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EARTH TERMINAL MEASUREMENT SYSTEM OPERATIONS MANUAL (Revised)

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U.S. Department of Commerce
Boulder, Colorado 80303

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NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

CONTENTS

FIGURES

TABLES

GLOSSARY

cut	The string of power measurements associated with a single antenna setting while the radio star drifts though the antenna beam.
measurement #	The number indicating an individual cut in a run.
offset	The declination distance of a cut from the calculated center of the antenna pattern.
run	The data associated with a group of data sets on a particular daily MEAS tape.
set	The data associated with 6 consecutive cuts starting with a cold sky cut, and followed by 5 equally spaced cuts through the antenna pattern.
sky profile	The dependence of the sky background temperature on elevation.
TRAP	"The Restart Alternatives Position". The point in each computer program accessable using the special function key 0 which provides for the program master RESET, measurement restart, or selected option functions.

Earth Terminal Measurement System

Operations Manual (Revised)

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The Earth Terminal Measurement System (ETMS) was developed by the National Bureau of Standards to make accurate measurements of earth terminal parameters such as the figure of merit (G/T), antenna gain relative to a reproducible reference level, the noise equivalent flux (NEF), and noise ulterior flux (NUF). This manual includes the theory of the measurements, measurement procedures, measurement troubleshooting, interpretation of the results, and a discussion of the ETMS software.

Key words: antenna gain; antenna half-power beamwidth; atmospheric loss; Cassiopeia A; earth terminal measurement system; figure of merit; moon; noise equivalent flux; noise measurement; noise ulterior flux; radio stars; satellite communication.

1. INTRODUCTION

This manual describes the operation of the earth terminal measurement system (ETMS) shown in figures 1 and 2. It includes the theory of the measurement procedures, the measurement trouble shooting, the interpretation of the results, and a discussion of the ETMS software. This manual does not include details on connection of the hardware, on hardware maintenance, or on hardware trouble shooting. These topics are discussed in the companion ETMS maintenance manual [7].

For someone unfamiliar with the ETMS who intends to operate it using primarily this instruction manual, the following suggestions are offered. First, one should realize that the concepts behind the measurement are simple. The ETMS basically measures the sensitivity of the earth terminal. This is done by pointing the earth terminal antenna at a known, weak source (Cassiopeia A, or the moon), and accurately measuring the resulting signal-to-noise ratio. Second, we recommend scanning through this manual and the companion maintenance manual in order to get a feel for what material is available, and where it is located. It is easy to lose sight of the basic simplicity of the measurement if one wades through too much fine detail at first. The mechanics of measurement can best be understood by becoming familiar with the nine steps in the measurement as listed in Table 1.

Third, one should get familiar with the ETMS in a nonstressful environment. The nature of computer-assisted measurements is such that, at the beginning, problems occur because of sequences of inappropriate entries. The normal recovery mode is to rewind the program tape (to protect it from turn off transients) and then to turn off the computer and start over. Soon the computer will have the operator trained to what it expects. The ETMS control unit contains a simulated star noise source, so one can become familiar with many of the situations that can occur during a measurement. What cannot be simulated is the excitement of finding the real radio star which, normally, is not difficult to locate. If the earth terminal and ETMS are functioning properly, and if the earth terminal location and the time are accurately known, the star MUST be there (within the antenna boresight error). To keep this naturally exciting time in bounds, it is highly recommended that everything possible be done ahead of time to assure that the equipment and software are working properly.

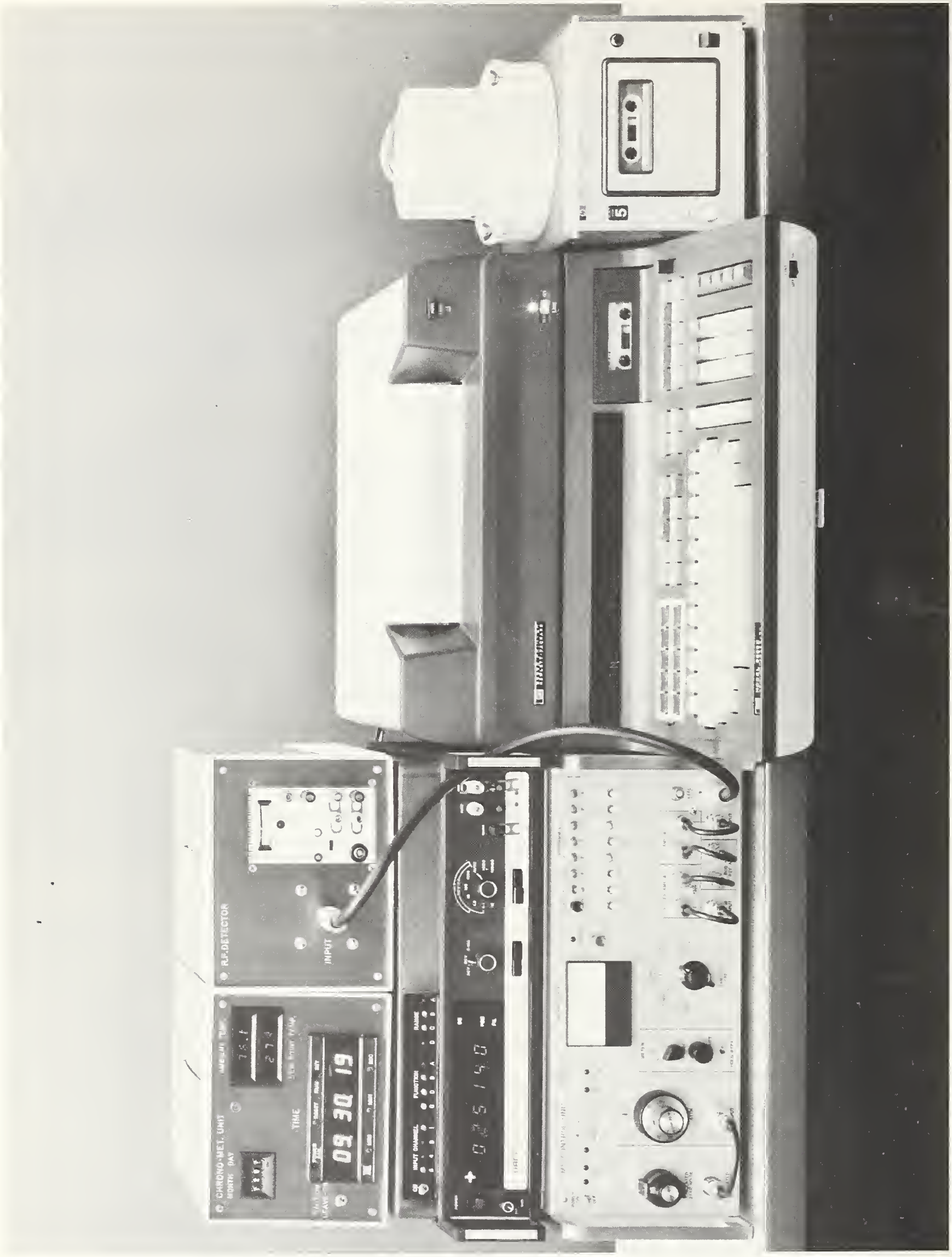


Figure 1. Earth Terminal Measuring System

Figure 2. Coaxial switch for the ETMS

Fourth, one should be mentally prepared to "lose" the first day at the measurement site. This will happen more often than one would like due to unforeseen difficulties. Examples of problems which have occurred include the inability to find a cable to go to the ETMS from the noise add source in the antenna room, an unexpected limitation in pointing the antenna, an intermittent cable, and the wrong site coordinates.

2. BACKGROUND

The radio star Cassiopeia A (Cas A) and the moon are used as calibration sources [1], [9] for the measurements described in this report. For X-band antenna systems, Cas A is the source of choice for large, low noise antenna systems (11- to 28-meter diameter antennas). The moon is the best source for medium-sized antenna systems (4- to 5.5-meter diameter antennas).

2.1 G/T and G/T_a

To determine G/T, the ratio (Y) of the output noise power when the earth terminal antenna is pointed to Cas A (or the moon) to the output noise power when the antenna is pointed to the nearby cold sky is measured. The measurable noise power when the antenna is pointed to Cas A (or the moon) is the power at the output of the antenna times the electronic gain (g) from the antenna output to the input to the ETMS. Thus

$$\text{Power to ETMS (on source)} = g\ k\ (\Delta T + T)\ B\ ,$$

and

$$\text{Power to ETMS (on sky)} = g\ k\ T\ B\ ,$$

so the ratio of these two measurable powers is,

$$Y = (\Delta T + T)/T \tag{1}$$

where ΔT is the temperature rise due to the radio source at the antenna output port, and T is the system temperature expressed relative to the antenna output port. The temperature of the cold sky is included in T. The temperature rise caused by the star depends on its flux density, S(W/m^2/Hz) [2], [9], and on the effective area of the antenna A_e (m^2),

$$\Delta T = (1/2) k_1 k_2 k_3 k_4 k_5 k_6 k_7\ S A_e/k\ , \tag{2}$$

where for Cas A, $S = (3154)\ e^{-0.0097\alpha}\ (f/1000)^{\alpha}\ 10^{-26}$, $\alpha = -0.792 + 0.0012\ \tau$, τ = the number of years since 1965.0, f is the frequency (Hz), k is Boltzmann's constant, ($k = 1.38045 \times 10^{[-23]}$J/K). For the moon, $S = 7.252\ F^2\ T_b\ d_m{}^2$, where F is the frequency (GHz), T_b is the brightness temperature, d_m is the apparent diameter, and the following definitions hold.

$$T_b = T_{bo}\ \ 1-(T_{b1}/T_{bo})\cos(\omega t - \zeta)\ \ ,$$

where

$$T_{bo} = (207.7 + 24.43/F) \pm 11.4\% = \text{mean brightness temperature},$$

$T_{b1}/T_{bo} = 0.004212 \pm 6.6\%$, ζ = 12.19 (deg/day) ± 0.9%, t = lunar age (days), lunar phase lag ζ = 43.83 deg/(1 + 0.0109 f) ± 28%,

$$d_m = 31.090/(r_o/a)/60.268 - 0.0166 \sin L \pm 0.12\%,$$

$$r_o/a = a_o + (a_1/500{,}000)(p - 0.5) + (a_2/500{,}000)(p - 0.5)^2,$$

where a_o, a_1, a_2 are coefficients given in the "American Ephemeris and Nautical Almanac", p is the fractional number of hours from 0 hours U.T. to 24 hours U.T. on the same day. The various k_i's are defined by Daywitt [3]; k_1 is the atmospheric transmission correction factor, k_2 is the star shape correction factor, k_3 is the bandwidth correction factor, k_4 is the differential system temperature factor, k_5 is the antenna pointing correction factor, k_6 is the polarization factor, and k_7 is the system response correction factor. The factor 1/2 in eq (2) accounts for the fact that only one polarization of radiation can be received from a star at any one time. If the antenna is reciprocal, then

$$A_e = c^2\, G/(4\, \pi\, f^2) \tag{3}$$

where G is the antenna gain, c is the velocity of light (2.99793×10^8 m/s), f is the frequency; (Hz), so

$$\Delta\, T = \zeta\, G \tag{4}$$

where

$$\zeta = k_1\, k_2\, \ldots\, k_7\, c^2\, S/(8\, \pi\, k\, f^2) \tag{5}$$

For the measurements included in this report, power is measured relative to a stable and reproducible noise add reference signal, T_a, to reduce the effects of electronic gain changes in the system, so

$$G/T_a = (\Delta\, T/T_a)/\zeta \tag{6}$$

Combining eqs (1) and (4)

$$G/T = (Y-1)/\zeta \tag{7}$$

or expressed in decibels above one inverse degree kelvin,

$$G/T\ (\mathrm{dB/K}) = 10 \log G/T. \tag{8}$$

2.2 Noise Equivalent Flux and Noise Ulterior Flux

The figure of merit (G/t) for an earth terminal has several shortcomings for the precise characterization of an earth terminal. First, it neither characterizes the hardware nor the hardware plus atmosphere, because the atmospheric effects are excluded from the antenna gain (G) part of G/T, but are included in the system temperature part. Second, earth terminal noise characteristics and efficiency are largely independent of frequency while G/T is a function of frequency squared. Thus, if an earth terminal is being characterized at several different frequencies, it becomes somewhat more difficult to identify an abnormal measurement when using G/T as opposed to the use of a parameter that is not frequency dependent. Last, inclusion of the atmospheric component in G/T makes it difficult to determine the "reasonableness" of a set of results. That is, with small sets of data it is important to be able to judge whether the end points are valid. A reasonable change in hardware characteristics is much easier to estimate than changes in hardware plus atmospheric effects. To avoid the above problems, the parameters Noise Equivalent Flux (NEF) and Noise Ulterior Flux (NUF) are introduced.

The Noise Equivalent Flux (NEF) density is a measure of the noise performance of the earth terminal analogous to effective input noise temperature for an amplifier. NEF is the ideal, white, random noise flux density [$w/(m^2\ Hz)$] incident normal to the aperture of a noiseless equivalent earth terminal such that the output noise power equals the output noise power of the actual earth terminal. By replacing T by (NEF A_{eo})/(2k) + T_{sky}, the Y-factor (eq 1) becomes

$$Y = (k_1 \ldots k_7 S + 2 k T_{sky}/A_{eo} + NEF)/(2 k T_{sky}/A_{eo} + NEF) \tag{9}$$

where $k_1 \ldots k_7$, S, and k are defined as in eq (2), T_{sky} is the noise power originating from the atmospheric losses along the antenna boresight plus the three-degree kelvin cosmic background temperature, and A_{eo} is the antenna effective area at the antenna aperture (i.e., no resistive antenna losses included). Boltzmann's constant, k, and the antenna effective area, A_{eo}, are used to convert T_{sky} to a power density expressed in watts/meter^2. Rearranging eq (9),

$$NEF = k_1 k_2 \ldots k_7 S/(Y-1) - 2 k T_{sky}/A_{eo}. \tag{10}$$

If the atmosphere is included as part of the earth terminal, the corresponding noise equivalent flux is denoted NUF, or the noise ulterior flux density to emphasize that the input reference plane to the earth terminal is beyond the upper atmosphere.

$$NUF = k_2 \ldots k_7 S/(Y-1) - 2 k T_{cosm}/A_{eo} \tag{11}$$

where T_{cosm} is the 3K cosmic background temperature, and no atmospheric absorption factor k_1 occurs.

2.3 Estimate of Antenna Gain and T_a using HPBW

Primarily T_a is intended as a stable reference signal to remove the effects of electronic gain variations from the measurement of NEF and of G/T. However it is useful to estimate T_a in order to display the variation of antenna gain implied in the variations of the G/T_a measurements. The calculation of T_a from the antenna half-power beamwidth (HPBW) in the REWORK PROGRAM involves several steps. First, the measured antenna HPBW and G/T_a are least squares fit to a constant plus cosecant of the antenna elevation term. The fit values at 30 degrees elevation for G/T_a and HPBW are used for the subsequent calculations for T_a. Then the antenna gain, G, is calculated using the following empirical equations relating aperture efficiency, η_{apr}, HPBW(deg), antenna diameter D(ft), and G.

$$\eta_{apr} = \eta_{rad}/(HPBW\ D\ F/50.6)^2 \tag{12}$$

where η_{rad} is the radiation efficiency (assumed to be 0.98), and F is the frequency in gigahertz and

$$G = 10.2\ \eta_{apr}\ (D\ F)^2$$

so

$$G = 26117\ \eta_{rad}/(HPBW)^2 \tag{13}$$

Using the value for G/T_a at 30 degrees elevation and the empirical value for G, the magnitude of T_a is calculated.

3. MEASUREMENT INSTRUMENTATION

The measurement of the pertinent power ratios is accomplished using the Earth Terminal Measurement System (ETMS). The ETMS is an automated measurement system developed around the most accurate power measurement bridge known--the NBS type IV self-balancing bridge [5]. This bridge, as implemented in the ETMS, measures the ratio of stable noise powers to an accuracy of better than ± 0.1%.

A simplified block diagram of the ETMS is shown in figure 3. The ETMS contains nine subsystems: (1) a calculator which provides computation capability, a means of controlling each of the remaining subsystems under automatic sequence control, a means of storing the measurement results on magnetic tape in order to rework the data at a later time, and a keyboard to control the measurement procedures or to enter program modifications; (2) an external cassette which allows redundant recording of measurement data; (3) an NBS type IV self-balancing power bridge used to measure noise power; (4) a programmable voltmeter whose accuracy is a major factor in determining the accuracy with which the noise power is measured; (5) a multiplexer which connects the digital voltmeter to various measurement points of interest; (6) a digital clock needed to provide time information required to determine current star coordinates; (7) dual X-band solid state noise source to provide a stable reference signal needed to eliminate the effects of gain fluctuations in the earth terminal; (8) an rf control unit which provided signal conditioning, system test signals, precision circuits which allow the calculator to control the various measuring instruments, and (9) a coaxial switch under computer control which allows the input of the rf control unit to be connected to any of three down converters of the earth terminal.

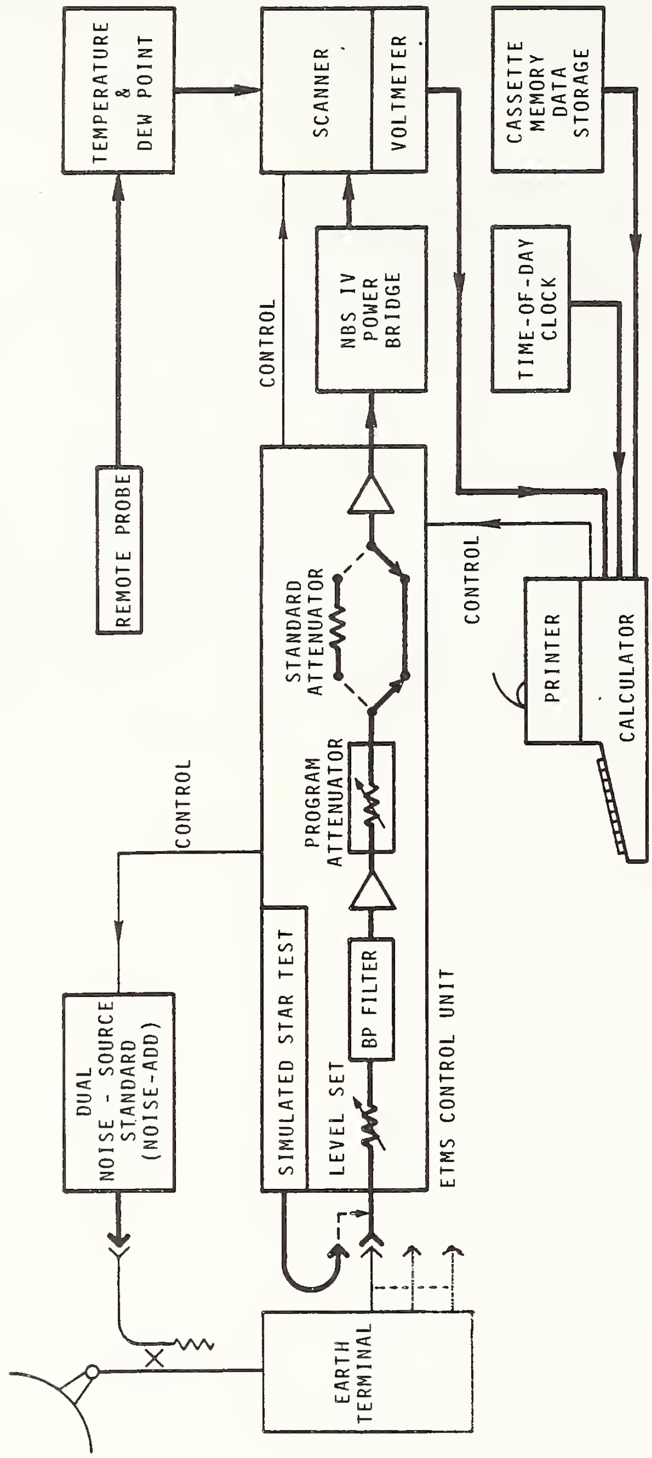


Figure 3. Block Diagram of the ETMS

4. OVERVIEW OF MEASUREMENT PROCEDURE

The measurement procedure of the ETMS is designed to measure G/T, G/T_a, NEF, NUF and to estimate the antenna gain. TO OBTAIN THE BEST ACCURACY, the ETMS OPERATOR MUST exercise good metrology techniques and especially TAKE METICULOUS CARE IN POINTING THE ANTENNA by carefully approaching each azimuth and elevation setting of the antenna from the same direction.

The measurement procedure contains nine steps as noted in table 1. First, prior to going to the measurement site, the daily MEAS tapes and the daily SUMMARY tapes (which will be used during the measurement) are prepared. These are prepared by duplications of the master MEAS tape and the master SUMMARY tape. Then the SITE PREP tape is used to prepare data and to store it on these daily MEAS tapes (e.g., the date of the measurement, the earth terminal's site coordinates, and the almanac data on the sun and the moon). The ETMS will print out the expected measurement error and the star positions versus time.

The second measurement step is to validate that the equipment is working properly and that the MEAS tapes have been correctly prepared before the equipment is shipped. To validate that the equipment is working properly, the EQUIP CHECK tape routine is utilized. To validate that the daily MEAS tapes have been correctly prepared and that the files have been stored and can be reloaded without difficulty, the MEAS tapes to be checked are inserted into the ETMS calculator and the beginning of the measurement routine is simulated (using the "simulated star noise" generator as the "rf input" for the ETMS CONTROL UNIT). In particular, the 1SKY option should be simulated. This simulation will execute the MEAS CHECK routine discussed in section 6.4.1 (the MEAS CHECK routine is also executed by the 2G/T routine, but the 2G/T routine does not function until after the 1SKY routine has been completed). The MEAS CHECK routine demands that four conditions be met or the measurement process is stopped. The ETMS operator needs to know instinctively how to correct any of the four deficiencies (or an unnecessary frustration will set in at the measurement site when there are already many things to think about).

Especially, it is pointless to arrive at the measurement site with the wrong system constants (data matrix N) stored on the daily MEAS tapes. This will cause the assumed magnitude for the standard attenuator (A3) to be incorrect. If the wrong data matrix N was stored, then go to a tape where the correct N matrix is stored (e.g., the EQUIP CHECK tape) and load the correct data. For example, to load the system S/N #3 constants from the EQUIP CHECK tape, use the keyboard command "LOAD 6, N (EXECUTE)". Then to store the correct data onto the daily MEAS tapes, use the keyboard command "STORE 10, N (EXECUTE)". These corrected daily MEAS tapes should be rechecked as described above to be sure that they will reload.

It can happen that the value of the standard attenuator is different from the value contained in the systems constants matrix N say, for example, because a new standard attenuator, or coaxial switch was installed, so that the right system constants were loaded, but the value for A3 is not within ± 0.05 dB demanded in the MEAS CHECK. In this case, the ETMS operator should change the value of A3 when the opportunity is presented during the MEAS CHECK routine as discussed in section 6.4.1.2 (or using the Key 2 routine discussed in section 6.4.7). Once the correct value for A3 is known, then the MEAS program is stopped (via "end" key on the calculator) and the correct value inserted in N(1,3). For example, if the correct value of A3 = 3.9502, then via the keyboard one enters "N(1,3) = 3.9502 (EXECUTE)". To indicate that one of the system constants has been altered, the ETMS serial number/system revision number, N(1,4) should be changed. Thus, if system 3 is being used, and the current N(1,4) = 3.04, then change it via the keyboard; "N(1,4) = 3.05 (EXECUTE)". The altered system matrix N is stored onto the daily MEAS tapes using the keyboard command "STORE 10, N (EXECUTE)" and then the tapes rechecked.

If the ETMS operator is not very familiar with the MEAS routine, then it is valuable to simulate collecting one complete data set using the 2G/T measurement routine including storing the data onto the daily SUMMARY and MEAS tapes (the data stored from the simulated run will be overwritten when the actual measurements are made). To do this, the 2G/T option is selected at the TRAP position (Key 0), and the program executed as if it were a real measurement. For the -3 CUT, the SIMULATED STAR NOISE attenuator is typically set at 9.9 dB and left unchanged during the cut. During the -2, -1, 0, +1, and +2 CUTs, the SIMULATED STAR NOISE attenuator is varied between each power measurement in the cut to simulate the varying power from the star. To do a fairly realistic simulation, the amplitudes of the five cuts through the star should be roughly in the ratio of 0.5, 0.7, 1.0, 0.7, and 0.5 (e.g., by using SIMULATED STAR NOISE attenuator settings of 3 dB, 1.5 dB, 0 dB, 1.5 dB, and 3 dB for the peaks in the simulation). The range used on the SIMULATED STAR NOISE attenuator does not matter except that if less than about 10 power level steps are used, the curve looks pretty ragged. The operator may want to use a range that requires a correction to the value assumed for T_a (via key 7) in order to gain experience in adjusting the magnitude of the star plot to be full scale for the 0 CUT.

TABLE 1. Steps in the measurement procedure.

STEP	TAPES USED	PURPOSE
(PRELIMINARIES)		
1	SITE PREP(B), MEAS(C),SUMMARY	Prepare daily data tapes, one for each measurement day
2	EQUIP CHECK (E), MEAS(C)	Validate hardware and tapes before shipping to antenna site
(DATA ACQUISITION)		
3	EQUIP CHECK (E)	Validate hardware after arrival
4	MEAS(C)	Determine antenna offsets, sky profile
5	MEAS(C),SUMMARY	Collect data
(DATA ANALYSIS)		
6	SUMMARY, SPLIT	Split multiple frequency data files into single frequency data files
7	CHECK SET (G)	Replace isolated bad data points
8	FIT (F)	Best fit parameters for data sets
9	REWORK(D),SUMMARY	Calculate G/T, etc. and plot results

The third measurement step is made at the measurement site. An equipment check is performed to validate that the equipment has been properly assembled and is in working condition.

The fourth measurement step is to connect the reference noise source to the directional coupler in the antenna room, and the output from one or more of the earth terminal down converters to the ETMS. Then the system is checked to verify it has been properly connected. Next the MEAS program is loaded and the offset corrections for the antenna pointing are determined using key 4 (STAR FIX routine) in the MEAS program, and the sky profiles (sky temperature versus antenna elevation along the star trajectory) are established using the 1SKY option in the MEAS program.

The fifth step is to collect measurement data for G/T, G/T_a, NEF, and NUF. A measurement set contains six cuts. For a cut, the antenna is pointed to a computed coordinate position; then a string of power measurements (typically 30) relative to the noise add signal are taken 6 seconds apart as Cas A or the moon drift through. One cut is taken on the cold sky about 2 degrees away (in declination) from Cas A or the moon. The remaining cuts are spaced equidistant throughout the main beam of the antenna pattern. For the string of power measurements, the ETMS is sequentially connected to the outputs of one, two, or three different down converters so that the information for one, two, or three frequencies are collected within one measurement set. For the data collecting program, selected data points near the predicted star maximum are least square fit to a two-dimensional parabolic curve. The result of this fit is used to calculate corrections to the antenna pointing. The data are stored and G/T, G/T_a, NEF, NUF, antenna half-power beamwidths (HPBW), and the updated antenna point offsets are calculated and printed out.

After all the data has been taken, the sixth step of the procedure is to load the SPLIT program and split the data files that contain data for two or three frequencies into two or three data files containing data for only a single frequency. Only single-frequency data can be processed in the remaining steps of the procedure.

The seventh step (which may be done after leaving the measurement site) is to replace any isolated bad data points in the data sets. Typically, this step is not needed and is bypassed.

In the eighth step, each data set is least squares fit to a three-dimensional Gaussian curve. The fit parameters are then stored back on the data tape for the precision G/T, etc. calculations done in the last step.

The ninth, and last, step in the procedure is to recalculate the values for G/T, G/T_a, NEF, NUF, and HPBW using the precision fit results for each data set and to plot or tabulate these results as a function of antenna elevation.

TABLE 2. Program and data file identification.
File size is in words.

SYMBOL	NAME	FILE SIZE	COMMENTS
*	spacer	10	Spacer file, used as safeguard
A	LOADER	2100	Loads and initializes B, C, D, and E
B	SITE PREP	12,000	Calculates and stores site and almanac information
C	MEAS	9,900	Measurement routine
D	REWORK	11,999	Final calculations of G/T, etc. plots and tabulates results
E	EQUIP CK	8,000	Check ETMS hardware performance
F	SPLIT	3,000	Splits multiple frequency data file into single frequency files
G	CHECKSET	5,000	Replaces isolated bad data points
H	FIT	9,000	Fits data sets to 3-D Gaussian
key	key	300	Program for the special keys in B, C, D, and E programs
X	SUBROUTINE	2,500	Subroutines used in B, C, D, and E
S	S data	200	Star data (positions etc.)
T	T data	300	Star and site data
N	N data	600	ETMS parameters data
M	M data	900	Summary of computed results
data	data	550	Measurement results storage

5. OVERVIEW OF THE COMPUTER CASSETTE TAPES

The ETMS has eight different computer tapes. These tapes are referred to in this paper by the major computer program on the tape or by the primary purpose of the tape. The eight tapes are: (1) SITE PREP (B) tape, (2) EQUIP CHECK (E) tape, (3) MEAS (C) tape, (4) SUMMARY tape, (5) SPLIT (F) tape, (6) CHECK SET (G) tape, (7) FIT (H) tape, and (8) REWORK (D) tape. The purpose of each of these tapes can be deduced from their use in the measurement routine as noted in table 1. Each of the eight tapes are marked for files of various lengths as determined by the file to be stored on the tape. There are a number of very short files (10 words long) that are not used to contain information. They are marked on the tape to speed the computer search for the major files, or as a safeguard against accidentally overwriting an important program if the wrong tape is inadvertently left in the computer (by having a numbered file which is too small when a computer store command is attempted with the wrong tape installed).

The programs or kinds of data stored in the tape files are listed in table 2, along with a brief explanation. The size of the file marked on the tape to accommodate these programs and data is given in computer words (the means by which the ETMS computer specifies file size). Table 3 lists the file maps for the eight tapes.

The summary tape is used in the external cassette at the same time either MEAS, SPLIT, or REWORK is used. The summary tape collects duplicated measurement data when used with the MEAS tape. When used with the REWORK tape, the summary tape is the source of measurement data being reworked and the tape upon which the results are stored. In contrast, a MEAS tape is an archives tape which is inserted for each data run and, at the end of the data run, the measurement program and the measurement conditions are stored, the protect tabs are removed, and nothing new is ever written on it again. That is, the summary tape is a working tape, and a MEAS tape is an archives tape.

TABLE 3. File maps of the eight computer tapes.

See table 2 for data file identification and the size of the marked tape file.

FILE	1 SITE	2 EQUIP	3 MEAS	4 SUM	5 SPLIT	6 CK SET	7 FIT	8 REWORK
0	A	E	A	*	F	G	H	D
1	*	*	*	M	*	*	*	*
2	key	key	key	*	key	key		key
3	*	*	*	N	*	*		*
4	X	X	X	*				X
5	*	*	*	M				*
6	S	N#3	S	*				S
7	*	*	*	N				*
8	T	N#4	T	*				T
9	*	*	*	data				*
10	N	N#5	N	data				N
11	*	*	*	data				*
12	B	N#6	C	data				D
13	*	*	*	data				
14			data	data				
15			*	data				
16			data	data				
...			...	...				
59			*	data				
60			data					
...			...	.				
65			*					
66			data					

* Spacer file

6. THE COMPUTER PROGRAMS

Following are brief descriptions of the purpose of particular programs and some comments about the key structural elements of the program. These comments are then followed by an annotated computer printout.

The purpose of the annotated computer printouts is to provide comments and instructions in a terse form for the operation of the various computer programs and to display the normal responses to the computer-generated questions. In the context of the computer printout, some instructions are easier to locate, and the meaning more obvious. Keyboard entries, which can be deduced from the printout, have no special notation on the printout. For example, the demand for a keyboard entry is indicated by a question mark, so the entry after the question mark is the keyboard response. If there is no obvious response, the response was a space bar followed by execute, which is the standard response when the value of the parameter currently in the computer memory is satisfactory and no change is desired. Keyboard questions that are needed but are not obvious on the printout are indicated with an asterisk, followed by an explanation of the operation performed.

Each program (i.e., LOADER, EQUIP CHECK, SITE PREP, MEAS, REWORK, etc.) contains a position in the computer program that will be referred to as "The Restart Alternatives Position" (TRAP). On every program tape, one way to reach TRAP is by pressing Key 0 (denoted f0 on the upper right hand set of program keys on the computer keyboard). This is the point on each program tape where the operator can choose the major options available on the program. This restart position is usually the position in the program where the computer stops when a task has been completed. Going to TRAP via key 0 normally clears all of the adverse internal computer flags, etc., sometimes set up when a computer error is encountered.

6.1 The EQUIP CK Program

The purpose of the equipment check (EQUIP CHECK) program is to validate that the ETMS is operating satisfactorily after being transported, to establish the operating points and characteristics of the earth terminal, and to collect historical information concerning normal operating conditions.

At TRAP (e.g., via Key 0), normally the "1 = AUTO CK" option is selected. The "0 = KEY LIST" option prints the list of manual tests that can be selected using the various program keys. The manual operations allow a selection of graph scales, or measurement repeat numbers, etc., that is not available with the "AUTO CK" option. In the AUTO CK, all the pertinent tests are performed in sequence with ranges and scales preselected. The various tests are discussed in the following paragraphs.

To execute a single test manually, enter TRAP to remove the AUTO CK flag (F2), then press the appropriate special function key. Additional information concerning the equipment check is contained on the annotated computer printouts in section 6.1.8.

6.1.1 Key 1: Check List

The check list sequentially lists the nominal settings and conditions that are required for the normal operation and test conditions of the ETMS. In the AUTO CK option, there is an opportunity to step over the check list. The step-over would be appropriate if the operator has already performed the check list once and is redoing the AUTO CK to determine if the ETMS has stabilized.

6.1.2 Key 2: Check DVM

The purpose of this routine is to verify that the digital voltmeter (DVM) is obeying the computer commands properly. The ETMS control unit sends a command to short the input to the DVM and change scale, etc. The calculator display indicates the appropriate response and holds this command condition until the operator presses some key--e.g., the space bar followed by pressing the "EXC" key. If the DVM fails to perform properly, check to insure that control cables between the "ETMS Control Unit," the calculator, and the DVM are secure. If this does not solve the discrepancy, refer to the maintenance manual.

6.1.3 Key 3: Check Channel Voltages

The purpose of this check is to verify that the various power supply voltages are correct, and that all of the multiplexer commands are being properly executed. This program sequentially selects the multiplexer channels starting with channel zero, then reads the voltmeter, prints out the results, compares the voltmeter reading with nominal conditions, and prints out "NOT NORMAL" for the channels which are outside the expected range for stabilized operation of the ETMS. When the equipment check is run right after the equipment is first turned on (as it should be), several of the channel checks typically indicate "NOT NORMAL". More will be said of this in the following sections. If a channel voltage continues to be out of normal range after three hours, unless otherwise indicated below, make sure that all the cables are connected properly, then consult the maintenance manual.

6.1.3.1 Channel 0: GROUND DVM

When the ETMS has stabilized, the output of the DVM with its input grounded should be zero within 10^{-5} volts. It typically requires three hours' operation before the voltage is consistently within tolerance. If the voltage is not within tolerance after three hours operation, the DVM should be rezeroed. To do this: (1) stop the program mode by pressing the "end" key, (2) manually short the input terminals of the DVM, (3) take the DVM out of program control via the "program control" button on the DVM front panel, (4) switch manually to the most sensitive voltage scale, (5) rotate the "external rate" knob to the full clockwise position, then (6) zero the DVM using the dc zero adjust on the front of the DVM. After the adjustment, the "program control" button must be returned to the "in" position, the "external rate" knob in the full ccw position, and THE EXTERNAL SHORT REMOVED. If this Channel 0 test of the Key 3: Check Channel Voltages test still is not within tolerance, then there is probably a problem in the multiplexer circuitry and the maintenance manual should be consulted.

6.1.3.2 Channel 1: Temperature

If the remote temperature probe is connected, the Channel 1 voltage reading is the probe temperature in Fahrenheit [8] divided by 100. The indicated temperature should immediately be within 3 degrees of the temperature as registered on the stand-by manual temperature/relative humidity meter, or as displayed by the temperature readout on the temperature/humidity unit. If the remote temperature probe is not connected, then the Channel 1 voltage is not important.

6.1.3.3 Channel 2: Dew Point

If the dew point sensor with its lithium chloride bobbin is installed according to the site setup instructions in the maintenance manual, the voltage in Channel 2 is the dew point temperature divided by 100 as indicated by the dew point readout. The dew point reading will not be accurate for at least 60 minutes after turning the equipment on. The dew point detector will not function when the outdoor temperature is below freezing. The relative humidity calculated from the dew point reading should agree with the relative humidity reading on the stand-by manual temperature/relative humidity meter within about 10%.

6.1.3.4 Channel 3: +20 Volts, RF Unit

Channel 3 monitors the primary power supply in the ETMS Control Unit which powers the two 10-200 MHz signal amplifiers. Check the J355/665 cable, or consult the maintenance manual in case of a not normal reading.

6.1.3.5 Channel 4: +12 volt, RF Unit

Channel 4 monitors the power supply/reference voltage which powers the simulated noise add sources.

6.1.3.6 Channel 5: D/A Output

Channel 5 monitors the programmable stable D/A offset voltage used for the NBS type IV power bridge.

6.1.3.7 Channel 6: Crystal Diode Voltage

Channel 6 monitors the crystal diode voltage. The crystal diode voltage is used to activate the power alarm circuit which is used to protect the thermistor power element in the NBS type IV power bridge. The crystal output is a negative voltage proportional to the incident power.

6.1.3.8 Channel 7: D/A Reference Voltage

Channel 7 monitors the precision reference voltage in the digital-to-analog voltage converter which is used as the precision offset voltage needed in conjunction with the NBS type IV power bridge. If this voltage is not normal, check the operation of the digital voltmeter or consult the maintenance manual.

6.1.3.9 Channel 8: Power Bridge Output

Channel 8 monitors the voltage across the NBS type IV power bridge. This voltage requires about three hours to stabilize to within ±0.2 volts.

6.1.3.10 Channel 9: Set Fine Voltage

Channel 9 sets the precision digital offset voltage used to buck out the voltage across the NBS type IV power bridge. This bucking voltage is used to improve the resolution of measuring the small change in voltage caused by the microwave power changing the resistance of the power-sensing thermistor. The magnitude of Channel 9 is approximately 1/10 of the Channel 5 voltage.

6.1.3.11 Channel 10: Power Bridge vs. Fine Reference

The Channel 10 voltage is the power bridge voltage bucked near zero by the precision digital offset voltage as set using a Channel 9 command.

6.1.4 Key 4: Check Program Attenuators

The purpose of this test is to verify the proper operation of the program attenuators. In addition, the measured value of the standard attenuation is measured over a 16-dB range. The variation (in dB) from the assumed value is printed out as STD CK @ #2. This check is one of the checks of the linearity of the ETMS measurement system. The repeatability of the measured values is printed out, as is a running printout of the drift in the absolute power level throughout the duration of the test. Thus, besides testing the attenuation steps of the programmable attenuator, this test also indicates short-term, and moderate-term stabilities of the ETMS measurement system. If a record of the earth terminal short- and medium-term stabilities is desired, instead of using the internal ETMS noise source, the earth terminal with the ETMS microwave noise sources can be connected as the test signal.

6.1.5 Key 5: Graph Option: Check Power, Linearity, and Stability

This check is a similar check to the last check, except the results are presented graphically. In this check, three measurements of the attenuation of the standard attenuator are averaged together, and the mean and the standard deviations are plotted. If the standard deviation is 0.3 dB or greater (i.e., have experienced some hardware malfunction), the crucial bridge voltages are listed automatically for every power measurement in the measurement set. BRIDGE V is the voltage measured across the bolometer of the NBS IV rf power meter (Channel 8). V7 and V9 (Channel 10) are the voltages across the bolometer minus the offset voltage when the rf power is OFF, and V8 is this difference voltage when the rf power is ON. The resulting computed power is listed under PWR(mW). The measurements occur in pairs. The second measurement in the pair is made with the standard attenuator inserted. Under the column listed as CK ERR, the difference (in dB) in the calculated attenuation of this standard attenuator from the assumed value for the standard is printed. The very first entry under CK ERR is equal to the value assumed for the check standard, because there is no prior power value and it is arbitrarily taken as zero power.

This check helps identify which relay is malfunctioning, or at least to narrow down the type of malfunction. The initial power level of this power ratio test is varied over a 16-dB range. Any nonlinearity to the type IV power bridge, or unusually noisy measurement conditions, are easiest to spot in this graph. The magnitude of the nonlinearity may also be identified on the Key 4 or Key 6 test. Any failure of the standard attenuator, or of the relays which switch the standard attenuator in and out, are most obvious in this test. If a power supply becomes very noisy, it can show up as a change in nonlinearity (i.e., a change in the change of the value measured for the standard attenuator versus input power magnitude).

The maximum input power level should be less than approximately 0.7 mW, otherwise, one of the power measurement voltages can go out of range of the digital voltmeter and a repeated REZERO will be indicated. If the program stops after a REZERO and displays PWR ERR, check the input power and readjust it to be less than 0.7 mW. Then press "cont", "execute". If this does not solve the difficulty, there may be a problem in the operation of Channel 9 in attempting to set the fine reference voltage.

6.1.6 Key 5: Table Option:

Check Power, Linearity, and Stability of the Type IV Bridge

A second option of Key 5 is to print out the key bridge voltages for repeated power measurements. If one of the multiplexed relays fails to operate correctly, the identification of which relay is malfunctioning is often obvious from which measured voltage value becomes unstable.

6.1.7 Key 6: Noise Add Test

This check is designed to check the operation and stability of the noise add sources. When the ETMS input is connected to the internal noise add sources, it checks the amplitudes and stabilities of the internal noise add sources. When the ETMS is connected to the earth terminal, this test checks the magnitude and stability of the microwave noise add. Information on the stability of the earth terminal is also recorded.

The power of the system noise (the power from noise add #1 and noise add #2) is printed out before the stability test begins. If one of the noise add sources is not functioning, it will be obvious here. In the main printout, the power measurements and power ratios are printed in the first row, and the standard deviation of the measurements are printed in the second row.

The power ratios listed in the five right-hand columns of the test should be independent of initial power level. In particular, the ratio of noise add #1 to noise add #2 at a particular frequency should not change significantly over a long period of time. If it does, it signifies that one of the noise add sources is drifting or is becoming unstable. An unstable noise add source introduces an unnecessary measurement error and needs to be corrected.

6.1.8 EQUIP CK annotated printout

* INSERT EQUIP CHECK tape

```
LOAD
RUN
FROM:5=EXT TAPE/DISK,10=INT TAPE?10
 10

0=KEY LIST,1=AUTO CK( =NO): 1
```

TRAP

```
KEY 0: RESTART
KEY 1: CHECK LIST
KEY 2: CHECK DVM
KEY 3: CHECK CHANNEL VOLTAGES
KEY 4: CHECK ATTENUATORS
KEY 5: CHECK PWR, TYPE IV & ATTEN STABILITY
KEY 6: CHECK NOISE AND STABILITY
KEY 7: CHANGE STANDARD ATTENUATIN VALUE
KEY 9: NEW FREQ, BW, INPUT ATTN, SIML STAR NOISE
```

ONLY VIA KEY FUNTION CAN NEW A3 = STD ATTN VALUE BE CHANGED

(Normally a new A3 value is not inserted until after the other checks have made the need for a change obvious).

* Press KEY 7

```
0=KEY LIST,1=AUTO CK( =NO): 1    ?STD( 6.1000  dB)( =NO): 4.0738  ?4.08
STD( 6.1066  dB)( =NO): 4.0000  ?4.085
STD( 6.1119  dB)( =NO): 4.0850  ?4.09
STD( 6.1172  dB)( =NO): 4.0900  ?4.0738
```

new A3

* press Key Ø to EXIT

```
0=KEY LIST,1=AUTO CHK =NO): 1      ?1
DO CHECK LIST & DVM (0=NO)?1
```

Ø response bypasses questions in this box

```
PRINT ALL ON?
8 AC PWR SWITHES ON?
DANA: EXT RATE FULL CCW?
DANA: DATA OUTPUT BUTTON IN?
DANA: PROGRAM CONTROL BUTTON IN?
RF UNIT:BANDPASS FREQ @ 5.3MHz/70MHz?
RF UNIT: ATTEN SET TO 17    dB?
RF UNIT: SIM STAR NOISE @ 3.5 dB?
RF UNIT: METER RANGE X1?
NOISE SOURCE CONNECTED TO RF INPUT?
RF UNIT: OUTPUT METER @ -5.5  dB?
CLOCK UNIT: SET DATE?
CLOCK UNIT: SET GMT TIME?
END

                              (76 1024 21.28)
NBS1E.12 (D5-F0)  EQUIP CHECK  T1-F0:      X.05 (D1-4) T2-4

                                     -1-
Sysm # 6.09                                                    RUN  0

              PROG  KEY 2:        CHECK DIGITAL MULTIMETER


DVM FUNCTION 1111: FILTER OUT?
DVM FUNCTION 11.0: FILTER IN?
 1000    VOLT RANGE            0           RANGE # 0    DEC PLACES 2
```

i.e. 0.00 displayed on DVM

```
?
 100  VOLT RANGE               0           RANGE # 1    DEC PLACES 3
```

i.e. 0.000 " " " "

```
?
 10   VOLT RANGE               0           RANGE # 2    DEC PLACES 4
```

etc.

```
?
 1    VOLT RANGE               0           RANGE # 3    DEC PLACES 5

?
 0.1  VOLT RANGE               0           RANGE # 4    DEC PLACES 6

?
 AUTO-VOLT RANGE               0           RANGE # 7


END
```

1976 October 24 21:29

hours min

[illegible]6 1024 21.29

NBS1E.12 DS-F0 $\boxed{\text{[illegible]}}$ T1-F0: $\boxed{\text{[illegible]}}$ D1-4 T2-4

REVISION MAIN PROGM LOADED SUBROUTINE LOADED

-2-

Sysm # 6.09 [illegible]

REVISION

ETMS SERIAL NO.

PROG KEY 3: CHECK CHANNEL VOLTAGES

CHANNEL	VOLTAGE	STATUS	NOMINAL	+- RANGE
0=DC OFFSET	0	OK	0	1.00000E-05
1=TEMP	0.74184 = 74.184 F	OK	0.5	0.5
2=DEW POINT	0.4313 = 43.13 F.	OK	0.5	0.5
3=+20 VOLTS	20.019	OK	20	0.2
4=+12 VOLTS	11.9878	OK	11.9	0.1
5=DAC OUTPUT	4.8326	OK	4.8333	0.02
6=XTAL DIODE	-1.71600E-03	OK	-0.0125	0.0125
7=D.A REF	6.2367	OK	6.24	0.01
8=BRDG OUTPUT	2.4823	OK	2.5	0.1
9=SET FINE REF	0.48333	OK	0.486688	5.00000E-03
10=BRDG vs REF	-1.07000E-04	OK	0	1.00000E-03

NBS1E.12 <D5-F0> EQUIP CHECK T1-F0: X.05 <D1-4> T2-4

-3-

Sysm # 6.09 RUN 6

PROG KEY 4: CHECK ATTENUATORS

SIML STAR ATTN: 3.5 dB IF FREQ: 70 MHz
INPUT ATTN: 17 dB BNDWD: 5.3 MHz
STD ATTN: 6.100 dB #1/#2add: 0.2468
VALUE ASSUMED FOR STD

NBS TYPE IV OUTPUT $\boxed{0.43401}$ MW +- 0.152 % 3 MEAS STD CK: 0.014 DB

difference

1σ for 3 meas

% ATTN	PRGM ATTN #1 PRGM ATTN #2	#1 PRW OR VOLT #2 PWR OR VOLT	ORIG PWR/#1 PWR STD CK @ #2	#1 PWR #2 PWR NOMINAL #1 #2	PRGM ATTN USED
17 DB	0 DB	$\boxed{0.43348}$ +- 0.19 %	$\boxed{0.00[illegible]\ DB}$	$\boxed{0.974\ DB}$	
	1 DB	0.34637 +- 0.19 %	0.025 DB	1 DB	* 1dB
17 DB	0 DB	0.43298 +- 0.13 %	0.010 DB	$\boxed{1.956\ DB}$	
	2 DB	0.27599 +- 0.19 %	0.007 DB	2 DB	* 2dB
17 DB	0 DB	0.43347 +- 0.03 %	0.005 DB	2.940 DB	
	3 DB	0.22026 +- 0.12 %	0.017 DB	3 DB	1+2
17 DB	0 DB	0.43249 +- 0.14 %	0.015 DB	$\boxed{3.924\ DB}$	
	4 DB	0.17480 +- 0.38 %	0.013 DB	4 DB	* 4dB
17 DB	0 DB	0.43336 +- 0.11 %	0.007 DB	4.923 DB	
	5 DB	0.13949 +- 0.14 %	0.00[illegible] DB	5 DB	4+1
17 DB	0 DB	0.43273 +- 0.14 %	0.01[illegible] DB	5.889 DB	
	6 DB	0.11151 +- 0.12 %	0.014 DB	6 DB	4+2
17 DB	0 DB	0.43292 +- 0.28 %	0.011 DB	6.870 DB	
	7 DB	0.08900 +- 0.07 %	0.005 DB	7 DB	4+2+1
17 DB	0 DB	0.43256 +- 0.28 %	0.015 DB	$\boxed{7.97[illegible]}$	
	8 DB	0.06903 +- 0.08 %	0.013 DB	8 DB	* 8dB
17 DB	0 DB	0.43297 +- 0.13 %	0.010 DB	8.958 DB	
	9 DB	0.05504 +- 0.21 %	0.019 DB	9 DB	8+1
17 DB	0 DB	0.43148 +- 0.15 %	0.025 DB	9.924 DB	
	10 DB	0.04391 +- 0.08 %	0.010 DB	10 DB	8+2
17 DB	0 DB	0.43103 +- 0.10 %	0.030 DB	10.902 DB	
	11 DB	0.03502 +- 0.17 %	0.004 DB	11 DB	8+2+1
17 DB	0 DB	0.43114 +- 0.12 %	0.029 DB	12.860 DB	
	12 DB	0.02232 +- 0.06 %	0.007 DB	12 DB	8+4
17 DB	0 DB	0.43290 +- 0.18 %	0.011 DB	12.870 DB	
	13 DB	0.02236 +- 0.26 %	-0.001 DB	13 DB	8+4+1
17 DB	0 DB	0.43306 +- 0.16 %	0.010 DB	13.852 DB	
	14 DB	0.01784 + 0.20 %	0.009 DB	14 DB	8+4+2
17 DB	0 DB	0.43207 +- 0.19 %	$\boxed{[illegible]}$	14.[illegible] DB	
	15 DB	0.01430 +- 0.18 %	0.00[illegible] DB	15 DB	8+4+2+1

Should Be Less than ± 0.030

PWR STABILITY over 10 minutes

(76 1024 11.32)
NBS1E.12 (D5-F0. EQUIP CHECK T1-F0: X.05 (D1-4) T2-4

-4-

Sysm # 6.09 RUN 0

PROG KEY 5: CHECK PWR,LINEARITY,STAB OF TYPE IV

SIML STAR ATTN: 3.5 dB IF FREQ: 70 MHz
INPUT ATTN: 17 dB BNDWD: 5.3 MHz
STD ATTN: 6.100 dB #1/#2add: 0.2468

NO.	BRDG V	ΔV, rf pwr off V7	ΔV, rf pwr ON V8	ΔV, rf pwr off again V9	PWR(MW)	CK ERR	SIGMA
1	2.4839	0.000436	-0.012847	0.000435	0.3290MW	NO MEANING 1st READ ~~[illegible]~~	0.00%
2	2.4839	0.000439	-0.002803	0.000436	0.0804MW	0.0179DB	0.00%
3	2.4839	0.000438	-0.012810	0.000434	0.3281MW	0.0060DB	0.19%
4	2.4839	0.000437	-0.002798	0.000431	0.0802MW	0.0174DB	0.19%
5	2.4839	0.000435	-0.012810	0.000432	0.3281MW	0.0166DB	0.16%
6	2.4839	0.000434	-0.002807	0.000429	0.0804MW	0.0078DB	0.14%
7	2.4839	0.000431	-0.012863	0.000427	0.3293MW	0.0237DB	0.19%
8	2.4839	0.000431	-0.002808	0.000426	0.0803MW	0.0263DB	0.11%
9	2.4839	0.000429	-0.012810	0.000426	0.3279MW	0.0085DB	0.19%
10	2.4839	0.000428	-0.002814	0.000424	0.0804MW	0.0039DB	0.11%
11	2.4839	0.000428	-0.012797	0.000423	0.3276MW	-0.0011DB	0.20%
12	2.4839	0.000425	-0.002815	0.000422	0.0804MW	0.0010DB	0.10%
13	2.4839	0.000425	-0.012866	0.000421	0.3292MW	0.0227DB	0.21%
14	2.4839	0.000423	-0.002813	0.000420	0.0803MW	0.0280DB	0.10%
15	2.4839	0.000420	-0.012854	0.000416	0.3288MW	0.0225DB	0.20%
16	2.4839	0.000421	-0.002821	0.000416	0.0804MW	0.0156DB	0.09%
17	2.4839	0.000418	-0.012837	0.000414	0.3283MW	0.0096DB	0.19%
18	2.4839	0.000417	-0.002820	0.000413	0.0803MW	0.0150DB	0.09%
19	2.4839	0.000415	-0.012849	0.000411	0.3285MW	0.0189DB	0.19%
20	2.4839	0.000413	-0.002829	0.000410	0.0804MW	0.0112DB	0.09%
21	2.4839	0.000412	-0.012841	0.000410	0.3283MW	0.0079DB	0.17%
22	2.4839	0.000410	-0.002832	0.000407	0.0804MW	0.0079DB	0.09%
23	2.4839	0.000410	-0.012831	0.000406	0.3280MW	0.0037DB	0.17%
24	2.4839	0.000407	-0.002836	0.000403	0.0805MW	0.0030DB	0.09%
25	2.4839	0.000406	-0.012804	0.000402	0.3292MW	0.0190DB	0.17%
26	2.4839	0.000404	-0.002841	0.000400	0.0805MW	0.0163DB	0.10%
27	2.4839	0.000404	-0.012850	0.000399	0.3282MW	-0.0044DB	0.17%
28	2.4839	0.000402	-0.002845	0.000399	0.0806MW	0.0011DB	0.11%

0

1σ of 14 MEAS at 0.08 MW

1σ of 14 MEAS at 0.33 MW

```
                                      (76 1024 21.40)
NBS1E.12 (D5-F0)  EQUIP CHECK  T1-F0:      X.05 <I1-4   T2-4

                                              -5-
Sys # 6.09                                                              RUN  0

                    PROG  KEY 5:       CHECK PWR,LINEARITY,STAB OF TYPE IV

          SIML STAR ATTN: 3.5 dB          IF FREQ:        70 MHz
          INPUT ATTN:       17 dB          BNDWD:         5.3 MHz
          STD   ATTN:    6.100 dB          #1/#2add:  0.2468

     #1 LEVEL: 17 DB EXT  +  0 DB CK STD      MEAS/PLOT PT =  3
     #2 LEVEL: 17 DB EXT  +  1 DB CK STD      UNIT  = 0.0100 DB

     -0.250    -0.150    -0.050     0.050     0.150     0.250 DB
        !....!....!....!....!....!....!....!....!....!....!
#/TIME                     ZERO= 6.125 DB                      AVE        #1 PWR
   1                        !    + <--- AVERAGE OF            6.1247DB  0.425MW
   2                    !      +      !  THE THREE MEASUREMENTS 6.1129DB  0.344MW
   3                        !   +   !                         6.1218DB  0.275MW
   4                           !+!                            6.1164DB  0.219MW
   5                      !    +    !                         6.1113DB  0.175MW
   6                         ! + !                            6.1119DB  0.140MW
   7                     !     +     !                        6.1086DB  0.111MW
   8                        !   +   !                         6.1202DB  0.089MW  INPUT
   9                       !   +   !                          6.1139DB  0.069MW  PWR
  10                    !      +      !                       6.1093DB  0.055MW
  11                           !+!                            6.1148DB  0.044MW  CYCLE
  12                     !     +     !                        6.1057DB  0.035MW
  13                   !    +    !                            6.0790DB  0.014MW
  14                 !         +         !                    6.1051DB  0.022MW
  15                     !    +    !                          6.0971DB  0.018MW
  16                         ! + !     STATISTICAL ERROR OF   6.1088DB  0.01[illegible]
  17                      !    +    !    THE 3 MEASUREMENTS   6.1145DB  0.42[illegible]
  18                       !    +                             6.1205DB  0.340MW
  19                    <- 1σ --+-- 1σ ->                     6.1201DB  0.271MW
  20                         !  +  !                          6.1227DB  0.217MW
  21                          ! + !                           6.1197DB  0.172MW
  22                     !      +      !                      6.1187DB  0.137MW
 21.50<- TIME              !    +    !                        6.1169DB  0.109MW
  24     21 hrs 50 min        ! + !                           6.1181DB  0.087MW
  25                       !   +   !                          6.1127DB  0.068MW
  26                       !  +  !                            6.1019DB  0.055MW
  27                         !  +  !                          6.1149DB  0.044MW
  28                            !+!                           6.1294DB  0.035MW
  29                    !     +     !                         6.1025DB  0.028MW
        !....!....!....!....!....!....!....!....!....!....!
  30                      !    +    !                         6.1095DB  0.022MW
  31               !           +           !                  6.1088DB  0.018MW
  32             !          +          !                      6.0756DB  0.014MW
  33                    !      +      !                       6.1095DB  0.428MW
  34                        !   +   !                         6.1188DB  0.342MW
  35                        !   +   !                         6.1213DB  0.27[illegible]MW
  36                            !+!                           6.1288DB  0.218MW
```

(76 1024 21.55)
NBS1E.12 NS-F0 EQUIP CHECK T1-F0 N.35 D1-4 T2-4

-6-

Sysm # 6.09 — ETMS CONNECTED TO SIMULATED NOISE SOURCES — RUN 0

PROG KEY 6: [SIMULATED] NOISE ADD TEST

SIML STAR ATTN: 3.5 dB — IF FREQ: 70 MHz
INPUT ATTN: 17 dB — BNDWD: 5.2 MHz
STD ATTN: 6.100 dB — #1/#2add: 0.2468 — SHOULD AGREE

PWR MEASURED INDIRECTLY

P= 0.4244 mW — add #1= 0.1545 mW — add #2= 0.6021 mW — meas/set= 5

WILL AGREE ONLY IF STD ATTN CORRECT VALUE

SHOULD BE BASICALLY INDEPENDANT OF INPUT PWR VALUE

PWR MEASURED DIRECTLY

P(mW)	P+1+2	#1(mW)	#2(mW)	#1+#2	#1/#2	P/#1	P/#2	P/1+2	STDUF dB
0.4260	0.2878	0.1541	0.5993	0.7466	0.2572	2.7631	0.7117	0.5704	0.0213
0.13%	0.07%	0.67%	0.37%	0.12%	0.30%	0.76%	0.50%	0.16%	0.0157
0.3403	0.2299	0.1232	0.4775	0.5959	0.2579	2.7612	0.7120	0.5719	0.0161
0.16%	0.17%	0.24%	0.16%	0.25%	0.12%	0.07%	0.11%	0.22%	0.0058
0.2712	0.1832	0.0979	0.3812	0.4751	0.2570	2.7712	0.7119	0.5706	0.0147
0.14%	0.15%	0.58%	0.58%	0.29%	1.01%	0.66%	0.70%	0.45%	0.0043
0.2168	0.1466	0.0782	0.3045	0.3803	0.2568	2.7720	0.7116	0.5699	0.0310
0.11%	0.11%	1.17%	0.48%	0.13%	0.97%	1.27%	0.46%	0.13%	0.0040
0.1721	0.1161	0.0620	0.2423	0.3007	0.2560	2.7734	0.7095	0.5724	0.0161
0.13%	0.12%	0.86%	0.55%	0.16%	0.32%	0.91%	0.56%	0.11%	0.0051
0.1374	0.0930	0.0498	0.1932	0.2414	0.2580	2.7571	0.7123	0.5689	0.0120
0.13%	0.21%	0.47%	0.34%	0.28%	0.80%	0.56%	0.35%	0.27%	0.0267
0.1097	0.0742	0.0397	0.1555	0.1926	0.2551	2.7669	0.7056	0.5702	0.0132
0.10%	0.37%	1.23%	0.30%	0.65%	0.93%	1.17%	0.29%	0.78%	0.0062
0.0877	0.0594	0.0315	0.1228	0.1541	0.2566	2.7807	0.7140	0.5688	0.0142
0.15%	0.27%	0.38%	0.12%	0.55%	0.41%	0.42%	0.15%	0.78%	0.0051
0.0680	0.0460	0.0245	0.0956	0.1195	0.2564	2.7727	0.7111	0.5689	0.0109
0.14%	0.32%	0.71%	0.61%	0.47%	0.38%	0.75%	0.14%	0.47%	0.0108
0.0543	0.0367	0.0198	0.0765	0.0953	0.2585	2.7441	0.7096	0.5675	0.0101
0.10%	0.08%	0.63%	0.06%	0.15%	0.08%	0.63%	0.05%	0.22%	0.0072
0.0433	0.0293	0.0156	0.0612	0.0761	0.2545	2.7792	0.7072	0.5691	-0.0077
0.17%	0.34%	0.70%	0.18%	0.40%	0.73%	0.99%	0.11%	0.38%	0.0120
0.0346	0.0234	0.0125	0.0485	0.0608	0.2583	2.7662	0.7146	0.5688	0.0014
0.17%	0.16%	1.07%	0.45%	0.31%	1.32%	1.27%	0.65%	0.15%	0.0177
0.0263	0.0186	0.0084	0.0387	0.0482	0.2161	2.7400	0.7105	0.5685	-0.0058
14.76%	0.20%	24.31%	0.28%	0.30%	24.74%	1.10%	0.15%	0.28%	0.0071
0.0219	0.0148	0.0079	0.0310	0.0384	0.2551	2.7733	0.7078	0.5706	0.0043
0.20%	0.00%	0.31%	0.30%	0.11%	0.39%	0.55%	0.23%	0.31%	0.0204
0.0175	0.0118	0.0063	0.0246	0.0307	0.2577	2.7586	0.7103	0.5689	0.0103
0.17%	0.32%	1.41%	0.61%	0.45%	0.81%	1.47%	0.79%	0.41%	0.0197

1σ deviation from mean printed in the previous row

OBVIOUSLY ONE OR MORE NOISY VALUES FOR THIS SET

BAG PWR with #1 #2 ADD OFF

BAG PWR with #1 #2 ADD ON, NOT A 6dB ATTN INSERTED

CALCULATED #1 ADD PWR USING (P+1) − P

CALCULATED #2 ADD PWR USING (P+2) − P

CALCULATED #1 + #2 ADD PWR USING (P+1+2) − P

(#1 ADD PWR)/(#2 ADD PWR)

"SIGNAL" PWR /(NOISE ADD #1 PWR)

"SIGNAL" PWR / (NOISE ADD #2 PWR)

"SIGNAL" PWR / (NOISE ADD #1 + #2 PWR)

EQUIP CHECK (cont)

(76 1024 23.13)
NBS1E.12 (D5-F0) EQUIP CHECK T1-F0: X.05 .D1-4) (2-4

REPEATED TO SEE IF SYSTEM WARMED UP

-7-

Sysm # 6.09 RUN 0

PROG KEY 3: CHECK CHANNEL VOLTAGES

CHANNEL	VOLTAGE	STATUS	NOMINAL	+- RANGE
0=DC OFFSET	0	OK	0	1.00000E-05
1=TEMP	0.73299	OK	0.5	0.5
2=DEW POINT	0.43129	OK	0.5	0.5
3=+20 VOLTS	20.019	OK	20	0.2
4=+12 VOLTS	11.9881	OK	11.9	0.1
5=DAC OUTPUT	4.8326	OK	4.8382	0.02
6=XTAL DIODE	-1.73800E-03	OK	-0.0125	0.0125
7=D/A REF	6.2367	OK	6.24	0.01
8=BRDG OUTPUT	2.4828	OK	2.5	0.1
9=SET FINE REF	0.48382	OK	0.487188	5.00000E-03
10=BRDG vs REF	3.85000E-04	OK	0	1.00000E-03

Request to connect earth terminal to ETMS for the earth terminal test

CONNECT EARTH TERM,SET PWR LEVEL(=NO): 1 ?

IF NEED TO CHANGE ATTN etc., when finished (1) press key Ø (to remove AUTO fly) then (2) press key 6 for Earth terminal test

(76 1024 0.29)
NBS1E.12 (D5-F0) EQUIP CHECK T1-F0: 0.05 (D1-4) T2-4

-8-

Sysm # 6.09

TESTS ETMS MICROWAVE NOISE ADD SOURCES RUN 3
& the PROPERTIES OF THE EARTH TERMINAL

1670:
CONT

PROG KEY 6: EARTH TERMINAL TEST

OTHER WISE SAME AS SIMULATED NOISE ADD TEST

SIML STAR ATTN: 3.5 dB
INPUT ATTN: 17 dB
STD ATTN: 6.100 dB

IF FREQ: 70 MHz
BNDWD: 5.3 MHz
#1/#2add: 0.2468

P= 0.3198 mW   add #1= 0.1152 mW   add #2= 0.4515 mW   meas/set= 3

P(mW)	P+1+2	#1(mW)	#2(mW)	#1+#2	#1/#2	P/#1	P/#2	P/1+2	STDck dB
0.3255	0.2197	0.1167	0.4555	0.5634	0.2562	2.7795	0.7119	0.5722	0.0116
0.92%	1.16%	0.47%	0.82%	1.32%	0.56%	1.04%	0.33%	0.49%	0.0041
0.2661	0.1798	0.0962	0.3732	0.4656	0.2579	2.7574	0.7114	0.5728	0.0129
0.61%	0.66%	1.67%	0.61%	0.70%	1.45%	1.48%	0.16%	0.40%	0.0170
0.2190	0.1476	0.0789	0.3081	0.3826	0.2561	2.7756	0.7095	0.5720	0.0135
0.33%	0.34%	0.85%	0.68%	0.30%	1.53%	1.10%	0.33%	0.32%	0.0027
0.1771	0.1195	0.0639	0.2483	0.3099	0.2574	2.7673	0.7128	0.5716	0.0153
0.18%	0.10%	0.92%	0.59%	0.12%	0.79%	0.83%	0.58%	0.18%	0.0062
0.1405	0.0950	0.0510	0.1973	0.2464	0.2585	2.7539	0.7129	0.5709	-0.0020
0.16%	0.34%	0.67%	0.29%	0.45%	0.53%	0.70%	0.11%	0.31%	0.0174
0.1148	0.0775	0.0416	0.1611	0.2009	0.2583	2.7525	0.7112	0.5719	-0.0028
1.06%	1.46%	1.23%	1.33%	1.56%	0.72%	0.65%	0.20%	0.27%	0.0084
0.1119	0.0754	0.0404	0.1574	0.1952	0.2566	2.7724	0.7103	0.5733	0.0162
0.13%	0.18%	0.36%	0.11%	0.33%	0.28%	0.49%	0.13%	0.41%	0.0133
0.0893	0.0603	0.0322	0.1252	0.1562	0.2571	2.7730	0.7135	0.5716	0.0166
0.16%	0.10%	0.20%	0.14%	0.11%	0.12%	0.14%	0.28%	0.19%	0.0083
0.0694	0.0468	0.0250	0.0974	0.1213	0.2562	2.7805	0.7123	0.5723	0.0106
0.13%	0.11%	0.22%	0.46%	0.18%	0.66%	0.23%	0.52%	0.34%	0.0070
0.0553	0.0374	0.0199	0.0774	0.0969	0.2573	2.7766	0.7149	0.5710	0.0155
0.30%	0.23%	0.17%	0.37%	0.38%	0.41%	0.54%	0.22%	0.48%	0.0143
0.0442	0.0298	0.0159	0.0620	0.0773	0.2570	2.7765	0.7139	0.5717	0.0085
0.14%	0.13%	0.47%	0.27%	0.19%	0.64%	0.42%	0.31%	0.18%	0.0176
0.0353	0.0238	0.0126	0.0496	0.0616	0.2548	2.7949	0.7121	0.5739	0.0086
0.09%	0.10%	0.30%	0.43%	0.17%	0.23%	0.23%	0.45%	0.16%	0.0131
0.0177	0.0123	0.0068	0.0201	0.0331	0.3381	2.7779	0.7109	0.5709	-0.0282
35.13%	43.03%	41.23%	0.53%	42.04%	41.50%	1.30%	0.46%	0.27%	0.0255
0.0224	0.0151	0.0080	0.0315	0.0392	0.2546	2.8036	0.7126	0.5722	0.0034
0.17%	0.09%	1.01%	0.52%	0.07%	1.53%	1.21%	0.56%	0.23%	0.0388
0.0179	0.0121	0.0064	0.0252	0.0314	0.2554	2.7704	0.7100	0.5703	[illegible]
0.19%	0.35%	0.69%	0.47%	0.40%	0.43%	0.69%	0.34%	0.28%	[illegible]

6.2 The LOADER program

The purpose of the loader program is to load the key programs, the common subroutines, the star data, the site data, and the ETMS characteristic data. This provides an opportunity to modify any of these program constants, and to link in one of the major computer programs such as SITE PREP (B), MEAS (C), or REWORK (D). The LOADER program is the first file on each of the B, C, and D tapes. The annotated printout for the loader program appears with the SITE PREP program that follows.

6.3 The SITE PREP program and Annotated Printout

One purpose of the site preparation program (SITE PREP) is to anticipate measurement conditions. A second purpose is to calculate and store the site-related data onto the measurement tapes.

The normal means of loading and using SITE PREP is covered on the annotated printout. However, using key 0 (TRAP), two options, "RESTRT:0 = REGULAR" and 1 = ALL QUESTIONS," are available. For option 0 = REGULAR (the default option), the minimum number of questions are asked. For the option "1 = ALL QUESTIONS", additional questions are asked that are not needed on the measurement tape, such as the operating frequency, antenna constants, system temperature, T_a, etc. The answer to these additional questions are helpful in anticipating the measurement conditions for an unusual antenna system, but, in general, are of no concern.

The major features available on SITE PREP are (1) Enter site data and sun/moon almanac data to be stored onto the daily MEAS cassette tapes, (2) printout of the site and star data for measurement documentation, (3) printout of expected/actual measurement conditions and errors using Cassiopeia A to measure G/T, (4) printout of measurement conditions using the alternate stars, Cygnus A, Taurus A, or Orion A, and (5) graph the elevation of Cas A, Cyg A, Tau A, Ori A, sun and moon, and tabulate the azimuth and elevation of Cas A or the moon versus Greenwich Mean Time (GMT).

* INSERT SITE PREP TAPE

```
LOAD
RUN
PRINT ALL ON (1=YES)?1
SITE PREP:SITE DATA(10=INT,5=EXT)?5
PRGM CONST CHANGE OPTION(0=NO)?0
 5.1
YEAR( =NO): 1981     ?

                        1981/03/13  13:37
NBS1A.09  LOADER  (D1-F0) T2-F0:    X.25        + (D1-4) T2-4
```

ETMS SERIAL NUMBER
REVISION # OF SYSTEM CONSTANTS BELOW

```
Sysm # 6.11                                                        RUN  2

                   AN/TSC-54 #3 Wahiawa,Hawaii
                   FRI:  1980 FEB 8    ( 1980.100)
                   7300 MHz(#), 7500 MHz(o),

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                        PROG CONSTS
```

ATTN OF STD

```
      A2: 2.3               A3: 3.945             A4: 6.11
      A5: 6.403             A6: 0.3128            A7:-17.55

      B2: 0.65              B3: 0.92              B5: 0.190451
      B6: 7.59224E-03       B9: 13.0092           B0: 30.8314
      B : 30.8315

      C1: 4.86079E+18       C2: 1                 C4: 158
      C5: 21.51             C6: 136.285           C7: 0.23
      C8: 0.1               C9: 0.2               C0: 0.1524
      C : 1980.1

      D1: 0.1               D2: 1.5               D3: 0.6
      D4: 1981              D5: 0.0256929         D8: 0.75
      D9: 0.18              D0: 0.0168887         D : 18

      E1: 7.3               E2: 7.5               E6: 3.37323E-03
      E7:-4.94796E-03       E8: 0.696983          E9: 0.696983
      E : 2

      F1: 10000             F2: 10000             F3: 1500
      F4: 1500              F0: 0.01              F : 7.3

      G4: 5.97740E-03       G5: 7.45196E-04       G6: 2.04549E-03
      G : 96931.6

      H1: 0.0278884         H5: 1                 H9: 1500

      L5: 2.10242           L6: 2.17              L7: 7.7532
      L8: 1.03803           L9: 0.013             L : 5

      M5: 4.779             M6: 0.973             M7: 1.957
      M8: 3.924             M9: 7.949             M0: 6.1
      M : 316.227

      N1: 6                 N6: 2                 N7: 500
      N : 1
```

```
O1: 3.552            O4: 2.56            O6: 1.25
O9: 5.634

P1: 2.875            P4: 5.814           P6: 5.67
P9: 4.083

Q6: 0.083            Q7: 1.78200E-03     Q9: 4.719

R0: 0.2561

T : 306.524

W : 5.5
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
```

* REWIND SITE PREP TAPE

* INSERT THE APPROPIATE DAILY MEAS TAPE

```
CHANGE RUN/DATE/SITE:1=YES( =NO): 0    ?1
RUN NUMBER( =NO): 2    ?1
YEAR( =NO)NOW: 1980??1980
MONTH( =NO)NOW: FEB?
DAY OF MONTH( =NO)NOW: 8 ?5
DAY OF WEEK( =NO)NOW: FRI?TUE
MEAS ID( =NO)NOW: AN/TSC-54 #3 Wahiawa,Hawaii ?
SITE:W. LONG(deg)( =NO): 158  ?
MIN( =NO): 0     ?
SITE:N.LAT(deg)( =NO): 21    ?
MIN( =NO): 30.6     ?
SITE:ALT(KM)( =NO): 0.1524  ?
ANT DIAM (FT)( =NO): 18    ?
G/T(DB)=( =NO): 24.99998948    ?25
AMBIENT TEMP(F)( =NO): 80.3     ?
DEW PT TEMP(F)( =NO): 46.2     ?
ENTER SUN/MOON ALMINAC DATA(1=YES)( =NO): 0     ?1
```

STEPS BYPASSED IF "SPACE BAR", "EXECUTE"

```
FOLLOWING INPUTS ARE IN 2 PARTS:1st=deg,2nd=min
IF DEC IS South: enter deg and min NEGATIVE

SUN :GHA @ 0 GMT(deg)( =NO): 176  ?
MIN( =NO): 28.5     ?18.5
SUN :GHA @ 12 GMT(deg)( =NO): 356  ?
MIN( =NO): 17.76    ?18.1
N.DEC @ 0 GMT(deg)( =NO):-15    ?-16
MIN( =NO):-22.104   ?8.6
N.DEC @ 12 GMT(deg)( =NO):-15    ?-16
MIN( =NO):-0.582    ?3.2
N.DEC @ 24 GMT(deg)( =NO):-15    ?
MIN( =NO): 50.178   ?33.8
MOON:GHA @ 0 GMT(deg)( =NO): 294   ?315
MIN( =NO):-2018.3   ?4.7
MOON:GHA @ 12 GMT(deg)( =NO): 489   ?130
MIN( =NO): 35958.68    ?1.1
N.DEC @ 0 GMT(deg)( =NO):-4      ?3
MIN( =NO): 732.7996     ?4.8
N.DEC @ 12 GMT(deg)( =NO): 1      ?
MIN( =NO): 9.18     ?7.7
N.DEC @ 24 GMT(deg)( =NO): 0      ?
MIN( =NO): 45.12    ??-25.7
HOR PARALLAX(min)( =NO): 54.18    ?32.5
AGE (DAYS)( =NO): 20    ?19
```

STEPS BYPASSED IF "SPACE BAR", "EXECUTE"

```
                         1981/03/13  13:56
NBS1B.30+ SITE PREP  <D1-F12> T2-F12:     X.25
+ <D1-4> T2-4

                                    -2-
Syam # 6.11                                                            RUN  1

                        AN/TSC-54 #3 Wahiawa,Hawaii
                        TUE:  1980 FEB 5   ( 1980.099)
                        7300 MHz(#), 7500 MHz(o),

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

     SITE: W. LONG         N. LAT          ALTITUDE     GHA TO ARIES @ 0 GMT
      158.000 deg        21.510 deg        0.152 km          134.315 deg
       C4                 C5                 CØ                C6

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                                 FLUX DATA

    STAR         FLUX in F.U.             RANGE(GHz) SIZE(min)  SPEC INDEX
    Epoch        Secular Decay              T(1,19) T(1,20)     Secular Expansion
    T(1,1)     S(1,1)     T(1,8)/10   T(1,18)/100         T(1,9)/100  T(1,6)/1000    T(1,7)/1000
 1  CAS A      3154 +-   4.5 %  @    1 GHz    1 TO 10     4.60    -0.792 +- 0.006
    1965.0     0.97 +-  0.05 %/Yr                                  0.126 +- 0.023 %/Yr
    T(1,15)/10  T(1,16)/100  T(1,17)/100
 2  CYG A      2250 +-   4.5 %  @    1 GHz    2 TO 10     1.60    -1.090 +- 0.020
 3  TAU A      1024 +-   4.5 %  @    1 GHz    2 TO 10     4.00    -0.263 +- 0.020

 4  ORI A       420 +-   4.5 %  @    3 GHz    3 TO 10     3.50     0.000 +- 0.005
 5  SUN      500000 +-   7.6 %  @    1 GHz    3 TO 10    32.00     0.900 +- 0.005
 6  MOON        471 +-   9.9 %  @    1 GHz    2 TO 10    32.00     1.963 +- 0.000


================================================================================
                              LOCATION & MISC DATA


  STAR EPOCH  (DAYS AFTER 1977.0)          SOLAR EPOCH    (DAYS AFTER 1977.0)
   1980.099          1131                   1976.923            -29


    STAR:       RT.ASC      N. DEC.           LINEAR POLZ              POLZ ANG
    SOLAR:   GHA:0 GMT   @12 GMT    N.DEC:0 GMT   @12 GMT  @24 GMT    HOR PRLX   PHASE
              S(1,2)       S(1,3)       T(1,11)/10      T(1,12)/10     T(1,13)/10      T(1,14)/10
 1  CAS A    350.59 deg   58.69 deg      1.5     +-     0.0 %        40.0    +-   0.0 deg
 2  CYG A    299.67 deg   40.66 deg      8.0     +-     0.0 %       146.0    +-   0.0 deg
 3  TAU A     83.28 deg   22.00 deg      7.0     +-     0.0 %       143.0    +    0.0 deg

 4  ORI A     83.53 deg   -5.40 deg      0.0     +-     0.0 %         0.0    +-   0.0 deg
 5  SUN     176.185 d.m  356.178  -16.086 d.m -16.032 -15.338      0.000 d.m     0 day
 6  MOON    315.047 d.m  130.008    3.048 d.m   1.077   0.000      0.325 d.m    19 day


================================================================================
```

```
  H$                                                          X$
                                   1981/03/13  13:57
NBS18.30+ SITE PREP  <D1-F12> T2-F12:     X.25
* (D1-4> T2-4

                                            -3-
Sysm # 6.11 N(1,4)                                                              RUN  1

                            AN/TSC-54 #3 Wahiawa,Hawaii   P$
                            TUE:  1980 FEB 5   ( 1980.099) C
                          F 7300 MHz(#), 7500 MHz(o),


                          TYPICAL VALUES for G/T MEASUREMENT using CAS A


  FREQ(MHz)      G(dB)           T(K)            G/T(dB/K)         G/Ta(dB/K)
   7500          50.82          382.38             25.00             27.81
    F          10*LGT G           T            10*LGT (G/T)      10*LGT (G/H9)

ANT DIAM    ANT ELEV   APER EFF     RAD EFF     ANT HPBW        CONVL HPBW      EFF AREA
 18.0 ft     5.0 deg    0.6500       0.98      0.4601 deg      0.4601 deg       15.4 m↑2
  D           L          B2           B3         B0/60           B/60             B9
        PARAMETER                                                           ERR TO G/T
------------------------------------------------------------------------------------------
     F    FREQUENCY (GHz)              F 7.500 +-   0.01 % F0               +-   0.00 % E0
     S    FLUX (F.U.=10↑(-26)W) S(1,4) 573.9 +-   5.80 % S                +-   5.80 % S
           T(ant) =      2.4 K (Y-1)*T
           X1    = 1.960E-05 K (Y-1)*T/G
     Y    Y-FACTOR                     Y 1.006 +-   0.10 % C8               +- 16.23 % C8*Y5
           Y(dB) =  0.027 dB 10*LGT Y
     K1   ATM ABSORPTION FACTOR       K1 0.906 +-   5.19 % E1               +-   5.19 % E1
           oxygen attn= 0.0310 dB G4*L4
           water attn = 0.0064 dB/gm*m↑3 G5*L5 + G6*L6
           water dens=  7.8 gm/m↑3 L7
           atm bright= 26.3 K  B4
           site alt   =  0.152 Km C0
           amb temp   = 80.3 F  A(3)/10
           dew point= 46.2 F  A(4)/10
     K8   DIFFUS+- 6D8 0.75*(1/K8-1)   K8 0.851 +- 13.18 % E8              +- 13.18 % E8
     K9   REFRAC+ D9 0.18*(1/K9-1)     K9 0.973 +-   0.51 % E9              +-   0.51 % E9
           1st const: 1.0380 L8
           2nd const: 0.0130 L9
     K2   STAR SHAPE  (CAS A) 6D1      K2 0.989 +-   0.21 % E2              +-   0.21 % E2
           +-( 10.8*(1-K2)+ 0.1))%
           HPBW (+- 1.50%) D2
     K3   BNDWD EFFECTS FACTOR         K3 1.000 +-   0.00 % E3              +-   0.00 % E3
          bandwidth = 5.5 W MHz
     K4   DIFF SYSTEM TEMP  D5         K4 1.000 +-   0.72 % E4              +-   0.72 % E4
     K5   ANT POINT(+- 0.0257 deg)     K5 1.000 +-   0.80 % E5              +-   0.80 % E5
           or G/T data fit= +-   0.035dB H1
     K6   ANT POLARIZATION FACT        K6 1.000 +-   0.35 % E6              +-   0.35 % E6
     K7   SYSTEM RESPONCE FACT         K7 1.000 +- 32.55 % E7              +- 32.55 % E7
           instr pwr resp (+-   0.200%) C9
           Y/(Y-1)= 162.340 Y5
           gauss curve fit(+-   2.300%) A2
     Ta   ADDED NOISE (K)              H9 200.0 +-   0.60 % D3              +-   0.60 % D3
------------------------------------------------------------------------------------------
     TOTAL ERROR, quad sum + diffus & refr err                           +- 50.90 %
```

STORE S,T,N:0=NO,5=EXT,10=INT(=NO): 0 ?5 ← STORES SITE DATA ONTO MEAS TAPE
STORE S,T,N:0=NO,5=EXT,10=INT(=NO): 0 ?0
LIST ALTERNATE STARS(0=NO)?1

1981/03/13 14:07
NBS18.30+ SITE PREP <D1-F12> T2-F12: X.25
* <D1-4> T2-4

Sysm # 6.11 RUN 1

AN TSC-54 #3 Wahiawa,Hawaii
TUE: 1980 FEB 5 (1980.099)
7300 MHz(#), 7500 MHz(o),

FREQ(MHz)	G(dB)	T(K)	G/T(dB/K)	G/To(dB/K)
7500	50.82	382.38	25.00	27.81

ANT DIAM	ANT ELEV	APER EFF	RAD EFF	ANT HPBW	CONVL HPBW	EFF AREA
18.0 ft	5.0 deg	0.6500	0.98	0.4601 deg	0.4601 deg	15.4 m↑2

	STAR	FLUX in F.U.	T(ant)	K2	Y-factor	Y(dB)	Y(K)
1	CAS A	574 +- 5.8 %	2.37 K	0.989	1.0062	0.03 DB	1.960E-05
2	CYG A	250 +- 8.8 %	1.04 K	0.998	1.0027	0.01 DB	8.605E-06
3	TAU A	603 +- 8.8 %	2.49 K	0.992	1.0065	0.03 DB	2.062E-05
4	ORI A	420 +- 5.0 %	1.74 K	0.993	1.0046	0.02 DB	1.439E-05
5	SUN	3065660 +- 8.7 %	8909.34 K	0.650	24.2999	13.86 DB	7.368E-02
6	MOON	24590 +- 9.9 %	71.46 K	0.650	1.1869	0.74 DB	5.910E-04

G/T or G/TA MEASUREMENT ERRORS: ELEV= 5.0deg

		CYG A	TAU A	ORI A	SUN	MOON
E-S	FLUX	8.80 %	8.80 %	5.00 %	8.70 %	9.90 %
E-F	FREQUENCY	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
E-Y	Y-FACTOR	36.85 %	15.43 %	22.08 %	0.10 %	0.64 %
E-K1	ATM TRANS FACT	5.19 %	5.19 %	5.19 %	5.19 %	5.19 %
E-K2	STAR SHAPE	0.21 %	0.12 %	0.19 %	0.17 %	3.89 %
E-K3	BNDWD EFFECTS	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
E-K4	DIFF SYST TEMP	1.64 %	0.68 %	0.98 %	0.00 %	0.02 %
E-K5	ANTENNA POINT	0.80 %	0.80 %	0.80 %	0.80 %	0.80 %
E-K6	ANT POLARZ	0.35 %	0.35 %	0.35 %	0.35 %	0.35 %
E-K7	SYST RESPONSE	73.74 %	30.95 %	44.21 %	2.31 %	2.63 %
E-K8	ATM DIFFUS	13.18 %	13.18 %	13.18 %	13.18 %	13.18 %
E-K9	ATM REFRAC	0.52 %	0.52 %	0.52 %	0.52 %	0.52 %
E-To	NOISE ADD	0.60 %	0.60 %	0.60 %	0.60 %	0.60 %
TOTAL	LINEAR SUM	141.88 %	76.62 %	93.09 %	31.92 %	37.71 %
TOTAL	QUADRATIC SUM	84.13 %	38.42 %	51.67 %	16.82 %	17.96 %

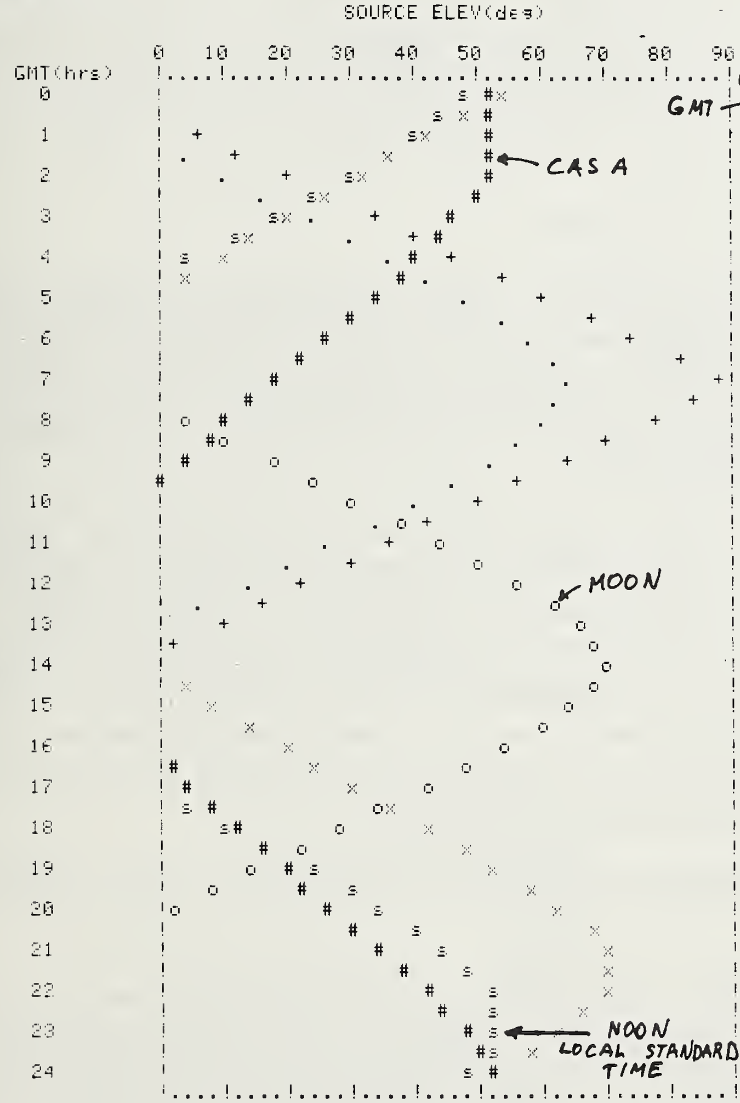
ELEV vs GMT PRINT OUT(1=YES)(=NO): 0 ?1
EL,AZ for 1=CAS,6=MOON(=NO): 1 ?6

1981/03/13 14:08
NBS1B.30* SITE PREP <D1-F12> T2-F12: X.25
* <D1-4> T2-4

Sysm # 6.11 RUN 1

AN/TSC-54 #3 Wahiowa,Hawaii
TUE: 1980 FEB 5 (1980.099)
7300 MHz(#), 7500 MHz(o),

# = CAS A x = CYG A + = TAU A . = ORI A s = SUN
o = MOON



ANTENNA POINTING for

MOON	EL	AZ
0	-57.02	314.87
	-61.39	326.14
1	-64.52	340.50
	-65.91	357.44
2	-65.27	14.89
	-62.75	30.38
3	-58.80	42.81
	-53.89	52.39
4	-48.35	59.81
	-42.41	65.70
5	-36.20	70.51
	-29.81	74.57
6	-23.30	78.11
	-16.70	81.29
7	-10.06	84.24
	-3.57	87.04
8	3.74	89.73
	10.37	92.55
9	17.09	95.42
	23.80	98.42
10	30.46	101.85
	37.05	105.70
11	43.50	110.25
	49.75	115.86
12	55.66	123.0[illegible]
	61.03	132.66
13	65.46	145.74
	68.39	163.03
14	69.16	183.32
	67.53	202.64
15	63.96	218.56
	59.12	230.22
16	53.52	238.80
	47.45	245.31
17	41.10	250.45
	34.58	254.66
18	27.94	258.28
	21.23	261.47
19	14.48	264.38
	7.75	267.11
20	1.18	269.77
	-6.15	272.41
21	-12.81	275.12
	-19.52	277.97
22	-26.18	281.07
	-32.77	284.54
23	-39.24	288.56
	-45.55	292.39
24	-51.59	[illegible]

6.4 The MEAS program

The purpose of the measurement program is to collect and validate data to be used in the rework programs. The measurement program collects two types of data; sky profile data, and star cut data. The sky profile data (sky background temperature as a function of elevation) is used only for the data collecting routine. It is needed to keep the data collecting plots on scale, and it is needed to estimate the sky temperature for the preliminary estimates of G/T, etc. The star cut data are used to compute G/T, antenna half-power beamwidth (HPBW), and G/T_a.

