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A Technique for Recording HF Oblique-Incidence-Sounder Data

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<p>This report documents the equipment, software, and procedures developed for digitization, recording, and display of high-frequency propagation data produced by the AN/TRQ-35 RCS-4B oblique-incidence sounder receiver. The data format is described in detail so that it could be used as a basis for an oblique-incidence sounder data base accessible by any organization interested in HF propagation problems.</p>					
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A TECHNIQUE FOR RECORDING HF OBLIQUE-INCIDENCE-SOUNDER DATA

I. Introduction

This report details the equipment, formats, and procedures developed for recording and displaying HF propagation data produced by the AN/TRQ-35 RCS-4B oblique-incidence sounder receiver. The information is being published in this form because of numerous requests regarding a means for using the large volume of sounder data accumulated by NRL in the course of its ionospheric effects studies. These techniques may ultimately be incorporated in a proposed world-wide data base of ionospheric data.

The AN/TRQ-35 sounder equipment is available to all branches of the DoD and is widely used for near-real-time HF frequency management. The data it produces, if properly recorded and stored, can also be used for numerous other purposes related to studies of ionospheric structure and HF skywave communications. These include studies of the electron density versus height profile of the ionosphere; of forecasts of propagation conditions relevant to HF communications; of the geographical and temporal limitations of sounder data application; and of the effectiveness of frequency management techniques. Permanent records of ionospheric propagation have also proved valuable in evaluating tests of HF devices which are dependent on ionospheric propagation, such as communications transmitters and receivers, or direction finding equipment. — (1.2.1)

The recording equipment described here was developed to record the data efficiently and to make its retrieval easy. Once set up, the recording equipment requires a minimum of operator attention, since the data need be transferred to tape only once per day. The sounder data, in the form of ionograms, are stored in a compact form: four day's worth of data from one sounder receiver can be stored on a 1/4" magnetic tape cartridge of dimensions 153mm x 102mm x 17mm. The system records the amplitudes of the HF signals received, so the ionogram can be later reconstructed with various discrimination levels. With such post-processing it is sometimes possible to detect propagating modes not otherwise apparent.

II. Data Taken from the Sounder Receiver

Figure 1 shows a photograph of both the original CRT display from a sounder receiver and the ionogram data after being digitized, recorded, and

displayed with the equipment described in this report. The main part of the display shows the relative propagation delay times (over a 0-5 msec range) of HF signals as a function of frequency (over a 2-30 MHz range). Above the main display is a display of the receiver's AGC voltage, which is a measure of the amplitude of the strongest (in the range -120 to -65 dBm) mode.

The sounder signals relevant to data recording are listed in Table 1. Although the signals are developed inside the receiver in digital form, most of them are externally accessible only as analog voltages. The propagation delay time data are presented as a sequence of 279 60-msec voltage sweeps, each corresponding to a specific frequency, which arrive at 1-second intervals. In each of these 0-60 msec time intervals the analog voltage represents the variation in the RF signal strength over relative propagation delay times of 0-5 msec. The beginning of ionogram data output is signalled by a TTL trigger pulse (labelled "SA Sync") which goes low at the beginning of the ionogram and stays low until the 279th sweep has been delivered. The onset of each sweep is announced by another TTL trigger pulse (designated "SRS"). The Jth sweep characterizes propagation at the frequency

$$f \text{ [Mhz]} = 1.95 + 0.1 J .$$

The voltage (0-5 volts) of each sweep is sampled at 200 points within the 60-msec interval, so that the Ith sample corresponds to the time delay

$$t \text{ [msec]} = 0.025 I .$$

The 300-microsecond sampling interval was chosen to be somewhat less than the time constant of the output electronics.

The time-delay information is thus contained in $279 \times 200 = 55800$ voltage samples, each of which represents the HF signal amplitude for a unique combination of frequency and propagation time delay. On the CRT, each of the 279 sweeps corresponds to a vertical line at the appropriate frequency, parts of which are illuminated whenever the signal amplitude exceeds a threshold value. When the digitized data are used to recreate an ionogram, a 279×200 pixel array is created and each pixel I,J for which the corresponding amplitude exceeds the threshold amount is illuminated. Most of the storage space is used to store these amplitude values.

The AGC signal is also presented externally as an analog voltage. This voltage is sampled 279 times during each ionogram, one measurement immediately following each 60-millisecond sweep.

In addition, three TTL logic outputs from the receiver indicate which one of the three paths for which the sounder can be set up is being sounded.

III. Recording Instrumentation

The electronic equipment used in the data recording system is listed in Table II and illustrated in the block diagram of Figure 2. The last item, a 3-

1/2" Flexible Disc Drive, is included in Table I because some means is required initially to load the Operating System and the ADC Interface Software into the computer. In typical use this software is usually also stored on both the fixed disc and on the cartridge tape, so that the flexible disc drive is not required.

The electrical connections between the components are illustrated in Figure 3. The circuitry required to electrically isolate the SA Sync pulses, which come once per second during the 279-second ionogram recording period, is diagrammed in Figure 4. This circuitry also generates an addition TTL signal (called EPCON), which starts with each SA sync pulse but lasts for about 450 msec, to maintain the A/D converter in an enabled state until all of the required signals have been digitized.

IV. Computer Programming Details

Data collection is controlled by the BASIC computer program CHIRP4, a listing for which is given in Appendix A. In normal use, the data collection system computer is configured with a memory of 1.6 Mbytes, of which approximately 1.0 Mbytes are used to store the HP BASIC 4.0 System with all of its Drivers and Language Extensions. (Some space could be saved by omitting some of the unneeded Drivers and Language Extensions.) The CHIRP4 program requires about 300 Kbytes. A considerable amount of effort has been expended to make the program user-friendly. Prompts have been built in to explain information to be entered by the user.

Each ionogram recorded by the system is given a name corresponding to the nominal time (Zulu) at which that ionogram started. For example, the ionogram 02FE881215 was collected starting 1215Z on 2 February 1988. Nominal times are all integral multiples of 5 minutes, corresponding to the twelve sounder time slots each hour.

While running, the CHIRP4 program requires the following fixed disc files:

<u>File Name</u>	<u>File Type</u>	<u>Size</u>
ICNOGRAMS	BDAT	16,645,600
PATHDATA	BDAT	5,000
GRAMGRID	BDAT	51,200

Any of these files may, but need not, exist when the program is started. If the program requires one of these files and it doesn't exist, it will create the file.

The ICNOGRAMS file stores the data for up to 291 ionograms, in the format described in Tables III, IV, and V. The data in each ionogram is stored in 143 records, each of 400 bytes length. Since each amplitude sample from the ionogram data requires only a single byte of memory, two samples have been compacted into each 2-byte computer (integer) word.

The PATHDATA file is a small file which stores the names, start time delays, and operating segments for the three paths currently being sounded. When sounder paths on the RCS-4B receiver are changed, this file should be updated with the CHANGE PATHS function, which will prompt the operator to enter the new path information. If the PATHDATA file does not exist when the program is started, the file will be created and default-loaded with data for three paths commonly used at NRL.

The GRAMGRID file contains graphics data with which the ionogram grid and labels can be displayed on the CRT with a simple GLOAD command, rather than being produced in a long series of PLOT and LABEL sequences. While the saving in time is only about two seconds, this amount of time can be critical if the paths chosen require that one ionogram be started very soon after the previous one is concluded. When the RECORDING or DISPLAYING function is started, the program attempts to find the graphics data in RAM memory; if not found there, it goes to the fixed-disc memory; and failing that, the grid and labels are generated with the subprogram Plot_grid. If the grid data must be generated, a GRAMGRID file is created and the grid data stored there.

For some purposes it is useful to compile the program with the BASIC 4.0 Compiler produced by IEM, Inc., P. O Box 8915, Fort Collins, CO 80525. The compiled version is of no advantage when recording data, but can reduce the time required to DISPLAY and produce hard copies of a series of ionograms by about 30%.

V. OPERATING PROCEDURES

With the equipment indicated in Figure 2, data collection is controlled by RUNNING the program CHIRP4. A listing of this program appears in Appendix 1. Most operations are initiated by "softkeys", the labels for which appear on the CRT and form the MENU for the user. Data collection and storage are accomplished by the following functions:

RECORD function: Data collection is started by pressing the softkey corresponding to RECORD on the MENU. The user is first presented with the current time on the computer clock and the three path descriptions with which the program will label the ionograms from the three sounder paths. Since accurate time and path information are essential to the integrity of the data, the user is requested to verify the correctness of this information. The program waits for the start of the next ionogram and then records it and all following ionograms until RECORDING is stopped with the QUIT softkey. Up to 291 ionograms, equal to the full sounder output for slightly over 24 hours, can be stored in the IONOGRAMS file, after which the data must be transferred to magnetic tape for permanent storage. The operator may also stop the program with a PAUSE or RESET computer command. When data RECORDING is again started, the computer remembers the previously recorded ionograms. Thus, if the computer records 20 ionograms and then is stopped, it will start recording ionogram number 21 when RECORDING is again started. If the computer is stopped in the middle of an ionogram, the fractional ionogram is not retained in storage.

DISPLAY Function: This softkey function displays any ionogram whose data exist on the hard disc. The operator is prompted for the name of a single ionogram, or for a list of ionograms to be displayed. When a series of ionograms is selected, the operator may choose which paths shall be chosen. Hard copies are automatically produced, two per page. The computer requires about 110 seconds to display an entire ionogram.

