

NBSIR 75-692

A Minicomputer-Based System for the Measurement and Analysis of Community Noise

R. L. Fisher, D. S. Blomquist, J. S. Forrer, D. M. Corley

Mechanics Division
Institute for Basic Standards
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Bioacoustics Division
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U. S. DEPARTMENT OF COMMERCE, Rogers C.B. Morton, Secretary
NATIONAL BUREAU OF STANDARDS, Richard W. Roberts, Director

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A Minicomputer-Based System for the Measurement and Analysis of Community Noise

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An operating system for the measurement and analysis of community noise was turned over to the Army for their use in February 1975, thus accomplishing the transfer of technology developed by NBS to the Bioacoustics Division, U. S. Army Environmental Hygiene Agency. This report documents the hardware and software packages prepared by NBS in support of this system.

1. INTRODUCTION

The Applied Acoustics Section, Mechanics Division, of the National Bureau of Standards developed a specialized minicomputer-based system for the measurement and analysis of community noise. Since the system originally was developed for in-house use, the hardware and software were in a form that could only be fully utilized by members of the section who were intimately familiar with the operation of the system.

The Bioacoustics Division (BAD) of the U. S. Army Environmental Hygiene Agency, Aberdeen Proving Grounds, required similar measurement and analysis capability to effectively carry out its mission; however, their system would have to be in a form that could be used by personnel not possessing an in-depth familiarity with measurement systems or computer software.

In May 1974, a program was initiated at NBS under BAD sponsorship. The overall objective of this program was the transfer of the technology of measurement and analysis of community noise developed by NBS to BAD. NBS provided the technical expertise in assisting BAD in assembling and documenting such a system and provided the following hardware and software packages: (1) software for sampling community noise levels, (2) software for processing community noise data, (3) utility software programs, (4) community noise interface hardware, and (5) real time analyzer interface hardware and appropriate software driver.

An operating system was turned over to the Army for their use in February 1975. This report documents the hardware and software packages developed by NBS. The documentation includes:

- explanation of the hardware and its interaction with the software,
- block diagrams to aid understanding of the system and facilitate any future system modifications,
- sample calculations for testing and diagnostics,
- user instructions.

2. SYSTEM DESCRIPTION

The community noise measurement system developed by NBS for the Bio-acoustics Division was designed to be essentially a "turn-key" data acquisition and analysis system. The hardware portion of the system is comprised of commercially produced analog equipment (microphones, measuring amplifiers, etc.), an interface designed and fabricated by NBS, and an off-the-shelf minicomputer together with its digital peripheral devices.

The input to the present system consists of two microphones which monitor the acoustic environment to be studied and an optional wind sensor for monitoring wind speed during data acquisition.^{1/}

Once the proper programs (see Section 4.1. for description of software and loading instructions) are loaded, the minicomputer operates as a hardware controller, sampling and storing the A-weighted sound levels (in decibels re 20 μ Pa) for both acoustic data channels every 0.1 second. After a minute of data (600 samples) has been stored, the minicomputer writes the data on IBM^{2/} compatible digital magnetic tape for later analysis. It should be noted that a 731.5 metre (2400 foot) digital magnetic tape can store approximately 50 hours of community noise data. Every ten minutes the minicomputer prints out a summary line of statistical descriptors of the community noise -- L_1 , L_{10} , L_{50} and L_{eq} ^{3/} (for a ten minute interval) -- on the Teletype, thus providing an indication of overall system operation. These line summaries which include the tape number, time of day, A-weighted sound levels, etc., are formatted such that they can conveniently serve as the basis for an accurate data log.

The complete data tapes can be processed on a Univac 1108 computer system which utilizes FORTRAN programs (described in Section 4.2.). Once analysis is complete, the community noise data can be produced in tabular and/or graphical form.

^{1/}The system design provides the capability for expansion to a maximum of eight channels of analog data.

^{2/}Certain commercial equipment, instruments, or material are identified in this report in order to adequately specify the BAD system. In no case does such identification imply recommendation or endorsement by the National Bureau of Standards, nor does it imply that the material or equipment identified is necessarily the best available for the purpose.

^{3/} L_1 is the A-weighted sound level which is exceeded 1 percent of the time. L_{10} is the A-weighted sound level which is exceeded 10 percent of the time. Both L_1 and L_{10} are often used to represent the higher-level, shorter-duration sounds. L_{50} is the A-weighted sound level which is exceeded 50 percent of the time. L_{eq} is the energy equivalent A-weighted sound level.

Except for brief periods (generally 7 seconds every 10 minutes) while the Teletype is printing out the data line summaries, the A-weighted sound level (in decibels re 20 μ Pa multiplied by a factor of ten) for either channel 1 or channel 2 (selectable by a switch on the front panel of the interface) is digitally displayed (four digit display) on the front panel of the interface for the convenience of the experimenter. These A-weighted sound levels will typically agree very closely with the analog meter readings of the measuring amplifier for the appropriate channel and therefore provides on the spot confirmation that the procedures for system calibration were correctly followed.

The computer interface designed and fabricated by NBS also contains a time-of-day clock, which the minicomputer interrogates once each minute (and stores the time to the nearest second), and a Brüel and Kjaer one-third-octave-band real-time-analyzer controller which is functionally independent from the community noise system.

Using a software driver (see Section 4.1.3) the real time analyzer can be sampled to obtain the root mean square (rms) value of the level in each one-third octave band from 12.5 Hz to 40 kHz (if these filters exist in the real time analyzer), a selected weighted sound level and the overall sound pressure level (linear) at the output of the analyzer in binary coded decimal (BCD) code. A FORTRAN controlling program (not supplied by NBS) could be written to store these data and dump them on to digital magnetic tape for later processing and plotting by a large computer system.

The four digit hexadecimal display on the front panel of the interface which was discussed earlier is independent (hardware wise) from the remainder of the system; therefore, it can be utilized to display up to four hexadecimal digits of information on command from the minicomputer.

Field experience pointed out the necessity for a fast-acting 117 v A.C. power line conditioner to protect the system from power transients and offset the effect of power brownouts on the computer system. This feature was included in the BAD system. In the event of a longer term (greater than a few milliseconds) power outage that cannot be handled by the conditioner, a power-fail-safe software driver was written by NBS to provide, in conjunction with minicomputer hardware, for orderly shutdown of the central processing unit (CPU) during power failure and a resumption of the program when power is restored. Long term power outages result in the complete shutdown of the minicomputer's digital magnetic tape system. The power-fail-safe hardware-software cannot restart the tape system after it shuts down. When the tape unit goes down one must follow the normal manual start up procedures.

The remainder of this report will concentrate on the details of the hardware and software packages developed by NBS.

3. DESCRIPTION OF INTERFACE HARDWARE

The system developed for the Bioacoustics Division has two channels for acoustic data and one channel for wind data. The two acoustic channels have an input impedance of 68 K Ω and have a voltage range of 0 to 4.5 volts. The windsensor input has an input impedance of 500 K Ω and an voltage range of 0 to 4 volts. The windsensor input has RC integration for smoothing of data. The time constant is 500 milliseconds. The windsensor is a small full wave rectified alternating current generator driven by a conventional 3 bladed anemometer.

Additional channels may be added by inclusion of a buffer amplifier, sample and hold module, timing changes and software changes for each channel added. Maximum expansion of the system -- eight channels -- would also require an expansion of the interface memory capacity.

In addition to the community noise measurement system, the interface also contains the necessary logic to allow a Brüel and Kjaer one-third octave band real time analyzer (model 3347) to be coupled to the minicomputer.

This section contains a simplified explanation of interface operation. For clarity, the minicomputer as well as the commercial analog equipment are shown in the block diagram (Figure 1) describing interface components.

The input signal from the RMS detector log converter is the logarithm of the A-weighted root mean square (rms) value of the acoustic signal and is buffered by the input amplifier. The buffered signal is fed to a sample and hold module. System timing and control is maintained by a programmable read only memory (PROM). This PROM is addressed by an eight stage counter which is controlled by the crystal controlled oscillator in the time-of-day clock. The PROM strobes the sample and hold module ten times per second. The output of the sample and hold module is fed to a multiplexer (MUX) and then through a buffer amplifier to an analog to digital converter (ADC).

The timing sequence is as follows:

1. The sample and hold module is strobed and the data are held on the storage capacitor.
2. After the data have settled on the hold capacitor (10 RC time constants) the input channels are multiplexed to the ADC.
3. The ADC is strobed to start conversion.

The analog signal is converted to a 10 bit digital word by the ADC. The 10 bit ADC results in a quantization error of 0.05 dB when the analog signal is sent to a Brüel and Kjaer measuring amplifier type 2607 and the log, dc, output is connected to the interface. The end of conversion pulse from the ADC stores the digitized voltage and a channel number in a 12 bit by 320 word asynchronous first-in/first-out (FIFO) memory. The purpose of the memory is to allow the computer enough time to perform the necessary calculations and "house keeping" without loss of data. The minicomputer is interfaced to the FIFO memory on an interrupt basis.

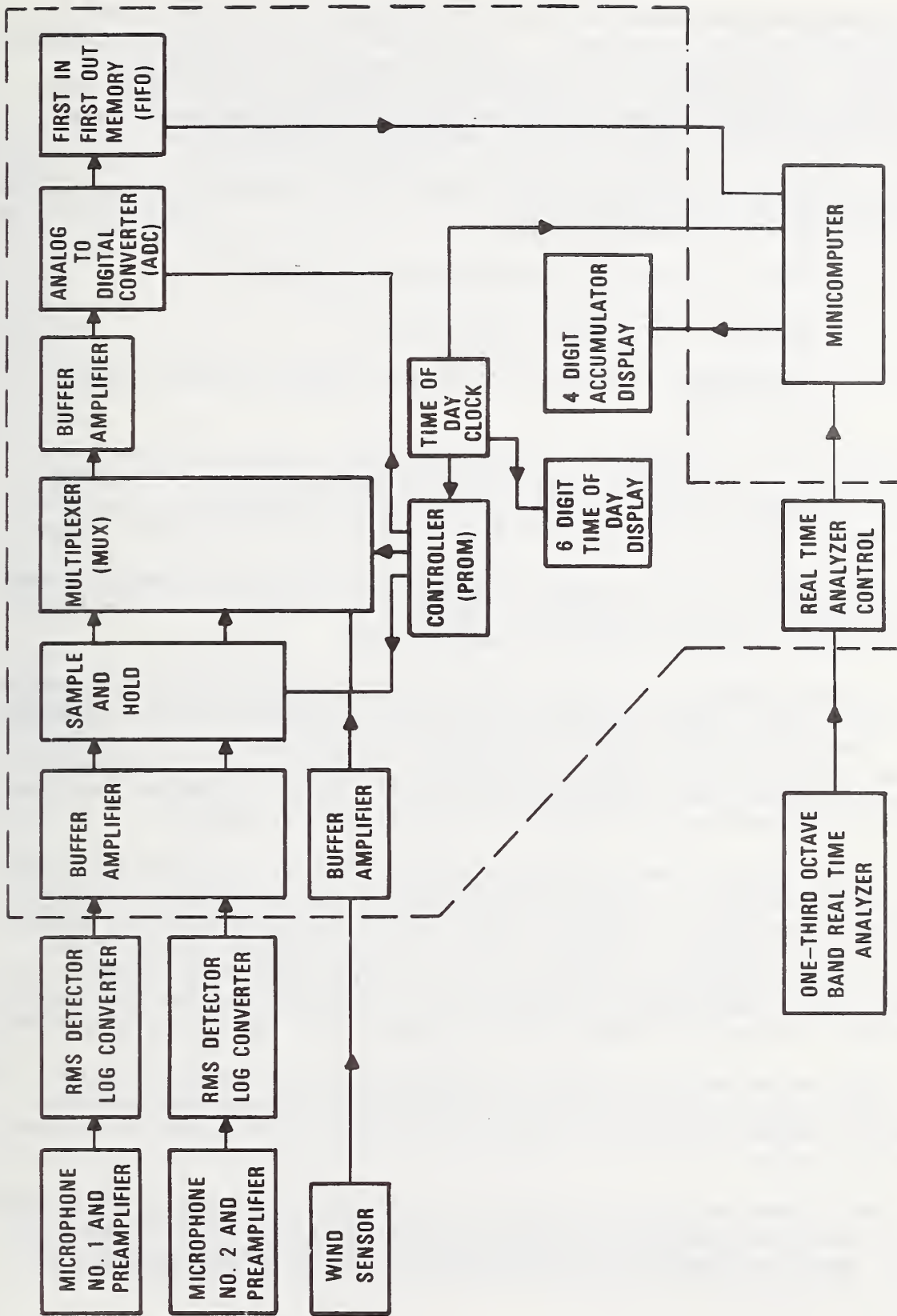


Figure 1. Block diagram showing community noise measurement system with emphasis on the functions of the interface (shown within the dashed lines) designed and fabricated by NBS.

The system also includes a CMOS time-of-day clock, which is read by the minicomputer once each minute. The time base for the clock is crystal controlled. The format of the clock is 24 hours with six BCD digits for hours, minutes and seconds. The clock has a battery powered standby mode which allows for clock operation for a minimum of 1 hour without external power.

The accuracy of the time-of-day clock is governed by the tolerances supplied by the crystal manufacturer:

1. Initial value within 5 ppm (parts per million).
2. Aging per year equals 2 ppm or less.
3. Temperatures from 10°C to 40°C will cause additional errors up to 8 ppm.

Using a worst case assumption for each of the three factors (15 ppm), the total error in one year if the clock were not reset would be 7.9 minutes (about 1.3 seconds per day). After the crystal is one year old, the total drift over a 48 hour period at 20°C would be less than 0.6 seconds (7 ppm).

In December 1974 the crystal oscillator in the clock in the BAD interface was found, in actual laboratory tests, to be accurate to within 5 ppm of the nominal specified frequency value at 20°C.

As stated earlier, the system also has the necessary logic for reading out the data from a Brüel and Kjaer one-third octave band real time analyzer (RTA). The 3 1/2 digits from the analyzer are accompanied by two status bits for indicating underrange and overload. In this case, underrange is defined as a level that is less than the RTA's internal reference level while overload is defined as an overload of the analog input amplifier.

On the front of the interface panel there are two displays which allow for operator control -- a time-of-day display and an accumulator display. The time-of-day display shows the time of day in hours, minutes and seconds on a six digit display in 24 hour format. The accumulator display shows the accumulator contents (16 bits) on a four digit hexadecimal readout. A single computer instruction is required for the display and the data are set in latches such that the data will be displayed until new data are received.

The time of day is set by use of the hold, slow and fast switches. The hold switch stops the clock, the slow switch advances the clock at a one minute per second rate and the fast switch advances the clock at a one hour per second rate.

Front panel switches also include an external sense switch for computer control and a power switch to disable the battery power for the time-of-day clock. When the computer is to be turned off for more than one hour, the

battery power should also be turned off to avoid completely discharging the batteries.

There are three switches on the back of the interface. The purpose of these switches is for trouble shooting the hardware and software. All the switches are debounced to eliminate multiple pulses. The Master Reset switch clears the interface memory of all data and resets the PROM to the first location. There are two switches for either shifting data into or out of the memory.

4. DESCRIPTION OF SYSTEM SOFTWARE

This section and the appendices document the FORTRAN and SYM II (assembly language for this particular 16-bit minicomputer [Raytheon 704]) assembly language software for the minicomputer-based community noise system and real-time analyzer interface system as well as the FORTRAN software for the analysis of community noise tapes. The documentation includes program listings, overall block diagrams, test programs to be utilized for diagnosis of system problems and typical examples of the output from the main FORTRAN programs.

4.1. Fortran and Assembly Language Software for the Minicomputer-Based Community Noise System and Real-Time Analyzer Interface System.

The operation of the minicomputer-based data acquisition system is discussed from a software point of view in this section. The level of explanations assumes familiarity with programming in conversational FORTRAN and SYM II^{4/} assembly language.

In general, two main FORTRAN programs and their respective subroutines must be loaded into the minicomputer and be operable in order to be able to acquire a possible eight channels of data on digital magnetic tape (for later analysis utilizing a large computer system such as the Univac 1108 at the National Bureau of Standards). It should be noted that substantial changes to both the hardware interface and to the software would be necessary for expanding the present system (2 channels) to a maximum of eight channels.

The first main program is called "CHECK". Once the "CHECK" program is loaded (see Section 4.1.5. for loading procedures) the measuring amplifier (Brüel and Kjaer 2607) provides the output for acoustic data channel 1 and is manually stepped over its entire 50 dB range and a linear fit is performed on the resulting digital values received by the minicomputer from the community noise interface using the method of least squares. This procedure determines the factor relating analog A-weighted sound levels in decibels (re 20 μ Pa) to the digital values transferred to the minicomputer via the community noise interface. The process is repeated for acoustic data channel 2 and a calibration paper tape is automatically punched out for use in the "NOISE" program.

The second main program, called "NOISE", (1) receives and buffers the digital values which are proportional to the output values of the measuring amplifier, (2) converts these values to exact decibel values and (3) writes the community noise data on digital tape. The reference decibel value is maintained in the program by periodic application of a pistonphone calibration on the microphone for each acoustic data channel.

If either of the two main FORTRAN programs malfunction, the Raytheon supplied diagnostic programs^{2/} -- CPU 30, 31, etc. -- and the system interface

^{4/}"Raytheon 704 Users Manual"
Raytheon Data Systems
1415 Boston-Providence Turnpike
Norwood, Massachusetts 02062
page 8.12

^{2/}Raytheon 704 Users Manual, page 8.84

test programs written by NBS (outlined in Section 4.1.3.) should be run to determine whether the fault lies in the central processing unit (CPU) or the interface.

4.1.1. Conversational FORTRAN Programs for Calibration and Use of the Community Noise Measurement System

The measuring amplifier (Brüel and Kjaer 2607) used in the BAD community noise system has a dc output that is directly proportional to the logarithm of the root mean square (rms) input voltage. This dc output is connected to an analog multiplexer (for switching channels) and then to an analog to digital converter in the community noise interface. Therefore, the digital output of the interface is also directly proportional to the logarithm of the rms input voltage of the measuring amplifier. Once the values for f and c in the following equation have been determined, the "NOISE" program will directly compute the A-weighted sound level (SPL) in decibels (re 20 μ Pa) from the raw digital values transferred from the interface to the minicomputer.

$$\text{SPL} = fD + c \quad (1)$$

where D = raw digital value from the community noise interface
 f = slope of the least squares curve fit discussed in Section 4.1.
 c = constant based on the pistonphone level.

The conversational FORTRAN program called "CHECK" in conjunction with the manual switching of the input attenuator of the measuring amplifier (previously discussed in Section 4.1.) establishes the f values for both acoustic data channels. (See appendices A and B for program listings). The procedure to use is as follows:

1. Load "CHECK" program using one of the methods outlined in Section 4.1.5. of this report.
2. Follow the directions provided by program "CHECK" which are typed on the Teletype.
3. Save the listing produced by the "CHECK" program for future reference. Save the paper tape punched for later use by the "NOISE" program.

The conversational FORTRAN subroutine "ORTH" is a least squares curve fitting routine using orthogonal polynomials. The "CHECK" program calls subroutine "ORTH" to perform a first order (linear) fit on the array of measuring amplifier input values (0 to 50 dB) versus an array of raw interface value (0 to 1023) solving for c and f in equation (1). The values of f for both acoustic data channel 1 and acoustic data channel 2 are punched on a paper tape (along with the year, day and time) by the "CHECK" program for later use in the "NOISE" program. The values for c are not stored because c will be determined by pistonphone calibration and measuring amplifier gain settings in the "NOISE" program. The flow diagram for the "CHECK" program is presented in Appendix A.

The "NOISE" program conducts a two-channel community noise survey by sampling the acoustic data channels and the optional wind data channel at a 10 Hz rate. Once a minute, the noise data (A-weighted sound level in decibels re 20 μ Pa) and the maximum wind speed are written on magnetic tape for later analysis.

The procedure for using the "NOISE" program is as follows:

- 1) Load "NOISE" program into the minicomputer using one of the methods shown in Section 4.1.5. of this report.
- 2) Follow the directions given by the "NOISE" program in the Teletype printout.
- 3) After the program is routinely recording data on magnetic tape, a new pistonphone calibration can be initiated by putting sense switch 1 up on the CPU. Similarly putting sense switch 2 up will request a new 2607 gain setting.
- 4) Save the listing produced by the "NOISE" program as a data log for the data stored on the magnetic tape.

The "NOISE" program will print out L_1 , L_{10} , L_{50} and L_{eq} every ten minutes on the system Teletype. (These values are not recorded on the magnetic tape). The Teletype printout forms a valuable record of the data recorded on the magnetic tape. L_1 is a useful guide for determining the proper input attenuator settings for the measuring amplifier. Set the measuring amplifier attenuators so that the value of L_1 is within 10 dB of full scale on the measuring amplifier. These L_i values (calculated on fixed 10 minute intervals) will not agree exactly with L_i values calculated by a box car averaging method in the program described in Section 4.2. The flow diagram for the "NOISE" program is presented in Appendix A.

"TOGGLE" is a conversational FORTRAN subroutine used by both the "CHECK" program and the "NOISE" program to detect sense switch 0 changes signaling a user response.

4.1.2. Assembly Language Subroutines

a. Subroutine "STEM 1"

Main programs such as "CHECK" and "NOISE" and their subroutines can be added to the normal Raytheon systems tape as described in Section 4 of the Raytheon Magnetic Tape Operating System Manual^{6/}. Developing this normal systems tape is time consuming and calling the required programs under "XRAY" control would be a lengthy process. To avoid this problem and in addition avoid operating exclusively with long paper tapes the "STEM 1" program was written. (See appendix B for program testing.)

