NATIONAL RADIO ASTRONOMY OBSERVATORY

SOCORRO, NEW MEXICO

VERY LARGE ARRAY PROGRAM

VLA ELECTRONICS MEMORANDUM NO. 195

THE VLA INTERFERENCE MONITORING SYSTEM

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1.0 INTRODUCTION

The interference monitoring system at the VLA site basically consists of a Hewlett Packard model 8555 spectrum analyzer controlled by an H.P. model 9830 calculator. It is designed to scan any required portion of the radio spectrum and record the received signal levels. The monitoring antenna used is usually a horn or log periodic antenna mounted on a tower. This system was originally set up in 1973: see J. L. Dolan, VLA Electronics Memo No. 108 and various addenda to that memorandum by JLD and G. A. Bonebrake. During the following years the system was extended to include monitoring of weather data, power failures, and total power received in a series of channels covering 1300-1800 MHz. A battery power supply was added to allow

operation during failures of utility power. By about 1979 much of this capability was no longer needed, and the necessary software was complicated and almost totally lacking in documentation. During the summer of 1980 the system was overhauled and only the spectral scanning capability retained. The software was simplified, and flow charts and listings with explanatory notes were generated and are given in Appendix I.

2.0 THE BASIC SYSTEM

A basic block diagram of the system is shown in Figure 1. The spectrum analyzer is set up to cover the required frequency range using the comb generator or a signal generator. In operation it runs on external sweep, driven by a signal from the interface. The computer controls the sweep, which consists of 200 steps across the analyzer range, by sending out a series of 200 commands to the interface unit. As the analyzer moves from one point to the next, its output goes to a peak detector in the interface, which is read and reset to zero before the next step of the sweep is performed. In the interface each step is performed by generating a series of 10 voltage substeps. Thus the complete range is actually swept in 2000 substeps, and the output data are averaged over ten of them at a time. The time interval for each of the 200 main steps can be set from 0.1 to 1 sec. by a front panel adjustment on the interface. The interface sends to the

computer a signal to indicate the completion of each of the 200 steps, so the timing of the computer program automatically follows the rate set by the interface. At the slowest rate (1 sec per step) a scan takes approximately 5 minutes, time being taken between each step for the computer to complete certain program operations.

During a run the system first performs one scan, referred to as the reference scan, in which the receiver is terminated in a matched load. It then performs a specified number of monitoring scans, n, keeping account of the minimum, maximum and average values read from the peak detector for each of the 200 frequency intervals of a scan. After the specified number of scans is performed the max., min., and average data are written in a file on the 8965A tape unit. The cassette tapes used are long enough to hold 36 such files, so, for example, specifying n = 8 scans per file results in 24 hours of monitoring. In another file the on the tape the computer keeps account of the running min. max. and average values for each frequency interval from the start of the first monitoring scan. This file is updated every time one of the n-scan data files is written. Also updated at that time is a file in which the computer keeps account of the number of times since the first monitor scan that, for each

frequency interval, the signal level has exceeded each of two threshold levels. These levels are specified at the start of the run as dB values above the reference-scan level. At the end of the 36th n-scan file the program goes to a routine for preparing the data for plotting and then awaits further commands.

Several options for plotting the output data are available. The maximum, minimum and average values for each frequency interval over the whole run can be plotted as a function of frequency. The maximum and minimum values for the n scans in each file can be averaged over the files (they are then referred to as <max> and <min>) and plotted as a function of frequency. The percentage of times over the whole run that the level exceeds the two specified thresholds can be plotted as a function of frequency. The maximum, minimum and average values, computed for a specified number of frequency steps, can be plotted as a function of time. In this plot the time intervals are no finer than the time to complete n scans, since the data are not recorded on a finer time scale. Finally, any n-scan file can be examined by plotting the maximum values as a function of frequency. In the plotting routines the signal strength is converted to power flux at the antenna using a value of gain specified at the start of the program and the data on the antenna collecting areas given in Appendix II.

3.0 CALIBRATION AND SETUP OF THE EQUIPMENT

3.1 Frequency

The scan voltage from the interface unit drives the spectrum analyzer across the full scan range of its crt., so the scan range can be set up on internal sweep, and then switched to external for the monitoring program.

3.2 Bandwidth

The analyzer bandwidth should be $\frac{1}{200}$ of the scan range, or a little less, but greater than $\frac{1}{2000}$ of the scan range. The video bandwidth should be greater than the reciprocal of the step time by at least a factor of 2, i.e. >20 Hz for the fastest scan rate. Note that use of the video filter will improve sensitivity to constant signals but will greatly attenuate pulsed radar signals.

3.3 Signal Level

The Log Reference Level of the spectrum analyzer should be set to 0 dBm. The analyzer output voltage for a 0 dBm signal should then be 1.0 v which should produce a value of 999 from A/D converter in the interference unit. The relationship between input power to the spectrum analyzer p and the interface output number, c, is

$$p\ (\text{dBm}) = (c-999)/13.79$$

The number 13.79 in the above expression was determined by measurement on July 17, 1980, and a test routine to aid in repeating this calibration is given in File 6 of Appendix I. The monitoring program requires the total gain in dB from the antenna terminals to the input of the spectrum analyzer, and this figure must be specified at the beginning of a run.

3.4 Tests

Tests of correct operation of the system can be made by injecting signals of known frequency and power level into the calibration coupler in Figure 1 and operating the system in the normal manner. A check of the data processing in the interface can be made by replacing the spectrum analyzer output signal with a calibrated constant-voltage source.

4.0 OPERATION OF THE INTERFERENCE MONITOR

To start a data collection, load a copy of the EMI Programs tape into the calculator-cassette drive and a blank tape into the data-cassette drive (9865A). Clear existing memory and/or programs by typing SCRATCH A EXEC. The programs can now be loaded with the command LOAD 0,10,10 EXEC. After a pause (while the calculator finds the file) the program will start by printing out

a list of items to check on the interface. Afterwards the following questions will be asked:

0- START, 1- RESTART?

Enter 0 for new tape.

LOAD, REWIND BLANK TAPE IN 9865A?

This display will remain until the data-cassette is manually rewound.

ENTER R.F. CODES?

See printer for explination of codes; enter code for frequency range used.

ENTER START, STOP FREQUENCIES?

Enter the frequency limits of the spectral analyzer.

ENTER FEED ORIENT. IN DEGREES?

This is the orientation of the monitoring antenna, 0 degrees = North.

ENTER GAIN (dB)?

This is the gain between the horn and the spectrum analyzer.

ENTER # OF SCANS/DATA BLOCK?

This is the number of scans per file. The program will scan this number of times and then store min, max and avg for the set of scans.

ENTER THRESHOLD LEVELS : DB1, DB2?

The program will count the occurance of high counts above the reference scan + each threshold level. Two levels can be entered.

TERMINATE RCVR INPUTS?

This display will last only 18 seconds, during which time the input to the horn or antenna amplifier should be terminated for the reference scan to be taken. Also, be sure the spectrum analyzer is set to external scan and 0 dB reference level.

The reference scan will take approximately 5 minutes. After it is completed, the program is finished requesting information. However, it will remind the user to attach the antenna or horn to the receiver inputs. The collection program will be loaded automatically and started. The entire data-tape is initialized with the appropriate marks for the locations of the files to be written, before any data scans are started. This procedure helps to avoid errors and saves some program time later. When the program prints the START TIME the data collection routine has just begun. At this point the title file and reference scan have been stored on tape. Assume that you have just noticed that an error in setting of the spectrum analyzer has occured. It is not necessary at this point to retype all of the code back in and wait for the tape to be initialized again, instead the restart procedure can be used. Perform the following steps:

Press the STOP key.

LOAD 0,10,10

0- START, 1-RESTART?

In this case type in a 1.

LOAD, REWIND PREVIOUS TAPE?

Press the rewind switch on the data-cassette.

After a pause the calculator should respond with a printout of the file number which it will restart with. In this case it should be FILE #1.

REF SCAN: ENTER 0- NEW, 1- OLD?

Enter whichever is appropriate for the error which occured. If 1 is entered the old scan will be read off the tape.

The restart mode can be used any time after the tape is marked. If restart is attempted on an unmarked (un-initialized) tape, ERROR 58 will occur. Also, if there are no more files left on the data-tape the program will respond with: TAPE FULL, RESTART NOT ALLOWED. If you want to change the title block in a restart (for example, an error occured in the input) LOAD 0 and edit the program in lines 530-620. Then press RUN. The editing will only be temporary and will not be saved. A good example of a cause for using the editing would be to change the number of files in order to write over a certain number of files. In any case of editing, however, be sure that the change you are making is correct. For example, the number of files

that are stored on tape is equal to the number of sets-of-scans + 5 because of the reserved files at the beginning of the tape.

The program can also be interrupted during execution. At the end of every scan the program allows ten seconds to type in an interrupt code. The codes are given on the calculator printout. Select the code which is appropriate and then wait for the calculator display to write:

INTERRUPT DURING NEXT 10 SEC.?

Then type:

STOP EXEC.

Y = 111 or 888 or 999 (anything else will be taken as 999)

CONT EXEC.

The calculator will respond with the number of scans left in the last set of scans and the interrupt code you typed in. Depending on the interrupt code and the number of scans left, the stop time will vary. The restart feature and later programs can be used without difficulty after a correct interrupt procedure.

Under normal operation the calculator will continue through all of its programs and load all of the plotting programs without interruption. However, in some cases (for example, a power failure) the program will be interrupted and the user would simply like to prepare the tape for plotting directly. In

this case type: LOAD 2,10,10. The program will prepare the plots of <max> and <min> and then load the plotting programs. The user can also skip the preparation of the <max> and <min> and load the plotting programs directly by typing LOAD 3,10,10. In any case, when the plotting programs are loaded the display will write READY. At this point the Special Function Keys of the calculator are ready to be used. Turn on the plotter and secure a piece of graph paper onto the plotter. The keys have the following functions:

RUN FO max, min, avg plotting (array A).

All three plots and the reference scan can be plotted, with the required axes, on one sheet of paper. However, this is usually crowded so the user can select which plots to go onto a given sheet. If more than one plot is specified the user can change the pens on the plotter (quickly - only 10 sec. allowed) between plots. At the end of the plots the program will ask for a number between 0 to 1 for the title block. This number determines the position of the title block on the upper portion of the graph paper.

RUN F1 <max> and <min> plotting.

Both <max> and <min> are plotted with time in between for changing pens. The title block is drawn again as above. If the tape has not been prepared for this plot it will respond with NOT PREPARED.

RUN F2 % counts above thresholds

This key will plot both high-count files versus frequency. The threshold levels will be given on the plot for reference. The title block will be drawn afterwards given the position 0-1.

RUN F3 Flux averaged over frequency versus time.

This program will calculate the max, min, and average over a given frequency range and plot it versus the file end time. If the tape was prepared for plotting the average over the complete frequency range is already stored on tape and will take only a few minutes to plot. Otherwise, this program could take up to 20 minutes to plot the data requested. At the end of this plot the title block will again be drawn if desired.

RUN F4 Plot the maxima of any single data file. The program on this key will draw the reference scan and then request the number of the data file (1 through 36). It will then plot the maxima of that file. More than one file can be put on a set of axes. If a seperate plot is desired, simply type 0 for the next file # and draw the title block. This program could be run as many times as necessary.

5.0 DOCUMENTATION

In addition to this memorandum the following documents are required:

Electronics Division Internal Report No. 133, RFI Surveillance Computer Interface, by J. Greenberg, October, 1973. (Note that this report describes the operation of the interface with the H.P. 9810A calculator, whereas the model now used is 9830A.)

Manuals for the H.P. 9830A Computer and Peripherals:

- 9830A Calculator Operating & Programming Manual
- 9830A Plotter Control ROM Operating Manual
- 9830A Plotter Pac Manual
- 9862A Calculator Plotter Operating Manual
- 9865A Cassette Memory Peripheral Manual
- 9830A Advanced Programming 1 ROM Operating Manual
- 11202A I/O Interface Installation and Service Manual

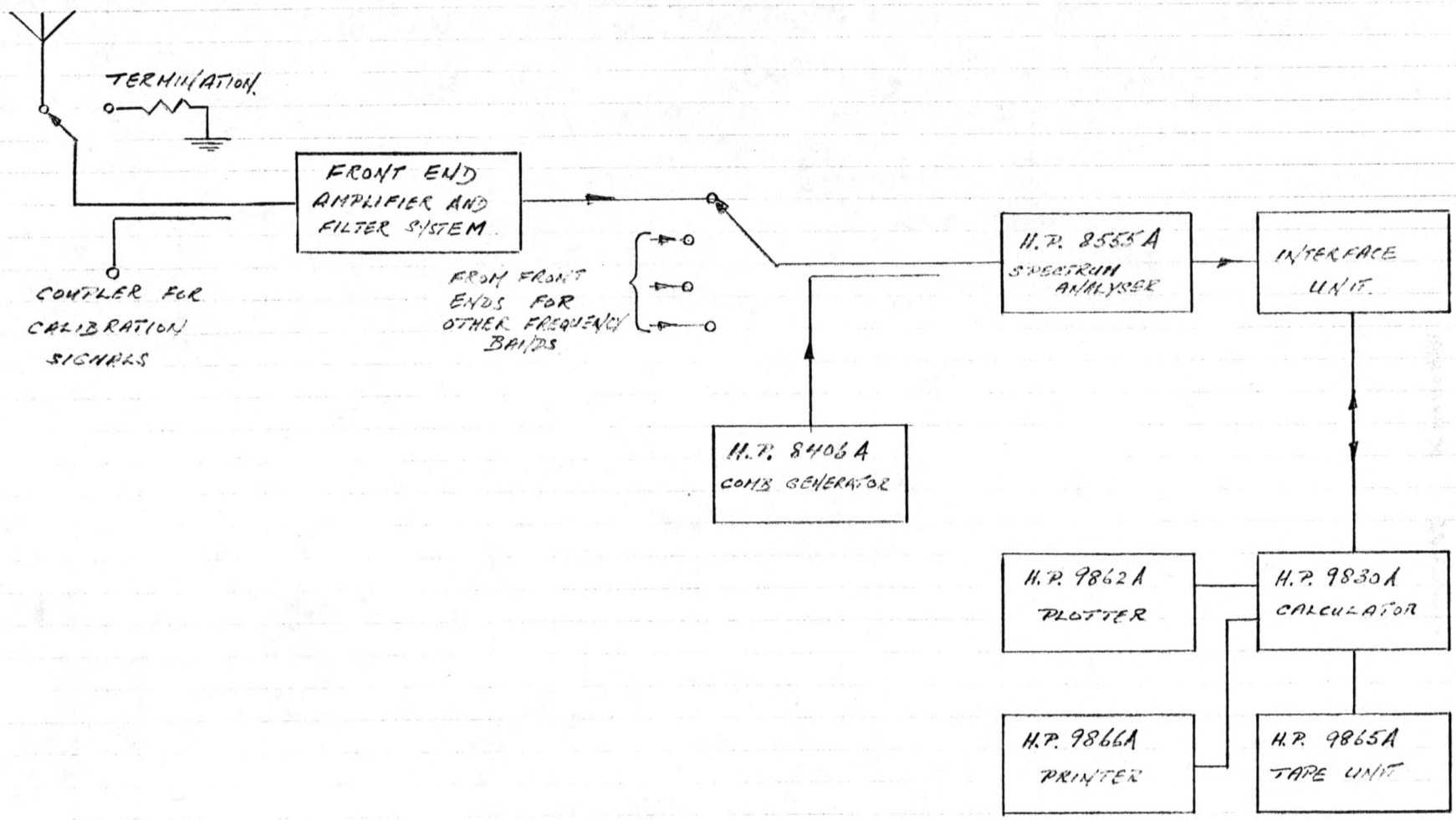
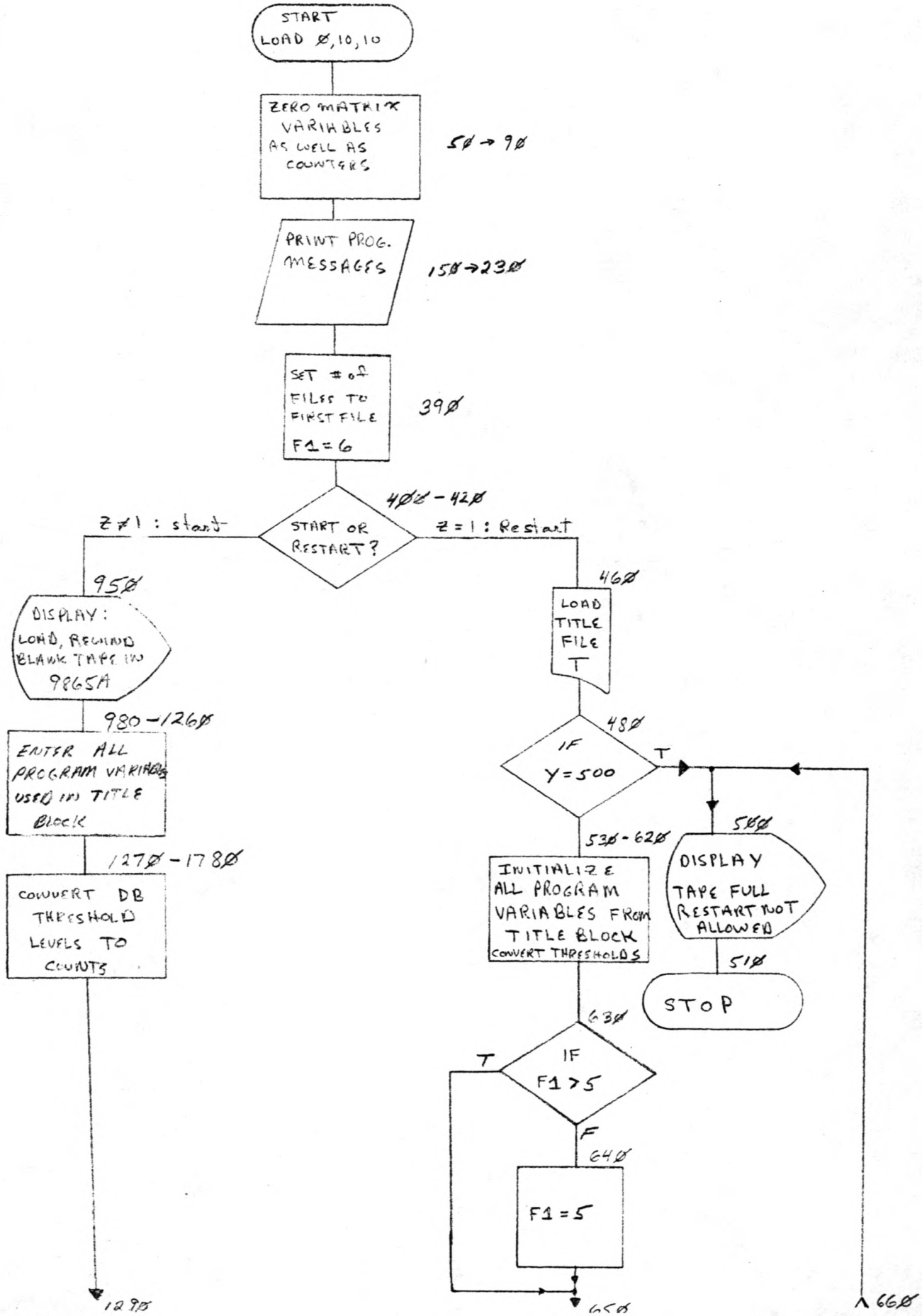


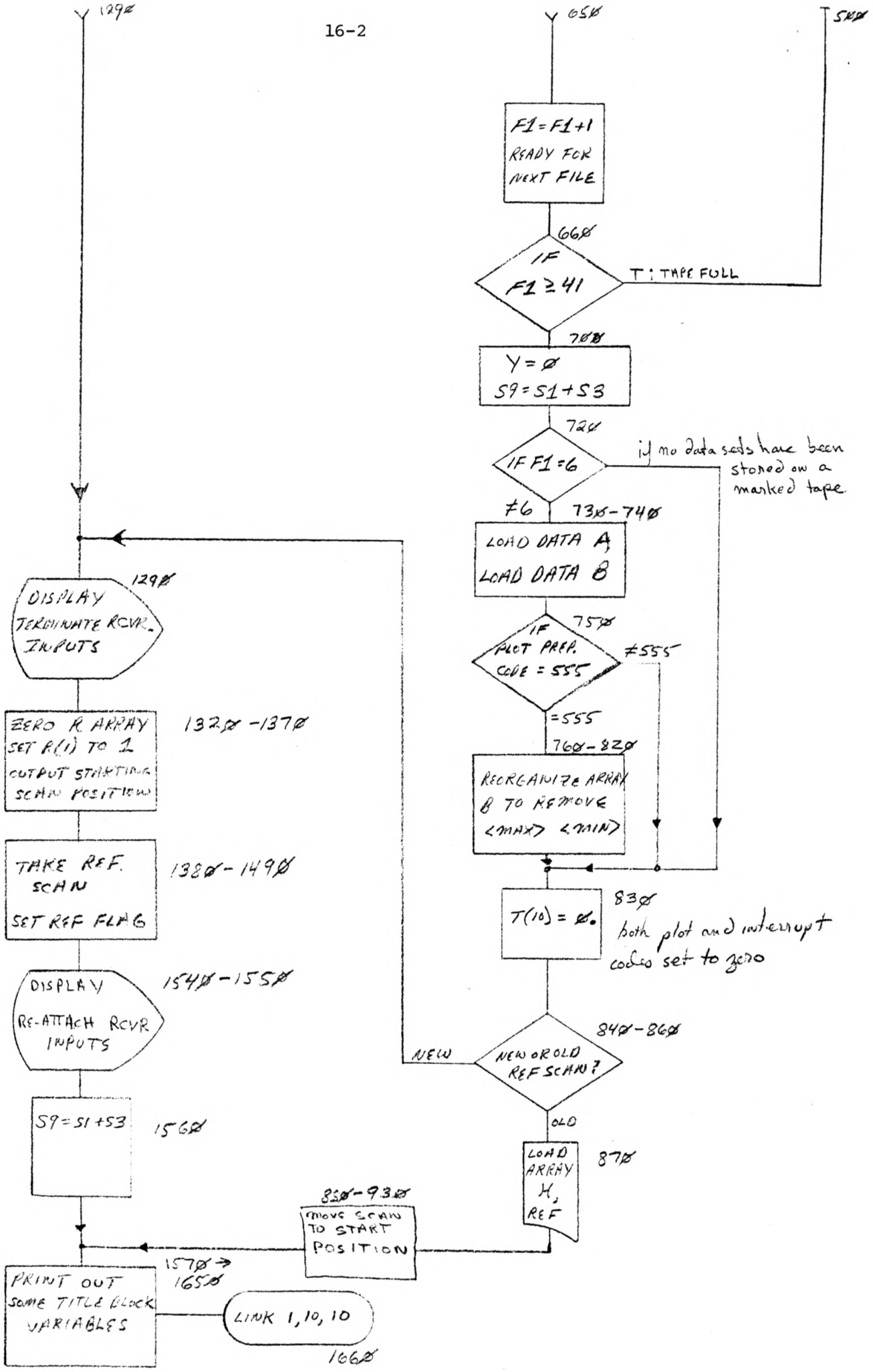
Figure 1 Interference monitoring system. The comb generator is switched on during initial setup procedures only.

