NBSIR 78-879

EARTH TERMINAL MEASUREMENT SYSTEM OPERATIONS MANUAL

David F. Wait

Electromagnetic Fields Division
National Engineering Laboratory
National Bureau of Standards
Boulder, Colorado 80303

Prepared for:
Commanding General
United States Army Communications Command
Fort Huachuca, Arizona 85613

April 1978

NBSIR 78-879

EARTH TERMINAL MEASUREMENT SYSTEM OPERATIONS MANUAL

David F. Wait

Electromagnetic Fields Division
National Engineering Laboratory
National Bureau of Standards
Boulder, Colorado 80303

April 1978

Prepared for:
Commanding General
United States Army Communications Command
Fort Huachuca, Arizona 85613

U.S. DEPARTMENT OF COMMERCE, Juanita M. Kreps, Secretary
Sidney Harman, Under Secretary
Jordan J. Baruch, Assistant Secretary for Science and Technology

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, Director

TABLE OF CONTENTS

EARTH TERMINAL MEASUREMENT SYSTEM
OPERATIONS MANUAL

David F. Wait

The Earth Terminal Measurement System (ETMS) was developed by the National Bureau of Standards to make accurate measurements of earth terminal and satellite parameters such as figure of merit (G/T), antenna gain relative to a reproducible reference level, satellite effective isotropic radiated power (EIRP), and ratio of carrier power to the operating noise temperature (C/kT). Because of difficulties of using the standard earth terminal parameters to precisely characterize the earth terminal, the parameters noise equivalent flux (NEF) and noise ulterior flux (NUF) are introduced. NEF characterizes the earth terminal hardware, and it is defined so that it is largely independent of frequency and antenna elevation angle. Thus, it is easier to evaluate the "reasonableness" of a particular set of results in light of the other results taken at various frequencies and elevation angles. 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: Earth terminal; effective isotropic radiated power; figure of merit; measurement procedure; noise temperature; satellite communication.

1. INTRODUCTION

This manual describes the operation of the earth terminal measurement system (ETMS). It includes the theory of the measurements that are implemented on the ETMS, the measurement procedures, the measurement troubleshooting, the interpretation of the results, and a discussion of the ETMS software. This manual does not include details on connecting the hardware, on hardware maintenance, or on hardware troubleshooting. These topics are discussed in the companion ETMS maintenance manual [7].

2. BACKGROUND

The radio star Cassiopeia A (Cas A) is used as a calibration source [1] for the measurements described in this report.

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 to the output noise power when the antenna is pointed to the nearby cold sky is measured.

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

where ΔT_{Cas} is the temperature rise due to Cas A 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 the flux density of Cas A, $S_{Cas}(W/m^2/Hz)$ [2], and on the effective area of the antenna A_e (m^2),

$$\Delta T_{Cas} = (1/2)k_1k_2k_3k_4k_5k_6k_7S_{Cas}A_e/k \tag{2}$$

where $S_{Cas} = (3154)e^{-0.0097\tau}(f/1000)^{\alpha}\times 10^{-26}$, τ = the number of years since 1965.0, $\alpha = -0.792 + 0.0012\tau$, f is the frequency (Hz), k is Boltzmann's constant, ($k = 1.38046 \times 10^{-23}$ J/K). 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

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

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

$$\Delta T_{Cas} = \xi_{Cas}\, G \tag{4}$$

where $$\xi = k_1 k_2 \cdots k_7 \, c^2 \, S/(8\pi k f^2) \quad . \tag{5}$$

For the measurements included in this report, power is measured relative to a stable and reproducible noise add reference signal, T_a, so

$$G/T_a = (\Delta T_{Cas}/T_a)/\xi_{Cas} \quad . \tag{6}$$

Combining eqs. (1) and (4)

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

or expressed in decibels above one inverse degree kelvin,

$$G/T \text{ (dB/K)} = 10 \log_{10} G/T \quad . \tag{8}$$

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. Secondly, the noise performance of subcomponents of an earth terminal is characterized in terms of an effective noise temperative (or noise figure) and a gain/loss which obey familiar rules of combination. In contrast G/T has more complex combinational rules which are sometimes confused with the more familiar rules.

Thirdly, 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. Lastly, inclusion of the atmospheric component in G/T makes it very 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 ($wm^{-2}Hz^{-1}$) 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. In terms of NEF, the Y-factor (eq. 1) is

$$Y = (k_1 \cdots k_7 \, S_{cas} + kT_{sky}/A_{eo} + NEF)/(kT_{sky}/A_{eo} + NEF) \qquad (9)$$

where $k_1 \cdots k_7$, S_{cas}, 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),

$$NEF = k_1 k_2 \ldots k_7 \, S/(Y-1) - kT_{sky}/A_{eo} \; . \qquad (10)$$

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.

$$NUF = k_2 \cdots k_7 \, S/(Y-1) - kT_{cosm}/A_{eo} \qquad (11)$$

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

2.3 EIRP

To measure satellite power, note that the power change, C, (watts) due to the carrier power at frequency f_o at the output port of the antenna is

$$C = W_o A_e \tag{12}$$

where W_o (W/m^2) is the flux incident on the antenna. The flux incident on the antenna depends on the effective isotropic radiated power (EIRP) from the satellite and on the slant distance from the satellite to the earth terminal antenna, d(m),

$$W_o = k_1' k_2' k_3' k_4' k_5' k_6' k_7' EIRP'/(4\pi d^2) \tag{13}$$

where the k_i' correction factors are similar to those in eq. (2) and are described by Daywitt [4], and the prime on EIRP' is a reminder that the EIRP depends on the angle between the boresight direction of the satellite antenna and the direction to the earth terminal. This difference in boresight EIRP and EIRP' is an antenna pointing correction factor known as the tilt differential. Rewriting eq. (13) using eqs. (3) and (12),

$$EIRP = L(C/G)/ (k_1'...k_7') \tag{14}$$

where the space loss $L \equiv (4\pi df/c)^2$. For measurements in this report, powers are measured relative to a noise add reference, T_a, hence, $C = kT_aB[y_o - \frac{1}{2}(y_- + y_+)]$ and

$$EIRP' = LkB[y_o - 1/2(y_- + y_+)]/\{(G/T_a)\ k_1' \cdots k_7'\} \tag{15}$$

where k is Boltzmann's constant, B is the receive noise bandwidth of the Earth Terminal Measuring System (ETMS), y_o is the power relative to the noise add power when f_o is centered in the measurement pass band, y_- is the power relative to the noise add power when the frequency of the band pass is lowered so that none of the f_o power is in the measurement pass band, and y_+ is the power relative to the noise add power when the measurement band pass is just above f_o.

2.4 C/kT

The measurement of C/kT (ratio of carrier power to the operating noise temperature per hertz) differs from the other measurements in this report in

that no flux standard such as Cas A is required. Traditionally, there is accepted ambiguity between the parameters G/T and C/kT in that the symbol T is used differently. The T in G/T refers to the noise of only the earth terminal and is called the system noise temperature (SNT), while the T in C/kT refers to the operating noise temperature (ONT) of both the earth terminal and the noise being broadcast by the satellite. In terms of the symbols in eqs. (14) and (15)

$$C/kT = \left(\frac{y_o}{1/2(y_- + y_+)} - 1 \right) \frac{B}{k_3' k_4' k_7'} \tag{16}$$

2.5 Estimate of T_a Using Moon Measurements

The moon is an extended source (large relative to the antenna beamwidth) for an AN/FSC-78 or AN/MSC-60 earth terminal. The temperature rise in the antenna output due to the moon is the physical temperature of the moon diminished by the losses which occur between the moon and the antenna output port.

$$\Delta T_{moon} = k_1 \, \eta_{rad} \, \eta_{bm} \, (T_{moon} - T_{cosm}) \tag{17}$$

where k_1 is the atmospheric loss, η_{rad} is the radiation efficiency of the antenna, and η_{bm} is the fraction of the antenna radiation pattern which "sees" the moon. To the extent that the right hand parameters in eq. (17) are known, the moon provides a signal of known amplitude in the earth terminal which can be used to calibrate T_a, and thus antenna gain.

2.6 Estimate of T_a Using Antenna HPBW

The calculation of T_a from 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 zenith fit values for G/T_a and HPBW are used for the subsequent calculations for T_a. The zenith HPBW value is corrected for the effect caused by the finite size of Cas A. Then the antenna gain, G, is calculated using the following empirical equations relating aperture efficiency, η_{apr}, HPBW(min), antenna diameter(ft), D, and G.

$$\eta_{apr} = \eta_{rad} / (HPBW \times D \times F / 3035)^2 \tag{18}$$

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

$$G = \eta_{apr} (DF/0.313)^2 . \qquad (19)$$

Using the zenith value for G/T_a, 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 less than ±0.1%.

A simplified block diagram of the ETMS is shown in figure 1. The ETMS contains eight 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 NBS type IV self-balancing power bridge used to measure noise power; (3) a programmable voltmeter whose accuracy is a major factor in determining the accuracy with which the noise power is measured; (4) a multiplexer which connects the digital voltmeter to various measurement points of interest; (5) a digital clock needed to provide time information required to determine current star coordinates; (6) 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; (7) an external cassette which allows redundant recording of measurement data; and (8) an rf control unit which provides signal conditioning, system test signals, precision programmable attenuators, signal monitoring, alarm circuits, and interface circuits which allow the calculator to control the various measuring instruments.

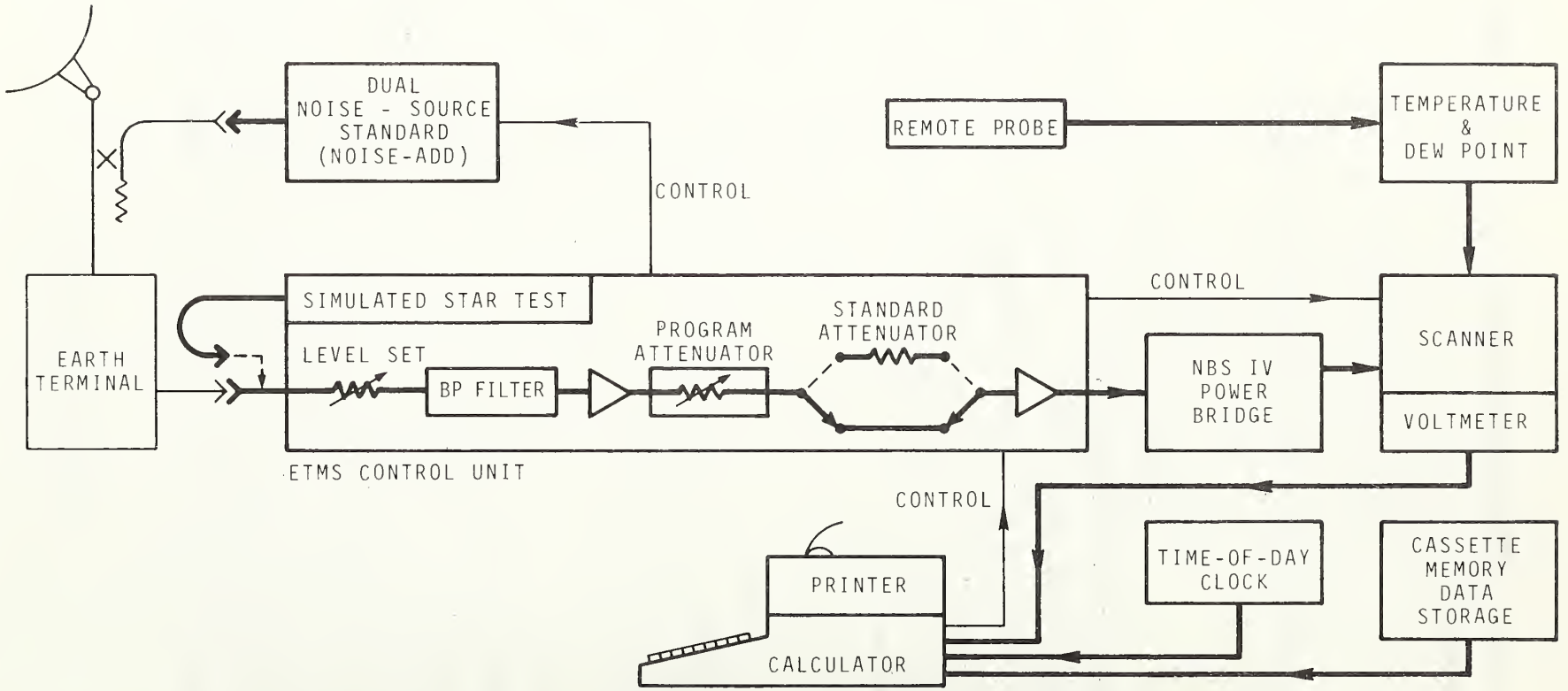


Figure 1. Block diagram of the Earth Terminal Measurement System.

4. OVERVIEW OF MEASUREMENT PROCEDURES

The measurement procedure can vary with the measurement to be performed, so different procedures will be discussed separately.

4.1 G/T, G/T_a, NEF, and NUF Procedure

The G/T, G/T_a, NEF, and NUF are measured in the same procedure. Antenna gain is not measured directly because there is no access to the antenna output port. The output level of the reference noise source is calibrated but the signal which is coupled into the front end of the earth terminal and referred to as the noise add signal, T_a, is not known accurately because the coupling coefficient of the directional coupler is unknown. The magnitude of T_a is known approximately from antenna HPBW and moon measurements.

The measurement procedure contains seven steps. First, prior to arriving at the measurement site, the date of the measurement, the earth terminal's site coordinates, antenna diameter, aperture efficiency, radiation efficiency, operating frequency, bandwidth, and approximate G/T are entered into the computer program, and the expected measurement errors are printed, the star positions versus time are plotted, and the resulting data are stored onto a data cassette to be used at the measurement site. Using this information, the on-site measurement schedule is planned. The second measurement step is at the measurement site. The reference noise source is connected to the directional coupler in the antenna room, and the output from one of the earth terminal down converters is connected to the ETMS. A system check and an earth terminal system stability check is then performed. Thirdly, offset corrections for the antenna pointing are determined, and sky profiles (sky temperature versus antenna elevation along the star trajectory) are established. The fourth step, measurement data for G/T, G/T_a, NEF, and NUF is taken. 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. One cut is taken on the cold sky about 2 degrees away (in declination) from Cas A. The remaining cuts are spaced equidistant throughout the main beam of the antenna pattern, and selected data points are least squares fit to a two-dimensional parabolic curve. The parabolic curve fit is used because it is the fit that requires the least computation time and computer memory yet still provides the needed antenna

pointing correction information. The data are stored and G/T, G/T_a, NEF, NUF antenna half power beamwidths (HPBW), and updated antenna point offsets are calculated and printed out.

The fifth step of the procedure is the first level rework of the data. Each set of data (which consists of 6 cuts) is refit to a two-dimensional gaussian curve, and the resulting G/T, G/T_a, NEF, NUF, and HPBW for each set are plotted as a function of antenna elevation. The gaussian curve fit is much slower than the parabolic fit, but it is a better approximation to the true curve shape. The gaussian curve can be used to fit the entire drift curve and thus allows a direct measurement of the relative temperature change caused by the star, $\Delta T_{cas}/T_a$, without depending on sky profile measurements made at a different time. This direct measurement of $\Delta T_{cas}/T_a$ using gaussian curve fitting is immune from errors caused by directional dependent interference sources. The sixth step is to use the results of the first level rework to readjust the computation parameters and then to perform a second level rework. The seventh step is to delete any bad measurement sets and perform a third level rework which plots the results for the remaining measurement sets. The eighth and last step is to take the results from the last data rework and to enter them into the program used in step one which lists all the program assumptions and the resulting errors. The purpose for step seven is to reexamine the assumption and to record explicitly the conditions of the measurement.

4.2 EIRP Procedure

The EIRP of a specific frequency from a satellite is measured in three steps. The first step is to measure G/T_a as a function of antenna elevation as described in section 4.1. Secondly, a narrowband filter in the ETMS is selected, and the power out of the earth terminal patch board is measured both in milliwatts and relative to the noise add reference for four situations: (1) the antenna pointed to the cold sky near the satellite, (2) the antenna pointed at the satellite and the earth terminal down-converter tuned to the satellite frequency of interest, f_o, (3) same as (2) except the down-converter tuned to the noise floor at a frequency just below f_o, and (4) same as (3) except at a frequency just above f_o. The EIRP is calculated using eq. (15). For each measurement situation, repeated measurements are taken to obtain a sense of the repeatability of the power level.

4.3 C/kT Procedure

C/kT is measured at the same time as EIRP, but also may be measured separately. The first step in the EIRP is not used for the C/kT measurement but the last two steps are used, and the results of the power measurements are entered into eq. (16) for the calculation.

5. OVERVIEW OF THE COMPUTER CASSETTE TAPES

The ETMS has eight computer tapes, (1) the equipment check (EQUIP CHECK) tape, (2) the site preparation program tape (SITE PREP), (3) the measurement program tape (MEAS), (4) the summary tape, (5) the rework program tape (REWORK), (6) the comments tape one which includes the list of simple computer variables and meanings, (7) the comment tape two containing the program matrix variables and meanings, (8) the comment tape three containing the special functions and meanings.

The major programs EQUIP CHECK, SITE PREP, MEAS, and REWORK can be loaded using a single cassette tape for each. This is made possible by duplicating certain files.

On the first three tapes each contain an identical file of subroutines, denoted as program "X." The rework tape also contains many of the same subroutines found in "X." Three tapes, SITE PREP, MEAS, and REWORK each contain star, site, and equipment characteristics information filed in the matrices S, T, and N. The EQUIP CHECK tape contains the matrix N file. Three tapes contain very similar files denoted LOADER used to load the "X" subroutines and the S, T, N matrices and the main program on that specific tape.

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 Ø (denoted f_o 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 Ø normally clears all of the adverse internal computer flags, etc., sometimes set up when a computer error is encountered.

After loading the SITE PREP program, either the MEAS or the REWORK programs can be loaded from TRAP without using LOADER or reloading the subroutines and the S, T, N matrices. Similarly, REWORK can be reached from TRAP in MEAS.

The summary tape is used in the external cassette at the same time either MEAS or REWORK is used. The summary tape collects duplicate 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 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.

6. THE COMPUTER PROGRAMS

Following are a brief description of the purpose of a particular program and comment 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 is 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.

6.1. The Equipment Check 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 to aid in diagnosing which element of the system has failed.

At TRAP (e.g., via Key Ø) normally the "1 = AUTO CK" option is selected. The "Ø = 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 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 prop-

erly 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 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 detailed considerations of the channel voltage checks. If a channel voltage continues to be out of normal range after three hours, unless otherwise indicated below, check that all the cables are connected properly, then consult the maintenance manual.

6.1.3.1 Channel Ø: 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 using the zero set adjust on the front of the DVM. To ground the DVM, one can either stop the program mode by pressing the "end" key, then use the keyboard entry FNX 111, Exc, or enter the control code 111 (binary number 110 1111) into the program switch keys on the ETMS Control Unit and press the "load" switch. For the adjustment, the DVM is taken out of program control via the "program control" button on the DVM front panel and switched manually to the most sensitive voltage scale, and the "external rate" knob rotated full cw. After the adjustment, the "program control" button must be returned to the in position, and the "external rate" knob in the full ccw position.

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 standby 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 set-up 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 30 minutes. 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 standby 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.

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 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 voltage which determines the accuracy of the digital voltage to analogue 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, particularly for measurements of EIRP or C/kT. In addition, the measured value of the standard attenuation is measured over a 16-dB range. 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 and ETMS internal noise sources. 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 of Type IV Bridge

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 standard deviations are plotted. The initial power level of this power ratio test is varied over a 16-dB range. Any nonlinearity of the type IV power bridge, or unusually noisy measurement conditions are easiest to spot on this graph. The magnitude of the nonlinearity may also be identified on the Key 4 or Key 6 tests. 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).

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 multiplexer 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 also is 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, this 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 CHECK ANNOTATED PRINTOUT

* INSERT EQUIP CHECK tape

```
LOAD
RUN
PROGRAM:S=EXIT TAPE DISK :I=INIT TAPE:I0
  I0
```

```
0=RE   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 ADD STABILITY
KEY 7: CHANGE STANDARD ATTENUATIN VALUE
KEY 8: 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=RE  LIST,1=AUTO CK  =NO: 1    ?STD  6.1000  dB)  =NO : 4.0738  ?4.08
STD(  6.1066  dB)(  =NO: 4.0800  ?4.085
STD(  6.1119  dB)(  =NO): 4.0850  ?4.09
STD(  6.1172  dB)(  =NO): 4.0930  ?4.0738
```

← new A3

* press Key 0 to EXIT

EQUIP CHECK (cont)

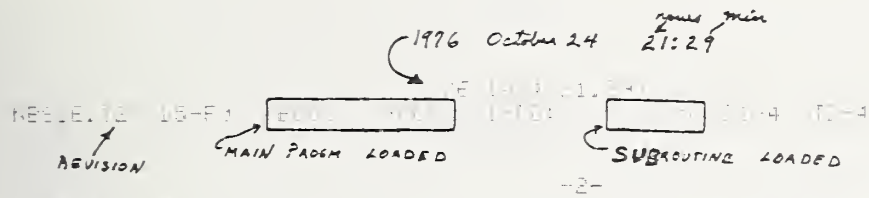
```
0=ENTER LIST, 1-AUTO CHECK, 2-MANUAL: 1
IF CHECK LIST = DVM, 99=NO?1
```

Ø response bypasses questions in this box

```
FF: 1, FULL SW?
6 ML PWR SWITCHES ON?
DANA: EXT RATE FULL CCW?
DANA: DATA OUTPUT BUTTON IN?
DANA: PROGRAM CONTROL BUTTON IN?
RF UNIT:BANDPASS FREQ @ 5.3ML/70MHz?
RF UNIT: ATTEN SET TO 17   dB?
RF UNIT: SIN S-AR 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 CNT TIME?
END
```

```
                                (76 1024 21.28)
MB51E.12  D5-F0:  EQUIP CHECK  T1-F0:      %.05  D1-4  T2-4


                                  -1-
Sysm # 6.09                                                          RUN  0

                    PROG  KEY 2:        CHECK DIGITAL MULTIMETER



DVM FUNCTION 1111: FILTER OUT?
DVM FUNCTION 1?.0: FILTER IN?
 1>00    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



-2-

REVISION
ETMS SERIAL NO.

PROG KEY 3: CHECK CHANNEL VOLTAGES

CHANNEL	VOLTAGE	STATUS	NOMINAL	+- RANGE
0=IC 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=TAL DIODE	-1.71600E-03	OK	-0.0125	0.0125
7=D A REF	6.2367	OK	6.24	0.01
8=BRDG OUTPUT	3.4821	OK	3.5	0.1
9=SET FINE REF	0.48333	OK	0.486688	3.00000E-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-

Sysn # 6.09 RUN 0

PROG KEY 4: CHECK ATTENUATORS

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

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

VALUE ASSUMED FOR STD

NBS TYPE IV OUTPUT 0.43401 MW +- 0.152 % (3 MEAS) STD CK: 0.014 DB

% ATTN	PRGM ATTN #1 / PRGM ATTN #2	#1 PWR OR VOLT / #2 PWR OR VOLT	ORIG PWR/#1 PWR STD CK @ #2	#1 PWR/#2 PWR NOMINAL #1/#2	PRGM ATTN USED
					PRGM ATTN USED
17 DB	0 DB	0.43343 +- 0.19 %	0.00 DB	0.974 DB	
	1 DB	0.34637 +- 0.19 %	0.023 DB	1 DB *	1dB
17 DB	0 DB	0.43298 +- 0.13 %	0.010 DB	1.956 DB	
	2 DB	0.27599 +- 0.19 %	0.007 DB	2 DB *	2 dB
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	3.934 DB	
	4 DB	0.17480 +- 0.38 %	0.013 DB	4 DB *	4 dB
17 DB	0 DB	0.43336 +- 0.11 %	0.007 DB	4.923 DB	
	5 DB	0.13949 +- 0.14 %	0.005 DB	5 DB	4+1
17 DB	0 DB	0.43273 +- 0.14 %	0.015 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	7.970 DB	
	8 DB	0.06903 +- 0.08 %	0.013 DB	8 DB *	8 dB
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 %	0.019 DB	13.852 DB	
	14 DB	0.01784 +- 0.20 %	0.005 DB	14 DB	8+4+2
17 DB	0 DB	0.43207 +- 0.19 %	0.[illegible] DB	14.[illegible] DB	
	15 DB	0.01420 +- 0.18 %	0.003 DB	15 DB	8+4+2+1

Difference

10 for 3 meas

SHOULD BE 4.923 DB
Less than ± 0.030

PWR STABILITY over 10 minutes

PRGM ATTN USED

EQUIP CHECK (cont)

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

-4-

Sysn # 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	V7 (ΔV, RF pwr off)	V8 (ΔV, RF pwr ON)	V9 (ΔV, RF pwr off again)	PWR(MW)	CK ERR	SIGMA
1	2.4839	0.000436	-0.012847	0.000435	0.3290MW	NO MEANING 1ST READ	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	0.0158DB	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	0.0156DB	0.09%
19	2.4839	0.000415	-0.012849	0.000411	0.3285MW	0.0186DB	0.18%
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	-0.012884	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	0.3283MW	0.0044DB	0.17%
28	2.4839	0.000402	-0.002845	0.000399	0.0806MW	0.0011DB	0.11%

0

10 of 14 MEAS at 0.38 MW

10 of 14 MEAS at 0.08 MW

```
                                  -76 1024 21.40)
NBS1E.12 (D5-F0)  EQUIP CHECK  T1-F0:      X.05 (D1-4  T2-4


                                   -5-
Sysm # 6.09                                                          RUN  0

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

          SIML STAR ATTN: 5.5 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                                  !     +     !              6.1247DB  0.423MW
   2                                !       +       !            6.1129DB  0.344MW
   3                                   !    +    !               6.1218DB  0.375MW
   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
   9                                   !     +     !            6.1139DB  0.069MW
  10                                !       +       !           6.1093DB  0.055MW
  11                                   !+!                      6.1148DB  0.044MW
  12                                !     +     !              6.1057DB  0.035MW
  13                              !     +     !                6.0790DB  0.014MW
  14                           !          +          !         6.1051DB  0.022MW
  15                                !     +     !              6.0971DB  0.018MW
  16                                   ! + !                   6.1088DB  0.21[illegible]
  17                                !     +     !              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  0.273MW
  36                                      !+!                   6.1286DB  0.218MW
```

INPUT PWR CYCLE

```
                                  (76 1024 21.55)
NBS1E.1&  D5-F0)  EQUIP CHECK  T1-F0)      ).35  D1-4  T2-4

                                  -6-
Sysm # 6.09                                                        RUN  0

                                  ETMS CONNECTED TO SIMULATED NOISE SOURCES
                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:   1.2968

                PWR MEASURED INDIRECTLY                SHOULD AGREE
P= 0.4264 mW      add #1= 0.1545 mW      add #2= 0.6021 mW      meas/set=  3
   WILL AGREE ONLY IF STD ATTN CORRECT VALUE   SHOULD BE/ BASICALLY INDEPENDANT OF INPUT PWR VALUE

P(mW)    P+1+2    #1(mW)   #2(mW)   #1+#2    #1/#2(    P/#1     P/#2     P/1+2    STDdB
                                                                                    dB
         PWR MEASURED DIRECTLY
0.4260   0.2878   0.1541   0.5993   0.7466   0.2572   2.7631   0.7117   0.5704   0.0213
0.12%    0.07%    0.67%    0.37%    0.12%    0.30%    0.76%    0.50%    0.16%    0.0157
1σ deviation from mean   PAINTED IN 2nd ROW
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   0.0210
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%    0.12%    0.0091

0.1374   0.0930   0.0498   0.1932   0.2414   0.2580   2.7871   0.7123   0.5689   0.0120
0.13%    0.21%    0.47%    0.34%    0.28%    0.80%    0.58%    0.33%    0.27%    0.0267

0.1037   0.0742   0.0397   0.1555   0.1926   0.2551   2.7669   0.7053   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   0.2568   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%    0.74%    0.47%    0.0188

0.0543   0.0367   0.0198   0.0765   0.0953   0.2585   2.7441   0.7096   0.5695   0.0101
0.10%    0.08%    0.63%    0.06%    0.15%    0.68%    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%    0.76%    3.18%    0.48%    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%    0.48%    0.21%    1.32%    1.27%    0.65%    0.15%    0.0177

0.0263   0.0186   0.0094   0.0387   0.0482   0.2161   2.7480   0.7105   0.5695   -0.0068
14.16%   0.20%    34.31%   0.20%    0.30%    34.14%   1.10%    0.15%    0.28%    0.0071
                  OBVIOUSLY ONE OR MORE NOISY VALUES FOR THIS SET
0.0219   0.0148   0.0079   0.0310   0.0389   0.2577   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   2.7536   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
```

BAG PWR with #1 & #2 ADD ON, NOTE 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)

(76 1024 23.13)
NBS1E.12 (D5-F0) EQUIP CHECK T1-F0: X.05 (D1-4) T2-4

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(=NC): 1 ?

IF NEED TO CHANGE ATTN etc., when finished (1) press key 0 (to remove AUTO fly) then (2) press key 6 for Earth terminal test

.76 1024 0.29)
MBS1E.12 <D5-F0> EQUIP CHECK T1-F0: %.05 <D1-4 T2-4

-8-

Sysm # 6.09 TESTS ETMS MICROWAVE NOISE ADD SOURCES & THE PROPERTIES OF THE EARTH TERMINAL RUN 0

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	0.5694	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
0.18%	0.11%	0.22%	0.46%	0.18%	0.66%	0.23%	0.52%	0.34%	0.0090
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%	0.18%	0.0131
0.0177	0.0123	0.0068	0.0201	0.0331	0.3381	2.7779	0.7109	0.5709	-0.0282
35.13%	42.03%	41.23%	0.53%	42.04%	41.50%	1.36%	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%	0.58%	0.23%	0.0388
0.0179	0.0121	0.0064	0.0252	0.0314	0.2554	2.7784	0.7100	0.5703	0.0032
0.19%	0.35%	0.69%	0.47%	0.46%	0.41%	0.69%	0.34%	0.28%	0.0373

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, to provide an opportunity to modify any of these program constants, and then finally link in one of the major computer programs such as SITE PREP, MEAS, or REWORK. The annotated printout for the loader program appears with the SITE PREP program that follows.

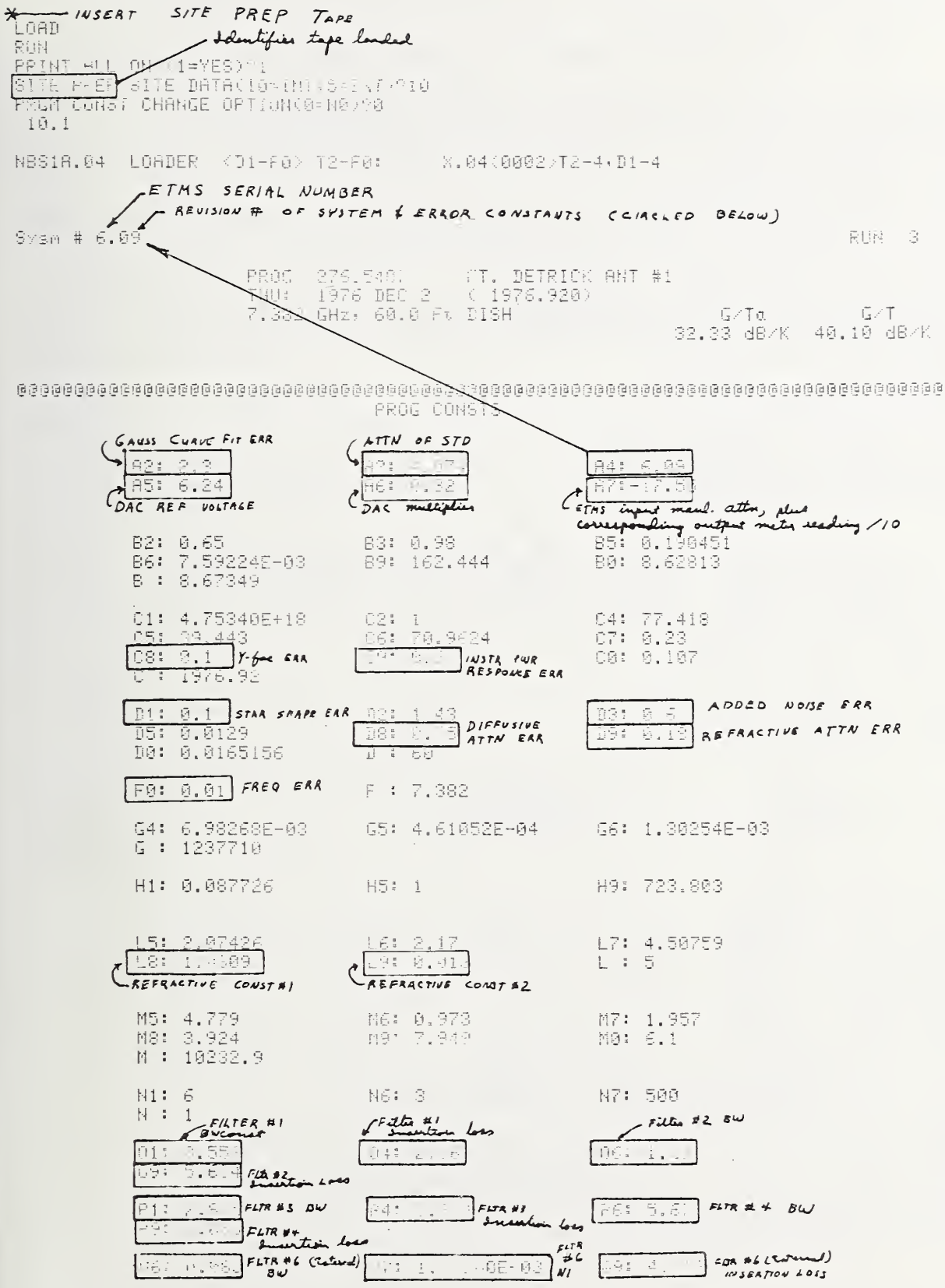
6.3 The Site Preparation Program and Annotated Printout

One purpose of the site preparation program (SITE PREP) is to anticipate measurement conditions and to prepare the daily measurement tapes before traveling to a measurement site. The second purpose of the SITE PREP program is as an aid to double checking the measurement conditions after a site measurement analysis is finished and to provide a computer printout of the final measurement conditions in an easier to read format. An additional use of SITE PREP is to set up site parameters or error assumptions for a data rework.

The normal means of loading and using SITE PREP is covered on the annotated printout in section 11.2. At TRAP, option "3 = KEY LIST" prints out the key functions on this program, option "2 = LK MEAS" can be used to exit SITE PREP and link in the MEAS program, and option "3 = LK REWORK" can be used to exit SITE PREP and link in the rework program.

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 azumuth and elevation of Cas A versus Greenwich Mean Time (GMT).

SITE PREP


INSERT SITE PREP TAPE
Identifier tape loaded
LOAD
RUN
PRINT ALL ON (1=YES)?1
SITE P-E: SITE DATA(0=NO,S=S,F=10
PROM CONST CHANGE OPTION(0=NO)?0
10.1
NBS1A.04 LOADER <D1-F0> T2-F0: X.04(0002)T2-4,D1-4
ETMS SERIAL NUMBER
REVISION # OF SYSTEM & ERROR CONSTANTS (CIRCLED BELOW)
Sysm # 6.09
RUN 3
PROC 275.540: FT. DETRICK ANT #1
TIME: 1976 DEC 2 (1976.920)
7.382 GHz; 60.0 Ft DISH
G/To 32.33 dB/K
G/T 40.10 dB/K
PROG CONSTS
GAUSS CURVE FIT ERR
A2: 2.2
A5: 6.24
DAC REF VOLTAGE
ATTN OF STD
A4: 6.09
A7: -17.5
ETMS input manl. attn, plus corresponding output meter reading /10
H6: 0.32
DAC multiplier
B2: 0.65
B3: 0.98
B5: 0.190451
B6: 7.59224E-03
B9: 162.444
B0: 8.62813
B : 8.67349
C1: 4.75340E+18
C2: 1
C4: 77.418
C5: 99.443
C6: 70.9424
C7: 0.23
C8: 0.1
Y-fac ERR
C0: 0.107
C : 1976.92
INSTR FUR RESPONSE ERR
D1: 0.1
STAR SHAPE ERR
D2: 1.43
D3: 0.5
ADDED NOISE ERR
D5: 0.0129
D8: 0.5
DIFFUSIVE ATTN ERR
D9: 0.19
REFRACTIVE ATTN ERR
D0: 0.0165156
D : 60
F0: 0.01
FREQ ERR
F : 7.382
G4: 6.98268E-03
G5: 4.61052E-04
G6: 1.30254E-03
G : 1237710
H1: 0.087726
H5: 1
H9: 723.803
L5: 2.07426
L6: 2.17
L7: 4.50759
L8: 1.
L9: 0.91
L : 5
REFRACTIVE CONST #1
REFRACTIVE CONST #2
M5: 4.779
M6: 0.973
M7: 1.957
M8: 3.924
M9: 7.949
M0: 6.1
M : 10232.9
N1: 6
N6: 3
N7: 500
N : 1
FILTER #1 BW CONST
Filter #1 insertion loss
Filter #2 BW
D1: 3.55
D4: 2.
D6: 1.
D9: 5.64
Filt #2 insertion Loss
P1: 2.5
FLTR #3 BW
P4:
FLTR #3 insertion loss
P6: 5.6
FLTR # 4 BW
P9:
FLTR #4 insertion loss
M6:
FLTR #6 (retard) BW
M7: 1.
FLTR #6 N1
M9:
COR #6 (retard) INSERTION LOSS

* REWIND SITE PREP TAPE
* INSERT APPROPRIATE RUN (MEAS) TAPE (either internal or external cassette)

Boxes show questions bypassed if "space bar", "execute"

