A Technique for Recording HF Oblique-Incidence-Sounder Data

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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.
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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.

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 sounding 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 x 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 x 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:

<table>
<thead>
<tr>
<th>File Name</th>
<th>File Type</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>IONOGRAMS</td>
<td>BDAT</td>
<td>16,645,600</td>
</tr>
<tr>
<td>PATHDATA</td>
<td>BDAT</td>
<td>5,000</td>
</tr>
<tr>
<td>GRAMGRID</td>
<td>BDAT</td>
<td>51,200</td>
</tr>
</tbody>
</table>

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 IONOGRAMS 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 25 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 houskeeping 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 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 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

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

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

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

<table>
<thead>
<tr>
<th>Record</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Header (396 characters)</td>
</tr>
<tr>
<td>2-3</td>
<td>AGC data (279 two-byte integers, representing the AGC values for the 279 sounder sweeps)</td>
</tr>
<tr>
<td>4</td>
<td>Ionogram data for sweep 1 (200 two-byte integers representing the amplitudes for the 200 digitized ionogram pixels of sweep 1)</td>
</tr>
<tr>
<td>5-143</td>
<td>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.)</td>
</tr>
<tr>
<td>Character</td>
<td>Contents</td>
</tr>
<tr>
<td>-----------</td>
<td>----------</td>
</tr>
<tr>
<td>1-10</td>
<td>Ionogram name (for example: 03JA871345, which describes the nominal Zulu date and time of ionogram start)</td>
</tr>
<tr>
<td>11-12</td>
<td>&quot; &quot; (2 blank characters)</td>
</tr>
<tr>
<td>13-40</td>
<td>Path name (for example &quot;TINKER TO FT HUACHUCA &quot;</td>
</tr>
<tr>
<td>41-48</td>
<td>Sounder path number (1,2,or 3; for example: &quot; PATH 2&quot;)</td>
</tr>
<tr>
<td>49-50</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>51-56</td>
<td>Time delay of sounder transmitter start (for example: 01M50S)</td>
</tr>
<tr>
<td>57-58</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>59-69</td>
<td>Date of start of sounder transmission (for example: 15 Jan 1988)</td>
</tr>
<tr>
<td>70-71</td>
<td>&quot; &quot;</td>
</tr>
<tr>
<td>72-79</td>
<td>Zulu time of start of sounder transmission (for example: 16:17:11)</td>
</tr>
<tr>
<td>80</td>
<td>&quot;Z&quot; (referring to Zulu time)</td>
</tr>
<tr>
<td>81-400</td>
<td>Blank</td>
</tr>
</tbody>
</table>
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.
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.
PROGRAM CHIRP4

This program for the Hewlett-Packard 310 computer enables data from a Barry Research RCS-4B ionospheric sounder receiver to be recorded on an HP7942 fixed-disc storage unit, and to be reproduced on an HP 222SA ThinkJet printer.

Up to 291 ionograms may be stored in the "IONOGRAMS" fixed-disc file.

In routine operation, the "IONOGRAMS" file is filled, copied onto a 1/4" cartridge magnetic tape, and then purged, making it possible to fill another "IONOGRAMS" file. Up to four such files, typically named IONOGRAMS1", "IONOGRAMS2", "IONOGRAMS3", and "IONOGRAMS4", can be copied onto a single 85-Mbyte tape.

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

- Rec. 1: Header (400 characters)
- Recs. 2-3: IAOC, 279 integers of AGC data (in 400-element array)
- Rec. 4: 200 integers representing SPEC data for first sweep
- Recs. 5-143: 139 records of 200 characters each, in which the least significant bytes represent SPEC data for one sweep and the more significant bytes represent SPEC data for the following sweep

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

The CSUB routines at the end of this program must be loaded from the HP9645A software for the HP9864A AGC interface. They are required only for the RECORD function.

Program written by:
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Code 4181
Naval Research Laboratory
Washington, DC 20375
(202)767-2891