A.R.T 8/29/80

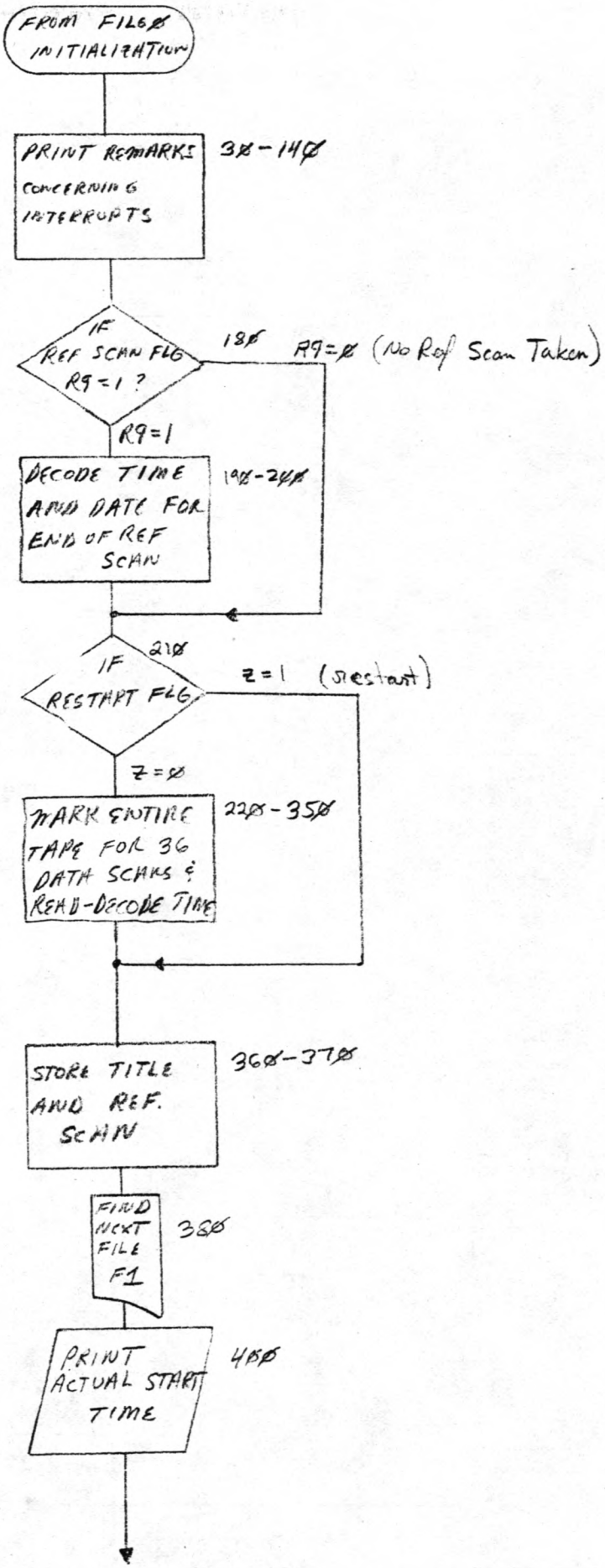
APPENDIX I

File Ø Initialization

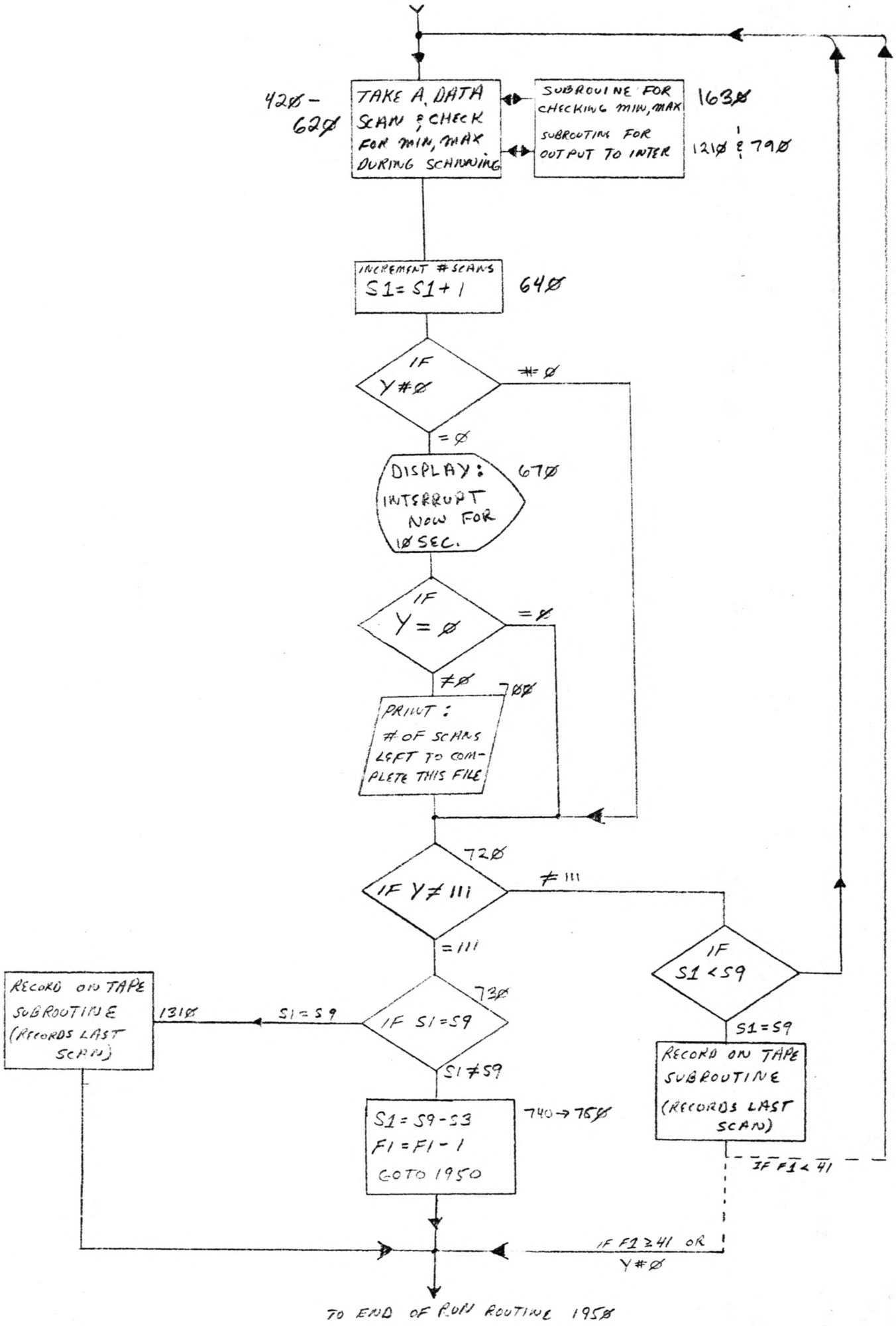



1290
650
500
F1 = F1 + 1
READY FOR NEXT FILE
660
IF F1 ≥ 41
T : TAPE FULL
700
Y = Ø
S9 = S1 + S3
720
IF F1 = 6
if no data sets have been stored on a marked tape
≠6
730-740
LOAD DATA A
LOAD DATA B
750
IF PLOT PREP. CODE = 555
≠555
=555
760-820
REORGANIZE ARRAY B TO REMOVE <MAX> <MIN>
830
T(10) = Ø.
both plot and interrupt codes set to zero
840-860
NEW OR OLD REF SCAN?
NEW
OLD
LOAD ARRAY H, REF
870
850-930
MOVE SCAN TO START POSITION
1290
DISPLAY TERMINATE RCVR. INPUTS
ZERO R ARRAY
SET R(1) TO 1
OUTPUT STARTING SCAN POSITION
1320-1370
TAKE REF. SCAN
SET REF FLAG
1380-1490
DISPLAY RE-ATTACH RCVR INPUTS
1540-1550
S9 = S1 + S3
1560
1570 → 1650
PRINT OUT SOME TITLE BLOCK VARIABLES
LINK 1,10,10
1660

FILE 1 COLLECTION OF DATA

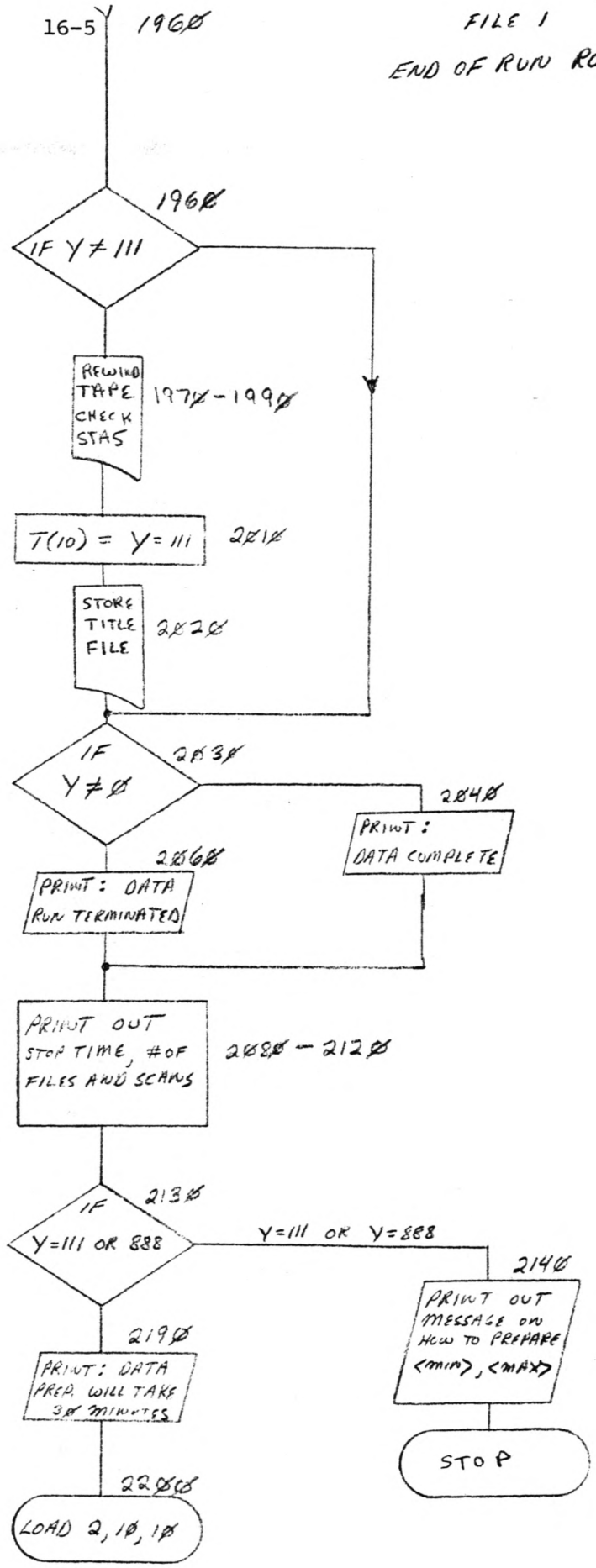


FILE 1


420 - 620
TAKE A DATA SCAN & CHECK FOR MIN, MAX DURING SCANNING
SUBROUTINE FOR CHECKING MIN, MAX
1630
SUBROUTINE FOR OUTPUT TO INTER
1210 & 790
INCREMENT # SCANS
S1 = S1 + 1
640
IF Y # Ø
Ø
= Ø
DISPLAY: INTERRUPT NOW FOR 10 SEC.
670
IF Y = Ø
= Ø
≠ Ø
100
PRINT: # OF SCANS LEFT TO COMPLETE THIS FILE
720
IF Y ≠ 111
≠ 111
= 111
IF S1 < S9
S1 = S9
RECORD ON TAPE SUBROUTINE (RECORDS LAST SCAN)
IF F1 < 41
730
IF S1 = S9
S1 = S9
1310
RECORD ON TAPE SUBROUTINE (RECORDS LAST SCAN)
S1 ≠ S9
S1 = S9 - S3
F1 = F1 - 1
GOTO 1950
740 → 760
IF F1 ≥ 41 OR Y # Ø
TO END OF RUN ROUTINE 1950

FILE 1

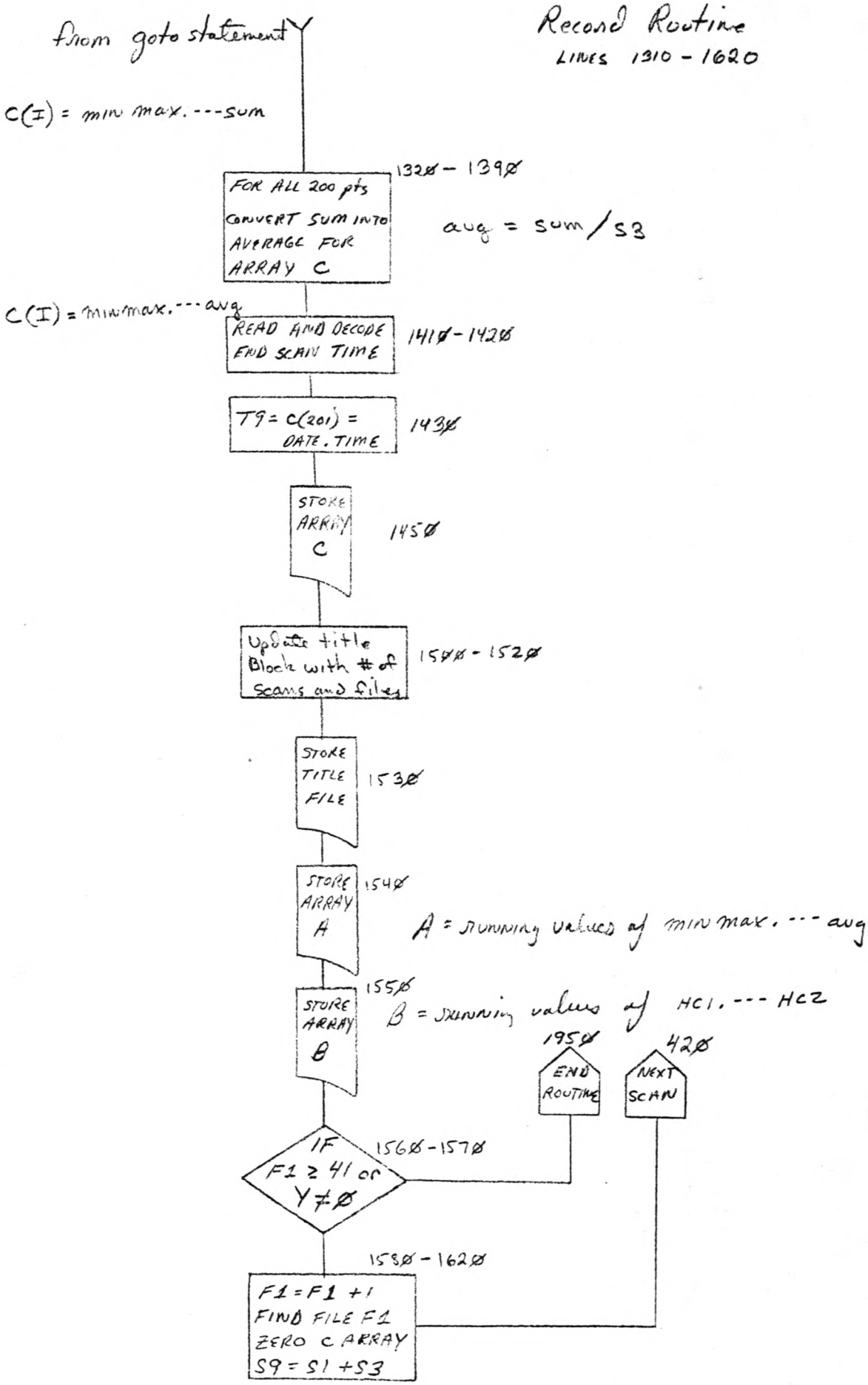
END OF RUN ROUTINE



File 1

Record Routine

LINES 1310 - 1620



ENTER FROM GOTO STATEMENTS

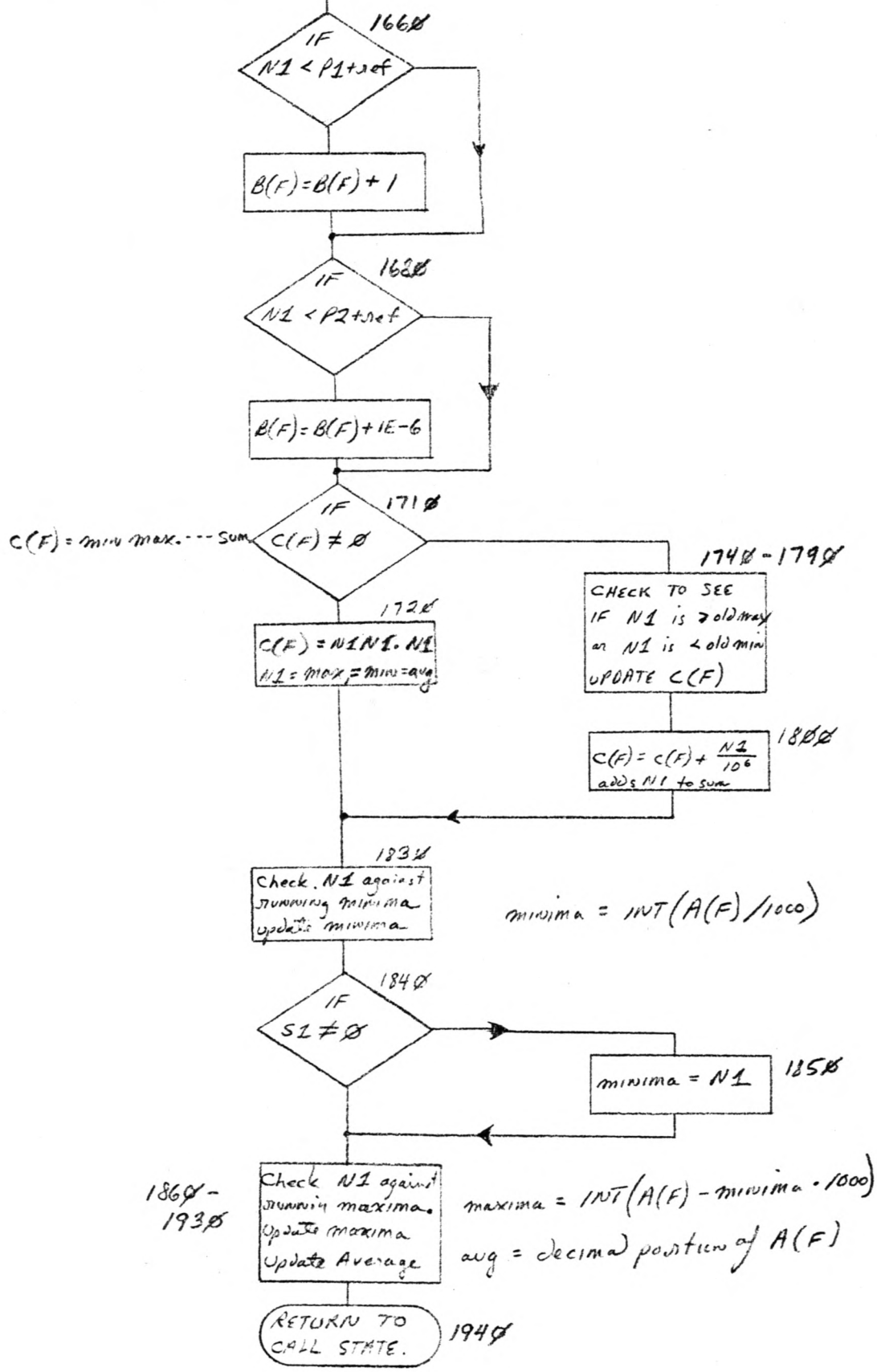
FILE 1

MIN MAX. SUM ROUTINE

LINES 1630 - 1940

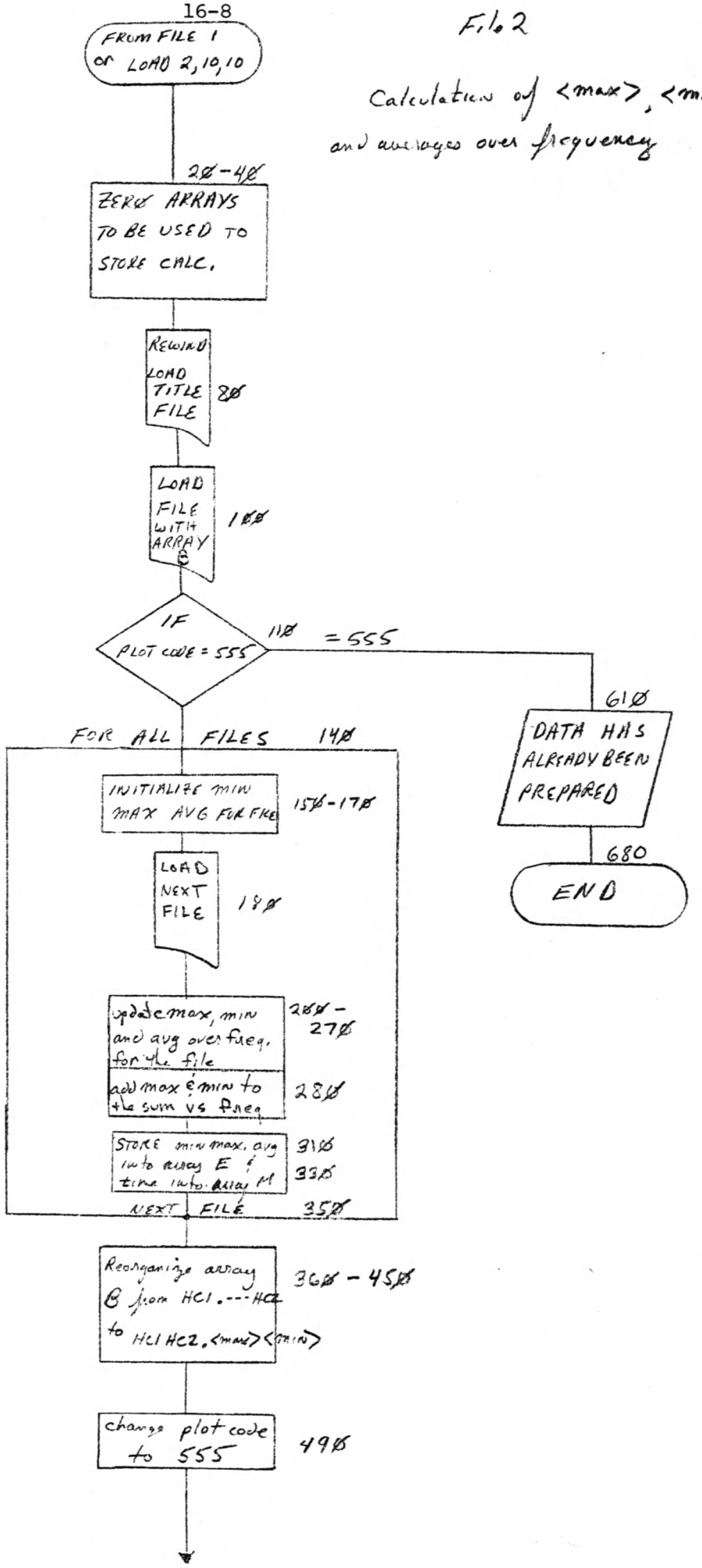
N1 is the count being checked for min, max