```
CHANGE RUN/DATE/SITE:1=YES( =NC): 0     ?1
RUN NUMBER( =NC): 3     ?1
YEAR( =NC)NOW: 1976?1977
MONTH( =NC)NOW: DEC?MAY
DAY OF MONTH( =NC)NOW: 2 ?10
DAY OF WEEK( =NC)NOW: THU?TUE
PROJ #( =NC)NOW: 276.5407?27?.5411
LOCATION( =NC)NOW: FT. DETRICK ANT #1  ?CAMP ROBERTS, ANT#1
SITE:W. LONG( =NC): 77.418  ?120.753
SITE:N.LAT( =NC): 39.443  ?35.734
SITE:ALT(FM)( =NC): 0.107    ?.369
NEW F/BW/ELEV ANT CONT:1=YES( =NC): 0     ?1
CENTER FREQ(GHZ)( =NC): 7.382    ?7.55
ERR IN FREQ(%)( =NC): 0.01     ?
BANDWIDTH(MHZ)( =NC): 5.5  ?
ELEV(DEG)( =NC): 5     ?
ANT DIAM (FT)( =NC): 60    ?
1=APR EFF,2=ANT HPBW,3=CNVL HPBW( =NC): 0     ?1
APERTURE EFFICIENCY( =NC): 0.65     ?
HPBW ERR(1S,%)( =NC): 1.43     ?
ANT PT ERR:1=DEG,2=%HPBW( =NC): 0     ?1
DEG( =NC): 0.0129  ?.015

ANT PT ERR corresponds to G/T data fit (3+1S/SQR(#PTS) of 0.128587804
dB  This information is important when SITE PREP is being used to recheck
    final results and you are trying to obtain a specific G/T data fit value.
 0.128587804    DB:0=TRY AGAIN( =NC): 1     ?
CHANGE:1=T(K)? 2=G/T(DB)( =NC): 0     ?2
G/T(DB)=( =NC): 40.0999873     ?
CHANGE:1=G/TA, 2=TA( =NC): 0     ?1
G/TA(dB/K)( =NC): 32.74400707     ?
AMBIENT TEMP(F)( =NC): 80.3     ?
DEW PT TEMP(F)( =NC): 46.2     ?
ENTER SUN/MOON ALMINAC DATA(1=YES)  =NC): 0     ?1

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

SUN  :GHA @ 0 GMT( =NC): 182.665     ?180
MIN( =NC): 0     ?54.7
SUN  :GHA @ 12 GMT( =NC): 360.863     ?0
MIN( =NC): 0     ?55.0
N.DEC @ 0 GMT( =NC):-21.9416     ?17
MIN( =NC): 0     ?31.9
N.DEC @ 12 GMT( =NC): 17.4096     ?17
MIN( =NC): 0     ?39.7
MOON :GHA @ 0 GMT( =NC): 54.55     ?[illegible]
MIN( =NC): 0     ?38.1
MOON :GHA @ 12 GMT( =NC): 444.391     ?[illegible]
MIN( =NC): 0     ?38.7
N.DEC @ 0 GMT( =NC): 6.45     ?[illegible]
MIN( =NC): 0     ?6.1
N.DEC @ 12 GMT( =NC): -9.[illegible]
MIN( =NC): 0     ?17.6
HOR PARALLAX( =NC): 0.9     ?[illegible]
MIN( =NC): 0     ?57.4
AGE (DAYS)  =NC): 11     ?[illegible]
PRT S1:0  JHR DATA(0=[illegible]( =NC): 1     ?
```

(negative sign on minutes is optional)

horizontal parallax is always less than 2 deg. If you inadvertently try to insert a value > 2 deg, the calculator warns you to do better

NBS18.07 SITE PREP <D1-F12 T2-F12: X.04/0002:T2-4:D1-4

-2-

Sysm # 6.09 RUN 1

PROG 276.5411 CAMP ROBERTS, ANT#1
TUE: 19:7 MM: 1J \ 1977.358)
7.550 GHz, 60.0 Ft DISH G/Ta G/T
32.74 dB.k 40.10 dB.k

SITE: W. LONG 120.753 deg (C4)
N. LAT 35.734 deg (C5)
ALTITUDE 0.369 km (C0)
GHA TO ARIES @ 0 GMT 227.680 deg (C6)

FLUX DATA

	STAR / Epoch	FLUX in F.U. Secular Decay		RANGE(GHz)	SIZE(min)	SPEC INDEX Secular Expansion
	String start at T(1,1)	S(1,1)	T(1,8)/10	T(1,18)/100	T(1,19) T(1,20)	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 T(1,15)/10	0.97 +- 0.05 %/Yr T(1,16)/100 T(1,17)/100				0.126 +- 0.023 %/Yr T(1,4)/1000 T(1,5)/1000
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	325000 +- 7.0 % @	1 GHz	1 TO 10	32.00	2.000 +- 0.005
6	MOON	1881 +- 9.9 % @	2 GHz	2 TO 10	22.00	2.000 +- 0.030

PROG CONSTS

N	T(N,1)	S(N,1)	T(N,8)	T(N,18)	T(N,19/20)	T(N,9)	T(N,6)	T(N,7)
	T(N,15)	T(N,16)	T(N,17)				T(N,4)	T(N,5)

LOCATION & MISC DATA

STAR EPOCH (DAYS AFTER 1977.0)	SOLAR EPOCH (DAYS AFTER 1977.0)
1977.358 130	1976.923 -29

	STAR: / SOLAR:	RT.ASC GHA @ 0 GMT	N. DEC. N.DEC @ 0	LINEAR POLZ GHA/Hr	N.DEC/Hr	POLZ ANG 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	180.91 deg	17.53 deg	15.000 deg	0.011 deg	0.000 deg	0 day
6	MOON	269.64 deg	-11.10 deg	14.501 deg T(6,11)/1000	0.151 deg T(6,12)/1000	0.957 deg T(6,13)/1000	22 day T(6,14)

PROG CONSTS

N	T(N,1)	S(N,2)	S(N,3)	T(N,11)	T(N,12)	T(N,13)	T(N,14)

NBS1B.07 SITE PREP [illegible] T2-4*D1-4

-3-

Sysm # 6.09 N(1,4) RUN 1

PROG 27L.5411 CAMP ROBERTS, ANT#1

TUE: 1977 MAY 10 1977.358

F 7.550 GHz, 60.0 Ft DISH

G/Ta	G/T
32.74 dB/K	40.10 dB/K

TYPICAL VALUES for G/T MEASUREMENT using CAS A

G	T	APER EFF	PHY EFF	ANT HPBW	CONVL HPBW	EFF AREA
61.34 dB	133.1 K	0.4500	0.98	0.1371 deg	0.1382 deg	170.8 mt2

Antenna Elev = 5.0 deg

	PARAMETER		ERR TO G/T
F	FREQUENCY (GHz)	F 7.550 +- 0.01 %	+- 0.00 %
S	FLUX (F.U.=10^(-26)W)	S(1,4) 82.3 +- 5.80 %	+- 5.80 %
	T(cont) = 24.8 K (Y-1)*T		
	X1 = 1.822E-05 K (Y-1)*T/G		
Y	Y-FACTOR	Y 1.186 +- 0.10 %	+- 0.64 %
	Y(dB) = 0.742 dB 10*LGT Y		
K1	ATM ABSORPTION FACTOR	K1 0.910 +- 4.95 %	+- 4.95 %
	oxygen attn= 0.0294 dB G4*L4		
	water attn = 0.0063 dB G5*L5+G6*L6		
	water dens= 7.8 gm/mt3 L7		
	atm bright= 25.2 K B4		
	site alt = 0.369 km C0		
	amb temp = 80.3 F A(3)/10		
	dew point= 46.2 F A(4)/10		
K8	DIFFUSE (0.5*(1/K9-1))	K8 0.262 +- 12.03 %	+- 12.03 %
K9	REFRAC (0.18*(1/K9-1))	K9 0.376 +- 0.45 %	+- 0.45 %
	1st const: 1.0155 L8		
	2nd const: 0.0139 L9		
K2	STAR SHAPE (CAS A)	K2 1.000 +- 1.14 %	+- 1.14 %
	+-(10.4*(1-K2)+ 0.1)%		
	HPBW (+- 1.43% D2		
K3	BNDWD EFFECTS FACTOR	K3 1.000 +- 0.00 %	+- 0.00 %
	bandwidth = 5.5 MHz		
K4	DIFF SYSTEM TEMP	K4 1.000 +- 0.07 %	+- 0.07 %
K5	ANT POINT(+- 0.0150 deg)	K5 1.000 +- 3.01 %	+- 3.01 %
	or G/T data fit= +- 0.129dB H1		
K6	ANT POLARIZATION FACT	K6 1.000 +- 0.35 %	+- 0.35 %
K7	SYSTEM RESPONSE FACT	K7 1.000 +- 2.63 %	+- 2.63 %
	instr pwr resp (+- 0.206% C9		
	Y/(Y-1)= 6.365 Y5		
	gauss curve fit(+- 2.30% A2		
Ta	ADDED NOISE (K)	H9 [illegible] +- 0.60 %	+- 0.60 %
	TOTAL ERROR: quad sum + diff & refr err		+- 21.19 %

STORE S,T,N:0=NO,5=EXT,10=INT: =N : : 0 ?10 ← STORES SITE DATA onto RUN(MGAS) Tape
LIST ALTERNATE STARS:0=NO:?1 ← normally bypass this listing

NBS1B.07 SITE PREP D1-F12 T2-F12: X.04.0002 [illegible] 4,01-4

-4-

System # 6.09 RUN 1

PROG 276.5411 CAMP ROBERTS, ANT#1
TUE: 1977 MAY 10 (1977.358)
7.550 GHz, 60.0 F: DISH

G/Ta 32.74 dB/K G/T 40.10 dB/K

	STAR	FLUX in F.U.			T(ant)	K2	Y-factor	Y(dB)	Xi(K)
1	CAS A	582	+-	5.8 %	24.80 K	0.900	1.1864	0.74 DB	1.822E-05
2	CYG A	248	+-	8.8 %	11.40 K	0.986	1.0857	0.36 DB	8.376E-06
3	TAU A	602	+-	8.8 %	26.16 K	0.923	1.1966	0.78 DB	1.922E-05
4	ORI A	420	+-	5.0 %	18.54 K	0.940	1.1393	0.57 DB	1.[illegible]3E-05
5	SUN	2E+07	+-	8.1 %	1.01E+05 K	0.0[illegible]	[illegible]	[illegible] DB	[illegible]
6	MOON	26805	+-	9.9 %	145.92 K	0.0[illegible]	[illegible]	.22 DB	[illegible]

WHEN K2 < 0.8, REST OF PRINT OUT IS MEANINGLESS

G/T or C/T2 MEASUREMENT ERRORS: ELEV= 5.0deg

		CYG A	TAU A	ORI A	SUN	MOON
E-S	FLUX	8.80 %	8.80 %	5.00 %	5.10 %	9.90 %
E-F	FREQUENCY	0.00 %	0.00 %	0.00 %	0.00 %	0.01 %
E-Y	Y-FACTOR	1.27 %	0.61 %	0.82 %	0.1[illegible] %	0.[illegible] %
E-K1	ATM TRANS FACT	4.95 %	4.95 %	4.95 %	4.95 %	4.95 %
E-K2	STAR SHAPE	1.14 %	0.24 %	0.90 %	0.72 %	0.45 %
E-K3	BNDWD EFFECTS	0.00 %	0.00 %	0.00 %	0.00 %	0.00 %
E-K4	DIFF SYST TEMP	0.16 %	0.06 %	0.09 %	0.03 %	0.01 %
E-K5	ANTENNA POINT	3.01 %	3.01 %	3.01 %	3.01 %	3.01 %
E-K6	ANT POLARZ	0.35 %	0.35 %	0.35 %	0.35 %	0.35 %
E-K7	SYST RESPONSE	3.42 %	2.60 %	2.82 %	2.31 %	2.33 %
E-K8	ATM DIFFUS	12.03 %	12.03 %	12.03 %	12.03 %	12.03 %
E-K9	ATM REFAC	0.46 %	0.46 %	0.46 %	0.46 %	0.46 %
E-Ta	NOISE AID	0.60 %	0.60 %	0.60 %	0.60 %	0.60 %
TOTAL LINEAR SUM		36.17 %	33.70 %	31.02 %	[illegible].62 %	21.88 %
TOTAL QUADRATIC SUM		16.46 %	16.23 %	14.61 %	[illegible].82 %	13.88 %

ELEV vs GMT PRINT OUT? 1=YES, 2=NO ? 0 ?1

N6S1B.07 SITE PREP D1-P1, F2-P1: X.04,0002>T2-4,D1-4

-5-

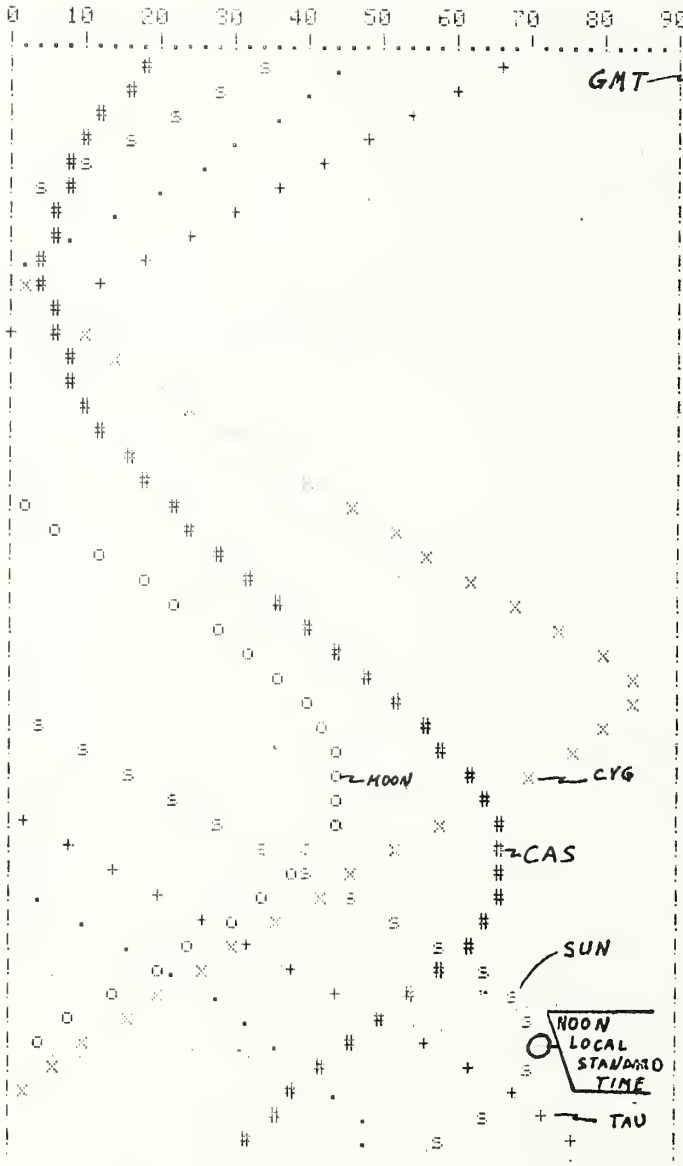
S/sm # 6.09 RUN 1

PROG 275.5411 CAMP ROBERTS, ANT#1
TUE: 1977 MAY 10 (1977.358)
7.550 GHz, 60.0 Ft DISH

G/Ta 32.74 dB/K G/T 40.10 dB/K

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

SOURCE ELEV(deg)



CAS A POINTING ANTENNA COORDINATES

CAS:	EL	AZ
0	18.22	330.65
	15.37	333.42
1	12.79	336.44
	10.52	339.67
2	8.59	343.10
	7.02	346.70
3	5.83	350.44
	5.04	354.26
4	4.65	358.17
	4.66	2.09
5	5.08	5.99
	5.90	9.82
6	7.12	13.55
	8.71	17.14
7	10.67	20.56
	12.96	23.78
8	15.55	26.78
	18.43	29.53
9	21.54	32.03
	24.88	34.23
10	28.39	36.13
	32.05	37.68
11	35.83	38.85
	39.70	39.59
12	43.60	39.80
	47.49	39.40
13	51.32	38.25
	55.02	36.15
14	58.48	32.86
	61.59	28.12
15	64.17	21.69
	66.03	13.52
16	66.97	4.00
	66.86	354.03
17	65.73	344.73
	63.71	336.89
18	61.01	330.80
	57.82	326.38
19	54.29	323.35
	50.56	321.45
20	46.72	320.46
	42.82	320.19
21	38.92	320.52
	35.07	321.35
22	31.31	322.60

FOR RUN TAPE #2, MOST ITEMS ARE BYPASSED

```
0=RSTRT,1=LK MEAS,2=LK SWRM,?=NEW'S LIST  =NC): 0     ^0
CHANGE RUN DATE,SITE?(Y,CR=NC): N     ^1
RUN NUMBER( =NC): 1     ^
YEAR( =NC)NOW: 1977
MONTH( =NC)NOW: MAY?
DAY OF MONTH( =NC)NOW: 10^11
DAY OF WEEK( =NC)NOW: TUE^WED
PROJ #( =NC)NOW: 276.5+11?
LOCATION( =NC)NOW: CAMP ROBERTS, ANT#1 ^
SITE:W. LONG( =NC): 120.753     ^
SITE:N.LAT( =NC): 35.794     ^
SITE:ALT(KM)( =NC): 0.369     ^
NEW ? BW,ELEV,ANT GAIN,T1,T2:  ^ ^ ^     ^
ANT PT ERR:1=DEC,2=XHPBW( =NC): 0     ^
CHANGE:1=T(K), 2=G/T,DB( =NC): 0     ^
CHANGE:1=G/TA, 2=TA( =NC): 0     ^
AMBIENT TEMP(F)( =NC): 80.3     ^
DEW PT TEMP(F)( =NC): 46.2     ^
ENTER SUN/MOON ALMANAC DATA(1=YES)( =NC): 0     ^1

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

SUN  :GHA @ 0 GMT( =NC): 180.911     ^180
MIN( =NC): 0     ^55.3
SUN  :GHA @ 12 GMT( =NC): 360.921     ^0
MIN( =NC): 0     ^55.5
N.DEC @ 0 GMT( =NC): 17.5316     ^17
MIN( =NC): 0     ^47.5
N.DEC @ 12 GMT( =NC): 17.9236     ^17
MIN( =NC): 0     ^55.2
MOON :GHA @ 0 GMT( =NC): 269.635     ^257
MIN( =NC): 0     ^48.8
MOON :GHA @ 12 GMT( =NC): 431.825     ^71
MIN( =NC): 0     ^7.2
N.DEC @ 0 GMT( =NC):-11.1016     ^-7
MIN( =NC): 0     ^33.5
N.DEC @ 12 GMT( =NC):-[illegible]     ^-8
MIN( =NC): 0     ^26.5
HOR PARALLAX( =NC): 0.95     ^0
MIN( =NC): 0     ^56.6
[illegible]
PRT SITE,STAR DATA(0=NO)( =NC): 1     ^
```

NB81B.07 SITE PREP (D1-F1, T1-F13: 1.04<0002>T2-4,D1-4

Scan # 6.00 RUN 2

PROG 276.5+11 CAMP ROBERTS, ANT#1
WED: 1977 MAY 11 = 1977.361
7.550 GHz, 64.0 Ft DISH

G/To G/T
32.74 dB/K 40.10 dB/K

6.4 The MEAS Program and the Summary Data Tape

The purpose of the measurement program is to collect and validate data to be used in the rework program. The measurement program collects three types of data: sky profile data; star cuts used to measure G/T, antenna half power beam width (HPBW), and G/T_a; and satellite power data used to calculate C/kT and EIRP.

6.4.1 The Standard Check, and Providing the Proper Measurement Conditions

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 standard check contains 9 pieces of information labeled as follows: BRG PWR, BRG PWR+a, PWR+a/STD, STD, Ta#, MANL, PRGM, STD CK, and FLTR.

6.4.1.1 Meaning of Labels, and Normal Conditions

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 when the standard attenuator is out, and both microwave noise add noise sources are 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, and 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 Ta#. If Ta# = 1, then only noise add #1 is commanded ON. If Ta# = 2, then only noise add #2 is commanded ON. If Ta# = Ø, 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 unless BRG PWR is greater. In the latter case 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 read on 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 reasonably 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 in an attempt to keep the input power levels in the normal range.

STD CK is the measured attenuation minus the assumed attenuation of the standard attenuator contained in the ETMS control unit. 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 at 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	Bandwidth
1	30 MHz	2.5MHz
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. STD CK is the best overall indicator of the "health" of the measurement process. The STD CK can fall out of normal because the attenuation of standard changes due to temperature changes, or because the two relays that switch the standard attenuator become faulty, or because the RF control unit amplifiers are nonlinear, or the earth terminal gain is unstable during the measurement cycle, or any other number of reasons.

There is provision in the EQUIP CHECK program to adjust the value of A3, but if while using the MEAS program the average STD CK should be adjusted closer to zero, I suggest the following procedure. (1) Stop the program (e.g., pressing the END key on the calculator keyboard), (2) via the keyboard enter A3 (i.e., press key "A," then key "3," then the key "EXECUTE"). In the computer display will be the current value of A3, (3) press key "RECALL." In the display should appear "A3." (4) Press key "=," then enter the new value you wish for A3 and press "EXECUTE." 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 want to increase A3 by 2.3% (i.e., if originally A3 = 4.000, then new A3 = 4.092). (5) To check the new value of A3, add the following program to the end of the existing program.

```
9000  Q = FNDØ + FND1
9010  Q = FNU1
9020  Print
9030  go to 9010
```

(6) The program in (5) repeatedly runs the standard check. To use it you enter via the keyboard "CONT 9000," then press "EXCECUTE." When you are satisfied of the new average value for STD CK, press the key "STOP" twice. If the new STD CK average is satisfactorily close to zero, you can erase your temporary program by entering "DEL 9000," then press "EXECUTE." Otherwise repeat steps (1), (2), (3), (4) and (6).

6.4.1.3 "NOT NORMAL" Display

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

(1) PRGM between 2dB and 10dB

(2) (BRG PWR+a)/(BRG PWR) < 4

(3) (BRG PWR)/(BRG PWR+a) < 4

(4) STD CK < |0.05dB|

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 change (a) the value of the ETMS input attenuator, (b) the

noise add source, and/or (c) whether the standard attenuator is inserted when the noise add source is turned on.

Condition Not Met	Changes to Consider
1	a
2 or 3	b,c
4	change A3 (see §9.1.2)

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 azumuth and elevation angles be biased in order to obtain the needed earth terminal azumuth, elevation command angles. The need for the bias corrections is due to an unknown mix of situations such as antenna bore sight errors, elevation dependence 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.1 and with the meter offset knob recenter the meter reading. If any of the four pointing biases (hour angle, declination angle, azumuth, or elevation) are currently in the program, it is usually best to zero them using 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 azumuth 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 for 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 you cannot find the star 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 if there is an obstruction in or near the line of sight, 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 ETMS output meter. (3) Compare the predicted Cas A azumuth 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 disply), enter "C6," press "EXECUTE." In the disply 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 0GMT 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 was 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 at 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 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 this is 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 30 sequential power measurements taken at six-second intervals on the output of the earth terminal. 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 when 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). These eleven points 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 predicting of the 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, azumuth 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 store 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 remember - do not change an azumuth 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 $f_{\emptyset}$) 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 and the computer program. When all the information has been stored onto the cassettes, NBS recommends the computer program be listed out.

After the program is listed out, the rework program can be loaded at TRAP using the option "4LNK."

6.4.5 The EIRP and C/kT Measurement

The EIRP or C/kT measurement is initiated by selecting the "3 EIRP" option at TRAP. The EIRP or C/kT measurement routine uses measurement of power at a point in the satellite spectrum free of signals within the bandwidth selected, and a measurement of power with the satellite signal centered in the ETMS filter bandpass. The narrowest filter provided has a nominal bandwidth of 1 MHz. The measurements of EIRP and C/kT were not specified as being part of the ETMS package, and these measurements have not been engineered nor programmed for the inexperienced metrologist. The program that exists was developed to collect sufficient data for NBS metrologists for accurate measurements of EIRP and C/kT,

but the accuracy considerations and the measurement precautions required for accurate EIRP and C/kT measurements are not dealt with in this manual.

6.4.6 Data Storage on the Run Tape, and the Summary Tape

Ideally, each set of measurement data is recorded twice, once on the run cassette tape (which contains the MEAS program) and secondly on the summary tape. The run 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, and it is intended to be an archives tape which is write protected as soon as a run is finished. In contrast, the summary tape is a working tape. The measurement data from several runs can be accumulated onto the tape, and the rework program updates the summary tape files with the latest results.

The particular file on the run tape on which data is stored depends on the set number (computer variable is N7). In turn, N7 is determined by the run number (computer variable is N) which is controlled by the ETMS operator. It is possible to overwrite a "run" data file by intentionally or inadvertently re-using 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 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.

6.4.7 Changing the Run or Summary Data Tapes

When the run tape or summary tape data files are full, the operator is notified and the program automatically performs the "Last Measurement" routine of storing the summary data, etc. To continue on with the measurement process without reloading the MEAS program, a new run and/or summary tape needs 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 run or summary tape is desired, the "5 NEW TAPE" option is selected at TRAP (e.g. Key Ø) and the appropriate entries made in response to the computer-generated questions.

6.4.8 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 for the normal operation of the measurement. The ten special function keys are labeled f_0, f_1,. . ., f_9. 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 f_0 is denoted as Key Ø, and so forth through Key 9. Key 10 is the routine activated by pressing the shift key and the special function key f_0, and so forth through Key 19. The routines associated with the special function keys for the MEAS program are described in the following paragraphs.

Key Ø 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 "Ø MASTER RESTART," which is used to initialize certain program constants. These constants need only be initialized once, and this is done automatically when the program is loaded. "Ø MASTER RESTART" 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 "1 SKY" option initiates the sky profile measurement routine, "2 G/T" initiates the G/T measurement routine, "3 EIRP" initiates the EIRP, C/kT measurement routine, "4 LNK" deletes the MEAS program and links in REWORK program, and "5 NEW TAPE" changes the calculator constants to store data to the proper files on a new tape.

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

Key 2 is used to restart a measurement set in the EIRP measurement routine.

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 into the computer program a change in the ETMS input attenuator or a change in 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 its zenith value, and the coefficient of the cosecant of the elevation angle. 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 6 dB standard attenuator is switched in when the noise add source is 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 run tape. Key 12 stores the summary data matrix M, and the program constants matrix N onto the summary data tape.

Key 13 is used to list out all of the data contained in the data summary tape. 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 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 run and summary data tapes.

6.4.9 MEAS Annotated Printout

The annotated printout for the MEAS program follows. As usual, the MEAS program is loaded by the LOADER program, which is also included here.

* INSERT RUN (MEAS) TAPE into INTERNAL CASSETTE

```
LOAD
RUN         ← IDENTIFIES TAPE LOADED
PRINT ALL ON (1=YES)?1
MEAS SITE DATA(10=INT,5=EXT)?5
FRGM CONST CHANGE OPTION(0=NO)?0
 5.?
                                                        ← NOT NORMAL
ERROR 59 IN LINE 4150 ← DIRTY READ HEAD, Cleaned head
FETCH4150 ← LOOKED AT PRGM STEP TO BE SURE WHAT THE TROUBLE WAS
CONT4150 ← RETRIED TO LOAD, IT WORKED!!
```

```
                                  (76 1024  3.14)
NBS1A.04  LOADER  <D1-F0> T2-F0:        %.05 <D1-4> T2-4

                                  -1-
Sysm # 6.09
                                                                RUN  2
                  PROG  276.5411      CAMP ROBERTS, ANT#1
                  TUE:  1977 MAY 10   ( 1976.470)
                  7.551 GHz, 60.0 Ft DISH
                                                          G/Ta          G/T
                                                    34.15 dB/K    40.83 dB/K
```

@@@

PROG CONSTS

A2: 2.3	A3: 4.074	A4: 6.09
A5: 6.24	A6: 0.32	A7:-17.55
B2: 0.65	B3: 0.98	B5: 0.190451
B6: 7.59224E-03	B9: 170.827	B : 8.22544
C1: 4.54300E+18	C2: 1	C4: 122.03
C5: 37.38	C6: 270.302	C7: 0.23
C8: 0.1	C9: 0.2	C0: 6.00000E-03
C : 1976.47		
D1: 0.1	D2: 6	D3: 0.6
D5: 0.015	D8: 0.75	D9: 0.18
D0: 0.0157845	D : 60	
F0: 0.01	F : 7.551	
G4: 6.53155E-03	G5: 1.11238E-03	G6: 3.01622E-03
G : 1361870		
H1: 0.8	H5: 1	H9: 523.6
L5: 2.09331	L6: 2.17	L7: 10.1245
L8: 1.11961	L9: 0.013	L : 5
M5: 4.779	M6: 0.973	M7: 1.957
M8: 3.924	M9: 7.949	M0: 6.1
M : 12234.8		
N1: 6	N6: 2	N7: 500
N : 1		
O1: 3.552	O4: 2.56	O6: 1.25
O9: 5.634		

```
P1: 2.875           P4: 5.014           P6: 5.67
P9: 4.063

Q6: 0.063           Q7: 1.7[illegible]E-03      Q9: 4.719


P0: 0.2463

T : 111.311

W : 5.5
```

[illegible]

```
IF HARDWARE HANGS UP

(1)STOP+STOP
(2)KEY 0
(3)0 (PSTRT)


SUN TAPE EXT, MEAS INT( =NC): 1    ?

SET ANT DELAY @ BRK PTS:NOW 48 SEC(1=REREAD)( =NC): 0    ?
ADD 24hr: TO CLOCK READ(1=YES)( =NC): 0    ?
FLTR:1=20@30,2=10@70,3=20@70,4=50@70( =NC): 4    ?4
MANL ATN(AB)( =NC): 65    ?2
NOISE ADD:0=#1,1=#1,2=#2,3=#3( =NC): 0    ?0
INSERT SUB WHEN ( (ADD)( =NC): 1    ?
TEMP HUMD:0=AUTO,1=MANL( =NC): 0    ?
ISFT,SG,T,SETRP,4LNK,5NEW TAPE(OK,NO)( =NC): 2    ?

SOURCE:CAL AC( =NC): 1    ?
CAS A:  SET#( =NC): 1    ?


SKY:GMT(HRS):START,STOP,STEP?4,6,1


CLOUDS,0 TO 9=RAIN)( =NC): 0    ?
WIND (MPH)( =NC): 0    ?