Latest revision: 5 April 1998

OPTION BASE 1
SIN1
PRINTER 13 !
CONTROL CRT,12:1 ! Key labels off
PRINT CHR$129 ! Stop blinking and inverse video, if on
OUTPUT -80:CHR$155,CHR$175 ! Clear screen
MASS STORAGE IS :HP7942,1400 ! Fixed-disc/cartidge tape combination
CONTROL 'EC,'E0:1 ! Makes EIL keyboard 300 series (and compatible
with 88200 keyboard (the LED on HP9832B).
DIM Soundata(5),Sdata(400),Asg(400),Title$(396),Hoskeec(7),Spec(200),Tmo(279),Paths(0:3),Us(100),$$(10),Te-$(30),Tts(30),Q$(31),Temp(200)
DIM Lat(3),Long(3),Oseeg$(1:20),Newpath$(20),Newoseeg$(20),A$(20)
INTEGER Is
ALLOCATE Ocat$(294)
Function$="PROGMASTART"
Gridread$="NO"
Journal$="NO JOURNAL"
DIM Mon$(36),Mon$(24)
Mon$="JANFEBMARAPRJUNJULAOUGSEPOCTNOVDEC"
Mon2$="JAFEMRAPMYJNLAUSEOCNODE"
Discrim=.45
Halt$="" Recreation time AT
IF TIMEDATE 2,117717218$+1 THEN GOTO Settime 1 T Jan 56 32:00:00
Menu:
Oldfunction$=Function$
Function$="MENU"
IF Oldfunction$="CHANGEPATHS" THEN GOTO 73
OUTPUT KBO;CHR$(255)&CHR$(75); Clear screen
IF Oldfunction$="SETTIME" THEN GOSUB Displaytime
PRINTER IN
OFF ERROR
CONTROL CRT,12:0 Turn on user-key labels
ON KEY 0 LABEL "RECORD"; GOTO Record
ON KEY 1 LABEL "DISPLAY"; GOTO DIS30
ON KEY 2 LABEL "LIST GRAMS"; GOSUB 817
ON KEY 3 LABEL "PURGE"; GOTO Purge
ON KEY 4 GOSUB Do nothing
ON KEY 5 GOSUB Do nothing
ON KEY 6 LABEL "QUIT"; GOTO End
ON KEY 7 GOSUB Do nothing
ON KEY 8 LABEL "CHANGE PATHS"; GOTO Changepaths
ON KEY 9 LABEL "SET TIME"; GOTO Settime
IF Function$="SETTIME" THEN GOTO 89
PRINT USING SEBB;DATES;TIMEDATE;TIME;TIMEDATE
GOTO Loc
IF Oldfunction$="PROGRAMSTART" THEN
CONTROL CRT,1:1 Set to CRT line 1
A$=RPT$( 20)
PRINT A$; NAVAL RESEARCH LABORATORY
PRINT A$; WASHINGTON, DC 20375 USA
PRINT
PRINT A$; CHIRPBOUNDER IONOSM RECORDING PROGRAM
IF Function$="" END IF
IF Function$="DISPLAY" THEN PRINT RPT$(CHR$(12),3);RPT$( 17);THE "ION
GRAMS" FILE CONTAINS NO IONOGSM FROM THE REQUESTED PATHS
CONTROL CRT,1:2 Key labels always on
Function$="MENU"
Loc: GOTO Loc
154 CONTROL @Gramopath,7:4,814  Set EOF pointer to end of file
155 GOSUB Plot_grid
156 Cat_ whatdate="NO"
157 US=RPT$(",",75)
158 OFF KEY
159 ON KEY 0 GOTO Do_nothing
160 ON KEY 1 GOTO Do_nothing
161 ON KEY 2 GOTO Do_nothing
162 ON KEY 3 GOTO Do_nothing
163 ON KEY 4 GOTO Do_nothing
164 ON KEY 5 GOTO Do_nothing
165 ON KEY 6 LABEL "QUIT"; GOTO 65
166 ON KEY 7 GOTO Do_nothing
167 ON KEY 8 GOTO Do_nothing
168 ON KEY 9 GOTO Do_nothing
169 CONTROL CRT,12:2  Key labels on
170 PRINT RPT$(CHR$(10),15) CHR$(10)=line feed
171 PRINT USING ""IONOGRAM",4D";Gramnum
172 PRINT
173 PRINT "Sweep",I:EOL CHR$(13) OR only (no linefeed) after PRINT statement
174 PRINT "Sweep"
175 IMAGE 5,40
176 Start_search: Time1=TIMEDATE  Wait for beginning of ionogram
177 Sequential_scan("SPECTRUM",2,2,000301,Spec(*),200)
178 Sequential_scan("SOUNDER",1,7,00002,Houskeep(+),1)
179 Time2=TIMEDATE  TIME2 is start time for this ionogram
180 IF (Time2-Time1)>=1.0 THEN GOTO First_scan
181 WAIT 10
182 GOTO Start_search
183 First_scan: Path="SBN(Houskeep5)-2.5-1/2/SBN(Houskeep6)-2.5-1-i-1/3
184 Houskeep(7)-2.5-1/1/2
185 Houskeep(4)
186 Plot_data: FOR J=1 TO 200  Plot data for first sweep
187 Spec(J)=MAX(0,Spec(J))
188 IF Spec(J)<Discrim THEN 191
189 PLOT V,J
190 RENUM
191 NEXT J
192 IF Path J OR Path 1 THEN Path=0
193 US=Path$;Path=2$;US=Name of ionogram
194 J=1: T=""TIMES=Time2"
195 J=AL T=""[4,5"
196 IF PRCT(J,.5,.8)=0 THEN GOTO 200
197 J=2:1
198 J=3:4
199 J=4:7
200 J=5:0:VAL 2
210 J=6:0:LEN D
211 J=7:0:LEN D
212 Cat=DATE'Time2
213 J=FROM:POS "Mo",UFOR Date(4,5),",Z
214 J=FROM:POS "Day",UFOR Date(10,11),"TIMES(1) GOP1S"
215 IF $="1": THEN $="2":528(4,3)
206    MAT spec = (51.2)*Spec  \* 51.2 = 256/5.0
207    OUTPUT @Gramath, 4+143*(Gramnum-1):Spec*;
208    PRINT USING 223:K
209    PLOT 1,220+10*Agc(K)
210    PENUP
211    FOR K=1 TO 139
212    MAT Spec = (-22768)
213    K=2*K
214    Even_scan=Sequential_scan("SPECTRUM",2,2,200001.Spec*);220
215    Sequential_scan("SOUNDER",1,7,200001.Housekeep-1..)
216    Agc(K)=Housekeep(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    PLOT K,J
221    PENUP
222    NEXT J
223    MAT Item= (51.2)*Spec  \* Round spectrum values to integers
224    MAT Temp= Item  \* Convert to real
225    MAT Temp= (256.0)*Temp
226    MAT Spec= Spec=Temp
227    PRINT USING 222:K
228    IMAGE "SWEEP", 3D
229    PLOT K,220+10*Agc(K)
230    PENUP
231    IF K=1 THEN
232    OSIZE 4.5
233    MOVE 365,375
234    LABEL 0%
235    MOVE Yzero,Yzero
236    END IF
237    IF K=2 THEN
238    MOVE 76,360
239    OSIZE 4.406
240    LABEL USING '11x.12x:Discrim
241    MOVE Yzero,Yzero
242    END IF
243    IF K=3 THEN
244    MOVE 76.248
245    LABEL USING '11x.12x:Path
246    MOVE Yzero,Yzero
247    END IF
248    IF K=4 THEN
249    MOVE 76.248
250    OSIZE 4.406
251    LABEL USING '14x.14x:Path (1-1)
252    MOVE Yzero,Yzero
253    END IF
254    IF K=5 THEN
255    MOVE 75.250
256    OSIZE 4.406
257    LABEL USING '14x.14x:Path (2-2)
258  MOVE Xzero,Yzero
259  END IF
260  Odd_scan:  K=K+1
261  Sequential_scan("SPECTRUM",2,2,000001,Spec(*),200)
262  Sequential_scan("SOUNDER",1,7,00002,Housel1(1,1))
263  Agc(K)=Housel1(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       Rplot K,J
268       PenUp
269       NEXT J
270       Mat Temp= (Spec(J)*Spec(J)
271       Mat Ispec= Ispec+Temp
272       PRINT USING "228;K"
273       Rplot K,220+10*Agc(K)
274       PenUp
275       Output @Grampath;Ispec(*)
276       NEXT K1
277       Printer IS 1
278       Mat Iagc= (Spec(J)*Agc(J)
279       Delay$="0"&VAL$(Tdelay(Path,2))
280       Delay$=Delay$&LEN(Delay$)-1,LEN(Delay$)&"5"
281       OS=0"&VAL$(Tdelay(Path,2))
282       Delay$=Delay$&LEN(Delay$)-1,LEN(Delay$)&"5"&Delay$ 1 PATH DELAY (XMMYYS): 5 CHRS
283       Title$=""&"396"&"396"&" "&"1,2S"&"13 PATH "$VAL$(Path)&" $Delay$" "$Dat$" "$T"
284       Title$=Title$&"RPT$"("396-LEN(Title$)"
285       Output @Grampath,1+13,J*(Gramnum-1) USING "396A";Title$
286       Output @Grampath;Iagc(*)
287       Gramnum=Gramnum+1
288       Jcat=Jcat+1
289       Jcat$=Jcat$=0$8
290       Output @Grampath,4+14 USING "10";Jcat
291       PRINT "ALL DONE"
292       Move Xzero,Yzero USING "10";Jcat
293       For J=1 TO 279
294       IF Agc(J)<10 THEN 296
295       Rplot J,10*Agc(J)
296       Rplot J,2*Agc(J)
297       PenUp
298       NEXT J
299       Move 75,350
300       Csize 4,400
301       Label USING 30B;US,Data,Tims
302       Image 13A,12%3A,2%3A,"Z"
303       If Journal$="NOJOURNAL" THEN 309
304       Printer IS 705
305       Print USING 30B;Path,Data,Tims,2%
306       Image 13A,"PATH="&"C.DD.XX",1X,3A,"2",1X,10A
307       Printer IS 701
308       Output KEO;CHR$(159)"CHR";75 1 CLEAR ALPHA screen
309       Soto 155
310 | *************** OUTPUT IONOGRAM TO HP22ISA THINKJET PRINTER ***************
311 |
312 | Hard-copy: Function="HARDCOPY"
313 |
314 | PRINTER IS 1
315 | PRINT TABXY(1,1) ;   | Move cursor to upper left-hand corner of CRT
316 | PRINT RPT$(CHR$(13),15) | 15 line-feeds
317 | PRINT " "              | Remove "IONOGRAM" from CRT
318 | PRINT " "              | Remove "XXX OF XXX" from CRT
319 | PRINT " "              | Remove "SWEEP XXX" from CRT
320 | PRINTER IS 701
321 | GRAPHICS ON
322 | CLEAR ?    | This command required when using HP22ISA printer
323 | INTEGER S2(25600)
324 | STATUS CRT,12;zzz;
325 | CONTROL CRT,12;1;
326 | GSTORE S2(1;)
327 | DUMP GRAPHICS
328 | RETURN
329 |
330 | *************** DISPLAY IONOGRAMS FROM DISC ***************
331 |
332 | PRINTER IS 1
333 | OFF TIME
334 | OUTPUT KBD:CHR$(2553&CHR$(75)); | Clear screen
335 | GRAPHICS OFF
336 | Function="DISPLAY"
337 | IF Catup2pate="NO" THEN
338 |   CONTROL CRT,1;111 ; Set CRT cursor to line 111
339 |   PRINT RPT$(" ",'19);"READING LIST OF IONOGRAMS IN ..."
340 |   GOSUB List_files
341 |   CONTROL CRT,1;111
342 |   PRINT RPT$(" ",'30
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"; 1 GOTO Remindoperation
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"; 1 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;10; | K = Current CRT line position
359 | PRINT " ENTER names of ionograms to be plotted as in following examples:"
360 | PRINT
PRINT "SINGLE IONOGRAM: 2AP960005"
PRINT "MULTIPLE IONOGRAMS: 2JU860015-3JU861025"
PRINT "ALL, OR ALL OF ONE PATH: ALL"