6.4.1 The MEAS CHECK

Periodically throughout all of the measurement routines contained in the ETMS program MEAS, a check procedure is initiated to verify that the proper measurement conditions exist for a valid measurement, and to provide documentary evidence that the ETMS is operating satisfactorily. The MEAS CHECK contains 9 pieces of information labeled as follows: BRG PWR, BRG PRW+a, PWR+a/STD, STD, T_a#, MANL, PRGM, STD CK, and FLTR.

6.4.1.1 Meaning of Labels, and the Normal Condition

BRG PWR is the power incident on the NBS type IV power bridge due to the output of the earth terminal after being attenuated, amplified, and filtered through the ETMS control unit with the standard attenuator "out", and both microwave noise add noise sources "off". For normal operating conditions, this power level is between 0.66 mW and 0.48 mW if BRG PWR is greater than BRG PWR+a; otherwise, BRG PWR should be greater than 0.12 mW.

BRG PRW+a is the power incident on the NBS type IV bridge due to the output of the earth terminal passing through the ETMS unit under the same conditions as for BRG PRW, except that one, or both, of the microwave noise add sources are commanded ON. If PRW+a/STD = 1, then the signal has been attenuated by the standard attenuator. Which noise add sources are commanded ON is indicated under T_a#. If T_a# = 1, then only noise add #1 is commanded ON. If T_a# = 2, then only noise add #2 is commanded ON. If T_a# = 0, then both noise add #1 and noise add #2 are commanded ON. For normal operating conditions, the BRG PWR+a power level is between 0.66 mW and 0.48 mW if BRG PWR+a is greater than BRG PWR; otherwise, BRG PWR+a should be greater than 0.24 mW.

STD is the assumed absolute attenuation of the standard attenuator (i.e., STD = 4 implies a 6.02 dB standard attenuator).

MANL is the attenuation of the manual input attenuator in the "ETMS control unit." The value of the manual attenuator is entered via the calculator keyboard. There is no computer readout of the input attenuation value, so the operator must be careful to record any change. This is done via the special Key 15. Normally, the MANL attenuator is adjusted so that the program attenuator is away from its extreme attenuation limits (viz., 0 dB and 15 dB).

PRGM is the attenuation of the program attenuator in the "ETMS Control Unit." This value is set by the calculator to keep the power to the type IV bridge in the most accurate measurement range.

STD CK is the measured attenuation minus the assumed attenuation of the standard attenuator. On the average, the absolute magnitude of STD CK is normally less than 0.02 dB, but because noise signals are used in the test, it will sometimes be as great as 0.05 dB.

FLTR is a number which indicates which filter is being used within the "ETMS Control Unit." The nominal identification of the filters is as follows:

FLTR Number	Center Frequency	Nominal Bandwidth
1	30 MHz	2.5 MHz
2	70	1
3	70	2.5
4	70	5.5

6.4.1.2 Adjusting STD CK

It is important that the assumed magnitude of the standard attenuator (A3) is close to the true value, because the standard attenuator is inserted each time the noise add is turned on, in order to keep the type IV power bridge in its most accurate range. Thus to have an accurate knowledge of the earth terminal signal plus noise add power, the assumed attenuation of the standard attenuator must be accurate.

The difference between the assumed attenuation and the actual measured attenuations is printed under the heading STD CK in the MEAS CHECK routine. If for any reason the STD CK is greater than 0.02 dB, the measurement process stops and the error message, "STD CK NOT NORMAL (1=ADJUST)," is printed out. This may have been caused by a large noise spike, which is to be expected from time to time. In this case, striking the space bar then the execute key will allow the measurement to continue. If, on the other hand, the assumed attenuation is different than the actual attenuation (e.g., because one of the two relays that switch the standard attenuator becomes resistive, or because the wrong N matrix data was loaded into the calculator), there is a provision in the standard check routine to adjust the value of A3. When the computer stops with the display "STD NOT NORMAL (1 = ADJT)(=NC):?", returning 1 provides an opportunity to adjust the value for the STD. If the attenuation of the standard is known in decibels, say AdB, then $A3 = 10^{AdB/10}$. The nominal values for A3 for the four ETMS systems are:

for S/N = 3	STD = 3.9502
4	4.2306
5	4.0935
6	3.839

STD CK is the measured value minus the assumed value of the standard attenuation expressed in decibels; so, if the STD CK is averaging, say 0.1 dB, then you would increase STD by 2.3% (i.e., if originally STD = 4.000, then the new STD = 4.092).

6.4.1.3 "NOT NORMAL" Display

If, during the MEAS CHECK one of the measurement conditions is not normal, then the computer will stop with the display "NOT NORMAL (1=ADJT)(= NC):0?" or "STD NOT NORMAL (1 = ADJT)(=NC):?". Specifically, one of the following conditions is not met.

(1) STD CK < abs(0.05 dB)
(2) PRGM between 2 dB and 10 dB
(3) 0.24 mW < BRG PWR < 0.66 mW
(4) 0.24 mW < BRG PWR+a < 0.66 mW

If condition (1) is not met, the "STD NOT NORMAL" display will occur. If the operator chooses to continue with the conditions "as is," then he presses the space bar, then "EXECUTE". On the other hand, if he wishes to correct the operating condition, he enters "1","EXECUTE". The operator will then be given an opportunity to (a) change the value of STD, (b) change the value of the ETMS input attenuator, (c) change the noise add source, and/or (d) change whether the standard attenuator is inserted when the noise add source is turned on. In making the changes, remember that BRG PWR+a includes the effect of whether the standard attenuator is inserted when the noise add sources are turned on. So, if BRG PWR+a is too large when BRG PWR is too small, then the standard attenuator needs to be inserted when the noise add source is turned on; and if that is not sufficient, then use only the weakest noise source by itself for the noise add signal. If this still does not satisfy, then the only thing left is to insert an attenuator on the output of the noise source. Similarly, each of the other conditions have to be dealt with depending on the nature of the problem. For example,

Condition Not Met	Changes to Consider
1	a
2	b
3,4	c,d

6.4.2 Establishing the Antenna Biases

The G/T measurement routine does not operate well unless the star center prediction is well within the half-power beamwidth (HPBW) of the antenna. This normally requires that the computer-predicted azimuth and elevation angles be biased in order to obtain the needed earth terminal azimuth, elevation command angles. The need for the bias corrections is due to an unknown mix of situations such as antenna boresight errors, elevation dependent feed sag, atmospheric refraction errors, errors in the site coordinates, and error in time. The first step is to find the star.

6.4.2.1 Finding the Star

With the ETMS connected to a down converter output of the earth terminal, adjust the ETMS input attenuator with the meter bypass in the BYPASS position until the output meter is midscale (at 0) on the meter x 1 scale. Then switch the meter scale to x 0.1 and with the meter offset knob, recenter the meter reading. If any of the four pointing biases (hour angle, declination angle, azimuth, or elevation) are currently in the program, it is usually best to zero them using the special function

Key 5. Next, press special function Key 4 and start the star fix routine (normally for star #1 = Cas A). This routine displays the predicted azimuth and elevation angle for the star, and this prediction is updated about every 10 seconds. Command the antennas to the predicted pointing angles adjusting the meter offset or sensitivity as needed; search in the vicinity of the predicted azimuth and elevation for a pointing angle which gives the maximum star output. Compare the antenna pointing position readout with the predicted pointing. Stop the star fix routines by pressing the "STOP" key twice; insert the appropriate AZ and EL biases via Key 5. Again, restart the Star Fix routine (key 4) and verify that the antenna pointing position indicators agree with the biased pointing prediction displayed by the ETMS.

6.4.2.2 What to Do if You Cannot Find the Star

If, for some reason, the star is not found using the above routine, try the following check list.

(1) If the antenna elevation angle is below 15 degrees, and there are unusual atmospheric conditions, the refractive corrections may be incorrect, or there may be an obstruction in or near the line of sight. In either case, switch to a star with a larger elevation angle. (2) Check that the earth terminal down converter output is connected to the ETMS control unit input. To double check, turn on and off noise add #1 (via keyboard, FNX82 and FNX83, or via program switches, 82 and 83) and observe change in the ETMS output meter or on a spectrum analyzer monitoring the earth terminal. (3) Compare the predicted Cas A azimuth and elevation angles with those generated before the trip with the SITE PREP Program. If an obvious difference exists, the wrong site data may have been entered, or perhaps there is a computer load problem. If it looks like a computer load problem, turn the calculator off and start up all over again. (4) Check that the time is correct. The clock should read Greenwich Mean Time, not local time. The date from which the star positions are calculated is the date in the page heading, not the one set in the clock unit, and it should be the proper day in Greenwich, England. To double check that the correct date is in the calculator, gain keyboard control of the calculator (denoted by the lazy T in the display), enter "C6," press "EXECUTE." In the display will be the Greenwich hour angle (GHA) to Aries at 0 GMT expressed in decimal degrees. Using "The Nautical Almanac" or "The Air Almanac" of the proper year, look up the GHA to Aries at 0 hr GMT. In the Almanacs this will be expressed in degrees and decimal minutes. Divide the decimal minutes listed in the Almanac by 60 and add to the listed degrees to obtain GHA to Aries at 0 GMT expressed in decimal degrees. This should agree with the computer constant C6; if not, double check the value obtained in the Almanac. If they still disagree, the wrong site data were loaded. If only the day is incorrect, you can correct the computer value of C6 ("RECALL","=", enter new value, "EXECUTE", or "C6 = ___.____", "EXECUTE") and look for the star again. (5) Check that the site coordinates are correct. In a manner similar to (4) above, check the computer constants C4 (West Longitude of the site in decimal degrees), and C5 (North Latitude of the site in decimal degrees). If the site is EAST of the zero Longitude, C4 should be a negative number. If the site is SOUTH of the Equator, C5 should be negative.

6.4.3 Sky Profile

The sky profile option is selected at TRAP via option 1SKY. A sky profile is a series of sky temperature measurements made at various elevations along the path that Cas A will take. The measurement results are then least squares fit to a constant plus a cosecant of the elevation term.

The purpose of the sky profile is threefold. First, it yields information concerning atmospheric loss. Secondly, the curve fit parameters are used to correct for the change in sky background temperature as the various star cuts are taken to determine G/T. Lastly, the sky profile results are used to identify when any unusual changes in atmospheric conditions occur.

6.4.4 The G/T Measurement

Before the G/T measurement routine can succeed, the ETMS manual input attenuator needs to be properly set, the noise add sources functioning appropriately, and the antenna bias corrections established as discussed in the preceding paragraphs. Once these are done, the G/T measurement routine is initiated by selecting the "2G/T" option at TRAP. One measurement set consists of 6 cuts. For the first cut, the antenna is pointed and braked at the cold sky two degrees offset from the path of Cas A. A "cut" consists of approximately 40 sequential power measurements taken at six-second intervals. The purpose of the sky cut is to compare the current sky temperature with the earlier sky profile results. This helps identify atmospheric changes and/or interference situations.

For the remaining 5 cuts, the antenna is pointed to a computed coordinate position so that the radio star Cas A drifts through the antenna beam in equidistant spaced cuts. After each cut, a parabolic curve is fit to those measurement points where the radio star is predicted to lie between the half power beam width (HPBW) points of the antenna pattern. Cas A will remain between the HPBW points for 11 successive measurements (66 seconds of time). Those points that occur during these 66 seconds of time (and are at frequency #1) are curve fit to a parabola, and the discrepancy between the time the star was predicted to be centered in the antenna pattern and the time the star was actually centered is used to calculate and print out the equivalent antenna hour angle offset. If it is desired that a new hour angle bias be entered for improving the predicted time of the star maximum, Key 5 is pressed and the new hour angle bias entered. The hour angle bias (or declination angle bias can be entered at anytime without invalidating the measurement data. Remember, however, AZIMUTH or ELEVATION biases can ONLY be entered BETWEEN MEASUREMENT SETS; otherwise, the antenna declination offsets between cuts are incorrectly calculated and the two-dimensional curve fit to the data is incorrect, which invalidates the entire measurement set.

After the last cut in a measurement set, the calculator fits a parabola to the maximum of the prior stored cuts versus declination offset from the unbiased predicted star center. The difference between the unbiased predicted declination angle for a star maximum and the actual declination angle for the star maximum is printed out. If it is desired that a new declination angle bias be entered for improving the biased prediction of the declination angle for star maximum, Key 5 is pressed and the new declination angle bias entered. The declination angle bias (or hour angle bias) can be entered at anytime without invalidating the measurement set (but DO NOT CHANGE AN AZIMUTH OR ELEVATION BIAS during a measurement set). It is best to wait until the measurement set is stored on magnetic tape before changing the declination bias. If the bias is changed before the measurement set is stored, the most graceful way to continue is to press Key 10 (shift plus f0) to store the data.

When all the data for a particular run have been taken, Key 19 (Last Meas) is used to store the summary information on the summary tape and the computer program on the MEAS tape. When all the information has been stored, it is good practice to list out the computer program.

6.4.5 Data Storage on the MEAS Tape, and the Summary Tape

Each set of measurement data is recorded twice, once on the MEAS cassette tape (which contains the MEAS program) and, secondly, on the summary tape. The MEAS tape has the measurement program, the site data, the star data, the measurement conditions, and all of the measurement results for one particular run all recorded on it. The MEAS tape is intended to be an archives tape. In contrast, the summary tape is intended to be a working tape. The rework program uses the summary tape files and writes back into them the latest results. Thus, the summary tape is more vulnerable to the accidental erasure of a data file.

The particular file on the MEAS tape on which data are stored depends on the set number (computer variable is N7). In turn, N7 is determined by the measurement number (computer variable is N) which is controlled by the ETMS operator. It is possible to overwrite a "MEAS" data file by intentionally or otherwise reusing a series of N values.

The summary data tape files are filled sequentially. Every store operation is stored in the next available file.

The reason for storing the data twice is to avoid losing data when cassette recording errors are encountered (ERROR 59). This occurs because of a flaw in the tape, or an unclean recording head, or other causes. If the problem occurs during the read operation, the file can sometimes be recovered by cleaning the read head and then rereading the file, but usually that data file is lost.

6.4.6 Changing the MEAS or Summary Data Tapes

When the MEAS tape or summary tape data files are full, the operator is notified and the program automatically performs the "Last Measurement" routine of storing summary data onto the summary tape, and the program onto the MEAS tape. To continue on with the measurement process without reloading the MEAS program, a new MEAS and/or summary tape need to be inserted and the appropriate changes made to the computer variables so the data store locations will be appropriate for the new tape. Whenever insertion of a new MEAS or summary tape is desired, the "5 NEW TAPE" option is selected at TRAP (e.g., Key 0) and the appropriate entries made in response to the computer-generated questions.

6.4.7 The Use of the Special Function Keys

In the MEAS program, the special function keys found in the upper left-hand corner of the calculator are important to the normal operation of the measurement. The ten special function keys are labeled f0, f1, ..., f9. Twenty special functions are available by using the above keys in conjunction with the shift key. A special function can be activated anytime the calculator is stopped (by pressing the stop key) or waiting for an input.

For convenience, the routine activated by pressing f0 is denoted as Key 0, and so forth through Key 9. Key 10 is the routine activated by pressing the shift key and the special function key f0 simultaneously, and so forth through Key 19. The routines associated with the special function keys for the MEAS program are listed in table 4 and are described in the following paragraphs.

Key 0 sets the MEAS program to "the restart alternative position," TRAP, namely the position in the program that chooses the major program option. The options in the MEAS program are "0RSTRT," which is a master restart that is used to initialize certain program constants. These constants need only be initialized once, and this is done automatically when the program in loaded. "0RSTRT" is used primarily for the case when the calculator gets hung up waiting for a return flag from the digital voltmeter. This is a calculator quirk that sometimes occurs on the first command to read the voltmeter. The operator is warned of this problem on the printout, so no special concern for this option is necessary. The "1SKY" option initiates the sky profile measurement routine, "2G/T" initiates the G/T measurement routine, "3EIRP" initiates the EIRP, C/kT measurement routine, and "4 NEW TAPE" changes the calculator constants to store data to the proper files on a new tape.

TABLE 4. The Special Function Keys for the MEAS program.

KEY		PURPOSE
0	Restart:	1SKY, 2G/T, 3EIRP, 4NEW TAPE, ORSTRT
1	Restart:	at measurement number N
2	Change:	STANDARD ATTENUATOR value
3		Refit 5 cuts (used after one cut was retaken)
4		STAR FIX (to correct for antenna boresight error)
5	Change:	BIAS: HR. ANG, DECL, AZ, ELEV
6	Change:	input ATTN (dB), FILTER #
7	Change:	T_a (added noise) value
8	Change:	$T(syst)/T_a$
9	Change:	INSERT 5dB WHEN T(ADD)?
10	STORE:	measurement set
11	STORE:	star and site parameters
12	STORE:	summary data matrix M
13	unused	
14	LIST:	current data matrix D
15	Change:	FREQUENCY and calculate new star flux
16	Change:	# MEAS PTS, # PTS IN FIT ZONE
17	Change:	G/T_a
18	Change:	NOISE ADD SOURCES used in measurement
19		LAST MEASUREMENT routine

Key 1 is used to restart a "cut" in the G/T measurement routine. This key typically is used after the operator realizes the antenna pointing is incorrect and needs to start the measurement over again.

Key 2 is used to change the assumed value for the attenuation of the standard attenuator (A3).

Key 3 is used to refit a parabola to the results of a set of five cuts. This key is used when, for some reason, one of the measurement cuts is replaced and there is no need to remeasure the remaining cuts.

Key 4 initiates the star fix routine, and Key 5 is used to enter new antenna biases and is discussed in paragraph 9.2.

Key 6 is used to enter a change in the ETMS input attenuator value or to change the filter being used.

Key 7 is used to change the estimated magnitude of the noise add reference, T_a, which changes the scale factor for the data collecting graphs.

Key 8 is used to change the estimated value for the system temperature relative to the noise add reference (T/T_a); both the zenith value and the coefficient of the cosecant of the elevation angle can be adjusted. T/T_a determines the zero values for the data collecting graph. Because T/T_a is calculated automatically from the sky profile measurement, and because the zenith value of T/T_a is recalculated after each cold sky cut, there is not much reason to reenter a new value. However, when the measurement frequency is changed, T/T_a can be somewhat in error, and, sometimes, it is convenient to manually correct the value.

Key 9 is used to change whether the 5 dB standard attenuator is or is not inserted into the circuit each time the noise add source is turned on.

Key 10 is used to store a partial measurement set. For example, a single additional cold sky cut may be taken for a record concerning the atmospheric conditions.

Key 11 is used to store the star and site parameters, and the current measurement program onto the MEAS tape.

Key 12 stores the summary data matrix M, and the program constants matrix N onto the summary data tape. Key 13 is not used.

Key 14 is used to list out the data contained in the current data matrix D.

Key 15 is used to enter a new measurement frequency and corrects the frequency dependent parameters such as star flux.

Key 16 is used to change the number of points used in the parabolic fit routine. For Cas A, 11 points are normally used. Because the fitting routine works best when the star is between the HPBW points, fewer points are used for the other stars.

Key 17 is used primarily as an alternate way to calculate the magnitude of the noise add, T_a, which, in turn, adjusts the scale factor of the data collecting graphs. Because the magnitude of G/T_a is calculated after one measurement set is finished, this value of G/T_a can be entered via Key 17 and used to calculate T_a by using a value for the antenna gain based on the antenna diameter and the operating frequency.

Key 18 is used to change whether noise diode #1, diode #2, or both diodes are used for the noise add signal.

Key 19 is used when the last measurement data have been taken for a particular run. This key starts a routine which stores the summary data and the current programs onto the MEAS and summary data tapes.

* CONNECT NOISE ADD TO DIRECTIONAL COUPLER ON INPUT TO PARAMP AND VERIFY IT IS CONNECTED TO ON-LINE PARAMP
* INSERT DAILY MEAS TAPE

```
LOAD
RUN
PRINT ALL ON (1=YES)?1
MEAS:SITE DATA(10=INT,5=EXT)?5
PRGM CONST CHANGE OPTION(0=NO)?0
 5.2
YEAR( =NC): 1981     ?

                         1981/11/06  15:08
NBS1A.09  LOADER  <D1-F0> T2-F0:      X.25         * <D1-4> T2-4


                                   -1-
Sysm # 6.11

                    AN/TSC-54 #3 Wahiawa,Hawaii
                    TUE:  1980 FEB 5   ( 1980.090)    : 500
                    7300 MHz(#), 7500 MHz(o),

                                                       O6: 1.25
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                              PROG CON
                                  14                   P6: 5.67

          A2: 2.3                 A
          A5: 6.403               Q7: 1.78200E-03      Q9: 4.719


          B2: 0.65
          B6: 7.59
          B : 9 2.377

            : 5.5

    @@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

IF HARDWARE HANGS UP

(1)STOP+STOP
(2)KEY 0
(3)0 (RSTRT)
```

REMINDER TO SET BREAK POINT SET ON ETMS CONTROL UNIT TO SET ANTENNA POINTING TIME DELAY

```
SUM TAPE EXT, MEAS INT( =NC): 1     ?1
SET ANT DELAY @ BRK PTS:NOW 2    SEC(1=REREAD)( =NC): 0    ?1
SET ANT DELAY @ BRK PTS:NOW 18   SEC(1=REREAD)( =NC): 0    ?
ADD 24hrs TO CLOCK READ(1=YES)( =NC): 0    ?
```

(allows you to use daily tape from prior day - SELDOM USED)

```
FLTR:1=2030,2=1070,3=2070,4=5070( =NC): 4    ?
INPUT ATTN(dB)( =NC): 65    ?14
```

MANUALLY SELECTED ON RF CONTROL UNIT. THESE QUESTIONS ALLOW YOU TO RECORD YOUR SELECTIONS

```
NOISE ADD:0=#1&#2,1=#1,2=#2,3=NO( =NC): 0    ?
INSERT 5DB WHEN T(ADD)( =NC): 1    ?


TEMP/HUMD:0=AUTO,1=MANL( =NC): 0    ?
```

1SKY,2G/T,3EIRP,4NEW TAPE,0RSTRT(=NC): 1 ?1

THIS OPERATION IS TO OBTAIN A SKY PROFILE SO THAT THE CHANGE OF T WITH ANT ELEV CAN BE ACCOUNTED FOR

:MAT D=0) SOURCE:CAS A(=NC): 1 ?6 SELECTS MOON

VERIFIES WHAT WAS THE NEW SELECTION

:MAT D=0) SOURCE:MOON (=NC): 6 ?
NEW FREQS(=NC): 0 ?1

# of FREQS(=NC): 3 ?
FREQ(MHz) # 1 (=NC): 7300 ?
FREQ(MHz) # 2 (=NC): 7500 ?
FREQ(MHz) # 3 (=NC): 7500 ?

13 SPACES RESERVED FOR OPERATORS NAME

YOUR NAME(=NC,x13): DAVE WAIT?

VIA SITE PREP PRINTOUT, THE MOON ELEVATION ANGLE IS LOW AT THIS GMT TIME (use low angle even if actual data will not use this low an angle)

SKY:GMT(HRS):START,STOP,STEP?8.5,13.5,1

THE ELEVATION ANGLE IS HIGH AT THIS GMT TIME

1981/11/06 15:50
NBS1C.47 MEAS (D1-F14) T3-F12: X.25 by DAVE WAIT

-2-

Sysm # 6.11 RUN 1

AN/TSC-54 #3 Wahiawa,Hawaii
TUE: 1980 FEB 5 (1980.090)
7300 MHz(#), 7500 MHz(o), 7500 MHz(x),

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
79.6 F	61.6 F	54.3 %	13.5 gm/m13	0	0 mph

==

BRG PWR	BRG PRW+a	PWR+a/STD?	STD	Ta#	MANL	PRGM	STD CK	FLTR
0.5940mW	0.3941mW	1	3.9450	0	14dB	1dB	0.117dB	4

NORMAL is BETWEEN 0.24 mW and 0.66 mW

NORMAL IS BETWEEN 1 and 15 dB

NORMAL IS LESS THAN 0.05dB

STD CK NOT NORMAL 1=ADJT)(=NC): 0 ?1
STD(5.96 dB)(=NC): 3.945 ?3.839
STD(5.842 dB)(=NC): 3.839 ?

FLTR:1=2030,2=1070,3=2070,4=5070(=NC): 4 ?
INPUT ATTN(dB)(=NC): 14 ?
NOISE ADD:0=#1&#2,1=#1,2=#2,3=NO(=NC): 0 ?
INSERT 5DB WHEN T(ADD)(=NC): 1 ?

BRG PWR	BRG PRW+a	PWR+a/STD?	STD	Ta#	MANL	PRGM	STD CK	FLTR
0.5940mW	0.3942mW	1	3.8390	0	14dB	1dB	0.003dB	4

SET # 0 MOON

AZ	EL	CSC L	GMT		T/Ta
92.55012488	10.36883095	?			
		5.556047786	8.5	#	0.648611858
		5.556047786	8.5	o	0.647921464
		5.556047786	8.5	x	0.650025072
98.47608896	23.79665885	?			
		2.478364248	9.5	#	0.649673815
		2.478364248	9.5	o	0.647083212
		2.478364248	9.5	x	0.651855148
105.6996707	37.04758425	?			
		1.659811414	10.5	#	0.651142723
		1.659811414	10.5	o	0.646008458
		1.659811414	10.5	x	0.647884838
115.8637194	49.7494109	?			
		1.310228199	11.5	#	0.650374939
		1.310228199	11.5	o	0.650016057
		1.310228199	11.5	x	0.648807714
132.6632233	61.02622019	?			
		1.143064229	12.5	#	0.647750493
		1.143064229	12.5	o	0.647593714
		1.143064229	12.5	x	0.647205623
163.0287013	68.39144384	?			
		1.075590913	13.5	#	0.643886906
		1.075590913	13.5	o	0.646196215
		1.075590913	13.5	x	0.649729489

T/Ta = 0.6480 + 0.00024*CSC L #

ALTERNATE: IN PLACE OF 1SKY (AFTER 1ST DAY)

```
1SKY,2G/T,3EIRP,4NEW TAPE,0RSTRT( =NC): 1    *HR ANG BIAS(DEG)( =NC): 0    ?.005
DECL BIAS(DEG)( =NC): 0    ?0.032
AZ BIAS(DEG)( =NC): 0    ?.01
EL BIAS(DEG)( =NC): 0    ?-.02
```

KEY 5: (INSERT BIASES THAT WERE DETERMINED ON PRIOR RUN)

KEY 8: ENTER RESULTS OF PREVIOUS SKY PROFILE

```
MEAS #( =NC): 1    *T/Ta @ 90( =NC): 0.2  ?.6480
CSC COEF( =NC): 8.00000E-03   ?.00024
```

* KEY 7: ENTER PROPER TA VALUES THAT WORKED ON PIOR DAY
(Printed not shown)

```
MEAS #( =NC): 1     ?1SKY,[2G/T]3EIRP,4NEW TAPE,0RSTRT( =NC): 1     2
:MAT D=0)  SOURCE:CAS A( =NC): 1     ?6
:MAT D=0)  SOURCE:MOON ( =NC): 6     ?
NEW FREQS( =NC): 0    ?3
# of FREQS( =NC): 2    ?3
FREQ(MHz) # 1    ( =NC): 7300    ?
FREQ(MHz) # 2    ( =NC): 7500    ?
FREQ(MHz) # 3    ( =NC): 0    ?7700
```

ETC.

* KEY 5: IN CASE BIASES HAVE BEEN ENTERED, THEY SHOULD BE REMOVED BEFORE DOING STAR FIX

```
HR ANG BIAS(DEG)( =NC): 0    ?
DECL BIAS(DEG)( =NC): 0    ?0
AZ BIAS(DEG)( =NC): 0.01    ?0
EL BIAS(DEG)( =NC):-0.02    ?0
```

KEY 4: STAR FIX:

```
MEAS #( =NC): 1    *STAR#( =NC): 6    ?
AZ= 112.66    EL=  46.39    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.000  0.000 MOON

AZ= 112.69    EL=  46.42    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.000  0.000 MOON

AZ= 112.70    EL=  46.44    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.000  0.000 MOON

AZ= 112.72    EL=  46.46    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.000  0.000 MOON

AZ= 112.74    EL=  46.48    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.000  0.000 MOON

AZ= 112.76    EL=  46.50    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.000  0.000 MOON

AZ= 112.78    EL=  46.52    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.000  0.000 MOON
```

actual 112.79   46.50 ← AZ, EL of Star (MOON) MAXIMUM OUTPUT AS NOTED ON ETMS CONTROL UNIT OUTPUT LEVEL METER (X.1 RANGE)

+0.01   −0.02

* KEY 5: TO ENTER AZ, EL BIAS

```
HR ANG BIAS(DEG)( =NC): 0    ?0
DECL BIAS(DEG)( =NC): 0    ?0
AZ BIAS(DEG)( =NC): 0    ?.01
EL BIAS(DEG)( =NC): 0    ?-.02
```

KEY 4: STAR FIX: TO VERIFY BIAS

```
MEAS #( =NC): 1    *STAR#( =NC): 6    ?


AZ= 113.17    EL=  46.92    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.010 -0.020 MOON

AZ= 113.19    EL=  46.95    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.010 -0.020 MOON

AZ= 113.21    EL=  46.97    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.010 -0.020 MOON

AZ= 113.22    EL=  46.99    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.010 -0.020 MOON

AZ= 113.24    EL=  47.01    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.010 -0.020 MOON

AZ= 113.26    EL=  47.03    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.010 -0.020 MOON

AZ= 113.28    EL=  47.05    BIAS:HR,DLC,AZ,EL    0.000  0.000  0.010 -0.020 MOON

AZ=
```

```
1SKY,2G T,3EIRP,4NEW TAPE,0RSTRT( =NC): 1     ?2
:MAT D=0   SOURCE:MOON ( =NC): 6    ?
NEW FREQS( =NC): 0     ?
YOUR NAME( =NC,x13):  DAVE WAIT?
# MEAS PTS( =NC): 30    ?
# PTS IN FIT ZONE( =NC): 11    ?

MEAS #( =NC): 1     ?


SKY OFFSET(DEG)( =NC): 2     ?
CLOUDS(0 TO 9=RAIN)( =NC): 0     ?3

WIND (MPH)( =NC): 0     ?5
```

WARNING!! RIGHT AFTER THIS QUESTION IS ANSWERED, THE DATA MATRIX D IS SET TO ZERO. (IF YOU WANT TO RETAKE ONE BAD CUT IN THE LAST SET, DO NOT ANSWER THIS QUESTION. GO DIRECTLY TO KEY 1, RETAKE CUT, THEN KEY 3 (REFIT 5 CUTS AND STORE RESULTS))

```
                    1981/11/06  16:07
NBS1C.47  MEAS  <D1-F14> T3-F12:     X.25          by DAVE WAIT


                              -3-
Sysm # 6.11                                                    RUN  1

                    AN/TSC-54 #3 Wahiawa,Hawaii
                    TUE:  1980 FEB 5   ( 1980.090)
                    7300 MHz(#), 7500 MHz(o), 7500 MHz(x),

   TEMP       DEW PT.      REL HUMD      WATER DENS    CLOUD COVER    WIND
   77.2 F     61.5 F        58.6 %       13.5 gm/m↑3        3         5 mph

===========================================================================

AZIMUTH    ELEV     MEAS    HPBW     TIME(HRS)     OFFSET     CUT  RUN  SET  N
 243.74    52.79    6sec    0.5104   16.15694     2.000deg    -3    1    1   1

                     T/Ta = 0.6480 + 0.00024*CSC L  #
                     T/Ta = 0.6480 + 0.00024*CSC L  o
                     T/Ta = 0.6480 + 0.00024*CSC L  x

GO :1=NEW AZ,EL ( =NC): 0     ?
```

*SET ANTENNA, when done "SPACE BAR", "RETURN"

(TIME ELAPSED FROM TIME OF ANTENNA AZ,EL CALC. TILL ANTENNA SET)

```
 ELAPSE    PEAK#   PTS EX   HR BIAS      DCL BIAS      AZ BIAS      EL BIAS
  32sec     12      -3     0.0000deg    0.0000deg    0.0000deg    0.0000deg

 BRG PWR    BRG PRW+a   PWR+a/STD?   STD      Ta#   MANL   PRGM   STD CK     FLTR
 0.5980mW   0.3954mW        1       3.8390    0     14dB   1dB   -0.009dB    4
```

ZERO LEVEL	100% LEVEL	Xı(K)	K	Y(DB)	T(MOO)	S(UN)	T	To
0.6483+To	1.6360+To	1.63E-03	0.683	4.020	197.5	24590	129.7	200.0#
0.6483+To	1.6360+To	1.63E-03	0.683	4.020	197.5	24590	129.7	200.0o
0.6483+To	1.6360+To	1.63E-03	0.683	4.020	197.5	24590	129.7	200.0x

```
     -10       -6        -2         2         6        10   (%)
N3 sec!....!....!....!....!....!....!....!....!....!....!
```

N3	sec	(%)	PWR#1	PWR#2	P/Po
1	42	#	0.5981	0.3948	0.6502
2	50	o	0.5982	0.3963	0.6464
3	56	x	0.5981	0.3961	0.6465
4	2	#	0.5978	0.3953	0.6481
5	8	o	0.5984	0.3951	0.6498
6	14	x	0.5989	0.3951	0.6506
-7	20	#	0.5977	0.3955	0.6474
-8	26	o	0.5976	0.3947	0.6494
-9	32	x	0.5978	0.3954	0.6490
-10	38	#	0.5982	0.3943	0.6516
-11	44	o	0.5985	0.3955	0.6490
12	50	>	0.5979	0.3957	0.6472
-13	56	#	0.5905	0.3905	0.6480
-14	2	o	0.5975	0.3949	0.6489
-15	8	x	0.0062	0.0042	0.6391
-16	14	#	0.5963	0.3944	0.6481
-17	20	o	0.[illegible]968	0.3931	0.6524
18	26	x	0.5959	0.3956	0.6441
19	32	#!	[illegible].0069	0.0046	0.6373
20	38	o	0.5923	0.3917	0.6482
21	44	x	0.5976	0.3960	0.6460
22	50	#	[illegible].5946	0.3930	0.6488
23	56	o	0.5967	0.3[illegible]50	0.6469
24	2	!	0.[illegible]537	0.[illegible]289	0.9390
25	8	#	0.[illegible]977	0.3942	0.6511
26	14	o	0.5934	0.3918	0.6499
27	20	x	0.5[illegible]74	0.3954	0.6472
28	26	#	0.5989	0.3949	0.6513
29	32	o	0.5979	0.3945	0.6504
30	38	x	0.5990	0.3955	0.6498

```
        !....!....!....!....!....!....!....!....!....!....!
```

PWR READINGS MAY NOT PLOT ON THE GRAPH THE FIRST SET

PWR MEASURERED AT BRIDGE (mW) when NOISE ADD is OFF

BADG PWR WHEN NOISE ADD ON (? 6dB STD ATTN INSERTED)

x

	T(SKY)/To	SIGMA	MEAN	#PTS	T	:MOON
MEAN OF 10 (#) MEAS →	0.6482	0.64 %	0.21 %	10	129.6	#
of 10 (o) " " →	0.6492	0.27 %	0.09 %	10	129.8	o
of 10 (x) " " →	0.6758	13.69 %	4.56 %	10	135.2	x

1σ DEVIATION FROM MEAN FOR THE MEASURED VALUES

STANDARD DEVIATION OF THE MEAN $= \frac{\sigma_x}{\sqrt{n-1}}$

PWR RATIO STORED IN D MATRIX

MEAS #(=NC): 2

$$\sigma_x \overset{?}{=} \frac{100}{\text{mean}} \sqrt{\sum_{i=1}^{n} \frac{x_i^2 - \bar{x}^2}{n-1}}$$

1981/11/06 16:19

NBS1C.47 MEAS (D1-F14) T3-F12: X.25 by DAVE WAIT

-4-

Sysm # 6.11 RUN 1

AN/TSC-54 #3 Wahiawa, Hawaii
TUE: 1980 FEB 5 (1980.090)
7300 MHz(#), 7500 MHz(o), 7500 MHz(x),

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
76.0 F	61.2 F	60.3 %	13.4 gm/m13	3	5 mph

```
==========================================================================
AZIMUTH     ELEV     MEAS    HPBW     TIME(HRS)     OFFSET     CUT  RUN  SET  N
 247.55     44.38    6sec   0.5104    16.73417   -0.255deg     -2    1    1   2

                  T/Ta = 0.1148 + 0.00024*CSC L   #
                  T/Ta = 0.1149 + 0.00024*CSC L   o
                  T/Ta = 0.1147 + 0.00024*CSC L   x

GO :1=NEW AZ,EL ( =NO): 0     ?

 ELAPSE     PEAK#    PTS EX   HR BIAS       DCL BIAS      AZ BIAS       EL BIAS
  18sec      17        2     0.0000deg     0.0000deg     0.0000deg     0.0000deg

ZERO LEVEL   100% LEVEL    Xi(K)      K      Y(DB)   T(MOO)  S(JN)    T      Ta
 0.1151*Ta   0.5095*Ta   1.63E-03   0.681   6.460   197.2   24590   57.6   500.0#
 0.1153*Ta   0.5101*Ta   1.63E-03   0.681   6.460   197.2   24590   57.6   500.0o
 0.1151*Ta   0.5092*Ta   1.63E-03   0.681   6.460   197.2   24590   57.5   500.0x

      0         20        40        60        80        100  (%)
N3/sec!....!....!....!....!....!....!....!....!....!....!  PWR#1   PWR#2   P/Po
  1 34#                        !                           0.2154  0.5458  0.1149
  2 42o                        !                           0.2151  0.5448  0.1149
  3 48x                        !                           0.2156  0.5452  0.1151
  4 54#                        !                           0.2152  0.5463  0.1146
  5  0o                        !                           0.2153  0.5431  0.1154
  6  6x                        !                           0.2149  0.5464  0.1144
  7 12#                        !                           0.2148  0.5449  0.1147
  8 18o                        !                           0.2204  0.5475  0.1174
  9 24 x                       !                           0.2239  0.5462  0.1198
 10 30 #                       !                           0.2327  0.5487  0.1245
 11 36 o                       !                           0.2319  0.5434  0.1254
-12 42- - x - - - - - - - - - -!                           0.2699  0.5521  0.1463
-13 48     #                   !                           0.2955  0.5589  0.1600
-14 54          o              !                           0.3519  0.5715  0.1914
-15  0             x           !                           0.3795  0.5781  0.2066
-16  6                  #      !                           0.4663  0.6031  0.2525
 17 12                    x    !                           0.4776  0.6092  0.2569
-18 18                     x   !                           0.4931  0.6080  0.2681
-19 24                      #  !                           0.4987  0.6102  0.2708
-20 30                     o   !                           0.4899  0.6082  0.2658
-21 36                   x     !                           0.4649  0.6032  0.2515
-22 42- - - - - - - - -#- - - -!                           0.4440  0.5951  0.2416
 23 48              o          !                           0.3703  0.5770  0.2011
 24 54            x            !                           0.3454  0.5692  0.1881
 25  0        #                !                           0.3077  0.5633  0.1663
 26  6       o                 !                           0.2862  0.5572  0.1548
 27 12      x                  !                           0.2699  0.5564  0.1450
 28 18    #                    !                           0.2095  0.4640  0.1335
 29 24  o                      !                           0.2013  0.4714  0.1254
 30 30 x                       !                           0.1981  0.4713  0.1232
     !....!....!....!....!....!....!....!....!....!....!
                     1061645.3

#FIT   ANT HPBW    T(MOON )/Ta     HR ANG BIAS(fit)   PEAK#    LEVEL:    MOON
  4    0.253 deg   0.2749+-  1.53%   -0.0448 deg      18.80     40.6%

                   decrease DECL BIAS if 1st cut too deep
```

BIAS'S USED IN CALCULATION OF ANT POSITION

TIME PEAK EXPECTED

FIT ZONE

DATA USED FOR PARABOLIC FIT

FIT AMPLITUDE @ #1 FREQ

TIME PEAK OCCURED (via PARABOLIC FIT)

(via FIT for #1 FREQ

FIT AMPLITUDE EXPRESSED AS RATIO to T_a (FOR #1 FREQ)

(BIAS WHICH WOULD HAVE MADE THE EXPECTED PEAK COINSIDE WITH THE FIT PEAK

```
MEAS #( =NO): 3     ?

                              1981/11/06  16:45
NBS10.47  MEAS  <D1-F14> T3-F12:     X.25          by DAVE WAIT

                                     -12-
Sysm # 6.11
                         AN/TSC-54 #3 Wahiawa,Hawaii
                         TUE:   980 FEB 5   ( 19__        _FFSET      CUT   RUN   SET   N
                         7300 M   #), 75__                0.000deg     0      1     1    4

      TEMP                           48 + 0.00024*CSC L   # .
      7F                 T/Ta = 0.   49 + 0.00024*CSC L   o
                         T/Ta = 0.   47 + 0.00024*CSC L   x

GO :1=NEW AZ,EL ( =NO): 0     ?

 ELAPSE      PEAK#    PTS EX    HR BIAS        DCL BIAS        AZ BIAS        EL BIAS
  16sec       17        2      0.0000deg      0.0000deg      0.0000deg      0.0000deg

ZERO LEVEL  100% LEVEL      Xi(K)       K       Y(DB)    T(MOO)  S(JN)     T       Ta
 0.1151*Ta   0.5094*Ta   1.63E-03    0.680    6.458    197.1   24590    57.6    500.0#
 0.1153*Ta   0.5100*Ta   1.63E-03    0.680    6.458    197.1   24590    57.6    500.0o
 0.1151*Ta   0.5091*Ta   1.63E-03    0.680    6.458    197.1   24590    57.5    500.0x

        0         20        40        60        80        100  (%)
N3/sec!....!....!....!....!....!....!....!....!....!....!  PWR#1    PWR#2    P/Pa
  1 54#                                 !                  0.2183   0.5508   0.1154
  2  0o                                 !                  0.2178   0.5514   0.1150
  3  6x                                 !                  0.2229   0.5521   0.1178
  4 12  #                               !                  0.2462   0.5600   0.1296
  5 18    o                             !                  0.2789   0.5651   0.1478
  6 24      x                           !                  0.3117   0.5740   0.1651
  7 30         #                        !                  0.3514   0.5800   0.1877
  8 36                o                 !                  0.4372   0.6008   0.2342
  9 42                       x          !                  0.5445   0.6313   0.2899
 10 48                                  !                  0.6861   0.6677   0.3654
 11 54                                  !                o 0.8612   0.7092   0.4618
-12  0                                  !                  1.0973   0.7722   0.5852
-13  6                                  !                  1.3281   0.8261   0.7157
-14 12                                  !                  1.3568   0.8337   0.7307
-15 18                                  !                  1.3840   0.8381   0.7492
-16 24                                  !                  1.4095   0.8479   0.7578
 17 30                                  !                  1.3583   0.8342   0.7312
-18 36                                  !                  1.3623   0.8333   0.7363
-19 42                                  !                  1.0644 # 0.7552   0.5778
-20 48                                  !                o 0.8481   0.6999   0.4605
-21 54                                  !      x           0.6758   0.6566   0.3662
-22  0                       #          !                  0.5321   0.6196   0.2884
 23  6                o                 !                  0.4251   0.5939   0.2295
 24 12                    x             !                  0.4693   0.6052   0.2534
 25 18         #                        !                  0.3383   0.5730   0.1821
 26 24         o                        !                  0.3479   0.5739   0.1878
 27 30      x                           !                  0.2794   0.5573   0.1505
 28 36        #                         !                  0.3105   0.5656   0.1672
 29 42   o                              !                  0.2543   0.5500   0.1372
 30 48x                                 !                  0.2140   0.5409   0.1152
      !....!....!....!....!....!....!....!....!....!....!
                         1061652.48

#FIT     ANT HPBW       T(MOON )/Ta    HR ANG BIAS(fit)    PEAK#        MOON
  4      0.306 deg      0.7530+-  2.36%     0.0536 deg     14.85   LEVEL:
                                                                   161.9%
```

CENTER CUT

ADJUSTS GRAPH SCALE FOR 1st FREQ

THE FIT LEVEL OF THIS GRAPH WOULD HAVE BEEN 100% IF HAD USED

$$T_a' = \frac{T_a}{(\text{FIT LEVEL}/100)}$$

$$T_a' = 500/1.619$$

$$T_a' = 308.8$$

FIT ZONE

1st MEAS PT

FOR 1st FREQ

```
MEAS #( =NO): 6     ?
      :

                              1981/11/06  17:00
NBS1C.47  MEAS  <D1-F14> T3-F12:     X.25          by DAVE WAIT


                                      -16-
Sysm # 6.11                                                                  RUN  1

                         AN/TSC-54 #3 Wahiawa,Hawaii
                         TUE:  1980 FEB 5   ( 1980.090)
                         7300 MHz(#), 7500 MHz(o), 7500 MHz(x),

    TEMP        DEW PT.      REL HUMD      WATER DENS    CLOUD COVER    WIND
    77.3 F      61.6 F        58.6 %       13.6 gm/m↑3        3          0 mph
================================================================================

AZIMUTH     ELEV     MEAS     HPBW     TIME(HRS)     OFFSET     CUT  RUN  SET   N
 251.15     40.66    6sec    0.5104    17.04389     0.255deg     2    1    1    6

                          T/Ta = 0.1148 + 0.00024*CSC L  #
                          T/Ta = 0.1149 + 0.00024*CSC L  o
                          T/Ta = 0.1147 + 0.00024*CSC L  x

GO :1=NEW AZ,EL ( =NO): 0     ?

 ELAPSE     PEAK#   PTS EX   HR BIAS       DCL BIAS       AZ BIAS       EL BIAS
  18sec      17       2     0.0000deg     0.0000deg     0.0000deg     0.0000deg


ZERO LEVEL  100% LEVEL     Xi(K)      K      Y(DB)   T(MOO)  S(JN)    T       Ta
 0.1152*Ta   0.5091*Ta   1.63E-03   0.679   6.456   197.0   24590   57.6    500.0#
 0.1153*Ta   0.5097*Ta   1.63E-03   0.679   6.456   197.0   24590   57.6    500.0o
 0.1151*Ta   0.5089*Ta   1.63E-03   0.679   6.456   197.0   24590   57.5    500.0x

      0         20        40        60        80       100  (%)
N3/sec!....!....!....!....!....!....!....!....!....!....! PWR#1   PWR#2   P/Po
  1 10#                        !                         0.1921  0.4822  0.1161
  2 18o                        !                         0.1939  0.4882  0.1156
  3 24x                        !                         0.1980  0.4913  0.1176
  4 30 #                       !                         0.1997  0.4856  0.1202
  5 36 o                       !                         0.2054  0.4885  0.1232
  6 42  x                      !                         0.2156  0.4928  0.1289
  7 48   #                     !                         0.2270  0.4979  0.1350
  8 54    o                    !                         0.2414  0.5018  0.1436
  9  0     x                   !                         0.2538  0.5054  0.1508
 10  6      #                  !                         0.2780  0.5105  0.1656
 11 12         o               !                         0.3102  0.5218  0.1835
-12 18            x            !                         0.3492  0.5321  0.2066
-13 24    #                    !                         0.2451  0.4961  0.1480
-14 30               o         !                         0.3911  0.5327  0.2368
-15 36                  x      !                         0.4294  0.5463  0.2577
-16 42                     #   !                         0.4639  0.5575  0.2769
 17 48                       > !                         0.4948  0.5682  0.2935
-18 54                        x!                         0.5097  0.5693  0.3042
-19  0                       # !                         0.4995  0.5710  0.2952
-20  6                     o   !                         0.4773  0.5667  0.2812
-21 12                   x     !                         0.4412  0.5520  0.2632
-22 18                #        !                         0.4068  0.5428  0.2429
 23 24              o          !                         0.3816  0.5398  0.2260
 24 30          x              !                         0.3338  0.5277  0.1976
 25 36         #               !                         0.3027  0.5048  0.1854
```

```
26 42        o            !                              0.2883  0.5186  0.169
27 48      x              !                              0.2580  0.5035  0.1543
28 54   #                 !                              0.2563  0.5516  0.1380
29  0 o                   !                              0.2254  0.5395  0.1224
30  5                     !                              0.2120  0.5382  0.1146
    !....!....!....!....!....!....!....!....!....!....!....!
                     10617040
```

TIME OF MEAS (SECONDS)

ENDING TIME

HR MIN SEC

```
#FIT   ANT HPBW     T(MOON )/Ta      HR ANG BIAS(fit)   PEAK#    LEVEL:   MOON
  4    0.225 deg    0.3025+-  2.09%   -0.0375 deg       18.50     47.6%
```

decrease DECL BIAS if 1st cut too deep

```
                          1981/11/06  17:04
NBS10.47  MEAS  (D1-F14) T3-F12:     X.25          by DAVE WAIT
```



```
Sysm # 6.11                                                          RUN  1

                   AN/TSC-54 #3 Wahiawa,Hawaii
                   TUE:  1980 FEB 5   ( 1980.090)
                   7300 MHz(#), 7500 MHz(o), 7500 MHz(x),

    TEMP         DEW PT.      REL HUMID      WATER DENS     CLOUD COVER     WIND
    77.3 F       61.6 F        58.6 %        13.6 gm/m↑3         3          0 mph

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

                    BEST FIT FOR THE 5 CUTS  using  G= 50.8    dB

#FIT   ANT HPBW     T(MOON )/Ta      DECL OFFSET    T/Ta      ELEV     RUN  SET
  5    0.450 deg    0.6170+- 17.80%   0.004 deg    0.1151K  43.0deg    1    1

     Ta via G/Ta           G/T                  NEF                 NUF
     185.32 K           37.53 dB/K            1.12 K/m↑2          1.21 K/m↑2
```

IF YOU INTEND TO CHANGE DECL BIAS, WAIT!! UNTIL AFTER DATA IS STORED.

```
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                     100*(DATA-FIT)/(MAX dT(MOON )/Ta)

         CUT          -2         -1          0          1          2
                     4.0%      -16.9%      27.1%     -19.3%       5.2%

TO REPLACE A CUT:(1) KEY 1 then (2) KEY 3

REMARKS:?SIMULATED MOON CUT
STORE: INT FILE 14             EXT FILE  9              EXT SET#  1
```

MAT D:

SKY CUT

6825	4807	30	16534	2000
0	0	-22986	-22973	-22987
-23021	-22984	-20943	-20969	-18809
-18762	-16266	-16182	-16250	-22055
-22989	-23018	-22967	-22979	-22972
-22980	-23019	-23025	-23026	-22984
-23051	-23005	-23008	-23060	-23040
-23005	-23059	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	-2994	7300 ← 1st FREQ

LGT(dT_{STAR}/T_a)*10^4

−2 CUT

6755	4438	30	16734	-255
-14302	1700	-23026	-23023	-23005
-23050	-22977	-23065	-23040	-22808
-22604	-22225	-22152	-20611	-19711
-17923	-17159	-15153	-14978	-14553
-14454	-14640	-15193	-15595	-17429
-18096	-19330	-20043	-20701	-21522
-22149	-22325	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	24	7500 ← 2nd FREQ

−1 CUT

(AZ − 180) * 100	EL*100	# OF MEAS	TIME * 1000	DECL OFFSET * 1000
6834	4365	30	16796	-128
-9644	1800 ← YEAR #	-22980 ← for AB=1 LOG(P/U)*10^4	-22928 ← for AB=2	-23016 ← for AB=3 etc.
-22760	-22344	-22213	-22051	-21516
-20059	-18687	-15763	-14491	-12824
-10538	-10326	-10000	-9807	-9680
-9838	-10250	-10983	-11663	-13124
-15437	-17636	-18542	-19301	-20058
-21434	-22361	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	1148	7500 ← 3rd FREQ

LOG(((T_{STAR}+T)/T_a)/U)*10^4

T/T_a (for FREQ#1)*10^4

CENTER CUT

6909	4295	30	16857	0
-4227	1700	-22979	-23017	-22776
-21818	-20504	-19401	-18116	-15904
-13770	-11457	-9116	-6747	-4735
-4528	-4278	-4164	-4521	-4452
-6875	-9145	-11435	-13824	-16108
-15117	-18419	-18110	-20324	-19274
-21247	-22999	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	1149	0

FREQ#2 T/T_a*10^4

+1 CUT

6983	4222	30	16918	128
-9670	1800	-23064	-22999	-22607
-22338	-22173	-21726	-21117	-20073
-19162	-18148	-15592	-13055	-11313
-11209	-10251	-9666	-9629	-9881
-10247	-11239	-11686	-12858	-15132
-18343	-21173	-20298	-21693	-21907
-23031	-23026	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	1147	3

FREQ #3 T/Ta × 10^-4

NUMBER OF FREQUENCIES

+2 CUT

7115	4066	30	17044	255
-13346	1700	-22922	-22959	-22794
-22570	-22325	-21875	-21409	-20797
-20306	-19370	-18343	-17161	-20491
-15796	-14949	-14228	-13646	-13289
-13589	-14075	-14739	-15541	-16262
-17603	-18239	-19128	-20075	-21194
-22388	-23050	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	0
0	0	0	0	6

TIME BETWEEN MEASUREMENTS (SEC)

BEGIN SET 2

after this answer, MAT D is set equal to ZERO

```
:MAT D=0   SOURCE:MOON ( =NC): 6     ?
NEW FREQS( =NC): 0     ?
YOUR NAME( =NC,x13):  DAVE WAIT?
# MEAS PTS( =NC): 30    ?
# PTS IN FIT ZONE( =NC): 11    ?
MEAS #( =NC): 7   --9--
SKY OFFSET(DEG)( =NC): 2     ?
CLOUDS(0 TO 9=RAIN)( =NC): 0     ?2
WIND (MPH)( =NC): 0     ?5
```

6.5 The SPLIT program and annotated printout

The purpose of the SPLIT AND CHECKSET programs is to prepare the data for the fitting and reworking programs. These programs require that all of the data be in single frequency sets. If the data collected were only for a single frequency, then the SPLIT program is not required.

The SPLIT program contains three different routines. The first routine provides a way to list the contents in the various data files contained on the various daily MEAS tapes or SUMMARY tapes. It lists information with regard to whether the data have been processed by the FIT routine, whether the data are in a single frequency file, the run/set number of the file, and the frequency and antenna elevation conditions under which the data were taken.

The second routine in the SPLIT program takes a data set containing data for three (or two) data sets and splits it into three (two) data sets containing information only about one frequency each.

The last routine in the SPLIT program is a program to load data files from the various daily MEAS tapes and/or SUMMARY tapes and store them onto a different tape (e.g., a SUMMARY tape containing all the data for one frequency).

THE ANNOTATED PRINTOUT OF SPLIT PROGRAM.

INSERT SPLIT TAPE

```
LOAD
RUN
PROG EXT(5),INT(10)?10

FILES:(1)LIST,(2)SPLIT,(3)MOVE?1
LOAD from INT TAPE=0,EXT=1?0
LOAD FILES:START#,STOP#,STEP?9,25,1


NBS1F.39    DATA SPLIT  <D1-F27>

NBS1C.42  MEAS  <D1-F14> T3-F12:     X.25          by WAIT, JOHN W

                                       -1-
Sysm # 6.00                                                        RUN  103

                        AN TSC-54 #3 Wahiawa,Hawaii
                        FRI:  1980 FEB 8
                           0 MHz #,

                    N4 =  number of INTERATIONS in NONLINSFIT
```

LD FILE	N4	RN/ST	STAR	FREQ MHz	#	EL DEG	DATE	REMARKS
9	3	103.01	MOON	7500	1	57	FRIFEB8 1980	YSTRDY BIAS GUD&CLR SKYS OUTSID
10	0	103.02	MOON	7500	1	57	FRIFEB8 1980	DAVES GUNNA CHNG PRGM AT 6:42 A
11	0	103.03	MOON	7500	1	52	FRIFEB8 1980	SUNRISE. UT 0
12	0	103.04	MOON	7500	1	46	FRIFEB8 1980	WCD & JPW CONCUR ON MSSG CORCTN
13	0	103.05	MOON	7500	1	39	FRIFEB8 1980	SUN GETTING HOTTER ON PARAMPS
14	0	103.06	MOON	7500	1	32	FRIFEB8 1980	SUN ON PARAMPS
15	0	103.07	MOON	7500	1	24	FRIFEB8 1980	GOOD
16	0	103.08	MOON	7500	1	17	FRIFEB8 1980	SIGHTSEEING TIME!!!!!
17	0	103.09	MOON	7500	1	9	FRIFEB8 1980	VISITORS
18	0	2.01	MOON	7700	1	61	THUFEB7 1980	BAD PTS CUTS 1*2,DRIZZEL OUTSID
19	0	2.02	MOON	7700	1	59	THUFEB7 1980	BAD PT CUT-1,POOR DNCVR 7700
20	0	2.03	MOON	7500	1	53	THUFEB7 1980	HARD RAIN CUT-2,BAD PTS CUT 0
21	0	2.04	MOON	7500	1	46	THUFEB7 1980	HUMIDITY VARYING
22	0	2.05	MOON	7500	1	33	THUFEB7 1980	ROLLING NOW ! !!
23	0	2.06	MOON	7500	1	24	THUFEB7 1980	CHNGD TA1
24	0	2.07	MOON	7300	1	16	THUFEB7 1980	INTRCHNG FREQ
25	0	2.08	MOON	7300	1	8	THUFEB7 1980	FINISHED MOON

```
FILES:(1)LIST,(2)SPLIT,(3)MOVE?3
LOAD from INT TAPE=0,EXT=1?1
LOAD FILES:START#,STOP#,STEP?42,49,1
STORE to INT TAPE=0,EXT=1?0
STORE:(STARTING FILE #),STEP?9,1
FREQ(MHz) to be MOVED (0=ALL)?0
```

← CAN MOVE ONLY FILES OF ONE SPECIFIC FREQUENCY

```
NBS1F.39    DATA SPLIT  <D1-F27>

NBS1C.38  MEAS  <D1-F14> T3-F12:     X.24        by WAKEFIELD,WAIT

                                   -4-
Sysm # 6.00                                                       RUN    2

                     AN/TSC-54 #3 Wahiawa,Hawaii
                     THU:  1980 FEB 7
                     7700 MHz #,
                     7300 MHz o,

                            N4=STORE file #
```

LD FILE	N4	RN/ST	STAR	FREQ	#	EL	DATE	REMARKS
42	9	2.01	MOON	7300	2	61	THUFEB7 1980	BAD PTS CUTS 1&2,DRIZZEL OUTSID
43	10	2.02	MOON	7300	2	59	THUFEB7 1980	BAD PT CUT-1,POOR DNCVR 7700
44	11	2.03	MOON	7300	2	53	THUFEB7 1980	HARD RAIN CUT-2,BAD PTS CUT 0
45	12	2.04	MOON	7300	2	46	THUFEB7 1980	HUMIDITY VARYING
46	13	2.05	MOON	7300	2	33	THUFEB7 1980	ROLLING NOW ! !!
47	14	2.06	MOON	7300	2	24	THUFEB7 1980	CHNGD TA1
48	15	2.07	MOON	7500	2	16	THUFEB7 1980	INTRCHNG FREQ
49	16	2.08	MOON	7500	2	8	THUFEB7 1980	FINISHED MOON

```
FILES:(1)LIST,(2)SPLIT,(3)MOVE?2
LOAD from INT TAPE=0,EXT=1?1
LOAD FILES:START#,STOP#,STEP?42,50,1
```

```
NBS1F.39    DATA SPLIT  <D1-F27>

NBS1C.42  MEAS  <D1-F14> T3-F12:     X.25          by WAIT, JOHN W
```

-7-

Sysm # 6.00 RUN 3

AN/TSC-54 #3 Wahiawa,Hawawii
FRI: 1980 FEB 8
7300 MHz #,
7500 MHz o,
7300 MHz x,

N4=SET# in MAT B

LD FILE	N4	RN/ST	STAR	FREQ MHz	#	EL DEG	DATE	REMARKS
42	1	3.01	MOON	7300	3	57	FRIFEB8 1980	YSTRDY BIAS GUD&CLR SKYS
43	2	3.02	MOON	7300	3	57	FRIFEB8 1980	DAVES GUNNA CHNG PRGM AT 6:42 A
44	3	3.03	MOON	7300	3	52	FRIFEB8 1980	SUNRISE.
45	4	3.04	MOON	7300	3	46	FRIFEB8 1980	WCD & JPW CONCUR ON MSSG CORCTN
46	5	3.05	MOON	7300	3	39	FRIFEB8 1980	SUN GETTING HOTTER ON PARAMPS
47	6	3.06	MOON	7300	3	32	FRIFEB8 1980	SUN ON PARAMPS
48	7	3.07	MOON	7300	3	24	FRIFEB8 1980	GOOD
49	8	3.08	MOON	7300	3	17	FRIFEB8 1980	SIGHTSEEING TIME!!!!!
50	9	3.09	MOON	7300	3	9	FRIFEB8 1980	VISITORS

```
STORE FREQ #??1
STORE to INT TAPE=0,EXT=1?0
STORE:(STARTING FILE #),STEP?35,1
```

STORE FILE	RUN/SET	STAR	FREQ	ELEV	DATE	REMARKS
35	3.01	MOON	7300	57	FRIFEB8 1980	YSTRDY BIAS GUD&CLR SKYS OUTSI
36	3.02	MOON	7300	57	FRIFEB8 1980	DAVES GUNNA CHNG PRGM AT 6:42
37	3.03	MOON	7300	52	FRIFEB8 1980	SUNRISE. UT 0
38	3.04	MOON	7300	46	FRIFEB8 1980	WCD & JPW CONCUR ON MSSG CORCT
39	3.05	MOON	7300	39	FRIFEB8 1980	SUN GETTING HOTTER ON PARAMPS
40	3.06	MOON	7300	32	FRIFEB8 1980	SUN ON PARAMPS
41	3.07	MOON	7300	24	FRIFEB8 1980	GOOD
42	3.08	MOON	7300	17	FRIFEB8 1980	SIGHTSEEING TIME!!!!!
43	3.09	MOON	7300	9	FRIFEB8 1980	VISITORS

```
STORE FREQ #?2
STORE to INT TAPE=0,EXT=1?0
STORE:(STARTING FILE #),STEP?9,1
```

STORE FILE	RUN/SET	STAR	FREQ	ELEV	DATE	REMARKS
9	103.01	MOON	7500	57	FRIFEB8 1980	YSTRDY BIAS GUD&CLR SKYS OUTSI
10	103.02	MOON	7500	57	FRIFEB8 1980	DAVES GUNNA CHNG PRGM AT 6:42
11	103.03	MOON	7500	52	FRIFEB8 1980	SUNRISE. UT 0
12	103.04	MOON	7500	46	FRIFEB8 1980	WCD & JPW CONCUR ON MSSG CORCT
13	103.05	MOON	7500	39	FRIFEB8 1980	SUN GETTING HOTTER ON PARAMPS
14	103.06	MOON	7500	32	FRIFEB8 1980	SUN ON PARAMPS
15	103.07	MOON	7500	24	FRIFEB8 1980	GOOD
16	103.08	MOON	7500	17	FRIFEB8 1980	SIGHTSEEING TIME!!!!!
17	103.09	MOON	7500	9	FRIFEB8 1980	VISITORS

6.6 The CHECKSET program and annotated printout

The CHECKSET program is used to replace isolated bad data points. It operates only on a single frequency data set. Usually, this program is not needed. However, if one of the coaxial switches occasionally closes improperly, or if a data point was taken during a power transient, this program salvages the data set.

INSERT CHECK SET TAPE

```
LOAD
RUN
PROG EXT(5),INT(10)?10
```

REWIND CHECKSET TAPE & INSERT SUMMARY TAPE (NOT WRITE PROTECTED)

```
CHECKSET:LOAD FROM INT=0,EXT=1?0
LOAD FILES:START#,STOP#,STEP??28,35,1
STORE to INT TAPE=0,EXT=1?0


NBS1G.09    CHECKSET  <D1-F29>

NBS1C.38  MEAS  <D1-F14> T3-F12:     X.24        by WAKEFIELD,WAIT

                              -1-

              AN/TSC-54 #3 Wahiawa,Hawaii
              THU:  1980 FEB 7
                 0 MHz #,


 LDfile  RN/ST   STAR  FREQ  #  EL     DATE          REMARKS
 28     102.02   MOON  7300  1  59  THUFEB7 1980 BAD PT CUT-1,POOR DNCVR 7700
HADVAR= 7.65607E-03   ← CUT -2  OK
HADVAR= 0.399862911   ← CUT-1   variance too large
 1     0     0
=================================================================================
                                                               CUT  RUN  SET   N
                                                               -1   102    2   9
   N3 PWR/PWR(ADD)
    1  0.72940     2  0.73680     3  0.85587     4  0.75591     5  0.74943
    6  0.75530     7  0.77527     8  0.77947     9  0.79204    10  0.80587
   11  0.68740    12  0.96740    13  0.89670    14  0.76618    15  0.76251
   16  0.75071    17  0.88405    18  0.74242    19  0.76030    20  4.09498
.................................................................................
 AT POINT N3= 20 THE VALUE 4.09498 WAS REPLACED WITH 0.76626  ON CUTPASS 1
HADVAR= 0.084255917 ← NOW CUT -1 is OK
HADVAR= 0.867043758   CUT Ø variance too LARGE
 1     0     0
=================================================================================
                                                               CUT  RUN  SET   N
                                                               -0   102    2  10
   N3 PWR/PWR(ADD)
    1  0.73408     2  0.73687     3  0.74996     4  0.75116     5  0.76871
    6  0.77187     7  0.77118     8  0.78432     9  0.80918    10  0.79585
   11  0.83174    12  0.80000    13  3.96958    14  1.06169    15  0.77210
   16  0.76083    17  0.75274    18  0.74876    19  0.73093    20  0.72910
.................................................................................
 AT POINT N3= 13 THE VALUE 3.96958 WAS REPLACED WITH 0.97382  ON CUTPASS 1
HADVAR= 0.062312368 ← cut Ø NOW IS OK
HADVAR= 0.015146980 — cut 1  OK
HADVAR= 0.012875245 ← cut 2  OK
=================================================================================
```

CORRECTED DATA STORED

```
STORE  RUN/SET  STAR   FREQ   ELEV     DATE        REMARKS
 28    102.02   MOON   7300    59   THUFEB7 1980  BAD PT CUT-1,POOR DNCVR 7700
```

6.7 The FIT program and annotated printout

The purpose of the FIT program (also referred to, or labled, as NONLINLSFIT) is to make a precision, 3-D Gaussian fit to a set of data to obtain a precision measure of the amplitude of the signal caused by the star, to obtain a measure of the sky background temperature, and to obtain a measure of the half-power beamwidth (HPBW). This is a precision fitting program and it runs slow (30 minutes or more per data set).

* INSERT FIT TAPE

BE SURE you will waste a lot of time if you don't notice

```
LOAD
RUN
                     NBS1H.08 NONLINLSFIT <D1-F31>

PGM: VERSION V.00-A%-70-18-G
MAX NUMBER OF PASSES?8
KEY IN today's time/date?0830  10/26/81
BATCH RUN ID:
DATA FIT RUN TIME/DATE: 0830  10/26/81
K: beamwidth guess (deg)?.47
DATA DEVICE?: 5(DISC), 10(CASS)?10
KEY IN:    FIRSTFILE, LASTFILE?9,13,1
```

* REWIND FIT TAPE & REMOVE

* INSERT SUMMARY TAPE (NOT WRITE PROTECTED)

```
STARTSET STARTSET STARTSET STARTSET STARTSET STARTSET STARTSET STARTSET STARTSET

PGM: VERSION V.00-A%-70-18-G
NONLINLSFIT GAUSSIAN SHAPE MODEL        FILE:   9        RUN.SET 103.01
BATCH RUN ID:
DATA FIT RUN TIME/DATE: 0830  10/26/81
               FRIFEB8 1980AN/TSC-54 #3 Wahiawa,Hawawii
  N0= 6     S$ SOURCE: MOON          YSTRDY BIAS GUD&CLR SKYS OUTSIDE
  NBS1C.42  MEAS  <D1-F14> T3-F12          X.25by WAIT, JOHN W
D(6,75) = <DATAPOINTTIME> =  18 seconds          DATA STATUS D(1,70):     0
FREQ: 7500    MHz    nominal dTadd: 999  kelvin
ALPHA= 70   (the number of data points fitted in the set)
(MAX-MIN)=   0.11288 =(   0.93201 MINUS   0.81913)      RUN.SET: 103.01
```

CENTER PT OF FITTED CURVE — INITIAL VALUE FOR INITIAL MAX — INITIAL SYSTEM TEMP (AVE of -3 CUT)

```
X(11)= 0.10064267   J4= 36   , P(J4)= 0.926899   , C6= 0.826256330
--------------------------------------------------------------------------
PASSNUM= 1    D Tsrce 100.5420274    H width= 0.47      FILE: 9
               FRIFEB8 1980AN/TSC-54 #3 Wahiawa,Hawawii

N4 VALUES: 14    14    14    14    14    SYSTEMCUT N4: 14
OBSERVATIONS, P(obs), SELF-SCALED:   INITIAL CALCULATIONS, Z(calc):
=========================================================================
 N.DECL. OFFSET: -0.262 degrees    POINT  1    -0.262 degrees (FITTED)
 0.83368      o                    : 0.82764    o                      :
 0.83920        o                  : 0.82955    o                      :
 0.84526         o                 : 0.83320     o                     :
 0.85598           o               : 0.83911      o                    :
 0.86139            o              : 0.84721        o                  :
 0.88346                o          : 0.85633          o                :
 0.87738               o           : 0.86424            o              :
 0.88771                 o         : 0.86848             o             :
 0.87266              o            : 0.86758             o             :
 0.85410          o                : 0.86185           o               :
 0.85341          o                : 0.85324         o                 :
 0.84088        o                  : 0.84426       o                   :
 0.83076      o                    : 0.83683      o                    :
 0.92629     o                     : 0.83172     o                     :
=========================================================================
 N.DECL. OFFSET: -0.131 degrees    POINT 15    -0.131 degrees (FITTED)
 0.84264        o                  : 0.83254     o                     :
 0.85838           o               : 0.83948      o                    :
 0.87633               o           : 0.85076         o                 :
 0.90519                    o      : 0.86622            o              :
 0.91520                      o    : 0.88363                o          :
 0.92690                         o : 0.89873                   o       :
 0.91474                      o    : 0.90683                     o     :
 0.90456                    o      : 0.90510                     o     :
 0.89951                   o       : 0.89416                  o        :
 0.86165            o              : 0.87772               o           :
 0.85307          o                : 0.86059           o               :
 0.83459       o                   : 0.84641        o                  :
 0.83652       o                   : 0.83667      o                    :
 0.82861     o                     : 0.83099    o                      :
-------------------------------------------------------------------------
```

```
=======================================================================
 N.DECL. OFFSET:  0.000 degrees    POINT 29       0.000 degrees (FITTED)
 0.83326      o                    : 0.83065    o                      :
 0.84670         o                 : 0.83634      o                    :
 0.85838           o               : 0.84662        o                  :
 0.87467              o            : 0.86246           o               :
 0.89511                  o        : 0.88288                o          :
 0.91493                      o    : 0.90420                     o     :
 0.93201                          o: 0.92067                        o  :
 0.92690                         o : 0.92690                          o:
 0.92922                         o : 0.92067                        o  :
 0.90628                     o     : 0.90420                     o     :
 0.88851                 o         : 0.88288                o          :
 0.87240              o            : 0.86246           o               :
 0.85376          o                : 0.84662        o                  :
 0.84907         o                 : 0.83634      o                    :
=======================================================================
 N.DECL. OFFSET:  0.131 degrees    POINT 43       0.131 degrees (FITTED)
 0.84383        o                  : 0.82979    o                      :
 0.84551         o                 : 0.83437     o                     :
 0.85855           o               : 0.84265       o                   :
 0.87205              o            : 0.85542          o                :
 0.88789                 o         : 0.87189             o             :
 0.90546                    o      : 0.88908                 o         :
 0.90927                     o     : 0.90237                    o      :
 0.90982                     o     : 0.90740                     o     :
 0.90700                     o     : 0.90237                    o      :
 0.88709                 o         : 0.88908                 o         :
 0.88399                o          : 0.87189             o             :
 0.85864           o               : 0.85542          o                :
 0.84958          o                : 0.84265       o                   :
 0.84062        o                  : 0.83437     o                     :
=======================================================================
 N.DECL. OFFSET:  0.262 degrees    POINT 57       0.262 degrees (FITTED)
 0.82861     o                     : 0.83484     o                     :
 0.84628         o                 : 0.84153       o                   :
 0.85487           o               : 0.85016         o                 :
 0.87161              o            : 0.85917           o               :
 0.87179              o            : 0.86614            o              :
 0.86987             o             : 0.86878             o             :
 0.86329            o              : 0.86614            o              :
 0.86415            o              : 0.85917           o               :
 0.85069          o                : 0.85016         o                 :
 0.84163        o                  : 0.84153       o                   :
 0.83376      o                    : 0.83484     o                     :
 0.82736     o                     : 0.83050    o                      :
 0.81913    o                      : 0.82810    o                      :
 0.82695     o                     : 0.82696    o                      :
=======================================================================
(MAX-MIN)=    0.11288 =(    0.93201 MINUS    0.81913)        RUN.SET: 103.01
                                   fr HPBW (DEG)
PASSNUM= 1    D Tsrce 100.5420274    H width= 0.47         FILE: 9
STD DEV RESIDUALS:     0.014201     SLOP:      0.6954650     RUN.SET: 103.01
TWO LARGEST RESIDUALS:  Q       H(Q)     H(Q)/SIGMA    Q      H(Q)     H(Q)/SIGMA
                       18    0.03897     2.74393      19    0.03158     2.22361
-------------------------------------------------------------------------------
PASSNUM= 2    D Tsrce 101.9752827    H width= 0.5312707     FILE: 9
STD DEV RESIDUALS:     0.005496     SLOP:      0.4853367     RUN.SET: 103.01
TWO LARGEST RESIDUALS:  Q       H(Q)     H(Q)/SIGMA    Q      H(Q)     H(Q)/SIGMA
                       23    0.01534     2.79143      20    0.01184     2.15447
-------------------------------------------------------------------------------
PASSNUM= 3    D Tsrce 107.3730695    H width= 0.5201868     FILE: 9
STD DEV RESIDUALS:     0.004795     SLOP:      0.0120357     RUN.SET: 103.01
TWO LARGEST RESIDUALS:  Q       H(Q)     H(Q)/SIGMA    Q      H(Q)     H(Q)/SIGMA
                       23    0.01090     2.27313      57    0.00993     2.07082
-------------------------------------------------------------------------------
                                    GOODNESS-OF-FIT   PARAMETER
```

```
PASSNUM= 4    D Tsrce 107.8526375    H width= 0.52103239      FILE: 9
STD DEV RESIDUALS:    0.004784     SLOP:       0.0010028    RUN.SET: 103.01
TWO LARGEST RESIDUALS:  Q      H(Q)     H(Q)/SIGMA   Q      H(Q)     H(Q)/SIGMA
                       23   0.01136    2.37393    57   0.00977    2.04286
--------------------------------------------------------------------------------
PASSNUM= 5    D Tsrce 107.7833797    H width= 0.52041434      FILE: 9
STD DEV RESIDUALS:    0.004784     SLOP:       0.0001077    RUN.SET: 103.01
TWO LARGEST RESIDUALS:  Q      H(Q)     H(Q)/SIGMA   Q      H(Q)     H(Q)/SIGMA
                       23   0.01128    2.35726    57   0.00981    2.05105
--------------------------------------------------------------------------------
PASSNUM= 6    D Tsrce 107.8066647    H width= 0.520639217     FILE: 9
               FRIFEB8 1980AN/TSC-54 #3 Wahiawa,Hawawii

PASSNUM= 6    D Tsrce 107.8066647    H width= 0.520639217     FILE: 9
STD DEV RESIDUALS:    0.004784     SLOP:       0.0000107    RUN.SET: 103.01
TWO LARGEST RESIDUALS:  Q      H(Q)     H(Q)/SIGMA - Q      H(Q)     H(Q)/SIGMA
                       23   0.01129    2.36022    57   0.00980    2.04732
--------------------------------------------------------------------------------
PASSNUM= 7    D Tsrce 107.7999243    H width= 0.520569201     FILE: 9
STD DEV RESIDUALS:    0.004784     SLOP:       0.0000011    RUN.SET: 103.01
TWO LARGEST RESIDUALS:  Q      H(Q)     H(Q)/SIGMA   Q      H(Q)     H(Q)/SIGMA
                       23   0.01129    2.35960    57   0.00980    2.04837
--------------------------------------------------------------------------------
RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS RESULTS

SALIENT RESULTS HAVE BEEN WRITTEN IN D MATRIX OF FILE 9
BATCH RUN ID:
DATA FIT RUN TIME/DATE: 0830  10/26/81
               FRIFEB8 1980AN/TSC-54 #3 Wahiawa,Hawawii
  N0= 6     S# SOURCE: MOON             YSTRDY BIAS GUD&CLR SKYS OUTSIDE
  NBS1C.42  MEAS  <D1-F14> T3-F12          X.25by WAIT, JOHN W
NONLINLSFIT GAUSSIAN SHAPE MODEL         FILE:   9        RUN.SET 103.01

RESIDUALS H=P(obs)-Z,MAGNIFIEDx3:   FINAL CALCULATIONS, Z(calc):
========================================================================
 N.DECL. OFFSET: -0.262 degrees    POINT  1     -0.235 degrees (FITTED)
 0.00227                o          : 0.83141     o                     :
 0.00194                o          : 0.83725      o                    :
-0.00062              o            : 0.84588         o                 :
-0.00075              o            : 0.85673           o               :
-0.00675           o               : 0.86814             o             :
 0.00591                  o        : 0.87755               o           :
-0.00499            o              : 0.88238                o          :
 0.00661                    o      : 0.88110                o          :
-0.00131               o           : 0.87397               o           :
-0.00879         o                 : 0.86289            o              :
 0.00288                 o         : 0.85053          o                :
 0.00159                 o         : 0.83928        o                  :
 0.00024               o           : 0.83052     o                     :
 0.00177                o          : 0.82452    o                      :
========================================================================
 N.DECL. OFFSET: -0.131 degrees    POINT 15     -0.104 degrees (FITTED)
-0.00381             o             : 0.84646         o                 :
-0.00325              o            : 0.86162            o              :
-0.00364             o             : 0.87997                o          :
 0.00664                    o      : 0.89855                    o      :
 0.00198                 o         : 0.91322                       o   :
 0.00681                    o      : 0.92009                        o  :
-0.00246              o            : 0.91720                       o   :
-0.00091               o           : 0.90547                     o     :
 0.01129                      o    : 0.88822                  o        :
-0.00807           o               : 0.86971              o            :
-0.00040               o           : 0.85347           o               :
-0.00675            o              : 0.84134        o                  :
 0.00302                 o         : 0.83349       o                   :
-0.00046               o           : 0.82907      o                    :
------------------------------------------------------------------------
```

```
========================================================================
 N.DECL. OFFSET:  0.000 degrees    POINT 29      0.027 degrees (FITTED)
 0.00062               o           : 0.83264     o                     :
 0.00428                 o         : 0.84242       o                   :
 0.00141               o           : 0.85697          o                :
-0.00133              o            : 0.87600              o            :
-0.00222             o             : 0.89732                  o        :
-0.00202             o             : 0.91695                      o    :
 0.00186                o          : 0.93015                         o :
-0.00648           o               : 0.93338                          o:
 0.00338                 o         : 0.92584                        o  :
-0.00364            o              : 0.90992                     o     :
-0.00148              o            : 0.88999                 o         :
 0.00178                o          : 0.87062             o             :
-0.00117              o            : 0.85493          o                :
 0.00500                  o        : 0.84407        o                  :
========================================================================
 N.DECL. OFFSET:  0.131 degrees    POINT 43      0.158 degrees (FITTED)
 0.00356                 o         : 0.84027       o                   :
-0.00182              o            : 0.84734        o                  :
 0.00041               o           : 0.85815          o                :
-0.00035              o            : 0.87240             o             :
-0.00044              o            : 0.88833                 o         :
 0.00271                o          : 0.90275                   o       :
-0.00273             o             : 0.91200                     o     :
-0.00357            o              : 0.91339                      o    :
 0.00059               o           : 0.90641                    o      :
-0.00595           o               : 0.89304                 o         :
 0.00726                   o       : 0.87673              o            :
-0.00237             o             : 0.86101           o               :
 0.00134               o           : 0.84824        o                  :
 0.00137               o           : 0.83925       o                   :
========================================================================
 N.DECL. OFFSET:  0.262 degrees    POINT 57      0.289 degrees (FITTED)
-0.00980         o                 : 0.83841      o                    :
 0.00022               o           : 0.84606        o                  :
 0.00009               o           : 0.85477          o                :
 0.00875                    o      : 0.86286           o               :
 0.00348                 o         : 0.86831             o             :
 0.00034               o           : 0.86953             o             :
-0.00285             o             : 0.86614            o              :
 0.00508                  o        : 0.85907           o               :
 0.00051               o           : 0.85018         o                 :
 0.00019               o           : 0.84144       o                   :
-0.00048              o            : 0.83424      o                    :
-0.00173              o            : 0.82910     o                     :
-0.00673           o               : 0.82596    o                      :
 0.00292                o          : 0.82403    o                      :
========================================================================
(MAX-MIN)=   0.02109 =(   0.01129 MINUS  -0.00980)       RUN.SET: 103.01

STD DEV RESIDUALS:     0.004784      SLOP:      0.0000011    RUN.SET: 103.01
TWO LARGEST RESIDUALS:  Q      H(Q)    H(Q)/SIGMA   Q      H(Q)    H(Q)/SIGMA
                       23   0.01129    2.35960     57   0.00980    2.04837
```

X( )	PARAMETER	VALUE		Y(J)
			FIT SKY BACKGROUND FOR CUT #-2	
1	Tsystem	0.8211688	(CUT)	9.99000E+02
2	Tsystem	0.8235975	-1	9.99000E+02
3	Tsystem	0.8265191	0	9.99000E+02
4	Tsystem	0.8304253	1	9.99000E+02
5	Tsystem	0.8238832	2	9.99000E+02
			SLOPE FOR CUT -2	
6	SLOPE	-0.0004354		1.99800E+05
7	SLOPE	0.0001832	-1	1.99800E+05
8	SLOPE	0.0005808	0	1.99800E+05
9	SLOPE	-0.0002628	1	1.99800E+05
10	SLOPE	-0.0001479	2	1.99800E+05
11	D Tsrce	0.1079099		9.99000E+02
12	D ibias	-0.9633398	FIT HR ANG BIAS for CUT -2	7.13567E-02
13	D ibias	-1.1407674		7.13567E-02
14	D ibias	-0.2588832		7.13567E-02
15	D ibias	-0.3080618	etc.	7.13567E-02
16	D ibias	-0.2075402		7.13567E-02
17	Z tbias	0.0274947	FIT DECL BIAS	1.00000E+00
18	H width	HPBW 0.5205905	(DEG)	1.00000E+00

UNCERTAINTY OF PARAMETERS

X( )	PARAMETER	E: DELTAX	UNCERTAINTY	UNC/VALUE
1	Tsystem	-0.0031641	3.3642980	0.0041
2	Tsystem	-0.0036865	3.4649179	0.0042
3	Tsystem	-0.0033726	3.0370067	0.0037
4	Tsystem	-0.0035788	3.3743183	0.0041
5	Tsystem	-0.0044082	3.5539092	0.0043
6	SLOPE	0.0059574	109.0779543	-1.2540
7	SLOPE	0.0907857	111.0010728	3.0321
8	SLOPE	-0.0232847	108.7963486	0.9376
9	SLOPE	0.0014559	108.9596091	-2.0748
10	SLOPE	0.2284913	116.2118401	-3.9329
11	D Tsrce	0.0020645	2.7610098	0.0256
12	D ibias	-0.0000020	0.0179999	-0.2619
13	D ibias	-0.0000088	0.0110599	-0.1359
14	D ibias	0.0000019	0.0102988	-0.5575
15	D ibias	0.0000004	0.0132254	-0.6016
16	D ibias	-0.0000583	0.0231709	-1.5646
17	Z tbias	-0.0000008	0.0084491	0.3073
18	H width	0.0000213	0.0186479	0.0358

```
BATCH RUN ID:
DATA FIT RUN TIME/DATE: 0830  10/26/81
              FRIFEB8 1980AN/TSC-54 #3 Wahiawa,Hawaii
  N0= 6     S$ SOURCE: MOON           YSTRDY BIAS GUI&CLR SKYS OUTSIDE
  NBS1C.42  MEAS  <D1-F14> T3-F12          X.25by WAIT, JOHN W
SALIENT RESULTS HAVE BEEN WRITTEN IN D MATRIX OF FILE 9

PGM: VERSION V.00-A%-70-18-G
NONLINLSFIT GAUSSIAN SHAPE MODEL         FILE:   9        RUN.SET 103.01

endset endset endset endset endset endset endset endset endset endset endset
```

6.8 The REWORK Program

The purpose of the program REWORK is to calculate the primary parameters G/T, G/T_a, NEF, NUF, the half-power beamwidth of Cas A (or moon) convoluted with the antenna beam pattern along a path of constant declination (*HPBW#1), the half-power beamwidth perpendicular to the constant declination (*HPBW#2), and the antenna HPBW, each as a function of elevation. Then the program calculates a least squares fit for each of the six primary parameters to curves of the form $y = ax + b$ where x is either the elevation angle (linear fit) or the cosecant of the elevation angle (csc fit). For the parameters G/T, G/T_a, NEF, and NUF, the measurement errors are calculated. The measurement errors taken into account are those discussed in the site preparation section, and by Daywitt [3] in a separate publication. The deviations of the data paints from the fit curves are calculated for the primary parameters, and also for the measured Y-factor. The conditions assumed for measurement and for the error estimate are labeled and printed out. The results of many of the subcalculations used in the error calculations and some related parameters are printed out. The peripheral calculations are presented to help the metrologist using the REWORK program get a better feel about the conditions for the measurement and information to help decide whether to retain or reject a measurement set.

