPS
495 4414 105767 RD$2:    TSTB TKS
496 4420 100375          BPL RD$2
497 4422 116700          MOVB TKB,R0
498 4426 105767 RD$3:    TSTB TPS
499 4432 100375           BPL RD$3
500 4434 110067          MOVB R0,TPB
501 4440 105767 RD$4:    TSTB LPS
502 4444 100375          BPL RD$4
503 4446 110067          MOVB R0,LPB
504 4452 042700          BIC #177600,R0
505 4456 152767          BISB #100,TKS
506 4464 122700          CMPB #3,R0
507 4470 001001          BNE TP$1
508 4472 000205          RTS R5
509 4474 000207 TP$1:    RTS PC
510 4476 012701 RD$OCT:  MOV #HI,R1
511 4502 004767          JSR PC,R$OCT
512 4506 012701          MOV #LO,R1
513 4512 004767          JSR PC,R$OCT
```

200

```
514 4516 000207              RTS PC
515 4520         KBHIT:
516 4520 012767 ERRLP:       MOV #100,TKS
517 4526 000207              RTS PC
518 4530 000000 CTR1:        0
519 4532 000000 CTR2:        0
520 4534 000000 PTR1:        0
521 4536 000000 PTR2:        0
522 4540 000000 DM1:         0
523 4542 000000 DM2:         0
524 4544 012746 PRMD:        MOV #BFOUT,-(SP)
525 4550 012746             MOV #7,-(SP)
526 4554 012746             MOV #3,-(SP)
527 4560 005046             CLR -(SP)
528 4562 016146             MOV 2(R1),-(SP)
529 4566 011146             MOV (R1),-(SP)
530 4570 004767             JSR PC,$FCO
531 4574 112767             MOVB #0,BFOUT+7
532 4602 012701             MOV #BFOUT,R1
533 4606 004767             JSR PC,PMSG
534 4612 000207             RTS PC
535 4614 010167 PRINT:      MOV R1,HERE
536 4620 004567             JSR R5,IFIX
537 4624 000401             BR HERE+2
538 4626 000000 HERE:       .WORD 0
539 4630 012746 RINT:       MOV     #BFOUT,-(SP)
540 4634 012746             MOV     #5,-(SP)
541 4640 010046             MOV R0,-(SP)
542 4642 004767             JSR PC,$ICO
543 4646 112767             MOVB #0,BFOUT+5
544 4654 012701             MOV #BFOUT,R1
545 4660 004767             JSR PC,PMSG
546 4664 000207             RTS PC
547 4666 005003 R$DEC:      CLR R3
548 4670 012704             MOV #IBUF,R4
549 4674 004767 R$DC:       JSR PC,RD$1
550 4700 120027             CMPB R0,#137
551 4704 001770             BEQ R$DEC
552 4706 120027             CMPB R0,#60
553 4712 103406             BCS TSSP
554 4714 122700             CMPB #71,R0
555 4720 103403             BCS TSSP
556 4722 005203             INC R3
557 4724 110024             MOVB R0,(R4)+
558 4726 000762             BR R$DC
559 4730 122700 TSSP:       CMPB #40,R0
560 4734 001357             BNE R$DC
561 4736 005703             TST R3
562 4740 001003             BNE DATI
563 4742 005203             INC R3
564 4744 112724             MOVB #0,(R4)+
565 4750 012746 DATI:       MOV #IBUF,-(SP)
566 4754 010346             MOV R3,-(SP)
567 4756 004767             JSR PC,$ICI
568 4762 012600             MOV (SP)+,R0
569 4764 000207             RTS PC
570 4766 005003 DOTORL:     CLR R3
```

201

```
571 4770 004767                JSR  PC,RD$OCT
572 4774 004567 DOT:           JSR  R5,CVRT
573 5000 012746                MOV  #IBUF,-(SP)
574 5004 010346                MOV  R3,-(SP)
575 5006 005046                CLR  -(SP)
576 5010 005046                CLR  -(SP)
577 5012 004767                JSR  PC,$RCI
578 5016 012677                MOV  (SP)+,@PTR1
579 5022 062767                ADD  #2,PTR1
580 5030 012677                MOV  (SP)+,@PTR1
581 5034 062767                ADD      #2 PTR1
582 5042 000207                RTS  PC
583 5044 010104 PA$1:          MOV  R1,R4
584 5046 010267                MOV  R2,ARCT$
585 5052 012767 PA$2:          MOV  #5,BRCT
586 5060 004767                JSR  PC,PCR
587 5064 010401 PA$3:          MOV      R4,R1
588 5066 004767                JSR      PC,PR1
589 5072 022424                CMP      (R4)+,(R4)+
590 5074 005367                DEC  ARCT$
591 5100 003404                BLE  PA$4
592 5102 005367                DEC  BRCT
593 5106 003366                BGT  PA$3
594 5110 000760                BR   PA$2
595 5112 004767 PA$4:          JSR  PC,PCR
596 5116 000207                RTS  PC
597 5120 000000 ARCT$:         .WORD 0
598 5122 000000 BRCT:          .WORD 0
599 5124 012701 PSP:           MOV  #BFSP,R1
600 5130 004767                JSR  PC,PMSG
601 5134 000207                RTS  PC
602 5136 000040 BFSP:          40
603 5140 012701 PCR:           MOV  #BFCR,R1
604 5144 004767                JSR  PC,PMSG
605 5150 000207                RTS  PC
606 5152         PMSG:         STRG0    R1
607 5160 000207                RTS      PC
608 5162 005015 BFCR:          .WORD 5015,0
609 5166 012704 CVRT:          MOV  #IBUF,R4
610 5172 005767                TST  LO
611 5176 001007                BNE  NZE
612 5200 005767                TST  HI
613 5204 001004                BNE  NZE
614 5206 005203                INC  R3
615 5210 112724 ZERO:          MOVB #60,(R4)+
616 5214 000205                RTS  R5
617 5216 005067 NZE:           CLR  ZFLAG
618 5222 012702                MOV  #MTMEC,R2
619
620 5226 005067 RT:            CLR  BCD
621 5232 012267                MOV  (R2)+,HS
622 5236 012267                MOV  (R2)+,LS
623 5242 000241 DP:            CLC
624 5244 016767                MOV  LS,TL
625 5252 016767                MOV  HS,TH
626 5260 066767                ADD  LO,TL
627 5266 005567                ADC  TH
```

202

```
628 5272 103004          BCC CNS
629 5274 066767          ADD HI,TH
630 5302 000404          BR INBC
631 5304 066767 CNS:     ADD HI,TH
632 5312 103011          BCC DDN
633 5314 005267 INBC:    INC BCD
634 5320 016767          MOV TH,HI
635 5326 016767          MOV TL,LO
636 5334 000742          BR DP
637 5336 066767 DDN:     ADD BCD,ZFLAG
638 5344 003406          BLE TS
639 5346 062767          ADD #60,BCD
640 5354 116724          MOVB BCD,(R4)+
641 5360 005203          INC R3
642 5362 020227 TS:      CMP R2,#HS
643 5366 002717          BLT RT
644 5370 000205          RTS R5
645 5372 177547 MTMEG:   .WORD 177547,064600
646 5376 177760          .WORD 177760,136700
647 5402 177776          .WORD 177776,074540
648 5406 177777          .WORD 177777,154360
649 5412 177777          .WORD 177777,176030
650 5416 177777          .WORD 177777,177634
651 5422 177777          .WORD 177777,177766
652 5426 177777          .WORD 177777,177777
653 5432 000000 HS:      .WORD 0
654 5434 000000 LS:      .WORD 0
655 5436 000000 TL:      .WORD 0
656 5440 000000 TH:      .WORD 0
657 5442 000000 ZFLAG:   .WORD 0
658 5444 000000 HI:      .WORD 0
659 5446 000000 LO:      .WORD 0
660 5450 000000 BCD:     .WORD 0
661 5452 005472 BFOUT:   .=.+20
662 5472 011472 ARH:     .=.+4000
663 1472 015472 ARM:     .=.+4000
664 5472 005015 M$ER:    5015
665 5474    123          .ASCIZ /SCANS ERROR #/
666                      .EVEN
667 5512 005015 M$H:     5015
668 5514    115          .ASCIZ /MAGNETIC FIELD VALUES/
669                      .EVEN
670 5542 005015 MLST:    5015
671 5544    115          .ASCIZ /M(J+1)<M(J)/
672                      .EVEN
673 5560 005015 MBD:     5015
674 5562    102          .ASCIZ /BAD DATA!  START OVER /
675                      .EVEN
676 5612 005015 M$1:     5015
677 5614    124          .ASCIZ /TYPE RUN # AND SCAN # /
678                      .EVEN
679 5644 005015 M$2:     5015
680 5646    124          .ASCIZ /TYPE PEAK # AND MASS # /
681                      .EVEN
682      000001'         .END
```

203

A	002154R	AC =	177302	ACNTR	001334R
ADBUF =	176772	ADCSR =	176770	ADLBL	000534R
ADMES =	****** G	ADPRI =	000132	ADVEC =	000130
AK	003270R	ALUT =	****** G	ANOTM =	****** G
ARCT$	005120R	ARH	005472R	ARM	011472R
AS	002402R	ASH =	177316	A13LUT=	****** G
B	002150R	BB =	000011	BB11	002166R
BB42	002756R	BB44	003000R	BB56	003532R
BB6	003642R	BB62	003746R	BB74	003330R
BCL	005450R	BFCR	005162R	BFOUT	005452R
BFSP	005136R	BLANK =	****** G	BLNK =	****** G
BLOK =	****** G	BMD	004134R	BRCT	005122R
BS	002274R	B1	001640R	B11	002160R
B12	002174R	B13	002216R	B2	002334R
B21	002436R	B28	002476R	B3	002562R
B31	002630R	B4	002646R	B42	002744R
B44	003002R	B46	003064R	B48	003120R
B5	003234R	B51	003334R	B52	003346R
B53	003434R	B54	003422R	B55	003452R
B56	003514R	B58	003556R	B6	003616R
B62	003730R	B7	004002R	B71	004026R
B74	004064R	B75	004150R	B8	003640R
B84	004162R	B85	004242R	C	002266R
CHROMA=	****** G	CH7F	001512R	CLK =	177546
CM	002176R	CM1	001666R	CNS	005304R
CP1	002162R	CR =	000015	CTR1	004530R
CTR2	004532R	CVRT	005166R	CZO	002406R
D	003610R	DATAB =	****** G	DATI	004750R
DDN	005336R	DF	002366R	DIV =	177300
DM	002170R	DM1	004540R	DM2	004542R
DOT	004774R	DOTORL	004766R	DP	005242R
DPSCN =	****** G	DR =	165000	DRIN =	165004
DROUT =	165002	DS	003774R	DSKIN =	****** G
DSKOUT=	****** G	D84	003110R	EAENOR=	177312
EAESC =	177310	EAESR =	177311	ERR	001460R
ERRLP	004520R	FIN =	****** G	FIX =	****** G
FRLUT =	****** G	GCFLG =	****** G	GETPKS=	****** G
GETSPC=	****** G	HERE	004626R	HI	005444R
HS	005432R	IAXIS	000000RG	IBUF =	****** G
IFIX =	****** G	IMOREC=	****** G	INBC	005314R
INITIL=	****** G	INPUT =	****** G	INTMU =	****** G
IS	002374R	ISYMBL=	****** G	ITMP	002126R
J	002376R	JB6	002472R	JS	002400R
J62	003742R	KBHIT	004520R	KOOL	001610R
L	002134R	LBL	000356R	LDAR	003214R
LF	002136R	LININC=	****** G	LO	005446R
LOK	001534R	LOK11	001774R	LOK67	001610R
LOK68	001674R	LOK69	001514R	LOOK	001546R
LOOK11	002006R	LPB =	177516	LPF =	****** G
LPMM =	****** G	LPS =	177514	LS	005434R
LSH =	177314	MA	001452R	MBD	015560R
MBUF =	****** G	MD	004076R	MLST	015542R
MO =	177304	MS3OF =	****** G	MTMEG	005372R
MUL =	177306	MZRO	003156R	M$ER	015472R
M$H	015512R	M$1	015612R	M$2	015644R
M10	001320RG	M30	001312RG	NBOKPE=	****** G
NCHAR	001324R	NF	002370R	NLBL	000542R

204

NP	002140R	NR	002130R	NS	002142R
NUM =	****** G	NZE	005216R	OCRLF =	****** G
OFFS	001322R	OK	001462R	ONEE	001314RG
ORIGIN=	****** G	ORT	004376R	PA$1	005044R
PA$2	005052R	PA$3	005064R	PA$4	005112R
PC	=%000007	PCR	005140R	PEAKS =	****** G
PLT =	****** G	PLTR =	172554	PMSG	005152R
PPF =	****** G	PPMM =	****** G	PRINT	004614R
PRMD	004544R	PRTVEC=	000064	PR1	004256R
PSP	005124R	PSW =	177776	PTR1	004534R
PTR2	004536R	RAWREC=	****** G	RBG	004332R
RD$OCT	004476R	RD$1	004400R	RD$2	004414R
RD$3	004426R	RD$4	004440R	RINT	004630R
RNUM =	****** G	RRSTR =	****** G	RSAV =	****** G
RT	005226R	RTN	002372R	RT1	002416R
RT2	002450R	RT3	002640R	R$DC	004674R
R$DEC	004666R	R$OCT	004330R	R0	=%000000
R00 =	****** G	R1	=%000001	R10 =	****** G
R2	=%000002	R20 =	****** G	R3	=%000003
R30 =	****** G	R33 =	****** G	R4	=%000004
R40 =	****** G	R5	=%000005	R5SAV =	****** G
R50 =	****** G	R6	=%000006	R7	=%000007
SCANS =	****** G	SET =	****** G	SETINC=	****** G
SIZE =	****** G	SN	002144R	SNUM =	****** G
SF	=%000006	SPACEC=	****** G	SS	002412R
ST	002132R	STAR	003224R	START	001342RG
STPT	003166R	STRING=	****** G	SWR =	177570
SYMBOL=	****** G	S0	001650R	S10	000262R
S20	000564R	S30	000754R	S40	001266R
TH	005440R	TIC	001456R	TICC =	****** G
TICFLG=	****** G	TKB =	177562	TKS =	177560
TL	005436R	TLNK =	****** G	TPB =	177566
TPS =	177564	TP$1	004474R	TRAPH =	****** G
TRA. =	****** G	TRNUM =	****** G	TS	005362R
TSNUM =	****** G	TSSP	004730R	TTYI =	****** G
TTYO =	****** G	TUIC =	****** G	UIC =	****** G
U1X =	****** G	X	001310RG	XS	001332R
XSIZE	001326R	XSTORE=	****** G	XTMP	002014R
/	001336RG	YE =	****** G	YMUL	001340R
YSIZE	001330R	YSTORE=	****** G	ZERO	001316RG
ZERO	005210R	ZFLAG	005442R	ZTMP	003026R
$ECO =	****** G	$FCO =	****** G	$ICI =	****** G
.ICO =	****** G	$RCI =	****** G	. SYM =	000027

      ABS. 000000   000
            015676   001

ERRORS DETECTED: 0
FREE CORE: 14156. WORDS
,LP:/NL.BEX/CRF<CCLIB1

CROSS REFERENCE TABLE   S-1

```
A        2-125#   2-176    2-177    2-182@   2-183@   2-252    2-288    2-397
AC       1- 49#   1- 70#   1- 73#   1- 76#   1- 79#   1-104#   1-105#   1-136#
         1-141#   1-153#   1-164#
ACNTR    1- 70@   1- 90    1- 92    1-118@   1-138@   1-151    1-154    1-178@
         1-198#
ADBUF    1- 47#
ADCSR    1- 47#
ADLBL    1- 97@   1- 99    1-102@   1-117#
ADMES    1- 15#
ADPRI    1- 47#
ADVEC    1- 47#
AK       2-299#   2-303    2-308    2-312    2-429    2-433
ALUT     1- 21#
ANOTM    1- 15#

ARH      2- 46    2- 64    2-364    2-369    2-662#
ARM      2- 29    2-142    2-206    2-211    2-222    2-238    2-319    2-324
         2-350    2-435    2-452    2-663#
AS       2-167#   2-176@   2-177@   2-182    2-183
ASH      1- 49#   1- 70#   1- 73#   1- 76#   1- 79#   1-104#   1-105#   1-136#
         1-141#   1-153#   1-164#
A13LUT   1- 15#
B        2-124#   2-244    2-258@   2-259@
BB       1- 37#
BB11     2- 75    2-128#
BB42     2-228    2-231#
BB44     2-233    2-236#
3B56     2-352    2-354#
3B6      2-380    2-383#
BB62     2-403    2-405#
BB74     2-306    2-313#
BCD      2-620@   2-633@   2-637    2-639@   2-640    2-660#
BFCR     2-603    2-606#
BFOUT    2-467    2-474@   2-475    2-524    2-531@   2-532    2-539    2-543@
         2-544    2-661#
BFSP     2-599    2-602#
BLANK    1- 12#
BLNK     1- 19#
BLOK     1- 34#
BMD      2-440    2-443#
BRCT     2-585@   2-592@   2-598#
BS       2-148#   2-184    2-185
B1       2- 67#
B11      2- 72    2-126#
B12      2-130#
B13      2-135#   2-381    2-404    2-425
B2       2-154#   2-172    2-179
B21      2-171    2-174#
328      2-156    2-181#
B3       2-190#   2-196    2-203
B31      2-198    2-200#
B4       2-175    2-201    2-204#
B42      2-178    2-202    2-226#
B44      2-225    2-237#   2-362
B46      2-153    2-189    2-253    2-257#
B48      2-224    2-263#   2-353
B5       2-173    2-199    2-285#
B51      2-314#   2-339
```

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```
B52      2-316#   2-446
B53      2-333    2-335#   2-449
B54      2-332#
B55      2-331    2-341#
B56      2-330    2-349#
B58      2-159    2-195    2-363#
B6       2-180    2-376#
B62      2-399#
B7       2-378    2-414#
B71      2-415    2-420#
B74      2-313    2-426#
B75      2-437    2-445    2-447#
B8       2-377    2-382#
B84      2-261    2-448    2-450#
B85      2-334    2-462    2-464#
C        2-146#   2-184@   2-185@   2-242    2-258    2-259    2-290
CHROMA   1-  8#
CH7F     2- 37@   2- 42#   2- 43
CLK      1- 52#
CM       2-131#   2-216    2-388    2-410
CM1      2- 74#   2-151    2-152    2-230    2-338    2-442
CNS      2-628    2-631#
CP1      2-127#   2-186    2-187    2-310
CR       1- 36#
CTR1     2- 36@   2- 55@   2-111@   2-518#
CTR2     2- 48@   2- 49@   2- 57    2- 90@   2- 91@   2-113    2-519#
CVRT     2-572    2-609#
CZO      2-168#   2-213    2-214
D        2-248    2-286    2-374#
DATAB    1- 14#   2-  2#   2- 15    2- 37    2- 38    2- 76    2- 77
DATI     2-562    2-565#
DDN      2-632    2-637#
DF       2- 31@   2-161#   2-234@   2-254    2-332    2-376    2-422@   2-447
DIV      1- 49@   1- 70#@  1- 73#@  1- 76#   1- 79#   1-104#   1-105#   1-136#@
         1-141#@  1-153#   1-164#
DM       2-129#   2-209    2-218    2-220    2-227    2-386    2-408    2-420@
         2-421@
DM1      2-522#
DM2      2-523#
DOT      2- 25    2- 54    2- 84    2- 98    2-572#
DOTORL   2-570#
DP       2-623#   2-636
DPSCN    1- 28#
DR       1- 50#
DRIN     1- 50#
DROUT    1- 50#
DS       2-412#   2-420    2-421
DSKIN    1- 12#
DSKOUT   1- 32#
D84      2-255    2-261#
EAENOR   1- 49#   1- 70#   1- 73#   1- 76#   1- 79#   1-104#   1-105#   1-136#
         1-141#   1-153#   1-164#
EAESC    1- 49#   1- 70#   1- 73#   1- 76#   1- 79#   1-104#   1-105#   1-136#
         1-141#   1-153#   1-164#
EAESR    1- 49#   1- 70#   1- 73#   1- 76#   1- 79#   1-104#   1-105#   1-136#
         1-141#   1-153#   1-164#
ERR      2- 35#
ERRLP    2-516#
```

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CROSS REFERENCE TABLE   S-3

```
FIN      1-  9#
FIX      1- 25#
FRLUT    1- 23#
GCFLG    1- 17#
GETPKS   1- 14#
GETSPC   2- 12#   2- 14
HERE     2-535@   2-537    2-538#
HI       2- 22@   2- 52@   2- 81@   2- 96@   2-510    2-612    2-629    2-631
         2-634@   2-658#
HS       2-621@   2-625    2-642    2-653#
IAXIS    1- 11#   1- 55#
IBUF     1- 14#   2-  2#   2-548    2-565    2-573    2-609
IFIX     2- 13#   2-536
IMOREC   1- 14#
INBC     2-630    2-633#
INITIL   1-  3#
INPUT    1- 12#
INTMU    1- 30#
IS       2- 19@   2- 30    2- 71    2-135    2-164#   2-181    2-207
ISYMBL   1- 13#   1-114    1-174
ITMP     2-116#   2-316@   2-317@   2-320
J        2-135@   2-143    2-154@   2-155    2-165#   2-181@   2-190@   2-191
         2-212    2-223    2-239    2-257    2-263    2-266    2-314    2-317
         2-325    2-341    2-345    2-351    2-370    2-436    2-453
JB6      2-158    2-180#   2-192    2-194
JS       2-166#   2-257@   2-365
J62      2-404#   2-413
KBHIT    2-515#
KOOL     2- 56    2- 61#   2-112
L        2-119#   2-133@   2-450@   2-461    2-464@
LBL      1- 94    1- 97#
LDAR     2-141    2-205    2-221    2-237    2-279#   2-318    2-323    2-349
         2-363    2-368    2-451
LF       2-120#   2-149@   2-170    2-197    2-204@
LININC   1- 29#
LO       2- 21@   2- 51@   2- 80@   2- 95@   2-512    2-610    2-626    2-635@
         2-659#
LOK      2- 47#   2- 58
LOK11    2- 89#   2-114
LOK67    2- 60#
LOK68    2- 45    2- 76#
LOK69    2- 40    2- 43#
LOOK     2- 49#   2- 59
LOOK11   2- 91#   2-115
LPB      2- 11#   2-503@
LPF      1- 17#
LPMM     1- 20#
LPS      2- 10#   2-501
LS       2-622@   2-624    2-654#
LSH      1- 49#   1- 70#   1- 73#   1- 76#   1- 79#   1-104#   1-105#   1-136#
         1-141#   1-153#   1-164#
MA       2- 33#   2-232
MBD      2-416    2-673#
MBUF     1- 11#   1- 92    1- 93    1- 95    1- 97    1-154    1-155
MD       2-355    2-357    2-431#   2-439    2-459
MLST     2-342    2-670#
MQ       1- 49#   1- 70#@  1- 73#@  1- 76#@  1- 79#@  1-104#@  1-105#@  1-106
         1-136#@  1-138    1-141#@  1-153#@  1-164#@  2- 77@   2- 79    2- 85@
```