CONTROL CRT.12:2 'Key labels on
PRINT "CHOICE: "
Q1$=""
K=0
GOSUB Askfora
Q1$=TRIM$(UPC$(As$(1,31)))
IF Q1$="" THEN GOTO 365
IF Q1$="ALL" THEN
Qfirst$=Qcat$(1,10)
Qlast$=Qcat$(Jcat,1,10)
GOTO 361
END IF
Ipos=POS(Q1$,"-")
IF Ipos=0 THEN
Qfirst$=TRIM$(Q1$)
Qlast$=TRIM$(Q1$)
Quant=1 'Quant= number of ionograms to be plotted
GOTO 367
END IF
IF Ipos>9 THEN GOTO 365
Qfirst$=Q1$(Ipos,1)
Qlast$=Q1$(Ipos+1,LEN(Q1$))
IF LEN(Qfirst$)=10 THEN Qfirst$=Qfirst$(1,10)
IF LEN(Qlast$)=10 THEN Qlast$=Qlast$(1,10)
IF Qfirst$="0" THEN Qfirst$=0
IF Qlast$="0" THEN Qlast$=0
IF Quant=0 THEN GOSUB List_grams
FOR k1=1 TO Jcat
kfirst$=
IF Qfirst$=Qcat$(k1,1,10) THEN GOTO Met_cques
NEXT k1
PRINT USING "39":Qfirst$ 'There is no ionogram ",.k1,", enter request again."
GOTO 365
Met_cques: FOR k2=1 TO Jcat
klast$=
IF Qlast$=Qcat$(k2,1,10) THEN GOTO Choose_path
NEXT k2
PRINT USING "404":Qlast$ 'There is no ionogram ",.k2,", enter request again."
GOTO 365
Choose_path: Stepsize=360/Klast-=kfirst$'
IF Stepsize=0 THEN Stepsize=1
IF Quant=1 THEN GOTO 368
PRINT PFS$(CHR$(10)) 1 '2 line feeds
PRINT
PRINT "TO DISPLAY IONOGRAMS FROM JUST 1 OR TWO PATHS RETURN PATH NUMBERS.
";
PRINT "FOR EXAMPLE, FOR JUST PATH 1 RETURN 1"
PRINT "FOR PATHS 2 AND 3 RETURN 23"
PRINT "FOR ALL PATHS, PUSH RETURN"
PRINT "CHOICE: ":
GOSUB As fora
IF As="" THEN GOTO 428
Plot1=0
Plot2=0
Plot3=0
FOR K=1 TO LEN(As):
   IF As[K,K]="1" THEN Plot1=1
   IF As[K,K]="2" THEN Plot2=2
   IF As[K,K]="3" THEN Plot3=3
NEXT K
IF Plot1+Plot2+Plot3=0 THEN GOTO 431
Plot1=1
Plot2=2
Plot3=3
FOR Patheee=1 TO 3  ; Plot all of path 1, then path 2, then path 3.
   IF Patheee=1 AND Plot1=1 THEN GOTO Next_pathee
   IF Patheee=2 AND Plot2=2 THEN GOTO Next_pathee
   IF Patheee=3 AND Plot3=3 THEN GOTO Next_pathee
   Quant=0
NEXT K12
FOR K12=K1first TO Klast STEP Stepsize
   IF Qcat(K12)(48,48)=VAL(Patheee) THEN Quant=Quant+1
NEXT K12
GOTO Next_pathee
Remindoperator:  GOSUB 617  ; Fetch list of ionograms
GOTO 356  ; Go back & ask for grams to be displayed
Goahead:  Newyeg="YES"  ; 2 ionograms per page
ON KEy 2 GOTO Do_nothing
Nowk=0
FOR K12=K1first TO Klast STEP Stepsize
   Q1#=Qcat(K12)(1,10)
   IF Qcat(K12)(48,48)=VAL(Patheee) THEN GOTO 461
   Nowk=Nowk+1
GOSUB Displaygram
   PRINT CHR$(12)"page eject"  ; CHR$(12)=page eject
   PRINT CHR$(10),CHR$(13)  ; CHR$(10)=line feed
   Newyeg="NO"  ; CHR$(13)=clear line feed
   ELSE
       PRINT CHR$(10)
       Newyeg="YES"
   ELSE
       PRINT CHR$(10)
       Newyeg="NO"
   ELSE
   ENDF IF
GOSUB Hard_end}
NEXT k+2
NEXT pathee: NEXT pathee
PRINTER IS 1
CONTROL CRT,10;2 KEY LABELS ON
SOTO 65
Oasiagram: IF LEN(i$):10 THEN i$=i$&0'
OUTPUT KBD:CHR$(255)&CHR$(75): CLEAR screen
GOSUB Plot_grid
MOVE 366,375
CSIZE 4,.5
IF LEN(i$)=10 AND i$(10,10)=' ' THEN GOTO 474
LABEL " "G0:\$
SOTO 475
LABEL 01$
PRINTER IS 1
PRINT CRT:CHR$(12),15: CHR$(10)=Line feed
PRINT " IONOGRAM"
PRINT USING 480: Now, Quad
IMAGE 30," "0,0
PRINTER IS 1:EOLECHR$(13): End of line sequence is CR only (no LF)
PRINTER USING 515
ENTER 3grampath;i+143*(k+2-1) USING "396A":Title$i
جب=Title$(1,10)
جب=Title$(13,40)
Path VAL:Title$(48,49)
Date=Title$(51,56)
Days=Title$(59,63)
Times=Title$(72,79)
ENTER 3grampath:Image:*
MOVE 75,350
CSIZE 4,.496
LABEL USING 494:Us Discrim:Date$(1,2)Date$(3,5)Date$(3,11),Times
IMAGE 25A "D",20,3A,3A,2A,"Z"
LABEL USING 495:Path
IMAGE $X0
MAT A=Image:51,2
MOVE / cent. /zero=120 Set in position to plot AGC signal
FOR j=1 TO 279
320 IF A<1 THEN GOTO 532
321 PLOT J,0
322 PLOT J,0+A
323 PLOT J,0+A
324 NEXT j
325 MOVE / cent. /zero
326 First_sweep: ENTER 3grampath,4+i43*(i+2-1):ISpec$i
327 i=1
328 i=Spec:50,0.15,0.1:ISpec
329 FOR j=1 TO 200
330 IF Spec \ Discrim THEN 513
ARLOT K+J
PENUP
NEXT J
PRINT USING S15K
IMAGE "Sweep",30
FOR K=1 TO 139
ENTER @"Search thru:ispec+"
Even_sweep: K=2*K+1
MAT Spec= Ispec
MAT Spec= Spec+(32768)
MAT Spec= Spec/(256)
FOR J=1 TO 200
Spec(J)=INT(Spec(J))
Spec(J)=Spec(J)/51.2
IF Spec(J)>Discrim THEN 529
ARLOT 2*K+1,J
PENUP
NEXT J
PRINT USING S15K
Odd_sweep: K=2*K+1
MAT Spec= Ispec
MAT Spec= Spec+(32768)
FOR J=1 TO 200
Spec(J)=Spec(J) MODULO 256
Spec(J)=Spec(J)/51.2
IF Spec(J)>Discrim THEN SOTO 539
ARLOT 2*K+1,J
PENUP
NEXT J
PRINT USING S15K
NEXT K!
PRINT "IS! 
RETURN