Basically, the REWORK program calculates the measurement results based on the precision fit results from FIT and then plots them.

6.8.1 Summary Tapes

The REWORK program is designed to rework single frequency data contained on a single frequency summary tape; so, if data from different tapes are desired in the rework, the data have to be collected onto a single tape using the SPLIT program. Files are marked at the first of the summary tape to store the results of a REWORK of the data.

6.8.2 REWORK Program

Before the rework can begin, the data on the summary tape must be processed by the FIT program. Using the listing routine in SPLIT, it is handy to have a listing of all the data sets on the summary tape. The REWORK is loaded and run, and when the program arrives at the TRAP position, it displays

ORW,1LOAD,2AUTO,3DEL,4G/T(= NC) =0?

The options are as follows: ORW starts the rework procedure. Namely, new values of NEF, NUF, G/T, G/T_a, HPBW, etc. are calculated using the results of the FIT program. A summary of the new calculations is stored, and the results are plotted.

1LOAD loads the summary of calculations from a prior rework.

2AUTO is used to replot the data from a rework (ORW), or plot data that was loaded (1LOAD), or to replot the results after certain of the data sets were deleted via 3DEL.

3DEL is used to exclude the results from certain data sets from the result plots (2AUTO), or vice versa (i.e., to include previously excluded data sets). The data sets which are excluded are indicated with a minus sign before the elevation on the summary list (4G/T option).

4G/T is used to list out the summary of the calculations.

6.8.3 Selecting the Data to be Deleted

An important step in reworking the data is in the selection of the data sets to be deleted from the final results. The rule of thumb is "never remove a data set without a valid reason". This rule leaves a good deal of latitude, and nothing identifies a skilled metrologist more than the information and care used to document the reasons for rejecting data. The design of the rework steps is arranged to aid in recognizing invalid data. We recommend that, on the list of data sets deleted from the final results (indicated by a minus sign on the data list), the reason for each deletion be included with the final results. This practice encourages complete annotation of measurement anomalies as they occur during the measurement process and helps an outsider judge the reliability of the measurement process. Following are some of the reasons we have used for deleting data sets.

(1) The set was not processed by the calculator. The fitting procedure is very robust, but it needs power measurements surrounding the peak of the star output before the process can meaningfully converge.

(2) An error occurred in the measurement conditions (i.e., missetting the antenna, an error in setting the down converter frequency, or the frequency lock circuit was out of range). If the problem is discovered in time, the data usually can be retaken. Otherwise, a comment is recorded on the data sheets and in a measurement comment associated with a subsequent measurement. An antenna pointing error can usually be detected, because one cut will have the star peak in a distinctly different place than the other cuts.

(3) The star used was not Cas A. Sometimes it is useful to select a star other than Cas A to examine the G/T trend at angles lower than what is available using Cas A. Because the alternate stars are not as well studied as Cas A, this information is not usually included in the final results.

(4) The measurement conditions were abnormal (i.e., the data were taken during a violent rain storm). Measurements, particularly at low angles, can be greatly affected by condensed water particles. The atmospheric conditions between the star and the antenna are assumed to be uniform.

(5) The result of one data set has a large deviation compared to the others. If the frequency was incorrectly recorded, this is usually obvious on the G/T_a or Y-factor plot because the coupling ratio of the noise add directional coupler is frequency dependent. It is unusual for any measurement set to lie outside the error bars on the NEF plot. Any point that lies half again farther out than the error bar should be deleted. In fact, any point that is near the error bars on the NEF should be scrutinized on the rework sheets as to how well the measured data agree with the remaining data set results. In this regard, remember that the HPBW and Y-factor plots have only one-sigma error bars, so that one third of the data is expected to lie outside these error bars. If the offending measurement set is way out of line with the others (say three times the error bar) on one or more of the result plots, it is usually best to delete the data set.

6.8.4 Typical Rework Procedure

The typical rework procedure for data taken at three frequencies would go as foows:

1. Using SPLIT and the original three frequency summary tapes (and/or the data tapes if an ERROR 59 is encountered), split the data into three different Single Frequency Summary Tapes (SFST's).

2. Using each of the three SFST's and FIT, each data set is fit to a 3-D Gaussian curve and the fit results recorded back onto the three SFST's.

3. By looking at the graphs from FIT, identify the file numbers of the data sets that have isolated bad data points.

4. If there are any data sets with isolated bad data points, use CHECKSET on these files. CHECKSET will replace the bad data points with a point which is the mean of the data on either side.

5. Using FIT, refit each of the files corrected with CHECKSET.

6. Using each of the three SFST's and REWORK, perform option ORW in the REWORK program.

7. Examine the printouts and determine which (if any) data sets need to be deleted. If none, you are finished. Otherwise, using REWORK and the appropriate SFST, reload the summary results into the calculator (if it is not in the computer memory) using the 1LOAD option, delete the bad data sets (use 3DEL), and replot the results (use 2AUTO).

6.8.5 Interpretation of Results

The results of a measurement are printed out as a series of twelve computer printouts; (1) a summary table of the measurement results, (2) a table of the results of the least squares fits of G/T, G/T_a, antHPBW, Y-Factor, NEF, and NUF versus the cosecant of the elevation angle of the antenna, and versus the elevation angle directly, (3) a graph of NEF versus antenna elevation, (4) a graph of NUF versus antenna elevation, (5) a graph of G/T versus antenna elevation, (6) a graph of G/T_a versus antenna elevation, (7) a graph of antHPBW versus antenna elevation, (8) a graph of Y-factor versus elevation, (9) a table of NEF measurement results and error components at various antenna elevations, (10) a table of NUF measurement results and error components at various antenna elevations, (11) a table of G/T measurement results and error components at various antenna elevations, and (12) a table of G/T_a measurement results and error components at various antenna elevations. Much of what appears on the printouts is self-explanatory, but the following remarks are included to better understand some of the printouts.

In printout (2), each parameter is fit to two different curves, viz., the parameter versus the cosecant of the elevation angle of the antenna, and the parameter versus the elevation angle. The uncertainties listed are the one-sigma deviation of the measured points to the fit parameters.

For printouts (3) - (8), the measured points are plotted as a pound sign (#), and the measured value and the measurement label are listed on the right. The fit points are indicated with a period. At five-degree elevation intervals, error bars are plotted about the fit values, and the uncertainty is listed on the extreme right in lieu of the measurement label. The uncertainties listed with NEF, NUF, G/T, and T/T_a include the errors labeled and listed in the error table printed in SITE

PREP. For the plots of the measured half-power beamwidth (antHPBW) calculated from the antenna-star convolution measurements and for the Y-factor, the error bars indicate the one-sigma deviation of the measured values from the fit value.

For printouts (11) - (12), the results for NEF, NUF, G/T, and G/T_a are listed in an alternate way that shows the error contribution details at various elevations. The parameters for the error calculation are printed. Most of the parameters can be identified with the corresponding parameter listed with more explanation with SITE PREP error table. Other parameters are labeled with the values that are explained in the computer variables list given in section 7. The entry labeled "G-diff" denotes the difference in (1) calculating the antenna gain using the antenna HPBW (see section 2.6) at 30 degrees antenna elevation angle and using the measured G/T_a curve to obtain G at a particular elevation, and (2) calculating antenna gain directly from HPBW at the given elevation. For further explanation of the various items in these tables, consult the annotated printouts at the end of this section.

6.8.6 Measurement Pitfalls

As with any computer printout, the results flow easily. The computer results are not always correct! As more experience is gained, one can gain an intuition about the quality of the results. However, one can begin to trust their intuition too much. Intuition is not always correct! The best policy from my experience is to DOCUMENT. Use the measurement comments labels provided within the MEAS routine. Use them to document measurement conditions and to explicitly state the measurement concerns that you have at the time the measurement was being taken. These comment labels are stored along with the data--they are more apt to be noticed and can be a reminder to check the handwritten comments on the computer printouts. Again, BE SURE TO DOCUMENT THE MEASUREMENT CONDITIONS. Two measurement pitfalls occur regularly, so they will be discussed explicitly.

6.8.6.1 Atmospheric Conditions Pitfall

The model used in the computer is that for an atmosphere with a typical temperature, humidity profile. Primarily, this assumption excludes a large amount of condensed water, or a dramatic change in temperature/humidity as encountered when a weather front moves near the measurement site. Problems with the model atmosphere are easiest to spot on an all-frequency NEF plot. The NEF of an earth terminal should be independent of frequency and antenna elevation within about 5%. The dependencies are due to small changes in antenna gain with antenna elevation, small changes of the system temperature due to increased thermal radiation into the antenna side lobes at low antenna elevation angles, or small changes of the system temperature with frequency. When abnormal atmospheric conditions exist, THE ERROR ESTIMATE listed on the computer printout MAY BE TOO SMALL, especially at low antenna elevation angles.

6.8.6.2 Data Deletion Pitfalls

By the process of deleting the data sets farthest from the fit value, one could obtain a data set with relatively small deviation. Despite the appearance, the accuracy of this truncated data set is actually poorer (unless the data sets deleted were truly abnormal) because the measurement set is smaller. Because of the nature of random errors, the various measurement sets will naturally have somewhat greater or smaller variances from one another, especially when the numbers of measurement are small. The true uncertainty of the ideal measurement is not this variable. So, if the variance is smaller for one frequency than the other, this is not necessarily a more accurate result (and vice versa).

$\ast$ UT = ET − $50^{s}.9$

= ET − $0^{h}.0141$ = ET − $0^{d}.000589$

~~150~~. use U.T.

no sig. error

max. errors for 1980

MOON, 1980

FOR 0^h AND 12^h EPHEMERIS TIME

Date		Polynomial coefficients for TRUE GEOCENTRIC DISTANCE a_0	a_1	a_2	a_3
			0.8%	0.06%	0.003%
			489,000	39,000	1700
Jan.	0·0	59·857 853	+241 024	+ 6 297	− 154
	0·5	60·105 020	253 146	5 837	246
	1·0	60·363 757	264 072	5 100	346
	1·5	60·632 583	273 223	4 061	449
	2·0	60·909 418	279 989	2 715	549
	2·5	61·191 573	+283 761	+ 1 065	− 641
	3·0	61·475 758	283 961	− 860	719
	3·5	61·758 140	280 076	3 022	782
	4·0	62·034 412	271 681	5 373	824
	4·5	62·299 896	258 461	7 850	845
	5·0	62·549 662	+240 226	−10 391	− 843
	5·5	62·778 654	216 917	12 927	818
	6·0	62·981 826	188 615	15 386	771
	6·5	63·154 284	155 536	17 703	702
	7·0	63·291 415	118 033	19 813	612
	7·5	63·389 023	+ 76 582	−21 654	− 503
	8·0	63·443 448	+ 31 779	23 166	378
	8·5	63·451 683	− 15 673	24 303	237
	9·0	63·411 470	64 972	25 016	− 82
	9·5	63·321 400	115 234	25 264	+ 82
	10·0	63·180 984	−165 499	−25 020	+ 255
	10·5	62·990 720	214 755	24 256	434
	11·0	62·752 143	261 946	22 954	614
	11·5	62·467 857	305 994	21 111	792
	12·0	62·141 544	345 823	18 732	964
	12·5	61·777 953	−380 378	−15 837	+1 125
	13·0	61·382 863	408 662	12 457	1 267
	13·5	60·963 011	429 763	8 650	1 386
	14·0	60·525 984	442 896	4 485	1 473
	14·5	60·080 076	447 441	− 55	1 522
	15·0	59·634 102	−442 985	+ 4 523	+1 527
	15·5	59·197 167	429 362	9 116	1 483
	16·0	58·778 404	406 690	13 577	1 387
	16·5	58·386 678	375 390	17 750	1 238
	17·0	58·030 276	336 198	21 474	1 041
	17·5	57·716 593	−290 152	+24 604	+ 802
	18·0	57·451 847	238 564	27 017	533
	18·5	57·240 833	182 961	28 619	+ 248
	19·0	57·086 739	125 010	29 359	− 39
	19·5	56·991 049	66 436	29 239	311
	20·0	56·953 541	− 8 917	+28 298	− 553
	20·5	56·972 369	+ 45 999	26 628	754
	21·0	57·044 242	96 977	24 354	906
	21·5	57·164 667	142 956	21 623	1 005
	22·0	57·328 241	183 183	18 598	1 051
	22·5	57·528 971	+217 225	+15 434	−1 047
	23·0	57·760 583	+244 958	+12 285	−1 001

Date		Polynomial coefficients for TRUE GEOCENTRIC DISTANCE a_0	a_1	a_2	a_3
Jan.	23·0	57·760 583	+244 958	+12 285	−1 001
	23·5	58·016 825	266 532	9 274	921
	24·0	58·291 710	282 329	6 507	817
	24·5	58·579 729	292 905	4 056	697
	25·0	58·875 993	298 937	1 964	572
	25·5	59·176 322	+301 162	+ 250	− 449
	26·0	59·477 285	300 326	− 1 094	335
	26·5	59·776 182	297 142	2 096	237
	27·0	60·070 991	292 248	2 801	156
	27·5	60·360 282	286 183	3 265	98
	28·0	60·643 102	+279 363	− 3 553	− 62
	28·5	60·918 850	272 072	3 734	48
	29·0	61·187 140	264 460	3 872	56
	29·5	61·447 672	256 544	4 037	82
	30·0	61·700 097	248 219	4 280	125
	30·5	61·943 911	+239 279	− 4 652	− 179
	31·0	62·178 359	229 432	5 188	241
	31·5	62·402 362	218 325	5 912	307
Feb.	1·0	62·614 468	205 573	6 834	372
	1·5	62·812 835	190 783	7 953	432
	2·0	62·995 233	+173 575	− 9 251	− 484
	2·5	63·159 073	153 615	10 707	523
	3·0	63·301 458	130 628	12 281	548
	3·5	63·419 257	104 421	13 929	556
	4·0	63·509 193	74 896	15 601	545
	4·5	63·567 943	+ 42 062	−17 240	− 514
	5·0	63·592 251	+ 6 046	18 786	462
	5·5	63·579 049	− 32 905	20 177	390
	6·0	63·525 577	74 420	21 353	297
	6·5	63·429 507	118 004	22 248	185
	7·0	63·289 070	−163 043	−22 807	− 54
	7·5	63·103 166	208 805	22 974	+ 94
	8·0	62·871 481	254 453	22 694	258
	8·5	62·594 592	299 050	21 923	434
	9·0	62·274 053	341 576	20 623	620
	9·5	61·912 474	−380 942	−18 763	+ 811
	10·0	61·513 580	416 016	16 329	1 003
	10·5	61·082 238	445 646	13 317	1 189
	11·0	60·624 464	468 697	9 748	1 361
	11·5	60·147 380	484 093	5 658	1 511
	12·0	59·659 140	−490 864	− 1 116	+1 630
	12·5	59·168 790	488 199	+ 3 784	1 706
	13·0	58·686 081	475 511	8 914	1 731
	13·5	58·221 215	452 494	14 120	1 695
	14·0	57·784 536	419 179	19 220	1 593
	14·5	57·386 170	−375 976	+24 014	+1 423
	15·0	57·035 631	−323 703	+28 297	+1 186

Distance = $a_0 + a_1 p + a_2 p^2 + a_3 p^3$, where p is the fraction of the *forward* interval.
a_0 is expressed in units of the Earth's equatorial radius (6 378 160 m).
a_1, a_2, a_3 are tabulated in units of the end-figure of a_0.

gives a max. error of 1.4×10^{-6}

EPHEMERIS FOR PHYSICAL OBSERVATIONS

FOR 0ʰ UNIVERSAL TIME

Date	Age	The Earth's Selenographic Longitude		The Earth's Selenographic Latitude		Physical Libration Lg.	Lt.	P.A.	The Sun's Selenographic Colong.	The Sun's Selenographic Lat.	Position Angle of Axis		Position Angle of Bright Limb		Fraction Illuminated
	d	°	°	°	°	(0°01)			°	°	°	°	°	°	
Jan. 0	11.6	+4.87	+0.18	+6.55	−0.41	0	−1	+2	56.34	+1.23	351.98	+5.73	252.7	−1.0	0.94
1	12.6	5.05	−0.06	6.14	0.74	0	1	2	68.47	1.21	357.71	5.80	251.7	. .	0.98
2	13.6	4.99	0.33	5.40	1.00	0	1	2	80.60	1.19	3.51	5.53	230.0	. .	1.00
3	14.6	4.66	0.61	4.40	1.19	0	1	2	92.72	1.18	9.04	4.95	122.5	. .	1.00
4	15.6	4.05	0.88	3.21	1.33	0	1	2	104.85	1.16	13.99	4.13	109.8	−0.7	0.97
5	16.6	+3.17	−1.10	+1.88	−1.39	0	−1	+2	116.98	+1.14	18.12	+3.19	109.1	+1.1	0.93
6	17.6	2.07	1.28	+0.49	1.40	0	1	2	129.11	1.12	21.31	2.18	110.2	1.2	0.88
7	18.6	+0.79	1.38	−0.91	1.35	0	1	2	141.25	1.10	23.49	1.15	111.4	0.9	0.81
8	19.6	−0.59	1.40	2.26	1.25	0	1	2	153.39	1.08	24.64	+0.15	112.3	+0.3	0.73
9	20.6	1.99	1.34	3.51	1.11	−1	1	2	165.54	1.06	24.79	−0.86	112.6	−0.2	0.64
10	21.6	−3.33	−1.19	−4.62	−0.92	−1	−1	+2	177.69	+1.04	23.93	−1.85	112.4	−0.8	0.55
11	22.6	4.52	0.94	5.54	0.68	1	1	2	189.85	1.02	22.08	2.83	111.6	1.5	0.45
12	23.6	5.46	0.64	6.22	0.42	1	1	2	202.02	1.00	19.25	3.80	110.1	2.2	0.36
13	24.6	6.10	−0.26	6.64	−0.09	1	1	2	214.19	0.98	15.45	4.70	107.9	2.8	0.26
14	25.6	6.36	+0.15	6.73	+0.26	1	1	2	226.37	0.96	10.75	5.49	105.1	3.0	0.18
15	26.6	−6.21	+0.54	−6.47	+0.63	−1	−1	+2	238.55	+0.94	5.26	−6.02	102.1	−2.6	0.11
16	27.6	5.67	0.91	5.84	0.99	1	1	2	250.74	0.91	359.24	6.17	99.5	+1.7	0.05
17	28.6	4.76	1.20	4.85	1.32	1	1	2	262.93	0.89	353.07	5.86	101.2	. .	0.01
18	0.1	3.56	1.39	3.53	1.57	1	1	2	275.12	0.86	347.21	5.04	197.6	. .	0.00
19	1.1	2.17	1.48	1.96	1.71	1	1	2	287.31	0.84	342.17	3.82	248.2	+1.4	0.02
20	2.1	−0.69	+1.46	−0.25	+1.73	−1	−1	+2	299.50	+0.81	338.35	−2.36	249.6	−0.8	0.06
21	3.1	+0.77	1.36	+1.48	1.61	1	1	2	311.68	0.79	335.99	−0.80	248.8	−0.6	0.13
22	4.1	2.13	1.20	3.09	1.41	1	1	2	323.86	0.76	335.19	+0.71	248.2	+0.2	0.22
23	5.1	3.33	0.98	4.50	1.10	1	1	2	336.04	0.73	335.90	2.10	248.4	1.0	0.32
24	6.1	4.31	0.76	5.60	0.75	−1	1	2	348.21	0.71	338.00	3.31	249.4	2.0	0.43
25	7.1	+5.07	+0.50	+6.35	+0.37	0	−1	+2	0.37	+0.68	341.31	+4.31	251.4	+2.7	0.55
26	8.1	5.57	0.26	6.72	0.00	0	1	2	12.52	0.65	345.62	5.07	254.1	3.4	0.65
27	9.1	5.83	+0.02	6.72	−0.36	0	1	2	24.67	0.63	350.69	5.55	257.5	3.7	0.75
28	10.1	5.85	−0.23	6.36	0.68	0	1	2	36.81	0.60	356.24	5.71	261.2	3.8	0.84
29	11.1	5.62	0.46	5.68	0.96	−1	1	2	48.95	0.57	1.95	5.55	265.0	3.2	0.91
30	12.1	+5.16	−0.68	+4.72	−1.16	−1	−1	+2	61.09	+0.55	7.50	+5.08	268.2	+0.8	0.96
31	13.1	4.48	0.89	3.56	1.32	1	1	1	73.22	0.52	12.58	4.36	269.0	. .	0.99
Feb. 1	14.1	3.59	1.07	2.24	1.41	1	2	1	85.35	0.49	16.94	3.48	228.1	. .	1.00
2	15.1	2.52	1.22	+0.83	1.42	1	2	1	97.48	0.46	20.42	2.50	112.5	−2.3	0.99
3	16.1	+1.30	1.33	−0.59	1.39	1	2	1	109.62	0.43	22.92	1.47	110.2	+0.2	0.97
4	17.1	−0.03	−1.38	−1.98	−1.30	−1	−2	+2	121.76	+0.40	24.39	+0.45	110.4	+0.3	0.92
5	18.1	1.41	1.39	3.28	1.16	1	2	2	133.90	0.38	24.84	−0.56	110.7	−0.2	0.87
6	19.1	2.80	1.33	4.44	0.98	1	2	2	146.04	0.35	24.28	1.54	110.5	0.7	0.80
7	20.1	4.13	1.19	5.42	0.75	2	2	2	158.19	0.33	22.74	2.48	109.8	1.5	0.72
8	21.1	5.32	0.97	6.17	0.48	2	2	2	170.35	0.30	20.26	3.42	108.3	2.2	0.63
9	22.1	−6.29	−0.70	−6.65	−0.20	−2	−2	+2	182.51	+0.28	16.84	−4.28	106.1	−2.9	0.53
10	23.1	6.99	−0.34	6.85	+0.14	2	2	2	194.68	0.25	12.56	5.08	103.2	3.5	0.43
11	24.1	7.33	+0.06	6.71	0.49	2	2	2	206.85	0.23	7.48	5.69	99.6	4.2	0.33
12	25.1	7.27	0.49	6.22	0.86	2	2	2	219.03	0.21	1.79	6.04	95.4	4.7	0.24
13	26.1	6.78	0.91	5.36	1.19	2	2	2	231.22	0.18	355.75	5.98	90.7	4.7	0.15
14	27.1	−5.87	+1.31	−4.17	+1.50	−2	−2	+2	243.41	+0.15	349.77	−5.46	86.0	−4.3	0.08
15	28.1	−4.56		−2.67		−2	−2	+2	255.61	+0.12	344.31		81.7		0.03

USED IN SAMPLE

5 do. F

* INSERT REWORK TAPE into INTERNAL CASSETTE UNIT

```
LOAD
RUN
PRINT ALL ON (1=YES)?1
REWORKSITE DATA(10=INT,5=EXT)?5
PRGM CONST CHANGE OPTION(0=NO)?0
 5.3
YEAR( =NC): 1981    ?

                    1981/11/15  23:27
NBS1A.09  LOADER  <D1-F0> T2-F0:     X.25        * <D1-4>
                                                  1.25
                          -1-
Sysm # 6.11
                                                 P6: 5.67
                 AN/TSC-54 #3/Wahiaw
                 TUE:  1980 FEB
                 7300 MHz(#),  1.78200E-03       Q9: 4.719

@@@@@@@@@@@@@@@@@@@@@@@@@

              2.377

           W : 5.5

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
```

```
0 RW,1LOAD,2AUTO,3=DEL,4G/T( =NC): 0  ?0
```

CALLS FOR REWORK PROCEEDURE

```
SUM TAPE #( =NC): 0    ?60.1
REWORK#( =NC): 0    ?1
RESULT SET#:1=1ST,2=2nd( =NC): 1    ?
ANT DIAM(FT)( =NC): 18   ?
SITE ELEV(Km)( =NC): 0.1524  ?


NEW MOON DATA(0=NO)( =NC): 1    ?
```

← IF NOT USING MOON DATA, ENTER Ø

```
day(0=EXIT)( =NC): 0    ?5
MOON:via AENA,GEOCENTRIC DISTANCE chapter
```

"THE AMERICAN EPHEMERIS AND NAUTICAL ALMANAC"

```
day 5.5  :A0=( =NC): 0    ?63.579049
A1=( =NC): 0    ?-32905
A2=( =NC): 0    ?-20177
```

← SEE SAMPLE PAGE OF AENA THIS WAS OBTAINED FROM

```
MOON:via AENA,EPHEMERIS FOR PHYSICAL OBSEVATIONS section
```

CAREFULL - It is easy to overlook NEGATIVE SIGN

```
MOON:AGE(days)( =NC): 0    ?18.1
```

← SEE SAMPLE PAGE THIS WAS OBTAINED FROM

```
day(0=EXIT)( =NC): 0    ?6
MOON:via AENA,GEOCENTRIC DISTANCE chapter

day 6.5  :A0=( =NC): 0    ?63.429507
A1=( =NC): 0    ?-118004
A2=( =NC): 0    ?-22248
MOON:via AENA,EPHEMERIS FOR PHYSICAL OBSEVATIONS section
```

```
day(0=EXIT)( =NC): 0    ?0

FREQ(GHz)( =NC): 7.5  ?
PREFIT HPBW (1=YES)( =NC): 1    ?1
```

If you know what HPBW TO ENTER, use Ø. PROGRAM WILL ASK YOU TO ENTER THE HPBW

```
NBS1C.42  MEAS  <D1-F14> T3-F12,   X.25by WAIT, JOHN W     (78 1115 23.36)

                          -2-
                                                             RUN   1

              AN/TSC-54 #3 Wahiawa,Hawawii
              FRI:  1980 FEB 8
              7.500 GHz, 18.0 Ft DISH


FL#   RUN/SET   ELEV          HPBW#1        FREQ        STAR
 9     103.01   57.06         0.40775       7.5         MOON
 11    103.03   52.26         0.400121      7.5         MOON
 12    103.04   45.96         0.369816      7.5         MOON
ERROR 61 IN LINE 5195
```

EMPTY DATA FILE — SIGNAL PROGRAM USES TO GOTO NEXT STEP

```
TAPE 60.1    data 1   NBS1D.118*  REWORK  <D1-F16> T4-F12     REWORK  1.00
       FINISHED MOON

NBS1C.38  MEAS  <D1-F14> T3-F12,   X.24by WCD/HRA          (78 1115 23.39)

                          -3-
                                                             RUN   1

              AN/TSC-54 #3 Wahiawa,Hawawii
              THU:  1980 FEB 7
              7.500 GHz, 18.0 Ft DISH


                        # PTS = 3

G/T(dB)       =(   0.0000 +-  0.0000) + (  0.00000 +- 0.00000)*CSC L
G/T(dB)       =(   0.0000 +-  0.0000) + (  0.00000 +- 0.00000)*ELEV


G/TA(dB)      =(   0.0000 +-  0.0000) + (  0.00000 +- 0.00000)*CSC L
G/TA(dB)      =(   0.0000 +-  0.0000) + (  0.00000 +- 0.00000)*ELEV
```

FOR PREFIT, ONLY HPBW IS USED

```
ant HPBW(deg)=(   0.6434 +-  0.0050) + ( -0.19557 +- 0.03530)*CSC L
ant HPBW(deg)=(   0.2120 +-  0.0071) + (  0.00349 +- 0.00091)*ELEV


Y-factor      =(   0.0000 +-  0.0000) + (  0.00000 +- 0.00000)*CSC L
Y-factor      =(   0.0000 +-  0.0000) + (  0.00000 +- 0.00000)*ELEV
```

•••

```
RSLTS TO NOW SUMMARY(1=YES)( =NC): 0    ?
LOAD from INT=0,EXT=1( =NC): 0    ?0
LOAD FILES:START#,STOP#,STEP?9,23,1
FILE 10        FRIFEB8 1980AN/TSC-54 #3 Wahiawa,Hawaii        RUN SET
 103.02
     MOON      NBS1C.42  MEAS  <D1-F14> T3-F12                FREQ 7.5
```

THIS QUESTION ALLOWS YOU TO ADD NEW DATA ONTO AN OLD SUMMARY RESULTS (MAT M) BUT NORMALLY YOU DON'T DO THIS

THIS FILE WAS STEP OVER BECAUSE THE FIT PROGRAM COULDN'T FIT IT.

```
FILE 11        FRIFEB8 1980AN/TSC-54 #3 Wahiawa,Hawaii        RUN SET
 103.03
     MOON      NBS1C.42  MEAS  <D1-F14> T3-F12                FREQ 7.5
```

However, if the files on the Summary tape hadn't been run through the fit program it will step over every file in this manner!

RESULTS OF REWORK WITH ASSUMED CONDITIONS LISTED

```
TAPE 60.1    data 1    NBS1D.118*  REWORK  <D1-F16> T4-F12      REWORK  1.00
               SUNRISE.

NBS1C.42  MEAS  <D1-F14> T3-F12,   X.25by WAIT, JOHN W     (78 1115  0.08)


                                  -4-
                                                                    RUN 103

                    AN/TSC-54 #3 Wahiawa,Hawaii
                    FRI:  1980 FEB 8
                    7.500 GHz, 18.0 Ft DISH
```

SET PROGRAM MADE 5 INTERATIONS TO OBTAIN FIT

```
   TEMP          DEW PT.      REL HUMD       WATER DENS     CLOUD COVER     WIND
   69.0 F        67.2 F        94.0 %        16.7 gm/m↑3         1          0 mph

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
SET =  70 PTS, 5 inter, STD DEV RSDL = 0.005805,  max PTS(sigma)=  2.02,  1.82

REWORK  FILE  TAPE   TIME(Hrs)    EFF AREA    SKY BRIGHT   ELEV(deg)   RUN   SET
  1.0    11   60.1    17.328      15.4 m↑2     3.72 K        52.3      103    3


    *HPBW(deg)     HPBW(deg)         T/To            DT(MOON )/To     DECL OF MOON
 0.514 +- 0.023      0.400   0.8295 +- 0.0038   0.1097 +- 0.0034    -10.000deg


  version#    Y-FACTOR    *HPBW#1   *HPBW#2   *HPBWiso  G/T(dB)    NEF         NUF
   5.00        1.1322      0.514     0.514     0.514     23.57   94.263kFU   96.516kFU

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@


         MOON FLUX (  7500MHz, day  8, 17.3hrs) =  20953 FU

lunar age    elev      A0         A1         A2      moon diam   mean temp    temp
 0.72days    52.2   62.5945     299050     21923     0.504 deg    211.0 k    202.1 K

    ant HPBW = 0.64336 +-0.195569 CSC L = 0.3959  (L = 52.2 deg)

   K1    K2    K3    K6    K8    K9     K      APR-eff  R-eff     S(FU)      Xi(K)
 0.986 0.618 1.000 1.000 0.989 1.000 0.602   0.8777   0.98     20952.7   5.813E-04

 SITE ELEV    oxy attn     water attn     zenith attn   REFR #1  REFR #2  ant-DIAM
 0.152 km   0.03227 dB  0.0147 dB/dens  0.0470 dB      1.282    0.0130    18.0 ft
```

etc.

0 RW, $\boxed{\text{1LOAD}}$ 2AUTO, 3=DEL, 4G/T(=NC): 0 ?1
SUM TAPE #(=NC): 60.1 ?
RESULT SET#:1=1ST,2=2nd(=NC): 3 ?

NORMALLY YOU DO NOT NEED TO RELOAD CURRENT REWORK — UNLESS YOU TURNED OFF THE CALCULATOR

0 RW, 1LOAD, 2AUTO, 3=DEL, $\boxed{\text{4G/T}}$ =NC): 0 ?4

USE IF YOU ARE CURIOUS WHAT WAS LOADED

TAPE 60.1 data 3 NBS1D.119* REWORK <D1-F16> T4-F12 REWORK 14.12

NBS1A.09 LOADER <D1-F0> T2-F0, X.27* <D1-4> T2-4 (78 1115 7.19)

-5-

RUN 1

AN/TSC-54 #3 Wahiawa,Hawaii
FRI: 1980 FEB 8
7.500 GHz, 18.0 Ft DISH

MINUS SIGN MEANS DATA WILL NOT USED IN FINAL RESULTS

RUN SET	STAR	ELEV	G/T	G/TA	ant HPBW	FREQ	Y-fac	NEF	NUF
103.05	MOON	-39.4	25.037	24.107	0.702	7.500	1.218	66.78	69.05
2.06	MOON	-23.8	20.937	20.254	0.099	7.500	1.082	173.30	179.54
102.07	MOON	15.8	23.619	22.741	0.570	7.500	1.148	92.14	97.85
103.08	MOON	17.1	22.889	21.923	0.325	7.500	1.126	109.35	115.88
103.07	MOON	24.5	23.031	22.066	0.328	7.500	1.134	106.30	110.85
103.06	MOON	32.5	23.778	22.835	0.535	7.500	1.162	89.56	92.60
103.04	MOON	46.0	23.378	22.477	0.549	7.500	1.150	98.57	100.99
103.03	MOON	52.3	22.997	22.196	0.385	7.500	1.138	107.80	110.17
103.02	MOON	56.7	23.101	22.310	0.426	7.500	1.141	105.25	107.47
103.01	MOON	57.1	22.830	22.001	0.423	7.500	1.133	112.10	114.40

ERROR 50 IN LINE 3244 THE 4 ENTRY ENDS THIS WAY.

TO RESTART USE KEY f_0

```
0 RW,1LOAD,2AUTO,3=DEL,4G/T( =NC): 0      ?3
DEL:RUN/SET(0=EXIT)?103.08
DEL:RUN/SET(0=EXIT)?0


0 RW,1LOAD,2AUTO,3=DEL,4G/T( =NC): 0      ?2
TEMP(F)( =NC): 76.5     ?
DEW PT(F)( =NC): 69.3     ?
REWORK #( =NC): 14.12    ?14.13
```

TAPE 60.1   data 3   NBS1D.119* REWORK <D1-F16> T4-F12   REWORK 14.13

NBS1A.09 LOADER <D1-F0> T2-F0,   X.27* <D1-4> T2-4   (78 1115 7.20)

-6-

RUN 1

AN/TSC-54 #3 Wahiawa,Hawaii
FRI: 1980 FEB 8
7.500 GHz, 18.0 Ft DISH

NOT USED IN RESULTS

RUN/SET	STAR	ELEV	G/T	G/TA	ant HPBW	FREQ	Y-fac	NEF	NUF
103.05	MOON	-39.4	25.037	24.107	0.702	7.500	1.218	66.78	69.05
2.06	MOON	-23.8	20.937	20.254	0.099	7.500	1.082	173.30	179.54
102.07	MOON	15.8	23.619	22.741	0.570	7.500	1.148	92.14	97.85
103.08	MOON	-17.1	22.889	21.923	0.325	7.500	1.126	109.35	115.88
103.07	MOON	24.5	23.031	22.066	0.328	7.500	1.134	106.30	110.85
103.06	MOON	32.5	23.778	22.835	0.535	7.500	1.162	89.56	92.60
103.04	MOON	46.0	23.378	22.477	0.549	7.500	1.150	98.57	100.99
103.03	MOON	52.3	22.997	22.196	0.385	7.500	1.138	107.80	110.17
103.02	MOON	56.7	23.101	22.310	0.426	7.500	1.141	105.25	107.47
103.01	MOON	57.1	22.830	22.001	0.423	7.500	1.133	112.10	114.40

TAPE 60.1 data 3 NBS1D.118* REWORK <D1-F16> T4-F12 REWORK 14.12

NBS1C.38 MEAS <D1-F14> T3-F12, X.24by JPW/WCD (78 1115 0.23)

RUN 103

AN/TSC-54 #3 Wahiawa,Hawaii
FRI: 1980 FEB 8
7.500 GHz, 18.0 Ft DISH

PTS = 8

```
G/T(dB)        =(  23.0498 +-  0.3685) + (  0.07455 +- 0.13740)*CSC L
G/T(dB)        =(  23.4529 +-  0.3562) + ( -0.00663 +- 0.00773)*ELEV


G/TA(dB)       =(  22.2513 +-  0.3649) + (  0.03274 +- 0.13607)*CSC L
G/TA(dB)       =(  22.4473 +-  0.3610) + ( -0.00342 +- 0.00783)*ELEV


ant HPBW(deg)=(    0.4440 +-  0.1055) + ( -0.00069 +- 0.03936)*CSC L
ant HPBW(deg)=(    0.4424 +-  0.1056) + (  0.00001 +- 0.00229)*ELEV


Y-factor       =(   1.1445 +-  0.0121) + ( -0.00149 +- 0.00453)*CSC L
Y-factor       =(   1.1415 +-  0.0123) + ( -0.00000 +- 0.00027)*ELEV


NEF(kFU)       =( 107.1880 +-  8.6004) + ( -2.22051 +- 3.20687)*CSC L
NEF(kFU)       =(  95.7766 +-  8.2566) + (  0.18182 +- 0.17913)*ELEV


NUF(kFU)       =( 107.4310 +-  8.9393) + ( -0.56300 +- 3.33325)*CSC L
NUF(kFU)       =( 102.8890 +-  8.7997) + (  0.08982 +- 0.19091)*ELEV
```

RUN 103

```
                  AN/TSC-54 #3 Wahiawa,Hawaii
                  FRI:  1980 FEB 8
                  7.500 GHz, 18.0 Ft DISH

     TEMP          DEW PT.       REL HUMD        WATER DENS      CLOUD COVER     WIND
     76.5 F        69.3 F         78.5 %        17.7 gm/m↑3          2            0 mph
================================================================================
. = FIT        # = CAS A,  @ = CYG A,  0 = TAU A,  + = ORI A,  * = SUN
,  M = MOON ,

                              FIT TO   8    DATA
      NEF(kFU)     =( 107.1880 +-  8.6004) + ( -2.22051 +- 3.20687)*CSC L

      89.000    93.800    98.600    103.400   108.200   113.000  (UNIT= 0.4800)
 ELEV    !....!....!....!....!....!....!....!....!....!....!    VALUE    RUN/SET
 15      --------------------.------------------------------   98.6086+- 27.761
 15.8           M             .                                92.1352  102.07
 17.1                          .                   M          109.3460  103.08
 20      ------------------------.--------------------------  100.6957+- 22.269
 24.5                              .        M                 106.2990  103.07
 25      ---------------------------.-----------------------  101.9338+- 20.417
 30      -----------------------------.---------------------  102.7470+- 20.013
 32.5     M                             .                      89.5622  103.06
 35      ------------------------------.--------------------  103.3167+- 20.150
 40      -------------------------------.-------------------  103.7335+- 20.467
 45      -------------------------------.-------------------  104.0477+- 20.822
 46.0                        M          .                      98.5703  103.04
 50      --------------------------------.------------------  104.2893+- 21.158
 52.3                                    .      M             107.8030  103.03
 55      --------------------------------.------------------  104.4773+- 21.456
 56.7                                    . M                  105.2470  103.02
 57.1                                    .               M    112.1010  103.01
         !....!....!....!....!....!....!....!....!....!....!
```

INCLUDES ALL ERRORS LISTED IN LATER TABLE

```
TAPE 60.1    data 3    NBS1D.118*  REWORK  <D1-F16> T4-F12     REWORK 14.12

NBS1C.38  MEAS  <D1-F14> T3-F12,   X.24by JPW/WCD          (78 1115  0.31)

                                   -10-
                                                                     RUN 103

                    AN/TSC-54 #3 Wahiawa,Hawaii
                    FRI:  1980 FEB 8
                    7.500 GHz, 18.0 Ft DISH

   TEMP        DEW PT.      REL HUMD      WATER DENS     CLOUD COVER    WIND
   76.5 F      69.3 F        78.5 %       17.7 gm/m↑3         2          0 mph
=============================================================================
. = FIT        # = CAS A,  @ = CYG A,  0 = TAU A,  + = ORI A,  * = SUN
,  M = MOON ,

                                FIT TO   8    DATA
     NUF(kFU)      =( 107.4310 +-  8.9393) + ( -0.56300 +- 3.33325)*CSC L

      92.000    96.800   101.600   106.400   111.200   116.000  (UNIT= 0.4800)
ELEV        !....!....!....!....!....!....!....!....!....!....!    VALUE   RUN/SET
15          ----------------------------.----------------------  105.2557+- 30.221
15.8                    M               .                         97.8510  102.07
17.1                                    .                     M  115.8800  103.08
20          -----------------------------.---------------------  105.7849+- 23.692
24.5                                     .         M             110.8450  103.07
25          -----------------------------.---------------------  106.0988+- 21.447
30          ------------------------------.--------------------  106.3050+- 20.887
32.5         M                            .                       92.5989  103.06
35          ------------------------------.--------------------  106.4494+- 20.960
40          ------------------------------.--------------------  106.5551+- 21.249
45          ------------------------------.--------------------  106.6348+- 21.592
46.0                       M               .                     100.9910  103.04
50          -------------------------------.-------------------  106.6961+- 21.923
52.3                                       .      M              110.1710  103.03
55          -------------------------------.-------------------  106.7437+- 22.21[illegible]
56.7                                       .M                    107.4700  [illegible]3.02
57.1                                       .               M     114.4040  103.01
            !....!....!....!....!....!....!....!....!....!....!
```

INCLUDES ALL ERROR SOURCES
AS LISTED IN LATER TABLE

```
TAPE 60.1    data 3    NBS1D.118*  REWORK  <D1-F16> T4-F12     REWORK 14.12

NBS1C.38  MEAS  <D1-F14> T3-F12,   X.24by JPW/WCD          (78 1115  0.37)
```



```
                                                                            RUN 103

                     AN/TSC-54 #3 Wahiawa,Hawaii
                     FRI:  1980 FEB 8
                     7.500 GHz, 18.0 Ft DISH

     TEMP        DEW PT.      REL HUMD       WATER DENS     CLOUD COVER    WIND
     76.5 F      69.3 F        78.5 %       17.7 gm/m↑3          2          0 mph
================================================================================
. = FIT        # = CAS A,  @ = CYG A,  0 = TAU A,  + = ORI A,  * = SUN
,  M = MOON ,

                                          FIT TO   8    DATA
    G/T(dB)       =(  23.0498 +-  0.3685) + (  0.07455 +- 0.13740)*CSC L

      22.000    22.400    22.800    23.200    23.600    24.000  (UNIT= 0.0400)
ELEV     !....!....!....!....!....!....!....!....!....!....!     VALUE   RUN/SET
15           !----------------------------.-----------------   23.3379+-  1.159
15.8                                      .      M             23.6192  102.07
17.1                           M          .                    22.8890  103.08
20                 !---------------------.------------------   23.2678+-  0.897
24.5                               M    .                      23.0307  103.07
25                  !-------------------.-------------------   23.2262+-  0.808
30                 !-------------------.--------------------   23.1989+-  0.787
32.5                                   .             M         23.7776  103.06
35                !-------------------.-------------------!    23.1798+-  0.790
40                !-------------------.-------------------!    23.1658+-  0.802
45                !-------------------.-------------------!    23.1552+-  0.817
46.0                                  .    M                   23.3784  103.04
50               !--------------------.---------------------   23.1471+-  0.830
52.3                              M   .                        22.9966  103.03
55               !--------------------.---------------------   23.1408+-  0.84[illegible]
56.7                                 M                         23.1010  103.02
57.1                          M      .                         22.8298  103.01
         !....!....!....!....!....!....!....!....!....!....!
```

INCLUDES ALL ERROR SOURCES

```
TAPE 60.1     data 3    NBS1D.118*  REWORK  <D1-F16> T4-F12     REWORK 14.12

NBS1C.38  MEAS  <D1-F14> T3-F12,   X.24by JPW/WCD          (78 1115  0.43)

                                        -12-
                                                                      RUN 103

                    AN/TSC-54 #3 Wahiawa,Hawaii
                    FRI:  1980 FEB 8
                    7.500 GHz, 18.0 Ft DISH

     TEMP         DEW PT.      REL HUMD       WATER DENS     CLOUD COVER    WIND
     76.5 F       69.3 F        78.5 %      17.7 gm/m↑3           2          0 mph
=================================================================================
. = FIT        # = CAS A,  @ = CYG A,  0 = TAU A,   + = ORI A,   * = SUN
,   M = MOON ,

                                 FIT TO   8    DATA
      G/TA(dB)      =(  22.2513 +-  0.3649) + (  0.03274 +- 0.13607)*CSC L

      21.000    21.400    21.800    22.200    22.600    23.000  (UNIT= 0.0400)
ELEV      !....!....!....!....!....!....!....!....!....!....!    VALUE   RUN/SET
15             !----------------------------.----------------   22.3778+-  1.153
15.8                                        .         M         22.7412  102.07
17.1                             M          .                   21.9230  103.08
20                    !---------------------.----------------   22.3470+-  0.894
24.5                                 M     .                    22.0657  103.07
25                     !-------------------.-----------------   22.3288+-  0.806
30                     !-------------------.-----------------   22.3168+-  0.785
32.5                                       .             M      22.8346  103.06
35                     !-------------------.-----------------   22.3084+-  0.788
40                     !-------------------.-----------------   22.3022+-  0.800
45                  . !-------------------.------------------   22.2976+-  0.814
46.0                                      .    M                22.4774  103.04
50                   !--------------------.------------------   22.2940+-  0.827
52.3                                    M .                     22.1956  103.03
55                   !--------------------.------------------   22.291[illegible]+-  0.8[illegible]
56.7                                      .M                    22.31[illegible]  103.02
57.1                               M      .                     22.[illegible]008  103.01
          !....!....!....!....!....!....!....!....!....!....!
```

INCLUDES ALL ERRORS

```
TAPE 60.1     data 3     NBS1D.118*  REWORK  <D1-F16> T4-F12      REWORK 14.12

NBS1C.38  MEAS  <D1-F14> T3-F12,   X.24by JPW/WCD          (78 1115  0.49)
```



```
                                                                      RUN 103

                        AN/TSC-54 #3 Wahiawa,Hawaii
                        FRI:  1980 FEB 8
                        7.500 GHz, 18.0 Ft DISH

     TEMP         DEW PT.      REL HUMD       WATER DENS    CLOUD COVER    WIND
     76.5 F       69.3 F        78.5 %       17.7 gm/m↑3         2          0 mph
================================================================================
. = FIT        # = CAS A,  @ = CYG A,  0 = TAU A,  + = ORI A,  * = SUN
,  M = MOON ,

                                   FIT TO   8    DATA
     ant HPBW(deg)=(   0.4440 +-  0.1055) + ( -0.00069 +- 0.03936)*CSC L

        0.320     0.370     0.420     0.470     0.520     0.570  (UNIT= 0.0050)
ELEV      !....!....!....!....!....!....!....!....!....!....!    VALUE   RUN SET
15        -------------------------.--------------------------   0.4414+-  0.257
15.8                               .                         M   0.5700  102.07
17.1       M                       .                             0.3249  103.08
20        -------------------------.--------------------------   0.4426+-  0.162
24.5       M                       .                             0.3283  103.05
25       !-------------------------.-------------------------!   0.44[illegible]+-  0.1[illegible]
30        !------------------------.------------------------!    0.4427+-  0.119
32.5                               .                 M           0.5346  103.06
35       !-------------------------.--------------------------   0.4428+-  0.125
40        -------------------------.--------------------------   0.4430+-  0.134
45        -------------------------.--------------------------   0.4431+-  0.143
46.0                               .                    M        0.5489  103.04
50        -------------------------.--------------------------   0.4431+-  0.152
52.3                  M            .                             0.3854  103.03
55        -------------------------.--------------------------   0.4432+-  0.158
56.7                          M    .                             0.4257  103.02
57.1                          M    .                             0.4231  103.01
          !....!....!....!....!....!....!....!....!....!....!
```

ONLY KT ERROR

```
TAPE 60.1     data 3    NBS1D.118*  REWORK  <D1-F16> T4-F12     REWORK 14.12

NBS1C.38  MEAS  <D1-F14> T3-F12,   X.24by JPW/WCD          (78 1115  0.50)

                                  -14-
                                                                    RUN 103

                       AN/TSC-54 #3 Wahiawa,Hawaii
                       FRI:  1980 FEB 8
                       7.500 GHz, 18.0 Ft DISH

     TEMP         DEW PT.      REL HUMD       WATER DENS    CLOUD COVER    WIND
     76.5 F       69.3 F        78.5 %       17.7 gm/m↑3         2         0 mph
================================================================================
. = FIT        # = CAS A,   @ = CYG A,   0 = TAU A,   + = ORI A,   * = SUN
,  M = MOON ,

                                FIT TO   8    DATA
     Y-factor      =(   1.1445 +-  0.0121) + ( -0.00149 +- 0.00453)*CSC L

        1.100     1.120     1.140     1.160     1.180     1.200  (UNIT= 0.0020)
 ELEV     !....!....!....!....!....!....!....!....!....!....!    VALUE   RUN/SET
 15           !--------------.--------------!                    1.1387+-  0.029
 15.8                        .    M                              1.1482  102.07
 17.1                   M     .                                  1.1263  103.08
 20                    !--------.--------!                       1.1401+-  0.018
 24.5                       M   .                                1.1340  103.07
 25                      !------.------!                         1.1409+-  0.014
 30                       !------.------!                        1.1415+-  0.013
 32.5                            .         M                     1.1617  103.06
 35                       !------.------!                        1.1419+-  0.014
 40                      !-------.-------!      1σ               1.1422+-  0.015
 45                      !-------.-------!                       1.1424+-  0.016
 46.0                            .    M         ONLY             1.1497  103.04
 50                     !--------.--------!                      1.1425+-  0.017
 52.3                          M .                               1.1376  103.03
 55                     !--------.--------!                      1.1427+-  0.018
 56.7                            M                               1.1413  103.02
 57.1                       M    .                               1.1327  103.01
          !....!....!....!....!....!....!....!....!....!....!
```

TAPE 60.1 data 3 NBS1D.118* REWORK <D1-F16> T4-F12 REWORK 14.12

NBS1C.38 MEAS <D1-F14> T3-F12, X.24by JPW/WCD (78 1115 0.50)

RUN 103

AN/TSC-54 #3 Wahiawa,Hawaii
FRI: 1980 FEB 8
7.500 GHz, 18.0 Ft DISH

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
76.5 F	69.3 F	78.5 %	17.7 gm/m↑3	2	0 mph

==

FIT TO 8 DATA

NEF(kFU) =(107.1880 +- 8.6004) + (-2.22051 +- 3.20687)*CSC L

\+ = LINEAR CONTRIBUTION

LOWEST ANGLE PRINTOUT DETERMINED FROM LOWEST ANGLE MEASUREMENT

20.0deg: NEF(kFU) = 100.696 +- 0.87 dB (22.1 %) 7.500 GHZ

E-S	E-F	E-Y	E-K1	E-K2	E-K3	E-K4	E-K5	E-K6	E-K7	+E-K8	+E-K9	E-TA
14.4%	0.0	0.8	1.6	4.8	0.0	0.1	12.5	0.1	2.8	2.1	0.0	0.6%

##

G(dB)	G-hpbw	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
51.21	51.17	622.1	769.1	1.1526	23.86 %	0.505 dB	172.06%	8.62 K	16.8
10*LGT G	C7	T	H9	Y	D2	H1	P1	B4	B9

2.30=A2 0.20=C9 0.1=D1 0.44238=N(21,1) 460=T(1, 9) 0.9592=J1 6=N0
0.75=D8 0.18=D9 0.1=C8 0.10555=N(21,3) 15=T(1,11) 1.0098=C2

ant HPBW = 0.44405 +-0.000694 CSC L = 0.4420 (L = 20.0 deg)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.969	0.675	1.000	1.000	0.973	0.998	0.635	0.7042	0.98	24590.4	7.189E-04

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.152 km	0.03142 dB	0.0154 dB/dens	0.0468 dB	1.285	0.0130	18.0 ft

##

25.0deg: NEF(kFU) = 101.934 +- 0.79 dB (20.0 %) 7.500 GHZ

E-S	E-F	E-Y	E-K1	E-K2	E-K3	E-K4	E-K5	E-K6	E-K7	+E-K8	+E-K9	E-TA
14.4%	0.0	0.8	1.3	4.8	0.0	0.1	9.6	0.1	2.8	1.7	0.0	0.6%

Calculated using G/Ta FIT VALUE AND Ta

STAR SHAPE CORRECTION FACTOR

##

G(dB)	G-hpbw	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
51.19	51.17	625.5	769.1	1.1530	23.86 %	0.397 dB	172.06%	7.00 K	16.7

via fit HPBW: G = [illegible]26117/(HPBW)²

2.30=A2 0.20=C9 0.1=D1 0.44238=N(21,1) 460=T(1, 9) 0.9669=J1 6=N0
0.75=D8 0.18=D9 0.1=C8 0.10555=N(21,3) 15=T(1,11) 1.0082=C2

ant HPBW = 0.44405 +-0.000694 CSC L = 0.4424 (L = 25.0 deg)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.975	0.676	1.000	1.000	0.978	0.999	0.643	0.7030	0.98	24590.4	7.280E-04

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.152 km	0.03142 dB	0.0154 dB/dens	0.0468 dB	1.285	0.0130	18.0 ft

##

```
30.0deg:              NEF(kFU) =  102.747 +- 0.77 dB     (  19.5 %)      7.500 GHZ

 E-S    E-F    E-Y   E-K1   E-K2   E-K3   E-K4   E-K5   E-K6   E-K7  +E-K8  +E-K9   E-TA
14.4%   0.0    0.8    1.1    4.8    0.0    0.1    9.2    0.1    2.8    1.5    0.0    0.6%

###############################################################################
G(dB)  G-hpbw  T(K)    Ta(K)   Y-fac  HPBWerr   data fit  c(1-K2) bright   effAREA
51.18  51.16  627.7    769.1  1.1533  23.86 %  0.378 dB 172.06%  5.92 K     16.7

2.30=A2  0.20=C9  0.1=D1  0.44238=N(21,1)  460=T(1, 9)  0.9719=J1  6=N0
0.75=D8  0.18=D9  0.1=C8  0.10555=N(21,3)   15=T(1,11)  1.0073=C2

    ant HPBW = 0.44405 +-0.000694 CSC L = 0.4427  (L = 30.0 deg)

   K1    K2    K3    K6    K8    K9    K      APR-eff  R-eff     S(FU)      Xi(K)
 0.979 0.676 1.000 1.000 0.981 0.999 0.648  0.7022   0.98    24590.4  7.340E-04

 SITE ELEV     oxy attn      water attn    zenith attn    REFR #1   REFR #2   ant-DIAM
  0.152 km   0.03142 dB  0.0154 dB/dens  0.0468 dB     1.285     0.0130     18.0 ft
###############################################################################


35.0deg:              NEF(kFU) =  103.317 +- 0.77 dB     (  19.5 %)      7.500 GHZ

 E-S    E-F    E-Y   E-K1   E-K2   E-K3   E-K4   E-K5   E-K6   E-K7  +E-K8  +E-K9   E-TA
14.4%   0.0    0.8    1.0    4.8    0.0    0.1    9.6    0.1    2.8    1.3    0.0    0.6%

###############################################################################
G(dB)  G-hpbw  T(K)    Ta(K)   Y-fac  HPBWerr   data fit  c(1-K2) bright   effAREA
51.17  51.16  629.2    769.1  1.1535  23.86 %  0.396 dB 172.06%  5.17 K     16.6

2.30=A2  0.20=C9  0.1=D1  0.44238=N(21,1)  460=T(1, 9)  0.9755=J1  6=N0
0.75=D8  0.18=D9  0.1=C8  0.10555=N(21,3)   15=T(1,11)  1.0067=C2

    ant HPBW = 0.44405 +-0.000694 CSC L = 0.4428  (L = 35.0 deg)

   K1    K2    K3    K6    K8    K9    K      APR-eff  R-eff     S(FU)      Xi(K)
 0.981 0.676 1.000 1.000 0.983 0.999 0.652  0.7016   0.98    24590.4  7.382E-04

 SITE ELEV     oxy attn      water attn    zenith attn    REFR #1   REFR #2   ant-DIAM
  0.152 km   0.03142 dB  0.0154 dB/dens  0.0468 dB     1.285     0.0130     18.0 ft
###############################################################################


40.0deg:              NEF(kFU) =  103.733 +- 0.78 dB     (  19.7 %)      7.500 GHZ

 E-S    E-F    E-Y   E-K1   E-K2   E-K3   E-K4   E-K5   E-K6   E-K7  +E-K8  +E-K9   E-TA
14.4%   0.0    0.8    0.9    4.8    0.0    0.1   10.3    0.1    2.8    1.1    0.0    0.6%

###############################################################################
G(dB)  G-hpbw  T(K)    Ta(K)   Y-fac  HPBWerr   data fit  c(1-K2) bright   effAREA
51.16  51.15  630.4    769.1  1.1537  23.86 %  0.424 dB 172.06%  4.62 K     16.6

2.30=A2  0.20=C9  0.1=D1  0.44238=N(21,1)  460=T(1, 9)  0.9781=J1  6=N0
0.75=D8  0.18=D9  0.1=C8  0.10555=N(21,3)   15=T(1,11)  1.0062=C2

    ant HPBW = 0.44405 +-0.000694 CSC L = 0.4430  (L = 40.0 deg)

   K1    K2    K3    K6    K8    K9    K      APR-eff  R-eff     S(FU)      Xi(K)
 0.983 0.676 1.000 1.000 0.985 0.999 0.655  0.7012   0.98    24590.4  7.413E-04

 SITE ELEV     oxy attn      water attn    zenith attn    REFR #1   REFR #2   ant-DIAM
  0.152 km   0.03142 dB  0.0154 dB/dens  0.0468 dB     1.285     0.0130     18.0 ft
###############################################################################
```

```
45.0deg:              NEF(kFU) =  104.048 +- 0.79 dB    (  20.0 %)     7.500 GHZ

 E-S    E-F    E-Y  E-K1  E-K2  E-K3  E-K4  E-K5  E-K6  E-K7 +E-K8 +E-K9  E-TA
14.4%   0.0    0.8   0.8   4.8   0.0   0.1  11.0   0.1   2.8   1.0   0.0   0.6%

##################################################################################
G(dB)  G-hpbw  T(K)   Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
51.16  51.15  631.2   769.1  1.1538  23.86 %  0.451 dB 172.06%  4.20 K    16.6

2.30=A2  0.20=C9  0.1=D1  0.44238=N(21,1)  460=T(1, 9)  0.9801=J1  6=N0
0.75=D8  0.18=D9  0.1=C8  0.10555=N(21,3)   15=T(1,11)  1.0059=C2

    ant HPBW = 0.44405 +-0.000694 CSC L = 0.4431  (L = 45.0 deg)

  K1    K2    K3    K6    K8    K9    K     APR-eff  R-eff    S(FU)     Xi(K)
 0.985 0.676 1.000 1.000 0.987 1.000 0.657  0.7009   0.98    24590.4  7.437E-04

SITE ELEV    oxy attn     water attn   zenith attn   REFR #1  REFR #2  ant-DIAM
 0.152 km   0.03142 dB  0.0154 dB/dens  0.0468 dB    1.285    0.0130    18.0 ft
##################################################################################


50.0deg:              NEF(kFU) =  104.289 +- 0.80 dB    (  20.3 %)     7.500 GHZ

 E-S    E-F    E-Y  E-K1  E-K2  E-K3  E-K4  E-K5  E-K6  E-K7 +E-K8 +E-K9  E-TA
14.4%   0.0    0.8   0.7   4.8   0.0   0.1  11.6   0.1   2.8   1.0   0.0   0.6%

##################################################################################
G(dB)  G-hpbw  T(K)   Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
51.15  51.15  631.9   769.1  1.1539  23.86 %  0.475 dB 172.06%  3.88 K    16.6

2.30=A2  0.20=C9  0.1=D1  0.44238=N(21,1)  460=T(1, 9)  0.9816=J1  6=N0
0.75=D8  0.18=D9  0.1=C8  0.10555=N(21,3)   15=T(1,11)  1.0056=C2

    ant HPBW = 0.44405 +-0.000694 CSC L = 0.4431  (L = 50.0 deg)

  K1    K2    K3    K6    K8    K9    K     APR-eff  R-eff    S(FU)     Xi(K)
 0.986 0.676 1.000 1.000 0.988 1.000 0.658  0.7006   0.98    24590.4  7.455E-04

SITE ELEV    oxy attn     water attn   zenith attn   REFR #1  REFR #2  ant-DIAM
 0.152 km   0.03142 dB  0.0154 dB/dens  0.0468 dB    1.285    0.0130    18.0 ft
##################################################################################
         HIGHEST ELEVATION  PRINTOUT  IS DETERMINED
         FROM HIGHEST ELEVATION  USED IN  REWORK
55.0deg:              NEF(kFU) =  104.477 +- 0.81 dB    (  20.5 %)     7.500 GHZ

 E-S    E-F    E-Y  E-K1  E-K2  E-K3  E-K4  E-K5  E-K6  E-K7 +E-K8 +E-K9  E-TA
14.4%   0.0    0.8   0.7   4.8   0.0   0.1  12.1   0.1   2.8   0.9   0.0   0.6%

##################################################################################
G(dB)  G-hpbw  T(K)   Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
51.15  51.15  632.4   769.1  1.1539  23.86 %  0.495 dB 172.06%  3.63 K    16.6

2.30=A2  0.20=C9  0.1=D1  0.44238=N(21,1)  460=T(1, 9)  0.9828=J1  6=N0
0.75=D8  0.18=D9  0.1=C8  0.10555=N(21,3)   15=T(1,11)  1.0054=C2

    ant HPBW = 0.44405 +-0.000694 CSC L = 0.4432  (L = 55.0 deg)

  K1    K2    K3    K6    K8    K9    K     APR-eff  R-eff    S(FU)     Xi(K)
 0.987 0.676 1.000 1.000 0.988 1.000 0.660  0.7005   0.98    24590.4  7.468E-04

SITE ELEV    oxy attn     water attn   zenith attn   REFR #1  REFR #2  ant-DIAM
 0.152 km   0.03142 dB  0.0154 dB/dens  0.0468 dB    1.285    0.0130    18.0 ft
##################################################################################
```

RUN 103

AN/TSC-54 #3 Wahiawa,Hawaii
FRI: 1980 FEB 8
7.500 GHz, 18.0 Ft DISH

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
76.5 F	69.3 F	78.5 %	17.7 gm/m↑3	2	0 mph

==

FIT TO 8 DATA
NUF(kFU) =(107.4310 +- 8.9393) + (-0.56300 +- 3.33325)*CSC L

+ = LINEAR CONTRIBUTION

20.0deg: NUF(kFU) = 105.785 +- 0.88 dB (22.4 %) 7.500 GHZ

E-S	E-F	E-Y	E-K1	E-K2	E-K3	E-K4	E-K5	E-K6	E-K7	+E-K8	+E-K9	E-TA
14.4%	0.0	0.8	1.6	4.8	0.0	0.1	12.9	0.1	2.8	2.1	0.0	0.6%

##

G(dB)	G-hpbw	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
51.21	51.17	622.1	769.1	1.1526	23.86 %	0.523 dB	172.06%	8.62 K	16.8

2.30=A2 0.20=C9 0.1=D1 0.44238=N(21,1) 460=T(1, 9) 0.9592=J1 6=N0
0.75=D8 0.18=D9 0.1=C8 0.10555=N(21,3) 15=T(1,11) 1.0094=C2

ant HPBW = 0.44405 +-0.000694 CSC L = 0.4420 (L = 20.0 deg)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.969	0.675	1.000	1.000	0.973	0.998	0.635	0.7042	0.98	24590.4	7.189E-04

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.152 km	0.03142 dB	0.0154 dB/dens	0.0468 dB	1.285	0.0130	18.0 ft

##

25.0deg: NUF(kFU) = 106.099 +- 0.80 dB (20.2 %) 7.500 GHZ

E-S	E-F	E-Y	E-K1	E-K2	E-K3	E-K4	E-K5	E-K6	E-K7	+E-K8	+E-K9	E-TA
14.4%	0.0	0.8	1.3	4.8	0.0	0.1	10.0	0.1	2.8	1.7	0.0	0.6%

##

G(dB)	G-hpbw	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
51.19	51.17	625.5	769.1	1.1530	23.86 %	0.411 dB	172.06%	7.00 K	16.7

2.30=A2 0.20=C9 0.1=D1 0.44238=N(21,1) 460=T(1, 9) 0.9669=J1 6=N0
0.75=D8 0.18=D9 0.1=C8 0.10555=N(21,3) 15=T(1,11) 1.0079=C2

ant HPBW = 0.44405 +-0.000694 CSC L = 0.4424 (L = 25.0 deg)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.975	0.676	1.000	1.000	0.978	0.999	0.643	0.7030	0.98	24590.4	7.280E-04

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.152 km	0.03142 dB	0.0154 dB/dens	0.0468 dB	1.285	0.0130	18.0 ft

##

RUN 103

AN/TSC-54 #3 Wahiawa,Hawaii
FRI: 1980 FEB 8
7.500 GHz, 18.0 Ft DISH

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
76.5 F	69.3 F	78.5 %	17.7 gm/m↑3	2	0 mph

FIT TO 8 DATA

G/T(dB) =(23.0498 +- 0.3685) + (0.07455 +- 0.13740)*CSC L

+ = LINEAR CONTRIBUTION

20.0deg: G/T(dB) = 23.268 +- 0.90 dB (23.0 %) 7.500 GHZ

E-S	E-F	E-Y	E-K1	E-K2	E-K3	E-K4	E-K5	E-K6	E-K7	+E-K8	+E-K9	E-TA
14.3%	0.0	0.8	1.6	4.8	0.0	0.1	13.9	0.1	2.8	2.1	0.0	0.6%

G(dB)	G-hpbw	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
51.21	51.17	622.1	769.1	1.1526	23.86 %	0.566 dB	172.06%	8.62 K	16.8

2.30=A2 0.20=C9 0.1=D1 0.44238=N(21,1) 460=T(1, 9) 0.9592=J1 6=N0
0.75=D8 0.18=D9 0.1=C8 0.10555=N(21,3) 15=T(1,11) 1.0000=C2

ant HPBW = 0.44405 +-0.000694 CSC L = 0.4420 (L = 20.0 deg)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.969	0.675	1.000	1.000	0.973	0.998	0.635	0.7042	0.98	24590.4	7.189E-04

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.152 km	0.03142 dB	0.0154 dB/dens	0.0468 dB	1.285	0.0130	18.0 ft

25.0deg: G/T(dB) = 23.226 +- 0.81 dB (20.5 %) 7.500 GHZ

E-S	E-F	E-Y	E-K1	E-K2	E-K3	E-K4	E-K5	E-K6	E-K7	+E-K8	+E-K9	E-TA
14.3%	0.0	0.8	1.3	4.8	0.0	0.1	10.6	0.1	2.7	1.7	0.0	0.6%

G(dB)	G-hpbw	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
51.19	51.17	625.5	769.1	1.1530	23.86 %	0.439 dB	172.06%	7.00 K	16.7

2.30=A2 0.20=C9 0.1=D1 0.44238=N(21,1) 460=T(1, 9) 0.9669=J1 6=N0
0.75=D8 0.18=D9 0.1=C8 0.10555=N(21,3) 15=T(1,11) 1.0000=C2

ant HPBW = 0.44405 +-0.000694 CSC L = 0.4424 (L = 25.0 deg)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.975	0.676	1.000	1.000	0.978	0.999	0.643	0.7030	0.98	24590.4	7.280E-04

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.152 km	0.03142 dB	0.0154 dB/dens	0.0468 dB	1.285	0.0130	18.0 ft

7. COMPUTER PROGRAM CONSTANTS

The meanings of the computer program constants are listed in this section. Some of the program constants are used more than once, so the appropriate meaning must be deduced from the context of the program. For convenience, the simple program variables are listed first, the matrix variables listed next, and the defined functions, key function, flags, and multiplex function (FNX functions) are listed last. Each of the lists are printed twice, once in alphabetical order by the variable name, and once in alphabetical order by meaning. The use of these definition lists, with the use of the cross-reference lists included at the end of the program listings, makes it possible to rapidly locate a specific calculation within a program.