F is the index

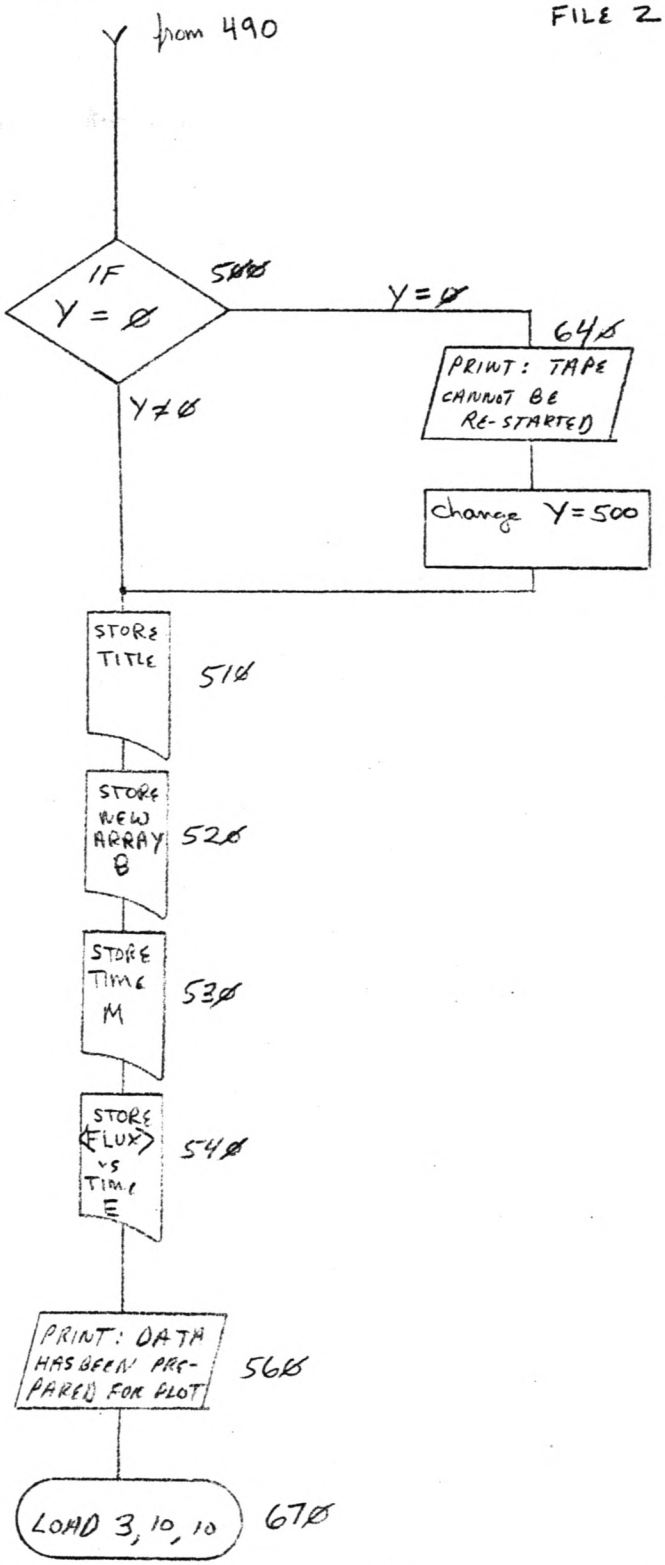


File 2

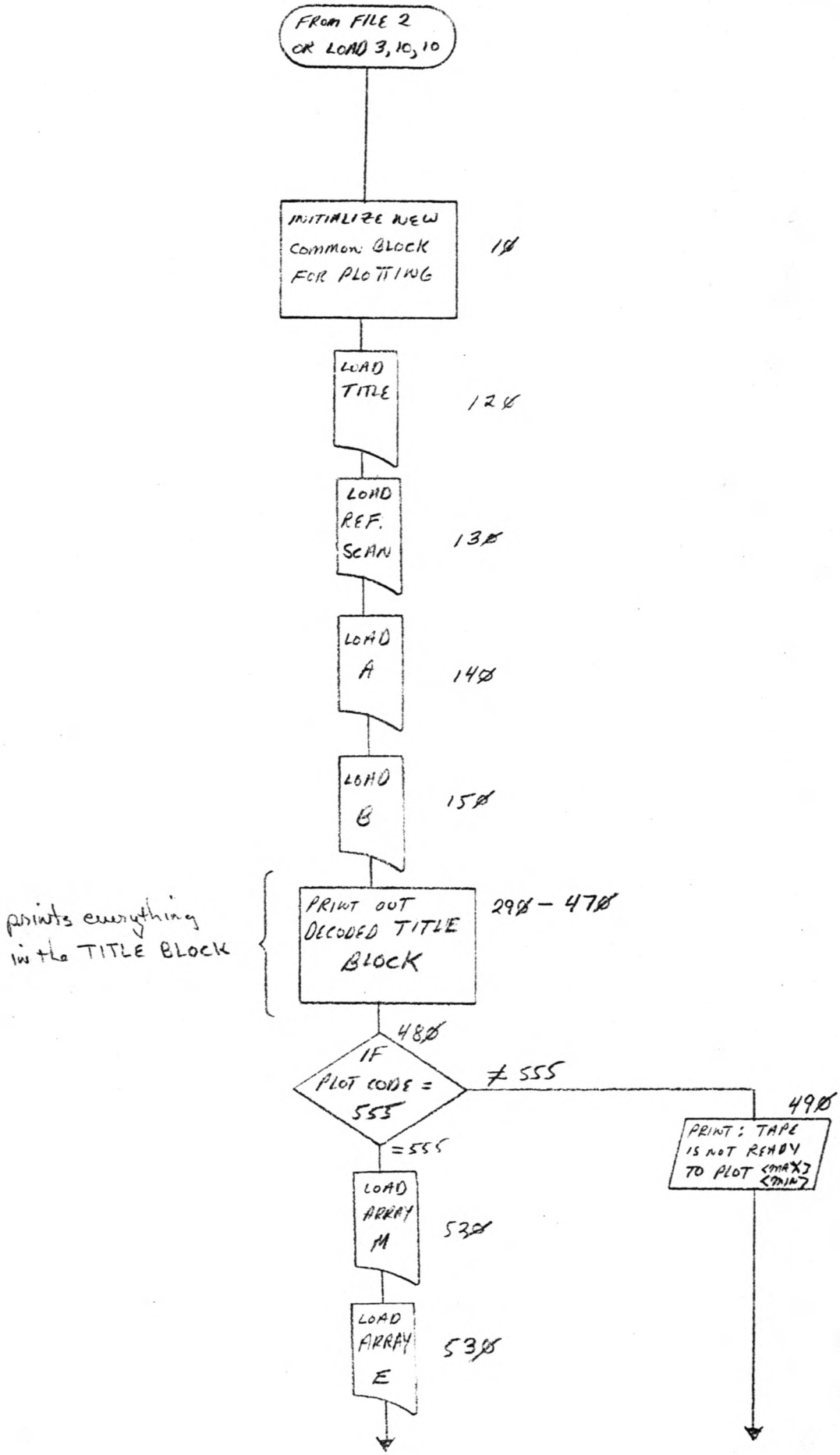
Calculation of <max>, <min> and averages over frequency



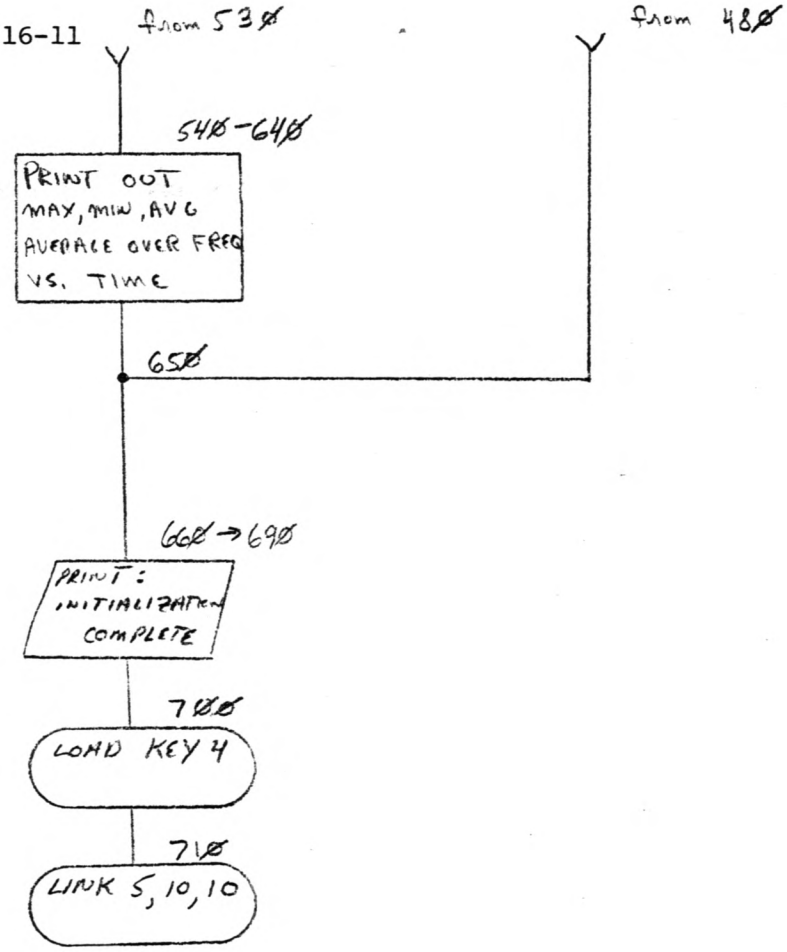
FILE 2


from 490
IF Y = Ø
500
Y = Ø
640
PRINT: TAPE CANNOT BE RE-STARTED
change Y = 500
Y ≠ Ø
STORE TITLE
510
STORE NEW ARRAY B
520
STORE TIME M
530
STORE ⟨FLUX⟩ vs TIME E
540
PRINT: DATA HAS BEEN PREPARED FOR PLOT
560
LOAD 3, 10, 10
670

FILE 3 PLOTTER INITIALIZATION



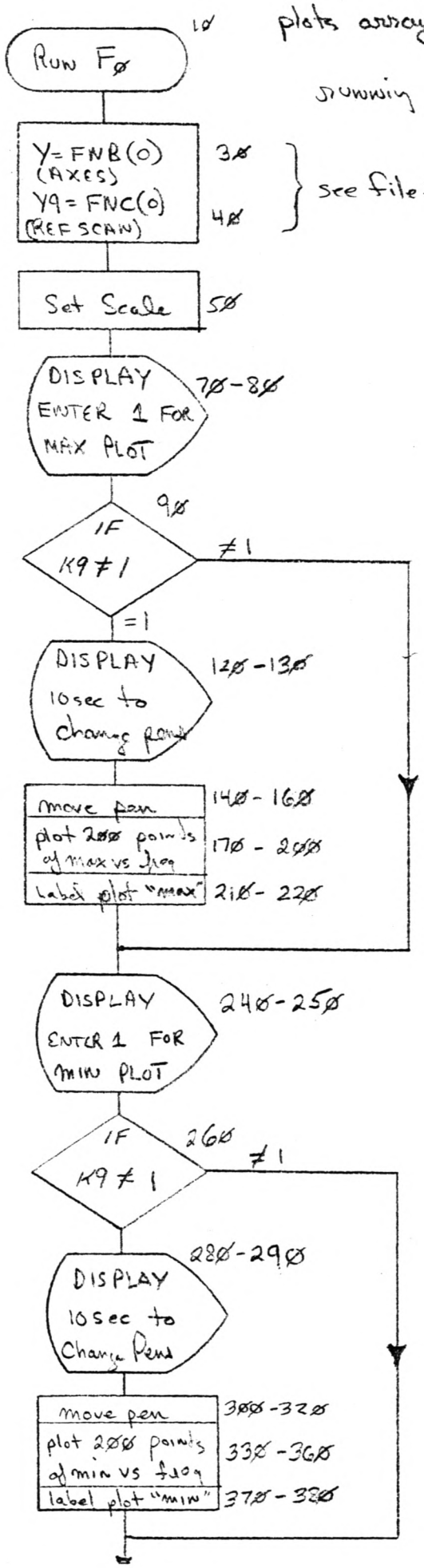
FILE 3


from 530
from 480
540-640
PRINT OUT
MAX, MIN, AVG
AVERAGE OVER FREQ
VS. TIME
650
660 → 690
PRINT:
INITIALIZATION
COMPLETE
700
LOAD KEY 4
710
LINK 5, 10, 10

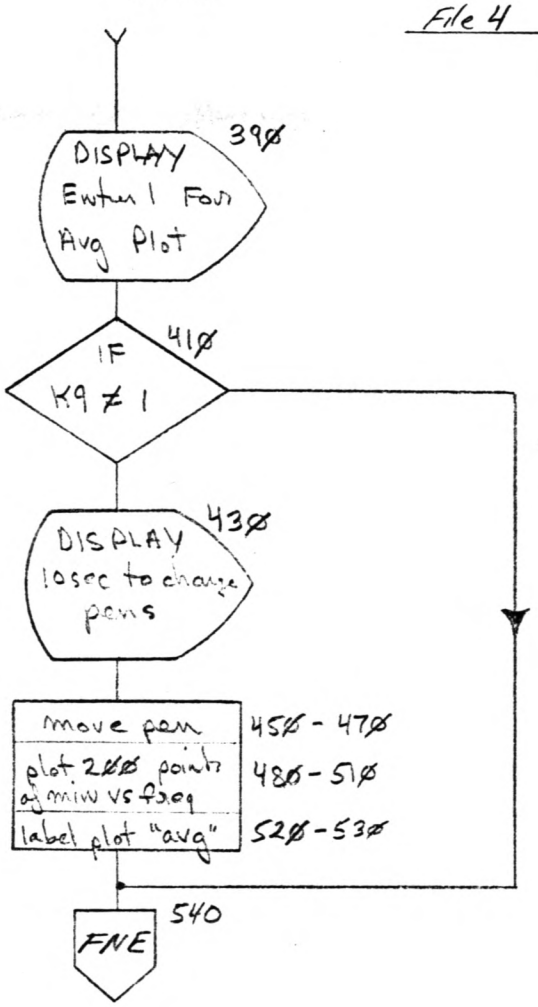
File 4 Key F0

plots array A(200

showing values of min max. --- dig

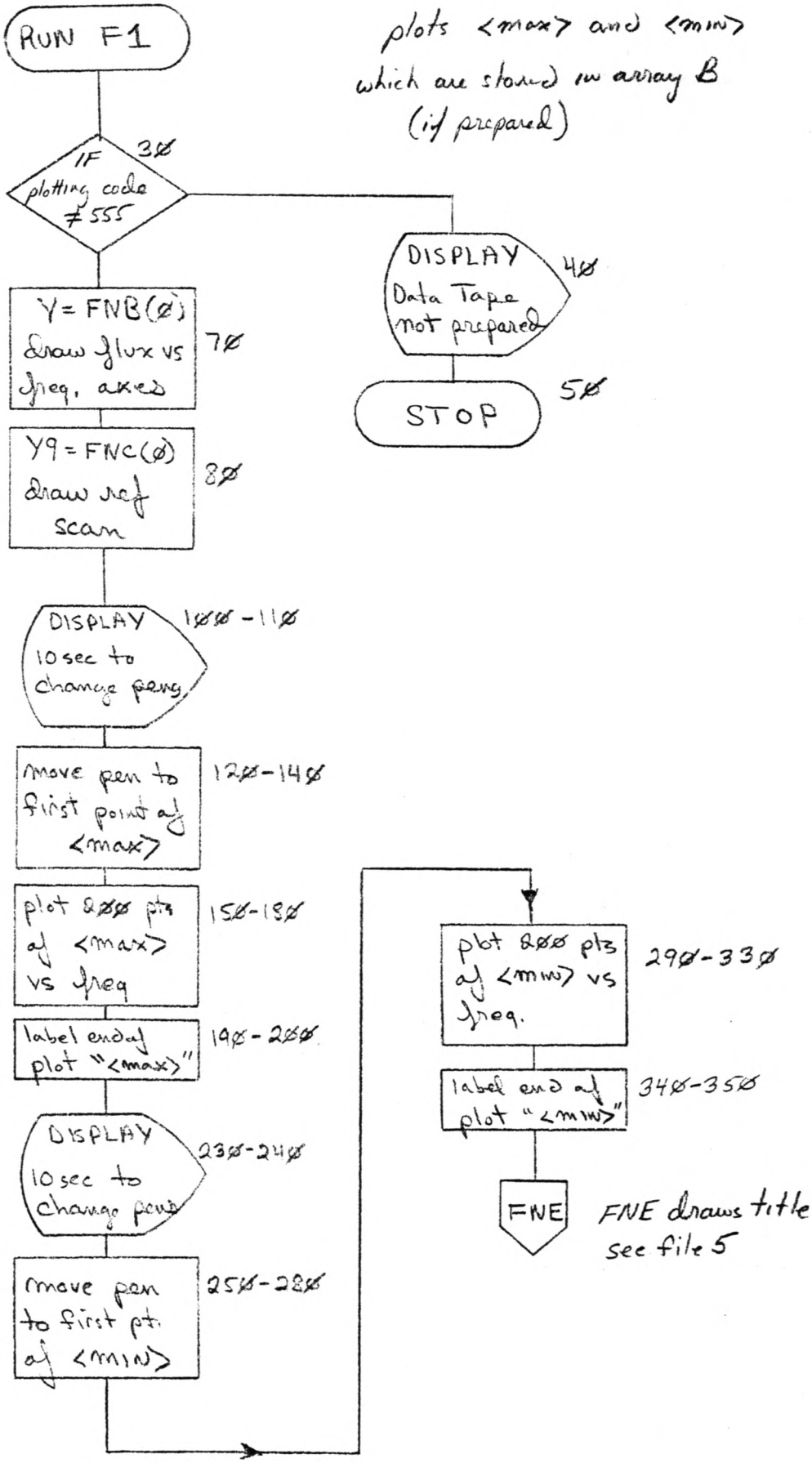


File 4 Key F0


390
DISPLAY
Enter 1 For
Avg Plot
410
IF
K9 ≠ 1
430
DISPLAY
10sec to change
pens
move pen
450 - 470
plot 200 points
of miw vs freq
480 - 510
label plot "avg"
520 - 530
540
FNE

File 4 Key F1

plots <max> and <min> which are stored in array B (if prepared)