*************** SET TIME ***************
PRINT "ENTER UNIVERSAL DATE (DD MMM YYYY) ":
OFF ERROR
STATUS CRT,1:Nowline
STATUS CRT,0:Nowcol
GOSUB Askfora
Oldrsecs=DATE$DATE$(TIME DATE):
Old date in seconds
IF AS="" THEN
  CONTROL CRT,1:Nowline
  CONTROL CRT,0:Nowcol
  PRINT DATE$(TIME DATE):
  Newrsecs=0
  GOTO 582
END IF
CONTROL CRT,1:Nowline
CONTROL CRT,0:1
ON ERROR GOTO 560
Newrsecs=DATE$(AS):1
IF Newrsecs<2.0862912E+11 THEN GOTO 560
IF Newrsecs<1.14351224E+11 THEN GOTO 560
OFF ERROR
Date$=AS
Nowline=Nowline+1
CONTROL CRT,1:Nowline+1
CONTROL CRT,0:1
PRINT "ENTER ZULU TIME (HH MM SS) ":
OFF ERROR
STATUS CRT,1:Nowline
STATUS CRT,0:Nowcol
GOSUB Askfora
Oldtimesecs=TIME$/TIME$(TIME DATE):
Old time when 1st RETURN was pushed
IF AS="" THEN
  IF Newrsecs=0 THEN GOTO 510
  Newtimesecs=TIME$TIME$-Oldrsecs-Newrsecs
  SET TIMEDATE Newtimesecs
  GOTO 510
END IF
Nowline=Nowline+1
CONTROL CRT,1:Nowline
CONTROL CRT,0:1
IN ERROR GOTO 565
Newtimesecs=TIME$TIME$(AS):1
IF Newtimesecs<2 THEN GOTO 565
IF Newtimesecs<1.14351224E+11 THEN GOTO 565
OFF ERROR
IF Newrsecs=0 THEN
  SET TIMEDATE Oldrsecs-Newrsecs
  GOTO 510
END IF
SET TIMEDATE Newrsecs-Newtimesecs
OUTPUT #01:CHR$ 13+CHR$ 75 : Clear screen
OFF ERROR