^{6/} "Magnetic Tape Operating System"
Raytheon Data Systems
1415 Boston-Providence Turnpike
Norwood, Massachusetts 02062

When called by a conversational FORTRAN program, "STEM 1" checks to see if sense switches 0, 1, and 2 are up. If these switches are up and the magnetic tape is "write enabled", a small loader and a complete core image dump will be written on magnetic tape thus developing a "special" systems tape. The program on the special systems tape can be called into memory by:

1. Mounting special tape in the magnetic tape drive and bringing the tape to load point (BOT) and on line.
2. Push RESET on the CPU.
3. Push magnetic tape LOAD button N times where N equals 1 plus 2 times the number of programs ahead of the desired program on magnetic tape.
4. Push RUN on CPU.
5. Push RUN on CPU.

b. Subroutine "DATA"

This program establishes interrupt level 5 linkage which allows data to be brought into the computer from the interface. (Subroutine "INTL" must also be called to enable interrupt level 5 thereby starting actual data transfer.) "DATA" makes the instantaneous values of the wind channel, acoustic data channel 1 and acoustic data channel 2 available for use in the main FORTRAN program at a 10 Hz rate. Program "CHECK" utilizes the "DATA" subroutine to input raw interface data for curve fitting and to send these data to the interface display. Program "NOISE" utilizes the "DATA" subroutine only for pistonphone calibration and does not send any data to the interface display. (Program "NOISE" uses subroutine "DISP" to send A-weighted sound level data to the display.)

c. Subroutine "LFD"

Program "NOISE" cannot convert raw interface values to actual A-weighted sound levels in decibels (re 20 μ Pa) while the Teletype is typing. Therefore, typing time must be minimized. By calling subroutine "LFD", the "NOISE" program can space up to ten lines per second instead of two lines per second when utilizing normal Raytheon formatting. When called by a conversational FORTRAN program, subroutine "LFD" sends a line feed character to the Teletype causing the paper to space up by one line.

d. Subroutine "POWF5"

This subroutine provides for the orderly shutdown of the central processing unit (CPU) with no program loss in the event of power interruption. When power is restored, "POWF5" sends a master reset signal to the interface and the system returns to the program that was in progress when the power failure occurred. If the power is off for more than a few milliseconds, the magnetic

tape unit will shut down and manual intervention is required to prepare it for operation. If bit 5 of word X'4B' was set prior to the power failure (by "INTL" subroutine), "POWF5" would reenable interrupt level 5 when power was restored.

e. Subroutine "MULT1"

The "NOISE" program utilizes subroutine "MULT1" to allow the values for the wind channel and the two acoustic data channels to be transferred from the interface to the minicomputer during actual data collection. (Program "NOISE" utilizes subroutine "DATA" to bring in raw data during pistonphone calibration.) Subroutine "MULT1" fills a 1200 word array -- one minute of data -- with raw data from acoustic data channels 1 and 2. Subroutine "INTL" must be utilized to enable interrupt level 5 before subroutine "MULT1" can transfer data from the interface to the minicomputer.

f. Subroutine "MMON"

Subroutine "MMON" modifies the Raytheon supplied operating software so that it will not continuously write out MO, MO, on the Teletype when the magnetic tape unit shuts down.

g. Subroutine "DMAMAG"

Subroutine "DMAMAG" checks the direct memory access (DMA) magnetic tape unit status and returns the status to the calling conversational FORTRAN program. It is particularly useful for locating end of tape (EOT) and for determining whether or not the magnetic tape is "write enabled".

h. Subroutine "INTL"

Subroutine "INTL" is used to enable or disable any one of the interrupt levels and to record the enable status of each level in the enable status word in location X'4B'. Subroutine "POWF5" uses this status word following a power failure to determine if interrupt level 5 should be reenabled.

i. Subroutine "DISP"

This subroutine has two modes of operation. In the first mode, "DISP" converts a binary number to binary coded decimal (BCD) format and sends it to the interface display. In the second mode, "DISP" converts the number to BCD and sends it to the interface display only if the external sense switch setting agrees with a calling parameter JCHAN (see program listing in Appendix B). The "NOISE" program calls subroutine "DISP" to display A-weighted sound level data in decibels (re 20 μ Pa). The person performing the data analysis can elect to display either acoustic data channel 1 or acoustic data channel 2 by placing the external sense switch up or down respectively.

j. Subroutine "LEADR"

When called by a main conversational FORTRAN program, this subroutine will punch a leader on the Teletype. The "CHECK" program calls subroutine "LEADR" to punch a leader in front of and behind the calibration tape it produces for use in the "NOISE" program.

k. Subroutine "CLOK"

When called by a main program, subroutine "CLOK" reads the interface clock until the time agrees for two successive interrogations. The time in hours, minutes and seconds is then utilized by the main program as data.

Program listings for subroutines discussed in this Section are contained in Appendix B.

4.1.3. Test Programs for the Community Noise/Real Time Analyzer Interface (Plus Real Time Analyzer Subroutine Driver)

a. Absolute Binary Routine "MINOS1"^{1/}

This program is used for system checkout and for performing elementary tests on:

- 1) interface display
 - external sense switch up for a decimal display.
 - external sense switch down for a hexadecimal display.
- 2) wind channel
 - sense switches 1 and 2 down to display raw wind values (not corrected to knots).
- 3) acoustic data channel 1
 - sense switch 1 (SS1) up (SS2 down) to display raw channel 1 values (not converted to decibels).
- 4) acoustic data channel 2
 - sense switch 2 (SS2) up (SS1 down) to display raw channel 2 acoustic values (not converted to decibels).
- 5) master reset
 - sense switch 3 up to provide a master reset command to the interface after each number is displayed.
- 6) interrupt level 5.

Note: Put sense switch 0 up to halt the CPU after each value is displayed if desired. (Push RUN to continue.)

^{1/}The program listing for MINOS1 and the remaining programs in Section 4.1.3. are in Appendix C.

The "MINOS1" program is loaded into the minicomputer by giving the XRAY directive: AL. If the word FACE remains on the interface display more than a fraction of a second after loading the program, something is wrong with interrupt level 5. Either the interface is not sending an interrupt pulse to the CPU or the interrupt card in the CPU is bad.

b. Conversational FORTRAN Program "TCLOK"

"TCLOK" is a test program utilized for printing out the current time read from the interface clock. Program "TCLOK" calls subroutine "CLOK" to transfer the hours, minutes and seconds values from the display to the Teletype.

An example of the printout from "TCLOK" is shown in Section 4.1.4.

c. Conversational FORTRAN Program "TRTAL"

The "TRTAL" program receives values for the sound pressure level in each one-third octave band, a selected weighted sound level and the value for the overall sound pressure level (linear) in BCD format from the output of the real time analyzer (RTA) by calling the RTA driver subroutine "RTAL". The "TRTAL" program prints out these values along with a channel underflow bit on the Teletype. If the underflow bit is a 1, that particular channel is at or below the base line value of the real time analyzer. If the underflow bit is a 0, the value is above the baseline. If the input amplifier of the real time analyzer was overloaded during the time period that data were sampled and sent to the interface, an overload message will be printed out.

An example of "TRTAL" output is shown in Section 4.1.4.

d. Subroutine "RTAL"

When called by a conversational FORTRAN program, subroutine "RTAL" commands the real time analyzer to digitize the values in each one-third octave band, the selected weighted band and the overall (linear) band and to send the values in BCD format to the "RTAL" program as data. Subroutine "RTAL" converts these BCD numbers to binary numbers (decibel times a factor of ten) and sends them to the main conversational FORTRAN program as fixed point integers. Channel underflow bits and the input attenuator overload values are also sent to the FORTRAN main program.

4.1.4. Typical Output Listings

This section contains output listings from the "CHECK", "NOISE", "TCLOK", and "TRTAL" programs.

The portion of the output listing for the "CHECK" program shown below should be kept in a log book since these calibration data establish the system accuracy. The year, date and time of the calibration is printed in the upper right hand corner of the printout and also appears at the beginning of the punched paper tape output which will be read by the "NOISE" program. The first three columns in the middle of the listing show the five step 50 dB dynamic range of the Brüel and Kjaer measuring amplifier (type 2607), values for acoustic data channel 1 (raw interface numbers) and values for acoustic data channel 2 (raw interface numbers). These data are utilized as the basis for the linear curve fitting routine discussed in Sections 4.1. and 4.1.1. The fourth and fifth columns show the difference in decibels between the 2607 values and the values determined by the curve fitting routine. In the example, the maximum system error was 0.12 dB. The linear equations for acoustic data channels 1 and 2 are printed out and the factor relating raw interface values (ADC values) to 2607 values are also punched out on the special output paper tape that is read by the "NOISE" program.

2607 - INTERFACE NOISE SYSTEM LINEARITY CHECK

YEAR = 1975
 DAY = 58
 HOUR = 2
 MINUTE = 23

2607 DB	CH1 ADC VALUE	CH2 ADC VALUE	CH1 DB DIFF	CH2 DB DIFF	
0	5	5	.11	-.00	(0 DB VALUE NOT USED)
10	204	205	.07	.11	
20	400	398	-.12	-.12	
30	603	597	.03	-.05	
40	803	796	.03	.01	
50	1002	994	-.01	.03	

CH1 DB = CONSTANT + 50.02387E -3 * (ADC VALUE)
 CH2 DB = CONSTANT + 50.60568E -3 * (ADC VALUE)

TURN ON PUNCH, TOGGLE SENSE SWITCH 0
 1975 58 2 23 50.02387E -3 50.60568E -3
 TURN OFF PUNCH, TOGGLE SENSE SWITCH 0 TO RESTART
 CHECK OUT IS COMPLETED. USE PAPER TAPE IN NOISE
 PROGRAM IF ABOVE RESULTS ARE SATISFACTORY.

An example printout of the "NOISE" program is presented on the next page. The second line of the heading contains the page number, magnetic tape number, year, and date and time of the calibration. The time of calibration refers to the time the calibration paper tape was prepared. Below the heading, there are sixteen labeled columns of numbers that make up the main body of the listing and serve as the basis for an accurate data log of the noise levels measured as well as certain checks on the minicomputer system. The first four columns give the day of the year and the time (hours, minutes, seconds) corresponding to the end of the 10 minute block of data. The next four columns show the L_1 , L_{10} , L_{50} and L_{eq} values for acoustic data channel 1. The next four columns show similar data for acoustic data channel 2. The column labeled WIND shows the highest wind speed (in knots) for the entire 10 minute block. The column labeled AC PFS is a count of the number of ac power failures that occurred during the 10 minute block. The column labeled # ERR is a count of the number of incorrect channel numbers generated by the interface during the 10 minute block. Finally, the column labeled # SKIP is a count of the number of missing or skipped channel numbers during the 10 minute block. Non-zero values for either # ERR or # SKIP indicate interface malfunction unless AC PFS is also non-zero in the same time block. In the example shown, an attenuator change was made on the measuring amplifier between data blocks 3 and 4. The new attenuator settings for channels 1 and 2 were .01 volts. A new pistonphone calibration was also made after data block 4. The system drift, in this case, was 0.1 dB.

An example of the printout of the "TCLOCK" program is reproduced below. When one pushes the hold button on the interface clock, the clock is stopped and a comparison can be made between the displayed time and the time printed on the Teletype.

HR	MIN	SEC
11	6	14
11	6	16
11	6	17
11	6	19
11	6	21
11	6	23
11	6	24
11	6	26
11	6	28
11	6	29
11	6	31
11	6	33
11	6	35
11	6	36
11	6	38

^{8/} L_1 is the A-weighted sound level which is exceeded 1 percent of the time.
 L_{10} is the A-weighted sound level which is exceeded 10 percent of the time.
 Both L_1 and L_{10} are often used to represent the higher-level, shorter-duration sounds. L_{50} is the A-weighted sound level which is exceeded 50 percent of the time. L_{eq} is the energy equivalent A-weighted sound level.

'BAD' DIGITALLY CONTROLLED SOUND LEVEL SURVEY

PAGE 1 TAPE # 1 YEAR 1975 (2607 CAL 1975 58 2 23)

DAY	HR	MN	SEC	1- CHANNEL 1 -1				1- CHANNEL 2 -1				WIND K	AC PFS	# ERR	# SKIP	
				1%	10%	50%	LEQ	1%	10%	50%	LEQ					
1	58	2	51	4	74	69	65	67	80	80	79	79	0	0	0	0
2	58	3	1	4	76	68	65	67	80	79	79	79	0	0	0	0
3	58	3	11	4	75	69	66	67	80	80	79	79	0	0	0	0
(58 3 12 4 LAST TAPE RECORD) PUT SS2 DOWN.																
A WT BUTTON IN, NORMAL NOISE SIGNAL CONDITIONS.																
ENTER ATTENUATOR SETTINGS (BOTH ON ONE LINE)																
.01 .01																
4	58	3	23	0	75	69	66	67	80	79	79	78	0	0	0	0
(58 3 24 0 LAST TAPE RECORD) PUT SS1 SS2 DOWN																
HAVE A WT. BUTTON OUT ON BOTH 2607 UNITS.																
PUT PISTONPHONE ON CH 1, HAVE METER READ ABOUT 44 DB.																
ENTER ATTENUATOR SETTING WHILE PISTONPHONE IS ON.																
.3 .3																
PUT PISTONPHONE ON CH 2, HAVE METER READ ABOUT 44 DB.																
ENTER ATTENUATOR SETTING WHILE PISTONPHONE IS ON.																
.3																
CH 1 DRIFT = -.10 DB CH 2 DRIFT = -.10 DB																
A WT BUTTON IN, NORMAL NOISE SIGNAL CONDITIONS.																
ENTER ATTENUATOR SETTINGS (BOTH ON ONE LINE)																
.03 .03																

An example of the printout from the "TRTAL" program is shown below. The listing prints out the sound pressure level (in decibels re 20 μ Pa) in each one-third octave band from 12.5 Hz to 40 kHz (depending on which filters are utilized in the particular RTA), the sound level for the selected weighting network and the overall sound pressure level (linear). As discussed in Section 4.1.3.c., the underflow indicates whether or not the value is above or below the RTA baseline, while the overflow, i.e., an indication of RTA saturation, is indicated by the printing out on the listing -- RTA INPUT AMPLIFIER WAS OVERLOADED -- if saturation occurred.

PUI 550 UP TO BRING IN DATA FROM RTA.

REAL - TIME 1/3 OCTAVE ANALYZER TYPE 3347 OUTPUT

BAND	DB	UFLOW	BAND	DB	UFLOW
BASE L.	70.0	1	400.0	97.6	0
12.5	78.8	0	500.0	98.0	0
16.0	85.4	0	630.0	98.2	0
20.0	89.6	0	800.0	98.4	0
25.0	97.8	0	1000.0	99.8	0
31.5	101.6	0	1250.0	95.0	0
40.0	102.0	0	1600.0	93.2	0
50.0	99.4	0	2000.0	93.2	0
63.0	101.0	0	2500.0	90.4	0
80.0	100.0	0	3150.0	88.2	0
100.0	99.2	0	4000.0	84.8	0
125.0	98.0	0	5000.0	80.0	0
160.0	98.4	0	6300.0	77.6	0
200.0	100.4	0	8000.0	71.4	0
250.0	102.0	0	10000.0	70.0	1
315.0	98.2	0	12500.0	70.0	1
WEIGHT.	106.0	0	16000.0	70.0	1
LINEAR	113.6	0	20000.0	70.0	1

4.1.5. Procedure for Loading Programs -- "CHECK", "NOISE", "TCLOK" and "TRTAL"

These programs which are written in conversational FORTRAN utilize one or more subroutines which are written in conversational FORTRAN or assembly language. The most efficient procedure for loading any one of these programs (and their subroutines) from paper tape is to utilize a high speed reader (HSR) format. (Copies of "CHECK", "NOISE", "TCLOK", and "TRTAL" have been supplied to BAD in HSR format.)

To run a high speed reader format tape the following procedure should be followed:

1. load XRAY (executive routine)
2. turn on high speed paper tape reader and place paper tape on reader.
3. enter the following command on the Teletype keyboard.

```
:IO, 1, 20  
:EX
```

Execution will then be automatic.

For reference purposes, steps 1 to 10 explain the punching order necessary to create a HSR tape.

1. Punch the following step 1 commands on paper tape:

```
line feed :QU,CF carriage return  
line feed :EX carriage return  
line feed GC carriage return
```
2. Copy-punch the FORTRAN main program.
3. If there are any FORTRAN subroutines, continue in to step 4. If there are no FORTRAN subroutines go to step 6.
4. Punch the following command on the paper tape:

```
line feed GC carriage return
```
5. Copy-punch the FORTRAN subroutine. Repeat steps 4 and 5 for all FORTRAN subroutines.
6. Punch the following commands on the paper tape:

```
line feed E carriage return  
line feed :QU,CFR carriage return
```

7. If there are one or more assembly language subroutines, skip to step 9. If there are no assembly language subroutines proceed to step 8.
8. Punch the following command on the paper tape:

line feed :EX carriage return

Skip to step 11.
9. Punch the following command on the paper tape:

line feed :AL carriage return
10. Copy-punch the assembly language subroutines on the paper tape with execution addresses of X'78'. The last subroutine should transfer to X'40'.
11. Punch the following command on the paper tape:

line feed G carriage return

To load the "CHECK" and "NOISE" programs from a special magnetic tape the reader is referred to the discussion of subroutine "STEM1" (Section 4.1.2.a.).

4.1.6. Interface Software Commands

The Interface Software Command (Table 1) lists all the direct input (DIN) and direct output (DOT) commands that affect the community noise interface and the real time analyzer (RTA). Examples for the 16-bit words are given as an aid in understanding the usage of the commands. This table is mainly for reference because these commands are already used in the software drivers supplied with the community noise and real time analyzer programs.

Table 1. Interface Software Commands

Raytheon 704 Command

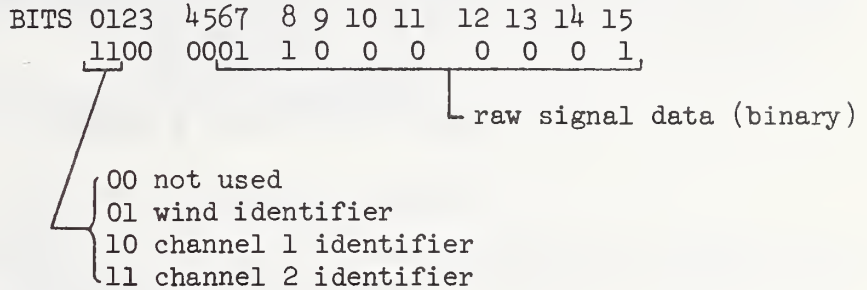
Effect or Results

DOT 15,6

sends master reset to interface (resets PROM counter, and clears FIFO memory)

DIN 15,2

sends 16 bits of data from interface to CPU* accumulator



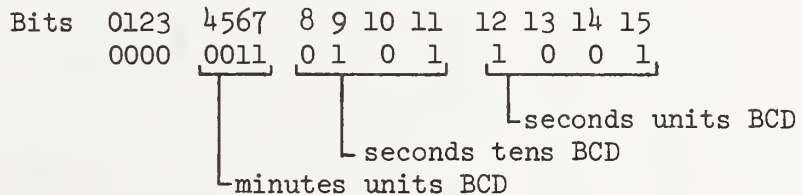
The above example has channel 2 raw data equal to 385.

DOT 15,2

sends 16 bits of data from CPU accumulator to 4 digit hexadecimal display. (Use software to convert binary numbers to decimal BCD** numbers for ordinary base 10 displays)

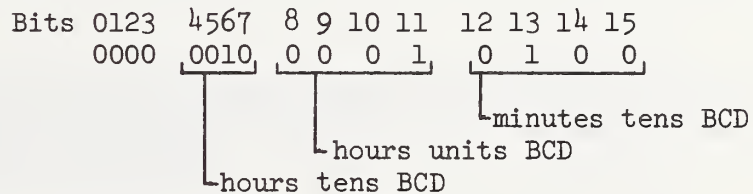
DIN 15,3

send 16 bits of clock data to CPU accumulator



DIN 15,4

send 16 bits of clock data to CPU accumulator



The above time of day example = 21:43:59.

DOT 6,1

send data request to real time analyzer (RTA)

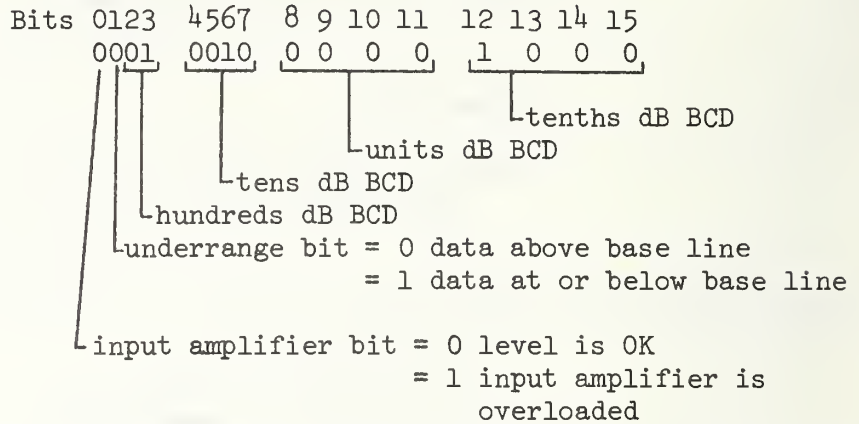
Table 1 Interface Software Commands (Con't)

Raytheon 704 Command

Effect or Results

DIN 6,1

send 16 bits of RTA data to CPU accumulator



The above example shows 120.8 dB for the particular channel digitized by the RTA

* CPU stands for Central Processing Unit

**BCD stands for Binary Coded Decimal

4.2. FORTRAN Software for the Analysis of Community Noise Data

The analysis of the community noise tapes produced by the minicomputer-based data acquisition system is most satisfactorily performed on a large computer system with a high speed printer and digital plotter capability. The main programs and subroutines discussed in this section were specifically written for the Univac 1108 computer system at the National Bureau of Standards but can be adopted for use in almost any large scale system. The software described herein utilizes three utility packages available on the Univac 1108 system, "NTRAN", "ATTINT", and "GDS" plotting package, for which detailed documentation was supplied to BAD as part of the operating system.

4.2.1. Nine-track Tape Translation Program

a. Purpose

This program is designed to translate nine-track magnetic tapes written by the 704 Raytheon computer using the Raytheon FORTRAN unformatted write statement. (See program listings in Appendix D.)

In addition to translation of the nine-track tapes, the program also bins the data into selected sound pressure levels with a choice of bin size and range, calculates L_1 , L_{10} , L_{50} , L_{90} , L_{99} and L_{eq} and lists the results on a line printer. L_j is that level which is exceeded j percent of the time while L_{eq} is the equivalent sound level averaged on an energy basis.

$$L_{eq} = 10 \log_{10} \left(\frac{\sum_{i=1}^n 10^{SPL(i/10)}}{N} \right)$$

where $SPL(i)$ are the sound pressure levels
and N is the total number of data points.

If desired all or part of any block of data can be printed for examination.

b. Control Cards

There are a total of three control cards required which allow (a) choice of bin size and range, (b) choice of the portion of the tape to analyze and (c) choice of data to be displayed.

Card 1: IBEG, IEND, IDEL

Format is free, i.e., numbers separated by commas. All formats are of this type unless stated otherwise.

IBEG is the lower bound of range.

IEND is the upper bound of range.

IDEL is the step size within the range,
e.g., 40, 80, 2 means that the data will be binned
in 20 bins from 40 to 80 dB in 2 dB bins.

Card 2: DAYST, HRST, MINST, DAYFIN, HRFIN, MINFIN

First three are the starting day, hour, minute.
Second three are the finishing day, hour, minute.
e.g. 209, 19, 1, 209, 19, 2 will result in two blocks
of data being read into memory.

Card 3: ICTRL

Legal values are:

- 0 No listing of the blocks of data.
- 1 List each control section (1201-1224)
- 2 List entire 1224 word block

Caution: Use option 2 with care as large amounts of out-
put can be generated.

Note: Each block represents 1 minute of data taken every
0.1 second for two microphones. These 1200 data points
are the first 1200 words of the block. In addition there
is a 24 word control section at the end of each block
giving information pertinent to the block. The output of
the program is self explanatory with the exception that
each time a read problem occurs (a parity error) -3 is
printed and that block is ignored. Also if control word
1207 in the control section is non zero that block is
skipped.

c. Subroutines

The program utilizes 3 subroutines for reading, translating and inter-
polating the data.

- 1) Reading of the nine-track tapes is accomplished by a routine
called RDUNPK which in turn calls the Univac routine NTRAN
(described below). RDUNPK (M,N) contains two transfer
arguments (M,N). M is the unit number assigned to the tape at
execution. N is the status word described in the NTRAN guide.
This routine uses NTRAN to read blocks of integers from tape
(see below). The 16 digit Raytheon integers are unpacked from
the 36 digit Univac words. (The Raytheon integers enter the
Univac memory sequentially in 8 bit "bytes" two bytes per
integer.) This subroutine is listed in Appendix D under the
Nine-track Tape Translation Program.
- 2) NTRAN is a Univac 1108 Fortran library routine used to read
blocks of data from tape or drum.