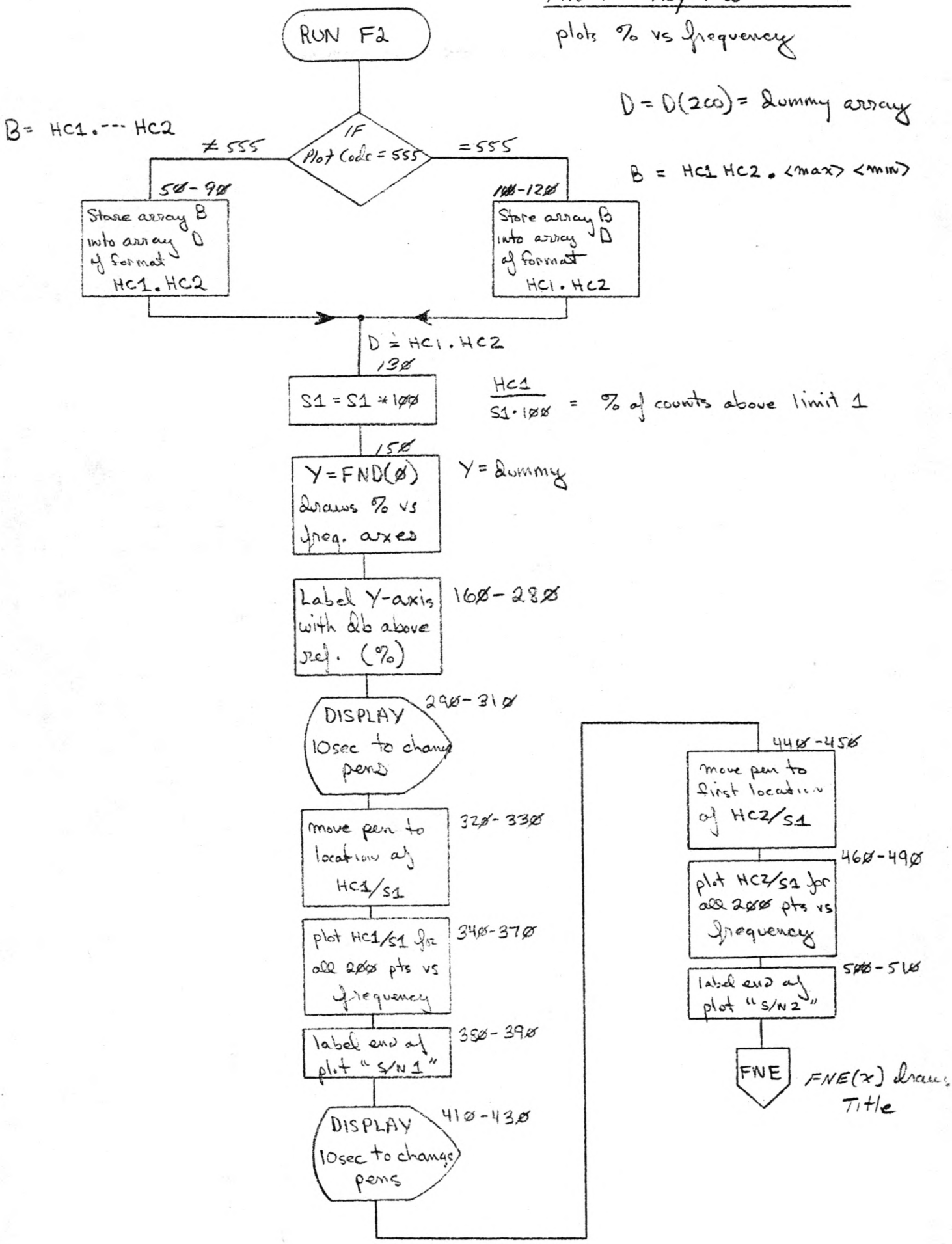


File 4 Key F2

plots % vs frequency

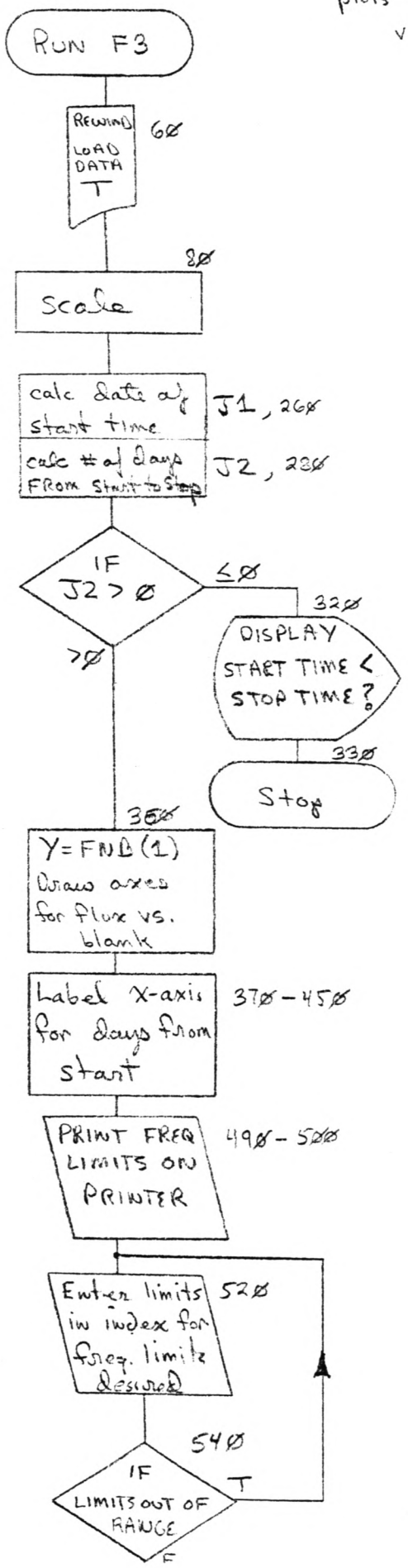
D = D(200) = dummy array

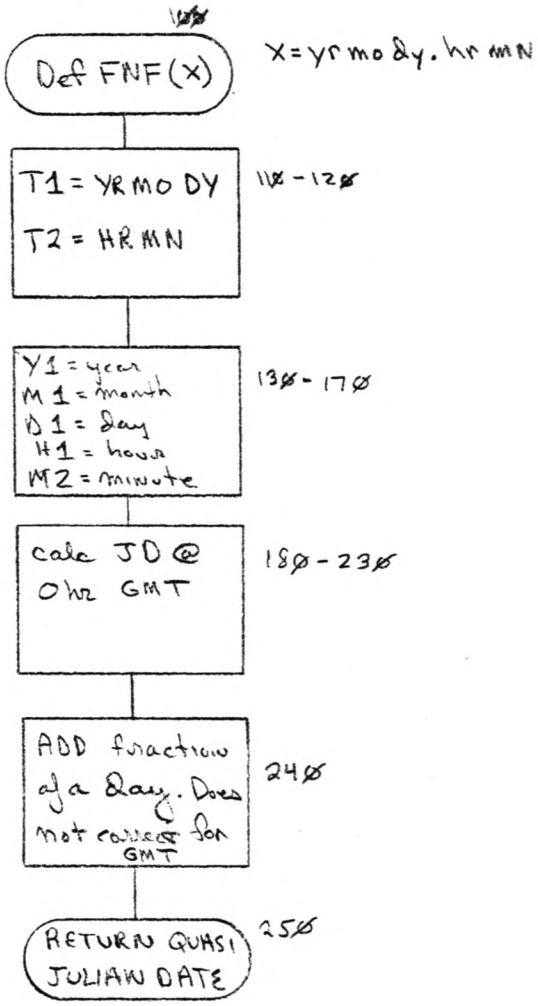
B = HC1 HC2 . <max> <min>



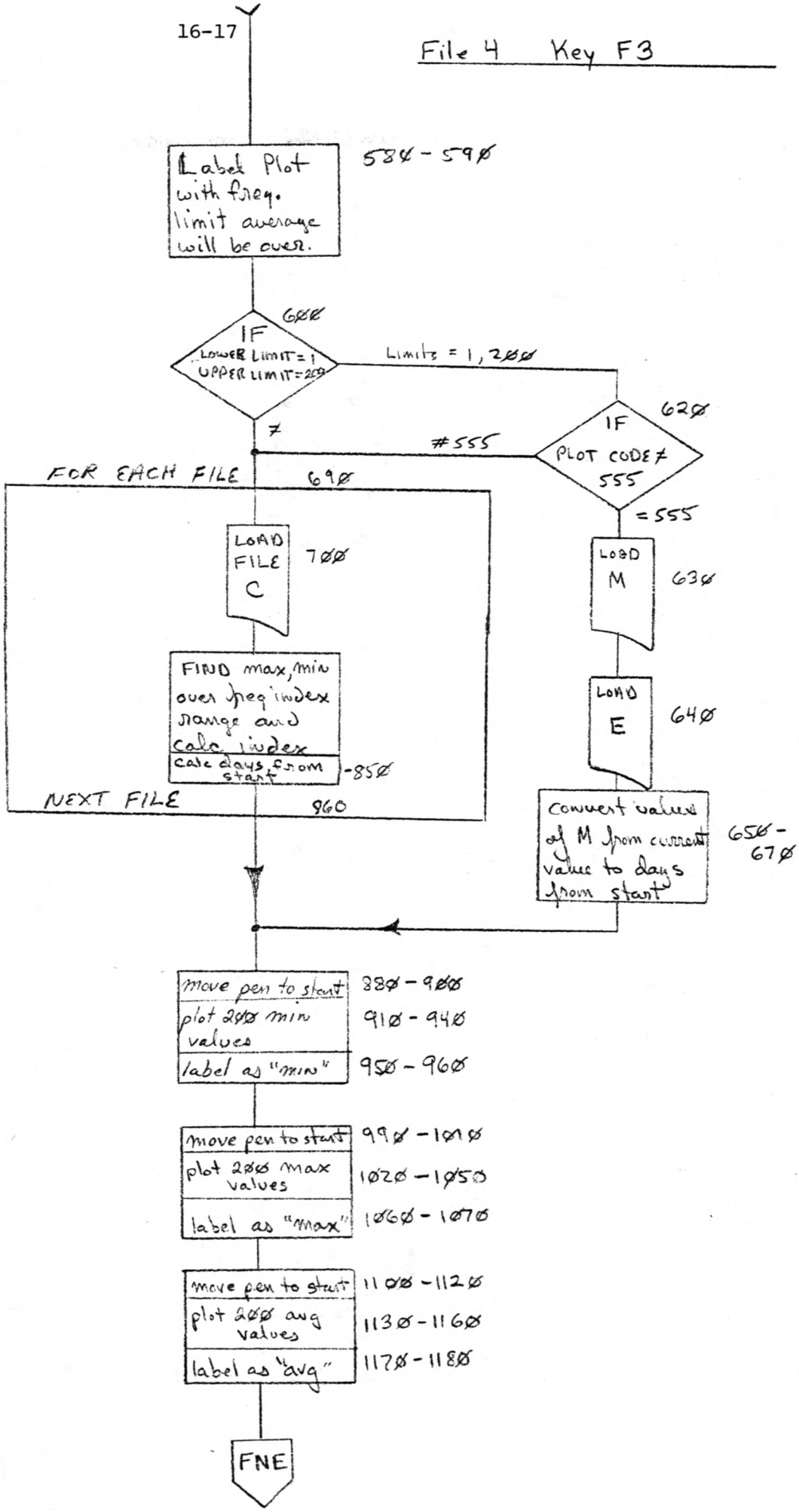
File 4 Key F3

plots min max avg over freq verses time



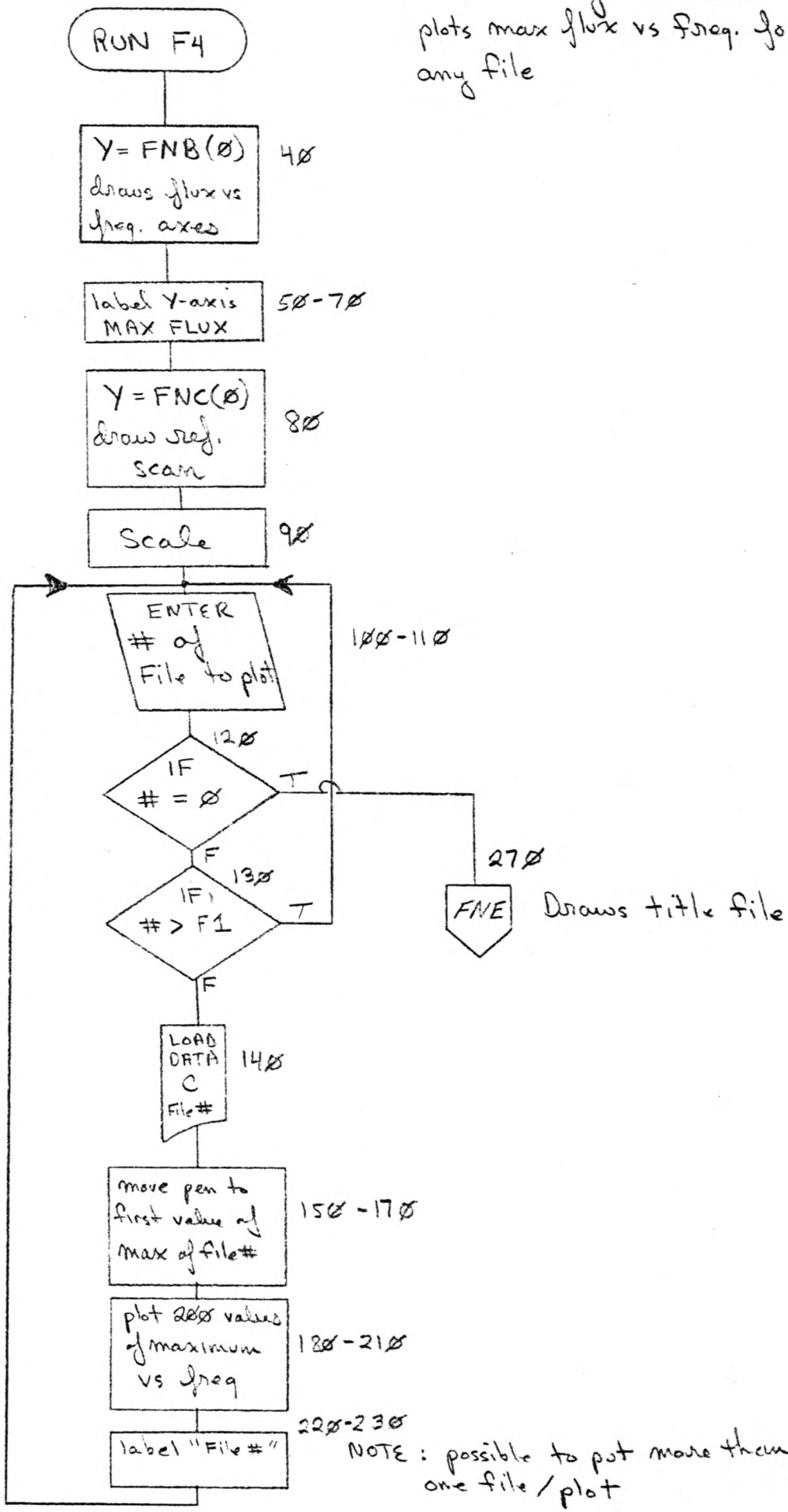


File 4 Key F3


Label Plot with freq. limit average will be over.
580 - 590
600
IF LOWER LIMIT = 1 UPPER LIMIT = 200
Limits = 1, 200
620
IF PLOT CODE ≠ 555
≠
≠555
=555
FOR EACH FILE
690
LOAD FILE C
700
FIND max, min over freq index range and calc index
calc days from start
850
NEXT FILE
960
LOAD M
630
LOAD E
640
convert values of M from current value to days from start
650 - 670
move pen to start
880 - 900
plot 200 min values
910 - 940
label as "min"
950 - 960
move pen to start
990 - 1010
plot 200 max values
1020 - 1050
label as "max"
1060 - 1070
move pen to start
1100 - 1120
plot 200 avg values
1130 - 1160
label as "avg"
1170 - 1180
FNE

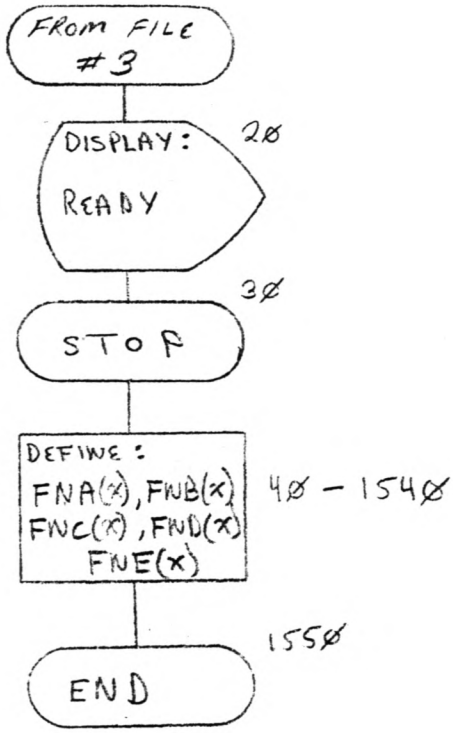
file 4 Key F4

plots max flux vs freq. for any file



NOTE: possible to put more than one file / plot

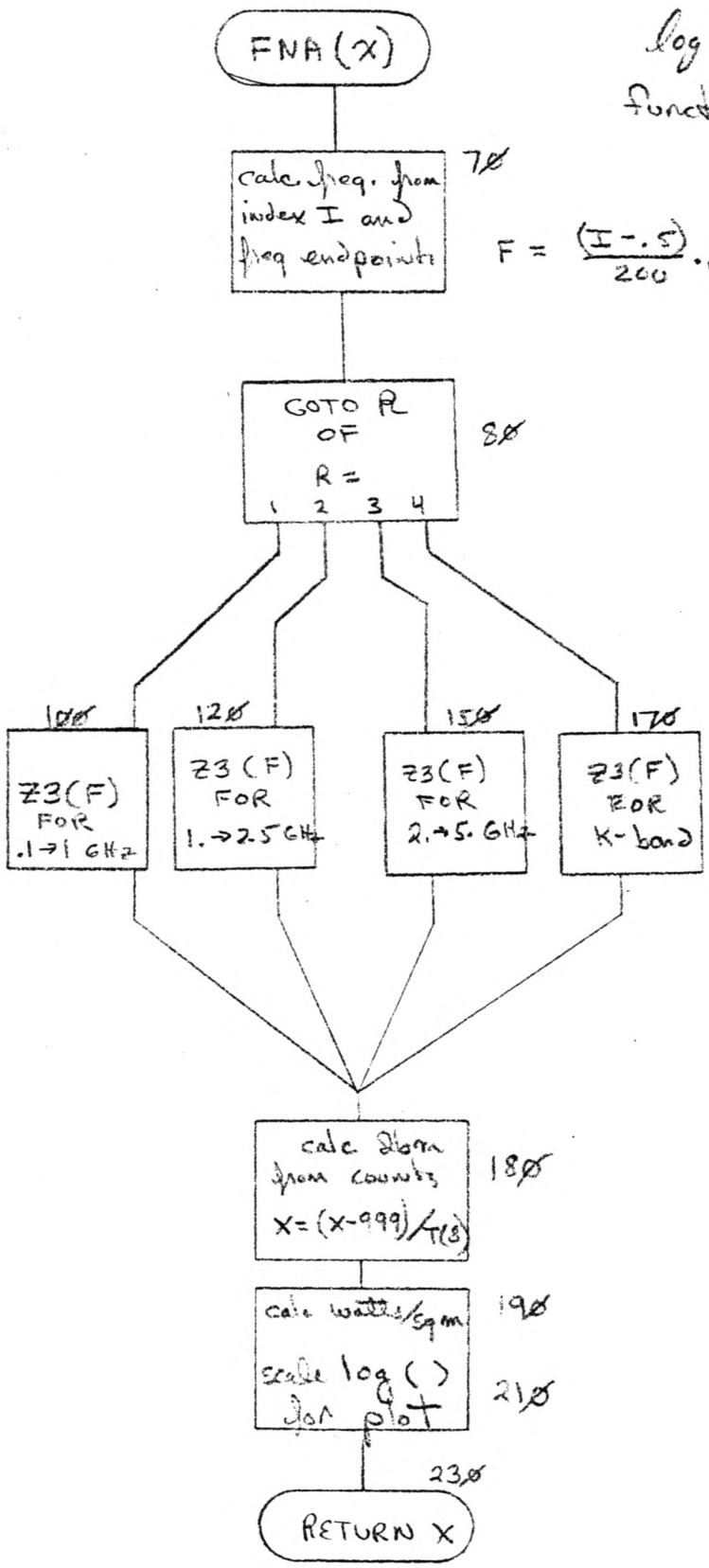
FILE 5 PLOTTER



See attached sheets for listings of the individual functions.

FILE 5 FNA(X)

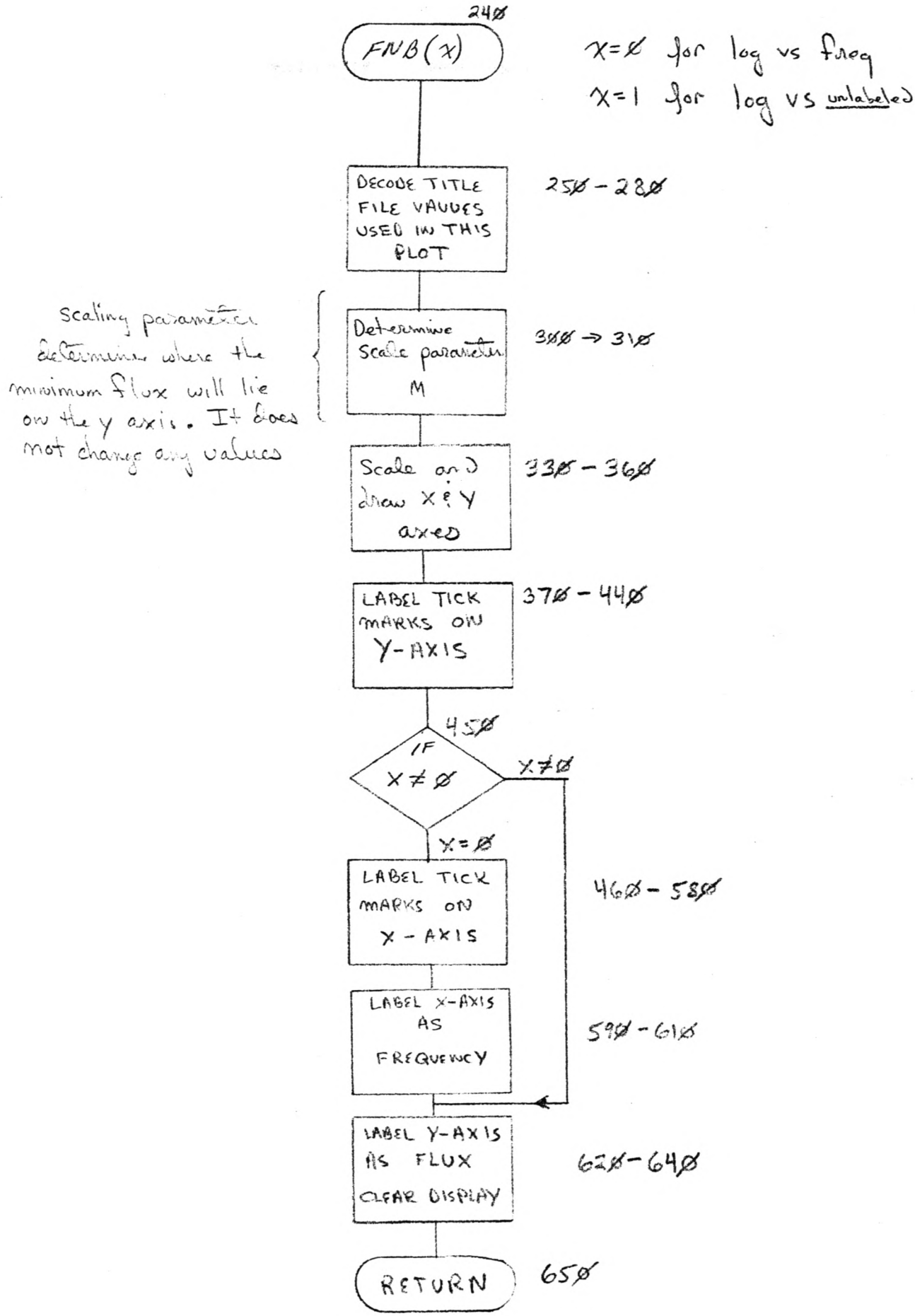
log(Watts/sq m) as a function of counts and frequency