IF Oldfunctions="RECORD" THEN GOTO Record

GOTO Menu

==================================================================== PRODUCE CATALOG OF HARD-DISC IONOGRAMS ==

Oldfunctions=Function$

Function="LISDISCGRAMS"

List_grams: GRAPHICS OFF

Ac=""

IF Catuotodate="YES" THEN GOTO 645

ASSIGN @Grampath TO *

ON ERROR GOTO File_error ; IF NO "IONOGRAMS" FILE, CREATE ONE

ASSIGN @Grampath TO "IONOGRAMS"

OFF ERROR

CONTROL @Grampath,7:41614 ; MOVES ECF MARKER TO END OF IF FILE

ENTER @Grampath,41614 USING "4D":jcattest

IF jcattest=0 THEN

jcat=0

IF Functions="RECORD" THEN GOTO 633

IF Functions="DISPLAY" THEN GOTO 633

PRINT "THERE ARE NO IONOGRAMS RECORDED ON THE HARD DISC"

Catuotodate="YES"

RETURN

END IF

IF jcat=jcattest THEN GOTO 643

jcat=jcattest

FOR K=1 TO jcat

ON ERROR GOTO 643

ENTER @Grampath,143+(K-1) USING "336A":Title$

Qcat$(K)=Title$(1,48)

NEXT K

OFF ERROR

Catuotodate="YES"

IF Functions="RECORD" THEN RETURN

IF Functions="DISPLAY" THEN RETURN

PRINTER IS 1

CLEAR SCREEN

Display_list: PRINT USING 650:jcat

IMAGE 3X,"THE DISC CONTAINS THE FOLLOWING":4D," IONOGRAMS:";

FOR K=1 TO jcat;6+1

PRINT USING 651;@cat$(6*K);"@",@cat$(6*K-1);@cat$(6*K-2);@cat$(6*K-3);

NEXT K

IMAGE 5(0A), 2X;

NEXT K

PRINT USING "K,":"HARD COPY \(Y/N\) ?"

A=""