- 3) AITINT - is an interpolation program available in the Univac 1108 Math-Pack Library. This program is included with the main program on cards but can be accessed from the fastran drum system at execution time if desired.

4.2.2. Calcomp Plot Program

a. Purpose

Given a specified starting day and hour, this program searches the tape for the starting block; then it calculates L_1 , L_{10} , L_{50} , L_{90} , L_{99} and L_{eq} for a specified number of hours (minimum two hours). The six quantities are plotted as a function of time on a simple graph. Each plot contains the data points connected by solid straight lines. Up to a maximum of 100 hours of data can be plotted.

b. Control Cards

Card 1: IBERG, IEND, IDEL

Same interpretation as in Section 4.2.1.a.

Card 2: DAYST, HRST, NHR
Format I6 and Right Justified

These are the starting day and hour. Calculation begins with first good data block in the specified hour and continues for NHR number of hours.

c. Subroutines

This program utilizes RDUNPK, NTRAN, and AITINT which are described in Section 4.1.1. In addition the graphical display system (GDS) subroutines are used. These include: GDLILI, NODLIB, NODLIL, TITLEB, TITLEL, TITLEG, PSLILI, SLLILI, NXTFRM, and GDSEND.

5. APPENDIX A. PROGRAM LISTINGS AND FLOW CHARTS FOR CONVERSATIONAL FORTRAN CALIBRATION AND COMMUNITY NOISE PROGRAMS.

Appendix A contains flow charts for the "CHECK" and "NOISE" programs. It also contains program listings for the "CHECK", "TOGGLE", "ORTH", and "NOISE" programs.

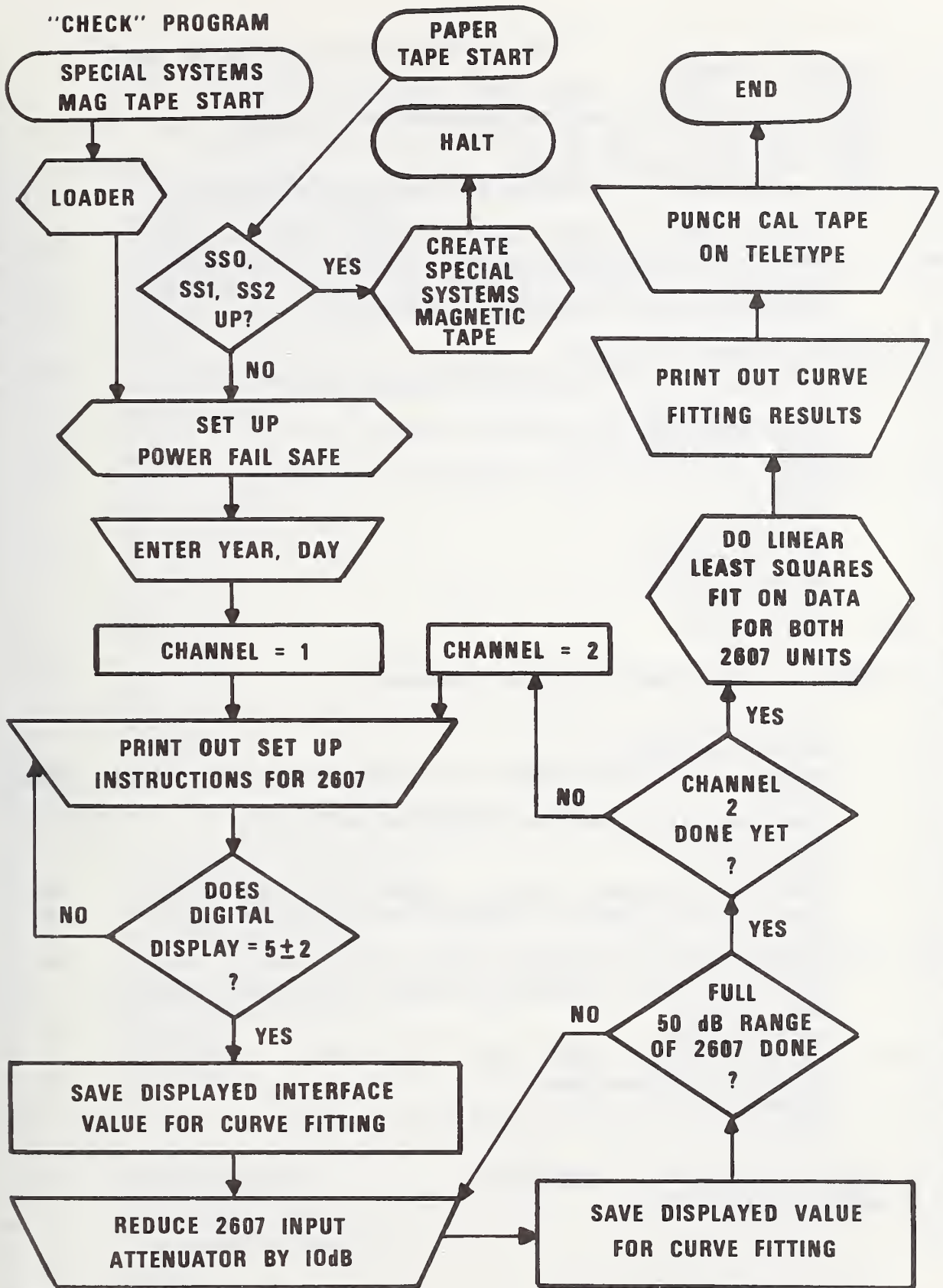


Figure A-1. Flow diagram for "CHECK" program.

```

1 C 1/3/75:1 'CHECK'
2 C PROGRAM IS USED TO CHECK THE LINEARITY OF THE
3 C 2607 ADC INTERFACE SYSTEM AND PRODUCE A PAPER
4 C TAPE CONTAINING THE DATE, TIME, AND THE FACTOR
5 C RELATING ADC VALUES TO DB.
6 C THIS PAPER TAPE IS READ BY THE 'NOISE' PROGRAM.
7 C
8     LOCATE STEM1,X'2730',DATA,X'2800',POWF5,X'2890'
9     LOCATE INTL,X'29E0',LEADR,X'2A20',CLOK,X'2A70'
10    DIMENSION JXX(2,7),XX(2,7),Y(7),X(7),JY(7),CZ(2)
11    DIMENSION YC1(7),DBER1(7),DBER2(7)
12 C
13 C SET UP POWER FAIL SAFE
14 C STEM1 ALLOWS CREATION OF SPECIAL SYSTEM MAG TAPE
15 C
16     CALL STEM1(0)
17     CALL POWF5(NPF)
18     NP=5
19     JZ=0
20     JBOT=5
21     JBOT1=JBOT-2
22     JBOT2=JBOT+2
23     DO 101 J=1,NP
24     JY(J)=J*10
25 101  Y(J)=JY(J)
26 C
27 C CHECK IF ANY POWER FAILURES OCCURED
28 C
29     IF(NPF)3,3,2
30 2    WRITE(3,4)NPF
31 4    FORMAT(3/,'THERE WERE',15,' POWER FAILURES, RELOAD CHECK')
32     PAUSE
33 3    KK=ISWCH(0)+ISWCH(1)+ISWCH(2)+ISWCH(3)+1
34     GO TO(8,5),KK
35 5    WRITE(3,6)
36 6    FORMAT(3/,'PLEASE PUT ALL SENSE SWITCHES DOWN')
37 7    KK=ISWCH(0)+ISWCH(1)+ISWCH(2)+ISWCH(3)+1
38     GO TO(8,7),KK
39 8    WRITE(3,9)
40 9    FORMAT(3/,'SET INTERFACE CLOCK TO CORRECT TIME')
41     CALL TOGLE
42     WRITE(3,70)
43 70   FORMAT('ENTER YEAR DAY      (ON SAME LINE)')
44     READ(3,71)JYEAR,JDAY
45 71   FORMAT(FF)
46     JCH=1
47 C
48 C SET UP LINKAGE TO INTERFACE
49 C ENABLE INTERRUPT 5
50 C

```

```

51      CALL DATA(JWIND, JRAW1, JRAW2, JCH)
52      CALL INTL(5,2)
53 C
54 C BEGIN 2607 - INTERFACE SYSTEM CHECK
55 C
56 27      WRITE(3,10)JCH
57 10      FORMAT(3/, 'CHANNEL', 12, ' CHECK')
58          IF(JCH-1)100,100,102
59 100      WRITE(3,11)
60 11      FORMAT('USE 50 MV INTERNAL REFERENCE AS ONLY INPUT TO 2607')
61 102      WRITE(3,12)
62 12      FORMAT('SET 2607 INPUT ATTENUATOR TO 3.0 VOLTS')
63          IF(JCH-1)103,103,13
64 103      WRITE(3,95)
65 95      FORMAT('SET 2607 OUTPUT ATTENUATOR TO X1 POSITION')
66          WRITE(3,96)
67 96      FORMAT('SET 2607 OUTPUT SWITCHES TO LOG AND DC')
68 13      WRITE(3,14)JBOT
69 14      FORMAT('ADJUST 2607 VARIABLE GAIN SO DIGITAL DISPLAY =', 13)
70          CALL TOGLE
71          GO TO(15,16), JCH
72 15      JR=JRAW1
73          A=JR
74          JADC1=JR
75          XADC1=A
76          GO TO 17
77 16      JR=JRAW2
78          A=JR
79          JADC2=JR
80          XADC2=A
81 17      JA=A
82 C
83 C CONTINUE IF DISPLAY IS NEARLY = JBOT
84 C
85          IF(JA-JBOT1)13,18,18
86 18      IF(JA-JBOT2)19,19,13
87 19      DO 24 J=1,NP
88          WRITE(3,20)JCH
89 20      FORMAT('REDUCE 2607 INPUT ATTENUATOR BY 10 DB (CHAN', 12, ')')
90          CALL TOGLE
91          GO TO(21,22), JCH
92 21      A=JRAW1
93          GO TO 23
94 22      A=JRAW2
95 C
96 C SAVE DATA FOR PRINTOUT & LEAST SQUARES FIT
97 C
98 23      JXX(JCH, J)=A
99          XX(JCH, J)=A
100 24      CONTINUE
101          IF(JCH-2)25,26,26
102 25      JCH=2
103          GO TO 27
104 26      DO 31 J=1,NP
105 31      X(J)=XX(1, J)
106 C

```

```

107 C DO 1ST ORDER FIT ON CHANNEL 1 DATA
108 C
109     CALL ORTH(X(1),Y(1),CZ(1),YC1(1),ER,1,JRD,1,0,NP,0.)
110     DO 32 J=1,NP
111 32     DBER1(J)=YC1(J)-Y(J)
112     FACT1=CZ(2)
113     CON1=CZ(1)
114     DO 33 J=1,NP
115 33     X(J)=XX(2,J)
116 C
117 C DO 1ST ORDER FIT ON CHANNEL 2 DATA
118 C
119     CALL ORTH(X(1),Y(1),CZ(1),YC1(1),ER,1,JRD,1,0,NP,0.)
120     DO 34 J=1,NP
121 34     DBER2(J)=YC1(J)-Y(J)
122     FACT2=CZ(2)
123     CON2=CZ(1)
124     YDB1=CON1+XADC1*FACT1
125     YDB2=CON2+XADC2*FACT2
126 C
127 C DETERMINE TIME FROM CLOCK
128 C
129     CALL CLOK(JH, JM, JS)
130 C
131 C BEGIN PRINTOUT OF LINEARITY CHECK
132 C
133     WRITE(3,45)
134 45     FORMAT(15/)
135     WRITE(3,46)
136 46     FORMAT('2607 - INTERFACE NOISE SYSTEM LINEARITY CHECK')
137     WRITE(3,47)JYEAR, JDAY
138 47     FORMAT(/,53X,'YEAR   =',15,/,53X,'DAY     =',15)
139     WRITE(3,48)JH, JM
140 48     FORMAT(53X,'HOUR    =',15,/,53X,'MINUTE =',15)
141     WRITE(3,49)
142 49     FORMAT(6X,'2607',4X,'CH1',5X,'CH2',5X,'CH1',5X,'CH2')
143     WRITE(3,50)
144 50     FORMAT(7X,'DB',5X,'ADC',5X,'ADC',5X,'DB',6X,'DB')
145     WRITE(3,51)
146 51     FORMAT(13X,'VALUE',3X,'VALUE',4X,'DIFF',4X,'DIFF',/)
147     WRITE(3,110)JZ, JADC1, JADC2, YDB1, YDB2
148 110    FORMAT(4X,15,3X,15,3X,15,F9.2,F8.2,' (0 DB VALUE NOT USED)')
149     DO 52 J=1,NP
150 52     WRITE(3,53)JY(J), JXX(1,J), JXX(2,J), DBER1(J), DBER2(J)
151 53     FORMAT(4X,15,3X,15,3X,15,F9.2,F8.2)
152     WRITE(3,54)FACT1
153 54     FORMAT(3/,6X,'CH1 DB = CONSTANT +',E13.5,2X,'* (ADC VALUE)')
154     WRITE(3,55)FACT2
155 55     FORMAT(6X,'CH2 DB = CONSTANT +',E13.5,2X,'* (ADC VALUE)')
156     WRITE(3,40)
157 40     FORMAT(3/,TURN ON PUNCH, TOGGLE SENSE SWITCH 0')
158 80     KK=ISWCH(0)+1
159     GO TO(80,81),KK
160 81     KK=ISWCH(0)+1
161     GO TO(82,81),KK
162 C

```

```
1 63 C PUNCH LEADER, PUNCH NUMBERS, PUNCH LEADER
1 64 C
1 65 82 CALL LEADR
1 66 WRITE(3,41)JYEAR, JDAY, JH, JM, FACT1, FACT2
1 67 41 FORMAT(I5, I4, I3, I3, 1X, E13.5, 1X, E13.5)
1 68 CALL LEADR
1 69 IF(NPF)60,60,2
1 70 60 WRITE(3,42)
1 71 42 FORMAT('TURN OFF PUNCH, TOGGLE SENSE SWITCH 0 TO RESTART')
1 72 WRITE(3,90)
1 73 90 FORMAT('CHECK OUT IS COMPLETED. USE PAPER TAPE IN NOISE')
1 74 WRITE(3,91)
1 75 91 FORMAT('PROGRAM IF ABOVE RESULTS ARE SATISFACTORY.',3/)
1 76 85 KK=ISWCH(0)+1
1 77 GO TO(85,86),KK
1 78 86 KK=ISWCH(0)+1
1 79 GO TO(3,86),KK
END
```

```

1 C 12/11/74:1 'TOGGLE'
2 C PRINTS OUT 'TOGGLE SENSE SWITCH 0 MESSAGE'
3 C AND RETURNS TO MAIN PROGRAM WHEN SENSE
4 C SWITCH 0 IS TOGGLED. (IE. UP & DOWN)
5 C
6     SUBROUTINE TOGLE
7     WRITE(3,1)
8 1   FORMAT(5X, '(TOGGLE SENSE SWITCH 0 WHEN ABOVE IS OK)',3/)
9 2   KK=ISWCH(0)+1
10  GO TO(2,3),KK
11 3   KK=ISWCH(0)+1
12  GO TO(4,3),KK
13 4   RETURN
     END

```

```

1 C 11/12/74:8 'ORTH'
2 C
3     SUBROUTINE ORTH(X,Y,CZ,YC1,ERROR,NHIGH,JRD,KT,NOR,NP,SG)
4     DIMENSION CP1(10),CP2(10),CP3(10),CP4(10),CX(10)
5     DIMENSION PV1(50),PV2(50),SS(50)
6     DIMENSION CZ(10),X(50),Y(50),YC1(50)
7 C
8 C ABOVE DIMENSIONS ALLOW FITTING UP TO
9 C X**9 ORDER AND UP TO 50 DATA POINTS.
10 C
11 C IN MAIN PROGRAM DIMENSION CZ(10),X(50),Y(50),YC1(50)
12 C
13     BONE=1.
14     ZERO=0.
15 C
16 C X IS AN ARRAY CONTAINING VALUES OF THE INDEPENDENT VARIABLE.
17 C Y IS AN ARRAY CONTAINING VALUES OF THE DEPENDENT VARIABLE.
18 C CZ IS AN ARRAY CONTAINING CURVE FITTING MONOMIAL COEFFICIENTS.
19 C ERROR IS THE STANDARD DEVIATION OF (Y-OBSERVED - YFIT)
20 C NHIGH IS HIGHEST FITTING ORDER IF SUBROUTINE IS REQUESTED
21 C     TO DO COMPLETE FIT ON ONE CALL. (IE. KT NOT = 0)
22 C JRD IS PRESENT ORDER OF FIT. ON SINGLE PASS MODE (KT = 0)
23 C     SET JRD = 0 ON FIRST PASS.
24 C KT = 0 FOR EXIT ON EACH PASS. KT NOT = 0 IN MULTIPASS MODE.
25 C NOR = 0 FOR ORDINARY ORTHOGONAL FIT. NOR = 1 FOR ODD POWER
26 C     ORTHOGNAL FIT. NOR = 2 FOR EVEN POWER ORTHOGONAL FIT.
27 C NP IS THE NUMBER OF DATA POINTS TO BE FITTED.
28 C SG IS DESIRED ERROR OF FIT TEST. IF KT NOT = 0 THE PROGRAM
29 C     EXITS WHEN EITHER JRD = NHIGH OR WHEN ERROR = SG OR LESS.
30 C YC1 IS AN ARRAY CONTAINING POLYNOMIAL VALUES FOR Y (NO NEED
31 C     FOR USER TO DIRECTLY EVALUATE TOTAL POLYNOMIAL TO
32 C     OBTAIN YFIT)
33 C FOR THE BEST ACCURACY OF FIT THE VALUES OF X SHOULD BE
34 C     BETWEEN -2.0 AND +2.0 (IE. TRANSFORM INDEPENDENT
35 C     VARIABLE TO -2.0 +2.0 RANGE BEFORE CALLING SUB ORTH.)
36 C
37     JJM1=NP
38     AM=NP
39     KORD=NHIGH+1
40     IF(KT)703,704,703
41 703     JRD=0
42 704     IF(JRD-1)400,301,302
43 C
44 C ZEROING COEFFICIENTS
45 C
46 400     DO 54 J=1,KORD
47         CP1(J)=ZERO
48         CP2(J)=ZERO
49         CP3(J)=ZERO
50         CP4(J)=ZERO
51         CZ(J)=ZERO
52 54     CX(J)=ZERO
53         S=ZERO

```

```

54 C
55 C PART 1 FINDING P OF ORDER ZERO
56 C
57 CP3(1)=BONE
58 S1=ZERO
59 DO 56 J=1, JJM1
60 IF(NOR-1)500,501,500
61 501 PV1(J)=X(J)
62 Z=Y(J)*X(J)
63 GO TO 502
64 500 PV1(J)=BONE
65 WN=AM
66 Z=Y(J)
67 502 S=S+Z
68 56 S1=S1+Y(J)*Y(J)
69 IF(NOR-1)503,504,503
70 504 S2=ZERO
71 DO 506 J=1, JJM1
72 506 S2=S2+X(J)*X(J)
73 WN=S2
74 503 B=S/WN
75 DO 325 J=1, JJM1
76 325 YC1(J)=B
77 CX(1)=B
78 U=S1-B*B*WN
79 Z=U/AM
80 Z=ABS(Z)
81 SN=SQRT(Z)
82 Z=U/(AM-BONE)
83 Z=ABS(Z)
84 SPOLY=SQRT(Z)
85 Z=SQRT(WN)
86 SCO=SPOLY/Z
87 JRD=1
88 JRDM1=0
89 JGO=1
90 GO TO 100
91 C
92 C PART 2 FINDING P OF ORDER 1
93 C
94 301 CONTINUE
95 S=ZERO
96 DO 57 J=1, JJM1
97 IF(NOR-1)507,508,630
98 630 Z=X(J)
99 S=S+Z*Z
100 GO TO 57
101 508 Z=X(J)
102 S=S+Z*Z*Z*Z
103 GO TO 57
104 507 S=S+X(J)
105 57 CONTINUE
106 AL=S/WN
107 S=ZERO
108 S1=ZERO
109 CP2(1)=CP3(1)
110 CP3(2)=BONE

```



```

1 11      CP3(1)=-AL
1 12      WO=WN
1 13      DO 58 J=1, JJM1
1 14      IF(NOR-1)509,510,631
1 15 631   Z=X(J)
1 16      Z=Z*Z-AL
1 17      GO TO 511
1 18 510   Z=X(J)
1 19      Z=Z*Z*Z-AL*Z
1 20      GO TO 511
1 21 509   Z=X(J)-AL
1 22 511   PV2(J)=Z
1 23      S=S+Z*Z
1 24 58    S1=S1+Y(J)*Z
1 25      WN=S
1 26      B=S1/WN
1 27      DO 326 J=1, JJM1
1 28 326   YC1(J)=YC1(J)+B*PV2(J)
1 29      CX(1)=CX(1)+CP3(1)*B
1 30      CX(2)=B
1 31      BT=WN/WO
1 32      U=U-B*B*WN
1 33      Z=U/AM
1 34      Z=ABS(Z)
1 35      SN=SQRT(Z)
1 36      Z=U/(AM-2.)
1 37      Z=ABS(Z)
1 38      SPOLY=SQRT(Z)
1 39      Z=SQRT(WN)
1 40      SCO=SPOLY/Z
1 41      JRD=2
1 42      JRDM1=1
1 43      JGO=2
1 44      GO TO 100
1 45 C
1 46 C PART 3 FINDING P OF ORDER JRD - 1
1 47 C
1 48 302   JRD=JRD+1
1 49      BORD=JRD
1 50      JRDM1=JRD-1
1 51      JRDM2=JRD-2
1 52      S=ZERO
1 53      DO 61 J=1, JJM1
1 54      Z=PV2(J)
1 55      IF(NOR-1)512,513,513
1 56 513   S2=X(J)
1 57      S=S+S2*S2*Z*Z
1 58      GO TO 61
1 59 512   S=S+X(J)*Z*Z
1 60 61    CONTINUE
1 61      AL=S/WN
1 62      S=ZERO
1 63      S2=ZERO
1 64      DO 62 J=1, JRDM2
1 65 62    CP1(J)=CP2(J)
1 66      DO 63 J=1, JRDM1
1 67 63    CP2(J)=CP3(J)