                    +76 1024  8.20)
MB:1C,05  MEAS  D1-F14  T3-F12:     1.05  D1-4  T2-4
```

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

The program automatically adds 24 hrs to clock reading when clock passes from 24 hrs to 0 hrs. This step allows you to remove this 24 hr addition in case the program was loaded the night before.

Use ORSTRT to reach this statement.

THIS STATEMENT IS THE "RESTART POSITION"

IF TEMP, DEW POINT PROBE NOT WORKING, e.g. TEMP below freezing, can put Temp, humidity in by keyboard

-2-

Sim # 6.09 RUN 2

PROG 276.5411 CAMP ROBERTS, ANT#1
TUE: 1977 MAY 10 (1976.470)
7.551 GHz, 60.0 Ft DISH

G To	G/T
54.15 dB-K	40.83 dB-K

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
80.9 F	45.1 F	28.6 %	7.4 gm/m^3	0	0 mph

* NOT NORMAL

ERROR 103 IN LINE 4615 ← THE 1ST READ to the DVM often goes astray as we see below, V9 wasn't read properly

FETCH4615
4605 Q=V9*(2*V-V9)/Q1*A[7]/1000 J

† VIA KEYBOARD
V9,V,Q1,A(7),J
0 2.4878 -2.48780E-06 490 0.331576610
↑ V9 ↑ V ↑ Q1 ↑ A(7) ↑ J

* VIA KEYBOARD
FN00+FUN1+FMP3 ← THIS IS A GOOD KEYBOARD COMMAND TO CLEAR "FUNNY" FLAGS AND THEN MEASURES POWER.
1.21401542E-3 ← MW of power at the NBS TYPE III BRIDGE

*PRESS KEY 0

1SKY,2G/T,3EIRP,4LNK,5NEW 'APE,0RSTRT' =NC): 1 ?
SOURCE:CAS A(=NC): 1 ?
CAS A: SET#(=NC): 2 ?
SKY:GMT(HRS),START,STOP,STEP?4,6,1

CLOUDS(0 TO 9=RAIN)(=NC): 0 ?
WIND (MPH)(=NC): 0 ?

(76 1024 8.24)
MEAS1C.05 MEAS D1-F14 T3-F12: 11.05 (D1-4, T2-4

-3-

System # 6.09 RUN 2

PROG 276.5411 CAMP ROBERTS, ANT#1
TUE: 1977 MAY 10 (1976.470)
7.551 GHz; 60.0 Ft DISH

G/To	G/T
34.15 dB/K	40.88 dB/K

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
80.6 F	45.2 F	28.8 %	7.5 gm/mt3	0	0 mph

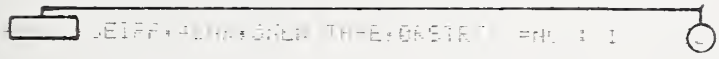
BRG PWR	BRG PRW+σ	PWR+σ STD?	STD	To#	MANL	PRGM	STD CK	FLTR
0.4900mW	0.3827mW	1	4.0740	0	2dB	4dB	0.0010dB	4

GOOD RANGE — NORMAL SETTING (i.e. throw in 6dB when noise add on)
SET # 2 ORS A
GOOD RANGE otherwise adjust pwr and attn
good! Less than 0.03 or change A3 via keyboard

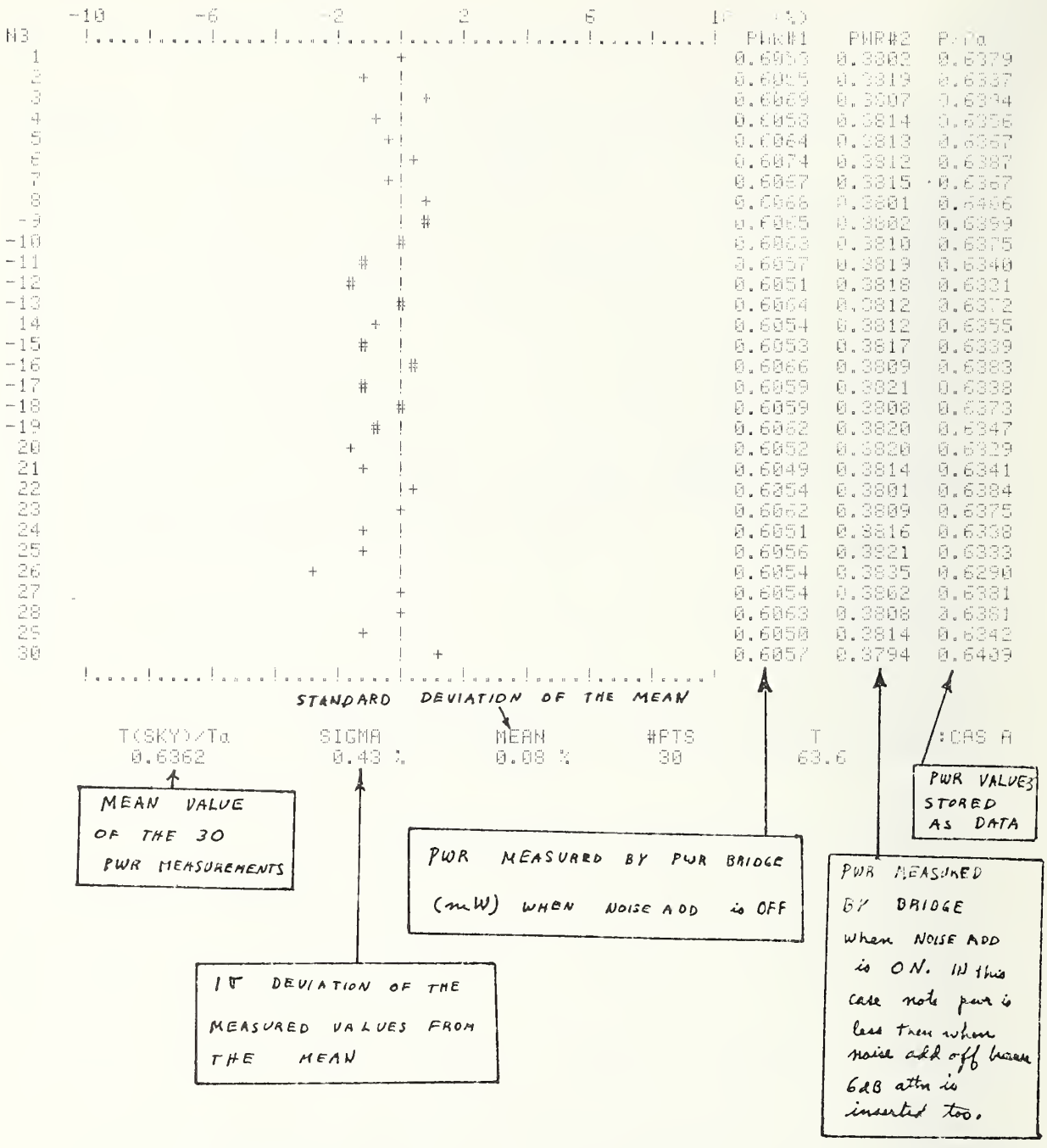
AZ	EL		GMT	T/To
18.9595007	11.19171132	READY?		
			4	0.568952886
25.48772698	15.69755805	READY?		
			5	0.565285416
31.12720388	21.36047576	READY?		
			6	0.567557997

usually 8 or ten readings spaced to cover the elevations of interest (SEE SITE PREP plot)

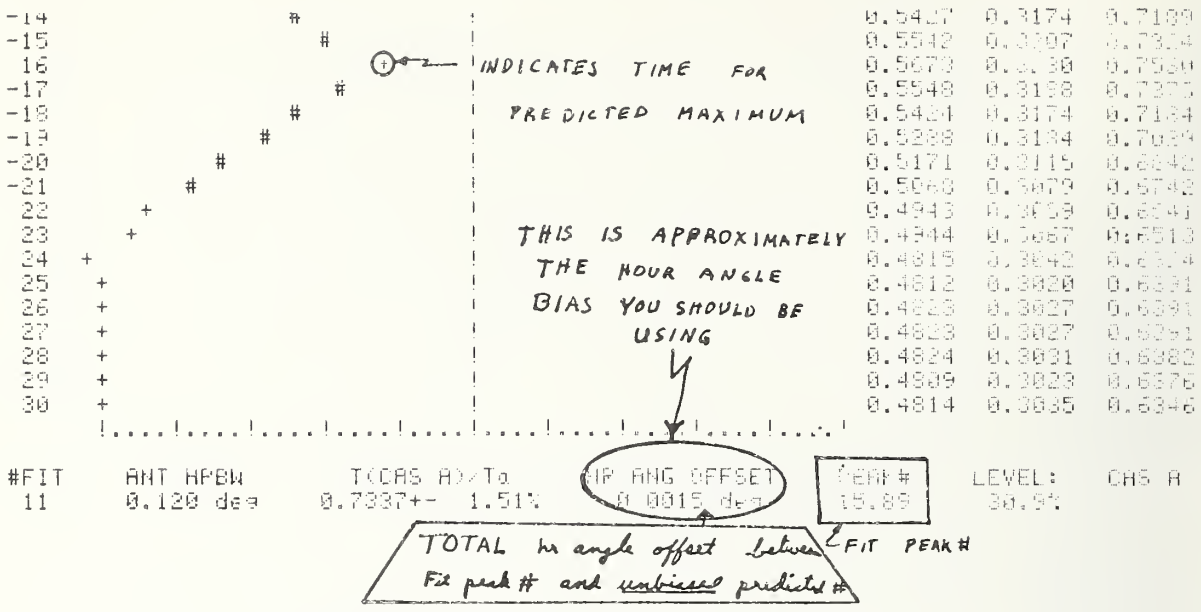
T/To = 0.5644 + 0.0007/SIN L




```
SOURCE:CAS A( =NC): 1     ?
FREQ(MHZ)( =NC): 7551     ?


# MEAS PTS( =NC): 30    ?
# PTS IN FIT( =NC): 11    ?


N (@ SET# 2     )( =NC): 8     ?? ← A CHANCE TO CHANGE N & REDO A MEASUREMENT
SKY OFFSET(DEG)( =NC): 2     ? ←DECLINATION OFFSET FROM STAR CENTER FOR SKY CUT


CLOUDS(0 TO 9=RAIN)( =NC): 0     ?3
WIND (MPH)( =NC): 0     ?3

                              (77 1027 11.25)
NBS1C.05  MEAS  (D1-F14) T3-F12:      X.06 (D1-4) T2-4

                                -7-
System # 3.04                                                  RUN  2

                    PROG  276.5411      CAMP ROBERTS, ANT#1
                    TUE:  1977 MAY 10   ( 1976.470)
                    7.551 GHz: 60.0 Ft DISH                  G/To          G/T
                                                          41.34 dB/K   43.00 dB/K

     TEMP          DEW PT.       REL HUMI       WATER DENS     CLOUD COVER     WIND
     85.8 F        45.8 F         25.0 %         7.6 gm/m^3          3          3 mph

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

 MEAS     HPBW       TIME(HRS)       OFFSET       AZIMUTH       ELEV      CUT   RUN   SET    N
 6sec    0.1371      11.45139      2.000deg        29.62       60.01      -3     2     2     7

                        T/To = 0.0565 + 0.00115*18C L

CC):1=NEW AZ-EL ( =NC): 0
(TIME USED TO SET THE ANTENNA)
(TIME ALLOWED TO SET ANTENNA ON BREAK POINT SWITCHES — TIME USED) — 6 sec

 CLAPS(      PEAK#    PTS E/      AZ ERR          EL ERR          AZ ERR          EL ERR
  27sec       14        -1      0.0000deg       0.0000deg       0.0000deg       0.0000deg

 BRG PWR    BRG PPW+a   PWR+a/STD    STD      To#     MANL      PRGM     STD CK     FLTR
 0.5870mW    0.3830mW        1       4.0800     0      4dB       3dB     0.0150dB     4

ZERO LEVEL   100% LEVEL       X1(0)        K        Y(DB)     T(CAL)    S(JN)     T        To
 0.6375*To    0.9530*To     2.31E-05     0.975     1.746      31.5       562     63.8     100.0
```


-10 -6 -2 2 6 10 (%)
N3
PWR#1 PWR#2 P-Pa
1 0.6053 0.3802 0.6379
2 0.6055 0.3819 0.6387
3 0.6069 0.3807 0.6394
4 0.6058 0.3814 0.6386
5 0.6064 0.3813 0.6387
6 0.6074 0.3812 0.6387
7 0.6067 0.3815 0.6387
8 0.6066 0.3801 0.6406
9 0.6065 0.3802 0.6399
-10 0.6063 0.3810 0.6375
-11 0.6057 0.3819 0.6340
-12 0.6051 0.3818 0.6331
-13 0.6064 0.3812 0.6372
14 0.6054 0.3812 0.6355
-15 0.6053 0.3817 0.6339
-16 0.6066 0.3809 0.6383
-17 0.6059 0.3821 0.6388
-18 0.6059 0.3808 0.6373
-19 0.6062 0.3820 0.6347
20 0.6052 0.3820 0.6329
21 0.6049 0.3814 0.6341
22 0.6054 0.3801 0.6384
23 0.6062 0.3809 0.6375
24 0.6051 0.3816 0.6388
25 0.6056 0.3821 0.6383
26 0.6054 0.3835 0.6290
27 0.6054 0.3802 0.6381
28 0.6063 0.3808 0.6361
29 0.6050 0.3814 0.6342
30 0.6057 0.3794 0.6409
STANDARD DEVIATION OF THE MEAN
T(SKY)/Ta SIGMA MEAN #PTS T :CAS A
0.6362 0.43 % 0.08 % 30 63.6
MEAN VALUE OF THE 30 PWR MEASUREMENTS
PWR MEASURED BY PWR BRIDGE (mW) WHEN NOISE ADD is OFF
PWR VALUES STORED AS DATA
PWR MEASURED BY BRIDGE when NOISE ADD is ON. IN this case note pwr is less than when noise add off because 6dB attn is inserted too.
1σ DEVIATION OF THE MEASURED VALUES FROM THE MEAN

```
N (@ SET# 2     )( =NC): 8     ?

                                1977  OCT 27  11 hrs 29 min  GMT time
                                ?/ ___: ::.??
NBS1C.05  MEAS  (D1-F14) T3-F12:      ?.06  D1-4) T2-4

   ETMS SYSTEM SERIAL #                -8-
Sysm # 3.04                                                        RUN  2

                  PROG  276.5411      CAMP ROBERTS, ANT#1
                  TUE:  1977 MAY 10   ( 1976.470)
                  7.551 GHz, 60.0 Ft DISH                  G/To        G/T
                                                        41.34 dB/K  43.31 dB/K

     TEMP         DEW PT.      REL HUMD      WATER DENS    CLOUD COVER     WIND
     88.8 F       45.8 F         22.7 %        7.5 gm/mT3        3          3 mph
                                                  BIASED PREDICTION OF DESIRED ANT COORDINATES
==========================================================================================

 MEAS     HPBW      TIME(HRS)      OFFSET      AZIMUTH      ELEV      CUT  RUN  SET   N
 6sec    0.1371     11.52026     -0.069deg      32.39       61.56      -2    2    2    8

                        T/To = 0.6349 + 0.00115*CSC L

GO :1=NEW AZ,EL : =NC): 0        * SPACE BAR, EXECUTE WHEN ANTENNA SET     BIASES USED IN PREDICTION

 ELAPSE      PEAK#     PTS EX    HR BIAS        DCL BIAS        AZ BIAS        EL BIAS
  14sec        16         1     0.0000deg      0.0000deg      0.0000deg      0.0000deg

ZERO LEVEL  100% LEVEL      Xi(K)       K      Y(DB)   T(CAS)  S(JN)    T       To
 0.6362*To   0.9518*To    2.32E-05    0.876    1.750    31.6     582    63.6    100.0

      0         20         40         60         80        100  (%)
N3    !....!....!....!....!....!....!....!....!....!....!   PWR#1    PWR#2   P/Po
  1     +                                                  0.6076   0.3984  0.6412
  2    +                                                   0.6048   0.3802  0.6372
  3    +                                                   0.6051   0.3810  0.6352
  4    +                                                   0.6050   0.3813  0.6345
  5     +                                                  0.6059   0.3798  0.6401
  6    +                                                   0.6048   0.3816  0.6322
  7    +                                                   0.6055   0.3800  0.6356
  8      +      # signs INDICATE which points used         0.6216   0.3863  0.6452
  9       +                                                0.6228   0.3851  0.6516
 10         +    in the parabolic fit.                     0.6361   0.3873  0.6713
-11           #                                           0.6514   0.3912  0.6768
-12          #                                            0.6515   0.3927  0.6824
-13             #                                         0.6520   0.3948  0.7004
```



#FIT	ANT HPBW	T(CAS A)/To	HR ANG OFFSET	PEAK #	LEVEL:	CAS A
11	0.120 deg	0.7337+- 1.51%	-0.0015 deg	15.89	30.9%	

TOTAL hr angle offset between Fit peak # and unbiased predicted #

FIT PEAK #

increase HR BIAS if peak before PEAK#
decrease DECL BIAS if 1st cut too deep

N (@ SET# 2)(=NO): 9 ?

(77 1027 11.33)
NBS1C.05 MEAS (D1-F14) T3-F12: %.06 D1-4) T3-4

-9-

Sysm # 3.04 RUN 2

```
                PROG  276.5411      CHMP ROBERTS, ANT#1
                TUE:  1977 MAY 10   ( 1976.470)
                7.551 GHz, 60.0 Ft DISH                          G/Ta          G/T
                                                              41.34 dB/K    43.31 dB/K

     TEMP          DEW PT.       REL HUMD       WATER DENS     CLOUD COVER      WIND
     88.9 F        45.8 F          22.7 %       7.5 gm/mt3          3          3 mph

 MEAS    R.DM      TIME(HRS)      OFFSET       AZIMUTH       ELEV      CUT  RUN  SET   N
 6sec   0.1371     11.58194     -0.034deg       31.73       62.00      -1    2    2    9

                                                 PREDICTED
                                 Ta = 0.6349 + 0.00115*CSC L

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

 ELAPSE      PEAK#     PTS ES    HR BIAS        DCL BIAS        AZ BIAS        EL BIAS
  15sec        16         1     0.0000deg      0.0000deg      0.0000deg      0.0000deg

ZERO LEVEL   100% LEVEL      X1(K)      K      Y(DB)   T(CAS)  S(JN)    T       Ta
 0.6362*Ta    0.9518*Ta    2.32E-05   0.876    1.750    31.6     582    63.6    100.0

                                                                                  TIME OF PREDICTED MAXIMUM
      0          20          40          60          80         100  (%)
N3    !....!....!....!....!....!....!....!....!....!....!   PWR#1    PWR#2    P/Ta
  1   +                                                     0.4804   0.3034   0.6327
  2    +                                                    0.4831   0.3022   0.6424
  3   +                                                     0.4803   0.3027   0.6348
  4    +                                                    0.4819   0.3022   0.6401
  5     +                                                   0.4937   0.3070   0.6489
  6      +                                                  0.4944   0.3050   0.6572
  7       +                                                 0.5059   0.3076   0.6737
  8        +                                                0.5169   0.3119   0.6820
  9             +                                           0.5411   0.3166   0.7136
 10                  +                                     0.5673   0.3224   0.7557
-11                    #                                   0.5947   0.3309   0.7841
-12                     #                                  0.6200   0.3356   0.8238
-13                                 #                       0.6505   0.3427   0.8660
-14                      .                    #            0.6650   0.3466   0.8833
-15                                 #                       0.5197   0.2740   0.8654
 16                                  +                      0.5083   0.2720   0.8420
-17                     #                                  0.4849   0.2657   0.8063
-18                        #                               0.4649   0.2612   0.7713
-19                     #                                  0.5546   0.3203   0.7349
-20                  #                                     0.5304   0.3149   0.7010
-21       #                                                0.5071   0.3077   0.6759
 22        +                                                0.5071   0.3092   0.6703
 23         +                                               0.4949   0.3062   0.6544
 24          +                                              0.4832   0.3022   0.6429
 25           +                                             0.4828   0.3037   0.6369
 26           +                                             0.4823   0.3035   0.6366
 27            +                                            0.4825   0.3028   0.6393
 28            +                                            0.4823   0.3024   0.6431
 29            +                                            0.4834   0.3027   0.6413
 30            +                                            0.4828   0.3029   0.6397
      !....!....!....!....!....!....!....!....!....!....!
                FIT

#FIT    ANT HPBW        T(CAS A)/Ta      HR ANG OFFSET     PEAK#     LEVEL:    CAS A
 11    0.132 deg    0.8550+-  2.34%       0.0219 deg      14.31       69.3%

          increase HR BIAS if peak before PEAK#
          decrease DECL BIAS if 1st cut too deep
```

10-

Sysm # 3.04 RUN 2

PROG 276.411 CHMU MULERTS, MNT#1
TUE: 1977 MAY 10 + 19:6.4700
7.551 GHz, 60.0 Fr Dish

G To	G T
41.34 dB/K	43.31 dB/K

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
89.0 F	45.8 F	22.6 %	7.5 gm/m^3		

PREDICTED CENTER CUT

MEAS	HPBW	TIME(HRS)	OFFSET	AZIMUTH	ELEV	CUT	RUN	SET	N
6sec	0.1371	11.64259	0.0000deg	31.05	62.38	0	2	2	10

T/To = 0.6349 + 0.00115*COS L

GO :1=NEW AZ,EL (=NC): 0 °

ELAPSE	PEAK#	PTS EX	HR BIAS	DCL BIAS	AZ BIAS	EL BIAS
14sec	16	1	0.0000deg	0.0000deg	0.0000deg	0.0000deg

CENTER CUT PREDICTION

ADJUSTS GRAPH SCALE

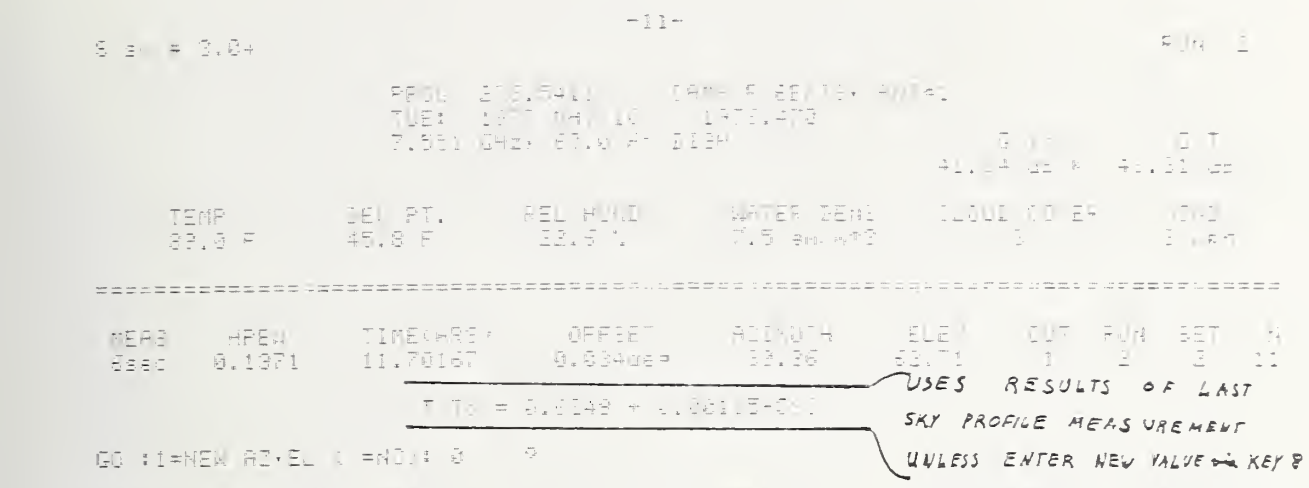
ZERO LEVEL	100% LEVEL	Xi(K)	K	D6	IND	T	To
0.6362*To	0.9518*To	2.32E-05	0.876	.7E5	582	63.6	100.

N3	PWR#1	PWR#2	P/Po
1	0.4819	0.3025	0.6390
2	0.4829	0.3028	0.6403
3	0.4823	0.3032	0.6374
4	0.4835	0.3043	0.6293
5	0.4949	0.3057	0.6560
6	0.5081	0.3098	0.6703
7	0.5298	0.3149	0.6956
8	0.5351	0.3203	0.7261
9	0.5812	0.3267	0.7703
10	0.6095	0.3327	0.8114
11	0.6375	0.3406	0.8437
12	0.6834	0.3504	0.9110
13	0.5436	0.2799	0.9044
14	0.5420	0.2804	0.9034
15	0.5567	0.2845	0.9178
16	0.5702	0.2870	0.9401
17	0.5670	0.2826	0.9305
18	0.5317	0.2772	0.8823
19	0.5190	0.2741	0.8628
20	0.5087	0.2721	0.8459
21	0.4841	0.2658	0.8039
22	0.4650	0.2617	0.7691
23	0.5665	0.3244	0.7504
24	0.5553	0.3211	0.7231
25	0.5309	0.3142	0.7049
26	0.5074	0.3077	0.6734
27	0.4946	0.3067	0.6530
28	0.4818	0.3026	0.6377
29	0.4832	0.3029	0.6388
30	0.4814	0.3029	0.6360

THIS GRAPH WOULD HAVE BEEN FULL SCALE IF HAD USED $T_a' \simeq T_a \div \frac{\text{LEVEL}}{100}$ i.e. $T_a' \simeq 108.1$ K

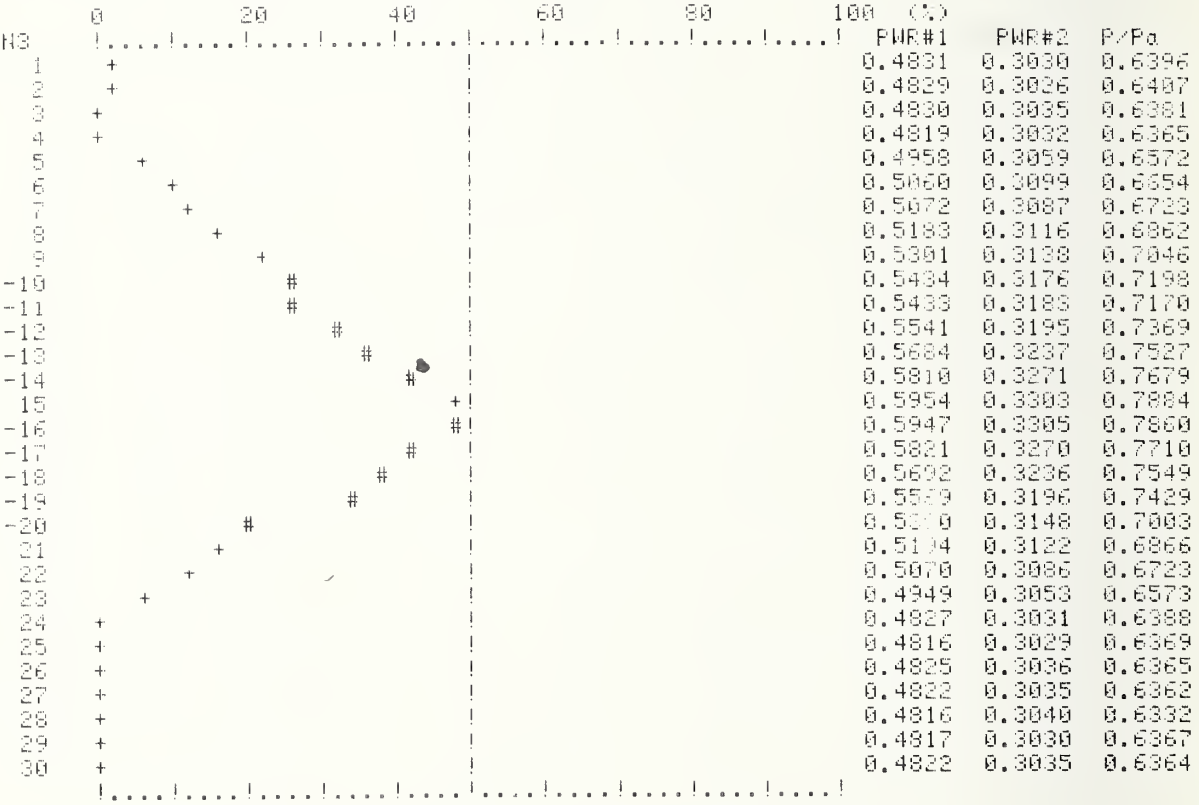
FIT MAX LEVEL

#FIT	ANT HPBW	T/CAS H+/-To	HR ANG OFFSET	PL/Ka	LEVEL	CAS A
11	0.165 deg	0.9283+- 1.61%	0.0000 deg	1.00	99	


-11-
USES RESULTS OF LAST
SKY PROFILE MEASUREMENT
UNLESS ENTER NEW VALUE ↵ KEY ?

MEAS (cont)

```
                    PROG  276.5411      CHMP ROBERTS, ANT#1
                    TUE:  1987 MAY 10  ( 1986.470)
                    7.551 GHz, 60.0 Ft DISH
                                                          G/Ta          G/T
                                                       41.34 dB/K    43.31 dB/K

     TEMP          DEW PT.       REL HUMD       WATER DENS     CLOUD COVER     WIND
     69.0 F        45.8 F          22.6 %        7.5 gm/M3           3          3 mph

==========|==========|==========|==========|==========|==========|==========|==========|==========

 MEAS     HPBW      TIME(HRS)      OFFSET      AZIMUTH      ELEV      CUT  RUN  SET    N
 6sec    0.1371     11.76139     0.069deg       25.64       63.05      2    2    2    12

                              T/Ta = 0.6349 + 0.00115*CSC L

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

 ELAPSE      PEAK#    PTS EX    HR BIAS        DCL BIAS       AZ BIAS        EL BIAS
  15sec       15        0      0.0000deg      0.0000deg      0.0000deg      0.0000deg

ZERO LEVEL  100% LEVEL      Xi(K)       K      Y(DB)   T(CAS)   S(JN)    T       Ta
 0.6362*Ta   0.9519*Ta    2.32E-05    0.876    1.750     31.6      582    63.6    100.0
```



N3	PWR#1	PWR#2	P/Po
1	0.4831	0.3030	0.6396
2	0.4829	0.3026	0.6407
3	0.4830	0.3035	0.6381
4	0.4819	0.3032	0.6365
5	0.4958	0.3059	0.6572
6	0.5060	0.3099	0.6654
7	0.5072	0.3087	0.6723
8	0.5183	0.3116	0.6862
9	0.5301	0.3138	0.7046
-10	0.5434	0.3176	0.7198
-11	0.5433	0.3188	0.7170
-12	0.5541	0.3195	0.7369
-13	0.5684	0.3237	0.7527
-14	0.5810	0.3271	0.7679
15	0.5954	0.3303	0.7884
-16	0.5947	0.3305	0.7860
-17	0.5821	0.3270	0.7710
-18	0.5692	0.3236	0.7549
-19	0.5569	0.3196	0.7429
-20	0.5310	0.3148	0.7003
21	0.5194	0.3122	0.6866
22	0.5070	0.3086	0.6723
23	0.4949	0.3053	0.6573
24	0.4827	0.3031	0.6388
25	0.4816	0.3029	0.6369
26	0.4825	0.3036	0.6365
27	0.4822	0.3035	0.6362
28	0.4816	0.3040	0.6332
29	0.4817	0.3030	0.6367
30	0.4822	0.3035	0.6364

```
#FIT    ANT HPBW        T(CAS A)/Ta      HR ANG OFFSET     PEAK#     LEVEL:    CAS A
 11     0.135 deg    0.7775+-  1.47%     -0.0054 deg       15.18      44.8%


                    increase HR BIAS if peak before PEAK#
                    decrease DECL BIAS if 1st cut too deep
```

```
                                   (77 1027 11.47)
NBS10.05   MEAS   (D1-F14) T3-F12:       X.06 (D1-4) T2-4

                                          -13-
Sysm # 3.04                                                              RUN  2

                   PROG  276.5411      CAMP ROBERTS, ANT#1
                   TUE:  1977 MAY 10   ( 1976.470)
                   7.551 GHz, 60.0 Ft DISH                    G/Ta        G/T
                                                         41.34 dB/K  43.31 dB/K

    TEMP         DEW PT.      REL HUMD      WATER DENS    CLOUD COVER    WIND
    89.0 F       45.8 F        22.6 %       7.5 gm/m↑3         3         3 mph

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

                    BEST FIT FOR THE 5 CUTS     Ta= 100  K

#FIT    ANT HPBW        T(CAS A)/Ta        DECL OFFSET   T/Ta       ELEV    RUN  SET
  5    10.263 deg     0.9162+-  1.14%      0.005 deg   0.6362K   62.4deg    2    2

          G                G/T                   NEF                NUF
     60.82 dB         42.78 +- 0.18 dB       0.404 K/M↑2        0.406 K/M↑2

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                        100*(DATA-FIT)/(MAX dT(CAS A)/Ta)

         CUT          -2        -1         0          1          2
                     1.0%     -3.6%      4.6%      -2.5%       0.5%

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

REMARKS:??THIS IS A SIMULATION OF CAS A !!