GOSUB Askfora

IF UPCASE(A[1])="Y" THEN

STATUS CRT,Aa

CONTROL OPT:1:Aa-1
661 PRINT " 
662 RETURN 
663 END IF 
664 PRINT USING 666:DATE$(TIME)$,TIME$(TIME)$ 
665 IMAGE 6X,11A,2X,8A ,"Z" 
666 PRINT USING 650:Jcat 
667 FOR Ky=1 TO Jcat/6+1 
668 PRINT USING 670:Ocat$(6*Ky-5),Ocat$(6*Ky-4),Ocat$(6*Ky-3),Ocat$(6*Ky-2 
669 ),Ocat$(6*Ky-1),Ocat$(6*Ky) 
670 IMAGE 6X,6<10A,2X) 
671 NEXT Ky 
672 Ac$="" 
673 PRINT I3:1 
674 RETURN 
675 File_error: OFF ERROR 
676 ASSIGN @Gramath TO A* 
677 ON ERROR GOTO 679 
678 PURGE "IONOGRAMS" 
679 ON ERROR GOTO 681 
680 CREATE BOAT "IONOGRAMS",41614,400 
681 OFF ERROR 
682 ASSIGN @Gramath TO "IONOGRAMS" 
683 CONTROL @Gramath,7:41614 
684 Jcat=0 
685 OUTPUT @Gramath,41614 USING "4D":Jcat 
686 SOTO 524 
687 Return: RETURN I Return from request for list of fixed-disc ionograms 
688 
689 "*********** PURGE IONOGRAMS FROM "IONOGRAMS" FILE ***********" 
690 
691 Purge: 
692 OFF KEY 
693 CONTROL CRT.12:1 I KEY LABELS OFF 
694 GRAPHICS OFF 
695 OUTPUT NEW:CHR$(355)&CHR$(75): I CLEAR SCREEN 
696 PRINT " REQUEST PERMISSION TO PURGE IONOGRAMS 
697 A$="" 
698 PRINT USING "36A,:";"PURGE ALL IONOGRAMS FROM DISC ? (Y,N)?" 
699 INPUT A$ 
700 PRINT USING "ZX,30A":UPC$(A$(1,1)) 
701 IF UPC$(A$):"Y" THEN GOTO 723 
702 Te$=CHR$(131):PURGE ALL IONOGRAMS FROM DISC ? (Y,N)?CHR$(128), 
703 CHR$(131) AND CHR$(128) TURN INVERSE AND BLINKING ON AND OFF, Resp. 
704 PRINT I3:1 
705 PRINT USING "39A,:";Te$ 
706 A$="" 
707 INPUT A$ 
708 PRINT USING "ZX,30A":HE$(1) 
709 IF UPC$(A$):"Y" THEN GOTO 723 
710
711  ON ERROR GOTO Bad_or_no_file  ! IF NO "IONOGRAMS" FILE, SET Jcat= 1
712  ASSIGN @Grampath TC *
713  ASSIGN @Grampath TO "IONOGRAMS"
714  ENTER @Grampath,41614 USING "4D";Jcat
715  OFF ERROR
716  Jcat=0
717  OUTPUT @Grampath,41614 USING "4D";Jcat
718  Catuptodate$="NO"
719  OUTPUT KBD:CHR$(255)&CHR$(75);  ! CLEAR SCREEN
720  PRINT "ALL IONOGRAMS HAVE BEEN PURGED FROM ""IONOGRAMS"" FILE."
721  MAT Jcat$=""
722  GOTO 74
723  OUTPUT KBD:CHR$(255)&CHR$(75);  ! CLEAR SCREEN
724  GOTO 74
725  !
726  Bad_or_no_file:  PRINT "PROBLEM WITH ""IONOGRAMS"" FILE"
727  ON ERROR GOTO 728
728  PURGE "IONOGRAMS"
729  CREATE BDAT "IONOGRAMS:HP7942,1402,0",41614,400
730  ASSIGN @Grampath TO "IONOGRAMS"
731  OUTPUT @Grampath,41614 USING "4D";0  ! SET Jcat=0
732  OFF ERROR
733  RETURN
734  !
735  Plot_grid:  ***************** PLOT GRID ********************
736  !
737  ! If the ionogram grid pattern is stored in array GRIDARRAY(12430),SL=0
738  ! it into the CRT display. If it isn't there, get it from the hard disc.
739  ! If it isn't on the disc, generate it.
740  !
741  OUTPUT KBD:CHR$(255)&CHR$(75);  ! CLEAR SCREEN
742  GINIT
743  GCLEAR
744  GRAPHICS ON
745  SHOW 1,512,1,280
746  Xzero=150
747  Yzero=70
748  IF Gridready$="YES" THEN GOTO 367
749  ASSIGN @Griddpath TO *
750  ON ERROR GOTO 755
751  ASSIGN @Griddpath TO "GRAMGRID:HP7942,1402"
752  ENTER @Griddpath/Gridarray(*)
753  OFF ERROR
754  GOTO 367
755  OFF ERROR
756  PLOT Xzero,Yzero
757  IPLOT 0,-9
758  IPLOT 0,9
759  FOR K=1 TO 14
760  IPLOT 10,0
761  I Plot 0, -5
762  I Plot 0, 5
763  I Plot 10, 0
764  I Plot 0, -9
765  I Plot 0, 9
766  NExt K
767  I Plot 10, 0
768  I Plot -10, 0
769  FOr K=1 TO 5
770  I Plot 0, 20
771  I Plot 5, 0
772  I Plot -5, 0
773  I Plot 0, 20
774  I Plot 10, 0
775  I Plot -10, 0
776  NExt K
777  I Plot 0, 11
778  I Plot 0, -10
779  FOr K=1 TO 14
780  I Plot -10, 0
781  I Plot 0, 5
782  I Plot 0, -5
783  I Plot -10, 0
784  I Plot 0, 9
785  I Plot 0, -9
786  NExt K
787  I Plot 0, -1
788  I Plot -10, 0
789  I Plot 10, 0
790  FOr K=1 TO 5
791  I Plot 0, -20
792  I Plot -5, 0
793  I Plot 5, 0
794  I Plot 0, -20
795  I Plot -10, 0
796  I Plot 10, 0
797  NExt K
798  PEnup
799  PLOT /zerO, /zerO
800  PEn !
801  CSizE 4, 0, 5
802  FOr K=1 TO 15
803  MOVe /zerO+K-1*20-3.5, /zerO-25
804  IF K=5 THEN GOTO 311
805  MOVe /zerO+K-1*20-7.5, /zerO-25
806  A$=PLacE(C*K)
807  LAbEl A$[1, 1]
808  MOVe /zerO+K-1*20, /zerO-25
809  LAbEl A$[2, 2]
810  GOTO 312