```

```

168 DO 308 J=1, JRD
169 308 CP3(J)=ZERO
170 DO 64 J=1, JRDM2
171 64 CP3(J)=-CP1(J)*BT
172 DO 65 J=1, JRDM1
173 65 CP3(J)=CP3(J)-AL*CP2(J)
174 DO 66 J=2, JRD
175 66 CP3(J)=CP3(J)+CP2(J-1)
176 WO=WN
177 DO 68 J=1, JJM1
178 Z=X(J)
179 IF(NOR-1)514,515,515
180 515 Z=Z*Z
181 514 S1=-BT*PV1(J)+(Z-AL)*PV2(J)
182 S=S+S1*S1
183 S2=S2+Y(J)*S1
184 PV1(J)=PV2(J)
185 68 PV2(J)=S1
186 WN=S
187 B=S2/WN
188 DO 327 J=1, JJM1
189 327 YC1(J)=YC1(J)+B*PV2(J)
190 DO 67 J=1, JRD
191 67 CX(J)=CX(J)+CP3(J)*B
192 BT=WN/WO
193 U=U-B*B*WN
194 Z=U/AM
195 Z=ABS(Z)
196 SN=SQRT(Z)
197 Z=U/(AM-BORD)
198 Z=ABS(Z)
199 SPOLY=SQRT(Z)
200 Z=SQRT(WN)
201 SCO=SPOLY/Z
202 JGO=3
203 GO TO 100
204 C
205 C SETTING UP ORDINARY, ODD, OR EVEN ORTHOGONAL COEFFICIENTS
206 C AND THEIR MONOMIALS
207 C
208 100 S=ZERO
209 DO 328 J=1, JJM1
210 SS(J)=Y(J)-YC1(J)
211 328 S=S+SS(J)
212 AVYC=S/AM
213 S=ZERO
214 DO 329 J=1, JJM1
215 329 S=S+(AVYC-SS(J))*(AVYC-SS(J))
216 ERROR=SQRT(S/AM)
217 IF(KT)700,621,700
218 700 IF(JRD-KORD)701,621,621
219 701 IF(ERROR-SG)621,621,702
220 702 GO TO (301,302,302),JGO
221 621 IF(NOR-1)516,517,518
222 516 JORD=JRD
223 DO 519 J=1, JRD
224 CP4(J)=CP3(J)

```

```

225 519 CZ(J)=CX(J)
226      GO TO 520
227 517 JORD=JRD*2
228      DO 521 J=1, JORD
229      K=(J+1)/2
230      IF(J-2*(J/2))522, 522, 521
231 522 CZ(J)=CX(K)
232      CP4(J)=CP3(K)
233 521 CONTINUE
234      GO TO 520
235 518 JORD=JRD*2-1
236      DO 523 J=1, JORD
237      K=(J+1)/2
238      IF(J-2*(J/2))523, 523, 524
239 524 CZ(J)=CX(K)
240      CP4(J)=CP3(K)
241 523 CONTINUE
242 520 CONTINUE
243      RETURN
      END

```

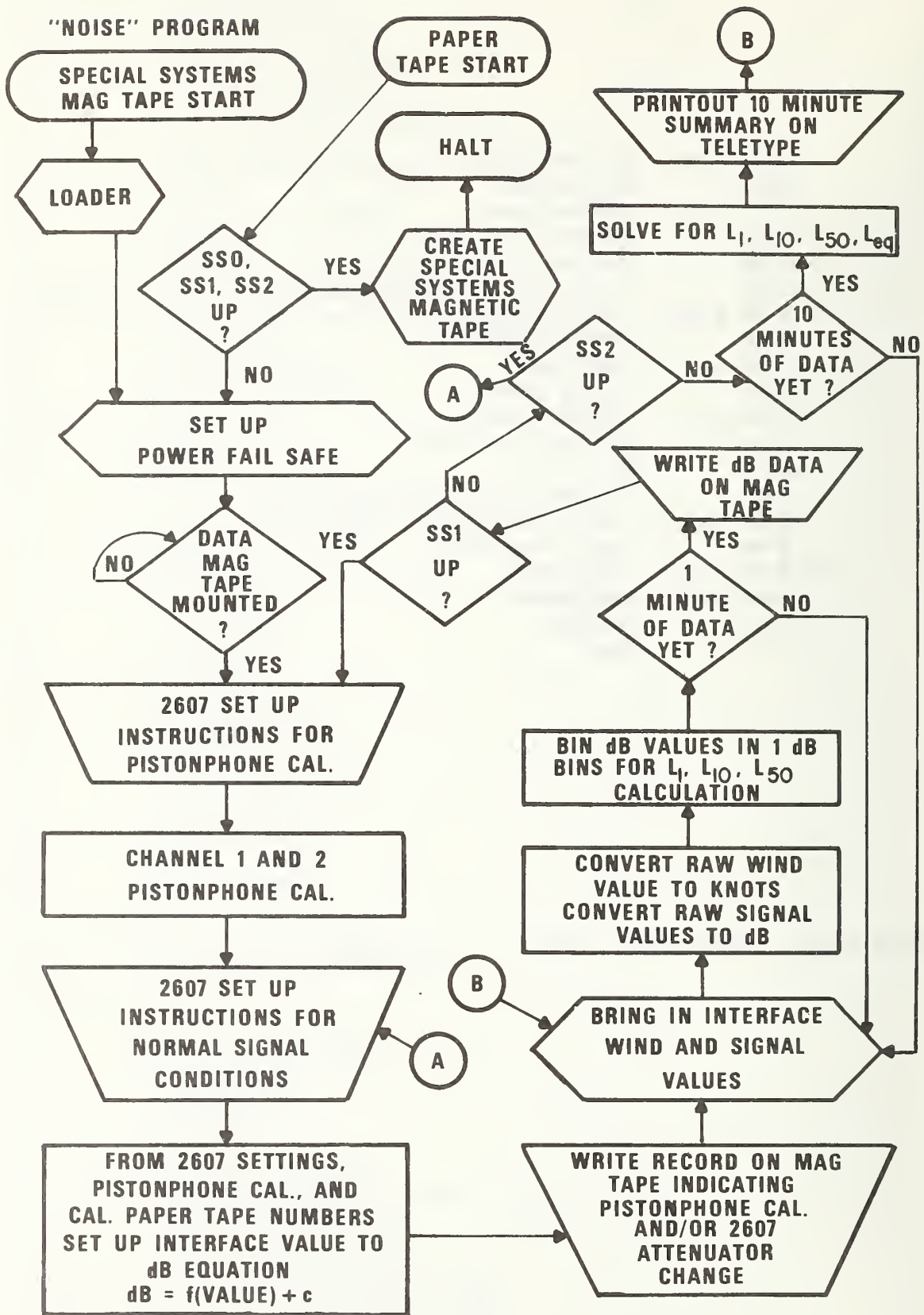


Figure A-2. Flow diagram for "NOISE" program.

```

1 C 1/23/75:4 'NOISE'
2 C THE PROGRAM CONDUCTS A TWO CHANNEL COMMUNITY
3 C NOISE SURVEY BY SAMPLING TWO DATA CHANNELS OF
4 C ENVIRONMENTAL NOISE AND A OPTIONAL WIND CHANNEL
5 C AT A 10 HZ RATE. ONCE A MINUTE THE NOISE DATA AND
6 C THE MAXIMUM WIND VALUE ARE DUMPED ON TO THE MAGNETIC
7 C TAPE UNIT FOR LATER ANALYSIS ON A UNIVAC 1108 COMPUTER.
8 C THE PROGRAM WILL PRINTOUT L1, L10, L50, LEQ,
9 C AND MAXIMUM WIND SPEED EVERY 10 MINUTES ON THE TELETYPE.
10 C
11 LOCATE STEMI,X'2730',DATA,X'2800',LFD,X'2870',POWF5,X'2890'
12 LOCATE MULTI,X'291B',MMON,X'299B',DMAMAG,X'29C0'
13 LOCATE INTL,X'29E0',DISP,X'2A20',CLOK,X'2A70'
14 DIMENSION K(1224),KPA(111),KPB(111)
15 C
16 C K(1) TO K(1200) VERY SOON AFTER EACH ELEMENT IS FILLED WITH
17 C AN ADC VALUE (VIA INTERRUPT LEVEL 5) IT IS
18 C CONVERTED TO DB.
19 C K(1201) = DAY
20 C K(1202) = HOUR
21 C K(1203) = MINUTE
22 C K(1204) = SECOND IMMEDIATELY AFTER RECEIVING & CONVERTING
23 C K(1200) VALUE AND JUST BEFORE WRITING ALL 1224
24 C NUMBERS ON MAG TAPE.
25 C K(1205) = NUMBER OF POWER FAILURES IN JUST THE PAST MINUTE.
26 C K(1206) = PROGRAM VERSION NUMBER
27 C K(1207) = 0 K ARRAY RECORD ON MAG TAPE CONTAINS REGULAR DB DATA
28 C = 1 RECORD ON MAG TAPE INDICATES PISTONPHONE CAL
29 C = 2 RECORD ON MAG TAPE INDICATES JUST 2607 ATTENUATOR
30 C CHANGE
31 C K(1208) = MAG TAPE ID NUMBER
32 C K(1209) = HIGHEST WIND SPEED IN KNOTS FOR THE PAST MINUTE.
33 C K(1210) = NUMBER OF CHANNEL ID ERRORS GENERATED BY INTERFACE.
34 C K(1211) = NUMBER OF MISSING DATA VALUES CAUSED BY OVERFLOWING
35 C FIFO MEMORY.
36 C K(1212) = CHANNEL 1 PISTONPHONE VALUE * 10. USING NEXT TO LAST
37 C CAL VALUE. (SHOWS CHANNEL 1 SYSTEM DRIFT)
38 C K(1213) = CHANNEL 2 PISTONPHONE VALUE * 10. USING NEXT TO LAST
39 C CAL VALUE. (SHOWS CHANNEL 2 SYSTEM DRIFT)
40 C K(1214) = YEAR
41 C K(1215) TO K(1224) = 0 (NOT USED)
42 DO 460 J=1215,1224
43 460 K(J)=0
44 C
45 C STEMI ALLOWS CREATION OF SPECIAL SYSTEM MAG TAPE.
46 C POWF5 SETS UP POWER FAIL SAFE.
47 C

```

```

48      CALL STEM1(1)
49      CALL POWF5(NPF)
50      ALGC=1./ALOG(10.)
51 C
52 C NFIL + 17 = NUMBER OF LINES PER PAGE IN PRINTOUT.
53 C PCAL = PISTONPHONE DB VALUE.
54 C
55      NFIL=34
56      NTIME=0
57      M=0
58      N=0
59      PCAL=124.
60      JPG=1
61      WRITE(3,220)
62 220  FORMAT(3/, 'PUT SS1 UP FOR PISTONPHONE CAL. (NOT NOW)')
63      WRITE(3,25)
64 25   FORMAT('PUT SS2 UP TO CHANGE 2607 SETTINGS. (NOT NOW)')
65      KK=ISWCH(0)+ISWCH(1)+ISWCH(2)+ISWCH(3)+1
66      GO TO(340,341),KK
67 341  WRITE(3,342)
68 342  FORMAT(3/, 'PLEASE PUT ALL SENSE SWITCHES DOWN.')
69 343  KK=ISWCH(0)+ISWCH(1)+ISWCH(2)+ISWCH(3)+1
70      GO TO(340,343),KK
71 340  JWAY=0
72      WRITE(3,73)
73 73   FORMAT(2/, 'SET INTERFACE CLOCK TO CORRECT TIME.')
74      CALL TOGLE
75      WRITE(3,138)
76 138  FORMAT('ENTER YEAR DAY TAPE# (3 NUMBERS ON ONE LINE)')
77      READ(3,4)JYEAR,JDAY,NTAPE
78 4    FORMAT(FF)
79      K(1208)=NTAPE
80      K(1214)=JYEAR
81      CALL CLOK(JHR,JMIN,JSEC)
82      JHOLD=JHR
83      WRITE(3,270)
84 270  FORMAT(3/, 'TURN ON HIGH SPEED PAPER TAPE READER.')
85      WRITE(3,271)
86 271  FORMAT('PUT CAL TAPE (FROM CHECK PROGRAM) IN READER.')
87      CALL TOGLE
88 C
89 C READ CAL TAPE TO OBTAIN SLOPE OF LINEAR TRANSFER FUNCTION
90 C RELATING DB TO ADC VALUE.
91 C
92      READ(4,4)JYRC,JDC,JHC,JMC,FACT1,FACT2
93      WRITE(3,272)
94 272  FORMAT('TURN OFF HIGH SPEED PAPER TAPE READER.')
95      WRITE(3,7)
96 7    FORMAT(3/, 'MOUNT DATA TAPE & BRING TO LOAD POINT & ON LINE.')
97 207  CALL DMAMAG(MAG)
98      MAGG=MAG
99      IF(MAG-3)207,135,207
100 135  WRITE(3,240)
101 240  FORMAT(3/, 'DO THE FOLLOWING FOR BOTH 2607 UNITS.')

```

```

102      WRITE(3,241)
103 241  FORMAT(3X,'SET VARIABLE GAIN CONTROL TO CAL POSITION.')
```

```

104      WRITE(3,242)
105 242  FORMAT(3X,'SET OUTPUT ATTENUATOR TO X1 POSITION.')
```

```

106      WRITE(3,243)
107 243  FORMAT(3X,'A WT. BUTTON SHOULD BE OUT.')
```

```

108      WRITE(3,244)
109 244  FORMAT(3X,'50 MV INTERNAL REFERENCE BUTTON SHOULD BE OUT.')
```

```

110      WRITE(3,280)
111 280  FORMAT(3X,'SET 2607 OUTPUTS TO LOG, DC, RMS, & .1 SEC.')
```

```

112      CALL TOGLE
113      WRITE(3,245)
114 245  FORMAT('PUT PISTONPHONE ON CHANNEL 1.')
```

```

115      WRITE(3,246)
116 246  FORMAT('OBTAIN 44 DB METER READING BY ADJUSTING')
```

```

117      WRITE(3,248)
118 248  FORMAT(3X,'INPUT ATTENUATOR & SENSITIVITY SCREW.')
```

```

119      WRITE(3,247)
120 247  FORMAT('REPEAT ABOVE FOR CHANNEL 2.')
```

```

121      CALL TOGLE
122 295  WRITE(3,281)
123 281  FORMAT('HAVE A WT. BUTTON OUT ON BOTH 2607 UNITS.')
```

```

124      WRITE(3,250)
125 250  FORMAT('PUT PISTONPHONE ON CH 1, HAVE METER READ ABOUT 44 DB.')
```

```

126      CALL DATA(JXX,JRAW1,JRAW2,3)
127      CALL INTL(5,2)
128      WRITE(3,251)
129 251  FORMAT('ENTER ATTENUATOR SETTING WHILE PISTONPHONE IS ON.')
```

```

130      READ(3,4)PSET1
131      AJR1=JRAW1
132      K(1207)=1
133      OCON1=CON1
134      CON1=PCAL-FACT1*AJR1
135      DB=CON1+FACT1*AJR1
136      KKDA=DB*10.
137      CALL DISP(KKDA,0)
138      WRITE(3,252)
139 252  FORMAT('PUT PISTONPHONE ON CH 2, HAVE METER READ ABOUT 44 DB.')
```

```

140      WRITE(3,253)
141 253  FORMAT('ENTER ATTENUATOR SETTING WHILE PISTONPHONE IS ON.')
```

```

142      READ(3,4)PSET2
143      AJR2=JRAW2
144      OCON2=CON2
145      CON2=PCAL-FACT2*AJR2
146      DB=CON2+FACT2*AJR2
147      KKDB=DB*10.
148      CALL DISP(KKDB,0)
149      K(1212)=KKDA
150      K(1213)=KKDB
151      IF(JWAY)262,263,262
152 262  DBLD1=OCON1+FACT1*AJR1
153      DBLD2=OCON2+FACT2*AJR2
```

```

154 C
155 C CALCULATE SYSTEM DRIFT IN DB FROM PREVIOUS PISTONPHONE READING.
156 C
157     DRFT1=DBLD1-PCAL
158     DRFT2=DBLD2-PCAL
159     K(1212)=DBLD1*10.
160     K(1213)=DBLD2*10.
161     M=M+8
162     WRITE(3,265)DRFT1,DRFT2
163 265   FORMAT('CH 1 DRIFT =',F8.2,' DB   CH 2 DRIFT =',F8.2,' DB')
164 263   JWAY=1
165 311   WRITE(3,290)
166 290   FORMAT('A WT BUTTON IN, NORMAL NOISE SIGNAL CONDITIONS.')
167     WRITE(3,291)
168 291   FORMAT('ENTER ATTENUATOR SETTINGS (BOTH ON ONE LINE)')
169     READ(3,4)SET1,SET2
170     NTIME=NTIME+1
171     IF(K(1207))355,356,355
172 356   K(1207)=2
173 355   M=M+4
174     DW1=20.*(ALOG(PSET1/SET1))*ALGC
175     DW2=20.*(ALOG(PSET2/SET2))*ALGC
176     ADW1=ABS(DW1)+.5
177     ADW2=ABS(DW2)+.5
178     JDW1=ADW1
179     JDW2=ADW2
180     IF(DW1)450,451,451
181 450   JDW1=-JDW1
182 451   IF(DW2)452,453,453
183 452   JDW2=-JDW2
184 453   DBDW1=JDW1
185     DBDW2=JDW2
186 C
187 C CALCULATE INTERCEPT OF LINEAR TRANSFER FUNCTION RELATING DB
188 C     TO ADC VALUE.
189 C
190     CCON1=CON1-DBDW1
191     CCON2=CON2-DBDW2
192     CALL INTL(5,1)
193     DO 360 J=1,1200
194 360   K(J)=0
195     CALL CLOK(JJHR,JJMN,JJSEC)
196     JJDAY=JDAY
197     IF(JHOLD-23)422,421,422
198 421   IF(JJHR)422,423,422
199 423   JJDAY=JJDAY+1
200 422   K(1201)=JJDAY
201     K(1202)=JJHR
202     K(1203)=JJMN
203     K(1204)=JJSEC
204 C
205 C WRITE SPECIAL RECORD ON MAG TAPE INDICATING NEW PISTONPHONE
206 C     READINGS OR 2607 ATTENUATOR CHANGES.
207 C

```



```

208 WRITE(9)K
209 JCNT=0
210 C
211 C START TWO CHANNEL DATA COLLECTION.
212 C
213 CALL MULTI(K(1),JWIND,JCNT,JDONE,JEROR,JSKIP)
214 CALL INTL(5,2)
215 IF(NTIME-1)33,33,400
216 33 DO 351 J=1,3
217 CALL LFD
218 351 CONTINUE
219 WRITE(3,30)
220 30 FORMAT('--')
221 DO 352 J=1,5
222 CALL LFD
223 352 CONTINUE
224 WRITE(3,22)
225 22 FORMAT(5H'BAD', ' DIGITALLY CONTROLLED SOUND LEVEL SURVEY')
226 CALL LFD
227 CALL LFD
228 WRITE(3,21)JPG,NTAPE,JYEAR,JYRC,JDC,JHG,JMC
229 21 FORMAT('PAGE',I4,3X,'TAPE # ',I5,3X,'YEAR ',I5,3X,'(2607 CAL '5
230 14,I3,I3,')')
231 N=1
232 M=1
233 KSW=0
234 26 DO 50 J=1,111
235 KPA(J)=0
236 50 KPB(J)=0
237 K1A=0
238 K10A=0
239 K50A=0
240 K1B=0
241 K10B=0
242 K50B=0
243 K(1212)=0
244 K(1213)=0
245 K(1206)=3
246 K(1207)=0
247 JWM1=-30000
248 NPF1=0
249 JER=0
250 JSKP=0
251 ALQA=0.
252 ALQB=0.
253 DO 20 J1=1,10
254 IF(KSW)316,315,316
255 315 IF(J1-2)316,317,316

```

```

256 C
257 C THE HEADING IS LONG AND TO ALLOW ENOUGH TIME FOR ADC VALUE TO
258 C DB CONVERSION (CONVERSION HALTS DURING TTY PRINTOUT) THE
259 C SECOND HALF OF THE HEADING IS PRINTED OUT DURING THE SECOND
260 C MINUTE OF DATA COLLECTION. BRINGING IN ADC VALUES FROM FIFO
261 C MEMORY (VIA INTERRUPT LEVEL 5) IS HALTED ONLY WHEN THE MAG
262 C TAPE IS WRITING (ABOUT .5 SECOND) OR WHEN A NEW PISTONPHONE
263 C CALIBRATION OR 2607 ATTENUATOR CHANGE IS REQUESTED BY SS1
264 C OR SS2.
265 C
266 317 WRITE(3,23)
267 23 FORMAT(2/,20X,'1- CHANNEL 1 -1 1- CHANNEL 2 -1 WIND AC ##
268 1')
269 WRITE(3,90)
270 90 FORMAT(5X,'DAY HR MN SEC 1% 10% 50% LEQ 1% 10% 50% LEQ K
271 1,' PFS ERR SKIP',/)
272 KSW=1
273 316 JWMAX=30000
274 C
275 C DO LOOP WHERE ADC VALUES ARE CONVERTED TO DB AND WHERE DB VALUES
276 C ARE BINNED IN 1 DB STEPS.
277 C
278 DO 8 J=1,1200
279 80 IF(JCNT-J)80,147,147
280 147 IF(JCNT-1200)100,41,41
281 41 CALL INTL(5,1)
282 100 ANVAL=K(J)
283 IF(JWMAX-JWIND)125,125,126
284 126 JWMAX=JWIND
285 125 AJ=J
286 A=J/2
287 B=AJ/2.
288 IF(A-B)10,11,10
289 C
290 C CHANNEL 1 ADC DATA CONVERSION TO DB
291 C
292 10 DBA=CCON1+FACT1*ANVAL
293 KDBA=DBA*10.
294 CALL DISP(KDBA,1)
295 ALQA=ALQA+10.**(DBA/10.)
296 KP1=DBA+.5
297 IF(KP1-20)8,43,110
298 110 IF(KP1-130)43,43,8
299 C
300 C BINNING CHANNEL 1 DB VALUES IN 1 DB STEPS.
301 C
302 43 KPA(KP1-19)=KPA(KP1-19)+1
303 GO TO 8
304 C
305 C CHANNEL 2 ADC DATA CONVERSION TO DB
306 C
307 11 DBA=CCON2+FACT2*ANVAL
308 KDBA=DBA*10.
309 CALL DISP(KDBA,2)

```

```

310      ALQB=ALQB+10.**(DBA/10.)
311      KPI=DBA+.5
312      IF(KPI-20)8,62,111
313 111   IF(KPI-130)62,62,8
314 C
315 C BINNING CHANNEL 2 DB VALUES IN 1 DB STEPS.
316 C
317 62    KP(KPI-19)=KP(KPI-19)+1
318 8     K(J)=DBA*10.
319      CALL CLOK(JHR,JMIN,JSEC)
320 120   IF(JHOLD-23)122,123,122
321 123   IF(JHR)122,124,122
322 124   JDAY=JDAY+1
323 122   JHOLD=JHR
324      K(1201)=JDAY
325      K(1202)=JHR
326      K(1203)=JMIN
327      K(1204)=JSEC
328      K(1205)=NPF
329      K(1210)=JEROR
330      JER=JER+JEROR
331      K(1211)=JSKIP
332      AJWMX=JWMAX
333      VOLT=-.00821541*AJWMX+4.22168
334      JWM=12.5815*VOLT+3.53
335      IF(JWM-5)150,151,151
336 150   JWM=0
337 151   K(1209)=JWM
338      IF(JWM1-JWM)127,128,128
339 127   JWM1=JWM
340 C
341 C WRITE DATA FOR CURRENT MINUTE ON MAG TAPE.
342 C
343 128   WRITE(9)K
344      NPF1=NPF1+NPF
345      JSKP=JSKP+JSKIP
346      JSKIP=0
347      JEROR=0
348      NPF=0
349      JCNT=0
350      KK=ISWCH(1)+ISWCH(2)+1
351      GO TO(160,320),KK
352 320   IF(J1-10)156,20,20
353 C
354 C HALT DATA COLLECTION IF MAG TAPE IS FULL. (EOT)
355 C
356 160   CALL DMAMAG(MAG)
357      IF(MAG-17)401,402,402
358 401   CALL INTL(5,2)
359 20    CONTINUE
360 28    N1PA=60
361      N10PA=600
362      N50PA=3000
363      N1PB=60
364      N10PB=600