Transfer of Data to 1/4" Cartridge Tape function: The fixed-disc file IONOGRAMS holds 291 ionograms, just over 24 hours worth. Approximately once per day the data must be transferred to tape for permanent storage and the hard disc purged so that more data can be stored. The data can be transferred to tape when less than 291 ionograms have been recorded, but the amount of cartridge tape used is not reduced because the IONOGRAMS file has to be created with a fixed length. A cartridge can contain four transferred files, which are typically named IONOGRAMS1, IONOGRAMS2, IONOGRAMS3, and IONOGRAMS4. This procedure is done manually, rather than with a softkey:

1. Stop the computer with the QUIT softkey function;
2. Insert tape cartridge into the HP7942 drive. The unit will perform housekeeping tasks for about two minutes before being ready for data transfer;
3. Transfer data with the command:

COPY "IONOGRAMS" TO "IONOGRAMS1:7942,1402,1" [RETURN]

(Instead of IONOGRAMS1, use IONOGRAMS2, IONOGRAMS3, or IONOGRAMS4 respectively to transfer the 2nd, 3rd, and 4th loads of ionograms to the tape.) Transfer takes about 15 minutes. If you want to verify that the data have been transferred, or are uncertain about how many files have been transferred to the tape, you can get a catalog of files recorded on the tape with the command

CAT ":7942,1402,1" [RETURN]

4. If a list of the transferred ionograms is desired, press the LIST GRAMS key.
5. PURGE data from the fixed disc.

LIST GRAMS Function: This soft key function produces a CRT listing of all ionograms stored on the fixed disc, and the operator is offered the opportunity to have a hard copy. If the computer has not been PAUSED since the last RECORDING session, the list is available immediately. Otherwise, it can take up to about 20 seconds for the information to be read from the fixed disc.

PURGE Function: This softkey function resets the count of recorded ionograms to zero. (Ionogram data are not actually erased, because that is a time-consuming operation. New ionograms are written over the old ones, and the count is advanced after each new ionogram is completed.) To avoid accidental purges, the operator is asked twice to respond affirmatively to a question regarding his desire to purge the data file.

CHANGE PATHS Function: The data collection program automatically labels data for each ionogram with path name, delay time, and operating segments. If a sounder channel is changed to monitor a different transmitter, the identifying data in the computer must also be changed. The CHANGE PATHS function prompts the operator to enter the new data. The changed identifying information is automatically stored in the fixed disc file PATHDATA so that it will be available even if the computer is switched off and then restarted.

SET TIME function: This softkey function is included to make it easy to set the computer's internal data and time clock. The time should be set with an accuracy of ± 1 second, for which WWV is usually an appropriate standard. Operator is prompted first for date and then for time ZULU; in either case, RETURN leaves the current entry unchanged. When a changed time or date is entered, the clock is set as of the instant of pressing RETURN.

Table I. Electronic Signals Extracted at Jack J7
from the Barry RCS-4B Sounder Receiver

PIN	BARRY SIGNAL DESIGNATION	SIGNAL DESCRIPTION
1	GND	Ground
2	S/A Sync	Spectrum Analyzer (S/A) Sync; TTL LO during each 60-msec data transfer period (sweep)
3	S/A Spectrum Out	Time-of-arrival data: 0-5 v (\Rightarrow signal strength) for a 0-60 msec period (\Rightarrow 0-5 msec relative time delay), once for each of 279 sweeps
4	S/A Clock (3.3 kHz)	(not used in data collection system)
5	Sweep Run/Stop (SRS)	TTL LO during each 279-sec ionogram data collection period
6	Receiver AGC Voltage	Signal strength data: 0-5 v (\Rightarrow -110 to -55 dBm), strength of strongest mode
7	Upper Frequency Limit (UFL)	Sounder scanning range: LO \Rightarrow 2-30 MHz; HI \Rightarrow 2-16 MHz
8	Path 1	TTL LO when path 1 is being sounded
9	Path 2	TTL LO when path 2 is being sounded
10	Path 3	TTL LO when path 3 is being sounded
11	nc	
12	nc	

Table II
Electronic Components comprising the Data Collection System

1. Barry Research Corporation RCS-4B Chirpsounder Receiver
2. NRL-made pulse-shaping circuitry (See circuit diagram, Figure 4.)
3. Hewlett Packard Company (HP) 300-Series computer, Model 98580A Bundled System, option 4 (Operating System on 3 1/2" Flexible Discs); includes HP35731A Graphics Display CRT (medium resolution, bit-mapped, monochromatic Display)
 - 3a. HP 98620B DMA controller
 - 3b. HP 98625 HPIB Hi-speed disc interface
 - 3c. HP 98640A 7-channel ADC interface
 - 3d. HP 98645A software for ADC interface, Option 630 (3 1/2" flexible disc)
4. HP 7942 24 Mbyte Winchester/65Mbyte cartridge tape drive
5. Black Box Company 488 data buffer
6. HP Thinkjet printer
7. HP 9122S 3 1/2" flexible disc drive

TABLE III. Organization of the IONOGRAMS file, which is created as a data (BDAT) file of 41614 records, each of length 400 bytes.

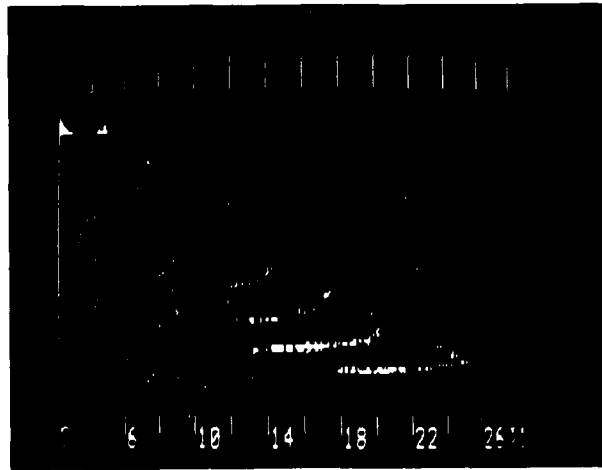
<u>Records</u>	<u>Contents</u>
1 - 143	Data for Ionogram 1
144-286	Data for Ionogram 2
287-429	Data for Ionogram 3
.	.
.	.
41470-41613	Data for Ionogram 291
41614	Number of ionograms recorded in the file, in I4 format

TABLE IV. Contents of the 143 records, of length 400 bytes each, comprising the data for a single ionogram.

<u>Record</u>	<u>Contents</u>
1	Header (396 characters)
2-3	AGC data (279 two-byte integers, representing the AGC values for the 279 sounder sweeps)
4	Ionogram data for sweep 1 (200 two-byte integers representing the amplitudes for the 200 digitized ionogram pixels of sweep 1)
5-143	Ionogram data for sweeps 2-279 (200 two-byte integers, representing the amplitudes for the 200 digitized pixels of each of two adjacent sweeps. The less-significant bytes contain amplitude data for one sweep, and the more-significant bytes contain amplitude data for the following sweep.)

TABLE V. Description of the 440-byte Header record.

<u>Character</u>	<u>Contents</u>
1-10	Ionogram name (for example: 03JA871345, which describes the nominal Zulu date and time of ionogram start)
11-12	" " (2 blank characters)
13-40	Path name (for example "TINKER TO FT HUACHUCA ")
41-48	Sounder path number (1,2,or 3; for example: " PATH 2")
49-50	" "
51-56	Time delay of sounder transmitter start (for example: 01M50S)
57-58	" "
59-69	Date of start of sounder transmission (for example: 15 Jan 1988)
70-71	" "
72-79	Zulu time of start of sounder transmission (for example: 16:17:11)
80	"Z" (referring to Zulu time)
81-400	Blank



NAVAL RESEARCH LABORATORY IONOGRAM 04MR881910
 GIBRALTAR TO NRL D=57 4Mar1988 19:11:29Z
 SOUNDER PATH 1

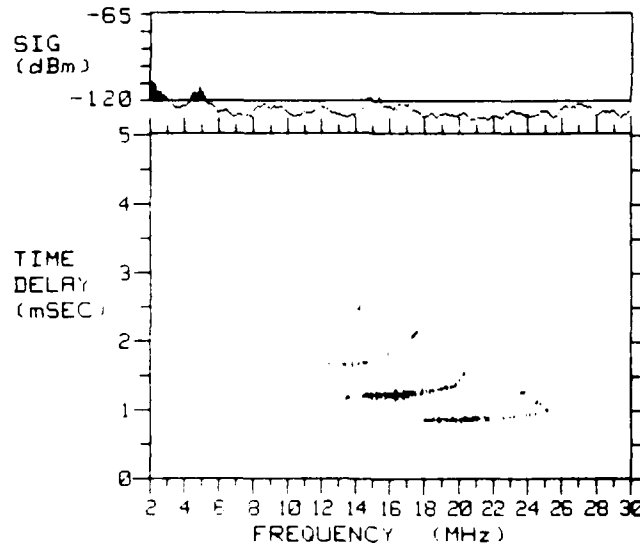


Figure 1. Ionogram 04MR881910, representing HF propagation over the Gibraltar (UK) to NRL path. Top: a photograph of the CRT display on the RCS-4B sounder receiver. Bottom: the same data after digitization and display on the NRL data recording system.