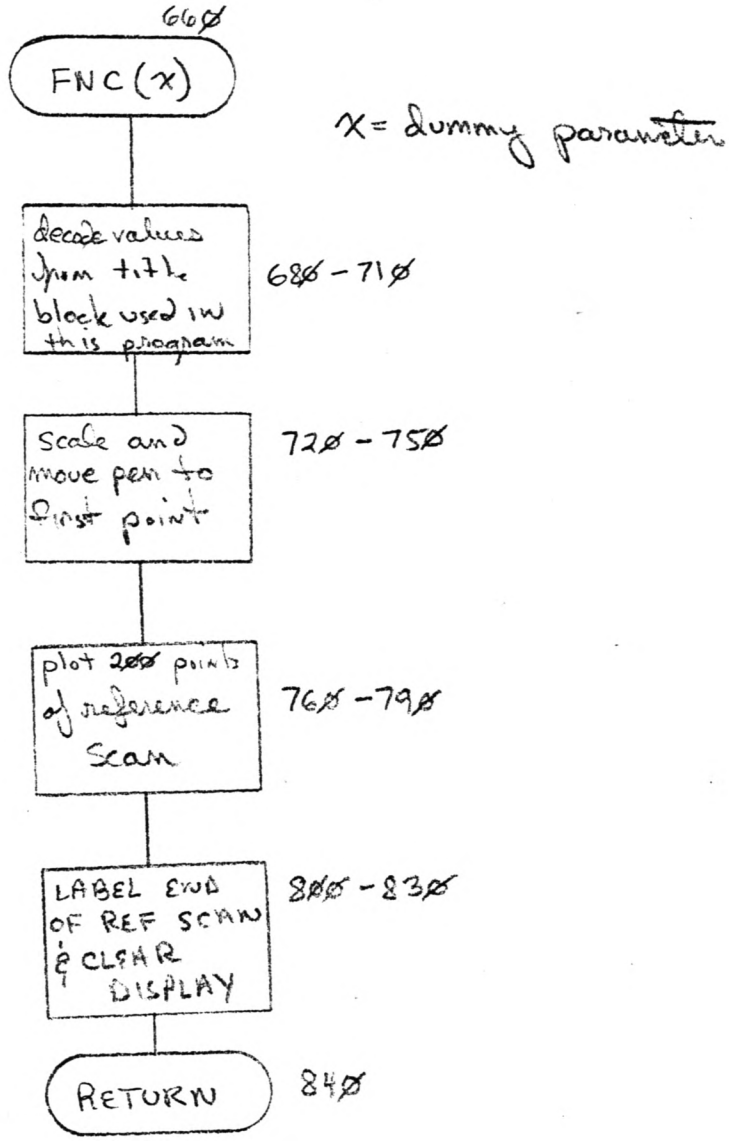
Z3 is the effective area of receiving element in sq m

Draw axes for log(W/m²)

FILE 5 FNB(x)

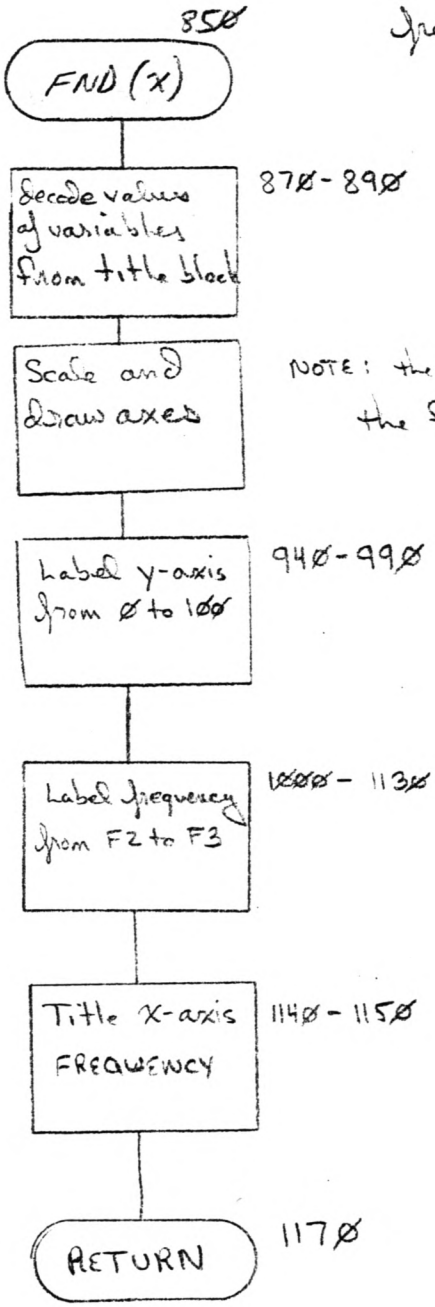


FILE 5 FNC(x)


660
FNC(x)
x = dummy parameter
decode values from title block used in this program
680 - 710
Scale and move pen to first point
720 - 750
plot 200 points of reference scan
760 - 790
LABEL END OF REF SCAN & CLEAR DISPLAY
800 - 830
RETURN
840

FILE 5 FND(X)

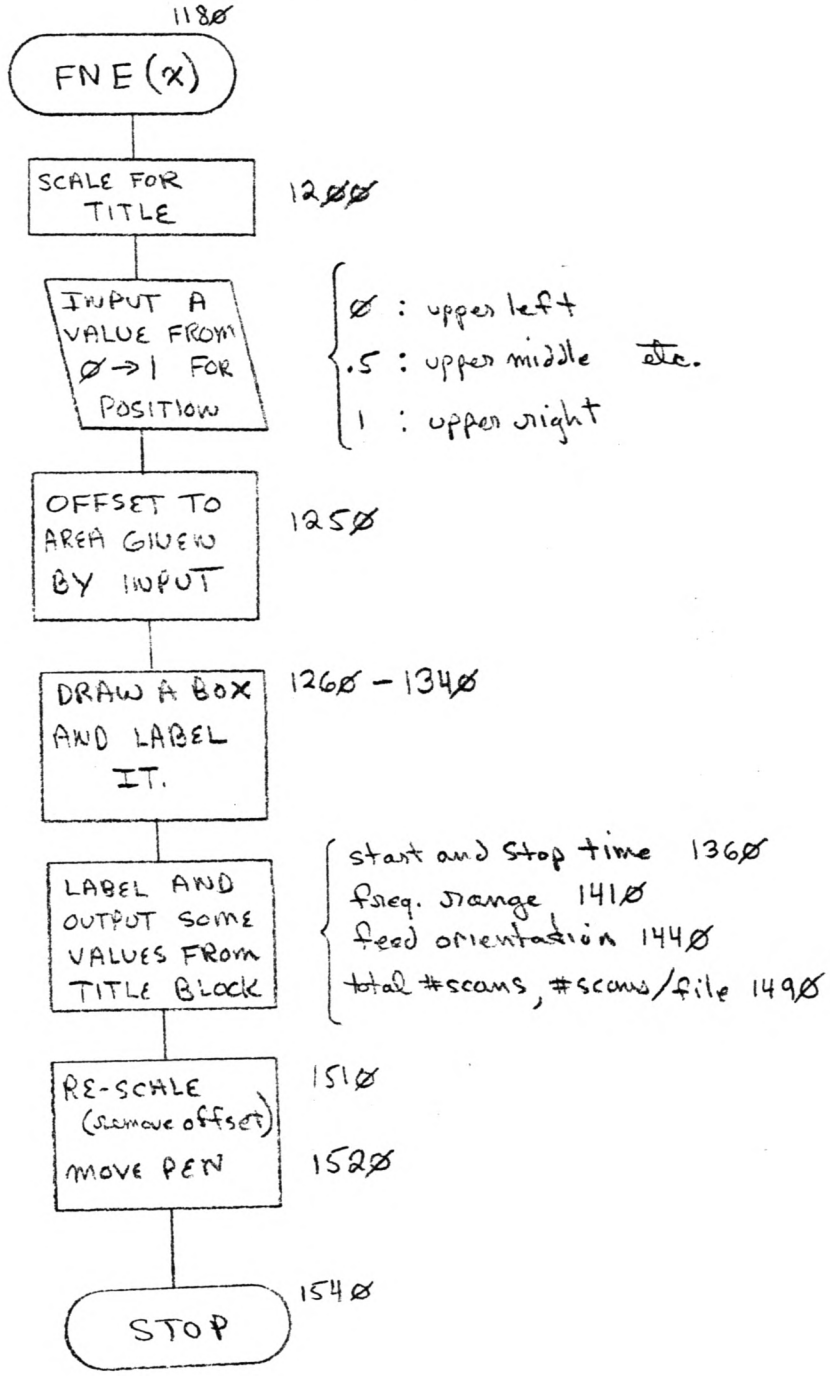
Draws axes for % vs frequency plots



NOTE: the scale is different from the flux vs frequency plots.

File 5 FNE(x)

Draws Title Block



NOTE: The title block is called at end of every plot. It could also be executed by typing:

Y= FNE(Ø) for example

Name	Function	found in : init	collec	plot	title
S9	# of scan to store next set of data	yes	yes	no	no
F9	used as dummy index for scan calc.	no	yes	no	no
N1	number of counts	yes	yes	no	no
M1	decoded month	no	yes	yes	no
D1	decoded day	no	yes	yes	no
H1	decoded hour	no	yes	yes	no
M2	decoded minute	no	yes	yes	no
Y1	year	yes	yes	no	no
D2	yr mo dy	no	yes	no	no
T	hr mn	no	yes	no	no
M(37)	all file stop times in one array	no	no	yes	no
E(37)	all file averages over freq.	no	no	yes	no
Z3	effective area of antenna or horn	no	no	yes	no
M	scaling parameter for flux calculation	no	no	yes	no
Z1	dummy variable for scaling plots	no	no	yes	no
F4	F4 = (F3-F2)/5	no	no	yes	no
F5	F5 = F2 + Index F4	no	no	yes	no
X	used in functions as pass parameter, changes	no	no	yes	no
T9	time last file was stored on tape	no	yes	no	no

Note : coefficient for spectrum analyser calibration is stored and used as T(8) in the title block array.

Name	Function	found in: init	collect	plot	title
T(10)	Title Block	yes	yes	yes	-
A(200)	min max.--- avg of entire run	yes	yes	yes	-
B(200)	HC1 HC2. max min for entire run	no	no	yes	-
B(200)	--- HC1.--- HC2 for entire run	yes	yes	no	-
C(201)	min max.--- avg for each file	yes	yes	yes	-
HI(200)	reference scan counts (integer array)	yes	yes	yes	-
X(8)	stores information read in from interface	yes	yes	no	-
R(8)	stores information to be output to interface	yes	yes	no	-
Y	interrupt code (normally=0)	yes	yes	yes	yes
Z	start/re-start code	yes	yes	no	no
R	R.F. Code	yes	yes	yes	yes
S1	# of scans that have occured	yes	yes	yes	yes
S3	# of scans per file	yes	yes	yes	yes
F1	total # of files or next file to be stored	yes	yes	yes	yes
R9	flag for storage of reference scan	yes	yes	no	no
A1	orientation of antenna in degrees	yes	yes	yes	yes
A2	gain of amplification between antenna and S.A.	yes	yes	yes	yes
F2	lower frequency limit MHz	yes	yes	yes	yes
F3	upper frequency linit MHz	yes	yes	yes	yes
DB1	threshold above ref. scan in DB for high count	yes	no	yes	yes
P1	threshold in counts equal to DB1	yes	yes	no	no
DB2	another threshold for high count in DB	yes	no	yes	yes
P2	threshold in counts equal to DB2	yes	yes	no	no
HC1	# of times above P1+ref counts	no	yes	no	no
HC2	# of times above P2+ref counts	no	yes	no	no

File Ø Initialization pg 1/4

```
10 COM T[10],DE[900],BL[80],SL[80],AL[80],AR[80],RL[80]
20 REM  THIS IS THE INITIALIZATION PROGRAM (FILE-0)
30 DISP "TURN ON PRINTER"
40 WAIT 3000
50 Y=Z=R=S1=R9=0
60 MAT A=ZER
70 MAT B=ZER
80 MAT C=ZER
90 MAT T=ZER
100 REM
110 REM ***   ENTER CURRENT YEAR   ***
120 Y1=80
130 REM T(8) IS THE PARAMETER FOR FLUX VS. COUNTS CALIBRATION FOR SPEC. ANAL.
140 T[8]=13.7921   counts/dB
150 PRINT
160 PRINT "YEAR = ";Y1+1900
170 PRINT
180 PRINT "CHECK THE FOLLOWING BEFORE STARTING :"
190 PRINT "- RESET AND ENABLE SWITCHES ON INTERFACE IN CENTER POSITION"
200 PRINT "- INTERFACE SCAN RATE SET AS DESIRED (.1 TO 1 SEC/PT)"
210 PRINT "- TIME, DATE AND #DAYS/MONTH SWITCH (IN BACK) ARE CORRECT"
220 PRINT "- MINIMUM OF 15 INCHES OF PAPER IN CALCULATOR"
230 PRINT
240 Y1=Y1*10000
250 REM  * * * * - PROGRAM INITIALIZATION AND REFERENCE SCAN - * * * * *
260 REM  *** TITLE FILE T FORMAT ***
270 REM T(1) = START TIME (YRMODY.HRMN)
280 REM T(2) = STOP TIME
290 REM T(3) = TIME OF REF. SCAN
300 REM T(4) = FEED ORIENT.GAIN; A1.A2
310 REM T(5) = START.STOP FREQ.;F2.F3
320 REM T(6) = S/N-1.S/N-2; P1.P2
330 REM T(7) = R.F. CODE.#SCANS/FILE; R.S3
340 REM T(8) = CALIBRATION PARAMETER FOR SPEC. ANAL.
350 REM T(9) = #FILES.# SCANS; F1.S1
360 REM T(10) = FLAG FOR RESTART.PLOTTER FLAG ; Y. (FLAG FOR PLOT PREPARED)
370 REM ***   ***   ***
380 BEEP
390 F1=6  for first data file location
400 DISP "0- START,  1-RESTART";
410 INPUT Z
420 IF Z#1 THEN 950
430 DISP "LOAD, REWIND PREVIOUS TAPE"
440 WAIT 500
450 IF STAT5#5 THEN 440
460 LOAD  DATA #5,0,T ———— LOAD PREVIOUS TITLE FILE
470 Y=INTT[10]
480 IF Y=500 THEN 500
490 GOTO 530
500 DISP "TAPE FULL,  RESTART NOT ALLOWED"
```

File Ø pg 2/4

```
510 STOP
520 GOTO 1850 ———— IN CASE CONT IS PRESSED
530 A1=INT(T[4])  Feed Orient.
540 A2=(T[4]-A1)*1000  Gain
550 F2=INT(T[5])  Start Freq #HZ
560 F3=(T[5]-F2)*1E+05  Stop Freq
570 P1=INT(T[6])*T[8]  dB Threshold Level #1 converted to "counts"
580 P2=(T[6]-INTT[6])*1000*T[8]  dB Threshold Level #2 converted to "counts"
590 R=INT(T[7])   R.F. Code
600 S3=(T[7]-R)*1000  #scans/file
610 F1=INT(T[9])  # of file completed
620 S1=(T[9]-F1)*1000  # of scans completed
630 IF F1>5 THEN 650
640 F1=5  — if no files has been stored
650 F1=F1+1
660 IF F1 >= 42 THEN 500 - full tape
670 PRINT "RESTART WILL BEGIN WITH DATA FILE # ";F1-5
680 PRINT
690 I1=T[10]-Y  — plotter code , 555 indicates <max>, <min> is folded into array B
700 Y=0
710 S9=S1+S3  — S9 is the scan which data will next be stored on tape
720 IF F1=6 THEN 830  — no data is stored on A & B
730 LOAD  DATA #5,2,A
740 LOAD  DATA #5,3,B
750 IF I1#0.555 THEN 830
760 REM B(I) HC1 HC2.<MAX> <MIN>
770 FOR I=1 TO 200
780 I1=INT(B[I]/1000)
790 I2=INT(B[I]-I1*1000)
800 B[I]=I1+I2/1E+06
810 REM B(I)  HC1.---HC2
820 NEXT I
830 T[10]=0
840 DISP "REF SCAN: ENTER 0-NEW, 1-OLD";
850 INPUT I1
860 IF I1=0 THEN 1290
870 LOAD  DATA #5,1,H  — load in old ref scan
880 MAT R=ZER
890 R[2]=1
900 R[3]=32
910 GOSUB 1850
920 WAIT 100
930 GOSUB 1690
940 GOTO 1570
```

return B array to format in collect program

T(10) = Ø : Y = Ø & plot prep = Ø

move scan over to start to avoid arrows

END OF RESTART

```
950 DISP "LOAD, REWIND BLANK TAPE IN 9865A"
960 WAIT 750
970 IF STAT5#5 THEN 950
980 PRINT
990 PRINT "R.F. CODE: "
1000 PRINT "1 - LOG-PERIODIC
```

File Ø pg 3/4

```
1010 PRINT "0 - HP9101 HARM- [illegible] 4 - 1-KHZ [illegible]"
1020 PRINT
1030 DISP "ENTER R.F. CODE";
1040 INPUT R
1050 IF R<1 OR R>4 THEN 1030
1060 DISP "ENTER START,STOP FREQUENCIES";
1070 INPUT F2,F3
1080 T[5]=F2+F3*0.00001
1090 DISP "ENTER FEED ORIENT. IN DEGREES";
1100 INPUT A1
1110 DISP "ENTER GAIN (DB)   ";
1120 INPUT A2
1130 T[4]=A1+A2/1000
1140 PRINT "THERE ARE TOTAL OF 36 FILES ON  A DATA TAPE"
1150 PRINT "TOTAL RUNNING TIME = 36 * (#SCANS/FILE * TIME/SCAN + 2 MIN)"
1160 PRINT "**WARNING**, OVER 27 SCANS/FILE COULD CAUSE INCORRECT VALUE OF HC2"
1170 PRINT
1180 DISP "ENTER # OF SCANS/DATA BLOCK";
1190 INPUT S3
1200 IF S3 <= 0 THEN 1180
1210 T[7]=R+S3/1000
1220 PRINT "THRESHOLD LEVELS ( IN DB ) ABOVE REFERENCE SCAN"
1230 PRINT
1240 DISP "ENTER THRESHOLD LEVELS : DB1,DB2";
1250 INPUT P1,P2
1260 T[6]=P1+P2/1000
1270 P1=P1*T[8]
1280 P2=P2*T[8]
1290 BEEP
1300 DISP "TERMINATE RCVR INPUTS"
1310 WAIT 18000
1320 MAT R=ZER
1330 R[2]=1
1340 R[3]=32
1350 GOSUB 1850
1360 WAIT 100
1370 GOSUB 1690
1380 FOR Q=1 TO 200
1390 F=Q-1
1400 R[3]=INT(0.04*F)
1410 R[4]=16*(INT(0.4*F)-10*R[3])
1420 R[4]=R[4]+F*4-100*R[3]-0.625*R[4]
1430 R[3]=R[3]+32
1440 GOSUB 1850
1450 WAIT 50
1460 GOSUB 1690
1470 H[Q]=N1
1480 NEXT Q
1490 P9=1
1500 MAT R=ZER
```

convert dB threshold levels to "counts"

move scan position to start freq.

take 2ØØ point reference scan and store in array H

ref. scan flag

File Ø pg 4/4

```
1510 BEEP
1520 WAIT 150
1530 BEEP
1540 DISP "RE-ATTACH RCVR INPUTS"
1550 WAIT 10000
1560 S9=S1+S3
1570 PRINT "--- INPUT PARAMETERS ---"
1580 PRINT
1590 FIXED 0
1600 PRINT "FEED ORIENT (DEG) = ";A1;"        SYSTEM GAIN (DB) = ";A2
1610 PRINT "R.F. CODE : ";R;"            #SCANS/FILE = ";S3
1620 PRINT "START FREQ.=";F2;"  STOP FREQ.=";F3;"    (MHZ)"
1630 WRITE (15,1640)INTT[6],(T[6]-INTT[6])*1000
1640 FORMAT "THRESHOLD LEVEL #1 =",F4.0,5X,"THRESHOLD LEVEL #2 = ",F4.0
1650 PRINT
1660 LINK 1,10,10
1670 REM
1680 REM
1690 REM SUBROUTINE INPUT * * * * * * * * * * * * * * * * * * * * * * * *
1700 X[1]=RBYTE2
1710 X[2]=RBYTE2
1720 X[3]=RBYTE2
1730 X[4]=RBYTE2
1740 X[5]=RBYTE2
1750 X[6]=RBYTE2
1760 X[7]=RBYTE2
1770 X[8]=RBYTE2
1780 N1=0
1790 IF X[7]<10 THEN 1830
1800 X[7]=X[7]-16
1810 N1=N1+10
1820 GOTO 1790
1830 N1=10*(N1+X[7])+X[8]/16
1840 RETURN
1850 REM SUBROUTINE OUTPUT * * * * * * * * * * * * * * * * * * * * * * * *
1860 OUTPUT (2,*)WBYTER[1];
1870 OUTPUT (2,*)WBYTER[2];
1880 OUTPUT (2,*)WBYTER[3];
1890 OUTPUT (2,*)WBYTER[4];
1900 OUTPUT (2,*)WBYTER[5];
1910 OUTPUT (2,*)WBYTER[6];
1920 OUTPUT (2,*)WBYTER[7];
1930 OUTPUT (2,*)WBYTER[8];
1940 RETURN
1950 END
```

— load collection program without destroying variables

read and decode counts

output directions to interface

i) scan start position

ii) reset peak detector

File 1 Collection pg 1/5

```
10 COM T[10],A[200],B[200],C[201],HI[200],X[8],R[8]
20 REM EMI SURVEILLANCE ROUTINE - MAIN PROGRAM -
30 PRINT "AT END OF EVERY SCAN THE PROGRAM ALLOWS 10 SEC. TO INTERRUPT"
40 PRINT " TO TERMINATE AT THIS TIME TYPE :"
50 PRINT "      STOP    EXECUTE"
60 PRINT "      Y=CODE  EXECUTE"
70 PRINT "      CONT    EXECUTE"
80 PRINT
90 PRINT "INTERRUPT CODES :"
100 PRINT "Y=111 FOR IMMEDIATE (END SCAN) TERMINATION, FRACTIONAL SETS OF SCANS"
110 PRINT "            ARE LOST."
120 PRINT "Y=888 FINISH PRESENT SET OF SCANS, STORE AND STOP"
130 PRINT "Y=999 FINISH PRESENT SET OF SCANS AND STORE, PREPARE TAPE FOR PLOT"
140 PRINT
150 R[2]=1
160 R[3]=32   } initialize start freq. position for scan
170 R[4]=0
180 IF R9#1 THEN 210
190 GOSUB 950
200 T[3]=D2+T/100
210 IF Z=1 THEN 360
220 PRINT "PROGRAM WILL START AFTER ENTIRE TAPE IS MARKED ( 8 MIN )"
230 MARK #5,1,42
240 MARK #5,1,204
250 MARK #5,2,804   } mark entire tape
260 MARK #5,2,150
270 MARK #5,36,808
280 REWIND #5
290 WAIT 500
300 IF STAT5#5 THEN 290
310 GOSUB 1210
320 WAIT 100        } read and decode start time, also moves scan to start freq.
330 GOSUB 790
340 GOSUB 950
350 T[1]=D2+T/100
360 STORE  DATA #5,0,T
370 STORE  DATA #5,1,H
380 FIND #5,F1
390 FIXED 4
400 PRINT "START TIME (YRMODY.HRMN) = ";T[1]
410 FIXED 0
420 REM ***   ***   ***   ***   ***   ***   ***   ***   ***   ***   ***
430 F=0
440 R[2]=1
450 R[3]=32
460 R[4]=0
470 GOSUB 1210 — move scan to ø and start first point in scan
480 WAIT 200
490 GOTO 520
500 GOSUB 1520 — check for min, max, avg
```