30
811 LABEL VAL$(2*K)
812 NEXT K
813 MOVE Xzero+50,Yzero+40
814 LABEL "FREQUENCY (MHz)"
815 MOVE Xzero,Yzero
816 FOR K=0 TO 5
817 MOVE Xzero-13,Yzero-9+40*K
818 LABEL VAL$(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+30
825 LABEL "SEC"
826 PEND
827 MOVE Xzero,Yzero+220
828 RPLT 230,0,-1
829 RPLT 230.51
830 RPLT 0.51
831 MOVE Xzero-30,Yzero+245
832 LABEL "S15"
833 MOVE Xzero-30,Yzero+132
834 LABEL "(dBm)"
835 MOVE Xzero,Yzero+220
836 IPLT -5.0
837 IPLT 6.0
838 FOR K=1 TO 5
839 IPLT 0.10
840 IPLT -5.0
841 IPLT 5.0
842 NEXT K
843 MOVE Xzero-47,Yzero+213
844 LABEL "100"
845 MOVE Xzero-38,Yzero+251
846 LABEL "85"
847 MOVE 76,375
848 CSIZE 4.0,50
849 LABEL "NAVAL RESEARCH LABORATORY CNOGRAM"
850 MOVE 75,250
851 CSIZE 4.408
852 LABEL USING 953
853 IMAGE 23x,3*
854 LABEL "SOUNDER 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 MSG 653
861 PURGE "GRAMGRID"
862 OFF ERROR
863 CREATE BDAT "GRAMGRID:HP7942,1402,3",1,51200
864 OFF ERROR
865 ASSIGN @GridPath TO "GRAMGRID"
866 OUTPUT @GridPath(Gridarray(*)
867 ASSIGN @GridPath TO *
868 SLOAD Gridarray(*)
869 ON KEY 2 GOSUB Do nothing
870 CONTROL CRT:12:2 Key labels displayed at all times
871 Gridarray$="YES"
872 MOVE Yzero,Yzero
873 GRAPHICS ON
874 RETURN
875
876 Do nothing: RETURN REMOVES FUNCTION OF USER-DEFINED KEYS WHILE RUNNING
877
878 *************** SUBROUTINE FOR CHANGING PATHLABELS ***************
879
880 Pathlabels: ON ERROR GOTO 886
881 ASSIGN @Path TO *
882 ASSIGN @Path TO "PATHDATA"
883 OFF ERROR
884 ENTER @Path;Path$(,1,Lat(*),Long(*),Tdelay(*),0seg$*)
885 RETURN
886 CREATE BDAT "PATHDATA",1,5000
887 OFF ERROR
888 Path$(1)="ISABELA (PR) TO NFL"
889 Path$(2)="CORINNE (UT) TO NFL"
890 Path$(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
898 Tdelay(2,:)=40
899 Tdelay(3,:)=0
900 Tdelay(4,:)=0
901 Tdelay(5,:)=1
902 Tdelay(6,:)=50
903 0seg$1="3 25 40 55"
904 0seg$2="25 20 35 50"
905 0seg$3="20 15 30 45"
906 ASSIGN @Path TO "PATHDATA"
907 OUTPUT @Path;Path$(,1,Lat(*),Long(*),Tdelay(*),0seg$*)
908 PRINT "PATHDATA FILE STUFFED WITH DATA"
909 PRINT "LENGTH OF 0seg$:1=":LEN(0seg$1)"
910 PRINT "LENGTH OF 0seg$:2=":LEN(0seg$2)"

32
PRINT "LENGTH OF Goseg$:";LEN(Goseg$)+1
PRINT Goseg$(1):
ASSIGN @Path TO *:
RETURN

Changeaths:
OUTPUT KBD;CHR$(255):CHR$(195): CLEAR SCREEN:
OFF TIME
CONTROL CRT,121: KEY LABELS OFF
IF Path$(1)="" AND Path$(2)="" AND Path$(3)="" THEN GOSUB Pathlabels
PRINT "Present path descriptions are:":
US=CHR$(132): UNDERLINE
NS=CHR$(129): STOP UNDERLINES
PRINT
PRINT USING "36",K:"Time Delay"
PRINT USING 93;U$"Path"&N$,U$"Name"&N$,U$"min"&N$,U$"sec"&N$,U$"ms"&N$:operating Segments"&N$:
PRINT IMAGE 1X,K,3X,K,19X,K,4X,K,5X,K
PRINT FOR K1 TO 3
PRINT USING 931;K,Path$(K),delay$(K),delay$(K),Goseg$(K)
PRINT IMAGE 3D,4X,25A,1X,2D,5X,2D,5X,20A
NEXT K
PRINT
PRINT "To change a path description, ENTER 1, 2, or 3."
PRINT PRINT "PATH TO BE CHANGED: ":
A$=RPT$("",200)
ON KBD GOTO 951
OFF KEY
ON KEY 0 GOSUB Do_nothing
ON KEY 1 GOSUB Do_nothing
ON KEY 2 GOSUB Do_nothing
ON KEY 3 GOSUB Do_nothing
ON KEY 4 GOSUB Do_nothing
ON KEY 5 GOSUB Do_nothing
ON KEY 6 LABEL "QUIT",! GOTO 12:1
ON KEY 7 GOSUB Do_nothing
ON KEY 8 GOSUB Do_nothing
ON KEY 9 GOSUB Do_nothing
CONTROL CRT,121: KEY LABELS ON
GOTO 951
951 GOTO 951
952 A$=KBD$
953 CONTROL CRT,121: KEY LABELS OFF
OFF KEY
IF A$=CHR$(255):CHR$(133) THEN GOTO 937
PRINT A$
ON ERROR GOTO 953
959 IF LEN(A$)=1 AND NUM(A$):13 AND NUM(A$):52 THEN GOTO 951
OFF ERROR