```

```

365         N50PB=3000
366 C
367 C COMPUTE 10 MINUTE VERSION OF LEQ.
368 C
369         LEQA=10.*ALOG(ALQA/6000.)/ALOG(10.)
370         LEQB=10.*ALOG(ALQB/6000.)/ALOG(10.)
371         JUMA=0
372         JUMB=0
373 C
374 C DO LOOP TO ADD UP DB BINS AND DETERMINE 1%, 10%, 50% LEVELS.
375 C
376         DO 60 J2=1,111
377         J3=112-J2
378         JUMA=JUMA+KPA(J3)
379         JUMB=JUMB+KPB(J3)
380         IF(JUMA-N1PA)45,46,46
381 46      N1PA=30000
382         K1A=J3+19
383 45      IF(JUMA-N10PA)47,48,48
384 48      N10PA=30000
385         K10A=J3+19
386 47      IF(JUMA-N50PA)52,51,51
387 51      N50PA=30000
388         K50A=J3+19
389 52      IF(JUMB-N1PB)54,55,55
390 55      N1PB=30000
391         K1B=J3+19
392 54      IF(JUMB-N10PB)56,57,57
393 57      N10PB=30000
394         K10B=J3+19
395 56      IF(JUMB-N50PB)60,59,59
396 59      N50PB=30000
397         K50B=J3+19
398 60      CONTINUE
399 C
400 C OUTPUT DATA TO TTY EVERY 10 MINUTES.
401 C
402 76      WRITE(3,35)N,JDAY,JHR,JMIN,JSEC,K1A,K10A,K50A,LEQA,K1B,K10B,KB
403         IEQB,JWM1,NPF1,JER,JSKP
404 35      FORMAT(14,14,13,13,13,1X,15,14,14,14,1X,15,14,14,14,1X,15,14,8
405         1)
406 156     KK=ISWCH(1)+1
407         GO TO(301,302),KK
408 302     WRITE(3,303)JDAY,JHR,JMIN,JSEC
409 303     FORMAT(' (',14,13,13,13,' LAST TAPE RECORD) PUT SS1 SS2 DOWN
410 304     KK=ISWCH(1)+ISWCH(2)+1
411         GO TO(295,304),KK
412 301     KK=ISWCH(2)+1
413         GO TO(307,308),KK
414 308     WRITE(3,309)JDAY,JHR,JMIN,JSEC
415 309     FORMAT(' (',14,13,13,13,' LAST TAPE RECORD) PUT SS2 DOWN.')
416 310     KK=ISWCH(2)+1
417         GO TO(311,310),KK

```

```

418 307 N=N+1
419 M=M+1
420 400 MORE=M-NFIL
421 MOR2=17-(M-NFIL)
422 C
423 C IF CURRENT PAGE IS FULL START NEW PAGE.
424 C
425 IF(MORE)26,31,31
426 31 IF(MOR2)332,332,330
427 330 DO 331 J=1,MOR2
428 CALL LFD
429 331 CONTINUE
430 332 WRITE(3,350)
431 350 FORMAT('----')
432 JPG=JPG+1
433 GO TO 33
434 402 WRITE(3,403)JDAY,JHR,JMIN,JSEC
435 403 FORMAT(' (',I4,I3,I3,I3,' LAST TAPE RECORD) END OF TAPE.')
436 WRITE(3,404)
437 404 FORMAT('MOUNT NEW DATA TAPE, RESET CPU, GO TO ',I0HX'80', RUN)
438 WRITE(3,410)
439 410 FORMAT('ON TTY DO FOLLOWING',/, 'LINE FEED G CARRIAGE RETURN',)
440 REWIND 14
441 405 GO TO 405
END

```

6. APPENDIX B. PROGRAM LISTINGS FOR ASSEMBLY LANGUAGE SUBROUTINES

Appendix B contains program listings for "STEM1", "DATA", "LFD", "POWF5", "MULTI1", "MMON", "DMAMAG", "INTL", "DISP", "LEADR", and "CLOK" programs.

```

1 * 11/11/74:5 'STEM1'
2 * ORIG X'2730'
3 * THIS PROGRAM WHEN CALLED BY C. FORTRAN MAIN
4 * PROGRAM DUMPS ALL OF CORE ONTO MAG TAPE
5 * SO THAT THE SYSTEM CAN BE STARTED UP BY:
6 * 1) MOUNTING SPECIAL SYSTEM TAPE ON DMA DRIVE
7 * 2) PUSH RESET ON CPU
8 * 3) PUSH MAG TAPE LOAD BUTTON N TIMES
9 * WHERE N = 1 + 2 X NUMBER OF
10 * PROGRAMS AHEAD OF
11 * DESIRED PROGRAM
12 * 4) PUSH RUN ON CPU
13 * 5) PUSH RUN ON CPU
14 *
15 * SS0, SS1, SS2 MUST BE UP WHEN THIS
16 * PROGRAM IS CALLED TO CREATE SPECIAL
17 * MAGNETIC TAPE.
18 *
19 * THIS PROGRAM EXAMINES THE PEAT TABLE
20 * TO CHECK THE SYSTEM DIRECTIVE INPUT
21 * ASSIGNMENT. (LU 1) IF IT IS ASSIGNED
22 * TO THE HIGH SPEED READER THE PROGRAM
23 * CHANGES THE ASSIGNMENT TO THE TTY.
24 *
25 * IN FORTRAN PROGRAM USE:
26 * CALL STEM1(NUM)
27 * WHERE:
28 * NUM = NUMBER OF PROGRAMS
29 * ALREADY ON MAG TAPE
30 *
2730 0082 31 STEM DATA X'82'
2731 0000 32 NUM DATA 0
2732 0080 33 SMB 0
2733 9059 34 LDX X'59' ADDRESS OF PEAT TABLE
2734 8801 35 LDW * 1 SYSTEM DIRECTIVE UNIT #
2735 F7E5 36 CMW X1400
2736 0860 37 SEQ IS IT HIGH SPEED READER?
2737 173A 38 JMP CONT2 NO
2738 87E6 39 LDW XD00 YES, CHANGE TO TTY
2739 7801 40 STW * 1
273A 08C0 41 CONT2 SS0
273B 173D 42 JMP SS1
273C 17CA 43 JMP RET
273D 08D0 44 SS1 SS1
273E 1740 45 JMP SS2
273F 17CA 46 JMP RET
2740 08E0 47 SS2 SS2
2741 1743 48 JMP CONT
2742 17CA 49 JMP RET
2743 0080 50 CONT SMB 0
2744 805C 51 LDW X'5C'
2745 77EB 52 STW CORE LAST CORE LOCATION
2746 A7E2 53 ADD DI
2747 77D4 54 STW CSIZE TOTAL # OF WORDS IN CORE
2748 0220 55 STAT4 DIN 2,0 MAG TAPE STATUS
2749 0A1D 56 SLL 13
274A 0820 57 SAM

```

274B	179A	58	JMP	RING	NEED WRITE RING	
274C	97EB	59	LDX	CORE		
274D	8800	60	LDW	* 0		
274E	77ED	61	STW	SF	SAVE CONT. OF CORE END	
274F	0501	62	DXS	1		
275Q	8800	63	LDW	* 0		
2751	77EC	64	STW	SE	SAVE CONT. CORE END -1	
2752	9731	65	LDX	NUM		
2753	88Q0	66	LDW	* Q	# PROGS ALREADY ON TAPE	
2754	0A11	67	SLL	1	X2	
2755	77EA	68	STW	NUMP		
2756	Q800	69	SAZ		IS TAPE EMPTY?	
2757	1759	70	JMP	SKIP	NO	
2758	176F	71	JMP	CONT1	YES	
2759	Q220	72	SKIP	DIN	2,0	MAG TAPE STATUS
275A	0810	73	SAP		CONTROLLER BUSY?	
275B	1759	74	JMP	SKIP	YES, WAIT	
275C	0A11	75	SLL	1		
275D	Q810	76	SAP		TAPE UNIT BUSY?	
275E	1759	77	JMP	SKIP	YES, WAIT	
275F	87EB	78	LDW	CORE		
2760	0321	79	DOT	2,1	START ADDRESS = END CORE	
2761	87E2	80	LDW	D1	WON'T USE DATA	
2762	0326	81	DOT	2,6	READ RECORD	
2763	Q220	82	STAT3	DIN	2,0	MAG TAPE STATUS
2764	0A17	83	SLL	7		
2765	Q820	84	SAM		DONE READING RECORD?	
2766	1763	85	JMP	STAT3	NO, WAIT	
2767	E7E4	86	AND	X0180	KEEP BITS 14,15	
2768	Q800	87	SAZ			
2769	17B2	88	JMP	ERR	RATE OR TAPE ERROR	
276A	87EA	89	LDW	NUMP		
276B	B7E2	90	SUB	D1		
276C	77EA	91	STW	NUMP		
276D	0800	92	SAZ			
276E	1759	93	JMP	SKIP	MORE TO SKIP	
276F	87E3	94	CONT1	LDW	D9	
277Q	77E7	95	STW	WC	SET # OF WORDS = 9	
2771	87E9	96	LDW	LLOAD	SET LOADER START	
2772	77E8	97	STW	MEM	ADDRESS	
2773	277E	98	JSX	MAG	GO WRITE LOADER ON TAPE	
2774	0100	99	CLR			
2775	77E8	100	STW	MEM	SET START ADDRESS = 0	
2776	87D4	101	LDW	Csize		
2777	77E7	102	STW	WC	SET # WORDS = ALL OF CORE	
2778	27D5	103	JSX	Csum	CALCULATE CHECK SUM	
2779	97EB	104	LDX	CORE		
277A	7800	105	STW	* 0	STUFF C SUM IN CORE END	
277B	277E	106	JSX	MAG	WRITE ALL CORE ON TAPE	
277C	0000	107	STOP	HLT	HALT, TAPE IS DONE	
277D	177C	108	JMP	STOP	IF RUN IS PUSHED	
		109	*			
		110	*	MAG TAPE SECTION		
		111	*			
277E	0140	112	MAG	CXA		
277F	97EB	113	LDX	CORE		
2780	0501	114	DXS	1		

2781	7800	115		STW * 0	SAVE RETURN
2782	0220	116	STAT1	DIN 2,0	MAG TAPE STATUS
2783	0810	117		SAP	CONTROLLER BUSY?
2784	1782	118		JMP STAT1	YES, WAIT
2785	0A11	119		SLL 1	
2786	0810	120		SAP	TAPE UNIT BUSY?
2787	1782	121		JMP STAT1	YES, WAIT
2788	0A13	122		SLL 3	
2789	0810	123		SAP	IS TAPE REWINDING?
278A	1782	124		JMP STAT1	YES, WAIT
278B	87E8	125		LDW MEM	
278C	0321	126		DOT 2,1	SET MEMORY START ADDRESS
278D	87E7	127		LDW WC	NUMBER OF WORDS
278E	0324	128		DOT 2,4	SET WORD COUNT, WRITE REC.
278F	0220	129	STAT2	DIN 2,0	MAG TAPE STATUS
2790	0A17	130		SLL 7	
2791	0820	131		SAM	DONE WRITING A RECORD?
2792	178F	132		JMP STAT2	NO, WAIT
2793	E7E4	133		AND X0180	KEEP BITS 14,15
2794	0800	134		SAZ	
2795	17B2	135		JMP ERR	RATE OR TAPE ERROR
2796	97EB	136		LDX CORE	
2797	0501	137		DXS 1	
2798	9800	138		LDX * 0	GET RETURN
2799	1800	139		JMP * 0	DO THE RETURN
279A	0080	140	RING	SMB 0	
279B	206E	141		JSX X'6E'	
279C	CEC5	142		TEXT 'NEED'	
279D	C5C4				
279E	0080	143		SMB 0	
279F	206E	144		JSX X'6E'	
27A0	D7D2	145		TEXT 'WRIT'	
27A1	C9D4				
27A2	0080	146		SMB 0	
27A3	206E	147		JSX X'6E'	
27A4	D2C9	148		TEXT 'RING'	
27A5	CEC7				
27A6	0000	149		HLT	MOUNT TAPE, PUSH RUN
27A7	1748	150		JMP STAT4	
27A8	0080	151	CERR	SMB 0	
27A9	206E	152		JSX X'6E'	
27AA	C2C1	153		TEXT 'BAD'	
27AB	C4A0				
27AC	0080	154		SMB 0	
27AD	206E	155		JSX X'6E'	
27AE	C3D3	156		TEXT 'CSUM'	
27AF	D5CD				
27B0	0000	157		HLT	REDO MAG TAPE
27B1	17A8	158		JMP CERR	IF RUN IS PUSHED
27B2	0080	159	ERR	SMB 0	
27B3	206E	160		JSX X'6E'	
27B4	D4C1	161		TEXT 'TAPE'	
27B5	D0C5				
27B6	0080	162		SMB 0	
27B7	206E	163		JSX X'6E'	
27B8	C5D2	164		TEXT 'ERROR'	
27B9	CFD2				

27BA	0000	165	HLT		TAPE ERROR, REDO
27BB	17B2	166	JMP	ERR	IF RUN IS PUSHED
		167	*		
		168	*	RESTART SECTION	
		169	*		
27BC	0000	170	SMB	HLT	(LOADER HALTS HERE)
27BD	0089	171	RESTART	SMB	\$
27BE	0050	172		SGM	
27BF	27D5	173	JSX	CSUM	CALCULATE CHECK SUM
27C0	97EB	174	LDX	CORE	
27C1	F800	175	CMW	* 0	
27C2	0860	176	SEQ		DO CHECK SUMS AGREE?
27C3	17A8	177	JMP	CERR	NO
27C4	97EB	178	LDX	CORE	
27C5	87ED	179	LDW	SF	
27C6	7800	180	STW	* 0	RESTORE CORE END
27C7	0501	181	DXS	1	
27C8	87EC	182	LDW	SE	
27C9	7800	183	STW	* 0	RESTORE CORE END -1
27CA	0080	184	RET	SMB	0
27CB	2083	185	JSX	X'83'	RETURN TO C. FORTRAN
		186	*		
		187	*	LOADER SECTION	
		188	*		
27CC	0100	189	LOADER	CLR	
27CD	0089	190		SMB	SMB
27CE	77BC	191		STW	SMB
27CF	0321	192		DOT	2,1
27D0	8008	193		LDW	8
27D1	0326	194		DOT	2,6
27D2	0089	195		SMB	SMB
27D3	17BC	196		JMP	SMB
27D4	0000	197	CSIZE	D	0
		198	*		
		199	*	CHECK SUM ROUTINE,	ANSWER IN ACR.
		200	*		
27D5	0140	201	CSUM	CXA	
27D6	97EB	202		LDX	CORE
27D7	0501	203		DXS	1
27D8	7800	204		STW	* 0
27D9	0100	205		CLR	
27DA	0501	206	AGAIN	DXS	1
27DB	17E0	207		JMP	ADDUP
27DC	97EB	208		LDX	CORE
27DD	0501	209		DXS	1
27DE	9800	210		LDX	* 0
27DF	1800	211		JMP	* 0
27E0	A800	212	ADDUP	ADD	* 0
27E1	17DA	213		JMP	AGAIN
		214	*		END OF CHECK SUM
27E2	0001	215	D1	D	1
27E3	0009	216	D9	D	9
27E4	0180	217	XQ180	D	X'180'
27E5	1400	218	X1400	D	X'1400'
27E6	0D00	219	XD00	D	X'D00'
27E7	0000	220	WC	D	0
27E8	0000	221	MEM	D	0

27E9	27CC	222	LLOAD	D	LOADER
27EA	0000	223	NUMP	DATA	0
27EB	0000	224	CORE	D	0
27EC	0000	225	SE	D	0
27ED	0000	226	SF	D	0
		227		END	

NO ERRORS

ADDUP	27E0	AGAIN	27DA	CERR	27A8	CONT	2743
CONT1	276F	CQNT2	273A	CORE	27EB	CSIZE	27D4
CSUM	27D5	D1	27E2	D9	27E3	ERR	27B2
LLOAD	27E9	LOADER	27CC	MAG	277E	MEM	27E8
NUM	2731	NUMP	27EA	RESTART	27BD	RET	27CA
RING	279A	SE.	27EC	SF	27ED	SKIP	2759
SMB	27BC	SS1	273D	SS2	2740	STAT1	2782
STAT2	278F	STAT3	2763	STAT4	2748	STEM	2730
STOP	277C	WC	27E7	X0180	27E4	X1400	27E5
XD00	27E6						
PAS?							

```

1 ' 12/20/74:4 'DATA'
2   ORIG 'X'2800'
3 * PROGRAM BRINGS IN DATA FROM INTERFACE
4 * AND SENDS DATA FROM A DESIGNATED
5 * CHANNEL TO THE DIGITAL DISPLAY ON THE
6 * INTERFACE.
7 *
8 * IN FORTRAN USE:
9 *   CALL DATA(JWIND, JRAW1, JRAW2, JCH)
10 * WHERE
11 *   JWIND = DATA FROM INTERFACE WIND CHANNEL
12 *   JRAW1 = DATA FROM INTERFACE CH1
13 *   JRAW2 = DATA FROM INTERFACE CH2
14 *   JCH   = 0 (SEND WIND TO DIGITAL DISPLAY)
15 *         = 1 (SEND CH1 DATA TO DIGITAL DISPLAY)
16 *         = 2 (SEND CH2 DATA TO DIGITAL DISPLAY)
17 *         > 2 (SEND NO DATA TO DIGITAL DISPLAY)
18 *
2800 0082 19 DATA DATA X'82'
2801 0000 20 JWIND D 0
2802 0000 21 JRAW1 D 0
2803 0000 22 JRAW2 D 0
2804 0000 23 JCH D 0
2805 03F6 24 DOT 15,6 MASTER RESET TO FIFO
2806 806C 25 LDW DINT
2807 0080 26 SMB 0
2808 7015 27 STW X'15'
2809 0080 28 SMB 0
280A 2083 29 JSX X'83' RETURN TO C. FORTRAN
30 *
31 * INTERRUPT LEVEL 5
32 *
280B 008A 33 INT SMB TX
280C 6069 34 STX TX
280D 706A 35 STW TA
280E 02F2 36 DIN 15,2 BRING IN DATA FROM FIFO
280F 7068 37 STW T
2810 0A0E 38 SRL 14
2811 F065 39 CMW D1
2812 0860 40 SEQ IS DATA FROM WIND?
2813 101D 41 JMP A NO
2814 8068 42 LDW T YES
2815 E06B 43 AND X3FF EXTRACT WIND DATA
2816 9001 44 LDX JWIND
2817 7800 45 STW * 0 STORE WIND DATA
2818 9004 46 LDX JCH
2819 8800 47 LDW * 0
281A 0800 48 SAZ DISPLAY WIND VALUE?
281B 1047 49 JMP RET NO
281C 1033 50 JMP DISP YES
281D F067 51 A CMW D2
281E 0860 52 SEQ IS DATA FROM CH1?
281F 102A 53 JMP B NO
2820 8068 54 LDW T YES
2821 E06B 55 AND X3FF EXTRACT CH1 DATA
2822 9002 56 LDX JRAW1
2823 7800 57 STW * 0 STORE CH1 DATA

```

2824	9004	58	LDX	JCH	
2825	8800	59	LDW	* 0	
2826	F065	60	CMW	D1	
2827	0860	61	SEQ		DISPLAY CH1 DATA?
2828	1047	62	JMP	RET	NO
2829	1033	63	JMP	DISP	YES
282A	8068	64	B	LDW	T
282B	E06B	65	AND	X3FF	EXTRACT CH2 DATA
282C	9003	66	LDX	JRAW2	
282D	7800	67	STW	* 0	STORE CH2 DATA
282E	9004	68	LDX	JCH	
282F	8800	69	LDW	* 0	
2830	F067	70	CMW	D2	
2831	0860	71	SEQ		DISPLAY CH2 DATA?
2832	1047	72	JMP	RET	NO
2833	8068	73	DISP	LDW	T
2834	E06B	74	AND	X3FF	EXTRACT DATA
		75	*		
		76	*	CONVERT TO BCD	
		77	*		
2835	0810	78	SAP		NEGATIVE VALUE?
2836	0110	79	CMP		YES, ABSOLUTE VALUE
2837	F066	80	CMW	D9999	
2838	0890	81	SLE		TOO BIG?
2839	8066	82	LDW	D9999	YES, LIMIT VALUE
283A	204A	83	JSX	RM10	REMAINDER SUBROUTINE
283B	0000	84	DIG4	D	0
283C	204A	85	JSX	RM10	LEAST SIG. DIGIT
283D	0000	86	DIG3	D	0
283E	204A	87	JSX	RM10	
283F	0000	88	DIG2	D	0
2840	0A14	89	SLL	4	MOST SIG. DIGIT IN ACR
2841	C03F	90	ORI	DIG2	
2842	0A14	91	SLL	4	
2843	C03D	92	ORI	DIG3	
2844	0A14	93	SLL	4	
2845	C03B	94	ORI	DIG4	PACKED BCD IN ACR
2846	03F2	95	SEND	DOT	15,2
2847	9069	96	RET	LDX	TX
2848	806A	97	LDW	TA	RESTORE INDEX
2849	0015	98	INR	5	RESTORE ACR
284A	7063	99	RM10	STW	ASAV
284B	0800	100	SAZ		INTERRUPT RETURN
284C	104F	101	JMP	S+3	CHECK FOR ZERO NUMERATOR
284D	7800	102	STW	* 0	STUFF ZERO REMAINDER
284E	1801	103	JMP	* 1	
284F	0A11	104	SLL	1	
2850	A063	105	ADD	ASAV	
2851	7064	106	STW	TSAV	
2852	0A04	107	SRL	4	
2853	A064	108	ADD	TSAV	
2854	0A04	109	SRL	4	
2855	A064	110	ADD	TSAV	
2856	0A04	111	SRL	4	
2857	A064	112	ADD	TSAV	
2858	A065	113	ADD	D1	
2859	0A05	114	SRL	5	

285A	7064	115		STW	TSAV	QUOTIENT
285B	0A13	116		SLL	3	
285C	A064	117		ADD	TSAV	
285D	A064	118		ADD	TSAV	
285E	0110	119		CMP		-10*QUOTIENT
285F	A063	120		ADD	ASAV	
2860	7800	121		STW *	0	REMAINDER
2861	8064	122		LDW	TSAV	QUOTIENT IN ACR
2862	1801	123		JMP *	1	
2863	0000	124	ASAV	D	0	
2864	0000	125	TSAV	D	0	
2865	0001	126	D1	D	1	
2866	270F	127	D9999	D	9999	
2867	0002	128	D2	D	2	(NOT IN BASIC BCD)
2868	0000	129	T	DATA	0	
2869	0000	130	TX	D	0	
286A	0000	131	TA	D	0	
286B	03FF	132	X3FF	D	X'3FF'	
286C	280B	133	DINT	D	INT	
		134		END		

NO ERRORS

12/20/74:4 'DATA'

PAGE 4

A	281D	ASAV	2863	B	282A	D1	2865
D2	2867	D9999	2866	DATA	2800	DIG2	283F
DIG3	283D	DIG4	283B	DINT	286C	DISP	2833
INT	280B	JCH	2804	JRAW1	2802	JRAW2	2803
JWIND	2801	RET	2847	RM10	284A	SEND	2846
T	2868	TA	286A	TSAV	2864	TX	2869
X3FF	286B						
PAS?							