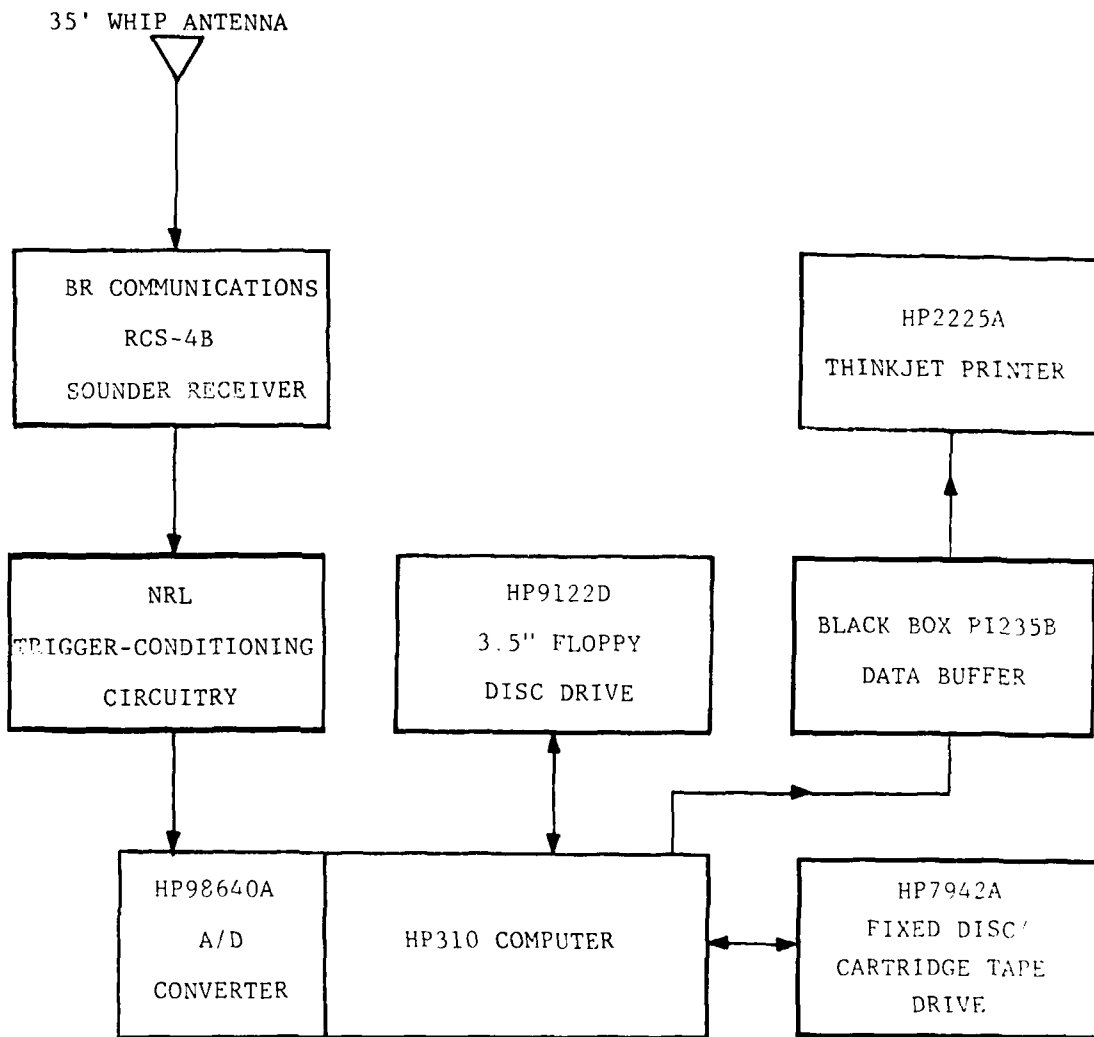


Figure 2. Block diagram of the oblique-incidence-sounder data collection system.

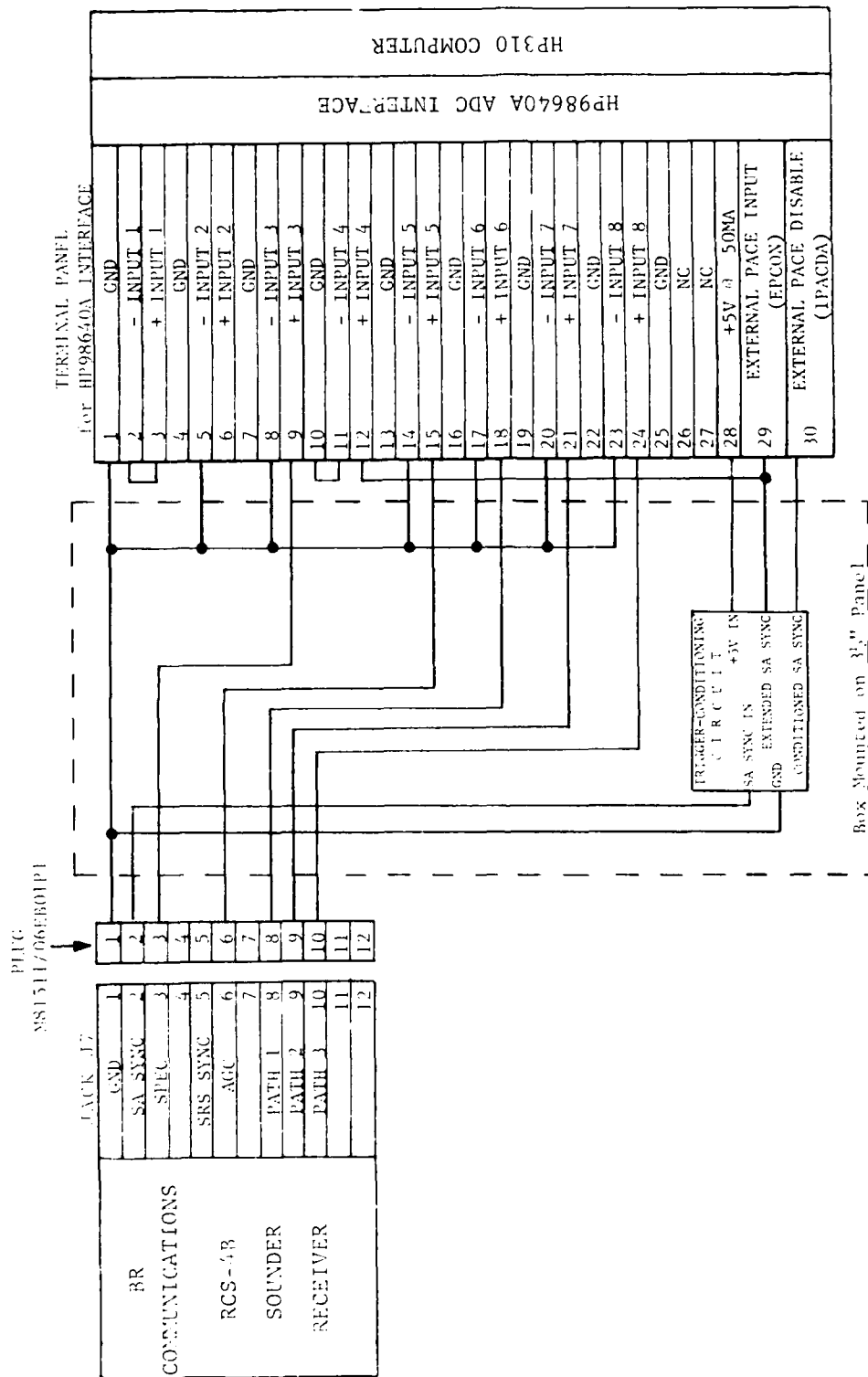


Figure 3. Electrical circuitry connecting the RCS-4B sounder receiver, the trigger-conditioning circuit, and the ADC interface attached to the HP310 computer.

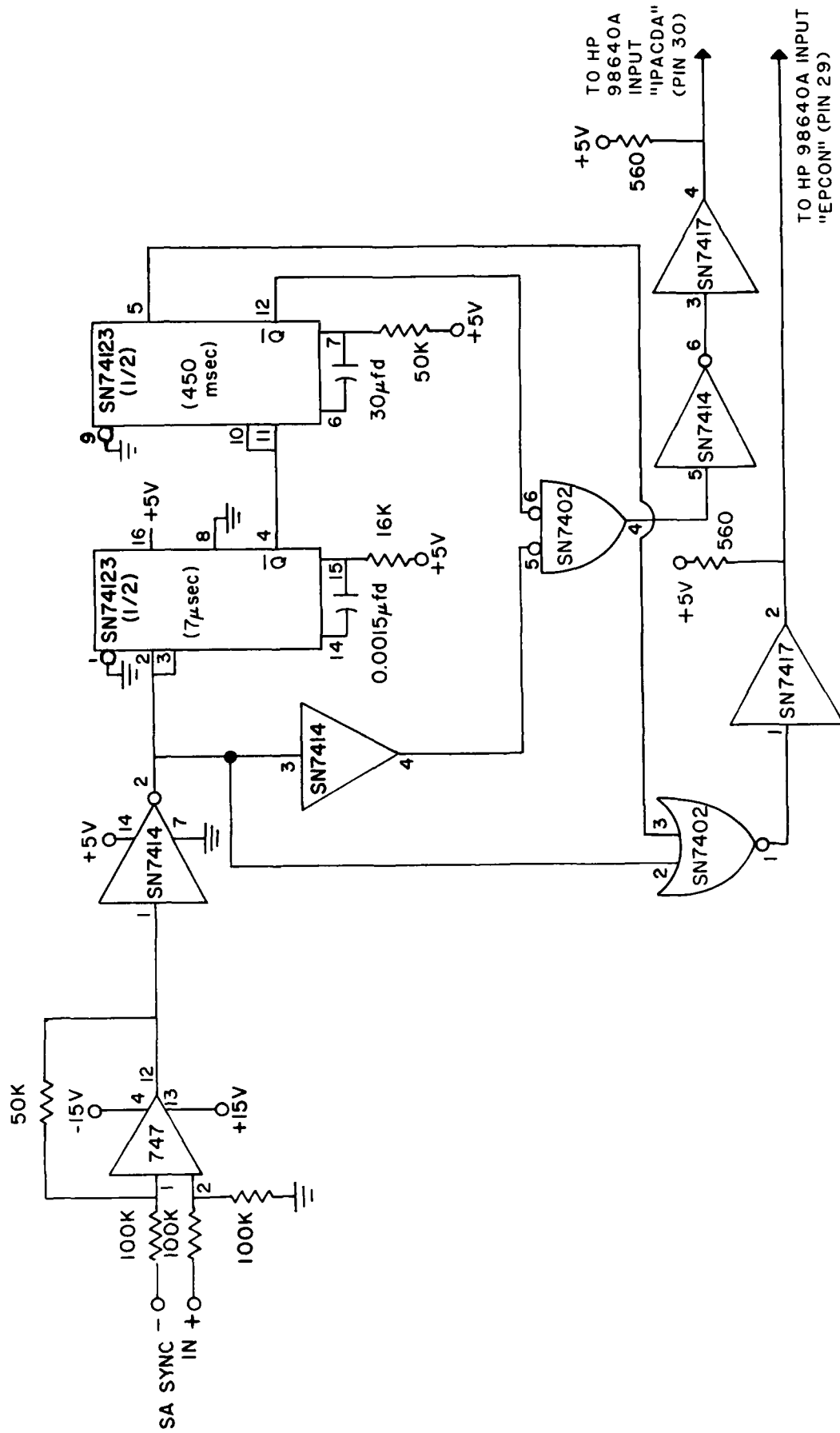


Figure 4. Circuitry used to isolate the sounder receiver's SA Sync pulse, and to generate an additional "EPCON" pulse required by the A/D converter.