33
961  GOTO 74
962  
963  OFF ERROR
964  Ptn=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$(8),11): CHR$(8) IS A BACKSPACE
972  PRINT USING "K,:";RPT$( " ",10)
973  PRINT USING "K,:";RPT$(CHR$(8),11): CHR$(8) IS A BACKSPACE
974  PRINT USING "DIA":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$) = 0 OR VAL(A$) =\n986  OFF ERROR
987  Newmin=VAL(A$)
988  TDelay$=Ptn.1=VAL(A$)
989  PRINT USING "K,:":RPT$(CHR$(8),7): CHR$(8) = BACKSPACE
990  PRINT USING "K,:":RPT$( " ",5)
991  PRINT USING "K,:":RPT$(CHR$(8),7)
992  PRINT USING "DIA":TDelay$Pth,1)
993  PRINT USING "K,:": min sec"
994  A$=RPT$(" ",200)
995  INPUT A$
996  IF A$=RPT$(" ",200) THEN GOTO 1001
997  IN ERROR GOTO 995
998  IF VAL(A$) = 0 OR VAL(A$) =\n999  OFF ERROR
1000  TDelay$=Ptn.2=VAL(A$)
1001  PRINT USING "K,:":RPT$(CHR$(8),6)
1002  PRINT USING "K,:":TDelay$Ptn.2,1 sec"
1003  Newsec=TDelay$Ptn.2)
1004  PRINT
1005  PRINT USING "G,:": New operating segments for path "Pth":
1006  A$=OSeg$(Ptn)
1007  INPUT A$
1008  Newsseg$=A$[1,20]
1009  ASSIGN 3Path TO *
1010  ASSIGN 3Path TO "PATHDATA"
1011  ENTRP $Path$:$Path$$:$Lat$$:$Long$$:$Tdelay$$:$10seg$$:
1012  Path$:$Path$=Newpath$:
1013  Tdelay$:$Path$$:$=Newmin$:
1014  Tdelay$:$Path$$:$=Newsec$:
1015  10seg$:$Path$$:$=New10seg$:
1016  ASSIGN $Path$ TO $+
1017  ASSIGN $Path$ TO "PATHDATA"
1018  OUTPUT $Path$:$Path$$:$Lat$$:$Long$$:$Tdelay$$:$10seg$$:
1019  ASSIGN $Path$ TO $+
1020  GOTO Changedaths
1021  IF Function$="RECORD" THEN GOTO Record
1022  GOTO Menu
1023  GOTO Menu
1024  "******** CHANGE # OF IONOGRAMS LISTED IN "IONOGRAM" DIRECTI-********
1025  |
1026  ASSIGN $Path$ TO $+
1027  ON ERROR GOTO 1029
1028  ASSIGN $Path$ TO "IONOGRAMS"
1029  OFF ERROR
1030  CONTROL $Path$:$141614$ MOVES EOF MARKER TO END OF FILE
1031  ENTER $Path$ $41614$ USING "4D";$cat
1032  PRINT "LISTED NUMBER OF IONOGRAMS ON TAPE IS ";$cat
1033  PRINT "ENTER NEW NUMBER OF IONOGRAMS:";
1034  INPUT "+",";
1035  PRINT $J$;
1036  OUTPUT $Path$ $41614$ USING "4D";$J$;
1037  PRINT "NUMBER OF IONOGRAMS HAS BEEN CHANGED TO ";$J$;
1038  GOTO End
1039  |
1040  "***** ROUTINE TO INPUT DATA FROM KEYBOARD WITHOUT CHANGING -5- LABELS *****
1041  |
1042  As$e$as$e$: $4S$=
1043  STATUS CRT$$:Col$  A is current col line
1044  STATUS CRT$$:Col$  Col is current line position
1045  Prescedence
1046  IF Function$="LISTIONOGRAMS" THEN Precedence$=
1047  ON REC Prescedence GOTO 1243
1048  GOTO 1243
1049  keyboardin$: $bdin$=#BD
1050  IF LEN$:$bdin$#1 THEN GOTO 1052
1051  IF NUM$:$bdin$$(2.2)$=#0 THEN "Recognize backspace CHR$135$ DEL$0
1052  IF LEN$:$bdin$#0 THEN GOTO 1054
1053  $bd$=#$bd$+1 LEN$:$bd$=#1
1054  GOTO 1062
1055  END IF
1056  IF NUM$:$bdin$$(2.2)$=#0 THEN "Recognize ahead space CHR$135$ SPACE$0
1057  $bd$=#$bd$+1
1058  GOTO 1062
1059  END IF
1060  IF $bdin$=CHR$135$CHR$135$ THEN GOTO input$done$"Recognize PAR$1$";
1061 GOTO 1048
1062 A$=A$&"\n"
1063 IF LEN(A$)=79+C1 THEN A$=A$(1,79+C1)
1064 CONTROL CRT,1:nea
1065 CONTROL CRT,3:C1+1:
1066 PRINT USING "X.Y,Z";A$,RPTS;':',50-C1-LEN(A$);
1067 GOTO 1048
1068 Input_done= OFF KBD
1069 IF Function$="SETTIME" THEN GOTO 1072
1070 IF Function$="MENU" THEN GOTO 1072
1071 OFF TIME
1072 PRINT
1073 RETURN
1074
1075 ! *********************** DYNAMIC TIME DISPLAY ***********************
1076 !
1077 Display_time;  ' Subroutine to display time each second
1078 IF Function$="SETTIME" THEN
1079 CONTROL CRT,1:11
1080 CONTROL CRT,0:11
1081 PRINT USING 1082;DATE$;TIME$;TIME$;TIME$;
1082 IMAGE 'UNIVERSAL TIME IS";X,"AA,XX,XX," 2"
1083 ON TIME: INT(TIME$) MOD 86400 +1: 50SUB Display_time
1084 RETURN
1085 END IF
1086 IF Function$="MENU" THEN
1087 CONTROL CRT,1:11
1088 CONTROL CRT,0:11
1089 PRINT USING 1089;DATE$;TIME$;TIME$;
1090 IMAGE 'UNIVERSAL TIME IS";X,"AA,XX,XX," 2"
1091 ON TIME: INT(TIME$) MOD 86400 +1: 50SUB Display_time
1092 RETURN
1093 END IF
1094 IF Function$="RECORD" THEN
1095 CONTROL CRT,1:12
1096 CONTROL CRT,0:11
1097 PRINT ':Timer= clock reads; "";DATE$;TIME$;TIME$;
1098 ON TIME: INT(TIME$) MOD 86400 +1: 50SUB Display_time
1099 RETURN
1100 END IF
1101 RETURN
1102 END
1103 016 Measilee Init
1104 016 System init
1105 016 Init Names
1106 016 Input Name$ INTEGER Channel REAL Var OPTIONAL INTEGER Gain REAL Products
1107 016 Sequential scan Name$ INTEGER Start Stop REAL Period $Data_array +, If
1108 016 INTEGER Repeat
1109 016 Random scan Name$ INTEGER Azm array REAL Data array OPTIONAL INTEGER Repeat REAL Data array INTEGER Gain array +
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 Scale, INTEGER Number);
1161  CSUB Config_0(Name#, OPTIONAL Model#, INTEGER Select_code, Gain, REAL Scale, Report_err#, Units#, Multiplier, Offset);
END
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