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                2- 87
MS30F   1- 17#
MTMEG   2-618    2-645#
MUL     1- 49#   1- 70#   1- 73#   1- 76#@ 1- 79#@ 1-104#@ 1-105#@ 1-136#
        1-137@   1-141#   1-153#@ 1-164#@ 2- 78@  2- 86@
MZRO    2-264    2-270#
M$ER    2-664%
M$H     2- 61    2-667#
M$1     2-676#
M$2     2- 16    2-679#
M10     1- 7#    1- 83    1-165    1-192#
M30     1- 7#    1- 82    1- 89    1-150    1-166    1-189#
NBOKRE  1- 22#
NCHAR   1- 98@   1-101@   1-104    1-105    1-107@   1-117    1-156@   1-159@
        1-163@   1-164    1-177    1-194#
NF      2-140@   2-157    2-162#   2-193    2-235@   2-263@   2-314@   2-341@
        2-379    2-423@
NLBL    1- 91    1- 96    1-118#
NP      2- 15@   2- 36    2- 39    2- 65    2- 71    2- 85    2-121#   2-136
        2-155
NR      2-117#   2-132@   2-383@   2-414
NS      2-122#   2-150@   2-154    2-188@   2-190    2-316
NUM     1- 16#
NZE     2-611    2-613    2-617#
OCRLF   1- 23#
OFFS    1- 76@   1- 77    1- 81@   1- 82@   1- 83@   1-112    1-116    1-193#
OK      2- 32    2- 36#
ONEE    1- 7#    1- 65    1- 89    1-131    1-150    1-190#
ORIGIN  1- 5#
ORT     2-483    2-485    2-492#
PA$1    2- 66    2-583#
PA$2    2-585#   2-594
PA$3    2-587#   2-593
PA$4    2-591    2-595#
PC      1- 53#   2- 17@   2- 18@   2- 20@   2- 25@   2- 54@   2- 62@   2- 63@
        2- 66@   2- 84@   2- 98@   2-134@   2-153@   2-159@   2-178@,  2-189@
        2-195@   2-202@   2-236@   2-253@   2-260@   2-261@   2-285@   2-267@
        2-268@   2-278@   2-279@   2-282@   2-343@   2-344@   2-346@   2-347@
        2-375@   2-384@   2-392@   2-393@   2-395@   2-396@   2-398@   2-417@
        2-418@   2-424@   2-457@   2-458@   2-460@   2-465@   2-473@   2-476@
        2-477@   2-479@   2-492@   2-509@   2-511@   2-513@   2-514@   2-517@
        2-530@   2-533@   2-534@   2-542@   2-545@   2-546@   2-549@   2-567@
        2-569@   2-571@   2-577@   2-582@   2-586@   2-588@   2-595@   2-596@
        2-600@   2-601@   2-604@   2-605@   2-607@
PCR     2- 63    2-134    2-268    2-347    2-384    2-418    2-424    2-465
        2-586    2-595    2-603#
PEAKS   1- 31#
PLT     1- 5#    1- 58    1- 62    1- 84    1- 87    1-110    1-123    1-128
        1-145    1-148    1-171    1-183
PLTR    1- 51#
PMSG    2- 17    2- 62    2-265    2-343    2-417    2-476    2-533    2-545
        2-600    2-604    2-606#
PPF     1- 17#
PPMM    1- 18#
PRINT   2-457    2-535#
PRMD    2-460    2-524#
PRTVEC  1- 38#   1- 48#
PR1     2-392    2-395    2-398    2-467#   2-588
```

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```
PSP      2-344    2-393    2-396    2-458    2-599#
PSW      1- 53#
PTR1     2- 24@   2- 46@   2- 82@   2- 87@   2- 88@   2- 99    2-107    2-520#
         2-578@   2-579@   2-580@   2-581@
PTR2     2-521#
RAWREC   1- 14#
RBG      2-479#   2-491
RD$OCT   2-510#   2-571
RD$1     2-479    2-493#   2-549
RD$2     2-495#   2-496
RD$3     2-498#   2-499
RD$4     2-501#   2-502
RINT     2-267    2-346    2-539#
RNUM     1- 35#
RRSTR    1- 33#   1-186    2-  9#
RSAV     1- 33#   1- 56    2-  9#
RT       2-620#   2-643
RTN      2-163#   2-172@   2-174@   2-196@   2-200@   2-256    2-262    2-269
         2-315    2-340    2-348    2-463    2-466
RT1      2-160    2-170#
RT2      2-174    2-176#
RT3      2-200    2-202#
R$DC     2-549#   2-558    2-560
R$DEC    2- 18    2- 20    2-547#   2-551
R$OCT    2-478#   2-481    2-511    2-513
R0       1- 53#   2- 19    2- 21    2-266@   2-272@   2-273@   2-274@   2-275@
         2-276@   2-277@   2-345@   2-480    2-482    2-484    2-489@   2-490
         2-497@   2-500    2-503    2-504@   2-506    2-541    2-550    2-552
         2-554    2-557    2-559    2-568@
R00      1- 26#
R1       1- 53#   2- 16@   2- 38@   2- 47@   2- 50    2- 51    2- 52    2- 61@
         2- 64@   2- 89@   2- 94    2- 95    2- 96    2-264@   2-342@   2-391@
         2-394@   2-397@   2-416@   2-456@   2-459@   2-471    2-472    2-475@
         2-478@   2-486@   2-487@   2-488@   2-490@   2-510@   2-512@   2-528
         2-529    2-532@   2-535    2-544@   2-583    2-587@   2-599@   2-603@
         2-606
R10      1- 26#
R2       1- 53#   2- 65@   2-584    2-618@   2-621    2-622    2-642
R20      1- 26#
R3       1- 53#   2- 23@   2- 53@   2- 76@   2- 79@   2- 80    2- 81    2- 83@
         2- 97@   2- 99@   2-100@   2-101    2-102    2-107@   2-108@   2-109@
         2-110@   2-547@   2-556@   2-561    2-563@   2-566    2-570@   2-574
         2-614@   2-641@
R30      1- 26#
R33      1- 12#
R4       1- 53#   2-548@   2-557@   2-564@   2-583@   2-587    2-589    2-609@
         2-615@   2-640@
R40      1- 26#
R5       1- 53#   1- 56@   1- 57    1- 58@   1- 61    1- 62@   1- 66    1- 70
         1- 71    1- 73    1- 74    1- 76    1- 79    1- 84@   1- 87@   1-110@
         1-113    1-114@   1-119    1-122    1-123@   1-127    1-128@   1-132
         1-136    1-139    1-141    1-142    1-145@   1-148@   1-153    1-171@
         1-174@   1-180    1-183@   1-186@   1-187@   2- 14@   2- 28@   2- 41@
         2-141@   2-205@   2-210@   2-221@   2-237@   2-272    2-273    2-274
         2-275    2-276    2-281@   2-284@   2-318@   2-323@   2-349@   2-363@
         2-368@   2-382@   2-419@   2-434@   2-451@   2-508@   2-536@   2-572@
         2-606@   2-616@   2-644@
R5SAV    1- 12#
```

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```
R50      1- 26#
R6       1- 53#
R7       1- 53#
SCANS    1-  3#   2- 13#
SET      1-  5#
SETINC   1-  8#
SIZE     1- 10#   1-113@   1-116    1-176
SN       2-123#   2-151@   2-152@   2-186@   2-187@   2-329
SNUM     1- 35#
SP       1- 53#   1- 92@   1-154#@  2-467@   2-468@   2-469@   2-470@   2-471@
         2-472@   2-524@   2-525@   2-526@   2-527@   2-528@   2-529@   2-539@
         2-540@   2-541@   2-565@   2-566@   2-568    2-573@   2-574@   2-575@
         2-576@   2-578    2-580    2-606@
SPACEC   1- 24#   1-105    1-162
SS       2-169#   2-213@   2-214@   2-359    2-361    2-394    2-402    2-405
         2-406
ST       2-118#   2-136@   2-137@   2-138@   2-139@   2-336
STAR     2- 28    2-210    2-282#   2-434
START    2-  3#   2- 14#
STPT     2-272#   2-279    2-282
STRING   1-  4#   2-  2#   2-606#
SWR      1- 53#
SYMBOL   1- 13#
S0       2- 70#   2-400    2-405@   2-406@
S10      1- 84#   1-121
S20      1- 68    1-122#
S30      1-145#   1-182
S40      1-134    1-183#
TH       2-625@   2-627@   2-629@   2-631@   2-634    2-656#
TIC      2- 34#
TICC     1- 33#
TICFLG   1- 14#
TKB      1- 48#   2-497
TKS      1- 48#   2-493@   2-495    2-505@   2-516@
TL       2-624@   2-626@   2-635    2-655#
TLNK     1- 32#
TPB      1- 48#   2-500@
TPS      1- 48#   2-494@   2-498
TP#1     2-507    2-509#
TRAPH    2- 13#
TRA      1- 27#
TRNUM    2- 12#
TS       2-638    2-642#
TSNUM    2- 12#
TSSP     2-553    2-555    2-559#
TTYI     1- 33#
TTYO     1- 33#
TUIC     2- 12#
UIC      1- 35#
U1X      1- 14#
X        1-  6#   1- 70@   1- 71@   1- 72@   1- 86    1- 89    1-108    1-119@
         1-120    1-141@   1-142@   1-144@   1-181    1-188#
XS       1-104@   1-106@   1-108@   1-109@   1-112    1-116    1-143@   1-168
         1-197#
XSIZE    1- 79@   1- 80@   1-104    1-153@   1-162@   1-164@   1-165@   1-166@
         1-167@   1-173    1-176    1-195#
XSTORE   1- 13#
XTMP     2- 82    2- 93#
```

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CROSS REFERENCE TABLE   S-7

```
Y        1-  6#   1- 73@   1- 74@   1- 75@   1-120    1-136@   1-139@   1-140@
         1-147    1-150    1-169    1-180@   1-181    1-199#
YE       1- 12#
YMUL     1-137    1-200#
YSIZE    1- 77@   1- 78@   1-143    1-168@   1-169@   1-170@   1-173    1-176
         1-196#
YSTORE   1- 13#
ZERO     1-  7#   1- 60    1- 65    1- 86    1-112    1-117    1-125    1-126
         1-130    1-147    1-173    1-177    1-185    1-191#
ZERO     2-615#
ZFLAG    2-617@   2-637@   2-657#
ZTMP     2- 24    2- 27    2-101@   2-102@   2-104    2-106    2-109    2-110
         2-246#   2-250    2-292    2-294    2-296    2-301    2-322    2-327
         2-367    2-372    2-390    2-391    2-427    2-455    2-456
$ECO     2- 13#   2-473
$FCO     2- 13#   2-530
$ICI     2- 13#   2-567
$ICO     2- 13#   2-542
$RCI     2- 13#   2-577
         1- 59    1- 63    1- 85    1- 88    1-111    1-115    1-124    1-129
         1-146    1-149    1-172    1-175    1-184    2- 27    2-104    2-106
         2-209    2-216    2-218    2-220    2-227    2-230    2-232    2-242
         2-244    2-248    2-250    2-252    2-286    2-288    2-290    2-292
         2-294    2-296    2-301    2-303    2-308    2-310    2-312    2-322
         2-327    2-329    2-336    2-338    2-355    2-357    2-359    2-361
         2-367    2-372    2-386    2-388    2-390    2-400    2-402    2-408
         2-410    2-427    2-429    2-433    2-439    2-442    2-455    2-661#
         2-662#   2-663#
SYM      1- 92#   1-154#
```

```
CROSS REFERENCE TABLE    M-1

DIVD     1- 41#   1- 70   1- 73   1-136    1-141
MULT     1- 41#   1- 76   1- 79   1-104    1-105    1-153    1-164
RESUL    1- 70#   1- 73#  1- 76#  1- 79#   1-104#   1-105#   1-136#   1-141#
         1-153#   1-164#
STRGO    2-  4#   2-606
.AMODE   1- 92#   1-154#
.BIN2D   1- 45#   1- 92   1-154
.BIN2O   1- 45#
.CLOSE   1- 44#
.CVTDT   1- 40#
.DATE    1- 43#
.D2BIN   1- 39#
.GTUIC   1- 43#
.INIT    1- 43#
.OPENO   1- 44#
.O2BIN   1- 42#
.PARAD   1- 46#   1- 47
.PARAM   1- 43#   1- 53
.PARDR   1- 46#   1- 50
.PAREA   1- 46#   1- 49   1- 70#  1- 73#   1- 76#   1- 79#   1-104#   1-105#
         1-136#   1-141#  1-153#  1-164#
.PARTY   1- 46#   1- 48
.RADPK   1- 45#
.RLSE    1- 43#
.TIME    1- 43#
.TRAN    1- 43#
.WAIT    1- 43#
.WRITE   1- 44#
```

214

CCLIB Module Real Time Data Aquisition Routine

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CCLIB MACRO VR05A 01-JAN-72 01:12
TABLE OF CONTENTS

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```
1                               . TITLE   CCLIB
2                               . GLOBL   XSTORE, YSTORE, SPACEC
3                               . GLOBL   ISYMBL, SYMBOL, PLOT, FIX, RSAV, RRSTR, SET, ORIGIN
4                               . GLOBL   LININC
5                               . GLOBL   FIN, PLT
6                               . MCALL   . PARAM, . PAREA, . PARTY
7   ....000                     . PARAM
8   000000                      . PAREA
9   000000          .           . PARTY
10          000015              CR=15
11          000012              LF=12
12          172554              PLTR=172554
13                              . GLOBL   STRING
14                              . MACRO   STRGO   ARG1
15                              MOV       ARG1, -( SP )
16                              JSR       R5, STRING
17                              . ENDM
18                              . SBTTL   CALCOMP SYMBOL ROUTINE
19 00000 000006 SPACEC: . WORD   6
20 00002 000000 QSTO:   . WORD   0
21 00004 000000 RSTOY:  . WORD   0
22 00006 000000 XKQ:    . WORD   0
23 00010 000000 YKQ:    . WORD   0
24 00012 000000 CHAR:   0
25 00014 000000 PENARG: 0
26 00016 016737 QMORE:  MOV SPACEC, @#MQ
27 00024 010437         MOV R4, @#MUL
28 00030 063767         ADD @#MQ, QSTO
29 00036          NULLC:
30 00036 005301         DEC R1
31 00040 003075         BGT AGAIN
32 00042 004567         JSR       R5, RRSTR
33 00046 000205         RTS R5
34 00050          BCHAR:  STRGO     #BADCHM
35 00060 000167         JMP       NULLC
36 00064    040 BADCHM: . ASCII   / BAD CHARACTER CALCOMP SYMBOL ROUTINE /
37 00132    015         . BYTE    CR, LF, 0
38                       . EVEN
39 00136          ISYMBL:
40 00136 004567         JSR       R5, RSAV
41 00142 017567         MOV       @2( R5 ), QSTO
42 00150 017567         MOV       @4( R5 ), RSTOY
43 00156 000420         BR        IENTRY
44 00160 004567 SYMBOL: JSR       R5, RSAV
45 00164 016500         MOV       2( R5 ), R0
46 00170 004767         JSR PC, FIX
47 00174 013767         MOV @#MQ, QSTO
48 00202 016500         MOV 4( R5 ), R0                 ; GET Y
49 00206 004767         JSR PC, FIX
50 00212 013767         MOV @#MQ, RSTOY
51 00220          IENTRY:
52 00220 017504         MOV @6( R5 ), R4                ; GET @#MULTIPLIER
53 00224 016500         MOV 10( R5 ), R0                ; GET BASE ADDRESS OF TEXT
54 00230 017501         MOV @14( R5 ), R1               ; # OF CHARACTERS
55 00234 112067 AGAIN:  MOVB ( R0 )+, CHAR              ; PUT ASCII CHARACTER IN CHAR
56 00240 126727         CMPB CHAR, #40
57 00246 001663         BEQ QMORE
```

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```
58 00250 105767            TSTB    CHAR
59 00254 001670            BEQ     NULLC
60 00256 126727            CMPB    CHAR,#37
61 00264 003671            BLE     BCHAR
62 00266 126727            CMPB    CHAR,#141
63 00274 002413            BLT     GOOD
64 00276 126727            CMPB    CHAR,#173
65 00304 002661            BLT     BCHAR
66 00306 126727            CMPB    CHAR,#177
67 00314 001650            BEQ     NULLC
68 00316 162767            SUB     #32,CHAR
69 00324          GOOD
70 00324 162767            SUB #41,CHAR
71 00332 006367            ASL CHAR
72 00336 062767            ADD #BASE,CHAR
73 00344 016767 WRITE:     MOV RSTOY,YKQ
74 00352 016767            MOV QSTO,XKQ
75 00360 005067            CLR PENARG
76 00364 004767            JSR PC,CALL
77 00370 017702            MOV @CHAR,R2
78 00374 111203            MOVB @R2,R3
79 00376 005722            TST (R2)+
80 00400 005267            INC PENARG
81 00404 005303 LOPE:      DEC R3
82 00406 100603            BMI QMORE
83 00410 012267            MOV (R2)+,CHAR
84 00414 105767            TSTB CHAR
85 00420 100013            BPL LOOP1
86 00422 005067            CLR PENARG
87 00426 105467            NEGB CHAR
88 00432 126727            CMPB CHAR,#6
89 00440 003403            BLE LOOP1
90 00442 112767            MOVB #0,CHAR
91 00450 116737 LOOP1:     MOVB CHAR+1,@#MQ
92 00456 010437            MOV R4,@#MUL
93 00462 016767            MOV QSTO,XKQ
94 00470 016767            MOV RSTOY,YKQ
95 00476 063767            ADD @#MQ,YKQ
96 00504 105067            CLRB CHAR+1
97 00510 016737            MOV CHAR,@#MQ
98 00516 010437            MOV R4,@#MUL
99 00522 063767            ADD @#MQ,XKQ
100 0530 004767            JSR PC,CALL
101 0534 012767            MOV #1,PENARG
102 0542 000720            BR LOPE
103 0544          CALL:
104 0544 004567            JSR R5,PLT
105 0550 000403            BR .+10
106 0552 000006            .WORD   XKQ
107 0554 000010            .WORD   YKQ
108 0556 000014            PENARG
109 0560 000207            RTS PC
110 0562          BASE:
111 0562 000770            .WORD    EXCLAM,QUOTE,POUND,DOLLAR,PERCNT,ANDDD,SQUOTE
112 0600 001162            .WORD    LEFT,RIGHT,ASTER,PLUS,COMMA,MINUS,PERIOD,SLASH
113 0620 001310            .WORD    ZZERO,ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHTS
114 0642 001602            .WORD    NINE,COLON,SEMI,LT,EQ,GT,QQUES,AT
```

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CALCOMP SYMBOL ROUTINE