	1	'	12/20/74:3	'LFD'	
	2		ORIG	X'2870'	
	3	*	OUTPUTS LINE FEED TO TTY (OR TEK TERMINAL)		
	4	*	IN FORTRAN USE:		
	5	*	CALL LFD		
	6	*			
2870	0082	7	LFD	DATA	X'82'
2871	02E0	8	A	DIN	14,0
2872	0810	9		SAP	
2873	1071	10		JMP	A
2874	03EA	11	B	DOT	14,10
2875	807E	12		LDW	LF
2876	03EE	13		DOT	14,14
2877	02E0	14	C	DIN	14,0
2878	0A17	15		SLL	7
2879	0820	16		SAM	
287A	1077	17		JMP	C
287B	03E0	18	D	DOT	14,0
287C	0080	19		SMB	0
287D	2083	20		JSX	X'83'
287E	008A	21	LF	DATA	X'8A'
		22		END	

BRING IN TEK STATUS
IS TEK STILL CONNECTED?

SELECT TEK TERMINAL
LOAD LINE FEED
SEND DATA TO TEK TERMINAL
TEK STATUS

DONE YET?
NO
DISCONNECT TEK TERMINAL
GO BACK TO C. FORTRAN

NO ERRORS

12/20/74:3 'LFD'

PAGE 2

A	2871	B	2874	C	2877	D	287B
LF	287E	LFD	2870				
PAS?							

```

1 * 11/6/74:5 'POWF5'
2     ORIG X'2890'
3 *
4 * PROGRAM IS A POWER FAIL SAFE ROUTINE.
5 * SET POWER FAIL SAFE IN FORTRAN PROGRAM BY:
6 *     CALL POWF5(NPF)
7 * WHERE NPF IS THE NUMBER OF POWER INTERRUPTS
8 * THAT OCCURED.
9 *
10 * LOCATION X'4B' IS THE INTERRUPT ENABLE
11 * STATUS WORD.
12 * BITS 0 - 11 OF LOC X'4D' SET = #
13 * OF POWER FAILURES.
14 * BITS 12-15 OF
15 * LOCATION X'4D' ARE SET TO 1,2,3,4 TO
16 * SHOW HOW FAR THE POWERFAIL SAFE
17 * ROUTINE GOT.
18 * THIS PROGRAM CAN RESTART TTY & MAG TAPE IO
19 * IF A POWER FAILURE OCCURS.
20 *
      0007
21 INT     EQU     7
2890 0082 22 POWF  DATA X'82'
2891 0000 23 NPF   D      0
2892 9091 24     LDX   NPF
2893 0100 25     CLR
2894 7101 26     STW   TPF     SET TPF = 0
2895 7800 27     STW   * 0     SET NPF = 0
2896 8102 28     LDW   DI
2897 0080 29     SMB   0
2898 704D 30     STW   X'4D'   SET = 1
2899 8109 31     LDW   DSMBH
289A 0080 32     SMB   0
289B 701D 33     STW   INT+INT+INT+INT+1
289C 0027 34     ENB   INT
289D 0080 35     SMB   X'83'
289E 2083 36     JSX   X'83'   RETURN TO FORTRAN PROGRAM
37 *
38 * POWER DOWN SEQUENCE
39 *
289F 008A 40 SMBH   SMB   $
28A0 00A0 41     MSK   MASK INTERRUPTS
28A1 60FE 42     STX   PFSX   SAVE INDEX VALUE
28A2 70FD 43     STW   PFSA   SAVE ACC. VALUE
44 *
45 *
46 *
47 *
28A3 9106 48     LDX   X10    GET DEVICE COUNT
28A4 8107 49     LDW   X300   DOT 0,0
28A5 70A6 50     STW   $+1    SET TO EXECUTE
28A6 0000 51     D      0
28A7 A106 52     ADD   X10    GET TO NEXT DEVICE
28A8 0501 53     DXS   1      DEC COUNT
28A9 10A5 54     JMP   $-4    NOT DONE
28AA 8801 55     LDW   * 1    GET CELL 0 (IX = FFFF)
28AB 70FF 56     STW   PFS0   SAVE VALUE IN LOC 0
28AC 809F 57     LDW   SMBH

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28AD	0080	58	SMB	0	
28AE	707D	59	STW	X'7D'	PUT SMB IN LOC X'7D'
28AF	80C1	60	LDW	JMPH	
28B0	0080	61	SMB	0	
28B1	707E	62	STW	X'7E'	PUT POWER UP JMP IN LOC X'7E'
28B2	8108	63	LDW	X107D	
28B3	0080	64	SMB	0	
28B4	7000	65	STW	0	STORE JMP TO X'7D' IN LOC 0
28B5	9091	66	LDX	NPF	
28B6	8800	67	LDW	* 0	
28B7	A102	68	ADD	D1	
28B8	7800	69	STW	* 0	NPF=NPF+1
28B9	8101	70	LDW	TPF	
28BA	A102	71	ADD	D1	
28BB	7101	72	STW	TPF	TPF = TPF + 1
28BC	0A14	73	SLL	4	MOVE 4 BITS TO LEFT
28BD	A103	74	ADD	D2	SHOWS PFS GOT TO HERE
28BE	0080	75	SMB	0	
28BF	704D	76	STW	X'4D'	RESTORE PF STATUS
28C0	0000	77	HLT		WAIT FOR A.C. POWER UP
28C1	10C2	78	JMPH	JMP	\$+1
		79	*		
		80	* POWER UP SEQUENCE		
		81	*		
28C2	0027	82	ENB	INT	ENABLE POWER FAIL SAFE
28C3	0080	83	SMB	0	
28C4	804D	84	LDW	X'4D'	LOAD PF STATUS
28C5	E10A	85	AND	XFFF0	KEEP # OF POWER FAILS
28C6	A104	86	ADD	D3	SHOWS PFS GOT TO HERE
28C7	0080	87	SMB	0	
28C8	704D	88	STW	X'4D'	SET = 3
28C9	0050	89	SGM		
28CA	80FF	90	LDW	PFS0	
28CB	0080	91	SMB	0	
28CC	7000	92	STW	0	RESTORE LOCATION 0
28CD	03F6	93	DOT	15,6	MASTER RESET FIFO
28CE	0080	94	SMB	X'4B'	
28CF	804B	95	LDW	X'4B'	
28D0	E10B	96	AND	X400	EXTRACT INT. ENABLE 5 STATUS
28D1	0800	97	SAZ		
28D2	0025	98	ENB	5	
28D3	0080	99	SMB	0	
28D4	905C	100	LDX	X'5C'	FIND END OF CORE
28D5	0507	101	DXS	7	
28D6	8804	102	LDW	* 4	
28D7	710C	103	STW	I0RET	SAVE IO RETURN
28D8	9800	104	LDX	* 0	
28D9	6100	105	STX	SAVE	SAVE LOC OF LAST FIOT
28DA	8800	106	LDW	* 0	WORD 0 OF FIOT
28DB	0820	107	SAM		POWER DOWN DURING IO?
28DC	10F4	108	JMP	INRR	NO, NORMAL INR
28DD	E10D	109	AND	X7FFF	YES
28DE	7800	110	STW	* 0	SET BUSY BIT = 0
28DF	8802	111	LDW	* 2	WORD 2 OF FIOT
28E0	7111	112	STW	WORD2	SAVE WORD 2 OF FIOT
28E1	E10E	113	AND	X1F0	EXTRACT UNIT NUMBER
28E2	F112	114	CMW	XD0	

28E3	0860	115		SEQ		WAS DEVICE = TTY?
28E4	10F0	116		JMP	RETURN	NO
28E5	8111	117		LDW	WORD2	
28E6	E10F	118		AND	X1FF	KEEP BITS 6-15
28E7	A110	119		ADD	X1800	PUT DISCONNECT IN JMP CODE
28E8	7802	120		STW	* 2	CHANGE WORD 2 OF FIOT
28E9	0020	121		ENB	0	ALLOW TTY TO INTERRUPT
28EA	8113	122		LDW	CR	
28EB	03EE	123		DOT	14,14	SEND CARRIAGE RETURN
28EC	02E0	124	WAIT	DIN	14,0	TTY STATUS
28ED	0A17	125		SLL	7	
28EE	0820	126		SAM		
28EF	10EC	127		JMP	WAIT	
28F0	910C	128	RETURN	LDX	IORET	PRETEND IO WAS FINISHED
28F1	0501	129		DXS	1	
28F2	0A10	130		NOP		
28F3	1800	131		JMP	* 0	GO BACK TO DOIO
28F4	0080	132	INRR	SMB	0	
28F5	804D	133		LDW	X'4D'	LOAD PF STATUS
28F6	E10A	134		AND	XFFF0	KEEP # OF POWER FAILS
28F7	A105	135		ADD	D4	SHOWS IO WAS NOT IN PROGRESS
28F8	0080	136		SMB	0	WHEN THE POWER FAILED
28F9	704D	137		STW	X'4D'	
28FA	90FE	138		LDX	PFSX	RESTORE INDEX
28FB	80FD	139		LDW	PFSA	RESTORE ACC.
28FC	0017	140		INR	INT	
28FD	0000	141	PFSA	D	0	
28FE	0000	142	PFSX	D	0	
28FF	0000	143	PFS0	D	0	
2900	0000	144	SAVE	D	0	
2901	0000	145	TPF	D	0	
2902	0001	146	D1	D	1	
2903	0002	147	D2	D	2	
2904	0003	148	D3	D	3	
2905	0004	149	D4	D	4	
2906	0010	150	X10	D	X'10'	
2907	0300	151	X300	D	X'300'	
2908	107D	152	X107D	D	X'107D'	
2909	289F	153	DSMBH	D	SMBH	
290A	FFF0	154	XFFF0	D	X'FFF0'	
290B	0400	155	X400	D	X'400'	
290C	0000	156	IORET	D	0	
290D	7FFF	157	X7FFF	D	X'7FFF'	
290E	01F0	158	X1F0	D	X'1F0'	
290F	01FF	159	X1FF	D	X'1FF'	
2910	1800	160	X1800	D	X'1800'	
2911	0000	161	WORD2	D	0	
2912	00D0	162	XD0	D	X'D0'	
2913	008D	163	CR	D	X'8D'	
		164		END		

NO ERRORS

CR	2913	D1	2902	D2	2903	D3	2904
D4	2905	DSMBH	2909	INRR	28F4	INT	0007
IORET	290C	JMPH	28C1	NPF	2891	PFS0	28FF
PFSA	28FD	PFSX	28FE	POWF	2890	RETURN	28F0
SAVE	2900	SMBH	289F	TPF	2901	WAIT	28EC
WORD2	2911	X10	2906	X107D	2908	X1800	2910
X1F0	290E	X1FF	290F	X300	2907	X400	290B
X7FFF	290D	XD0	2912	XFFF0	290A		
PAS?							

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1  ' 10/31/74:5 'MULTI'
2      ORIG  X'291B'
291B 0082 3 MULTI  D    X'82'
291C 0000 4 NVAL   D    0
291D 0000 5 JWIND  D    0
291E 0000 6 JCOUNT D    0
291F 0000 7 JDONE  D    0
2920 0000 8 JEROR  D    0
2921 0000 9 JSKIP  D    0
10 * 'MULTI' PROGRAM BRINGS IN WIND
11 * DATA AND CH1 CH2 DATA FROM
12 * MUX FIFO SYSTEM VIA INTERRUPT
13 * LEVEL 5.
14 * IN FORTRAN USE:
15 *     CALL MULTI(K(1),JWIND,JCOUNT,JDONE,JEROR,JSKIP)
16 * K(1) IS FIRST ELEMENT IN ARRAY
17 * JWIND IS CURRENT WIND VALUE.
18 * JCOUNT INDICATES THE ARRAY
19 * ELEMENT CURRENTLY FILLED.
20 * JDONE=1 WHEN ARRAY IS FULL.
21 * JEROR = COUNT OF NUMBER OF BAD
22 * DATA VALUES
23 * JSKIP = NUMBER OF SAMPLES SKIPPED DUE
24 * TO MISSING CHANNEL NUMBERS.
25 * IN FORTRAN SET JDONE, JSKIP, AND
26 * JCOUNT = 0 BEFORE STARTING
27 * TO FILL ARRAY WITH DATA.
2922 008A 28     SMB  $
2923 0100 29     CLR
2924 9120 30     LDX  JEROR
2925 7800 31     STW  * 0      SET JEROR = 0
2926 9121 32     LDX  JSKIP
2927 7800 33     STW  * 0      SET JSKIP = 0
2928 818E 34     LDW  =2
2929 718D 35     STW  SW      SET SW = 2
292A 811C 36     LDW  NVAL
292B B18F 37     SUB  =1
292C 718C 38     STW  N      SET N=BEGINNING OF ARRAY - 1
292D 03F6 39     DOT  15,6  MASTER RESET TO MUX FIFO
292E 8190 40     LDW  =MULT5
292F 0080 41     SMB  X'15'
2930 7015 42     STW  X'15'
2931 0080 43     SMB  X'83'
2932 2083 44     JSX  X'83'
45 * INTERRUPT LEVEL 5
2933 008A 46 MULT5 SMB  TX
2934 618A 47     STX  TX
2935 7189 48     STW  TA
2936 02F2 49     DIN  15,2  BRING IN DATA FROM MUX FIFO
2937 718B 50     STW  T
2938 0A0E 51     SRL  14
2939 F18F 52     CMW  =1
293A 0860 53     SEQ
293B 1141 54     JMP  A
293C 818B 55     LDW  T
293D E191 56     AND  =X'03FF'  EXTRACT WIND DATA
293E 911D 57     LDX  JWIND

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293F	7800	58		STW * 0	STORE WIND DATA
2940	1163	59		JMP RET	
2941	F18E	60	A	CMW =2	
2942	0860	61		SEQ	
2943	1166	62		JMP B	
2944	818D	63		LDW SW	
2945	F18E	64		CMW =2	
2946	0860	65		SEQ	
2947	1149	66		JMP REFIL2	
2948	1153	67		JMP NRM2	
2949	9121	68	REFIL2	LDX JSKIP	MISSED CHANNEL
294A	8800	69		LDW * 0	
294B	A18F	70		ADD =1	
294C	7800	71		STW * 0	JSKIP=JSKIP+1
294D	818C	72		LDW N	
294E	0130	73		CAX	POINTER IN INDEX
294F	818B	74		LDW T	
2950	E191	75		AND =X'03FF'	
2951	7800	76		STW * 0	OVERWRITE LAST CH DATA
2952	1163	77		JMP RET	
2953	818C	78	NRM2	LDW N	
2954	A18F	79		ADD =1	
2955	718C	80		STW N	N=N+1
2956	0130	81		CAX	STORE PT. ADDRESS IN INDEX R.
2957	818B	82		LDW T	
2958	E191	83		AND =X'03FF'	EXTRACT CH1 DATA
2959	7800	84		STW * 0	STORE CH1 DATA IN ARRAY
295A	8192	85		LDW =3	
295B	718D	86		STW SW	SET SW = 3
295C	911E	87	UPCNT	LDX JCOUNT	
295D	8800	88		LDW * 0	
295E	A18F	89		ADD =1	
295F	7800	90		STW * 0	COUNT=COUNT+1
2960	F193	91		CMW =1199	
2961	0890	92		SLE	
2962	117D	93		JMP DONE	ARRAY IS FULL
2963	918A	94	RET	LDX TX	
2964	8189	95		LDW TA	
2965	0015	96		INR 5	
2966	F192	97	B	CMW =3	
2967	0860	98		SEQ	
2968	1184	99		JMP ERROR	
2969	818D	100		LDW SW	
296A	F192	101		CMW =3	
296B	0860	102		SEQ	
296C	116E	103		JMP REFIL3	
296D	1173	104		JMP NRM3	
296E	9121	105	REFIL3	LDX JSKIP	
296F	8800	106		LDW * 0	
2970	A18F	107		ADD =1	
2971	7800	108		STW * 0	JSKIP=JSKIP+1
2972	1163	109		JMP RET	
2973	818C	110	NRM3	LDW N	
2974	A18F	111		ADD =1	
2975	718C	112		STW N	N=N+1
2976	0130	113		CAX	STORE PT. ADDRESS IN INDEX R.
2977	818B	114		LDW T	

2978	E191	115	AND	=X'03FF'	EXTRACT CH2 DATA
2979	7800	116	STW	* 0	STORE CH2 DATA IN ARRAY
297A	818E	117	LDW	=2	
297B	718D	118	STW	SW	SET SW = 2
297C	115C	119	JMP	UPCNT	
297D	811C	120	DONE	LDW	NVAL
297E	B18F	121	SUB	=1	
297F	718C	122	STW	N	SET N=BEGINNING OF ARRAY - 1
2980	911F	123	LDX	JDONE	
2981	818F	124	LDW	=1	
2982	7800	125	STW	* 0	SET JDONE=1 (ARRAY IS FULL)
2983	1163	126	JMP	RET	
2984	9120	127	ERROR	LDX	JEROR
2985	8800	128	LDW	* 0	
2986	A18F	129	ADD	=1	JEROR=JEROR+1
2987	7800	130	STW	* 0	JEROR = COUNT OF BAD DATA
2988	1163	131	JMP	RET	
2989	0000	132	TA	D	0
298A	0000	133	TX	D	0
298B	0000	134	T	D	0
298C	0000	135	N	D	0
298D	0000	136	SW	D	0
		137	END		

298E 0002
 298F 0001
 2990 2933
 2991 03FF
 2992 0003
 2993 04AF

NO ERRORS

A	2941	B	2966	DONE	297D	ERROR	2984
JCOUNT	291E	JDONE	291F	JEROR	2920	JSKIP	2921
JWIND	291D	MULTI	291B	MULT5	2933	N	298C
NRM2	2953	NRM3	2973	NVAL	291C	REFIL2	2949
REFIL3	296E	RET	2963	SW	298D	T	298B
TA	2989	TX	298A	UPCNT	295C		
PAS?							

```

1 * 10/31/74:3 'MMON'
2 * ORIG X'299B'
3 * MMON MODIFIES THE MONITOR SO THAT
4 * IT WILL NOT WRITE OUT M0 M0 ON THE TTY
5 * CONTINUOUSLY WHEN THE TAPE UNIT GOES
6 * DOWN.
7 * IF UNIT GOES DOWN IT WILL TYPE:
8 * TAPE
9 * UNIT
10 * DOWN
11 * LOAD
12 * PROG
13 *
14 * THEN IT WILL HALT WITH THE NUMBER
15 * OF POWER FAILURES IN THE ACCUMULATOR
16 * IN FORTRAN USE:
17 * CALL MMON(LOC)
18 * WHERE LOC = DECIMAL VALUE OF MONITOR
19 * LOCATION TO BE REPLACED WITH SMB & JMP.
20 *
21 * THE TWO LINES IN MONITOR TO BE REPLACED
22 * ARE AS FOLLOWS:
23 * STW * 0 AND PLUG INTO MESSAGE
24 * JMP TYPE TYPE WILL RETURN TO CALLER
25 *

```

299B 0082	26	MMON	DATA	X'82'	
299C 0000	27	LOC	D	0	
299D 919C	28		LDX	LOC	
299E 9800	29		LDX	* 0	
299F 81A5	30		LDW	SMB	
29A0 7800	31		STW	* 0	STORE SMB IN MONITOR
29A1 81A6	32		LDW	JMP	
29A2 7801	33		STW	* 1	STORE JMP IN MONITOR
29A3 0080	34		SMB	0	
29A4 2083	35		JSX	X'83'	RETURN TO C. FORTRAN
29A5 008A	36	SMB	SMB	A	
29A6 11A7	37	JMP	JMP	A	
29A7 0080	38	A	SMB	0	
29A8 206E	39		JSX	X'6E'	
29A9 D4C1	40		TEXT	'TAPE'	
29AA D0C5					
29AB 0080	41		SMB	0	
29AC 206E	42		JSX	X'6E'	
29AD D5CE	43		TEXT	'UNIT'	
29AE C9D4					
29AF 0080	44		SMB	0	
29B0 206E	45		JSX	X'6E'	
29B1 C4CF	46		TEXT	'DOWN'	
29B2 D7CE					
29B3 0080	47		SMB	0	
29B4 206E	48		JSX	X'6E'	
29B5 CCCC	49		TEXT	'LOAD'	
29B6 C1C4					
29B7 0080	50		SMB	0	
29B8 206E	51		JSX	X'6E'	
29B9 D0D2	52		TEXT	'PROG'	
29BA CFC7					

29BB	0080	53	SMB	0	
29BC	804D	54	LDW	X'4D'	
29BD	0A04	55	SRL	4	
29BE	0000	56	HLT		RELOAD PROGRAM
		57	END		

NO ERRORS

10/31/74:3 'MMON'

PAGE 3

A
SMB
PAS?
29A7 JMP 29A6 LOC 299C MMON 299B
29A5

```

1 * 10/31/74:2 'DMAMAG'
2   ORIG X'29C0'
3 * DMAMAG CHECKS DMA MAG TAPE STATUS
4 * IT SETS:
5 * MAG = 1 ON LINE, WRITE ENABLED, NOT ON BOT
6 * MAG = 2 ON LINE, NOT WRITE ENABLED, BOT
7 * MAG = 3 ON LINE, WRITE ENABLED, BOT
8 * MAG = 13 TAPE UNIT NOT READY
9 *           UNIT TURNED OFF OR
10 *          OFF LINE OR REWINDING
11 * MAG = 16 NOT WRITE ENABLED, EOT
12 * MAG = 17 WRITE ENABLED, EOT
13 * IN FORTRAN USE:
14 *   CALL DMAMAG(MAG)
29C0 0082 15 DMAMAG DATA X'82'
29C1 0000 16 MAG     D      0
29C2 008A 17           SMB     $
29C3 0220 18           DIN     2,0   GET MAG TAPE STATUS
29C4 0A02 19           SRL     2
29C5 E1D5 20           AND     =1
29C6 71D4 21           STW     T     SAVE BIT 13
29C7 0220 22           DIN     2,0   GET MAG TAPE STATUS
29C8 0A0C 23           SRL     12
29C9 E1D6 24           AND     =7   SAVE BITS 0,1&2
29CA C1D4 25           ORI     T     COMBINE BITS 0,1,2,13
29CB 71D4 26           STW     T
29CC 0220 27           DIN     2,0   GET MAG TAPE STATUS
29CD 0A08 28           SRL     8     MOVE BIT 3 OVER
29CE E1D7 29           AND     =X'10'
29CF C1D4 30           ORI     T     COMBINE BITS 3,0,1,2,13
29D0 91C1 31           LDX     MAG
29D1 7800 32           STW     * 0
29D2 0080 33           SMB     X'83'
29D3 2083 34           JSX     X'83'
29D4 0000 35 T       D      0
36           END

29D5 0001
29D6 0007
29D7 0010

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NO ERRORS

10/31/74:2 'DMAMAG'

PAGE 2

DMAMAG
PAS?