File 1 pg 2/5

```
510 IF F >= 200 THEN 640
520 F=F+1
530 GOSUB 790 — read last "counts" and decode
540 F9=F
550 IF F9<200 THEN 570
560 F9=0
570 R[3]=INT(0.04*F9)
580 R[4]=16*(INT(0.4*F9)-10*R[3])
590 R[4]=R[4]+F9*4-100*R[3]-0.625*R[4]   } set up next points start position
600 R[3]=R[3]+32
610 GOSUB 1210 — output new position and start scan
620 GOTO 500
630 REM ***   ***   ***   ***   ***   ***   ***   ***   ***   ***   ***   ***
640 S1=S1+1
650 BEEP
660 IF Y#0 THEN 710
670 DISP "INTERRUPT DURING NEXT 10 SEC."
680 WAIT 10000
690 IF Y=0 THEN 710                    — print this line only once when interrupt occurs
700 PRINT "INTERRUPT : "Y"    #SCANS LEFT TO COMPLETE FILE = "S9-S1
710 DISP "  "
720 IF Y#111 THEN 770
730 IF S1=S9 THEN 1310 —— store set of scans if it is last scan of set
740 S1=S9-S3   } otherwise return #scans, #files to old values
750 F1=F1-1
760 GOTO 1950 — end routine
770 IF S1<S9 THEN 430 — then take another scan (under normal conditions)
780 GOTO 1310 — second routine
790 REM  SUB INPUT  * *
800 X[1]=RBYTE2
810 X[2]=RBYTE2
820 X[3]=RBYTE2
830 X[4]=RBYTE2
840 X[5]=RBYTE2                        read interface and decode counts
850 X[6]=RBYTE2
860 X[7]=RBYTE2
870 X[8]=RBYTE2
880 N1=0
890 IF X[7]<10 THEN 930
900 X[7]=X[7]-16
910 N1=N1+10
920 GOTO 890
930 N1=10*(N1+X[7])+X[8]/16
940 RETURN
950 M1=0
960 X[3]=X[3]-32          Decode Date and Time Routine
970 IF X[3]<10 THEN 990
980 M1=-6
990 M1=M1+X[3]
1000 M1=0
```

File 1 pg 3/5

```
1010 IF X[4]<10 THEN 1040
1020 X[4]=X[4]-16
1030 D1=D1+10
1040 GOTO 1010
1050 D1=D1+X[4]
1060 H1=0
1070 IF X[5]<10 THEN 1110
1080 X[5]=X[5]-16
1090 H1=H1+10
1100 GOTO 1070
1110 H1=H1+X[5]
1120 M2=0
1130 IF X[6]<10 THEN 1170
1140 X[6]=X[6]-16
1150 M2=M2+10
1160 GOTO 1130
1170 M2=M2+X[6]
1180 D2=Y1+100*M1+D1   — yrmo dy
1190 T=H1+M2/100       — hr mn
1200 RETURN
1210 REM SUB OUTPUT  * *
1220 OUTPUT (2,*)WBYTER[1];
1230 OUTPUT (2,*)WBYTER[2];
1240 OUTPUT (2,*)WBYTER[3];
1250 OUTPUT (2,*)WBYTER[4];
1260 OUTPUT (2,*)WBYTER[5];
1270 OUTPUT (2,*)WBYTER[6];
1280 OUTPUT (2,*)WBYTER[7];
1290 OUTPUT (2,*)WBYTER[8];
1300 RETURN
1310 REM  * * * RECORD ROUTINE * * *
1320 REM I1=MIN, I2=MAX, I3= SUM
1330 FOR I=1 TO 200
1340 I1=INT(C[I]/1000)
1350 I2=INT(C[I])-I1*1000
1360 I3=(C[I]-INTC[I])*1E+06
1370 I3=I3/S3
1380 C[I]=I1*1000+I2+I3/1E+06
1390 NEXT I
1400 REM C(I) MINMAX.---AVG
1410 GOSUB 790
1420 GOSUB 950
1430 C[201]=D2+T/100
1440 T9=C[201]
1450 STORE  DATA #5,F1,C
1460 DISP "DATA FILE #";F1-5;"STORED ON TAPE"
1470 REWIND #5
1480 WAIT 1000
1490 IF STATE#5 THEN 1490
1500 TL2=T9
```

output to interface

average = $\frac{\text{sum}}{\#\text{scans/file}}$

decode scan end time and store in C array

— store on tape

— store last file end time as run-end time

File 1 pg 4/5

```
1510 T[10]=S1*1000
1520 T[10]=T
1530 STORE  DATA #5,0,T
1540 STORE  DATA #5,2,A
1550 STORE  DATA #5,3,B
1560 IF F1 >= 41 THEN 1950
1570 IF Y#0 THEN 1950
1580 F1=F1+1
1590 FIND #5,F1
1600 MAT C=ZER
1610 S9=S1+S3
1620 GOTO 430
1630 REM  MIN,MAX,SUM ROUTINE ----------
1640 REM C(F)= MINMAX.---SUM
1650 REM B(F)= HC1.---HC2
1660 IF N1 <= H[F]+P1 THEN 1680
1670 B[F]=B[F]+1
1680 IF N1 <= H[F]+P2 THEN 1700
1690 B[F]=B[F]+1E-06
1700 REM I1=MIN, I2=MAX
1710 IF C[F]#0 THEN 1740
1720 C[F]=N1+N1/1E+06+N1*1000
1730 GOTO 1830
1740 I1=INT(C[F]/1000)
1750 I2=INTC[F]-I1*1000
1760 IF N1 <= I2 THEN 1780
1770 C[F]=C[F]+(N1-I2)
1780 IF N1 >= I1 THEN 1800
1790 C[F]=C[F]+(N1-I1)*1000
1800 C[F]=C[F]+N1/1E+06
1810 REM A(F)=MINMAX.---AVG
1820 REM I1=MIN, I2=MAX, I3=AVG
1830 I1=INT(A[F]/1000)
1840 IF S1#0 THEN 1860
1850 I1=N1
1860 I2=INTA[F]-I1*1000
1870 I3=(A[F]-INTA[F])*1E+06
1880 I3=INT((I3*S1+N1)/(S1+1))
1890 IF N1 >= I1 THEN 1910
1900 I1=N1
1910 IF N1 <= I2 THEN 1930
1920 I2=N1
1930 A[F]=I1*1000+I2+I3/1E+06
1940 RETURN
1950 REM *** END OF RUN *** ----------
1960 IF Y#111 THEN 2030
1970 REWIND #5
1980 WAIT 500
1990 IF STAT5#5 THEN 1980
2000 LOAD  DATA #5,0
```

update running statistics

— tape full end

z interrupt end

setup for another scan

— everything ok take another scan

check for high counts

— first scan: set min, max and avg to count

check count against old min and max for file

— up

← first scan; set minima to count

check count against old running min and max and update average

— update A. array

update interrupt code in title file if interrupt code = 111

File 1 pg 5/5

```
2010 T[10]=Y
2020 STORE  [illegible]
2030 IF Y#0 THEN 2060
2040 PRINT "DATA RUN COMPLETE, TAPE FULL"   — normal end
2050 GOTO 2070
2060 PRINT "DATA RUN TERMINATED,  Y = ";Y   — for any interrupt
2070 FIXED 4
2080 PRINT "STOP TIME (YRMODY.HRMN) = ";T[2]
2090 PRINT
2100 FIXED 0
2110 PRINT "TOTAL # OF FILES = ";F1-5;"   TOTAL # OF SCANS = ";S1
2120 PRINT
2130 IF Y#111 AND Y#888 THEN 2190
2140 PRINT "IF YOU WOULD LIKE THE PRESENT DATA PREPARED FOR ANALYSIS PRESS:"
2150 PRINT "    CONT    EXECUTE"
2160 PRINT
2170 DISP "INTERRUPT COMPLETE"
2180 STOP
2190 PRINT "DATA PLOTTING PREPARATION TAKES 30 MINUTES FOR F FULL TAPE"
2200 LOAD 2,10,10
2210 END
```

printout end of run conditions

File 2, <max>, <min> pg 1/2

```
10 DIM T[10],B[200],C[201],D[200],E[50],M[50]
20 MAT D=ZER
30 MAT E=ZER
40 MAT M=ZER
50 REWIND #5
60 WAIT 500
70 IF STAT5#5 THEN 60
80 LOAD  DATA #5,0,T
90 REM FILE#1=REF COUNTS (ARRAY H)
100 LOAD  DATA #5,3,B
110 IF (T[10]-INTT[10])#0 THEN 600
120 F1=INTT[9]
130 I1=0
140 FOR F9=6 TO F1
150 S=0 ——— initialize sum
160 M1=0 ——— initialize maxima
170 M2=1000 — initialize minima
180 LOAD  DATA #5,F9,C — load next file
190 FOR I=1 TO 200
200 S=S+(C[I]-INTC[I])*1E+06
210 REM I1=# OF FILES, I2=MIN, I3=MAX
220 I2=INT(C[I]/1000)
230 IF I2>M2 THEN 250
240 M2=I2
250 I3=INTC[I]-I2*1000
260 IF I3<M1 THEN 280
270 M1=I3
280 D[I]=D[I]+I3+I2/1E+06 — {sum of max}.{sum of min}
290 NEXT I
300 I1=I1+1 -file counter
310 E[I1]=S*1E-06/200+M1+M2*1000
320 REM E ARRAY RECORDS  MINMAX.---AVG FOR EACH FILE
330 M[I1]=C[201]
340 REM M ARRAY RECORDS TIME OF EACH FILE
350 NEXT F9
360 FOR I=1 TO 200
370 REM I1=# OF FILES, I2=#S/N1, I3=#S/N2, I4=<MAX>, I5=<MIN>
380 I2=INTB[I]
390 I3=(B[I]-I2)*1E+06
400 I4=INT(D[I])
410 I5=(D[I]-I4)*1E+06
420 I5=INT(I5/I1)
430 I4=INT(I4/I1)
440 B[I]=I2*1000+I3+I4/1000+I5/1E+06
450 NEXT I
460 REWIND #5
470 WAIT 500
480 IF STAT5#5 THEN 470
490 T[10]=T[10]+0.555 — plot prepared code
500 IF T[10]=0.555 THEN — if normal end of tape occurred - keep from restarting
```

reorganize B array · HC1 HC2 . <max> <min>

File 3 pg 1/2

```
COM T[10],HI[200],A[200],B[200]
DIM E[37],M[37]
REM  (FILE 3)  TAPE INITIALIZATION
IF STAT5#1 AND STAT5#3 THEN 60
GOTO 90
DISP "LOAD, DATA TAPE AND REWIND"
WAIT 3000
IF STAT5#5 AND STAT5#7 THEN 70
REWIND #5
WAIT 500
IF STAT5#5 AND STAT5#7 THEN 100
LOAD  DATA #5,0,T
LOAD  DATA #5,1,H
LOAD  DATA #5,2,A
LOAD  DATA #5,3,B
F2=INTT[5]
F3=(T[5]-F2)*1E+05
F4=(F3-F2)/5
A1=INTT[4]
A2=(T[4]-A1)*1000
P1=INTT[6]
P2=(T[6]-P1)*1000
R=INTT[7]
S3=(T[7]-R)*1000
F1=INTT[9]
S1=(T[9]-F1)*1000
Y=INTT[10]
Y1=(T[10]-Y)*1000
FIXED 4
PRINT "TIME REF SCAN WAS TAKEN  : ";T[3]
PRINT "START TIME (YRMODY.HRMN) : ";T[1]
PRINT "STOP TIME (YRMODY.HRMN)  : ";T[2]
PRINT
FIXED 0
PRINT "FEED ORIENT. : ";A1;"   SYSTEM GAIN : ";A2
PRINT "START FREQ. (MHZ) : ";F2;"   STOP FREQ. : ";F3
WRITE (15,380)P1,P2
FORMAT "THRESHOLD LEVEL #1 =",F4.0," DB     THRESHOLD LEVEL #2 =",F4.0," DB"
FIXED 3
PRINT "SPECTRUM ANALYSER PARAMETER = ";T[8];" COUNTS/DB"
PRINT
FIXED 0
PRINT "R.F. CODE : ";R;"   #SCANS/FILE : ";S3
PRINT "TOTAL # OF FILES : ";F1;"   TOTAL # SCANS : ";S1
PRINT "          TOTAL # OF DATA (SCAN) FILES = ";F1-5
PRINT "TERMINATION CODE : ";Y;"   PLOTTER CODE : ";Y1
PRINT
IF Y1=555 THEN 520
PRINT "TAPE IS NOT READY TO PLOT /MIN\ OR /MAX\"
```

← Decode variables to print

rewind for protected or unprotected tape

load data to initialize common block

print complete Title Block

File 2 pg 2/2

```
510 STORE  DATA #5,0,T
520 STORE  DATA #5,3,B
530 STORE  DATA #5,4,M
540 STORE  DATA #5,5,E
550 PRINT
560 PRINT "DATA TAPE HAS BEEN PREPARED FOR PLOTTING"
570 PRINT "----------------------------------------"
580 PRINT
590 GOTO 670
600 PRINT
610 PRINT "DATA HAS ALREADY BEEN PREPARED FOR PLOTTING"
620 PRINT
630 GOTO 680
640 T[10]=T[10]+500
650 PRINT "***   DATA TAPE CANNOT BE RESTARTED   ***"
660 GOTO 510
670 LOAD 3,10,10
680 END
```

store new calculations

File 3 pg 2/2

```
510 GOTO 650
520 LOAD  DATA #5,1,1
530 LOAD  DATA #5,5,E
540 PRINT
550 PRINT "MIN, MAX, AVG OF EACH FILE : "
560 PRINT
570 PRINT "  FILE END TIME (YRMODY.HRMN)      MIN.     MAX.     AVG."
580 FOR I=1 TO F1-5
590 I1=INT(E[I]/1000)
600 I2=INT(E[I]-I1*1000)
610 I3=(E[I]-INTE[I])*1E+06
620 WRITE (15,640)I,M[I],I1,I2,I3
630 NEXT I
640 FORMAT F5.0,9X,F14.4,5X,F4.0,4X,F4.0,4X,F4.0
650 PRINT
660 PRINT "PLOTTER INITIALIZATION COMPLETE"
670 PRINT
680 PRINT "TO AVOID ERRORS IN PLOTTING TYPE  RUN  BEFORE EACH SPEC. FUNC. KEY"
690 PRINT
700 LOAD  KEY 4
710 LINK 5,10,10
720 END
```

print min max avg over frequency for each file if plot prep. has occurred

load plotting keys

load subroutines over this program

File 4 Key F0 pg 1/7

```
10 COM [10],A[1200],A[200],A[200]
20 REM ( F0 ) PLOTS ARRAY A = MINMAX.---AVG
30 Y=FNB(0)
40 Y9=FNC(0)
50 SCALE -30,220,-20,160
60 LABEL (*,1.2,1.5,0,0.72)
70 DISP "MAX. ON THIS PLOT ?   1=YES     ";
80 INPUT K9
90 IF K9#1 THEN 240
100 PLOT 0,0,1
110 BEEP
120 DISP "10 SEC TO CHANGE PENS"
130 WAIT 12000
140 X=INTA[1]-INT(A[I]/1000)*1000
150 I=1
160 PLOT 1,FNAX,1
170 FOR I=1 TO 200
180 X=INTA[I]-INT(A[I]/1000)*1000
190 PLOT I,FNAX,2
200 NEXT I
210 PLOT 201,X+3,1
220 LABEL (*)" MAX"
230 PLOT 1,0,1
240 DISP "MIN. ON THIS PLOT ?    1=YES    ";
250 INPUT K9
260 IF K9#1 THEN 390
270 BEEP
280 DISP "10 SEC TO CHANGE PENS"
290 WAIT 12000
300 X=INT(A[1]/1000)
310 I=1
320 PLOT 1,FNAX,1
330 FOR I=1 TO 200
340 X=INT(A[I]/1000)
350 PLOT I,FNAX,2
360 NEXT I
370 PLOT 201,X-2,1
380 LABEL (*)" MIN"
390 DISP "AVG. ON THIS PLOT ?     1=YES    ";
400 INPUT K9
410 IF K9#1 THEN 540
420 BEEP
430 DISP "10 SEC TO CHANGE PENS "
440 WAIT 12000
450 X=(A[1]-INTA[1])*1E+06
460 I=1
470 PLOT 1,FNAX,1
480 FOR I=1 TO 200
490 X=(A[I]-INTA[I])*1E+06
500 PLOT I,FNAX,2
510 NEXT I
520 PLOT 201,X,1
530 LABEL (*)" AVG"
540 PLOT 1,0,1
550 Y=FNE(0)
560 STOP
570 END
```

draws axes

draws reference scan

plot max vs freq

plot min vs freq

plot avg vs freq

File 4 Key F1 pg 2/7

```
COM T[10],H[200],B[200],A[200]
REM (.F1 ) PLOTS <MIN> AND <MAX> OVERALL FREQ
IF (T[10]-INT(T[10])=0.555 THEN 70
DISP "DATA TAPE NOT PREPARED"
STOP
GOTO 380 ← draw axes
Y=FNB(0)
Y9=FNC(0) ← draw ref
BEEP
DISP "10 SEC TO CHANGE PENS"
WAIT 12000
X=INT((B[1]-INTB[1])*1000)
I=1
PLOT 1,FNAX,1 - move pen
FOR I=1 TO 200
X=INT((B[I]-INTB[I])*1000)
PLOT I,FNAX,2
NEXT I
PLOT 201,X+3,1
LABEL (*,1.2,1.5,0,0.72)" <MAX>"
PLOT 1,0,1
BEEP
DISP "10 SEC TO CHANGE PENS"
WAIT 12000
X=(B[1]-INTB[I])*1E+06
X=X-INT(X/1000)*1000
I=1
PLOT 1,FNAX,1 - move pen
FOR I=1 TO 200
X=(B[I]-INTB[I])*1E+06
X=X-INT(X/1000)*1000
PLOT I,FNAX,2
NEXT I
PLOT 201,X-2,1
LABEL (*)" <MIN>"
PLOT 1,0,1
Y=FNE(0) ← go to titleblock
END
```

plot <max>

plot <min>

File 4 Key F2 pg 3/7

```
10 COM T[10],MI[200],AL[200],M[2]
20 REM ( F2 ) PLOTS % ABOVE S/N
30 DIM D[200]
40 IF (T[10]-INTT[10])=0.555 THEN 100
50 FOR I=1 TO 200
60 I1=INTB[I]
70 D[I]=I1+(B[I]-I1)*1000
80 NEXT I
90 GOTO 130
100 FOR I=1 TO 200
110 D[I]=INTB[I]/1000
120 NEXT I
130 S1=(T[9]-INTT[9])*10
140 REM S1= TOTAL # OF SCANS/100
150 Y=FND(0)
160 SCALE -30,220,-20,110
170 PLOT -20,0,1
180 LABEL (*,2.5,1.7,PI/2,0.72)"% ABOVE S/N + REF."
190 P1=INTT[6]
200 P2=(T[6]-P1)*1000
210 LABEL (*,1.5,1.7,PI/2,0.72)
220 PLOT -25,65,1
230 LABEL (240)P1
240 FORMAT "S/N#1=",F6.1," DB"
250 PLOT -15,65,1
260 LABEL (270)P2
270 FORMAT "S/N#2=",F6.1," DB"
280 DISP "    "
290 BEEP
300 DISP "10 SEC TO CHANGE PENS"
310 WAIT 12000
320 X=INT(D[1])/S1
330 PLOT 1,X,1
340 FOR I=1 TO 200
350 X=INT(D[I])/S1
360 PLOT I,X,2
370 NEXT I
380 PLOT 201,X+2,1
390 LABEL (*,1.2,1.5,0,0.72)" S/N#1"
400 PLOT 1,0,1
410 BEEP
420 DISP "10 SEC TO CHANGE PENS"
430 WAIT 12000
440 X=(D[1]-INTD[1])*1000/S1
450 PLOT 1,X,1
460 FOR I=1 TO 200
470 X=(D[I]-INTD[I])*1000/S1
480 PLOT I,X,2
490 NEXT I
500 PLOT 201,X-2,1
510 LABEL (*)" S/N#2"
520 PLOT 1,0,1
530 Y=FNE(0)
540 STOP
550 END
```

reformats Barray into dummy D array

removes <max>, <min> from B array, reformats

draws axes

label y-axis

plot % high counts vs freq

plot % high count 2 vs. freq

go to title block

File 4 Key F3 pg 4/7

```
[redacted] DIM M[37],E[37],T[10],C[201]
[redacted] REM ( F3 ) PLOTS MIN,MAX,AVG VERSE TIME
30 REWIND #5
[redacted] WAIT 500
[redacted] IF STAT5#5 AND STAT5#7 THEN 40
60 LOAD  DATA #5,0,T
70 F1=INTT[9]
[redacted] SCALE -30,220,-20,160
[redacted] GOTO 260
100 DEF FNF(X)
[redacted] T1=INT(X)
[redacted] T2=(X-T1)*10000
130 Y1=INT(T1/10000)
140 M1=INT((T1-Y1*10000)/100)
[redacted] D1=T1-M1*100-Y1*10000
[redacted] H1=INT(T2/100)
170 M2=(T2-H1*100)
[redacted] X=INT(30.57*M1)+INT(365.25*Y1-395.25)+D1-24615.5
[redacted] IF M1<3 THEN 240
200 IF Y1=4*INT(Y1/4) THEN 230
[redacted] X=X-2
[redacted] GOTO 240
230 X=X-1
240 X=X+H1/24+M2/1440
[redacted] RETURN X
```

Subroutine to calculate "quasi" Julian Date (does not correct for MDT)

```
[redacted] J1=T[1]
270 J1=FNF(J1)
[redacted] J2=T[2]
[redacted] J2=FNF(J2)-J1
300 IF J2>0 THEN 350
310 BEEP
[redacted] DISP "STOP TIME < START TIME  ?"
[redacted] STOP
340 GOTO 1210
[redacted] S4=J2/200
[redacted] Y=FNB(1)
370 PLOT 40,-18,1
380 LABEL (*,2.5,1.7,0,0.72)"DAYS RELATIVE TO START TIME";
[redacted] LABEL (*,1.4,1.7,0,0.72)
[redacted] FOR Z=0 TO 200 STEP 40
410 PLOT -15+Z,-8,1
[redacted] J6=S4*Z
[redacted] LABEL (440)J6
440 FORMAT F11.4
450 NEXT Z
[redacted] PLOT 1,0,1
470 DISP "  "
480 BEEP
[redacted] WRITE (15,500)F2,F3
[redacted] FORMAT "INDEX POINTS [redacted] MAX"
```