APPENDIX. CHIRP4 LISTING

This BASIC program is written for Hewlett-Packard 300-series computers. The fixed-disc is addressed ":7942,1402,0" and the 1/4" magnetic cartridge tape unit designation is "HP7942,1402,1". Lines 1155-1166 represent machine-language subprograms from the HP98645A Measurement Library, which permit BASIC control of the HP98640A A/D converter.

1 PROGRAM CHIRP4

2
3 This program for the Hewlett-Packard 310 computer enables data from
4 a Barry Research RCS-4B ionospheric sounder receiver to be recorded
5 on an HP7942 fixed-disc storage unit, and to be reproduced on an
6 HP 2225A Thinkjet printer.

7
8 Up to 291 ionograms may be stored in the "IONOGRAMS" fixed-disc file.
9 In routine operation, the "IONOGRAMS" file is filled, copied onto a 1/4"
10 cartridge magnetic tape, and then purged, making it possible to fill
11 another "IONOGRAMS" file. Up to four such files, typically named
12 IONOGRAMS1", "IONOGRAMS2", "IONOGRAMS3", and "IONOGRAMS4", can be
13 copied onto a single 65-Mbyte tape.

14
15 The "IONOGRAMS" fixed-disc file contains 41614 records of 400 bytes each.
16 Data for individual ionograms are stored in successive blocks of 143
17 records, each of which has the following format:

18
19 Rec. 1 Header (400 characters)
20 Recs. 2-3 IAGC, 279 integers of AGC data (in 400-element array)
21 Rec. 4 200 integers representing SPEC data for first sweep
22 Recs.5-143 139 records of 200 characters each, in which the
23 least significant bytes represent SPEC data for one
24 sweep and the more significant bytes represent SPEC
25 data for the following sweep

26
27 Record 41614 contains (in I4 format) the number of ionograms recorded
28 in the "IONOGRAMS" file.

29
30 The OSUB routines at the end of this program must be loaded from the
31 HP98645A software for the HP98640A ADC interface. They are required
32 only for the RECORD function.

33
34
35 Program written by:
36 Mark Daehler
37 Code 4181
38 Naval Research Laboratory
39 Washington, DC 20375
40 (202)767-2991

41
42 Latest revision: 5 April 1988

43
44 OPTION BASE 1
45 GINIT
46 PRINTER IS 1
47 CONTROL CRT,12:1 1 Key labels off
48 PRINT CHR\$(128) 1 Stop blinking and inverse video, if on
49 OUTPUT #60:CHR\$(255);CHR\$(75); 1 Clean screen
50 MASS STORAGE IS " :HP7942,1402 " 1 Fixed-disc/cartridge tape combination
51 CONTROL #60,15:1 1 Makes HIL keyboard (200 series keyboard) compatible
52 1 with 98203 keyboard (the keyboard on HP9836)

```
53 DIM Soundata(5),Sdata(400),Agc(400),Titles$(396),Houskeep(7),Spec(200),Tmd  
t(279),Path$(0:3)(28),U$(180),O$(10),Tex$(80),Tt$(80),O1$(31),Temp(200)  
54 DIM Lat(3),Long(3),Oseq$(3)(20),Newopath$(29),Newoosseq$(20),A$(200)  
55 INTEGER Ispec(200),Iagc(400),Iout(200),Gridarray(25600),Imonth,Path,Itemp  
(200),Tdelay(0:3,2),Tdmn,Tdsec,Jcattest  
56 ALLOCATE Ocat$(294)(48)  
57 Function$="PROGRAMSTART"  
58 Gridready$="NO"  
59 Catuotodate$="NO"  
60 Journal$="NOJOURNAL"  
61 DIM Mon$(36),Mon2$(24)  
62 Mon$="JANFEBMARAPRMAJUNJULAUGSEPOCTNOVDEC"  
63 Mon2$="JAFEMRAPMYJNJLAUSEOCNODE"  
64 Discrim=.45  
65 Halt$=""  
66 IF TIMEDATE(2,113717248)ISE+11 THEN GOTO Settime ! Reset time if  
67 Menu:!  
68 Oldfunction$=Function$  
69 Function$="MENU"  
70 IF Oldfunction$="CHANGEPATHS" THEN GOTO 73  
71 OUTPUT KBD:CHR$(255)&CHR$(75): ! Clear screen  
72 IF Oldfunction$="SETTIME" THEN GOSUB Displaytime  
73 PRINTER IS 1  
74 OFF ERROR  
75 CONTROL CRT,12:0 ! Turn on user-key labels  
76 ON KEY 0 LABEL "RECORD",1 GOTO Record  
77 ON KEY 1 LABEL "DISPLAY",1 GOTO 330  
78 ON KEY 2 LABEL "LIST GRAMS",1 GOSUB 517  
79 ON KEY 3 LABEL "PURGE" GOTO Purge  
80 ON KEY 4 GOSUB Do_nothing  
81 ON KEY 5 GOSUB Do_nothing  
82 ON KEY 6 LABEL "QUIT" GOTO End  
83 ON KEY 7 GOSUB Do_nothing  
84 ON KEY 8 LABEL "CHANGE PATHS",1 GOTO Changepaths  
85 ON KEY 9 LABEL "SET TIME",1 GOTO Settime  
86 IF Function$="SETTIME" THEN GOTO 39  
87 PRINT USING 556:DATE$(TIMEDATE),TIME$(TIMEDATE)  
88 GOTO Loop  
89 IF Oldfunction$="PROGRAMSTART" THEN  
90 CONTROL CRT,1:11 ! Set to CRT line 11  
91 A$=RPT$( " ",20)  
92 PRINT A$:" NAVAL RESEARCH LABORATORY"  
93 PRINT A$:" WASHINGTON, DC 20375 USA"  
94 PRINT  
95 PRINT A$:"CHIRPSOUNDER IONOGRAM RECORDING PROGRAM"  
96 Function$=""  
97 END IF  
99 IF Function$="DISPLAY" THEN PRINT RPT$(CHR$(10),3)&RPT$( " ",31):THE IONO  
GRAMS' FILE CONTAINS NO IONOGRAMS FROM THE REQUESTED PATHS"  
99 CONTROL CRT,12:2 ! Key labels always on  
100 Function$="MENU"  
101 Loop: GOTO Loop
```

```

154 CONTROL @Grampath,7:41614 ! Set EOF pointer to end of file
155 GOSUB Plot_grid
156 Catuptodate$="NO"
157 U$=RPT$(" ",75)
158 OFF KEY
159 ON KEY 0 GOTO Do_nothing
160 ON KEY 1 GOTO Do_nothing
161 ON KEY 2 GOTO Do_nothing
162 ON KEY 3 GOTO Do_nothing
163 ON KEY 4 GOTO Do_nothing
164 ON KEY 5 GOTO Do_nothing
165 ON KEY 6 LABEL " QUIT",1 GOTO 65
166 ON KEY 7 GOTO Do_nothing
167 ON KEY 8 GOTO Do_nothing
168 ON KEY 9 GOTO Do_nothing
169 CONTROL CRT,12:2 ! Key labels on
170 PRINT RPT$(CHR$(10),15) ! CHR$(10)=line feed
171 PRINT USING "" "IONOGRAM" ",40":Gramnum
172 PRINT
173 PRINTER IS 1:EOL CHR$(13) ! CR only (no linefeed) after PRINT statement
174 PRINT "SWEEP"
175 IMAGE 5 X,40
176 Start_search: Time1=TIMEDATE ! Wait for beginning of ionogram
177 Sequential_scan("SPECTRUM",2,2,.000301,Spec(+),200)
178 Sequential_scan("SOUNDER",1,7,.00002,Houskeep(+),1)
179 Time2=TIMEDATE ! TIME2 is start time for this ionogram
180 IF (Time2-Time1)>.10 THEN GOTO First_scan
181 WAIT .10
182 GOTO Start_search
183 First_scan: Path=-1*SGN(Houskeep(5)-2.5)-1)/2-(SGN(Houskeep(6)-2.5)-1)-3*(S
GN(Houskeep(7)-2.5)-1)/2
184 K=1
185 Apc(K)=Houskeep(4)
186 Plot_data: FOR J=1 TO 200 ! Plot data for first sweep
187 Spec(J)=MAX(0,Spec(J))
188 IF Spec(J)≠Discrim THEN 191
189 PLOT X,J
190 PENUP
191 NEXT J
192 IF Path 0 OR Path 3 THEN Path=0
193 U$=Path$Path/2RPT$(" ",25) ! U$=Name of ionogram
194 U$=U$(1,25)
195 T1$=TIME$(Time2)
196 D1=VAL(T1$(4,5))
197 IF FRACT(D1*.5)=0 THEN GOTO 200
198 D1=D1-1
199 GOTO 187
200 D1$="00"VAL$D1
201 D1$=D1$(LEN(D1$)-1,LEN(D1$))
202 Dat$=DATE$(Time2)
203 Month=POS(Mon$)UPC$(Dat$(4,5))-2)/3
204 D$=Dat$(1,2)Mon$(2,2)*Month-1,2+Month/3Dat$(10,11)D1$(1,2)D1$
205 IF D$(1,1)≠" " THEN D$="0"2D$(2,10)