STORE: INT FILE 16               EXT FILE 11                EXT SET#  3
```

RUN SET	DIP BIRD STAR	CODE ELEV	T/Ta P/Pa G/T	CSC PWR G/Ta	TIME dPadd HPBW#1	TEMP C/kT HPBW#2	FREQ	WATER E+C/Ta DECL	#PTS CNT/Ta NEF	Padd NUF
2.01	CAS A	-0.0	0.556	0.001	10.313	90.900	7.551	7.548	4.000	0.000
2.02	CAS A	62.4	42.784	40.820	0.165	10.263	7.551	0.005	0.404	0.406

MAT ID: 1	2	3	4	5	6	7	8	9	10
(dφ −180)×100	CL×100	# of meas	TIME×1000	DECL offset×1000					
−15061	6001	30	11451	2000	0	0	−42	−88	−97
−78	−61	−28	−51	1	10	−47	−102	−118	−112
SKY −66	−105	−16	−103	−50	−92	−120	−102	−84	−47
CUT 187	−11	42	−22	−1	−9	5			
				Log(((T_atm+T)/T_a)/U)×10⁴					
4784	168	78	11520	1	1537	1569	11	−52	−82
−2 −96	−7	−115	−30	134	216	469	726	640	921
CUT 1154	1340	1617	1406	1146	928	659	512	209	167
−128	−23	−22	−23	−36	−47	−93			
						FIT MEAS # AT PEAK			
−1 −14850	6202	30	11582	−34	2886	1431	−134	29	−31
CUT −7	129	257	504	627	1150	1653	2032	2516	3015
3213	3009	2735	2301	1857	1373	902	536	454	214
37	−57	−62	−19	−8	12	−13			
							FOR N3=1		
							LOG(P/U)×1044		etc.
0 −14918	6238	30	11643	0	3709	1526	−24	−4	−49
Cut −66	238	453	882	1390	1844	2364	2755	3522	3450
3504	3597	3890	3734	3213	2979	2745	2271	1828	1583
1349	958	545	177	−32	−58	−59			
+1 −14987	6271	30	11702	34	3178	1469	−9	−23	−84
CUT −102	285	481	731	730	1158	1664	2128	2725	3140
3273	3192	2994	2777	2296	1876	1386	904	748	424
194	−55	−28	−45	−96	2	−42			
+2 −15059	6305	30	11761	69	1937	1518	−14	2	−39
CUT −63	256	381	483	689	952	1166	1127	1401	1613
1813	2077	2046	1854	1643	1482	892	694	483	258
−27	−57	−64	−69	−115	−60	−64			

ELEMENTS OF THE STORED DATA MATRIX D

EIRP, C/kT Routine

```
* KEY 0
1SKY,2C/T,3EIRP,4LNK,5NAM TAPE,6RSTRT, =NC): 2
SLANT RANGE,10^3=Km( =NC): 40.349  ?
RCR GAIN SLOPE/MHz( =NC): 0    ?
AZ(DEG)( =NC): 29.40555e92   ?
EL(DEG)( =NC): 15   ?
NOISE ADD:0=#1&#2,1=#1,2=#2( =NC): 0    ?0
BIRD:  SET#( =NC): 4    ?3
CLOUDS(0 TO 9=RAIN)( =NC): 0    ?3
WIND (MPH)( =NC): 0    ?12
CODE:0=SKY,1=-F, 2=RCR @ F, 3=+F,4=OTHER( =NC): 0.068545333   ?0
INSERT 5DB WHEN T(ADD)( =NC): 1    ?1
FREQ(MHZ)( =NC): 7551    ?



FLTR:1=20@30,2=10@70,3=20@70,4=50@70( =NC): 4    ?4
MANL ATN(dB)( =NC): 4    ?
# MEAS PTS( =NC): 30   ?5


                          (77 1027 12.10)
NBS1C.05  MEAS  <D1-F14> T3-F12:     X.06 <D1-4> T2-4


                          -14-
Sysm # 3.04                                                    RUN  2

                  PROG  276.5411     CAMP ROBERTS, ANT#1
                  TUE:  1977 MAY 10  ( 1976.470)
                  7.551 GHz, 60.0 Ft DISH                  G/Ta        G/T
                                                        41.34 dB/K  43.29 dB/K

    TEMP        DEW PT.     REL HUMD      WATER DENS    CLOUD COVER    WIND
    85.9 F      45.8 F       25.0 %       7.6 gm/m^3         3        12 mph

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

 BRG PWR   BRG PWR*a  PWR+a/STD?   STD      Ta#   MANL    PRGM     STD CK    FLTR
 0.4830mW  0.3050mW        1      4.0800     0     4dB     4dB   -0.0160dB     4

                  CODE:0=SKY,1=-F, 2=RCR @ F, 3=+F,4=OTHER

  SLANT RANGE      AZIMUTH    ELEV      RCR F      BNDWD      CODE  RUN  SET
  4.035E+07Km       29.41     15.00     7.5510    5.5 MZ        0    2    3

 FILTER#    NOISE PW      1st CONST      2nd CONST       GAIN SLOPE      EDIT Cw
    4       5.734 MHz   -0.1400 MHz    0.0000 MHz^2     0.5000/MHz     5.734 MHz
```

NB	P/P(ADD)	PWR#1	PWR#2	MANUAL	PROG	TIME(MP
1	0.63731	3.04	7.80	4 dB	4 dB	12.19167
2	0.63532	3.04	7.83	4 dB	4 dB	12.19380
3	0.63857	3.04	7.81	4 dB	4 dB	12.19583
4	0.64180	3.04	7.78	4 dB	4 dB	12.19778
5	0.64248	3.04	7.77	4 dB	4 dB	12.19944

#PTS	P/P(ADD)	PWR#1 (mW)	(PWR#2-PWR#1) (mW)
5	0.63910 +- 0.5 %	3.04053 +- 0.1 %	4.75764 +- 0.5 %

(77 1027 12.12)
MBS1C.05 MEAS D1-F14 T3-F12: 8.06 D1 4 12-4

-15-

Sysm # 3.04

PROG 276.5411 CAMP ROBERTS, ANT#1
TUE: 1977 MAY 10 (1976.470)
7.551 GHz, 60.0 Ft DISH

G/To	G/T
41.24 dB K	4..

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
85.9 F	45.8 F	25.0 %	7.6	5	12

0.946:K8 0.996:K9 0.00dP(add) 40.35*10↑6:SR 5.734:BW

SPACE LOSS	T/To	ONT/To	ONT/SNT	rcv EIRP*G/To	C/kT	RUN	SET
202.12 dB	0.6391	0.0000	0.0000	0.00 dBW	0.00 dB	2	

REMARKS:?SIMULATION OF COLD SKY, OFF SATELLITE

STORE: INT FILE 18 EXT FILE 12 EXT SET# 4

MAT ID:	1	2	3	4	5	6	7	8	9	10
(AZ-180)*100	-15059	EL*100 1500	1000* LGT (PWR with noise add off at BRDG) -3174	-3171	-3166	-3170	-3170	0	0	0
	0	0								
C2: 1=STD ATTN when noise add	1	MANL 4	1000* LGT (BRDG PWR noise add on) 924	935	925	909	907	0	0	0
	0	0								
(# MEAS	5	BW*10 57	1000* LGT (P/Pn) -1956	-1970	-1948	-1926	-1921	0	0	0
	0	0								
LGT (P/Pn) 1024	1944	0	1000 * TIME (hrs) 12192	12194	12196	12198,	12199	0	0	0
	0	0								
LGT (PWR#1) *1024	483	0 GAIN SLOPE	0	0	0	0	0	0	0	0
	0	0								
LGT (PWR#1 - PWR#2) *1024	677	0	TOTAL ATTN (E2+E6) 8	8	8	8	8	0	0	0
	0	0								

1st MEAS 2nd MEAS 3rd MEAS 4th MEAS 5th MEAS

```
RESET MEAS(1=YES)( =NC): 0     ?
BIRD:  SET#( =NC): 4     ?
CLOUDS(0 TO 9=RAIN)( =NC): 0     ?2
WIND (MPH)( =NC): 0     ?10
CODE:0=SKY,1=CAL,2=RCVR @ F1,3=+F,4=OTHER( =NC): 0     ?1
INSERT SUB WHEN T(ADD)( =NC): 1     ?
FREQ(MHZ)( =NC): 7551     ?7540



FLTR:1=2@30,2=1@70,3=2@70,4=5@70( =NC): 4     ?
MANL ATN(DB)( =NC): 4     ?
# MEAS PTS( =NC): 5     ?


                              (77 1027 12.14)
NBS1C.05  MEAS  (D1-F14) T3-F12:      X.06 (D1-4) T2-4


                              -16-
Sysm # 3.04                                                        RUN  2

                    PROG  276.5411      CAMP ROBERTS, ANT#1
                    TUE:  1977 MAY 10  ( 1976.470)
                    7.540 GHz, 60.0 Ft DISH                  G/To        G/T
                                                          41.33 dB/K  43.28 dB/K

     TEMP         DEW PT.      REL HUMD      WATER DENS    CLOUD COVER     WIND
     88.6 F       45.8 F         22.9 %       7.5 gm/m↑3         2         10 mph
```

BRG PWR	BRG PRW+σ	PWR+σ/STD?	STD	To#	MANL	PRGM	STD CK	FLTR
0.5290mW	0.3143mW	1	4.0800	0	4dB	4dB	0.0240dB	4

CODE:0=SKY [1=CAL] 2=RCVR @ F1 3=+F,4=OTHER

SLANT RANGE	AZIMUTH	ELEV	RCVR F	BNDWD	CODE	RUN	SET
4.035E+07Km	2.00	15.00	7.5400	5.7 MZ	1	2	4

FILTER#	NOISE BW	1st CONST	2nd CONST	GAIN SLOPE	EQIV BW
4	5.734 MHz	-0.1400 MHz	0.0000 MHz↑2	0.0000/MHz	5.734 MHz

N3	P/P(ADD)	PWR#1	PWR#2	MANUAL	PROG	TIME(HRS)
1	0.69756	3.34	8.12	4 dB	4 dB	12.25667
2	0.70232	3.34	8.10	4 dB	4 dB	12.25833
3	0.70332	3.34	8.10	4 dB	4 dB	12.26000
4	0.69762	3.34	8.12	4 dB	4 dB	12.26167
5	0.69620	3.34	8.13	4 dB	4 dB	12.26333

#PTS	P/P(ADD)	PWR1(mW)	CPWR, PWR#1 (mW)	[ ]
5	0.69940 +- 0.5 %	3.3456 +- 0.1 %	4.7756 +- 0.4 %	[ ]

MAY 1977 12.15

HB310.05 MEAS (D1-F14, T1-F12) .06 (D1-4, T1-4)

-17-

S/sn # 3.24 RUN 2

PROG 276.5411 CAMP RCEEPTS, ANT#1
TUE: 1977 MAY 10 (1976.470)
7.540 GHz: 60.0 FT DISH

	G/To	G/T
	41.33 dB/K	41.28 dB/K

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
68.6 F	45.8 F	22.9 %	7.5 gm/M3	2	10 mph

@@@

0.946:K8 0.996:K9 3.34dP(add) 40.35*10^16:SR 5.734:BW

SPACE LOSS	T/Ta	ONT/Ta	ONT/SNT	rcv EIRP+G/Ta	C/kT	RUN	SET
202.11 dB	3.6391	0.6974	1.0044	0.00 dBW	0.00 dB	2	4

@@@

REMARKS:"SIMULATION OF ON SATELLITE BUT BELOW THE CARRIER FREQ

STORE: INT FILE 20 EXT FILE 13 EXT SET# 5

MAT D: 1	2	3	4	5	6	7	8	9	10
-17880	1500	-2765	-2761	-2757	-2764	-2767	0	0	0
2	0								
1	4	1097	1084	1085	1098	1100	0	0	0
0	0								
5	57	-1564	-1535	-1528	-1564	-1573	0	0	0
0	0								
-1553	0	12257	12258	12260	12262	12263	0	0	0
0	0								
524	0	0	0	0	0	0	0	0	0
0	0								
679	0	8	8	8	8	8	0	0	0
0	0								

```
RESET MEAS (1=YES) =NC : 0
BIAS: SET# =NC : 5
CLOUD (0 TO 7=MIL) =NC : 0
WIND (MPH) =NC : 0
CODE:0=SKY,1=-F, 2=RCR @ F, 3=+F,4=OTHER =NC : 1
INSERT 5DB WHEN T-ADD =NC : 1
FREQ (GHz) =NC : 7551
FLTR:1=60MHz,2=10MHz,3=2MHz,4=5MHz =NC : 4
MANL ATN=dB =NC : 4
# MEAS PTS =NC : 5
```

(77 1027 12.18)

NBS17.05 MEAS (D1-F14 T3-F12: N.06 (D1-4) T2-4

-18-

System # 3.04 RUN 2

PROG 276.5411 CAMP ROBERTS, ANT#1
TUE: 1977 MAY 10 (1976.470)
7.551 GHz, 60.0 Ft DISH

G/Ta	G/T
41.34 dB/K	43.29 dB/K

TEMP	DEW PT.	REL HUMID	WATER DENS	CLOUD COVER	WIND
68.6 F	45.8 F	22.9 %	7.5 gm/m↑3	0	1 m/h

BRG PWR	BRG PRW+σ	PWR+σ/STD?	STD	Ta#	MANL	PROM	STD CK	FLTR
0.3170mW	0.5564mW	0	4.0800	0	6dB	7dB	-0.0030dB	4

CODE:0=SKY,1=-F, [2=RCR @ F] 3=+F,4=OTHER

SLANT RANGE	AZIMUTH	ELEV	RCR F	BNDWD	CODE	RUN	SET
4.035E+07km	2.00	15.00	7.5510	5.7 MZ	2	2	5

FILTER#	NOISE BW	1st CONST	2nd CONST	GAIN SLOPE	EQIV BW
4	5.734 MHz	-0.1400 MHz	0.0000 MHz↑2	0.0000/MHz	5.734 MHz

N3	P/P(ADD)	PWR#1	PWR#2	MANUAL	PROG	TIME(HRS)
1	1.28660	6.27	11.15	6 dB	7 dB	12.31944
2	1.29363	6.27	11.12	6 dB	7 dB	12.32111
3	1.28655	6.27	11.14	6 dB	7 dB	12.32278
4	1.28604	6.26	11.14	6 dB	7 dB	12.32444
5	1.29431	6.27	11.11	6 dB	7 dB	12.32611

#P/S	P/P(ADD)	PWR#1(mW)	(PWR#2-PWR#1)(mW)	CODE
5	1.28922 +- 0.3 %	6.26943 +- 0.1 %	4.66298 +- 0.3 %	2

[illegible] 1A3F 12.19
MEAS [illegible] T0-[illegible] .00 W1-4 T2-4

-13-

System # 3.04 RU: 1

PROG 276.5411 CAMP ROBERTS, ANT#1
TUE: 1977 MAY 10 - 1776.4700
7.951 GHz, 60.0 Ft DISH G/To G/T
41.34 dB/K 43.29 dB

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
38.6 F	45.8 F	23.9 %	7.5 gm/m3	0	1 mph

0.945:KB 0.996:K9 3.34dB(add) 40.35*1016:8R 5.734:BW

SPACE LOSS	T/To	ONT/To	ONT/SNT	rcv EIRP*G/To	C/kT	RUN	SET
202.12 dB	0.6391	0.6994	1.0944	39.25 dBW	67.02 dB	2	5

REMARKS: SIMULATED COMPLETE MEASURE, BUT ONT MEAS ONLY ON ONE SIDE

STORE: INT FILE 22 EXT FILE 14 EXT SET# 6

MAT ID:	1	2	3	4	5	6	7	8	9	10
	-17800	1500	-5026	-5026	-5028	-5031	-5026	[illegible]	0	0
	0	0								
	0	6	-2528	-2538	-2531	-2533	-2541	0	0	0
	0	0								
	5	57	1094	1115	1094	1053	1120	0	0	0
	0	0								
	1103	0	12914	13111	12123	12114	12326	0	0	0
	0	0								
	197	0	0	0	0	0	0	0	0	0
	0	0								
	687	0	13	13	13	13	13	0	0	0
	0	0								

```
RESET MEAS<1=YES>( =NC): 0     ?
EIRP:  SET#( =NC): 7     ?6
CLOUDS<0 TO 9=RAIN>( =NC): 0     ?
WIND <MPH>( =NC): 0     ?
CODE:0=SKY,1=-F, 2=RCR @ F, 3=+F,4=OTHER( =NC): 2     ?3
INSERT SDD WHEN T<ADD>( =NC): 0     ?1
FREQ<MHZ>( =NC): 7551     ?7561
FLTR:1=2@30,2=1@70,3=2@70,4=5@70( =NC): 4     ?
MANL ATTN<dB>( =NC): 6     ?4
# MEAS PTS( =NC): 5     ?
```

(77 1027 12.25)

NBS1C.05 MEAS <D1-F14> T3-F12: X.06 <D1-4 T2-4

-20-

Sysm # 3.04 RUN 2

PROG 276.5411 CAMP ROBERTS, ANT#1
TUE: 1977 MAY 10 (1976.470)
7.561 GHz, 60.0 Ft DISH

G/Ts	G/T
41.35 dB/K	43.30 dB/K

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
83.6 F	45.8 F	26.9 %	7.6 gm/m↑3	0	0 mph

BRG PWR	BRG PRW+σ	PWR+σ/STD?	STD	To#	MANL	PRGM	STD CK	FLTR
0.5840mW	0.3286mW	1	4.0800	0	4dB	4dB	0.0130dB	4

CODE:0=SKY,1=-F, 2=RCR @ F, [3=+F],4=OTHER

SLANT RANGE	AZIMUTH	ELEV	RCR F	BNDWD	[...]	RUN	SET
4.035E+07Km	2.00	15.00	7.5610	5.7 MZ	[3]	2	6

FILTER#	NOISE BW	1st CONST	2nd CO↑ST	GAIN SLOPE	EQIV BW
4	5.734 MHz	-0.1400 MHz	0.0000 MHz↑2	0.0000 MHz	5.734 MHz

M3	P/P(ADD)	PWR#1	PWR#2	MANUAL	PROG	TIME(HRS)
1	0.76847	3.68	8.47	4 dB	4 dB	12.43639
2	0.76878	3.68	8.46	4 dB	4 dB	12.43861
3	0.77030	3.68	8.45	4 dB	4 dB	12.44006
4	0.76936	3.68	8.46	4 dB	4 dB	12.44194
5	0.77110	3.69	8.47	4 dB	4 dB	12.44383

#PTS	P/P(ADD)	PWR#1(mW)	(PWR#1-...)(mW)	[...]
5	0.76960 +- 0.1 %	3.68036 +- 0.1 %	4.70216 +- 0.1 %	[3]

```
                             .77 102.  12.26
NBS1C.05  MEAS  D1-F14  T3-F12:      .06  D1-4   12-4

                              -21-
Sysm # 3.04

                 PROG  276.5411      CAMP ROBERTS, ANT#1
                 TUE:  1977 MAY 10  ( 1976.479)
                 7.561 GHz, 60.0 Ft DISH                        G/Ta         G T
                                                           41.35 dB/K   43.30 dB K

    TEMP          DEW PT.      REL HUMD       WATER DENS    CLOUD COVER    WIND
    83.6 F        45.8 F        26.9 %        7.6 gm/m↑3         0         0 mph

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

 0.946:K8    0.996:K9    3.51dP(add)       40.35*10↑6:GR    5.734:BW

SPACE LOSS     T/Ta      ONT/Ta    ONT/SNT    rcv EIRP*G/Ta     C/kT        RUN   SET
 202.14 dB    0.6391     0.7345     1.1493      39.00 dBW      66.54 dB      2     6

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

REMARKS:?USES 2nd ONT, RECALCULATES C/kT USING AVERAGE OF THE TWO ONT VALUES

STORE: INT FILE 24             EXT FILE 15              EXT SET#  7
```

MAT D: 1	2	3	4	5	6	7	8	9	10
-17800	1500	-2340	-2343	-2344	-2345	-2338	0	0	0
0	0								
1	4	1280	1275	1270	1272	1278	0	0	0
0	0								
5	57	-1144	-1142	-1133	-1139	-1129	0	0	0
0	0								
-1137	0	12436	12439	12440	12442	12443	0	0	0
0	0								
566	0	0	0	0	0	0	0	0	0
0	0								
680	0	8	8	8	8	8	0	0	0
0	0								

6.5 The REWORK Program

The purpose of the program REWORK is to fit the data sets collected with the MEAS program and curve fit it to a two-dimensional gaussian curve and calculate six primary parameters G/T, G/T_a, NEF, NUF, the half power beam width of emission Cas A convoluted with the antenna beam pattern along a path of constant declination (HPBW#1), the half power beam width perpendicualr to constant declination (HPBW#2), each as a function of elevation. Then the program calculates 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 points from the fit curves are calculated for the six 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 of the measurement and information to help decide on whether to retain or reject a measurement set.

6.5.1 General Information

Basically, the REWORK program reworks the measurement data at one of three rework levels and prints out the results. A full first level rework is activated by using an integer rework number entered into the rework data statements located at the end of the REWORK program and selecting option "Ø=REWORK" at "the restart alternatives position"(TRAP) reached, e.g., via Key Ø. The first level rework fits the data to a two-dimensional gaussian, uses the fit data to calculate G/T, G/T_a, NEF, NUF, HPBW#1, HPBW#2, etc., for each data set (typically 180 data points), and then least squares fits the results to a linear and to a cosecant function of the antenna elevation angle.

A partial second level rework is activated by using a noninteger rework number in the rework data statements and selecting option "Ø=REWORK" at TRAP. The second level rework uses the last stored fit data information and/or new

site or error data (e.g. site elevation, HPBW#1, ambient temperature, . . .) to recalculate G/T, G/T_a, . . ., and refits the results to a linear and to a cosecant function of the antenna elevation angle.

The third level rework option is activated from "2 = AUTO" in conjunction with "3 = DEL" option at TRAP (e.g. Key Ø). For this option G/T, G/T_a, NEF, and NUF are not recalculated for the individual sets, but the least squares fits of the various parameters versus elevation are refit and the measurement errors recalculated. Primarily this rework option is for deleting data sets and recalculating the least squares fits.

The refit programs are interactive, and typically the data are reworked four times--first level rework for all frequencies, first level rework for a specific frequency, second level rework for a specific frequency, and finally deletion of bad data sets plus a third level rework for a specific frequency.

6.5.2 Entry into the REWORK Program

The REWORK program can be accessed via links to the REWORK program (REWORK) available from "the restart alternatives position" (TRAP) in either the SITE PREP or the MEAS programs, or by inserting the REWORK tape into the internal cassette and (1) Load, execute (2) Run, execute, (3) appropriate response to computer-generated instructions until REWORK is loaded. When REWORK is loaded the program stops at TRAP with the display "Ø REWORK, 1LOAD, 2AUTO, 3DEL, ..." If the rework data statements have not been altered, then the program needs to be halted by pressing the END Key (a lazy T appears in the display) and fetching the data statements (FETCH 6000, EXC) and using the editing keys to enter the appropriate changes. We recommend that the REWORK remark statement and REWORK data statements be listed (LIST 6000, EXC) and taped to the cover of the notebook which is used to collect the REWORK results.

6.5.3 Data Tapes and Data Statements for a Level One Rework

The REWORK program is designed to rework the data contained on a single summary tape, so if data from different tapes are desired in the rework, the data have to be collected onto a single tape. On any single summary tape, files exist to store results for two different reworks. If the results of more than two reworks are needed for a data set, a duplicate summary tape per two additional results is needed. The full rework is accomplished by providing an

integer rework number in the data statements at the end of the computer program and selecting the "ØREWORK" at TRAP.

Rules for the rework data statement are as follows. For convenience, the identification of entries in the data rework statements is in a remark statement immediately preceding the rework data. The rework data statement has eight entries. First is the rework number. For a complete rework this number is an integer. To avoid confusion, we recommend this number be unique for each rework associated with a particular measurement site. The computer program requires that the rework number in successive rework data statements be larger than each preceding number. This allows starting at a particular rework statement and stepping over previous reworks.

The second rework entry is the file set (1 or 2). This entry determines the locations where the results of the rework are stored on the summary tape.

The third rework entry is the measurement frequency (expressed in gigahertz) of the data sets included in the rework. The frequency recorded with a data set on the summary tape must agree exactly with this rework entry or else it is not included in this rework. If the frequency was incorrectly entered at the time the data was recorded, it has to be corrected to be included with a rework. An exception to this rule is for an all-frequency rework. To rework all data sets regardless of frequency, a Ø is entered for the frequency entry.

The fourth and fifth entries in the data rework statement are the zenith value and the cosecant coefficient of T/T_a (ratio of system temperatures to noise add temperature). This is information obtained from the sky profile measurements.

The sixth and seventh entries in the data rework statement are the zenith value and the cosecant coefficient of HPBW#1. Unless there has been a previous rework of the data, these values are not known and the values 0.14 and 0 are entered.

The last and eighth entry in a data rework statement is the value of the noise add, T_a, in kelvins. The magnitude for T_a has to be estimated from the printouts that occur using the MEAS program. The T_a used is the value that makes the graph of the center cut (N3=0) reach 100%.

The rework process is an interactive process so that reasonable errors in entering the values in the rework data statement do not effect the ultimate results. Rather, a poor estimate may require an additional rework step.

6.5.4 Deleting Data and Refitting Results

One of the most critical steps in reworking the data is in selecting 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 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 measurement process. Following are some of the reasons we have used for deleting data. (1) The major reason for rejecting a data set is that one or more of the cuts in a set cannot be processed by the computer. To refit to a gaussian curve the computer uses a logarithmic method that requires that the peak value be greater than the sky temperature. In cases where the amplitude caused by the star is within the natural scatter or drift in temperatures of the data for the sky temperature, the program hangs up trying to take the logarithm of a negative number. This problem usually occurs because a cut is not taken sufficiently close to the center of the star to give maximum clearly greater than the normal scatter. To avoid this potential refit problem, attention is required to keep the data sets centered up on the star and/or to retake data that does not give a reasonable star signal to sky noise. (2) Another cause for rejecting data sets is due to recognized accidental measurement conditions such as missetting the antenna pointing, and incorrectly setting the down converter frequency or operating the frequency lock circuit 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 a comment is recorded on the offending measurement or a subsequent measurement. A bad antenna set is sometimes detected from a very poor fit of the set of five cuts to a gaussian curve, as noted on rework printouts. A difference on the printout of greater than 7% between the measured amplitude and the fit value generally indicates a problem in the antenna pointing. (3) Star data other than from Cas A are sometimes collected. Until the information and software in the ETMS are corrected to properly take advantage of these stars, this information is normally rejected from the results. (4) Star data

taken under abnormal or unusual measurement conditions are either omitted, or an explicit comment is given noting that data under abnormal conditions are retained. Abnormal conditions refer to conditions abnormal to the error analysis assumptions for the computer program. In particular, hail cloud conditions, rain, snow or condensed water particles in the air are conditions with which the error analysis in the computer program is not designed to deal. The atmospheric conditions between the star and the antenna are assumed to be uniform. Measurements, particularly at low angles where an atmospheric change occurs between the star and the antenna, may need to be rejected. (5) A final reason for rejecting data is that the data obviously do not fit with the reworked data collected. To spot an abnormal data set, several techniques are available. If the frequency is incorrectly recorded, this is usually most obvious on the G/T_a or Y-factor plot on a single frequency rework, because the coupling ratio of the noise add directional coupler is usually frequency dependent. Normally the NEF or NUF will not be frequency dependent, so an abnormal measurement set will often stand out most clearly on the NEF plot on an all-frequency rework. It is unusual for any measurement set to lie outside the error bars indicated on an all-frequency NEF plot. Any point that lies half again farther out than the error bar should be deleted. Any point that is near the error bars on the NEF all-frequency plot should be scrutinized on the rework sheets as to how well the measured data agree with the fit values. After examining the NEF all-frequency plot, all of the single frequency plots should be examined. The HPBW#1, and HPBW#2, and Y-factor plots have only one-sigma error bars, so one third of the data is expected to lie outside these error bars.

6.5.5 Typical Rework Procedure

The typical rework for data at three frequencies would go as follows: (1) The data are collected onto a single rework tape. (2) The REWORK tape is loaded, lines 10 through 66 are deleted from the program, the data statements are entered for Rework #1 on file set 1 for an all-frequencies rework and Rework #2 on file set 2 for the lowest single frequency rework. (3) Key Ø, select option Ø RW to initiate the first level reworks. At the end of the reworks, the program stops at "the restart alternatives position" (TRAP). (4) The rework results are examined and the data sets to be deleted from Rework #1 are determined. (5) The rework results are reloaded into memory by selecting "1 LOAD" option. (6) The bad data sets are negated using the "3 DEL" option. (7) Re-

work #1.01, a third level rework is initiated using the "2 AUTO" TRAP option. (8) The Rework #2 results are reloaded into memory by selecting "1 LOAD" TRAP option. (9) The data sets to be deleted for the single frequency Rework #2 are negated using the "3 DEL" option. (10) Rework #2.01 is initiated with the "2 Auto" TRAP option. Steps (5-10) are needed only to obtain a reasonable fit for HPBW#1 and a valid estimate of T_a to be used in the upcoming second level reworks. If no data points are grossly out of line, steps (5-10) can be omitted. (11) Now second level reworks are needed which use the newly calculated HPBW#1 and T_a but do not take the time to fit the cuts again to gaussian curves. The second level rework is activated by the rework number in the rework data statements to be noninteger, so 1.1 replaces 1, and 2.1 replaces 2 as the data entries for the rework number. No other entry in the rework statements need be changed as the entries for HPBW #1 and T_a are not used (but must be entered anyway). (12) The second level rework is initiated via Key Ø, "Ø RW" TRAP option. (13) After the second level reworks are complete, the bad data are again removed and the third level Rework #1.11 and Rework #2.11 are performed. (14) The summary tape is duplicated (keyboard command, DUP 5). (15) Rework data statements are entered, etc., for Reworks #3 and #4 for the remaining two measurement frequencies. (16) . . .(26) Repeat steps (3) through (13) for Rework #3 and Rework #4. When all the reworks are finished, the measurement conditions should be double checked. To do this the "SITE PREP" tape is loaded, and the measurement conditions are entered which correspond with those recorded on the G/T(dB) error table printed in the final rework. If all of the measurement conditions are correct, the reworks are finished.

6.5.6 Interpretation of Results

The results of a measurement are printed out as a series of computer printouts as the last step of a rework (any level). The normal sequence of computer printouts is as follows: (1) Table of measurement sets incorporated into the rework; (2) table of the results of the least squares fits of G/T, G/Ta, HPBW#1, HPBW#2, Y-factor, NEF, and NUF versus the cosecant of the elevation, and versus elevation angle directly; (3) graph of NEF versus antenna elevation; (4) graph of NUF versus elevation; (5) graph of G/T versus elevation; (6) graph of G/Ta versus elevation; (7) graph of HPBW#1 versus elevation; (8) graph of HPBW#2 versus elevation; (9) Y-factor versus elevation; (10) table of NEF measurement errors, and measurement conditions at various elevations; (11)

similar NUF error table; (12) G/T error table; and (13) G/Ta error table. Much of what appears on the printouts is self-explanatory, but the following remarks are included to better understand some of the printouts. Sample printouts are in the annotated computer printouts section (section 6.5.8).

Printout (2) is a table of results of a least squares fit of the various parameters versus elevation. Each parameter is fit to two different curves, viz. the parameter versus the cosecant of the elevation angle, and the parameter versus the elevation angle. The uncertainties listed are the one-sigma deviation of the measured points to the fit parameters.

Printouts (3)-(9) are a series of plots of various parameters versus antenna elevation. 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 lable. 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 beam width (HPBW) of 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. HPBW#1 refers to the HPBW of the antenna pattern of a center cut along a line of constant declination, and HPBW#2 refers to the HPBW perpendicular to the line of constant declination.

For printouts (10)-(13) 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 the SITE PREP error table. Other parameters are labeled with the computer variable table. The meaning of the computer variables are 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 zenith 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 futher explanation of the various items in these tables, consult the annotated printouts.

6.5.7 Measurement Pitfalls

As with any computer printout, the results flow so easily and the valid results flow out with no more effort than the unvalid results. It becomes such a bother to worry about which is which, that sometimes the effort is not taken, and the quality of the measurements slowly ebbs away. In the opposite direction, as certain operators gain more experience, they gain a sense of the quality and conditions of the results that transends what can be programmed, or in some cases--even what can be easily communicated to others. My experience is that neither the computer results nor measurement intuition should be given the upper hand--but equal weight given to each. Documenting measurement conditions and explicitly stating measurement concerns will ultimately give rise to an improved measurement procedure. Certain measurement pitfalls occur regularly so they will be discussed explicitly.

6.5.7.1 Extending Results Beyond Measurement Range

One should be particularly careful of extending the measurement results to antenna elevation angles beyond the elevation angles of any measured data sets. The computer printout tables print out the results at 10 degrees; but if no data sets were taken lower than 15 degrees elevation, the validity of the error uncertainty should be seriously examined. Measurement experience and reasonable measurement implications of the extended results need to be intelligently considered.

6.5.7.2 Abnormal Atmospheric Conditions

The model used in the computer is that the atmosphere has a typical profile of temperature and humidity. Primarily, this excludes 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% due to small changes in antenna gain with elevation, small changes of the system temperature due to increased thermal radiation into the antenna side lobes at low elevation angles, or small changes of 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.

6.5.7.3 Data Deletion

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, especially when the numbers of measurement data are small. The true uncertainty of the ideal measurement should not be variable.

6.5.8 REWORK Annotated Printout

The annotated printout for the rework program follows.

*—INSERT REWORK TAPE into INTERNAL CASSETTE UNIT
LOAD
RUN
PRINT ALL ON (1=YES)?1
REWORK SITE DATA(10=INT,5=E
PROM CONST CHANGE OPTION(0=NO)?0
 10.3

identifies tape being loaded

you may want to modify the program constants, if so enter '1' here

N881A.04 LOADER (D1-F0) T2-F0:   V.04.0002 T2-4,D1-4

-1-

Sysm # 0.00 RUN 3

PROG 276.5411 HARROGATE ENG
SAT: 1977 MAY 28 (1977.400)
7.550 GHz, 60.0 Ft DISH

G/To	G/T
33.02 dB/K	40.16 dB/K

PROG CONSTS

A2: 2.3

B2: 0.65	B3: 0.98	B5: 0.190451
B6: 7.59224E-03	B9: 170.827	B : 8.2943

C1: 4.54421E+18	C2: 1	C4: 1.683
C5: 54	C6: 245.421	C7: 0.23
C8: 0.1	C9: 0.2	C0: 0.5
C : 1977.4		

D1: 0.1	D2: 1.34754	D3: 0.6
D5: 0.01615	D8: 0.75	D9: 0.18
D0: 0.0157887	D : 60	

F6: 5	F0: 0.01	F : 7.55

G4: 8.61841E-03	G5: 1.09405E-04	G6: 3.35159E-04
G : 1361510		

H1: 0.151166	H5: 1	H9: 679.844

L5: 2.00457	L6: 2.17	L7: 1.00241
L8: 1.02064	L9: 0.013	L : 5

M : 10366

N1: 6	N6: 3	N7: 500
N : 1		

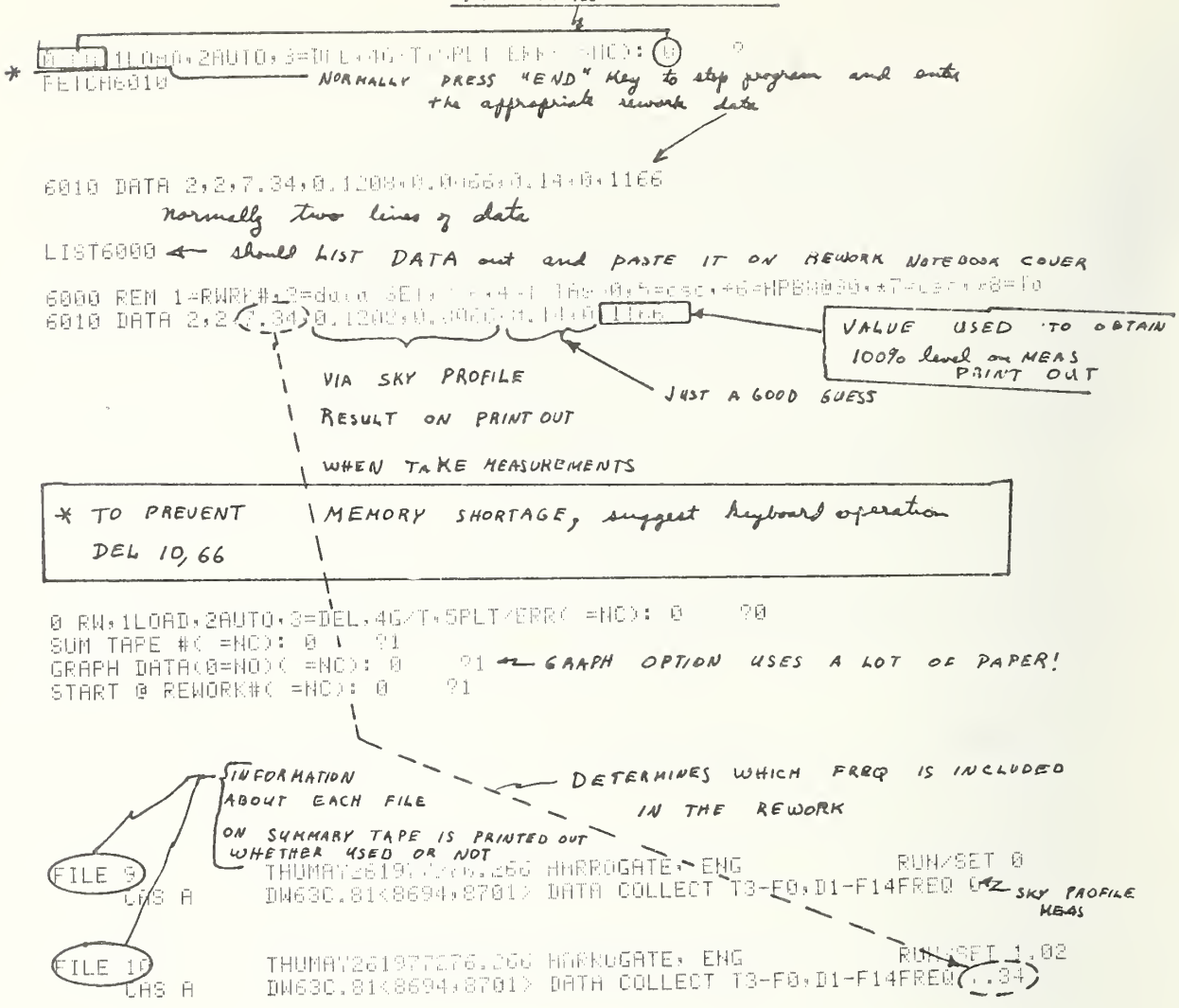
O3: 8.22653	O6: 1.25	O7:-0.0439
O8:-0.0485		

T : 131.343

W : 5.5

Z1: 0.0377515

FIRST LEVEL REWORK



TAPE 1 data 2 [illegible] REWORK 2.00

DFW,JFW,HUCKINS' ← COMMENT STORED WITH DATA

INTEGER MEANS COMPLETE REWORK

IW63C.81 8694,8701) DATA [illegible] F14, 1.5, 6693 T2-4,D1-4

IDENTIFIES PROGRAM REVISION FOR MEAS ROUTINE

-2-

IDENTIFIES SUBROUTINE USED DURING MEASUREMENT

PROG 37e.66 HARROGATE, ENG
THU: 19/7 MAY 26 (1977.400)
7.34e GHz 60.0 Fr DISH

STORED WITH DATA

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
46.2 F	43.2 F	89.4 %	7.4 gm/mt3	4	0 mph

MEAS	AZIMUTH	HPBW	TIME(HRS)	OFFSET	ELEV	CUT	RUN	SET	N
6sec	352.47	0.1400	7.360	2.000 dea	83.40	-3	1	2	7

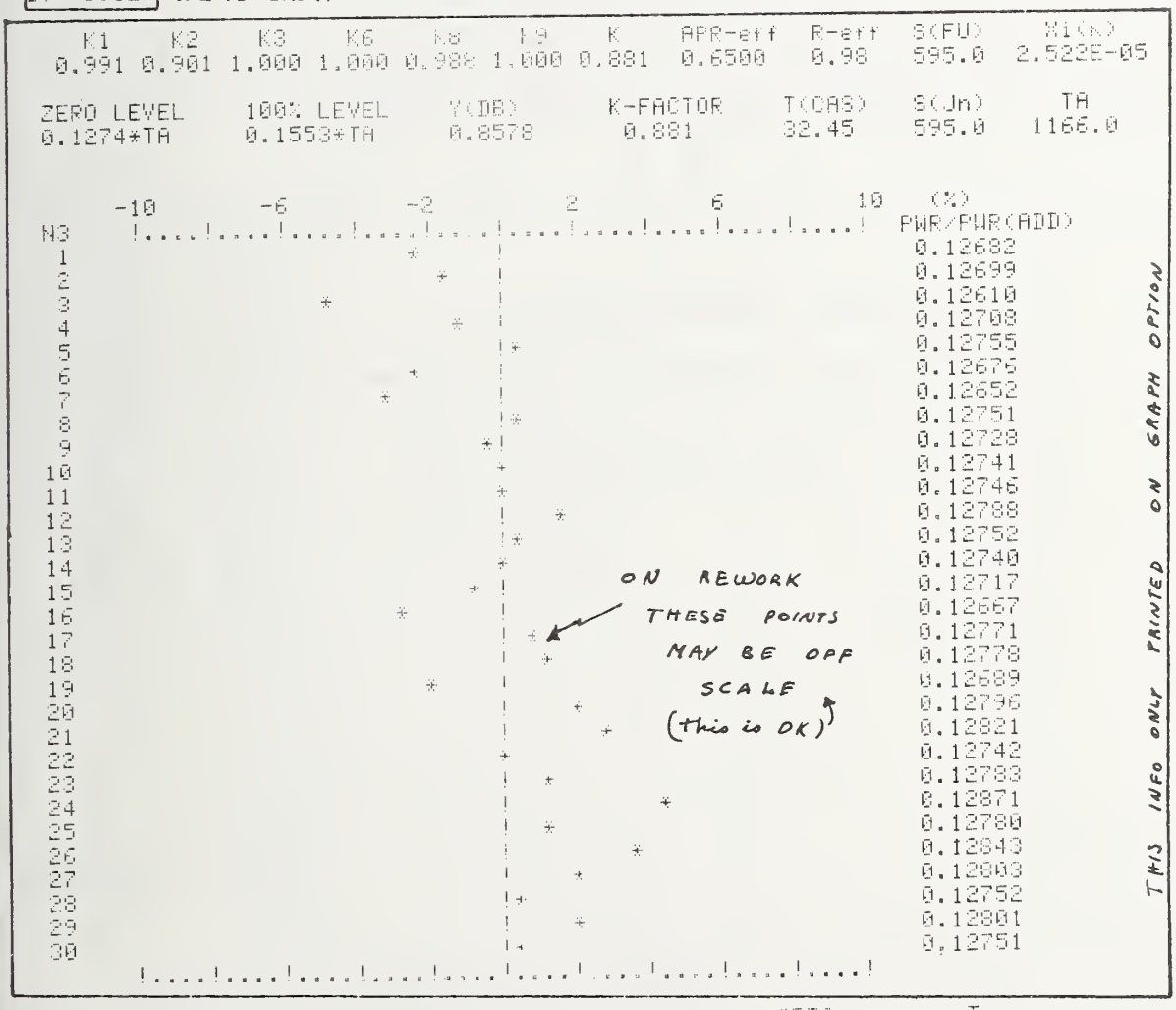
ΔT= 0.028 ← PREDICTED ΔT/Ta due to CAS A

T/TA = 0.1209 + 0.00660*OSC L

CAS A

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.991	0.901	1.000	1.000	0.986	1.000	0.881	0.6500	0.98	595.0	2.522E-05

ZERO LEVEL	100% LEVEL	Y(DB)	K-FACTOR	T(CAS)	S(Jn)	TA
0.1274*TA	0.1553*TA	0.8578	0.881	32.45	595.0	1166.0

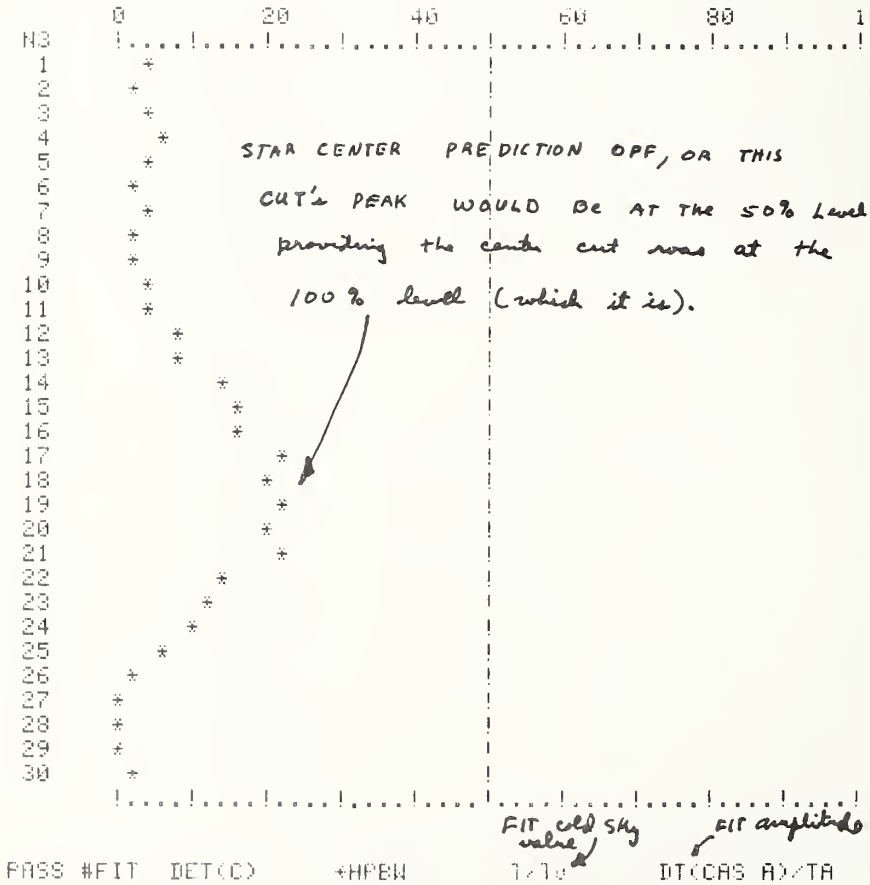


N3	(%) PWR/PWR(ADD)
1	0.12682
2	0.12699
3	0.12610
4	0.12708
5	0.12755
6	0.12676
7	0.12652
8	0.12751
9	0.12728
10	0.12741
11	0.12746
12	0.12788
13	0.12752
14	0.12740
15	0.12717
16	0.12667
17	0.12771
18	0.12778
19	0.12689
20	0.12796
21	0.12821
22	0.12742
23	0.12783
24	0.12871
25	0.12780
26	0.12843
27	0.12803
28	0.12752
29	0.12801
30	0.12751

THIS INFO ONLY PRINTED ON GRAPH OPTION

T/TA	SIGMA	MEAN	#PTS	T
0.1275	0.15 %	0.08 %	30	148.6