— calc days (Julian Date) of start time

— calc days elapsed between start and stop time

— draw flux axes

draw labels for x-axis

File 4 Key F_3 pg 5/7

```
510 PRINT
520 DISP "ENTER INDEX LIMITS FOR FREQ.";
530 INPUT F7,F8
540 IF F7 >= F8 OR F7<1 OR F8>200 THEN 520 — checks for out of range
550 PLOT 115,2,1
560 L1=((F7-1)/200)*(F3-F2)+F2 ] limits of frequency
570 L2=(F8/200)*(F3-F2)+F2
580 LABEL (590)L1,L2
590 FORMAT "AVERAGED OVER ",F6.0," TO ",F6.0," MHZ" — label plot
600 IF F7=1 AND F8=200 THEN 620 — check to see if this is already calc
610 GOTO 690
620 IF (T[10]-INTT[10])#0.555 THEN 690 — is it calc?
630 LOAD  DATA #5,4,M
640 LOAD  DATA #5,5,E > if yes, load into program
650 FOR J=1 TO F1-5
660 M[J]=(FNF(M[J])-J1)/S4      convert YRMODY.HRMN to days from start time
670 NEXT J
680 GOTO 880
690 FOR J=1 TO F1-5
700 LOAD  DATA #5,J+5,C
710 I3=L2=I4=0
720 L1=1000
730 FOR I=F7 TO F8                calc min max. avg vs time over
740 I4=I4+1                       frequency interval
750 I2=INT(C[I]
760 I3=I3+(C[I]-I2)*1E+06
770 I1=INT(I2/1000)
780 I2=I2-1000*I1
790 IF I1>L1 THEN 810
800 L1=I1
810 IF I2<L2 THEN 830
820 L2=I2
830 NEXT I
840 E[J]=L1*1000+L2+INT(I3/I4)*1E-06
850 M[J]=(FNF(C[201])-J1)/S4
860 NEXT J
870 REWIND #5
880 X=INT(E[1]/1000)
890 I=1
900 PLOT M[1],FNAX,1
910 FOR I=1 TO F1-5
920 X=INT(E[I]/1000)              } plot min vs time
930 PLOT M[I],FNAX,2
940 NEXT I
950 PLOT 201,X-2,1
960 LABEL (*,1.2,1.5,0,0.72)" MIN"
970 BEEP
980 WAIT 10000
990 X=INT(E[1]-1000*INT(E[1]/1000)
1000 I=1
```

File 4 Key F3 pg 6/7

```
1010 PLOT M[1],FNAX,1
1020 FOR I=1 TO F1-5
1030 X=INTE[I]-1000*INT(E[I]/1000)
1040 PLOT M[I],FNAX,2
1050 NEXT I
1060 PLOT 201,X+2,I
1070 LABEL (*)" MAX";
1080 BEEP
1090 WAIT 10000
1100 X=1E+06*(E[I]-INTE[I])
1110 I=1
1120 PLOT M[1],FNAX,1
1130 FOR I=1 TO F1-5
1140 X=1E+06*(E[I]-INTE[I])
1150 PLOT M[I],FNAX,2
1160 NEXT I
1170 PLOT 201,X,I
1180 LABEL (*)" AVG";
1190 PLOT 1,0,1
1200 Y=FNE(0)
1210 STOP
1220 END
```

move pen

plot max vs time

label plot

move pen

plot avg vs time

label plot

goto title routine

File 4 Key F4 pg 7/7

```
10 COM T[10],A1[200],A2[200],B1[200]
20 DIM C[201]
30 REM ( F4 ) PLOTS ANY FILE : AVG-FLUX VS. FREQ
40 Y=FNB(0) — draw axes
50 PLOT -20,2.5,1
60 LABEL (*,2.5,1.7,PI/2,0.72)"MAX ";
70 DISP "    "
80 Y=FNC(0) — draw ref scan
90 SCALE -30,220,-20,160
100 DISP "ENTER FILE # TO PLOT,  0=END";  — input file #
110 INPUT I2
120 IF I2=0 THEN 270 — check to see if end
130 IF I2>INTT[9]-5 THEN 100 — check to see if out of range
140 LOAD  DATA #5,I2+5,C — load file #
150 X=INTC[1]-INT(C[1]/1000)*1000
160 I=1                                  } move pen
170 PLOT 1,FNAX,1
180 FOR I=1 TO 200
190 X=INTC[I]-INT(C[I]/1000)*1000        } calc and plot max vs freq
200 PLOT I,FNAX,2
210 NEXT I
220 PLOT 201,X,1
230 LABEL (240,1.2,1.5,0,0.72)"FILE"I2  — label plot
240 FORMAT F3.0
250 PLOT 1,0,1
260 GOTO 100
270 Y=FNE(0)  — goto title routine
280 STOP
290 END
```

File 5, FNA(x) pg 1/5

```
10 COM T[10],HI[200],A[200],B[200]
20 DISP "READY"
30 STOP
40 DEF FNA(X)
50 REM THIS FUNCTION CALC. FLUX(COUNTS)
60 REM  I IS THE INDEX FOR FREQUENCY (0-200)
70 F=((I-0.5)/200)*(F3-F2)+F2 — calc. freq.
80 GOTO R OF 100,120,150,170  — select proper calc. for effective area (sq.m)
90 GOTO 120
100 Z3=45189/F↑2
110 GOTO 180
120 Z3=5.161358E-01-1.037295E-03*F+9.642604E-07*F*F-4.03698E-10*F*F*F
130 Z3=Z3+6.275523E-14*F↑4
140 GOTO 180
150 Z3=389075.39/F↑2
160 GOTO 180
170 Z3=9441.32/F↑2 — convert counts to dBm
180 X=(X-999)/T[8]
190 X=10↑((X-A2-30)/10)/Z3
200 REM X IS IN WATTS/(SQUARE METERS)
210 X=20*LGT(X*10↑M)
220 REM M IS A SCALING PARAMETER AND 20*LGT IS FOR SCALING ONLY
230 RETURN X
```

File 5, FNB(x) pg 2/5

Draws and labels x and y axis

```
240 DEF FNB(X)
250 F2=INTT[5]
260 F3=(T[5]-F2)*1E+05
270 R=INTT[7]
280 A2=(T[4]-INTT[4])*1000
290 REM DRAWS LOG(FLUX) VS FREQ AXIS"
300 M=I=0
310 M=-1*INT(FNA(0)/20+0.5)
320 F4=(F3-F2)/5
330 SCALE -30,220,-20,160
340 XAXIS 0,-40,200.5,0.5
350 YAXIS 0,20,0,145
360 PEN
370 Z1=160
380 LABEL (*,1.4,1.7,0,0.72)
390 FOR Z=M-7 TO M
400 Z1=Z1-20
410 PLOT -12,Z1,1
420 LABEL (440)-Z
430 NEXT Z
440 FORMAT F3.0
450 IF X#0 THEN 610
460 FOR Z=0 TO 5
470 PLOT -5+40*Z,-7,1
480 IF F2+Z*F4<100 THEN 540
490 IF F2+Z*F4<10000 THEN 520
500 LABEL (560)F2+Z*F4
510 GOTO 550
520 LABEL (570)F2+Z*F4
530 GOTO 550
540 LABEL (580)F2+Z*F4
550 NEXT Z
560 FORMAT 2F6.0
570 FORMAT 2F5.0
580 FORMAT 2F4.0
590 PLOT 65,-15,1
600 LABEL (*,2.5,1.7,0,0.72)"FREQUENCY (MHZ)";
610 PLOT -19,22,1
620 LABEL (*,2.5,1.7,PI/2,0.72)"FLUX (LOG W/SQ. M)";
630 PLOT 1,0,1
640 DISP "    "
650 RETURN X
```

initialize variables

calc zero pt. of plot

← if x ≠ ∅ then this function does not put on freq. labels

— clear display

File 5, FNC(x), pg 3/5

```
660 DEF FNC(X)
670 REM DRAWS REF SCHM FOR FLOW PLOTS
680 F2=INTT[5]
690 F3=(T[5]-F2)*1E+05
700 R=INTT[7]
710 A2=(T[4]-INTT[4])*1000
720 SCALE -30,220,-20,160
730 I=1
740 X=H[I]
750 PLOT I,FNAX,1          move pen to starting position
760 FOR I=1 TO 200
770 X=H[I]                 plot 200 pt. ref.
780 PLOT I,FNAX,2
790 NEXT I
800 PLOT 201,X-3,1
810 LABEL (*,1.2,1.5,0,0.72)"  --REF"   - label ref. plot
820 PLOT 1,0,1
830 DISP "    "
840 RETURN X
```

File 5, FND(x), pg 4/5

```
870 F2=INT[5]
880 F3=(T[5]-F2)*1E+05
890 F4=(F3-F2)/5
900 SCALE -30,220,-20,110
910 XAXIS 0,-40,200.5,0.5
920 YAXIS 0,20,0,100
930 PEN
940 LABEL (*,1.4,1.7,0,0.72)
950 FOR Z=0 TO 100 STEP 20
960 PLOT -15,100-Z,1
970 LABEL (990)100-Z
980 NEXT Z
990 FORMAT F4.0
1000 FOR Z=0 TO 5
1010 PLOT -5+40*Z,-7,1
1020 F5=F2+Z*F4
1030 IF F5<100 THEN 1090
1040 IF F5<10000 THEN 1070
1050 LABEL (1110)F5
1060 GOTO 1100
1070 LABEL (1120)F5
1080 GOTO 1100
1090 LABEL (1130)F5
1100 NEXT Z
1110 FORMAT 2F6.0
1120 FORMAT 2F5.0
1130 FORMAT 2F4.0
1140 PLOT 65,-15,1
1150 LABEL (*,2.5,1.7,0,0.72)"FREQUENCY (MHZ)";
1160 DISP "     "
1170 RETURN X
```

NOTE: This scale different than Flux vs freq scale

labels y-axis Ø to 1ØØ

labels x-axis with frequency values

File 5, FNE(x) pg 5/5

```
1180 DEF FNE(X)
1190 REM THIS FUNCTION DRAWS THE TITLE BLOCK
1200 SCALE -30,220,-20,160
1210 DISP "     "
1220 BEEP
1230 DISP "TITLE  : 0 (LEFT) TO 1 (RIGHT) ";
1240 INPUT I1
1250 OFFSET 15+I1*120,125 ——— re-scale and move zero point
1260 PLOT 0,0,1
1270 IPLOT 0,30,2
1280 IPLOT 80,0,0
1290 IPLOT 0,-30,0
1300 IPLOT -80,0,0
1310 IPLOT 0,25,1
1320 IPLOT 80,0,2
1330 PLOT 5,26,1
1340 LABEL (*,1.35,1.5,0,0.72)"VLA EMI MONITORING SURVEY"
1350 PLOT 3,20,1
1360 LABEL (1370,1.2,1.5,0,0.72)T[1]" TO "T[2]
1370 FORMAT 2F12.4
1380 PLOT 5,14,1
1390 F2=INTT[5]
1400 F3=(T[5]-INTT[5])*1E+05
1410 LABEL (1420)F2" TO "F3"  MHZ"
1420 FORMAT 3F5.0
1430 PLOT 5,8,1
1440 LABEL (1450)"FEED ORIENT : "INTT[4]
1450 FORMAT 2F4.0
1460 S3=(T[7]-INTT[7])*1000
1470 S1=(T[9]-INTT[9])*1000
1480 PLOT 5,2,1
1490 LABEL (1450)"#SCANS= "S1"  #SCANS/FILE="S3
1500 DISP "  "
1510 SCALE -30,220,-20,160 — set scale back to a flux vs freq value
1520 PLOT 1,0,1
1530 DISP "TITLE COMPLETE"
1540 STOP
1550 END
```

Draw Box

File 6 Calibration pg 1/3

```
10 REM  CALIBRATION PROGRAM
20 PRINT "CALIBRATION PROCEDURE :"
30 PRINT "HAVE A SIGNAL SOURCE WITH A STEP ATTENUATOR (0 TO -70 DB) CONNECTED"
40 PRINT " HAVE THE ATTENUATOR SET TO 0"
50 PRINT
60 PRINT "SET THE FOLLOWING CONTROLS ON THE H.P. SPEC. ANAL. :"
70 PRINT " INPUT ATTENUATION = -10 DB"
80 PRINT " LOG REF LEVEL = 0"
90 PRINT
100 PRINT "INPUT A ZERO DBM SIGNAL AND ADJUST THE INTERFACE TRIMPOT MARKED"
110 PRINT "SPECTRUM ANALYSER PEAK DETECTOR GAIN UNTIL COUNTER READS 999"
120 PRINT
130 PRINT "SET THE ATTENUATOR AS THE PROGRAM REQUESTS "
140 PRINT
150 PRINT
160 DIM R[8],X[8],C[100],D[100]
170 MAT C=ZER
180 MAT D=ZER
190 MAT R=ZER
200 R[2]=1
210 R[3]=32
220 PRINT "                    DBM              COUNTS"
230 PRINT "                    ---              ------"
240 J=1
250 I9=10
260 D[J]=0
270 DISP "SET THE ATTENUATOR TO ";D[J];" DB";
280 INPUT I1
290 GOSUB 770
300 WAIT 100
310 GOSUB 610
320 GOSUB 770
330 WAIT 100
340 GOSUB 610
350 WAIT 100
360 GOSUB 770
370 WAIT 100
380 GOSUB 610
390 IF J#1 THEN 430
400 IF N1 >= 995 THEN 430
410 PRINT "*** ERROR *** COUNTER SHOULD READ 999 FOR 0 DB"
420 GOTO 270
430 S1=0
440 FOR I=1 TO I9
450 R[2]=1
460 R[3]=32
470 GOSUB 770
480 WAIT 100
490 GOSUB 610
500 S1=S1+N1
```

makes a few measurements to let interface, signal generator etc settle down

← FOR FIRST COUNT ONLY

averages 10 measurements

File 6 pg 2/3

```
[redacted]10 NEXT I
[redacted]20 C[J]=S[I]/[redacted]
530 WRITE (15,540)D[J],C[J]
[redacted]40 FORMAT 13X,F5.1,10X,F8.2
[redacted]50 IF D[J]<-69 THEN 870
560 J=J+1
570 D[J]=D[J-1]-10
[redacted]80 FIXED 0
[redacted]90 GOTO 270
600 REM
[redacted]10 REM  SUB INPUT  * *
[redacted]20 X[1]=RBYTE2
630 X[2]=RBYTE2
[redacted]40 X[3]=RBYTE2
[redacted]50 X[4]=RBYTE2
[redacted]60 X[5]=RBYTE2
670 X[6]=RBYTE2
[redacted]80 X[7]=RBYTE2
[redacted]90 X[8]=RBYTE2
700 N1=0
[redacted]10 IF X[7]<10 THEN 750
[redacted]20 X[7]=X[7]-16
730 N1=N1+10
740 GOTO 710
[redacted]50 N1=10*(N1+X[7])+X[8]/16
[redacted]50 RETURN
770 REM SUB OUTPUT  * *
[redacted]80 OUTPUT (2,*)WBYTER[1];
[redacted]90 OUTPUT (2,*)WBYTER[2];
800 OUTPUT (2,*)WBYTER[3];
810 OUTPUT (2,*)WBYTER[4];
[redacted]20 OUTPUT (2,*)WBYTER[5];
[redacted]30 OUTPUT (2,*)WBYTER[6];
840 OUTPUT (2,*)WBYTER[7];
[redacted]50 OUTPUT (2,*)WBYTER[8];
[redacted]60 RETURN
870 REM LINEAR LEAST SQUARES SUBROUTINE
880 S1=S2=S3=S4=S5=0
[redacted]90 WRITE (15,900)
[redacted]00 FORMAT "-----------------------------------------------------------------------"
910 FOR K=1 TO J
[redacted]20 S1=S1+C[K]
[redacted]30 S2=S2+C[K]*C[K]
940 S3=S3+C[K]*D[K]
950 S4=S4+D[K]
[redacted]60 S5=S5+D[K]*D[K]
[redacted]70 NEXT K
980 M=(S3-S1*S4/J)/(S2-(S1*S1/J))
[redacted]90 B=(S4-M*S1)/J
[redacted]000 C1=0
```

read interface and decode counts

write to interface to reset peak detector and start scan

$$dB = m\cdot(\text{counts}) + b$$

$S1 = \sum \text{counts}$

$S2 = \sum \text{counts}^2$

$S3 = \sum \text{counts}\cdot db$

$S4 = \sum db$

$S5 = \sum db^2$

File 6 pg 3/3

```
1010 FOR K=1 TO J
1020 C1=C1+(M*C[K]-S4+S3)↑2
1030 NEXT K
1040 C2=J*S2-S1*S1
1050 E1=SQR(C1/C2)
1060 E2=SQR(S2*C1/C2/J)
1070 WRITE (15,1080)M,E1
1080 FORMAT "SLOPE = ",F9.5," +- ",F10.6
1090 WRITE (15,1100)B,E2
1100 FORMAT "DB INTERCEPT = ",F8.4," +- ",F9.5
1110 C0=M*SQR(S2-S1*S1/J)/SQR(S5-S4*S4/J)
1120 WRITE (15,1130)C0
1130 FORMAT "CORRELATION =",F8.5
1140 FIXED 2
1150 PRINT "SUM OF ERRORS SQUARED = ";C1
1160 PRINT
1170 C0=1/M
1180 FIXED 4
1190 PRINT "PARAMETER FOR COLLECTION PROGRAM = ";C0
1200 PRINT "USE AS FOLLOWS :   DB(COUNTS)=(COUNTS-999)/PARAMETER"
1210 WRITE (15,900)
1220 PRINT
1230 STOP
1240 END
```

File 7

marks a blank tape in Data cassette
to copy this set of programs on

```
10 DISP "LOAD, REWIND BLANK TAPE IN 9865A"
20 WAIT 1000
30 IF STAT5#5 THEN 10
40 MARK #5,2,2400
50 MARK #5,1,800
60 MARK #5,1,1100
70 MARK #5,1,3200
80 MARK #5,1,1800
90 MARK #5,1,1500
100 MARK #5,3,300
110 DISP "FINISHED"
120 REWIND #5
130 STOP
140 END
```

APPENDIX II

1. H-5001 Horn 1.0 to 2.5 GHz

(See attached gain curve)

Freq	Gain	Apperture
1000 MHz	11.55 dB	0.102337 M^2
1100	12.10	.095995
1200	12.70	.092613
1300	13.25	.089566
1400	13.80	.087655
1500	14.25	.084694
1600	14.70	.082564
1700	15.10	.080193
1800	15.45	.077533
1900	15.80	.075427
2000	16.10	.072941

$$Ap = \frac{G\lambda^2}{4\pi}$$

$$= \frac{G\left(\frac{300}{F}\right)^2}{4\pi}$$

$$= \frac{9x10^4xG}{4\pi F^2}$$

Utilizing polynomial regression techniques to determine A_p = F (freq) yields:

$$A_p = 5.161358E\text{-}Ø1 - 1.Ø37295E\text{-}Ø3xf + 9.6426Ø4E\text{-}Ø7xf^2$$
$$- 4.Ø36988E\text{-}1Øxf^3 + 6.275523E\text{-}14xf^4$$

2. H-5101 Horn 2.0 to 5.0 GHz

Over the range 4.5 to 5.0 GHz, the gain varies from 17.1 to 17.6 dB. Therefore an assumed constant gain of 17.35 dB would yield a maximum error of 0.25 dB. (See attached curve.)

$$Ap = \frac{G\lambda^2}{4\pi}$$

$$= \frac{54.325\left(\frac{300}{F}\right)^2}{4\pi}$$

$$= \frac{389075}{F^2}$$

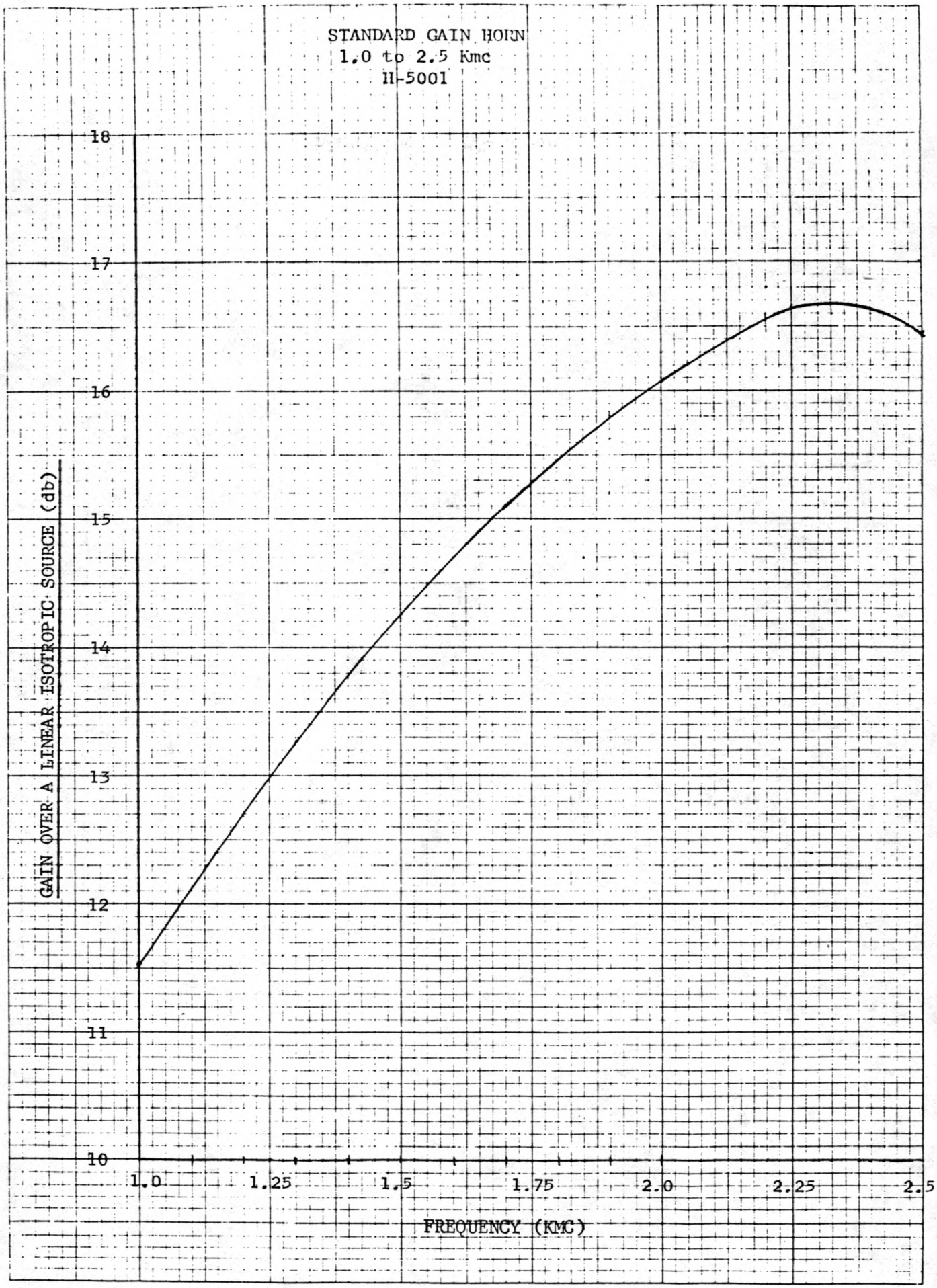
3. AEL Log Periodic .1 to 1.0 GHz

The gain is constant at 8 dB over the operating range.