7.1 Variables List Alphabetical by Variable

VARIABLES LIST by variable

for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

1	A	AZIMUTH(deg) OR DUMMY
2	A$,B$	DUMMY
3	A(N7)	SET DATA: SEE MATRIX LIST
4	A0	REWORK #, (d) MOON CONST
5	A1	FILTER #,(d) MOON CONST
6	A2	GAUSS CURVE FIT ERROR,% dT
7	A3	ATTN OF STD ATTN (abs>1),NOT dB) =N(13,10)
8	A4,A5,A6	SYST CONSTS:PRGM USES N(1,4),N(1,5),N(1,6)
9	A8	RATIO #1 add/#2 add uses N(18,5 or 10)
10	B	HPBW#1(min of arc),AS MEASURED
11	B(I,J)	DUMMY MATRIX
12	B0	HPBW(minutes) with Kanda correction
13	B1	CODE FOR SATELLITE CARRIER MEAS:0=SKY,1=-F,2=RCR
14	B1	DECL OFFSET (deg)
15	B2,B3	ANTENNA APERTURE EFFICIENCY, ANT RADIATION EFF
16	B4	ATMOSPHERIC BRIGHTNESS TEMPERATURE, K
17	B5	T/Ta ZENITH
18	B5	TEMPERATURE(F)
19	B6	DEW POINT(F)
20	B6	T/Ta CSC COEFF
21	B7,B8	G/Ta(dB) ZENITH COEFF,CSC COEFF
22	B8	P(ONT),mW=(F5+F8)/2: in C/kT MEAS
23	B9	ANTENNA EFFECTIVE AREA
24	C	DATE, DECIMAL
25	C(I,J)	G(I,J) INVERSE OR DUMMY
26	C0	SITE ELEV (Km)
27	C1	C^2/(8*PI*K*F^2)
28	C1	SPACE LOSS
29	C2	ERROR enhancement of NEF,NUF compared to G/T
30	C2	FLAG-5dB ATTN IN NOISE ADD PWR MEAS:0=NO,1=YES
31	C3	FLAG-NOISE ADD: 0=#1&#2,1=#1,2=#2
32	C4,C5	SITE: W.LONG (deg), N. LAT (deg)
33	C6	GHA TO ARIES @ 0 GMT (hrs)

34	C7	G via HPBW - G via G/Ta, dB
35	C8	FILTER FREQ (MHz)
36	C8	Y-FACTOR ERR,%
37	C9	FILTER BANDPASS(MHz)
38	C9	INSTRUMENTAL POWER RESPONSE ERR,%
39	D	ANTENNA DIAMETER(FT)
40	D$	REMARKS
41	D(T6,I)	DATA MATRIX: SEE MATRIX LIST
42	D0	SKY BACKGROUND ERR, 0.9/F^2
43	D1	STAR SHAPE ERR,%
44	D2	HPBW UNCERTAINTY,%
45	D3	ADDED NOISE ERROR,%
46	D4	YEAR,(d) day for SUN/MOON FLUX CALC
47	D5	ANTENNA POINTING ERROR (deg)
48	D8	DIFFUSIVE ATTENUATION ERR,%
49	D9	REFRACTIVE ATTENUATION ERROR,%
50	D9	no. of MEAS for MULT FREQ ROUTINE
51	E	DAYS SINCE 1900.00
52	E	EIRP*G/Ta
53	E	HOUR ANGLE(deg)
54	E0	ATTENUATION(dB) OF PROGRAM ATTENUATOR, TEMPORARY
55	E0	G/T ERR-FREQ
56	E1	EIRP:PWR no noise add (mW)
57	E1	G/T ERR-ATMOSPHERIC ABSORPTION
58	E1	TIME OF STAR PEAK (hrs)
59	E1,3,4,E5	EIRP:PWR no add(mW),PWR+#1,PWR+#2,PWR+#1&#2
60	E2	ATTENUATION(dB) OF PROGRAM ATTENUATOR
61	E2	G/T ERR-STAR SHAPE
62	E2,E3	MONTH, DAY
63	E3	EIRP:PWR+noise add #1 (mW)
64	E3	G/T ERR-BANDWIDTH
65	E4	EIRP:PWR+noise add #2 (mW)
66	E4	G/T ERR-DIFFERENTIAL SKY TEMP

67	E5	EIRP:PWR+noise add #1 & #2 (mW)
68	E5	G/T ERR-ANTENNA POINTING
69	E5	TIME/MEASUREMENT (hrs)
70	E6	ATTENUATION(dB), MANUAL ATTENUATOR
71	E6	G/T ERR-ANT POLARIZATION
72	E6	MEASUREMENT # OF FIT GAUSSIAN CURVE
73	E6	YEARS SINCE 1977
74	E7	G/T ERR-SYSTEM RESPONSE
75	E7	HPBW FIT BY GAUSSIAN CURVE TO DRIFT CURVE
76	E7	SLANT RANGE,10^6 Km
77	E8	G/T ERR-ATMOSPHERIC DIFFUSION
78	E8	TIME(hrs)/(ARC deg)
79	E9	G/T ERR-ATMOSPHERIC REFRACTION
80	E9	GHA TO ARIES(deg)
81	E9	PWR(mW) ON SAT SIGNAL
82	F	FREQ OF MEASUREMENT(GHz)
83	F	RECEIVER FREQ(MHz)
84	F(I)	DUMMY MATRIX
85	F0	FREQ ERR,%
86	F0	VALUE OF C2 IN FNW
87	F1	FLAG-GRAPH:0=NO,1=DATA,2=&FIT,3=FIT,4=EXIT
88	F1	FLAG:(c)0=STAR,1=SAT;(b)1=SUBROUTINE LOADED
89	F1	FLAG:0=PRT PWR & VOLTS,2=GRAPH PWR RATIO (in E)
90	F1	SPACE LOSS: in C/kT MEAS
91	F2	FLAG-PRT:0=ALL,1=PROG DATA,2=INPUT ASSUMPS,3=G/T
92	F2	FLAG: 0=NORMAL,1=DIFF PLOT DATA,2=DIFFPLOT CUTS
93	F2	FLAG:0=CSC fit, 1=LINEAR fit
94	F2	FLAG:0=NO AUTO CHECK,1=YES (in E)
95	F2	P/Pa for LOWER FREQ ONT: in C/kT meas
96	F3	FLAG-SORT & FIT:1=G/T-ELEV,2=G/T-CSC,3=DIP-ELEV,
97	F3	FLAG: 0=MANUAL TEMP,HUMIDITY, 1=AUTO TEMP,DEW
98	F3	FLAG:0=XTAL,1=TYPE IV bridge (in E)
99	F3	FLAG:(b) 1=bypass trivial ques,(e)0=XTAL,1=TYPE

100	F4	FILE # OF N7=1, STARTING M(40,1)
101	F4	FILE LOAD #
102	F4	FLAG IN E:1=SIMULATED NOISE ADD,2=EARTH TERMINAL
103	F5	FLAG IN D:1=PRGM REWORK
104	F5	FLAG IN E:1=NOISE ADD #1 WORKS
105	F5	FLAG-PROGR REWORK PATTERN:0=NO
106	F5	FLAG: 0,1=LINEARITY ck table, 2,3=stab graph
107	F5	P(ONT) @ -F: in C/kT meas
108	F6	FLAG IN E:0=PRGM ATTN,1=STD ATTN
109	F6	FLAG IN E:1=NOISE ADD #2 WORKS
110	F6	FLAG TASK:1=NEW SITE,2=MEAS,3=REWORK,0=MANL
111	F6	FLAG-AUTO SEQUENCE:1=YES
112	F6	FLAG:0=RESTART,1=SKY,2=G/T,3=EIRP,4=LINK
113	F7	FLAG-PWR LEVEL: 0=CONST, 1=STEPPED (in E)
114	F7	FLAG: 0=CASSETTE BEING USED,1=DISK
115	F8	FLAG:(d)1=prefit HPBW
116	F8	FLG in E:(KEY5)0=GRAPH,1=LIST,(KEY6)0=Nadd,ET
117	F8	P(ONT) @ +F: in C/kT meas
118	F9	ATTN VALUE OF LAST PROG ATTEN IN FNW
119	F9	STORE SET # OF SUMMARY OF REWORK DATA
120	F9	T(sky)/Ta: in C/kT meas
121	G	ANTENNA GAIN,REL
122	G(I,J)	CURVE FIT MATRIX
123	G4	OXYGEN ABSORPTION (dB/Km)
124	G5	WATER ABSORPTION, #1 CONST (dB/Km)
125	G6	WATER ABSORPTION, #2 CONST (dB/Km)
126	H	HOUR ANGLE OFFSET (deg)
127	H	SIMULATED STAR NOISE(dB)
128	H$	MAIN PROGRAM HEADING
129	H1	FIT TO G/T or NEF data (3*1S/SQR(#PTS)),dB
130	H5	INSTR PWR RESPONSE FACTOR
131	H6,H7	MOON LUNAR AGE(days),DECL of SUN/MOON (in d)
132	H7	DECL of SUN/MOON

133	H9	ADDED NOISE,K
134	I	HPBW
135	I	LOOP VARIABLE
136	I5	PLOT UNIT
137	J	BRDG PWR when NOISE ADD sources ON
138	J	MAXIMUM FLUX IN F.U.
139	J	SELECT FUNCTION:19=G/T,20=G/Ta,21=HPBW#1,22=#2, 24=DECL,25=NEF
140	J1	K8 for POINT SOURCE
141	J1	LOOP VARIABLE
142	K	K1*K2*...*K9
143	K1	ATMOSPHERIC ABSORPTION TRANSMISSION COEFF
144	K2	STAR SHAPE FACTOR
145	K3	BANDWIDTHS EFFECTS FACTOR
146	K4	DIFFERENTIAL SKY TEMPERATURE FACTOR
147	K5	ANTENNA POINTING FACTOR
148	K6	ANTENNA POLARIZATION FACTOR
149	K7	SYSTEM RESPONSE FACTOR
150	K8	DIFFUSIVE ATTENUATION FACTOR
151	K9	REFRACTIVE ATTENUATION FACTOR
152	L	ELEVATION(deg)
153	L$	FREQ,DIAM,G/T HEADING
154	L0	ELEVATION--NO REFRACTION CORRECTION
155	L0	FLGd:0=GRAPH,1=ERRPRTOUT-no VARIABLES,2=with
156	L1	ELEVATION REFRACTION CORRECTION,deg
157	L1	ELEVATION FOR FITTING G/T OR G
158	L4	EFFECTIVE OXYGEN LENGTH, Km
159	L5,L6	WATER PATH LENGTH CONST #1, CONST #2, Km
160	L7	WATER DENSITY (gm/m^3)
161	L8	REFRACTION CONST #1
162	L9	REFRACTION CONST #2
163	M	G/T RELATIVE
164	M(N7,J)	SUMMARY DATA: SEE MATRIX LIST
165	M1	LOOP VARIABLE

166	M1,M2,M3	SUM on P,SUM on X,SUM on Y
167	M1...M4	ATTN OFPGM1,2,4,8@30MHz,PGMUSES N(13,1...4)
168	M3	MEASUREMENT # @ MAXIMUM AMPLITUDE
169	M5,M6	PORT(freq) # current,# of PORTS=N(5,11)
170	M6...M9	ATTNOF PGM 1,2,4,8@70MHZ,pgmuses N(13,6.9)
171	N	DATE, DECIMAL FOR MOON DATA
172	N	MEASUREMENT NUMBER
173	N(I,J)	INPUT DATA CONST, SEE MATRIX LIST
174	NO	STAR#(current) 1=CAS,2=CYG,3=TAU,4=ORI,5=SUN,6=M
175	N1	NO. OF STAR SOURCES
176	N2	CUT NUMBER
177	N3	PWR MEASUREMENT # WITHIN A CUT
178	N4	LARGEST N3
179	N5	PAGE NUMBER
180	N6	RUN #
181	N7	SET #
182	N8	SUMMARY DATA $ = M(40,1) = N7+F4
183	N9	NUMBER POINTS IN FIT
184	01,02,03	FILTER#1(2.5MHz @ 30MHz) CONSTS:N(15,1),N(15,2),
185	06,07,08	FILTER#2(1MHz @ 70MHz) CONSTS:N(15,6),N(15,7),
186	P	POWER MEASURED,MILLIWATTS
187	P$	PROJECT HEADING
188	P1	RECEIVER GAIN SLOPE/mHz
189	P1	STAR SHAPE ERROR,%
190	P1,P2,P3	FILTER#3 (2.5MHz @ 70MHz) CONSTS:N(16,1),N(16,2)
191	P6,P7,P8	FILTER#4 (5.3MHz @ 70MHz) CONSTS:N(16,6),N(16,7)
192	Q,Q0,Q1	DUMMY
193	Q2,Q3	DUMMY
194	Q3	FLG:(LOC SITE DATA).(F6=TASK)(F4=PRM CHANGE?)(F7
195	Q3	HPBW,ANTENNA ALONE(i.e. with KANDA CORRECTION)
196	Q3	POWER WITH NOISE ADD ON
197	Q5,Q6	dP(add) in C/kT meas: @ -F, @ +F
198	R	REMARKS: SEE REMARK LIST

VARIABLES LIST by variable

for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

199	R0	RATIO #1add/#2add @ 70 MHz, pgm uses N(18,10)
200	R1	ZERO FOR GRAPH
201	R2	RESIDUALS FROM CURVE FIT
202	R5	NUMBER OF POINTS FIT TO PARABOLA
203	S	G/T ERR-FLUX
204	S	TIME(hrs), CURRENT
205	S$	STAR NAME
206	S(I,J)	STAR DATA: SEE MATRIX LIST
207	S1,S2	SUN FLUX (current time) at 4.995 GHz, AT 8.8 GHz
208	S3	PREDICTED MEASUREMENT # FOR MAXIMUM STAR PWR
209	S6	MOON'S MEAN TEMP = Tbo
210	T	T(syst)
211	T(NO,J)	INPUT STAR DATA: SEE MATRIX LIST
212	T1	G/T OR G/Ta VALUE
213	T1	TIME OF 1st MEASUREMENT
214	T2	CURRENT MEASUREMENT TIME
215	T2	RUN/SET
216	T6	N-6*(N7-1)
217	T9	MOON TEMP (current)
218	U,U1,V	LOAD START#,STOP#,STEP (in d)
219	V	-ALPHA,GAUSSIAN COEFF
220	V	VOLTAGE ACROSS PWR BRIDGE
221	V1,2,3,V4	SUMS on X^4,X^2,X^3,P*X^2
222	V5	PARABOLIC FIT PARAMETER h
223	V5,V6	SUMS on P*X,P^2
224	V6	Tstar/Ta=EXP(X-F(2)*W1^2)
225	V7	DV,#1 RF OFF
226	V7	N3 OF STAR MAX
227	V7	dT(star)/Ta
228	V8	DISK OR TAPE #
229	V8	DV, RF ON
230	V9	DV,#2 RF OFF
231	V9	dT(STAR)/Ta PREDICTED

VARIABLES LIST by variable

for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

232	W	BANDWIDTH(MHz)
233	W1	VARIANCE OF P(STAR)/P(ADD)
234	X	TIME VARIABLE, 2*I/N4-1
235	X$	SUBROUTINE HEADING
236	X1	LOOP VARIABLE
237	X1	TIME VARIABLE, 2*(N3-M3)/N4
238	X1	Xi = G/dT(star)
239	X2	GAMMA,PARABOLIC FIT
240	X2	VARIABLE IN FNG(N3)
241	X4	K*S/2/k
242	X5	AZIMUTH BIAS (deg)
243	X6	ELEVATION BIAS (deg)
244	Y	Y-FACTOR
245	Y(I)	MATRIX USED IN CURVE FIT OR DUMMY
246	Y1	G/T ERR-Y factor (C8*Y5)
247	Y5	Y/(Y-1)
248	Z	COLD SKY POWER / Ta
249	Z1	ZENITH ATM ATTN, dB
250	Z5	C/kT MEAS:T(ONT)/Ta FOR UPPER FREQ
251	Z5	SERROR VARIABLE

7.2 Matrix List Alphabetical by Variable

MATRIX LIST by variable
for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

1	A(1)	RUN/SET=(FREQ#*1000)+N6*100+N7;N6=RUN#,N7=set#
2	A(2)	FREQ(MHz)
3	A(3)	AMBIENT TEMP(F) *10
4	A(4)	DEW PT(F) *10
5	A(5)	RELATIVE HUMIDITY(%) *10
6	A(6)	CLOUD COVER * 100 + WIND(mph)
7	A(7)*	PWR LEVEL,microwatts (1st pwr measured in FNU)
8	A(7)x	CODE(B1):0=SKY, 1=-F, 2=RCR @ F, 3=+F, 4=OTHER
9	A(8)	PWR RATIO CHECK: (STD CK results from FNU)
10	A(8)rw	T/Ta*10^4
11	A(9)*	U*10^4: REFERENCE PWR via 1st meas in -3 CUT
12	A(9)x	NOT USED
13	A(10)*	SITE ELEVATION (CO*1000)
14	A(10)x	SLANT DIST(Km): LGT(E7)*1000
15	D(1, 1)x	AZIMUTH:(AZ(deg)-180)*100
16	D(1, 2)x	ELEV(deg)*100
17	D(2, 1)x	FLAG C2: 0=NO STD ATTN WHEN NOISE ADD ON, 1=STD
18	D(2, 2)x	MANUAL ATTN SETTING,dB (E6)
19	D(3, 1)x	NUMBER OF MEAS(N4)
20	D(3, 2)x	FILTER BANDWIDTH,MHz (W)*10
21	D(4, 1)x	P/Padd(ave of set):LGT(P/Padd)10^4
22	D(4, 2)x	TRX PWR:LGT(E4)*10^4
23	D(5, 1)x	PWR#1,mW(ave,noise add OFF):LGT(PWR)*10^((E2+E6)
24	D(5, 2)x	GAIN SLOPE OF RCR (P1) * 1000
25	D(6, 1)x	PWR due to NOISE ADD,mW:LGT(PWR#2-PWR#1)*10^4
26	D(1,73)	TIME START of MEAS*100
27	D(1,73)	NO.DATA PTS/SET*100 + NO.PARAMETERS FIT
28	D(1,73)	T/Ta via NONLINSFIT as LGT(T/Ta)*10^4
29	D(1,74)	LGT(dTstar/Ta)*10^4
30	D(1,75)	FREQ#1 (MHz)
31	D(1,N3+2)x	PWR WITH noise add OFF @ BOLO: LGT(PWR)*10^4
32	D(2,73)	TIME END of MEAS*100
33	D(2,73)	HPBWisotr (deg) via NONLINSFIT ,LGT(HPBW)*!0^4

34	D(2,74)	Tsky/Ta*10^5
35	D(2,75)	FREQ#2 (MHz)
36	D(2,N3+2)x	PWR(noise add ON): LGT(BOLO PWR)*10^4
37	D(3,74)	T/Ta (for FREQ#1) * 10^4
38	D(3,74)	HPBWparallel (deg) via NONLINSFIT as LGT(HPBW)*1
39	D(3,75)	FREQ#3 (MHz)
40	D(3,N3+2)x	PWR/Padd:LGT(P/Padd)*10^4
41	D(4,73)	HPBWperp(deg) via NONLINSFIT as LGT(HPBW)*10^4
42	D(4,74)	T/Ta (for FREQ#2) * 10^4
43	D(4,75)	FREQ#4 (MHz)
44	D(4,N3+2)x	TIME,hrs(E1)*10^3
45	D(5,73)	dTstar/Ta via NONLINSFIT as LGT(dTstar/Ta)*10^4
46	D(5,74)	T/Ta (for FREQ#3) * 10^4
47	D(5,75)	NO. of FREQS
48	D(5,N3+2)x	LGT(PWR METER VOLTAGE)*10^4
49	D(6,74)	T/Ta (for FREQ#4) * 10^4
50	D(6,75)	TIME(sec) BETWEEN MEAS (3600*E5)
51	D(6,N3+2)x	ATTN,TOTAL: E2+E6
52	D(T6, 1)*	AZIMUTH:(AZ(deg)-180)*100
53	D(T6, 2)*	ELEVATION(deg)*100
54	D(T6, 3)*	# OF MEAS(N4)
55	D(T6, 4)*	TIME OF PREDICTED STAR MAX: E1*1000
56	D(T6, 5)*	DECL OFFSET FROM PREDICTED STAR CENTER: (B1+L1)
57	D(T6, 6)*	LOG(((Tstar+Tsystem)/Tadd)/U)*10^4
58	D(T6, 6)rw	LGT(dT/Tadd)*10^4
59	D(T6, 7)*	PEAK # PREDICTED * 100
60	D(T6,N3+7)	LOG(P/U)*10^4: P=PWR/Padd(mW),U=PWR/Padd REF
61	M(40, 1)	NUMBER OF SUMMARY SETS STORED IN MATRIX M
62	M(40, 3)	NUMBER OF FILES USED IN DISK STORAGE
63	M(N8, 1)	ELEV(deg) + STAR#/100
64	M(N8, 1)d	STAR #/100
65	M(N8, 1)x	CODE + .07
66	M(N8, 2)*	G/T(dB)

MATRIX LIST by variable

for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

67	M(N8, 2)d	T/Ta ZENITH (b5)
68	M(N8, 2)x	PWR/Pa
69	M(N8, 3)*	G/Ta(dB)
70	M(N8, 3)d	T/Ta CSC COEFF (B6)
71	M(N8, 3)x	PWR(mW)
72	M(N8, 4)*	HPBW of antenna (not convolution, deg)
73	M(N8, 4)d	TIME, DECIMAL HRS (FNT2)
74	M(N8, 4)x	PWR due to Ta (mW)
75	M(N8, 5)*	unused
76	M(N8, 5)d	TEMPERATURE,F (A(3)/10)
77	M(N8, 5)x	C/kT(dB)
78	M(N8, 6)	FREQ (GHz)
79	M(N8, 7)*	Y-factor
80	M(N8, 7)d	WATER DENSITY (L7)
81	M(N8, 7)x	EIRP(dBw)+G/Ta(dB) = E
82	M(N8, 8)*	NEF (kFU)
83	M(N8, 8)d	NUMBER OF POINTS IN DIP CURVE
84	M(N8, 8)x	ONT/Tadd: (F2+Z5)/2
85	M(N8, 9)*	NUF (kFU)
86	M(N8, 9)x	Padd(Mw): (F5+F8)/2
87	M(N8,10)	RUN/SET: N6+N7/100
88	M(N8,M5)	M1 accumulation for FREQ M5
89	M(N8,M5+5)	V1 accumulation for FREQ M5
90	N(1, 4)	SYSTEM # + (DATA REVISION #/100)
91	N(1, 5)	DAC REF volt:#3=6.313,#4=6.367,#5=6.284,#6=6.24
92	N(1, 6)	DAC mult=-(chnl#9-#8)/#7:#3=0,3173,#4=0.32,#5=0.
93	N(1, 7)	ATTN+meter(dB/10) 5.3@70:#3=16.15,#4=17.3,#5=15.
94	N(1, 8)	RATIO #1 add/#2 add @ MICROWAVE FREQ
95	N(1, 9)	NUMBER OF POINTS IN FIT
96	N(1,10)	REWORK #
97	N(1,11)	NO. of DAYS of SUN/MOON DATA
98	N(5,1-4)	FREQ#1,#2,#3,#4 (MHz)
99	N(5,11)	NO. of FREQS used (M6)

100	N(5,5-9)	T/Ta (B5) for FREQ#1 to #4
101	N(6,1-4)	NOISE ADD (H9,K) for FREQ#1 to #4
102	N(13, 1)	ATTN of 1db prgm @ 30MHz:#3=0.961
103	N(13, 2)	ATTN of 2dB prgm @ 30MHz:#3=1.881
104	N(13, 3)	ATTN of 4dB prgm @ 30MHz:#3=3.947
105	N(13, 4)	ATTN of 8dB prgm @ 30MHz:#3=7.881
106	N(13, 5)	ATTN of STD RES 30MHz:#3=5.922,#6=4.779
107	N(13, 6)	ATTN OF 1dB prgm @ 70:#3=0.976,#4=0.947,#5=0.938
108	N(13, 7)	ATTN OF 2dB PRGM @70:#3=1.890,#4=1.95,#5=1.854,
109	N(13, 8)	ATTN of 4dB prgm @ 70:#3=3.909,#4=3.87,#5=3.957,
110	N(13, 9)	ATTN of 8dB PRGM @ 70:#3=7.896,#4=7.86,#5=7.845,
111	N(13,10)	ATTN of STD @ 70:#3=5.966,#4=5.92,#5=6.11,#6=6.1
112	N(15, 1)	FILT#1(2.5@30) NOISE BW:#3=3.915,#4=3.887,#5=3.6
113	N(15, 2)	FILT#1(2.5@30)N1,MHz:#3=0.00938,#4=0.01526,#5=0.
114	N(15, 3)	FILTER#1(2.5MHz @ 30MHz):2nd CONST
115	N(15, 4)	FILT#1(2.5@30)LOSS,dB:#3=3.092,#4=2.711,#5=2.391
116	N(15, 6)	FILT#2(1@70)NOISE BW:#3=1.193,#4=1.225,#5=1.23,
117	N(15, 7)	FILT#2(1@70)N1,MHz:#3=-0.1043,#4=0.0817,#5=0.127
118	N(15, 8)	FILTER#2(1MHz @ 70MHz):2nd CONST
119	N(15, 9)	FILT#2(1@70)LOSS,dB:#3=4.970,#4=4.910,#5=4.870,
120	N(16, 1)	FILT#3(2.5@70)NOISE BW:#3=2.808,#4=2.910,#5=2.93
121	N(16, 2)	FILT#3(2.5@70)N1,MHz:#3=-0.102,#4=0.0108,#5=-0.1
122	N(16, 3)	FILTER#3(2.5MHz @ 70MHz):2nd CONST
123	N(16, 4)	FILT#3(2.5@70)LOSS,dB:#4=5.78,#5=5.84,#6=5.814
124	N(16, 6)	FILT#4(5.3@70)NOISE BW:#3=5.734,#4=5.80,#5=5.856
125	N(16, 7)	FILT#4(5.3@70)N1,MHz:#3=-0.14,#4=-0.0782,#5=0.01
126	N(16, 8)	FILTER#4(5.3MHz @ 70MHz):2nd CONST
127	N(16, 9)	LOSS,dB:#4=4.18,#5=3.14,#6=4.083
128	N(17&18,1)	STORE STRING P$
129	N(17, 6)	FILT#6(0.06@70MHz)NOISE BW,MHz:#6=0.083
130	N(17, 7)	FILT#6(0.06@70MHz)N1,MHz:#6=0.00178
131	N(17, 9)	FILT#6(0.06@70MHz)INSER LOSS,dB:#6=4.719
132	N(18, 5)	RATIO #1 add/#2 add @ 30MHz

133	N(18,10)	RATIO #1add/#2add @ 70:#4=0.515,#5=0.526,#6=0.24
134	N(18,2)	T/Ta zenith
135	N(18,6)	T/Ta CSC COEFF
136	N(19, 1)	G/T(dB) INTERCEPT
137	N(19, 2)	G/T(dB) ZENITH
138	N(19, 3)	G/T(dB) SIGMA for LINEAR FIT
139	N(19, 4)	G/T(dB) SIGMA CSC FIT
140	N(19, 5)	G/T(dB) ELEV COEFF
141	N(19, 6)	G/T(dB) CSC COEFF
142	N(19, 7)	G/T(dB) ELEV COEFF ERR
143	N(19, 8)	G/T(dB) CSC COEFF ERR
144	N(19,10)	MAX VALUE
145	N(19,11)	ELEV AVERAGE
146	N(19,9)	MIN VALUE
147	N(20, 1)	G/Ta(dB) INTERCEPT
148	N(20, 2)	G/Ta(dB) ZENITH
149	N(20, 3)	G/Ta(dB) INTERCEPT 1S ERR
150	N(20, 4)	G/Ta ZENITH 1S ERR
151	N(20, 5)	G/Ta(dB) ELEV COEFF
152	N(20, 6)	G/Ta(dB) CSC COEFF
153	N(20, 7)	G/Ta(dB) ELEV COEFF ERR
154	N(20, 8)	G/Ta(dB) CSC COEFF ERR
155	N(20,22)	CSC ELEV AVERAGE
156	N(21, 1)	HPBW#1(deg) INTERCEPT
157	N(21, 2)	HPBW#1 ZENITH
158	N(21, 3)	HPBW#1(deg) INTERCEPT 1S ERR
159	N(21, 4)	HPBW#1(deg) ZENITH 1S ERR
160	N(21, 5)	HPBW#1(deg) ELEV COEFF
161	N(21, 6)	HPBW#1(deg) CSC COEFF
162	N(21, 7)	HPBW#1(deg) ELEV COEFF ERR
163	N(21, 8)	HPBW#1 CSC COEFF ERR
164	N(21,11)	SUM of (ELEV-AVE ELEV)^2
165	N(22, 1)	HPBW#2(deg) INTERCEPT

166	N(22, 2)	HPBW#2 ZENITH
167	N(22, 3)	HPBW#2(deg) INTERCEPT 1S ERR
168	N(22, 4)	HPBW#2(deg) ZENITH ERR
169	N(22, 5)	HPBW#2(deg) ELEV COEFF
170	N(22, 6)	HPBW#2(deg) CSC COEFF
171	N(22, 7)	HPBW#2(deg) ELEV COEFF ERR
172	N(22, 8)	HPBW#2(deg) CSC COEFF ERR
173	N(22,11)	SUM of (CSC ELEV - AVE CSC ELEV)^2
174	NO	STAR#(current) 1=CAS,2=CYG,3-TAU,4-ORI,5-SUN,6=M
175	N(24, 2)	D-DECL(deg) ZENITH
176	N(24, 3)	D-DECL(deg) INTERCEPT 1S ERR
177	N(24, 4)	D-DECL(deg) ZENITH 1S ERR
178	N(24, 5)	D-DECL(deg) ELEV COEFF
179	N(24, 6)	D-DECL(deg) CSC COEFF
180	N(24, 7)	D-DECL(deg) ELEV COEFF ERR
181	N(24, 8)	D-DECL(deg) CSC COEFF ERR
182	N(25, 1)	NEF(kFU) intercept
183	N(25, 2)	NEF(kFU) zenith
184	N(25, 3)	NEF(kFU) intercept 1S ERR
185	N(25, 4)	NEF(kFU) zenith 1S ERR
186	N(25, 5)	NEF(kFU) elev coeff
187	N(25, 6)	NEF(kFU) csc coeff
188	N(25, 7)	NEF(kFU) elev coeff err
189	N(25, 8)	NEF(kFU) csc coeff err
190	N(26, 1)	NUF(kFU) intercept
191	N(26, 2)	NUF(kFU) zenith
192	N(26, 3)	NUF(kFU) intercept 1S err
193	N(26, 4)	NUF(kFU) zenith 1S err
194	N(26, 5)	NUF(kFU) elev coeff
195	N(26, 6)	NUF(kFU) csc coeff
196	N(26, 7)	NUF(kFU) elev coeff err
197	N(26, 8)	NUF(kFU) csc coeff err
198	N(2i-1,j)	SUN DATA:i=1=date,2=DECL,3=DIST,5=t1,6=S5(T1),7=S8.8(t1)

MATRIX LIST by variable

for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

199	N(I,J)	PROG CONSTS I<26:I, 1=A,2=B,etc;J, 1=1,...,10=0,
200	N(i+5,j)	MOON DATA:j=day,I=2=A0,3=A1,4=A2,5=lunar age(day
201	S(NO,1)	STAR FLUX (F.U.) @ STANDARD FREQ
202	S(NO,2)	STAR=RT ASC (deg); SOLAR=GHA @ 0 gmt (deg)
203	S(NO,3)	STAR=N. DEC. (deg); SOLAR=N. DEC. @ 0 GMT (deg)
204	S(NO,4)	FLUX AT THE WORKING FREQ (F.U.)
205	S$	STAR NAME
206	T(14, 9)	DAYS(STAR EPIC) SINCE 1977
207	T(14,10)	DAYS(SOLAR EPIC) SINCE 1977
208	T(9&10,1)	STORE STRING P$
209	T(NO, 1)	STAR/SOLAR NAME
210	T(NO, 4)*	SPECTRAL INDEX SECULAR EXPANSION(%/Yr)*1000
211	T(NO, 5)*	SPEC INDEX SECULAR EXPN UNCERTAINTY(%/Yr)*1000
212	T(NO, 6)*	SPECTRAL INDEX * 1000
213	T(NO, 7)*	SPECTRAL INDEX ERR * 1000
214	T(NO, 8)*	FLUX ERR @ STD FREQ (%) * 10
215	T(NO, 9)*	DISK SIZE (ARC MIN) * 100
216	T(NO,10)*	FLUX ERR @ F(%) * 10
217	T(NO,11)*	LINEAR POLZ(%) * 10
218	T(NO,11)s	GHA/hr * 1000
219	T(NO,12)*	LINEAR POLZ ERR(%) * 10
220	T(NO,12)s	(N.DEC @ 12 GMT - N.DEC @ 0 GMT)*1000
221	T(NO,13)*	POLZ ANG (deg) * 10
222	T(NO,13)s	HORIZONTAL PARALLAX * 1000
223	T(NO,14)*	POLZ ANG ERR (deg) * 10
224	T(NO,14)s	AGE OF MOON (days)
225	T(NO,15)*	FLUX EPOCH, YEAR*10
226	T(NO,16)*	SECULAR DECAY of flux (%/Yr)*100
227	T(NO,17)*	SECULAR DECAY of flux ERR (%/Yr)*100
228	T(NO,18)*	STD FREQ(GHz) * 100
229	T(NO,19)*	MIN FREQ (GHz)*100 WHERE FLUX CALC VALID
230	T(NO,20)*	MAX FREQ (GHz)*100 WHERE FLUX CALC VALID
231	T(NO,21)	FLAG: 0=STAR DATA, 1=SOLAR DATA

MATRIX LIST by variable

for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

232	T(NO,21)s	GHA/HR (deg) * 1000
233	T(NO,23)s	N. DEC./hr (deg) * 1000
234	T(NO,5)s	SUN:(N.DEC @ 24GMT - N.DEC AT 0 GMT)*1000
235	X$	SUBROUTINE HEADING
236	X1	LOOP VARIABLE
237	X1	TIME VARIABLE, 2*(N3-M3)/N4
238	X1	Xi = G/dT(star)
239	X2	GAMMA,PARABLIC FIT
240	X2	VARIABLE IN FNG(N3)
241	X4	K*S/2/k
242	X5	AZIMUTH BIAS (deg)
243	X6	ELEVATION BIAS (deg)
244	Y	Y-FACTOR
245	Y(I)	MATRIX USED IN CURVE FIT OR DUMMY
246	Y1	G/T ERR-Y factor (C8*Y5)
247	Y5	Y/(Y-1)
248	Z	COLD SKY POWER / Ta
249	Z1	ZENITH ATM ATTN, dB
250	Z5	C/kT MEAS:T(ONT)/Ta FOR UPPER FREQ
251	Z5	SERROR VARIABLE

1	FLAG 1	STAR FLUX CALC FOR SPECIFIED FREQ & DATE
2	FLAG 1	1=EIPR DATA INPUT
3	FLAG 1	DISK STORAGE (F7) <prgm A>
4	FLAG 2	G/T ERRORS CALCULATED FOR SPECIFIC FREQ & DATE
5	FLAG 7	PRT OUT ERR:1=W/O CONSTS
6	FLAG 9	HEADING:1=BYPASS DATE,FREQ,ATN DIAM,G,G/T,G/Ta
7	FNA(NO)	ANT POINT:NO=STAR # IN:H,L1,B1,E1; OUT:A,L,LO
8	FNAd(Q)	HPBW of ant(deg), Q=HPBW*(deg), IN:NO
9	FNB(Q)	BEEP: Q=# OF BEEPS
10	FNC(Q)	PAGE HEADING: Q=# SPACES BEFORE PRT HEADING
11	FND(Q)	INIT HARDWARE: 0=VTVM,BRG,NOISE, 1=PWR BRG
12	FNDd(Q)	= 10^(Q/1E4)
13	FNE(NO)	ERROR CALC FOR G/T: NO=STAR #
14	FNFa 1	REWIND INT CASSETTE
15	FNFb 0	SITE: W. long, N. lat, alt
16	FNFc 0	STD VALUE(A3) CHANGE
17	FNFc 1	SOURCE# CHANGE, RESET MAT A & MAT D
18	FNFc 2	prt:T/Ta=(N(5,5+M5)) + (B6)*CSCL
19	FNFc 3	calc:T,R1,I5
20	FNFc 4	enter:REMARKS
21	FNFd 0	RESTART
22	FNFd 1	ques DATA ON TAPE/DISK,TAPE #
23	FNFd 2	heading G/T,G/Ta,NEF,NUF,Y-factor
24	FNFd 3	heading K1,...K9,K.A-eff,R-eff,S,Xi
25	FNFd 4	PRINT OUT FIT RESULTS,
26	FNFd 5	heading *HPBW #1 =...+...CSC L=... (ant HPBW =..
27	FNFd 6	prt:G(dB) G-hpbw T(K) Ta(K) Y-fac HPBWerr ...
28	FNFd 7	ques: DATA SET#
29	FNFd 8	A$= !....!....!....!....!....!....!....!....!...
30	FNFd 9	prt:SITE ELEV,oxy attn,water attn,zenith attn,
31	FNFd 10	prt A2,C9,D1,N(21,1),T(1,9),C8,D8,D9,J1,N(21,3),
32	FNFe 0	ATTN SETTING, FILTER IDENTIFICATION HEADING
33	FNG(Q)	CURVE FIT:0=INIT,-99=CALC FIT (out:I,R2,W1,V5,

34	FNGb(Q)	convert:Q in decimal DEG to DEG.MMSS
35	FNH(Q)	HEADINGS: 0=FIT #, 1=TAPE #
36	FNI(Q)	DRAW LINE:1 -;2 --;3 ==;4 ##;5 @@
37	FNJ(Q)	KEY SUB: Q=KEY #, SEE KEY LIST
38	FNK(NO)	K-FACTOR CALC,e.g. K1,K2,...,K9
39	FNL 1	G/T plot (J=19)
40	FNL 1.1	G/T err TABLE: no print variables
41	FNL 1.2	G/T err TABLE: print variables
42	FNL 2	G/Ta plot (J=20)
43	FNL 2.1	G/Ta err TABLE: no print variables
44	FNL 2.2	G/Ta err TABLE: print variables
45	FNL 3	HPBW#1 plot (J=21)
46	FNL 4	HPBW#2 plot (J=22)
47	FNL 6	Y-factor plot (J=24)
48	FNL 7	NEF plot (J=25)
49	FNL 8	NUF plot (J=26)
50	FNM(Q)	METEOROLINFO:0=INPUTDATA,1=PRT DATA,2=MAL/AUTO
51	FNMb	convert:DEG,MIN,SEC to DECIMAL DEGREES
52	FNN(Q)	ANSWER ROUTINE:DISPLAYS Q, SPACE = NO CHANGE
53	FNO(Q)	ANS ROUTINE SEQUENCE
54	FNP(Q)	PWR MEAS:0=#1&#2,1=#1,2=#2,3=PWR,mW(IN:A3,C3,B2,
55	FNQ(Q)	PRGM const(MAT N):1=LIST,2=correct,3=N(I,J)
56	FNQd(L)	HPBW of ant (min) at elev L
57	FNR(Q)	READ(ENTER DATA) DEVICE:2=DVM,3=CLOCK,4=BREAK SW
58	FNS(Q)	SPACE PAGE Q SPACES
59	FNT(Q)	TIME,DECIMAL HRS:1=SET UP E1 (IN: E3,E5,N4)
60	FNT(Q)	DUMMY USED IN ERROR PRT OUT IN MEAS
61	FNTd(L)	calc: ANT HPBW#1(min of arc)
62	FNU(Q)	PWR RATIO CHECK: IN:C2,B2,C3 OUT:A(7),A(8)
63	FNUd 0	LOAD from (F7), 0=INT, I=EXT
64	FNUd 1	LOAD:START#,STOP#,STEP (U,U1,V)
65	FNUd 2	enter:DAY into N(2*N-1,1)
66	FNUd 3	SUN microwave DIAM(deg) at freq F

67	FNUd 4	MOON OPTICAL DIAM(deg); for day D4 via MAT N
68	FNUd 5	SUN FLUX for day D4, time t1
69	FNUd 6	MOON FLUX for day D4
70	FNUd 7	SUN FLUX parameters PRINT OUT
71	FNUd 8	MOON FLUX parameters PRINT OUT
72	FNUd 9	STAR FLUX PRINT OUT
73	FNUd 10	ERROR,abs in G/T(etc) at L,98% probable STUDENT
74	FNUd 11	set:NO,elev interval for GRAPHS
75	FNVe(Q)	VOLTAGE READING:volt range + channel #/100
76	FNVd 0	RESTART
77	FNVd 1	calc: G/T,G/Ta,NEF,NUF errors
78	FNVd 2	change:ANT DIAM,SITE ELEV,NEW MOON DATA,FREQ
79	FNVd 3	calc: GRAPH RANGES for AUTO SEQ
80	FNVd 4	calc: LINEAR & CSC FIT PARAMETERS
81	FNVd 5	Q=FNF2 & RETURN
82	FNVd 6	change:*HPBW,CSC COEFF i.e. N(21,2),N(21,6)
83	FNVd 7	head:FL#,RUN/SET,ELEV,HPBW#1,FREQ,STAR;MAT M=0
84	FNVd 8	set:F4,N8 and LOAD DATA
85	FNVd 9	calc:Ta(H9) via G at 30deg G=B2*(D*F/0.3.3)^2
86	FNVd 10	set:L,E7,M(N8,1),M(N8,4),M(N8,6),M(N8,10)
87	FNVd 11	load PRIOR SUMMARY MAT M, MAT N
88	FNVd 12	STORE MAT M & MAT N
89	FNVd 13	calc B,B0,B2,G via B2,G-diff=C7,Ta=H9,B9
90	FNW(Q)	WAIT Q MILLISEC
91	FNX 24	DVM AUTORANGE
92	FNX 27	0.100000 V DVM RANGE
93	FNX 28	1.00000 V DVM RANGE
94	FNX 29	10.0000 V DVM RANGE
95	FNX 30	100.000 V DVM RANGE
96	FNX 31	1000.00 V DVM RANGE
97	FNX 32	DC FILTER OUT
98	FNX 33	DC FILTER IN
99	FNX 34	RATIO: FILTER IN

100	FNX 36	AC VOLTS (not installed)
101	FNX 40	OHMS (not installed)
102	FNX 48	PRGM ATTN =15dB
103	FNX 49	PRGM ATTN =14dB
104	FNX 50	PRGM ATTN =13dB
105	FNX 51	PRGM ATTN =12dB
106	FNX 52	PRGM ATTN =11dB
107	FNX 53	PRGM ATTN =10dB
108	FNX 54	PRGM ATTN = 9dB
109	FNX 55	PRGM ATTN = 8dB
110	FNX 56	PRGM ATTN = 7dB
111	FNX 57	PRGM ATTN = 6dB
112	FNX 58	PRGM ATTN = 5dB
113	FNX 59	PRGM ATTN = 4dB
114	FNX 60	PRGM ATTN = 3dB
115	FNX 61	PRGM ATTN = 2dB
116	FNX 62	PRGM ATTN = 1dB
117	FNX 63	PRGM ATTN = 0dB
118	FNX 64	NO RF to BOLOMETER & STD PAD IN
119	FNX 65	RF to BOLOMETER & STD PAD OUT
120	FNX 66	STD ATTN IN
121	FNX 67	STD ATTN OUT
122	FNX 68	NO RF TO BOLOMETER
123	FNX 69	RF TO BOLOMETER
124	FNX 72	NO RF to BOLOMETER & STD PAD IN (avoid-USE FNX64
125	FNX 73	RF to BOLOMETER & STD pad OUT (avoid-USE FNX65)
126	FNX 74	STD ATTN IN (avoid - use FNX66)
127	FNX 75	STD attn OUT (avoid - use FNX67)
128	FNX 76	NO RF to BOLOMETER (avoid - use FNX68)
129	FNX 77	RF to BOLOMETER (avoid - use FNX69)
130	FNX 80	NOISE ADD #1 & #2 ON
131	FNX 81	NOISE ADD #1 & #2 OFF
132	FNX 82	NOISE ADD #1 ON

133	FNX 83	NOISE ADD #1 OFF
134	FNX 84	NOISE ADD #2 ON
135	FNX 85	NOISE ADD #2 OFF
136	FNX 88	NOISE ADD #1 & #2 ON (avoid - use FNX80)
137	FNX 89	NOISE ADD #1 & #2 OFF (avoid - use FNX81)
138	FNX 90	NOISE ADD #1 ON (avoid - use FNX82)
139	FNX 91	NOISE ADD #1 OFF (avoid - use FNX83)
140	FNX 92	NOISE ADD #2 ON (avoid - use FNX84)
141	FNX 93	NOISE ADD #2 OFF (avoid - use FNX85)
142	FNX 96	OPENS MULTIPLEXER so can use front panel inputs
143	FNX 97	OPENS MULTIPLEXER so can use front panel inputs
144	FNX 98	OPENS MULTIPLEXER so can use front panel inputs
145	FNX 99	OPENS MULTIPLEXER so can use front panel inputs
146	FNX100	J357 INPUT(e.g. ext pwr meter):channel #11 = 110
147	FNX101	PWR BRDG vs FINE REF: channel #10 = 110 0101
148	FNX102	PWR BRDG vs REF VOLT, set fine volt:ch #9 = 110
149	FNX103	PRW BRDG OUTPUT: channel #8 = 110 0110
150	FNX104	D/A REFERENCE voltage: channel #7 = 110 1000
151	FNX105	CRYSTAL DIODE voltage: channel #6 = 110 1001
152	FNX106	D/A OUTPUT: channel #5 = 110 1010
153	FNX107	+12 volts, RF UNIT: channel #4 = 110 1011
154	FNX108	+20 volts, RF UNIT: channel #3 = 110 1100
155	FNX109	DEW POINT: channel #2 = 110 1101
156	FNX110	TEMP (F/100): channel #1 = 110 1110
157	FNX111	GROUND DVM: channel #0 = 110 1111
158	FNX124	PORT 4 selected
159	FNX125	PORT 3 selected
160	FNX126	PORT 2 selected
161	FNX127	PORT 1 selected
162	FNY(Q)	PLOT DATA: 1=PRT HEADING
163	FNZ(NO)	Xi=FNK(NO)*C1*S(NO,4)*1E-26
164	KEYa 0	RESTART
165	KEYa 1	CHANGE PRGM CONST & MODIFY CORRESPONDING N(I,J)

166	KEYa	2	LINK: 1=SITE PREP, 2=MEAS, 3=REWORK
167	KEYb	0	RESTART:0=RESTART,1=LINKMEAS,2=REWORK,3=KEY LIST
168	KEYb	1	UPDATE:RUN#,DATE,SITE
169	KEYb	2	UPDATE: FREQ,BW,ANT PARAMETERS
170	KEYb	3	UPDATE:ANT POINTING ERROR
171	KEYb	4	UPDATE:T,G/T,Ta,PWR RESP
172	KEYb	5	UPDATE:TEMP, DEW PT
173	KEYb	6	UPDATE:SUN/MOON ALMANAC DATA
174	KEYb	7	PRT:SITE&FLUX DATA
175	KEYb	8	CALC:STAR FLUX @ f
176	KEYb	9	PRT:TYPICAL G/T VALUES AND ERRORS
177	KEYb	10	STORE: S,T,N
178	KEYb	11	PRT:LIST OF ALTERNATE STAR ERR
179	KEYb	12	PRT: ELEV vs GMT
180	KEYb	13	UPDATE: N(I,J)
181	KEYc	0	RESTART:1SKY,2G/T,3EIRP,4LNK,5NEW TAPE,0MASTER R
182	KEYc	1	restart STAR:at MEAS #=N
183	KEYc	2	EIRP:START @ SET ?
184	KEYc	3	REFIT 5 CUTS
185	KEYc	4	STAR FIX:routine to estab ANT BIAS
186	KEYc	5	CHANGE BIAS:HR ANG, DECL, AZ, ELEV
187	KEYc	6	CHANGE:input ATTN (dB), FILTER #
188	KEYc	7	CHANGE: Ta = ADDED NOISE,K
189	KEYc	8	CHANGE: T(syst)/Ta
190	KEYc	9	change:INSERT 5DB WHEN T(ADD)?
191	KEYc	10	set:RDY STORE SET ?
192	KEYc	11	STORE INT: MAT N,S,T and PRGM
193	KEYc	12	STORE:MAT M(summary data),N(prgm consts) on ext
194	KEYc	13	unused
195	KEYc	14	LIST CURRENT DATAMAT D
196	KEYc	15	CHANGE FREQ & calc new STAR FLUX
197	KEYc	16	change:# MEAS PTS, # PTS IN FIT ZONE
198	KEYc	17	change:G/Ta=B7 set:Ta H9=G/10^(B7/10)

199	KEYc	18	CHANGE NOISE ADD SOURCES (C3):0=#1&#2,1=#1,2=#2,
200	KEYc	19	LAST MEASUREMENT:initiates storage steps
201	KEYd	0	RESTART:0REWORK,1LOAD,2AUTO SEQ,3DEL,4G/T,5FIT,6
202	KEYd	1	RESTART @ N=?
203	KEYd	2	calc:STAR FLUX VALUES,Ta,eff area
204	KEYd	3	ENTER TEMP,A(3);AND DEW PT ,A(4) USED IN REWORK
205	KEYd	4	prt: G/T DATA SUMMARY with page heading
206	KEYd	5	SORT,FIT and LIST DATA
207	KEYd	6	prt: G/T DATA SUMMARY (no heading)
208	KEYd	7	STORE MAT M & MAT N
209	KEYe	0	RESTART:0=KEY LIST,1=AUTO CK,2=NO AUTO(F2=0)
210	KEYe	1	CHECK LIST
211	KEYe	2	CHECK DVM
212	KEYe	3	CHECK CHANNEL VOLTAGES
213	KEYe	4	CHECK PRGM ATTENUATORS
214	KEYe	5	CHECK PWR,TYPEIV & ATTN STABILITY
215	KEYe	6	CHECK NOISE ADD STABILITY
216	KEYe	9	ques: NEW FREQ,BW,INPUT ATTN,SIML STAR NOISE
217	read	CLOCK	ENTER(3,*)C,D:C=#1 THUMB SW,D=SW #2 #3 #4 HHMM.S
218	read	DVM	ENTER(2,*)A,B: A=FUNCTION, B=VOLTAGE
219	read	SW	RBYTE 4=INTEGER SUM OF BINARY SWITCHES
220	read	SW Y	BIAND(ROT(RBYTE4,Y)1)=1 IF SWITCH Y IS UP

7.4 Variables List Alphabetical by Meaning

VARIABLES LIST by meaning
for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

1	V	-ALPHA,GAUSSIAN COEFF
2	D3	ADDED NOISE ERROR,%
3	H9	ADDED NOISE,K
4	B2,B3	ANTENNA APERTURE EFFICIENCY, ANT RADIATION EFF
5	D	ANTENNA DIAMETER(FT)
6	B9	ANTENNA EFFECTIVE AREA
7	G	ANTENNA GAIN, relative
8	D5	ANTENNA POINTING ERROR (deg)
9	K5	ANTENNA POINTING FACTOR
10	K6	ANTENNA POLARIZATION FACTOR
11	B4	ATMOSPHERIC BRIGHTNESS TEMPERATURE, K
12	K1	ATMOSPHERIC ABSORPTION TRANSMISSION COEFF
13	E0	ATTENUATION(dB) OF PROGRAM ATTENUATOR, TEMPORARY
14	M1...M4	ATTNOFPGM1,2,4,8@30MHz,PGMUSES N(13,1..4)
15	M6...M9	ATTN OF PGM 1,2,4,8 @ 70 MHZ, pgm uses N(13,6...
16	A3	ATTN OF STD ATTN (abs>1),NOT dB)
17	F9	ATTN VALUE OF LAST PROG ATTEN IN FNW
18	E2	ATTENUATION(dB) OF PROGRAM ATTENUATOR
19	E6	ATTENUATION(dB), MANUAL ATTENUATOR
20	A	AZIMUTH(deg) OR DUMMY
21	X5	AZIMUTH BIAS (deg)
22	W	BANDWIDTH(MHz)
23	K3	BANDWIDTHS EFFECTS FACTOR
24	J	BRDG PWR when NOISE ADD sources ON
25	Z5	C/kT MEAS:T(ONT)/Ta FOR UPPER FREQ
26	B1	CODE FOR SATELLITE CARRIER MEAS:0=SKY,1=-F,2=RCR
27	Z	COLD SKY POWER / Ta
28	T2	CURRENT MEASUREMENT TIME
29	G(I,J)	CURVE FIT MATRIX
30	N2	CUT NUMBER
31	C1	C^2/(8*PI*K*F^2)
32	D(T6,I)	DATA MATRIX: SEE MATRIX LIST
33	C	DATE, DECIMAL

34	N	DATE, DECIMAL FOR MOON DATA
35	E	DAYS SINCE 1900.00
36	B1	DECL OFFSET (deg)
37	H7	DECL of SUN/MOON
38	B6	DEW POINT(F)
39	K4	DIFFERENTIAL SKY TEMPERATURE FACTOR
40	D8	DIFFUSIVE ATTENUATION ERR,%
41	K8	DIFFUSIVE ATTENUATION FACTOR
42	V8	DISK OR TAPE #
43	A$,B$	DUMMY
44	Q,Q0,Q1	DUMMY
45	Q2,Q3	DUMMY
46	B(I,J)	DUMMY MATRIX
47	F(I)	DUMMY MATRIX
48	V8	DV, RF ON
49	V7	DV,#1 RF OFF
50	V9	DV,#2 RF OFF
51	L4	EFFECTIVE OXYGEN LENGTH, Km
52	E	EIRP*G/Ta
53	E1	EIRP:PWR no noise add (mW)
54	E1,3,4,E5	EIRP:PWR no add(mW),PWR+#1,PWR+#2,PWR+#1&#2
55	E3	EIRP:PWR+noise add #1 (mW)
56	E4	EIRP:PWR+noise add #2 (mW)
57	E5	EIRP:PWR+noise add #1 & #2 (mW)
58	L1	ELEVATION REFRACTION CORRECTION,deg
59	L1	ELEVATION FOR FITTING G/T OR G
60	X6	ELEVATION BIAS (deg)
61	L	ELEVATION(deg)
62	L0	ELEVATION--NO REFRACTION CORRECTION
63	C2	ERROR enhancement factor forNEF,NUF
64	F4	FILE # OF N7=1, STARTING M(40,1)
65	F4	FILE LOAD #
66	A1	FILTER #,(d) MOON CONST

67	C9	FILTER BANDPASS(MHz)
68	C8	FILTER FREQ (MHz)
69	01,02,03	FILTER#1(2.5MHz @ 30MHz) CONSTS:N(15,1),N(15,2),
70	06,07,08	FILTER#2(1MHz @ 70MHz) CONSTS:N(15,6),N(15,7),
71	P1,P2,P3	FILTER#3 (2.5MHz @ 70MHz) CONSTS:N(16,1),N(16,2)
72	P6,P7,P8	FILTER#4 (5.3MHz @ 70MHz) CONSTS:N(16,6),N(16,7)
73	H1	FIT TO G/T or NEF data (3*1S/SQR(#PTS)),dB
74	F5	FLAG IN D:1=PRGM REWORK
75	L0	FLGd:0=GRAPH,1=ERR PRT OUT-no VARIABLES,2=with
76	F4	FLAG IN E:1=SIMULATED NOISE ADD,2=EARTH TERMINAL
77	F5	FLAG IN E:1=NOISE ADD #1 WORKS
78	F6	FLAG IN E:0=PRGM ATTN,1=STD ATTN
79	F6	FLAG IN E:1=NOISE ADD #2 WORKS
80	F6	FLAG TASK:1=NEW SITE,2=MEAS,3=REWORK,0=MANL VIA
81	F6	FLAG-AUTO SEQUENCE:1=YES
82	F1	FLAG-GRAPH:0=NO,1=DATA,2=&FIT,3=FIT,4=EXIT
83	C3	FLAG-NOISE ADD: 0=#1&#2,1=#1,2=#2
84	F5	FLAG-PROGR REWORK PATTERN:0=NO
85	F2	FLAG-PRT:0=ALL,1=PROG DATA,2=INPUT ASSUMPS,3=G/T
86	F7	FLAG-PWR LEVEL: 0=CONST, 1=STEPPED (in E)
87	F3	FLAG-SORT & FIT:1=G/T-ELEV,2=G/T-CSC,3=DIP-ELEV,
88	F5	FLAG: 0,1= LINEARITY ck table, 2,3=stab GRAPH
89	F7	FLAG: 0=CASSETTE BEING USED,1=DISK
90	F3	FLAG: 0=MANUAL READ TEMP,HUMIDITY,1=AUTO TEMP,
91	F2	FLAG:0=NORMAL,1=DIFF PLOT DATA,2=DIFFPLOT cuts
92	F3	FLAG:(b) 1=bypass trivial ques,(e)0=XTAL,1=TYPE
93	F1	FLAG:(c)0=STAR,1=SATELLITE;(b)1=SUBROUTINE LOADE
94	F8	FLAG:(d)1=prefit HPBW
95	F2	FLAG:0=CSC fit, 1=LINEAR fit
96	F2	FLAG:0=NO AUTO CHECK,1=YES(in E)
97	F1	FLAG:0=PRT PWR & VOLTS, 2=GRAPH PWR RATIO
98	F6	FLAG:0=RESTART,1=SKY,2=G/T,3=EIRP,4=LINK
99	F3	FLAG:0=XTAL,1=TYPE IV bridge (in E)

100	C2	FLAG-5dB ATTN IN NOISE ADD PWR MEAS:0=NO,1=YES
101	F8	FLG in E:(KEY 5)0=GRAPH,1=LIST,(KEY 6)0=SIML NOI
102	Q3	FLG:(LOC SITE DATA).(F6=TASK)(F4=PRM CHANGE?)(F7
103	F0	FREQ ERR,%
104	F	FREQ OF MEASUREMENT(GHz)
105	L$	FREQ,DIAM,G/T HEADING
106	C7	G via HPBW - G via G/Ta, dB
107	C(I,J)	G(I,J) INVERSEORDUMMY
108	T1	G/TORG/TaVALUE
109	E5	G/T ERR-ANTENNA POINTING
110	E6	G/T ERR-ANT POLARIZATION
111	E1	G/T ERR-ATMOSPHERIC ABSORPTION
112	E8	G/T ERR-ATMOSPHERIC DIFFUSION
113	E9	G/T ERR-ATMOSPHERIC REFRACTION
114	E3	G/T ERR-BANDWIDTH
115	E4	G/T ERR-DIFFERENTIAL SKY TEMP
116	S	G/T ERR-FLUX
117	E0	G/T ERR-FREQ
118	E2	G/T ERR-STAR SHAPE
119	E7	G/T ERR-SYSTEM RESPONSE
120	Y1	G/T ERR-Y factor (C8*Y5)
121	M	G/T RELATIVE
122	B7,B8	G/Ta(dB) ZENITH COEFF,CSC COEFF
123	X2	GAMMA,PARABOLIC FIT
124	A2	GAUSS CURVE FIT ERROR,% dT
125	C6	GHA TO ARIES @ 0 GMT (hrs)
126	E9	GHA TO ARIES(deg)
127	E	HOUR ANGLE(deg)
128	H	HOUR ANGLE OFFSET (deg)
129	I	HPBW
130	E7	HPBW FIT BY GAUSSIAN CURVE TO DRIFT CURVE
131	D2	HPBW UNCERTAINTY,%
132	B	HPBW#1(min of arc),AS MEASURED

133	B0	HPBW(minutes) with Kanda correction
134	Q3	HPBW,ANTENNA ALONE(i.e. with KANDA CORRECTION)
135	N(I,J)	INPUT DATA CONST,SEE MATRIX LIST
136	T(NO,J)	INPUT STAR DATA: SEE MATRIX LIST
137	H5	INSTR PWR RESPONSE FACTOR
138	C9	INSTRUMENTAL POWER RESPONSE ERR,%
139	X4	K*S/2/k
140	K	K1*K2*...*K9
141	J1	K8 for POINT SOURCE
142	N4	LARGEST N3
143	U,U1,V	LOAD START#,STOP#,STEP (in d)
144	I	LOOP VARIABLE
145	J1	LOOP VARIABLE
146	M1	LOOP VARIABLE
147	X1	LOOP VARIABLE
148	H$	MAIN PROGRAM HEADING
149	Y(I)	MATRIX USED IN CURVE FITORDUMMY
150	J	MAXIMUM FLUX IN F.U.
151	E6	MEASUREMENT # OF FIT GAUSSIAN CURVE
152	M3	MEASUREMENT # @ MAXIMUM AMPLITUDE
153	N	MEASUREMENT NUMBER
154	E2,E3	MONTH, DAY
155	H6,H7	MOON LUNAR AGE(days),DECL of SUN/MOON (in d)
156	T9	MOON TEMP (current)
157	S6	MOON'S MEAN TEMP = Tbo
158	T6	N-6*(N7-1)
159	V7	N3 OF STAR MAX
160	N1	NO. OF STAR SOURCES
161	R5	NUMBER OF POINTS FIT TO PARABOLA
162	N9	NUMBER POINTS IN FIT
163	G4	OXYGEN ABSORPTION (dB/Km)
164	F8	P(ONT) @ +F: in C/kT meas
165	F5	P(ONT) @ -F: in C/kT meas

166	B8	P(ONT),mW=(F5+F8)/2: in C/kT MEAS
167	F2	P/Pa for LOWER FREQ ONT:in C/kT meas
168	N5	PAGE NUMBER
169	V5	PARABOLIC FIT PARAMETER h
170	I5	PLOT UNIT
171	M5,M6	PORT(freq) # currently being used,# of PORTS
172	P	POWER MEASURED,MILLIWATTS
173	Q3	POWER WITH NOISE ADD ON
174	S3	PREDICTED MEASUREMENT # FOR MAXIMUM STAR PWR
175	P$	PROJECT HEADING
176	N3	PWR MEASUREMENT # WITHIN A CUT
177	E9	PWR(mW) ON SAT SIGNAL
178	A8	RATIO #1 add/#2 add uses N(18,5 or 10)
179	R0	RATIO #1add/#2add @ 70 MHz, pgm uses N(18,10)
180	F	RECEIVER FREQ(MHz)
181	P1	RECEIVER GAIN SLOPE/mHz
182	K9	REFRACTIVE ATTENUATION FACTOR
183	L8	REFRACTION CONST #1
184	L9	REFRACTION CONST #2
185	D9	REFRACTIVE ATTENUATION ERROR,%
186	D$	REMARKS
187	R	REMARKS:SEE REMARK LIST
188	R2	RESIDUALS FROM CURVE FIT
189	A0	REWORK #, (d) MOON CONST
190	N6	RUN #
191	T2	RUN/SET
192	J	SELECT FUNCTION:19=G/T,20=G/Ta,21=HPBW#1,22=#2,24
193	Z5	SERROR VARIABLE
194	N7	SET #
195	A(N7)	SET DATA: SEE MATRIX LIST
196	H	SIMULATEDSTAR NOISE(dB)
197	C0	SITE ELEV (Km)
198	C4,C5	SITE: W.LONG (deg), N. LAT (deg)

VARIABLES LIST by meaning

for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

199	DO	SKY BACKGROUND ERR,0.9/F^2
200	C1	SPACE LOSS
201	F1	SPACE LOSS: in C/kT MEAS
202	E7	SLANT RANGE,10^6 Km
203	S(I,J)	STAR DATA: SEE MATRIX LIST
204	S$	STAR NAME
205	D1	STAR SHAPE ERR,%
206	K2	STAR SHAPE FACTOR
207	P1	STAR SHAPE ERROR,%
208	NO	STAR#(current) 1=CAS,2=CYG,3=TAU,4=ORI,5=SUN,6=M
209	F9	STORE SET # OF SUMMARY OF REWORK DATA
210	X$	SUBROUTINE HEADING
211	M1,M2,M3	SUM on P,SUM on X,SUM on Y
212	M(N7,J)	SUMMARY DATA: SEE MATRIX LIST
213	N8	SUMMARY DATA $ = M(40,1) = N7+F4
214	V5,V6	SUMS on P*X,P^2
215	V1,2,3,V4	SUMS on X^4,X^2,X^3,P*X^2
216	S1,S2	SUN FLUX (current time) at 4.995 GHz, AT 8.8 GHz
217	A4,A5,A6	SYST CONSTS:PRGM USES N(1,4),N(1,5),N(1,6)
218	K7	SYSTEM RESPONSE FACTOR
219	F9	T(sky)/Ta: in C/kT meas
220	T	T(syst)
221	B6	T/TaCSC COEFF
222	B5	T/TaZENITH
223	B5	TEMPERATURE(F)
224	T1	TIME OF 1st MEASUREMENT
225	E1	TIME OF STAR PEAK (hrs)
226	X	TIME VARIABLE, 2*I/N4-1
227	X1	TIME VARIABLE, 2*(N3-M3)/N4
228	S	TIME(hrs), CURRENT
229	E8	TIME(hrs)/(ARC deg)
230	E5	TIME/MEASUREMENT (hrs)
231	V6	Tstar/Ta=EXP(X-F(2)*W1^2)

232	FO	VALUE OF C2 IN FNW
233	X2	VARIABLE IN FNG(N3)
234	W1	VARIANCE OF P(STAR)/P(ADD)
235	V	VOLTAGE ACROSS PWR BRIDGE
236	G5	WATER ABSORPTION, #1 CONST (dB/Km)
237	G6	WATER ABSORPTION, #2 CONST (dB/Km)
238	L7	WATER DENSITY (gm/m^3)
239	L5,L6	WATER PATH LENGTH CONST #1, CONST #2, Km
240	X1	Xi = G/dT(star)
241	Y	Y-FACTOR
242	C8	Y-FACTOR ERR,%
243	Y5	Y/(Y-1)
244	D4	YEAR,(d) day for SUN/MOON FLUX CALC
245	E6	YEARS SINCE 1977
246	Z1	ZENITH ATM ATTN, dB
247	R1	ZERO FOR GRAPH
248	Q5,Q6	dP(add) in C/kT meas: @ -F, @ +F
249	V9	dT(STAR)/Ta PREDICTED
250	V7	dT(star)/Ta
251	D9	no. of MEAS for MULT FREQ ROUTINE

7.5 Matrix List Alphabetical by Meaning

MATRIX LIST by meaning
for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

1	D(T6, 3)*	# OF MEAS(N4)
2	T(NO,12)s	(N.DEC @ 12 GMT - N.DEC @ 0 GMT)*1000
3	T(NO,14)s	AGE OF MOON (days)
4	A(3)	AMBIENT TEMP(F) *10
5	N(13, 6)	ATTN OF 1dB prgm @ 70:#3=0.976,#4=0.947,#5=0.938
6	N(13, 7)	ATTN OF 2dB PRGM @70:#3=1.890,#4=1.95,#5=1.854,
7	N(13, 1)	ATTN of 1db prgm @ 30MHz:#3=0.961
8	N(13, 2)	ATTN of 2dB prgm @ 30MHz:#3=1.881
9	N(13, 3)	ATTN of 4dB prgm @ 30MHz:#3=3.947
10	N(13, 8)	ATTN of 4dB prgm @ 70:#3=3.909,#4=3.87,#5=3.957,
11	N(13, 4)	ATTN of 8dB prgm @ 30MHz:#3=7.881
12	N(13, 9)	ATTN of 8dB PRGM @ 70:#3=7.896,#4=7.86,#5=7.845,
13	N(13, 5)	ATTN of STD RES 30MHz:#3=5.922,#6=4.779
14	N(13,10)	ATTN of STD @ 70:#3=5.966,#4=5.92,#5=6.11,#6=6.1
15	N(1, 7)	ATTN+meter(dB/10) 5.3@70:#3=16.15,#4=17.3,#5=15.
16	D(6,N3+2)x	ATTN,TOTAL: E2+E6
17	D(1, 1)x	AZIMUTH:(AZ(deg)-180)*100
18	D(T6, 1)*	AZIMUTH:(AZ(deg)-180)*100
19	M(N8, 5)x	C/kT(dB)
20	A(6)	CLOUD COVER * 100 + WIND(mph)
21	M(N8, 1)x	CODE + .07
22	A(7)x	CODE(B1):0=SKY, 1=-F, 2=RCR @ F, 3=+F, 4=OTHER
23	N(20,22)	CSC ELEV AVERAGE
24	N(24, 1)	D-DECL(deg) INTERCEPT
25	N(24, 2)	D-DECL(deg) ZENITH
26	N(24, 3)	D-DECL(deg) INTERCEPT 1S ERR
27	N(24, 4)	D-DECL(deg) ZENITH 1S ERR
28	N(24, 5)	D-DECL(deg) ELEV COEFF
29	N(24, 6)	D-DECL(deg) CSC COEFF
30	N(24, 7)	D-DECL(deg) ELEV COEFF ERR
31	N(24, 8)	D-DECL(deg) CSC COEFF ERR
32	N(1, 5)	DAC REF volt:#3=6.313,#4=6.367,#5=6.284,#6=6.24
33	N(1, 6)	DAC mult=-(chnl#9-#8)/#7:#3=0,3173,#4=0.32,#5=0.

34	T(14,10)	DAYS(SOLAR EPIC) SINCE 1977=#DAYS SINCE 1900 - 2
35	T(14, 9)	DAYS(STAR EPIC) SINCE 1977=#DAYS SINCE 1900 - 28
36	D(T6, 5)*	DECL OFFSET FROM PREDICTED STAR CENTER: (B1+L1)
37	A(4)	DEW PT(F) *10
38	T(NO, 9)*	DISK SIZE (ARC MIN) * 100
39	M(N8, 7)x	EIRP(dBw)+G/Ta(dB) = E
40	N(19,11)	ELEV AVERAGE
41	M(N8, 1)	ELEV(deg) + STAR#/100
42	D(1, 2)x	ELEV(deg)*100
43	D(T6, 2)*	ELEVATION(deg)*100
44	N(15, 1)	FILT#1(2.5@30) NOISE BW:#3=3.915,#4=3.887,#5=3.6
45	N(15, 2)	FILT#1(2.5@30)N1,MHz:#3=0.00938,#4=0.01526,#5=0.
46	N(15, 4)	FILT#1(2.5@30)LOSS,dB:#3=3.092,#4=2.711,#5=2.391
47	N(15, 6)	FILT#2(1@70)NOISE BW:#3=1.193,#4=1.225,#5=1.23,
48	N(15, 7)	FILT#2(1@70)N1,MHz:#3=-0.1043,#4=0.0817,#5=0.127
49	N(15, 9)	FILT#2(1@70)LOSS,dB:#3=4.970,#4=4.910,#5=4.870,
50	N(16, 1)	FILT#3(2.5@70)NOISE BW:#3=2.808,#4=2.910,#5=2.93
51	N(16, 2)	FILT#3(2.5@70)N1,MHz:#3=-0.102,#4=0.0108,#5=-0.1
52	N(16, 4)	FILT#3(2.5@70)LOSS,dB:#4=5.78,#5=5.84,#6=5.814
53	N(16, 6)	FILT#4(5.3@70)NOISE BW:#3=5.734,#4=5.80,#5=5.856
54	N(16, 7)	FILT#4(5.3@70)N1,MHz:#3=-0.14,#4=-0.0782,#5=0.01
55	N(17, 6)	FILT#6(0.06@70MHz)NOISE BW,MHz:#6=0.083
56	N(17, 7)	FILT#6(0.06@70MHz)N1,MHz:#6=0.00178
57	N(17, 9)	FILT#6(0.06@70MHz)INSER LOSS,dB:#6=4.719
58	D(3, 2)x	FILTER BANDWIDTH,MHz (W)*10
59	N(15, 3)	FILTER#1(2.5MHz @ 30MHz):2nd CONST
60	N(15, 8)	FILTER#2(1MHz @ 70MHz):2nd CONST
61	N(16, 3)	FILTER#3(2.5MHz @ 70MHz):2nd CONST
62	N(16, 8)	FILTER#4(5.3MHz @ 70MHz):2nd CONST
63	D(2, 1)x	FLAG C2: 0=NO STD ATTN WHEN NOISE ADD ON, 1=STD
64	T(NO,21)	FLAG: 0=STAR DATA, 1=SOLAR DATA
65	S(NO,4)	FLUX AT THE WORKING FREQ (F.U.)
66	T(NO,15)*	FLUX EPOCH, YEAR*10

67	T(NO, 8)*	FLUX ERR @ STD FREQ (%) * 10
68	T(NO,10)*	FLUX ERR @ F(%) * 10
69	M(N8, 6)	FREQ (GHz)
70	D(1,75)	FREQ#1 (MHz)
71	N(5,1-4)	FREQ#1,#2,#3,#4 (MHz)
72	D(2,75)	FREQ#2 (MHz)
73	D(3,75)	FREQ#3 (MHz)
74	D(4,75)	FREQ#4 (MHz)
75	A(2)	FREQ(MHz)
76	M(N8, 2)*	G/T(dB)
77	N(19, 6)	G/T(dB) CSC COEFF
78	N(19, 8)	G/T(dB) CSC COEFF ERR
79	N(19, 5)	G/T(dB) ELEV COEFF
80	N(19, 7)	G/T(dB) ELEV COEFF ERR
81	N(19, 1)	G/T(dB) INTERCEPT
82	N(19, 3)	G/T(dB) SIGMA for LINEAR FIT
83	N(19, 4)	G/T(dB) SIGMA CSC FIT
84	N(19, 2)	G/T(dB) ZENITH
85	N(20, 4)	G/Ta ZENITH 1S ERR
86	M(N8, 3)*	G/Ta(dB)
87	N(20, 6)	G/Ta(dB) CSC COEFF
88	N(20, 8)	G/Ta(dB) CSC COEFF ERR
89	N(20, 5)	G/Ta(dB) ELEV COEFF
90	N(20, 7)	G/Ta(dB) ELEV COEFF ERR
91	N(20, 1)	G/Ta(dB) INTERCEPT
92	N(20, 3)	G/Ta(dB) INTERCEPT 1S ERR
93	N(20, 2)	G/Ta(dB) ZENITH
94	D(5, 2)x	GAIN SLOPE OF RCR (P1) * 1000
95	T(NO,21)s	GHA/HR (deg) * 1000
96	T(NO,11)s	GHA/hr * 1000
97	T(NO,13)s	HORIZONTAL PARALLAX * 1000
98	M(N8, 4)*	HPBW of antenna (not convolution, deg)
99	N(21, 8)	HPBW#1 CSC COEFF ERR

100	N(21, 2)	HPBW#1 ZENITH
101	N(21, 1)	HPBW#1(deg) INTERCEPT
102	N(21, 3)	HPBW#1(deg) INTERCEPT 1S ERR
103	N(21, 4)	HPBW#1(deg) ZENITH 1S ERR
104	N(21, 5)	HPBW#1(deg) ELEV COEFF
105	N(21, 6)	HPBW#1(deg) CSC COEFF
106	N(21, 7)	HPBW#1(deg) ELEV COEFF ERR
107	N(22, 2)	HPBW#2 ZENITH
108	N(22, 1)	HPBW#2(deg) INTERCEPT
109	N(22, 3)	HPBW#2(deg) INTERCEPT 1S ERR
110	N(22, 4)	HPBW#2(deg) ZENITH ERR
111	N(22, 5)	HPBW#2(deg) ELEV COEFF
112	N(22, 6)	HPBW#2(deg) CSC COEFF
113	N(22, 7)	HPBW#2(deg) ELEV COEFF ERR
114	N(22, 8)	HPBW#2(deg) CSC COEFF ERR
115	D(2,73)	HPBWisotropic (deg) via NONLINSFIT
116	D(3,74)	HPBWparallel (deg) via NONLINSFIT
117	D(4,73)	HPBWperpendicular(deg) via NONLINSFIT
118	D(5,N3+2)x	LGT(PWR METER VOLTAGE)*10^4
119	D(T6, 6)rw	LGT(dT/Tadd)*10^4
120	D(1,74)	LGT(dTstar/Ta)*10^4
121	T(NO,11)*	LINEAR POLZ(%) * 10
122	T(NO,12)*	LINEAR POLZ ERR(%) * 10
123	D(T6, 6)*	LOG(((Tstar+Tsystem)/Tadd)/U)*10^4
124	D(T6,N3+7)	LOG(P/U)*10^4: P=PWR/Padd(mW),U=PWR/Padd REF
125	N(16, 9)	LOSS,dB:#4=4.18,#5=3.14,#6=4.083
126	M(N8,M5)	M1accumulation for FREQ M5
127	D(2, 2)x	MANUAL ATTN SETTING,dB (E6)
128	T(NO,20)*	MAX FREQ (GHz)*100 WHERE FLUX CALC VALID
129	N(19,10)	MAX VALUE
130	T(NO,19)*	MIN FREQ (GHz)*100 WHERE FLUX CALC VALID
131	N(19,9)	MIN VALUE
132	N(i+5,j)	MOON DATA:j=day,I=2=A0,3=A1,4=A2,5=lunar age(day

133	T(NO,23)s	N. DEC./hr (deg) * 1000
134	M(N8, 8)*	NEF (kFU)
135	N(25, 6)	NEF(kFU) csc coeff
136	N(25, 8)	NEF(kFU) csc coeff err
137	N(25, 5)	NEF(kFU) elev coeff
138	N(25, 7)	NEF(kFU) elev coeff err
139	N(25, 1)	NEF(kFU) intercept
140	N(25, 3)	NEF(kFU) intercept 1S ERR
141	N(25, 2)	NEF(kFU) zenith
142	N(25, 4)	NEF(kFU) zenith 1S ERR
143	N(1,11)	NO. of DAYS of SUN/MOON DATA
144	D(5,75)	NO. of FREQS
145	N(5,11)	NO. of FREQS used (M6)
146	D(1,73)	NO.DATA PTS/SET*100 + NO.PARAMETERS FIT
147	N(6,1-4)	NOISE ADD (H9,K) for FREQ#1 to #4
148	A(9)x	NOT USED
149	M(N8, 9)*	NUF (kFU)
150	N(26, 6)	NUF(kFU) csc coeff
151	N(26, 8)	NUF(kFU) csc coeff err
152	N(26, 5)	NUF(kFU) elev coeff
153	N(26, 7)	NUF(kFU) elev coeff err
154	N(26, 1)	NUF(kFU) intercept
155	N(26, 3)	NUF(kFU) intercept 1S err
156	N(26, 2)	NUF(kFU) zenith
157	N(26, 4)	NUF(kFU) zenith 1S err
158	D(3, 1)x	NUMBER OF MEAS(N4)
159	M(40, 1)	NUMBER OF SUMMARY SETS STORED IN MATRIX M
160	M(40, 3)	NUMBER OF FILES USED IN DISK STORAGE
161	M(N8, 8)d	NUMBER OF POINTS IN DIP CURVE
162	N(1, 9)	NUMBER OF POINTS IN FIT
163	M(N8, 8)x	ONT/Tadd: (F2+Z5)/2
164	D(4, 1)x	P/Padd(ave of set):LGT(P/Padd)10^4
165	D(T6, 7)*	PEAK # PREDICTED * 100

166	T(NO,13)*	POLZ ANG (deg) * 10
167	T(NO,14)*	POLZ ANG ERR (deg) * 10
168	N(I,J)	PROG CONSTS I<26:I, 1=A,2=B,etc;J, 1=1,...,10=0,
169	A(7)*	PWR LEVEL,microwatts (1st pwr measured in FNU
170	A(8)	PWR RATIO CHECK:microbels/10 (STD CK results)
171	D(1,N3+2)x	PWR WITH noise add OFF @ BOLO: LGT(PWR)*10^4
172	D(6, 1)x	PWR due to NOISE ADD,mW:LGT(PWR#2-PWR#1)*10^4
173	M(N8, 4)x	PWR due to Ta (mW)
174	D(5, 1)x	PWR#1,mW(ave,noise add OFF):LGT(PWR)*10^((E2+E6)
175	M(N8, 3)x	PWR(mW)
176	D(2,N3+2)x	PWR(noise add ON): LGT(BOLO PWR)*10^4
177	M(N8, 2)x	PWR/Pa
178	D(3,N3+2)x	PWR/Padd:LGT(P/Padd)*10^4
179	M(N8, 9)x	Padd(Mw): (F5+F8)/2
180	N(1, 8)	RATIO #1 add/#2 add @ MICROWAVE FREQ
181	N(18, 5)	RATIO #1 add/#2 add @ 30MHz
182	N(18,10)	RATIO #1add/#2add @ 70:#4=0.515,#5=0.526,#6=0.24
183	A(5)	RELATIVE HUMIDITY(%) *10
184	N(1,10)	REWORK #
185	A(1)	RUN/SET = (FREQ#*1000) + N6*100 + N7; N6=RUN#,N7
186	M(N8,10)	RUN/SET: N6+N7/100
187	T(NO,16)*	SECULAR DECAY of flux (%/Yr)*100
188	T(NO,17)*	SECULAR DECAY of flux ERR (%/Yr)*100
189	A(10)*	SITE ELEVATION (CO*1000)
190	A(10)x	SLANT DIST(Km): LGT(E7)*1000
191	T(NO, 5)*	SPEC INDEX SECULAR EXPN UNCERTAINTY(%/Yr)*1000
192	T(NO, 4)*	SPECTRAL INDEX SECULAR EXPANSION(%/Yr)*1000
193	T(NO, 6)*	SPECTRAL INDEX * 1000
194	T(NO, 7)*	SPECTRAL INDEX ERR * 1000
195	M(N8, 1)d	STAR #/100
196	S(NO,1)	STAR FLUX (F.U.) @ STANDARD FREQ
197	T(NO, 1)	STAR/SOLAR NAME
198	S(NO,3)	STAR=N. DEC. (deg);SOLAR=N. DEC. @ 0 GMT (deg)

199	S(NO,2)	STAR=RT ASC (deg);SOLAR=GHA @ 0 gmt (deg)
200	T(NO,18)*	STD FREQ(GHz) * 100
201	N(17&18,1)	STORE STRING P$
202	T(9, 1)	STORE STRING P$
203	T(9&10,1)	STORE STRING P$
204	N(22,11)	SUM of (CSC ELEV - AVE CSC ELEV)^2
205	N(21,11)	SUM of (ELEV-AVE ELEV)^2
206	N(2i-1,j)	SUN DATA:i=1=date,2=DECL,3=DIST,5=t1,6=S5(T1),
207	T(NO,5)s	SUN:(N.DEC @ 24GMT - N.DEC AT 0 GMT)*1000
208	N(1, 4)	SYSTEM # + (DATA REVISION #/100)
209	N(5,5-9)	T/Ta (B5) for FREQ#1 to #4
210	D(3,74)	T/Ta (for FREQ#1) * 10^4
211	D(4,74)	T/Ta (for FREQ#2) * 10^4
212	D(5,74)	T/Ta (for FREQ#3) * 10^4
213	D(6,74)	T/Ta (for FREQ#4) * 10^4
214	M(N8, 3)d	T/Ta CSC COEFF (B6)
215	N(18,6)	T/Ta CSC COEFF
216	M(N8, 2)d	T/Ta ZENITH (b5)
217	D(1,73)	T/Ta via NONLINSFIT as LGT(T/Ta)*10^4
218	N(18,2)	T/Ta zenith
219	A(8)rw	T/Ta*10^4
220	M(N8, 5)d	TEMPERATURE,F (A(3)/10)
221	D(2,73)	TIME END of MEAS*100
222	D(T6, 4)*	TIME OF PREDICTED STAR MAX: E1*1000
223	D(1,73)	TIME START of MEAS*100
224	D(6,75)	TIME(sec) BETWEEN MEAS (3600*E5)
225	M(N8, 4)d	TIME, DECIMAL HRS (FNT2)
226	D(4,N3+2)x	TIME,hrs(E1)*10^3
227	D(4, 2)x	TRX PWR:LGT(E4)*10^4
228	D(2,74)	Tsky/Ta*10^5
229	A(9)*	U*10^4: REFERENCE PWR via 1st meas in -3 CUT
230	M(N8,M5+5)	V1 accumulation for FREQ M5
231	M(N8, 7)d	WATER DENSITY (L7)

232	M(N8, 7)*	Y-factor
233	D(5,73)	dTstar/Ta via NONLINSFIT as LGT(dTstar/Ta)*10^4
234	M(N8, 5)*	unused

FUNCTION, KEY, & FLAG LIST by meaning
for NBS1X.26, NBS1A.09, NBS1B.29, NBS1C.45, NBS1D.117

1	FNX107	+12 volts, RF UNIT:channel #4 = 110 1011
2	FNX108	+20 volts, RF UNIT:channel #3 = 110 1100
3	FNX 27	0.100000 V DVM RANGE
4	FNX 28	1.00000 V DVM RANGE
5	FNX 29	10.0000 V DVM RANGE
6	FNX 30	100.000 V DVM RANGE
7	FNX 31	1000.00 V DVM RANGE
8	FLAG 1	1=EIPR DATA INPUT
9	FNDd(Q)	= 10^(Q/1E4)
10	FNFd8	A$= !....!....!....!....!....!....!....!...
11	FNX 36	AC VOLTS (not installed)
12	FNO(Q)	ANS ROUTINE SEQUENCE
13	FNN(Q)	ANSWER ROUTINE:DISPLAYS Q, SPACE = NO CHANGE
14	FNA(NO)	ANT POINT:NO=STAR # IN:H,L1,B1,E1; OUT:A,L,LO
15	FNFe 0	ATTN SETTING, FILTER IDENTIFICATION HEADING
16	FNB(Q)	BEEP: Q=# OF BEEPS
17	read SW Y	BIAND(ROT(RBYTE4,Y)1)=1 IF SWITCH Y IS UP
18	KEYb 8	CALC:STAR FLUX @ f
19	KEYc 5	CHANGE BIAS:HR ANG, DECL, AZ, ELEV
20	KEYc 15	CHANGE FREQ & calc new STAR FLUX
21	KEYc 18	CHANGE NOISE ADD SOURCES (C3):0=#1&#2,1=#1,2=#2,
22	KEYa 1	CHANGE PRGM CONST & MODIFY CORRESPONDING N(I,J)
23	KEYc 8	CHANGE: T(syst)/Ta
24	KEYc 7	CHANGE: Ta = ADDED NOISE,K
25	KEYc 6	CHANGE:input ATTN (dB), FILTER #
26	KEYe 3	CHECK CHANNEL VOLTAGES
27	KEYe 2	CHECK DVM
28	KEYe 1	CHECK LIST
29	KEYe 6	CHECK NOISE ADD STABILITY
30	KEYe 4	CHECK PRGM ATTENUATORS
31	KEYe 5	CHECK PWR,TYPEIV & ATTN STABILITY
32	FNX105	CRYSTAL DIODE voltage: channel #6 = 110 1001
33	FNG(Q)	CURVE FIT:0=INIT,-99=CALC FIT (out:I,R2,W1,V5,

34	FNX106	D/A OUTPUT:channel #5 = 110 1010
35	FNX104	D/A REFERENCE voltage: channel #7 = 110 1000
36	FNX 32	DC FILTER OUT
37	FNX 33	DC FILTER IN
38	FNX109	DEW POINT:channel #2 = 110 1101
39	FLAG 1	DISK STORAGE (F7) <prgm A>
40	FNI(Q)	DRAW LINE:1 -;2 --;3 ==;4 ##;5 @@
41	FNT(Q)	DUMMY USED IN ERROR PRT OUT IN MEAS
42	FNX 24	DVM AUTORANGE
43	KEYc 2	EIRP:START @ SET ?
44	KEYd 3	ENTER TEMP,A(3);AND DEW PT ,A(4) USED IN REWORK
45	read DVM	ENTER(2,*)A,B: A=FUNCTION, B=VOLTAGE
46	read CLOCK	ENTER(3,*)C,D:C=#1 THUMB SW,D=SW #2 #3 #4 HHMM.S
47	FNE(NO)	ERROR CALC FOR G/T: NO=STAR #
48	FNUd 10	ERROR,abs in G/T(etc) at L,98% probable STUDENT
49	FLAG 2	G/T ERRORS CALCULATED FOR SPECIFIC FREQ & DATE
50	FNL 1.1	G/T err TABLE: no print variables
51	FNL 1.2	G/T err TABLE: print variables
52	FNL 1	G/T plot (J=19)
53	FNL 2.1	G/Ta err TABLE: no print variables
54	FNL 2.2	G/Ta err TABLE: print variables
55	FNL 2	G/Ta plot (J=20)
56	FNX111	GROUND DVM:channel #0 = 110 1111
57	FLAG 9	HEADING:1=BYPASS DATE,FREQ,ATN DIAM,G,G/T,G/Ta
58	FNH(Q)	HEADINGS: 0=FIT #, 1=TAPE #
59	FNAd(Q)	HPBW of ant(deg), Q=HPBW*(deg),IN:NO
60	FNQd(L)	HPBW of ant (min) at elev L
61	FNL 3	HPBW#1 plot (J=21)
62	FNL 4	HPBW#2 plot (J=22)
63	FND(Q)	INIT HARDWARE: 0=VTVM,BRG,NOISE @ NOMINAL, 1=INI
64	FNX100	J357 INPUT(e.g. ext pwr meter):channel #11 = 110
65	FNK(NO)	K-FACTOR CALC,e.g. K1,K2,...,K9
66	FNJ(Q)	KEY SUB: Q=KEY #, SEE KEY LIST

67	KEYc 19	LAST MEASUREMENT:initiates storage steps
68	KEYa 2	LINK: 1=SITE PREP, 2=MEAS, 3=REWORK
69	KEYc 14	LIST CURRENT DATAMAT D
70	FNUd 0	LOAD from (F7), 0=INT, I=EXT
71	FNUd 1	LOAD:START#,STOP#,STEP (U,U1,V)
72	FNM(Q)	METEOROLOGICAL INFO:0=INPUT DATA,1=PRT DATA,
73	FNUd 6	MOON FLUX for day D4
74	FNUd 8	MOON FLUX parameters PRINT OUT
75	FNUd 4	MOON OPTICAL DIAM(deg); for day D4 via data in M
76	FNX 76	NO RF to BOLOMETER (avoid - use FNX68)
77	FNL 7	NEF plot (J=25)
78	FNX 68	NO RF TO BOLOMETER
79	FNX 64	NO RF to BOLOMETER&STD PAD IN
80	FNX 72	NO RF to BOLOMETER & STD PAD IN (avoid-USE FNX64
81	FNX 80	NOISE ADD #1 & #2 ON
82	FNX 81	NOISE ADD #1 & #2 OFF
83	FNX 82	NOISE ADD #1 ON
84	FNX 83	NOISE ADD #1 OFF
85	FNX 84	NOISE ADD #2 ON
86	FNX 85	NOISE ADD #2 OFF
87	FNX 88	NOISE ADD #1 & #2 ON (avoid - use FNX80)
88	FNX 89	NOISE ADD #1 & #2 OFF (avoid - use FNX81)
89	FNX 90	NOISE ADD #1 ON(avoid - use FNX82)
90	FNX 91	NOISE ADD #1 OFF(avoid - use FNX83)
91	FNX 92	NOISE ADD #2 ON(avoid - use FNX84)
92	FNX 93	NOISE ADD #2 OFF(avoid - use FNX85)
93	FNL 8	NUF plot (J=26)
94	FNX 40	OHMS (not installed)
95	FNX 96	OPENS MULTIPLEXER so can use front panel inputs
96	FNX 97	OPENS MULTIPLEXER so can use front panel inputs
97	FNX 98	OPENS MULTIPLEXER so can use front panel inputs
98	FNX 99	OPENS MULTIPLEXER so can use front panel inputs
99	FNC(Q)	PAGE HEADING: Q=# SPACES BEFORE PRT HEADING

100	FNY(Q)	PLOT DATA: 1=PRT HEADING
101	FNX127	PORT 1 selected
102	FNX126	PORT 2 selected
103	FNX125	PORT 3 selected
104	FNX124	PORT 4 selected
105	FNX 48	PRGM ATTN =15dB
106	FNX 49	PRGM ATTN =14dB
107	FNX 50	PRGM ATTN =13dB
108	FNX 51	PRGM ATTN =12dB
109	FNX 52	PRGM ATTN =11dB
110	FNX 53	PRGM ATTN =10dB
111	FNX 54	PRGM ATTN = 9dB
112	FNX 55	PRGM ATTN = 8dB
113	FNX 56	PRGM ATTN = 7dB
114	FNX 57	PRGM ATTN = 6dB
115	FNX 58	PRGM ATTN = 5dB
116	FNX 59	PRGM ATTN = 4dB
117	FNX 60	PRGM ATTN = 3dB
118	FNX 61	PRGM ATTN = 2dB
119	FNX 62	PRGM ATTN = 1dB
120	FNX 63	PRGM ATTN = 0dB
121	FNQ(Q)	PRGM const(MAT N):1=LIST,2=correct,3=N(I,J)
122	FNFd 4	PRINT OUT FIT RESULTS,REWORK # etc,HPBW,T/Ta,
123	FLAG 7	PRT OUT ERR:1=W/O CONSTS
124	KEYb 12	PRT: ELEV vs GMT
125	KEYb 11	PRT:LIST OF ALTERNATE STAR ERR
126	KEYb 7	PRT:SITE&FLUX DATA
127	KEYb 9	PRT:TYPICAL G/T VALUES AND ERRORS
128	FNX103	PRW BRDG OUTPUT: channel #8 = 110 0110
129	FNX101	PWR BRDG vs FINE REF: channel #10 = 110 0101
130	FNX102	PWR BRDG vs REF VOLT, set fine volt:ch #9 = 110
131	FNP(Q)	PWR MEAS:0=#1&#2,1=#1,2=#2,3=PWR,mW(IN:A3,C3,B2,
132	FNU(Q)	PWR RATIO CHECK: IN:C2,B2,C3 OUT:A(7),A(8)

133	FNVd 5	Q=FNF2 & RETURN
134	FNX 34	RATIO: FILTER IN
135	read SW	RBYTE 4=INTEGER SUM OF BINARY SWITCHES
136	FNR(Q)	READ(ENTER DATA) DEVICE:2=DVM,3=CLOCK,4=BREAK SW
137	KEYc 3	REFIT 5 CUTS: USED AFTER ONE CUT IS RETAKEN
138	FNFd 0	RESTART
139	FNVd 0	RESTART
140	KEYa 0	RESTART
141	KEYd 1	RESTART @ N=?
142	KEYb 0	RESTART:0=RESTART,1=LINKMEAS,2=REWORK,3=KEY LIST
143	KEYe 0	RESTART:0=KEY LIST,1=AUTO CK,2=NO AUTO(F2=0)
144	KEYd 0	RESTART:0REWORK,1LOAD,2AUTO SEQ,3DEL,4G/T,5FIT,
145	KEYc 0	RESTART:1SKY,2G/T,3EIRP,4LNK,5NEW TAPE,0MASTER R
146	FNFa 1	REWIND INT CASSETTE
147	FNX 69	RF TO BOLOMETER
148	FNX 65	RF to BOLOMETER&STD PAD OUT
149	FNX 73	RF to BOLOMETER & STD pad OUT (avoid-USE FNX65)
150	FNX 77	RF to BOLOMETER (avoid - use FNX69)
151	FNFb 0	SITE: W. long, N. lat, alt
152	KEYd 5	SORT,FIT and LIST DATA
153	FNFc 1	SOURCE# CHANGE, RESET MAT A & MAT D
154	FNS(Q)	SPACE PAGE Q SPACES
155	KEYc 4	STAR FIX:routine to estab ANT BIAS
156	FLAG 1	STAR FLUX CALC FOR SPECIFIED FREQ & DATE
157	FNUd 9	STAR FLUX PRINT OUT
158	FNX 66	STD ATTN IN
159	FNX 74	STD ATTN IN (avoid - use FNX66)
160	FNX 67	STD ATTN OUT
161	FNFc 0	STD VALUE(A3) CHANGE
162	FNX 75	STD attn OUT (avoid - use FNX67)
163	FNVd 12	STOREMAT M & MAT N
164	KEYc 11	STORE INT: MAT N,S,T and PRGM
165	KEYd 7	STORE MAT M & MAT N

166	KEYb 10	STORE: S,T,N
167	KEYc 12	STORE:MAT M(summary data),N(prgm consts)
168	FNUd 5	SUN FLUX for day D4, time t1
169	FNUd 7	SUN FLUX parameters PRINT OUT
170	FNUd 3	SUN microwave DIAM(deg) at freq F
171	FNX110	TEMP (F/100):channel #1 = 110 1110
172	FNT(Q)	TIME,DECIMAL HRS:1=SET UP E1 (IN: E3,E5,N4)
173	KEYb 2	UPDATE: FREQ,BW,ANT PARAMETERS
174	KEYb 13	UPDATE: N(I,J)
175	KEYb 3	UPDATE:ANT POINTING ERROR
176	KEYb 1	UPDATE:RUN#,DATE,SITE
177	KEYb 6	UPDATE:SUN/MOON ALMANAC DATA
178	KEYb 4	UPDATE:T,G/T,Ta,PWR RESP
179	KEYb 5	UPDATE:TEMP, DEW PT
180	FNV(Q)	VOLTAGE READING:volt range + channel #/100
181	FNW(Q)	WAIT Q MILLISEC
182	FNZ(NO)	Xi=FNK(NO)*C1*S(NO,4)*1E-26
183	FNL 6	Y-factor plot (J=24)
184	FNVd 13	calc B,BO,B2,G via B2,G-diff=C7,Ta=H9,B9
185	FNTd(L)	calc: ANT HPBW#1(min of arc)
186	FNVd1	calc: G/T,G/Ta,NEF,NUF errors
187	FNVd 3	calc: GRAPH RANGES for AUTO SEQ
188	FNVd 4	calc: LINEAR & CSC FIT PARAMETERS
189	KEYd 2	calc:STAR FLUX VALUES,Ta,eff area
190	FNFc 3	calc:T,R1,I5
191	FNVd 9	calc:Ta(H9) via G at 30degG=B2*(D*F/0.3.3)^2
192	KEYc 16	change:# MEAS PTS, # PTS IN FIT ZONE
193	FNVd 6	change:*HPBW,CSC COEFFi.e. N(21,2),N(21,6)
194	FNVd 2	change:ANT DIAM,SITE ELEV,NEW MOON DATA,FREQ
195	KEYc 17	change:G/Ta=B7 set:Ta H9=G/10^(B7/10)
196	KEYc 9	change:INSERT 5DB WHEN T(ADD)?
197	FNMb	convert:DEG,MIN,SEC to DECIMAL DEGREES
198	FNGb(Q)	convert:Q in decimal DEG to DEG.MMSS

8. COMPUTER PROGRAM LISTINGS

In this section, the flow charts for the computer programs are printed followed by a listing of the program. Following the program listing is a cross reference list of the program constants and of all the line numbers where these constants occur. The meanings of the program constants are given in section 7.