```
TAPE 1     data 2     NBS1D.42  REWORK  (D1-F16) T4-F12      REWORK  2.00
                DFW,JPW,HOORAY!

DW63C.81(8694,8701) DATA COLLECT T3-F0,D1-F14,   X.52(8699)T2-4,D1-4

                                   -3-
                                                                   RUN  1

                    PROG  276.266       HARROGATE, ENG
                    THU:  1977 MAY 26  ( 1977.400)
                    7.340 GHz, 60.0 Ft DISH

     TEMP          DEW PT.       REL HUMP       WATER DENS     CLOUD COVER     WIND
     46.2 F        43.2 F         89.4 %         7.4 gm/m^3          4          0 mph
=============================================================================================

 MEAS     AZIMUTH      HPBW     TIME(HRS)     OFFSET       ELEV      CUT  RUN  SET   N
 6sec      314.40     0.1400       7.874   -0.168 deg     83.17     -2    1    2    8

dT= 0.028                    T/TA = 0.1208 + 0.00660*CSC L                    CAS A

PASS #FIT  DET(C)      *HPBW        T/Ta        DT(CAS A)/TA     PEAK#   SLOPE  T-FIT
 1    30    0.031         -         0.1262    0.0059 +-  8.01%  18.55  -1.23%  -4.4%
 2    13   31.262    0.130deg         -       0.0061 +-#####%  18.88      -       -
 ZERO LEVEL     100% LEVEL     Y(DB)       K-FACTOR     T(CAS)    S(Jn)      TA
 0.1262*TA      0.1541*TA      0.8651       0.881        32.45     595.0   1166.0
```

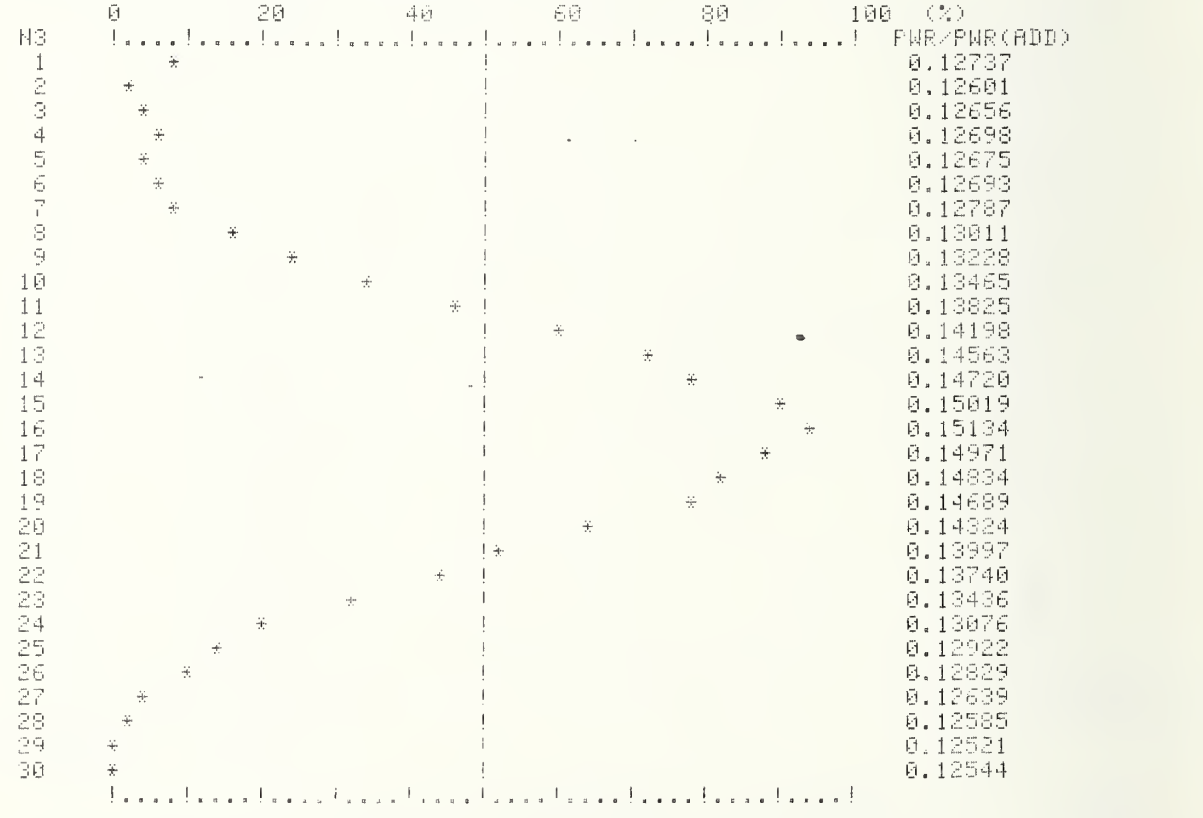



```
PASS #FIT  DET(C)      *HPBW        T/Ta        DT(CAS A)/TA     PEAK#   SLOPE  T-FIT
 3    30    0.031    0.130deg     0.1264    0.0059 +-  6.85%  18.88  -1.34%   0.4%
```

```
TAPE 1     data 2     NBS1D.42  REWORK    D1-F16> T4-F12      REWORK  2.00
                DFW,JPW,HOOFRAY:

DW63C.81<8694,8701> DATA COLLECT 13-FW,D1-F14,   %.52<8699>T2-4,D1-4

                                    -4-

                                                                    RUN  1

                    PROG  276.366       HARROGATE, ENG
                    THU:  1977 MAY 26  ( 1977.400)
                    7.840 GHz, 60.0 Ft DISH

     TEMP          DEW PT.       REL HUMD       WATER DENS     CLOUD COVER     WIND
     46.2 F       -43.2 F         89.4 %        7.4 gm/mt3          4          0 mph
=============================================================================

 MEAS     AZIMUTH      HPBW     TIME(HRS)     OFFSET       ELEV      CUT  RUN  SET   N
 6sec      312.37    0.1400       7.938    -0.129 deg     82.74     -1    1    2    9

dT= 0.028                  T/TA = 0.1196 + 0.00660*CSC L                    CAS A

PASS #FIT  DET(C)      *HPBW        T/To      DT(CAS A)/TA     PEAK#    SLOPE  T-FIT
 1    30    0.029         -        0.1262   0.0141 +-  4.28%  17.59  -0.71%  -0.2%
 2    13   31.262    0.132deg        -      0.0146 +-#####%   18.09     -        -
 ZERO LEVEL     100% LEVEL     Y(DB)       K-FACTOR    T(CAS)    S(Jn)      TA
 0.1262*TA      0.1540*TA      0.8675       0.881       32.45     595.0    1166.0

        0          20         40         60|        80         100  (%)
 N3     !....!....!....!....!....!....!....!....!....!....!   PWR/PWR(ADD)
  1       *                                                    0.12715
  2       *                                                    0.12724
  3        *                                                   0.12759
  4      *                                                     0.12694
  5       *                                                    0.12750
  6       *                                                    0.12737
  7       *                                                    0.12712
  8        *                                                   0.12778
  9         *                                                  0.12842
 10          *          THIS IS                                0.12896
 11              *                                            0.13040
 12                 *    WHAT THE FIRST                       0.13226
 13                   *    CUT WOULD                          0.13386
 14                     *   LOOK LIKE                         0.13618
 15                         IF STAR _ PREDICTION              0.13846
 16                         WAS CORRECT                       0.13916
 17                                                           0.14011
 18                                 *                         0.14089
 19                                  *                        0.13941
 20                                   *                       0.13884
 21                                    *                      0.13823
 22                                 *                         0.13557
 23                              *                            0.13295
 24                            *                              0.13179
 25                         *                                 0.12997
 26                      *                                    0.12869  DIFFERENCE
 27                     *                                     0.12792  IN FIT SKY
 28                  *                                        0.12608
 29                    *                                      0.12689  & PREDICTED
 30                *                                         0.12564    SKY TEMP
      !....!....!....!....!....!....!....!....!....!....!

PASS #FIT  DET(C)      *HPBW        T/To      DT(CAS A)/TA     PEAK#    SLOPE  T-FIT
 3    30    0.029    0.132deg      0.1        0.0144 +-  2.70%  18.09  -1.39%  0.6%
```

```
TAPE 1     data 2     NBS1D.42  REWORK  <D1-F16> T4-F12      REWORK  2.00
                DFW;JPW;HOORAY!

DW63C.81<8694,8701> DATA COLLECT T3-F0,D1-F14,   X.52<8699>T2-4,D1-4

                                   -5-
                                                                    RUN  1

                      PROG  276.266       HARROGATE, ENG
                      THU:  1977 MAY 26   ( 1977.400)
                      7.340 GHz, 60.0 Ft DISH

     TEMP          DEW PT.       REL HUMD       WATER DENS     CLOUD COVER     WIND
     46.2 F        43.2 F          89.4 %         7.4 gm/m↑3         4          0 mph
=============================================================================================
                                        DECLINATION  OFFSET  FROM  UNBIASED  STAR CENTER  PREDICTION
 MEAS     AZIMUTH      HPBW      TIME(HRS)      OFFSET          ELEV      CUT  RUN  SET   N
 6sec      310.37    0.1400        8.014     -0.090 deg        82.23       0    1    2   10

dT= 0.028                      T/TA = 0.1195 + 0.00660*CSC L                    CAS A

PASS #FIT  DET(C)      *HPBW        T/To       DT(CAS A)/TA      PEAK#   SLOPE  T-FIT
 1    30    0.027        -         0.1254   0.0252 +-  2.93%   16.06  -0.07%  -2.8%
 2    13   31.262    0.138deg       -        0.0254 +-######    15.98     -       -
 ZERO LEVEL     100% LEVEL     Y(DL)       K-FACTOR     T(CAS)     S(Jn)      TA
 0.1254*TA      0.1532*TA      0.8703        0.881       32.45     595.0    1166.0
```

PREDICTED VALUES BASED ON EARTH TERMINAL ASSUMPTIONS




```
PASS #FIT  DET(C)      *HPBW        T/To       DT(CAS A)/TA      PEAK#   SLOPE  T-FIT
 3    30    0.027    0.138deg      0.1255   0.0251 +-  3.27%   15.98   0.18%   0.5%
```

```
TAPE 1     data 2     WBSID.=_   REWORK    I1-F16  T4-F12      REWORK  3.00
           DFW,JFW,HOOFAY!

DW630.81(8694,8701) DATA COLLECT TO PW,I1-F14,   ...SI 8695 T2-+,I1-4

                                   -E-
                                                                  RUN  1

                    PROG  276.266       HARROGATE, ENG
                    THU:  1977 MAY 26   ( 1977,400)
                    7.340 GHz, 60.0 Ft DISH

     TEMP          DEW PT.       RE_ HUMD       WATER DENS     CLOUD COVER     WIND
     46.2 F        43.2 F         89.4 %         7.4 gm/m^3          4          0 MPH
==========================================================================================

 MEAS     AZIMUTH      HPBW     TIME(HRS)     OFFSET       ELEV      CUT  RUN  SET   N
 6sec      308.88     0.1400       6.073    -0.051 deg     81.77      1    1    2   11

dT= 0.028                    T/TA = 0.1185 + 0.00680*CSC L                    CAS A

PASS #FIT  DET(C)      #HPBW        T/Ta        DT/CAS A)/TA     PEAK#    SLOPE  T-FIT
 1    30   0.027         -         0.1347     0.0272 +-  3.67%  14.67    1.34%  -2.5%
 2    13   31.262    0.137deg       -        0.0276 +-#####%   15.29      -      -
 ZERO LEVEL     100% LEVEL      Y(DB)       K-FACTOR     T(CAS)    S(Jm)      TA
 0.1247*TA      0.1526+TA      0.8746        0.881        32.45     595.0   [ 11o6.0 ]

                                          THE VALUE OF Ta DETERMINES SCALE OF GRAPH

      0          20          40          60          80          100
N3    !....!....!....!....!....!....!....!....!....!....!....!  PWR/PWR(ADD)
 1      *                                                        0.12609
 2      *                                                        0.12590
 3      *                                                        0.12581
 4      *                                                        0.12600
 5        *                                                      0.12671
 6         *                                                     0.12734
 7            *                                                  0.12976
 8              *                                                0.13138
 9                 *                                             0.13317
10                                                               0.13987
11                                                               0.14414
12                                                               0.14540
13                                                               0.14956
14                                                               0.15079
15                                                               0.15226
16                                                               0.15134
17                                                               0.15013
18                                                               0.14697
19                                                               0.14404
20                                                               0.13967
21                                                               0.13732
22                                                               0.13910
23                                                               0.13079
24                                                               0.12859
25                                                               0.12687
26                                                               0.12627
27      +                                                        0.12551
28      +                                                        0.12525
29      +                                                        0.12545
30      +                                                        0.12547
      !....!....!....!....!....!....!....!....!....!....!....!

Ta adjusted so center cut is about 100%

Reasonable agreement

CLOSE TO THE TRUE CENTER CUT

1σ uncertainty of peak value

PASS #FIT  DET(C)      #HPBW        T/Ta        DT/CAS A)/TA     PEAK#    SLOPE  T-FIT
 3    30   0.027      0.137deg      0.1.01   [ W.    1 ]  -      19.2*   -0.72%   1.2%
```

```
TAPE 1     data 2     NBS1D.42  REWORK  <D1-F16> T4-F12      REWORK  2.00
           DFW,JFW,HOORAY!

DW63C.81<8694,8701> DATA COLLECT T3-F0,D1-F14,   %.52<8699>T2-4,D1-4

                                   -7-
                                                                    RUN  1

                    PROG  276.266       HARROGATE, ENG
                    THU:  1977 MAY 26  ( 1977.400)
                    7.340 GHz, 60.0 Ft DISH

     TEMP          DEW PT.       REL HUMD       WATER DENS     CLOUD COVER     WIND
     46.2 F        43.2 F         89.4 %         7.4 gm/mt3          4          0 mph
```

TIME BETWEEN MEASUREMENTS

MEAS	AZIMUTH	HPBW	TIME(HRS)	OFFSET	ELEV
6sec	307.56	0.1400	8.144	-0.012 deg	81.30

MEASUREMENT IDENTIFICATION

CUT	RUN	SET	N
2	1	2	12

PREDICTED

```
dT= 0.028                 T/TA = 0.1181 + 0.00660*CSC L                CAS A

PASS #FIT  DET(C)      *HPBW        T/To       DT(CAS A)/TA     PEAK#   SLOPE  T-FIT
 1    30    0.027        -         0.1247   0.0192 +-  3.55%  16.16  -0.55%  -0.0%
 2    13   31.262     0.133deg       -      0.0196 +-###.##%  15.64     -       -
 ZERO LEVEL     100% LEVEL     Y(DB)       K-FACTOR     T(CAS)    S(Jn)      TA
 0.1247*TA      0.1526*TA      0.8716        0.881       32.45    595.0    1166.0

          0         20        40        60        80        100  (%)
 N3       !....!....!....!....!....!....!....!....!....!  PWR/PWR(ADD)
  1        *                                               0.12542
  2         *                                              0.12601
  3        *                                               0.12532
  4        *                                               0.12531
  5         *                                              0.12568
  6         *                                              0.12576
  7           *                                            0.12712
  8              *                                         0.12865
  9                 *                                      0.13062
 10                    *                                   0.13266
 11                      *                                 0.13525
 12                       *                                0.13874
 13                        *                               0.14006
 14                          *                             0.14296
 15                           *                            0.14365
 16                            *                           0.14450
 17                           *                            0.14385
 18                         *                              0.14221
 19                       *                                0.13980
 20                     *                                  0.13680
 21                   *                                    0.13448
 22                 *                                      0.13189
 23               *                                        0.12980
 24             *                                          0.12830
 25             *                                          0.12792
 26           *                                            0.12717
 27         *                                              0.12571
 28        *                                               0.12546
 29        *                                               0.12519
 30         *                                              0.12580
          !....!....!....!....!....!....!....!....!....!
```

MEASURED

PASS	#FIT	DET(C)	*HPBW	T/To	DT(CAS A)/TA	PEAK#	SLOPE	T-FIT
3	30	0.027	0.1234deg	0.1252	0.0191 +- 2.47%	15.64	0.67%	1.9%

TAPE 1 data 2 NBS1D.42 REWORK (D1-F16) T4-F12 REWORK 2.00
DFW,JFW,HOOPHY)

DW63C.81(8694,8701) DATA COLLECT (3-F9,D1-F14, (%.52:8699)T2-4,D1-4

-8-

RUN 1

PROG 276,266 HARROGATE, ENG
THU: 1977 MAY 26 (1977.400)
7.340 GHz, 60.0 Ft DISH

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
46.2 F	43.2 F	89.4 %	7.4 gm/mt3	4	0 mph

BEST FIT FOR 5 CUTS ELEV OF 0 CUT

REWORK FILE	TAPE	TIME(Hrs)	EFF AREA	Ta(K)	SKY BRIGHT	ELEV(deg)	RUN	SET
2.0 9	1	8.014	170.8 mt2	1166.0	2.31 K	82.2	1	2

PASS	#FIT	DET(C)	+HPBW	T/Ta	DT(CAS A)/Ta	DECL OFFSET: CAS A
1	5	15.286	0.142deg	0.1255	0.0274 +- 1.91%	-0.063deg
2	5	7.208	0.142deg	0.1255	0.0276 +- 0.91%	-0.063deg

*HPBW#1	Y-FACTOR	T(K)	DT(CAS A)	G(dB)	G/T(dB)	NEF	NUF
0.139deg	1.2195	146.33	32.13 K	61.05	39.40	2.346kFU	2.386kFU

100*(DATA-FIT)/(MAX DT(CAS A)/TA)

CUT	-2	-1	0	1	2
	0.86%	-1.66%	0.79%	-0.02%	0.04%

CONDITIONS AND ASSUMPTIONS USED IN CALCULATION of G, G/T, NEF, & NUF

*HPBW #1 = 0.14000 + 0.000000 COS L = 0.1400 (ant HPBW = 0.1390)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.991	0.901	1.000	1.000	0.588	1.000	0.881	0.6500	0.98	535.0	2.522E-05

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.500 km	0.03209 dB	0.0060 dB/dens	0.0361 dB	1.062	0.0130	60.0 ft

ETC.

2ND LEVEL REWORK

```
0 RW,1LOAD,2AUTO,3=DEL,4G T,5PLT ERR( =NC): 0     ^

* END


FETCH6000
6000 REM 1=RWRK#,2=data SEL,3=F,4=T TA@90,5=csc,*6=HPBW@90,*7=csc,*8=To

6010 DATA 12.2,2,7.385,0.1200,0.0066,0.14,0,1166

                NON INTEGER REWORK ACTIVATES 2ND LEVEL REWORK
LIST6000

6000 REM 1=RWRK#,2=data SEL,3=F,4=T TA@90,5=csc,*6=HPBW@90,*7=csc,*8=To
6010 DATA 12.2,2,.385,0.1200,0.0066,0.14,0,1166

* KEY Ø
0 RW,1LOAD,2AUTO,3=DEL,4G T,5PLT ERR( =NC): 0      Ø
SUM TAPE #( =NC): 10    Y
GRAPH DATA(0=NO)( =NC): 0     ^0


START @ REWORK#( =NC): 12.21    ?1c

      INFORMATION ON EACH SUMMARY TAPE FILE IS LISTED
FILE 9          TUEMAY101977276.5411CAMP ROBERTS, ANT#1       RUN/SET Ø
     CAS A      DW63C.76(8694,8701) DATA COLLECT T3-F0,D1-F14FREQ 0

FILE 10         TUEMAY101977276.5411CAMP ROBERTS, ANT#1       RUN/SET 1.02
     CAS A      DW63C.76(8694,8701) DATA COLLECT T3-F0,D1-F14FREQ 7.5

FILE 11         TUEMAY101977276.5411CAMP ROBERTS, ANT#1       RUN/SET 1.03
     CAS A      DW63C.76(8694,8701) DATA COLLECT T3-F0,D1-F14FREQ  .385


TAPE 10   data 2    NBSID,4,3  REWORK  (D1-F16) T4-F12      REWORK 12.20
                    ANT SET PROBLEMS

DW63C.76(8694,8701) DATA COLLECT T3-F0,D1-F14,    .52(8699)T2-4,D1--4

                                -4-

                                                              RUN  1

                    PROG  276.5411      CAMP ROBERTS, ANT#1
                    TUE,    29.7 MAY 10  ( 1977.400)
                    .385 GHz, 60.0 Ft DISH

          SPECIFIED REWORK FREQ
```

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
49.3 F	43.2 F	79.7 %	7.3 gm/m13	2	0 mph

BEST FIT FOR 5 CUTS

REWORK	FILE	TAPE	TIME(Hrs)	EFF AREA	Ta(K)	SKY BRIGHT	ELEV(deg)	RUN	SET
12.2	9	10	7.559	170.8 m2	321.1	9.78 K	13.3	1	3

PASS	#FIT	DET(C)	*HPBW	T/Ta	DT(CAS A)/Ta	DECL OFFSET: CAS A
1	5	21.735	0.178deg	0.0029	0.0906 +- 5.65%	0.075deg
2	5	6.350	0.178deg	0.0029	0.0908 +- 5.21%	0.075deg

*HPBW#1	Y-FACTOR	T(K)	DT(CAS A)	G(dB)	G/T(dB)	NEF	NUF
0.000deg	32.2949	0.93	29.14 K	60.98	61.29	-0.088kFU	-0.008kFU

100*(DATA-FIT)/(MAX DT(CAS A)/TA)

CUT	-2	-1	0	1	2
	-4.36%	9.46%	-4.65%	-2.03%	1.49%

*HPBW #1 = 0.14741 + 0.000241 CSC L = 0.1485 (ant HPBW = 0.1479)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.963	0.911	1.000	1.000	0.947	0.995	0.827	0.6500	0.98	532.2	2.326E-05

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.500 km	0.03176 dB	0.0060 dB/dens	0.0378 dB	1.055	0.0130	60.0 ft

CONDITIONS

FOR 2nd LEVEL REWORK, CUTS ARE NOT REFIT, BUT SETS ARE

FILE 12 TUEMAY10197?27?5.5411CAMP ROBERTS, ANT#1 RUN/SET 1.04
CAS A DW63C.76.8694.8701 DATA COLLECT T3-F0,D1-F14FREQ 7.6

FILE 13 TUEMAY10197?7?6.5411CAMP ROBERTS, ANT#1 RUN/SET 1.05
CAS A DW63C.76.8694.8701 DATA COLLECT T3-F0,D1-F14FREQ 7.675

FILE 14 TUEMAY10197?7?6.5411CAMP ROBERTS, ANT#1 RUN/SET 1.06
CAS A DW63C.76.8694.8701 DATA COLLECT T3-F0,D1-F14FREQ 7.385

```
TAPE 10    data 2     H651D.4:  REWORK    D1-F16> T4-F12      REWORK 12.20
                NONE

DW630.76<8694,8701> DATA COLLECT T?-F9,D1-F14,    X.52<8699>T2-4,D1-4

                                   -5-
                                                                       RUN  1

                    PROG  276.5411      CAMP ROBERTS, ANT#1
                    TUE:  1977 MAY 10  ( 1977.400)
                    7.385 GHz, 60.0 Ft DISH


    TEMP          DEW PT.      REL HUMD      WATER DENS    CLOUD COVER    WIND
    48.7 F        43.2 F        81.4 %       7.4 gm/m↑3         5         0 mph

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
                           BEST FIT FOR 5 CUTS

REWORK FILE TAPE  TIME(Hrs)  EFF AREA   Ta(K)  SKY BRIGHT  ELEV(deg)  RUN  SET
 12.2   11   10     9.359    170.8 m↑2  321.1    5.60 K      23.9      1    6

PASS #FIT  DET(C)     *HPBW       T/Ta      DT(CAS A)/Ta       DECL OFFSET: CAS A
 1     5   21.342   0.158deg    0.0005   0.0862 +-  7.92%       0.068deg
 2     5    6.618   0.158deg    0.0005   0.0890 +-  5.37%       0.068deg


 *HPBW#1    Y-FACTOR   T(K)    DT(CAS A)   G(dB)   G/T(dB)    NEF      NUF
 0.000deg  179.0870    0.16    28.59 K     60.71    68.66  -0.067kFU -0.021kFU

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

                       100*(DATA-FIT)/(MAX DT(CAS A)/TA)

          CUT          -2        -1        0         1         2
                      4.31%    -9.58%    5.80%    -0.10%    -0.43%

      *HPBW #1 = 0.14741 + 0.000241 CSC L = 0.1480  (ant HPBW = 0.1474)

     K1    K2     K3     K6     K8     K9     K     APR-eff   R-eff   S(FU)    Xi(K)
  0.979 0.911 1.000 1.000 0.969 0.998 0.863  0.6500    0.98   592.2  2.427E-05

  SITE ELEV    oxy attn     water attn    zenith attn   REFR #1  REFR #2   ant-DIAM
  0.500 km   0.03183 dB  0.0060 dB/dens  0.0379 dB     1.056    0.0130     60.0 ft
```

ETC.

3rd LEVEL REWORK

```
0 FW:1LOAD:2AUTO:3=DEL:4G T:5PLT ERR: =NC): 0      (1)
SUB TAPE #  =NC): 0      ?3
DATA SET:1=1ST:2=2nd:  =NC): 1      ?2
```

```
0 FW:1LOAD:2AUTO:3=DEL:4G T:5PLT ERR: =NC): 0      (3)
DEL:RUN:SET?0=EXIT?  ...03
DEL:RUN:SET?0=EXIT?^0
```

1) THE DEL OPERATION PUTS A NEGATIVE SIGN WITH THE ELEVATION ANGLE.
2) In the rework, negative elevation angles are not reworked.
3) To reobtain the data, a second DEL operation returns the + sign and then the data is reworked.