```
115 0662 (+2034'      . WORD   A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W
116 0740 002570'      . WORD   XX, YY
117 0744 002616'      WORD    Z, LBRKT, BSLAS, RBRKT, UPAROW, BKAROW, LPBRKT
118 0762 002732'      . WORD   BARRR, RPBRKT, TWIDLE
119                 ;  FORMAT OF TABLE:
120                 ;  CHARACTERS ARE 5 BY 7
121                 ;  WORD 1  =# MOVES
122                 ;  WORD 2-N  X. XKQ  COORDINATES IN CHARACTER
123                 ;          X NEGATIVE. PENARG UP, XKQ>6 SET X=0
124
125 0770 000007 EXCLAM:  WORD   7
126 0772    376       BYTE   -2, 0, 1, 0, 1, 1, 2, 1, 2, 0, -2, 2, 2, 6
127 1010 000004 QUOTE:   WORD   4
128 1012    376       BYTE   -2, 5, 2, 6, -3, 6, 3, 5
129 1022 000010 POUND:   WORD   8.
130 1024    377       BYTE   -1, 0, 2, 5, -3, 5, 2, 0, -4, 2, 0, 2, -4, 3, 0, 3
131 1044 000016 DOLLAR   WORD   14.
132 1046    371       BYTE  -7, 1, 1, 0, 3, 0, 4, 1, 4, 2, 3, 3, 1, 3, 0, 4, 0, 5, 1, 6, 3, 6, 4, 5
133 1076    376       BYTE   -2, 6, 2, 0
134 1102 000013 PERCNT:  . WORD   11.
135 1104    004       BYTE   4, 6, -1, 6, 1, 5, 0, 5, 0, 6, 1, 6, -3, 1, 3, 0, 4, 0, 4, 1, 3, 1
136 1132 000010 ANDDD:   WORD   8.
137 1134    374       BYTE   -4, 2, 2, 0, 1, 0, 0, 1, 3, 5, 2, 6, 1, 5, 4, 0
138 1154 000002 SQUOTE:  WORD   2
139 1156    375       BYTE   -3, 6, 3, 5
140 1162 000004 LEFT:    4
141 1164    375       BYTE  -3, 0, 2, 1, 2, 5, 3, 6
142 1174 000004 RIGHT:   4
143 1176    377       BYTE  -1, 0, 2, 1, 2, 5, 1, 6
144 1206 000010 ASTER:   8.
145 1210    371       BYTE  -7, 3, 4, 3, 2, 3, 1, 5, 3, 1, 2, 3, 1, 1, 3, 5
146 1230 000005 PLUS:    5
147 1232    377       BYTE  -1, 3, 3, 3, 2, 3, 2, 4, 2, 2
148 1244 000006 COMMA:   6
149 1246    376       BYTE  -2, 1, 1, 1, 1, 2, 2, 2, 2, 1, 1, 0
150 1262 000002 MINUS:   2
151 1264    377       BYTE  -1, 3, 3, 3
152 1270 000005 PERIOD:  5
153 1272    376       BYTE  -2, 0, 1, 0, 1, 1, 2, 1, 2, 0
154 1304 000001 SLASH:   1
155 1306    004       BYTE  4, 6
156 1310 000012 ZZERO:   10.
157 1312    377       BYTE  -1, 0, 0, 1, 0, 5, 1, 6, 3, 6, 4, 5, 4, 1, 3, 0, 1, 0, 3, 6
158 1336 000005 ONE:     5
159 1340    377       BYTE  -1, 5, 2, 6, 2, 0, 1, 0, 3, 0
160 1352 000013 TWO:     11.
161 1354    371       BYTE  -7, 4, 0, 5, 1, 6, 3, 6, 4, 5, 4, 4, 3, 3, 1, 2, 0, 1, 0, 0, 4, 0
162 1402 000015 THREE:   13.
163 1404    371       BYTE  -7, 5, 1, 6, 3, 6, 4, 5, 4, 4, 3, 3, 2, 3, 3, 3, 4, 2, 4, 1, 3, 0, 1, 0, 0, 1
164 1436 000004 FOUR:    4
165 1440    374       BYTE  -4, 0, 4, 6, 0, 2, 4, 2
166 1450 000011 FIVE:    9.
167 1452    371       BYTE  -7, 1, 1, 0, 3, 0, 4, 1, 4, 2, 3, 3, 0, 3, 0, 6, 4, 6
168 1474 000014 SIX:     12.
169 1476    371       BYTE  -7, 2, 1, 3, 3, 3, 4, 2, 4, 1, 3, 0, 1, 0, 0, 1, 0, 5, 1, 6, 3, 6, 4, 5
170 1526 000003 SEVEN:   3
171 1530    371       BYTE  -7, 6, 4, 6, 1, 0
```

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```
172 1536 000021 EIGHTS: 17.
173 1540    375          .BYTE -3,0,1,0,0,1,0,2,1,3,0,4,0,5,1,6,3,6,4,5,4,4
174 1566    003          .BYTE 3,3,1,3,3,3,4,2,4,1,3,0
175 1602 000015 NINE:   13.
176 1604    371          .BYTE -7,1,1,0,3,0,4,1,4,4,3,3,1,3,0,4,0,5,1,6,3,6,4,5,4,4
177 1636 000012 COLON:  10.
178 1640    377          .BYTE -1,4,1,5,2,5,2,4,1,4,-2,1,1,1,1,2,2,2,2,1
179 1664 000013 SEMI:   11.
180 1666    377          .BYTE -1,4,1,5,2,5,2,4,1,4,-2,1,1,1,1,2,2,2,2,1,1,0
181 1714 000003 LT:      3
182 1716    375          .BYTE -3,4,1,3,3,2
183 1724 000004 EQ:      4
184 1726    377          .BYTE -1,4,3,4,-1,2,3,2
185 1736 000003 GT:      3
186 1740    377          .BYTE -1,4,3,3,1,2
187 1746 000015 QQUES:  13.
188 1750    371          .BYTE -7,5,1,6,3,6,4,5,4,4,3,3,2,3,2,2,-2,1,3,1,3,0,2,0,2,1
189 2002 000014 AT:     12.
190 2004    375          .BYTE -3,2,3,4,1,4,1,2,4,2,4,4,3,5,1,5,0,4,0,2,1,1,4,1
191 2034 000010 A:       8.
192 2036    000          .BYTE 0,5,1,6,3,6,4,5,4,3,0,3,4,3,4,0
193 2056 000013 B:      11.
194 2060    000          .BYTE 0,6,3,6,4,5,4,4,3,3,0,3,3,3,4,2,4,1,3,0,0,0
195 2106 000010 C:       8.
196 2110    374          .BYTE -4,5,3,6,1,6,0,5,0,1,1,0,3,0,4,1
197 2130 000006 D:       6
198 2132    000          .BYTE 0,6,3,6,4,5,4,1,3,0,0,0
199 2146 000007 E:       7
200 2150    374          .BYTE -4,6,0,6,0,3,2,3,0,3,0,0,4,0
201 2166 000005 F:       5
202 2170    000          .BYTE 0,3,2,3,0,3,0,6,4,6
203 2202 000012 G:      10.
204 2204    374          .BYTE -4,5,3,6,1,6,0,5,0,1,1,0,3,0,4,1,4,3,3,3
205 2230 000005 H:       5
206 2232    000          .BYTE 0,6,0,3,4,3,4,6,4,0
207 2244 000006 I:       6
208 2246    377          .BYTE -1,0,3,0,2,0,2,6,1,6,3,6
209 2262 000006 J:       6
210 2264    371          .BYTE -7,2,0,1,1,0,3,0,4,1,4,6
211 2300 000005 K:       5
212 2302    000          .BYTE 0,6,0,3,4,6,0,3,4,0
213 2314 000003 L:       3
214 2316    000          .BYTE 0,6,0,0,4,0
215 2324 000004 M:       4
216 2326    000          .BYTE 0,6,2,3,4,6,4,0
217 2336 000003 N:       3
218 2340    000          .BYTE 0,6,4,0,4,6
219 2346 000011 O:       9.
220 2350    371          .BYTE -7,1,0,5,1,6,3,6,4,5,4,1,3,0,1,0,0,1
221 2372 000006 P:       6
222 2374    000          .BYTE 0,6,3,6,4,5,4,4,3,3,0,3
223 2410 000013 Q:      11.
224 2412    375          .BYTE -3,0,1,0,0,1,0,5,1,6,3,6,4,5,4,1,3,0,-3,1,4,0
225 2440 000010 R:       8.
226 2442    000          .BYTE 0,6,3,6,4,5,4,4,3,3,0,3,2,3,4,0
227 2462 000014 S:      12.
228 2464    371          .BYTE -7,1,1,0,3,0,4,1,4,2,3,3,1,3,0,4,0,5,1,6,3,6,4,5
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229 2514 000004 T:              4
230 2516     376        . BYTE  -2, 0, 2, 6, 0, 6, 4, 6
231 2526 000006 U:              6
232 2530     371        . BYTE  -7, 6, 0, 1, 1, 0, 3, 0, 4, 1, 4, 6
233 2544 000003 V:              3
234 2546     371        . BYTE  -7, 6, 2, 0, 4, 6
235 2554 000005 W:              5
236 2556     371        . BYTE  -7, 6, 1, 0, 2, 3, 3, 0, 4, 6
237 2570 000004 XX:             4
238 2572     004        . BYTE  4, 6, 2, 3, 0, 6, 4, 0
239 2602 000005 YY:             5
240 2604     371        . BYTE  -7, 6, 2, 3, 4, 6, 2, 3, 2, 0
241 2616 000004 Z:              4
242 2620     371        . BYTE  -7, 6, 4, 6, 0, 0, 4, 0
243 2630 000004 LBRKT:   . WORD 4
244 2632     375        . BYTE  -3, 0, 2, 0, 2, 6, 3, 6
245 2642 000002 BSLAS:   . WORD 2
246 2644     374        . BYTE  -4, 0, 0, 6
247 2650 000004 RBRKT:   . WORD 4
248 2652     376        . BYTE  -2, 0, 3, 0, 3, 6, 2, 6
249 2662 000005 UPAROW:  . WORD 5
250 2664     376        . BYTE  -2, 0, 2 6, 1, 5, 2, 6, 3, 5
251 2676 000005 BKAROW:  . WORD 5
252 2700     374        . BYTE  -4, 3, 0, 3, 1, 4, 0, 3, 1, 2
253 2712 000007 LPBRKT:  . WORD 7
254 2714     375        . BYTE  -3, 0, 2, 0, 2, 2, 1, 3, 2, 4, 2, 6, 3, 6
255 2732 000002 BARRR:   . WORD 2
256 2734     376        . BYTE  -2, 0, 2, 6
257 2740 000007 RPBRKT:  . WORD 7
258 2742     376        . BYTE  -2, 0, 3, 0, 3, 2, 4, 3, 3, 4, 3, 6, 2, 6
259 2760 000004 TWIDLE:  . WORD 4
260 2762     374        . BYTE  -4, 3, 3, 2, 1, 3, 0, 2
```

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```
 1                              .SBTTL  PLOT ROUTINE, FIX ROUTINE
 2  002772 004567 PLOT:   JSR      R5,RSAV
 3  002776 016500         MOV      2(R5),R0
 4  003002 004767         JSR  PC,FIX      ;GET A VALUE,FIX IT
 5  003006 013767         MOV  @#MQ,XQ     ;STORE IT IN X
 6  003014 016500         MOV  4(R5),R0    ;GET THE Y VALUE FROM FORTRN
 7  003020 004767         JSR  PC,FIX
 8  003024 013767         MOV  @#MQ,YQ     ;STORE THE Y VALUE
 9  003032 017567         MOV  @6(R5),PEN1 ;PASS ON THE PEN1 COMMAND
10  03040 004567          JSR  R5,PLT      ;CALL THE PLT ROUTINE AS THOUGH YOU THINK
11  03044 000403          BR   .+10        ;YOU WERE A FORTRAN CALLING ROUTINE SINCE
12  03046 003062'         .WORD    XQ
13  03050 003064'         .WORD    YQ
14  03052 003066'         PEN1
15  03054 004567          JSR      R5,RRSTR
16  03060 000205          RTS  R5
17
18  03062 000000 XQ:      .WORD    0
19  03064 000000 YQ:      .WORD    0
20  03066 000000 PEN1:    0
21
22  03070 016037 FIX:     MOV  2(R0),@#MQ  ;GET LO ORDER FRACTION
23  03076 011001          MOV  (R0),R1     ;GET HI ORDER FRACTION AND EXPONENT WORD
24  03100 110167          MOVB R1,PEN1     ;FRACTION PART (MUST USE CORE,SINCE REG  MOVB
25                                         ;EXTENDS SIGN TO HIGH ORDER BYTE,ALSO CANT
26                                         ;ADDRESS THE HIGH ORDER BYTE OF A REG.
27  03104 052767          BIS #128.,PEN1   ;RESET THE LOST BIT
28  03112 105067          CLRB PEN1+1      ;CLEAR HI BYTE INCASE ITS SET
29  03116 016767          MOV PEN1,AC      ;SET UP THE SHIFT
30  03124 006101          ROL R1           ;NOW GO BACK AND GET EXPONENT
31  03126 000301          SWAB R1          ;TO BAD YOU CANT ADDRESS HI BYTE OF REG
32  03130 110167          MOVB R1,PEN1     ;EXTRACT THE EXPONENT
33  03134 105067          CLRB PEN1+1      ;CLEAR HI ORDER BYTE AGAIN
34  03140 162767          SUB #152.,PEN1   ;GET RID OF THE 128 EXCESS,PLUS SET UP FOR SHIFT
35  03146 016737          MOV PEN1,@#ASH   ;SHIFT IT TO MAKE IT INTEGER
36  03154 005710          TST (R0)         ;IS IT NEGATIVE ?
37  03156 100002          BPL BACK         ;NO
38  03160 005437          NEG @#MQ
39  03164 000207 BACK:    RTS PC
```

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```
 1                          .SBTTL   SET ROUTINE, FIN ROUTINE
 2 003166 004767 SET:       JSR PC,CLEAR
 3 003172 005067            CLR      LININC
 4 003176 005067            CLR      LININC+2
 5 003202 012767            MOV #800.,XMAXX
 6 003210 012767            MOV #-2794.,YMAXX
 7 003216 004767            JSR PC,ACALL
 8 003222 004767 ORIGIN:    JSR PC,CLEAR
 9 003226 000205            RTS R5
10 03230 004567 ACALL:      JSR R5,PLT
11 03234 000403             BR .+10
12 03236 003324'            XMAXX
13 03240 003326'            YMAXX
14 03242 003330'            PEN
15 03244 000207             RTS PC
16 03246 062767 FIN:        ADD #500.,XMAXX
17 03254 012767             MOV #2794.,YMAXX
18 03262 004767             JSR PC,ACALL
19 03266 004767             JSR PC,CLEAR
20 03272 005267             INC PEN
21 03276 012767             MOV #-2794.,YMAXX
22 03304 004767             JSR PC,ACALL
23 03310 004767             JSR PC,CLEAR
24 03314 000205             RTS R5
25 03316 000000 XSTORE:     0
26 03320 000000 YSTORE:     0
27 03322 000000 PSTORE:     0
28 03324 000000 XMAXX:      0
29 03326 000000 YMAXX:      0
30 03330 000000 PEN:        0
31 03332 000000 LININC:     .WORD    0,0
32 03336          CLEAR:
33 03336 004567             JSR      R5,RSAV
34 03342 012700             MOV      #XSTORE,R0
35 03346 005020 CLEAR1:     CLR (R0)+
36 03350 020027             CMP R0,#XSTORE+12.
37 03354 002774             BLT CLEAR1
38 03356 005267             INC PSTORE
39 03362 004767             JSR PC,ACALL
40 03366 004567             JSR      R5,RRSTR
41 03372 000207             RTS PC
```

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```
1                        .SBTTL   PLT CALCOMP SUBROUTINE
2 003374 000000 SAVE1:  .WORD    0
3 003376 000000 SAVE2:  .WORD    0
4 003400 000000 FLAG22: .WORD    0
5 003402        PLT:
6 003402 004567          JSR      R5,RSAV
7 003406         1$:
8 003406 105737          TSTB    @#PLTR
9 003412 100375          BPL     1$
10 03414 005067          CLR     FLAG22
11 03420 010546          MOV     R5,-(SP)
12 03422 005725          TST     (R5)+
13 03424 017501          MOV     @(R5),R1
14 03430 166701          SUB     XSTORE,R1
15 03434 013567          MOV     @(R5)+,XSTORE
16 03440 017502          MOV     @(R5),R2
17 03444 166702          SUB     YSTORE,R2
18 03450 013567          MOV     @(R5)+,YSTORE
19 03454 017500          MOV     @(R5),R0
20 03460 012737          MOV     #LOOPQQ,@#120
21 03466 012737          MOV     #200,@#122
22 03474 020067          CMP     R0,PSTORE
23 03500 001411          BEQ     NOPEN
24 03502 010067          MOV     R0,PSTORE
25 03506 001403          BEQ     UP
26 03510 012737          MOV     #120,@#PLTR
27 03516 012737 UP:      MOV     #140,@#PLTR
28 03524 026767 NOPEN:   CMP     XSTORE,XMAXX
29 03532 002403          BLT     LESS
30 03534 016767          MOV     XSTORE,XMAXX              224
31 03542 012703 LESS:    MOV     #1,R3         ;SET UP +X AND +Y BITS TO LOAD INTO PLTR
32 03546 012704          MOV     #4,R4
33 03552 005701          TST     R1            ;IF DX NEGATIVE
34 03554 002002          BGE     1$
35 03556 006303          ASL     R3            ;CHANGE +X BIT TO -X BIT
36 03560 005401          NEG     R1            ;AND NEGATE DX
37 03562 005702 1$:      TST     R2            ;IF DY NEGATIVE
38 03564 002002          BGE     2$
39 03566 006304          ASL     R4            ;CHANGE +Y BIT TO -Y BIT
40 03570 005402          NEG     R2            ;AND NEGATE DY
41 03572 020102 2$:      CMP     R1,R2         ;IF DY IS GREATER THAN DX
42 03574 002006          BGE     3$
43 03576 010200          MOV     R2,R0         ;SWAP DX AND DY
44 03600 010102          MOV     R1,R2
45 03602 010001          MOV     R0,R1
46 03604 010400          MOV     R4,R0         ;AND SWAP X AND Y BITS
47 03606 010304          MOV     R3,R4
48 03610 010003          MOV     R0,R3
49                                             ;NOW HAVE ONLY POSITIVE DELTAS, WITH
50                                             ;LARGEST IN R1, CALL IT M, AND SMALLEST
51                                             ;IN R2, CALL IT N. HAVE M BIT IN R3, N BIT
52                                             ;IN R4
53 03612 010467 3$:      MOV     R4,SAVE1      ;MOVE BITS TO SAVE1
54 03616 010367          MOV     R3,SAVE2
55 03622 052767          BIS     #100,SAVE2
56 03630 010105          MOV     R1,R5         ;INITIALIZE DONEQQ COUNTER
57 03632 010100          MOV     R1,R0         ;INITIALIZE SUM TO M
```

```
58 03634 006301              ASL R1          ;FORM 2*M
59 03636 006302              ASL R2          ;FORM 2*N
60 03640 012737              MOV #100,@#PLTR
61 03646 105767 4$:          TSTB SWR
62 03652 100403              BMI DONEQQ
63 03654 005767              TST FLAG22
64 03660 001772              BEQ 4$
65 03662 012605 DONEQQ:      MOV (SP)+,R5
66 03664 005037              CLR @#PLTR
67 03670 004567              JSR     R5,RRSTR
68 03674 000205              RTS R5
69 03676 005305 LOOPQQ:      DEC R5
70 03700 100416              BMI FINI
71 03702 016703              MOV SAVE2,R3    ;SET UP BIT TO MOVE IN M DIRECTION
72 03706 160200              SUB R2,R0       ;SUBTRACT 2*N FROM SUM
73 03710 002003              BGE 5$          ;IF SUM NEGATIVE
74 03712 060100              ADD R1,R0       ;ADD 2*M TO SUM
75 03714 056703              BIS SAVE1,R3    ;AND INCLUDE MOVE IN N DIRECTION
76 03720 010337 5$:          MOV R3,@#PLTR   ;MOVE COMMAND TO PLOTTER
77 03724 005267              INC     LININC+2
78 03730 005567              ADC     LININC
79 03734 000002              RTI
80 03736 005267 FINI:        INC FLAG22
81 03742 000002              RTI
82        000001'            .END
```

```
A       002034R     AC      = 177302    ACALL   003230R
AGAIN   000234R     ANDDD   001132R     ASH     = 177316
ASTER   001206R     AT      002002R     B       002056R
BACK    003164R     BADCHM  000064R     BARRR   002732R
BASE    000562R     BCHAR   000050R     BKAROW  002676R
BSLAS   002642R     C       002106R     CALL    000544R
CHAR    000012R     CLEAR   003336R     CLEAR1  003346R
COLON   001636R     COMMA   001244R     CR      = 000015
D       002130R     DIV     = 177300    DOLLAR  001044R
DONEQQ  003662R     E       002146R     EAENOR= 177312
EAESC = 177310      EAESR = 177311      EIGHTS  001536R
EQ      001724R     EXCLAM  000770R     F       002166R
FIN     003246RG    FINI    003736R     FIVE    001450R
FIX     003070RG    FLAG22  003400R     FOUR    001436R
G       002202R     GOOD    000324R     GT      001736R
H       002230R     I       002244R     IENTRY  000220R
ISYMBL  000136RG    J       002262R     K       002300R
L       002314R     LBRKT   002630R     LEFT    001162R
LESS    003542R     LF      = 000012    LININC  003332RG
LOOPQQ  003676R     LOOP1   000450R     LOPE    000404R
LPBRKT  002712R     LSH     = 177314    LT      001714R
M       002324R     MINUS   001262R     MO      = 177304
MUL     = 177306    N       002336R     NINE    001602R
NOPEN   003524R     NULLC   000036R     O       002346R
ONE     001336R     ORIGIN  003222RG    P       002372R
PC      =%000007    PEN     003330R     PENARG  000014R
PEN1    003066R     PERCNT  001102R     PERIOD  001270R
PLOT    002772RG    PLT     003402RG    PLTR    = 172554
PLUS    001230R     POUND   001022R     PRTVEC= 000064
PSTORE  003322R     PSW     = 177776    Q       002410R
QMORE   000016R     QQUES   001746R     QSTO    000002R
QUOTE   001010R     R       002440R     RBRKT   002650R
RIGHT   001174R     RPBRKT  002740R     RRSTR = ****** G
RSAV = ****** G     RSTOY   000004R     RO      =%000000
R1      =%000001    R2      =%000002    R3      =%000003
R4      =%000004    R5      =%000005    R6      =%000006
R7      =%000007    S       002462R     SAVE1   003374R
SAVE2   003376R     SEMI    001664R     SET     003166RG
SEVEN   001526R     SIX     001474R     SLASH   001304R
SP      =%000006    SPACEC  000000RG    SQUOTE  001154R
STRING= ****** G    SWR     = 177570    SYMBOL  000160RG
T       002514R     THREE   001402R     TKB     = 177562
TKS     = 177560    TPB     = 177566    TPS     = 177564
TWIDLE  002760R     TWO     001352R     U       002526R
UP      003516R     UPAROW  002662R     V       002544R
W       002554R     WRITE   000344R     XKQ     000006R
XMAXX   003324R     XQ      003062R     XSTORE  003316RG
XX      002570R     YKQ     000010R     YMAXX   003326R
YQ      003064R     YSTORE  003320RG    YY      002602R
/       002616R     ZZERO   001310R
  ABS.  000000     000
        003744     001
```

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ERRORS DETECTED: 0
FREE CORE: 16172 WORDS
.LP:/NL:BEX/CRF<CCLIB