The numbers on the flow charts are the line numbers in the computer program. When a subroutine is called for in a program step, the line number of the beginning of the subroutine and the name of the subroutine are enclosed in parentheses.

TABLE 5. Funtions contained in X - SUBROUTINES.

LINE	FUNCTION	COMMENT
510:	FNA(NO)	ANT POINT:NO=STAR # IN:H,L1,B1,E1; OUT:A,L,LO
900:	FNB(Q)	BEEP: Q=# OF BEEPS
1470:	FNC(Q)	PAGE HEADING: Q=# SPACES BEFORE PRT HEADING
150:	FND(Q)	INIT HARDWARE: 0=VTVM,BRG,NOISE, 1=PWR BRG
1020:	FNI(Q)	DRAW LINE:1 -;2 --;3 ==;4 ##;5 @@
1100:	FNK(NO)	K-FACTOR CALC,e.g. K1,K2,...,K9
960:	FNN(Q)	ANSWER ROUTINE:DISPLAYS Q, SPACE = NO CHANGE
210:	FNP(Q)	PWR MEAS:0=#1&#2,1=#1,2=#2,3=PWR,mW(IN:A3,C3,B2,
120:	FNR(Q)	READ(ENTER DATA) DEVICE:2=DVM,3=CLOCK,4=BREAK SW
1790:	FNS(Q)	SPACE PAGE Q SPACES
1430:	FNW(Q)	WAIT Q MILLISEC
70:	FNX(Q)	EQUIPMENT MULTIPLEX FUNCTION (see section 7.3)
1460:	FNZ(NO)	Xi=FNK(NO)*C1*S(NO,4)*1E-26

```
50    X$="X.27* <D1-4> T2=4"
60    GOT 3960
70    DEF FNX(Q)
80    FORMAT B
90    WRITE (4,80)WBYTEQ;
100   WAIT 50
110   RETURN 0
120   DEF FNR(Q)
122   IF Q=4 THEN 142
124   WAIT 40
130   ENTER (Q,*)Q1,Q
140   RETURN Q
142   RETURN RBYTE4
150   DEF FND(Q)
160   IF Q THEN 180
170   RETURN FNX68+FNX67+FNX63+FNX81+FNX33+FNX127
180   Q=FNX68+FNX28+FNX102+FNW460+FNR2+FNR2
190   V=FNX68+FNX29+FNX103+FNW550+FNR2+FNX111+FNX27+FNW100
200   RETURN 0
210   DEF FNP(Q)
220   IF E2 >= 0 THEN 240
230   E2=0
240   IF E2<16 THEN 260
250   E2=15
252   IF E2<16 THEN 260
254   PRINT "PWR ERR"
256   STOP
260   IF Q>2 THEN 440
270   V7=FNX67+FNX68+FNX(63-E2)+FNX(81+2*Q)+FNX101+FNX27+FNW460+FNR2
280   V8=FNX69+FNW460+FNR2
290   V9=FNX(67-C2)+FNX(80+2*Q)+V7+FNW460-FNR2
300   V8=FNX(81+2*Q)+FNX67+FNW460+V7-(V8+FNR2)/2
310   IF ABS(V7+V8+V9+V)>1E+70 THEN 400
320   Q1=V8*(2*V-V8)
330   Q2=V9*(2*V-V9)
340   Q3=(1-C2+C2*A3)*Q2
350   IF Q1>0.096 OR Q2>0.096 THEN 370
360   E2=E2-1
370   IF Q1<0.132 AND Q2<0.132 THEN 390
380   E2=E2+1
390   RETURN Q1/(Q3-Q1)
400   PRINT "REZERO"
410   E2=E2+1
420   Q1=FNX(63-E2)+FND0+FND1
430   GOTO 252
440   V7=FNX68+FNX101+FNX27+FNW460+FNR2
450   V8=FNX69+FNW460+FNR2
460   V9=FNX68+FNW460+FNR2
470   V=FNX103+FNX29+FNW460+FNR2
480   IF ABS(V7+V8+V9)>1E+70 THEN 400
490   Q1=(V7+V9)/2-V8
500   RETURN Q1*(2*V-Q1)*5
```

```
 510   DEF FNA(NO)
 530   E8=24/360/COSS[NO,3]
 540   E9=((E1+H*E8)/24)*24.06570982
 550   IF T[NO,21]=0 THEN 580
 560   E=S[NO,2]+(E1+H*E8)*T[NO,11]/1000-C4
 570   GOTO 650
 580   E9=E9+C6*24/360
 590   IF E9 >= 24.06570982 THEN 610
 600   GOTO 630
 610   E9=E9-24
 620   GOTO 590
 630   E9=E9*360/24
 640   E=E9+360-S[NO,2]-C4
 650   IF E >= 360 THEN 670
 660   GOTO 690
 670   E=E-360
 680   GOTO 650
 690   Q1=(4*T[NO,12]-T[NO,5])/24000
 692   Q2=(T[NO,5]-2*T[NO,12])/288000
 694   Q=S[NO,3]+T[NO,21]*(Q1*E1+Q2*E1^2)+L1+B1
 700   L=SINC5*SINQ+COSC5*COSQ*COSE
 710   L=ATN(L/SQR(1-L*L+1E-99))
 720   A=SINQ/COSC5/COSL-TANC5*TANL
 730   A=ATN(SQR(1-A*A)/(A+1E-99))+2*ATN1E+99*(A<0)
 740   IF E <= -180 THEN 780
 750   IF E <= 0 THEN 820
 760   IF E <= 180 THEN 780
 770   GOTO 790
 780   A=360-A
 790   IF T[NO,21]=0 THEN 820
 800   Q=T[NO,13]/1000
 810   L=L-ATN(COSL*SINQ/(1-SINL*SINQ))
 820   Q=L0=L
 840   FOR I=1 TO 4
 850   Q0=(L8/TANQ-L9/(TANQ^2))/60
 860   Q=Q0+L
 870   NEXT I
 880   L=Q
 890   RETURN A
 900   DEF FNB(Q)
 910   FOR I=1 TO Q
 920   BEEP
 930   WAIT ABS(100*(I-4))
 940   NEXT I
 950   RETURN 0
 960   DEF FNN(Q)
 970   DISP "( =NC):";Q;
 980   INPUT B$
 990   IF B$[1,1]=" " THEN 1010
1000   RETURN VAL(B$)
```

```
1010    RETURN Q
1020    DEF FNI(Q)
1030    A$="-  -  ----====####@@@@"
1040    A$=A$[4*Q-3,4*Q]
1050    A$[5]=A$
1060    A$[9]=A$
1070    FORMAT F5.1
1080    WRITE (15,1070)A$;A$;A$;A$;A$
1090    RETURN 0
1100    DEF FNK(NO)
1120    L7=256*EXP(0.111*(A[4]/10)^0.78)/(5*(A[3]/10-32)/9+273.16)
1130    Q=(0.9211/(1+0.2912/F^2)+5.107*(1+3596/F^2)/(1-3596/F^2)^2)
1140    Q2=293/((A[3]/10-32)*5/9+273.15)
1150    G4=6.644E-03*(1-0.02252*CO)^10.52*Q2^2.75*Q
1160    Q=1-0.02215*(11.02-CO)*Q2
1170    L4=5.145/Q2*(1-Q^8.775)+3.172*Q^7.775
1180    Q=(1+493.3/F^2)/(1-493.3/F^2)^2*L7*(1+0.0046*L7)
1190    G5=1.451E+05*(1-0.02252*CO)^5.262*EXP(-644*Q2/293)/(1/Q2*293)^3*Q
1200    L5=2.09+0.27*(1-Q2^2)
1210    G6=2.529E-02*(1-0.02252*CO)^5.262*F^2/(1/Q2*293)^1.5*L7*(1+0.0046*L7)
1220    L6=2.17
1230    Z1=G4*L4+G5*L5+G6*L6
1240    L8=Q2*(0.9227*(1-0.02252*CO)^5.262+0.0202*L7)
1250    L9=0.013
1260    K1=10^(-Z1/10/SINL)
1270    B4=293/Q2*(1-K1)/1.0716
1280    Q2=(T[NO,9]/100/(1.2012*B))^2
1290    K2=(1-EXP(-Q2))/Q2/1.001
1300    K3=1
1310    Q=(W/F/2E+03)^2
1320    K4=1
1330    K5=1
1340    K6=1
1350    K7=1
1360    J1=10^(-0.00011*F*F/SINL)
1370    K8=1-(1-J1)*EXP(-0.467*Q2)
1380    Q=1+(2.909E-04)*(L8-2*L9/TANL)/(SINL)^2
1390    S=1/Q
1400    K9=1-(1-S)*EXP(-0.467*Q2)
1410    K=K1*K2*K3*K4*K5*K6*K7*K8*K9
1420    RETURN K
1430    DEF FNW(Q)
1440    WAIT Q
1450    RETURN 0
1460    DEF FNZ(NO)=FNK(NO)*C1*S[NO,4]*1E-26
```

```
1470    DEF FNC(Q)
1475    N5=N5+1
1477    IF STAT3=0 THEN 1590
1480    IF N5>1 THEN 1490
1482    DISP "YEAR";
1484    D4=FNB2+FNND4
1490    Q=FNSQ
1510    Q=FNR3
1520    IF Q<10^9 THEN 1570
1530    PRINT
1540    DISP "CLOCK RESET";
1550    INPUT Q1
1560    GOTO 1490
1568    FORMAT F2.0,F11.2
1570    OUTPUT (A$,1568)Q1,Q
1572    FORMAT 26X,F5.0,2F2.0
1574    WRITE (15,1572)D4,"/",A$[2,2];A$[4,4],"/",A$[5,6],"  ",A$[7,8],":",A$[9,1]
1590    Q=20
1600    PRINT H$;":     ";X$[1,4],TAB50,X$[5]
1610    PRINT
1620    PRINT
1630    FORMAT 35X,F4.0,"-",/,"Sysm #",F5.2,61X,"RUN",F3.0
1640    WRITE (15,1630)-N5,N[1,4],N6
1660    PRINT
1670    PRINT TAB20,P$[13]
1690    IF FLAG9 THEN 1738
1700    PRINT TAB(Q),P$[1,3];":  ";P$[9,12];" ";P$[4,6];" ";P$[7,8];
1705    FORMAT "  (",F9.3,")",/,19X
1710    WRITE (15,1705)C;
1720    FORMAT F5.0," MHz(",F2.0
1725    B$="#ox."
1728    FOR M5=1 TO N[5,11]
1730    WRITE (15,1720)1000*N[5,M5];B$[M5,M5];"),";
1734    NEXT M5
1735    M5=1
1736    Q=FNS2
1738    RETURN 0
1790    DEF FNS(Q)
1800    FOR I=1 TO Q
1810    PRINT
1820    NEXT I
1830    RETURN 0
```

SYMBOL	REFERENCE LINE				
142	122				
180	160				
220	430				
240	220				
260	240				
370	350				
390	370				
400	310	480			
440	260				
580	550				
590	620				
610	590				
630	600				
650	570	680			
670	650				
690	660				
780	740	760			
790	770				
820	750	790			
1010	990				
1490	1480	1560			
1570	1520				
1590	1477				
1738	1690				
3960	60				
A	720	730	780	890	
A$	1030	1040	1050	1060	1080
	1570				
A$[	1040	1050	1060	1574	
A3	340				
A[	1120	1140			
B	1280				
B$	980	1000	1725		
B$[	990	1730			
B1	694				
B4	1270				
BEEP	920				

C	1710				
C0	1150	1160	1190	1210	1240
C1	1460				
C2	290	340			
C4	560	640			
C5	700	720			
C6	580				
D4	1484	1574			
DISP	970	1482	1540		
E	560	640	650	670	
	700	740	750	760	
E1	540	560	694		
E2	220	230	240	250	270
	360	380	410	420	
E8	530	540	560		
E9	540	580	590	610	630
	640				
ENTER	130				
F	1130	1180	1210	1310	1360
F2	1568	1572	1720		
F3	1630				
F4	1630				
F5	1070	1572	1630	1720	
F9	1705				
FLAG9	1690				
FNA(	510				
FNB(	900				
FNB2	1484				
FNC(	1470				
FND(	150				
FND0	420				
FND1	420				
FNI(	1020				
FNK(	1100	1460			
FNN(	960				
FNND4	1484				
FNP(	210				
FNR(	120				

FNR2	180	190	270	280	290
	300	440	450	460	470
FNR3	1510				
FNS(	1790				
FNS2	1736				
FNSQ	1490				
FNW(	1430				
FNW100	190				
FNW460	180	270	280	290	300
	440	450	460	470	
FNW550	190				
FNX(	70	270	290	300	420
FNX101	270	440			
FNX102	180				
FNX103	190	470			
FNX111	190				
FNX127	170				
FNX27	190	270	440		
FNX28	180				
FNX29	190	470			
FNX33	170				
FNX63	170				
FNX67	170	270	300		
FNX68	170	180	190	270	440
	460				
FNX69	280	450			
FNX81	170				
FNZ(	1460				
G4	1150	1230			
G5	1190	1230			
G6	1210	1230			
H	540	560			
H$	1600				
I	840	870	910	930	940
	1800	1820			
J1	1360	1370			
K	1410	1420			

K1	1260	1270	1410		
K2	1290	1410			
K3	1300	1410			
K4	1320	1410			
K5	1330	1410			
K6	1340	1410			
K7	1350	1410			
K8	1370	1410			
K9	1400	1410			
L	700	710	720	810	820
	860	880	1260	1360	1380
L0	820				
L1	694				
L4	1170	1230			
L5	1200	1230			
L6	1220	1230			
L7	1120	1180	1210	1240	
L8	850	1240	1380		
L9	850	1250	1380		
M5	1728	1730	1734	1735	
MAT	1070	1568	1572	1630	1705
	1720				
N0	510	530	550	560	640
	690	692	694	790	800
	1100	1280	1460		
N5	1475	1480	1640		
N6	1640				
N[	1640	1728	1730		
P$[	1670	1700			
Q	0	122	130	140	150
	160	180	210	260	270
	290	300	694	700	720
	800	810	820	850	860
	880	900	910	960	970
	1010	1020	1040	1130	1150
	1160	1170	1180	1190	1310
	1380	1390	1430	1440	1470
	1490	1510	1520	1570	1590
	1700	1736	1790	1800	
Q0	850	860			

```
---------------------------------------------------------------------------
Q1                         130      320      350      370      390
                           420      490      500      690      694
                          1550     1570
Q2                         330      340      350      370      692
                           694     1140     1150     1160     1170
                          1190     1200     1210     1240     1270
                          1280     1290     1370     1400
Q3                         340      390
---------------------------------------------------------------------------
RBYTE4                     142
S                         1390     1400
STAT3                     1477
---------------------------------------------------------------------------
S[                         530      560      640      694     1460
TAB20                     1670
TAB50                     1600
---------------------------------------------------------------------------
T[                         550      560      690      692      694
                           790      800     1280
V                          190      310      320      330      470
                           500
V7                         270      290      300      310      440
                           480      490
---------------------------------------------------------------------------
V8                         280      300      310      320      450
                           480      490
V9                         290      310      330      460      480
                           490
W                         1310
---------------------------------------------------------------------------
WBYTEQ                      90
WRITE                     1080     1574     1640     1710     1730
X                           90     1572     1630     1705
X$[                         60     1600
---------------------------------------------------------------------------
Z1                        1230     1260
===========================================================================
LINES:  179      BYTES:  4361      SYMBOLS:  150      REFERENCES:  443
```

8.2 E - EQUIP CHECK flow diagram

```
                                       RUN
                                        |
                                        |
3700:     >---------------------   INITIALIZE
3890:                      PRGM: 5=EXT TAPE, 10=INT TAPE
                                        |
3920:                               LOAD KEY
3940:                          MERGE X-SUBROUTINES
                                        |
3962:                             ETMS SYSTEM S/N?
                                        |
3968:                               LOAD DATA, N
                                        |
4022:                        SET UP PROGRAM CONSTANTS
                                        |
                                        |
4200:     >>----------   TRAP: 0=KEY LIST, 1=AUTO CK    <---------------------
                                     |       |                               |
                                     |     4466:                             |
                                     |                                       |
                                     |                                       |
4270:                         PRINT KEY LIST                                 |
4340:                         goto TRAP -------------------------------  >4200:


4466:     >>-------------------1=AUTO CK
                                     |
4468:               DO CHECK LIST & DVM: 0=NO,  1=YES
                                           |      |
                                         4478:    |
                                                  |
                                      -------------
                                     |
4476:       (4530: FNJ1)    DO CHECK LIST
4476:       (4830: FNJ2)    CHECK DVM
                                     |
4478:     >-------------------    0=NO
4478:       (7910: FNJ3)    CHECK CHANNEL VOLTAGES
4478:       (5020: FNJ4)    CHECK PRGM ATTENUATORS
4478:       (5870: FNJ5.1)  CHECK PWR STABILITY
4478:       (5870: FNJ5)    CHECK PWR LINEARITY
4478:       (8650: FNJ6)    CHECK SIMULATED NOISE ADD STABILITY
4478:       (7910: FNJ3)    RECHECK CHANNEL VOLTAGES
                                     |
4480:       CONNECT EARTH TERMINAL & SET PWR LEVEL?
                                     |
4500:       (8560: FNJ6.1)  CHECK RF NOISE ADD STABILITY
                                     |
4510:                              STOP
```

```
3700  R=500
3890  DISP "PRGM:5=EXT TAPE/DISK,10=INT TAPE";
3900  INPUT Q
3910  PRINT Q
3920  LOAD  KEY #Q,2
3930  Q=RES
3940  MERGE #Q,4,50,50
3960  H$="E.22M  EQUIP CK  <D7-F0> T1-F0"
3962  PRINT "  ETMS  SYSTEM  S/N  ";
3963  INPUT Q
3964  IF Q<3 OR Q>6 THEN 3962
3968  LOAD  DATA #RES,2*Q,N
3969  REWIND #RES
3970  DIM A$[72],B$[11],D$[25],H$[72],L$[25],P$[72],X$[30],NS[26,11],MS[128,6]
3980  R=A=A1=A2=C=C2=C3=C8=C9=E6=F1=F2=F3=F4=F5=F6=F7=F9=0
3990  H=I=I5=I6=J=J1=M=M1=M2=N=N1=N2=N3=N5=N6=O5=O6=0
4000  P=P0=P1=P2=P3=P5=P6=Q=Q0=Q1=Q2=Q3=Q4=R1=R2=R5=S=S1=S2=T0=T1=T2=T3=T4=0
4010  V=V1=V2=V7=V8=V9=0
4020  X2=X3=X4=Z=0
4022  A3=10^(N[13,10]/10)
4024  A8=N[18,10]
4030  C8=70
4032  C9=5.3
4033  D=60
4034  D4=1979
4035  H=3.5
4040  F=7
4050  E2=1
4060  G=10^4
4070  M6=1
4080  T=100
4090  P$[1,12]=""
4100  SFLAG 9
4110  Q=FNJ0
4120  STOP
4122  DEF FNF(Q)
4126  GOTO 8500
4130  R=501
4140  DEF FNV(Q)=FNX(31-INTQ)+FNX(111-(Q-INTQ)*100)+FNW1000+FNR2
4150  R=502
4160  DEF FNJ(Q)
4170  GOTO Q OF 4530,4830,7910,5020,5870,8560,9500,4180,4350
4180  P$[13]="KEY 0:  CHECK LIST AND KEY LIST"
4190  Q=FNS2
```

```
4200  R=503
4202  F2=0
4204  STANDARD
4210  DISP "O=KEY LIST,1=AUTO CK";
4220  Q=FNB2+FNN1
4230  GOTO Q OF 4466
4240  PRINT
4250  PRINT
4260  A=18
4270  PRINT TABA"KEY 0: RESTART"
4280  PRINT TABA"KEY 1: CHECK LIST"
4290  PRINT TABA"KEY 2: CHECK DVM"
4300  PRINT TABA"KEY 3: CHECK CHANNEL VOLTAGES"
4310  PRINT TABA"KEY 4: CHECK ATTENUATORS"
4320  PRINT TABA"KEY 5: CHECK PWR, TYPE IV & ATTEN STABILITY"
4322  PRINT TABA"KEY 6: CHECK NOISE ADD STABILITY"
4324  PRINT TABA"KEY 7: CHANGE STANDARD ATTENUATION VALUE"
4328  PRINT TABA"KEY 9: NEW FREQ, BW, INPUT ATTN, SIML STAR NOISE"
4330  Q=FNS2
4340  GOTO 4210
4350  R=504
4370  DISP "RUN #";
4380  N6=FNB3+FNNN6
4390  DISP "FILTER FREQ(MHz)";
4400  C8=FNNC8
4405  A3=10^(N[13,5+(C8>49)*5]/10)
4407  A8=N[18,5+(C8>49)*5]
4410  DISP "FILTER BANDPASS(MHz)";
4420  C9=FNNC9
4430  DISP "INPUT ATTN(dB)";
4440  E6=FNNE6
4450  DISP "SIMUL STAR NOISE(dB)";
4460  H=FNNH+FNS3
4464  RETURN 0
4466  R=504.1
4467  F2=1
4468  DISP "DO CHECK LIST & DVM (0=NO)";
4469  INPUT Q
4470  IF Q=0 THEN 4478
4476  Q=FNJ1+FNS6+FNJ2
4478  Q=FNS4+FNJ3+FNS9+FNJ4+FNJ5.1+FNS8+FNJ5+FNJ6+FNJ3
4480  DISP "CONNECT EARTH TERM,SET PWR LEVEL";
4490  Q=FNB3+FNN1
4500  Q=FNS5+FNJ6.1
4510  STOP
```

```
4530  R=506
4540  DISP "PRINT ALL ON";
4550  INPUT A$
4560  PRINT "8 AC PWR SWITCHES ON";
4570  INPUT A$
4580  PRINT "DANA: EXT RATE FULL CCW";
4590  INPUT A$
4600  PRINT "DANA: DATA OUTPUT BUTTON IN";
4610  INPUT A$
4620  PRINT "DANA: PROGRAM CONTROL BUTTON IN";
4630  INPUT A$
4640  PRINT "RF UNIT:BANDPASS/FREQ @ 5.3Mz/70MHz";
4650  INPUT A$
4655  E6=INT(ABSN[1,7])
4660  PRINT "RF UNIT: ATTEN SET TO";E6;"dB";
4670  INPUT A$
4672  PRINT "RF UNIT: SIM STAR NOISE @ 3.5 dB";
4674  INPUT A$
4680  PRINT "RF UNIT: METER RANGE X1";
4690  INPUT A$
4700  PRINT "(SIMUL STAR OUT)  to  (RF INPUT)";
4710  INPUT A$
4712  PRINT "# OF INPUT PORTS TO RF INPUT";
4714  M6=FNNM6
4715  IF M6=0 THEN 4718
4716  M5=1+FNX127
4718  Q=FNDO
4720  PRINT "RF UNIT: OUTPUT METER @ ";10*SGNN[1,7]*(ABSN[1,7]-E6);"dB";
4730  INPUT A$
4740  PRINT "CLOCK UNIT: SET DATE";
4750  INPUT A$
4760  PRINT "CLOCK UNIT: SET GMT TIME";
4770  INPUT A$
4780  DISP "END"
4790  PRINT
4800  PRINT
4810  RETURN 0
4820  STOP
4830  R=507
4840  P$[13]="KEY 2:   CHECK DIGITAL MULTIMETER"
4850  Q=FNC3+FNDO+FNS3+FNX32
4860  PRINT "DVM FUNCTION 1111: FILTER OUT";
4870  INPUT A$
4880  Q=FNX33
4890  PRINT "DVM FUNCTION 1110: FILTER IN";
4900  INPUT A$
4910  FOR I=0 TO 4
4920  PRINT 10^(3-I);"VOLT RANGE",FNV(I),"RANGE #";I;"DEC PLACES";I+2
4930  PRINT
4940  INPUT A$
4950  NEXT I
```

```
4960  PRINT " AUTO-VOLT RANGE",FNV(7),"RANGE #";7
4970  FOR I=1 TO 5
4980  PRINT
4990  NEXT I
5000  DISP "END";
5010  RETURN 0
5020  R=508
5030  P$[13]="KEY 4:  CHECK ATTENUATORS"
5040  Q=FNDO
5050  F3=1
5060  N=3
5070  C2=1
5080  R=509
5090  IF F2 THEN 5180
5100  DISP "0=XTAL,1=TYPE IV BRIDGE";
5110  F3=FNB4+FNN1+FNJ9
5140  DISP "# REPEAT PWR MEAS/SET";
5150  N=FNB2+FNNN
5180  R=510
5190  GOSUB 5620
5200  PO=P
5210  Q=FNC3+FNS2+FNFO+FNS2
5220  IF F3 THEN 5260
5230  FORMAT 3X,"CRYSTAL OUTPUT=",F9.5," VOLTS  +-",F6.3," %",2X,"(",F3.0," MEAS)
5240  WRITE (15,5230)PO,S,N,
5250  GOTO 5280
5260  FORMAT 3X,"NBS TYPE IV OUTPUT",F9.5," MW +-",F6.3," %",2X,"(",F3.0," MEAS)"
5270  WRITE (15,5260)PO,S,N,
5280  GOSUB 5800
5290  FORMAT 2X,"STD CK:",F6.3," DB"
5300  WRITE (15,5290)Q
5310  PRINT
5320  PRINT
5330  PRINT "X ATTN   PRGM ATTN #1   #1 PWR OR VOLT   ORIG PWR/#1 PWR";
5340  PRINT "   #1 PWR/#2 PWR"
5350  PRINT "         PRGM ATTN #2   #2 PWR OR VOLT   STD CK @ #2  ";
5360  PRINT "    NOMINAL #1/#2"
5370  PRINT
5380  PRINT
5390  FOR A1=0 TO 8
5400  IF F2=0 THEN 5420
5410  IF A1 THEN 5590
5420  IF A1=3 OR A1=5 OR A1=7 THEN 5590
5430  FOR A2=1 TO 15
5440  Q=FNX(63-A1)
5450  GOSUB 5620
5460  P1=P
5470  S1=S
5480  Q=FNX(63-A2)
5490  GOSUB 5620
```

```
5500  P2=P
5510  S2=S
5520  GOSUB 5800
5530  FORMAT F3.0," DB",F7.0," DB",F13.5," +-",F5.2," %",F10.3," DB",F13.3," DB"
5540  WRITE (15,5530)E6,A1,P1,S1,10*LGT(P0/P1),10*LGT(P1/P2)
5550  FORMAT F13.0," DB",F13.5," +-",F5.2," %",F10.3," DB",F11.0,"   DB"
5560  WRITE (15,5550)A2,P2,S2,Q,A2-A1
5570  PRINT
5580  NEXT A2
5590  NEXT A1
5600  Q=FNS8
5610  RETURN 0
5620  R=511
5630  REM ****PWR: F3=0 FOR XTAL DET,  F3=1  FOR NBS TYPE IV ***
5640  S=M=V1=0
5650  IF F3=0 THEN 5670
5660  Q=FND1
5670  FOR I=1 TO N
5680  IF F3 THEN 5720
5690  WAIT 50
5700  P5=FNV(4.06)
5710  GOTO 5730
5720  P5=FNP3
5730  M=M+P5
5740  V1=V1+P5*P5
5750  NEXT I
5760  P=M/N
5770  IF N=1 THEN 5790
5780  S=100*SQR((V1-M*M/N)/(N-1))/ABSP
5790  RETURN
5800  R=512
5810  REM **** 1 DB CHECK: Q=DIFF IN MILLI DB = Q
5820  Z=P
5830  Q=FNX66
5840  GOSUB 5620
5850  Q=FNX75-10*LGT(P/Z)+10*LGT(1/A3)
5860  RETURN
5870  R=513
5880  P$[13]="KEY 5:  CHECK PWR,LINEARITY,STAB OF TYPE IV"
5882  F8=10*(Q-INTQ)
5890  C3=3
5900  T1=FNR3
5910  Q=FND0+FND1
5920  F1=F5=2
5930  F7=1
5940  F6=12
5950  I5=0.01
5960  N3=3
5962  A1=0
5964  A2=1
5970  IF F8=0 THEN 6000
```

```
5975  F1=F5=0
5990  R=514
6000  IF F2 THEN 6480
6010  DISP "0=PRT PWR&V'S, 2=GRAPH PWR RATIO";
6020  F1=FNB3+FNNF1
6030  IF F1=0 THEN 6230
6040  DISP "PWR LEVEL:0=CONST,1=STEPPED";
6050  F7=FNNF7
6060  IF F7=0 THEN 6090
6070  F6=1
6080  GOTO 6110
6090  DISP "MEAS:0=PRGM ATTN,1=STD ATTN";
6100  F6=FNNF6
6110  A1=0
6120  A2=1
6130  IF F6 THEN 6170
6140  DISP "#1 LEVEL,#2 LEVEL (PRGM ATTEN)";
6150  INPUT A1,A2
6160  GOTO 6180
6170  F6=12
6180  DISP "# OF MEAS/PLOT";
6190  N3=FNNN3
6200  DISP "SMALLEST GRAPH UNIT(DB)";
6210  I5=FNNI5
6220  REM BYPASS NOISE ADD OPTION
6230  Q0=0
6240  GOTO 6270
6250  DISP "PWR VIA NOISE ADD(0=NO,1=YES)";
6260  Q0=FNNO
6270  C2=0
6280  F5=F1+Q0
6290  IF Q0=0 THEN 6340
6300  DISP "ADD SOURCE:0=(#1&#2),1=(#1),2=(#2)";
6310  C3=FNNC3
6320  DISP "INSERT 6DB WHEN ADD ON(0=NO,1=YES)";
6330  C2=FNNC2
6340  T0=0
6350  DISP "INPUT ATTEN (DB)";
6360  E6=FNNE6
6370  IF F1=2 THEN 6420
6380  DISP "SIMULATED STAR NOISE LEVEL(DB)";
6390  H=FNNH
6400  FIXED 4
6405  DISP "STD(";10*LGTA3;"dB)";
6410  A3=N[1,3]=FNNA3
6415  STANDARD
6420  DISP "IF FREQ(MHZ)";
6430  C8=FNNC8
6440  DISP "BANDWIDTH(MHZ)";
6450  C9=FNNC9
```

```
6480  R=515
6490  Q=FNC2+FNFO+FNS2
6540  IF F5>1 THEN 6880
6550  FORMAT "  NO. BRDG V        V7          V8          V9        PWR(MW)"
6560  WRITE (15,6550)"    CK ERR    SIGMA"
6570  PRINT
6580  Q=FND1
6590  M1=M2=N=N1=N2=P2=V1=V2=S=S1=S2=0
6600  P=FNPC3
6602  IF F2 THEN 6650
6610  Q4=FNR3
6620  IF INT(Q4/10)-INT(T1/10)=0 THEN 6650
6630  Q=FNC2+FND0+FND1
6640  T1=Q4
6650  N=N+1
6660  IF N/2-INT(N/2) THEN 6740
6670  Q=FNX67
6680  N1=N1+1
6690  M1=M1+P
6700  V1=V1+P*P
6710  IF N1=1 THEN 6730
6720  S=SQR((V1-M1*M1/N1)/(N1-1))/M1*N1*100
6730  GOTO 6810
6740  Q=FNX66
6750  N2=N2+1
6760  M2=M2+P
6770  V2=V2+P*P
6780  IF N2=1 THEN 6800
6790  S=SQR((V2-M2*M2/N2)/(N2-1))/M2*N2*100
6800  FORMAT F4.0,F8.4,3F12.6,F11.4,"MW",F9.4,"DB",F7.2,"%"
6810  IF N>1 THEN 6830
6820  P2=P
6830  WRITE (15,6800)N,V,V7,V8,V9,P,(-1)^N*10*LGT(P2/P)-10*LGTA3,S
6840  P2=P
6850  IF N/2-INT(N/2) THEN 6862
6860  PRINT
6862  IF F2 AND N>27 THEN 6872
6870  GOTO 6600
6872  RETURN 0
```

```
6880  R=516
6890  REM **  STABILITY GRAPH **
6900  FORMAT 5X,"#1 LEVEL:",F3.0," DB EXT  +",F3.0
6910  FORMAT F3.0,"DB PROG"
6920  FORMAT F3.0," DB CK STD"
6930  FORMAT 5X,"MEAS/PLOT PT =",F3.0
6940  WRITE (15,6900)E6,
6950  IF F6 THEN 6980
6960  WRITE (15,6910)A1,
6970  GOTO 6990
6980  WRITE (15,6920)A1,
6990  WRITE (15,6930)N3
7000  FORMAT 5X,"#2 LEVEL:",F3.0," DB EXT  +",F3.0
7010  FORMAT 5X,"UNIT  =",F7.4," DB",F7.4
7020  WRITE (15,7000)E6,
7030  IF F6 THEN 7060
7040  WRITE (15,6910)A2,
7050  GOTO 7070
7060  WRITE (15,6920)A2,
7070  WRITE (15,7010)I5
7080  PRINT
7090  FORMAT 5X,F6.3,4X,F6.3,4X,F6.3,4X,F6.3,4X,F6.3,4X,F6.3," DB",F6.3
7100  WRITE (15,7090)-25*I5,-15*I5,-5*I5,5*I5,15*I5,25*I5
7110  A$="!....!....!....!....!....!....!....!....!....!....!"
7120  PRINT TAB8,A$
7130  N=1
7140  J1=0
7142  M5=1
7150  T3=FNR3
7160  GOSUB 7690
7170  R5=R2
7180  I6=R5
7190  FORMAT "#/TIME",21X,"ZERO=",F6.3," DB",22X," AVE   ",3X,"#1 PWR"
7200  WRITE (15,7190)I6
7210  GOTO 7340
```

```
7220  R=517
7230  N=N+1
7240  IF N>36 AND F2=1 THEN 7890
7250  IF F7=0 THEN 7290
7260  J1=J1+1
7261  IF M6=0 THEN 7270
7262  M5=M5+1
7264  IF M5<M6+1 THEN 7268
7266  M5=1
7268  Q=FNX(128-M5)
7270  IF J1<16 THEN 7290
7280  J1=0
7290  Q=FNX(63-J1)
7300  IF N/30-INT(N/30) THEN 7320
7302  IF F2=1 THEN 7310
7303  IF STAT3=0 THEN 7308
7304  Q=FNR3
7305  IF Q>10^9 THEN 7308
7306  FORMAT 28X,F5.0,F5.0,F6.2,")"
7307  WRITE (15,7306)D4,Q1*10^3+INT(Q/10^4),INTQ/100-100*INT(Q/10^4)
7308  PRINT H$;":   ";X$;"     SYSM #";N[1,4]
7309  WRITE (15,7090)-25*I5,-15*I5,-5*I5,5*I5,15*I5,25*I5
7310  PRINT TAB8,A$
7320  GOSUB 7690
7322  IF ABS(R5-R2)>0.1 THEN 7340
7330  R5=(9*R5+R2)/10
7340  X3=(R2-I6)/I5+25
7350  IF ABS((R5-I6)/I5)<10 THEN 7380
7360  I6=R5
7370  WRITE (15,7190)I6
7380  IF X3<0 OR X3>50 THEN 7560
7390  ENTER (3,*)Q,T4
7400  IF INT(T4/10)-INT(T3/10) THEN 7450
7410  FORMAT F4.0,4X
7420  WRITE (15,7410)N,
7430  Q0=FND1
7440  GOTO 7480
7450  FORMAT F6.2,2X
7460  WRITE (15,7450)(INTT4-10^4*INT(T4/10^4))/100,
7470  T3=T4
7480  X4=INT(S/I5)
7490  IF X4>1 THEN 7510
7500  X4=1
7510  IF (X3-X4)<0 AND (X3+X4)>50 THEN 7650
7520  IF (X3-X4)<0 THEN 7590
7530  IF (X3+X4)>50 THEN 7610
7540  PRINT TAB(X3-X4),"!";TABX3,"+";TAB(X3+X4),"!";TAB50,
7550  GOTO 7630
7560  FORMAT 4X,"(OFF SCALE) RATIO=",F8.4," DB +-",F7.4," DB",4X,F5.1
7570  WRITE (15,7560)R2,S,
```

```
7580  GOTO 7630
7590  PRINT TABX3,"+";TAB(X3+X4),"!";TAB50,
7600  GOTO 7630
7610  PRINT TAB(X3-X4);"!";TABX3,"+";TAB50,
7620  FORMAT F10.4,"DB",F7.3,"MW",F8.4
7630  WRITE (15,7620)R2,P
7640  GOTO 7220
7650  PRINT TABX3,"+";TAB50,
7660  FORMAT 4X,"SIGMA =",F6.3," DB"
7670  WRITE (15,7660)S
7680  GOTO 7220
7690  R=518
7700  REM **** PWR SUB; P=PWR, S=SIGMA IN DB
7710  S=M1=M2=V2=0
7720  Q=FND1
7730  FOR I=1 TO N3
7740  Q=FNX(63-A1+F6)
7750  P4=FNPC3
7751  M[2*I-1,1]=V
7752  M[2*I-1,2]=V7
7753  M[2*I-1,3]=V8
7754  M[2*I-1,4]=V9
7755  M[2*I-1,5]=P4
7756  M[2*I-1,6]=10*LGT(P4/P)
7760  P6=P4
7770  M1=M1+P6
7780  P=FNX(63-A2+F6)+FNP3
7781  M[2*I,1]=V
7782  M[2*I,2]=V7
7783  M[2*I,3]=V8
7784  M[2*I,4]=V9
7785  M[2*I,5]=P
7786  M[2*I,6]=10*LGT(P6/P)
7789  IF P=0 THEN 7804
7790  IF (P6/P) <= 0 THEN 7804
7800  R1=10*LGT(P6/P)
7802  GOTO 7810
7804  PRINT "7804:P6,P",P6,P
7810  M2=M2+R1
7820  V2=V2+R1*R1
7830  NEXT I
7840  P=M1/N3
7850  R2=M2/N3
7860  IF N3=1 THEN 7880
7870  S=10*LGT(1+SQR((V2-M2*M2/N3)/(N3-1)))
7871  IF S<0.3 THEN 7880
7872  PRINT
7873  WRITE (15,6550)"    CK ERR"
```

```
7874  FOR I=1 TO 2*N3
7876  WRITE (15,6800)I/2,M[I,1],M[I,2],M[I,3],M[I,4],M[I,5],M[I,6]-10*LGTA3
7877  IF I/2#INT(I/2) THEN 7879
7878  PRINT
7879  NEXT I
7880  RETURN
7890  Q=FNS6
7900  RETURN 0
7910  R=519
7920  P$[13]="KEY 3:  CHECK CHANNEL VOLTAGES"
7930  Q=FNC3+FND0+FND1
7940  RESTORE 7940
7950  FORMAT 3X,"CHANNEL",7X,"VOLTAGE",8X,"STATUS",6X,"NOMINAL",10X,"+- RANGE"
7960  WRITE (15,7950)
7970  Q=FNS2
7980  FOR J=0 TO 10
7990  READ A$,A1,A2
8000  GOTO INT(A1/100) OF 8020,8040,8060
8010  GOTO 8080
8020  A1=10*FNV7.09
8030  GOTO 8080
8040  A1=N[1,5]
8050  GOTO 8080
8060  Q=FNV7.09
8070  A1=FNV7.08-N[1,6]*FNV7.07
8080  Q=FNV(7+J/100)
8090  PRINT A$,TAB15,Q,TAB30,
8100  A$="   OK"
8110  IF Q<A1+A2 AND Q>A1-A2 THEN 8140
8120  A$="*NOT NORMAL!"
8130  Q=FNB3
8140  PRINT A$,TAB45,A1,A2
8150  PRINT
8160  NEXT J
8170  Q=FNS10
8180  DATA "0=DC OFFSET",0,1E-05
8190  DATA "1=TEMP",0.5,0.5
8200  DATA "2=DEW POINT",0.5,0.5
8210  DATA "3=+20 VOLTS",20,0.2
8220  DATA "4=+12 VOLTS",12,0.15
8230  DATA "5=DAC OUTPUT",100,0.02
8240  DATA "6=XTAL DIODE",-0.0125,0.0125
8250  DATA "7=D/A REF",200,0.01
8260  DATA "8=BRDG OUTPUT",2.415,0.17
8270  DATA "9=SET FINE REF",300,0.005
8280  DATA "10=BRDG vs REF",0,0.001
8290  Q=FNS12
8300  RETURN 0
```

```
8500  R=520
8510  FORMAT 10X,"SIML STAR ATTN:",F4.1," dB",11X,"IF FREQ:",F9.0," MHz"
8520  FORMAT 10X,"INPUT ATTN:",F8.0," dB",11X,"BNDWD:",F11.1," MHz"
8525  FORMAT 10X,"STD   ATTN:",F8.3," dB",11X,"#1/#2add:",F8.4
8530  WRITE (15,8510)H,C8
8540  WRITE (15,8520)E6,C9
8545  WRITE (15,8525)10*LGTA3,A8
8550  RETURN 0
8560  R=521
8570  P$[13]="KEY 6:  "
8580  F8=10*(Q-INTQ)
8590  N=3
8600  F4=1
8610  IF F2 AND  NOT F8 THEN 8722
8620  F4=2
8705  IF F2 THEN 8722
8710  DISP "1=SIMUL,2=EARTH TERM";
8712  F4=FNB2+FNNF4
8714  DISP "#MEAS/SET";
8716  N=FNNN+FND0+FND1+FNJ9
8722  C2=1
8724  P=FNP0
8726  IF Q/Q1>0.5 THEN 8740
8728  C2=0
8740  P$[21]="SIMULATED NOISE ADD TEST"
8760  IF F4=1 THEN 8772
8770  P$[21]="EARTH TERMINAL TEST"
8772  Q=FNC4+FNS1+FNF0+FNS2
8776  P=FND0+FNX66+FNP3*A3
8778  P1=FNX82+FNP3*A3
8780  P2=FNX83+FNX84+FNP3*A3
8782  FORMAT "  P=",F7.4," mW",5X,"add #1=",F7.4," mW",5X,"add #2=",F7.4,F4.0
8784  WRITE (15,8782)P,P1-P,P2-P," mW       meas/set=",N
8785  IF (P1/P-1)<0.1 THEN 8787
8786  F5=1
8787  IF (P2/P-1)<0.1 THEN 8790
8788  F6=1
8790  Q=FNS2
8800  FORMAT " P(mW)   P+1+2   #1(mW)  #2(mW)   #1+#2   #1/#2   P/#1"
8810  WRITE (15,8800)"    P/#2    P/1+2    STDck"
8815  FORMAT 76X,"dB"
8816  WRITE (15,8815)
8817  E2=-1
```

```
8820  NO=N1=N2=N3=N4=05=06=N7=N8=N9=MO=M1=M2=M3=M4=M5=M6=M7=M8=M9=0
8824  F7=E2=E2+1
8826  IF E2=16 AND F2=1 THEN 9400
8828  IF E2=16 THEN 8772
8830  FOR A=1 TO N
8832  E2=F7
8840  C2=1+FNX81+FND1
8842  IF F5=0 THEN 8945
8850  P=FNP1
8852  E2=F7
8860  IF Q2/Q1>0.5 THEN 8890
8870  C2=0
8880  P=FNP1
8882  E2=F7
8890  N7=N7+P
8900  M7=M7+P^2
8908  P1=5*(Q3-Q1)
8910  N3=N3+P1
8920  M3=M3+P1^2
8930  N1=N1+5*Q1
8940  M1=M1+25*Q1^2
8945  IF F6=0 THEN 9055
8950  C2=1
8960  P=FNP2
8962  E2=F7
8970  IF Q2/Q1>0.5 THEN 9000
8980  C2=0
8990  P=FNP2
8992  E2=F7
9000  N8=N8+P
9010  M8=M8+P^2
9018  P2=5*(Q3-Q1)
9020  N4=N4+P2
9030  M4=M4+P2^2
9040  N1=N1+5*Q1
9050  M1=M1+25*Q1^2
9055  IF (F5+F6)=0 THEN 9210
9060  C2=1
9070  P=FNP0
9072  E2=F7
9080  IF Q2/Q1>0.5 THEN 9110
9090  C2=0
9100  P=FNP0
9102  E2=F7
```

```
9110  N9=N9+P
9120  M9=M9+P^2
9130  05=05+5*(Q3-Q1)
9140  M5=M5+(25*(Q3-Q1)^2)
9150  N1=N1+5*Q1
9160  M1=M1+25*Q1^2
9162  Q=P1/P2
9170  06=06+Q
9180  M6=M6+Q*Q
9190  N2=N2+5*Q2
9200  M2=M2+25*Q2^2
9210  P=FNX67+FNP3
9212  E2=F7
9220  N1=N1+P
9230  M1=M1+P^2
9240  P1=FNX66+FNP3
9242  E2=F7
9250  Q=10*LGT(P/P1)-10*LGTA3
9260  NO=NO+Q
9270  MO=MO+Q^2
9275  NEXT A
9280  FORMAT 10F8.4
9282  Q=(1+F5+F6+((F5+F6)#0))*N
9290  WRITE (15,9280)N1/Q,N2/N,N3/N,N4/N,05/N,06/N,N7/N,N8/N,N9/N,NO/N
9300  FORMAT F6.2,"% ",F6.2,"% ",F6.2
9301  E=N-1
9302  Q1=(M1-N1^2/Q)/(Q-1+(Q=1))
9303  IF Q1>0 THEN 9305
9304  Q1=1
9305  Q2=(M2-N2^2/N)/E
9306  IF Q2>0 THEN 9309
9307  Q2=1
9309  N2=N2+(N2=0)
9310  WRITE (15,9300)100*SQRQ1/N1*Q,100*SQRQ2/N2*N,
9311  N3=N3+(N3=0)
9312  Q1=(M3-N3^2/N)/E
9313  IF Q1>0 THEN 9316
9314  Q1=1
9316  N4=N4+(N4=0)
9317  Q2=(M4-N4^2/N)/E
9318  IF Q2>0 THEN 9320
9319  Q2=1
9320  WRITE (15,9300)100*SQRQ1/N3*N,100*SQRQ2/N4*N,
9322  05=05+(05=0)
9323  Q1=(M5-05*05/N)/E
9324  IF Q1>0 THEN 9326
9325  Q1=1
9326  06=06+(06=0)
9327  Q2=(M6-06*06/N)/E
9328  IF Q2>0 THEN 9330
```

```
9329  Q2=1
9330  WRITE (15,9300)100*SQRQ1/05*N,100*SQRQ2/06*N,
9332  N7=N7+(N7=0)
9333  Q1=(M7-N7*N7/N)/E
9334  IF Q1>0 THEN 9336
9335  Q1=1
9336  N8=N8+(N8=0)
9337  Q2=(M8-N8*N8/N)/E
9338  IF Q2>0 THEN 9340
9339  Q2=1
9340  WRITE (15,9300)100*SQRQ1/N7*N,100*SQRQ2/N8*N,
9341  N9=N9+(N9=0)
9342  Q1=(M9-N9*N9/N)/E
9343  IF Q1>0 THEN 9345
9344  Q1=1
9345  NO=NO+(NO=0)
9346  Q2=(MO-NO*NO/N)/E
9347  IF Q2>0 THEN 9350
9348  Q2=1
9349  FORMAT F6.2,"% ",F8.4
9350  WRITE (15,9349)100*SQRQ1/N9*N,SQRQ2
9352  PRINT
9390  GOTO 8820
9400  RETURN 0
9500  R=522
9510  P$[13]="KEY 7:  CHANGE STANDARD ATTENUATION VALUE"
9515  FIXED 4
9520  PRINT "STD(";10*LGTA3;"dB)";
9530  A3=N[1,3]=FNNA3
9570  GOTO 9515
9900  GOTO 9998
```

SYMBOL	REFERENCE LINE			
3962	3964			
4210	4340			
4478	4470			
4718	4715			
5180	5090			
5260	5220			
5280	5250			
5420	5400			
5590	5410	5420		
5620	5190	5450	5490	5840
5670	5650			
5720	5680			
5730	5710			
5790	5770			
5800	5280	5520		
6000	5970			
6090	6060			
6110	6080			
6170	6130			
6180	6160			
6230	6030			
6270	6240			
6340	6290			
6420	6370			
6480	6000			
6600	6870			
6650	6602	6620		
6730	6710			
6740	6660			
6800	6780			
6810	6730			
6830	6810			
6862	6850			
6872	6862			
6880	6540			

SYMBOL	REFERENCE LINE		
6980	6950		
6990	6970		
7060	7030		
7070	7050		
7220	7640	7680	
7268	7264		
7270	7261		
7290	7250	7270	
7308	7303	7305	
7310	7302		
7320	7300		
7340	7210	7322	
7380	7350		
7450	7400		
7480	7440		
7510	7490		
7560	7380		
7590	7520		
7610	7530		
7630	7550	7580	7600
7650	7510		
7690	7160	7320	
7804	7789	7790	
7810	7802		
7879	7877		
7880	7860	7871	
7890	7240		
8080	8010	8030	8050
8140	8110		
8500	4126		
8722	8610	8705	
8740	8726		
8772	8760	8828	
8787	8785		
8790	8787		
8820	9390		

SYMBOL	REFERENCE LINE				
8890	8860				
8945	8842				
9000	8970				
9055	8945				
9110	9080				
9210	9055				
9305	9303				
9309	9306				
9316	9313				
9320	9318				
9326	9324				
9330	9328				
9336	9334				
9340	9338				
9345	9343				
9350	9347				
9400	8826				
9515	9570				
9998	9900				
A	3980	4260	8830	9275	
A$	4550	4570	4590	4610	4630
	4650	4670	4674	4690	4710
	4730	4750	4770	4870	4900
	4940	7110	7120	7310	7990
	8090	8100	8120	8140	
A$[	3970				
A1	3980	5390	5410	5420	5440
	5540	5560	5590	5962	6110
	6150	6960	6980	7740	7990
	8000	8020	8040	8070	8110
	8140				
A2	3980	5430	5480	5560	5580
	5964	6120	6150	7040	7060
	7780	7990	8110	8140	
A3	4022	4405	5850	6410	8776
	8778	8780	9530		
A8	4024	4407	8545		
B$[	3970				
C	3980				
C2	3980	5070	6270	6330	8722
	8728	8840	8870	8950	8980
	9060	9090			

SYMBOL	REFERENCE LINE				
C3	3980	5890	6310		
C8	3980	4030	4400	4405	4407
	6430	8530			
C9	3980	4032	4420	6450	8540
D	4033				
D$[	3970				
D4	4034	7307			
DISP	3890	4210	4370	4390	4410
	4430	4450	4468	4480	4540
	4780	5000	5100	5140	6010
	6040	6090	6140	6180	6200
	6250	6300	6320	6350	6380
	6405	6420	6440	8710	8714
E	9301	9305	9312	9317	9323
	9327	9333	9337	9342	9346
E2	4050	8817	8824	8826	8828
	8832	8852	8882	8962	8992
	9072	9102	9212	9242	
E6	3980	4440	4655	4660	4720
	5540	6360	6940	7020	8540
ED	6400	9515			
ENTER	7390				
F	4040				
F1	3980	5920	5975	6020	6030
	6280	6370			
F2	3980	4202	4467	5090	5400
	6000	6602	6862	7240	7302
	8610	8705	8826		
F3	3980	5050	5110	5220	5230
	5260	5530	5650	5680	6900
	6910	6920	6930	7000	
F4	3980	6800	7410	8510	8600
	8620	8712	8760	8782	
F5	3980	5530	5550	5920	5975
	6280	6540	7306	7560	8786
	8842	9055	9282		
F6	3980	5230	5260	5290	5940
	6070	6100	6130	6170	6950
	7030	7090	7190	7306	7450
	7660	7740	7780	8788	8945
	9055	9282	9300	9349	

SYMBOL	REFERENCE LINE				
F7	3980	5530	5930	6050	6060
	6800	7010	7250	7560	7620
	8782	8824	8832	8852	8882
	8962	8992	9072	9102	9212
	9242				
F8	5882	5970	6800	7560	7620
	8520	8525	8580	8610	9280
	9349				
F9	3980	5230	5260	6800	8510
FNB2	4220	5150	8712		
FNB3	4380	4490	6020	8130	
FNB4	5110				
FNC2	6490	6630			
FNC3	4850	5210	7930		
FNC4	8772				
FND0	4718	4850	5040	5910	6630
	7930	8716	8776		
FND1	5660	5910	6580	6630	7430
	7720	7930	8716	8840	
FNF(	4122				
FNF0	5210	6490	8772		
FNJ(	4160				
FNJ0	4110				
FNJ1	4476				
FNJ2	4476				
FNJ3	4478				
FNJ4	4478				
FNJ5	4478				
FNJ6	4478	4500			
FNJ9	5110	8716			
FNN0	6260				
FNN1	4220	4490	5110		
FNNA3	6410	9530			
FNNC2	6330				
FNNC3	6310				
FNNC8	4400	6430			
FNNC9	4420	6450			
FNNE6	4440	6360			
FNNF1	6020				
FNNF4	8712				

SYMBOL	REFERENCE LINE				
FNNF6	6100				
FNNF7	6050				
FNNH	4460	6390			
FNNI5	6210				
FNNM6	4714				
FNNN	5150	8716			
FNNN3	6190				
FNNN6	4380				
FNPO	8724	9070	9100		
FNP1	8850	8880			
FNP2	8960	8990			
FNP3	5720	7780	8776	8778	8780
	9210	9240			
FNPC3	6600	7750			
FNR2	4140				
FNR3	5900	6610	7150	7304	
FNS1	8772				
FNS10	8170				
FNS12	8290				
FNS2	4190	4330	5210	6490	7970
	8772	8790			
FNS3	4460	4850			
FNS4	4478				
FNS5	4500				
FNS6	4476	7890			
FNS8	4478	5600			
FNS9	4478				
FNV(	4140	4920	4960	5700	8080
FNV7	8020	8060	8070		
FNW	1000	4140			
FNX(	4140	5440	5480	7268	7290
	7740	7780			
FNX127	4716				
FNX32	4850				
FNX33	4880				
FNX66	5830	6740	8776	9240	
FNX67	6670	9210			
FNX75	5850				
FNX81	8840				

SYMBOL	REFERENCE LINE				
FNX82	8778				
FNX83	8780				
FNX84	8780				
G	4060				
H	3990	4035	4460	6390	8530
H$	3960	7308			
H$[	3970				
I	3990	4910	4920	4950	4970
	4990	5670	5750	7730	7751
	7752	7753	7754	7755	7756
	7781	7782	7783	7784	7785
	7786	7830	7874	7876	7877
	7879				
I5	3990	5950	6210	7070	7100
	7309	7340	7350	7480	
I6	3990	7180	7200	7340	7350
	7360	7370			
J	3990	7980	8080	8160	
J1	3990	7140	7260	7270	7280
	7290				
KEY	3920				
L$[	3970				
LGT(	5540	5850	6830	7756	7786
	7800	7870	9250		
LGTA3	6405	6830	7876	8545	9250
	9520				
M	3990	5640	5730	5760	5780
M0	8820	9270	9346		
M1	3990	6590	6690	6720	7710
	7770	7840	8820	8940	9050
	9160	9230	9302		
M2	3990	6590	6760	6790	7710
	7810	7850	7870	8820	9200
	9305				
M3	8820	8920	9312		
M4	8820	9030	9317		
M5	4716	7142	7262	7264	7266
	7268	8820	9140	9323	
M6	4070	4714	4715	7261	7264
	8820	9180	9327		

SYMBOL	REFERENCE LINE				
M7	8820	8900	9333		
M8	8820	9010	9337		
M9	8820	9120	9342		
FORMAT	5230	5260	5290	5530	5550
	6550	6800	6900	6910	6920
	6930	7000	7010	7090	7190
	7306	7410	7450	7560	7620
	7660	7950	8510	8520	8525
	8782	8800	8815	9280	9300
	9349				
MS[	3970				
M[	7751	7752	7753	7754	7755
	7756	7781	7782	7783	7784
	7785	7786	7876		
N	3990	5060	5150	5240	5270
	5670	5760	5770	5780	6590
	6650	6660	6810	6830	6850
	6862	7130	7230	7240	7300
	7420	8590	8716	8784	8830
	9282	9290	9301	9305	9310
	9312	9317	9320	9323	9327
	9330	9333	9337	9340	9342
	9346	9350			
N0	8820	9260	9290	9345	9346
N1	3990	6590	6680	6710	6720
	8820	8930	9040	9150	9220
	9290	9302	9310		
N2	3990	6590	6750	6780	6790
	8820	9190	9290	9305	9309
	9310				
N3	3990	5960	6190	6990	7730
	7840	7850	7860	7870	7874
	8820	8910	9290	9311	9312
	9320				
N4	8820	9020	9290	9316	9317
	9320				
N5	3990				
N6	3990	4380			
N7	8820	8890	9290	9332	9333
	9340				

SYMBOL	REFERENCE LINE				
N8	8820	9000	9290	9336	9337
	9340				
N9	8820	9110	9290	9341	9342
	9350				
NS[	3970				
N[	4022	4024	4405	4407	4655
	4720	6410	7308	8040	8070
	9530				
05	3990	8820	9130	9290	9322
	9323	9330			
06	3990	8820	9170	9290	9326
	9327	9330			
OF	4170	4230	8000		
P	4000	5200	5460	5500	5760
	5780	5820	5850	6600	6690
	6700	6760	6770	6820	6830
	6840	7630	7756	7780	7785
	7786	7789	7790	7800	7804
	7840	8724	8776	8784	8785
	8787	8850	8880	8890	8900
	8960	8990	9000	9010	9070
	9100	9110	9120	9210	9220
	9230	9250			
P$[	3970	4090	4180	4840	5030
	5880	7920	8570	8740	8770
	9510				
P0	4000	5200	5240	5270	5540
P1	4000	5460	5540	8778	8784
	8785	8908	8910	8920	9162
	9240	9250			
P2	4000	5500	5540	5560	6590
	6820	6830	6840	8780	8784
	8787	9018	9020	9030	9162
P3	4000				
P4	7750	7755	7756	7760	
P5	4000	5700	5720	5730	5740
P6	4000	7760	7770	7786	7790
	7800	7804			

SYMBOL	REFERENCE LINE				
Q	3900	3910	3920	3930	3940
	3963	3964	4000	4110	4122
	4140	4160	4170	4190	4220
	4230	4330	4469	4470	4476
	4478	4490	4500	4718	4850
	4880	5040	5210	5300	5440
	5480	5560	5600	5660	5830
	5850	5882	5910	6490	6580
	6630	6670	6740	7268	7290
	7304	7305	7307	7390	7720
	7740	7890	7930	7970	8060
	8080	8090	8110	8130	8170
	8290	8580	8726	8772	8790
	9162	9170	9180	9250	9260
	9270	9282	9290	9302	9310
Q0	4000	6230	6260	6280	6290
	7430				
Q1	4000	7307	8726	8860	8908
	8930	8940	8970	9018	9040
	9050	9080	9130	9140	9150
	9160	9302	9303	9304	9310
	9312	9313	9314	9320	9323
	9324	9325	9330	9333	9334
	9335	9340	9342	9343	9344
	9350				
Q2	4000	8860	8970	9080	9190
	9200	9305	9306	9307	9310
	9317	9318	9319	9320	9327
	9328	9329	9330	9337	9338
	9339	9340	9346	9347	9348
	9350				
Q3	4000	8908	9018	9130	9140
Q4	4000	6610	6620	6640	
R	0	3980	4130	4150	4200
	4350	4466	4530	4830	5020
	5080	5180	5620	5800	5870
	5990	6480	6880	7220	7690
	7910	8500	8560	9500	
R1	4000	7800	7810	7820	
R2	4000	7170	7322	7330	7340
	7570	7630	7850		
R5	4000	7170	7180	7322	7330
	7350	7360			
RES	3930	3969			

SYMBOL	REFERENCE LINE				
REWIND	3969				
S	4000	5240	5270	5470	5510
	5640	5780	6590	6720	6790
	6830	7480	7570	7670	7710
	7870	7871			
S1	4000	5470	5540	6590	
S2	4000	5510	5560	6590	
SFLAG	4100				
STANDARD	4204	6415			
STAT3	7303				
T	4080				
T0	4000	6340			
T1	4000	5900	6620	6640	
T2	4000				
T3	4000	7150	7400	7470	
T4	4000	7390	7400	7460	7470
V	4010	6830	7751	7781	
V1	4010	5640	5740	5780	6590
	6700	6720			
V2	4010	6590	6770	6790	7710
	7820	7870			
V7	4010	6830	7752	7782	
V8	4010	6830	7753	7783	
V9	4010	6830	7754	7784	
WRITE	5240	5270	5300	5540	5560
	6560	6830	6940	6960	6980
	6990	7020	7040	7060	7070
	7100	7200	7307	7309	7370
	7420	7460	7570	7630	7670
	7873	7876	7960	8530	8540
	8545	8784	8810	8816	9290
	9310	9320	9330	9340	9350
X	5230	5260	5290	6900	6930
	7000	7010	7090	7190	7306
	7410	7450	7560	7660	7950
	8510	8520	8525	8782	8815
X$	7308				
X$[	3970				

SYMBOL	REFERENCE LINE				
X2	4020				
X3	4020	7340	7380	7510	7520
	7530	7540	7590	610	
X4	4020	7480	7490	7500	7510
	7520	7530	7540	7590	7610
Z	4020	5820	5850		

LINES: 679 BYTES: 15308 SYMBOLS: 291 REFERENCES: 1370

```
                                  RUN
                                   |
                                   |
3700:      >-----------------  INITIALIZE
3805:                   SITE DATA(10=INT,5=EXT)?
                                   |
3920:                          LOAD KEYS
3940:                    MERGE X-SUBROUTINES
                                   |
4120:                       LOAD DATA, S,T,N
                                   |
4195:      (4520: FNQ1)  PRINTOUT SYSTEM DATA MATRIX
                                   |
4265:      SET UP PRGM CONSTANTS AND LINK NEXT PRGM
                                   |
                         (BEGIN LINKED PROGRAM)
```

8.6 A - LOADER computer listing

```
3700  REM this is TAPE version
3701  REM tape: 3754 GOTO 3790, 3790 REM "TASK...",*3795 F6=3,*3800 A$="REWORK"
3703  REM tape: 3805 DISP A$":SITE ;.... , 3825 Q3=Q3+Q0+F6/10+F4/100
3710  DIM A$[72],L$[50],B$[11]
3715  DIM B[2,2],C[3,3],F[6],G[3,3],MS[40,10],NS[26,11],SS[10,4]
3720  DIM TI[14,21],Y[6],ZI[1]
3725  R=101
3730  CFLAG 1
3750  CFLAG 9
3752  DISP "PRINT ALL ON (1=YES)";
3753  INPUT Q
3754  GOTO 3790
3755  DISP "DISK STORAGE(0=NO)";
3760  INPUT F7
3765  IF F7=0 THEN 3790
3770  SFLAG 1
3790  REM DISP "TASK(F6):1=SITE PREP,2=MEAS,3=REWORK,0=KEYBOARD LINK";
3792  F1=Q3=0
3795  F6=3
3800  A$="REWORK"
3805  DISP A$;"SITE DATA(10=INT,5=EXT)";
3810  INPUT Q0
3815  DISP "PRGM CONST CHANGE OPTION(0=NO)";
3820  INPUT F4
3825  Q3=Q3+Q0+F6/10+F4/100
3840  PRINT Q3
3915  IF F1=1 THEN 3960
3920  LOAD  KEY #(10-5*FLAG1),2
3940  MERGE #(10-5*FLAG1),4,50,50
3960  H$="NBS1A.09  LOADER  <D1-F0> T2-F0"
3970  DEG
3980  A=B6=B8=C3=E0=E2=E4=E6=E9=F1=F2=F3=F5=F8=H=L1=N=N7=P1=Z=0
3990  GOTO 4030
3995  R=102
4000  DEF FNJ(Q)
4010  GOTO Q OF 4210,4270
4015  F1=1
4020  GOTO 3725
4030  R=103
4040  N5=0
4050  REM  ARMY G/T,G,T
4065  Q3=RES
4070  Q=INTQ3
4075  F6=INT((Q3-Q)*10)
4080  F4=INT(100*Q3-10*INT(10*Q3))
4085  F7=1000*Q3-10*INT(100*Q3)
4120  LOAD  DATA #Q,6,S
4130  LOAD  DATA #Q,8,T
4150  LOAD  DATA #Q,10,N
```

```
4160  IF  NOT F4 THEN 4190
4170  DISP "RUN #";
4180  N[14,6]=FNB3+FNNN[14,6]
4190  R=104
4195  Q=FNQ3+FNC1+FNS1+FNQ1+FNS5
4200  IF  NOT F4 THEN 4260
4210  R=105
4212  DISP "CHANGE ANY PRGM CONST(1=YES)";
4220  Q=FNB4+FNNO
4230  IF Q=0 THEN 4260
4240  Q=FNQ2
4250  GOTO 4190
4260  R=106
4265  GOTO F6 OF 4310,4320,4470
4270  DISP "LINK:1=SITE PREP,2=MEAS,3=REWORK";
4280  INPUT F6
4300  GOTO 4260
4310  R=107
4315  LINK #(10-5*F7),12,3700,3700
4320  R=108
4325  REDIM F[2],Y[2],G[2,2],C[2,2]
4326  MAT M=ZER[40,10]
4330  A1=4
4335  B1=N=N7=X5=X6=0
4336  B6=0.008
4340  B5=N[5,6]=N[5,7]=N[5,8]=0.2
4350  B7=10*LGT(G/H9)
4360  C2=NO=U=Z=1
4370  E2=6
4380  E3=30/3600
4390  E5=6/3600
4395  E6=65
4400  E7=40.349
4405  M5=1
4410  N4=30
4420  R5=11
4422  Y=1.2
4426  N[6,1]=N[6,2]=N[6,3]=N[6,4]=H9
4430  CFLAG 1
4440  CFLAG 5
4460  LINK #(10-5*F7),(12+F6*F7),3700,3700
4470  R=109
4475  Q=5
4510  LINK #(10-5*F7),(12+F7*(F6+1)),50,50
4515  R=110
4520  DEF FNQ(Q)
4530  A$="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
4540  B$="1234567890 "
4550  GOTO Q OF 5290,5530,5710
4560  GOSUB 4580
4570  RETURN 0
```

```
4580  DISP "N DATA VIA 5=EXT CASS,10=INT CASS";
4590  INPUT Q
4610  MAT N=ZER[26,11]
4620  LOAD  DATA #Q,10,N
4630  RETURN
4650  A1=N[1,1]
4660  A2=N[1,2]
4670  A3=N[1,3]
4680  B=N[2,11]
4682  B0=N[2,10]
4700  B2=N[2,2]
4710  B3=N[2,3]
4720  B7=N[2,7]
4730  B8=N[2,8]
4740  B9=N[2,9]
4750  C=N[3,11]
4760  C0=N[3,10]
4770  C1=N[3,1]
4780  C2=N[3,2]
4790  C3=N[3,3]
4800  C4=N[3,4]
4810  C5=N[3,5]
4820  C6=N[3,6]
4830  C7=N[3,7]
4840  C8=N[3,8]
4850  C9=N[3,9]
4860  D=N[4,11]
4870  D0=N[4,10]
4880  D1=N[4,1]
4890  D2=N[4,2]
4900  D3=N[4,3]
4910  D4=N[4,4]
4920  D5=N[4,5]
4930  D8=N[4,8]
4940  D9=N[4,9]
4950  E=N[5,11]
4960  F=N[6,11]
4970  F0=N[6,10]
4980  F1=0
5000  G=N[7,11]
5010  G4=N[7,4]
5020  G5=N[7,5]
5030  G6=N[7,6]
5040  H=N[8,11]
5050  H1=N[8,1]
5060  H5=N[8,5]
5070  H9=N[8,9]
```

```
5080  L=N[12,11]
5090  L1=N[12,1]
5100  L5=N[12,5]
5110  L6=N[12,6]
5120  L7=N[12,7]
5130  L8=N[12,8]
5140  L9=N[12,9]
5150  M=N[13,11]
5160  N=N[14,11]
5170  N1=N[14,1]
5180  N2=N[14,2]
5190  N5=0
5200  N6=N[14,6]
5210  N7=N[14,7]
5215  Q3=N[15,3]
5220  T=N[20,11]
5230  W=N[23,11]
5240  TRANSFER T[9,1] TO P$
5250  RETURN
5290  Q=FNI5
5300  PRINT TAB31,"PROG CONSTS"
5310  A$="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
5320  Q1=0
5330  Q2=-10
5340  FOR I=1 TO 26
5350  FOR J=1 TO 11
5360  IF N[I,J]=0 THEN 5470
5370  Q1=Q1+1
5380  Q2=Q2+20
5390  IF Q2<55 THEN 5410
5400  Q2=10
5410  IF Q1#1 THEN 5440
5420  PRINT
5430  PRINT
5440  PRINT TABQ2,A$[I,I];B$[J,J];":";N[I,J];
5450  IF INT(Q1/3)-Q1/3 THEN 5470
5460  PRINT
5470  NEXT J
5480  Q2=-10
5490  Q1=0
5500  NEXT I
5510  Q=FNS2+FNI5
5520  RETURN 0
```

```
5530  R=111
5540  DISP "WHICH PROG  CONST (0=EXIT)";
5550  INPUT S$[1,2]
5560  IF S$[1,1]="0" THEN 5650
5570  I=POS(A$,S$[1,1])
5580  IF I=0 THEN 5540
5590  B$="1234567890 "
5600  J=POS(B$,S$[2,2])
5610  DISP "NEW VALUE: NOW";N[I,J];
5620  INPUT N[I,J]
5630  GOSUB 4650
5640  GOTO 5540
5650  R=112
5655  DISP "STORE N: 0=NO,5=EXT CASS,10=INT CASS";
5660  INPUT Q
5670  IF Q THEN 5690
5680  GOTO 5700
5690  STORE  DATA #Q,10,N
5700  RETURN 0
5710  GOSUB 4650
5720  RETURN 0
```

SYMBOL	REFERENCE LINE		
3725	4020		
3790	3765		
3960	3915		
4030	3990		
4190	4160	4250	
4260	4200	4230	4300
4580	4560		
4650	5630	5710	
5410	5390		
5440	5410		
5470	5360	5450	
5540	5580	5640	
5650	5560		
5690	5670		
5700	5680		
A	3980		
A$	4530	5310	5570
A$[	3710	5440	
A1	4330	4650	
A2	4660		
A3	4670		
B	4680		
B$	4540	5590	5600
B$[	3710	5440	
B0	4682		
B1	4335		
B2	4700		
B3	4710		
B5	4340		
B6	3980	4336	
B7	4350	4720	
B8	3980	4730	
B9	4740		
B[	3715		
C	4750		

SYMBOL	REFERENCE LINE				
C0	4760				
C1	4770				
C2	4360	4780			
C3	3980	4790			
C4	4800				
C5	4810				
C6	4820				
C7	4830				
C8	4840				
C9	4850				
CFLAG	3730	3750	4430	4440	
C[	3715	4325			
D	4860				
D0	4870				
D1	4880				
D2	4890				
D3	4900				
D4	4910				
D5	4920				
D8	4930				
D9	4940				
DEG	3970				
DISP	3752	3755	3790	3805	3815
	4170	4212	4270	4580	5540
	5610	5655			
E	4950				
E0	3980				
E2	3980	4370			
E3	4380				
E4	3980				
E5	4390				
E6	3980	4395			
E7	4400				
E9	3980				
F	4960				

SYMBOL	REFERENCE LINE				
F0	4970				
F1	3792	3915	3980	4015	4980
F2	3980				
F3	3980				
F4	3820	3825	4080	4160	4200
F5	3980				
F6	3795	3825	4075	4265	4280
	4460	4510			
F7	3760	3765	3825	4085	4315
	4460	4510			
F8	3980C				
FLAG1	3920	3940			
FNB3	4180				
FNB4	4220				
FNC1	4195				
FNI5	5290	5510			
FNJ(	4000				
FNNO	4220				
FNNN[	4180				
FNQ(	4520				
FNQ1	4195				
FNQ2	4240				
FNQ3	4195				
FNS1	4195				
FNS2	5510				
FNS5	4195				
F[	3715	4325			
G	4350	5000			
G4	5010				
G5	5020				
G6	5030				
G[	3715	4325			
H	3980	5040			
H$	3960				
H1	5050				

SYMBOL	REFERENCE LINE				
H5	5060				
H9	4350	4426	5070		
I	5340	5360	5440	5500	5570
	5580	5610	5620		
J	5350	5360	5440	5470	5600
	5610	5620			
KEY	3920				
L	5080				
L$[	3710				
L1	3980	5090			
L5	5100				
L6	5110				
L7	5120				
L8	5130				
L9	5140				
LGT(	4350				
LINK	4315	4460	4510		
M	4326	5150			
M5	4405				
MAT	4326	4610			
MS[	3715				
N	3980	4335	4610	5160	
NO	4360				
N1	5170				
N2	5180				
N4	4410				
N5	4040	5190			
N6	5200				
N7	3980	4335	5210		
NS[	3715				

SYMBOL	REFERENCE LINE				
N[	4180	4340	4426	4650	4660
	4670	4680	4682	4700	4710
	4720	4730	4740	4750	4760
	4770	4780	4790	4800	4810
	4820	4830	4840	4850	4860
	4870	4880	4890	4900	4910
	4920	4930	4940	4950	4960
	4970	5000	5010	5020	5030
	5040	5050	5060	5070	5080
	5090	5100	5110	5120	5130
	5140	5150	5160	5170	5180
	5200	5210	5215	5220	5230
	5360	5440	5610	5620	
OF	4010	4265	4550		
P$	5240				
P1	3980				
Q	3753	4000	4010	4070	4075
	4195	4220	4230	4240	4475
	4520	4550	4590	5290	
	5660	5670			
Q0	3810	3825			
Q1	5320	5370	5410	5450	5490
Q2	5330	5380	5390	5400	5480
Q3	3792	3825	3840	4065	4070
	4075	4080	4085	5215	
R	3725	3995	4030	4190	4210
	4260	4310	4320	4470	4515
	5530	5650			
R5	4420				
REDIM	4325				
RES	4065				
S$[	5550	5560	5570	5600	
SFLAG	3770				
SS[	3715				
STORE	5690				
T	5220				
T[	3720	5240			
TRANSFER	5240				
U	4360				
W	5230				
X5	4335				