```

```

206   MAT Ispec= (51.2)*Spec      ! 51.2=256/5.0
207   OUTPUT @Grampath,4+143*(Gramnum-1):Ispec(*)
208   PRINT USING 228:K
209   RPLOT 1,220+10*Agc(1)
210   PENUP
211   FOR K1=1 TO 139
212   MAT Ispec= (-32768)
213   K=2*K1
214   Even_scan:Sequential_scan("SPECTRUM",2,2,.00030),Spec(*),200
215   Sequential_scan("SOUNDER",1,7,.00002,Houskeep(*),1)
216   Agc(K)=Houskeep(4)
217   FOR J=1 TO 200      ! PLOT DATA FOR THIS SWEEP
218     Spec(J)=MAX(0,Spec(J))
219     IF Spec(J) > Discrim THEN 222
220     RPLLOT K,J
221     PENUP
222   NEXT J
223   MAT Itemp= (51.2)*Spec      ! Round spectrum values to integers
224   MAT Temp= Itemp            ! Convert to real
225   MAT Temp= (256.0)*Temp
226   MAT Ispec= Ispec+Temp
227   PRINT USING 228:K
228   IMAGE "SWEEP ",30
229   RPLLOT K,220+10*Agc(K)
230   PENUP
231   IF K1=1 THEN
232     OSIZE 4,.5
233     MOVE 366,375
234     LABEL 0$
235     MOVE Xzero,Yzero
236   END IF
237   IF K1=2 THEN
238     MOVE 76,360
239     OSIZE 4,.406
240     LABEL USING "32x,.20" Discrim
241     MOVE Xzero,Yzero
242   END IF
243   IF K1=3 THEN
244     MOVE 76,345
245     LABEL USING "13x,.21" Path
246     MOVE Xzero,Yzero
247   END IF
248   IF K1=4 THEN
249     MOVE 76,380
250     OSIZE 4,.406
251     LABEL USING "14x,.14" Path$ Path [1] 141
252     MOVE Xzero,Yzero
253   END IF
254   IF K1=5 THEN
255     MOVE 76,350
256     OSIZE 4,.406
257     LABEL USING "14x,.14" Path$ Path [1] 15 131

```

```

258     MOVE Xzero,Yzero
259     END IF
260 Odd_scan:      K=K+1
261     Sequential_scan("SPECTRUM",2,2,,.000301,Spec(+),200)
262     Sequential_scan("SOUNDER",1,7,,.00002,Houskeep(+),1)
263     Agc(K)=Houskeep(4)
264     FOR J=1 TO 200     ! PLOT DATA FOR THIS SWEEP
265         Spec(J)=MAX(0,Spec(J))
266         IF Spec(J) Discrim THEN 269
267         RPLLOT K,J
268         PENUP
269         NEXT J
270         MAT Temp= (51.2)*Spec
271         MAT Ispec= Ispec+Temp
272         PRINT USING 228:K
273         RPLLOT K,220+10*Agc(K)
274         PENUP
275         OUTPUT @Grampath:Ispec(*)
276     NEXT K1
277     PRINTER IS 1
278     MAT Iagc= (51.2)*Agc
279     Delay$="0"&VAL$(Tdelay(Path,2))
280     Delay$=Delay$[LEN(Delay$)-1,LEN(Delay$)]&"S"
281     D$="0"&VAL$(Tdelay(Path,2))
282     Delay$=D$[LEN(D$)-1,LEN(D$)]&"M"&Delay$     ! PATH DELAY (XXMYYS); 5 CHRS
283     Title$=Q$3" "&U$[1,28]3" PATH "&VAL$(Path)&" "&Delay$&" "&Dat$&" "&T
1m$
284     Title$=Title$&RPT$(" ",396-LEN(Title$))     ! Title$ IS 396 CHARACTERS LONG
285     OUTPUT @Grampath,1+143.0*(Gramnum-1) USING "396A":Title$
286     OUTPUT @Grampath:Iagc(*)
287     Gramnum=Gramnum+1
288     Jcat=Jcat+1
289     Qcat$(Jcat)=Q$
290     OUTPUT @Grampath,416+4 USING "40":Jcat
291     PRINT "ALL DONE"
292     MOVE Xzero,Yzero+220
293     FOR J=1 TO 279
294     IF Agc(J) 0 THEN 296
295     RPLLOT J,0
296     RPLLOT J,10*Agc(J)
297     PENUP
298     NEXT J
299     MOVE 75,360
300     CSIZE 4,,406
301     LABEL USING 302:U$,Dat$,Tim$
302     IMAGE 2BA,10X,3A,2X,3A,"Z"
303     IF Journal$="NOJOURNAL" THEN GOTO 308
304     PRINTER IS 701
305     PRINT USING 306:U$,Path,Dat$,Tim$,Q$
306     IMAGE 2BA," PATH="&D,2D,3X," 11A,1X,3A," Z",3X,10A
307     PRINTER IS 1
308     OUTPUT K80:CHR$(155)3CHR$(75):      ! Clear ALPHA screen
309     GOTO 155

```

```

310 |
311 | ***** OUTPUT IONOGRAM TO HP2225A THINKJET PRINTER *****
312 |
313 Hard_copy: Function$="HARDCOPY"
314 PRINTER IS 1
315 PRINT TABXY(1,1): | Move cursor to upper left-hand corner of CRT
316 PRINT RPT$(CHR$(10),15) | 15 line-feeds
317 PRINT " " | Remove "IONOGRAM" from CRT
318 PRINT " " | Remove "XXX OF XXX" from CRT
319 PRINT " " | Remove "SWEEP XXX" from CRT
320 PRINTER IS 701
321 GRAPHICS ON
322 CLEAR 7 | This command required when using HP25716 printers
323 INTEGER S2(25600)
324 STATUS CRT,12:Zzz
325 CONTROL CRT,12:1
326 GSTORE S2(*)
327 DUMP GRAPHICS
328 RETURN
329 |
330 | ***** DISPLAY IONOGRAMS FROM DISC *****
331 |
332 PRINTER IS 1
333 OFF TIME
334 OUTPUT KBD:CHR$(255)&CHR$(75): | Clean screen
335 GRAPHICS OFF
336 Function$="DISPLAY"
337 IF Catuptodate$="NO" THEN
338 CONTROL CRT,1:11 | Set CRT cursor to line 11
339 PRINT RPT$(" ",19):"READING LIST OF IONOGRAMS IN HARD DISC"
340 GOSUB List_grams
341 CONTROL CRT,1:11
342 PRINT RPT$(" ",80)
343 CONTROL CRT,1:1
344 END IF
345 OFF KEY
346 ON KEY 0 GOSUB Do_nothing
347 ON KEY 1 GOSUB Do_nothing
348 ON KEY 2 LABEL " LIST GRAMS",! GOTO Remindoperator
349 ON KEY 3 GOSUB Do_nothing
350 ON KEY 4 GOSUB Do_nothing
351 ON KEY 5 GOSUB Do_nothing
352 ON KEY 6 LABEL " QUIT",! GOTO 74
353 ON KEY 7 GOSUB Do_nothing
354 ON KEY 8 GOSUB Do_nothing
355 ON KEY 9 GOSUB Do_nothing
356 CONTROL CRT,12:2 | Key labels on
357 Quant=0 | Quant= number of ionograms to be plotted
358 STATUS CRT,1:K | K = Current CRT line position
359 PRINT " ENTER names of ionograms to be plotted as in following examples:"
360 PRINT

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361 PRINT "          SINGLE IONOGRAM:                ZAP850005"
362 PRINT "          MULTIPLE IONOGRAMS:           2JU860015-3JU861025"
363 PRINT "          ALL, OR ALL OF ONE PATH:        ALL"
364 PRINT
365 CONTROL CRT,12:2          ! Key labels on
366 PRINT " CHOICE:  ":
367 Q1$=""
368 K=0
369 GOSUB Askfora
370 Q1$=TRIM$(UPC$(A$(1,31)))
371 IF Q1$="" THEN GOTO 365
372 IF Q1$="ALL" THEN
373     Qfirst$=Qcat$(1)(1,10)
374     Qlast$=Qcat$(Jcat)(1,10)
375     GOTO 391
376 END IF
377 Ipos=POS(Q1$,"-")
378 IF Ipos=0 THEN
379     Qfirst$=TRIM$(Q1$)
380     Qlast$=TRIM$(Q1$)
381     Quant=1          ! Quant= number of ionograms to be plotted
382     GOTO 387
383 END IF
384 IF Ipos<9 THEN GOTO 365
385 Qfirst$=Q1$(1,Ipos-1)
386 Qlast$=Q1$(Ipos+1,LEN(Q1$))
387 IF LEN(Qfirst$)>10 THEN Qfirst$=Qfirst$(1,10)
388 IF LEN(Qlast$)>10 THEN Qlast$=Qlast$(1,10)
389 IF LEN(Qfirst$)=9 THEN Qfirst$="0"3Qfirst$
390 IF LEN(Qlast$)=9 THEN Qlast$="0"3Qlast$
391 IF Datuotodate$="NO" THEN GOSUB List_grams
392 FOR K1=1 TO Jcat
393     Kfirst=K1
394     IF Qfirst$=Qcat$(K1)(1,10) THEN GOTO Nexttques
395 NEXT K1
396 PRINT USING 397:Qfirst$
397 IMAGE " THERE IS NO IONOGRAM ",K,".  ENTER REQUEST AGAIN."
398 GOTO 365
399 Nexttques:  FOR K2=1 TO Jcat
400     Klast=K2
401     IF Qlast$=Qcat$(K2)(1,10) THEN GOTO Choose_path
402 NEXT K2
403 PRINT USING 404:Qlast$
404 IMAGE " THERE IS NO IONOGRAM ",K,".  ENTER REQUEST AGAIN."
405 GOTO 357
406 Choose_path:  Stepsize=SGN(Klast-Kfirst)
407 IF Stepsize=0 THEN Stepsize=1
408 IF Quant=1 THEN GOTO 403
409 PRINT PRT$(CHR$(10),3)          ! 3 line feeds
410 PRINT