```
A        1-115    1-191#
AC       1-  8#   2- 29@
ACALL    3-  7    3- 10#   3- 18    3- 22    3- 39
AGAIN    1- 31    1- 55#
ANDDD    1-111    1-136#
ASH      1-  8#   2- 35@
ASTER    1-112    1-144#
AT       1-114    1-189#
B        1-115    1-193#
BACK     2- 37    2- 39#
BADCHM   1- 34    1- 36#
BARRR    1-118    1-255#
BASE     1- 72    1-110#
BCHAR    1- 34#   1- 61    1- 65
BKAROW   1-117    1-251#
BSLAS    1-117    1-245#
C        1-115    1-195#
CALL     1- 76    1-100    1-103#
CHAR     1- 24#   1- 55@   1- 56    1- 58    1- 60    1- 62    1- 64    1- 66
         1- 68@   1- 70@   1- 71@   1- 72@   1- 77    1- 83@   1- 84    1- 87@
         1- 88    1- 90@   1- 91    1- 96@   1- 97
CLEAR    3-  2    3-  8    3- 19    3- 23    3- 32#
CLEAR1   3- 35#   3- 37
COLON    1-114    1-177#
COMMA    1-112    1-148#
CR       1- 10#   1- 37
D        1-115    1-197#
DIV      1-  8#
DOLLAR   1-111    1-131#
DONEQQ   4- 62    4- 65#
E        1-115    1-199#
EAENOR   1-  8#
EAESC    1-  8#
EAESR    1-  8#
EIGHT8   1-113    1-172#
EQ       1-114    1-183#
EXCLAM   1-111    1-125#
F        1-115    1-201#
FIN      1-  5#   3- 16#
FINI     4- 70    4- 80#
FIVE     1-113    1-166#
FIX      1-  3#   1- 46    1- 49    2-  4    2-  7    2- 22#
FLAG22   4-  4#   4- 10@   4- 63    4- 80@
FOUR     1-113    1-164#
G        1-115    1-203#
GOOD     1- 63    1- 69#
GT       1-114    1-185#
H        1-115    1-205#
I        1-115    1-207#
IENTRY   1- 43    1- 51#
ISYMBL   1-  3#   1- 39#
J        1-115    1-209#
K        1-115    1-211#
L        1-115    1-213#
LBRKT    1-117    1-243#
LEFT     1-112    1-140#
LESS     4- 29    4- 31#
LF       1- 11#   1- 37
```

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CROSS REFERENCE TABLE   S-2

```
LININC    1-  4#    3-  3@    3-  4@    3- 31#    4- 77@    4- 78@
LOOPQQ    4- 20     4- 69#
LOOP1     1- 85     1- 89     1- 91#
LOPE      1- 81#    1-102
LPBRKT    1-117     1-253#
LSH       1-  8#
LT        1-114     1-181#
M         1-115     1-215#
MINUS     1-112     1-150#
MQ        1-  8#    1- 26@    1- 28     1- 47     1- 50     1- 91@    1- 95     1- 97@
          1- 99     2-  5     2-  8     2- 22@    2- 38@
MUL       1-  8#    1- 27@    1- 92@    1- 98@
N         1-115     1-217#
NINE      1-114     1-175#
NOPEN     4- 23     4- 28#
NULLC     1- 29#    1- 35     1- 59     1- 67
O         1-115     1-219#
ONE       1-113     1-158#
ORIGIN    1-  3#    3-  8#
P         1-115     1-221#
PC        1-  7#    1- 46@    1- 49@    1- 76@    1-100@    1-109@    2-  4@    2-  7@
          2- 39@    3-  2@    3-  7@    3-  8@    3- 15@    3- 18@    3- 19@    3- 22@
          3- 23@    3- 39@    3- 41@
PEN       3- 14     3- 20#    3- 30#
PENARG    1- 25#    1- 75@    1- 80@    1- 86@    1-101@    1-108
PEN1      2-  9@    2- 14     2- 20#    2- 24@    2- 27@    2- 28@    2- 29     2- 32@
          2- 33@    2- 34@    2- 35
PERCNT    1-111     1-134#
PERIOD    1-112     1-152#
PLOT      1-  3#    2-  2#
PLT       1-  5#    1-104     2- 10     3- 10     4-  5#
PLTR      1- 12#    4-  8     4- 26@    4- 27@    4- 60@    4- 66@    4- 76@
PLUS      1-112     1-146#
POUND     1-111     1-129#
PRTVEC    1-  9#
PSTORE    3- 27#    3- 38@    4- 22     4- 24@
PSW       1-  7#
Q         1-115     1-223#
QMORE     1- 26#    1- 57     1- 82
QQUES     1-114     1-187#
QSTO      1- 20#    1- 28@    1- 41@    1- 47@    1- 74     1- 93
QUOTE     1-111     1-127#
R         1-115     1-225#
RBRKT     1-117     1-247#
RIGHT     1-112     1-142#
RPBRKT    1-118     1-257#
RRSTR     1-  3#    1- 32     2- 15     3- 40     4- 67
RSAV      1-  3#    1- 40     1- 44     2-  2     3- 33     4-  6
RSTOY     1- 21#    1- 42@    1- 50@    1- 73     1- 94
R0        1-  7#    1- 45@    1- 48@    1- 53@    1- 55     2-  3@    2-  6@    2- 22
          2- 23     2- 36     3- 34@    3- 35@    3- 36     4- 19@    4- 22     4- 24
          4- 43@    4- 45     4- 46@    4- 48     4- 57@    4- 72@    4- 74@
R1        1-  7#    1- 30@    1- 54@    2- 23@    2- 24     2- 30@    2- 31@    2- 32
          4- 13@    4- 14@    4- 33     4- 36@    4- 41     4- 44     4- 45@    4- 56
          4- 57     4- 58@    4- 74
R2        1-  7#    1- 77@    1- 78     1- 79     1- 83     4- 16@    4- 17@    4- 37
          4- 40@    4- 41     4- 43     4- 44@    4- 59@    4- 72
R3        1-  7#    1- 78@    1- 81@    4- 31@    4- 35@    4- 47     4- 48@    4- 54
```

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```
                4- 71¢   4- 75¢   4- 76
R4        1-  7#   1- 27    1- 52¢   1- 92    1- 98    4- 32¢   4- 39¢   4- 46
          4- 47¢   4- 53
R5        1-  7#   1- 32¢   1- 33¢   1- 34¢   1- 40¢   1- 41    1- 42    1- 44¢
          1- 45    1- 48    1- 52    1- 53    1- 54    1-104¢   2-  2¢   2-  3
          2-  6    2-  9    2- 10¢   2- 15¢   2- 16¢   3-  9¢   3- 10¢   3- 24¢
          3- 33¢   3- 40¢   4-  6¢   4- 11    4- 12    4- 13    4- 15    4- 16
          4- 18    4- 19    4- 56¢   4- 65¢   4- 67¢   4- 68¢   4- 69¢
R6        1-  7#
R7        1-  7#
S         1-115    1-227#
SAVE1     4-  2#   4- 53¢   4- 75
SAVE2     4-  3#   4- 54¢   4- 55¢   4- 71
SEMI      1-114    1-179#
SET       1-  3#   3-  2#
SEVEN     1-113    1-170#
SIX       1-113    1-168#
SLASH     1-112    1-154#
SP        1-  7#   1- 34¢   4- 11¢   4- 65
SPACEC    1-  2#   1- 19#   1- 26
SQUOTE    1-111    1-138#
STRING    1- 13#   1- 34
SWR       1-  7#   4- 61
SYMBOL    1-  3#   1- 44#
T         1-115    1-229#
THREE     1-113    1-162#
TKB       1-  9#
TKS       1-  9#
TPB       1-  9#
TPS       1-  9#
TWIDLE    1-118    1-259#
TWO       1-113    1-160#
U         1-115    1-231#
UP        4- 25    4- 27#
UPAROW    1-117    1-249#
V         1-115    1-233#
W         1-115    1-235#
WRITE     1- 73#
XKQ       1- 22#   1- 74¢   1- 93¢   1- 99¢   1-106
XMAXX     3-  5¢   3- 12    3- 16¢   3- 28#   4- 28    4- 30¢
XQ        2-  5¢   2- 12    2- 18#
XSTORE    1-  2#   3- 25#   3- 34    3- 36    4- 14    4- 15¢   4- 28    4- 30
XX        1-116    1-237#
YKQ       1- 23#   1- 73¢   1- 94¢   1- 95¢   1-107
YMAXX     3-  6¢   3- 13    3- 17¢   3- 21¢   3- 29#
YQ        2-  8¢   2- 13    2- 19#
YSTORE    1-  2#   3- 26#   4- 17    4- 18¢
YY        1-116    1-239#
Z         1-117    1-241#
ZZERO     1-113    1-156#
          1-105    2- 11    3- 11
```

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CROSS REFERENCE TABLE   M-1

```
STRGO    1- 14#   1- 34
 PARAM   1-  6#   1-  7
 PAREA   1-  6#   1-  8
 PARTY   1-  6#   1-  9
```

SLIB01 MAC   MACRO VR05A 01-JAN-72 01.23
TABLE OF CONTENTS

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```
1                           .TITLE   SLIB01.MAC
2                           .MCALL   STRGO
3                           .GLOBL   CHROMA,LINTO,VECTO,AXIS,GETBEM,LOSBEM
4                           .GLOBL   DPSCN,INTMU,XLIT,XSPEC,LINS,ARG,XAXT,SPP,XOLD
5                           .GLOBL   R00,R10,R20,R30,R40,R50
6                           .GLOBL   INC
7                           .MCALL   MULT
8                           .MCALL   .PAREA,PUSH,POP,CLREM,DIVD,RESUL,MULTDV,LOGSHT
9  000000                  .PAREA
10                          .MCALL   .PARAM
11 00000                   .PARAM
12       176764            X=176764
13       176766            Y=176766
```

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```
 1                      . SBTTL   DATA LOCATIONS FOR ALL ROUTINES
 2 000000 000012 DPSCN:  . WORD   10.     ; POINTS PER SCAN
 3 000002 000000 INTMU:  . WORD   0       ; INTENSITY MULTIPLIER
 4 000004 000000 XLIT:   . WORD   0       ; TEMPORARY
 5 000006 000000 XSPEC:  . WORD   0       , TEMP
 6 000010 000000 LINS:   . WORD   0       ; TEMP
 7 000012 000000 ARG:    . WORD   0       ; TEMP
 8 000014 000000 XAXT:   . WORD   0       ; TEMP
 9 000016 000000 SPP:    . WORD   0       ; TEMP
10 00020 000000 XOLD:    . WORD   0       ; OLD X
11 00022 000000 YOLD:    . WORD   0       ; OLD Y
12 00024 000001 XINC:    . WORD   1       ; X INCREMENT
13 00026 000001 YINC:    . WORD   1       ; Y INCREMENT
14 00030 000000 R5SAV:   . WORD   0       ; TEMP
15 00032 000000 PR5S:    . WORD   0       ; TEMP
16 00034 000000 XTMP:    . WORD   0       ; TEMP
17 00036 000000 YTMP:    . WORD   0       ; TEMP
18 00040 177760 STEP:    . WORD   -20     ; STEP SIZE
19 00042 000000 TMP:     . WORD   0       ; TEMPORARY
20 00044 000144 INC:     . WORD   100.    ; AXIS INCREMENT
```

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```
 1                         . TITLE  SLIB02
 2                         . GLOBL  GETX, GETY, XOLD, YOLD, PR5S
 3                         . SBTTL  GETX, GETY, TICX, TICY
 4 000046        GETX:
 5 000046                  POP     PR5S
 6 000052                  PUSH    XOLD
 7 000056        RTRN:
 8 000056                  PUSH    PR5S
 9 000062 000207           RTS     PC
10 00064         GETY:
11 00064                   POP     PR5S
12 00070                   PUSH    YOLD
13 00074 000770            BR      RTRN
14                         . TITLE  SLIB03
15                         . GLOBL  TICX, TICY, GETX, GETY, STEP, XLIN, YLIN
16 00076 004767 TICX:      JSR     PC, GETX
17 00102                   PUSH    ( SP )
18 00104 066716            ADD     STEP, ( SP )
19 00110 004767            JSR     PC, XLIN
20 00114 004767            JSR     PC, XVECTO
21 00120 000207            RTS     PC
22 00122 004767 TICY:      JSR     FC, GETY
23 00126                   PUSH    ( SP )
24 00130 066716            ADD     STEP, ( SP )
25 00134 004767            JSR     PC, YLIN
26 00140 004767            JSR     PC, YVECTO
27 00144 000207            RTS     PC
```

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```
 1                            . TITLE   SLIB04
 2                    ;       . GLOBL   XAXIS, XAXT, ARG, RSAV, GETX, XLIN, TICY, XOLD, INC, DAX
 3                            . SBTTL   XAXIS, YAXIS
 4 000146          XAXIS:
 5 000146                     POP       XAXT, ARG
 6 000156 004767             JSR       PC, RSAV
 7 000162 016767             MOV       ARG, R00
 8 000170 004767             JSR       PC, GETX
 9 000174 011667             MOV       (SP), R10
10 00200 016767              MOV       INC, R20
11 00206 066767   LP5:       ADD       R20, R10
12 00214                     PUSH      R10
13 00220 004767              JSR       PC, XLIN
14 00224 004767              JSR       PC, TICY
15 00230 005367              DEC       R00
16 00234 003364              BGT       LP5
17 00236                     POP       XOLD
18 00242 000167              JMP       DAX
19                            . TITLE   SLIB05
20                    ;       . GLOBL   YAXIS, XAXT, ARG, RSAV, GETY, INC, YLIN, TICX, YOLD, DAX
21 00246          YAXIS:
22 00246                     POP       XAXT, ARG
23 00256 004767              JSR       PC, RSAV
24 00262 016767              MOV       ARG, R00
25 00270 004767              JSR       PC, GETY
26 00274 011667              MOV       (SP), R10
27 00300 016767              MOV       INC, R20
28 00306 066767   LP6:       ADD       R20, R10
29 00314                     PUSH      R10
30 00320 004767              JSR       PC, YLIN
31 00324 004767              JSR       PC, TICX
32 00330 ···5367             DEC       R00
33 00334 003364              BGT       LP6
34 00336                     POP       YOLD
35 00342 000167              JMP       DAX
```

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```
1                               . TITLE  SLIB06
2                               . GLOBL  DAX, BACK, RRSTR, XAXT
3                               . SBTTL  DAX, AXIS, SETAX, KURV
4 000346          DAX:
5 000346 004767         JSR     PC, BACK
6 000352 004767         JSR     PC, RRSTR
7 000356                PUSH    XAXT
8 000362 000207         RTS     PC
9                               . TITLE  SLIB08
10                              . GLOBL  SETAX, TMP, INC, STEP
11 00364          SETAX:
12 00364                POP     TMP, INC, STEP
13 00400                PUSH    TMP
14 00404 000207         RTS     PC
15                              . TITLE  SLIB09
16                              . GLOBL  KURV, TMP, LINTO
17 00406          KURV:
18 00406                POP     TMP, R00, R10
19 00422          LP7:
20 00422                PUSH    @R10
21 00426 062767         ADD     #2, R10
22 00434                PUSH    @R10
23 00440 062767         ADD     #2, R10
24 00446 004767         JSR     PC, LINTO
25 00452 005367         DEC     R00
26 00456 003361         BGT     LP7
27 00460                PUSH    TMP
28 00464 000207         RTS     PC
29                              . GLOBL  YKURV
30 00466          YKURV:
31 00466                POP     TMP, R00, R10, R20    ; R00=XINC, R10=# OF PT$,
32                                                    ;    R20=STARTING ADD
33 00506 005067         CLR     R30                   ; R30=XCOOR
34 00512          1$:
35 00512 066767         ADD     R00, R30              ; XC=XC+XINC
36 00520                PUSH    R30, @R20             ; XC, YC
37 00530 004767         JSR     PC, LINTO             ; DISPLAY IT
38 00534 062767         ADD     #2, R20               ; BUMP ADDRESS
39 00542 005367         DEC     R10                   ; NOPE
40 00546 003361         BGT     1$                    ;
41 00550                PUSH    TMP                   ;
42 00554 000207         RTS     PC                    ; GO HOME
```

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```
1                              . TITLE  SLIB77
2                              . SBTTL  AXIS
3 000556          AXIS:   POP     JOE
4 000562 004767           JSR     PC, YAXIS
5 000566 004767           JSR     PC, XAXIS
6 000572                  PUSH    JOE
7 000576 000207 .         RTS     PC
8 000600 000000 JOE:      . WORD   0
9                              . TITLE  SLIB30
10               ;         . GLOBL  XVECTO, YVECTO, VECTO, R5SAV, XOLD, YOLD, BACK
11                             . SBTTL  XVECTO, YVECTO, VECTO, DOIT
12 00602         XVECTO:  POP     R5SAV, XOLD
13 00612 000413           BR      DOIT
14 00614         YVECTO:  POP     R5SAV, YOLD
15 00624 000406           BR      DOIT
16 00626         VECTO:   POP     R5SAV, YOLD, XOLD
17 00642 004767 DOIT:     JSR     PC, BACK
18 00646                  PUSH    R5SAV
19 00652 000207           RTS     PC
```

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```
 1                          . TITLE  SLIB31
 2                          . GLOBL  SETX, XOLD, XINC
 3                          . SBTTL  SETX, SETY, XLIN, YLIN
 4 000654 016767 SETX:      MOV     XOLD, R10
 5 000662 016767           MOV     XINC, R20
 6 000670 166767           SUB     R00, R10
 7 000676 003402           BLE     NEGX
 8 000700 005467           NEG     R20
 9 000704          NEGX:    PUSH    R10, R20
10 00714 004767            JSR     PC, DIVDM
11 00720                   POP     R10
12                                 ;R00=XNEW R10=#OF X STEPS R20=DELTA X
13 00724 005467            NEG     R10
14 00730 000207            RTS     PC
15                          . TITLE  SLIB32
16                          . GLOBL  SETY, YOLD, YINC
17 00732 016767 SETY:      MOV     YOLD, R30                  ; YOLD
18 00740 016767            MOV     YINC, R40                  ; INCREMENT
19 00746 166767            SUB     R00, R30        ; YOLD-YNEW
20 00754 003402            BLE     NEGY            ; DELTA Y>0?
21 00756 005467            NEG     R40             ; NEGATIVE INCREMENT
22 00762          NEGY:    PUSH    R30, R40
23 00772 004767            JSR     PC, DIVDM
24 00776                   POP     R30
25                                          ; R00=YNEW R30=#OF Y STEPS,
26                                          ;   R40=DELTA Y
27 01002 005467            NEG     R30             ; ALWAYS NEGATIVE
28 01006 000207            RTS     PC              ; GO HOME
29                          . TITLE  SLIB33
30               ;          . GLOBL  XLIN, DONE, XLIT, ARG, XOLD, RSAV, RRSTR, SETX, BACK
31 01010          XLIN:    POP     XLIT, ARG
32 01020 026767            CMP     ARG, XOLD
33 01026 001003            BNE     NSAME
34 01030          SAME:    PUSH    XLIT
35 01034 000207            RTS     PC
36 01036          NSAME.
37 01036 004767            JSR     PC, RSAV
38 01042 016767            MOV     ARG, R00
39 01050 004767            JSR     PC, SETX        ; GET THEE X PARAMETERS
40 01054 016767            MOV     XOLD, R30            ; STARTING POINT
41 01062 066767 LP1:       ADD     R20, R30        ; ADD XINC
42 01070 016737            MOV     R30, @#X        ; OUTPUT X
43 01076 005367            DEC     R10             ; DONE YET?
44 01102 003367            BGT     LP1             ; NOPE IF BRANCH
45 01104 016767            MOV     R00, XOLD             ; UPDATE XOLD
46 01112          DONE:
47 01112 004767            JSR     PC, BACK
48 01116 004767            JSR     PC, RRSTR
49 01122                   PUSH    XLIT
50 01126 000207            RTS     PC              ; GO HOME
51                          . TITLE  SLIB34
52               ;          . GLOBL  YLIN, XLIT, ARG, YOLD, DONE, RSAV, SETY
53 01130          YLIN:    POP     XLIT, ARG
54 01140 026767            CMP     ARG, YOLD
55 01146 001730            BEQ     SAME
56 01150 004767            JSR     PC, RSAV
57 01154 016767            MOV     ARG, R00
```

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```
58 01162 004767          JSR      PC, SETY            ; GET THE Y PARAMETERS
59 01166 016767          MOV      YOLD, R10                     ; STARTING POINT
60 01174 066767 LP2:     ADD      R40, R10            ; BUMP    Y
61 01202 016737          MOV      R10, @#Y            ; OUTPUT  Y
62 01210 005367          DEC      R30                 ; DONE YET
63 01214 003367          BGT      LP2                 ; NOPE
64 01216 016767          MOV      R00, YOLD                     ; UPDATE  YOLD
65 01224 000167          JMP      DONE                ; FINISH UP
66                       . TITLE  SLIB15
67                  ;    . GLOBL  GETBEM, BACK, LOSBEM, XOLD, YOLD
68                       . SBTTL  GETBEM, LOSBEM
69 01230        GETBEM:  CLREM    XOLD, YOLD
70 01240 004767          JSR      PC, BACK
71 01244 000207          RTS      PC
72 01246 012737 LOSBEM:  MOV      #6777, @#X
73 01254 012737          MOV      #6777, @#Y
74 01262 000207          RTS      PC
75                       . TITLE  SLIB36
76                  ;    . GLOBL  BACK, XOLD, YOLD
77 01264 016737 BACK:    MOV      XOLD, @#X
78 01272 016737          MOV      YOLD, @#Y
79 01300 000207          RTS      PC
80                       . TITLE  SLIB37
81                  ;    . GLOBL  SPECTR, XSPEC, ARG, TMP, RSAV, RRSTR, VECTO, AXIS
82                  ;    . GLOBL  XVECTO, YVECTO, YLIN, YOLD
83                       . SBTTL  SPECTR, LINTO
84 01302        SPECTR:  POP      XSPEC, ARG, TMP
85 01316 004767          JSR      PC, RSAV
86 01322 016767          MOV      ARG, R00
87 01330 016767          MOV      TMP, R10
88 01336                 CLREM    -( SP ), -( SP )
89 01342 004767          JSR      PC, VECTO
90 01346                 PUSH     #20. , #10.
91 01356 004767          JSR      PC, AXIS ;
92 01362        LPSP:    PUSH     @R10
93 01366 062767          ADD      #2, R10
94 01374 004767          JSR      PC, XVECTO
95 01400                 PUSH     YOLD, @R10
96 01410 062767          ADD      #2, R10
97 01416 004767          JSR      PC, YLIN
98 01422 004767          JSR      PC, YVECTO
99 01426 005367          DEC      R00
100 1432 003353          BGT      LPSP
101 1434 004767          JSR      PC, RRSTR
102 1440                 PUSH     XSPEC
103 1444 000207          RTS      PC
104                      . TITLE  SLIB38
105                 ;    . GLOBL  LINTO, YTMP, XTMP, YLIN, LINS, XLIN, XOLD, YOLD
106                 ;    . GLOBL  RSAV, RRSTR, SETX, SETY, PR5S, SPP
107 1446        NDX:     PUSH     YTMP
108 1452 004767          JSR      PC, YLIN
109 1456        DXX:     PUSH     LINS
110 1462 000207          RTS      PC
111 1464        NDY:     PUSH     XTMP
112 1470 004767          JSR      PC, XLIN
113 1474 000770          BR       DXX
114 1476        LINTO:   POP      LINS, YTMP, XTMP ; PREVIOUS R50
```