```
0 FW:1LOAD:2AUTO:3=DEL:4G T:5PLT ERR: =NC): 0      (2)
TEMP(F)( =NC): 53    ?
DEW PT(F)( =NC): 30.9     ?
REWORK #( =NC): 15.01    ?
```

DIGIT TO INDICATE WHICH 3rd LEVEL REWORK

TAPE 9 data 2 NBS1D.41 REWORK 9848,0006) T4-F12,D1-F16 REWORK 15.01

NBS1A.01 LOADER 9913,0003 T2-F0,D1-F0, N.04(0002)T2-4,D1-4

-55-

RUN 3

PROG 276.5407 FT. DETRICK ANT #1
THU: 1976 DEC 2 (1976.920)
7.319 GHz, 60.0 Ft DISH

THIS DATA POINT IS NOT INCLUDED IN THE REWORK

RUN/SET	STAR	ELEV	G/T	G/TA	HPBW#1	HPBW#2	FREQ	Y-fac	NEF	NUF
33.08	CAS A	-18.1	40.084	31.891	0.136	0.135	7.319	1.248	1.945	2.065
3.02	CAS A	9.0	40.240	32.524	0.143	0.151	7.319	1.239	1.816	2.051
2.03	CAS A	11.1	40.471	32.422	0.145	0.136	7.319	1.259	1.736	1.923
3.05	CAS A	12.4	40.516	32.590	0.139	0.120	7.319	1.265	1.726	1.893
2.07	CAS A	24.9	41.039	32.535	0.144	0.130	7.319	1.315	1.559	1.640
3.11	CAS A	26.6	40.799	32.398	0.146	0.129	7.319	1.299	1.654	1.732
3.13	CAS A	38.4	41.096	32.548	0.142	0.128	7.319	1.324	1.552	1.606
1.06	CAS A	61.2	41.020	32.578	0.140	0.139	7.319	1.322	1.590	1.628
33.09	CAS A	64.6	40.843	32.157	0.143	0.164	7.319	1.310	1.657	1.695

TAPE 9 data 2 NBS1D.41 REWORK (9840,0006) T4-F12,D1-F15 REWORK 15.01

NBS1A.01 LOADER (9913,0003) T2-F0,D1-F0, M.04(0002)T2-4,D1-4

-56-

RUN 3

PROG 276.5407 FT. DETRICK ANT #1
THU: 1976 DEC 2 (1975.920)
7.319 GHz, 60.0 Ft DISH

PTS = 8

G/T(dB)	=(41.1930 +- 0.1258)	+ (-0.14234 +- 0.02341)*OSC L
G/T(dB)	=(40.4494 +- 0.2434)	+ (0.00980 +- 0.00419)*ELEV
G/TA(dB)	=(32.3407 +- 0.1315)	+ (0.03342 +- 0.02446)*OSC L
G/TA(dB)	=(32.5840 +- 0.1357)	+ (-0.00452 +- 0.00182)*ELEV
HPBW#1(deg)	=(0.1428 +- 0.0027)	+ (-0.00001 +- 0.00049)*OSC L
HPBW#1(deg)	=(0.1435 +- 0.0026)	+ (-0.00002 +- 0.00004)*ELEV
HPBW#2(deg)	=(0.1385 +- 0.0153)	+ (-0.00045 +- 0.00284)*OSC L
HPBW#2(deg)	=(0.1279 +- 0.0136)	+ (0.00030 +- 0.00023)*ELEV
Y-factor	=(1.3394 +- 0.0086)	+ (-0.01545 +- 0.00161)*OSC L
Y-factor	=(1.2562 +- 0.0221)	+ (0.00114 +- 0.00038)*ELEV
NEF(kFU)	=(1.5377 +- 0.0497)	+ (0.04003 +- 0.00925)*OSC L
NEF(kFU)	=(1.7399 +- 0.0810)	+ (-0.00253 +- 0.00139)*ELEV
NUF(kFU)	=(1.5323 +- 0.0511)	+ (0.07731 +- 0.00951)*OSC L
NUF(kFU)	=(1.9416 +- 0.1199)	+ (-0.00550 +- 0.00206)*ELEV

TAPE 9 data 2 NBS1D.41 REWORK <9848,0006> T4-F12,D1-F16 REWORK 15.01

NBS1A.01 LOADER <9913,0003, T2-F0,D1-F0, X.04<0002>T2-4,D1-4

-57-

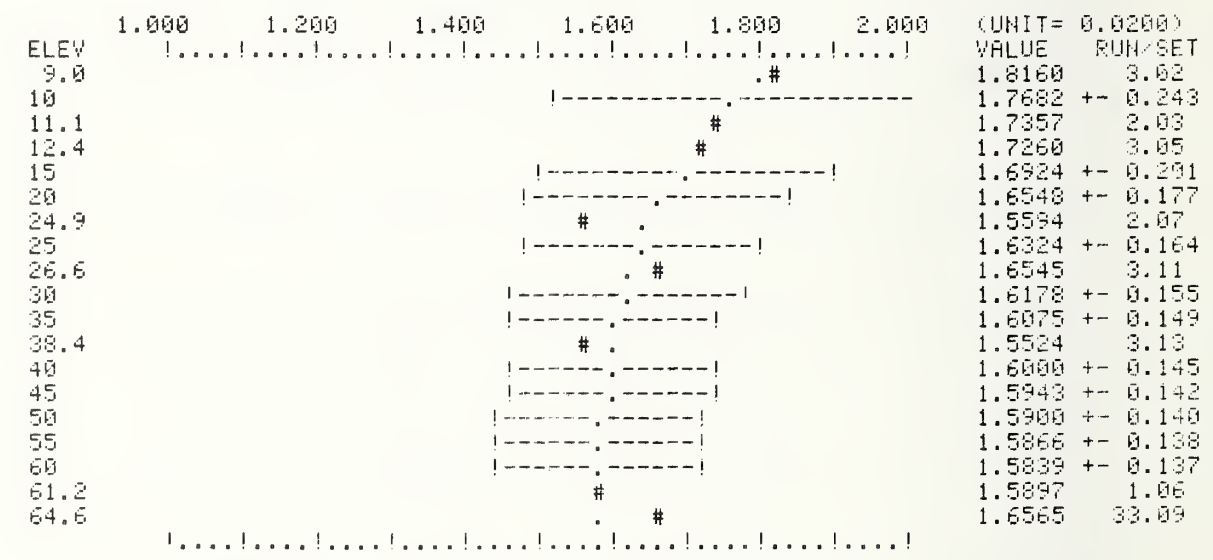
RUN 3

PROG 276.5407 PT. DETRICK ANT #1
THU: 1976 DEC 2 (1976.920)
7.319 GHz, 60.0 Ft DISH

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
53.0 F	30.9 F	43.0 %	4.5 gm/m↑3	74	0 mph

. = FIT # = CAS A @ = CYG A 0 = TAU A + = ORI A

FIT TO 8 DATA
NEF(kFU) =(1.5377 +- 0.0497) + (0.04003 +- 0.00925)*CSC L



```
TAPE 9    data 2    NBS1D.41  REWORK  <9848,0006> T4-F12,D1-F16     REWORK 15.01

NBS1A.01  LOADER  <9913,0003> T2-F0,D1-F0;   %.04<0002>T2-4,D1-4

                                   -58-
                                                                    RUN  3

                    PROG  276.5407      FT. DETRICK ANT #1
                    THU:  1976 DEC 2    ( 1976.920)
                    7.319 GHz, 60.0 Ft DISH

     TEMP         DEW PT.      REL HUMD       WATER DENS     CLOUD COVER     WIND
     53.0 F       30.9 F        43.0 %        4.5 gm/mt3         74          0 mph
=============================================================================
. = FIT        # = CAS A       @ = CYG A       0 = TAU A       + = ORI A


                                FIT TO   8    DATA
     NUF(kFU)      =(  1.5323 +- 0.0511) + (  0.07731 +- 0.00951)*CSC L

       1.000     1.400     1.800     2.200     2.600     3.000   (UNIT= 0.0400)
ELEV    !....!....!....!....!....!....!....!....!....!....!     VALUE    RUN/SET
 9.0                              #                              2.0507     3.02
10                          !------.------!                     1.9775 +- 0.272
11.1                             #                              1.9234     2.63
12.4                            #                               1.8925     3.05
15                          !----.----!                         1.8310 +- 0.218
20                        !----.----!                           1.7583 +- 0.188
24.9                      # .                                   1.6401     2.07
25                        !---.---!                             1.7152 +- 0.172
26.6                         #                                  1.7319     3.11
30                       !---.---!                              1.6869 +- 0.163
35                       !---.---!                              1.6671 +- 0.156
38.4                     #.                                     1.6061     3.13
40                     !---.---!                                1.6526 +- 0.151
45                     !---.---!                                1.6416 +- 0.147
50                     !---.---!                                1.6332 +- 0.145
55                     !---.---!                                1.6267 +- 0.143
60                     !---.---!                                1.6216 +- 0.141
61.2                      #                                     1.6282     1.06
64.6                    . #                                     1.6945    33.09
      !....!....!....!....!....!....!....!....!....!....!
```

```
TAPE 9    data 2    NBS1D.41  REWORK  (9848,0006) T4-F12,D1-F16      REWORK 15.01

NBS1A.01  LOADER  (9913,0003  T3-F0,D1-F0,   X.04(0002)T2-4,D1-4

                                   -59-
                                                                  . RUN  3

                    PROG  27e.5407      FT. DETRICK ANT #1
                    THU:  197e DEC 2    ( 1976.920)
                    7.319 GHz, 60.0 Ft DISH

     TEMP         DEW PT.      REL HUMD       WATER DENS     CLOUD COVER     WIND
     53.0 F       30.9 F        43.0 %        4.5 gm/mt3         74          0 mph
==========================================================================================
. = FIT         # = CAS A       @ = CYG A       0 = TAU A       + = ORI A


                                FIT TO   8    DATA
      G/T(dB)       =( 41.1930 +- 0.1258) + ( -0.14234 +- 0.02341)*CSC L

       40.000    40.400    40.800    41.200    41.600    42.000  (UNIT= 0.0400)
ELEV    !....!....!....!....!....!....!....!....!....!....!     VALUE   RUN/SET
 9.0          #.                                                40.2403     3.02
10       ---------.-------------!                                40.3733 +- 0.543
11.1              .#                                             40.4714     2.03
12.4                #                                            40.5162     3.05
15             !----------.----------!                           40.6430 +- 0.458
20                !----------.----------!                        40.7768 +- 0.418
24.9                          .    #                             41.0392     2.07
25                !----------.----------!                        40.8562 +- 0.395
26.6                         # .                                 40.7991     3.11
30                  !---------.---------!                        40.9083 +- 0.380
35                    !---------.---------!                      40.9448 +- 0.369
38.4                          .  #                               41.0961     3.13
40                    !---------.---------!                      40.9716 +- 0.362
45                     !---------.---------!                     40.9917 +- 0.356
50                     !---------.---------!                     41.0072 +- 0.352
55                     !---------.---------!                     41.0192 +- 0.343
60                      !---------.---------!                    41.0286 +- 0.346
61.2                            #.                               41.0199     1.06
64.6                         #    .                              40.8476    33.09
        !....!....!....!....!....!....!....!....!....!....!
```

```
TAPE 9    data 2    NBS1D.41  REWORK  (9848,0006)  T4-F12,D1-F15      REWORK 15.01

NBS1A.01  LOADER  (9913,0003)  T2-F0,D1-F0,   X.04(0002)T2-4,D1-4

                                    -60-
                                                                       RUN  3

                    PROG  276.5407      FT. DETRICK ANT #1
                    THU:  1976 DEC 2    ( 1976.920)
                    7.319 GHz, 60.0 Ft DISH

     TEMP         DEW PT.      REL HUMD       WATER DENS     CLOUD COVER     WIND
     53.0 F       30.9 F        43.0 %        4.5 gm/m^3         74          0 mph
==========================================================================================
. = FIT         # = CAS A       @ = CYG A       0 = TAU A       + = ORI A


                                  FIT TO   8    DATA
      G/TA(dB)      =( 32.3407 +- 0.1315) + (  0.03342 +- 0.02446)*CSC L

       31.000    31.400    31.800    32.200    32.600    33.000  (UNIT= 0.0400)
ELEV     !....!....!....!....!....!....!....!....!....!....!     VALUE    RUN/SET
 9.0                                          #.                32.5243     3.02
10                                 !-------------.-------------   32.5332 +- 0.545
11.1                                          # .                32.4220     2.03
12.4                                           .  #              32.5898     3.05
15                                  !-----------.-----------!     32.4690 +- 0.461
20                                  !----------.----------!       32.4384 +- 0.420
24.9                                           . #              32.5345     2.07
25                                  !---------.---------!         32.4198 +- 0.397
26.6                                          #                 32.3977     3.11
30                                  !---------.---------!         32.4075 +- 0.382
35                                   !--------.--------!          32.3990 +- 0.372
38.4                                          .   #             32.5480     3.13
40                                   !--------.--------!          32.3927 +- 0.364
45                                   !--------.--------!          32.3880 +- 0.359
50                                   !--------.--------!          32.3843 +- 0.354
55                                   !--------.--------!          32.3815 +- 0.351
60                                  !--------.--------!           32.3793 +- 0.348
61.2                                         #                   32.3776     1.06
64.6                                     #    .                  32.1573    33.09
       !....!....!....!....!....!....!....!....!....!....!
```

```
TAPE 9    data 2    NBS1B.41  REWORK   9848,0006) T4-F12,D1-F16      REWORK 15.01

NBS1A.01  LOADER  (9913,0003) T2-F0,D1-F0,   %.04(0002)T2-4,D1-4

                                    -61-
                                                                    RUN  3

                    PROG  276.5497      PT. DETRICK ANT #1
                    THU:  1976 DEC 2    ( 1976.920)
                    7.319 GHz, 60.0 Ft DISH

     TEMP         DEW PT.      REL HUMD       WATER DENS     CLOUD COVER     WIND
     53.0 F       30.9 F        43.0 %        4.5 gm/mt3         74          0 mph
=============================================================================
. = FIT         # = CAS A       @ = CYG A       0 = TAU A       + = ORI A


                                FIT TO   8    DATA
      HPBW#1(deg)  =(  0.1428 +- 0.0027) + ( -0.00001 +- 0.00049)*CSC L

       0.130      0.134      0.138      0.142      0.146      0.150    (UNIT= 0.0004)
ELEV     !....!....!....!....!....!....!....!....!....!....!     VALUE    RUN/SET
 9.0                                      #                      0.1427     3.02
10                                  !------.------!               0.1427 +- 0.002
11.1                                       .    #                 0.1446     2.03
12.4                                 #     .                      0.1390     3.05
15                                  !------.------!               0.1427 +- 0.002
20                                  !------.------!               0.1427 +- 0.002
24.9                                       .   #                  0.1444     2.07
25                                  !------.------!               0.1427 +- 0.002
26.6                                       .        #             0.1462     3.11
30                                  !------.------!               0.1427 +- 0.002
35                                  !------.------!               0.1427 +- 0.002
38.4                                     #.                       0.1423     3.13
40                                  !------.------!               0.1427 +- 0.002
45                                  !------.------!               0.1427 +- 0.002
50                                  !------.------!               0.1427 +- 0.002
55                                  !------.------!               0.1427 +- 0.002
60                                  !------.------!               0.1427 +- 0.002
61.2                                 #     .                      0.1396     1.06
64.6                                       .#                     0.1431    33.09
        !....!....!....!....!....!....!....!....!....!....!
```

TAPE 9 data 2 NBS1D.41 REWORK (9848,0006) T4-F12,D1-F16 REWORK 15.01

NBS1A.01 LOADER (9913,0003) T2-F6,D1-F8, %.04(0002)T2-4,D1-4

-62-

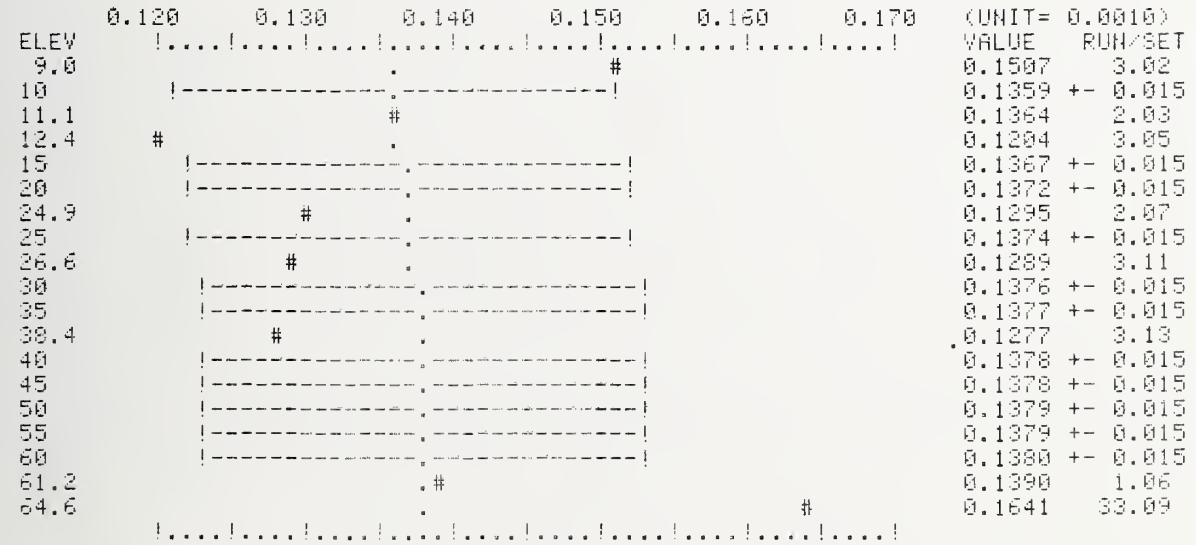
RUN 3

PROG 276.5407 FT. DETRICK ANT #1
THU: 1976 DEC 2 (1976.920)
7.319 GHz, 60.0 Ft DISH

TEMP	DEW PT.	REL HUMD	WATER DENS	CLOUD COVER	WIND
53.0 F	30.9 F	43.0 %	4.5 gm/mt3	74	0 mph

. = FIT # = CAS A @ = CYG A 0 = TAU A + = ORI A

FIT TO 8 DATA
HPBW#2(deg) =(0.1385 +- 0.0153) + (-0.00045 +- 0.00284)*CSC L



```
TAPE 9    data 2    NBS1B.41  REwork  (.848,0006) T4-F12,D1-F16      REWORK 15.01

NBS1A.01  LOADER   9913,0003  T2-F0,D1-F0,   (.04,0002)T2-4,D1-4

                                   -63-
                                                                      RUN  3

                    PROG  276.5437      FT. DETPICK ANT #1
                    THU:  1976 DEC 2    ( 1976.920)
                    7.319 GHz, 60.0 Ft DISH

     TEMP          DEW PT.       REL HUMD       WATER DENS     CLOUD COVER     WIND
     53.0 F        30.9 F         43.0 %         4.5 gm/mt3         74          0 mph
=============================================================================================
. = FIT         # = CAS A       @ = CYG A       0 = TAU A       + = ORI A


                                FIT TO   8    DATA
      Y-factor      =(  1.3394 +- 0.0006) + ( -0.01546 +- 0.00161)*CSC(L

       1.200     1.240     1.280     1.320     1.360     1.400    (UNIT= 0.0040)
 ELEV     !....!....!....!....!....!....!....!....!....!....!     VALUE    RUN/SET
  9.0               #                                            1.2394     3.02
 10                  !-.-!                                       1.2504 +- 0.008
 11.1                    #                                       1.2593     2.03
 12.4                     #.                                     1.2653     3.05
 15                         !-.-!                                1.2796 +- 0.008
 20                             !-.-!                            1.2942 +- 0.008
 24.9                             .  #                           1.3148     2.07
 25                             !-.-!                            1.3028 +- 0.008
 26.6                            #.                              1.2988     3.11
 30                              !-.-!                           1.3085 +- 0.008
 35                               !-.-!                          1.3124 +- 0.008
 38.4                                . #                        1.3243     3.13
 40                               !-.-!                          1.3153 +- 0.008
 45                               !-.-!                          1.3175 +- 0.008
 50                                !-.-!                         1.3192 +- 0.008
 55                                !-.-!                         1.3205 +- 0.008
 60                                !-.-!                         1.3215 +- 0.008
 61.2                               #                            1.3218     1.06
 64.6                             #   .                          1.3095    33.09
          !....!....!....!....!....!....!....!....!....!....!
```

```
TAPE 9    data 2    NBS1D.41  REWORK  .9848,0006. T4-F12,D1-F16     REWORK 15.01

NBS1A.01  LOADER  (9913,0003) T2-F0,D1-F0,   X.04(0002)T2-4,D1-4

                                  -64-
                                                                      RUN  3

                    PROG  276.5407     FT. DETRICK ANT #1
                    THU:  1976 DEC 2   ( 1976.920)
                    7.319 GHz, 60.0 Ft DISH

    TEMP         DEW PT.      REL HUMD       WATER DENS     CLOUD COVER     WIND
    53.0 F       30.9 F        43.0 %         4.5 gm/m3          74          0 mph
=============================================================================

                                FIT TO   8    DATA
     NEF(kFU)     =(  1.5377 +- 0.0497) + (  0.04003 +- 0.00925)*CSC L

                      + = LINEAR CONTRIBUTION


 10.0deg:              NEF(kFU) =  1.768 +- 0.56 dB    (  13.7 %)     7.319 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
 5.96%  0.00  0.51  2.66  1.39  0.00  0.06  3.52  0.35  2.57  5.65  0.14  0.62%

##############################################################################
 G(dB)  G-diff  T(K)   Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
 61.15   0.11  119.6   727.1  1.2506   1.81 %  0.147 dB  13.10% 13.11 K   174.0

 2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9248=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0269=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1    K2    K3    K6    K8    K9    K    APR-eff  R-eff  S(FU)    Xi(K)
 0.951 0.904 1.000 1.000 0.922 0.992 0.795  0.6461   0.98   598.4  2.300E-05

 SITE ELEV    oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km   0.03443 dB  0.0027 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################


 20.0deg:              NEF(kFU) =  1.655 +- 0.45 dB    (  10.9 %)     7.319 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
 6.29%  0.00  0.48  1.41  1.47  0.00  0.06  3.72  0.37  2.67  2.99  0.04  0.65%
CALCULATED VIA G/Ta FIT and Ta
##############################################################################
 G(dB)  G-diff  T(K)   Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
 61.05   0.01  108.6   727.1  1.2936   1.81 %  0.147 dB  13.10%  6.74 K   170.2
                 c.f. G calculated from HPBW is 61.06 dB
 2.30=A2  0.20=C9  0.1=D1  0.14347=N(21,1)  460=T(1, 9)  0.9611=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0850=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1    K2    K3    K6    K8    K9    K    APR-eff  R-eff  S(FU)    Xi(K)
 0.975 0.904 1.000 1.000 0.965 0.990 0.848  0.6459   0.98   598.4  2.455E-05

 SITE ELEV    oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km   0.03443 dB  0.0027 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################
```

```
30.0deg:                NEF(kFU) =  1.618 +- 0.40 dB    (   9.7 %)      7.319 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
6.10% 0.00  0.45  0.93  1.42  0.00  0.06  3.61  0.36  2.58  1.97  0.02  0.63%

##############################################################################
G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
61.02  -0.02  102.7   727.1  1.3089   1.81 %  0.147 dB  13.10%  4.63 K   169.0

2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9732=J1
0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0521=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

   K1    K2    K3    K6    K8    K9    K    APR-eff  R-eff  S(FU)    Xi(K)
0.983 0.904 1.000 1.000 0.976 0.999 0.866  0.6458   0.98   598.4  2.506E-05

SITE ELEV    oxy attn     water attn   zenith attn   REFR #1  REFR #2  ant-DIAM
 0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB    1.031    0.0130    60.0 ft
##############################################################################


40.0deg:                NEF(kFU) =  1.600 +- 0.38 dB    (   9.1 %)      7.319 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
6.04% 0.00  0.43  0.72  1.41  0.00  0.06  3.57  0.36  2.55  1.51  0.01  0.62%

##############################################################################
G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
61.01  -0.03  100.9   727.1  1.3165   1.81 %  0.147 dB  13.10%  3.61 K   168.4

2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9791=J1
0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0411=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

   K1    K2    K3    K6    K8    K9    K    APR-eff  R-eff  S(FU)    Xi(K)
0.986 0.904 1.000 1.000 0.981 0.999 0.875  0.6458   0.98   598.4  2.531E-05

SITE ELEV    oxy attn     water attn   zenith attn   REFR #1  REFR #2  ant-DIAM
 0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB    1.031    0.0130    60.0 ft
##############################################################################


50.0deg:                NEF(kFU) =  1.590 +- 0.37 dB    (   8.9 %)      7.319 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
6.01% 0.00  0.43  0.60  1.40  0.00  0.06  3.55  0.36  2.53  1.26  0.01  0.62%

##############################################################################
G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
61.00  -0.04   99.8   727.1  1.3209   1.81 %  0.147 dB  13.10%  3.03 K   168.1

2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9824=J1
0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0358=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

   K1    K2    K3    K6    K8    K9    K    APR-eff  R-eff  S(FU)    Xi(K)
0.989 0.904 1.000 1.000 0.984 1.000 0.879  0.6458   0.98   598.4  2.545E-05

SITE ELEV    oxy attn     water attn   zenith attn   REFR #1  REFR #2  ant-DIAM
 0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB    1.031    0.0130    60.0 ft
##############################################################################
```

```
TAPE 9    data 2    NBS1D.41  REWORK  (9848,0006) T4-F12,D1-F16     REWORK 15.01

NBS1A.01  LOADER  (9913,0003) T2-F0,D1-F0,   X.04(0002)T2-4,D1-4

                                   -65-
                                                                      RUN  3

                    PROG  276.5407     FT. DETRICK ANT #1
                    THU:  1976 DEC 2   ( 1976.920)
                    7.319 GHz, 60.0 Ft DISH

    TEMP         DEW PT.      REL HUMD       WATER DENS     CLOUD COVER     WIND
    53.0 F       30.9 F         43.0 %        4.5 gm/mt3         74          0 mph
=============================================================================

                              FIT TO   8    DATA
     NUF(kFU)     =(  1.5323 +- 0.0511) + (  0.07731 +- 0.00951)*CSC L

                      + = LINEAR CONTRIBUTION


 10.0deg:              NUF(kFU) =  1.578 +- 0.56 dB     (  13.7 %)      7.319 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
 5.94%  0.00  0.51  2.66  1.39  0.00  0.06  3.63  0.35  2.57  5.64  0.14  0.61%

#############################################################################
 G(dB)  G-diff  T(K)    Ta(K)   Y-fac   HPBWerr  data fit  c(1-K2) bright  effAREA
 61.15   0.11  119.6   727.1  1.2506   1.81 %  0.151 dB  13.10% 13.11 K   174.0

 2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9248=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0245=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1    K2    K3    K6    K8    K9    K    APR-eff  R-eff  S(FU)    Xi(K)
 0.951 0.904 1.000 1.000 0.932 0.992 0.795  0.6461   0.98   598.4  2.300E-05

 SITE ELEV    oxy attn     water attn   zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB    1.031    0.0130    60.0 ft
#############################################################################


 20.0deg:              NUF(kFU) =  1.758 +- 0.45 dB     (  10.9 %)      7.319 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
 6.26%  0.00  0.48  1.40  1.46  0.00  0.06  3.82  0.37  2.66  2.97  0.04  0.65%

#############################################################################
 G(dB)  G-diff  T(K)    Ta(K)   Y-fac   HPBWerr  data fit  c(1-K2) bright  effAREA
 61.05   0.01  106.6   727.1  1.2936   1.81 %  0.151 dB  13.10%  6.74 K   170.2

 2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9611=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0796=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1    K2    K3    K6    K8    K9    K    APR-eff  R-eff  S(FU)    Xi(K)
 0.975 0.904 1.000 1.000 0.965 0.993 0.848  0.6459   0.98   598.4  2.455E-05

 SITE ELEV    oxy attn     water attn   zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB    1.031    0.0130    60.0 ft
#############################################################################
```

```
30.0deg:              NUF(kFU) =  1.687 +- 0.40 dB    (   9.7 %)      7.319 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
 6.09%  0.00  0.44  0.93  1.42  0.00  0.06  3.72  0.36  2.57  1.97  0.02  0.68%

##############################################################################
 G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
 61.02  -0.02  102.7   727.1  1.3089   1.81 %  0.151 dB  13.10%  4.63 K    169.0

 2.30=A2  0.20=C9  0.1=D1  0.14345=W(21,1)  460=T(1, 9)  0.9732=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=W(21,3)   15=T(1,11)  1.0498=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1     K2     K3     K6     K8     K9     K     APR-eff  R-eff  S(FU)    X1(K)
 0.983 0.904 1.000 1.000 0.976 0.999 0.866  0.6458   0.98   598.4  2.506E-05

 SITE ELEV     oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km    0.03443 dB  0.0037 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################


40.0deg:              NUF(kFU) =  1.653 +- 0.38 dB    (   9.2 %)      7.319 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
 6.03%  0.00  0.43  0.72  1.41  0.00  0.06  3.68  0.36  2.54  1.51  0.01  0.62%

##############################################################################
 G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
 61.01  -0.03  100.9   727.1  1.3165   1.81 %  0.151 dB  13.10%  3.61 K    168.4

 2.30=A2  0.20=C9  0.1=D1  0.14345=W(21,1)  460=T(1, 9)  0.9791=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=W(21,3)   15=T(1,11)  1.0399=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1     K2     K3     K6     K8     K9     K     APR-eff  R-eff  S(FU)    X1(K)
 0.986 0.904 1.000 1.000 0.981 0.999 0.875  0.6458   0.98   598.4  2.531E-05

 SITE ELEV     oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km    0.03443 dB  0.0037 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################


50.0deg:              NUF(kFU) =  1.633 +- 0.37 dB    (   8.9 %)      7.319 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
 6.00%  0.00  0.43  0.68  1.40  0.00  0.06  3.67  0.36  2.53  1.26  0.01  0.62%

##############################################################################
 G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
 61.00  -0.04   99.8   727.1  1.3209   1.81 %  0.151 dB  13.10%  3.03 K    168.1

 2.30=A2  0.20=C9  0.1=D1  0.14345=W(21,1)  460=T(1, 9)  0.9824=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=W(21,3)   15=T(1,11)  1.0348=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1     K2     K3     K6     K8     K9     K     APR-eff  R-eff  S(FU)    X1(K)
 0.989 0.904 1.000 1.000 0.984 1.000 0.879  0.6458   0.98   598.4  2.545E-05