```

```

411 PRINT "TO DISPLAY IONOGRAMS FROM JUST 1 OR TWO PATHS RETURN PATH NUMBERS."
"
412 PRINT "FOR EXAMPLE, FOR JUST PATH 1 RETURN 1"
413 PRINT " FOR PATHS 2 AND 3 RETURN 23"
414 PRINT "FOR ALL PATHS, PUSH RETURN"
415 PRINT
416 PRINT "CHOICE: ";
417 GOSUB Ask_fora
418 IF A$="" THEN GOTO 428
419 Plot1=0
420 Plot2=0
421 Plot3=0
422 FOR K=1 TO LEN(A$)
423 IF A$(K,K)="1" THEN Plot1=1
424 IF A$(K,K)="2" THEN Plot2=2
425 IF A$(K,K)="3" THEN Plot3=3
426 NEXT K
427 IF Plot1+Plot2+Plot3<>0 THEN GOTO 431
428 Plot1=1
429 Plot2=2
430 Plot3=3
431 FOR Pathee=1 TO 3 ! Plot all of path 1, then path 2, then path 3
432 IF Pathee=1 AND Plot1<>1 THEN GOTO Next_pathee
433 IF Pathee=2 AND Plot2<>2 THEN GOTO Next_pathee
434 IF Pathee=3 AND Plot3<>3 THEN GOTO Next_pathee
435 Quant=0
436 FOR KK2=Kfirst TO Klast STEP Stepsize
437 IF Qcat$(KK2)[48,48]=VAL$(Pathee) THEN Quant=Quant+1
438 NEXT KK2
439 IF Quant<0 THEN GOTO Goahead
440 GOTO Next_pathee
441 Remindoperator: GOSUB 617 ! Fetch list of ionograms
442 GOTO 356 ! Go back & ask for grams to be displayed
443 Goahead: Newpage$="YES" ! 2 ionograms per page
444 ON KEY 2 GOTO Do_nothing
445 Nowk=0
446 FOR KK2=Kfirst TO Klast STEP Stepsize
447 Q1$=Qcat$(KK2)[1,10]
448 IF Qcat$(KK2)[48,48]=VAL$(Pathee) THEN GOTO 461
449 Nowk=Nowk+1
450 GOSUB Displaygram ! This is the routine in which a
451 PRINTER IS 701 ! series of ionograms is plotted.
452 IF Newpage$="YES" THEN
453 PRINT CHR$(12) ! CHR$(12)=page eject
454 PRINT CHR$(10),CHR$(13) ! CHR$(10)=wide line feed
455 Newpage$="NO" ! CHR$(13)=narrow line feed
456 ELSE
457 PRINT CHR$(10) ! line feed
458 Newpage$="YES"
459 END IF
460 GOSUB Hand_body

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```

461         NEXT Kk2
462 Next_pathee:     NEXT Pathee
463     PRINTER IS 1
464     CONTROL CRT,12:2     ! KEY LABELS ON
465     GOTO SS
466 Displaygram:     ! IF LEN(Q1$)>10 THEN Q1$=Q1$*10"
467     OUTPUT KBD:CHR$(255)&CHR$(75):     ! Clean screen
468     GOSUB Plot_Grid
469     MOVE 366,375
470     CSIZE 4,,5
471     IF LEN(Q1$)=10 AND Q1$(10,10)="" THEN GOTO 474
472     LABEL " "3Q1$
473     GOTO 475
474     LABEL Q1$
475     PRINTER IS 1
476     PRINT RPT$(CHR$(10),15)     ! CHR$(10)=Line feed
477     IF Qlast$="" THEN GOTO 481
478     PRINT " IONOGRAM"
479     PRINT USING 480:Nowk,Quant
480     IMAGE 30," OF ",30
481     PRINTER IS 1:EOL CHR$(13)     ! End of line sequence is CR only (no LF)
482     PRINT USING 515
483     ENTER @Grampath,1+143*(Kk2-1) USING "396A":Title$
484     Q$=Title$(1,10)
485     U$=Title$(13,40)
486     Path=VAL:Title$(48,48)
487     Delay$=Title$(51,56)
488     Dat$=Title$(59,69)
489     Tim$=Title$(72,79)
490     ENTER @Grampath:Iagc(*)
491     MOVE 76,360
492     CSIZE 4,,406
493     LABEL USING 494:U$,Discrim,Dat$(1,2)3Dat$(4,5)3Dat$(8,11),Tim$
494     IMAGE 26A," D=",,20,3X,6A,2X,3A,"Z"
495     LABEL USING 495:Path
496     IMAGE 13X,0
497     MAT Agc= Iagc/51,21
498     MOVE /zenc,/zenc+220     ! Set in position to plot A60 signal
499     FOR J=1 TO 279
500         IF Agc(J)=0 THEN GOTO 502
501         PLOT J,0
502         PLOT J,12*Agc(J)
503         PENUP
504     NEXT J
505     MOVE /zenc,/zenc
506 First_sweep:     ENTER @Grampath,4+143*(Kk2-1):Ispec(*)
507     n=1
508     MAT Spec= 5.0,198.0,Ispec
509     FOR J=1 TO 200
510         IF Spec(J) Discrim THEN 513

```

```

511     RPL0T K,J
512     PENUP
513     NEXT J
514     PRINT USING 515:K
515     IMAGE " SWEEP ",30
516     FOR K1=1 TO 139
517         ENTER @Grampath:Ispec(*)
518     Even_sweep: K=2*K1
519         MAT Spec= Ispec
520         MAT Spec= Spec+(32768)
521         MAT Spec= Spec/(256)
522         FOR J=1 TO 200
523             Spec(J)=INT(Spec(J))
524             Spec(J)=Spec(J)/51.2
525             IF Spec(J) Discrim THEN 528
526             RPL0T 2*K1,J
527             PENUP
528         NEXT J
529         PRINT USING 515:K
530     Odd_sweep: K=2*K1+1
531         MAT Spec= Ispec
532         MAT Spec= Spec+(32768)
533         FOR J=1 TO 200
534             Spec(J)=Spec(J) MODULO 256
535             Spec(J)=Spec(J)/51.2
536             IF Spec(J) Discrim THEN GOTO 539
537             RPL0T 2*K1+1,J
538             PENUP
539         NEXT J
540         PRINT USING 515:K
541     NEXT K1
542     PRINTER IS 1
543     RETURN
544
545     ***** SET TIME *****
546
547     Settime: Oldfunction$=Function$
548     Function$="SETTIME"
549     OUTPUT KBD:CHR$(255)\CHR$(75): CLEAR SCREEN
550     ON KEY 0 GOSUB Do_nothing
551     ON KEY 1 GOSUB Do_nothing
552     ON KEY 2 GOSUB Do_nothing
553     ON KEY 3 GOSUB Do_nothing
554     ON KEY 5 LABEL " QUIT" GOTO 510
555     ON KEY 8 GOSUB Do_nothing
556     ON KEY 9 GOSUB Do_nothing
557     GOSUB Displaytime
558     PRINT
559     PRINT "Data on time stated above may be retained by entering RETURN."
560     PRINT

```

```

561 PRINT "ENTER UNIVERSAL DATE (DD MMM YYYY) ";
562 OFF ERROR
563 STATUS CRT,1:Nowline
564 STATUS CRT,0:Nowcol
565 GOSUB Ask fora
566 Oldynsecs=DATE(DATE$(TIMEDATE)) ' Old date in seconds
567 IF A$="" THEN
568     CONTROL CRT,1:Nowline
569     CONTROL CRT,0:Nowcol
570     PRINT DATE$(TIMEDATE)
571     Newynsecs=0
572     GOTO 582
573 END IF
574 CONTROL CRT,1:Nowline
575 CONTROL CRT,0:1
576 ON ERROR GOTO 562
577 Newynsecs=DATE(A$)
578 IF Newynsecs>2.08862912E+11 THEN GOTO 560
579 IF Newynsecs>2.143252224E+11 THEN GOTO 560
580 OFF ERROR
581 Date$=A$
582 Nowline=Nowline+1
583 CONTROL CRT,1:Nowline+1
584 CONTROL CRT,0:1
585 PRINT "ENTER ZULU TIME (HH MM SS) ";
586 OFF ERROR
587 STATUS CRT,1:Nowline
588 STATUS CRT,0:Nowcol
589 GOSUB Ask fora
590 Oldtimesecs=TIME(TIME$(TIMEDATE)) ' =time when kbd RETURN was pushed
591 IF A$="" THEN
592     IF Newynsecs=0 THEN GOTO 510
593     Newtimedate=TIMEDATE-Oldynsecs+Newynsecs
594     SET TIMEDATE Newtimedate
595     GOTO 510
596 END IF
597 Nowline=Nowline+1
598 CONTROL CRT,1:Nowline
599 CONTROL CRT,0:1
600 ON ERROR GOTO 585
601 Newtimesecs=TIME(A$(0,20):"3A$(4,50):"5A$(7,8))
602 IF Newtimesecs<0 THEN GOTO 585
603 IF Newtimesecs>86399.999 THEN GOTO 585
604 OFF ERROR
605 IF Newynsecs=0 THEN
606     SET TIMEDATE Oldynsecs+Newtimesecs
607     GOTO 510
608 END IF
609 SET TIMEDATE Newynsecs+Newtimesecs
610 OUTPUT KBD:CHR$(255)CHR$(255) ' Clean screen

```

```

611 OFF ERROR
612 IF Oldfunction$="RECORD" THEN GOTO Record
613 GOTO Menu
614 |
615 |***** PRODUCE CATALOG OF HARD-DISC IONOGRAMS *****
616 |
617 Oldfunction$=Function$
618 Function$="LISDISOGRAMS"
619 List_grams: GRAPHICS OFF
620 Ac$=""
621 IF Catuotodate$="YES" THEN GOTO 645
622 ASSIGN @Grampath TO *
623 ON ERROR GOTO File_error ! IF NO "IONOGRAMS" FILE, CREATE ONE
624 ASSIGN @Grampath TO "IONOGRAMS"
625 OFF ERROR
626 CONTROL @Grampath,7:41614 ! MOVES EOF MARKER TO END OF FILE
627 ENTER @Grampath,41614 USING "40":Jcattest
628 IF Jcattest=0 THEN
629 Jcat=0
630 IF Function$="RECORD" THEN GOTO 633
631 IF Function$="DISPLAY" THEN GOTO 633
632 PRINT "THERE ARE NO IONOGRAMS RECORDED ON THE HARD DISC"
633 Catuotodate$="YES"
634 RETURN
635 END IF
636 IF Jcat=Jcattest THEN GOTO 643
637 Jcat=Jcattest
638 FOR K=1 TO Jcat
639 ON ERROR GOTO 643
640 ENTER @Grampath,1+143*(K-1) USING "396A":Title$
641 Qcat$(K)=Title$(1,48)
642 NEXT K
643 OFF ERROR
644 Catuotodate$="YES"
645 IF Function$="RECORD" THEN RETURN
646 IF Function$="DISPLAY" THEN RETURN
647 PRINTER IS 1
648 OUTPUT #80:CHR$(255)CHR$(75): ! Clean screen
649 Display_list: PRINT USING 550:Jcat
650 IMAGE 8X,"THE DISC CONTAINS THE FOLLOWING",40," IONOGRAMS:"
651 FOR Ky=1 TO Jcat/6+1
652 PRINT USING 553:Qcat$(6*Ky-5),Qcat$(6*Ky-4),Qcat$(6*Ky-3),Qcat$(6*Ky-2),
653 Qcat$(6*Ky-1),Qcat$(6*Ky)
654 NEXT Ky
655 PRINT USING "K, #": "HARD COPY (Y/N) ?"
656 Ac$=""
657 GOSUB Ask_for_a
658 IF UPC$(Ac$(1,1))="Y" THEN
659 STATUS CRT,1:Ac$
660 CONTROL CRT,1:Ac$-1