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```
115 1512 026767          CMP     XTMP.XOLD
116 1520 001752          BEQ     NDX
117 1522 026767          CMP     YTMP.YOLD
118 1530 001755          BEQ     NDY
119 1532 004767          JSR     PC.RSAV
120 1536 016767          MOV     XTMP.R00
121 1544 004767          JSR     PC.SETX
122 1550 016767          MOV     YTMP.R00
123 1556 004767          JSR     PC.SETY
124 1562 016767          MOV     R50.PR5S
125 1570 005067          CLR     R00
126 1574 016767          MOV     XOLD.R50
127 1602 016767          MOV     YOLD.SPP
128 1610 016767          MOV     XTMP.XOLD
129 1616 016767          MOV     YTMP.YOLD
130 1624 026767          CMP     R10.R30
131 1632 002454          BLT     MOREY
132 1634        MX:      PUSH    R30.R00
133 1644 004767          JSR     PC.MULTM
134 1650                 PUSH    R10
135 1654 004767          JSR     PC.DIVDM
136 1660 005716          TST     (SP)
137 1662 001413          BEQ     NOY
138 1664                 PUSH    R40
139 1670 004767          JSR     PC.MULTM
140 1674 061667          ADD     (SP).SPP
141 1700 016737          MOV     SPP.@#Y
142 1706 161667          SUB     (SP).SPP
143 1712 005726 NOY:     TST     (SP)+
144 1714 066767          ADD     R20.R50
145 1722 016737          MOV     R50.@#X
146 1730 005267          INC     R00
147 1734 026767          CMP     R00.R10
148 1742 002734          BLT     MX
149 1744 016767 LINF:    MOV     PR5S.R50
150 1752 004767          JSR     PC.RRSTR
151 1756                 PUSH    LINS
152 1762 000207          RTS     PC
153 1764        MOREY:   PUSH    R10.R00
154 1774 004767          JSR     PC.MULTM
155 2000                 PUSH    R30
156 2004 004767          JSR     PC.DIVDM
157 2010 005716          TST     (SP)
158 2012 001413          BEQ     NOX
159 2014                 PUSH    R20
160 2020 004767          JSR     PC.MULTM
161 2024 061667          ADD     (SP).R50
162 2030 016737          MOV     R50.@#X
163 2036 161667          SUB     (SP).R50
164 2042 005726 NOX:     TST     (SP)+
165 2044 066767          ADD     R40.SPP
166 2052 016737          MOV     SPP.@#Y
167 2060 005267          INC     R00
168 2064 026767          CMP     R00.R30
169 2072 002734          BLT     MOREY
170 2074 000723          BR      LINF
```

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```
1                          .TITLE   SLIB39
2                          .GLOBL   AXIS
3          177314          LSL=177314
4                          .GLOBL   CHROMA,AXIS,VECTO,XSPEC,ARG,TMP,RSAV,RRSTR
5                          .GLOBL   LINTO,LSL,DPSCN,INTMU
6                          .SBTTL   CHROMA
7 002076        CHROMA:   PUSH     #20.,#10.
8 002106 004767           JSR      PC,AXIS
9 002112                  CLREM    -(SP),-(SP)
10 02116 004767           JSR      PC,VECTO
11 02122                  POP      XSPEC,ARG,TMP
12 02136 004767           JSR      PC,RSAV
13 02142 016767           MOV      ARG,R10
14 02150 016767           MOV      TMP,R00
15 02156 005067           CLR      R20
16 02162 016767           MOV      DPSCN,R30
17 02170 016767           MOV      INTMU,R40
18 02176 066767 LPCH:     ADD      R30,R20
19 02204 017746           MOV      @R10,-(SP)
20 02210 062767           ADD      #2,R10
21 02216                  PUSH     @R10
22 02222 062767           ADD      #2,R10
23 02230                  PUSH     R40
24 02234 ···4767          JSR      PC,DLSHM
25 02240                  POP      TEMP
26 02244                  PUSH     R20,TEMP
27 02254 004767           JSR      PC,LINTO
28 02260 005367           DEC      R00
29 02264 003344           BGT      LPCH
3·· 02266 ···4767         JSR      PC,RRSTR
31 02272                  PUSH     XSPEC
32 02276                  CLREM    -(SP),-(SP)
33 02302 004767           JSR      PC,VECTO
34 02306 000207           RTS      PC
35                         .TITLE   SLIB40
36               ;         .GLOBL   RSAV,RRSTR,TEMP
37                         .SBTTL   RSAV,RRSTR
38               ;*******************************************************
39               ;         REGISTER SAVE/RESTORE ROUTINE
40               ;         BY:   P. C. ABEGGLEN
41               ;         OCT. 30, 1972
42               ;         CALLING SEQUENCE:
43               ;                  SAVE
44               ;                          JSR      PC,RSAV
45               ;                  RESTORE
46               ;                          JSR      PC,RRSTR
47               ;         NOTE:
48               ;                  NAMES MUST BE DECLARED GLOBAL IF NOT CONCATE-
49               ;                  NATED TO SOURCE.
50               ;*******************************************************
51 02310        RSAV:
52 02310                  POP      TEMP
53 02314                  PUSH     R50,R40
54 02324                  PUSH     R30,R20,R10,R00,TEMP
55 02350 000207           RTS      PC
56 02352        RRSTR:
57 02352                  POP      TEMP,R00,R10,R20
```

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```
58 02372                   POP     R30, R40, R50
59 02406          OUT:     PUSH    TEMP
60 02412 000207            RTS     PC                        ; GO HOME WITH EVERYTHING
61 02414 000000 TEMP:      . WORD   0
62                         . TITLE  SLIB41
63                         . SBTTL  SETINC, TSTINC
64                         . GLOBL  SETINC, TSTINC
65 02416          SETINC:  POP     TEMP, YINC, XINC
66 02432 000765            BR      OUT
67 02434 012667 TSTINC:    MOV     (SP)+, TEMP
68 02440                   PUSH    YINC, XINC
69 02450 000756            BR      OUT
70 02452 000000  OPC:      . WORD  0
71 02454 000000  R09:      . WORD  0
72 02456 000000  R19:      . WORD  0
73 02460 000000  R29:      . WORD  0
74 02462 000000  R39:      . WORD  0
75 02464 000000  R49:      . WORD  0
76 02466 000000  R59:      . WORD  0
77
78 02470 012667 DIVDM:     MOV     (SP)+, OPC
79 02474 005067            CLR     R09                        ; SIGN OF THE RESULT
80 02500 012667            MOV     (SP)+, R19                 ; GET DENOMINATOR
81 02504 003005            BGT     1$                         ; SIGN RIGHT IF >
82 02506 001467            BEQ     2$                         ; CAN'T DIVIDE BY ZERO
83 02510 005267            INC     R09                        ; SIGN MINUS
84 02514 005467            NEG     R19                        ; MAKE POSITIVE
85
86 02520 011667 1$:        MOV     (SP), R39                  ; GET NUMERATOR
87 02524 003005            BGT     3$                         ; ALSO POSITIVE
88 02526 001465            BEQ     4$                         ; RESULT ZERO
89 02530 005267            INC     R09                        ; FOR SIGN
90 02534 005467            NEG     R39                        ; MAKE POSITIVE
91
92 02540 012767 3$:        MOV     #10, R49                   ; 8 ITERATIONS
93 02546 005067            CLR     R29                        ; HIGH DIVIDEND
94 02552 000367            SWAB    R39                        ; LOOK AT HIGH NUMERATOR
95 02556 001404            BEQ     5$                         ; DON'T NEED 16
96 02560 006367            ASL     R49                        ; 16 ITERATIONS
97 02564 000367            SWAB    R39                        ; SWAP BACK
98
99 02570 006367 5$:        ASL     R39                        ; DOUBLE THE DIVIDEND
100 2574 006167            ROL     R29                        ; GET THE  C  BIT
101 2600 001413            BEQ     6$                         ; NO CHANGE
102 2602 005267            INC     R39                        ; PUT IN A BIT
103 2606 166767            SUB     R19, R29                   ; TRY IT
104 2614 103005            BHIS    6$                         ; OK
105 2616 066767            ADD     R19, R29                   ; DIVIDEND BIG ENUFF?
106 2624 005367            DEC     R39                        ; TAKE OUT A BIT
107
108 2630 005367 6$:        DEC     R49                        ; DONE YET?
109 2634 003355            BGT     5$                         ; DO SOME MORE
110 2636 005467            NEG     R39                        ; NEGATIVE MAX
111 2642 006267            ASR     R09                        ; GET SIGN
112 2646 103403            BCS     8$                         ; POSITIVE RESULT
113 2650 005467            NEG     R39                        ; NEGATIVE RESULT
114 2654 102404            BVS     2$                         ; NEGATIVE MAX
```

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```
115
116 2656 016716 8$:      MOV     R39,(SP)           ;RESULT
117 2662 000177          JMP     @OPC               ;RETURN
118
119 2666        2$:      STRGO   #DERR              ;ERROR MESSAGE
120 2676 000177          JMP     @OPC               ;RETURN
121
122 2702 005016 4$:      CLR     (SP)               ;RESULT ZERO
123 2704 000177          JMP     @OPC               ;RETURN
124
125 2710    040 DERR:    .ASCIZ  / SOFTWARE DIVIDE ERROR/<15><12>
126                      .EVEN
```

```
 1 002742 012667 MULTM:   MOV     (SP)+,OPC          ;OLD PC
 2 002746 005067          CLR     R09                ;PRODUCT SIGN
 3 002752 012667          MOV     (SP)+,R19          ;GET MULTIPLICAND
 4 002756 003005          BGT     1$                 ;POSITIVE
 5 002760 001507          BEQ     2$                 ;0 => 0
 6 002762 005267          INC     R09                ;SET MINUS
 7 002766 005467          NEG     R19                ;MAKE IT POSITIVE
 8
 9 002772 011667 1$:      MOV     (SP),R39           ;GET MULTIPLIER
10 02776 003005           BGT     3$                 ;POSITIVE
11 03000 001477           BEQ     2$                 ;0 => 0
12 03002 005267           INC     R09                ;SET UP REAL SIGN
13 03006 005467           NEG     R39                ;MAKE +
14
15 03012 012767 3$:       MOV     #10,R49            ;DO BYTES FAST
16 03020 026767           CMP     R19,R39            ;WHICH IS BIGGEST?
17 03026 002011           BGE     4$                 ;MULTIPLICAND IS
18 03030 016767           MOV     R19,R29            ; INTERCHANGE THEM
19 03036 016767           MOV     R39,R19
20 03044 016767           MOV     R29,R39
21
22 03052 005067 4$:       CLR     R29                ;HIGH ORDER PRODUCT
23
24 03056 006067 5$:       ROR     R29                ;START SHIFTING
25 03062 006067           ROR     R39
26 03066 103003           BCC     6$                 ;MULTIPLIER BIT 0
27 03070 066767           ADD     R19,R29            ;ADD IN MULTIPLICAND
28
29 03076 005367 6$:       DEC     R49                ;DONE YET?
30 03102 003365           BGT     5$                 ;NOPE
31 03104 105767           TSTB    R39                ;MULTIPLIER GONE?
32 03110 001036           BNE     7$                 ;OVERFLOW
33 03112 156767           BISB    R29,R39            ;MOVE IT
34 03120 000367           SWAB    R39                ;RIGHT
35 03124 105067           CLRB    R29                ;FOR MORE
36 03130 000367           SWAB    R29
37 03134 006267           ASR     R29                ;ONE MORE TIME
38 03140 001022           BNE     7$                 ;OVERFLOW
39 03142 006067           ROR     R39
40 03146 005467           NEG     R39                ;MAKE -
41 03152 100015           BPL     7$                 ;OVERFLOW
42 03154 006067           ROR     R09                ;GET SIGN
43 03*60 103403           BCS     8$                 ;-
44 03162 005467           NEG     R39                ;MAKE IT +
45 03166 102407           BVS     7$                 ;OVERFLOW
46
47 03170 016716 8$:       MOV     R39,(SP)           ;RESULT
48 03174 000177           JMP     @OPC               ;RETURN
49
50 03200 005016 2$:       CLR     (SP)               ;RESULT = 0
51 03202 000177           JMP     @OPC               ;RETURN
52
53 03206         7$:      STRGO   #MERR              ;ERROR
54 03216 000177           JMP     @OPC               ;RETURN
55
56 03222    040 MERR:     .ASCIZ  / SOFTWARE MULTIPLY OVERFLOW/<15><12>
57                        .EVEN
```

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```
1 003260          DLSHM:  POP     OPC, R09, R19, R29    ; GET ARGUMENTS
2 003300 005767          TST     R09                   ; LEFT OR RIGHT
3 003304 002415          BLT     1$                    ; RIGHT
4 003306 001410          BEQ     2$                    ; NEITHER
5
6 003310 000241 3$:      CLC                           ; CLEAR CARRY
7 003312 006067          ROR     R19                   ; SHIFT IT
8 003316 006067          ROR     R29
9 003322 005367          DEC     R09                   ; DONE YET?
10 03326 003370          SGT     3$                    ; NOPE
11
12 03330 016746 2$·      MOV     R29,-(SP )            ; SEND BACK RESULT
13 03334 000177          JMP     @OPC                  ; RETURN
14
15 03340 000241 1$:      CLC                           ; CARRY CLEAR
16 03342 006167          ROL     R29                   ; SHIFT IT
17 03346 006167          ROL     R19
18 03352 005267          INC     R09                   ; DONE?
19 03356 002770          BLT     1$                    ; NOPE
20 03360 000763          BR      2$                    ; YUP, RETURN
```

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```
1       0000001'          .END
```

SYMBOL TABLE

AC	= 177302	ARG	000012RG	ASH	= 177316
AXIS	000556RG	BACK	001264R	CHROMA	002076RG
DAX	000346R	DERR	002710R	DIV	= 177300
DIVDM	002470R	DLSHM	003260R	DOIT	000642R
DONE	001112R	DPSCN	000000RG	DXX	001456R
EAENOR=	177312	EAESC	= 177310	EAESR	= 177311
GETBEM	001230RG	GETX	000046R	GETY	000064R
INC	000044RG	INTMU	000002RG	JOE	000600R
KURV	000406RG	LINF	001744R	LINS	000010RG
LINTO	001476RG	LOSBEM	001246RG	LPCH	002176R
LPSP	001362R	LP1	001062R	LP2	001174R
LP5	000206R	LP6	000306R	LP7	000422R
LSH	= 177314	LSL	= 177314 G	MERR	003222R
MOREY	001764R	MQ	= 177304	MUL	= 177306
MULTM	002742R	MX	001634R	NDX	001446R
NDY	001464R	NEGX	000704R	NEGY	000762R
NOX	002042R	NOY	001712R	NSAME	001036R
OPC	002452R	OUT	002406R	PC	=%000007
PR5S	000032R	PSW	= 177776	RRSTR	002352R
RSAV	002310R	RTRN	000056R	R0	=%000000
R00	= ****** G	R09	002454R	R1	=%000001
R10	= ****** G	R19	002456R	R2	=%000002
R20	= ****** G	R29	002460R	R3	=%000003
R30	= ****** G	R39	002462R	R4	=%000004
R40	= ****** G	R49	002464R	R5	=%000005
R5SAV	000030R	R50	= ****** G	R59	002466R
R6	=%000006	R7	=%000007	SAME	001030R
SETAX	000364RG	SETINC	002416RG	SETX	000654RG
SETY	000732RG	SP	=%000006	SPECTR	001302R
SPP	000016RG	STEP	000040RG	STRING=	****** G
SWR	= 177570	TEMP	002414R	TICX	000076R
TICY	000122R	TMP	000042RG	TSTINC	002434RG
VECTO	000626RG	X	= 176764	XAXIS	000146R
XAXT	000014RG	XINC	000024RG	XLIN	001010R
XLIT	000004RG	XOLD	000020RG	XSPEC	000006RG
XTMP	000034R	XVECTO	000602R	Y	= 176766
YAXIS	000246R	YINC	000026RG	YKURV	000466RG
YLIN	001130R	YOLD	000022RG	YTMP	000036R
YVECTO	000614R				

ABS.	000000	000
	003362	001

ERRORS DETECTED: 0
FREE CORE: 15658. WORDS
,LP:/NL:BEX/CRF<SCPLIB

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CROSS REFERENCE TABLE   S-1

```
AC        1-  9#
ARG       1-  4#     2-  7#     4-  5¢     4-  7      4- 22¢     4- 24      7- 31¢
          7- 32      7- 38      7- 53¢     7- 54      7- 57      7- 84¢     7- 86
          8- 11¢     8- 13
ASH       1-  9#
AXIS      1-  3#     6-  3#     7- 91      8-  2#     8-  8
BACK      5-  5      6- 17      7- 47      7- 70      7- 77#
CHROMA    1-  3#     8-  7#
DAX       4- 18      4- 35      5-  4#
DERR      8-119      8-125#
DIV       1-  9#
DIVDM     7- 10      7- 23      7-135      7-156      8- 78#
DLSHM     8- 24     10-  1#
DOIT      6- 13      6- 15      6- 17#
DONE      7- 46#     7- 65
DPSCN     1-  4#     2-  2#     8-  5#     8- 16
DXX       7-109#     7-113
EAENOR    1-  9#
EAESC     1-  9#
EAESR     1-  9#
GETBEM    1-  3#     7- 69#
GETX      3-  4#     3- 16      4-  8
GETY      3- 10#     3- .      4- 25
INC       1-  6#     2- 20#     4- 10      4- 27      5- 10#     5- 12¢
INTMU     1-  4#     2-  3#     8-  5#     8- 17
JOE       6-  3¢     6-  6      6-  8#
KURV      5- 16#     5- 17#
LINF      7-149#     7-170
LINS      1-  4#     2-  6#     7-109      7-114¢     7-151
LINTO     1-  3#     5- 16#     5- 24      5- 37      7-114#     8-  5#     8- 27
LOSBEM    1-  3#     7- 72#
LPCH      8- 18#     8- 29
LPSP      7- 92#     7-100
LP1       7- 41#     7- 44
LP2       7- 60#     7- 63
LP5       4- 11#     4- 16
LP6       4- 28#     4- 33
LP7       5- 19#     5- 26
LSH       1-  9#
LSL       8-  3#     8-  5#
MERR      9- 53      9- 56#
MOREY     7-131      7-153#     7-169
MQ        1-  9#
MUL       1-  9#
MULTM     7-133      7-139      7-154      7-160      9-  1#
MX        7-132#     7-148
NDX       7-107#     7-116
NDY       7-111#     7-118
NEGX      7-  7      7-  9#
NEGY      7- 20      7- 22#
NOX       7-158      7-164#
NOY       7-137      7-143#
NSAME     7- 33      7- 36#
OPC       8- 70#     8- 78¢     8-117      8-120      8-123      9-  1¢     9- 48
          9- 51      9- 54     10-  1¢    10- 13
OUT       8- 59#     8- 66      8- 69
PC        1- 11#     3-  9¢     3- 16¢     3- 19¢     3- 20¢     3- 21¢     3- 22¢
          3- 25¢     3- 26¢     3- 27¢     4-  6¢     4-  8¢     4- 13¢     4- 14¢
```