 SITE ELEV     oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km    0.03443 dB  0.0037 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################
```

```
TAPE 9    data 2    NBS1D.41  REWORK   9848.0006  T4-F12.D1-F16      REWORK 15.01
NBS1A.01  LOADER   9913.0003  T2-F0.D1-F0.   K.04 0002.T2-4.D1-4

                              -66-
                                                                  RUN  3

                PROG  276.5407      FT. DETRICK ANT #1
                THU:  1976 DEC  2   ( 1976.920)
                7.319 GHz  60.0 Ft DISH

   TEMP          DEW PT.       REL HUMD       WATER DENS     CLOUD COVER     WIND
   53.0 F        30.3 F         43.0 %         4.5 gm/mt3         74          0 mph
==========================================================================================

                              FIT TO   8    DATA
      G/T(dB)      =( 41.1930 +- 0.1258) + ( -0.14234 +- 0.02341)*CSC L

                  + = LINEAR CONTRIBUTION


 10.0deg:              G/T(dB)  = 40.373 +- 0.54 dB    (  13.3 %)      7.319 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
 5.80%  0.00  0.50  2.59  1.35  0.00  0.06  3.12  0.35  2.51  5.51  0.14  0.60%

##########################################################################################
 G(dB)  G-diff  T(K)   Ta(K)   Y-fac   HPBWerr  data fit   c(1-K2) bright   eff*AREA
 61.15   0.11  119.6   727.1  1.2506   1.81 %  0.133 dB  13.10% 13.11 K    174.0

 2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9248=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0000=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1     K2     K3     K6     K8     K9     K     APR-eff  R-eff   S(FU)     Xi(K)
 0.951  0.904  1.000  1.000  0.932  0.992  0.795   0.6461   0.98    598.4   2.300E-05

 SITE ELEV     oxy attn      water attn    zenith attn   REFR #1   REFR #2   ant-DIAM
  0.107 km    0.03443 dB  0.0037 dB/dens   0.0381 dB     1.031     0.0130     60.0 ft
##########################################################################################


 20.0deg:              G/T(dB)  = 40.3[illegible]  +- 0.42 dB    (  10.1 %)      7.319 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
 5.80%  0.00  0.44  1.30  1.35  0.00  0.06  3.12  0.35  2.46  2.75  0.04  0.60%

##########################################################################################
 G(dB)  G-diff  T(K)   Ta(K)   Y-fac   HPBWerr  data fit   c(1-K2) bright   eff*AREA
 61.05   0.01  108.6   727.1  1.2936   1.81 %  0.132 dB  13.10%  6.74 K    170.2

 2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  3.9611=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0000=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1     K2     K3     K6     K8     K9     K     APR-eff  R-eff   S(FU)     Xi(K)
 0.975  0.904  1.000  1.000  0.965  0.998  0.848   0.6459   0.98    598.4   2.455E-05

 SITE ELEV     oxy attn      water attn    zenith attn   REFR #1   REFR #2   ant-DIAM
  0.107 km    0.03443 dB  0.0[illegible]  0.0[illegible] dB  1.031     0.0130     60.0 ft
##########################################################################################
```

HPBW #1 INTERCEPT

DISH size (arc min) * 100

LIN POLZ (%) * 10

e-K8 for point source

e-K9 enhancement (for NEF & NUE)

```
30.0deg:                G/T(dB)  = 40.900 +- 0.38 dB     (   9.1 %)      7.319 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
5.80%  0.00  0.42  0.89  1.35  0.00  0.06  3.12  0.35  2.45  1.87  0.02  0.60%

##############################################################################
G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
61.02  -0.02  102.7   727.1  1.3089   1.81 %  0.133 dB  13.10%  4.63 K   169.0

2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9732=J1
0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0000=C2

    *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

   K1    K2    K3    K6    K8    K9    K     APR-eff  R-eff  S(FU)    Xi(K)
0.983 0.904 1.000 1.000 0.976 0.995 0.866  0.6458   0.98   598.4  2.506E-05

SITE ELEV     oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
 0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################


40.0deg:                G/T(dB)  = 40.972 +- 0.36 dB     (   8.7 %)      7.319 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
5.80%  0.00  0.42  0.89  1.35  0.00  0.06  3.12  0.35  2.45  1.45  0.01  0.60%

##############################################################################
G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
61.01  -0.03  100.9   727.1  1.3165   1.81 %  0.133 dB  13.10%  3.61 K   168.4

2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9791=J1
0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0000=C2

    *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

   K1    K2    K3    K6    K8    K9    K     APR-eff  R-eff  S(FU)    Xi(K)
0.986 0.904 1.000 1.000 0.981 0.999 0.875  0.6458   0.98   598.4  2.531E-05

SITE ELEV     oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
 0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################


50.0deg:                G/T(dB)  = 41.007 +- 0.35 dB     (   8.4 %)      7.319 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
5.80%  0.00  0.41  0.58  1.35  0.00  0.06  3.12  0.35  2.44  1.22  0.01  0.60%

##############################################################################
G(dB)  G-diff  T(K)    Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
61.00  -0.04   99.8   727.1  1.3289   1.81 %  0.133 dB  13.10%  3.03 K   168.1

2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9824=J1
0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0000=C2

    *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

   K1    K2    K3    K6    K8    K9    K     APR-eff  R-eff  S(FU)    Xi(K)
0.983 0.904 1.000 1.000 0.984 1.000 0.879  0.6458   0.98   598.4  2.545E-05

SITE ELEV     oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
 0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################
```

```
TAPE 9    data 2    NBS1D.41  REWORK  9848,0006  T4-F12,D1-F16      REWORK 15.01

NBS1A.01  LOADER   9913,0003  T2-F0,D1-F0,   X.04 0002 T2-4,D1-4

                                -67-
                                                                      RUN  3

                    PROG  276.5407      FT. DETRICK ANT #1
                    THU:  1976 DEC 2    ( 1976.920)
                    7.319 GHz, 60.0 Ft DISH

    TEMP         DEW PT.      REL HUMD       WATER DENS     CLOUD COVER     WIND
    53.0 F       30.9 F         43.0 %         4.5 gm/m^3         74          0 mph
=============================================================================

                              FIT TO   8    DATA
     G/TA(dB)     =( 32.3407 +- 0.1315) + (  0.03342 +- 0.02446)*CSC L

                        + = LINEAR CONTRIBUTION


 10.0deg:              G/TA(dB) = 32.533 +- 0.55 dB    (  13.4 %)     7.319 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
 5.80%  0.00  0.50  2.59  1.35  0.00  0.06  3.26  0.35  2.51  5.51  0.14  0.60%

##############################################################################
 G(dB)  G-diff  T(K)   Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
 61.15   0.11  119.6   727.1  1.2506   1.81 %  0.139 dB  13.10% 13.11 K   174.0

 2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9248=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0000=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1     K2     K3     K6     K8     K9     K     APR-eff  R-eff  S(FU)    Xi(K)
  0.951 0.904 1.000 1.000 0.332 0.992 0.795  0.6461   0.98   598.4  2.300E-05

 SITE ELEV     oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################



 20.0deg:              G/TA(dB) = 32.438 +- 0.42 dB    (  10.2 %)     7.319 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
 5.80%  0.00  0.44  1.30  1.35  0.00  0.06  3.26  0.35  2.46  2.75  0.04  0.60%

##############################################################################
 G(dB)  G-diff  T(K)   Ta(K)   Y-fac  HPBWerr  data fit  c(1-K2) bright  effAREA
 61.05   0.01  106.6   727.1  1.2936   1.81 %  0.139 dB  13.10%  6.74 K   170.2

 2.30=A2  0.20=C9  0.1=D1  0.14345=N(21,1)  460=T(1, 9)  0.9611=J1
 0.75=D8  0.18=D9  0.1=C8  0.00260=N(21,3)   15=T(1,11)  1.0000=C2

     *HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427  (ant HPBW = 0.1419)

    K1     K2     K3     K6     K8     K9     K     APR-eff  R-eff  S(FU)    Xi(K)
  0.975 0.904 1.000 1.000 0.955 0.998 0.848  0.6459   0.98   598.4  2.455E-05

 SITE ELEV     oxy attn      water attn    zenith attn   REFR #1  REFR #2  ant-DIAM
  0.107 km   0.03443 dB  0.0037 dB/dens  0.0381 dB     1.031    0.0130    60.0 ft
##############################################################################
```

30.0deg: G/TA(dB) = [illegible] +- 0.38 dB (9.2 %) 7.319 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
5.80%	0.00	0.42	0.89	1.35	0.00	0.06	3.26	0.35	2.45	1.87	0.02	0.60%

G(dB)	G-diff	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
61.02	-0.02	102.7	727.1	1.3669	1.81 %	0.139 dB	13.10%	4.63 K	169.0

2.30=A2 0.20=C9 0.1=D1 0.14345=N(21,1) 460=T(1, 9) 0.9782=J1
0.75=D8 0.18=D9 0.1=C8 0.00260=N(21,3) 15=T(1,11) 1.0000=C2

*HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427 (ant HPBW = 0.1419)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.983	0.904	1.000	1.000	0.976	0.999	0.866	0.6458	0.98	598.4	2.506E-05

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.107 km	0.03443 dB	0.0037 dB/dens	0.0381 dB	1.031	0.0130	60.0 ft

40.0deg: G/TA(dB) = 32.393 +- 0.36 dB (8.8 %) 7.319 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
5.80%	0.00	0.42	0.89	1.35	0.00	0.06	3.26	0.35	2.45	1.45	0.01	0.60%

G(dB)	G-diff	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
61.01	-0.03	100.9	727.1	1.3165	1.81 %	0.139 dB	13.10%	3.61 K	168.4

2.30=A2 0.20=C9 0.1=D1 0.14345=N(21,1) 460=T(1, 9) 0.9791=J1
0.75=D8 0.18=D9 0.1=C8 0.00260=N(21,3) 15=T(1,11) 1.0000=C2

*HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427 (ant HPBW = 0.1419)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.986	0.904	1.000	1.000	0.981	0.999	0.875	0.6458	0.98	598.4	2.531E-05

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.107 km	0.03443 dB	0.0037 dB/dens	0.0381 dB	1.031	0.0130	60.0 ft

50.0deg: G/TA(dB) = 32.384 +- 0.35 dB (8.5 %) 7.319 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
5.80%	0.00	0.41	0.58	1.35	0.00	0.06	3.26	0.35	2.44	1.22	0.01	0.60%

G(dB)	G-diff	T(K)	Ta(K)	Y-fac	HPBWerr	data fit	c(1-K2)	bright	effAREA
61.00	-0.04	99.8	727.1	1.3209	1.81 %	0.139 dB	13.10%	3.03 K	168.1

2.30=A2 0.20=C9 0.1=D1 0.14345=N(21,1) 460=T(1, 9) 0.9824=J1
0.75=D8 0.18=D9 0.1=C8 0.00260=N(21,3) 15=T(1,11) 1.0000=C2

*HPBW #1 = 0.14276 +-0.000006 CSC L = 0.1427 (ant HPBW = 0.1419)

K1	K2	K3	K6	K8	K9	K	APR-eff	R-eff	S(FU)	Xi(K)
0.989	0.904	1.000	1.000	0.984	1.000	0.879	0.6458	0.98	598.4	2.545E-05

SITE ELEV	oxy attn	water attn	zenith attn	REFR #1	REFR #2	ant-DIAM
0.107 km	0.03443 dB	0.0037 dB/dens	0.0381 dB	1.031	0.0130	60.0 ft

6.5.9 Documentation of Final Results

The last step in the measurement procedure is to enter the results from the last data rework into the SITE PREP program, which lists all the program assumptions and measurement errors in a more explicit form. To better understand this procedure, an annotated printout of the important entrees is given in the following paragraph. For this illustration, the final rework is assumed to be the one used in the annotated printout for the third level rework in the immediately preceding section. The information used from this rework is encircled on the G/T error table printout, and corresponding use of this information is encircled in the data entry portion on the following annotation. The SITE PREP error table printout contains the same information as the REWORK error table printout. To facilitate the comparison, some of the information on the following SITE PREP printout has the corresponding REWORK table printed next to it.

```
CHANGE RUN DATE/SITE:1=YES(  NO): 0     ?1
RUN NUMBER?( =NC): 3
YEAR?( =NC)NOW: 1976?
MONTH?( =NC)NOW: DEC?
DAY OF MONTH?( =NC)NOW: 2 ?
DAY OF WEEK?( =NC)NOW: THU?
PROJ #?( =NC)NOW: 276,540??
LOCATION?( =NC)NOW: FT  BF[illegible] ANT 4?
SITE:W. LONG?( =NC): 1[illegible]
SITE:N.LAT?( =NC): 37[illegible]
SITE:ALT(KM)?( =NC): [illegible]

NEW F BW/ELEV/ANT CONT?(1=YES  NO): 0     ?1
CENTER FREQ(GHZ)?( =NC) [illegible]
EPR IN FREQ(*)?( =NC): 0.01
BANDWIDTH?(MHZ)?( =NC): [illegible]
ELEV(DEG)?( =NC) [illegible]
ANT DIAM (FT)?( =NC): 60    ?

1=APR EFF,2=ANT HPBW,3=CNVL HPBW? (1-3): 0     ?2
ANT HPBW(DEG)?( =NC): [illegible]
HPBW ERR(1S,*)?( =NC): [illegible]
ANT PT ERR:1=DEG,2=%HPBW?(1-2 =NC): 0     ?1
DEG?( =NC): 0.015    ?

ANT PT ERR corresponds to G/T data fit (3*1S/SQR(#PTS) of 0.120787507
dB

 0.120787507    DB:0=TRY AGAIN?  =NC): 1     ?0
DEG?( =NC): 0.015    ?.016

ANT PT ERR corresponds to G/T data fit (3*1S/SQR(#PTS) of 0.136957186
dB

 0.136957186    DB:0=TRY AGAIN?  =NC): 1     ?0
DEG?( =NC): 0.016    ?.0158

ANT PT ERR corresponds to G/T data fit (3*1S/SQR(#PTS) of 0.133648859
dB

 0.133648859    DB:0=TRY AGAIN?  =NC): 1     ?0
DEG?( =NC): 0.0158   ?.01575

ANT PT ERR corresponds [illegible]
dB

 0.132991632    DB:0=TRY AGAIN?  =NC): 1     ?
CHANGE:1=T(K); 2=G/T DB    =NC): 0     ?
G/T(DB)=?( =NC): [illegible]
CHANGE:1=G/TA, 2=TA(K)  =NC): 1     ?
ADDED NOISE (K)?( =NC): [illegible]
AMBIENT TEMP(F)?( =NC): [illegible]
DEW PT TEMP(F)?( =NC): [illegible]
ENTER SUN/MOON ALMINAC DATA? (1=YES  =NC) : 0     ?0
PRT SITE/STAR DATA(0=NO)?  =NC): 1     ?0
```

N8818.07 SITE PREP DI F[illegible] ..00 D:-4 TC-4

-4-

Sten # 8.07

PRNG [illegible] P[illegible] DETECTOR AMP #1
THRM [illegible] 1976.883
7.31 [illegible] SYS[illegible] IIBW G =
32.43 dB

TYPICAL [illegible] MEASUREMENT Site IAS A

differs from REWORK value because of G value

G: 61.04 dB — G(dB) − G-Diff

T: 106.3 K — T(K)

APR-EFF — APR-eff

R-EFF — R-eff

[illegible] dB

SDev_MFS: 3.1428 deg — effAREA

Antenna Elev = 20.0 deg

	PARAMETER			ERR TO [illegible]
F	FREQUENCY (GHz)		7.319 +- 0.01 %	+- 0.00 % E-F
S	FLUX (F.U.=10^(-26)W [illegible]	S(FU)	30.4 +- 5.00 %	+- 5.00 % E-S
	Tsamp) = 21.2 K			
	Xi = 2.458E-05	Xi(K)		
Y	Y-FACTOR	Y-fac	1.114 +- 0.10 % C8	+- 3.44 % E-Y
	Y(dB) = 1.119 dB			
K1	ATM ABSORPTION FACTOR	K1	1.375 +- 1.00 %	+- 1.30 % E-K1
	oxygen attn= 0.0244 dB	oxy attn		
	water attn = 0.0367 dB	water attn		
	water dens= 4.5 gm/M3			
	atm orient= [illegible]	bright		
	site alt = 0.2			
	amb temp = 22.4			
	dew point = 20.9 F	D8		
K8	DIFFUSE [illegible]	K8	0.985 +- 3.75 %	+- 2.72 % E-K8
K9	REFRACT [illegible]	K9	0.998 +- 0.04 %	+- 0.04 % E-K9
	1st comet: 1.0000	REFR #1		
	2nd comet: 0.0130	REFR #2		
K2	STAR SIZE [illegible]	K2	0.965 +- 1.34 %	+- 1.34 % E-K2
	+-(13.1 [illegible]	D1		
	HPBW +- 1.1'	HPBWerr		
K3	BEAM EFFICIENCY [illegible]	K3	1.000 +- 0.00 %	+- 0.00 % E-K3
	bandwidth = 5.5 MHz			
K4	DIFF SYSTEM TEMP		1.000 +- 0.06 %	+- 0.06 % E-K4
K5	ANT POINT(+- 0.01°) [illegible]		1.000 +- 3.11 %	+- 3.11 % E-K5
	or C.T data +it= +- [illegible]	data fit		
K6	ANT POLARIZATION FAC [illegible]	K6	1.000 +- 0.35 %	+- 0.35 % E-K6
K7	SYSTEM RESPONCE FAC [illegible]		1.000 +- 2.46 %	+- 2.46 % E-K7
	inst amp resp (+- 0.20%)	C9		
	Y/(Y-1)= 4.402			
	gauss curve fit(+- 2.500%	A2		
Ta	ADDED NOISE (K)	Ta(K)	[illegible] 1 +- 3.60 %	+- 0.00 % E-TA
	TOTAL ERROR: quad sum + datfac + refr err			+- [illegible]

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 that 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 functions, flags, and multiplex functions (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.

As a courtesy, the program and file tapes to generate these lists have been included in the software library of the ETMS. To use the program, tape 6 is inserted into the cassette unit, LOAD 10, then RUN. Then the appropriate tape needs to be inserted into the cassette unit (tape 6 for the variables list, tape 7 for the matrix list, or tape 8 for the function, key, flag list). The computer generated messages will guide one through the required steps. To print out a program constants listing, at the TRAP select 5 = LIST. For the question PRT: X,A,B,C,D (Ø = NO, 1 = YES, 9 = ALL), 5 keyboard entries are required before the sort and list are initiated.

7.1 VARIABLES LIST ALPHABETICAL BY VARIABLE

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

1	A	AZIUMTH(deg) OR DUMMY
2	A$,B$	DUMMY
3	A(N7)	SET DATA: SEE MATRIX LIST
4	A0	REWORK #
5	A1	FILTER #
6	A2	GAUSS CURVE FIT ERROR,% dT
7	A3	ATTENUATION OF STD ATTN (abS>1 , NOT dB),RELATED TO 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-NO KANDA CORRECTION
11	B(I,J)	DUMMY MATRIX
12	B0	HPBW(minutes) with Kanda correction
13	B1	DECL OFFSET (deg)
14	B1	CODE FOR SATELLITE CARRIER MEAS:0=SKY,1=-F,2=RCR @ F,3=+F,4=OTHER
15	B2,B3	ANTENNA APERTURE EFFICENCY, ANT RADIATION EFFICIENCY
16	B4	ATMOSPHERIC BRIGHTNESS TEMPERATURE, K
17	B5	TEMPERATURE(F)
18	B5	T/TA ZENITH
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=(P5+P8)/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 factor for NDF,NUF compared to G/T
30	C2	FLAT-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	Y-FACTOR ERR,%
36	C8	FILTER FREQ (MHz)
37	C9	INSTRUMENTAL POWER RESPONCE ERR,%
38	C9	FILTER BANDPASS(MHz)
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

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

43	D1	STAR SHAPE ERR,%
44	D2	HPBW UNCERTAINTY,%
45	D3	ADDED NOISE ERROR,%
46	D5	ANTENNA POINTING ERROR (deg)
47	D6	DIFFUSIVE ATTENUATION ERR,%
48	D9	REFRACTIVE ATTENUATION ERROR,%
49	E	HOUR ANGLE(deg)
50	E	EIRP*G/Ta
51	E	DAYS SINCE 1900.00
52	E0	G/T ERR-FREQ
53	E0	ATTENUATION(dB) OF PROGRAM ATTENUATOR, TEMPORARY VALUE
54	E1	TIME OF STAR PEAK (hrs)
55	E1	YEAR
56	E1	G/T ERR-ATMOSPHERIC ABSORPTION
57	E1	EIRP:PWR no noise add (mW)
58	E2	ATTNUATION(dB) OF PROGRAM ATTENUATOR
59	E2	G/T ERR-STAR SHAPE
60	E2,E3	MONTH, DAY
61	E3	G/T ERR-BANDWIDTH
62	E3	TIME DELAY TO SET ANTENNA (SEC)
63	E3	EIRP:PWR+noise add #1 (mW)
64	E4	G/T ERR-DIFFERENTIAL SKY TEMP
65	E4	TRANSMITTER POWER, WATTS
66	E4	EIRP:PWR+noise add #2 (mW)
67	E5	TIME/MEASUREMENT (hrs)
68	E5	G/T ERR-ANTENNA POINTING
69	E5	YEARS (JULIAN) SINCE 1900 /4
70	E5	EIRP:PWR+noise add #1 & #2 (mW)
71	E6	YEARS SINCE 1977
72	E6	G/T ERR-ANT POLARIZATION
73	E6	ATTUNATION(dB), MANUAL ATTENUATOR
74	E6	MEASUREMENT # OF FIT GAUSSIAN CURVE TO DRIFT CURVE
75	E7	G/T ERR-SYSTEM RESPONCE
76	E7	STANT RANGE,10^6 Km
77	E7	HPBW FIT BY GAUSSIAN CURVE TO DRIFT CURVE
78	E8	TIME(hrs)/(ARC deg)
79	E8	G/T ERR-ATMOSPHERIC DIFFUSION
80	E9	GHA TO ARIES(deg)

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

81	E9	G/T ERR-ATMOSPHERIC REFRACION
82	E9	PWR(mW) ON SAT SIGNAL
83	F	FREQ OF MEASUREMENT(GHz)
84	F	RECEIVER FREQ(GHz)
85	F(I)	DUMMY MATRIX
86	F0	FREQ LPR,%
87	F0	VALUE OF C2 IN FNN
88	F1	FLAG: 0=STAR,1=SATELLITE
89	F1	SPACE LOSS: in C/kT MEAS
90	F1	FLAG-GRAPH:0=NO,1=DATA,2=&FIT,3=FIT,4=EXIT
91	F1	FLAG: 1=SUBROUTINE LOADED
92	F1	FLAG:0=ANT PWR & VOLTS, 2=GRAPH PWR RATIO (in E)
93	F2	FLAG-PRT:0=ALL,1=PROG DATA,2=INPUT ASSUMPS,3=G/T ERR,4=ANT ELEV vs GMT
94	F2	P/Pa for LOWER FREQ CNT: in C/kT meas
95	F2	FLAG: 0=NORMAL,1=DIFF PLOT DATA,2=DIFF PLOT OF 5 CUTS
96	F2	FLAG:0=CSC fit, 1=LINEAR fit
97	F2	FLAG:0=NO AUTO CHECK,1=YES (in E)
98	F3	FLAG: 0=MANUAL READ TEMP,HUMIDITY, 1=AUTO TEMP,DEW PT
99	F3	FLAG-SORT & FIT:1=G/T-ELEV,2=G/T-CSC,3=DIP-ELEV,4=DIP-TIME
100	F3	FREQ(GHz) SELECTED FOR REWORK, 0=REWORK ALL FREQ
101	F3	FLAG:0=XTAL,1=TYPE IV bridge (in E)
102	F4	FLAG IN D:1=SIMULATED NOISE ADD,2=EARTH TERMINAL
103	F4	FILE LOAD #
104	F4	FILE # OF N7=1, STARTING M(40,1)
105	F5	FLAG IN D:1=PRGM REWORK
106	F5	FLAG IN D:1=NOISE ADD #1 WORKS
107	F5	P(CNT) @ -F: in C/kT meas
108	F5	FLAG-PROGR REWORK PATTERN:0=NO
109	F5	FLAG: 0,1= volt table in LINEARITY ck, 2,3=stability GRAPH (in E)
110	F6	FLAG TASK:1=NEW SITE,2=MEAS,3=REWORK,0=MANL VIA KEYBOARD
111	F6	FLAG-AUTO SEQUENCE:1=YES
112	F6	FLAG:0=RESTART,1=SKY,2=G/T,3=EIRP,4=LINK
113	F6	FLAG IN E:0=PRGM ATTN,1=STD ATTN
114	F6	FLAG IN E:1=NOISE ADD #2 WORKS
115	F7	FLAG: 0=CASSETTE BEING USED,1=DISK
116	F7	FLAG-PWR LEVEL: 0=CONST, 1=STEPPED (in E)
117	F8	FLG in D:(KEY 5)0=GRAPH,1=LIST,(KEY 6)0=SIML NOISE ADD,1=EARTH TERM
118	F8	P(CNT) @ +F: in C/kT meas

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

119	F8	FLAG IN D:1=NO FIT CUTS
120	F9	STORE SET # OF SUMMARY OF REWORK DATA
121	F9	ATTN VALUE OF LAST PROG ATTEN IN FNW
122	F9	T(sky)/Ta: in C/kT meas
123	G	ANTENNA GAIN,REL
124	G(I,J)	CURVE FIT MATRIX
125	G4	OXYGEN ABSORPTION (dB/Km)
126	G5	WATER ABSORPTION,#1 CONST (dB/Km)
127	G6	WATER ABSORTION, #2 CONST (dB/Km)
128	H	HOUR ANGLE OFFSET (deg)
129	H	SIMULATED STAR NOISE(dB)
130	H$	MAIN PROGRAM HEADING
131	H1	FIT TO G/T or NEF data (3*1S/SQR(#PTS)),dB
132	H5	INSTR PWR RESPONCE FACTOR
133	H9	ADDED NOISE,K
134	I	LOOP VARIABLE
135	I	HPBW
136	I5	PLOT UNIT
137	J	DRDC PWR when NOISE ADD sources ON
138	J	MAXIMUM FLUX IN F.U.
139	J	SELECT FUNTION:19=G/T,20=G/TA,21=HPBW#1,22=#2,24=DELTA,25=NEF,26=NUF
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 RESPONCE FACTOR
150	K8	DIFFUSIVE ATTENUATION FACTOR
151	K9	REFACTIVE ATTENUATION FACTOR
152	L	ELEVATION(deg)
153	L$	FREQ,DIAM,G/T HEADING
154	L0	ELEVATION--NO REFRACTION CORRECTION
155	L0	FLAG IN D:0=GRAPH,1=ERR PRT OUT-no VARIABLES,2=with variables
156	L1	ELLVATION REFRACTION CORRECTION,deg

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

157	L1	ELEVATION FOR FITTING G/T OR G
158	L4	EFFECTIVE OXYGEN LENGTH, Km
159	L5	WATER PATH LENGTH CONST#1
160	L6	WATER PATH LENGTH CONST#2, Km
161	L7	WATER DENSITY (gm/m^3)
162	L8	REFRACTION CONST #1
163	L9	REFRACTION CONST #2
164	M	G/T RELATIVE
165	M(N7,J)	SUMMARY DATA: SEE MATRIX LIST
166	M1	LOOP VARIABLE
167	M1	SUM ON P
168	M1...M4	ATTN OF PGM 1,2,4,8 @ 30 MHz,PGM USES N(13,1...4)
169	M2	SUM ON X
170	M3	SUM ON Y
171	M3	MEASUREMENT # @ MAXIMUM AMPLITUDE
172	M6...M9	ATTN OF PGM 1,2,4,8 @ 70 MHZ, pgm uses N(13,6...9)
173	N	DATE, DECIMAL FOR MOON DATA
174	N	MEASUREMENT NUMBER
175	N(I,J)	INPUT DATA CONST, SEE MATRIX LIST
176	N0	STAR NUMBER, CURRENT
177	N1	NO. OF STAR SOURCES
178	N2	CUT NUMBER
179	N3	PWR MEASUREMENT # WITHIN A CUT
180	N4	LARGEST N3
181	N5	PAGE NUMBER
182	N6	RUN #
183	N7	SET #
184	N8	SUMMARY DATA # = M(50,1) = N7+F4
185	N9	NUMBER POINTS IN FIT
186	O1,O2,O3	FILTER#1(2.5MHz @ 30MHz) CONSTS:N(15,1),N(15,2),N(15,3)
187	O6,O7,O8	FILTER#2(1MHz @ 70MHz) CONSTS:N(15,6),N(15,7),N(15,8)
188	P	POWER MEASURED,MILLIWATTS
189	P$	PROJECT HEADING
190	P1	STAR SHAPE ERROR,%
191	P1	RECEIVER GAIN SLOPE/mHz
192	P1,P2,P3	FILTER#3 (2.5MHz @ 70MHz) CONSTS:N(16,1),N(16,2),N(16,3)
193	P6,P7,P8	FILTER#4 (5.3MHz @ 70MHz) CONSTS:N(16,6),N(16,7),N(16,8)
194	Q,Q0,Q1	DUMMY

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

195	Q2,Q3	DUMMY
196	Q3	HPBW,ANTENNA ALONE(i.e. with KANDA CORRECTION)
197	Q3	POWER WITH NOISE ADD ON
198	Q3	FLG:(LOC SITE DATA).(F6=TASK)(F4=PRM CHANGE?)(F7=DISK)
199	Q5,Q6	dP(add) in C/kT meas: @ -F, @ +F
200	R	REMARKS: SEE REMARK LIST
201	R0	RATIO #1add/#2add @ 70 MHz, pgm uses N(18,10)
202	R1	zERO FOR GRAPH
203	R2	RESIDUALS FROM CURVE FIT
204	R5	NUMBER OF POINTS FIT TO PARABOLA
205	S	G/T ERR-FLUX
206	S	TIME(hrs), CURRENT
207	S$	STAR NAME
208	S(1,J)	STAR DATA: SEE MATRIX LIST
209	S3	PREDICTED MEASUREMENT # FOR MAXIMUM STAR PWR
210	T	T(syst)
211	T(N0,J)	INPUT STAR DATA: SEE MATRIX LIST
212	T1	TIME OF 1st MEASUREMENT
213	T1	G/T OR G/TA VALUE
214	T2	CURRENT MEASUREMENT TIME
215	T2	RUN/SET
216	T6	N-6*(N7-1)
217	U	POWER NORMALIZATION
218	V	VOLTAGE ACROSS PWR BRIDGE
219	V	-ALPHA,GAUSSIAN COEFF
220	V1	SUM ON X^4
221	V2	SUM ON X^2
222	V3	SUM ON X^3
223	V4	SUM ON P*X^2
224	V5	SUM ON P*X
225	V5	PARABOLIC FIT PARAMETER h
226	V6	Tstar/Ta=EXP(X-F(2)*W1^2)
227	V6	SUM ON P^2
228	V7	dT(star)/TA
229	V7	DV,#1 RF OFF
230	V7	N3 OF STAR MAX
231	V8	DV, RF ON
232	V8	DISK OR TAPE #

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

233	V9	DV,#2 RF OFF
234	V9	dT(STAR)/TA PREDICTED
235	W	BANDWIDTH(MHz)
236	W1	VARIENCE OF P(STAR)/P(ADD)
237	X	TIME VARIABLE, 2*I/N4-1
238	X$	SUBROUTINE HEADING
239	X1	Xi = G/dT(star)
240	X1	LOOP VARIABLE
241	X1	TIME VARIABLE, 2*(N3-M3)/N4
242	X2	GAMMA,PARABOLIC FIT
243	X2	VARIABLE IN FNG(N3)
244	X4	K*S/2/k
245	X5	AZUMUTH BIAS (deg)
246	X6	ELEVATION BIAS (deg)
247	Y	Y-FACTOR
248	Y(I)	MATRIX USED IN CURVE FIT OR DUMMY
249	Y1	G/T ERR-Y factor (C8*Y5)
250	Y5	Y/(Y-1)
251	Z	COLD SKY POWER / TA
252	Z1	ZENITh ATM ATTN, dB
253	Z5	SERROR VARIABLE
254	Z5	C/kT MEAS:T(ONT)/Ta FOR UPPER FREQ

7.2 MATRIX LIST ALPHABETICAL BY VARIABLE

NBS2.00 <NBS 9915, 0007> T6 & D5-F10

REVISION # 9

-1-

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
 1   A( 1)        RUN/SET = 100*N6+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
 8   A( 7)x       CODE(E1):0=SKY, 1=-F, 2=RCR @ F, 3=+F, 4=OTHER
 9   A( 8)        PWR RATIO CHECK:microbells/10

10   A( 8)rw      T/Ta*10^4
11   A( 9)*       U*10^4: REFERENCE PWR
12   A( 9)x       NOT USED

13   A(10)*       HPBW#1*10^4
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 ATTN WHEN ...
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 BANDWITH,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)/10)*10^4
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,N3+2)x   PWR WITH noise add OFF @ BOLO: LGT(PWR)*10^4
27   D(2,N3+2)x   PWR(noise add ON): LGT(BOLO PWR)*10^4

28   D(3,N3+2)x   PWR/Padd:LGT(P/Padd)*10^4
29   D(4,N3+2)x   TIME,hrs(E1)*10^3
30   D(5,N3+2)x   LGT(PWR METER VOLTAGE)*10^4

31   D(6,N3+2)x   ATTN,TOTAL: E2+E6
32   D(T6, 1)*    AZIMUTH:(AZ(deg)-180)*100
33   D(T6, 2)*    ELEVATION(deg)*100

34   D(T6, 3)*    # OF MEAS(N4)
35   D(T6, 4)*    TIME OF PREDICTED STAR MAX: E1*1000
36   D(T6, 5)*    DECL OFFSET FROM PREDICTED STAR CENTER: (B1+L1)deg *1000

37   D(T6, 6)*    LOG(((Tstar+Tsystem)/Tadd)/U)*10^4
38   D(T6, 6)rw   LGT(dT/Tadd)*10^4
39   D(T6, 7)*    FIT MEAS # AT PEAK  * 100

40   D(T6,N3+7)   LOG(P/U)*10^4: P=PWR MEAS mW, U=PWR REF
41   M(40, 1)     NUMBER OF SUMMARY SETS STORED IN MATRIX M
42   M(40, 3)     NUMBER OF FILES USED IN DISK STORAGE
```