29C0 MAG

29C1 T

29D4

```

1 ' 10/31/74:1 'INTL'
2          ORIG  X'29E0'
29E0 0082 3 INT    D    X'82'
29E1 0000 4 LEV    DATA 0
29E2 0000 5 N      D      0
6 * INT PROGRAM DISABLES OR ENABLES
7 * INTERRUPT LEVEL LEV
8 * FOR N = 1 DISABLE LEV
9 * FOR N <> 1 ENABLE LEV
10 * LOCATION X'4B' CONTAINS ENABLE
11 * STATUS FOR ALL 15 INTERRUPTS
12 * IE BIT=1 IF INTERRUPT IS ENABLED
13 * THIS STATUS WORD IS USED IN
14 * POWERFAIL SAFE PROGRAMS TO REENABLE
15 * THE PROPER INTERRUPTS.
16 * IN FORTRAN USE:
17 *      CALL INTL(LEV,N)
18 * WHERE LEV = 0 TO 15
29E3 0080 19      SMB  X'4B'
29E4 804B 20      LDW  X'4B'      LOAD INTERRUPT ENABLE STATUS
29E5 7210 21      STW  STAT
29E6 91E2 22      LDX  N
29E7 8800 23      LDW  * 0
29E8 F214 24      CMW  =1
29E9 0860 25      SEQ
29EA 11FF 26      JMP  A
29EB 91E1 27      LDX  LEV
29EC 8800 28      LDW  * 0
29ED F215 29      CMW  =15
29EE 0890 30      SLE
29EF 0000 31      HLT          BAD LEV VALUE
29F0 C211 32      ORI  F
29F1 71F2 33      STW  B  MODIFY DSB INSTRUCTION
29F2 0030 34 B    DSB  0  DISABLE LEV INTERRUPT
29F3 91E1 35      LDX  LEV
29F4 8800 36      LDW  * 0
29F5 C212 37      ORI  G
29F6 71F8 38      STW  C  MODIFY SRC INSTRUCTION
29F7 8216 39      LDW  =X'7FFF'
29F8 0A40 40 C    SRC  0          SHIFT 0 ALONG
29F9 E210 41      AND  STAT  SET BIT LEV = 0
29FA 0080 42 R    SMB  X'4B'
29FB 704B 43      STW  X'4B'      RESTORE INT. ENABLE STATUS
29FC 00B0 44      UNM          UNMASK POWERFAIL SAFE
29FD 0080 45      SMB  X'83'
29FE 2083 46      JSX  X'83'
29FF 00A0 47 A    MSK          MASK POWERFAIL SAFE
2A00 91E1 48      LDX  LEV
2A01 8800 49      LDW  * 0
2A02 F215 50      CMW  =15
2A03 0890 51      SLE
2A04 0000 52      HLT          BAD LEV VALUE
2A05 C213 53      ORI  H
2A06 7207 54      STW  D  MODIFY ENB INSTRUCTION
2A07 0020 55 D    ENB  0  ENABLE LEV INTERRUPT
2A08 91E1 56      LDX  LEV
2A09 8800 57      LDW  * 0

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2A0A	C212	58	ORI	G	
2A0B	720D	59	STW	E	MODIFY SRC INSTRUCTION
2A0C	8217	60	LDW	=X'8000'	
2A0D	0A40	61	E SRC	0	SHIFT 1 ALONG
2A0E	C210	62	ORI	STAT	SET BIT LEV = 1
2A0F	11FA	63	JMP	R	
2A10	0000	64	STAT	D	0
2A11	0030	65	F DSB	0	
2A12	0A40	66	G SRC	0	
2A13	0020	67	H ENB	0	
		68	END		

2A14 0001
2A15 000F
2A16 7FFF
2A17 8000

NO ERRORS

A	29FF	B	29F2	C	29F8	D	2A07
E	2A0D	F	2A11	G	2A12	H	2A13
INT	29E0	LEV	29E1	N	29E2	R	29FA
STAT	2A10						
PAS?							

```

1 ' 12/20/74:6 'DISP'
2 -   ORIG 'X'2A20'
3 *
4 * WHEN CALLED BY FORTRAN IT CHECKS TO
5 * SEE IF VALUE OF JCHAN (CHANNEL #)
6 * AGREES WITH THE CHANNEL SWITCH SETTING
7 * (SSE) CHANGES K FROM BINARY TO BCD
8 * AND SENDS THE VALUE TO THE LED DISPLAY.
9 * IF JCHAN = 0 NO NEED TO CHECK SSE
10 * JUST CONVERT TO BCD AND SEND TO DISPLAY.
11 *
12 * IN FORTRAN USE:
13 *   CALL DISP(K, JCHAN)
14 * WHERE
15 *   JCHAN = 0  CONVERT TO BCD, SEND TO DISPLAY
16 *           = 1  CHECK SSE, IF OK TO BCD & DISPLAY
17 *           = 2  CHECK SSE, IF OK TO BCD & DISPLAY
18 *
2A20 0082 19 DISP   DATA  X'82'
2A21 0000 20 K      D      0
2A22 0000 21 JCHAN  D      0
2A23 9222 22      LDX   JCHAN
2A24 8800 23      LDW  * 0      GET CHANNEL NUMBER
2A25 0800 24      SAZ      NEED TO TEST CHANNEL #?
2A26 1228 25      JMP   TEST  YES
2A27 1231 26      JMP   BEGIN NO, TO BCD TO DISPLAY
2A28 08B0 27 TEST   SSE
2A29 122E 28      JMP   TRUE   SWITCH SET TO CHAN 1
2A2A F264 29      CMW   D2     SWITCH SET TO CHAN 2
2A2B 0860 30      SEQ      DATA FROM CHAN 2?
2A2C 1245 31      JMP   RET    NO
2A2D 1231 32      JMP   BEGIN  YES, CONVERT TO BCD
2A2E F262 33 TRUE   CMW   D1
2A2F 0860 34      SEQ      DATA FROM CHAN 1?
2A30 1245 35      JMP   RET    NO
2A31 9221 36 BEGIN  LDX   K
2A32 8800 37      LDW  * 0      LOAD VALUE TO BE DISPLAYED
38 *
39 * CONVERT TO BCD
40 *
41      SAP      NEGATIVE VALUE?
42      CMP      YES, ABSOLUTE VALUE
43      CMW   D9999
44      SLE      TOO BIG?
45      LDW   D9999 YES, LIMIT VALUE
46      JSX   RM10  REMAINDER SUBROUTINE
47 DIG4  D      0      LEAST SIG. DIGIT
48      JSX   RM10
49 DIG3  D      0
50      JSX   RM10
51 DIG2  D      0
52      SLL   4      MOST SIG. DIGIT IN ACR
53      ORI   DIG2
54      SLL   4
55      ORI   DIG3
56      SLL   4
57      ORI   DIG4  PACKED BCD IN ACR

```

2A44	03F2	58	SEND	DOT	15,2	SEND TO DISPLAY
2A45	0080	59	RET	SMB	0	
2A46	2083	60		JSX	X'83'	RETURN TO C. FORTRAN
2A47	7260	61	RM10	STW	ASAV	
2A48	0800	62		SAZ		CHECK FOR ZERO NUMERATOR
2A49	124C	63		JMP	S+3	
2A4A	7800	64		STW	* 0	STUFF ZERO REMAINDER
2A4B	1801	65		JMP	* 1	
2A4C	0A11	66		SLL	1	
2A4D	A260	67		ADD	ASAV	
2A4E	7261	68		STW	TSAV	
2A4F	0A04	69		SRL	4	
2A50	A261	70		ADD	TSAV	
2A51	0A04	71		SRL	4	
2A52	A261	72		ADD	TSAV	
2A53	0A04	73		SRL	4	
2A54	A261	74		ADD	TSAV	
2A55	A262	75		ADD	D1	
2A56	0A05	76		SRL	5	
2A57	7261	77		STW	TSAV	QUOTIENT
2A58	0A13	78		SLL	3	
2A59	A261	79		ADD	TSAV	
2A5A	A261	80		ADD	TSAV	
2A5B	0110	81		CMP		-10*QUOTIENT
2A5C	A260	82		ADD	ASAV	
2A5D	7800	83		STW	* 0	REMAINDER
2A5E	8261	84		LDW	TSAV	QUOTIENT IN ACR
2A5F	1801	85		JMP	* 1	
2A60	0000	86	ASAV	D	0	
2A61	0000	87	TSAV	D	0	
2A62	0001	88	D1	D	1	
2A63	270F	89	D9999	D	9999	
2A64	0002	90	D2	D	2	(NOT IN BASIC BCD)
		91		END		

NO ERRORS

A SAV	2A60	BEGIN	2A31	D1	2A62	D2	2A64
D 9999	2A63	DIG2	2A3D	DIG3	2A3B	DIG4	2A39
D ISP	2A20	JCHAN	2A22	K	2A21	RET	2A45
RM10	2A47	SEND	2A44	TEST	2A28	TRUE	2A2E
T SAV	2A61						
PAS?							

```

1 * 12/11/74:8 'LEADR'
2 * ORIG 'X'2A20'
3 * PUNCHES PAPER TAPE LEADER WHEN CALLED
4 * BY MAIN PROGRAM.
5 *
6 * IN FORTRAN USE:
7 * CALL LEADR
8 *
9 LEADR DATA X'82'
10 UNIT EQU 5
11 OPEN F, BUF, WC, UNIT, X'E', 1

S 2A20 0082
   0005
2A21 0080
S 2A22 2042
   2A23 2A37
   2A24 2A40
   2A25 2A3F
   2A26 0005
   2A27 000E
   2A28 8001
   2A29 823D 12 LDW F+6
   2A2A C236 13 ORI X8000 SET SPECIAL FORMAT
   2A2B 723D 14 STW F+6
   2A2C 0080 15 DOIO F, BUF, WC
S 2A2D 2044
   2A2E 2A37
   2A2F 2A40
   2A30 AA3F
   2A31 0080 16 STAT F
S 2A32 2046
   2A33 AA37
   2A34 0080 17 SMB 0
   2A35 2083 18 JSX X'83' RETURN TO C. FORTRAN
   2A36 8000 19 X8000 D X'8000'
   2A37 20 F RES 8
   2A3F 0023 21 WC DATA 35
   2A40 22 BUF RES 35
   0042 23 OPEN EQU 66
   0044 24 DOIO EQU 68
   0046 25 STAT EQU 70
26 END

```

NO ERRORS

BUF	2A40	DO10	0044	F	2A37	LEADR	2A20
OPEN	0042	STAT	0046	UNIT	0005	WC	2A3F
X8000	2A36						
PAS?							

```

1 * 11/6/74:8 'CLOK'
2   ORIG X'2A70'
3 * PROGRAM READS NEW CMOS CLOCK UNTIL
4 * TIME AGREES IN TWO SUCCESSIVE READS.
5 *
6 * IN FORTRAN USE:
7 *   CALL CLOK(JH, JM, JS)
8 * WHERE:
9 *   JH = HOURS
10 *  JM = MINUTES
11 *  JS = SECONDS
12 *
2A70 0082 13 CLOK   DATA  X'82'
2A71 0000 14 JH     D      0
2A72 0000 15 JM     D      0
2A73 0000 16 JS     D      0
2A74 02F3 17       DIN   15,3  BRING IN M1, S10, S1
2A75 72AB 18       STW   TM1
2A76 02F4 19       DIN   15,4  BRING IN H10, H1, M10
2A77 72AD 20       STW   TH1
2A78 02F3 21 NEW   DIN   15,3
2A79 72AC 22       STW   TM2
2A7A 02F4 23       DIN   15,4
2A7B 72AE 24       STW   TH2
2A7C F2AD 25       CMW   TH1
2A7D 0860 26       SEQ           SAME TIME?
2A7E 1283 27       JMP   MOVE   TIMES DO NOT AGREE
2A7F 82AC 28       LDW   TM2
2A80 F2AB 29       CMW   TM1
2A81 0870 30       SNE           SAME TIME?
2A82 1288 31       JMP   DONE   TIMES AGREE
2A83 82AC 32 MOVE   LDW   TM2
2A84 72AB 33       STW   TM1
2A85 82AE 34       LDW   TH2
2A86 72AD 35       STW   TH1
2A87 1278 36       JMP   NEW    READ TIME AGAIN
2A88 82AC 37 DONE   LDW   TM2
2A89 229D 38       JSX   COMB   COMBINE SECONDS DIGITS
2A8A 9273 39       LDX   JS
2A8B 7800 40       STW * 0      STORE TOTAL SECONDS
2A8C 82AE 41       LDW   TH2
2A8D 0A04 42       SRL   4
2A8E 229D 43       JSX   COMB   COMBINE HOURS DIGITS
2A8F 9271 44       LDX   JH
2A90 7800 45       STW * 0      STORE TOTAL HOURS
2A91 82AC 46       LDW   TM2
2A92 0A08 47       SRL   8
2A93 72B1 48       STW   T1
2A94 82AE 49       LDW   TH2
2A95 E2AF 50       AND   XF
2A96 0A14 51       SLL   4
2A97 A2B1 52       ADD   T1
2A98 229D 53       JSX   COMB   COMBINE MINUTES DIGITS
2A99 9272 54       LDX   JM
2A9A 7800 55       STW * 0      STORE TOTAL MINUTES
2A9B 0080 56       SMB   0
2A9C 2083 57       JSX   X'83'  RETURN TO C. FORTRAN

```


2A9D	62B0	58	COMB	STX	HERE	BCD TO DECIMAL VALUE
2A9E	72B1	59		STW	T1	
2A9F	E2AF	60		AND	XF	
2AA0	72B2	61		STW	T2	SAVE UNITS VALUE
2AA1	82B1	62		LDW	T1	
2AA2	0A04	63		SRL	4	
2AA3	E2AF	64		AND	XF	
2AA4	72B1	65		STW	T1	
2AA5	0A13	66		SLL	3	
2AA6	A2B1	67		ADD	T1	
2AA7	A2B1	68		ADD	T1	X10 (TENS VALUE)
2AA8	A2B2	69		ADD	T2	TOTAL VALUE
2AA9	92B0	70		LDX	HERE	
2AAA	1800	71		JMP	* 0	BACK TO MAIN ROUTINE
2AAB	0000	72	TM1	D	0	
2AAC	0000	73	TM2	D	0	
2AAD	0000	74	TH1	D	0	
2AAE	0000	75	TH2	D	0	
2AAF	000F	76	XF	D	X'F'	
2AB0	0000	77	HERE	D	0	
2AB1	0000	78	T1	D	0	
2AB2	0000	79	T2	D	0	
		80		END		

NO ERRORS

CLOK	2A70	COMB	2A9D	DONE	2A88	HERE	2AB0
JH	2A71	JM	2A72	JS	2A73	MOVE	2A83
NEW	2A78	T1	2AB1	T2	2AB2	TH1	2AAD
TH2	2AAE	TM1	2AAB	TM2	2AAC	XF	2AAF
PAS?							

7. APPENDIX C. PROGRAM LISTINGS FOR INTERFACE TEST PROGRAMS AND REAL-TIME ANALYZER ASSEMBLY LANGUAGE DRIVER

Appendix C contains program listings for "MINOS1", TCLOK", TRTA1", and "RTA1".

```

1 * 11/26/74:4 'MINOS1'
2 * ORIG X'1800'
3 * MINIMAL TEST OF COMMUNITY NOISE SYSTEM.
4 * CHANGE LOC B TO GIVE DIFFERENT DELAY
5 * TIME BETWEEN INTERRUPT AND THE DIN IN.
6 * USE SS1 AND SS2 TO GIVE THE FOLLOWING
7 * VALUES ON EXTERNAL DISPLAY:
8 *
9 * WIND SS1, SS2 DOWN (ID = A)
10 * CH1 SS1 UP (ID = B)
11 * CH2 SS2 UP (ID = C)
12 *
13 * EXTERNAL SENSE UP FOR DECIMAL DISPLAY
14 * EXTERNAL SENSE DOWN FOR HEX DISPLAY
15 * (IN HEX MODE MOST SIGNIFICANT DIGIT
16 * IS ID)
17 *
18 * PUT SS0 UP TO HALT AFTER DISPLAY
19 * PUT SS3 UP TO GIVE MASTER RESET
20 * AFTER DISPLAY
21 *
22 *
23 * IF THE WORD 'FACE' REMAINS ON THE DISPLAY
24 * IT SAYS THAT:
25 * 1) DISPLAY IS WORKING
26 * 2) LEVEL 5 DATA INTERRUPT
27 * FROM INTERFACE IS
28 * MISSING OR CPU INTERRUPT
29 * CARD IS MALFUNCTIONING
30 *
1800 0086 31 START SMB $
1801 0050 32 SGM
1802 806E 33 LDW =IT
1803 0080 34 SMB 0
1804 7015 35 STW X'15'
1805 03F6 36 DOT 15,6 MASTER RESET TO FIFO
1806 803C 37 LDW FACE
1807 03F2 38 DOT 15,2 SEND FACE TO DISPLAY
1808 0025 39 ENB 5
1809 1009 40 A JMP A
180A 9035 41 IT LDX B
180B 0501 42 C DXS 1 DELAY
180C 100B 43 JMP C
180D 02F2 44 DIN 15,2 BRING IN FIFO DATA
180E 7037 45 STW T
180F 08D0 46 SS1
1810 1029 47 JMP S1
1811 08E0 48 SS2
1812 102F 49 JMP S2
1813 0A0E 50 SRL 14
1814 F06F 51 CMW =1
1815 0860 52 SEQ WIND DATA?
1816 1028 53 JMP RETA NO
1817 8037 54 DISP LDW T
1818 E03B 55 AND X3FF
1819 08B0 56 SSE WANT HEX OR DECIMAL?
181A 1022 57 JMP JBCD DECIMAL

```

181B	7038	58	STW	T2	SAVE VALUE	
181C	8037	59	LDW	T		
181D	E039	60	AND	XC000		
181E	0A02	61	SRL	2		
181F	A03A	62	ADD	X9000	A, B, OR C ID	
1820	A038	63	ADD	T2	TOTAL HEX NUMBER	
1821	1023	64	JMP	SEND		
1822	203D	65	JBCD	JSX	BCD	CONVERT TO BCD
1823	03F2	66	SEND	DOT	15,2	SEND TO DISPLAY
1824	08C0	67		SS0		
1825	0000	68		HLT		PUSH RUN TO CONTINUE
1826	08F0	69		SS3		
1827	03F6	70		DOT	15,6	MASTER RESET TO FIFO
1828	0015	71	RETA	INR	5	
1829	8037	72	S1	LDW	T	
182A	0A0E	73		SRL	14	
182B	F070	74		CMW	=2	
182C	0860	75		SEQ		DATA CHANNEL 1?
182D	1028	76		JMP	RETA	NO
182E	1017	77		JMP	DISP	YES
182F	8037	78	S2	LDW	T	
1830	0A0E	79		SRL	14	
1831	F071	80		CMW	=3	
1832	0860	81		SEQ		DATA CHANNEL 2?
1833	1028	82		JMP	RETA	NO
1834	1017	83		JMP	DISP	YES
1835	0000	84	B	D	0	
1836	0000	85	RSAVE	D	0	
1837	0000	86	T	D	0	
1838	0000	87	T2	D	0	
1839	C000	88	XC000	D	X'C000'	
183A	9000	89	X9000	D	X'9000'	
183B	03FF	90	X3FF	D	X'3FF'	
183C	FACE	91	FACE	D	X'FACE'	
		92	*			
		93	* CONVERT TO BCD			
		94	*			
183D	6036	95	BCD	STX	RSAVE	SAVE RETURN
183E	0810	96		SAP		NEGATIVE VALUE?
183F	0110	97		CMP		YES, ABSOLUTE VALUE
1840	F06D	98		CMW	D9999	
1841	0890	99		SLE		TOO BIG?
1842	806D	100		LDW	D9999	YES, LIMIT VALUE
1843	2051	101		JSX	RM10	REMAINDER SUBROUTINE
1844	0000	102	DIG4	D	0	LEAST SIG. DIGIT
1845	2051	103		JSX	RM10	
1846	0000	104	DIG3	D	0	
1847	2051	105		JSX	RM10	
1848	0000	106	DIG2	D	0	
1849	0A14	107		SLL	4	MOST SIG. DIGIT IN ACR
184A	C048	108		ORI	DIG2	
184B	0A14	109		SLL	4	
184C	C046	110		ORI	DIG3	
184D	0A14	111		SLL	4	
184E	C044	112		ORI	DIG4	PACKED BCD IN ACR
184F	9036	113	RET	LDX	RSAVE	GET RETURN
1850	1800	114		JMP	* 0	

1851	706A	115	RM10	STW	ASAV	
1852	0800	116		SAZ		CHECK FOR ZERO NUMERATOR
1853	1056	117		JMP	S+3	
1854	7800	118		STW *	0	STUFF ZERO REMAINDER
1855	1801	119		JMP *	1	
1856	0A11	120		SLL	1	
1857	A06A	121		ADD	ASAV	
1858	706B	122		STW	TSAV	
1859	0A04	123		SRL	4	
185A	A06B	124		ADD	TSAV	
185B	0A04	125		SRL	4	
185C	A06B	126		ADD	TSAV	
185D	0A04	127		SRL	4	
185E	A06B	128		ADD	TSAV	
185F	A06C	129		ADD	D1	
1860	0A05	130		SRL	5	
1861	706B	131		STW	TSAV	QUOTIENT
1862	0A13	132		SLL	3	
1863	A06B	133		ADD	TSAV	
1864	A06B	134		ADD	TSAV	
1865	0110	135		CMP		-10*QUOTIENT
1866	A06A	136		ADD	ASAV	
1867	7800	137		STW *	0	REMAINDER
1868	806B	138		LDW	TSAV	QUOTIENT IN ACR
1869	1801	139		JMP *	1	
186A	0000	140	ASAV	D	0	
186B	0000	141	TSAV	D	0	
186C	0001	142	D1	D	1	
186D	270F	143	D9999	D	9999	
	1800	144		END	START	
186E	180A					
186F	0001					
1870	0002					
1871	0003					

NO ERRORS

A	1809	ASAV	186A	B	1835	BCD	183D
C	180B	D1	186C	D9999	186D	DIG2	1848
DIG3	1846	DIG4	1844	DISP	1817	FACE	183C
IT	180A	JBCD	1822	RET	184F	RETA	1828
RM10	1851	RSAVE	1836	S1	1829	S2	182F
SEND	1823	START	1800	T	1837	T2	1838
TSAV	186B	X3FF	183B	X9000	183A	XC000	1839
PAS?							