$$AP = \frac{G\lambda^2}{4\pi}$$

$$= \frac{6.310 \left(\frac{300}{F}\right)^2}{4\pi}$$

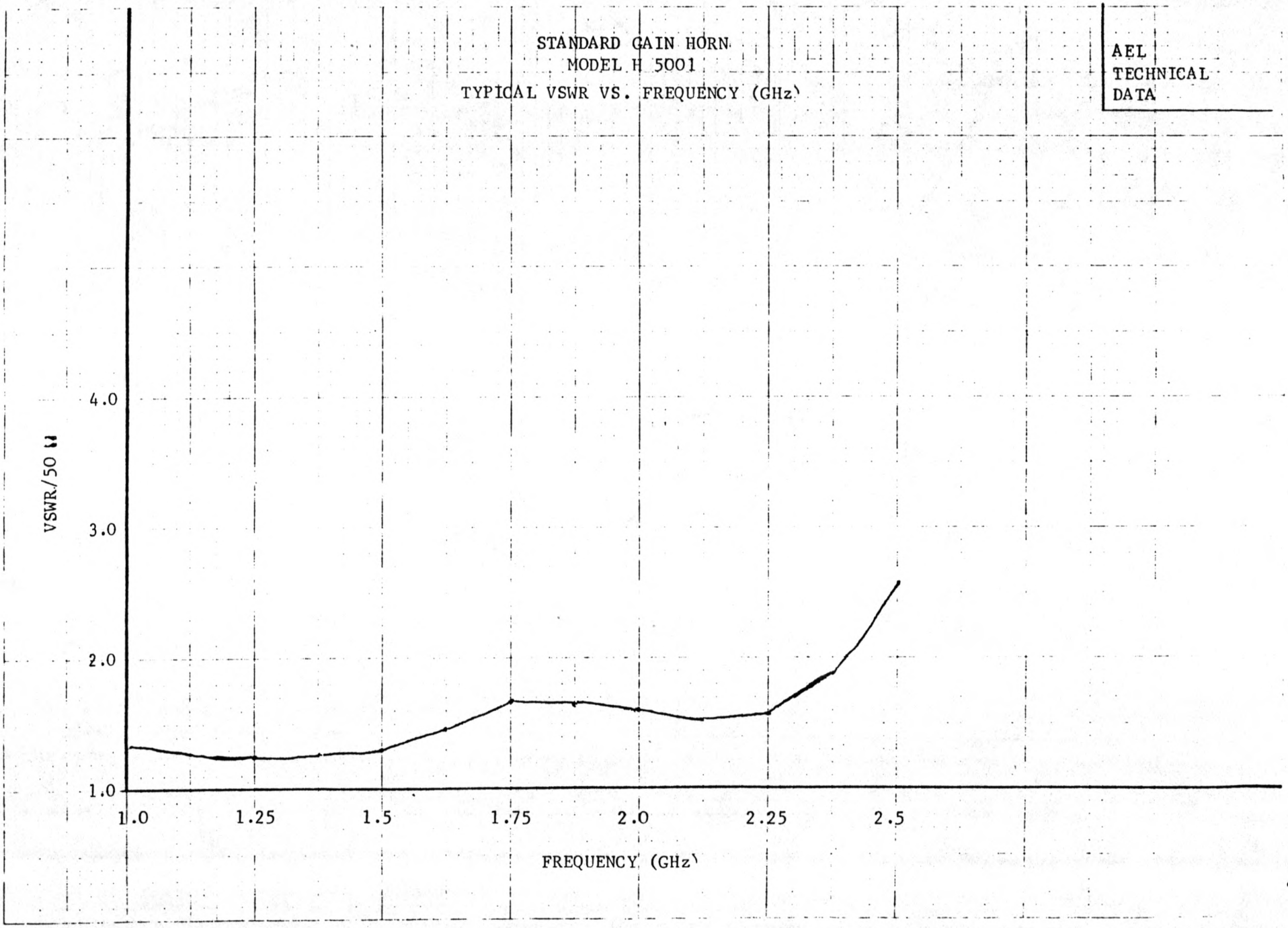
$$= \frac{45189}{F^2}$$

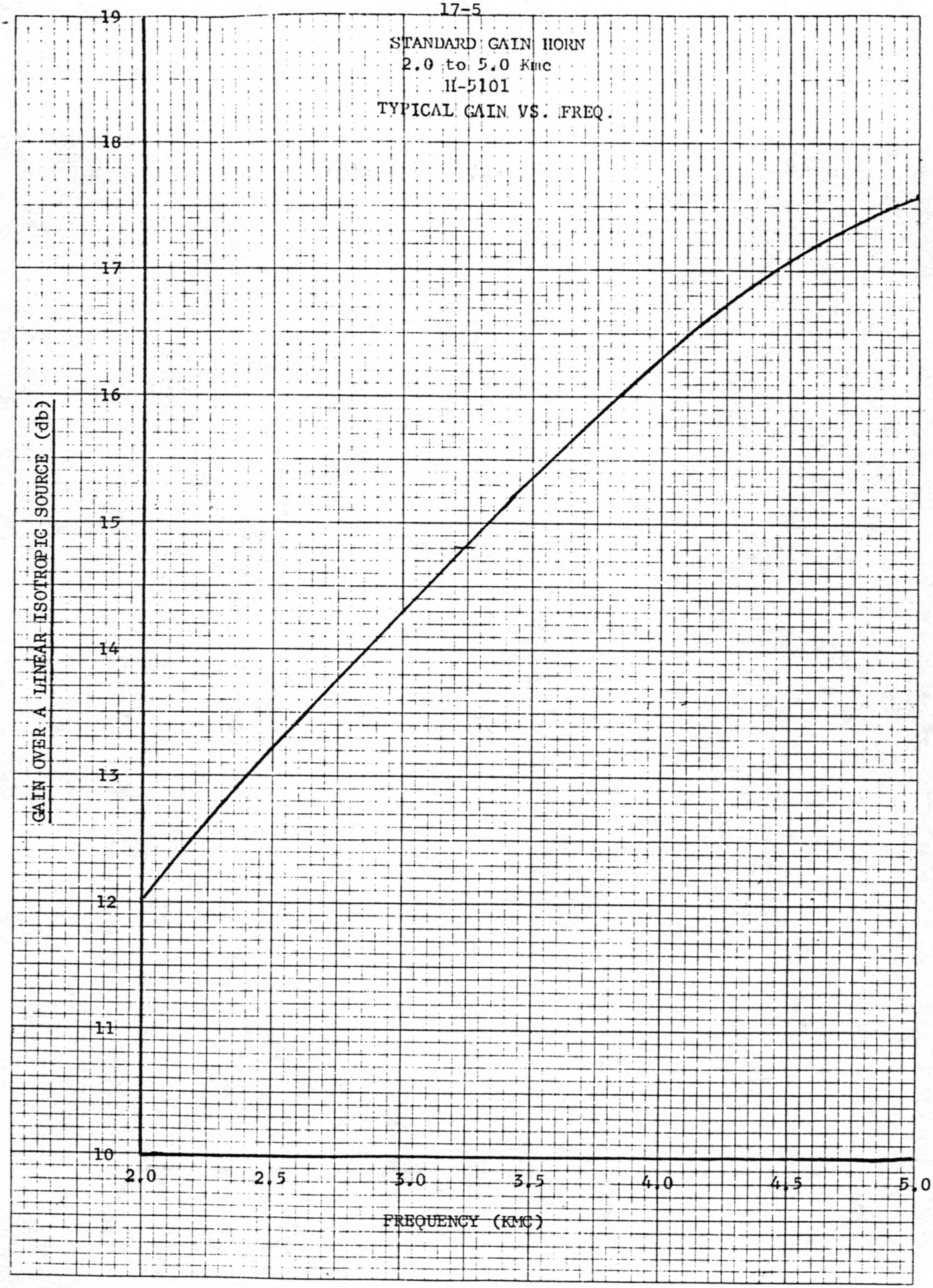


EUGENE DIETZGEN CO. [redacted]
NO. 340-10 DIETZGEN GRAPH PAPER [redacted]

NO. 340R-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

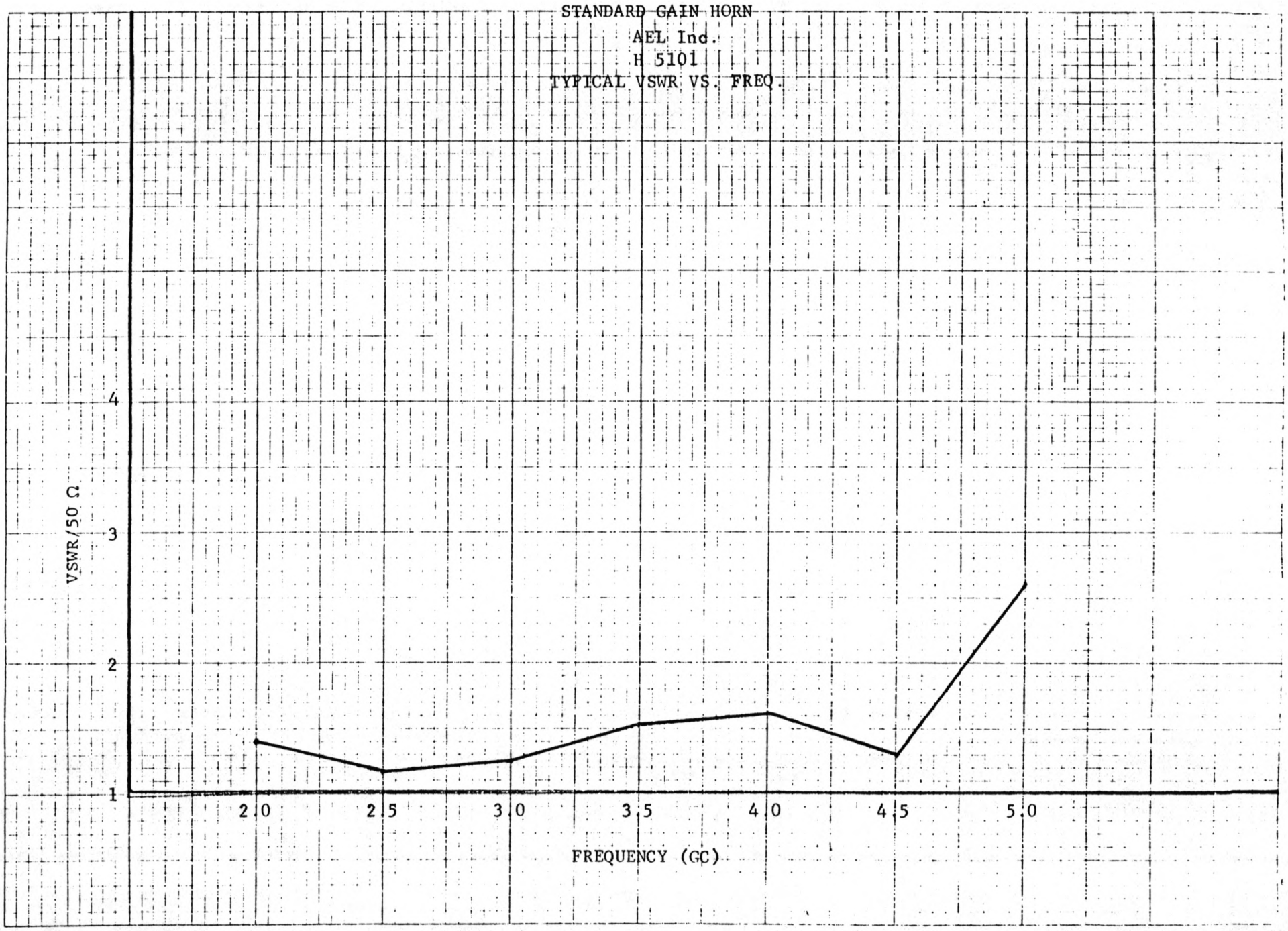




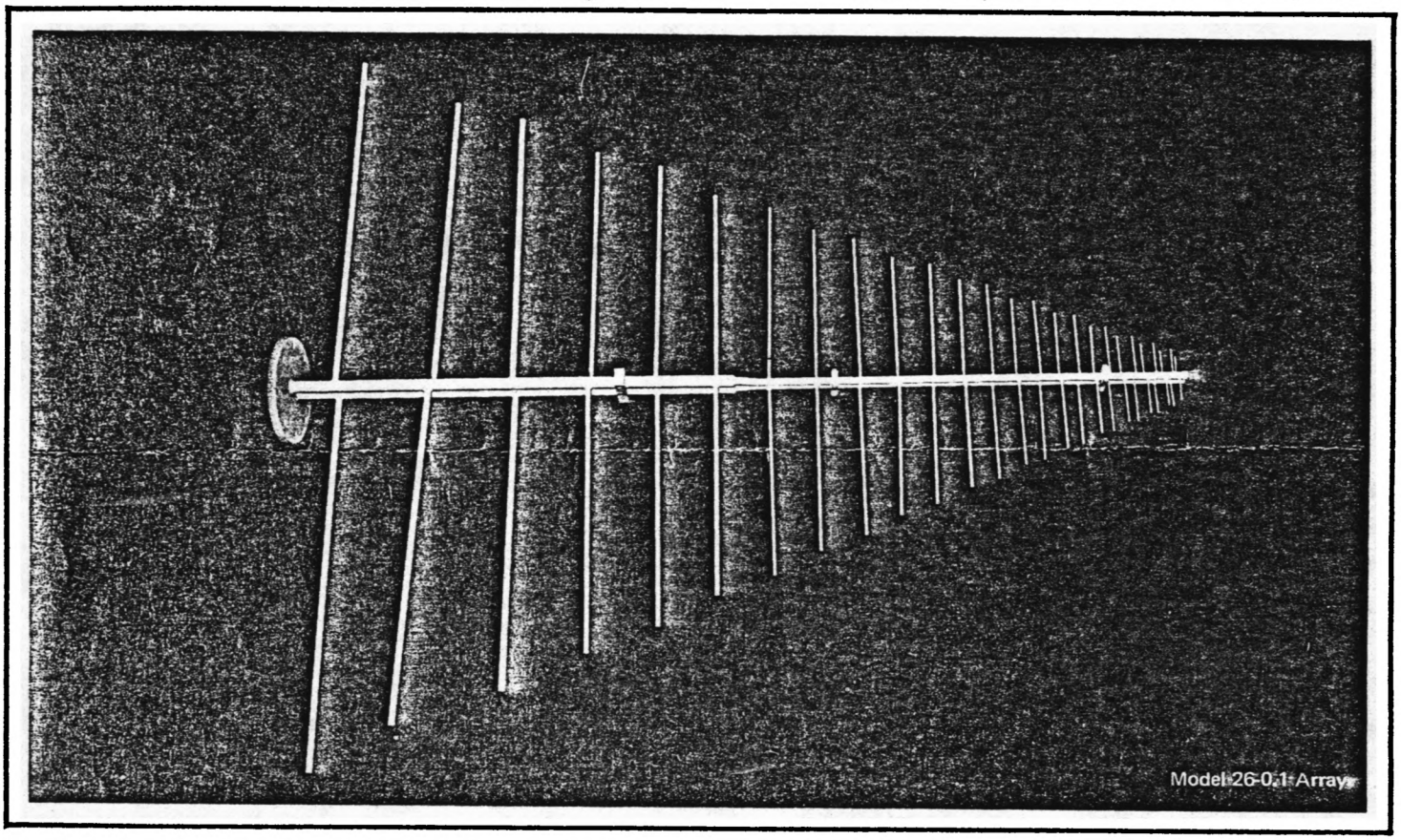
EUGENE DIETZGEN CO. [redacted] MADE [redacted] S. A.
NO. 340-10 DIETZGEN GRAPH PAPER [redacted] 10 P[redacted]CH

NO. 340-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.



Log-Periodic Transmitting Antenna Arrays and Feeds, Series 26/27



FEATURES

Extremely Wide Frequency Coverage

Easily Interchangeable Feeds

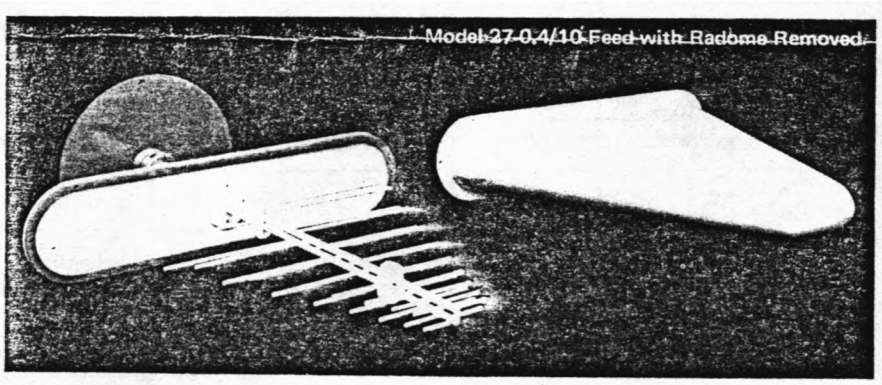
Mechanically Compatible Feeds For Use In Series 22 Reflectors

Minimal Size

All-Weather Operation

Feeds Radome Protected

The Scientific-Atlanta Series 26 Log-Periodic Antennas and Series 27 Log-Periodic Feeds offer broadband frequency coverage and other characteristics ideally suited for antenna pattern range applications. Series 27 units cover the frequency range of 0.4 to 12.4 GHz; Series 26 units are recommended for use below 0.4 GHz. With the Series 26 Antennas and 27 Feeds significant time can be saved by eliminating frequent changes that would be required to cover the same bandwidths with conventional units.



DESCRIPTION

Series 26 Antennas are log-periodic dipole antennas specifically designed for use in VHF and UHF antenna test ranges. Each ran array has essentially constant gain, beamwidth, and input impedance over its design frequency range. Series 26 E- and H-plane patterns for any 3 frequencies can be supplied at an additional cost of $350.00 per antennas. A mounting flange at the rear of the array can be attached to any Scientific-Atlanta Series 5600 Polarization Positioner.

Scientific-Atlanta

Model 27-1.0/8 Feed with radome removed

Series 27 Feeds are primarily intended for use in Scientific-Atlanta Series 22-4, -6, -8, and -10 foot reflectors and at frequencies between 0.4 and 12.4 GHz.

To obtain the element thickness and accuracy required for performance through 12.4 GHz, the high frequency feeds are of printed-circuit construction. They are photoetched from low-loss, copper-clad materials. Each feed is protected by a radome in which a desiccator is installed to prevent accumulation of moisture.

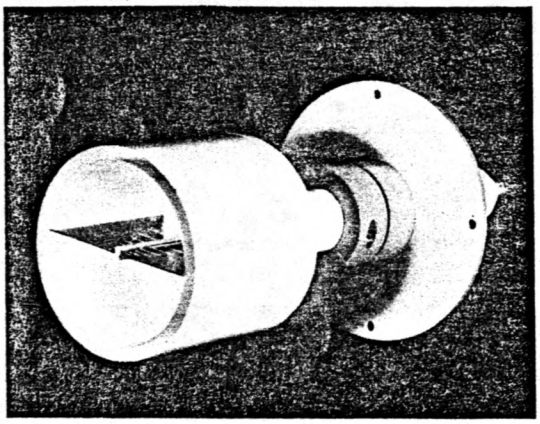
All Series 27 Feeds are supplied mechanically aligned and adjusted for their respective reflectors. Electrical alignment and focusing for optimum radiation patterns can be performed at the factory and copies of the data supplied for an additional cost per unit

Other frequency ranges and feed-reflector combinations available upon request.

SERIES 26 SPECIFICATIONS

Array Model Number	Model 26-0.05	Model 26-0.1
Frequency Range (GHz)	0.05 to 0.50	0.10 to 1.00
Nominal Gain	8 dB	8 dB
Nominal Beamwidth (degrees) E-Plane H-Plane	 60 120	 60 120
Maximum VSWR	2.0	2.0
Input Impedance (ohms)	50	50
Power (watts)	100	100
Connector	Type "N" Female	Type "N" Female
Max. Front-to-Back Ratio, down	−20 dB	−20 dB
Max. Cross Polarization, down	−25 dB	−25 dB
Approx. Max. Projected Wind Area (in.^{2})	830	138
Approx. Center of Gravity	44 in. from mounting flange	24 in. from mounting flange
Dimension (inches) Length Width	 141±1.0 120±1.0	 71±1.0 60±1.0
Weight (pounds) Net Shipping	 75 275	 11 90

Model 27-4.0/4 Feed with radome installed



SERIES 27 SPECIFICATIONS

Feed Model Number	Reflector Model No. *	Frequency Range (GHz)	Nominal Gain at Band Edges (dB)	Nominal Beamwidth at Band Edges (degrees)	Max. VSWR	Power (watts)	Shipping Weight (pounds)
27-0.4/10 27-1.0/8	22-10/A 22-8	0.4 to 1.7 1.0 to 6.0	19-32 25-40	18-4 9-1.5	2.0 2.0	100 5	8 5
27-4.0/8 27-1.0/6	22-8 22-6	4.0 to 12.4 1.0 to 6.0	37-45 22-36	2-0.7 12-2	2.5 2.0	5 5	4 5
27-4.0/6 27-4.0/4	22-6 22-4	4.0 to 12.4 4.0 to 12.4	35-42 31-38	3-1 4.5-1.5	2.5 2.5	5 5	4 4

Maximum cross-polarization, down −25 dB.
Nominal side lobes, 18 dB.
A female Type N connector is employed on each model feed.
*Refer to the Series 22/23 data sheet for information of Series 22 Reflectors.

Scientific-Atlanta, Inc. Box 13654, Atlanta, Georgia 30324 • Telephone 404-938-2930
TWX 810-766-4912 • Telex 54-2898 • Cable: SCIATLADORA

MODEL 26-0.1 SERIAL #222

VSWR VS FREQUENCY
VSWR SPECIFICATION 2.0:1 MAXIMUM

Frequency MHz	VSWR
100	1.90
150	1.62
200	1.30
400	1.73
600	1.32
800	1.48
1000	1.19

Tech. P P Gagne

Date 4-24-74