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	4- 23@	4- 25@	4- 30@	4- 31@	5- 5@	5- 6@	5- 8@
	5- 14@	5- 24@	5- 28@	5- 37@	5- 42@	6- 4@	6- 5@
	6- 7@	6- 17@	6- 19@	7- 10@	7- 14@	7- 23@	7- 28@
	7- 35@	7- 37@	7- 39@	7- 47@	7- 48@	7- 50@	7- 56@
	7- 58@	7- 70@	7- 71@	7- 74@	7- 79@	7- 85@	7- 89@
	7- 91@	7- 94@	7- 97@	7- 98@	7-101@	7-103@	7-108@
	7-110@	7-112@	7-119@	7-121@	7-123@	7-133@	7-135@
	7-139@	7-150@	7-152@	7-154@	7-156@	7-160@	8- 8@
	8- 10@	8- 12@	8- 24@	8- 27@	8- 30@	8- 33@	8- 34@
	8- 55@	8- 60@					
PR5S	2- 15#	3- 5@	3- 8	3- 11@	7-124@	7-149	
PSW	1- 11#						
RRSTR	5- 6	7- 48	7-101	7-150	8- 30	8- 56#	
RSAV	4- 6	4- 23	7- 37	7- 56	7- 85	7-119	8- 12
	8- 51#						
RTRN	3- 7#	3- 13					
R0	1- 11#						
R00	1- 5@	4- 7@	4- 15@	4- 24@	4- 32@	5- 18@	5- 25@
	5- 31@	5- 35	7- 6	7- 19	7- 38@	7- 45	7- 57@
	7- 64	7- 86@	7- 99@	7-120@	7-122@	7-125@	7-132
	7-146@	7-147	7-153	7-167@	7-168	8- 14@	8- 28@
	8- 54	8- 57@					
R09	8- 71#	8- 79@	8- 83@	8- 89@	8-111@	9- 2@	9- 6@
	9- 12@	9- 42@	10- 1@	10- 2	10- 9@	10- 18@	
R1	1- 11#						
R10	1- 5#	4- 9@	4- 11@	4- 12	4- 26@	4- 28@	4- 29
	5- 18@	5- 20	5- 21@	5- 22	5- 23@	5- 31@	5- 39@
	7- 4@	7- 6@	7- 11@	7- 9	7- 13@	7- 43@	7- 59@
	7- 60@	7- 61	7- 87@	7- 92	7- 93@	7- 95	7- 96@
	7-130	7-134	7-147	7-153	8- 13@	8- 19	8- 20@
	8- 21	8- 22@	8- 54	8- 57@			
R19	8- 72#	8- 80@	8- 84@	8-103	8-105	9- 3@	9- 7@
	9- 16	9- 18	9- 19@	9- 27	10- 1@	10- 7@	10- 17@
R2	1- 11#						
R20	1- 5#	4- 10@	4- 11	4- 27@	4- 28	5- 31@	5- 36
	5- 38@	7- 5@	7- 8@	7- 9	7- 41@	7-144	7-159
	8- 15@	8- 18@	8- 26	8- 54	8- 57@		
R29	8- 73#	8- 93@	8-100@	8-103@	8-105@	9- 18@	9- 20
	9- 22@	9- 24@	9- 27@	9- 33	9- 35@	9- 36@	9- 37@
	10- 1@	10- 8@	10- 12	10- 16@			
R3	1- 11#						
R30	1- 5#	5- 33@	5- 35	5- 36	7- 17@	7- 19@	7- 22
	7- 24@	7- 27@	7- 40@	7- 41@	7- 42	7- 62@	7-130
	7-132	7-155	7-168	8- 16@	8- 18	8- 54	8- 58@
R39	8- 74#	8- 86@	8- 90@	8- 94@	8- 97@	8- 99@	8-102@
	8-106@	8-110@	8-113@	8-116	9- 9@	9- 13@	9- 16
	9- 19	9- 20@	9- 25@	9- 31	9- 33@	9- 34@	9- 39@
	9- 40@	9- 44@	9- 47				
R4	1- 11#						
R40	1- 5#	7- 18@	7- 21@	7- 22	7- 60	7-138	7-165
	8- 17@	8- 23	8- 53	8- 58@			
R49	8- 75#	8- 92@	8- 96@	8-108@	9- 15@	9- 29@	
R5	1- 11#	8-119@	9- 53@				
R5SAV	2- 14#	6- 12@	6- 14@	6- 16@	6- 18		
R50	1- 5#	7-124@	7-126@	7-144@	7-145	7-149@	7-161@
	7-162	7-163@	8- 53	8- 58@			
R59	8- 76#						
R6	1- 11#						

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```
R7        1- 11#
SAME      7- 34#    7- 55
SETAX     5- 10#    5- 11#
SETINC    8- 64#    8- 65#
SETX      7-  2#    7-  4#    7- 39     7-121
SETY      7- 16#    7- 17#    7- 58     7-123
SP        1- 11#    3-  5     3-  6@    3-  8@    3- 11     3- 12@    3- 17@
          3- 18@    3- 23@    3- 24@    4-  5     4-  9     4- 12@    4- 17
          4- 22     4- 26     4- 29@    4- 34     5-  7@    5- 12     5- 13@
          5- 18     5- 20@    5- 22@    5- 27@    5- 31     5- 36@    5- 41@
          6-  3     6-  6@    6- 12     6- 14     6- 16     6- 18@    7-  9@
          7- 11     7- 22@    7- 24     7- 31     7- 34@    7- 49@    7- 53
          7- 84     7- 88@    7- 90@    7- 92@    7- 95@    7-102@    7-107@
          7-109@    7-111@    7-114     7-132@    7-134@    7-136     7-138@
          7-140     7-142     7-143     7-151@    7-153@    7-155@    7-157
          7-159@    7-161     7-163     7-164     8-  7@    8-  9@    8- 11
          8- 19@    8- 21@    8- 23@    8- 25     8- 26@    8- 31@    8- 32@
          8- 52     8- 53@    8- 54@    8- 57     8- 58     8- 59@    8- 65
          8- 67     8- 68@    8- 78     8- 80     8- 86     8-116@    8-119@
          8-122@    9-  1     9-  3     9-  9     9- 47@    9- 50@    9- 53@
         10-  1    10- 12@
SPECTR    7- 84#
SPP       1-  4#    2-  9#    7-127@    7-140@    7-141     7-142@    7-165@
          7-166
STEP      2- 18#    3- 18     3- 24     5- 10#    5- 12@
STRING    8-119#    9- 53#
SWR       1- 11#
TEMP      8- 25@    8- 26     8- 52@    8- 54     8- 57@    8- 59     8- 61#
          8- 65@    8- 67@
TICX      3- 16#    4- 31
TICY      3- 22#    4- 14
TMP       2- 19#    5- 10#    5- 12@    5- 13     5- 16#    5- 18@    5- 27
          5- 31@    5- 41     7- 84@    7- 87     8- 11@    8- 14
TSTINC    8- 64#    8- 67#
VECTO     1-  3#    6- 16#    7- 89     8- 10     8- 33
X         1- 12#    7- 42@    7- 72@    7- 77@    7-145@    7-162@
XAXIS     4-  4#    6-  5
XAXT      1-  4#    2-  8#    4-  5@    4- 22@    5-  7
XINC      2- 12#    7-  2#    7-  5     8- 65@    8- 68
XLIN      3- 19     4- 13     7- 31#    7-112
XLIT      1-  4#    2-  4#    7- 31@    7- 34     7- 49     7- 53@
XOLD      1-  4#    2- 10#    3-  6     4- 17@    6- 12@    6- 16@    7-  2#
          7-  4     7- 32     7- 40     7- 45@    7- 69@    7- 77     7-115
          7-126     7-128@
XSPEC     1-  4#    2-  5#    7- 84@    7-102     8- 11@    8- 31
XTMP      2- 16#    7-111     7-114@    7-115     7-120     7-128
XVECTO    3- 20     6- 12#    7- 94
Y         1- 13#    7- 61@    7- 73@    7- 78@    7-141@    7-166@
YAXIS     4- 21#    6-  4
YAXT      2- 13#    7- 16#    7- 18     8- 65@    8- 68
YINC      5- 29#    5- 30#
YKURV     3- 25     4- 30     7- 53#    7- 97     7-108
YLIN      2- 11#    3- 12     4- 34@    6- 14@    6- 16@    7- 16#    7- 17
YOLD      7- 54     7- 59     7- 64@    7- 69@    7- 78     7- 95     7-117
          7-127     7-129@
YTMP      2- 17#    7-107     7-114@    7-117     7-122     7-129
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```

```
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DIVD     1-   8#
LOGSHT   1-   8#
MULT     1-   7#
MULTDV   1-   8#
POP      1-   8#    3-   5    3-  11    4-   5    4-  17    4-  22    4-  34
         5-  12    5-  18    5-  31    6-   3    6-  12    6-  14    6-  16
         7-  11    7-  24    7-  31    7-  53    7-  84    7-114    8-  11
         8-  25    8-  52    8-  57    8-  58    8-  65   10-   1
PUSH     1-   8#    3-   6    3-   8    3-  12    3-  17    3-  23    4-  12
         4-  29    5-   7    5-  13    5-  20    5-  22    5-  27    5-  36
         5-  41    6-   6    6-  18    7-   9    7-  22    7-  34    7-  49
         7-  90    7-  92    7-  95    7-102    7-107    7-109    7-111
         7-132    7-134    7-138    7-151    7-153    7-155    7-159
         8-   7    8-  21    8-  23    8-  26    8-  31    8-  53    8-  54
         8-  59    8-  68
RESUL    1-   8#
STRGO    1-   2#    8-119    9-  53
.PARAM   1-  10#    1-  11
.PAREA   1-   8#    1-   9
```

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RAWLIB Module Real Time Data Aquisition Routine

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RAWLIB   MACRO VR05A 01-JAN-72 00:00
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23                             . GLOBL  LPMM
24                             . GLOBL  ALUT
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31                             . GLOBL  DPSCN
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34                             . GLOBL PEAKS
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36                             . GLOBL  TICC, RSAV, RRSTR, TTYI, TTYO
37                             . GLOBL  BLOK
38                             . GLOBL  RNUM, UIC, SNUM
39      000015                 CR=15
40      000011                 BB=11
41      000016                 UN=16
42      000012                 LF=12
43      000064                 PRTVEC=64
44                             . MCALL  . D2BIN
45                             . MCALL  . CVTDT
46                             . MCALL  . O2BIN
47                             . MCALL   . PARAM, . DATE, . TIME, . GTUIC, . INIT, . RLSE, . WAIT, . TRAN
48                             . MCALL   . WRITE, . OPENO, . CLOSE
49                             . MCALL   . BIN2O, . RADPK, . BIN2D
50                             . MCALL   . PARAD, . PARTY, . PAREA, . PARDR
51                             . MCALL  RESUL, CLREM, CONVER, DIVD, DSKI, DSKO, EMT442
52                             . MCALL  LOGSHT, MULT, POPTST, POP, PUSH, STRGO, TTYIO
53 00000                       . PARAD
54 00000                       . PARTY
55 00000                       . PAREA
56 00000                       . PARDR
57      172554                 PLTR.=172554
```

```
58        177546          CLK=177546
59 00000                  . PARAM
```

```
1                       . SBTTL   RAW DATA OUTPUT ROUTINE(OVERLAYED)
2 000000 000755'VMLUT:  . WORD    FORM, V1, V3, V2, VMES
3 000012 000165'NUMPKS: . WORD    NUMPKM
4 000014    015 VMES:   . ASCIZ   <CR><LF><BB><UN>/MASS SPECTRAL RAW DATA/<CR><LF><CR><LF>
5 000053    011 V1:     . ASCIZ   <BB><UN>/MASS SPECTROMETRY CENTER/
6 000106    011 V2:     . ASCIZ   <BB><UN>/UNIVERSITY OF UTAH/
7 000133    011 V3:     . ASCIZ   <BB><UN>/DEPARTMENT OF CHEMISTRY/
8 000165    011 NUMPKM: . ASCIZ   <BB>/D- NUMBER OF PEAKS= /
9                       . EVEN
10 00214        RAWREC:
11 00214 012767         MOV      #1, TICFLG
12 00222 052767         BIS      #1, IOSWT
13 00230        U2X:    STRGO    #ADMES
14 00240 004567         JSR      R5, BLANK
15 00244 004567         JSR      R5, INPUT
16 00250                EMT442
17 00262                POPTST   R0
18 00266 ··12701        MOV      #1, R1
19 00272                DSKI     R1, R0, #DATAB
20 00306        U1X:
21 00306 005067         CLR      PPF
22 00312 012767         MOV      #1, LPF
23 00320        3$:
24 00320 004567         JSR      R5, FIXLP
25 00324 012700         MOV      #VMLUT, R0
26 00330 112767         MOVB     #15, IBUF
27 00336 004567 6$:     JSR      R5, MOVSTG
28 00342 020027         CMP      R0, #VMLUT+10.
29 00346 002773         BLT      6$
30 00350        VLSB:
31 00350 012700         MOV      #A13LUT, R0
32 00354 112767         MOVB     #15, IBUF+5
33 00362                . BIN2D   #IBUF, DATAB
34 00400 004567         JSR      R5, MOVSTG
35 00404 112767         MOVB     #15, IBUF+6
36 00412                . BIN2O   #IBUF, DATAB+2
37 00430 004567         JSR      R5, MOVSTG
38 00434 112767         MOVB     #15, IBUF+5
39 00442                . BIN2D   #IBUF, DATAB+4
40 00460 004567         JSR      R5, MOVSTG
41 00464 ··12700        MOV      #NUMPKS, R0
42 00470                . BIN2D   #IBUF, DATAB+6
43 00506 004567         JSR      R5, MOVSTG
44 00512                PUSH     #SMES, #FMES, #DSPACE, #DSPACE, #4
45 00536 004567         JSR      R5, OUTHDG
46 00542 004567         JSR      R5, GETPKS
47 00546 012767         MOV      #1, NUM
48 00554        1$:
49 00554 004567         JSR      R5, BLANKM
50 00560 004567         JSR      R5, TODEC
51 00564 112767         MOVB     #15, LPBUF+66
52 00572 105067         CLRB     LPBUF+70
53 00576 112767         MOVB     #40, LPBUF
54 00604 112767         MOVB     #12, LPBUF+67
55 00612 012702         MOV      #70, R2
56 00616 004567         JSR      R5, WRITM
57 00622 005301         DEC      R1
```

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```
58 00624 003353          BGT     1$
59 00626 005767          TST     TICFLG
60 00632 001415          BEQ     4$
61 00634 042767          BIC     #1,IOSWT
62 00642                 TTYIO   #ANOTM
63 00664 001404          BEQ     5$
64 00666          4$:
65 00666 004567          JSR     R5,CLOSM
66 00672 000177          JMP     @IMOREC
67 00676 000167 5$:      JMP     U2X
68 00702 012667 OUTHDG:  MOV     (SP)+,R5SAV
69 00706 012604          MOV     (SP)+,R4
70 00710 010467          MOV     R4,R33
71 00714 010600          MOV     SP,R0
72 00716 112767          MOVB    #15,IBUF
73 00724 004567 1$:      JSR     R5,MOVSTG
74 00730 005304          DEC     R4
75 00732 003374          BGT     1$
76 00734 006367          ASL     R33
77 00740 066706          ADD     R33,SP
78 00744 016746          MOV     R5SAV,-(SP)
79 00750 000205          RTS     R5
80 00752    040 DSPACE:  .BYTE   40,40,0
81 00755    014 FORM:    .ASCIZ  <14><0>
82 00760    040 FMES:    .ASCII  / PEAK     HIGH      LOW      INTENSITY  1 AMU     SQUARED/
83 01046    040          .ASCIZ  / 1 AMU/
84 01055    040 SMES:    .ASCII  /         FIELD     FIELD              FIELD       FIELD/
85 01145    040          .ASCIZ  /         /
86                       .EVEN
87 01156 005710 TODEC:   TST     (R0)
88 01160 100004          BPL     1$
89 01162 005410          NEG     (R0)
90 01164 112767          MOVB    #55,LPBUF+27.
91 01172        1$:      .BIN2D  #LPBUF+28.,(R0)+
92 01206                 .BIN2D  #LPBUF+18.,(R0)
93 01222                 LOGSHT  (R0)+,,#-12.,R3
94 01244                 .BIN2D  #LPBUF+8.,(R0)
95 01260                 LOGSHT  (R0)+,,#4
96 01276 053703          BIS     @#MQ,R3
97 01302 100004          BPL     2$
98 01304 005403          NEG     R3
99 01306 112767          MOVB    #55,LPBUF+37.
100 1314        2$:      .BIN2D  #LPBUF+38.,R3
101 1330                 MULT    R3,R3
102 1340 004567          JSR     R5,DASCII
103 1344 177302          .WORD   AC,MQ,LPBUF+48.
104 1352                 .BIN2D  #LPBUF+1,NUM
105 1370 005267          INC     NUM
106 1374 000205          RTS     R5
107 1376 000000          .WORD   0
108 1400 000000 PPLNK:   .WORD   0
109 1402 063204          .RAD50  /PPD/
110 1404 000001          .WORD   1
111 1406 063200          .RAD50  /PP/
112 1410 000000          .WORD   0
113 1412 000000 LPLNK:   .WORD   0
114 1414 046604          .RAD50  /LPD/
```

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```
115 1416 000001              . WORD     1
116 1420 046600              . RAD50    /LP/
117 1422 000000              . WORD     0, 0
118 1426 000000 LPFIL:       . WORD     0, 0, 0, 0, 0
119 1440 000204 LPHDR:       . WORD     132. , 0, 130.
120 1446 000000 LPBUF:       . WORD     0
121      001646´             . = . +126
122 1646     015             . BYTE     CR., LF
123 1650         BLANKM:
124 1650 005767              TST       LPF
125 1654 000403              BR        2$
126 1656                     . WAIT     #LPLNK
127 1664 005767 2$:          TST       PPF
128 1670 001403              BEQ       3$
129 1672                     . WAIT     #PPLNK
130 1700         3$:
131 1700                     PUSH      #LPBUF, #126
132 1710 004767              JSR       PC, BLANKF
133 1714 000205              RTS       R5
```

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```
1                               .SBTTL   NOTEBOOK INFORMATION MESSAGES(OVERLAYED)
2           000016              UN=16
3 001716    040 LPMM:   .ASCIZ  / LINE PRINTER OUT /
4 001741    040 PPMM:   .ASCIZ  / PAPER TAPE OUT /
5 001762    015 A1:     .ASCII  <CR><LF><BB><UN>/MASS SPECTRAL INFORMATION /<CR><LF><CR><LF>
6 002024    015         .BYTE   CR,LF,0
7 002027    061 A2:     .ASCIZ  /1-      DATE: /
8 002041    062 A3:     .ASCIZ  /2-      TIME: /
9 002053    063 A4:     .ASCIZ  /3-      OPERATOR: /
10 02071    064 A5:     .ASCIZ  /4-      SAMPLE NAME: /
11 02112    065 A6:     .ASCIZ  /5-      INSTRUMENT: /
12 02132    066 A7:     .ASCIZ  /6-      RUN TYPE: /
13 02150    067 A8:     .ASCIZ  /7-      CHARGES: /
14 02165    070 A9:     .ASCIZ  /8-      INSTRUMENT SETTINGS: /<CR><LF>
15 02220    011 B1:     .ASCIZ  <BB>/A- MASS RANGE: /
16 02241    011 B2:     .ASCIZ  <BB>/B- FILTER SETTING: /
17 02266    011 B3:     .ASCIZ  <BB>/C- SCAN RATE: /
18 02306    011 B4:     .ASCIZ  <BB>/D- SOURCE PRESSURE: /
19 02334    011 B5:     .ASCIZ  <BB>/E- GAIN: /
20 02347    011 B6:     .ASCIZ  <BB>/F- RESOLUTION: /
21 02370    011 B7:     .ASCIZ  <BB>/G- ACCELLERATING POTENTIAL: /
22 02426    011 B8:     .ASCIZ  <BB>/H- EI OR CI: /
23 02445    011 B81:    .ASCIZ  <BP><BB>/1-      REAGENT GAS: /
24 02470    015 A10:    .ASCIZ  <CR><LF>/9-      SAMPLE PARAMETERS: /<CR><LF>
25 02523    011 C1:     .ASCIZ  <BB>/A- TYPE: /
26 02536    011 C2:     .ASCIZ  <BB>/B- AMOUNT: /
27 02553    011 C3:     .ASCIZ  <BB>/C- INLET METHOD: /
28 02576    011 C4:     .ASCIZ  <BB>/D- SOURCE TEMPERATURE: /
29 02627    011 C5:     .ASCIZ  <BB>/E- MOLECULAR FORMULA: /
30 02657    011 C6:     .ASCIZ  <BB>/F- MOLECULAR WEIGHT: /                        259
31 02706    011 C7:     .ASCIZ  <BB>/G- COMMENT: /
32 02724    015 A11:    .ASCIZ  <CR><LF>#10-     G/C PARAMETERS: #<CR><LF>
33 02755    011 D1:     .ASCIZ  <BB>/A- COLUMN: /
34 02772    011 D2:     .ASCIZ  <BB>/B- COLUMN TEMPERATURE: /
35 03023    011 D3:     .ASCIZ  <BB>/C- CARRIER GAS: /
36 03045    011 D4:     .ASCIZ  <BB>/D- FLOW RATE: /
37 03065    011 D5.     .ASCIZ  <BB>/E- ADDITIONAL REAGENT: /
38 03116    011 D6:     .ASCIZ  <BB>/F- COMMENT: /
39 03134    015 A12:    .ASCIZ  <CR><LF>/11-     COMPUTER PARAMETERS: /<CR><LF>
40 03172    011 E1:     .ASCIZ  <BB>/A- SAMPLING RATE: /
41 03216    011 E2:     .ASCIZ  <BB>/B- INTENSITY THRESHOLD: /
42 03250    011 E3:     .ASCIZ  <BB>/C- LOW MASS THRESHOLD: /
43 03301    011 E4:     .ASCIZ  <BB>/D- HIGH MASS THRESHOLD: /
44 03333    011 E5:     .ASCIZ  <BB>/E- CENTERING METHOD: /
45 03362    011 E6:     .ASCIZ  <BB>/F- COMMENT: /
46 03400    015 A13:    .ASCIZ  <CR><LF>/12-     COMPUTER ASSIGNMENTS: /<CR><LF>
47 03437    011 F11:    .ASCIZ  <BB>/A- RUN NUMBER: /
48 03460    011 F22:    .ASCIZ  <BB>/B- UIC: /
49 03472    011 F3:     .ASCIZ  <BB>/C- SCAN NUMBER: /
50 03514    011 F4:     .ASCIZ  <BB>/D- SCAN DISC ADDRESS: /
51 03544    011 F5:     .ASCIZ  <BB>/E- TIC DISC ADDRESS: /
52 03573    011 F6:     .ASCIZ  <BB>/F- INFORMATION DISC ADDRESS: /
53                      .EVEN
54 03632 001762'ALUT:   .WORD   A1,A2,A3,A4,A5,A6,A7,A8
55 03652 002165'        .WORD   A9
56 03654 002220'        .WORD   B1,B2,B3,B4,B5,B6,B7,B8
57 03674 002445'        .WORD   B81
```

```
58 03676 002470'           . WORD    A10
59 03700 002523'           . WORD    C1, C2, C3, C4, C5, C6, C7
60 03716 002724'           . WORD    A11
61 03720 002755'           . WORD    D1, D2, D3, D4, D5, D6
62 03734 003134'           . WORD    A12
63 03736 003172'           . WORD    E1, E2, E3, E4, E5, E6
64 03752 003400'           . WORD    A13
65 03754 003437'A13LUT:    . WORD    F11, F22, F3, F4, F5, F6
66 03770 000000GFRLUT:     . WORD    RNUM, UIC, SNUM, ABLOK, TICA, INFAD
67 04004 002220'BLUT:      . WORD    B1, B2, B3, B4, B5, B6, B7, B8
68 04024 002523'CLUT:      . WORD    C1, C2, C3, C4, C5, C6, C7
69 04042 002755'DLUT:      . WORD    D1, D2, D3, D4, D5, D6
70 04056 003172'ELUT:      . WORD    E1, E2, E3, E4, E5, E6
```

```
 1                         . SBTTL   DOUBLE PRECISION INTEGER TO ASCII SUBROUTINE
 2                 ; *****************************************************************
 3                 ;        DOUBLE PRECISION INTEGER TO ASCII CONVERSION ROUTINE
 4                 ;        BY:      P. C. ABEGGLEN
 5                 ;        31 AUG. 1973
 6                 ;        CALLING SEQUENCE:
 7                 ;                 JSR     R5. DASCII
 8                 ;                 . WORD   HIGH. LOW. BUFFER
 9                 ;        WHERE:
10                 ;                 HIGH=HIGH ORDER WORD
11                 ;                 LOW=LOW ORDER WORD
12                 ;                 BUFFER=BUFFER FOR RETURNED ASCII
13                 ;        NOTE:
14                 ;                 ROUTINE USES TABLE LOOKUP AND RECURSIVE DOUBLE
15                 ;                 PRECISION SUBTRACTION FOR CONVERSION.   YIELDS
16                 ;                 UPTO TEN ASCII CHARACTERS.   SUPPRESSES LEADING
17                 ;                 ZEROS.
18                 ; *****************************************************************
19 04072          DASCII:
20 04072 004567           JSR      R5. RSAV
21 04076 013502           MOV      @( R5 )+. R2
22 04100 013503           MOV      @( R5 )+. R3
23 04102 012504           MOV      ( R5 )+. R4
24 04104 005703           TST      R3
25 04106 001013           BNE      1$
26 04110 005702           TST      R2
27 04112 001011           BNE      1$
28 04114 112724 2$:       MOVB     #60. ( R4 )+
29 04120 010567           MOV      R5. HS
30 04124 004567           JSR      R5. RRSTR
31 04130 016705           MOV      HS. R5
32 04134 000205           RTS      R5
33 04136 005067 1$:       CLR      ZFLAG
34 04142 012700           MOV      #MTMEG. R0
35 04146 005067 3$:       CLR      BCD
36 04152 012067           MOV      ( R0 )+. HS
37 04156 012067           MOV      ( R0 )+. LS
38 04162 000241 4$:       CLC
39 04164 016767           MOV      LS. TL
40 04172 016767           MOV      HS. TH
41 04200 060367           ADD      R3. TL
42 04204 005567           ADC      TH
43 04210 103003           BCC      5$
44 04212 060267           ADD      R2. TH
45 04216 000403           BR       6$
46 04220 060267 5$:       ADD      R2. TH
47 04224 103007           BCC      7$
48 04226 005267 6$:       INC      BCD
49 04232 016702           MOV      TH. R2
50 04236 016703           MOV      TL. R3
51 04242 000747           BR       4$
52 04244 066767 7$:       ADD      BCD. ZFLAG
53 04252 003405           BLE      9$
54 04254 062767 8$:       ADD      #60. BCD
55 04262 116724           MOVB     BCD. ( R4 )+
56 04266 020027 9$:       CMP      R0. #HS
57 04272 002725           BLT      3$
```

```
58 04274 010567          MOV     R5,HS
59 04300 004567          JSR     R5,RRSTR
60 04304 016705          MOV     HS,R5
61 04310 000205          RTS     R5
62 04312 142145 MTMEG:   .WORD   142145,033000,175012,017400,177547,064600
63 04326 177760          .WORD   177760,136700,177776,074540,-1,154360
64 04342 177777          .WORD   -1,176030,-1,177634,-1,177766,-1,-1
65 04362 000000 HS:      .WORD   0
66 04364 000000 LS:      .WORD   0
67 04366 000000 TL:      .WORD   0
68 04370 000000 TH:      .WORD   0
69 04372 000000 ZFLAG:   .WORD   0
70 04374 000000 BCD:     .WORD   0
```