```

1 C 10/30/74:4 'TCLOK'
2 C     TEST CMOS 'CLOK' PROGRAM
3 C     PUT SSO UP TO STOP PRINTOUT.
4     LOCATE CLOK,X '2A70 '
5     WRITE(3,10)
6 10   FORMAT(3/, 'PUT SSO UP TO STOP PRINTOUT')
7     WRITE (3,1)
8 1    FORMAT (5/, ' HR MIN SEC',/)
9 3    CALL CLOK (JH,JM,JS)
10    WRITE (3,2) JH,JM,JS
11 2   FORMAT (I3,I4,I4)
12 4   KK = ISWCH(0) + 1
13    GO TO (3,4),KK
      END

```



```

1 C 1/27/75:6 'TRTA1'
2 C TESTS RTA1 PROGRAM & PRINTS OUT ALL 1/3 OCTAVE
3 C VALUES, WEIGHTED VALUE, LINEAR VALUE.
4 C
5     LOCATE RTA1,X'2400'
6     DIMENSION KVAL(40),KUND(40),B(33)
7     B(1)=12.5
8     B(2)=16.
9     B(3)=20.
10    B(4)=25.
11    B(5)=31.5
12    B(6)=40.
13    B(7)=50.
14    B(8)=63.
15    B(9)=80.
16    B(10)=100.
17    B(11)=125.
18    B(12)=160.
19    B(13)=200.
20    B(14)=250.
21    B(15)=315.
22    B(16)=400.
23    B(17)=500.
24    B(18)=630.
25    B(19)=800.
26    B(20)=1000.
27    B(21)=1250.
28    B(22)=1600.
29    B(23)=2000.
30    B(24)=2500.
31    B(25)=3150.
32    B(26)=4000.
33    B(27)=5000.
34    B(28)=6300.
35    B(29)=8000.
36    B(30)=10000.
37    B(31)=12500.
38    B(32)=16000.
39    B(33)=20000.
40    WRITE(3,1)
41 1   FORMAT(2/, 'PUT SSO UP TO BRING IN DATA FROM RTA.',3/)
42 2   KK=ISWCH(0)+1
43    GO TO(2,3),KK
44 3   KVAL(40)=0

```

```

45 CALL RTA1(KVAL(1),KUND(1),JOVER)
46 WRITE(3,4)
47 4  FORMAT(4/, ' REAL - TIME 1/3 OCTAVE ANALYZER TYPE 3347 OUTPUT '
48 WRITE(3,5)
49 5  FORMAT(3X, 'BAND', 5X, 'DB', 3X, 'UFLOW', 5X, 'BAND', 5X, 'DB', 3X, 'UFL
50 AVAL=FLOAT(KVAL(1))/10.
51 BVAL=FLOAT(KVAL(17))/10.
52 WRITE(3,6)AVAL, KUND(1), B(16), BVAL, KUND(17)
53 6  FORMAT(/, ' BASE L. ', F7.1, 15, 4X, F8.1, F7.1, 15)
54 DO 10 J=2,16
55 JJ=J+16
56 AVAL=FLOAT(KVAL(J))/10.
57 BVAL=FLOAT(KVAL(JJ))/10.
58 10 WRITE(3,11)B(J-1),AVAL, KUND(J), B(JJ-1), BVAL, KUND(JJ)
59 11  FORMAT(F8.1, F7.1, 15, 4X, F8.1, F7.1, 15)
60 AVAL=FLOAT(KVAL(38))/10.
61 BVAL=FLOAT(KVAL(33))/10.
62 WRITE(3,12)AVAL, KUND(38), B(32), BVAL, KUND(33)
63 12  FORMAT(' WEIGHT. ', F7.1, 15, 4X, F8.1, F7.1, 15)
64 AVAL=FLOAT(KVAL(39))/10.
65 BVAL=FLOAT(KVAL(34))/10.
66 WRITE(3,13)AVAL, KUND(39), B(33), BVAL, KUND(34)
67 13  FORMAT(' LINEAR ', F7.1, 15, 4X, F8.1, F7.1, 15)
68 IF(JOVER)23, 22, 23
69 23  WRITE(3,25)
70 25  FORMAT(/, 'RTA INPUT AMPLIFIER WAS OVERLOADED.')
71 22  IF(KVAL(40))20, 2, 20
72 20  WRITE(3,21)KVAL(40)
73 21  FORMAT(/, 'EXTRA VALUE FROM RTA.  KVAL(40) = ', 15)
74 GO TO 2
END

```

```

1 * 1/27/75:2 'RTA1'
2 *     ORIG X'2400'
3 *
4 * WHEN CALLED BY C. FORTRAN MAIN PROGRAM IT BRINGS
5 * IN 39 VALUES FROM THE REAL TIME ANALYZER.
6 *
7 * IN C. FORTRAN USE:
8 *     DIMENSION KVAL(39),KUND(39)
9 *     CALL RTA(KVAL(1),KUND(1),JOVER)
10 * WHERE
11 *     KVAL(1) = BASE LINE VALUE (DB X 10)
12 *     KVAL(2) = 12.5 HZ VALUE (DB X 10)
13 *
14 *
15 *
16 *     KVAL(34) = 20000 HZ VALUE (DB X 10)
17 *     KVAL(38) = WEIGHTED VALUE (DB X 10)
18 *     KVAL(39) = LINEAR VALUE (DB X 10)
19 *
20 *     KUND IS 39 WORD ARRAY IDICATING IF
21 *         A PARTICULAR 1/3 OCTAVE VALUE
22 *         IS ABOVE THE BASE LINE OR EQUAL
23 *         TO OR BELOW THE BASE LINE
24 *         (CALLED UNDERANGE)
25 * I.E. KUND(11) = 0 (100 HZ BAND > BASE LINE)
26 *       KUND(11) = 1 (100 HZ BAND = OR < BASE LINE)
27 *
28 *     JOVER = 0  NORMAL SIGNAL LEVEL
29 *           = 1  INPUT AMPLIFIER IS OVERLOADED
30 *               (CHANGE INPUT ATTENUATOR SETTING
31 *               TO REDUCE SIGNAL LEVEL)
32 *
2400 0082 33 RTA1  DATA X'82'
2401 0000 34 KVAL  D      0
2402 0000 35 KUND  D      0
2403 0000 36 JOVER  D      0
2404 8432 37     LDW  DEND
2405 0080 38     SMB  0
2406 7009 39     STW  9      STUFF INTERRUPT 2 LINKAGE
2407 8433 40     LDW  DDATA
2408 0080 41     SMB  0
2409 700D 42     STW  X'D'    STUFF INTERRUPT 3 LINKAGE
240A 8401 43     LDW  KVAL
240B 7428 44     STW  COUNT1  LOCATION OF KVAL(1)
240C 8402 45     LDW  KUND
240D 7420 46     STW  COUNT2  LOCATION OF KUND(1)
240E 0100 47     CLR
240F 7434 48     STW  TJOVER  SET TJOVER = 0
2410 0023 49     ENB  3      ENABLE DATA READY INTERRUPT
2411 0361 50     DOT  6,1   DATA REQUEST TO RTA
2412 0022 51     ENB  2      ENABLE END OF SCAN INTERRUPT
2413 1413 52 WAIT  JMP  WAIT  WAIT FOR DATA READY INTERRUPT
53 *
54 * DATA READY INTERRUPT LEVEL 3
55 *
2414 0261 56 DATARDY DIN  6,1   BRING IN DATA FROM RTA
2415 7435 57     STW  T

```

2416	0820	58	SAM		INPUT AMPLIFIER OVERLOADED?	
2417	141A	59	JMP	CONT	NO	
2418	8436	60	LDW	ONE	YES	
2419	7434	61	STW	TJOVER	SET TJOVER = 1	
241A	8435	62	LDW	T		
241B	9420	63	LDX	COUNT2	IX POINTS TO KUND ELEMENT	
241C	E437	64	AND	X4000	EXTRACT UNDERANGE BIT	
241D	0A0E	65	SRL	14	MOVE UNDERANGE BIT	
241E	7800	66	STW	* 0	STORE IN KUND ARRAY	
241F	0401	67	IXS	1		
2420	0000	68	D	0		
2421	6420	69	STX	COUNT2	COUNT2 = COUNT2 + 1	
2422	8435	70	LDW	T		
2423	E438	71	AND	X3FFF	EXTRACT BCD DATA	
2424	2439	72	JSX	BCDB	CONVERT BCD TO BINARY	
2425	9428	73	LDX	COUNT1		
2426	7800	74	STW	* 0	STORE BINARY IN KVAL ARRAY	
2427	0401	75	IXS	1		
2428	0000	76	D	0		
2429	6428	77	STX	COUNT1	COUNT1 = COUNT1 + 1	
242A	0013	78	INR	3	DATA INTERRUPT RETURN	
		79	*			
		80	*	END OF SCAN	INTERRUPT LEVEL 2	
		81	*			
242B	0033	82	ENDSCAN	DSB	3	DISABLE INTERRUPT 3
242C	0032	83		DSB	2	DISABLE INTERRUPT 2
242D	8434	84	LDW	TJOVER		
242E	9403	85	LDX	JOVER		
242F	7800	86	STW	* 0		PASS JOVER VALUE TO FORTRAN
2430	0080	87	SMB	0		
2431	2083	88	JSX	X'83'		RETURN TO C. FORTRAN
2432	242B	89	DEND	D	ENDSCAN	
2433	2414	90	DDATA	D	DATARDY	
2434	0000	91	TJOVER	D	0	
2435	0000	92	T	D	0	
2436	0001	93	ONE	D	1	
2437	4000	94	X4000	D	X'4000'	
2438	3FFF	95	X3FFF	D	X'3FFF'	
		96	*			
		97	*	CONVERT BCD	TO BINARY ROUTINE	
		98	*			
2439	6451	99	BCDB	STX	RT	SAVE RETURN
243A	7452	100		STW	BCDN	
243B	0100	101		CLR		
243C	7453	102		STW	TOT	ZERO BINARY NUMBER
243D	2446	103		JSX	MB10	DIG1 X 10
243E	2446	104		JSX	MB10	DIG2 X 10 + DIG1 X 100
243F	2446	105		JSX	MB10	DIG3X10+DIG2X100+DIG1X1000
2440	8452	106		LDW	BCDN	
2441	0A54	107		SLC	4	
2442	E454	108		AND	XF	
2443	A453	109		ADD	TOT	+DIG4
2444	9451	110		LDX	RT	
2445	1800	111		JMP	* 0	
2446	8452	112	MB10	LDW	BCDN	
2447	0A54	113		SLC	4	
2448	7452	114		STW	BCDN	

2449	E454	115		AND	XF	NEW DIGIT
244A	A453	116		ADD	TOT	
244B	7453	117		STW	TOT	
244C	0A13	118		SLL	3	X8
244D	A453	119		ADD	TOT	
244E	A453	120		ADD	TOT	X10
244F	7453	121		STW	TOT	NEW TOTAL
2450	1800	122		JMP *	0	
2451	0000	123	RT	D	0	RETURN LOC
2452	0000	124	BCDN	D	0	BCD STRING
2453	0000	125	TOT	D	0	BINARY TOTAL
2454	000F	126	XF	D	X'F'	MASK
		127		END		

NO ERRORS

BCDB	2439	BCDN	2452	CONT	241A	COUNT1	2428
COUNT2	2420	DATARDY	2414	DDATA	2433	DEND	2432
ENDSCAN	242B	JOVER	2403	KUND	2402	KVAL	2401
MB10	2446	ONE	2436	RT	2451	RTA1	2400
T	2435	TJOVER	2434	TOT	2453	WAIT	2413
X3FFF	2438	X4000	2437	XF	2454		
PAS?							

8. APPENDIX D. FORTRAN SOFTWARE LISTINGS FOR THE ANALYSIS OF COMMUNITY NOISE DATA

Appendix D contains program listings for Tape Read Program and Calcomp Plot Program.

Tape Read Program

```

10 C PROGRAM TO READ 24 HOURS OF DATA AND PLOT LI ETC.,LEQ EACH HOUR.
20 DIMENSION IOAY(5),LINE(2,6)
30 DIMENSION SPLF(24,6,2),SPECS(351)
40 DIMENSION YF(100),XF(100),FIT(5)
50 INTEGER DAYST,HRST
60 DIMENSION NRIN(100,2),IC2(2),J3(2,1000)
70 COMMON J1(2000),J2(1000)
80 EQUIVALENCE(J1(1),J3(1,1))
90 DATA(FIT(J),J=1,5)/1.,10.,50.,90.,99./
100 C READ IN BEGINNING,END,DELTA FOR BIN - E.G. 40,80,2 MEANS BIN IN 20 BINS FROM
110 C • 40 TO 80 DB WITH 2 DB BIN WIDTH.
120 READ(5,1) IREG,IFND,IDEL
130 C FORMAT() MEANS FREF FORMAT, ALL NUMBERS SEPARATED BY COMMAS. E.G 40,80,2
140 1 FORMAT()
150 NUM=(IEND-IREG)/IDEL
160 WRITE(6,2) NUM,IREG,IEND,IDFL
170 2 FORMAT(1H),'FOLLOWING DATA IS FOR',I3,'BINS FROM',I3,' TO',I3,
180 ' DB IN',I3,' DB STEPS')
190 C READ IN STARTING DAY,HR,NUM OF HRS
200 READ(5,9)DAYST,HRST,NHR
210 9 FORMAT(3I6)
220 READ(0,10)IDAY(2),IDAY(4)
230 10 FORMAT(2A6)
240 IDAY(1)=' DAY'
250 IDAY(3)=' HOUR'
260 IDAY(5)=-0
270 50 CALL ROUNPK(7,L2)
280 IF(J1(1201).EQ.DAYST.AND.J1(1202).EQ.HRST)GO TO 11
290 GO TO 50
300 11 00 100 I1=1,NHR
310 CALL NTPAN(7,7,-1)
320 DO 15 J=1,2
330 IC2(J)=0
340 DO 15 I=1,100
350 15 NRIN(I,J)=0
360 17 IHR=J1(1202)
370 13 CALL ROUNPK(7,L2)
380 C L2 NEGATIVE MEANS READ ERROR. IGNORE BLOCK AND CONTINUE
390 IF(L2.LT.0) GO TO 13
400 IF(J1(1207).NE.0)GO TO 13
410 IF(J1(1202).NE.IHR)GO TO 16
420 C TO 30 BINS DATA IN GIVFN RANGE. IGNORE DATA OUTSIDE RANGE.
430 C DATA GREATER THAN OR EQUAL TO 40 AND LESS THAN 41 PUT IN 40DB BIN.
440 DO 30 J=1,2
450 DO 30 I=1,600
460 IF(J3(J,1)/10..LT.IREG.OR.J3(J,1)/10..GT.IEND) GO TO 30
470 IC2(J)=IC2(J)+1
480 SPLF(11,6,J)=SPLF(11,6,J)+10.*(J3(J,1)/100.1
490 DO 20 K=1,NUM
500 TEST =IREG+K*IDEL
510 20 IF(J3(J,1)/10..LT. TEST) GO TO 21
520 21 NBIN(K,J)=NRIN(K,J)+1
530 30 CONTINUE
540 GO TO 17
550 16 00 40 J=1,2
560 IF(IC2(J).EQ.0) GO TO 40
570 SPLF(11,6,J)=10*ALOG10(SPLF(11,6,J)/IC2(J))
580 XF(1)=NRIN(NUM,J)
590 DO 31 K=2,NUM
600 J4=NUM-K+1
610 31 XF(K)=XF(K-1)+NBIN(J4,J)
620 DO 41 K=1,NUM
630 XF(K)=XF(K)/IC2(J)*100.
640 41 YF(K)=IEND+1-K
650 C INTERPOLATE TO CALCULATE LI,L10 ETC.
660 DO 53 L=1,5
670 53 SPLF(1),L,J)=A1TINT(XF,YF,NUM,FIT(L),2,1)
680 40 CONTINUE

```



```

69*          100 CONTINUE
70*      C   SPECS ARRAY IS FOR GRAPHICAL DISPLAY SYSTEM(CALCOMP)
71*          SPECS(1)=1
72*          SPECS(2)=1
73*          SPECS(3)=NHR
74*          SPECS(4)=1
75*          SPECS(5)=IEND
76*          SPECS(6)=IBEG
77*          SPECS(7)=NHR-1
78*          SPECS(8)=8
79*          SPECS(11)=1
80*          SPECS(12)=8
81*          SPECS(13)=NHR
82*          SPECS(14)=1
83*          SPECS(15)=1
84*          SPECS(16)=1
85*          SPECS(17)=.1
86*          SPECS(18)=.1
87*          SPECS(19)=0
88*          SPECS(20)=0
89*          SPECS(21)=1
90*          LINE(1,1)=' L1'
91*          LINE(1,2)=' L10'
92*          LINE(1,3)=' L50'
93*          LINE(1,4)=' L90'
94*          LINE(1,5)=' L99'
95*          LINE(1,6)=' LEQ'
96*          DO 14 I=1,6
97*      14  LINE(2,I)=-0
98*          DO 12 I=1,NHR
99*      12  XF(I)=I
100*          J=1
101*          SPECS(24)=0
102*          SPECS(26)=0
103*          SPECS(9)=1
104*          SPECS(10)=1
105*          CALL GDLILI(SPECS)
106*          SPECS(9)=NHR-1
107*          SPECS(10)=4
108*          CALL NODLIB(SPECS)
109*          CALL NODLIL(SPECS)
110*          CALL TITLEB('HOURS AFTER START',SPECS)
111*          SPECS(22)=1.5
112*          SPECS(23)=8.5
113*          CALL TITLEG(1.,IDAY,SPECS)
114*          SPECS(22)=.2
115*          SPECS(23)=4.83
116*          DO 102 L=1,6
117*          SPECS(23)=SPECS(23)-.15
118*          SPECS(16)=L
119*          CALL SYMKEY(1.,LINE(1,L),SPECS)
120*          CALL PSLILI(XF,SPLF(1,L,J),SPECS)
121*          CALL SLLILI(XF,SPLF(1,L,J),SPECS)
122*      102 CONTINUE
123*          CALL GDSEND(SPECS)
124*          STOP
125*          END

```

```

1•      SUBROUTINE PDUNPK(M,L2)
2•      COMMON J1(2000),J2(1000)
3•      CALL NTRAN(M,2,ADD,J2,L2,22)
4•      IF(L2.GT.0)GO TO 15
5•      WRITE(6,1)L2
6•      1 FORMAT(1H ,2015)
7•      GO TO 99
8•      15 N=9*L2/4
9•      DO 10 I=1,N,9
10•     K=1+4*(I-1)/9
11•     J1(I)=FLD(0,16,J2(K))
12•     J1(I+1)=FLD(16,16,J2(K+1))
13•     J1(I+2)=FLD(32,4,J2(K+1)*16*16*16+FLD(0,12,J2(K+1)))
14•     J1(I+3)=FLD(12,16,J2(K+1))
15•     J1(I+4)=FLD(28,8,J2(K+1))*16*16+FLD(0,8,J2(K+2))
16•     J1(I+5)=FLD(8,16,J2(K+2))
17•     J1(I+6)=FLD(24,12,J2(K+2)*16+FLD(0,4,J2(K+3)))
18•     J1(I+7)=FLD(4,16,J2(K+3))
19•     J1(I+8)=FLD(20,16,J2(K+3))
20•     10 CONTINUE
21•     99 RETURN
22•     END

```

```

10 C PROGRAM TO READ DATA, BIN, CALCULATE LI, IO, SD, 9D, 99, LEQ AND LIST.
20 DIMENSION YF(100), XF(100), FIT(5), SPLF(5), XLEG(2)
30 INTEGER DAYST, HRST, MINST, DAYFIN, HRFIN, MINFIN
40 DIMENSION NBIN(100,2), IC2(2), J3(2,600)
50 COMMON J1(1215), J2(1000)
60 EQUIVALENCE(J1(1), J3(1,1))
70 DATA(FIT(J), J=1,5)/1., 10., 50., 90., 99./
100 C READ IN BEGINNING, END, DELTA FOR BIN - E.G. 40,80,2 MEANS BIN IN 20 BINS FROM
110 C   40 TO 80 DB WITH 2 DB BIN WIDTH.
120 READ(5,1) IBEG, IEND, IDEL
130 C FORMAT() MEANS FREE FORMAT, ALL NUMBERS SEPARATED BY COMMAS. E.G 40,80,2
140   1 FORMAT()
150   NUM=(IEND-IBEG)/IDEL
160   WRITE(6,2) NUM, IBEG, IEND, IDEL
170   2 FORMAT(1H1, 'FOLLOWING DATA IS FOR', I3, ' BINS FROM', I3, ' TO', I3,
180     ' DB IN', I3, ' DB STEPS')
190 C READ IN STARTING DAY, HR, MIN AND FINISHING DAY, HR, MIN.
200 READ(5,1) DAYST, HRST, MINST, DAYFIN, HRFIN, MINFIN
210 READ(5,1) ICTRL
220 50 CALL RDUNPK(7, L2)
230 IF(J1(1201).EQ.DAYST.AND.J1(1202).EQ.HRST.AND.J1(1203).GE.MINSTIGD
240   .TD II
250   GO TO 50
260   11 CALL NTRAN(7,7,-1)
270   13 CALL RDUNPK(7, L2)
280 C L2 NEGATIVE MEANS READ ERROR. IGNORE BLOCK AND CONTINUE
290 IF(L2.LT.0) GO TO 13
300 IC1=IC1+1
310 IF(ICTRL.EQ.1)WRITE(6,10)(J1(J), J=1201,1215)
320 IF(ICTRL.EQ.2)WRITE(6,10)J1
330 10 FORMAT(1H 2D15)
340 C TO 3D BINS DATA IN GIVEN RANGE. IGNORE DATA OUTSIDE RANGE.
350 C DATA GREATER THAN OR EQUAL TO 40 AND LESS THAN 41 PUT IN 40DB BIN.
360   DD 3D J=1,2
370   DD 3D I=1,600
380   J3(J,1)=J3(J,11)*10
390   IF(J3(J,1)/10..LT.IBEG.OR.J3(J,11/10..GE.IEND) GO TO 3D
400   IC2(J)=IC2(J)+1
410   XLEG(J)=XLEG(J)+10*(J3(J,11/100.)
420   DD 2D K=1, NUM
430   TEST =IBEG+K*IDEL
440 20 IF(J3(J,1)/10..LT. TEST) GO TO 21
450 21 NBIN(K,J)=NBIN(K,J)+1
460 30 CONTINUE
470 IF(J1(1201).EQ.DAYFIN.AND.J1(1202).EQ.HRFIN.AND.J1(1203).GE.MINFIN
480   .) GO TO 12
490   GO TO 13
500 12 IC1=6DU*IC1
510   WRITE(6,3) DAYST, HRST, MINST
520   3 FORMAT(1H , 'DATA STARTS ON DAY', I4, ' HOUR', I3, ' MINUTE', I3)
530   WRITE(6,4) DAYFIN, HRFIN, MINFIN
540   4 FORMAT(1H , 'DATA ENDS ON DAY', I4, ' HOUR', I3, ' MINUTE', I3)
550   WRITE(6,5) IC1
560   5 FORMAT(1H , 'TOTAL POINTS READ =', I10)
570   DO 40 J=1,2
580   WRITE(6,6) J, IC2(J)
590   6 FORMAT(1H0, 'FOR CHANNEL', I2, ' TOTAL POINTS BINNED IN RANGE =', I10)
600   IF(IC2(J).EQ.0) GO TO 40
610   WRITE(6,7)
620   7 FORMAT(1H , ' XLEG LI L10 L50 L90 L99')
630   XLEG(J)=10*ALDGD(XLEG(J)/IC2(J))
640   XF(1)=NBIN(NUM, J)
650   DO 31 K=2, NUM
660   J4=NUM-K+1
670 31 XF(K)=XF(K-1)+NBIN(J4, J)
680   DO 41 K=1, NUM
690   XF(K)=XF(K)/IC2(J)*100.
700 41 YF(K)=IEND+1-K
710 C INTERPOLATE TO CALCULATE LI, LIO ETC.
720   DO 53 L=1,5
730   53 SPLF(L)=AITINT(XF, YF, NUM, FIT(L,2, T))
740   WRITE(6,8) XLEG(J), SPLF
750   8 FORMAT(1H , 10F6.1)
760 40 CONTINUE
770   STDP
780   END

```

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