```

```

661     PRINT "
662     RETURN
663     END IF
664     PRINTER IS 701
665     PRINT USING 666:DATE$(TIMEDATE),TIME$(TIMEDATE)
666     IMAGE 8X,11A,2X,8A , "Z"
667     PRINT USING 650:Jcat
668     FOR Ky=1 TO Jcat/6+1
669         PRINT USING 670:Qcat$(6*Ky-5),Qcat$(6*Ky-4),Qcat$(6*Ky-3),Qcat$(6*Ky-2
),Qcat$(6*Ky-1),Qcat$(6*Ky)
670         IMAGE 8X,6(10A,2X)
671     NEXT Ky
672     Ac$=""
673     PRINTER IS 1
674     RETURN
675 File_error: OFF ERROR
676     ASSIGN @Grampath TO *
677     ON ERROR GOTO 679
678     PURGE "IONOGRAMS"
679     ON ERROR GOTO 681
680     CREATE BOAT "IONOGRAMS",41614,400
681     OFF ERROR
682     ASSIGN @Grampath TO "IONOGRAMS"
683     CONTROL @Grampath,7:41614
684     Jcat=0
685     OUTPUT @Grampath,41614 USING "40":Jcat
686     GOTO 624
687 Return: RETURN      ! Return from request for list of fixed-disc ionograms
688 !
689 !***** PURGE IONOGRAMS FROM "IONOGRAMS" FILE *****
690 !
691 Purge: !
692     OFF KEY
693     CONTROL CRT,12:1      ! KEY LABELS OFF
694     GRAPHICS OFF
695     OUTPUT KEY:CHR$(255)&CHR$(75):      ! CLEAR SCREEN
696     PRINT      ! REQUEST PERMISSION TO PURGE IONOGRAMS
697     A$=""
698     PRINT USING "38A,#":"PURGE ALL IONOGRAMS FROM DISC 2 (Y,N)"
699     INPUT A$
700     PRINT USING "2X,30A":UPC$(A$(1,1))
701     IF UPC$(A$)="Y" THEN GOTO 723
702     Tex$=CHR$(131)&"PURGE ALL IONOGRAMS FROM DISC 2 (Y,N)"&CHR$(128)
703     ! CHR$(131) AND CHR$(128) TURN INVERSE AND BLINKING ON AND OFF,RESP.
704     PRINTER IS 1
705     PRINT USING "38A,#":Tex$
706     A$=""
707     INPUT A$
708     PRINT USING "3X,30A":A$(1,1)
709     IF UPC$(A$)="Y" THEN GOTO 723
710

```

```

711 ON ERROR GOTO Bad_or_no_file          ! IF NO "IONOGRAMS" FILE, SET Jcat=
1
712 ASSIGN @Grampath TO *
713 ASSIGN @Grampath TO "IONOGRAMS"
714 ENTER @Grampath,41614 USING "4D":Jcat
715 OFF ERROR
716 Jcat=0
717 OUTPUT @Grampath,41614 USING "4D":Jcat
718 Catuptodate$="NO"
719 OUTPUT KBD:CHR$(255)&CHR$(75):      ! CLEAR SCREEN
720 PRINT "ALL IONOGRAMS HAVE BEEN PURGED FROM ""IONOGRAMS"" FILE."
721 MAT Qcat$= ("")
722 GOTO 74
723 OUTPUT KBD:CHR$(255)&CHR$(75):      ! CLEAR SCREEN
724 GOTO 74
725 !
726 Bad_or_no_file: PRINT "PROBLEM WITH ""IONOGRAMS"" FILE"
727 ON ERROR GOTO 728
728 PURGE "IONOGRAMS"
729 CREATE BDAT "IONOGRAMS:HP7942,1402,0",41614,400
730 ASSIGN @Grampath TO "IONOGRAMS"
731 OUTPUT @Grampath,41614 USING "4D":0    ! SETT JCAT=0
732 OFF ERROR
733 RETURN
734 !
735 Plot_grid: ! ***** PLOT GRID *****
736 !
737 ! If the ionogram grid pattern is stored in array GRIDARRAY(12480),LOAD
738 ! it into the crt display.  If it isn't there, get it from the hard disc.
739 ! If it isn't on the disc, generate it.
740 !
741 OUTPUT KBD:CHR$(255)&CHR$(75):      ! CLEAR SCREEN
742 GINIT
743 GCLEAR
744 GRAPHICS ON
745 SHOW 1,512,1,390
746 Xzero=150
747 Yzero=70
748 IF Gridready$="YES" THEN GOTO 367
749 ASSIGN @Gridpath TO *
750 ON ERROR GOTO 755
751 ASSIGN @Gridpath TO "GRAMGRID:HP7942,1402"
752 ENTER @Gridpath:Gridarray(*)
753 OFF ERROR
754 GOTO 367
755 OFF ERROR
756 PLOT Xzero,Yzero
757 I PLOT 0,-9
758 I PLOT 0,9
759 FOR K=1 TO 14
760 I PLOT 10,0

```

```

761 IPLOT 0,-5
762 IPLOT 0,5
763 IPLOT 10,0
764 IPLOT 0,-9
765 IPLOT 0,9
766 NEXT K
767 IPLOT 10,0
768 IPLOT -10,0
769 FOR K=1 TO 5
770 IPLOT 0,20
771 IPLOT 6,0
772 IPLOT -6,0
773 IPLOT 0,20
774 IPLOT 10,0
775 IPLOT -10,0
776 NEXT K
777 IPLOT 0,11
778 IPLOT 0,-10
779 FOR K=1 TO 14
780 IPLOT -10,0
781 IPLOT 0,5
782 IPLOT 0,-5
783 IPLOT -10,0
784 IPLOT 0,9
785 IPLOT 0,-9
786 NEXT K
787 IPLOT 0,-1
788 IPLOT -10,0
789 IPLOT 10,0
790 FOR K=1 TO 5
791 IPLOT 0,-20
792 IPLOT -6,0
793 IPLOT 6,0
794 IPLOT 0,-20
795 IPLOT -10,0
796 IPLOT 10,0
797 NEXT K
798 PENUP
799 PLOT Xzero,Yzero
800 PEN 1
801 CSIZE 4.0,.6
802 FOR K=1 TO 15
803 MOVE Xzero+(K-1)*20-3.5,Yzero-25
804 IF K=5 THEN GOTO 811
805 MOVE Xzero+(K-1)*20-7.5,Yzero-25
806 A$=VAL$(C+K)
807 LABEL A$(1,1)
808 MOVE Xzero+(K-1)*20,Yzero-25
809 LABEL A$(2,2)
810 GOTO 812

```

```

811 LABEL VAL$(2*K)
812 NEXT K
813 MOVE Xzero+50,Yzero+40
814 LABEL "FREQUENCY (MHz)"
815 MOVE Xzero,Yzero
816 FOR K=0 TO 5
817 MOVE Xzero-13,Yzero-8+40*K
818 LABEL VAL$(K)
819 NEXT K
820 MOVE Xzero-30,Yzero+120
821 LABEL "TIME"
822 MOVE Xzero-30,Yzero+105
823 LABEL "DELAY"
824 MOVE Xzero-30,Yzero+90
825 LABEL "(mSEC)"
826 PENUP
827 MOVE Xzero,Yzero+220
828 RPLLOT 230,0,-1
829 RPLLOT 290,51
830 RPLLOT 0,51
831 MOVE Xzero-30,Yzero+245
832 LABEL "SIG"
833 MOVE Xzero-30,Yzero+232
834 LABEL "(dBm)"
835 MOVE Xzero,Yzero+220
836 IPLLOT -6,0
837 IPLLOT 5,0
838 FOR K=1 TO 5
839 IPLLOT 0,10
840 IPLLOT -6,0
841 IPLLOT 5,0
842 NEXT K
843 MOVE Xzero-47,Yzero+213
844 LABEL "-120"
845 MOVE Xzero-38,Yzero+251
846 LABEL "-65"
847 MOVE 76,375
848 CSIZE 4,0,.50
849 LABEL "NAVAL RESEARCH LABORATORY LOGOGRAM"
850 MOVE 76,360
851 CSIZE 4,.406
852 LABEL USING 953
853 IMAGE 23x,"D="
854 LABEL "BOUNDER PATH"
855 MOVE Xzero,Yzero
856 CONTROL CRT,12:1
857 GSTORE @Gridarray/*
858 CONTROL CRT,12:0
859 ASSIGN @Gridpath TO *
860 ON ERROR GOTO 853