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```
 1                                  .SBTTL   NOTEBOOK INFORMATION ROUTINE(OVERLAYED)
 2 004376    107 GC:               .ASCIZ   /GC/
 3                                  .EVEN
 4 004402    115 MS:               .ASCIZ   /MS/
 5                                  .EVEN
 6 004406    103 CH:               .ASCIZ   /CH/
 7                                  .EVEN
 8 004412    105 EI:               .ASCIZ   /EI/
 9                                  .EVEN
10 04416     103 CI:               .ASCIZ   /CI/
11                                  .EVEN
12 04422 000000 PNTRR:            .WORD    0
13 04424 000000 GCFLG:            .WORD    0
14 04426          NBOKRE:
15 04426                           CLREM    MS30F,GCFLG,LPF,PPF
16 04446 012767                   MOV      #DATAB+2,PNTRR
17 04454                          TTYIO    #PPMM
18 04476 001002                   BNE      2$
19 04500 005267                   INC      PPF
20 04504          2$:
21 04504                          TTYIO    #LPMM
22 04526 001002                   BNE      7$
23 04530 005267                   INC      LPF
24 04534          7$:
25 04534 004567                   JSR      R5,FIXLP
26 04540 012700                   MOV      #ALUT,R0
27 04544 112767                   MOVB     #15,IBUF
28 04552 004567                   JSR      R5,MOVIT
29 04556 004567                   JSR      R5,MOVSTG
30 04562                          STRGO    #LPBUF
31 04572                          .CVTDT   #0,#IBUF
32 04604 112767                   MOVB     #15,IBUF+9.
33 04612 004567                   JSR      R5,MOVIT
34 04616 004567                   JSR      R5,MOVSTG
35 04622                          STRGO    #LPBUF
36 04632                          .CVTDT   #1,#IBUF
37 04644 112767                   MOVB     #15,IBUF+8.
38 04652 004567                   JSR      R5,MOVIT
39 04656 004567                   JSR      R5,MOVSTG
40 04662                          STRGO    #LPBUF
41 04672          U1U:
42 04672 020027                   CMP      R0,#ALUT+12.
43 04676 001006                   BNE      11$
44 04700 026767                   CMP      IBUF,MS
45 04706 001413                   BEQ      12$
46 04710 005267                   INC      MS30F
47 04714 020027 11$:             CMP      R0,#ALUT+14.
48 04720 001006                   BNE      12$
49 04722 026767                   CMP      IBUF,GC
50 04730 001002                   BNE      12$
51 04732 005267                   INC      GCFLG
52 04736          12$:
53 04736 020027                   CMP      R0,#ALUT+16
54 04742 003404                   BLE      6$
55 04744 127027                   CMPB     @(R0),#11
56 04752 001110                   BNE      U4U
57 04754          6$:
```

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```
58 04754 020027        CMP     R0, #ALUT+54.
59 04760 001006        BNE     10$
60 04762 005767        TST     GCFLG
61 04766 001014        BNE     9$
62 04770 062700        ADD     #12. , R0
63 04774 000477        BR      U4U
64 04776 020027 10$:   CMP     R0, #ALUT+34.
65 05002 001006        BNE     9$
66 05004 026767        CMP     IBUF, EI
67 05012 001002        BNE     9$
68 05014 005720        TST     (R0)+
69 05016 ''''466       BR      U4U
70 05020          9$:
71 05020               TTYIO   (R0)
72 05040 126727        CMPB    IBUF, #4
73 05046 001003        BNE     U8U
74 05050 004567        JSR     R5, ONEDE
75 05054 000407        BR      U5U
76 05056          U8U:
77 05056 126727        CMPB    IBUF, #1
78 05064 001003        BNE     U5U
79 05066 004567        JSR     R5, MANYDE
80 05072 000677        BR      U1U
81 05074          U5U:
82 05074 004567        JSR     R5, MOVIT
83 05100 004567        JSR     R5, MOVSTG
84 05104 020027        CMP     R0, #A13LUT
85 05110 002670        BLT     U1U
86 05112 112767        MOVB    #15, IBUF+6
87 05120          U3U:
88 05120               . BIN20  #IBUF, #FRLUT-A13LUT(R0)
89 05136 004567        JSR     R5, MOVSTG
90 05142               STRGO   #LPBUF
91 05152 020027        CMP     R0, #FRLUT
92 05156 002760        BLT     U3U
93 05160 004567        JSR     R5, OUTIT
94 05164 004567        JSR     R5, CLOSM
95 05170 000177        JMP     @IMOREC
96 05174          U4U: STRGO   (R0)
97 05202 004567        JSR     R5, OCRLF
98 05206 112767        MOVB    #15, IBUF
99 05214 000727        BR      U5U
100 5216          FIXLP:
101 5216 ''05767       TST     LPF
102 5222 000414        BR      2$
103 5224               . INIT   #LPLNK
104 5232 ''12700       MOV     #LPFIL, R0
105 5236               . OPENO  #LPLNK, R0
106 5254          2$:
107 5254 ''05767       TST     PPF
108 5260 001412        BEQ     1$
109 5262               . INIT   #PPLNK
110 5270               . OPENO  #PPLNK, R0
111 5306          1$:
112 5306 000205        RTS     R5
113 5310          MOVSTG:
114 5310 004567 4$:    JSR     R5, BLANKM
```

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```
115 5314 012001          MOV     (R0)+,R1
116 5316 012702          MOV     #LPBUF,R2
117 5322 112122 1$:      MOVB    (R1)+,(R2)+
118 5324 105711          TSTB    (R1)
119 5326 001375          BNE     1$
120 5330 012701          MOV     #IBUF,R1
121 5334 111122 2$:      MOVB    (R1),(R2)+
122 5336 122127          CMPB    (R1)+,#15
123 5342 001374          BNE     2$
124 5344 112722          MOVB    #15,(R2)+
125 5350 112722          MOVB    #12,(R2)+
126 5354 105012          CLRB    (R2)
127 5356 162702          SUB     #LPBUF,R2
128 5362         WRITM:
129 5362 010267          MOV     R2,LPHDR+4
130 5366 105062          CLRB    LPBUF+1(R2)
131 5372 005767          TST     LPF
132 5376 001404          BEQ     2$
133 5400                 STRGO   #LPBUF
134 5410         2$:
135 5410 005767          TST     PPF
136 5414 001410          BEQ     1$
137 5416                 .WAIT   #PPLNK
138 5424                 .WRITE  #PPLNK,#LPHDR
139 5436         1$:
140 5436 000205          RTS     R5
141 5440 005767 CLOSM:   TST     LPF
142 5444 000415          BR      2$
143 5446 032767          BIT     #1,IOSWT
144 5454 001411          BEQ     2$
145 5456                 .WAIT   #LPLNK
146 5464                 .CLOSE  #LPLNK
147 5472                 .RLSE   #LPLNK
148 5500         2$:
149 5500 005767          TST     PPF
150 5504 001415          BEQ     1$
151 5506 032767          BIT     #1,IOSWT
152 5514 001411          BEQ     1$
153 5516                 .WAIT   #PPLNK
154 5524                 .CLOSE  #PPLNK
155 5532                 .RLSE   #PPLNK
156 5540         1$:
157 5540 000205          RTS     R5
158 5542 000000 LPF:     .WORD   0
159 5544 112767 ONEDE:   MOVB    #136,IBUF
160 5552 112767          MOVB    #104,IBUF+1
161 5560 112767          MOVB    #15,IBUF+2
162 5566 000205          RTS     R5
163 5570 004567 MANYDE:  JSR     R5,ONEDE
164 5574 004567          JSR     R5,MOVIT
165 5600 004567          JSR     R5,MOVSTG
166 5604 127027          CMPB    @(R0),#11
167 5612 001005          BNE     1$
168 5614                 STRGO   #LPBUF
169 5624 000761          BR      MANYDE
170 5626 000205 1$:      RTS     R5
171 5630 016767 OUTIT:   MOV     PNTRR,DATAB
```

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```
172 5636 162767           SUB     #DATAB,DATAB
173 5644                  DIVD    DATAB,,#512.
174 5660 005737           TST     @#AC
175 5664 001402           BEQ     1$
176 5666 ...5237          INC     @#MQ
177 5672           1$:    DSKO    @#MQ,INFAD,#DATAB
178 5712 016767           MOV     INFAD,INFADR
179 5720 063767           ADD     @#MQ,INFAD
180 5726 000205           RTS     R5
181 5730 012767 MOVIT:    MOV     #IBUF,ANADR
182 5736           2$:
183 5736 127727           CMPB    @ANADR,#15
184 5744 001410           BEQ     1$
185 5746 117777           MOVB    @ANADR,@PNTRR
186 5754 005267           INC     ANADR
187 5760 005267           INC     PNTRR
188 5764 000764           BR      2$
189 5766 117777 1$:       MOVB    @ANADR,@PNTRR
190 5774 005267           INC     PNTRR
191 6000 112777           MOVB     2,@PNTRR
192 6006 005267           INC     NTRR
193 6012 000205           RTS     5
194 6014 000000 ANADR:    WORD    .
```

```
 1                         . SBTTL   RAW DATA SAVE ROUTINE(OVERLAYED)
 2                         . MCALL   . RADPK
 3                         . MCALL   POPR, DSKO, . OPENI, . READ, . WAIT, DIVD
 4  '106016      DTINIT:
 5 006016 004567           JSR      R5, THENUM
 6 006022                  . BIN2D   #HS, TRNUM
 7 006040                  . RADPK   #HS+2
 8 006050                  POPTST   DTFIL+4
 9 006056                  . INIT    #DTLNK
10 006064 012700           MOV      #DTFIL, R0
11 06070 000207            RTS      PC
12 06072        RAWSAV:
13 06072 '114767           JSR      PC, DTINIT
14 06076                   . OPENO   #DTLNK, R0
15 06114       3$:
16 06114 004567            JSR      R5, SCANS
17 06120 000407            BR       . +20
18 06122 000000G           . WORD    TRNUM, TUIC, TSNUM, DATAB, PKSNM, HS, LS
19 06140 005367            DEC      LS
20 06144 001045            BNE      1$
21 06146                   DIVD     DATAB+6, , #82.
22 06162 005737            TST      @#AC
23 06166 001402            BEQ      2$
24 06170 005237            INC      @#MQ
25 06174       2$:
26 06174 005037            CLR      @#AC
27 06200 012767            MOV      #512, , MUL
28 06206 '113767           MOV      @#MQ, DTHDR+4
29 06214                   . WAIT    #DTLNK
30 06222                   . WRITE   #DTLNK, #DTHDR
31 06234 005267            INC      TSNUM
32 06240 026767            CMP      TSNUM, SSNUM
33 06246 003722            BLE      3$
34 06250 004767 5$:        JSR      PC, DTCLSE
35 06254 000177            JMP      @IMOREC
36 06260       1$:         STRGO    #LOKER
37 06270 000167            JMP      5$
38 06274        DTCLSE:    . WAIT    #DTLNK
39 06302                   . CLOSE   #DTLNK
40 06310                   . RLSE    #DTLNK
41 06316 000207            RTS      PC
42 06320    040 LOKER:     . ASCIZ   / DIRECTORY LOOKUP ERROR /
43                         . EVEN
44 06352 000000            . WORD    0
45 06354 000000 DTLNK:     . WORD    0
46 06356 070277            . RAD50   /RAW/
47 06360 000001            . WORD    1
48 06362 016040            . RAD50   /DT/
49 06364 000000            . WORD    0, 2
50 06370 070277 DTFIL:     . RAD50   /RAW/
51 06372 014474            . RAD50   /DAT/
52 06374 014474            . RAD50   /DAT/
53 06376 000000            . WORD    0, 0
54 06402 004000 DTHDR:     . WORD    2048. , 7, 0, DATAB
```

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```
1                              . SBTTL    RAW DATA UNSAVE ROUTINE
2                              . GLOBL    BNUM, TICBUF, DIRP, TICA, DIRFUL, TICFUL, TTYLOK
3  006412  004767 RAWGET:  JSR       PC, DTINIT
4  006416                     . OPENI    #DTLNK, RO
5  006434  005067        CLR       TICBUF
6  006440  012702        MOV       #TICBUF+14. , R2
7  006444          1$:   . WAIT     #DTLNK
8  006452                     . READ     #DTLNK, #DTHDR
9  006464  016700        MOV       DIRP, RO
10 06470  012701         MOV       #DATAB, R1
11 06474                 POPR      RO, (R1 )+, (R1 )+, (R1 )+
12 06502                 POPR      RO, BLOK, TICA, BLOK, TICA
13 06522  005267         INC       DIRBUF
14 06526  004567         JSR       R5, DIRFUL
15 06532                 POPR      R2, DATAB+8.
16 06536  005267         INC       TICBUF
17 06542  004567         JSR       R5, TICFUL
18 06546                 DIVD      DATAB+6. , #82. , BNUM
19 06570  005737         TST       @#AC
20 06574  001402         BEQ       2$
21 06576  005267         INC       BNUM
22 06602          2$:    DSKO      BNUM, BLOK, #DATAB
23 06622  066767         ADD       BNUM, BLOK
24 06630  005267         INC       TSNUM
25 06634  026767         CMP       TSNUM, SSNUM
26 06642  003700         BLE       1$
27 06644                 DSKO      #1, TICA, #TICBUF
28 06664  005267         INC       TICA
29 06670                 DSKO      #1, DIRA, #DIRBUF
30 06710  004767         JSR       PC, DTCLSE
31 06714  004767         JSR       PC, TTYLOK
32 06720  000177         JMP       @IMOREC
33         000001        . END
```

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```
ABLOK = ****** G      AC     = 177302       ADBUF = 176772
ADCSR = 176770        ADMES = ****** G      ADPRI = 000132
ADVEC = 000130        ALUT    003632RG      ANADR   006014R
ANOTM = ****** G      ASH    = 177316       A1      001762R
A10     002470R       A11     002724R       A12     003134R
A13     003400R       A13LUT  003754RG      A2      002027R
A3      002041R       A4      002053R       A5      002071R
A6      002112R       A7      002132R       A8      002150R
A9      002165R       BB     = 000011       BCD     004374R
BLANK = ****** G      BLANKF= ****** G      BLANKM  001650R
BLNK  = ****** G      BLOK  = ****** G      BLUT    004004R
BNUM  = ****** G      B1      002220R       B2      002241R
B3      002266R       B4      002306R       B5      002334R
B6      002347R       B7      002370R       B8      002426R
B81     002445R       CH      004406R       CHROMA= ****** G
CI      004416R       CLK    = 177546       CLOSM   005440RG
CLUT    004024R       CR     = 000015       C1      002523R
C2      002536R       C3      002553R       C4      002576R
C5      002627R       C6      002657R       C7      002706R
DASCII  004072RG      DATAB = ****** G      DIRA  = ****** G
DIRBUF= ****** G      DIRFUL= ****** G      DIRP  = ****** G
DIV   = 177300        DLUT    004042R       DPSCN = ****** G
DR    = 165000        DRIN  = 165004        DROUT = 165002
DSKIN = ****** G      DSKOUT= ****** G      DSPACE  000752R
DTCLSE  006274R       DTFIL   006370R       DTHDR   006402R
DTINIT  006016R       DTLNK   006354R       D1      002755R
D2      002772R       D3      003023R       D4      003045R
D5      003065R       D6      003116R       EAENOR= 177312
EAESC = 177310        EAESR = 177311        EI      004412R
ELUT    004056R       E1      003172R       E2      003216R
E3      003250R       E4      003301R       E5      003333R
E6      003362R       FIN   = ****** G      FIX   = ****** G
FIXLP   005216RG      FMES    000760R       FORM    000755R
FRLUT   003770RG      F11     003437R       F22     003460R
F3      003472R       F4      003514R       F5      003544R
F6      003573R       GC      004376R       GCFLG   004424RG
GETPKS= ****** G      HS      004362R       IBUF  = ****** G
IMOREC= ****** G      INFAD = ****** G      INFADR= ****** G
INITIL= ****** G      INPUT = ****** G      INTMU = ****** G
IOSWT = ****** G      ISYMBL= ****** G      LF    = 000012
LININC= ****** G      LOKER   006320R       LPBUF   001446R
LPF     005542RG      LPFIL   001426R       LPHDR   001440R
LPLNK   001412R       LPMM    001716RG      LS      004364R
LSH   = 177314        MANYDE  005570R       MOVIT   005730R
MOVSTG  005310RG      MQ    = 177304        MS      004402R
MS30F = ****** G      MTMEG   004312R       MUL   = 177306
NBOKRE  004426RG      NUM   = ****** G      NUMPKM  000165R
NUMPKS  000012R       OCRLF = ****** G      ONEDE   005544R
ORIGIN= ****** G      OUTHDG  000702R       OUTIT   005630R
PC    = %000007       PEAKS = ****** G      PKSNM = ****** G
PLT   = ****** G      PLTR  = 172554        PNTRR   004422R
PPF   = ****** G      PPLNK   001400R       PPMM    001741RG
PRTVEC= 000064        PSW   = 177776        RAWGET  006412R
RAWREC  000214RG      RAWSAV  006072RG      RNUM  = ****** G
RRSTR = ****** G      RSAV  = ****** G      R0    = %000000
R00   = ****** G      R1    = %000001       R10   = ****** G
R2    = %000002       R20   = ****** G      R3    = %000003
```