SYMBOL	REFERENCE LINE	
X6	4335	
Y	4422	
Y[	3720	4325
Z	3980	4360
ZER[	4326	4610
ZI[	3720	

LINES: 209 BYTES: 4013 SYMBOLS: 161 REFERENCES: 363

8.8 B - SITE PREP flow chart

```
                                      LINK FROM LOADER
                                              |
                                              |    ----------------------------
                                                                               |
                                                                               |
3975:        >>-----   TRAP: RESTRT:0=REGULAR,1=ALL QUESTIONS?                 |
4005:                              SET FLAG F3 = 0, 1                          |
                                              |                                |
                                              |                                |
3725:        >--------           SITE INFORMATION UPDATE      <-------------
3730:        (4190: FNJ1)  update RUN#,DATE,SITE COORDINATES
3730:        (5190: FNJ2)  update FREQ,BW,ANT PARAMETERS
3730:        (5565: FNJ3)  update ANT POINTING ERROR
3730:        (5415: FNJ4)  update T,G/T,Ta,PWR RESP
3730:        (5685: FNJ5)  update TEMP, DEW PT
3730:        (4915: FNJ6)  update SUN/MOON ALMANAC DATA
                                              |
                                              |
3730:        (4450: FNJ7)  print SITE AND FLUX DATA
3730:        (5960: FNJ8)  calculate STAR FLUX at F
3730:        (6040: FNJ9)  print TYPICAL G/T VALUES AND ERRORS
                                              |
                                              |
3730:        (5740: FNJ10) store S, T, N
                                              |
                                              |
3730:        (6385: FNJ11) print ALTERNATE STAR ERRORS
3730:        (7570: FNJ12) print ELEVATION vs GMT
3732:                                 goto TRAP -------------------->3975:
```

```
3700 H$="NBS1B.30* SITE PREP  <D1-F12> T2-F12"
3705 DEG
3708 CFLAG 9
3710 A[3]=803
3715 A[4]=462
3717 B2=0.65
3718 F=7.5
3720 F2=0
3721 F3=1
3722 H9=200
3725 R=201
3730 Q=FNJ1+FNJ2+FNJ3+FNJ4+FNJ5+FNJ6+FNJ7+FNJ8+FNJ9+FNJ10+FNJ11+FNJ12
3732 GOTO 3975
3734 DEF FNG(Q)
3736 Q1=Q*SGNQ
3738 RETURN SGNQ*(INTQ1+(Q1-INTQ1)*0.6)
3740 R=202
3741 DEF FNH(Q)
3742 GOTO Q OF 3743,6065
3743 PRINT "  FREQ(MHz)","  G(dB)","  T(K)","G/T(dB/K)","G/Ta(dB/K)"
3744 FORMAT F7.0,4F15.2
3746 WRITE (15,3744)1000*F,10*LGTG,T,10*LGT(G/T),10*LGT(G/H9)
3747 RETURN 0
3748 DEF FNE(NO)
3750 REM <NBS 9913>
3755 E0=0
3760 E1=50*(1/K1-1)
3765 IF B<14 THEN 3780
3770 Q2=0
3775 GOTO 3795
3780 Q0=4.73*(5.9-BO)+5.39*SQR((5.9-BO)^2+0.479)
3785 Q1=(7.12-BO)/ABS(7.12-BO)*2.04*SQR((Q0/1.79)^2-1)
3790 Q2=0.15+0.354*(Q0+Q1)
3795 P1=2*SQR(Q2^2+13*D2^2)
3800 E2=((1-K2)*P1+D1)
3805 E3=(W/F/2E+03)^2*50
3810 E4=0.4*BO*BO/K1/K2/S[NO,4]/K8/K9
3815 Q2=60*D5*2.784/B
3820 E5=(1-(SIN(Q2*180/PI)/Q2)^2)*100
3825 E6=0.023*T[NO,11]
3830 Y=1+FNZNO*G/T
3835 Y5=Y/(Y-1)
3840 E7=SQR((C9*Y5)^2+A2^2)
3845 E8=100*D8*(1/K8-1)
3850 E9=100*D9*(1/K9-1)
3855 RETURN 0
```

```
3860  R=203
3865  DEF FNO(Q)
3870  DISP "( =NC)NOW: ";A$;
3875  INPUT L$
3880  IF L$=" " THEN 3890
3885  A$=L$
3890  RETURN 0
3892  DEF FNF(Q)
3893  GOTO Q OF 4170
3894  GOTO 4870
3895  R=204
3900  DEF FNJ(Q)
3905  GOTO Q OF 4190,5190,5565,5415,5685,4915,4450,5960,6040
3910  GOTO Q-9 OF 5740,6385,7570,6995
3913  GOTO 3975
3914  R=205
3915  DEF FNM(Q0)
3916  DISP "(deg)";
3918  Q3=FNNINT(SGNQ0*INTSQR(Q0^2))
3919  DISP "MIN";
3920  Q4=FNN(100*SGNQ0*FNG(Q0-Q3))
3923  RETURN SGNQ3*(ABSQ3+ABSQ4/60)
3925  DEF FNT(Q)
3930  FOR X1=1 TO X2
3935  J=A[X1]
3940  V=M[J,Q]
3942  IF M[J,10]<0.6 THEN 3965
3945  WRITE (15,6670)V*100;
3950  M[J,6]=M[J,6]+V*100
3955  M[J,7]=M[J,7]+(V*100)^2
3960  NEXT X1
3965  PRINT
3970  RETURN 0
3975  R=206
3977  F3=1
3978  L=15
3980  PRINT
3985  DISP "RESTRT:0=REGULAR,1=ALL QUESTIONS";
3990  Q=FNB2+FNNO
3995  GOTO Q OF 4005
4000  GOTO 3725
4005  R=207
4010  F3=0
4020  GOTO 3725
4170  R=211
4175  IF STAT10 >= 4 THEN 4185
4180  REWIND
4185  RETURN 0
```

```
4190  R=212
4195  E=T[14,9]+28125
4200  DISP "CHANGE RUN/DATE/SITE;1=YES";
4205  Q=FNB2+FNNO
4210  IF  NOT Q THEN 4445
4215  DISP "RUN NUMBER";
4220  N6=FNB3+FNNN6
4225  DISP "YEAR";
4230  A$=P$[9,12]
4235  Q=FNO5
4240  P$[9,12]=A$
4245  E1=VAL(A$)
4250  DISP "MONTH";
4255  A$=P$[4,6]
4260  Q=FNO5
4265  P$[4,6]=A$
4270  A$="JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC"
4275  E2=(POS(A$,P$[4,6])+2)/3
4280  IF E2=2/3 THEN 4250
4285  P$[4,6]=A$[3*E2-2,3*E2+1]
4290  DISP "DAY OF MONTH";
4295  A$=P$[7,8]
4300  Q=FNO5
4305  P$[7,8]=A$
4310  E3=VAL(A$)
4315  Q=(E1-1900)/4
4320  Q1=INTQ
4325  Q2=4*(Q-Q1)
4330  J=INT((Q2+3)/4)
4335  IF E2>2 THEN 4350
4340  J1=0
4345  GOTO 4355
4350  J1=1
4355  E=31*(E2-1)+E3+J1*(-INT((0.4*E2)+2.3)+1-J)+J+(Q2*365)+(4*Q1*365.25)
4360  T[14,9]=E-28125
4365  E5=E/365.25/4
4370  C6=0.030757*Q1+360.00627*4*(E5-INT(E5))+98.2162
4375  C6=C6/360
4380  C6=360*(C6-INTC6)
4385  DISP "DAY OF WEEK";
4390  A$=P$[1,3]
4395  Q=FNO9
4400  P$[1,3]=A$
4425  DISP "MEAS ID";
4430  A$=P$[13,40]
4435  Q=FNO9
4440  P$[13,40]=A$
4442  Q=FNFO
4445  RETURN 0
```

```
4450  R=213
4455  C=1900+(T[14,9]+28125)/365.25
4460  Q=FNS2+FNC3+FNI5+FNS1
4465  FORMAT 5X,"SITE: W. LONG",8X,"N. LAT",10X,"ALTITUDE",5X
4470  WRITE (15,4465)"GHA TO ARIES @ 0 GMT"
4475  FORMAT 3F13.3,2F16.3
4480  WRITE (15,4475)C4;" deg",C5;" deg",C0," km",C6;" deg"
4485  Q=FNS2+FNI5
4490  PRINT TAB34,"FLUX DATA"
4495  FORMAT F2.0,F8.0," +-",F5.1," %  @",F4.0," GHz",F4.0," TO",F3.0
4500  FORMAT F8.2,F8.3," +-",F6.3
4505  FORMAT F10.1,F7.2," +-",F5.2," %/Yr",F35.3," +-",F6.3," %/Yr"
4510  PRINT
4515  PRINT "    STAR"TAB17"FLUX in F.U."TAB40"RANGE(GHz) SIZE(min)";
4520  PRINT "  SPEC INDEX"
4525  FORMAT "    Epoch",8X,"Secular Decay",32X,"Secular Expansion"
4530  WRITE (15,4525)
4535  PRINT
4540  FOR I=1 TO N1
4545  TRANSFER T[I,1] TO S$
4550  WRITE (15,4495)I,"  ",S$,S[I,1],T[I,8]/10,T[I,18]/100,T[I,19],T[I,20],
4555  WRITE (15,4500)T[I,9]/100," ",T[I,6]/1000,T[I,7]/1000
4560  IF ABST[I,4]+ABST[I,15]+ABST[I,16]+ABST[I,17]=0 THEN 4580
4565  Q=T[I,5]/1000
4570  WRITE (15,4505)T[I,15]/10,T[I,16]/100,T[I,17]/100,T[I,4]/1000,Q
4575  PRINT
4580  IF I/3-INT(I/3)#0 THEN 4590
4585  PRINT
4590  NEXT I
4625  R=214
4630  Q=FNS2+FNI3
4635  PRINT TAB30,"LOCATION & MISC DATA"
4640  Q=FNS3
4645  FORMAT "  STAR EPOCH  (DAYS AFTER 1977.0)",9X
4650  WRITE (15,4645)"SOLAR EPOCH    (DAYS AFTER 1977.0)"
4655  FORMAT F11.3,F13.0,F27.3,F16.0
4660  Q=1900+(28125+T[14,9])/365.25
4665  Q1=1900+(28125+T[14,10])/365.25
4670  WRITE (15,4655)Q,T[14,9],Q1,T[14,10]
4675  Q=FNS2
4680  FORMAT 4X,"STAR:",6X,"RT.ASC",5X,"N. DEC.",9X,"LINEAR POLZ",12X
4685  WRITE (15,4680)"POLZ ANG"
4690  FORMAT 4X,"SOLAR:  GHA:0 GMT  @12 GMT   N.DEC:0 GMT  @12 GMT  @24 GMT "
4695  WRITE (15,4690)"  HOR PRLX  PHASE"
4700  Q=FNS1
```

```
4705  FOR I=1 TO N1
4710  TRANSFER T[I,1] TO S$[1,5]
4725  IF T[I,21]=0 THEN 4745
4730  FORMAT F2.0,F9.3," d.m",F9.3,F9.3," d.m"
4731  Q=S[I,2]+12*T[I,11]/1000
4732  IF Q<360 THEN 4735
4733  Q=Q-360
4735  WRITE (15,4730)I,"  ",S$,FNGS[I,2],FNGQ,FNGS[I,3],
4737  FORMAT 2F8.3,F8.3," d.m",F4.0," day"
4738  Q=FNG(S[I,3]+T[I,5]/1000)
4739  Q1=FNG(S[I,3]+T[I,12]/1000)
4740  WRITE (15,4737)Q1,Q,FNG(T[I,13]/1000),T[I,14]
4742  GOTO 4755
4745  FORMAT F2.0,F9.2," deg",F8.2," deg",F8.1,"   +-"
4747  WRITE (15,4745)I,"  ",S$,S[I,2],S[I,3],T[I,11]/10,
4750  FORMAT F7.1," %",F10.1,"   +-",F5.1," deg"
4752  WRITE (15,4750)T[I,12]/10,T[I,13]/10,T[I,14]/10
4755  IF I/3-INT(I/3)#0 THEN 4765
4760  PRINT
4765  NEXT I
4790  Q=FNS2+FNI3+FNS12
4795  RETURN 0
4800  R=215
4805  RESTORE
4810  READ T[14,9],S[1,2],S[2,2],S[3,2],S[4,2],S[1,3],S[2,3],S[3,3],S[4,3]
4815  DATA -730,350.578,299.654,83.256,83.515,58.6812,40.6516,21.9988,-5.4039
4820  E6=(E-28125-T[14,9])/365.25
4825  FOR I=1 TO N1
4830  IF T[I,21] THEN 4855
4835  Q=(0.012807229+5.5667917E-03*SINS[I,2]*TANS[I,3])*E6
4840  Q1=5.5667927E-03*COSS[I,2]*E6
4845  S[I,2]=S[I,2]+Q
4850  S[I,3]=S[I,3]+Q1
4855  NEXT I
4860  T[14,9]=E-28125
4865  GOTO 4450
4870  R=216
4875  DISP "SITE:W. LONG";
4880  C4=FNMC4
4885  DISP "SITE:N.LAT";
4890  C5=FNMC5
4895  DISP "SITE:ALT(KM)";
4900  C0=FNNC0
4905  RETURN 0
```

```
4915  R=217
4920  DISP "ENTER SUN/MOON ALMINAC DATA(1=YES)";
4925  Q=FNNO
4930  IF  NOT Q THEN 5175
4935  T[14,10]=T[12,10]
4940  SERROR Q,4945
4945  NO=5+FNS2
4950  PRINT "FOLLOWING INPUTS ARE IN 2 PARTS:1st=deg,2nd=min"
4955  PRINT "IF DEC IS South: enter deg and min NEGATIVE"
4960  Q=FNS1+FNB8
4965  TRANSFER T[NO,1] TO S$
4970  DISP S$[1,4];":GHA @ 0 GMT";
4975  S[NO,2]=FNMS[NO,2]
4995  DISP S$[1,4];":GHA @ 12 GMT";
4997  Q1=FNM(S[NO,2]+0.012*T[NO,11])
5020  IF Q1>S[NO,2] THEN 5030
5025  Q1=Q1+360
5030  T[NO,11]=1000*(Q1-S[NO,2])/12
5035  DISP "N.DEC @ 0 GMT";
5040  S[NO,3]=FNMS[NO,3]
5075  DISP "N.DEC @ 12 GMT";
5080  Q3=FNM(S[NO,3]+T[NO,12]/1000)
5110  T[NO,12]=1000*(Q3-S[NO,3])
5115  DISP "N.DEC @ 24 GMT";
5120  Q3=FNM(S[NO,3]+T[NO,5]/1000)
5144  T[NO,5]=1000*(Q3-S[NO,3])
5145  IF NO=5 THEN 5180
5150  DISP "HOR PARALLAX(min)";
5155  Q=FNN(100*FNG(T[NO,13]/1000))
5160  T[NO,13]=1000*(Q/60)
5165  DISP "AGE (DAYS)";
5170  T[NO,14]=FNNT[NO,14]
5175  RETURN 0
5180  NO=6
5185  GOTO 4965
5190  R=218
5192  IF F3 THEN 5225
5195  DISP "NEW F/BW/ELEV/ANT CONTS(1=YES)";
5200  Q=FNNO
5205  IF  NOT Q THEN 5410
5210  F1=0
5215  DISP "CENTER FREQ(GHZ)";
5220  F=FNNF
5225  C1=2.997925E+08^2/(8*PI*1.38054E-23*(F*10^9)^2)
5230  D0=0.9/F^2
5232  IF F3 THEN 5265
5235  DISP "ERR IN FREQ(%)";
5240  F0=FNNF0
5245  DISP "BANDWIDTH(MHZ)";
5250  W=FNNW
```

```
5255  DISP "ELEV(DEG)";
5260  L=FNNL
5265  DISP "ANT DIAM (FT)";
5270  D=FNND
5275  IF F3 THEN 5300
5277  DISP "1=APR EFF,2=ANT HPBW,3=CNVL HPBW";
5280  Q=FNNO
5285  GOTO Q OF 5290,5310,5350
5287  GOTO 5380
5290  DISP "APERTURE EFFICIENCY";
5295  B2=FNNB2
5300  BO=3035/D/F*SQR(B3/B2)
5305  GOTO 5325
5310  DISP "ANT HPBW(DEG)";
5315  Q=FNN(BO/60)
5320  BO=60*Q
5325  B=BO
5330  IF B>14 THEN 5380
5335  Q=4.248-1.1468*BO+0.10259*BO^2-0.0030247*BO^3
5340  B=BO+Q/(2.1468-0.20518*BO+0.0090741*BO^2)
5345  GOTO 5380
5350  DISP "CNVL HPBW(DEG)";
5355  Q=FNN(B/60)
5360  B=60*Q
5365  BO=B
5370  IF B>14 THEN 5380
5375  BO=-4.248+2.1468*B-0.10259*B^2+0.0030247*B^3
5380  B2=B3/(BO*D*F/3035)^2
5385  G=B2*(D*F/0.313)^2
5390  B9=2*C1*1.38054E-23*G
5395  BO=3035/D/F*SQR(B3/B2)
5397  IF F3 THEN 5410
5400  DISP "HPBW ERR(1S,%)";
5405  D2=FNND2
5410  RETURN 0
5415  R=219
5420  IF F3 THEN 5470
5435  DISP "CHANGE:1=G/T(dB); 2=T(K)";
5440  Q=FNNO
5445  GOTO Q OF 5470,5450
5447  GOTO 5515
5450  DISP "T(K)=";
5455  T=FNNT
5460  M=G/T
5465  GOTO 5515
```

```
5470  DISP "G/T(DB)=";
5475  Q=10*LGTM
5480  Q=FNNQ
5485  M=10^(Q/10)
5490  T=G/M
5495  IF F3 THEN 5560
5515  DISP "CHANGE:1=Ta, 2=G/Ta";
5520  Q=FNNO
5525  GOTO Q OF 5550,5530
5527  GOTO 5560
5530  DISP "G/TA(dB/K)";
5535  Q=FNN(10*LGT(G/H9))
5540  H9=G/10^(Q/10)
5545  GOTO 5560
5550  DISP "ADDED NOISE (K)";
5555  H9=FNNH9
5560  RETURN 0
5565  R=220
5567  IF F3 THEN 5635
5585  DISP "ANT PT ERR:1=DEG,2=%HPBW";
5590  Q=FNNO
5595  IF Q=0 THEN 5680
5600  IF Q=2 THEN 5615
5605  DISP "DEG";
5610  GOTO 5620
5615  DISP "% HPBW";
5620  D5=FNN(D5*(Q=1)+D5*6000/B0*(Q=2))
5625  IF Q=1 THEN 5635
5630  D5=D5*B0/6000
5635  Q2=60*D5*2.784/B
5640  E5=(1-(SIN(Q2*180/PI)/Q2)^2)*100
5645  H1=10*LGT(1+E5/100)
5647  IF F3 THEN 5680
5650  PRINT
5652  FORMAT "G/T data fit=",F8.5," DB"
5654  OUTPUT (A$,5652)H1
5655  PRINT "ANT PT ERR corresponds to ";A$
5660  PRINT
5665  DISP A$;":1=RETRY";
5670  Q1=FNNO
5675  IF Q1=1 THEN 5600
5680  RETURN 0
5685  R=221
5705  DISP "AMBIENT TEMP(F)";
5710  Q=FNN(A[3]/10)
5715  A[3]=Q*10
5720  DISP "DEW PT TEMP(F)";
5725  Q=FNN(A[4]/10)
5730  A[4]=10*Q
5735  RETURN 0
```

```
5740  R=222
5745  DISP "STORE S,T,N:0=NO,5=EXT,10=INT";
5750  Q=FNB2+FNNO
5755  IF  NOT Q THEN 5955
5760  N[1,1]=A1
5765  N[1,2]=A2
5770  N[2,11]=B
5772  N[2,10]=BO
5775  N[2,9]=B9
5780  N[3,1]=C1
5785  N[3,4]=C4
5790  N[3,5]=C5
5795  N[3,6]=C6
5800  N[3,10]=CO
5805  N[3,11]=C
5810  N[4,1]=D1
5815  N[4,2]=D2
5820  N[4,3]=D3
5825  N[4,10]=DO
5830  N[4,11]=D
5835  N[4,5]=D5
5840  N[6,11]=F
5845  N[7,11]=G
5850  N[7,4]=G4
5855  N[7,5]=G5
5860  N[7,6]=G6
5865  N[8,1]=H1
5870  N[8,9]=H9
5875  N[6,10]=FO
5880  N[12,5]=L5
5885  N[12,6]=L6
5890  N[12,7]=L7
5895  N[12,8]=L8
5900  N[12,9]=L9
5905  N[13,11]=M
5910  N[14,6]=N6
5920  N[20,11]=T
5925  N[23,11]=W
5930  STORE  DATA #Q,6,S
5935  TRANSFER P$ TO T[9,1]
5940  STORE  DATA #Q,8,T
5945  STORE  DATA #Q,10,N
5950  REWIND #Q
5952  GOTO 5745
5955  RETURN 0
```

```
5960  R=223
5965  MAT M=ZER[10,20]
5970  FOR I=1 TO N1
5975  Q=C-T[I,15]/10
5980  S=T[I,6]/1E+03+T[I,4]*Q/1E+05
5985  Q2=EXP(-T[I,16]/1E+04*Q)*S[I,1]*(F/T[I,18]*100)^S
5990  I5=S[I,1]+T[I,8]/10^3*S[I,1]
5992  Q4=(I#5)*(I#6)*T[I,5]/1E+05
5995  N=S+(((F/T[I,18]*100) >= 1)-(F/T[I,18]*100<1))*(T[I,7]/1E+03+Q4)
6000  N3=F+((N>0)-(N<0))*F0/100
6005  Q=EXP(-T[I,16]/1E+04*Q)*I5*(N3/T[I,18]*100)^N
6010  T[I,10]=(Q-Q2)/Q2*10^3
6015  S[I,4]=Q2
6020  M[I,1]=T[I,10]/10^3
6025  NEXT I
6030  SFLAG 1
6035  RETURN 0
6040  R=224
6045  L0=L
6050  N0=1
6055  Q=FNC(1)+FNS2
6060  PRINT TAB18,"TYPICAL VALUES for G/T MEASUREMENT using CAS A"
6062  GOTO 6090
6065  Q=FNS2
6070  FORMAT "ANT DIAM   ANT ELEV  APER EFF    RAD EFF    "
6075  WRITE (15,6070)"ANT HPBW      CONVL HPBW    EFF AREA"
6080  FORMAT F5.1,F7.1,F9.4,F10.2,F11.4," deg",F10.4," deg",F9.1," m^2"
6085  WRITE (15,6080)D," ft",L," deg",B2,B3,B0/60,B/60,B9
6086  RETURN 0
6090  Q=FNS2+FNH1+FNH2+FNS2
6095  FORMAT 8X,"PARAMETER",50X
6100  WRITE (15,6095)"ERR TO G/T"
6105  Q=FNI2+FNK1+FNE1
6110  WRITE (15,6275)"F   FREQUENCY (GHz)       ";F,F0,E0
6115  S=T[1,10]/10
6120  WRITE (15,6285)"S   FLUX (F.U.=10^(-26)W)";S[1,4],S,S
6125  FORMAT 10X,2F8.1
6130  WRITE (15,6125)"T(ant) =",(Y-1)*T," K"
6135  FORMAT 10X,2E10.3
6140  WRITE (15,6135)"Xi   =",(Y-1)*T/G," K"
6145  WRITE (15,6275)"Y   Y-FACTOR                ";Y,C8,C8*Y5
6150  WRITE (15,6220)"Y(dB) =",10*LGT(Y)," dB"
6155  FORMAT 16X,F6.1,2F6.2
6160  Q=SQR(E1*E1+E8*E8+E9*E9)
6165  Q=K1*K8*K9
6170  WRITE (15,6275)"K1  ATM ABSORPTION FACTOR";K1,E1,E1
6175  WRITE (15,6235)"oxygen attn=",G4*L4;" dB"
6180  WRITE (15,6235)"water attn =";G5*L5+G6*L6;" dB/gm*m^3"
```

```
6185  FORMAT 10X,2F5.1
6190  WRITE (15,6185)"water dens=";L7;" gm/m^3"
6195  WRITE (15,6185)"atm bright=";B4;" K"
6200  WRITE (15,6220)"site alt  =",C0," Km"
6210  WRITE (15,6185)"amb temp  ="A[3]/10," F"
6215  WRITE (15,6185)"dew point =",A[4]/10," F"
6220  FORMAT 10X,2F7.3
6225  WRITE (15,6305)"K8  DIFFUS+-";D8;"*(1/K8-1)";K8,E8,E8
6230  WRITE (15,6305)"K9  REFRAC+-";D9;"*(1/K9-1)";K9,E9,E9
6235  FORMAT 10X,2F7.4
6240  WRITE (15,6235)"1st const:";L8
6245  WRITE (15,6235)"2nd const:";L9
6250  WRITE (15,6275)"K2  STAR SHAPE  (CAS A)  ";K2,E2,E2
6255  FORMAT 10X,"+-(",F5.1,"*(1-K2)+",F4.1,"))%"
6260  WRITE (15,6255)P1,D1
6265  FORMAT 10X,"HPBW (+-",F5.2,"%)"
6270  WRITE (15,6265)D2
6275  FORMAT 5X,F11.3," +-",F6.2," %",15X,"+-",F6.2," %"
6280  WRITE (15,6275)"K3  BNDWD EFFECTS FACTOR ";K3,E3,E3
6285  FORMAT 5X,F11.1," +-",F6.2," %",15X,"+-",F6.2," %"
6290  PRINT "          bandwidth =";W;" MHz"
6295  FORMAT 10X,2F8.3
6300  Q2=T*(Y-1)
6305  FORMAT 5X,F5.2,F10.3," +-",F6.2," %",15X,"+-",F6.2," %"
6310  WRITE (15,6275)"K4  DIFF SYSTEM TEMP      ";K4,E4,E4
6315  FORMAT 5X,F7.4,F7.3," +-",F6.2," %",14X," +-",F6.2," %"
6320  WRITE (15,6315)"K5  ANT POINT(+-";D5;" deg) ";K5,E5,E5
6325  WRITE (15,6295)"or G/T data fit= +-",H1,"dB"
6330  WRITE (15,6275)"K6  ANT POLARIZATION FACT";K6,E6,E6
6335  WRITE (15,6275)"K7  SYSTEM RESPONSE FACT ";K7,E7,E7
6340  WRITE (15,6295)"instr pwr resp (+-",C9,"%)"
6345  WRITE (15,6295)"Y/(Y-1)=",Y5
6350  WRITE (15,6295)"gauss curve fit(+-",A2,"%)"
6355  WRITE (15,6285)"Ta  ADDED NOISE (K)       ";H9,D3,D3
6360  Q=FNI2
6365  FORMAT 5X,"TOTAL ERROR, quad sum + diffus & refr err",21X,"+-",F6.2," %"
6370  WRITE (15,6365)SQR(S^2+(C8*Y5)^2+E1^2+E2^2+E3^2+E4^2+E5^2+E6^2+E7^2)+E8+E9
6375  Q=FNS12
6380  RETURN 0
6385  R=225
6390  IF FLAG1 THEN 6400
6395  Q=FNJ8
6400  DISP "LIST ALTERNATE STARS(0=NO)";
6405  INPUT Q
6410  IF Q=0 THEN 6990
6415  Q=FNS2+FNC1+FNH1+FNH2+FNS3
6420  PRINT "    STAR"TAB14"FLUX in F.U.";TAB31;"T(ant)";
6425  PRINT TAB43;"K2";TAB50;"Y-factor";TAB62;"Y(dB)";
6430  FORMAT 6X,"Xi(K)"
6435  WRITE (15,6430)
```

```
6440  PRINT
6445  J=1
6450  FOR A=1 TO N1
6455  TRANSFER T[A,1] TO S$
6460  Q=1
6465  FORMAT F2.0,F8.0," +-",F5.1," %",F9.2," K",F8.3,F11.4,F8.2," DB",E12.3
6470  Q=FNEA
6475  M[A,2]=C8*Y5/100
6480  M[A,3]=E4/100
6485  M[A,4]=E2/100
6490  M[A,5]=E7/100
6495  Q2=(Y-1)*T
6496  M[A,10]=K2
6500  WRITE (15,6465)A,"  ",S$,S[A,4],T[A,10]/10,Q2;K2,Y,10*LGT(Y),Q2/G
6505  NEXT A
6510  Q=FNS4
6515  R=226
6520  N8=A[3]
6525  N9=A[4]
6530  A[1]=2
6535  A[2]=3
6540  A[3]=4
6545  A[4]=5
6550  A[5]=6
6555  X2=-1
6560  X2=X2+1
6565  IF X2=5 THEN 6575
6570  IF A[X2+1]#0 THEN 6560
6575  FORMAT 19X,"G/T or G/TA  MEASUREMENT ERRORS:  ELEV=",F5.1,"deg"
6580  WRITE (15,6575)L
6585  Q=FNE1
6590  FOR I=1 TO 5
6595  M[I,6]=M[I,7]=0
6600  NEXT I
6605  PRINT
6610  A[6]=25
6615  A[7]=35
6620  A[8]=45
6625  A[9]=55
6630  A[10]=65
6635  FOR X1=1 TO X2
6640  I=A[X1]
6645  TRANSFER T[I,1] TO S$
6650  PRINT TAB(A[X1+5]);S$;
6655  NEXT X1
6660  PRINT
```

```
6665  PRINT
6670  FORMAT F8.2," %",F8.2," %",F8.2," %",F8.2," %",F8.2," %",F8.2," %"
6675  PRINT "E-S   FLUX            ";
6680  Q=FNT1
6685  PRINT "E-F   FREQUENCY       ";
6690  Q=E0
6695  GOSUB 6705
6700  GOTO 6770
6705  FOR X1=1 TO X2
6710  WRITE (15,6670)Q;
6712  J=A[X1]
6715  M[J,6]=M[J,6]+Q
6720  M[J,7]=M[J,7]+Q^2
6725  NEXT X1
6730  PRINT
6735  RETURN
6740  FOR X1=1 TO X2
6745  I=A[X1]
6747  IF M[I,10]<0.6 THEN 6760
6750  WRITE (15,6670)M[I,6];
6755  NEXT X1
6760  PRINT
6765  RETURN
6770  PRINT "E-Y   Y-FACTOR        ";
6775  Q=FNT2
6780  GOTO 6815
6785  FOR X1=1 TO X2
6790  I=A[X1]
6792  IF M[I,10]<0.6 THEN 6800
6795  WRITE (15,6670)SQR(M[I,7]);
6800  NEXT X1
6805  PRINT
6810  RETURN
6815  PRINT "E-K1  ATM TRANS FACT ";
6820  Q=E1
6825  GOSUB 6705
6830  PRINT "E-K2  STAR SHAPE      ";
6835  Q=FNT4
6840  PRINT "E-K3  BNDWD EFFECTS   ";
6845  Q=E3
6850  GOSUB 6705
6855  PRINT "E-K4  DIFF SYST TEMP ";
6860  Q=FNT3
6865  PRINT "E-K5  ANTENNA POINT   ";
6870  Q=E5
6875  GOSUB 6705
6880  PRINT "E-K6  ANT POLARZ      ";
6885  Q=E6
6890  GOSUB 6705
6895  PRINT "E-K7  SYST RESPONSE   ";
6900  Q=FNT5
```

```
6905  PRINT "E-K8  ATM DIFFUS      ";
6910  Q=E8
6915  GOSUB 6705
6920  PRINT "E-K9  ATM REFAC       ";
6925  Q=E9
6930  GOSUB 6705
6935  PRINT "E-Ta   NOISE ADD      ";
6940  Q=D3
6945  GOSUB 6705
6950  Q=FNI(2)
6955  PRINT "TOTAL LINEAR SUM      ";
6960  GOSUB 6740
6965  PRINT "TOTAL QUADRATIC SUM   ";
6970  GOSUB 6785
6975  A[3]=N8
6980  A[4]=N9
6985  Q=FNS27
6990  RETURN 0
6995  R=227
7000  Q=FNQ2
7005  GOTO 3975
7010  R=228
7015  DEF FNQ(Q)
7020  A$="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
7025  B$="1234567890 "
7030  GOTO Q OF 7335,7465,7560
7035  A1=N[1,1]
7040  A2=N[1,2]
7045  A3=N[1,3]
7050  B=N[2,11]
7052  B0=N[2,10]
7055  B1=N[2,1]
7060  B2=N[2,2]
7065  B3=N[2,3]
7070  B7=N[2,7]
7075  B8=N[2,8]
7080  B9=N[2,9]
7085  C=N[3,11]
7090  C0=N[3,10]
7095  C1=N[3,1]
7100  C2=N[3,2]
7105  C3=N[3,3]
7110  C4=N[3,4]
7115  C5=N[3,5]
7120  C6=N[3,6]
7125  C7=N[3,7]
7130  C8=N[3,8]
7135  C9=N[3,9]
```

```
7140  D=N[4,11]
7145  D0=N[4,10]
7150  D1=N[4,1]
7155  D2=N[4,2]
7160  D3=N[4,3]
7165  D4=N[4,4]
7170  D5=N[4,5]
7175  D8=N[4,8]
7180  D9=N[4,9]
7185  F=N[6,11]
7190  F0=N[6,10]
7195  F1=0
7200  F9=N[6,9]
7205  G=N[7,11]
7210  G4=N[7,4]
7215  G5=N[7,5]
7220  G6=N[7,6]
7225  H=N[8,11]
7230  H1=N[8,1]
7235  H5=N[8,5]
7240  H9=N[8,9]
7245  L=N[12,11]
7250  L1=N[12,1]
7255  L5=N[12,5]
7260  L6=N[12,6]
7265  L7=N[12,7]
7270  L8=N[12,8]
7275  L9=N[12,9]
7280  M=N[13,11]
7285  N=N[14,11]
7290  N1=N[14,1]
7295  N5=0
7300  N6=N[14,6]
7305  N7=N[14,7]
7315  T=N[20,11]
7320  W=N[23,11]
7325  TRANSFER T[9,1] TO P$
7330  RETURN
7335  Q=FNI5
7340  PRINT TAB31,"PROG CONSTS"
7345  A$="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
7355  Q1=0
7360  Q2=-10
```

```
7365  FOR I=1 TO 26
7370  FOR J=1 TO 11
7375  IF N[I,J]=0 THEN 7435
7380  Q1=Q1+1
7385  Q2=Q2+20
7390  IF Q2<55 THEN 7400
7395  Q2=10
7400  IF Q1#1 THEN 7420
7405  PRINT
7410  PRINT
7420  PRINT TABQ2,A$[I,I];B$[J,J];":";N[I,J];
7425  IF INT(Q1/3)-Q1/3 THEN 7435
7430  PRINT
7435  NEXT J
7440  Q2=-10
7445  Q1=0
7450  NEXT I
7455  Q=FNS2+FNI5
7460  RETURN 0
7465  R=229
7470  DISP "WHICH PROG  CONST (0=STORE/EXIT)";
7475  INPUT S$[1,2]
7480  IF S$[1,1]="0" THEN 7525
7485  I=POS(A$,S$[1,1])
7490  IF I=0 THEN 7470
7495  B$="1234567890 "
7500  J=POS(B$,S$[2,2])
7505  DISP "NEW VALUE: NOW";N[I,J];
7510  INPUT N[I,J]
7515  Q=FNQ3
7520  GOTO 7470
7525  R=230
7530  DISP "STORE N: 0=NO,5=EXT CASS,10=INT CASS";
7535  Q=FNN10
7540  IF Q=0 THEN 7553
7545  STORE  DATA #Q,10,N
7550  GOTO 7525
7553  Q=FNQ1
7555  RETURN 0
7560  GOSUB 7035
7565  RETURN 0
7570  R=231
7575  DISP "ELEV vs GMT PRINT OUT(1=YES)";
7580  Q=FNB3+FNN0
7585  IF  NOT Q THEN 7780
7586  DISP "EL,AZ for 1=CAS,6=MOON";
7588  Q4=FNN1
7590  B1=H=0
7595  Q=FNS2+FNC3
7600  D$="#x+.so"
```

```
7605  FOR I=1 TO N1
7610  TRANSFER T[I,1] TO S$
7615  PRINT D$[I,I];" = ";S$,
7620  NEXT I
7622  TRANSFER T[Q4,1] TO S$
7625  PRINT
7630  FORMAT 27X,"SOURCE ELEV(deg)",/,/,F13.0,9F5.0
7635  WRITE (15,7630)0,10,20,30,40,50,60,70,80,90
7640  FORMAT 9"!....","! "
7645  OUTPUT (A$,7640)"",
7650  WRITE (15,7745)" GMT(hrs)   ",A$,S$,"   EL       AZ"
7655  E1=-0.5
7660  E1=E1+0.5
7665  IF E1>24 THEN 7760
7670  A$[1,63]=""
7675  A$[13,13]="!"
7680  A$[58,58]="!"
7685  FOR NO=N1 TO 1 STEP -1
7690  IF S[NO,2]=0 THEN 7715
7695  Q=FNANO
7696  IF NO#Q4 THEN 7700
7697  Q3=L
7698  Q5=A
7700  IF L<0 THEN 7715
7705  Q=L/2+13
7710  A$[Q,Q]=D$[NO,NO]
7715  NEXT NO
7720  FORMAT F4.0
7725  IF E1-INTE1 THEN 7740
7730  OUTPUT (A$[1,5],7720)E1,
7735  OUTPUT (A$[59,63],7720)E1,
7740  WRITE (15,7745)A$,
7745  FORMAT F7.2,F9.2
7750  WRITE (15,7745)Q3,Q5
7755  GOTO 7660
7760  A$[1,72]=""
7765  OUTPUT (A$[13],7640)"",
7770  WRITE (15,7745)A$
7775  Q=FNS3
7780  RETURN 0
9000  GOTO 9999
```

SYMBOL	REFERENCE LINE			
3725	4000	4020		
3780	3765			
3795	3775			
3890	3880			
3965	3942			
3975	3732	3913	7005	
4185	4175			
4250	4280			
4350	4335			
4355	4345			
4445	4210			
4450	4865			
4580	4560			
4590	4580			
4735	4732			
4745	4725			
4755	4742			
4765	4755			
4855	4830			
4870	3894			
4965	5185			
5030	5020			
5175	4930			
5180	5145			
5225	5192			
5265	5232			
5300	5275			
5325	5305			
5380	5287	5330	5345	5370
5410	5205	5397		
5470	5420			
5515	5447	5465		
5560	5495	5527	5545	
5600	5675			
5615	5600			

SYMBOL	REFERENCE LINE				
5620	5610				
5635	5567	5625			
5680	5595	5647			
5745	5952				
5955	5755				
6090	6062				
6400	6390				
6560	6570				
6575	6565				
6705	6695	6825	6850	6875	6890
	6915	6930	6945		
6740	6960				
6760	6747				
6770	6700				
6785	6970				
6800	6792				
6815	6780				
6990	6410				
7035	7560				
7400	7390				
7420	7400				
7435	7375	7425			
7470	7490	7520			
7525	7480	7550			
7553	7540				
7660	7755				
7700	7696				
7715	7690	7700			
7740	7725				
7760	7665				
7780	7585				
9999	9000				

SYMBOL	REFERENCE LINE				
A	6450	6455	6475	6480	6485
	6490	6496	6500	6505	7698
A$	3870	3885	4230	4240	4245
	4255	4265	4270	4275	4295
	4305	4310	4390	4400	4430
	4440	5654	5655	5665	7020
	7345	7485	7645	7650	7740
	7770				
A$[	4285	7420	7670	7675	7680
	7710	7730	7735	7760	7765
A1	5760	7035			
A2	3840	5765	6350	7040	
A3	7045				
A[	3710	3715	3935	5710	5715
	5725	5730	6210	6215	6520
	6525	6530	6535	6540	6545
	6550	6570	6610	6615	6620
	6625	6630	6640	6650	6712
	6745	6790	6975	6980	
B	3765	3815	5325	5330	5340
	5355	5360	5365	5370	5375
	5635	5770	6085	7050	
B$	7025	7495	7500		
B$[	7420				
BO	3780	3785	3810	5300	5315
	5320	5325	5335	5340	5365
	5375	5380	5395	5620	5630
	5772	6085	7052		
B1	7055	7590			
B2	3717	5295	5300	5380	5385
	5395	6085	7060		
B3	5300	5380	5395	6085	7065
B4	6195				
B7	7070				
B8	7075				
B9	5390	5775	6085	7080	
C	4455	5805	5975	7085	
CO	4480	4900	5800	6200	7090

SYMBOL	REFERENCE LINE				
C1	5225	5390	5780	7095	
C2	7100				
C3	7105				
C4	4480	4880	5785	7110	
C5	4480	4890	5790	7115	
C6	4370	4375	4380	4480	5795
	7120				
C7	7125				
C8	6145	6370	6475	7130	
C9	3840	6340	7135		
CFLAG	3708				
D	5270	5300	5380	5385	5395
	5830	6085	7140		
D$	7600				
D$[	7615	7710			
D0	5230	5825	7145		
D1	3800	5810	6260	7150	
D2	3795	5405	5815	6270	7155
D3	5820	6355	6940	7160	
D4	7165				
D5	3815	5620	5630	5635	5835
	6320	7170			
D8	3845	6225	7175		
D9	3850	6230	7180		
DEG	3705				
DISP	3870	3916	3919	3985	4200
	4215	4225	4250	4290	4385
	4425	4875	4885	4895	4920
	4970	4995	5035	5075	5115
	5150	5165	5195	5215	5235
	5245	5255	5265	5277	5290
	5310	5350	5400	5435	5450
	5470	5515	5530	5550	5585
	5605	5615	5665	5705	5720
	5745	6400	7470	7505	7530
	7575	7586			

SYMBOL	REFERENCE LINE				
E	4195	4355	4360	4365	
	4820	4860			
E0	3755	6110	6690		
E1	3760	4245	4315	6160	6170
	6370	6820	7655	7660	7665
	7725	7730	7735		
E1C	6135				
E12	6465				
E2	3800	4275	4280	4285	4335
	4355	6250	6370	6485	
E3	3805	4310	4355	6280	6370
	6845				
E4	3810	6310	6370	6480	
E5	3820	4365	4370	5640	5645
	6320	6370	6870		
E6	3825	4820	4835	4840	6330
	6370	6885			
E7	3840	6335	6370	6490	
E8	3845	6160	6225	6370	6910
E9	3850	6160	6230	6370	6925
F	3718	3746	3805	5220	5225
	5230	5300	5380	5385	5395
	5840	5985	5995	6000	6110
	7185				
F0	5240	5875	6000	6110	7190
F1	5210	7195			
F2	3720				
F3	3721	3977	4010	5192	
	5232	5275	5397	5420	5495
	5567	5647			
F9	7200				
FLAG1	6390				
FNANO	7695				
FNB2	3990	4205	5750		
FNB3	4220	7580			
FNB8	4960				
FNC(	6055				

SYMBOL	REFERENCE LINE				
FNC1	6415				
FNC3	4460	7595			
FNE(	3748				
FNE1	6105	6585			
FNEA	6470				
FNF(	3892				
FNFO	4442				
FNG(	3734	3920	4738	4739	4740
	5155				
FNGQ	4735				
FNGS[	4735				
FNH(	3741				
FNH1	6090	6415			
FNH2	6090	6415			
FNI(	6950				
FNI2	6105	6360			
FNI3	4630	4790			
FNI5	4460	4485	7335	7455	
FNJ(	3900				
FNJ1	3730				
FNJ10	3730				
FNJ11	3730				
FNJ12	3730				
FNJ2	3730				
FNJ3	3730				
FNJ4	3730				
FNJ5	3730				
FNJ6	3730				
FNJ7	3730				
FNJ8	3730	6395			
FNJ9	3730				
FNK1	6105				
FNM(	3915	4997	5080	5120	
FNMC4	4880				

SYMBOL	REFERENCE LINE				
FNMC5	4890				
FNMS[	4975	5040			
FNN(	3920	5155	5315	5355	5535
	5620	5710	5725		
FNNO	3990	4205	4925	5200	5280
	5440	5520	5590	5670	5750
	7580				
FNN1	7588				
FNN10	7535				
FNNB2	5295				
FNNCO	4900				
FNND	5270				
FNND2	5405				
FNNF	5220				
FNNFO	5240				
FNNH9	5555				
FNNINT(	3918				
FNNL	5260				
FNNN6	4220				
FNNQ	5480				
FNNT	5455				
FNNT[	5170				
FNNW	5250				
FNO(	3865				
FNO5	4235	4260	4300		
FNO9	4395	4435			
FNQ(	7015				
FNQ1	7553				
FNQ2	7000				
FNQ3	7515				
FNS1	4460	4700	4960		
FNS12	4790	6375			
FNS2	4460	4485	4630	4675	4790
	4945	6055	6065	6090	6415
	7455	7595			

SYMBOL	REFERENCE LINE				
FNS27	6985				
FNS3	4640	6415	7775		
FNS4	6510				
FNT(	3925				
FNT1	6680				
FNT2	6775				
FNT3	6860				
FNT4	6835				
FNT5	6900				
FNZNO	3830				
FORMAT	3744	4465	4475	4495	4500
	4505	4525	4645	4655	4680
	4690	4730	4737	4745	4750
	5652	5965	6070	6080	6095
	6125	6135	6155	6185	6220
	6235	6255	6265	6275	6285
	6295	6305	6315	6365	6430
	6465	6575	6670	7630	7640
	7720	7745			
G	3746	3830	5385	5390	5460
	5490	5535	5540	5845	6140
	6500	7205			
G4	5850	6175	7210		
G5	5855	6180	7215		
G6	5860	6180	7220		
H	7225	7590			
H$	0				
H1	5645	5654	5865	6325	7230
H5	7235				

SYMBOL	REFERENCE LINE				
H9	3722	3746	5535	5540	5555
	5870	6355	7240		
I	4540	4545	4550	4555	4560
	4565	4570	4580	4590	4705
	4710	4725	4731	4735	4738
	4739	4740	4747	4752	4755
	4765	4825	4830	4835	4840
	4845	4850	4855	5970	5975
	5980	5985	5990	5992	5995
	6005	6010	6015	6020	6025
	6590	6595	6600	6640	6645
	6745	6747	6750	6790	6792
	6795	7365	7375	7420	7450
	7485	7490	7505	7510	7605
	7610	7615	7620		
I5	5990	6005			
J	3935	3940	3942	3950	3955
	4330	4355	6445	6712	6715
	6720	7370	7375	7420	7435
	7500	7505	7510		
J1	4340	4350	4355		
K1	3760	3810	6165	6170	
K2	3800	3810	6250	6496	6500
K3	6280				
K4	6310				
K5	6320				
K6	6330				
K7	6335				
K8	3810	3845	6165	6225	
K9	3810	3850	6165	6230	
L	3978	5260	6045	6085	6580
	7245	7697	7700	7705	
L$	3875	3880	3885		
L0	6045				
L1	7250				
L4	6175				
L5	5880	6180	7255		
L6	5885	6180	7260		

SYMBOL	REFERENCE LINE				
L7	5890	6190	7265		
L8	5895	6240	7270		
L9	5900	6245	7275		
LGT(	3746	5535	5645	6150	6500
LGTG	3746				
LGTM	5475				
M	5460	5485	5490	5905	5965
	7280				
M[	3940	3942	3950	3955	6020
	6475	6480	6485	6490	6496
	6595	6715	6720	6747	6750
	6792	6795			
N	5995	6000	6005	7285	
NO	3748	3810	3825	4945	4965
	4975	4997	5020	5030	5040
	5080	5110	5120	5144	5145
	5155	5160	5170	5180	6050
	7685	7690	7696	7710	7715
N1	4540	4705	4825	5970	6450
	7290	7605	7685		
N3	6000	6005			
N5	7295				
N6	4220	5910	7300		
N7	7305				
N8	6520	6975			
N9	6525	6980			

SYMBOL	REFERENCE LINE				
N[	5760	5765	5770	5772	5775
	5780	5785	5790	5795	5800
	5805	5810	5815	5820	5825
	5830	5835	5840	5845	5850
	5855	5860	5865	5870	5875
	5880	5885	5890	5895	5900
	5905	5910	5920	5925	7035
	7040	7045	7050	7052	7055
	7060	7065	7070	7075	7080
	7085	7090	7095	7100	7105
	7110	7115	7120	7125	7130
	7135	7140	7145	7150	7155
	7160	7165	7170	7175	7180
	7185	7190	7200	7205	7210
	7215	7220	7225	7230	7235
	7240	7245	7250	7255	7260
	7265	7270	7275	7280	7285
	7290	7300	7305	7315	7320
	7375	7420	7505	7510	
P$	5935	7325			
P$[	4230	4240	4255	4265	4275
	4285	4295	4305	4390	4400
	4430	4440			
P1	3795	3800	6260		
PI	3820	5225	5640		
Q	3730	3734	3736	3738	3741
	3742	3865	3892	3893	3900
	3905	3910	3925	3940	3990
	3995	4205	4210	4235	4260
	4300	4315	4320	4325	4395
	4435	4442	4460	4485	4565
	4570	4630	4640	4660	4670
	4675	4700	4731	4732	4733
	4738	4740	4790	4835	4845
	4925	4930	4940	4960	5155
	5160	5200	5205	5280	5285
	5315	5320	5335	5340	5355
	5360	5440	5445	5475	5480
	5485	5520	5525	5535	5540
	5590	5595	5600	5620	5625
	5710	5715	5725	5730	5750
	5755	5950	5975	5980	5985

SYMBOL	REFERENCE LINE				
Q (con t)	6005	6010	6055	6065	6090
	6105	6160	6165	6360	6375
	6395	6405	6410	6415	6460
	6470	6510	6585	6680	6690
	6710	6715	6720	6775	6820
	6835	6845	6860	6870	6885
	6900	6910	6925	6940	6950
	6985	7000	7015	7030	7335
	7455	7515	7535	7540	7553
	7580	7585	7595	7695	7705
	7710	7775			
Q0	3780	3785	3790	3915	3918
	3920				
Q1	3736	3738	3785	3790	4320
	4325	4355	4370	4665	4670
	4739	4740	4840	4850	4997
	5020	5025	5030	5670	5675
	7355	7380	7400	7425	7445
Q2	3770	3790	3795	3815	3820
	4325	4330	4355	5635	5640
	5985	6010	6015	6300	6495
	6500	7360	7385	7390	7395
	7440				
Q3	3918	3920	3923	5080	5110
	5120	5144	7697	7750	
Q4	3920	3923	5992	5995	7588
	7622	7696			
Q5	7698	7750			
R	3725	3740	3860	3895	3914
	3975	4005	4170	4190	4450
	4625	4800	4870	4915	5190
	5415	5565	5685	5740	5960
	6040	6385	6515	6995	7010
	7465	7525	7570		
REWIND	4180	5950			
S	5980	5985	5995	6115	6120
	6370				
S$	4545	4550	4735	4747	4965
	6455	6500	6645	6650	7610
	7615	7622	7650		
S$[	4710	4970	4995	7475	7480
	7485	7500			

SYMBOL	REFERENCE LINE				
SERROR	4940				
SFLAG	6030				
STAT10	4175				
STORE	5930	5940	5945	7545	
S[	3810	4550	4731	4738	4739
	4747	4810	4835	4840	4845
	4850	4975	4997	5020	5030
	5040	5080	5110	5120	5144
	5985	5990	6015	6120	6500
	7690				
T	3746	3830	5455	5460	5490
	5920	6130	6140	6300	6495
	7315				
TRANSFER	4545	4710	4965	5935	6455
	6645	7325	7610	7622	
T[	3825	4195	4360	4455	4545
	4550	4555	4560	4565	4570
	4660	4665	4670	4710	4725
	4731	4738	4739	4740	4747
	4752	4810	4820	4830	4860
	4935	4965	4997	5030	5080
	5110	5120	5144	5155	5160
	5170	5935	5975	5980	5985
	5990	5992	5995	6005	6010
	6020	6115	6455	6500	6645
	7325	7610	7622		
V	3940	3945	3950	3955	
W	3805	5250	5925	6290	7320
WRITE	3746	3945	4470	4480	4530
	4550	4555	4570	4650	4670
	4685	4695	4735	4740	4747
	4752	6075	6085	6100	6110
	6120	6130	6140	6145	6150
	6170	6175	6180	6190	6195
	6200	6210	6215	6225	6230
	6240	6245	6250	6260	6270
	6280	6310	6320	6325	6330
	6335	6340	6345	6350	6355
	6370	6435	6500	6580	6710
	6750	6795	7635	7650	7740
	7750	7770			

SYMBOL	REFERENCE LINE				
X	4465	4525	4645	4680	4690
	6095	6125	6135	6155	6185
	6220	6235	6255	6265	6275
	6285	6295	6305	6315	6365
	6430	6575	7630		
X1	3930	3935	3960	6635	6640
	6650	6655	6705	6712	6725
	6740	6745	6755	6785	6790
	6800				
X2	3930	6555	6560	6565	6570
	6635	6705	6740	6785	
Y	3830	3835	6130	6140	6145
	6150	6300	6495	6500	
Y5	3835	3840	6145	6345	6370
	6475				
ZER[	5965				

LINES: 799 BYTES: 18385 SYMBOLS: 312 REFERENCES: 1618

8.11 C - MEAS flow chart

```
                                            LINK FROM LOADED
                                                   |
                                                   |
4700:          >>-------------------            ORSTRT
4705:                                           INITIALIZE
                                                   |
4790:          >>-----TRAP:  1SKY,   2G/T,   3EIRP,   4NEW TAPE,   ORSTRT
                              |       |       |          |           |
                             6205:   4815:   6530:     7550:       4700:



4815:          >>------------------            2G/T
4820:              (7765:  FNF1)  SELECT SOURCE, MAT A & D = ZER
4820:              (7415:  FNJ15) SELECT FREQUENCIES
4822:                                    #MEAS PTS (N4)?
4826:                                  #PTS IN FIT ZONE ?
                                                   |
4900:          >-------------------           NEW CUT
4910:                                      (NEXT) MEAS# ?
4960:              if NOT  -3 CUT  then  calc AZ, EL      ---------------->4975:
                                                   |                             |
4965:                                   SKY OFFSET (DEG)?                        |
                                                   |                             |
4975:          >-----------------           calc AZ, EL              <-----------
                                                   |
5015:              (4350:  FNM0)  input TEMP, DEW PT
                                                   |
5015:              (4350:  FNM1)  print METEOROLOGICAL DATA
5025:                            LABEL START CONDITIONS
                                                   |
5055:                                             GO?
                                                   |
5065:          >----------------            MEAS SEQUENCE
5085:                          print ELAPSED TIME, BIAS's
5122:                            meas info into MAT D, A
5190:              (150:   FND0)  initialize VTVM, PWR BRIDGE
5190:              (4520:  FNU1)  MEAS CHECK
                                                   |
5215:              (3810:  FNY0)  LABEL PLOT
                                                   |
5220:          >-------------------           NEXT N3                <-----------
5245:              (210:  FNPC3)  MEASURE POWER                                  |
5255:                                        PLOT MEAS                           |
5265:                        if  -3 CUT  then --->5410:  SKY STATS    ---->5220:
5270:                                   UPDATE STATISTICS                        |
5295:                        if  N3 < N4  then  NEXT N3     -------------->5220:
                                                   |
                                                   |
                                                 5300:
```

```
                                     |
5300:        >-----------------       POST CUT
5305:                     calc ANT HPBW, HR ANG BIAS, etc.
5360:                               PRINT RESULTS
5500:                      if  NOT LAST CUT  then  NEW CUT     --------->4900:
                                     |
5505:           >--------------     END OF SET
5510:                     calc  FIT, G/T, DECL BIAS, etc.
5595:                               PRINT RESULTS
                                     |
5765:           (5740: FNF4)          REMARKS?
                                     |
5785:                            PRINT STORE LABEL
5795:                               STORE DATA
6045:                               goto  2G/T     -------------------->4815:



6205:        >>-----------------          1SKY
6210:           (7730: FNF1)  SELECT SOURCE, MAT A & D = ZER
6210:           (7415: FNJ15) SELECT FREQUENCIES
6225:                      SKY:GMT(HRS);START,STOP,STEP?
6240:           (160:  FNDO)  INITIALIZE HARDWARE
6240:           (4350: FNMO)  input TEMP, DEW POINT
6240:           (4520: FNU1)  MEAS CHECK
6250:                                SET#?
6270:                               STEP GMT                        <-----
6275:                         calc & print  AZ, L    --->STOP TO SET ANT  |
6295:           (210: FNPC3)  MEAS POWER                                  |
6322:                              NEXT GMT     ------------------------->
                                     |
6330:           (4175: FNG-99)  calc STATISTICS
6346:           (7805: FNF2)    print  T/Ta
6410:                               goto TRAP      -------------------->4790:


6530:        >>----------------          3EIRP                 <----------
6535:                               INITIALIZE                            |
6570:                      RESET: RANGE, FILTER, etc.                     |
6760:                               PRINT HEADING                         |
6870:                                STEP N3               <---------  |
6890:           (210: FNPC3)  MEAS POWER                               |  |
6990:                      if  N3 < N4 then STEP N3    ----------->6870: |
                                     |                                    |
7025:                               PRINT RESULTS                         |
                                     |                                    |
7080:                           calc  C/kT, etc.                          |
                                     |                                    |
7345:                               PRINT RESULTS                         |
7410:                              goto  3EIRP     -------------------->6530:
```

```
7550:          >>----------------         NEW TAPE
7575:                          NEW TAPE IS O=MEAS, 1=BOTH?
7590:                                   RESET N,N7
7595:                                      RUN#?
7605:                         if  O=MEAS  then  ORSTRT       -------------->4700:
                                                 |
7610:                               RESET F4, MAT M = ZER
7620:                                    goto  TRAP     --------------------->4790:
```

```
3700  H$="NBS1C.47  MEAS  <D1-F14> T3-F12"
3710  E5=6/3600
3770  FORMAT "IF HARDWARE HANGS UP",/,/,"(1)STOP+STOP",/,"(2)KEY 0",/
3775  WRITE (15,3770)"(3)0 (RSTRT)"
3780  Q=FNS2+FNB8
3785  GOTO 4700
3790  DEF FNF(Q)
3800  GOTO Q OF 7730,7805,7825,5740
3805  GOTO 7765
3810  DEF FNY(N3)
3814  IF NO=6 THEN 3820
3815  Q=FNF3
3816  IF N2#-3 THEN 3820
3817  I5=I5/5
3818  R1=R1-25*I5
3820  IF N3 THEN 3990
3825  IF NO=6 THEN 3845
3830  X1=FNZ(NO)
3835  P=A[9]/10^4*EXP(D[T6,8]/10^4)
3840  GOTO 3855
3845  Q=FNKNO
3850  X1=200*K1/G
3855  Y=1+X1*G/T
3860  R1=T/H9
3865  I5=(Y-1)*R1/50
3870  IF N#-3 THEN 3880
3875  I5=I5/5
3880  FORMAT "ZERO LEVEL  100% LEVEL     Xi(K)      K     Y(DB)   T("
3885  WRITE (15,3880)S$[1,3];")  S(JN)    T      Ta"
3890  FORMAT F7.4,"*Ta",F9.4,"*Ta",E11.2,2F8.3,F8.1,F7.0,F7.1,2F8.1
3891  B$="#ox."
3892  FOR M5=1 TO N[5,11]
3893  Q=FNF3
3895  WRITE (15,3890)R1,Y*R1,X1,K,10*LGTY,X1*G,S[NO,4],T,N[6,M5];B$[M5,M5]
3896  NEXT M5
3900  PRINT
3905  PRINT
3910  FOR I=0 TO 5
3915  PRINT TAB(10*I+5),
3920  IF N2=-3 OR NO=0 THEN 3935
3925  PRINT 20*I;
3930  GOTO 3940
3935  PRINT 4*I-10;
3940  NEXT I
```

```
3945  PRINT "(%)"
3950  FORMAT 10"!....","!"
3955  A$=""
3960  OUTPUT (A$,3950)"",
3965  FORMAT "N3/sec"
3970  WRITE (15,3965)A$;"  PWR#1   PWR#2  P/Pa"
3975  IF N2>-3 THEN 3985
3980  R1=R1-25*I5
3985  GOTO 4120
3990  Q=INT((P-R1)/I5+0.5)+7
3995  P=INT(10^5*P+0.5)/10^5
4000  IF ABS(N3-S3)>R5/2 OR N3=S3 THEN 4020
4005  N3=-N3
4010  B$="#ox."
4015  GOTO 4025
4020  B$=">>>>"
4022  IF N3=S3 THEN 4025
4024  B$="#ox."
4025  Q2=0
4030  A$=""
4035  A$[1,72]=""
4040  A$[32,32]="!"
4045  FORMAT F3.0
4050  FORMAT F8.4
4055  OUTPUT (A$[1,3],4045)N3,
4057  OUTPUT (A$[4,6],4045)(T2-INTT2)*100,
4058  IF C3=3 THEN 4070
4060  OUTPUT (A$[57,64],4050)5*V8*(2*V-V8),
4065  OUTPUT (A$[65,72],4050)5*V9*(2*V-V8),
4070  IF Q<1 OR Q>68 THEN 4080
4075  A$[Q,Q]=B$[M5,M5]
4080  WRITE (15,4045)A$;
4085  N3=ABSN3
4090  FORMAT F9.5
4095  WRITE (15,4090)P
4100  IF N3<N4 THEN 4120
4105  A$=""
4110  OUTPUT (A$,3950)"",
4115  PRINT TAB6;A$
4120  RETURN Q
4125  DEF FNT(I)
4135  Q=FNR3
4140  Q=INT(100*Q)/3600-100*INT(Q/10^4)-2/3*INT(Q/100)-INTQ/90
4145  IF FLAG5 THEN 4160
4150  T1=Q
4155  SFLAG 5
4160  IF I#1 THEN 4170
4165  E1=Q+E3+N4*E5/2+(Q<T1)*24
```

```
4170  RETURN Q+(Q<T1)*24
4175  DEF FNG(Q)
4190  IF Q=-99 THEN 4260
4195  IF Q>0 THEN 4205
4200  M1=M2=M3=N9=V1=V2=V3=V4=V5=V6=0
4205  N9=N9+1
4210  M1=M1+X2
4215  M2=M2+X
4220  M3=M3+P
4225  V1=V1+X2^2
4230  V2=V2+X^2
4235  V3=V3+X*X2
4240  V4=V4+P*X2
4245  V5=V5+P*X
4250  V6=V6+P^2
4255  GOTO 4340
4260  G[1,1]=V1-M1^2/N9
4265  G[1,2]=G[2,1]=V3-M1*M2/N9
4270  G[2,2]=V2-M2^2/N9
4275  MAT C=INV(G)
4280  Y[1]=V4-M1*M3/N9
4285  Y[2]=V5-M2*M3/N9
4290  V6=V6-M3^2/N9
4295  MAT F=C*Y
4300  X2=(M3-F[1]*M1-F[2]*M2)/N9
4305  V4=1/(4*F[1])
4310  V5=-2*V4*F[2]
4315  Q=X2-V5^2/4/V4
4320  R2=V6-F[1]*Y[1]-F[2]*Y[2]
4322  IF R2>0 THEN 4325
4323  R2=0
4325  W1=SQR(R2/(N9-2))/Q
4330  IF V4*(Z-Q) <= 0 THEN 4340
4335  BO=SQR(8.7*V4*(Z-Q))*N4*E5/2/E8
4340  RETURN Q
4350  DEF FNM(Q)
4360  GOTO Q OF 4465,4505
4365  IF F3=0 THEN 4410
4370  DISP "TEMP(F)";
4375  Q=FNB3+FNN(A[3]/10)
4380  A[3]=10*Q
4385  DISP "REL HUMID (%)";
4390  Q=FNN(A[5]/10)
4395  A[5]=10*Q
4400  A[4]=10*((A[3]/10)^0.78+LOG(A[5]/1000)/0.111)^1.282
4405  GOTO 4425
4410  A[3]=1000*(FNX110+FNX28+FNR2)
4415  A[4]=1000*(FNX109+FNR2)
4420  A[5]=1000*EXP(0.111*((A[4]/10)^0.78-(A[3]/10)^0.78))
```

```
4425  IF N2#-3 THEN 4460
4430  DISP "CLOUDS(0 TO 9=RAIN)";
4435  Q=FNB2+FNN(INT(A[6]/100))
4440  A[6]=100*Q
4445  DISP "WIND (MPH)";
4450  Q=FNNO
4455  A[6]=A[6]+Q
4460  RETURN 0
4465  FORMAT 5X,"TEMP       DEW PT.     REL HUMD      WATER DENS    "
4470  WRITE (15,4465)"CLOUD COVER    WIND"
4475  FORMAT F9.1," F",F10.1," F",F11.1," %",F10.1," gm/m^3",2F10.0," mph"
4480  Q=100*(A[6]/100-INT(A[6]/100))
4485  L7=256*EXP(0.111*(A[4]/10)^0.78)/(5*(A[3]/10-32)/9+273.16)
4490  WRITE (15,4475)A[3]/10,A[4]/10,A[5]/10,L7,INT(A[6]/100),Q
4495  PRINT
4500  RETURN 0
4505  DISP "TEMP/HUMD:0=AUTO,1=MANL";
4510  F3=FNB3+FNNF3
4515  RETURN 0
4520  DEF FNU(Q)
4530  I=C2
4535  E0=E2+FNX(63-E2)
4540  P=FNPC3
4545  IF E2#E0 THEN 4535
4546  IF C3#3 THEN 4550
4547  Q1=P/5
4550  A[7]=5000*Q1
4555  J=5*V9*(2*V-V9)*(C3#3)
4560  Q1=FNX66+FNP3+FNX67
4620  A[8]=-10^4*LGT(A[7]/1000/Q1/A3)
4625  FORMAT " BRG PWR   BRG PRW+a  PWR+a/STD?   STD     Ta#   "
4630  WRITE (15,4625)"MANL    PRGM    STD CK    FLTR"
4635  FORMAT F7.4,"mW",F9.4,"mW",F8.0,F11.4,3F6.0,"dB",F9.3,"dB",F5.0,/
4640  WRITE (15,4635)A[7]/1000,J,C2,A3,C3,E6,"dB",E2,A[8]/1000,A1
4642  Q=1000*J/A[7]+(C3=3)
4643  IF ABS(A[8])<30 THEN 4645
4644  DISP "STD CK ";
4645  IF E2>0 AND E2<11 AND Q<4 AND 1/Q<4 AND ABS(A[8])<30 THEN 4670
4650  DISP "NOT NORMAL(1=ADJT)";
4655  Q=FNB8+FNNO
4660  IF Q=0 THEN 4670
4665  Q=FND0+FND1+FNF0+FNJ6+FNJ18+FNJ9+FNS2+FNU1
4670  RETURN Q
4675  DEF FNJ(Q)
4685  GOTO Q OF 4900,6685,5505,7655,6115,7625,6100,6180,7535
4690  GOTO Q-9 OF 6075,5990,5945,6415,5835,7415,4822,6160,7520,5920
4695  GOTO 4790
```

```
4700  R=301
4705  DISP "SUM TAPE EXT, MEAS INT";
4710  Q=FNB4+FNN1
4735  F4=0
4740  DISP "SET ANT DELAY @ BRK PTS:NOW"FNR4"SEC(1=REREAD)";
4745  Q=FNB2+FNNO
4750  IF Q THEN 4740
4755  DISP "ADD 24hrs TO CLOCK READ(1=YES)";
4760  Q=FNNO
4765  CFLAG 5
4770  IF Q=0 THEN 4785
4775  SFLAG 5
4780  T1=24
4785  Q=FNDO+FNX69+FNB3+FNJ6+FNJ18+FNJ9+FNM2
4790  R=302
4795  DISP "1SKY,2G/T,3EIRP,4NEW TAPE,ORSTRT";
4800  F6=FNB2+FNN1
4805  GOTO F6 OF 6205,4815,6530,7550
4810  GOTO 4700
4815  R=303
4820  Q=FNF1+FNJ15
4822  DISP "# MEAS PTS";
4823  N4=FNNN4
4825  R=304
4826  DISP "# PTS IN FIT ZONE";
4830  R5=FNB4+FNNR5
4835  IF R5/2-INT(R5/2) THEN 4855
4840  R5=R5+1
4855  IF N4<68 THEN 4875
4860  DISP "ERR:#PTS>67";
4865  Q=FNB10+FNW2000
4870  GOTO 4822
4875  IF N4>R5 THEN 4900
4880  DISP "ERR: #MEAS<#FIT";
4885  Q=FNB10+FNW2000
4890  DISP
4895  GOTO 4822
```

```
4900  R=305
4905  N3=N9=0
4910  DISP "MEAS #";
4915  Q=FNB2+FNN(N+1)
4920  N=Q-1
4925  N=N+1
4930  N7=INT((N-1)/6)+1
4935  N8=N7+F4
4940  M[N8,10]=N6+N7/100
4945  N2=N+2-6*N7
4950  T6=N2+4
4955  B1=N2*B/240
4960  IF N2#-3 THEN 4975
4965  DISP "SKY OFFSET(DEG)";
4970  B1=FNB5+FNN2
4975  R=306
4980  E3=FNR4/3600
4985  S=FNT1
4990  A=FNA(N0)+X5
4992  M5=1
4995  L=L+X6+FNF3
5005  B9=2*C1*1.38054E-23*G
5010  R=307
5015  Q=FNM0+FNC2+FNM1+FNI3
5020  PRINT
5025  FORMAT "AZIMUTH     ELEV     MEAS    HPBW     TIME(HRS)     OFFSET     "
5030  WRITE (15,5025)"CUT  RUN  SET   N"
5035  FORMAT F7.2,F10.2,F5.0,"sec",F9.4,F12.5,F10.3,"deg",F6.0,3F5.0
5040  WRITE (15,5035)A,L,3600*E5,B/60,E1,B1,N2,N6,N7,N
5044  PRINT
5045  FOR M5=1 TO N[5,11]
5048  Q=FNF2
5050  NEXT M5
5051  PRINT
5055  DISP "GO :1=NEW AZ,EL ";
5060  Q=FNB1+FNW300+FNB1+FNN0+FNS1
5065  R=308
5070  IF Q THEN 4975
5075  J=FNT2
5080  S3=(E1-J)/E5
5085  WAIT (S3-INT(S3))*E5*3.6E+06
5090  S3=INT(S3)
5095  FORMAT " ELAPSE     PEAK#   PTS EX   HR BIAS       "
5100  WRITE (15,5095)"DCL BIAS      AZ BIAS        EL BIAS"
5105  FORMAT F4.0,2F8.0,3F11.4,"deg",F11.4,"deg"
5110  WRITE (15,5105)(J-S)*3600,"sec",S3,INT((E3+S-J)/E5),H,"deg",L1,"deg",X5,X6
5115  V1=M1=0
5120  Q=FNS2
```

```
5122  FOR I=1 TO 4
5123  D[I,75]=1000*N[5,I]
5124  NEXT I
5125  D[5,75]=N[5,11]
5126  D[6,75]=3600*E5
5130  D[T6,1]=(A-180)*100
5135  D[T6,2]=L*100
5140  D[T6,3]=N4
5145  Q=E1
5150  IF E1<32 THEN 5160
5155  Q=E1-24
5160  D[T6,4]=Q*1000
5165  D[T6,5]=(B1+L1)*1000
5170  A[1]=N7+100*N6
5175  A[2]=1000*F
5176  A[10]=1000*C0
5180  R=309
5185  IF N2#-3 THEN 5210
5190  Q=FND0+FND1+FNU1
5195  P=FNX127+FNPC3
5196  IF P<0.327 THEN 5200
5197  P=0.327
5200  A[9]=P*10^5
5205  U=A[9]/10^4
5206  T9=E2
5210  R=310
5212  M5=1
5215  Q=FNY0+FND1
5220  R=311
5225  N3=N3+1
5226  M5=N3-N[5,11]*(INT((N3-1)/N[5,11]))
5230  T2=FNR3
5232  E2=T9
5235  IF FNR3=T2 THEN 5235
5240  IF INT(T2/0.02)-T2/0.02 THEN 5230
5245  P=FNX(128-M5)+FNPC3
5246  IF P>0 AND ABSLOG(P/U)<3.27 THEN 5250
5247  PRINT "BAD PT:P,U=";P;U
5248  GOTO 5260
5250  D[T6,N3+7]=LOG(P/U)*10^4
5255  Q=FNY(N3)
5260  R=312
5265  IF N2=-3 THEN 5410
5270  Q1=N3-S3+R5/2+0.5
5275  X=2*(N3-S3)/N4
5280  X2=X^2
5285  IF Q1<1 OR Q1>R5 OR M5#1 THEN 5295
5290  Q=FNGN9
5295  IF N3<N4 THEN 5220
```

```
5300  R=313
5302  D[2,73]=1E+04*(T2/100-T2/100)
5303  PRINT TAB26,T2
5305  P=FNG(-99)
5310  D[T6,3]=N4
5315  D[T6,6]=LOG(P/U)*10^4
5320  Q0=H-V5*N4*E5/2/E8
5325  D[T6,7]=100*(S3+V5*N4/2)
5330  IF N2#0 THEN 5350
5335  M[N8,1]=INT(10*L+0.5)/10+N0/100
5340  M[N8,6]=F
5345  M[N8,4]=B0
5350  Q=1
5355  PRINT
5360  FORMAT "#FIT    ANT HPBW       T("
5365  WRITE (15,5360)S$;")/Ta    HR ANG BIAS(fit)    PEAK#     LEVEL:    ";S$
5370  FORMAT F3.0,F10.3," deg",F10.4,"+-",F6.2,"%"
5375  WRITE (15,5370)N9,B0,P,100*W1,
5380  FORMAT F11.4," deg",F10.2,2F9.1
5381  M5=1+FNF3
5382  Q=D[T6,7]/100
5383  IF Q>(S3-R5/2) AND Q<(S3+R5/2) THEN 5391
5384  WRITE (15,5380)"    UNKNOWN"
5386  Q=FNS2
5387  PRINT TAB15,"increase HR BIAS if peak before PEAK# (try 0.01deg/pt)"
5389  GOTO 5392
5391  WRITE (15,5380)Q0,Q,100*(P-R1)/R1/(Y-1);"%"
5392  D[T6,7]=100*S3
5394  Q=FNS4
5400  PRINT TAB20,"decrease DECL BIAS if 1st cut too deep"
5405  GOTO 5490
5410  R=314
5411  IF N3>1 THEN 5415
5412  V1=M1=M[N8,1]=M[N8,2]=M[N8,3]=M[N8,4]=M[N8,5]=M[N8,6]=M[N8,7]=M[N8,8]=0
5413  M[N8,5]=P
5414  GOTO 5425
5415  M[N8,M5]=M[N8,M5]+P-M[N8,5]
5420  M[N8,M5+5]=M[N8,M5+5]+(P-M[N8,5])^2
5425  R=315
5430  IF N3<N4 THEN 5220
5440  PRINT
5445  PRINT
5450  FORMAT 9X,"T(SKY)/Ta",7X,"SIGMA",9X,"MEAN",8X,"#PTS",9X,"T",9X,":"
5451  WRITE (15,5450)S$
```

```
5455  FOR M5=1 TO N[5,11]
5457  M1=M[N8,M5]
5459  V1=M[N8,M5+5]
5460  D9=INT((N3+N[5,11]-M5)/N[5,11])
5461  Z=M[N8,5]+M1/D9
5463  B$="#ox."
5464  Q=100*SQR((V1-M1^2/D9)/(D9-1))/Z
5465  FORMAT F16.4,F14.2," %",F11.2," %",F9.0,2F13.1
5470  WRITE (15,5465)Z,Q,Q/SQR(D9-1),D9,Z*H9,"  "B$[M5,M5]
5480  IF N2#-3 THEN 5490
5482  N[5,5+M5]=Z-B6/SINL
5483  B5=N[5,6]
5484  D[2,74]=B6*10^5
5485  D[2+M5,74]=N[5,5+M5]*10^4
5487  Z=B5+B6/SINL
5489  NEXT M5
5490  Q=FNS5
5495  R=316
5500  IF N2<2 THEN 4900
5505  Q1=N9=0
5510  FOR J1=2 TO 6
5515  X=D[J1,5]/1000
5520  X2=X^2
5525  P=U*EXP(D[J1,6]/10^4)
5530  Q=FNGN9
5535  NEXT J1
5540  V7=FNG(-99)
5545  Y=V7/Z
5550  X1=FNZ(N0)
5555  Q4=K*S[N0,4]/2/1.38054E+03
5560  M[N8,8]=Q4/(Y-1)-B4/B9
5565  M[N8,9]=Q4/K1/(Y-1)-3/B9
5570  M=(Y-1)/X1
5575  M[N8,2]=10*LGTM
5580  Y=(V7+W1)/Z
5585  M[N8,3]=10*LGT((V7-Z)/X1)
5587  M[N8,5]=B0*E8/N4/E5*2
5590  M[N8,7]=V5
5595  R=317
5600  Q=FNC1+FNM1+FNI5+FNS1+INT(100*LGTG+0.5)/10
5605  PRINT TAB22,"BEST FIT FOR THE 5 CUTS  using  G=";Q;"dB"
5610  PRINT
5625  WRITE (15,5360)S$;")/Ta      DECL OFFSET   T/Ta     ELEV     RUN  SET"
5630  WRITE (15,5370)N9,M[N8,5],V7,100*W1;
5635  FORMAT F10.3," deg",F9.4,"K",F6.1,"deg",F4.0,F5.0
5640  WRITE (15,5635)V5,Z,M[N8,1],N6,N7
```

```
5645  Q=FNS2
5650  FORMAT 7X,"Ta via G/Ta",11X,"G/T",18X,"NEF",15X,"NUF",/,6F14.2
5655  Q=G/(10^(M[N8,3]/10))
5665  WRITE (15,5650)Q," K",M[N8,2]," dB/K",M[N8,8]," K/m^2",M[N8,9]," K/m^2"
5670  Q=FNS2+FNI5
5672  D[1,74]=LGT(V7-Z)*10^4
5675  PRINT TAB23,"100*(DATA-FIT)/(MAX dT(";S$;")/Ta)"
5680  PRINT
5685  FORMAT 10X,"CUT",5F10.0,/,F24.1,"%",5F9.1
5690  REDIM Y[5]
5695  FOR I=2 TO 6
5700  X=D[I,5]/1000
5705  P=U*EXP(D[I,6]/10^4)
5710  Y[I-1]=100*(P-(X-V5)^2/4/V4-V7)/(V7-Z)
5715  NEXT I
5720  WRITE (15,5685)-2,-1,0,1,2,Y[1],Y[2],"%",Y[3],"%",Y[4],"%",Y[5],"%"
5725  Q=FNS2
5730  REDIM Y[2]
5735  PRINT "TO REPLACE A CUT:(1) KEY 1 then (2) KEY 1up"
5736  GOTO 5765
5740  R=318
5745  PRINT
5750  DISP "REMARKS:";
5755  Q=FNB5
5760  INPUT A$
5761  D$=A$[1,25]
5762  E$=A$[26,33]
5764  RETURN 0
5765  R=318.1
5768  Q=FNS1+FNF4
5770  M[40,1]=M[40,1]+1
5775  Q=2*N7+12
5780  Q0=M[40,1]+8+F7*33
5785  FORMAT "STORE: INT FILE",F3.0,15X,"EXT FILE",F3.0,15X,"EXT SET#",F3.0,/
5790  WRITE (15,5785)Q,Q0,M[40,1]
5795  STORE  DATA Q
5800  STORE  DATA #5,Q0
5805  R=319
5810  IF N0=7 THEN 5820
5815  Q=FNJ13+FNS2
5820  IF F6=1 THEN 5830
5825  Q=FNS2+FNJ14
5830  GOTO 6035
5835  R=320
5840  PRINT "MAT D:"
5850  MAT PRINT D
5910  Q=FNS2
5915  RETURN 0
```

```
5920  R=321
5925  DISP "LAST MEAS(0=NO)";
5930  INPUT Q
5935  IF Q THEN 6055
5940  GOTO 4815
5945  R=322
5950  Q=1+17*F7
5955  Q1=Q+2
5960  FORMAT "EXT STORE:  M:",F3.0,10X,"N:",F3.0,/
5965  WRITE (15,5960)Q,Q1
5970  STORE  DATA #5,Q,M
5975  STORE  DATA #5,Q1,N
5980  REWIND #5
5985  RETURN 0
5990  R=323
6005  STORE 4,50,2670
6010  STORE  DATA 6,S
6015  STORE  DATA 8,T
6020  STORE  DATA 10,N
6022  STORE 12,3700
6025  REWIND
6030  RETURN 0
6035  R=324
6040  IF N7>24 OR M[40,1]>42 THEN 6052
6045  IF F6=1 THEN 4790
6050  GOTO 4805
6052  PRINT "MEAS/SUM TAPE FULL"
6055  Q=FNJ12+FNS1+FNJ11
6060  DISP " LIST PRGM & GO HOME!"
6070  END
6075  R=325
6076  DISP "RDY STORE SET";
6080  INPUT A$
6085  N=N7*6
6090  M[N8,1]=-N0/100
6095  GOTO 5765
6100  R=326
6101  FOR M5=1 TO N[5,11]
6103  DISP "Ta(K) #";M5;
6109  N[6,M5]=FNB2+FNNN[6,M5]
6110  NEXT M5
6112  GOTO 4900
6115  R=327
6116  DISP "HR ANG BIAS(DEG)";
6120  H=FNNH
6125  DISP "DECL BIAS(DEG)";
6130  L1=FNNL1
6135  DISP "AZ BIAS(DEG)";
6140  X5=FNNX5
```

```
6145  DISP "EL BIAS(DEG)";
6150  X6=FNNX6
6155  GOTO 4900
6160  R=328
6161  DISP "G/TA(dB)";
6165  B7=FNNB7
6170  H9=G/10^(B7/10)
6175  GOTO 4900
6180  R=329
6181  DISP "T/Ta @ 90";
6185  B5=FNNB5
6190  DISP "CSC COEF";
6195  B6=FNNB6
6200  GOTO 4900
6205  R=330
6210  Q=FNF1+FNJ15
6220  N9=X=0
6225  DISP "SKY:GMT(HRS);START,STOP,STEP";
6230  INPUT I5,N3,J1
6235  R=331
6240  Q=FND0+FND1+FNM0+FNC5+FNM1+FNI3+FNS2+FNU1
6245  Q=FNS2
6250  PRINT TAB30,"SET #";N7,S$
6255  Q=FNS2
6260  PRINT "AZ","EL","CSC L","GMT","T/Ta"
6265  PRINT
6270  FOR E1=I5 TO N3 STEP J1
6275  PRINT FNAN0,L;
6285  INPUT A$
6286  FOR M5=1 TO N[5,11]
6288  B$="#ox."
6290  E0=E2
6295  P=FNX(128-M5)+FNPC3
6300  IF E0-E2 THEN 6290
6305  PRINT TAB30,1/SINL,E1;B$[M5,M5],P
6308  IF M5#1 THEN 6322
6310  X=L
6315  X2=1/SINL
6320  Q=FNGN9
6322  NEXT M5
6323  PRINT
6325  NEXT E1
6330  Q=FNG(-99)
6335  B6=Y[1]/G[1,1]
6340  B5=N[5,6]=N[5,7]=N[5,8]=N[5,9]=(M3-B6*M1)/N9
6344  M5=1
6346  Q=FNS2+FNF2
6355  Q=FNS(38-2*N9+65*INT((2*N9+20)/65))
6360  R=332
6410  GOTO 4790
```

```
6415  R=333
6525  RETURN 0
6530  R=334
6535  NO=7
6540  N3=0
6545  E2=6
6550  H=L1=0
6555  S$="BIRD"
6560  MAT A=ZER
6565  MAT D=ZER
6570  R=335
6575  IF FLAG1=0 THEN 6595
6580  DISP "RESET MEAS(1=YES)";
6585  Q=FNNO
6590  IF Q#1 THEN 6685
6595  F9=F2=F5=Q5=E9=Z5=F8=Q6=0
6600  IF FLAG1=0 THEN 6630
6605  PRINT TAB15,"MEAS RESET"
6610  Q=FNS1+FNJ13+FNS2
6630  DISP "SLANT RANGE,10^3*Km";
6635  E7=FNNE7
6640  DISP "RCR GAIN SLOPE/MHz";
6645  P1=FNNP1
6650  DISP "AZ(DEG)";
6655  A=FNNA
6660  DISP "EL(DEG)";
6665  L=FNNL
6670  SFLAG 1
6675  E4=1
6680  Q=FNJ18
6685  R=336
6690  N3=0
6695  Q=FNFO+FNMO
6700  Q=FNX68+FNX67
6705  L$="CODE:0=SKY,1=-F, 2=RCR @ F, 3=+F,4=OTHER"
6710  DISP L$;
6715  B1=FNNB1+FNJ9+FNJ15+FNJ6
6720  T=(B5+B6/SINL)*H9
6725  DISP "# MEAS PTS";
6730  N4=FNB2+FNNN4
6735  IF N4<73 THEN 6765
6740  DISP "ERROR: #MEAS<73";
6745  Q=FNB7+FNW2000
6750  PRINT
6755  GOTO 6725
```

```
6760  R=337
6765  Q=FNC3+FNM1+FNI3+FNS3+FND0+FND1+FNU1+FNS2+FNK1
6770  PRINT TAB20,L$
6775  Q=FNS2
6780  FORMAT "   SLANT RANGE      AZIMUTH   ELEV      RCR F       BNDWD    "
6785  WRITE (15,6780)" CODE  RUN  SET"
6790  FORMAT E12.3,"Km",F12.2,F9.2,F11.4,F7.1," MZ",F8.0,2F5.0
6795  WRITE (15,6790)E7*1E+06,A,L,F,W,B1,N6,N7
6800  M1=M2=M3=N3=V1=V2=V3=0
6805  Q=FNS3
6810  FORMAT " FILTER#    NOISE BW     1st CONST      2nd CONST        "
6815  WRITE (15,6810)"GAIN SLOPE     EQIV BW"
6820  Q=15+INT(A1/2-0.5)
6825  Q0=1+5*(A1/2=INT(A1/2))
6830  W=N[Q,Q0]*(1+P1*N[Q,Q0+1]+P1^2*N[Q,Q0+2])
6835  FORMAT F5.0,F12.3," MHz",F10.4," MHz",F10.4,F11.4,F9.3," MHz"
6840  WRITE (15,6835)A1,N[Q,Q0],N[Q,Q0+1],N[Q,Q0+2]," MHz^2",P1,"/MHz",W
6845  Q=FNS3
6850  FORMAT "   N3      P/P(ADD)        PWR#1         PWR#2    MANUAL    "
6855  WRITE (15,6850)"PROG    TIME(HRS)"
6860  Q=FND1+FNS1
6865  R=338
6870  N3=N3+1
6875  E1=FNT1
6880  I=FNX100+FNX24+FNR2
6885  R5=E2
6890  P=FNPC3
6895  IF R5-E2 THEN 6885
6910  IF P>0 THEN 6925
6915  P=1
6925  Q=E1
6930  IF E1<32 THEN 6950
6935  Q=E1-24
6950  FORMAT F5.0,F13.5,2F13.2,F6.0," dB",F6.0," dB",F12.5
6955  IF Q0=0 THEN 6965
6965  Q1=5*Q1*10^((E2+E6)/10)
6970  Q3=5*Q3*10^((E2+E6)/10)
6975  WRITE (15,6950)N3,P,Q1,Q3,E6,E2,E1
6980  IF N3/3-INT(N3/3) THEN 6990
6985  PRINT
6990  R=339
6995  M1=M1+P
7000  M2=M2+Q1
7005  M3=M3+(Q3-Q1)
7010  V1=V1+P^2
7015  V2=V2+Q1^2
7020  V3=V3+(Q3-Q1)^2
```

```
7025  R=340
7030  IF N3<N4 THEN 6865
7035  Z=M1/N3+FNS3
7040  FORMAT "#PTS",10X,"P/P(ADD) ",13X,"PWR#1(mW)",10X,"(PWR#2-PWR#1)(mW)"
7045  WRITE (15,7040)"    CODE"
7050  FORMAT F3.0,F13.5," +-",F5.1,F13.5," +-",F5.1," %",F13.5," +-",F5.1,F6.0
7055  Q1=100*SQR((V1-M1^2/N3)/(N3-1))/M1*N3
7060  Q2=100*SQR((V2-M2^2/N3)/(N3-1))/M2*N3
7065  Q=100*SQR((V3-M3^2/N3)/(N3-1))/M3*N3
7070  WRITE (15,7050)N3,M1/N3,Q1," %",M2/N3,Q2,M3/N3,Q," %",B1
7075  Q=FNS(25-4*N4/3+65*INT((4*N4/3+36)/65))
7080  R=341
7085  GOTO B1 OF 7100,7120,7130
7090  F9=M1/N3
7095  GOTO 7195
7100  F2=M1/N3
7105  F5=M2/N3
7110  Q5=M3/N3
7115  GOTO 7195
7120  E9=M2/N3
7125  GOTO 7195
7130  Z5=M1/N3
7135  F8=M2/N3
7140  Q6=M3/N3
7195  IF M3>0 THEN 7240
7200  M3=N3
7240  B8=(F5+F8)/2
7245  Q7=(Q5+Q6)/2
7250  IF F5 AND F8 THEN 7270
7255  B8=F5+F8
7260  Q7=Q5+Q6
7270  Q=(F2+Z5)/2
7275  IF F2 AND Z5 THEN 7300
7280  Q=F2+Z5
7300  M[N8,8]=Q
7315  E=1
7318  F1=(4E+07*PI*E7*F/2.9979)^2
7320  IF B8=0 OR E9=0 THEN 7345
7330  E=(E9-B8)/Q7*1.38E-17*F1*W/J1/S
7335  M[N8,5]=10*LGT((E9/B8-1)*W*1E+06)
7345  R=342
7350  Q=FNC1+FNM1+FNI5+FNS1
7355  FORMAT F6.3,":K8",F9.3,":K9",F8.2,"dP(add)",F12.2,"*10^6:SR",F9.3,":BW"
7360  WRITE (15,7355)J1,S,B8,E7,W
7365  Q=FNS2
7370  FORMAT "SPACE LOSS     T/Ta     ONT/Ta   ONT/SNT   rcv EIRP*G/Ta    "
7375  WRITE (15,7370)" C/kT        RUN  SET"
```

```
7380 FORMAT F7.2," dB",3F10.4,F10.2," dBW",F11.2," dB ",2F5.0
7385 Q=0
7390 IF F9=0 THEN 7400
7395 Q=M[N8,8]/F9
7400 WRITE (15,7380)10*LGTF1,F9,M[N8,8],Q,10*LGTE,M[N8,5],N6,N7
7405 Q=FNS2+FNI5+FNF4
7410 GOTO 6035
7415 R=343
7417 DISP "NEW FREQS";
7418 Q=FNB2+FNNO
7420 IF Q=0 THEN 7500
7421 DISP "# of FREQS";
7422 N[5,11]=FNB2+FNNN[5,11]
7424 FOR M5=1 TO N[5,11]
7425 DISP "FREQ(MHz) #";M5;
7428 Q=FNB2+FNN(N[5,M5]*1000)
7430 N[5,M5]=Q/1000
7431 NEXT M5
7432 F=N[5,M5]
7434 IF Q/1000=F THEN 7415
7435 F=Q/1000
7445 C1=2.997925E+08^2/(8*PI*1.38054E-23*(F*10^9)^2)
7450 D0=0.9/F^2
7455 G=B2*(D*F/0.313)^2
7460 B9=2*C1*1.38054E-23*G
7465 B=4134/D/F
7470 FOR I=1 TO N1
7475 Q2=(1-T[I,16]/1E+04)^(C-T[I,15]/10)*S[I,1]*(F/T[I,18]*100)^(T[I,6]/1000)
7480 I5=S[I,1]+T[I,8]/1000*S[I,1]
7485 A=T[I,6]/1000+(((F/T[I,18]*100) >= 1)-(F/T[I,18]*100<1))*T[I,7]/1000
7490 N3=F+((A>0)-(A<0))*F0/100
7492 Q=(1-T[I,16]/1E+04)^(C-T[I,15]/10)*I5*(N3/T[I,18]*100)^A
7494 T[I,10]=(Q-Q2)/Q2*1000
7496 S[I,4]=Q2
7498 NEXT I
7500 IF N[5,11]=0 THEN 7415
7502 DISP "YOUR NAME( =NC,x13):  ";X$[8];
7504 INPUT A$
7506 IF A$[1,1]=" " THEN 7515
7508 X$[5,7]="by "
7510 X$[8]=A$
7515 RETURN 0
7520 R=344
7521 DISP "NOISE ADD:0=#1&#2,1=#1,2=#2,3=NO";
7525 C3=FNNC3
7530 RETURN 0
```

```
7535 R=345
7536 DISP "INSERT 5DB WHEN T(ADD)";
7540 C2=FNNC2
7545 RETURN 0
7550 R=346
7555 DISP "STORE PRGM(1=YES)";
7560 Q=FNN1
7565 IF Q=0 THEN 7575
7570 Q=FNJ11
7575 DISP "NEW TAPE IS:0=MEAS,1=BOTH";
7580 Q=FNNO
7590 N=N7=0
7595 DISP "RUN #";
7600 N[6,6]=N6=FNNN6
7602 IF Q THEN 7610
7605 GOTO 4735
7610 MAT M=ZER
7615 F4=0
7620 GOTO 4790
7625 R=347
7630 DISP "FLTR:1=2Ø30,2=1Ø70,3=2Ø70,4=5Ø70";
7635 A1=FNNA1
7640 DISP "INPUT ATTN(dB)";
7645 E6=FNNE6
7650 RETURN 0
7655 R=348
7656 DISP "STAR#";
7660 NO=FNNNO
7665 B1=0
7670 TRANSFER T[NO,1] TO S$
7675 FORMAT "AZ=",F7.2,"    EL=",F7.2,"    BIAS:HR,DLC,AZ,EL ",5F7.3
7680 E1=FNTO+3/3600
7685 WRITE (15,7675)FNANO+X5,L+X6,H,B1,X5,X6," "S$,
7690 DISP "AZ="A+X5"  EL="L+X6
7695 WAIT 2000
7700 PRINT
7705 GOTO 7680
7710 R=349
7730 R=350
7742 TRANSFER T[NO,1] TO S$
7743 Q=NO
7745 DISP ":MAT D=0)  SOURCE:";S$;
7750 NO=FNB3+FNNNO
7755 IF Q#NO THEN 7742
7756 MAT A=ZER
7757 MAT D=ZER[6,75]
7760 RETURN 0
7765 R=351
7770 DISP "STD(";INT(10^4*LGTA3)/1000;"dB)";
7775 Q=FNNA3
7780 IF Q=A3 THEN 7800
7785 A3=Q
7787 GOTO 7770
7800 RETURN 0
7805 R=352
7806 B$="#ox."
7810 FORMAT 22X,"T/Ta =",F7.4," +",F8.5,"*CSC L  ",F2.0
7815 WRITE (15,7810)N[5,5+M5],B6,B$[M5,M5]
7820 RETURN 0
7825 R=353
7830 T=(N[5,5+M5]+B6/SINL)*N[6,M5]
7835 R1=T/N[6,M5]
7840 I5=(Y-1)*R1/50*N[6,1]/N[6,M5]
7845 RETURN 0
9000 PRINT FNPO;
9100 GOTO 9000
```