```

```

861 PURGE "GRAMGRID"
862 OFF ERROR
863 CREATE BDAT "GRAMGRID:HP7942,1402,0",1,51200
864 OFF ERROR
865 ASSIGN @Gridpath TO "GRAMGRID"
866 OUTPUT @Gridpath:Gridarray(*)
867 ASSIGN @Gridpath TO *
868 GLOAD Gridarray(*)
869 ON KEY 2 GOSUB Do_nothing
870 CONTROL CRT,12:2      | Key labels displayed at all times
871 Gridarray$="YES"
872 MOVE Xzero,Yzero
873 GRAPHICS ON
874 RETURN
875 |
876 Do_nothing: RETURN | REMOVES FUNCTION OF USER-DEFINED KEYS WHILE RUNNING
877 |
878 | ***** SUBROUTINE FOR CHANGING PATHLABELS *****
879 |
880 Pathlabels: ON ERROR GOTO 886
881 ASSIGN @Path TO *
882 ASSIGN @Path TO "PATHDATA"
883 OFF ERROR
884 ENTER @Path:Path$(*),Lat(*),Long(*),Tdelay(*),Qoseg$(*):
885 RETURN
886 CREATE BDAT "PATHDATA",1,5000
887 OFF ERROR
888 Path$(1)="ISABELA (PR) TO NRL"
889 Path$(2)="CORINNE (UT) TO NRL"
890 Path$(3)="DRIVER (VA) TO NFL"
891 Lat(1)=0
892 Long(1)=0
893 Lat(2)=0
894 Long(2)=0
895 Lat(3)=0
896 Long(3)=0
897 Tdelay(1,1)=1
898 Tdelay(1,2)=40
899 Tdelay(2,1)=0
900 Tdelay(2,2)=0
901 Tdelay(3,1)=1
902 Tdelay(3,2)=50
903 Qoseg$(1)="10 25 40 55"
904 Qoseg$(2)="05 20 35 50"
905 Qoseg$(3)="20 15 30 45"
906 ASSIGN @Path TO "PATHDATA"
907 OUTPUT @Path:Path$(*),Lat(*),Long(*),Tdelay(*),Qoseg$(*):
908 PRINT "PATHDATA FILE STORED WITH DATA"
909 PRINT "LENGTH OF Qoseg$(1)=":LEN(Qoseg$(1))
910 PRINT "LENGTH OF Qoseg$(2)=":LEN(Qoseg$(2))

```

```

911         PRINT "LENGTH OF Ooseg$(3)=";LEN(Ooseg$(3))
912         PRINT Ooseg$(*)
913     ASSIGN @Path TO *
914     RETURN
915
916 Changepaths:|
917     OUTPUT KBD;CHR$(255)&CHR$(75); | CLEAR SCREEN
918     OFF TIME
919     CONTROL CRT,12;| | KEY LABELS OFF
920     IF Path$(1)="" AND Path$(2)="" AND Path$(3)="" THEN GOSUB Pathlabels
921     PRINT "Present path descriptions are:"
922     U$=CHR$(132) | UNDERLINE
923     N$=CHR$(128) | STOP UNDERLINING
924     PRINT
925     PRINT USING "36X,K":'Time Delay'
926     PRINT USING 927:U$&"Path"&N$,U$&"Name"&N$,U$&"min"&N$,U$&"sec"&N$,U$&"O
operating Segments"&N$
927     IMAGE 1X,K,8X,K,19X,K,4X,K,5X,K
928     PRINT
929     FOR K=1 TO 3
930     PRINT USING 931:K,Path$(K),Tdelay(K,1),Tdelay(K,2),Ooseg$(K)
931     IMAGE 3D,4X,29A,1X,2D,5X,2D,6X,20A
932     NEXT K
933     PRINT
934     PRINT "To change a path description, ENTER 1,2, or 3."
935     PRINT
936     PRINT "PATH TO BE CHANGED: ";
937     A$=RPT$(1,200)
938     ON KBD GOTO 953
939     OFF KEY
940     ON KEY 0 GOSUB Do_nothing
941     ON KEY 1 GOSUB Do_nothing
942     ON KEY 2 GOSUB Do_nothing
943     ON KEY 3 GOSUB Do_nothing
944     ON KEY 4 GOSUB Do_nothing
945     ON KEY 5 GOSUB Do_nothing
946     ON KEY 6 LABEL " QUIT",1 GOTO 1021
947     ON KEY 7 GOSUB Do_nothing
948     ON KEY 8 GOSUB Do_nothing
949     ON KEY 9 GOSUB Do_nothing
950     CONTROL CRT,12;C | KEY LABELS ON
951     GOTO 951
952     |
953     A$=KBD$
954     CONTROL CRT,12;| | KEY LABELS OFF
955     OFF KEY
956     IF A$=CHR$(255)&CHR$(69) THEN GOTO 937
957     PRINT A$
958     ON ERROR GOTO 950
959     IF LEN(A$)=1 AND NUM(A$)=48 AND NUM(A$)=52 THEN GOTO 962
960     OFF ERROR

```

```

961     GOTO 74
962     I
963     OFF ERROR
964     Pth=VAL(A$)
965     PRINT
966     PRINT USING "K,D,K,#": "          New name for path ",Pth," : _____"
967     A$=Path$(Pth)
968     INPUT A$
969     A$=A$&RPT$( " ",28)
970     Newpath$=A$(1,28)
971     PRINT USING "K,#":RPT$(CHR$(8),1) "    ! CHR$(8) IS A BACKSPACE
972     PRINT USING "K,#":RPT$( " ",10)
973     PRINT USING "K,#":RPT$(CHR$(8),1) "    ! CHR$(8) IS A BACKSPACE
974     PRINT USING "28A":Newpath$
975     PRINT
976     PRINT USING "K,D,K,#": "          New time delay for path ",Pth," : _____"
977     PRINT USING "K,#": "          ___ min:"
978     A$=RPT$( "(",200)
979     INPUT A$
980     IF A$=RPT$( "(",200) THEN
981         Newmin=Tdelay(Pth,1)
982         GOTO 989
983     END IF
984     ON ERROR GOTO 979
985     IF VAL(A$)>=0 OR VAL(A$)<=9 THEN GOTO 979
986     OFF ERROR
987     Newmin=VAL(A$)
988     Tdelay(Pth,1)=VAL(A$)
989     PRINT USING "K,#":RPT$(CHR$(8),7) "    ! CHR$(8)= BACKSPACE
990     PRINT USING "K,#":RPT$( " ",6)
991     PRINT USING "K,#":RPT$(CHR$(8),7)
992     PRINT USING "D,#":Tdelay(Pth,1)
993     PRINT USING "K,#": " min _____ sec"
994     A$=RPT$( "(",200)
995     INPUT A$
996     IF A$=RPT$( "(",200) THEN GOTO 1001
997     ON ERROR GOTO 995
998     IF VAL(A$)>=0 OR VAL(A$)<=59 THEN GOTO 995
999     OFF ERROR
1000    Tdelay(Pth,2)=VAL(A$)
1001    PRINT USING "K,#":RPT$(CHR$(8),6)
1002    PRINT USING "K,#":Tdelay(Pth,2)," sec "
1003    Newsec=Tdelay(Pth,2)
1004    PRINT
1005    PRINT USING "K,D,K,#": "          New operating segments for path ",Pth," : _____"
1006    A$=Ooseg$(Pth)
1007    INPUT A$
1008    Newooseg$=A$(1,20)
1009    ASSIGN @Path TO *
1010    ASSIGN @Path TO "PATHDATA"

```

```
1011 ENTER @Path:Path$(*),Lat$(*),Long$(*),Tdelay$(*),Osegs$(*)
1012 Path$(Pth)=Newpath$
1013 Tdelay$(Pth,1)=Newmin
1014 Tdelay$(Pth,2)=Newsec
1015 Osegs$(Pth)=Newosegs$
1016 ASSIGN @Path TO *
1017 ASSIGN @Path TO "PATHDATA"
1018 OUTPUT @Path:Path$(*),Lat$(*),Long$(*),Tdelay$(*),Osegs$(*)
1019 ASSIGN @Path TO *
1020 GOTO Changepaths
1021 IF Function$="RECORD" THEN GOTO Record
1022 GOTO Menu
1023 !
1024 ! ***** CHANGE # OF IONOGRAMS LISTED IN "IONOGRAMS" DIRECTORY *****
1025 !
1026 ASSIGN @Path TO *
1027 ON ERROR GOTO 1029
1028 ASSIGN @Path TO "IONOGRAMS"
1029 OFF ERROR
1030 CONTROL @Path,7:41614 ! MOVES EOF MARKER TO END OF FILE
1031 ENTER @Path,41614 USING "40":Jcat
1032 PRINT "LISTED NUMBER OF IONOGRAMS ON TAPE IS ":Jcat
1033 PRINT "ENTER NEW NUMBER OF IONOGRAMS:";
1034 INPUT "=";Jj
1035 PRINT Jj
1036 OUTPUT @Path,41614 USING "40":Jj
1037 PRINT "NUMBER OF IONOGRAMS HAS BEEN CHANGED TO ":Jj
1038 GOTO End
1039 !
1040 ! **** ROUTINE TO INPUT DATA FROM KEYBOARD WITHOUT CHANGING KEY LABELS ****
1041 !
1042 As:font: A$=""
1043 STATUS CRT,1:Aaa ! Aaa is current crt line
1044 STATUS CRT,0:Col ! Col is current line position
1045 Precedence=1
1046 IF Function$="LISTIONOGRAMS" THEN Precedence=0
1047 ON KEY:Precedence GOTO Keyboardin
1048 GOTO 1048
1049 Keyboardin: Kbdin$=""
1050 IF LEN(Kbdin$)=1 THEN GOTO 1050
1051 IF NUM(Kbdin$(2,2))=60 THEN ! Recognize backspace CHR$(255) CHR$(60)
1052 IF LEN(A$)=0 THEN GOTO 1054
1053 A$=A$(1),LEN(A$)-1
1054 GOTO 1053
1055 END IF
1056 IF NUM(Kbdin$(2,2))=62 THEN ! Recognize ahead space CHR$(255) CHR$(62)
1057 A$=A$&" "
1058 GOTO 1053
1059 END IF
1060 IF Kbdin$=CHR$(255) CHR$(59) THEN GOTO Input_done ! Recognize RETURN key
```


1156 CSUB Set_gain(Name\$,INTEGER Gain)
1157 CSUB Set_units(Name\$,Units\$,OPTIONAL Multiplier,Offset)
1158 CSUB Enable_intr(Name\$)
1159 CSUB Disable_intr(Name\$)
1160 CSUB Calibrate(Name\$,INTEGER Chan,REAL Pace,INTEGER Number)
1161 CSUB Config_0(Name\$,OPTIONAL Model\$,INTEGER Select_code,Gain,REAL Pace,Rep
ort_err\$,Units\$,Multiplier,Offset)

END

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