R30	= ****** G	R33	= ****** G	R4	=%000004		
R40	= ****** G	R5	=%000005	R5SAV	= ****** G		
R50	= ****** G	R6	=%000006	R7	=%000007		
SCANS	= ****** G	SET	= ****** G	SETINC=	****** G		
SMES	001055R	SNUM	= ****** G	SP	=%000006		
SPACEC=	****** G	SSNUM	= ****** G	STRING=	****** G		
SWR	= 177570	SYMBOL=	****** G	TH	004370R		
THENUM=	****** G	TICA	= ****** G	TICBUF=	****** G		
TICC	= ****** G	TICFLG=	****** G	TICFUL=	****** G		
TKB	= 177562	TKS	= 177560	TL	004366R		
TLNK	= ****** G	TODEC	001156R	TPB	= 177566		
TPS	= 177564	TRA.	= ****** G	TRNUM	= ****** G		
TSNUM	= ****** G	TTYI	= ****** G	TTYLOK=	****** G		
TTYO	= ****** G	TUIC	= ****** G	UIC	= ****** G		
UN	= 000016	U1U	004672R	U1X	000306RG		
U2X	000230R	U3U	005120R	U4U	005174R		
U5U	005074R	U8U	005056R	VLSB	000350R		
VMES	000014R	VMLUT	000000R	V1	000053R		
V2	000106R	V3	000133R	WRITM	005362RG		
XSTORE=	****** G	YE	= ****** G	YSTORE=	****** G		
ZFLAG	004372R	.SYM	= 000027				
ABS.	0*****00	000					
	006724	001					

ERRORS DETECTED: 0
FREE CORE: 13352. WORDS
.LP:/NL:BEX/CRF<RAWLIB

CROSS REFERENCE TABLE   S-1

```
ABLOK    1- 10#   3- 66
AC       1- 55#   2- 93#@ 2- 95#@ 2-101#   2-103    5-173#   5-174    6- 21#
         6- 22    6- 26@  7- 18#  7- 19
ADBUF    1- 53#
ADCSR    1- 53#
ADMES    1- 18#   2- 13
ADPRI    1- 53#
ADVEC    1- 53#
ALUT     1- 24#   3- 54#  5- 26    5- 42    5- 47    5- 53    5- 58    5- 64
ANADR    5-181@   5-183   5-185    5-186@   5-189    5-194#
ANOTM    1- 18#   2- 62
ASH      1- 55#   2- 93#  2- 95#  2-101#   5-173#   6- 21#   7- 18#
A1       3-  5#   3- 54
A10      3- 24#   3- 58
A11      3- 32#   3- 60
A12      3- 39#   3- 62
A13      3- 46#   3- 64
A13LUT   1- 18#   2- 31    3- 65#   5- 84    5- 88
A2       3-  7#   3- 54
A3       3-  8#   3- 54
A4       3-  9#   3- 54
A5       3- 10#   3- 54
A6       3- 11#   3- 54
A7       3- 12#   3- 54
A8       3- 13#   3- 54
A9       3- 14#   3- 55
BB       1- 40#   2-  4    2-  5    2-  6    2-  7    2-  8    3-  5    3- 15
         3- 16    3- 17    3- 18    3- 19    3- 20    3- 21    3- 22    3- 23
         3- 25    3- 26    3- 27    3- 28    3- 29    3- 30    3- 31    3- 33
         3- 34    3- 35   .3- 36    3- 37    3- 38    3- 40    3- 41    3- 42
         3- 43    3- 44    3- 45    3- 47    3- 48    3- 49    3- 50    3- 51
         3- 52
BCD      4- 35@   4- 48@   4- 52    4- 54@   4- 55    4- 70#
BLANK    1-  5#   2- 14
BLANKF   1- 11#   2-132
BLANKM   2- 49    2-123#   5-114
BLNK     1- 22#
BLOK     1- 37#   7- 12    7- 22    7- 23@
BLUT     3- 67#
BNUM     7-  2#   7- 18@   7- 21@   7- 22    7- 23
B1       3- 15#   3- 56    3- 67
B2       3- 16#   3- 56    3- 67
B3       3- 17#   3- 56    3- 67
B4       3- 18#   3- 56    3- 67
B5       3- 19#   3- 56    3- 67
B6       3- 20#   3- 56    3- 67
B7       3- 21#   3- 56    3- 67
B8       3- 22#   3- 56    3- 67
B81      3- 23#   3- 57
CH       5-  6#
CHROMA   1- 14#
CI       5- 10#
CLK      1- 58#
CLOSM    1-  6#   1- 12#   2- 65    5- 94    5-141#
CLUT     3- 68#
CR       1- 39#   2-  4    2-122    3-  5    3-  6    3- 14    3- 24    3- 32
         3- 39    3- 46
C1       3- 25#   3- 59    3- 68
```

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C2        3- 26#   3- 59    3- 68
C3        3- 27#   3- 59    3- 68
C4        3- 28#   3- 59    3- 68
C5        3- 29#   3- 59    3- 68
C6        3- 30#   3- 59    3- 68
C7        3- 31#   3- 59    3- 68
DASCII    1- 12#   2-102    4- 19#
DATAB     1- 17#   2- 19    2- 33    2- 36    2- 39    2- 42    5- 16    5-171@
          5-172@   5-173    5-177    6- 18    6- 21    6- 54    7- 10    7- 15
          7- 18    7- 22
DIRA      1-  9#   7- 29
DIRBUF    1-  9#   7- 13@   7- 29
DIRFUL    7-  2#   7- 14
DIRP      7-  2#   7-  9
DIV       1- 55#   2- 93#   2- 95#   2-101#   5-173##@  6- 21##@ 7- 18##@
DLUT      3- 69#
DPSCN     1- 31#
DR        1- 56#
DRIN      1- 56#
DROUT     1- 56#
DSKIN     1-  5#   2- 19#
DSKOUT    1- 35#   5-177#   7- 22#   7- 27#   7- 29#
DSPACE    2- 44    2- 80#
DTCLSE    6- 34    6- 38#   7- 30
DTFIL     6-  8@   6- 10    6- 50#
DTHDR     6- 28@   6- 30    6- 54#   7-  8
DTINIT    6-  4#   6- 13    7-  3
DTLNK     6-  9    6- 14    6- 29    6- 30    6- 38    6- 39    6- 40    6- 45#
          7-  4    7-  7    7-  8
D1        3- 33#   3- 61    3- 69
D2        3- 34#   3- 61    3- 69
D3        3- 35#   3- 61    3- 69
D4        3- 36#   3- 61    3- 69
D5        3- 37#   3- 61    3- 69
D6        3- 38#   3- 61    3- 69
EAENOR    1- 55#   2- 93#   2- 95#   2-101#   5-173#   6- 21#   7- 18#
EAESC     1- 55#   2- 93#   2- 95#   2-101#   5-173#   6- 21#   7- 18#
EAESR     1- 55#   2- 93#   2- 95#   2-101#   5-173#   6- 21#   7- 18#
EI        5-  8#   5- 66
ELUT      3- 70#
E1        3- 40#   3- 63    3- 70
E2        3- 41#   3- 63    3- 70
E3        3- 42#   3- 63    3- 70
E4        3- 43#   3- 63    3- 70
E5        3- 44#   3- 63    3- 70
E6        3- 45#   3- 63    3- 70
FIN       1- 15#
FIX       1- 28#
FIXLP     1- 12#   2- 24    5- 25    5-100#
FMES      2- 44    2- 82#
FORM      2-  2    2- 81#
FRLUT     1- 26#   3- 66#   5- 88    5- 91
F11       3- 47#   3- 65
F22       3- 48#   3- 65
F3        3- 49#   3- 65
F4        3- 50#   3- 65
F5        3- 51#   3- 65
F6        3- 52#   3- 65
```

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CROSS REFERENCE TABLE   S-3

```
GC        5-  2#  5- 49
GCFLG     1- 20#  5- 13#  5- 15@  5- 51@  5- 60
GETPKS    1- 17#  2- 46
HS        4- 29@  4- 31   4- 36@  4- 40   4- 56   4- 58@  4- 60   4- 65#
          6-  6   6-  7   6- 18
IBUF      1- 17#  2- 16   2- 26@  2- 32@  2- 33   2- 35@  2- 36   2- 38@
          2- 39   2- 42   2- 62#  2- 72@  5- 17@  5- 21#  5- 27@  5- 31
          5- 32@  5- 36   5- 37@  5- 44   5- 49   5- 66   5- 71#  5- 72
          5- 77   5- 86@  5- 88   5- 98@  5-120   5-159@  5-160@  5-161@
          5-181
IMOREC    1- 17#  2- 66   5- 95   6- 35   7- 32
INFAD     1- 10#  3- 66   5-177   5-178   5-179@
INFADR    1-  8#  5-178@
INITIL    1-  3#
INPUT     1-  5#  2- 15   2- 62#  5- 17#  5- 21#  5- 71#
INTMU     1- 33#
IOSWT     1-  6#  2- 12@  2- 61@  5-143   5-151
ISYMBL    1- 16#
LF        1- 42#  2-  4   2-122   3-  5   3-  6   3- 14   3- 24   3- 32
          3- 39   3- 46
LININC    1- 32#
LOKER     6- 36   6- 42#
LPBUF     2- 51@  2- 52@  2- 53@  2- 54@  2- 90@  2- 91   2- 92   2- 94
          2- 99@  2-100   2-103   2-104   2-120#  2-131   5- 30   5- 35
          5- 40   5- 90   5-116   5-127   5-130@  5-133   5-168
LPF       1- 20#  2- 22@  2-124   5- 15@  5- 23@  5-101   5-131   5-141
          5-158#
LPFIL     2-118#  5-104
LPHDR     2-119#  5-129@  5-138
LPLNK     2-113#  2-126   5-103   5-105   5-145   5-146   5-147
LPMM      1- 23#  3-  3#  5- 21
LS        4- 37@  4- 39   4- 66#  6- 18   6- 19@
LSH       1- 55#  2- 93#@ 2- 95#@ 2-101#  5-173#  6- 21#  7- 18#
MANYDE    5- 79   5-163#@ 5-169
MOVIT     5- 28   5- 33   5- 38   5- 82   5-164   5-181#
MOVSTG    1- 12#  2- 27   2- 34   2- 37   2- 40   2- 43   2- 73   5- 29
          5- 34   5- 39   5- 83   5- 89   5-113#  5-165
MQ        1- 55#  2- 93#@ 2- 95#@ 2- 96   2-101#@ 2-103   5-173#@ 5-176@
          5-177   5-179   6- 21#@ 6- 24@  6- 28   7- 18#@
MS        5-  4#  5- 44
MS30F     1- 20#  5- 15@  5- 46@
MTMEG     4- 34   4- 62#
MUL       1- 55#  2- 93#  2- 95#  2-101#@ 5-173#  6- 21#  6- 27@  7- 18#
NBOKRE    1- 25#  5- 14#
NUM       1- 19#  2- 47@  2-104   2-105@
NUMPKM    2-  3   2-  8#
NUMPKS    2-  3#  2- 41
OCRLF     1- 26#  5- 97
ONEDE     5- 74   5-159#  5-163
ORIGIN    1- 13#
OUTHDG    2- 45   2- 68#
OUTIT     5- 93   5-171#
PC        1- 59#  2-132@  6- 11@  6- 13@  6- 34@  6- 41@  7-  3@  7- 30@
          7- 31@
PEAKS     1- 34#
PKSNM     1-  7#  6- 18
PLT       1- 13#
PLTR      1- 57#
```

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CROSS REFERENCE TABLE   S-4

```
FNTRR   5- 12#  5- 16@  5-171   5-185@  5-187@  5-189@  5-190@  5-191@
        5-192@
FPF     1- 20#  2- 21@  2-127   5- 15@  5- 19@  5-107   5-135   5-149
FPLNK   2-108#  2-129   5-109   5-110   5-137   5-138   5-153   5-154
        5-155
PPMM    1- 21#  3-  4#  5- 17
PRTVEC  1- 43#  1- 54#
PSW     1- 59#
RAWGET  7-  3#
RAWREC  1- 17#  2- 10#
RAWSAV  1-  7#  6- 12#
RNUM    1- 38#  3- 66
RRSTR   1- 36#  4- 30   4- 59
RSAV    1- 36#  4- 20
R0      1- 59#  2- 17@  2- 19   2- 25@  2- 28   2- 31@  2- 41@  2- 71@
        2- 87   2- 89@  2- 91   2- 92   2- 93   2- 94   2- 95   4- 34@
        4- 36   4- 37   4- 56   5- 26@  5- 42   5- 47   5- 53   5- 55
        5- 58   5- 62@  5- 64   5- 68   5- 71   5- 84   5- 88   5- 91
        5- 96   5-104@  5-105@  5-110@  5-115   5-166   6- 10@  6- 14@
        7-  4@  7-  9@  7- 11@  7- 12@
R00     1- 29#
R1      1- 59#  2- 18@  2- 19   2- 57@  5-115@  5-117   5-118   5-120@
        5-121   5-122   7- 10@  7- 11
R10     1- 29#
R2      1- 59#  2- 55@  4- 21@  4- 26   4- 44   4- 46   4- 49@  5-116@
        5-117@  5-121@  5-124@  5-125@  5-126@  5-127@  5-129   5-130@
        7-  6@  7- 15@
R20     1- 29#
R3      1- 59#  2- 93@  2- 96@  2- 98@  2-100   2-101   4- 22@  4- 24
        4- 41   4- 50@
R30     1- 29#
R33     1-  5#  2- 70@  2- 76@  2- 77
R4      1- 59#  2- 69@  2- 70   2- 74@  4- 23@  4- 28@  4- 55@
R40     1- 29#
R5      1- 59#  2- 13@  2- 14@  2- 15@  2- 19@  2- 24@  2- 27@  2- 34@
        2- 37@  2- 40@  2- 43@  2- 45@  2- 46@  2- 49@  2- 50@  2- 56@
        2- 62@  2- 65@  2- 73@  2- 79@  2-102@  2-106@  2-133@  4- 20@
        4- 21   4- 22   4- 23   4- 29   4- 30   4- 31   4- 32@  4- 58
        4- 59@  4- 60@  4- 61@  5- 17@  5- 21@  5- 25@  5- 28@  5- 29@
        5- 30@  5- 33@  5- 34@  5- 35@  5- 38@  5- 39@  5- 40@  5- 71@
        5- 74@  5- 79@  5- 82@  5- 83@  5- 89@  5- 90@  5- 93@  5- 94@
        5- 96@  5- 97@  5-112@  5-114@  5-133@  5-140@  5-157@  5-162@
        5-163@  5-164@  5-165@  5-168@  5-170@  5-177@  5-180@  5-193@
        6-  5@  6- 16@  6- 36@  7- 14@  7- 17@  7- 22@  7- 27@  7- 29@
R5SAV   1-  5#  2- 68@  2- 78
R50     1- 29#
R6      1- 59#
R7      1- 59#
SCANS   1-  3#  6- 16
SET     1- 13#
SETINC  1- 14#
SMES    2- 44   2- 84#
SNUM    1- 38#  3- 66
SP      1- 59#  2- 13@  2- 16@  2- 17   2- 19@  2- 33#@ 2- 36#@ 2- 39#@
        2- 42#@ 2- 44@  2- 62@  2- 68   2- 69   2- 71   2- 77@  2- 78
        2- 91#@ 2- 92#@ 2- 94#@ 2-100#@ 2-104#@ 2-126#@ 2-129#@ 2-131@
        5- 17@  5- 21@  5- 30@  5- 31#@ 5- 35@  5- 36#@ 5- 40@  5- 71@
        5- 88#@ 5- 90@  5- 96@  5-103#@ 5-105#@ 5-109#@ 5-110#@ 5-133@
```

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            5-137#@ 5-138#@ 5-145#@ 5-146#@ 5-147#@ 5-153#@ 5-154#@ 5-155#@
            5-168@  5-177@  6-  6#@ 6-  7#@ 6-  8   6-  9#@ 6- 14#@ 6- 29#@
            6- 30#@ 6- 36@  6- 38#@ 6- 39#@ 6- 40#@ 7-  4#@ 7-  7#@ 7-  8#@
            7- 22@  7- 27@  7- 29@
SPACEC      1- 27#
SSNUM       1-  7#  6- 32   7- 25
STRING      1-  4#  2- 13#  2- 62#  5- 17#  5- 21#  5- 30#  5- 35#  5- 40#
            5- 71#  5- 90#  5- 96#  5-133#  5-168#  6- 36#
SWR         1- 59#
SYMBOL      1- 16#
TH          4- 40#  4- 42@  4- 44@  4- 46@  4- 49   4- 68#
THENUM      1-  6#  6-  5
TICA        1- 10#  3- 66   7-  2#  7- 12   7- 27   7- 28@
TICBUF      7-  2#  7-  5@  7-  6   7- 16@  7- 27
TICC        1- 36#
TICFLG      1- 17#  2- 11@  2- 59
TICFUL      7-  2#  7- 17
TKB         1- 54#
TKS         1- 54#
TL          4- 39@  4- 41@  4- 50   4- 67#
TLNK        1- 35#
TODEC       2- 50   2- 87#
TPB         1- 54#
TPS         1- 54#
TRA.        1- 30#
TRNUM       1-  7#  6-  6   6- 18
TSNUM       1-  7#  6- 18   6- 31@  6- 32   7- 24@  7- 25
TTYI        1- 36#
TTYLOK      7-  2#  7- 31
TTYO        1- 36#
TUIC        1-  7#  6- 18
UIC         1- 38#  3- 66
UN          1- 41#  2-  4   2-  5   2-  6   2-  7   3-  2#  3-  5
U1U         5- 41#  5- 80   5- 85
U1X         1- 17#  2- 20#
U2X         2- 13#  2- 67
U3U         5- 87#  5- 92
U4U         5- 56   5- 63   5- 69   5- 96#
U5U         5- 75   5- 78   5- 81#  5- 99
U8U         5- 73   5- 76#
VLSB        2- 30#
VMES        2-  2   2-  4#
VMLUT       2-  2#  2- 25   2- 28
V1          2-  2   2-  5#
V2          2-  2   2-  6#
V3          2-  2   2-  7#
WRITM       1- 12#  2- 56   5-128#
XSTORE      1- 16#
YE          1-  5#  2- 62#  5- 17#  5- 21#  5- 71#
YSTORE      1- 16#
ZFLAG       4- 33@  4- 52@  4- 69#
            2-121#  6- 17
    SYM     2- 33#  2- 36#  2- 39#  2- 42#  2- 91#  2- 92#  2- 94#  2-100#
            2-104#  2-126#  2-129#  5- 31#  5- 36#  5- 88#  5-103#  5-105#
            5-109#  5-110#  5-137#  5-138#  5-145#  5-146#  5-147#  5-153#
            5-154#  5-155#  6-  6#  6-  7#  6-  9#  6- 14#  6- 29#  6- 30#
            6- 38#  6- 39#  6- 40#  7-  4#  7-  7#  7-  8#
```

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CROSS REFERENCE TABLE    M-1

CLREM    1- 51#   5- 15
CONVER   1- 51#
DIVD     1- 51#   5-173   6-  3#   6- 21    7- 18
DSKI     1- 51#   2- 19
DSKO     1- 51#   5-177   6-  3#   7- 22    7- 27    7- 29
EMT442   1- 51#   2- 16
LOGSHT   1- 52#   2- 93   2- 95
MULT     1- 52#   2-101
POP      1- 52#
POPR     6-  3#   7- 11   7- 12    7- 15
POPTST   1- 52#   2- 17   6-  8
PUSH     1- 52#   2- 16#  2- 19#   2- 44    2-131    5-177#   7- 22#   7- 27#
         7- 29#
RESUL    1- 51#   2- 93#  2- 95#   2-101#   5-173#   6- 21#   7- 18#
STRGO    1- 52#   2- 13   2- 62#   5- 17#   5- 21#   5- 30    5- 35    5- 40
         5- 71#   5- 90   5- 96    5-133    5-168    6- 36
TTYIO    1- 52#   2- 62   5- 17    5- 21    5- 71
. AMODE  2- 33#   2- 36#  2- 39#   2- 42#   2- 91#   2- 92#   2- 94#   2-100#
         2-104#   2-126#  2-129#   5- 31#   5- 36#   5- 88#   5-103#   5-105#
         5-109#   5-110#  5-137#   5-138#   5-145#   5-146#   5-147#   5-153#
         5-154#   5-155#  6-  6#   6-  7#   6-  9#   6- 14#   6- 29#   6- 30#
         6- 38#   6- 39#  6- 40#   7-  4#   7-  7#   7-  8#
. BIN2D  1- 49#   2- 33   2- 39    2- 42    2- 91    2-100    2-104    6-  6
. BIN2O  1- 49#   2- 36   2- 92    2- 94    5- 88
. CLOSE  1- 48#   5-146   5-154    6- 39
. CODE   5-105#   5-110#  6- 14#   7-  4#
. CVTDT  1- 45#   5- 31   5- 36
. DATE   1- 47#
. D2BIN  1- 44#
. GTUIC  1- 47#
. INIT   1- 47#   5-103   5-109    6-  9
. OPEN   5-105#   5-110#  6- 14#   7-  4#
. OPENI  6-  3#   7-  4
. OPENO  1- 48#   5-105   5-110    6- 14
. O2BIN  1- 46#
. PARAD  1- 50#   1- 53
. PARAM  1- 47#   1- 59
. PARDR  1- 50#   1- 56
. PAREA  1- 50#   1- 55   2- 93#   2- 95#   2-101#   5-173#   6- 21#   7- 18#
. PARTY  1- 50#   1- 54
. RADPK  1- 49#   6-  2#  6-  7
. READ   6-  3#   7-  8
. RLSE   1- 47#   5-147   5-155    6- 40
. TIME   1- 47#
. TRAN   1- 47#
. WAIT   1- 47#   2-126   2-129    5-137    5-145    5-153    6-  3#   6- 29
         6- 38   7-  7
. WRITE  1- 48#   5-138   6- 30
```

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