SYMBOL	REFERENCE LINE			
3820	3814	3816		
3845	3825			
3855	3840			
3880	3870			
3935	3920			
3940	3930			
3985	3975			
3990	3820			
4020	4000			
4025	4015	4022		
4070	4058			
4080	4070			
4120	3985	4100		
4160	4145			
4170	4160			
4205	4195			
4260	4190			
4325	4322			
4340	4255	4330		
4410	4365			
4425	4405			
4460	4425			
4535	4545			
4550	4546			
4645	4643			
4670	4645	4660		
4700	3785	4810		
4735	7605			
4740	4750			
4785	4770			
4790	4695	6045	6410	7620
4805	6050			
4815	5940			
4822	4870	4895		
4855	4835			

SYMBOL	REFERENCE LINE				
4875	4855				
4900	4875	5500	6112	6155	6175
	6200				
4975	4960	5070			
5160	5150				
5200	5196				
5210	5185				
5220	5295	5430			
5230	5240				
5235	5235				
5250	5246				
5260	5248				
5295	5285				
5350	5330				
5391	5383				
5392	5389				
5410	5265				
5415	5411				
5425	5414				
5490	5405	5480			
5765	5736	6095			
5820	5810				
5830	5820				
6035	5830	7410			
6052	6040				
6055	5935				
6290	6300				
6322	6308				
6595	6575				
6630	6600				
6685	6590				
6725	6755				
6765	6735				
6865	7030				
6885	6895				
6925	6910				
6950	6930				

SYMBOL	REFERENCE LINE				
6965	6955				
6990	6980				
7195	7095	7115	7125		
7240	7195				
7270	7250				
7300	7275				
7345	7320				
7400	7390				
7415	7434	7500	7506	7512	
7515	7420				
7575	7565				
7610	7602				
7680	7705				
7742	7755				
7765	3805				
7770	7787				
7800	7780				
9000	9100				
A	4990	5040	5130	6560	6655
	6795	7485	7490	7492	7690
	7756				
A$	3955	3960	3970	4030	4080
	4105	4110	4115	5760	6080
	6285	7504	7510		
A$[	4035	4040	4055	4057	4060
	4065	4075	5761	5762	7506
A1	4640	6820	6825	6840	7635
A3	4620	4640	7780	7785	
A[	3835	4375	4380	4390	4395
	4400	4410	4415	4420	4435
	4440	4455	4480	4485	4490
	4550	4620	4640	4642	4643
	4645	5170	5175	5176	5200
	5205				
B	4955	5040	7465		
B$	3891	4010	4020	4024	5463
	6288	7806			
B$[	3895	4075	5470	6305	7815

SYMBOL	REFERENCE LINE				
O	4335	5345	5375	5587	
B1	4955	4970	5040	5165	6715
	6795	7070	7085	7665	7685
B2	7455				
B4	5560				
B5	5483	5487	6185	6340	6720
B6	5482	5484	5487	6195	6335
	6340	6720	7815	7830	
B7	6165	6170			
B8	7240	7255	7320	7330	7335
	7360				
B9	5005	5560	5565	7460	
C	4275	4295	7475	7492	
CO	5176				
C1	5005	7445	7460		
C2	4530	4640	7540		
C3	4058	4546	4555	4640	4642
	7525				
CFLAG	4765				
D	5850	6565	7455	7465	7757
D$	5761				
DO	7450				
D9	5460	5461	5464	5470	
DISP	4370	4385	4430	4445	4505
	4644	4650	4705	4740	4755
	4795	4822	4826	4860	4880
	4890	4910	4965	5055	5750
	5925	6060	6076	6103	6116
	6125	6135	6145	6161	6181
	6190	6225	6580	6630	6640
	6650	6660	6710	6725	6740
	7417	7421	7425	7502	7521
	7536	7555	7575	7595	7630
	7640	7656	7690	7745	7770
D[	3835	5123	5125	5126	5130
	5135	5140	5160	5165	5250
	5302	5310	5315	5325	5382
	5392	5484	5485	5515	5525
	5672	5700	5705		

SYMBOL	REFERENCE LINE				
E	7315	7330	7400		
E$	5762				
E0	4535	4545	6290	6300	
E1	4165	5040	5080	5145	5150
	5155	6270	6305	6325	6875
	6925	6930	6935	6975	7680
E2	4535	4545	4640	4645	5206
	5232	6290	6300	6545	6885
	6895	6965	6970	6975	
E3	4165	4980	5110		
E4	6675				
E5	3710	4165	4335	5040	5080
	5085	5110	5126	5320	5587
E6	4640	6965	6970	6975	7645
E7	6635	6795	7318	7360	
E8	4335	5320	5587		
E9	6595	7120	7320	7330	7335
F	4295	5175	5340	6795	7318
	7432	7434	7435	7445	7450
	7455	7465	7475	7485	7490
F0	7490				
F1	7318	7330			
F2	6595	7100	7270	7275	7280
	7810				
F3	4045	4365	4510	5370	5785
F4	4735	4935	7615		
F5	6595	7105	7240	7250	7255
F6	4800	4805	5035	5370	6045
F7	5780	5950			
F8	6595	7135	7240	7250	7255
F9	6595	7090	7390	7395	7400
FLAG1	6575	6600			
FLAG5	4145				
FNA(	4990				
FNANO	6275	7685			

SYMBOL	REFERENCE LINE				
FNB1	5060				
FNB10	4865	4885			
FNB2	4435	4745	4800	4915	6109
	6730	7418	7422	7428	
FNB3	4375	4510	4785	7750	
FNB4	4710	4830			
FNB5	4970	5755			
FNB7	6745				
FNB8	3780	4655			
FNC1	5600	7350			
FNC2	5015				
FNC3	6765				
FNC5	6240				
FND0	4665	4785	5190	6240	6765
FND1	4665	5190	5215	6240	6765
	6860				
FNF(	3790				
FNF0	4665	6695			
FNF1	4820	6210			
FNF2	5048	6346			
FNF3	3815	3893	4995	5381	
FNF4	5768	7405			
FNG(	4175	5305	5540	6330	
FNGN9	5290	5530	6320		
FNI3	5015	6240	6765		
FNI5	5600	5670	7350	7405	
FNJ(	4675				
FNJ11	6055	7570			
FNJ12	6055				
FNJ13	5815	6610			
FNJ14	5825				
FNJ15	4820	6210	6715		
FNJ18	4665	4785	6680		
FNJ6	4665	4785	6715		
FNJ9	4665	4785	6715		

SYMBOL	REFERENCE LINE				
FNK1	6765				
FNKNO	3845				
FNM(	4350				
FNMO	5015	6240	6695		
FNM1	5015	5600	6240	6765	7350
FNM2	4785				
FNN(	4375	4390	4435	4915	7428
FNNO	4450	4655	4745	4760	5060
	6585	7418	7580		
FNN1	4710	4800	7560		
FNN2	4970				
FNNA	6655				
FNNA1	7635				
FNNA3	7775				
FNNB1	6715				
FNNB5	6185				
FNNB6	6195				
FNNB7	6165				
FNNC2	7540				
FNNC3	7525				
FNNE6	7645				
FNNE7	6635				
FNNF3	4510				
FNNH	6120				
FNNL	6665				
FNNL1	6130				
FNNNO	7660	7750			
FNNN4	4823	6730			
FNNN6	7600				
FNNN[	6109	7422			
FNNP1	6645				
FNNR5	4830				
FNNX5	6140				
FNNX6	6150				

SYMBOL	REFERENCE LINE				
FNP0	9000				
FNP3	4560				
FNPC3	4540	5195	5245	6295	6890
FNR2	4410	4415	6880		
FNR3	4135	5230	5235		
FNR4	4740	4980			
FNS(	6355	7075			
FNS1	5060	5600	5768	6055	6610
	6860	7350			
FNS2	3780	4665	5120	5386	5645
	5670	5725	5815	5825	5910
	6240	6245	6255	6346	6610
	6765	6775	7365	7405	
FNS3	6765	6805	6845	7035	
FNS4	5394				
FNS5	5490				
FNT(	4125				
FNT0	7680				
FNT1	4985	6875			
FNT2	5075				
FNU(	4520				
FNU1	4665	5190	6240	6765	
FNW2000	4865	4885	6745		
FNW300	5060				
FNX(	4535	5245	6295		
FNX100	6880				
FNX109	4415				
FNX110	4410				
FNX127	5195				
FNX24	6880				
FNX28	4410				
FNX66	4560				
FNX67	4560	6700			
FNX68	6700				
FNX69	4785				
FNY(	3810	5255			
FNY0	5215				

SYMBOL	REFERENCE LINE				
FNZ(	3830	5550			
FORMAT	3770	3880	3890	3950	3965
	4045	4050	4090	4275	4295
	4465	4475	4625	4635	5025
	5035	5095	5105	5360	5370
	5380	5450	5465	5635	5650
	5685	5785	5850	5960	6560
	6565	6780	6790	6810	6835
	6850	6950	7040	7050	7355
	7370	7380	7610	7675	7756
	7757	7810			
F[	4300	4305	4310	4320	
G	3850	3855	3895	4275	5005
	5655	6170	7455	7460	
G[	4260	4265	4270	6335	
H	5110	5320	6120	6550	7685
H$	0				
H9	3860	5470	6170	6720	
I	3910	3915	3925	3935	3940
	4125	4160	4530	5122	5123
	5124	5695	5700	5705	5710
	5715	6880	7470	7475	7480
	7485	7492	7494	7496	7498
I5	3817	3818	3865	3875	3980
	3990	6230	6270	7480	7492
	7840				
INV(	4275				
J	4555	4640	4642	5075	5080
	5110				
J1	5510	5515	5525	5535	6230
	6270	7330	7360		
K	3895	5555			
K1	3850	5565			
L	4995	5040	5135	5335	5482
	5487	6275	6305	6310	6315
	6665	6720	6795	7685	7690
	7830				
L$	6705	6710	6770		
L1	5110	5165	6130	6550	
L7	4485	4490			

SYMBOL	REFERENCE LINE				
LGT(	4620	5585	5672	7335	
LGTA3	7770				
LGTE	7400				
LGTF1	7400				
LGTG	5600				
LGTM	5575				
LGTY	3895				
M	5570	7610			
M1	4200	4210	4260	4265	4280
	4300	5115	5412	5457	5461
	5464	6340	6800	6995	7035
	7055	7070	7090	7100	7130
M2	4200	4215	4265	4270	4285
	4300	6800	7000	7060	7070
	7105	7120	7135		
M3	4200	4220	4280	4285	4290
	4300	6340	6800	7005	7065
	7070	7110	7140	7195	7200
M5	3892	3895	3896	4075	4992
	5045	5050	5212	5226	5245
	5285	5381	5415	5420	5455
	5457	5459	5460	5470	5482
	5485	5489	6101	6103	6109
	6110	6286	6295	6305	6308
	6322	6344	7424	7425	7428
	7430	7431	7432	7815	7830
	7835	7840			
M[	4940	5335	5340	5345	5412
	5413	5415	5420	5457	5459
	5461	5560	5565	5575	5585
	5587	5590	5630	5640	5655
	5665	5770	5780	5790	6040
	6090	7300	7335	7395	7400
N	3870	4915	4920	4925	4930
	4945	5040	6085	7590	

SYMBOL	REFERENCE LINE				
N0	3814	3825	3830	3895	3920
	4990	5335	5550	5555	5810
	6090	6535	7660	7670	7742
	7743	7750	7755		
N1	7470				
N2	3816	3920	3975	4425	4945
	4950	4955	4960	5040	5185
	5265	5330	5480	5500	
N3	3810	3820	4000	4005	4022
	4055	4085	4100	4905	5225
	5226	5250	5255	5270	5275
	5295	5411	5430	5460	6230
	6270	6540	6690	6800	6870
	6975	6980	7030	7035	7055
	7060	7065	7070	7090	7100
	7105	7110	7120	7130	7135
	7140	7200	7490	7492	
N4	4100	4165	4335	4823	4855
	4875	5140	5275	5295	5310
	5320	5325	5430	5587	6730
	6735	7030	7075		
N6	4940	5040	5170	5640	6795
	7400	7600			
N7	4930	4935	4940	4945	5040
	5170	5640	5775	6040	6085
	6250	6795	7400	7590	
N8	4935	4940	5335	5340	5345
	5412	5413	5415	5420	5457
	5459	5461	5560	5565	5575
	5585	5587	5590	5630	5640
	5655	5665	6090	7300	7335
	7395	7400			
N9	4200	4205	4260	4265	4270
	4280	4285	4290	4300	4325
	4905	5375	5505	5630	6220
	6340	6355			
N[	3892	3895	5045	5123	5125
	5226	5455	5460	5482	5483
	5485	6101	6109	6286	6340
	6830	6840	7422	7424	7428
	7430	7432	7600	7815	7830
	7835	7840			
OF	3800	4360	4685	4690	4805
	7085	7419			

SYMBOL	REFERENCE LINE				
P	3835	3990	3995	4095	4220
	4240	4245	4250	4540	4547
	5195	5196	5197	5200	5245
	5246	5247	5250	5305	5315
	5375	5391	5413	5415	5420
	5525	5705	5710	6295	6305
	6890	6910	6915	6975	6995
	7010				
P1	6645	6830	6840		
PI	7318	7445			
Q	3780	3790	3800	3815	3845
	3893	3990	4070	4075	4120
	4135	4140	4150	4165	4170
	4175	4190	4195	4315	4325
	4330	4335	4340	4350	4360
	4375	4380	4390	4395	4435
	4440	4450	4455	4480	4490
	4520	4642	4645	4655	4660
	4665	4670	4675	4685	4690
	4710	4745	4750	4760	4770
	4785	4820	4865	4885	4915
	4920	5015	5048	5060	5070
	5120	5145	5155	5160	5190
	5215	5255	5290	5350	5382
	5383	5386	5391	5394	5464
	5470	5490	5530	5600	5605
	5645	5655	5665	5670	5725
	5755	5768	5775	5790	5815
	5825	5910	5930	5935	5950
	5955	5965	6055	6210	6240
	6245	6255	6320	6330	6346
	6355	6585	6590	6610	6680
	6695	6700	6745	6765	6775
	6805	6820	6830	6840	6845
	6860	6925	6935	7065	7070
	7075	7270	7280	7300	7350
	7365	7385	7395	7400	7405
	7418	7419	7428	7430	7434
	7435	7492	7494	7560	7565
	7570	7580	7602	7743	7755
	7775	7780	7785		
Q0	5320	5391	5780	5790	6825
	6830	6840	6955		
Q1	4547	4550	4560	4620	5270
	5285	5505	5955	5965	6965
	6975	7000	7005	7015	7020
	7055	7070			

SYMBOL	REFERENCE LINE				
Q2	4025	7060	7070	7475	7494
	7496				
Q3	6970	6975	7005	7020	
Q4	5555	5560	5565		
Q5	6595	7110	7245	7260	
Q6	6595	7140	7245	7260	
Q7	7245	7260	7330		
R	4700	4790	4815	4825	4900
	4975	5010	5065	5180	5210
	5220	5260	5300	5410	5425
	5495	5595	5740	5765	5805
	5835	5920	5945	5990	6035
	6075	6100	6115	6160	6180
	6205	6235	6360	6415	6530
	6570	6685	6760	6865	6990
	7025	7080	7345	7415	7520
	7535	7550	7625	7655	7710
	7730	7765	7805	7825	
R1	3818	3860	3865	3895	3980
	3990	5391	7835	7840	
R2	4320	4322	4323	4325	
R5	4000	4830	4835	4840	4875
	5270	5285	5383	6885	6895
REDIM	5690	5730			
REWIND	5980	6025			
S	4985	5110	7330	7360	
S$	5365	5451	5625	5675	6250
	6555	7670	7685	7742	7745
S$[	3885				
S3	4000	4022	5080	5085	5090
	5110	5270	5275	5325	5383
	5392				
SFLAG	4155	4775	6670		
STORE	5795	5800	5970	5975	6005
	6010	6015	6020	6022	
S[	3895	5555	7475	7480	7496
T	3855	3860	3895	6720	7830
	7835				
T1	4150	4165	4170	4780	
T2	4057	5230	5235	5240	5302
	5303				

SYMBOL	REFERENCE LINE				
T6	3835	4950	5130	5135	5140
	5160	5165	5250	5310	5315
	5325	5382	5392		
T9	5206	5232			
TRANSFER	7670	7742			
T[	7475	7480	7485	7492	7494
	7670	7742			
U	5205	5246	5247	5250	5315
	5525	5705			
V	4060	4065	4555		
V1	4200	4225	4260	5115	5412
	5459	5464	6800	7010	7055
V2	4200	4230	4270	6800	7015
	7060				
V3	4200	4235	4265	6800	7020
	7065				
V4	4200	4240	4280	4305	4310
	4315	4330	4335	5710	
V5	4200	4245	4285	4310	4315
	5320	5325	5590	5640	5710
V6	4200	4250	4290	4320	
V7	5540	5545	5580	5585	5630
	5672	5710			
V8	4060	4065			
V9	4065	4555			
W	6795	6830	6840	7330	7335
	7360				
W1	4325	5375	5580	5630	
WRITE	3775	3885	3895	3970	4080
	4095	4470	4490	4630	4640
	5030	5040	5100	5110	5365
	5375	5384	5391	5451	5470
	5625	5630	5640	5665	5720
	5790	5965	6785	6795	6815
	6840	6855	6975	7045	7070
	7360	7375	7400	7685	7815
X	4215	4230	4235	4245	4465
	5275	5280	5450	5515	5520
	5650	5685	5700	5710	5785
	5960	6220	6310	7040	7810
X$[	7502	7508	7510		

SYMBOL	REFERENCE LINE				
X1	3830	3850	3855	3895	5550
	5570	5585			
X2	4210	4225	4235	4240	4300
	4315	5280	5520	6315	
X5	4990	5110	6140	7685	7690
X6	4995	5110	6150	7685	7690
Y	3855	3865	3895	4295	5391
	5545	5560	5565	5570	5580
	7840				
Y[	4280	4285	4320	5690	5710
	5720	5730	6335		
Z	4330	4335	5461	5464	5470
	5482	5487	5545	5580	5585
	5640	5672	5710	7035	
Z5	6595	7130	7270	7275	7280
ZER	6560	6565	7610	7756	
ZER[	7757				

LINES: 812 BYTES: 18742 SYMBOLS: 363 REFERENCES: 1895

```
                                          LINK FROM LOADER PROGRAM
                                                    |
                                                    |
50:      >--------------                       INITIALIZE
65:      (4895: FNJ2)      calc:  STAR FLUX VALUES                        <KEY 2]
                                                    |
                                                    |
1395:    >>----        TRAP: ORW, 1LOAD, 2AUTO, 3=DEL, 4G/T               <KEY 0]
                              |      |      |      |     |
                            1425:  5017:  3118:  4863:  3225:


1425:    >----------------------------    ORW
1425:                                  INITIALIZE
1440:        (4985: FNF1)             SUM TAPE #?
1460:                                  REWORK #?
1470:        (5008: FNF7)            RESULT SET #?
1470:        (2140: FNV2)   KEY IN MEASUREMENT PARAMETERS
1475:                                 OBTAIN HPBW
1625:        (5900: FNV0)  LOAD from INT or EXT cassette?
1625:        (5940: FNV1)   LOAD FILES:START#,STOP#,STEP?
                                        |
1645:    >-----------------------     NEXT FILE                           <-----
1672:                    if LASTFILE thenM,NSTORE -------------->3216: |
1680                                  LOAD DATA                            |
1685                                PRINT FILE DATA                        |
1700:                if INCORRECT FREQ then NEXT FILE  ----------->----|
                                        |                                  |
1744:                               calculate FLUX                         |
1746:                       info to MAT M , PRINT info                     |
1748:                               goto NEXT FILE ---------------------->----
```

```
3216:    >-------------------------    M,N STORE
3216:         (3025: FNV12)        STORE MAT M & N
3216:                             goto PRINT RESULTS-------------------->3135:
                                                                          |
                                                                          |
3118:    >>-------------------------     2AUTO                            |
3120:         (5075: FNJ3)       key in: TEMP, DEW PT            <KEY 3]  |
3128:                                 REWORK #?                           |
                                          |                               |
3135:    >-----------------------    PRINT RESULTS                  <------
3140:         (3225: FNJ4)        prt: G/T DATA SUMMARY          <KEY 4]
3140:         (3380: FNJ5)       SORT, FIT, & LIST DATA          <KEY 5]
3140:         (3565: FNL )      PRINT OUT PLOTS & TABLES
3148:         (5130: FNF7)            DATA SET #?
3148:         (3025: FNV12)          STORE RESULTS
3150:                                 goto TRAP ----------------------->1395:


3225:    >>------------------------      4 G/T
3240:         (3255: FNJ6)      print: G/T DATA SUMMARY          <KEY 6]


4863     >>------------------------      3=DEL
4864:                                DEL:RUN/SET?                      <----
4880:                     change sign of RUN/SET number  ------------->4864:


5017:    >>------------------------      1LOAD
5018:         (4985: FNF1)             SUM TAPE#?
5018:         (5008: FNF7)           RESULT SET #?
5018:         (5020: FNV11)          LOAD MAT M & N
5019:                                 goto TRAP ----------------------->1395:
```

```
50  L$="NBS1D.119*  REWORK  <D1-F16> T4-F12"
51  REM LIN FIT>>3615 F2=FNV3+1, DISK: 4995 F7=1
52  MAT M=ZER[40,10]
53  MAT N=ZER
54  REM to add SUN see D.105:2162,6004,6305,7000+
55  B5=53
58  T[6,8]=143
60  B6=30.9
61  D7=F3=F7=H9=V8=0
62  F5=F9=R5=1
63  N[21,2]=0.136
64  F=7.5
65  Q=FNJ2
66  GOTO 1395
69  DEF FNA(Q4)
72  GOTO NO-4 OF 84,87
75  IF Q4<0.23 THEN 81
78  RETURN Q4
81  RETURN -4.248+2.1468*Q4-0.10259*Q4^2+0.0030247*Q4^3
84  RETURN Q4*(1-0.2224*(Q4/FNU3)^(-2.1482))
87  RETURN Q4*(1-0.2319*(Q4/FNU4)^(-2.207))
200 DEF FNQ(L)=(N[21,2]+N[21,6]/SINL)*60
205 DEF FND(Q)=10^(Q/1E+04)
206 DEF FNT(Q)
208 Q1=Q*SGNQ
210 Q2=(Q1-INTQ1)*60
212 RETURN SGNQ*(INTQ1+INTQ2/100+(Q2-INTQ2)*0.006)
218 DEF FNR(Q0)
220 DISP ": HR/DEG";
222 Q3=FNNINT(SGNQ0*INTSQR(Q0^2))+10^(-14)
224 DISP "MIN";
226 Q4=FNN(INT(100*SGNQ0*FNT(Q0-Q3)))
228 DISP "SEC";
230 Q5=FNN(10000*FNT(SGNQ0*Q0-SGNQ3*Q3-SGNQ4*Q4/60))
232 RETURN SGNQ3*(ABSQ3+ABSQ4/60+ABSQ5/3600)
275 DEF FNB(Q)
280 FOR I=1 TO Q
285 BEEP
290 WAIT ABS(100*(I-4))
295 NEXT I
300 RETURN 0
305 DEF FNN(Q)
310 DISP "( =NC):";Q;
315 INPUT B$
320 IF B$=" " THEN 330
325 RETURN VAL(B$)
330 RETURN Q
```

```
335  DEF FNI(Q)
340  A$="- - ----====####@@@@"
345  A$=A$[4*Q-3,4*Q]
350  A$[5]=A$
355  A$[9]=A$
360  FORMAT F5.1
365  WRITE (15,360)A$;A$;A$;A$;A$
370  RETURN 0
375  DEF FNK(NO)
385  L7=256*EXP(0.111*(A[4]/10)^0.78)/(5*(A[3]/10-32)/9+273.16)
390  Q=(0.9211/(1+0.2912/F^2)+5.107*(1+3596/F^2)/(1-3596/F^2)^2)
395  Q2=293/((A[3]/10-32)*5/9+273.15)
400  G4=6.644E-03*(1-0.02252*CO)^10.52*Q2^2.75*Q
405  Q=1-0.02215*(11.02-CO)*Q2
410  L4=5.145/Q2*(1-Q^8.775)+3.172*Q^7.775
415  Q=(1+493.3/F^2)/(1-493.3/F^2)^2*L7*(1+0.0046*L7)
420  G5=1.451E+05*(1-0.02252*CO)^5.262*EXP(-644*Q2/293)/(1/Q2*293)^3*Q
425  L5=2.09+0.27*(1-Q2^2)
430  G6=2.529E-02*(1-0.02252*CO)^5.262*F^2/(1/Q2*293)^1.5*L7*(1+0.0046*L7)
435  L6=2.17
440  Z1=G4*L4+G5*L5+G6*L6
445  L8=Q2*(0.9523*(1-0.02215*CO) 5.262+0.0209*L7)
450  L9=0.013
455  K1=10^(-Z1/10/SINL)
460  B4=293/Q2*(1-K1)/1.0716
465  BO=FNQL
480  Q=0.6508*(60*FNU4/BO)^2
485  Q2=(NO<5)*(T[NO,9]/100/(1.2012*BO))^2+(NO=5)*2495*(FNU3/BO)^2+(NO=6)*Q
490  K2=(1-EXP(-Q2))/Q2*(1-(NO<5)*0.001+(NO=5)*0.0094)
495  K3=1
500  Q=(W/F/2E+03)^2
505  K4=K5=K6=K7=1
525  J1=10^(-0.00011*F*F/SINL)
530  K8=1-(1-J1)*EXP(-0.467*Q2)
535  Q=1+(2.909E-04)*(L8-2*L9/TANL)/(SINL)^2
540  S=1/Q
545  K9=1-(1-S)*EXP(-0.467*Q2)
550  K=K1*K2*K3*K4*K5*K6*K7*K8*K9
555  RETURN 0
560  DEF FNZ(NO)=FNK(NO)+K*C1*S[NO,4]*1E-26
565  DEF FNC(Q)
570  N5=N5+1
575  Q=FNSQ
580  PRINT H$;",    ";X$;
585  IF STAT3=0 THEN 630
590  ENTER (3,*)Q,Q1
595  IF Q1<10^9 THEN 620
600  PRINT
```

```
605  DISP "CLOCK RESET";
610  INPUT Q1
615  GOTO 575
620  FORMAT "    (78",F5.0,F6.2,")"
625  WRITE (15,620)Q*10^3+INT(Q1/10^4),INTQ1/100-100*INT(Q1/10^4)
630  Q=20
635  PRINT
640  PRINT
645  FORMAT 35X,F4.0,"-",/,71X,"RUN",F4.0
650  WRITE (15,645)-N5,N6
660  PRINT
665  PRINT TABQ,P$[13]
675  PRINT TAB(Q),P$[1,3];":  ";P$[9,12];" ";P$[4,6];" ";P$[7,8]
685  FORMAT 19X,F6.3," GHz,",F5.1," Ft DISH"
690  WRITE (15,685)F,D
695  PRINT
700  RETURN 0
705  DEF FNS(Q)
710  FOR I=1 TO Q
715  PRINT
720  NEXT I
725  RETURN 0
730  DEF FNE(NO)
740  E0=0
745  E1=50*(1/K1-1)
750  IF B0<14 THEN 765
755  Q2=0
760  GOTO 780
765  Q0=4.73*(5.9-B0)+5.39*SQR((5.9-B0)^2+0.479)
770  Q1=(7.12-B0)/ABS(7.12-B0)*2.04*SQR((Q0/1.79)^2-1)
775  Q2=0.15+0.354*(Q0+Q1)
780  D2=100*N[21,3]/N[21,1]
782  P1=2*SQR(Q2^2+13*D2^2)
784  IF NO<5 THEN 790
786  Q1=60*FNU4/B0
787  Q2=0.6508*Q1*Q1
788  Q=0.15*Q1^2.46*F^0.221+12.3*(1-Q2/(EXPQ2-1))
790  E2=((1-K2)*P1+D1)*(NO<5)+(NO=5)*(1.5+41.1*(1-K2))+(NO=6)*Q
795  E3=(W/F/2E+03)^2*50
796  E4=0
798  IF NO<5 THEN 810
800  E4=0.4*B0*B0/K1/K2/S[NO,4]/K8/K9*(NO<5)+(NO=5)*0.06+(NO=6)*0.09
810  E5=(10^(H1/10)-1)*100
812  E6=0.1
814  IF NO>4 THEN 820
815  E6=0.023*T[NO,11]
820  Y=1+FNZNO*G/T
825  Y5=Y/(Y-1)
830  E7=SQR((C9*Y5)^2+A2^2)
835  E8=100*D8*(1/K8-1)
840  E9=100*D9*(1/K9-1)
845  RETURN 0
```

```
865  DEF FNM(Q)
870  Q=FNSQ
875  FORMAT 5X,"TEMP         DEW PT.     REL HUMD      WATER DENS    "
880  WRITE (15,875)"CLOUD COVER    WIND"
885  FORMAT F9.1," F",F10.1," F",F11.1," %",F10.1," gm/m^3",F10.0,F10.0," mph"
890  A[5]=1000*EXP(0.111*((A[4]/10)^0.78-(A[3]/10)^0.78))
895  Q=100*(A[6]-INT(A[6]))
900  WRITE (15,885)A[3]/10,A[4]/10,A[5]/10,L7,INT(A[6]/100),Q
905  RETURN 0
910  DEF FNH(Q)
915  GOTO Q OF 930
920  PRINT TAB31,"FIT TO  ";N[1,9];"DATA"
925  RETURN 0
930  PRINT "TAPE";V8"data";F9;L$;
935  FORMAT 5X,"REWORK",F6.2
940  WRITE (15,935)N[1,10]
945  PRINT TAB15,D$
950  RETURN 0
1020 R=401
1026 FORMAT "    K1     K2     K3     K6     K8    K9     K  "
1030 WRITE (15,1026)"   APR-eff  R-eff     S(FU)      Xi(K)"
1035 FORMAT F7.3,6F6.3,F8.4,F7.2,F11.1,E11.3
1040 WRITE (15,1035)K1,K2,K3,K6,K8,K9,K,B2,B3,S[NO,4],FNZ(NO)
1045 PRINT
1050 RETURN 0
1250 DEF FNG(Q)
1255 REM <G/T #2 P135>
1260 IF Q=-9 THEN 1330
1265 IF Q>0 THEN 1275
1270 M1=M2=M3=N9=V1=V2=V3=V4=V5=V6=0
1275 N9=N9+1
1280 M1=M1+X2
1285 M2=M2+X1
1290 M3=M3+P
1295 V1=V1+X2^2
1300 V2=V2+X1^2
1305 V3=V3+X1*X2
1310 V4=V4+P*X2
1315 V5=V5+P*X1
1320 V6=V6+P^2
1325 GOTO 1368
1330 Y[1]=V4-M1*M3/N9
1335 Y[2]=V5-M2*M3/N9
1340 G[1,1]=V1-M1^2/N9
1345 G[1,2]=G[2,1]=V3-M1*M2/N9
1350 G[2,2]=V2-M2^2/N9
1355 MAT C=INV(G)
1360 MAT F=C*Y
1365 R2=V6-M3^2/N9-F[1]*Y[1]-F[2]*Y[2]
1366 X=(M3-F[1]*M1-F[2]*M2)/N9
1368 RETURN 0
```

```
1370  DEF FNF(Q)
1372  GOTO Q OF 4985,4815,1020,5320,5574,5624,5008,5690,5600,5633
1373  GOTO 1395
1375  DEF FNO(Q)
1376  Q=FNNQ
1377  RETURN 0
1380  DEF FNU(Q)
1381  GOTO Q OF 5940,5960,6300,6400,6700,6900,7000,7100,7200,7300,4190
1382  GOTO 5900
1383  DEF FNV(Q0)
1384  GOTO Q0 OF 4570,2140,4430,4480,4548,5800,5130,5175,5642,5660,5020,3025,5648
1385  GOTO 1395
1387  DEF FNJ(Q)
1390  GOTO Q OF 3165,4895,5075,3225,3380,3255,3018
1395  R=402
1400  F6=0
1405  REDIM C[2,2],G[2,2],F[2],M[40,10],Y[2]
1410  DISP "0 RW,1LOAD,2AUTO,3=DEL,4G/T";
1415  Q=FNB3+FNN0
1420  GOTO Q OF 5017,3118,4863,3225
1425  R=403
1440  Q=FNF1
1460  DISP "REWORK#";
1465  N[1,10]=FNNN[1,10]
1470  Q=FNF7+FNV2
1475  DISP "PREFIT HPBW (1=YES)";
1480  F8=FNN1
1485  IF F8=0 THEN 1590
1500  R=404
1505  Q=FNV7
1510  SERROR Z5,1520
1515  Q=FNV8
1520  IF Z5=59 THEN 1510
1525  SERROR Z5,1600
1530  Q=FNS(36-M[40,1])+FNS6+FNJ5
1540  GOTO 1600
1590  Q=FNV6
1600  R=404
1605  F4=0
1615  F6=F5=1
1616  DISP "RSLTS TO NOW SUMMARY(1=YES)";
1617  Q=FNN0
1618  IF Q THEN 1625
1620  MAT M=ZER[40,10]
1625  Q=FNU0+FNU1
```

```
1645  R=405
1650  SERROR Z5,3195
1655  F2=H=L1=N4=T6=0
1665  F4=F4+1
1670  N8=M[40,1]+1
1672  IF N8=40 THEN 3216
1675  N2=F4*V+U-V
1676  IF N2>U1 THEN 3216
1680  LOAD  DATA #(10-5*F7),N2
1685  PRINT "FILE";N2,P$,"RUN/SET";A[1]/100
1690  PRINT TAB5,S$,H$,"FREQ";A[2]/1000
1695  Q=FNS2
1697  A4=0
1700  IF D[1,2]=0 OR D[1,69]=0 THEN 1645
1705  Q3=A[2]/1000
1710  Q=F3-Q3
1715  R=406
1720  IF F3 AND Q THEN 1645
1725  IF F=Q3 THEN 1740
1728  F=Q3
1730  Q=FNJ2
1740  N7=(A[1]/100-INT(A[1]/100))*100
1741  N6=INT(A[1]/100)
1742  IF N0<5 THEN 1746
1743  D4=VAL(P$[7,8])
1744  Q=FNU(5*(N0=5)+6*(N0=6))
1746  Q=FNF4+FNU(7*(N0=5)+8*(N0=6)+9*(N0<5))+FNV13+FNF5+FNF9+FNS13
1747  M[40,1]=M[40,1]+1
1748  GOTO 1645
2140  R=411
2145  DISP "ANT DIAM(FT)";
2150  D=FNND
2155  DISP "SITE ELEV(Km)";
2160  C0=FNNC0
2162  DISP "NEW MOON DATA(0=NO)";
2163  Q=FNN1
2164  IF Q=0 THEN 2168
2165  Q=FNU2
2168  DISP "FREQ(GHz)";
2170  F=F3=FNNF
2175  Q=FNJ2
2195  RETURN 0
2990  R=415
2995  Q=N8+1
3000  M[Q,2]=M[Q,3]=M[Q,4]=M[Q,5]=M[Q,6]=0
3005  Q=FNI5
3010  Q=FNS5
3015  GOTO 1655
```

```
3018  R=416
3020  DISP "STORE MAT M&N(0=NO)";
3021  Q=FNB2+FNN1
3022  IF Q=0 THEN 3024
3023  Q=FNF7+FNV12+FNS10
3024  RETURN 0
3025  R=417
3026  N[6,11]=F
3028  N[8,9]=H9
3030  TRANSFER P$ TO T[9,1]
3035  FOR I=1 TO 10
3040  N[17,I]=T[9,I]
3045  N[18,I]=T[9,I+10]
3050  NEXT I
3055  Q=10-5*F7
3060  Q1=4*F9-3+17*F7
3065  STORE  DATA #Q,Q1,M
3070  STORE  DATA #Q,Q1+2,N
3075  FORMAT "    FREQ",10X,"M FILE",7X,"N FILE",8X,"TAPE",7X,"SUMMARY SET",4X
3080  WRITE (15,3075)"REWORK"
3085  FORMAT F9.3,3F13.0,F13.1,F15.2
3090  WRITE (15,3085)F,Q1,Q1+2,V8,F9,N[1,10]
3095  Q=FNS30
3100  RETURN 0
3118  R=418
3120  Q=FNJ3
3125  F5=0
3128  DISP "REWORK #";
3130  N[1,10]=FNNN[1,10]
3132  D4=VAL(P$[7,8])
3135  F6=N0=1
3136  IF F#0 THEN 3140
3138  F=7.5
3139  Q=FNJ2
3140  Q=FNJ4+FNJ5+FNL7+FNL8+FNL1+FNL2+FNL3+FNL6+FNL7.2+FNL8.2+FNL1.2+FNL2.2
3142  IF F5 THEN 3148
3144  Q=FNJ7
3146  GOTO 1395
3148  Q=FNF7+FNV12
3150  GOTO 1395
3165  R=419
3195  R=420
3196  A4=A4+1
3200  WAIT 1000
3205  Q=FNS6
3210  IF Z5=56 OR Z5=58 THEN 1395
3212  IF Z5#59 OR A4=4 THEN 3215
3213  F4=F4-1
3214  GOTO 1645
```

```
3215  IF Z5#61 THEN 1645
3216  Q=FNV12
3217  IF F6=0 THEN 1395
3218  IF F5=0 THEN 3135
3219  SERROR Z5,3221
3220  GOTO 3135
3221  Q=FNV6
3222  GOTO 1600
3225  R=421
3226  D$=""
3228  IF F6 THEN 3240
3240  Q=FNS6+FNH1+FNC1+FNJ6
3244  RETURN 0
3255  R=422
3285  FORMAT /," RUN/SET STAR     ELEV     G/T     G/TA  ant HPBW"
3290  WRITE (15,3285)"  FREQ    Y-fac      NEF       NUF"
3295  FORMAT F7.2,F7.1,2F8.3,3F8.3,2F9.2
3300  I=0
3305  I=I+1
3310  Q=M[I,1]
3315  IF Q-INTQ=0 OR I=40 THEN 3375
3325  Q0=M[I,6]
3330  Q1=M[I,7]
3335  Q2=M[I,8]
3340  J=M[I,9]
3345  E=ABSQ
3350  TRANSFER T[100*E-10*INT(10*E),1] TO S$
3355  WRITE (15,3295)M[I,10],"  ",S$,Q,M[I,2],M[I,3],M[I,4],Q0,Q1,Q2,J
3360  IF INT(I/3)-I/3 THEN 3370
3365  PRINT
3370  GOTO 3305
3375  Q=FNS30
3376  RETURN 0
3380  R=423
3384  A[3]=10*B5
3386  A[4]=10*B6
3405  REDIM M[M[40,1],10]
3410  SORT M,C,1
3415  Q=FNS3+FNH1+FNC1+FNS4
3420  REDIM M[40,10]
3425  IF M[40,1]<3 THEN 3585
3430  FOR J=19 TO 26
3435  IF J=22 OR J=23 THEN 3550
3440  I=N9=0
3445  I=I+1
3450  IF M[I,1]<0 THEN 3445
3455  N[J,9]=N[J,10]=M[I,J-17]
```

```
3460  FOR I=1 TO M[40,1]
3465  X1=M[I,1]
3470  IF X1 <= 0 THEN 3510
3475  X2=1/SINX1
3480  P=M[I,J-17]
3485  Q=FNGN9
3490  IF P>N[J,9] THEN 3500
3495  N[J,9]=P
3500  IF P<N[J,10] THEN 3510
3505  N[J,10]=P
3510  NEXT I
3515  Q=FNV4
3520  IF J>19 THEN 3540
3525  PRINT TAB35,"# PTS =";N9
3526  N[1,9]=N9
3528  N[19,11]=M2/N9
3530  N[20,11]=M1/N9
3532  N[21,11]=G[2,2]
3534  N[22,11]=G[1,1]
3535  PRINT
3540  Q=FNV5
3545  Q=FNS3
3550  NEXT J
3555  Q=FNS15
3560  RETURN 0
3565  DEF FNL(Q0)
3570  R=424
3572  X5=0
3575  D$=""
3580  J=INTQ0
3585  L0=10*(Q0-J)
3590  J=J+18
3595  IF N[J,9]#0 THEN 3610
3600  PRINT "DATA NOT FIT YET!!"
3605  RETURN 0
3610  IF L0 THEN 4260
3615  F2=FNV3+FNU11
3660  I5=Q-R1
3690  I5=I5/50
3692  L=30
3695  Q=FNS3+FNH1+FNC1+FNKN0+FNM1+FNI3
3700  PRINT ". = FIT",
3705  D$="#@O+*MX"
3710  FOR I=1 TO N1
3715  TRANSFER T[I,1] TO S$
3720  PRINT D$[I,I];" = ";S$;",  ";
3725  NEXT I
```

```
3730  Q=FNS3+FNHO+FNF2
3740  PRINT
3745  FORMAT 3X,6F10.3,"  (UNIT=",F7.4,")"
3750  WRITE (15,3745)R1,R1+10*I5,R1+20*I5,R1+30*I5,R1+40*I5,R1+50*I5,I5
3775  Q=FNF8
3790  PRINT " ELEV      ";A$;
3795  FORMAT 4X,"VALUE   RUN/SET"
3800  WRITE (15,3795)
3805  FORMAT F5.1
3810  I=N3=0
3815  R=425
3820  I=I+1
3825  IF I>M[40,1] THEN 4170
3830  L1=M[I,1]
3835  T2=M[I,10]
3840  IF L1<0 THEN 3820
3845  N3=N3+1
3850  IF N3/30-INT(N3/30) THEN 3860
3852  Q=FNF8
3855  PRINT TAB10,A$
3860  IF N3>1 THEN 3885
3865  L=INT(L1)
3870  IF INT(L/5)-L/5=0 THEN 3885
3875  L=L+1
3880  GOTO 3870
3885  J1=M[I,J-17]
3890  IF L1 >= L THEN 3990
3895  Q=INT((J1-R1)/I5+0.5)+1
3900  X=10*(10*L1-INT(10*L1))
3905  B$=D$[X,X]
3915  W1=N[J,2-F2]+N[J,6-F2]*((F2=0)/SINL1+(F2=1)*L1)
3930  X=INT((W1-R1)/I5+0.5)+1
3935  WRITE (15,3805)L1;
3940  A$=""
3945  A$[1,52]=""
3947  IF X>52 OR X<1 THEN 3955
3950  A$[X,X]="."
3955  A$[Q,Q]=B$
3975  FORMAT F9.4,F8.2
3979  X5=X5+1
3980  WRITE (15,3975)"     ",A$,J1,T2
3982  GOTO 3820
3990  E=FNU10
3995  T1=N[J,2-F2]+N[J,6-F2]*Q3
4000  IF J=21 OR J=22 OR J=24 THEN 4010
4005  E=FNKNO+FNV1+(C2=1)*10*LGT(1+E/100)+(C2#1)*E*T1/100
4008  E=FNV1+(C2=1)*10*LGT(1+E/100)+(C2#1)*E*T1/100
```

```
4010  Q=INT(E/I5+0.5)
4015  IF Q>1 THEN 4045
4020  Q=1
4045  X=INT((T1-R1)/I5+0.5)+2
4050  PRINT L;
4060  FORMAT " ",51"-"
4065  OUTPUT (A$,4060)"",
4070  IF X-Q<1 THEN 4085
4075  A$[1,X-Q]=""
4080  A$[X-Q,X-Q]="!"
4085  A$[X,X]="."
4090  IF X+Q>51 THEN 4150
4095  A$[X+Q,52]=""
4100  A$[X+Q,X+Q]="!"
4150  FORMAT F10.4,"+-",F8.4
4152  A$=A$[1,52]
4154  X5=X5+1
4155  WRITE (15,4150)"   ";A$;T1,E
4160  L=L+5
4165  GOTO 3885
4170  Q=FNF8
4172  PRINT TAB10,A$
4175  D$=""
4180  Q=FNS((X5>39)*36)+FNS(39-X5)
4185  RETURN 0
4190  R=426
4195  REDIM Y[3]
4196  I=0
4197  I=I+1
4198  IF M[I,1]<0 THEN 4197
4200  Y[1]=10*INT(M[I,1]/10)+10
4202  Y[1]=Y[1]-5*(Y[1]-M[I,1]>5)
4205  Y[2]=10*INT(M[M[40,1],1]/10)
4207  Y[2]=Y[2]+5*(M[M[40,1],1]-Y[2]>5)
4210  Y[3]=10-5*(Y[2]-Y[1]<36)
4215  N0=10*(10*M[I,1]-INT(10*M[I,1]))
4220  RETURN 0
```

```
4260  R=427
4268  Q=FNU11+FNS1+FNH1+FNCO+FNKNO+FNM1+FNI3+FNS1+FNHO+FNF2+FNS1
4270  PRINT TAB24,"+ = LINEAR CONTRIBUTION"
4275  Q=FNS2
4280  FOR L=Y[1] TO Y[2] STEP Y[3]
4285  TRANSFER T[INT((J+2)/2),1+20*(J/2-INT(J/2))] TO B$
4290  B$[10]="="
4300  FORMAT F5.1,"deg:",13X,F9.3," +-",F5.2," dB    (",F6.1," %)",4X,F6.3," GHZ"
4315  Q=FNV1
4335  WRITE (15,4300)L,B$,T1,10*LGT(1+E/100),E,F
4340  Q=FNS1
4345  FORMAT "  E-S    E-F   E-Y  E-K1  E-K2  E-K3  E-K4  E-K5  E-K6  "
4350  WRITE (15,4345)"E-K7 +E-K8 +E-K9  E-TA"
4355  FORMAT F5.1,"%",12F6.1,"%"
4356  Q=C2
4357  Q0=Q*E9
4358  Q1=Q*B1
4360  WRITE (15,4355)Q*S,Q*E0,Q*Y1,Q*E1,Q*E2,Q*E3,Q*E4,Q*E5,Q*E6,Q*E7,Q*E8,Q0,Q1
4365  R=428
4370  IF L0#2 THEN 4405
4380  Q=FNS1+FNI4+FNF6+FNF10+FNF5+FNF9++FNI4
4405  Q=FNS3
4410  NEXT L
4412  Q1=(INT((Y[2]-Y[1])/Y[3]+1)-2)/3
4414  Q=FNS(23*(3-3*(Q1-INTQ1))*(Q1-INTQ1#0))
4420  REDIM Y[2]
4425  RETURN 0
4430  R=429
4435  Q1=(J=19)+(J=20)+(J=25)+(J=26)+10*(J=24)+100*((J=21)+(J=22))
4440  R1=INT(Q1*N[J,9])/Q1
4445  Q=INT(Q1*N[J,10]+1)/Q1
4450  IF (Q-R1)>1 OR J>20 THEN 4475
4455  IF (N[J,9]-R1)>(Q-N[J,10]) THEN 4470
4460  R1=R1-1
4465  GOTO 4475
4470  Q=Q+1
4475  RETURN 0
4480  R=430
4485  Q=FNG(-9)
4490  R2=V6-M3^2/N9
4495  N[J,5]=Y[2]/G[2,2]
4500  N[J,1]=(M3-N[J,5]*M2)/N9
4505  S=SQR((R2-N[J,5]*Y[2])/(N9-2))
4510  N[J,3]=S
4515  N[J,7]=S/SQRG[2,2]
4520  N[J,6]=Y[1]/G[1,1]
4525  N[J,2]=(M3-N[J,6]*M1)/N9
4530  S3=SQR((R2-N[J,6]*Y[1])/(N9-2))
4535  N[J,4]=S3
4540  N[J,8]=S3/SQRG[1,1]
4545  RETURN 0
```

```
4548  R=431
4550  FOR F2=0 TO 1
4555  Q=FNF2
4560  NEXT F2
4565  RETURN 0
4570  R=432
4575  H1=FNU10+FNKNO
4576  IF J=19 OR J=20 THEN 4580
4578  H1=10*LGT(1+H1/N[J,2-F2])
4580  Q=(F2=0)/SINL+(F2=1)*L
4585  M=N[19,2-F2]+N[19,6-F2]*Q
4600  T1=N[J,2-F2]+N[J,6-F2]*Q
4602  C2=1+((J=25)+(J=26))*(1/(1-(B4+3)/B9*1.4/T1)-1)
4610  M=10^(M/10)
4615  G=10^((N[20,2-F2]+N[20,6-F2]*Q)/10)*FNV9
4617  T=G/M
4620  Q=FNV13+FNENO
4635  Y1=C8*Y5
4640  S=T[NO,10]/10
4645  B1=D3
4650  E=C2*SQR(S^2+Y1^2+E0^2+E1^2+E2^2+E3^2+E4^2+E5^2+E6^2+E7^2+B1^2)+E8+E9
4655  RETURN 0
4815  R=433
4820  A$=" "
4825  B$=" "
4830  FORMAT 6X,F9.4," +-",F8.4,") + (",F9.5," +-",2F8.5
4835  TRANSFER T[INT((J+2)/2),1+20*(J/2-INT(J/2))] TO A$[1,15]
4840  TRANSFER T[14,16-F2*5] TO B$[1,8]
4845  WRITE (15,4830)A$,N[J,2-F2],N[J,4-F2],N[J,6-F2],N[J,8-F2],B$
4846  RETURN 0
4863  R=435
4864  DISP "DEL:RUN/SET(0=EXIT)";
4865  Q=FNB2
4870  INPUT Q
4875  IF Q=0 THEN 1395
4880  SEARCH M,C,10,Q,Q1
4885  M[Q1,1]=-M[Q1,1]
4890  GOTO 4864
4895  R=436
4900  C1=2.997925E+08^2/(8*PI*1.38054E-23*(F*10^9)^2)
4905  D0=0.9/F^2
4910  G=B2*(D*F/0.313)^2
4915  B9=2*C1*1.38054E-23*G
4920  B0=3035/D/F*SQR(B3/B2)
```

```
4925  FOR I=1 TO N1
4930  Q=C-T[I,15]/10
4935  Q3=T[I,6]/1E+03+T[I,4]*Q/1E+05
4940  Q2=EXP(-T[I,16]/1E+04*Q)*S[I,1]*(F/T[I,18]*100)^Q3
4945  I5=S[I,1]+T[I,8]/1000*S[I,1]
4947  Q4=(I#5)*(I#6)*T[I,5]/1E+05
4950  A=Q3+(((F/T[I,18]*100) >= 1)-(F/T[I,18]*100<1))*(T[I,7]/1000+Q4)
4955  N3=F+((A>0)-(A<0))*F0/100
4960  Q=EXP(-T[I,16]/1E+04*Q)*I5*(N3/T[I,18]*100)^A
4965  T[I,10]=(Q-Q2)/Q2*1000
4970  S[I,4]=Q2
4975  NEXT I
4980  RETURN 0
4985  R=437
4995  F7=1
5000  DISP "SUM TAPE #";
5005  V8=FNNV8
5006  RETURN 0
5008  R=438
5010  DISP "RESULT SET#:1=1ST,2=2nd";
5015  F9=FNNF9
5016  RETURN 0
5017  R=439
5018  Q=FNF1+FNF7+FNV11
5019  GOTO 1395
5020  R=440
5022  Q=+10-5*F7
5025  Q1=4*F9-3+17*F7
5030  LOAD  DATA #Q,Q1,M
5035  LOAD  DATA #Q,Q1+2,N
5040  F=N[6,11]
5041  IF F#0 THEN 5043
5042  F=7.3
5043  Q=FNJ2
5045  FOR I=1 TO 10
5050  T[9,I]=N[17,I]
5055  T[9,I+10]=N[18,I]
5060  NEXT I
5065  TRANSFER T[9,1] TO P$
5070  RETURN 0
5075  R=441
5080  DISP "TEMP(F)";
5085  B5=FNB2+FNN(A[3]/10)
5090  A[3]=10*B5
5095  DISP "DEW PT(F)";
5100  B6=FNN(A[4]/10)
5105  A[4]=B6*10
5110  RETURN 0
```

```
5130  R=442
5140  MAT M=ZER[40,10]
5145  LOAD  DATA #(10-5*F7),9+F7*33
5150  Q=FNC1+FNS3
5155  PRINT "FL#   RUN/SET"," ELEV"," HPBW#1"," FREQ","STAR"
5160  EDIM Y[2]
5165  F4=0
5170  F6=F5=1
5172  RETURN 0
5175  R=443
5178  F4=F4+1
5185  N8=M[40,1]+1
5187  IF N8<40 THEN 5190
5188  N8=39
5190  Q=F4+8+F7*33
5195  LOAD  DATA #(10-5*F7),Q
5200  IF A[2]/1000#F OR D[1,2]=0 OR D[1,73]=0 THEN 5175
5202  PRINT Q;
5203  D4=VAL(P$[7,8])
5205  Q=FNV10
5207  M[40,1]=M[40,1]+1
5208  PRINT M[N8,10],M[N8,1],M[N8,4],M[N8,6],S$
5210  IF INT(N8/3)-N8/3 THEN 5225
5215  PRINT
5225  GOTO 5175
5230  REM: EXIT ON SERROR
5320  R=444
5322  Z=FNDD[6,73]+FNV10
5327  Q5=D[3,69]/100
5332  Q=FNS2+FNH1+FNC1+FNKNO+FNM3+FNS1+FNI5
5333  FORMAT "SET =",F4.0," PTS,",F3.0," inter,  STD DEV RSDL =",F9.6
5334  WRITE (15,5333)D[1,73]/100,D[1,69],FNDD[1,71]/100,
5335  FORMAT ",  max PTS(sigma)=",F6.2,",",F6.2,/
5336  WRITE (15,5335)FNDD[3,71],FNDD[5,71]
5338  FORMAT "REWORK  FILE  TAPE   TIME(Hrs)   EFF AREA    SKY BRIGHT   "
5340  WRITE (15,5338)"ELEV(deg)   RUN   SET"
5345  FORMAT F5.1,F6.0,F7.1,F10.3,F10.1," m^2",F9.2," K",F11.1,F8.0,F6.0
5350  WRITE (15,5345)N[1,10],N2,V8,D[4,4]/1000,B9,B4,M[N8,1],N6,N7
5355  Q=FNS2
5360  B=FNDD[E7,73]
5362  V6=FNDD[5,73]
5365  FORMAT 5X,"*HPBW(deg)    HPBW(deg)",7X,"T/Ta            DT("
5370  WRITE (15,5365)S$;")/Ta      DECL OF ";S$
5375  FORMAT F7.3," +-",F6.3,F10.3,F9.4,F7.4,F9.4," +-",F7.4,F11.3,"deg"
5379  Q=FNDD[5,72]/100
5380  WRITE (15,5375)B,FNDD[E7,72]/100,M[N8,4],Z," +-";FNDD[6,72]/100,V6,Q,Q5
5390  Y=(V6+Z)/Z
5395  X1=FNZNO
```

```
5400  M=(Y-1)/X1
5450  M[N8,2]=10*LGTM
5452  M[N8,3]=10*LGT(V6/X1)
5460  Q=K*S[NO,4]/(Y-1)/1000
5463  M[N8,7]=Y
5465  M[N8,8]=Q-2*(B4+3)/B9*1.38054
5470  M[N8,9]=Q/K1-3/B9*1.38054
5485  Q=FNS2
5490  FORMAT " version#   Y-FACTOR   *HPBW#1  *HPBW#2"
5495  WRITE (15,5490)"  *HPBWiso  G/T(dB)   NEF         NUF"
5498  Q3=FNDD[3,73]
5500  Q4=FNDD[4,73]
5502  Q=FNDD[2,73]
5505  FORMAT F7.2,F13.4,3F9.3,F9.2,2F9.3,"kFU"
5510  WRITE (15,5505)D[1,72]/100,Y,Q3,Q4,Q,M[N8,2],M[N8,8],"kFU",M[N8,9]
5515  Q=FNS1+FNI5+FNS3
5572  RETURN 0
5574  R=445
5580  FORMAT 5X,"ant HPBW =",F8.5," +",F9.6," CSC L =",F7.4,"  (L =",2F5.1
5585  WRITE (15,5580)N[21,2],N[21,6],B0/60,L," deg)"
5590  Q=FNS1+FNF3
5595  RETURN 0
5600  R=446
5605  FORMAT " SITE ELEV    oxy attn     water attn   zenith attn"
5610  WRITE (15,5605)"   REFR #1  REFR #2  ant-DIAM"
5615  FORMAT F7.3," km",F10.5," dB",F8.4," dB/dens",F8.4," dB",F9.3,F10.4,2F8.1
5620  WRITE (15,5615)C0,G4*L4,G5*L5+G6*L6,Z1,L8,L9,D," ft"
5622  RETURN 0
5624  R=447
5626  FORMAT " G(dB)  G-hpbw  T(K)   Ta(K)   Y-fac  HPBWerr"
5628  WRITE (15,5626)"  data fit  c(1-K2) bright  effAREA"
5630  FORMAT F6.2,F7.2,F7.1,F8.1,F8.4,F7.2," %",F7.3," dB",F7.2,"%",F6.2,F8.1
5631  WRITE (15,5630)10*LGTG,C7,T,H9,Y,D2,H1,P1,B4," K",B9
5632  RETURN 0
5633  R=448
5634  FORMAT /,F5.2,"=A2",F6.2,"=C9",F5.1,"=D1",F9.5,"=N(21,1)",F5.0,F8.4,2F3.0
5636  WRITE (15,5634)A2,C9,D1,N[21,1],T[1,9]"=T(1, 9)",J1"=J1",NO"=NO"
5638  FORMAT F5.2,"=D8",F6.2,"=D9",F5.1,"=C8",F9.5,F5.0,F8.4,"=C2",/
5640  WRITE (15,5638)D8,D9,C8,N[21,3]"=N(21,3)",T[1,11]"=T(1,11)",C2
5641  RETURN 0
5642  R=449
5644  H9=B3/(N[21,2]+N[21,6]*1.15)^2*26117/10^((N[20,2]+N[20,6]*1.15)/10)
5646  RETURN H9
```

```
5648  R=450
5650  B0=FNQL
5653  B2=B3/(B0*D*F/3035)^2
5655  C7=10*LGT(B3*26117/(N[21,2]+N[21,6]/SINL)^2)
5657  B9=2*C1*1.38054E-23*G
5658  RETURN 0
5660  R=451
5662  L=D[4,2]/100
5665  M[N8,1]=INT(10*L+0.5)/10+N0/100
5668  E7=2*(N0<5)+3*(N0=6)+4*(N0=5)
5670  M[N8,4]=B=FNA(FNDD[E7,73])
5680  M[N8,6]=F
5685  M[N8,10]=A[1]/100
5688  RETURN 0
5690  R=452
5695  A$=""
5700  FORMAT 10"!....","!"
5705  OUTPUT (A$,5700)"",
5710  RETURN 0
5800  R=453
5810  DISP "*HPBW @ 90 (deg)";
5820  N[21,2]=FNNN[21,2]
5830  DISP "CSC COEFF";
5840  N[21,6]=FNNN[21,6]
5850  RETURN 0
5900  R=454
5905  DISP "LOAD from INT=0,EXT=1";
5910  F7=FNNF7
5915  RETURN 0
5940  R=455
5945  DISP "LOAD FILES:START#,STOP#,STEP";
5950  INPUT U,U1,V
5955  RETURN 0
5960  R=456
5970  N=0
5980  N=N+1
5990  DISP "day(0=EXIT)";
5995  Q6=2*N-1
6000  Q=N[Q6,1]=FNB3+FNNN[Q6,1]
6004  IF Q THEN 6180
6006  RETURN 0
```

```
6010  PRINT TAB15,"via AFGL (617)468-3701"
6030  Q=FNS2+FNB5
6040  DISP "SUN FLUX,8.8GHZ,S.U.";
6050  N[Q6,7]=FNNN[Q6,7]
6060  DISP "@ 4.995 GHZ";
6070  N[Q6,6]=FNNN[Q6,6]
6080  DISP "U.T.@ SUN MEAS";
6090  N[Q6,5]=FNRN[Q6,5]
6100  DISP "via AENA SUN EPHEMERIS chap";
6110  Q=FNB5+FNS2
6120  DISP "day";N[Q6,1];"DECL";
6130  N[Q6,2]=FNRN[Q6,2]
6140  DISP "TRUE DIST fm EARTH";
6150  N[Q6,3]=FNNN[Q6,3]
6180  DISP "MOON:via AENA,GEOCENTRIC DISTANCE chapter";
6190  Q=FNB5+FNS2
6210  DISP "day";N[Q6,1]+0.5;":A0=";
6220  N[2*N,2]=FNNN[2*N,2]
6230  DISP "A1=";
6240  N[2*N,3]=FNNN[2*N,3]
6250  DISP "A2=";
6260  N[2*N,4]=FNNN[2*N,4]
6262  DISP "MOON: via AENA, EPHEMERIS FOR PHYSICAL OBSERVATIONS";
6264  Q=FNS2
6266  DISP "MOON:AGE(days)";
6268  N[2*N,5]=FNNN[2*N,5]
6270  GOTO 5980
6300  R=457
6305  GOTO 6390
6310  REDIM N[12,11]
6330  SEARCH N,C,1,D4,Q1
6340  REDIM N[26,11]
6345  IF Q1=0 THEN 6360
6350  RETURN 0.534*(1.574-0.1627*LOGF)/N[Q1,3]
6360  DISP "NO SUN DATA for day";D4;
6370  Q=FNB5
6380  STOP
6390  RETURN 0
6400  R=458
6410  REDIM N[12,11]
6430  SEARCH N,C,1,D4,Q1
6450  REDIM N[26,11]
6455  IF Q1=0 THEN 6490
6460  Q2=D[4,4]/2.4E+04
6462  A0=N[Q1+1,2]
6464  A1=N[Q1+1,3]
6466  A3=N[Q1+1,4]
6470  Q3=A0+A1*(Q2-0.5)/5E+05+A3*(Q2-0.5)^2/5E+05
6480  RETURN 0.51817/(Q3/60.268-0.0166*SIN(INT(D[4,2]/10+0.5)/10))
6490  DISP "NO MOON DATA for day";D4;
6500  Q=FNB5
6510  STOP
```

```
6700  R=459
6710  REDIM N[12,11]
6720  SEARCH N,C,1,D4,Q1
6730  IF Q1=0 THEN 6360
6735  R5=N[Q1,3]
6740  D5=N[Q1,5]
6750  C3=N[Q1,6]
6760  C4=N[Q1,7]
6765  H7=N[Q1,2]
6770  SEARCH N,C,1,D4+1,Q1
6780  IF Q1=0 THEN 6360
6790  D6=N[Q1,5]
6800  C5=N[Q1,6]
6810  C6=N[Q1,7]
6820  REDIM N[26,11]
6830  H5=(D[4,4]/1000-D5)/(D6+24-D5)
6840  S1=((1-H5)*C3+H5*C5)/10^(-0.0055/SIN(47.37+H7))/R5^2
6850  S2=((1-H5)*C4+H5*C6)/10^(-0.007/SIN(47.37+H7))/R5^2
6860  S5=0.5*(1-1.7658*LOG(F*F/43.95))
6870  S[5,4]=1.01*S1^S5*S2^(1-S5)*1E+04
6890  RETURN S[5,4]
6900  R=460
6910  REDIM N[12,11]
6920  SEARCH N,C,1,D4,Q1
6930  IF Q1=0 THEN 6490
6940  H6=N[Q1+1,5]+D[4,4]/2.4E+04
6950  S6=207.7+24.43/F
6960  T9=S6*(1-(0.004212*F^1.224)*COS(12.19*H6-43.83/(1+0.0109*F)))
6965  D7=FNU4
6970  S[6,4]=7.252*F*F*T9*D7^2
6980  RETURN S[6,4]
7000  R=461
7090  RETURN 0
7100  R=462
7110  FORMAT 10X,"MOON FLUX (",F6.0,"MHz, day",F3.0,",",F5.1,"hrs) =",F7.0," FU"
7120  WRITE (15,7110)F*1000,D4,D[4,4]/1000,S[6,4]
7130  PRINT
7140  FORMAT "lunar age   elev     A0          A1         A2     moon diam"
7150  WRITE (15,7140)"  mean temp   temp"
7160  FORMAT F6.2,"days",F6.1,F10.4,F10.0,F9.0,F9.3," deg",F8.1," k",F8.1," K"
7170  WRITE (15,7160)H6,L,A0,A1,A3,D7,S6,T9
7180  PRINT
7190  RETURN 0
7200  R=463
7210  FORMAT 10X,"Xi(K) =",E11.3,5X,"FLUX =",F8.1," F.U.  :",F3.0
7220  WRITE (15,7210)FNZ(NO),S[NO,4],S$
7230  PRINT
7240  RETURN 0
```

```
7300  R=464
7310  Q3=(F2=0)/SINL+(F2=1)*L
7320  Q=N[1,9]
7330  Q2=31.8-(Q>3)*24.7-(Q>4)*2.5-(Q>5)*1.1-(Q>7)*0.3-(Q>9)*0.3-(Q>11)*0.2
7340  RETURN Q2*(N[J,4-F2]*SQR(1/N[1,9]+(Q3-N[20-F2,11])^2/N[22-F2,11]))
9000  GOTO 9990
```

SYMBOL	REFERENCE LINE				
81	75				
330	320				
575	615				
620	595				
630	585				
765	750				
780	760				
790	784				
810	798				
820	814				
1275	1265				
1330	1260				
1368	1325				
1395	66	1373	1385	3146	3150
	3210	3217	4875	5019	
1510	1520				
1590	1485				
1600	1540	3222			
1625	1618				
1645	1700	1720	1748	3214	3215
1655	3015				
1740	1725				
1746	1742				
2168	2164				
3024	3022				
3135	3218	3220			
3140	3136				
3148	3142				
3215	3212				
3216	1672	1676			
3240	3228				
3305	3370				
3370	3360				
3375	3315				
3445	3450				
3500	3490				

SYMBOL	REFERENCE LINE		
3510	3470	3500	
3540	3520		
3550	3435		
3585	3425		
3610	3595		
3820	3840	3982	
3860	3850		
3870	3880		
3885	3860	3870	4165
3955	3947		
3990	3890		
4010	4000		
4045	4015		
4085	4070		
4150	4090		
4170	3825		
4197	4198		
4260	3610		
4405	4370		
4470	4455		
4475	4450	4465	
4580	4576		
4864	4890		
5043	5041		
5175	5200	5225	
5190	5187		
5225	5210		
5900	1382		
5980	6270		
6180	6004		
6360	6345	6730	6780
6390	6305		
6490	6455	6930	
9990	9000		

SYMBOL	REFERENCE LINE				
A	4950	4955	4960		
A$	340	345	350	355	365
	3790	3855	3940	3980	4065
	4152	4155	4172	4820	4845
	5695	5705			
A$[	345	350	355	3945	3950
	3955	4075	4080	4085	4095
	4100	4152	4835		
A0	6462	6470	7170		
A1	6464	6470	7170		
A2	830	5636			
A3	6466	6470	7170		
A4	1697	3196	3212		
A[	385	395	890	895	900
	1685	1690	1705	1740	1741
	3384	3386	5085	5090	5100
	5105	5200	5685		
B	5360	5380	5670		
B$	315	320	325	3905	3955
	4285	4335	4825	4845	
B$[	4290	4840			
B0	465	480	485	750	765
	770	786	800	4920	5585
	5650	5653			
B1	4358	4645	4650		
B2	1040	4910	4920	5653	
B3	1040	4920	5644	5653	5655
B4	460	4602	5350	5465	5631
B5	55	3384	5085	5090	
B6	60	3386	5100	5105	
B9	4602	4915	5350	5465	5470
	5631	5657			
BEEP	285				
C	1355	1360	3410	4880	4930
	6330	6430	6720	6770	6920
C0	400	405	420	430	445
	2160	5620			

SYMBOL	REFERENCE LINE				
C1	560	4900	4915	5657	
C2	4005	4008	4356	4602	4650
	5640				
C2#1	4005	4008			
C3	6750	6840			
C4	6760	6850			
C5	6800	6840			
C6	6810	6850			
C7	5631	5655			
C8	4635	5640			
C9	830	5636			
C[	1405				
D	690	2150	4910	4920	5620
	5653				
D$	945	3226	3575	3705	4175
D$[	3720	3905			
D0	4905				
D1	790	5636			
D2	780	782	5631		
D3	4645				
D4	1743	3132	6330	6360	6430
	6490	6720	6770	6920	7120
D5	6740	6830			
D6	6790	6830			
D7	61	6965	6970	7170	
D8	835	5640			
D9	840	5640			
DISP	220	224	228	310	605
	1410	1460	1475	1616	2145
	2155	2162	2168	3020	3128
	4864	5000	5010	5080	5095
	5810	5830	5905	5945	5990
	6040	6060	6080	6100	6120
	6140	6180	6210	6230	6250
	6360	6490			

SYMBOL	REFERENCE LINE				
D[	1700	5200	5327	5334	5350
	5510	5662	6460	6480	6830
	6940	7120			
E	3345	3350			
	3990	4005	4008	4010	4155
	4335	4650			
E0	740	4360	4650		
E1	745	4360	4650		
E11	1035	7210			
E2	790	4360	4650		
E3	795	4360	4650		
E4	796	800	4360	4650	
E5	810	4360	4650		
E6	812	815	4360	4650	
E7	830	4360	4650	5360	5380
	5668	5670			
E8	835	4360	4650		
E9	840	4357	4650		
ENTER	590				
F	64	390	415	430	500
	525	690	788	795	1360
	1725	1728	2170	3026	3090
	3138	4335	4900	4905	4910
	4920	4940	4950	4955	5040
	5042	5200	5653	5680	6350
	6860	6950	6960	6970	7120
	3136	5041			
F0	4955				
F2	1655	3615	3915	3995	4550
	4560	4578	4580	4585	4600
	4615	4840	4845	7310	7340
F3	61	1710	1720	2170	5333
	5634	7110	7210		
F4	645	1605	1665	1675	3213
	5165	5178	5190	5333	
F5	62	1615			
	3125	3142	3218	5170	

SYMBOL	REFERENCE LINE				
F6	1400	1615	3135	3217	3228
	5170				
F7	61	1680	3055	3060	
	4995	5022	5025	5190	
	5195	5910			
F8	1480	1485			
F9	62	930	3060	3090	
	5015	5025			
FNA(	69	5670			
FNB(	275				
FNB2	3021	4865	5085		
FNB3	1415	6000			
FNB5	6030	6110	6190	6370	6500
FNC(	565				
FNC0	4268				
FNC1	3240	3415	3695	5150	5332
FND(	205				
FNDD[	5322	5334	5336	5360	5362
	5379	5380	5498	5500	5502
	5670				
FNE(	730				
FNENO	4620				
FNF(	1370				
FNF1	1440	5018			
FNF10	4380				
FNF2	3730	4268	4555		
FNF3	5590				
FNF4	1746				
FNF5	1746	4380			
FNF6	4380				
FNF7	1470	3023	3148	5018	
FNF8	3775	3852	4170		
FNF9	1746	4380			
FNG(	1250	4485			
FNGN9	3485				
FNH(	910				
FNH0	3730	4268			

SYMBOL	REFERENCE LINE				
FNH1	3240	3415	3695	4268	5332
FNI(	335				
FNI3	3695	4268			
FNI4	4380				
FNI5	3005	5332	5515		
FNJ(	1387				
FNJ2	65	1730	2175	3139	5043
FNJ3	3120				
FNJ4	3140				
FNJ5	1530	3140			
FNJ6	3240				
FNJ7	3144				
FNK(	375	560			
FNKNO	3695	4005	4268	4575	5332
FNL(	3565				
FNL1	3140				
FNL2	3140				
FNL3	3140				
FNL6	3140				
FNL7	3140				
FNL8	3140				
FNM(	865				
FNM1	3695	4268			
FNM3	5332				
FNN(	226	230	305	5085	5100
FNNO	1415	1617			
FNN1	1480	2163	3021		
FNNCO	2160				
FNND	2150				
FNNF	2170				
FNNF7	5910				
FNNF9	5015				
FNNINT(	222				

SYMBOL	REFERENCE LINE				
FNNN[	1465	3130	5820	5840	6000
	6050	6070	6150	6220	6240
	6260				
FNNQ	1376				
FNNV8	5005				
FNO(	1375				
FNQ(	200				
FNQL	465	5650			
FNR(	218				
FNRN[	6090	6130			
FNS(	705	1530	4180	4414	
FNS1	4268	4340	4380	5332	5515
	5590				
FNS10	3023				
FNS13	1746				
FNS15	3555				
FNS2	1695	4275	5332	5355	5485
	6030	6110	6190		
FNS3	3415	3545	3695	3730	4405
	5150	5515			
FNS30	3095	3375			
FNS4	3415				
FNS5	3010				
FNS6	1530	3205	3240		
FNSQ	575	870			
FNT(	206	226	230		
FNU(	1380	1744	1746		
FNU0	1625				
FNU1	1625				
FNU10	3990	4575			
FNU11	3615	4268			
FNU2	2165				
FNU3	84	485			
FNU4	87	480	786	6965	
FNV(	1383				

SYMBOL	REFERENCE LINE				
FNV1	4005	4008	4315		
FNV10	5205	5322			
FNV11	5018				
FNV12	3023	3148	3216		
FNV13	1746	4620			
FNV2	1470				
FNV3	3615				
FNV4	3515				
FNV5	3540				
FNV6	1590	3221			
FNV7	1505				
FNV8	1515				
FNV9	4615				
FNZ(	560	1040	7220		
FNZNO	820	5395			
FORMAT	52	53	360	620	645
	685	875	885	935	1026
	1035	1355	1360	1620	3075
	3085	3285	3295	3745	3795
	3805	3975	4060	4150	4300
	4345	4355	4830	5140	5333
	5335	5338	5345	5365	5375
	5490	5505	5580	5605	5615
	5626	5630	5634	5638	5700
	7110	7140	7160	7210	
F[	1365	1366	1405		
G	820	1355	4615	4617	4910
	4915	5657			
G4	400	440	5620		
G5	420	440	5620		
G6	430	440	5620		
G[	1340	1345	1350	1405	3532
	3534	4495	4515	4520	4540
H	1655				
H$	580	1690			
H1	810	4575	4578	5631	

SYMBOL	REFERENCE LINE				
H5	6830	6840	6850		
H6	6940	6960	7170		
H7	6765	6840	6850		
H9	61	3028	5631	5644	5646
I	280	290	295	710	720
	3035	3040	3045	3050	3300
	3305	3310	3315	3325	3330
	3335	3340	3355	3360	3440
	3445	3450	3455	3460	3465
	3480	3510	3710	3715	3720
	3725	3810	3820	3825	3830
	3835	3885	4196	4197	4198
	4200	4202	4215	4925	4930
	4935	4940	4945	4947	4950
	4960	4965	4970	4975	5045
	5050	5055	5060		
I5	3660	3690	3750	3895	3930
	4010	4045	4945	4960	
INV(	1355				
J	3340	3355	3430	3435	3455
	3480	3490	3495	3500	3505
	3520	3550	3580	3585	3590
	3595	3885	3915	3995	4000
	4285	4435	4440	4445	4450
	4455	4495	4500	4505	4510
	4515	4520	4525	4530	4535
	4540	4576	4578	4600	4602
	4835	4845	7340		
J1	525	530	3885	3895	3980
	5636				
K	550	560	1040	5460	
K1	455	460	550	745	800
	1040	5470			
K2	490	550	790	800	1040
K3	495	550	1040		
K4	505	550			
K5	505	550			
K6	505	550	1040		
K7	505	550			
K8	530	550	800	835	1040
K9	545	550	800	840	1040

SYMBOL	REFERENCE LINE				
L	200	455	525	535	3692
	3865	3870	3875	3890	4050
	4160	4280	4335	4410	4580
	5585	5655	5662	5665	7170
	7310				
L$	0	930			
L0	3585	3610	4370		
L1	1655	3830	3840	3865	3890
	3900	3915	3935		
L4	410	440	5620		
L5	425	440	5620		
L6	435	440	5620		
L7	385	415	430	445	900
L8	445	535	5620		
L9	450	535	5620		
LGT(	4005	4008	4335	4578	5452
	5655				
LGTG	5631				
LGTM	5450				
M	52	1620	3410	4585	4610
	4617	4880	5140	5400	
M1	1270	1280	1330	1340	1345
	1366	3530	4525		
M2	1270	1285	1335	1345	1350
	1366	3528	4500		
M3	1270	1290	1330	1335	1365
	1366	4490	4500	4525	
M[	1405	1530	1670	1747	3000
	3310	3325	3330	3335	3340
	3355	3405	3420	3425	3450
	3455	3460	3465	3480	3825
	3830	3835	3885	4198	4200
	4202	4205	4207	4215	4885
	5185	5207	5208	5350	5380
	5450	5452	5463	5465	5470
	5510	5665	5670	5680	5685
N	53	5970	5980	5995	6220
	6240	6260	6330	6430	6720
	6770	6920			

SYMBOL	REFERENCE LINE				
NO	72	375	485	490	560
	730	784	790	798	800
	814	815	1040	1742	1744
	1746	3135	4215	4640	5460
	5636	5665	5668	7220	
N1	3710	4925			
N2	1675	1676	1685	5350	
N3	3810	3845	3850	3860	4955
	4960				
N4	1655				
N5	570	650			
N6	650	1741	5350		
N7	1740	5350			
N8	1670	1672	2995	5185	5187
	5188	5208	5210	5350	5380
	5450	5452	5463	5465	5470
	5510	5665	5670	5680	5685
N9	1270	1275	1330	1335	1340
	1345	1350	1365	1366	3440
	3525	3526	3528	3530	4490
	4500	4505	4525	4530	
N[	63	200	780	920	940
	1465	3026	3028	3040	3045
	3090	3130	3455	3490	3495
	3500	3505	3526	3528	3530
	3532	3534	3595	3915	3995
	4440	4445	4455	4495	4500
	4505	4510	4515	4520	4525
	4530	4535	4540	4578	4585
	4600	4615	4845	5040	5050
	5055	5350	5585	5636	5640
	5644	5655	5820	5840	6000
	6050	6070	6090	6120	6130
	6150	6210	6220	6240	6260
	6310	6340	6350	6410	6450
	6462	6464	6466	6710	6735
	6740	6750	6760	6765	6790
	6800	6810	6820	6910	6940
	7320	7340			
OF	72	915	1372	1381	1384
	1390	1420			
P	1290	1310	1315	1320	3480
	3490	3495	3500	3505	

SYMBOL	REFERENCE LINE				
P$	1685	3030	5065		
P$[	665	675	1743	3132	
P1	782	790	5631		
PI	4900				
Q	65	205	206	208	212
	275	280	305	310	330
	335	345	390	400	405
	410	415	420	480	485
	500	535	540	565	575
	590	625	630	675	705
	710	788	790	865	870
	895	900	910	915	1250
	1260	1265	1370	1372	1375
	1376	1380	1381	1387	1390
	1415	1420	1440	1470	1505
	1515	1530	1590	1617	1618
	1625	1695	1710	1720	1730
	1744	1746	2163	2164	2165
	2175	2995	3000	3005	3010
	3021	3022	3023	3055	3095
	3120	3139	3140	3144	3148
	3205	3216	3221	3240	3310
	3315	3345	3355	3375	3415
	3485	3515	3540	3545	3555
	3660	3695	3730	3775	3852
	3895	3955	4010	4015	4020
	4070	4075	4080	4090	4095
	4100	4170	4180	4268	4275
	4315	4340	4356	4357	4358
	4360	4380	4405	4414	4445
	4450	4455	4470	4485	4555
	4580	4585	4600	4615	4620
	4865	4870	4875	4880	4930
	4935	4940	4960	4965	5018
	5022	5043	5150	5190	5202
	5205	5332	5355	5379	5380
	5460	5465	5470	5485	5502
	5510	5515	5590	6000	6004
	6030	6110	6190	6370	6500
	7320	7330			
Q0	218	222	226	230	765
	770	775	1383	1384	3325
	3355	3565	3580	3585	4357
	4360				

SYMBOL	REFERENCE LINE				
Q1	208	210	212	590	595
	610	625	770	775	786
	787	788	3060	3090	3330
	3355	4358	4360	4412	4414
	4435	4440	4445	4880	4885
	5025	6330	6345	6350	6430
	6455	6462	6464	6466	6720
	6730	6735	6740	6750	6760
	6765	6770	6780	6790	6800
	6810	6920	6930	6940	
Q2	210	212	395	400	405
	410	420	425	430	445
	460	485	490	530	545
	755	775	782	787	788
	3335	3355	4940	4965	4970
	6460	6470	7330	7340	
Q3	222	226	230	232	1705
	1710	1725	1728	3995	4935
	4940	4950	5498	5510	6470
	6480	7310	7340		
Q4	69	75	78	81	84
	87	226	230	232	4947
	4950	5500	5510		
Q5	230	232	5327	5380	
Q6	5995	6000	6050	6070	6090
	6120	6130	6150	6210	
R	1020	1395	1425	1500	1600
	1645	1715	2140	2990	3018
	3025	3118	3165	3195	3225
	3255	3380	3570	3815	4190
	4260	4365	4430	4480	4548
	4570	4815	4863	4895	4985
	5008	5017	5020	5075	5130
	5175	5320	5574	5600	5624
	5633	5642	5648	5660	5690
	5800	5900	5940	5960	6300
	6400	6700	6900	7000	7100
	7200	7300			
R1	3660	3750	3895	3930	4045
	4440	4450	4455	4460	
R2	1365	4490	4505	4530	
R5	62	6735	6840	6850	

SYMBOL	REFERENCE LINE				
REDIM	1405	3405	3420	4195	4420
	5160	6310	6340	6410	6450
	6710	6820	6910		
S	540	545	4360	4505	4510
	4515	4640	4650		
S$	1690	3350	3355	3715	3720
	5208	5370	7220		
S1	6840	6870			
S2	6850	6870			
S3	4530	4535	4540		
S5	6860	6870			
S6	6950	6960	7170		
SEARCH	4880	6330	6430	6720	6770
	6920				
SERROR	1510	1525	1650	3219	
SORT	3410				
STAT3	585				
STORE	3065	3070			
S[	560	800	1040	4940	4945
	4970	5460	6870	6890	6970
	6980	7120	7220		
T	820	4617	5631		
T1	3995	4005	4008	4045	4155
	4335	4600	4602		
T2	3835	3980			
T6	1655				
T9	6960	6970	7170		
TRANSFER	3030	3350	3715	4285	4835
	4840	5065			
T[	58	485	815	3030	3040
	3045	3350	3715	4285	4640
	4835	4840	4930	4935	4940
	4945	4947	4950	4960	4965
	5050	5055	5065	5636	5640
U	1675	5950			
U1	1676	5950			
V	1675	5950			
V1	1270	1295	1340		
V2	1270	1300	1350		

SYMBOL	REFERENCE LINE				
V3	1270	1305	1345		
V4	1270	1310	1330		
V5	1270	1315	1335		
V6	1270	1320	1365	4490	5362
	5380	5390	5452		
V8	61	930	3090	5005	5350
W	500	795			
W1	3915	3930			
WRITE	365	625	650	690	880
	900	940	1030	1040	3080
	3090	3290	3355	3750	3800
	3935	3980	4155	4335	4350
	4360	4845	5334	5336	5340
	5350	5370	5380	5495	5510
	5585	5610	5620	5628	5631
	5636	5640	7120	7150	7170
	7220				
X	645	685	875	935	1366
	3075	3745	3795	3900	3905
	3930	3947	3950	4045	4070
	4075	4080	4085	4090	4095
	4100	4300	4830	5365	5580
	7110	7210			
X$	580				
X1	1285	1300	1305	1315	3465
	3470	3475	5395	5400	5452
X2	1280	1295	1305	1310	3475
X5	3572	3979	4154	4180	
Y	820	825	1360	5390	5400
	5460	5463	5510	5631	
Y1	4360	4635	4650		
Y5	825	830	4635		
Y[	1330	1335	1365	1405	4195
	4200	4202	4205	4207	4210
	4280	4412	4420	4495	4505
	4520	4530	5160		
Z	5322	5380	5390		
Z1	440	455	5620		
Z5	1510	1520	1525	1650	3210
	3212	3215	3219		

SYMBOL	REFERENCE LINE		
ZER	53		
ZER[	52	1620	5140

LINES: 894 BYTES: 21516 SYMBOLS: 389 REFERENCES: 2114

```
                                        RUN
                                         |
10:        >>==============          INITIALIZE
190:         >TRAP>>          FILES:(1)LIST, (2)SPLIT, (3)MOVE
                                     |        |        |
                                    310:     470:     5000


310:         >>==============            (1)LIST
320:              (690: FNF1)       DEVISE LOAD FROM?
320:              (790: FNF8)    LOAD FILES:START#, STEP?
                                         |
354:         >---------------         NEXT FILE
356:                                 IF LAST FILE            ---------------->190:TRAP
362:              (1010: FNF3)        LOAD FILE
365:              (1075: FNF14)      PRINT FILE INTO             ------------>354:NEXT


470:         >>=============           (2)SPLIT
472:              (690: FNF1)       DEVISE LOAD FROM?
472:              (790: FNF8) LOAD FILES:START#,STOP#,STEP?
                                         |
480:         >--------------          NEXT FILE
482:                                 IF LAST FILE            ------------------>510: -
490:              (1010: FNF3)        LOAD FILE                                      |
490:              (1075: FNF14)      PRINT FILE INFO                                 |
495:                                 GOTO NEXT FILE            ------------>480:     |
                                                                                     |
                                                                                     |
510:         >------------          STORE SEQUENCE                      <------------
510:              (1330: FNF7)      STORE FREQ#?
510               ( 772: FNF6)      STORE DEVICE?
510:              (1312: FNF9)      STORE:(STARTING FILE#),STEP?
510:              (1530: FNF5)      SPLIT & STORE FILE              ------------>510:


5000:      >>==============         (3)MOVE
5010:             (690:  FNF1)      DEVICE LOAD FROM?
5010:             (790:  FNF8)      LOAD FILES STAR#,STOP#,STEP?
5010:             (772:  FNF6)      DEVICE STORE TO?
5010:             (1312: FNF9)      STORE:(STARTING FILE#),STEPK?
5300:             (5300: FNF13)     FREQ to be MOVED(O=ALL)?
                                         |
5050:        >---------------         NEXT FILE                           <----------
5065:                                IF LAST FILE          ---------------->190:TRAP |
5080:             (1010:  FNF3)       LOAD FILE                                      |
5082:                                STORE FILE           ---------------->5050:NEXT:
```

```
10   COM D$[25],H$[50],P$[40],S$[5],AI[10],DI[6,75],NO,X$[21],E$[8]
50   REM (1)LOAD DATA,(1.1)STORE DATA,(2)FNB(N)=COM TO MAT B to Nth SET OF 7 ROWS
70   REM (4)FNX(N.M5)=Nth FILE,FREQ M5 to COM (M5=0 DOES ALL FREQS)
90   REM  7 ROWS OF  MAT B per DATA FILE
100  REM B(1,74)=N4,FNQ(Q)= STORE CONDITION(1=STORE)
105  DEF FNQ(Q)=((Q=0) OR (A[2]=Q))
110  DIM BI[147,75],B$[11],R$[50]
115  DISP "PROG EXT(5),INT(10)";
116  INPUT Q
120  LOAD  KEY #Q,2
125  R$="NBS1F.39    DATA SPLIT  <D1-F27>"
130  D4=F7=I=J=K=M1=M2=M3=M5=M6=N=N1=N2=N3=N4=N5=N6=N8=N9=Q=Q1=Q7=R=0
150  D4=1979
170  MAT B=ZER
175  DEF FNJ(Q)
180  GOTO Q OF 500
190  R=0.1
210  DISP "FILES:(1)LIST,(2)SPLIT,(3)MOVE";
230  BEEP
250  INPUT Q7
270  GOTO Q7 OF 310,470,5000
290  GOTO 190
310  R=0.11
320  Q=FNF1+FNF8+FNF2
325  PRINT TAB17,"N4 =  number of INTERATIONS in NONLINSFIT"
352  N=N1-N3+FNS2+FNF11
354  N=N+N3
356  IF N>N2 THEN 375
360  SERROR E,384
362  N4=FNF3+D[1,69]
365  Q=FNF14
370  GOTO 354
375  SERROR E,190
380  Q=FNS2
382  GOTO 190
384  R=0.111
385  WAIT 100
386  PRINT "FILE #";N;
394  GOTO 354
```

```
470  R=0.12
471  N4=0
472  Q=FNF1+FNF8+FNF2
474  PRINT TAB30,"N4=SET# in MAT B"
476  Q=FNS1+FNF11
478  N=N1-N3
480  N=N+N3
482  IF N>N2 THEN 500
485  SERROR E,495
490  Q=FNF3+FNF14
495  GOTO 480
500  Q=FNS2
505  SERROR E,190
510  Q=FNF7+FNF6+FNF9+FNF4+FNS1+FNF5
550  GOTO 500
630  REM 1=LOAD FROM,2=PAGE HEADER,3=LOAD FILE,4=STORE HEADER,5=SPLIT&STORE FILES
640  REM FNF6=STORE TO?,7=STORE FREQ #,8=LOAD START#,9=STORE START#
645  REM FNF11=LOAD HEAD,12=STORE MAT B,13=FREQ SELECT FOR MOVE,14=PRT STORE INFO
650  DEF FNF(Q)
670  GOTOQOF 690,840,1010,1410,1530,772,1330,790,1312,190,920,190,5300,1075
690  R=1
710  DISP "LOAD from INT TAPE=0,EXT=1";
730  BEEP
750  INPUT F7
770  RETURN 0
772  R=1.001
774  DISP "STORE to INT TAPE=0,EXT=1";
776  BEEP
778  INPUT F8
780  RETURN 0
790  R=1.01
810  DISP "LOAD FILES:START#,STOP#,STEP";
815  INPUT N1,N2,N3
820  RETURN 0
822  R=1.011
824  DISP "N4=START SET #(MAT B)";
826  INPUT N4
828  N4=N4-1
830  RETURN 0
840  R=1.012
850  LOAD  DATA #(10-F7*5),N1
870  N6=INT(A[1]/100)
890  M6=D[5,75]
910  Q=FNC5+FNS5
915  RETURN 0
920  R=1.013
930  FORMAT "  LD  N4  RN/ST  STAR  FREQ  #  EL     DATE",8X,"REMARKS",/
950  WRITE (15,930)" FILE"
970  PRINT
990  RETURN 0
```

```
1010  R=1.02
1070  LOAD  DATA #(10-F7*5),N
1072  RETURN 0
1075  R=1.021
1090  IF D[4,2]<100 THEN 1310
1110  FORMAT F4.0,F4.0,F7.2,2X,F5.0,F3.0,F4.0,2X,2F6.0
1150  IF INT(N/3)#N/3 THEN 1190
1170  PRINT
1190  IF Q7=1 OR Q7=3 THEN 1250
1210  N4=N4+1
1230  Q=FNBN4
1250  WRITE (15,1110)N,N4,A[1]/100,S$,A[2],D[5,75],D[4,2]/100,P$[1,12]," "D$;E$
1310  RETURN 0
1312  R=1.03
1314  DISP "STORE:(STARTING FILE #),STEP";
1316  INPUT M1,M3
1320  M2=M1+N4-1
1325  RETURN 0
1330  R=1.1
1350  DISP "STORE FREQ #";
1370  INPUT M5
1380  RETURN 0
1410  R=1.01
1450  Q=FNS2
1470  FORMAT "STORE  RUN/SET  STAR   FREQ   ELEV      DATE",8X,"REMARKS",/
1490  WRITE (15,1470)" FILE"
1510  RETURN 0
1530  R=1.2
1550  N8=N9=0
1570  FOR N=M1 TO M2 STEP M3
1590  N9=N9+1
1594  IF B[7*N9-2,75] >= M5 THEN 1610
1596  N8=N8+1
1598  GOTO 1730
1610  Q=FNX(N9+M5/10)
1630  FORMAT F4.0,F9.2,3X,F6.0,F6.0,3X,2F6.0
1645  A[1]=A[1]+10000*(M5-1)
1650  WRITE (15,1630)N-N8*M3,A[1]/100,S$,A[2],D[4,2]/100,P$[1,12],"  "D$;E$
1670  STORE  DATA #(10-5*F8),N-N8*M3
1690  IF INT(N/3)#N/3 THEN 1730
1710  PRINT
1730  NEXT N
1750  Q=FNS5
1790  RETURN 0
```

```
1810  R=2
1830  DEF FNB(Q)
1850  FOR I=1 TO 6
1870  FOR J=1 TO 75
1890  B[7*Q-7+I,J]=D[I,J]
1910  NEXT J
1930  NEXT I
1950  TRANSFER D$ TO B[7*Q,1]
1970  TRANSFER E$ TO B[7*Q,14]
1990  TRANSFER P$ TO B[7*Q,18]
2010  TRANSFER S$ TO B[7*Q,38]
2030  TRANSFER X$ TO B[7*Q,41]
2050  TRANSFER H$[5,8] TO B[7*Q,63]
2070  FOR I=1 TO 10
2090  B[7*Q,65+I]=A[I]
2110  NEXT I
2130  B[7*Q,75]=NO
2140  B[1,71]=N4
2150  RETURN 0
2170  R=3
2190  R=4
2210  REM M5=FREQ # (0=ALL FREQ)
2230  DEF FNX(N)
2250  M5=10*(N-INT(N))
2270  N=INTN
2290  M6=B[7*N-2,75]
2310  IF M6 THEN 2350
2330  M6=1
2350  MAT D=ZER
2370  FOR I=1 TO 6
2390  K=0
2410  FOR J=1 TO 75
2430  IF M5=0 THEN 2490
2450  IF J<8 THEN 2490
2470  IF INT((J-7-M5)/M6)-(J-7-M5)/M6 THEN 2530
2490  K=K+1
2510  D[I,K]=B[7*N-7+I,J]
2530  NEXT J
2550  NEXT I
2570  IF M5=0 THEN 2690
2590  FOR I=1 TO 6
2610  D[I,3]=INT((B[7*N-7+I,3]+M6-M5)/M6)
2630  D[I,7]=(B[7*N-7+I,7]+100*(M6-M5))/M6
2650  NEXT I
```

```
2670  D[5,75]=1
2680  D[6,75]=B[7*N-2,75]*B[7*N-1,75]
2690  TRANSFER B[7*N,1] TO D$
2710  TRANSFER B[7*N,14] TO E$
2730  TRANSFER B[7*N,18] TO P$
2750  TRANSFER B[7*N,38] TO S$
2770  TRANSFER B[7*N,41] TO X$
2790  TRANSFER B[7*N,63] TO H$[5,8]
2810  FOR I=1 TO 10
2830  A[I]=B[7*N,65+I]
2850  NEXT I
2870  IF M5=0 THEN 2910
2890  A[2]=B[7*N-7+M5,75]
2910  NO=B[7*N,75]
2930  RETURN 0
2950  DEF FNC(Q)
2970  N5=N5+1
3070  Q=FNSQ
3310  Q=20
3330  PRINT R$
3350  PRINT
3370  PRINT H$;":      ";X$[1,4],TAB50,X$[5]
3390  PRINT
3410  PRINT
3430  FORMAT 35X,F4.0,"-",/,"Sysm #",F5.2,59X,"RUN",F5.0
3450  WRITE (15,3430)-N5,6,N6
3470  PRINT
3510  PRINT TAB20,P$[13]
3530  IF FLAG9 THEN 3670
3550  PRINT TAB(Q),P$[1,3];":  ";P$[9,12];" ";P$[4,6];" ";P$[7,8];
3570  FORMAT /,19X,F5.0," MHz ",2F2.0
3590  B$="#ox."
3610  FOR M5=1 TO M6
3630  WRITE (15,3570)D[M5,75];B$[M5,M5];",";
3650  NEXT M5
3670  RETURN 0
3690  DEF FNS(Q)
3710  FOR I=1 TO Q
3730  PRINT
3750  NEXT I
3770  RETURN 0
```

```
3790  R=3
3810  REM LIST FILES
3830  Q=FNF1+FNF2
3850  GOTO 190
3870  R=4
3890  REM SPLIT FILES
3910  WRITE (15,930)" FILE"
3930  PRINT
3950  FOR I=102 TO 122
3970  LOAD  DATA #5,I
3990  A[1]=A[1]+3000
4010  WRITE (15,1110)I,A[1]/100,S$,A[2],D[5,75],D[4,2]/100,P$[1,12]," "D$;E$
4030  STORE  DATA #5,I
4050  NEXT I
4070  END
5000  R=5
5005  N8=0
5010  Q=FNF1+FNF8+FNF6+FNF9+FNF13+FNF2
5020  PRINT TAB30,"N4=STORE file #"
5030  PRINT
5035  N=FNF11+N1-N3
5040  N4=M1-M3
5050  N=N+N3
5065  IF N>N2 THEN 210
5070  SERROR E,5040
5080  Q=FNF3
5082  R=5.1
5084  IF FNQN8=0 THEN 5050
5086  N4=N4+M3
5088  Q=FNF14
5098  STORE  DATA #(10-F8*5),N4
5100  GOTO 5050
5200  R=6
5210  DISP "STORE MAT B (1=YES)";
5220  INPUT Q
5230  IF Q#1 THEN 5250
5240  STORE  DATA 4,B
5245  REWIND
5250  RETURN 0
5300  R=7
5310  DISP "FREQ(MHz) to be MOVED (0=ALL)";
5320  INPUT N8
5330  RETURN 0
```

SYMBOL	REFERENCE LINE				
190	290	382	3850		
210	5065				
354	370	394			
375	356				
480	495				
500	482	550			
1190	1150				
1250	1190				
1310	1090				
1610	1594				
1730	1598	1690			
2350	2310				
2490	2430	2450			
2530	2470				
2690	2570				
2910	2870				
3070	3210				
3110	3092				
3250	3130				
3310	3090				
3670	3530				
5050	5084	5100			
5250	5230				
A$	3250				
A$[	3290				
AI[	0				
A[	105	870	1250	1645	1650
	2090	2830	2890	3990	4010
B	170				
B$	3590				
B$[	110	3630			
BEEP	230	730	776	3096	
BI[	110				

SYMBOL	REFERENCE LINE				
B[	1594	1890	1950	1970	1990
	2010	2030	2050	2090	2130
	2140	2290	2510	2610	2630
	2680	2690	2710	2730	2750
	2770	2790	2830	2890	2910
COM	0				
D	2350				
D$	1250	1650	1950	2690	4010
D$[	0				
D4	130	150	3098	3290	
DISP	115	210	710	774	810
	824	1314	1350	3094	3170
	5210	5310			
DI[	0				
D[	362	890	1090	1250	1650
	1890	2510	2610	2630	2670
	2680	3630	4010		
E	360	375	485	505	5070
E$	1250	1650	1970	2710	4010
E$[	0				
F7	130	750	1110		
F8	778				
FLAG9	3530				
FNB(	1830				
FNBN4	1230				
FNC(	2950				
FNC5	910				
FNF(	650				
FNF1	320	472	3830	5010	
FNF10	472				
FNF11	352	476	5035		
FNF12	510				
FNF13	5010				
FNF14	365	490	5088		
FNF2	320	472	3830	5010	
FNF3	362	490	5080		
FNF4	510				

SYMBOL	REFERENCE LINE				
FNF5	510				
FNF6	510	5010			
FNF7	510				
FNF8	320	472	5010		
FNF9	510	5010			
FNJ(	175				
FNQ(	105				
FNQN8	5084				
FNR3	3110				
FNS(	3690				
FNS1	476	510			
FNS2	352	380	500	1450	
FNS5	910	1750			
FNSQ	3070				
FNX(	1610	2230			
FORMAT	170	930	1110	1470	1630
	2350	3230	3270	3430	3570
H$	3370				
H$[	0	2050	2790		
I	130	1850	1890	1930	2070
	2090	2110	2370	2510	2550
	2590	2610	2630	2650	2810
	2830	2850	3710	3750	3950
	4010	4050			
J	130	1870	1890	1910	2410
	2450	2470	2510	2530	
K	130	2390	2490	2510	
KEY	120				
M1	130	1316	1320	1570	5040
M2	130	1320	1570		
M3	130	1316	1570	1650	5040
	5086				
M5	130	1370	1594	1610	1645
	2250	2430	2470	2570	2610
	2630	2870	2890	3610	3630
	3650				
M6	130	890	2290	2310	2330
	2470	2610	2630	3610	

SYMBOL	REFERENCE LINE				
N	130	352	354	356	386
	478	480	482	1150	1250
	1570	1650	1690	1730	2230
	2250	2270	2290	2510	2610
	2630	2680	2690	2710	2730
	2750	2770	2790	2830	2890
	2910	5035	5050	5065	
NO	0	2130	2910		
N1	130	352	478	815	5035
N2	130	356	482	815	5065
N3	130	352	354	478	480
	815	5035	5050		
N4	130	362	826	828	1210
	1250	1320	2140	5040	5086
N5	130	2970	3092	3450	
N6	130	870	3450		
N8	130	1550	1596	1650	5005
	5320				
N9	130	1550	1590	1594	1610
OF	180	270	670		
P$	1990	2730			
P$[	0	1250	1650	3510	3550
	4010				
Q	105	116	120	130	175
	180	320	365	380	472
	476	490	500	510	650
	670	910	1230	1450	1610
	1750	1830	1890	1950	1970
	1990	2010	2030	2050	2090
	2130	2950	3070	3110	3130
	3250	3310	3550	3690	3710
	3830	5010	5080	5088	5220
	5230				
Q1	130	3190	3250		
Q7	130	250	270	1190	
R	130	190	310	384	470
	690	772	790	822	840
	920	1010	1075	1312	1330
	1410	1530	1810	2170	2190
	3790	3870	5000	5082	5200
	5300				
R$	125	3330			

SYMBOL	REFERENCE LINE				
R$[	110				
REWIND	5245				
S$	1250	1650	2010	2750	4010
S$[	0				
SERROR	360	375	485	505	5070
STAT3	3090				
STORE	1670	4030	5098	5240	
TRANSFER	1950	1970	1990	2010	2030
	2050	2690	2710	2730	2750
	2770	2790			
WRITE	950	1250	1490	1650	3290
	3450	3630	3910	4010	
X	930	1110	1470	1630	3270
	3430	3570			
X$	2030	2770			
X$[	0	3370			
ZER	170	2350			

LINES: 275 BYTES: 6017 SYMBOLS: 130 REFERENCES: 518

```
                                          RUN
                                           |
                                           |
10:                               INITIALIZE PROGRAM
                                           |
                                           |
150:      >>--------------            START PROGRAM
                  (2050: FNF2)          DATA DEVICE?
                  (2150: FNF3)          LOAD FILE START #?
                  (2100: FNF6)          STORE DEVICE?
                  (2460: FNF7)          STORE FILE START #?
                                           |
                                           |
                                           |
200:      >>----------------             NEXT FILE
                                         LAST FILE          --------------------> 150:
                  (2350: FNF5)           LOAD FILE
                  (5020: FNQ1)          FIND AND REPLACE BAD POINTS
                  (2600: FNF9)          STORE RESULTS               ----------------> 200:
```

```
10   COM D$[25],H$[50],P$[40],S$[5],AI[10],DI[6,75],NO,X$[21],E$[8]
53   REM <10 THRU 145> DEMONSTRATE THE USE OF THE CHECKCUT VER I.0
54   REM CHECKCUT IS CALLED VIA FNQ(Q) AND RETURNS THE NUMBER OF ACTIONS TAKEN
55   REM THE VALUE OF THE ARGUMENT IN THE FNQ( ) CALL IS A DUMMY (NOT USED)
60   DIM R$[50],B$[11]
70   DISP "PROG EXT(5),INT(10)";
80   INPUT Q
95   M1=M3=0
90   LOAD  KEY #Q,2
100  R$="NBS1G.09    CHECKSET  <D1-F29>"
110  N5=0
120  DEF FNJ(Q)
135  R=1
148  R=2
150  Q=FNF2+FNF3+FNF6
160  IF F7=F8 THEN 175
170  Q=FNF7
175  LOAD  DATA #(10-F7*5),N1
180  Q=FNF1+FNF4
190  N=N1-N7
195  N8=0
200  N=N+N7
210  IF N>N2 THEN 250
220  SERROR E,270
222  Q=FNF5
224  IF NO#6 OR A[2]#7300 THEN 200
226  N8=N8+1
230  Q=FNQ1+FNS2+FNF8+FNF9+FNS3+FNF4
240  GOTO 200
250  SERROR E,135
260  GOTO 135
270  R=3
280  WAIT 100
290  PRINT "FILE #";N;
300  GOTO 200
1990 R=4
2000 REM FNF1=PAGE HEADER,2=LOAD FROM,3=LOAD START#,4=LOAD HEADER,5=LOAD FILE
2010 REM FNF6=STORE TO?,7=STORE START#,8=STORE HEADER,9=STORE FILE
2030 DEF FNF(Q)
2040 GOTO Q OF 2240,2050,2150,2300,2350,2100,2460,2550,2600
2050 R=5
2060 DISP "CHECKSET:LOAD from INT TAPE=0,EXT=1";
2070 BEEP
2080 INPUT F7
2090 RETURN 0
```

```
2100  R=6
2110  DISP "STORE to INT TAPE=0,EXT=1";
2120  BEEP
2130  INPUT F8
2140  RETURN 0
2150  R=7
2160  DISP "LOAD FILES:START#,STOP#,STEP";
2170  INPUT N1,N2,N7
2180  RETURN 0
2240  R=8
2250  LOAD  DATA #(10-F7*5),N1
2270  M6=D[5,75]
2280  Q=FNC5+FNS5
2290  RETURN 0
2300  R=9
2310  FORMAT "  LDfile  RN/ST  STAR  FREQ  #  EL     DATE",8X,"REMARKS"
2320  WRITE (15,2310)
2340  RETURN 0
2350  R=10
2360  LOAD  DATA #(10-F7*5),N
2370  IF D[4,2]<1000 THEN 2450
2380  FORMAT F4.0,F11.2,2X,F5.0,F3.0,F4.0,2X,2F6.0
2440  WRITE (15,2380)N,A[1]/100,S$,A[2],D[5,75],D[4,2]/100,P$[1,12]," "D$;E$
2450  RETURN 0
2460  R=11
2470  DISP "STORE:(STARTING FILE #),STEP";
2480  INPUT M1,M3
2500  RETURN 0
2550  R=12
2560  Q=FNS2
2570  FORMAT "STORE  RUN/SET  STAR   FREQ   ELEV      DATE",8X,"REMARKS"
2580  WRITE (15,2570)
2590  RETURN 0
2600  R=13
2608  Q=N+(F7#F8)*(M1-N-M3+N8*M3)
2610  STORE  DATA #(10-5*F8),Q
2620  FORMAT F4.0,F9.2,3X,F6.0,F6.0,3X,2F6.0
2630  WRITE (15,2620)Q,A[1]/100,S$,A[2],D[4,2]/100,P$[1,12],"  "D$;E$
2640  RETURN 0
2700  R=13.1
2710  DEF FNS(Q)
2720  FOR I=1 TO Q
2730  PRINT
2740  NEXT I
2750  RETURN 0
```

```
2810  DEF FNC(Q)
2820  N5=N5+1
2830  Q=FNSQ
2840  Q=20
2850  PRINT R$
2860  PRINT
2870  PRINT H$;":      ";X$[1,4],TAB50,X$[5]
2880  PRINT
2890  PRINT
2900  FORMAT 35X,F4.0,"-"
2910  WRITE (15,2900)-N5
2920  PRINT
2930  PRINT TAB20,P$[13]
2940  IF FLAG9 THEN 3010
2950  PRINT TAB(Q),P$[1,3];":  ";P$[9,12];" ";P$[4,6];" ";P$[7,8];
2960  FORMAT /,19X,F5.0," MHz ",2F2.0
2970  B$="#ox."
2980  FOR M5=1 TO M6
2990  WRITE (15,2960)D[M5,75];B$[M5,M5];",";
3000  NEXT M5
3010  RETURN 0
5000  END
5010  REM BEGIN CHECKSET DEFINED FUNCTION VERSION I.0
5020  DEF FNQ(Q)
5030  Q=Q0=Q1=Q2=Q3=Q4=Q5=Q6=Q7=Q8=Q9=Z0=Z1=Z2=Z4=Z5=0
5040  Z4=A[9]*1E-04
5050  DEF FNZ(Z5)=Z4*EXP(D[T6,Z5]*1E-04)
5060  Q=0
5070  FOR T6=1 TO 6
5080  N4=D[T6,3]
5090  REM BEGIN CHECKCUT
5100  FOR Z0=1 TO 2
5110  Z1=1
5120  GOSUB T6 OF 5560,5700,5700,5700,5700,5700
5130  FOR N3=1 TO N4
5140  Q5=FNZ(N3+7)
5150  GOSUB T6 OF 5270,5330,5330,5330,5330,5330
5160  NEXT N3
5170  IF Z1=1 THEN 5190
5180  NEXT Z0
5190  GOSUB ( NOT Z1 AND T6=1) OF 5560
5200  REM END CHECKCUT
5210  NEXT T6
5220  IF Q=0 THEN 5240
5230  WRITE (15,5950)
5240  RETURN Q
5250  REM END CHECKSET
5260  END
```

```
5270 REM BEGIN SUB4
5280 Q8=Q0+Q1*N3
5290 GOSUB (ABS(Q5-Q8) >= 9*Q2) OF 5790
5300 RETURN
5310 REM END SUB4
5320 END
5330 REM BEGIN SUB5
5340 Q3=FNZ(N3+7-2)
5350 IF (N3-2) >= 1 THEN 5370
5360 Q3=FNZ(N3+7+2)
5370 Q4=FNZ(N3+7-1)
5380 IF (N3-1) >= 1 THEN 5400
5390 Q4=FNZ(N3+7+1)
5400 Q6=FNZ(N3+7+1)
5410 IF (N3+1) <= N4 THEN 5430
5420 Q6=FNZ(N3+7-1)
5430 Q7=FNZ(N3+7+2)
5440 IF (N3+2) <= N4 THEN 5460
5450 Q7=FNZ(N3+7-2)
5460 Q4=(Q4+Q6)/2
5470 Q3=(Q3+Q7)/2
5480 Q8=(4*Q4-Q3)/3
5490 Q6=ABS(Q5-Q9) >= 1*Q9
5500 Q4=ABS(Q5-Q4) >= 9*Q2
5510 Q3=ABS(Q5-Q3) >= 9*Q2
5520 GOSUB (Q6 OR (Q4 AND Q3)) OF 5790
5530 RETURN
5540 REM END SUB5
5550 END
5560 REM BEGIN FITLINESTAT ROUTINE
5570 Q1=(FNZ(N4+7)-FNZ(1+7))/(N4-1)
5580 Q4=Q3=0
5590 FOR Z2=1 TO N4
5600 Q5=FNZ(Z2+7)
5610 Q4=Q4+Q5
5620 Q3=Q3+Q5^2
5630 NEXT Z2
5640 Q9=Q4/N4
5650 Q0=Q9-Q1*(N4+1)/2
5660 Q2=SQR(ABS((Q3-Q4*Q9)/(N4-2)))
5670 RETURN
5680 REM END FITLINESTAT
5690 END
```

```
5700  REM BEGIN FITAVG SUBROUTINE
5703  REM*****USE NEWFITAVG AT 7000*****
5705  GOTO 7000
5710  Q4=0
5720  FOR Z2=1 TO N4
5730  Q4=Q4+FNZ(Z2+7)
5740  NEXT Z2
5750  Q9=Q4/N4
5760  RETURN
5770  REM END FITAVG
5780  END
5790  REM BEGIN BADPOINT SUBROUTINE
5795  PRINT Q6;Q4;Q3
5800  Q=Q+1
5810  IF Z1=0 THEN 5870
5820  GOSUB 5930
5830  IF T6#1 THEN 5860
5840  FORMAT "   SYSTEM FITTED LINE IS:",/,"   P(N3) =",F8.5,F10.7,F8.5
5850  WRITE (15,5840)Q0," + PSLOPE*N3;   PSLOPE = ",Q1,";     SIGMA =",Q2
5860  Z1=0
5870  FORMAT " AT POINT N3=",F3.0," THE VALUE",F8.5,F8.5,F2.0
5880  WRITE (15,5870)N3,Q5," WAS REPLACED WITH",Q8,"  ON CUTPASS",Z0
5890  D[T6,N3+7]=1E+04*LOG(Q8*1E+04/A[9])
5900  RETURN
5910  REM END BADPOINT
5920  END
5930  REM BEGIN PLOTANDDATA SUBROUTINE
5940  WRITE (15,5950)
5950  FORMAT 80"="
5960  Q7=A[1]-100*INT(A[1]/100)
5970  WRITE (15,5980)T6-4,INT(A[1]/100),Q7,(Q7-1)*6+T6
5980  FORMAT 63X,"CUT  RUN  SET   N",/,63X,F2.0,3F5.0
5990  REM DELETE <GOTO RETURN> TO ALLOW CUTDATAPRINT
6010  PRINT "    N3 PWR/PWR(ADD)"
6020  FORMAT 3X,F3.0,1X,F8.5
6030  FOR Z2=1 TO N4
6040  WRITE (15,6020)Z2,FNZ(Z2+7),
6050  IF 5*INT(Z2/5)#Z2 THEN 6070
6060  PRINT
6070  NEXT Z2
6080  WRITE (15,6090)
6090  FORMAT 80"."
6100  RETURN
```

```
6110  REM END PLOTANDDATA
7000  REM BEGIN NEWFITAVG SUBROUTINE (with Hadamard Variance)
7010  Q3=0
7020  Z7=FNZ(1+7)
7030  Z8=FNZ(2+7)
7040  Q4=Z7+Z8
7050  FOR Z2=3 TO N4
7060  Z9=FNZ(Z2+7)
7070  Q4=Q4+Z9
7080  Q3=Q3+(Z7-2*Z8+Z9)^2
7090  Z7=Z8
7100  Z8=Z9
7110  NEXT Z2
7120  Q9=Q4/N4
7130  Q3=Q3/(N4-2)
7140  Q3=Q3/4
7150  Q2=SQRQ3
7155  PRINT "HADVAR="Q2
7160  RETURN
7170  REM END NEWFITAVG
7180  END
```

SYMBOL	REFERENCE LINE				
135	260				
175	160				
200	224	240	300		
250	210				
2450	2370				
3010	2940				
5190	5170				
5240	5220				
5370	5350				
5400	5380				
5430	5410				
5460	5440				
5860	5830				
5870	5810				
5930	5820				
6070	6050				
7000	5705				
AI[	10				
A[	224	2440	2630	5040	5890
	5960	5970			
B$	2970				
B$[	60	2990			
BEEP	2070	2120			
COM	10				
D$	2440	2630			
D$[	10				
DISP	70	137	2060	2110	2160
	2470				
DI[	10				
D[	2270	2370	2440	2630	2990
	5050	5080	5890		
E	220	250			
E$	2440	2630			
E$[	10				
F7	160	2080	2608		
F8	160	2130	2608		

SYMBOL	REFERENCE LINE				
FLAG9	2940				
FNC(	2810				
FNC5	2280				
FNF(	2030				
FNF1	180				
FNF2	150				
FNF3	150				
FNF4	180	230			
FNF5	222				
FNF6	150				
FNF7	170				
FNF8	230				
FNF9	230				
FNJ(	120				
FNQ(	5020				
FNQ1	230				
FNS(	2710				
FNS2	230	2560			
FNS3	230				
FNS5	2280				
FNSQ	2830				
FNZ(	5050	5140	5340	5360	5370
	5390	5400	5420	5430	5450
	5570	5600	5730	6040	7020
	7030	7060			
FORMAT	2310	2380	2570	2620	2900
	2960	5840	5870	5950	5980
	6020	6090			
H$	2870				
H$[	10				
I	2720	2740			
KEY	90				
M1	2480	2608			
M3	2480	2608			
M5	2980	2990	3000		
M6	2270	2980			

SYMBOL	REFERENCE LINE				
N	190	200	210	290	2440
	2608				
NO	0	224			
N1	190	2170			
N2	210	2170			
N3	5130	5140	5160	5280	5340
	5350	5360	5370	5380	5390
	5400	5410	5420	5430	5440
	5450	5880	5890		
N4	5080	5130	5410	5440	5570
	5590	5640	5650	5660	5720
	5750	6030	7050	7120	7130
N5	110	2820	2910		
N7	190	200	2170		
N8	195	226	2608		
OF	2040	5120	5150	5190	5290
	5520				
P$[	0	2440	2630	2930	2950
Q	80	90	120	150	170
	180	222	230	2030	2040
	2280	2560	2608	2630	2710
	2720	2810	2830	2840	2950
	5020	5030	5060	5220	5240
	5800				
Q0	5030	5280	5650	5850	
Q1	5030	5280	5570	5650	5850
Q2	5030	5290	5500	5510	5660
	5850	7150	7155		
Q3	5030	5340	5360	5470	5480
	5510	5520	5580	5620	5660
	5795	7010	7080	7130	7140
	7150				
Q4	5030	5370	5390	5460	5480
	5500	5520	5580	5610	5640
	5660	5710	5730	5750	5795
	7040	7070	7120		
Q5	5030	5140	5290	5490	5500
	5510	5600	5610	5620	5880
Q6	5030	5400	5420	5460	5490
	5520	5795			

SYMBOL	REFERENCE LINE				
Q7	139	5030	5430	5450	5470
	5960	5970			
Q8	5030	5280	5290	5480	5880
	5890				
Q9	5030	5490	5640	5650	5660
	5750	7120			
R	135	148	270	1990	2050
	2100	2150	2240	2300	2350
	2460	2550	2600	2700	
R$	100	2850			
R$[	60				
S$	2440	2630			
S$[	10				
SERROR	220	250			
STORE	2610				
T6	5050	5070	5080	5120	5150
	5190	5210	5830	5890	5970
WRITE	2320	2440	2580	2630	2910
	2990	5230	5850	5880	5940
	5970	6040	6080		
X	2310	2380	2570	2620	2900
	2960	5980	6020		
X$[	10	2870			
Z0	5030	5100	5180	5880	
Z1	5030	5110	5170	5190	5810
	5860				
Z2	5030	5590	5600	5630	5720
	5730	5740	6030	6040	6050
	6070	7050	7060	7110	
Z4	5030	5040	5050		
Z5	5030	5050			
Z7	7020	7040	7080	7090	
Z8	7030	7040	7080	7090	7100
Z9	7060	7070	7080	7100	

LINES: 246 BYTES: 5593 SYMBOLS: 115 REFERENCES: 430

```
                          RUN
                           |
                           |
                           |
 980:                 COM_STATEMENT
                           |
1030:          >> (START)PGM
                           |
6410:          >> INITIALIZE
6480:                 NUMBER OF PASSES?
                           |
6500:          >> (NEXT)BATCH
                      IF LAST BATCH                    ------------------------------> STOP
6520:                 TODAYS TIME & DATE?
6520:                 BEAM WIDTH GUESS?
6550:                 SELECT DATA DEVICE
6590:                 IF 1ST BATCH THEN KEY IN FIRST FILE & LAST FILE
                           |
6620:          >> (NEXT)SET
6730:                 LOAD SET
                           |
6760:          >> DOSET
6800:                 GET SET PARAMETERS
6940:                 PRINT SET LABELS
                           |
7150:          >  ACQUIREOBSERVATIONS
7150:          >      SET UP P VECTOR
                           |
7410:          >  ACQUIRE PARAMETERS
7410:                 SYSTEM TEMPERATURE GUESS
7530:                 SLOPE GUESS
7570:                 SOURCE TEMPERATURE GUESS
7620:                 LONGITUDINAL BIAS GUESS
7660:                 TRANSVERSE BIAS GUESS
7700:                 BEAMWIDTH GUESS
                           |
7760:          >  STARTFIT
7780:                 INITIALIZE D MATRIX PARAMETERS
                           |
```

```
                                    |
7800:        >> IMPROVE PARAMETERS
                                    |
7820:        >  COMPUTE FUNCTION AND DESIGN MATRIX
                                    |
7890:        >  BEGIN PASS
                                    |
8000:        >  BEGIN CUTS
8000:               COMPUTE FUNCTION Z
8240:               COMPUTE DESIGN MATRIX K
                                    |
                                    |
8350:        >  END OF CUTS
8350:               USE N DECL OF CENTER CUT
8350:               IF 1st PASS then PRINT AND PLOT
                                    |
8440:        >  PERFORM MATRIX OPERATIONS
8440:               H:=P-Z::=OBSERVED CALCULATED
8450:               R:=TRANSPOSE(H)
8460:               W:=R*H
8480:               COMPUTE SIGMA
8530:               L:=TRANSPOSE(K)
8540:               U:=INVERSE(L*K)
8560:               E:=(U*L)*H
8590:               NEW X:=OLD X+E
                                    |
8650:        >  VARCOVAR PARAMETERS
8650:               VARCOVAR MATRIX:=SIGMA SQUARED*U
                                    |
8670:        >  SLOP TEST
8670:               COMPUTE SLOP
8790:               UPDATE D MATRIX PARAMETERS
8830:               IF SLOP EXCESSIVE THEN IMPROVE PARAMETERS--->7800:
                                    |
8860:        >> PRINT RESULTS
8900:               STORE RESULTS
                                    |
8930:        >> POSTSTORE
8950:               PRINT AND PLOT RESULTS
                                    |
9210:        >> ENDOFSET                      ---------------------------->6620:(NEXT)SET
```

```
980  COM D$[25],H$[50],P$[40],S$[5],AI[10],DI[6,75],NO,X$[21],E$[8]
985  PRINT TAB20,"NBS1H.08 NONLINLSFIT <D1-F31>"
990  REM:        VERSION V.00-A%-70-18-G   1980JUN20/1420   DH DISC#S38.14
1030 REM >>(START)PGM
1050 GOTO 6410
1060 END
1080 DIM ES[18],HS[70],KS[70,18],LS[18,70],O[18],PS[70]
1090 DIM RS[1,70],U[18,18],W[1,1],X[18],YS[18],ZS[70]
1100 A2=A7=A8=A9=C=C1=C2=C4=C5=C6=C7=C8=C9=C0=0
1110 E1=E2=E3=E4=E7=E9=F=F1=F8=F9=F0=G1=G2=H=H1=H2=H3=H4=0
1120 I=I1=I2=I5=I6=I9=I0=J=J1=J2=J3=J4=J6=J7=L=L1=L2=L3=L4=N4=N5=N6=0
1130 P=P1=P4=P6=P9=P0=Q=Q1=Q2=Q4=Q5=Q8=Q9=T6=U=U1=0
1140 DIM G$[72],I$[72],L$[72],M$[72],N$[133],O$[1],U$[133]
1150 N$[1,35]="TsystemTsystemTsystemTsystemTsystem"
1160 U$[1,35]="<K>    <K>    <K>    <K>    <K>    "
1170 N$[36,70]="  SLOPE  SLOPE  SLOPE  SLOPE  SLOPE"
1180 U$[36,70]="<K/hr> <K/hr> <K/hr> <K/hr> <K/hr> "
1190 N$[71,112]="D TsrceD ibiasD ibiasD ibiasD ibiasD ibias"
1200 U$[71,112]="<K>    <deg>  <deg>  <deg>  <deg>  <deg>  "
1210 N$[113,133]="Z tbiasH widthxxxxxxx"
1220 U$[113,133]="<deg>  <deg>  xxxxxxx"
1240 Q=Q4=Q5=I9=P4=L3=E4=A2=Q2=0
1250 MAT E=ZER
1260 MAT H=ZER
1270 MAT K=ZER
1280 MAT U=ZER
1290 MAT X=ZER
1300 MAT Z=ZER
1320 C5=(1/5)*70
1340 P1=5+1E-04*0
1350 PRINT TAB15, "PGM: VERSION V.00-A%-70-18-G"
1370 RETURN 0
1380 STOP
1400 DEF FND(U)
1410 GOTO U OF 1080,1320
1420 GOTO 1080
1430 END
1730 DEF FNB(U)
1750 GOTO U OF 1760,1760
1760 PRINT
1770 IF U=1 THEN 1800
1780 PRINT "  NO="NO;" S$ SOURCE: ";S$;"          ";D$;E$
1790 PRINT "  ";H$;"          ";X$
1800 RETURN 0
1810 END
```

```
1830  DEF FNE(U)
1840  L=U
1850  PRINT
1860  PRINT "AT LINE"L;"at least ONE VARIABLE OR ... IS TROUBLESOME:"
1870  PRINT "Check: Q="Q;"Q4="Q4;"Q5="Q5;"Q4-Q5="Q4-Q5;"I9="I9;"P4="P4
1880  PRINT "L3="L3;"F0="F0;"F8="F8;"X(18)="X[18]
1890  PRINT "E4="E4;"A2="A2;"Q2="Q2
1900  DISP "   ERROR NEAR LINE: "L"    look for trouble NEAR THAT LINE";
1930  IF STATIO<8 THEN 9240
1940  RETURN L
1950  END
1970  DEF FNG(U)
1980  GOTO U OF 2060,2080,2470,2490,2550,2570
2060  L=FNE(2060)
2070  STOP
2080  DISP "KEY IN:   FIRSTFILE, LASTFILE";
2090  INPUT F1,F9
2110  IF F1>F9 THEN 2080
2130  F0=F8=F1
2140  RETURN 0
2150  REM >>FNG3LOAD
2170  F0=F8
2180  L4=1
2200  SERROR L3,2310
2220  IF STATIO<8 THEN 2280
2240  DISP "PUT DATA IN DEV"IO"CONT, EXEC";
2250  STOP
2260  GOTO 2200
2280  LOAD  DATA #IO,F0
2290  GOTO 2410
2310  PRINT "    LOAD-ERROR, FILE:"F0
2320  L4=L4+1
2340  IF L3<56 THEN 6300
2360  IF L4 <= 5 THEN 2200
2380  F8=F8+1
2390  GOTO 6620
2410  F8=F8+1
2430  SERROR L3,6300
2460  GOTO 6760
2470  RETURN 0
2490  IF F8 <= F9 THEN 2540
2510  PRINT "     FILE"F9"IS THE last file OF FILES"F1"TO "F9
2520  PRINT
2540  RETURN (F8 <= F9)
2550  DISP "DATA DEVICE?: 5(DISC), 10(CASS)";
2560  INPUT IO
2570  RETURN 0
2580  END
```

```
2600  DEF FNH(U)
2610  GOTO U OF 2630,2660
2620  GOTO 2630
2630  PRINT "PASSNUM="P0"D Tsrce"O[11]*Y[11]" H width="O[18]*Y[18]"  FILE:"F0
2640  RETURN 0
2650  FORMAT "STD DEV RESIDUALS:",F12.6,5X,"SLOP:",F14.7,4X,F7.2
2660  WRITE (15,2650)Q2,Q1,"RUN.SET:",A[1]/100
2670  G1=G2=H1=H2=0
2680  FOR Q=1 TO Q4
2690  H3=ABS(H[Q])
2710  IF H3 <= H1 THEN 2790
2730  H2=H1
2740  G2=G1
2750  H1=H3
2760  G1=Q
2770  GOTO 2830
2790  IF H3 <= H2 THEN 2830
2810  H2=H3
2820  G2=Q
2830  NEXT Q
2840  FORMAT "TWO LARGEST RESIDUALS:  Q     H(Q)    H(Q)/SIGMA"
2850  WRITE (15,2840)"   Q     H(Q)    H(Q)/SIGMA"
2860  FORMAT 21X,F4.0,F10.5,F11.5,F6.0,F10.5,F11.5
2870  WRITE (15,2860)G1,H1,H1/Q2,G2,H2,H2/Q2
2880  RETURN 0
2890  END
2910  DEF FNI(U)
2920  GOTO U OF 3060,3060,3180,3200,3220,3220,3340,3360,3380,3380
3040  L=FNE(3040)
3050  STOP
3180  M$="<name/id CAN BE HARDCODED AS M$ IN FNI(3)>"
3190  RETURN 0
3200  PRINT "BATCH RUN ID: ";M$
3210  RETURN 0
3220  DISP "KEY IN today's time/date";
3230  INPUT G$
3250  IF G$[1]#" " THEN 3310
3270  IF U=6 THEN 3320
3290  DISP "PLEASE ";
3300  GOTO 3220
3310  I$=G$
3320  RETURN 0
3340  I$="<time/date CAN BE HARDCODED AS I$ IN FNI(7)>"
3350  RETURN 0
```

```
3360  PRINT "DATA FIT RUN TIME/DATE: ";I$
3370  RETURN 0
3380  DISP "K: beamwidth guess (deg)";
3400  INPUT H4
3420  IF H4 <= 0 THEN 3470
3440  C2=H4
3450  RETURN 0
3470  IF U=10 THEN 3450
3490  DISP "PLEASE ";
3500  GOTO 3380
3510  END
3530  DEF FNJ(U)
3540  GOTO U OF 3560,3560
3550  FORMAT "NONLINLSFIT GAUSSIAN SHAPE MODEL",9X,"FILE:",F4.0,8X,F7.2
3560  WRITE (15,3550)F0,"RUN.SET",A[1]/100
3570  IF U=1 THEN 3620
3590  F=FNI4+FNI8+FNB2
3600  FORMAT "D(6,75) = <DATAPOINTTIME> =",F4.0," seconds",10X,F6.0
3610  WRITE (15,3600)D[6,75],"DATA STATUS D(1,70):",D[1,70]
3620  RETURN 0
3630  END
3650  DEF FNL(U)
3670  L1=LGT(ABS(U))/1E-04
3690  IF ABS(L1) <= 32767 THEN 3720
3700  L2=L2+1
3710  RETURN SGN(L1)*32767
3720  RETURN L1
3730  END
3820  DEF FNN(U)
3840  N4=D[T6,3]
3850  Q8=(1+INT((N4-C5)/2))*(N4>C5)+1*(N4 <= C5)
3860  Q9=INT((N4+C5)/2)*(N4>C5)+N4*(N4 <= C5)
3870  RETURN 0
3880  END
3910  DEF FNO(U)=COSU*(1+0.00274*(NO <= 4)-0.0339*(NO=6))*360*I9/86400
3920  END
3950  DEF FNP(U)=P4*EXP(D[T6,U]*1E-04)
3960  END
```

```
3980  DEF FNR(U)
4000  IF P=3 THEN 4190
4010  FORMAT "X( )..PARAMETER...VALUE.....UNITS....E: DELTAX"
4020  WRITE (15,4010)".....UNCERTAINTY....UNC/VALUE"
4030  PRINT
4050  FOR J=1 TO Q5
4070  IF J#17 AND P=2 THEN 4170
4080  H=7*J-6
4090  C0=Y[J]
4100  C8=SQR(U[J,J])
4120  IF J#6 AND J#11 AND J#12 AND J#17 AND J#18 THEN 4160
4125  IF P=2 THEN 4160
4140  PRINT
4150  FORMAT F3.0,3X,F13.6,2X,F11.7,3X,F12.7,3X,F9.4
4160  WRITE (15,4150)J,N$[H,7*J],X[J]*C0,U$[H,7*J],E[J]*C0,C8*C0,C8/(X[J]+1E-15)
4170  NEXT J
4180  PRINT
4190  RETURN 0
4200  END
4220  DEF FNS(U)
4230  GOTO U OF 4290,4290,4290,4290
4290  FIXED 5
4300  Q=0
4320  I1=J1=P[1]
4330  J3=P[1]+P[2]+P[3]
4340  J4=2
4360  J6=2
4370  FOR T6=2 TO 6
4390  F=FNN0
4400  FOR I=Q8 TO Q9
4410  Q=Q+1
4430  IF P[Q]>I1 THEN 4470
4450  I1=P[Q]
4470  IF P[Q]<J1 THEN 4500
4490  J1=P[Q]
4500  IF I<Q8+3 THEN 4600
4510  H=P[Q-2]+P[Q-1]+P[Q]
4530  IF H<J3 THEN 4600
4550  J3=H
4570  J4=Q-1
4590  J6=2+INT((Q*5-1)/Q4)
4600  NEXT I
4610  NEXT T6
4630  IF U#4 THEN 4680
4650  STANDARD
```

```
4660  RETURN J6
4680  IF U>2 OR P=3 THEN 5190
4710  I2=J2=Z[1]
4720  FOR Q=2 TO Q4
4740  IF Z[Q]>I2 THEN 4780
4760  I2=Z[Q]
4780  IF Z[Q]<J2 THEN 4810
4800  J2=Z[Q]
4810  NEXT Q
4820  FORMAT 72"="
4830  WRITE (15,4820)
4840  Q=0
4850  FOR T6=2 TO 6
4860  FORMAT F7.3," degrees    POINT",F3.0,4X,F7.3," degrees (FITTED)"
4870  WRITE (15,4860)" N.DECL. OFFSET:",D[T6,5]/1000,Q+1,X[17]+D[T6,5]/1000
4890  F=FNNO
4900  FOR I=Q8 TO Q9
4920  Q=Q+1
4940  IF Q>2 AND P=2 THEN 5130
4960  IF (U <= 2) AND (J1-I1>0) AND (J2-I2>0) THEN 5000
4970  L=FNE(4970)
4980  STOP
5000  I5=INT(12.1+(P[Q]-I1)*(34-12)/(J1-I1))
5010  O$="o"
5020  IF U=1 THEN 5100
5040  I5=INT(23.1+P[Q]*(34-12)*J7/(J2-I2))
5060  IF I5<12 THEN 5090
5070  IF I5 <= 34 THEN 5100
5080  I5=34
5090  O$="$"
5100  I6=INT(48.1+(Z[Q]-I2)*(70-48)/(J2-I2))
5110  PRINT P[Q];TAB(I5);O$;TAB35;":";Z[Q];TAB(I6);"o";TAB71;":"
5120  NEXT I
5130  WRITE (15,4820)
5150  IF Q>2 AND P=2 THEN 5190
5170  NEXT T6
5180  FORMAT "(MAX-MIN)=",F10.5," =(",F10.5," MINUS",F10.5,")",7X,F7.2,/
5190  WRITE (15,5180)J1-I1,J1,I1,"RUN.SET:",A[1]/100
5200  STANDARD
5220  RETURN J1-I1
5230  END
```

```
5250  DEF FNT(U)
5270  P6=4
5280  IF T6#4 THEN 5310
5300  P6=3
5310  PRINT "CUT"T6" HAD ONLY"D[T6,3]" DATA POINTS (N4)"
5330  FOR I=1 TO 68
5340  D[T6,I]=D[P6,I]
5350  NEXT I
5360  D[T6,70]=D[P6,70]
5370  PRINT "CUT"T6" IS ASSIGNED THE VALUES OF CUT"P6" IN FILE"FO
5380  RETURN 0
5390  END
5410  DEF FNX(U)
5430  IF P=3 THEN 5590
5440  PRINT "X( )...PARAMETER........VALUE............Y(J)"
5460  PRINT
5480  FOR J=1 TO Q5
5500  IF J<Q5 AND P=2 THEN 5570
5520  IF J#6 AND J#11 AND J#12 AND J#17 AND J#18 THEN 5560
5525  IF P=2 THEN 5560
5540  PRINT
5550  FORMAT F3.0,5X,F16.7,E17.5
5560  WRITE (15,5550)J,N$[7*J-6,7*J],X[J],Y[J]
5570  NEXT J
5580  PRINT
5590  RETURN 0
5600  END
```

```
5620  DEF FNY(U)
5630  GOTO U OF 5730,5780,6240,6250
5690  GOTO 5730
5730  D[1,73]=100*Q4+Q5
5740  D[1,72]=INT(100*P1)
5750  D[2,69]=E3
5760  D[3,69]=100*C1
5770  D[4,69]=FNL(C6)
5780  D[2,73]=FNL(X[18]*Y[18])
5790  D[3,73]=FNL(X[18]*Y[18])
5800  D[4,73]=FNL(X[18]*Y[18])
5810  D[5,73]=FNL(X[11])
5820  D[6,73]=FNL(X[3])
5830  IF U=1 THEN 5960
5850  D[2,72]=FNL(100*SQR(U[18,18])*Y[18])
5860  D[3,72]=FNL(100*SQR(U[18,18])*Y[18])
5870  D[4,72]=FNL(100*SQR(U[18,18])*Y[18])
5880  D[5,72]=FNL(100*SQR(U[11,11]))
5890  D[6,72]=FNL(100*SQR(U[3,3]))
5900  D[1,71]=FNL(100*Q2)
5910  D[2,71]=FNL(100*SQR(Q1))
5920  D[3,71]=FNL(H1/Q2)
5930  D[4,71]=G1
5940  D[5,71]=FNL(H2/Q2)
5950  D[6,71]=G2
5960  D[1,69]=P0
5970  RETURN 0
5980  REM >>FNY3STORE
5990  L4=1
6010  SERROR L3,6150
6030  IF (STATIO=1) OR (STATIO=5) THEN 6090
6040  DISP "INSERT UNPROTECTED FILES, CONT, EXEC";
6050  STOP
6070  GOTO 6010
6090  STORE  DATA #I0,F0
6110  F=FNY4
6130  GOTO 6230
6150  PRINT "   STORE-ERROR, FILE:"F0
6160  L4=L4+1
6180  IF L3<56 THEN 6300
6200  IF L4 <= 5 THEN 6010
6220  PRINT "***** did NOT store results on file:"F0
6230  GOTO 8930
6240  RETURN 0
6250  PRINT "SALIENT RESULTS HAVE BEEN WRITTEN IN D MATRIX OF FILE";F0
6260  RETURN 0
6270  END
```

```
6300  REM >>SERRORDEFAULT
6310  STANDARD
6330  IF L3 <= 2 THEN 6360
6340  L=FNE(6340)
6350  DISP "CONT, EXEC, TO ABORT THIS FILE";
6360  STOP
6380  SERROR L3,6300
6400  GOTO 9240
6410  REM >>CONTINUEPGM
6430  F=FND1
6450  U1=0
6470  P=1
6480  DISP "MAX NUMBER OF PASSES";
6490  INPUT P9
6500  REM >>(NEXT)BATCH
6520  F=FNI(1+U1)+FNI(5+U1)+FNI4+FNI8+FNI(9+U1)
6550  F=FNG(5+U1)
6570  U1=1
6590  F=FNG2
6610  IF  NOT FNG4 THEN 6500
6620  REM >>(NEXT)SET
6640  SERROR L3,6300
6660  IF  NOT FNG4 THEN 6500
6670  STANDARD
6680  FORMAT 2/,9"STARTSET "
6690  WRITE (15,6680)
6710  F=FND2
6730  F=FNG3
6750  GOTO 2150
6760  REM >>DOSET
6770  STANDARD
6780  DEG
6800  C1=(NO=1)*58.69+(NO=2)*40.66+(NO=3)*22+(NO=4)*(-5.4)
6810  IF NO<5 THEN 6860
6830  N5=-15
6840  N6=-10
6850  C1=(NO=5)*N5+(NO=6)*N6
6860  IF C1#0 THEN 6900
6870  DISP "KEY IN SOURCE N.DECL. (degrees)";
6880  INPUT C1
6900  Q5=18
6910  P4=A[9]*1E-04
6920  I9=D[6,75]
6940  F=FNJ2
6960  IF P9>0 THEN 7010
6970  PRINT "PREPROCESSING OF FILE"F0" RUN.SET"A[1]/100" IS COMPLETE"
```

```
6990  GOTO 6620
7010  IF D[1,70]>5000 THEN 6620
7030  E4=FNO(C1+D[4,5]/1000)
7050  IF P4#0 AND I9#0 AND E4>0 THEN 7080
7060  L=FNE(7060)
7070  STOP
7080  E3=999*(A[2]=7300)+999*(A[2]=7500)+999*(A[2]=7700)
7110  E2=3600/I9
7120  E1=SQR(4*LOG2)
7130  PRINT "FREQ:"A[2]"MHz    nominal dTadd:"E3"kelvin"
7150  REDIM P[5*C5]
7160  Q=0
7170  FOR T6=2 TO 6
7190  IF D[T6,3] >= 6 THEN 7230
7210  F=FNTO
7230  F=FNNO
 240  FOR I=Q8 TO Q9
7250  Q=Q+1
7270  P[Q]=FNP(I+7)
7280  NEXT I
7290  NEXT T6
7300  Q4=Q
7310  PRINT "ALPHA="Q4"(the number of data points fitted in the set)"
7320  IF (Q4-Q5>0) THEN 7350
7330  L=FNE(7330)
7340  STOP
7350  REDIM H[Q4],K[Q4,Q5],L[Q5,Q4],P[Q4],R[1,Q4],Z[Q4]
7410  T6=1
7420  N4=D[T6,3]
7430  C4=0
7450  FOR I=1 TO N4
7460  C4=C4+FNP(I+7)
7470  NEXT I
7490  C6=C4/(N4+(N4=0)*1)
7500  X[1]=X[2]=X[3]=X[4]=X[5]=C6
7510  Y[1]=Y[2]=Y[3]=Y[4]=Y[5]=E3
7530  X[6]=X[7]=X[8]=X[9]=X[10]=0
7540  Y[6]=Y[7]=Y[8]=Y[9]=Y[10]=E2*E3
7570  F=FNS3
7580  X[11]=P[J4]-C6
7590  PRINT "X(11)="X[11]"J4="J4", P(J4)="P[J4]", C6="C6
7600  Y[11]=E3
7620  X[12]=X[13]=X[14]=X[15]=X[16]=0
7630  Y[12]=Y[13]=Y[14]=Y[15]=Y[16]=E4
7660  X[17]=-D[FNS4,5]/1000
7670  Y[17]=1
7700  X[18]=C2
7710  Y[18]=1
7760  P0=0
7780  F=FNY1
```

```
7800  REM >>IMPROVEPARAMETERS
7820  FORMAT 80"-"
7830  WRITE (15,7820)
7840  P0=P0+1
7860  MAT O=X
7870  F=FNH1
7890  L2=0
7900  Q=0
7910  REDIM K[Q4,Q5]
7920  MAT K=ZER
7930  IF P0#1 AND P0#6 THEN 8000
7970  F=FNB1
7980  PRINT
8000  FOR T6=2 TO 6
8010  C7=D[T6,7]/100
8020  A7=D[T6,5]/1000
8030  C9=C7+X[T6+10]
8040  A8=A7+X[17]
8060  E4=FNO(C1+A7)
8070  A9=(A8*E1/X[18])^2
8090  F=FNNO
8100  FOR I=Q8 TO Q9
8110  Q=Q+1
8120  C=I-C9
8130  A2=(C*E1*E4/X[18])^2+A9
8150  IF ABS(A2-49)<51 THEN 8180
8160  L=FNE(8160)
8170  STOP
8180  E9=EXP(-A2)
8200  E7=X[11]*E9
8220  Z[Q]=X[T6-1]+C*X[T6+4]+E7
8240  K[Q,T6-1]=1
8250  K[Q,T6+4]=C
8260  K[Q,11]=E9
8270  K[Q,T6+10]=-X[T6+4]+2*E7*C*(E1*E4/X[18])^2
8280  K[Q,17]=-2*E7*A8*(E1/X[18])^2
8290  K[Q,18]=+2*E7*E1^2*((E4*C)^2+A8^2)/X[18]^3
8310  NEXT I
8320  NEXT T6
```

```
8350  E4=FNO(C1+D[4,5]/1000)
8360  IF PO#1 THEN 8440
8380  PRINT "N4 VALUES:"D[2,3];D[3,3];D[4,3];D[5,3];D[6,3];" SYSTEMCUT N4:"D[1,3]
8390  WRITE (15,8400)"INITIAL CALCULATIONS, Z(calc):"
8400  FORMAT "OBSERVATIONS, P(obs), SELF-SCALED:",3X
8420  F=FNS1
8440  MAT H=P-Z
8450  MAT R=TRN(H)
8460  MAT W=R*H
8480  Q2=SQR(ABS(W[1,1]/(Q4-Q5)))
8500  IF Q2>0 THEN 8530
8510  L=FNE(8510)
8520  STOP
8530  MAT L=TRN(K)
8540  MAT U=L*K
8550  MAT U=INV(U)
8560  REDIM K[Q5,Q4]
8570  MAT K=U*L
8580  MAT E=K*H
8590  MAT X=X+E
8610  IF X[18]>0 THEN 8650
8620  L=FNE(8620)
8630  STOP
8650  MAT U=(Q2^2)*U
8670  Q1=0
8690  FOR J=1 TO Q5
8700  Q1=Q1+E[J]^2/(U[J,J]+(U[J,J]=0)*1E-07*E[J]^2)
8710  NEXT J
8720  Q1=Q1/Q5
8750  IF PO#1 AND PO#6 THEN 8770
8760  F=FNH1
8770  F=FNH2
8790  F=FNY2
8800  IF L2=0 THEN 8830
8810  PRINT "D MATRIX EXCEEDS RANGE"L2"TIMES THIS PASS"
8830  IF (Q1>0.000004) AND PO<P9 AND PO <= 12 THEN 7800
8860  REM >>PRINTRESULTS
8870  FORMAT 80"-",/,10"RESULTS ",/
8880  WRITE (15,8870)
8900  F=FNY3
8920  GOTO 5980
8930  REM >>POSTSTORE
8950  F=FNI4+FNI8
8970  F=FNB2+FNJ1
8980  PRINT
9000  MAT P=H
9020  J7=3
```

```
9030 FORMAT "RESIDUALS,H=P(obs)-Z,MAGNIFIEDx3:",3X
9050 WRITE (15,9030)"FINAL CALCULATIONS, Z(calc):"
9070 F=FNS2
9090 F=FNH2
9100 PRINT
9120 F=FNXO
9140 F=FNRO
9180 F=FNI4+FNI8+FNB2+FNY4+FND2+FNJ1
9190 FORMAT /,11"endset ",3/
9200 WRITE (15,9190)
9210 REM >>ENDOFSET
9230 GOTO 6620
9240 REM >>ABORTTHISFILE
9260 F8=FO+1
9280 GOTO 9210
9290 END
```

SYMBOL	REFERENCE LINE		
1080	1420		
1650	1560		
1670	1580		
1680	1540	1620	1660
1700	1470		
1800	1770		
2080	2110		
2150	6750		
2200	2260	2360	
2280	2220		
2410	2290		
2540	2490		
2630	2620		
2790	2710		
2830	2770	2790	
3060	3140		
3150	3090		
3160	3110		
3220	3300		
3310	3250		
3320	3270		
3380	3500		
3450	3470		
3470	3420		
3620	3570		
3720	3690		
3790	3760		
4160	4120	4125	
4170	4070		
4190	4000		
4470	4430		
4500	4470		
4600	4500	4530	
4680	4630		
4780	4740		

SYMBOL	REFERENCE LINE			
4810	4780			
5000	4960			
5090	5060			
5100	5020	5070		
5130	4940			
5190	4680	5150		
5310	5280			
5560	5520	5525		
5570	5500			
5590	5430			
5730	5690			
5960	5830			
5980	8920			
6010	6070	6200		
6090	6030			
6230	6130			
6300	2340	6180		
6360	6330			
6410	1050			
6500	6610	6660		
6620	2390	6990	7010	9230
6760	2460			
6860	6810			
6900	6860			
7010	6960			
7080	7050			
7230	7190			
7350	7320			
7800	8830			
8000	7930			
8180	8150			
8440	8360			
8530	8500			
8650	8610			
8770	8750			
8830	8800			

SYMBOL	REFERENCE LINE				
8930	6230				
9210	9280				
9240	1930	6400			
A2	1100	1240	1890	8130	8150
	8180				
A7	1100	8020	8040	8060	
A8	1100	8040	8070	8280	8290
A9	1100	8070	8130		
AI[	10				
A[	2660	3560	5190	6910	6970
	7080	7130			
C	1100	8120	8130	8220	8250
	8270	8290			
C0	1100	4090	4160		
C1	1100	5760	6800	6850	6860
	6880	7030	8060	8350	
C2	1100	3440	7700		
C4	1100	7430	7460	7490	
C5	1100	1320	3850	3860	7150
C6	1100	5770	7490	7500	7580
	7590				
C7	1100	8010	8030		
C8	1100	4100	4160		
C9	1100	8030	8120		
COM	10				
D$	1780				
D$[	10				
DEG	6780				
DISP	1900	2080	2240	2550	3060
	3130	3220	3290	3380	3490
	6040	6350	6460	6480	6870
DI[	10				

SYMBOL	REFERENCE LINE				
D[	3610	3840	3950	4870	5310
	5340	5360	5730	5740	5750
	5760	5770	5780	5790	5800
	5810	5820	5850	5860	5870
	5880	5890	5900	5910	5920
	5930	5940	5950	5960	6920
	7010	7030	7190	7420	7660
	8010	8020	8350	8380	
E	1250	1340	3670	3790	3950
	4160	6910	8580	8590	8700
E$	1780				
E$[	10				
E1	1110	7120	8070	8130	8270
	8280	8290			
E2	1110	7110	7540		
E3	1110	1610	5750	7080	7130
	7510	7540	7600		
E4	1110	1240	1890	7030	7050
	7630	8060	8130	8270	8290
	8350				
E7	1110	8200	8220	8270	8280
	8290				
E9	1110	8180	8200	8260	
ES[	1080				
E[	4160	8700			
F	1110	3590	4390	4890	6110
	6430	6520	6550	6590	6710
	6730	6940	7210	7230	7570
	7780	7870	7950	7970	8090
	8420	8760	8770	8790	8900
	8950	8970	9070	9090	9120
	9140	9160	9180		
F0	1110	1880	2130	2170	2310
	2630	3560	5370	6150	6220
	6250	6970	9260		
F1	1110	2090	2110	2130	2510

SYMBOL	REFERENCE LINE				
F3	1350	1600	1640	4150	4860
	5550				
F4	2860	3550	3600		
F6	2860	3600			
F7	2650	3550	4860	5180	
F8	1110	1880	2130	2170	2380
	2410	2490	2540	9260	
F9	1110	1600	1640	2090	2110
	2490	2510	2540	4150	
FNA(	1450				
FNA0	9160				
FNB(	1730				
FNB1	7970				
FNB2	3590	8970	9180		
FND(	1400				
FND1	6430				
FND2	6710	9180			
FNE(	1830	2060	3040	4970	6340
	7060	7330	8160	8510	8620
FNG(	1970	6550			
FNG2	6590				
FNG3	6730				
FNG4	6610	6660			
FNH(	2600				
FNH1	7870	8760			
FNH2	8770	9090			
FNI(	2910	6520			
FNI4	3590	6520	8950	9180	
FNI8	3590	6520	8950	9180	
FNJ(	3530				
FNJ1	8970	9180			
FNJ2	6940				
FNL(	3650	5770	5780	5790	5800
	5810	5820	5850	5860	5870
	5880	5890	5900	5910	5920
	5940				

SYMBOL	REFERENCE LINE				
FNM(	3750				
FNN(	3820				
FNNO	4390	4890	7230	8090	
FNO(	3910	7030	8060	8350	
FNP(	3950	7270	7460		
FNR(	3980				
FNRO	9140				
FNS(	4220				
FNS1	8420				
FNS2	9070				
FNS3	7570				
FNS4	7660				
FNT(	5250				
FNTO	7210				
FNX(	5410				
FNXO	7950	9120			
FNY(	5620				
FNY1	7780				
FNY2	8790				
FNY3	8900				
FNY4	6110	9180			
FORMAT	1250	1260	1270	1280	1290
	1300	1350	1490	1600	1640
	2650	2840	2860	3550	3600
	4010	4150	4820	4860	5180
	5550	6680	7820	7860	7920
	8400	8440	8450	8460	8530
	8540	8550	8570	8580	8590
	8650	8870	9000	9030	9190
G$	3230	3310			
G$[	1140	3250			
G1	1110	2670	2740	2760	2870
	5930				
G2	1110	2670	2740	2820	2870
	5950				
H	1110	1260	1550	1610	1650
	4080	4160	4510	4530	4550
	8440	8450	8460	8580	9000

SYMBOL	REFERENCE LINE				
H$	1790				
H$[	10				
H1	1110	2670	2710	2730	2750
	2870	5920			
H2	1110	2670	2730	2790	2810
	2870	5940			
H3	1110	2690	2710	2750	2790
	2810				
H4	1110	3400	3420	3440	
HS[	1080				
H[	2690	7350			
I	1120	4400	4500	4600	4900
	5120	5330	5340	5350	7240
	7270	7280	7450	7460	7470
	8100	8120	8310		
I$	3310	3340	3360		
I$[	1140				
I1	1120	4320	4430	4450	4960
	5000	5190	5220		
I2	1120	4710	4740	4760	4960
	5040	5100			
I5	1120	5000	5040	5060	5070
	5080	5110			
I6	1120	5100	5110		
I9	1120	1240	1610	1650	1870
	3910	6920	7050	7110	
INV(	8550				
J	1120	1520	1540	1550	1560
	1580	1610	1650	1680	4050
	4070	4080	4090	4100	4120
	4160	4170	5480	5500	5520
	5560	5570	8690	8700	8710
J1	1120	4320	4470	4490	4960
	5000	5190	5220		
J2	1120	4710	4780	4800	4960
	5040	5100			
J3	1120	4330	4530	4550	
J4	1120	4340	4570	7580	7590
J6	1120	4360	4590	4660	

SYMBOL	REFERENCE LINE				
J7	1120	5040	9020		
K	1270	7920	8530	8540	8570
	8580				
KS[	1080				
K[	7350	7910	8240	8250	8260
	8270	8280	290	8560	
L	1120	1840	1860	1900	1940
	2060	3040	4970	6340	7060
	7330	8160	8510	8530	8540
	8570	8620			
L$	3070	3150			
L$[	1140	3090			
L1	1120	3670	3690	3710	3720
L2	1120	3700	3770	7890	8800
	8810				
L3	1120	1240	1880	2200	2340
	2430	6010	6180	6330	6380
	6640				
L4	1120	2180	2320	2360	5990
	6160	6200			
LGT(	3670				
LS[	1080				
L[	7350				
M$	3150	3180	3200		
M$[	1140				
N$[	1140	1150	1170	1190	1210
	1610	1650	4160	5560	
NO	0	1780	3910	6800	6810
	6850				
N4	1120	3840	3850	3860	7420
	7450	7490			
N5	1120	6830	6850		
N6	1120	6840	6850		
O	7860				
O$	5010	5090	5110		
O$[	1140				
OF	1410	1750	1980	2610	2920
	3540	4230	5630		
O[	1080	2630			

SYMBOL	REFERENCE LINE				
P	1130	1470	1540	4000	4070
	4125	4680	4940	5150	5430
	5500	5525	6470	8440	9000
P$	1760				
P$[	0				
P0	1130	2630	5960	7760	7840
	7930	8360	8750	8830	
P1	1130	1340	5740		
P4	1130	1240	1870	3950	6910
	7050				
P6	1130	5270	5300	5340	5360
	5370				
P9	1130	6490	6960	8830	
PS[	1080				
P[	4320	4330	4430	4450	4470
	4490	4510	5000	5040	5110
	7150	7270	7350	7580	7590
Q	1130	1240	1870	2680	2690
	2760	2820	2830	4300	4410
	4430	4450	4470	4490	4510
	4570	4590	4720	4740	4760
	4780	4800	4810	4840	4870
	4920	4940	5000	5040	5100
	5110	5150	7160	7250	7270
	7300	7900	8110	8220	8240
	8250	8260	8270	8280	8290
Q1	1130	2660	5910	8670	8700
	8720	8830			
Q2	1130	1240	1890	2660	2870
	5900	5920	5940	8480	8500
	8650				
Q4	1130	1240	1870	2680	4590
	4720	5730	7300	7310	7320
	7350	7910	8480	8560	
Q5	1130	1240	1870	4050	5480
	5500	5730	6900	7320	7350
	7910	8480	8560	8690	8720
Q8	1130	3850	4400	4500	4900
	7240	8100			
Q9	1130	3860	4400	4900	7240
	8100				
R	8450	8460			

SYMBOL	REFERENCE LINE				
REDIM	7150	7350	7910	8560	
RS[	1090				
R[	7350				
S$	1780				
S$[	0				
SERROR	2200	2430	6010	6380	6640
STANDARD	4650	5200	6310	6670	6770
STATIO	1930	2220	6030		
STORE	6090				
T6	1130	3840	3950	4370	4610
	4850	4870	5170	5280	5310
	5340	5360	5370	7170	7190
	7290	7410	7420	8000	8010
	8020	8030	8220	8240	8250
	8270	8320			
TRN(	8450	8530			
U	1130	1280	1400	1410	1450
	1730	1750	1770	1830	1840
	1970	1980	2600	2610	2910
	2920	3110	3270	3470	3530
	3540	3570	3650	3670	3750
	3760	3780	3790	3820	3910
	3950	3980	4220	4230	4630
	4680	4960	5020	5250	5410
	5620	5630	5830	8540	8550
	8570	8650			
U$[	1140	1160	1180	1200	1220
	4160	5560			
U1	1130	6450	6520	6550	6570
U[	1090	4100	5850	5860	5870
	5880	5890	8700		
W	8460				
WRITE	1360	1500	1610	1650	2660
	2850	2870	3560	3610	4020
	4160	4830	4870	5130	5190
	5560	6690	7830	8390	8880
	9050	9200			
W[	1090	8480			
X	1290	1600	1640	2650	2860
	3550	3600	4150	4860	5180
	5550	7860	8400	8590	9030
X$	1790				

SYMBOL	REFERENCE LINE				
X$[	0				
X[	1090	1610	1650	1880	4160
	4870	5560	5780	5790	5800
	5810	5820	7500	7530	7580
	7590	7620	7660	7700	8030
	8040	8070	8130	8200	8220
	8270	8280	8290	8610	
YS[	1090				
Y[	2630	4090	5560	5780	5790
	5800	5850	5860	5870	7510
	7540	7600	7630	7670	7710
Z	1300	8440			
ZER	1250	1260	1270	1280	1290
	1300	7920			
ZS[	1090				
Z[	4710	4740	4760	4780	4800
	5100	5110	7350	8220	

LINES: 573 BYTES: 13780 SYMBOLS: 273 REFERENCES: 1195

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[8] The Fahrenheit temperature scale is used instead of the Celsius scale because it is easier to implement a temperature scale which in non-negative over the measurement range.

[9] Daywitt, W. C., An Error Analysis for the use of Lunar Radio Flux in Broadbeam Antenna-System Measurements, to be submitted to IEEE Transactions on Instrumentation and Measurements.

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David F. Wait

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10. SUPPLEMENTARY NOTES

Supersedes NBSIR 78-879 dated April 1978.

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

The Earth Terminal Measurement System (ETMS) was developed by the National Bureau of Standards to make accurate measurements of earth terminal parameters such as the figure of merit (G/T), antenna gain relative to a reproducible reference level, the noise equivalent flux (NEF), and noise ulterior flux (NUF). This manual includes the theory of the measurements, measurement procedures, measurement troubleshooting, interpretation of the results, and a discussion of the ETMS software.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

antenna gain; antenna half-power beamwidth; atmospheric loss; Cassiopeia A; earth terminal measurement system; figure of merit; moon; noise equivalent flux; noise measurement; noise ulterior flux; radio stars; satellite communication.

13. AVAILABILITY

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