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
43   M(N8, 1)     LLEV(deg) + STAR#/100
44   M(N8, 1)d    STAR #/100

45   M(N8, 1)x    CODE + .07
46   M(N8, 2)*    G/T(dB)
47   M(N8, 2)d    T/Ta ZENITH (b5)

48   M(N8, 2)x    PWR/Pa
49   M(N8, 3)*    G/TA(dB)
50   M(N8, 3)d    T/Ta CSC COEFF (B6)

51   M(N8, 3)x    PWR(mW)
52   M(N8, 4)*    HPBW#1 (deg)
53   M(N8, 4)d    TIME, DECIMAL HRS (FNT2)

54   M(N8, 4)x    PWR due to Ta (mW)
55   M(N8, 5)*    HPBW#2 (deg)
56   M(N8, 5)d    TEMPERATURE,F (A(3)/10)

57   M(N8, 5)x    C/kT(dB)
58   M(N8, 6)     FREQ (GHz)
59   M(N8, 7)*    Y-factor

60   M(N8, 7)d    WATER DENSITY (L7)
61   M(N8, 7)x    EIRP(dBw)+G/TA(dB) = E
62   M(N8, 8)*    NEF (kFU)

63   M(N8, 8)d    NUMBER OF POINTS IN DIP CURVE
64   M(N8, 8)x    CNT/Tadd: (F2+Z5)/2
65   M(N8, 9)*    NUF (kFU)

66   M(N8, 9)x    Padd(mW): (F5+F8)/2
67   M(N8,10)     RUN/SET: N6+N7/100
68   N( 1, 4)     SYSTEM # + (DATA REVISION #/100)

69   N( 1, 5)     DAC REF volt:#3=6.313,#4=6.367,#5=6.284,#6=6.24
70   N( 1, 6)     DAC mult=-(chnl#9-#8)/#7:#3=0,3173,#4=0.32,#5=0.3187,#6=0.32
71   N( 1, 7)     ATTN+meter(dB/10) 5.3@70:#3=16.15,#4=17.3,#5=15.27,#6=-17.55

72   N( 1, 8)     RATIO #1 add/#2 add @ MICROWAVE FREQ
73   N( 1, 9)     NUMBER OF POINTS IN FIT
74   N( 1,10)     REWORK #

75   N( 9&10,1)   STORE STRING P$
76   N(13, 1)     ATTN of 1db prgm @ 30MHz:#3=0.961
77   N(13, 2)     ATTN of 2dB prgm @ 30MHz:#3=1.881

78   N(13, 3)     ATTN of 4dB prgm @ 30MHz:#3=3.947
79   N(13, 4)     ATTN of 8dB prgm @ 30MHz:#3=7.881
80   N(13, 5)     ATTN of STD RES 30MHz:#3=5.922,#6=4.779
```

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
 81   N(13, 6)    ATTN OF 1dB prgm @ 70:#3=0.976,#4=0.947,#5=0.938,#6=0.973
 82   N(13, 7)    ATTN OF 2dB PRGM @70:#3=1.890,#4=1.95,#5=1.854,#6=1.957

 83   N(13, 8)    ATTN of 4dB prgm @ 70:#3=3.909,#4=3.87,#5=3.957,#6=3.924
 84   N(13, 9)    ATTN of 8dB PRGM @ 70:#3=7.896,#4=7.86,#5=7.845,#6=7.949
 85   N(13,10)    ATTN of STD @ 70:#3=5.966,#4=5.92,#5=6.11,#6=6.1

 86   N(15, 1)    FILT#1(2.5@30) NOISE BW:#3=3.915,#4=3.887,#5=3.643,#6=3.552
 87   N(15, 2)    FILT#1(2.5@30)N1,MHz:#3=0.00938,#4=0.01526,#5=0.0178
 88   N(15, 3)    FILTER#1(2.5MHz @ 30MHz):2nd CONST

 89   N(15, 4)    FILT#1(2.5@30)LOSS,dB:#3=3.092,#4=2.711,#5=2.391,#6=2.560
 90   N(15, 6)    FILT#2(1@70)NOISE BW:#3=1.193,#4=1.225,#5=1.23,#6=1.250
 91   N(15, 7)    FILT#2(1@70)N1,MHz:#3=-0.1043,#4=0.0817,#5=0.1271

 92   N(15, 8)    FILTER#2(1MHz @ 70MHz):2nd CONST
 93   N(15, 9)    FILT#2(1@70)LOSS,dB:#3=4.970,#4=4.910,#5=4.870,#6=5.634
 94   N(16, 1)    FILT#3(2.5@70)NOISE BW:#3=2.808,#4=2.910,#5=2.937,#6=2.875

 95   N(16, 2)    FILT#3(2.5@70)N1,MHz:#3=-0.102,#4=0.0108,#5=-0.130
 96   N(16, 3)    FILTER#3(2.5MHz @ 70MHz):2nd CONST
 97   N(16, 4)    FILT#3(2.5@70)LOSS,dB:#4=5.78,#5=5.84,#6=5.814

 98   N(16, 6)    FILT#4(5.3@70)NOISE BW:#3=5.734,#4=5.80,#5=5.856,#6=5.671
 99   N(16, 7)    FILT#4(5.3@70)N1,MHz:#3=-0.14,#4=-0.0782,#5=0.011
100   N(16, 8)    FILTER#4(5.3MHz @ 70MHz):2nd CONST

101   N(16, 9)    LOSS,dB:#4=4.18,#5=3.14,#6=4.083
102   N(17, 6)    FILT#6(0.06@70MHz)NOISE BW,MHz:#6=0.083
103   N(17, 7)    FILT#6(0.06@70MHz)N1,MHz:#6=0.00178

104   N(17, 9)    FILT#6(0.06@70MHz)INSER LOSS,dB:#6=4.719
105   N(18, 5)    RATIO #1 add/#2 add @ 30MHz
106   N(18,10)    RATIO #1add/#2add @ 70:#4=0.515,#5=0.526,#6=0.2468

107   N(19, 1)    G/T(dB) INTERCEPT
108   N(19, 2)    G/T(dB) ZENITH
109   N(19, 3)    G/T(dB) INTERCEPT 1S ERR

110   N(19, 4)    G/T(dB) ZENITH 1S ERR
111   N(19, 5)    G/T(dB) ELEV COEFF
112   N(19, 6)    G/T(dB) CSC COEFF

113   N(19, 7)    G/T(dB) ELEV COEFF ERR
114   N(19, 8)    G/T(dB) CSC COEFF ERR
115   N(20, 1)    G/TA(dB) INTERCEPT

116   N(20, 2)    G/TA(dB) ZENITH
117   N(20, 3)    G/TA(dB) INTERCEPT 1S ERR
118   N(20, 4)    C/TA ZENITH 1S ERR
```

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

119	N(20, 5)	G/TA(dB) ELEV COEFF
120	N(20, 6)	G/TA(dB) CSC COEFF
121	N(20, 7)	G/TA(dB) ELEV COEFF ERR
122	N(20, 8)	G/TA(dB) CSC COEFF ERR
123	N(21, 1)	HPBW#1(deg) INTERCEPT
124	N(21, 2)	HPBW#1 ZENITH
125	N(21, 3)	HPBW#1(deg) INTERCEPT 1S ERR
126	N(21, 4)	HPBW#1(deg) ZENITH 1S ERR
127	N(21, 5)	HPBW#1(deg) ELEV COEFF
128	N(21, 6)	HPBW#1(deg) CSC COEFF
129	N(21, 7)	HPBW#1(deg) ELEV COEFF ERR
130	N(21, 8)	HPBW#1 CSC COEFF ERR
131	N(22, 1)	HPBW#2(deg) INTERCEPT
132	N(22, 2)	HPBW#2 ZENITH
133	N(22, 3)	HPBW#2(deg) INTERCEPT 1S ERR
134	N(22, 4)	HPBW#2(deg) ZENITH ERR
135	N(22, 5)	HPBW#2(deg) ELEV COEFF
136	N(22, 6)	HPBW#2(deg) CSC COEFF
137	N(22, 7)	HPBW#2(deg) ELEV COEFF ERR
138	N(22, 8)	HPBW#2(deg) CSC COEFF ERR
139	N(24, 1)	D-DECL(deg) INTERCEPT
140	N(24, 2)	D-DECL(deg) ZENITH
141	N(24, 3)	D-DECL(deg) INTERCEPT 1S ERR
142	N(24, 4)	D-DECL(deg) ZENITH 1S ERR
143	N(24, 5)	D-DECL(deg) ELEV COEFF
144	N(24, 6)	D-DECL(deg) CSC COEFF
145	N(24, 7)	D-DECL(deg) ELEV COEFF ERR
146	N(24, 8)	D-DECL(deg) CSC COEFF ERR
147	N(25, 1)	NEF(kFU) intercept
148	N(25, 2)	NEF(kFU) zenith
149	N(25, 3)	NEF(kFU) intercept 1S ERR
150	N(25, 4)	NEF(kFU) zenith 1S ERR
151	N(25, 5)	NEF(kFU) elev coeff
152	N(25, 6)	NEF(kFU) csc coeff
153	N(25, 7)	NEF(kFU) elev coeff err
154	N(25, 8)	NEF(kFU) csc cceff err
155	N(26, 1)	NUF(kFU) intercept
156	N(26, 2)	NUF(kFU) zenith

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1E.02, NBS1C.01, NBS1D.02

```
157   N(26, 3)    NUF(kFU) intercept 1S err
158   N(26, 4)    NUF(kFU) zenith 1S err

159   N(26, 5)    NUF(kFU) elev coeff
160   N(26, 6)    NUF(kFU) csc coeff
161   N(26, 7)    NUF(kFU) elev coeff err

162   N(26, 8)    NUF(kFU) csc coeff err
163   N(I,J)      PROG CONSTS I<26:I, 1=A,2=B,etc;J, 1=1,...,10=0, 11=NO SUBSCRIPT
164   S(N0,1)     STAR FLUX (F.U.) @ STANDARD FREQ

165   S(N0,2)     STAR=RT ASC (deg);  SOLAR=GHA @ 0 gmt (deg)
166   S(N0,3)     STAR=N. DEC. (deg);  SOLAR=N. DEC. @ 0 GMT (deg)
167   S(N0,4)     FLUX AT THE WORKING FREQ (F.U.)

168   T( 9, 1)    STORE STRING P$
169   T(14, 9)    DAYS(STAR EPIC) SINCE 1977=#DAYS SINCE 1900 - 28125
170   T(14,10)    DAYS(SOLAR EPIC) SINCE 1977=#DAYS SINCE 1900 - 28125

171   T(N0, 1)    STAR/SOLAR NAME
172   T(N0, 4)*   SPECTRAL INDEX SECULAR EXPANSION(%/Yr)*1000
173   T(N0, 5)*   SPEC INDEX SECULAR EXPN UNCERTAINTY(%/Yr)*1000

174   T(N0, 6)*   SPECTRAL INDEX * 1000
175   T(N0, 7)*   SPECTRAL INDEX ERR * 1000
176   T(N0, 8)*   FLUX ERR @ STD FREQ (%) * 10

177   T(N0, 9)*   DISK SIZE (ARC MIN) * 100
178   T(N0,10)*   FLUX ERR @ F(%) * 10
179   T(N0,11)*   LINEAR POLZ(%) * 10

180   T(N0,11)s   GHA/hr * 1000
181   T(N0,12)*   LINEAR POLZ ERR(%) * 10
182   T(N0,12)s   N. DEC./hr * 1000

183   T(N0,13)*   POLZ ANG (deg) * 10
184   T(N0,13)s   HORIZONTAL PARALLAX * 1000
185   T(N0,14)*   POLZ ANG ERR (deg) * 10

186   T(N0,14)s   AGE OF MOON (days)
187   T(N0,15)*   FLUX EPOCH, YEAR*10
188   T(N0,16)*   SECULAR DECAY of flux (%/Yr)*100

189   T(N0,17)*   SECULAR DECAY of flux ERR (%/Yr)*100
190   T(N0,18)*   STD FREQ(GHz) * 100
191   T(N0,19)*   MIN FREQ (GHz)*100 WHERE FLUX CALC VALID

192   T(N0,20)*   MAX FREQ (GHz)*100 WHERE FLUX CALC VALID
193   T(N0,21)    FLAG: 0=STAR DATA, 1=SOLAR DATA
194   T(N0,22)s   GHA/HR (deg) * 1000
```

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

195 T(N0,23)s N. DEC./hr (deg) * 1000

7.3 FUNCTION LIST ALPHABETICAL BY VARIABLE

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
 1   FLAG 1      STAR FLUX CALC FOR SPECIFIED FREQ & DATE
 2   FLAG 1      1=ENTER 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(N0)     ANT POINT:N0=STAR # IN:H,L1,B1,E1; OUT:A,L,L0 <NBS7411,7449,8339>
 8   FNB(Q)      BEEP: Q=# OF BEEPS
 9   FNC(Q)      PAGE HEADING: Q=# SPACES BEFORE PRT HEADING

10   FND(Q)      INIT HARDWARE: 0=VTVM,BRG,NOISE @ NOMINAL, 1=INIT PWR BRG
11   FNE(N0)     ERROR CALC FOR G/T: N0=STAR #
12   FNFa  1     REWIND INT CASSETTE

13   FNFb  0     SITE: W. long, N. lat, alt
14   FNFc  0     SET# CHANGE
15   FNFc  1     SOURCE# CHANGE, RESET MAT A & MAT D

16   FNFd  0     RESTART
17   FNFd  1     ques DATA ON TAPE/DISK,TAPE #
18   FNFd  2     heading G/T,G/Ta,NEF,NUF,Y-factor

19   FNFd  3     heading K1,...K9,k.A-eff,R-eff,S,Xi
20   FNFd  4     BEST FIT 5 CUTS
21   FNFd  5     heading *HPBW #1 =...+...CSC L=... (ant HPBW =...)

22   FNFd  6     heading: G(dB) G-diff T(K) Ta(K) Y-fac HPBWerr data fit c(1-K2) ....
23   FNFd  7     ques: DATA SET#
24   FNFd  8     A$= !....!....!....!....!....!....!....!....!....!

25   FNFd  9     prt K1,K2,K3,K6,K8,K9,K,A-eff,R-eff,S,Xi
26   FNFd 10     prt A2,C9,D1,N(21,1),T(1,9),C8,D8,D9,J1,N(21,3),T(1,11),C2
27   FNFe  0     ATTN SETTING, FILTER IDENTIFICATION HEADING

28   FNG(Q)      CURVE FIT:0=INIT,-99=CALC FIT (out:I,R2,W1,V5,G(I,J),Y(I))
29   FNH(Q)      HEADINGS: 0=FIT #, 1=TAPE #
30   FNI(Q)      DRAW LINE:1 -;2 --;3 ==;4 ##;5 @@

31   FNJ(Q)      KEY SUB: Q=KEY #, SEE KEY LIST
32   FNK(N0)     K-FACTOR CALC,e.g. K1,K2,...,K9
33   FNL 1       G/T plot (J=19)

34   FNL 1.1     G/T err TABLE: no print variables
35   FNL 1.2     G/T err TABLE: print variables
36   FNL 2       G/Ta plot (J=20)

37   FNL 2.1     G/Ta err TABLE: no print variables
38   FNL 2.2     G/Ta err TABLE: print variables
39   FNL 3       HPBW#1 plot (J=21)

40   FNL 4       HPBW#2 plot (J=22)
41   FNL 6       Y-factor plot (J=24)
42   FNL 7       NEF plot (J=25)
```

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
43   FNL 8        NUF plot (J=26)
44   FNM(Q)       METEOROLOGICAL INFO:0=INPUT DATA,1=PRT DATA,2=SELECT MAN/AUTO

45   FNN(Q)       ANSWER ROUTINE:DISPLAYS Q, SPACE = NO CHANGE
46   FNO(Q)       ANS ROUTINE SEQUENCE
47   FNP(Q)       PRW MEAS:0=#1&#2,1=#1,2=#2,3=PWR,mw (IN: A3,C2,E2,V,FND1)

48   FNQ(Q)       PRGM const(MAT N):1=LIST,2=correct,3=N(I,J) to variables
49   FNR(Q)       READ(ENTER DATA) DEVICE:2=DVM,3=CLOCK,4=BREAK SWITCHS
50   FNS(Q)       SPACE PAGE Q SPACES

51   FNT(Q)       TIME,DECIMAL HRS:1=SET UP E1 (IN: E3,E5,N4)
52   FNT(Q)       DUMMY USED IN ERROR PRT OUT IN DW63B
53   FNTa(L)      calc: ANT HPBW#1(min of arc)

54   FNU(Q)       PRW RATIO CHECK:  IN:C2,E2,C3  OUT:A(7),A(8)
55   FNV(Q)       VOLTAGE READING:volt range + channel #/100
56   FNVa  0      RESTART

57   FNVa  1      calc: G/T,G/Ta,NEF,NUF errors
58   FNVa  2      FIT X=EXP(V*(V2-W1)^2)
59   FNVa  3      calc: GRAPH RANGES for AUTO SEQ

60   FNVa  4      calc: LINEAR & CSC FIT PARAMETERS
61   FNVa  5      Q=FNF2 & RETURN
62   FNVa  6      read: REWRK#,SET,F,T/Ta@90,csc,HPBW@90,csc,Ta

63   FNVa  7      FIT #1 OF 5 CUTS
64   FNVa  8      FIT #2 OF 5 CUTS
65   FNVa  9      calc Ta via G at zenith =B2*(D*F/0.313)^2,B2

66   FNVa 10      set FLAG F8 if REWORK# not integer
67   FNVa 11      load PIOR SUMMARY MAT M, MAT N
68   FNVa 12      STORE  MAT M & MAT N

69   FNVa 13      calc B,B0,B2,G via B2,G-diff=C7,Ta=H9,B9
70   FNW(Q)       WAIT Q MILLISEC
71   FNX 24       DVM AUTORANGE

72   FNX 27       0.100000 V DVM RANGE
73   FNX 28       1.00000 V DVM RANGE
74   FNX 29       10.0000 V DVM RANGE

75   FNX 30       100.000 V DVM RANGE
76   FNX 31       1000.00 V DVM RANGE
77   FNX 32       DC FILTER OUT

78   FNX 33       DC FILTER IN
79   FNX 34       RATIO: FILTER IN
80   FNX 36       AC VOLTS (not installed)
```

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

81	FNX 40	OHMS (not installed)
82	FNX 48	PRGM ATTN =15dB
83	FNX 49	PRGM ATTN =14dB
84	FNX 50	PRGM ATTN =13dB
85	FNX 51	PRGM ATTN =12dB
86	FNX 52	PRGM ATTN =11dB
87	FNX 53	PRGM ATTN =10dB
88	FNX 54	PRGM ATTN = 9dB
89	FNX 55	PRGM ATTN = 8dB
90	FNX 56	PRGM ATTN = 7dB
91	FNX 57	PRGM ATTN = 6dB
92	FNX 58	PRGM ATTN = 5dB
93	FNX 59	PRGM ATTN = 4dB
94	FNX 60	PRGM ATTN = 3dB
95	FNX 61	PRGM ATTN = 2dB
96	FNX 62	PRGM ATTN = 1dB
97	FNX 63	PRGM ATTN = 0dB
98	FNX 64	NO RF to BOLOMETER & STD PAD IN
99	FNX 65	RF to BOLOMETER & STD PAD OUT
100	FNX 66	STD ATTN IN
101	FNX 67	STD ATTN OUT
102	FNX 68	NO RF TO BOLOMETER
103	FNX 69	RF TO BOLOMETER
104	FNX 72	NO RF to BOLOMETER & STD PAD IN (avoid-USE FNX64)
105	FNX 73	RF to BOLOMETER & STD pad OUT (avoid-USE FNX65)
106	FNX 74	STD ATTN IN (avoid - use FNX66)
107	FNX 75	STD attn OUT (avoid - use FNX67)
108	FNX 76	NO RF to BOLOMETER (avoid - use FNX68)
109	FNX 77	RF to BOLOMETER (avoid - use FNX69)
110	FNX 80	NOISE ADD #1 & #2 ON
111	FNX 81	NOISE ADD #1 & #2 OFF
112	FNX 82	NOISE ADD #1 ON
113	FNX 83	NOISE ADD #1 OFF
114	FNX 84	NOISE ADD #2 ON
115	FNX 85	NOISE ADD #2 OFF
116	FNX 88	NOISE ADD #1 & #2 ON (avoid - use FNX80)
117	FNX 89	NOISE ADD #1 & #2 OFF (avoid - use FNX81)
118	FNX 90	NOISE ADD #1 ON (avoid - use FNX82)

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
119   FNX 91      NOISE ADD #1 OFF  (avoid - use FNX83)
120   FNX 92      NOISE ADD #2 ON   (avoid - use FNX84)

121   FNX 93      NOISE ADD #2 OFF  (avoid - use FNX85)
122   FNX 96      OPENS MULTIPLEXER so can use front panel inputs
123   FNX 97      OPENS MULTIPLEXER so can use front panel inputs

124   FNX 98      OPENS MULTIPLEXER so can use front panel inputs
125   FNX 99      OPENS MULTIPLEXER so can use front panel inputs
126   FNX100      J357 INPUT(e.g. ext pwr meter):channel #11 = 110 0100

127   FNX101      PWR BRDG vs FINE REF: channel #10 = 110 0101
128   FNX102      PWR BRDG vs REF VOLT, set fine volt:ch #9 = 110 0110
129   FNX103      PRW BRDG OUTPUT: channel #8 = 110 0110

130   FNX104      D/A REFERENCE voltage: channel #7 = 110 1000
131   FNX105      CRYSTAL DIODE voltage: channel #6 = 110 1001
132   FNX106      D/A OUTPUT:  channel #5 = 110 1010

133   FNX107      +12 volts, RF UNIT:  channel #4 = 110 1011
134   FNX108      +20 volts, RF UNIT:  channel #3 = 110 1100
135   FNX109      DEW POINT:  channel #2 = 110 1101

136   FNX110      TEMP (F/100):  channel #1 = 110 1110
137   FNX111      GROUND DVM:  channel #0 = 110 1111
138   FNY(Q)      PLOT DATA: 1=PRT HEADING

139   FNZ(N0)     Xi=FNK(N0)*C1*S(N0,4)*1E-26
140   KEYa  0     RESTART
141   KEYa  1     CHANGE PRGM CONST & MODIFY CORRESPONDING N(I,J)

142   KEYa  2     LIN1: 1=SITE PREP, 2=MEAS, 3=REWORK
143   KEYb  0     RESTART:0=RESTART,1=LINKMEAS,2=REWORK,3=KEY LIST
144   KEYb  1     UPDATE:RUN#,DATE,SITE

145   KEYb  2     UPDATE: FREQ,BW,ANT PARAMETERS
146   KEYb  3     UPDATE:ANT POINTING ERROR
147   KEYb  4     UPDATE:T,G/T,Ta,PWR RESP

148   KEYb  5     UPDATE:TEMP, DEW PT
149   KEYb  6     UPDATE:SUN/MOON ALMINAC DATA
150   KEYb  7     PRT:SITE  &  FLUX DATA

151   KEYb  8     CALC:STAR FLUX @ f
152   KEYb  9     PRT:TYPICAL G/T VALUES AND ERRORS
153   KEYb 10     STORE: S,T,N

154   KEYb 11     PRT:LIST OF ALTERATE STAR ERR
155   KEYb 12     PRT: ELEV vs GMT
156   KEYb 13     UPDATE: N(I,J)
```

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
157   KEYc  0     RESTART:1SKY,2G/T,3EIRP,4LNK,5NEW TAPE,0MASTER RESTART
158   KEYc  1     STAR:RESTART @ N

159   KEYc  2     EIRP:START @ SET ?
160   KEYc  3     REFIT 5 CUTS: USED AFTER ONE OF THE CUTS IS RETAKED
161   KEYc  4     STAR FIX:routine to estab ANT BIAS

162   KEYc  5     CHANGE BIAS:HR ANG, DECL, AZ, ELEV
163   KEYc  6     CHANGE:input ATTN (dB), FILTER #
164   KEYc  7     CHANGE: TA = ADDED NOISE,K

165   KEYc  8     CHANGE: T(syst)/Ta
166   KEYc  9     CHANGE STD attn(C2):0=OUT when noise add ON, 1=IN
167   KEYc 10     STORE CUTS TAKEN

168   KEYc 11     STORE INT: MAT N,S,T and PRGM
169   KEYc 12     STORE:MAT M(summary data),N(prgm consts) on ext CAS/DISK
170   KEYc 13     LIST G/T SUMMARY

171   KEYc 14     LIST CURRENT DATA  MAT D
172   KEYc 15     CHANGE FREQ & calc new STAR FLUX
173   KEYc 16     CHANGE # PTS IN PARABOLIC FIT ROUTINE

174   KEYc 17     CHANGE: G/TA(dB)
175   KEYc 18     CHANGE NOISE ADD SOURCES (C3):0=#1&#2,1=#1,2=#2,3=PWR(mW)
176   KEYc 19     LAST MEASUREMENT:initiates storage steps

177   KEYd  0     RESTART:0REWORK,1LOAD,2AUTO SEQ,3DEL,4G/T,5FIT,6PLT,7ERR
178   KEYd  1     RESTART @ N=?
179   KEYd  2     calc:STAR FLUX VALUES,Ta,eff area

180   KEYd  3     ENTER TEMP,A(3);AND DEW PT ,A(4) USED IN REWORK
181   KEYd  4     prt: G/T DATA SUMMARY with page heading
182   KEYd  5     SORT,FIT and LIST DATA

183   KEYd  6     prt: G/T DATA SUMMARY (no heading)
184   KEYd  7     STORE MAT M & MAT N
185   KEYe  0     RESTART:0=KEY LIST,1=AUTO CK,2=NO AUTO(F2=0)

186   KEYe  1     CHECK LIST
187   KEYe  2     CHECK DVM
188   KEYe  3     CHECK CHANNEL VOLTAGES

189   KEYe  4     CHECK PRGM ATTENUATORS
190   KEYe  5     CHEK PWR,TYPEIV & ATTN STABILITY
191   KEYe  6     CHECK NOISE ADD STABILITY

192   KEYe  9     ques: NEW FREQ,BW,INPUT ATTN,SIML STAR NOISE
193   read CLOCK  ENTER(3,*)C,D:C=#1 THUMB SW,D=SW #2 #3 #4 HHMM.SS
194   read DVM    ENTER(2,*)A,B: A=FUNCTION, B=VOLTAGE

195   read SW     KBYTE 4=INTEGER SUM OF BINARY SWITCHES
196   read SW Y   BIAND(ROT(KEYTE4,Y)1)=1 IF SWITCH Y IS UP
```

7.4 VARIABLES LIST ALPHABETICAL BY MEANING

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

1	V	-ALPHA,GAUSSIAN COEFF
2	D3	ADDED NOISE ERROR,%
3	B9	ADDED NOISE,K
4	B2,B3	ANTENNA APERTURE EFFICENCY, ANT RADIATION EFFICIENCY
5	D	ANTENNA DIAMETER(FT)
6	B9	ANTENNA EFFECTIVE AREA
7	G	ANTENNA GAIN,REL
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	A3	ATTENUATION OF STD ATTN (abs>1 , NOT dB),RELATED TO N(13,10)
14	E0	ATTENUATION(dB) OF PROGRAM ATTENUATOR, TEMPORARY VALUE
15	M1...M4	ATTN OF PGM 1,2,4,8 @ 30 MHz,PGM USES N(13,1...4)
16	M6...M9	ATTN OF PGM 1,2,4,8 @ 70 MHZ, pgm uses N(13,6...9)
17	F9	ATTN VALUE OF LAST PROG ATTEN IN FNW
18	E2	ATTENUATION(db) OF PROGRAM ATTENUATOR
19	E6	ATTENATION(dB), MANUAL ATTENUATOR
20	A	AZIUMTH(deg) OR DUMMY
21	X5	AZUMUTH 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(ANT)/Ta FOR UPPER FREQ
26	B1	CODE FOR SATELLITE CARRIER MEAS:0=SKY,1=-F,2=RCR @ F,3=+F,4=OTHER
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	B6	DEW POINT(F)
38	K4	DIFFERENTIAL SKY TEMPERATURE FACTOR
39	D8	DIFFUSIVE ATTENUATION ERR,%
40	K8	DIFFUSIVE ATTENUATION FACTOR
41	V8	DISK OR TAPE #
42	A$,B$	DUMMY

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

43	Q,Q0,Q1	DUMMY
44	Q2,Q3	DUMMY
45	B(I,J)	DUMMY MATRIX
46	F(I)	DUMMY MATRIX
47	V8	DV, RF ON
48	V7	DV,#1 RF OFF
49	V9	DV,#2 RF OFF
50	L4	EFFECTIVE OXYGEN LENGTH, Km
51	E	EIRP*G/Ta
52	E1	EIRP:PWR no noise add (mW)
53	E3	EIRP:PWR+noise add #1 (mW)
54	E4	EIRP:PWR+noise add #2 (mW)
55	E5	EIRP:PWR+noise add #1 & #2 (mW)
56	L1	ELEVATION REFRACTION CORRECTION,deg
57	L1	ELEVATION FOR FITTING G/T OR G
58	X6	ELEVATION BIAS (deg)
59	E	ELEVATION(deg)
60	L0	ELEVATION--NO REFRACTION CORRECTION
61	C2	ERROR enhancement factor for NEF,NUF compared to G/T
62	F4	FILE # OF N7=1, STARTING M(40,1)
63	F4	FILE LOAD #
64	A1	FILTER #
65	C9	FILTER BANDPASS(MHz)
66	C8	FILTER FREQ (MHz)
67	O1,O2,O3	FILTER#1(2.5MHz @ 30MHz) CONSTS:N(15,1),N(15,2),N(15,3)
68	O6,O7,O8	FILTER#2(1MHz @ 70MHz) CONSTS:N(15,6),N(15,7),N(15,8)
69	P1,P2,P3	FILTER#3 (2.5MHz @ 70MHz) CONSTS:N(16,1),N(16,2),N(16,3)
70	P6,P7,P8	FILTER#4 (5.3MHz @ 70MHz) CONSTS:N(16,6),N(16,7),N(16,8)
71	H1	FIT TO G/T or NEF data (3*1S/SQR(#PTS)),dB
72	F5	FLAG IN D:1=PRGM REWORK
73	F8	FLAG IN D:1=NO FIT CUTS
74	L0	FLAG IN D:0=GRAPH,1=ERR PRT OUT-no VARIABLES,2=with variables
75	F4	FLAG IN E:1=SIMULATED NOISE ADD,2=EARHT TERMINAL
76	F5	FLAG IN E:1=NOISE ADD #1 WORKS
77	F6	FLAG IN E:0=PRGM ATTN,1=STD ATTN
78	F6	FLAG IN E:1=NOISE ADD #2 WORKS
79	F6	FLAG TASK:1=NEW SITE,2=MEAS,3=REWORK,0=MANL VIA KEYBOARD
80	F6	FLAG-AUTO SEQUENCE:1=YES

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

81	F1	FLAG-GRAPH:0=NO,1=DATA,2=&FIT,3=FIT,4=EXIT
82	C3	FLAG-NOISE ADD: 0=#1&#2,1=#1,2=#2
83	F5	FLAG-PROGR REWORK PATTERN:0=NO
84	F2	FLAG-PRT:0=ALL,1=PROG DATA,2=INPUT ASSUMPS,3=G/T EPR,4=ANT ELEV vs GMT
85	F7	FLAG-PWR LEVEL: 0=CONST, 1=STEPPED (in E)
86	F3	FLAG-SORT & FIT:1=G/T-ELEV,2=G/T-CSC,3=DIP-ELEV,4=DIP-TIME
87	F5	FLAG: 0,1= volt table in LINEARITY ck, 2,3=stability GRAPH (in E)
88	F7	FLAG: 0=CASSETTE BEING USED,1=DISK
89	F3	FLAG: 0=MANUAL READ TEMP,HUMIDITY, 1=AUTO TEMP,DEW PT
90	F2	FLAG: 0=NORMAL,1=DIFF PLOT DATA,2=DIFF PLOT OF 5 CUTS
91	F1	FLAG: 0=STAR,1=SATELLITE
92	F1	FLAG: 1=SUBROUTINE LOADED
93	F2	FLAG:0=CSC fit, 1=LINEAR fit
94	F2	FLAG:0=NO AUTO CHECK,1=YES (in E)
95	F1	FLAG:0=PRT PWR & VOLTS, 2=GRAPH PWR RATIO (in E)
96	F6	FLAG:0=RESTART,1=SKY,2=G/T,3=EIRP,4=LINK
97	F3	FLAG:0=XTAL,1=TYPE IV bridge (in E)
98	C2	FLAT-5dB ATTN IN NOISE ADD PWR MEAS:0=NO,1=YES
99	F6	FLG in E:(KEY 5)0=GRAPH,1=LIST,(KEY 6)0=SIML NOISE ADD,1=EARTH TERM
100	C3	FLG:(LOC SITE DATA).(F6=TASK)(F4=PRM CHANGE?)(F7=DISK)
101	F0	FREQ ERR,%
102	F	FREQ OF MEASUREMENT(GHz)
103	F3	FREQ(GHz) SELECTED FOR REWORK, 0=REWORK ALL FREQ
104	L$	FREQ,DIAM,G/T HEADING
105	C7	G via HPBW - G via G/Ta, dB
106	C(I,J)	G(I,J) INVERSE OR DUMMY
107	T1	G/T OR G/TA VALUE
108	E5	G/T ERR-ANTENNA POINTING
109	E6	G/T ERR-ANT POLARIZATION
110	E1	G/T ERR-ATMOSPHERIC ABSORPTION
111	E8	G/T ERR-ATMOSPHERIC DIFFUSION
112	E9	G/T ERR-ATMOSPHERIC REFRACION
113	E3	G/T ERR-BANDWIDTH
114	E4	G/T ERR-DIFFERENTIAL SKY TEMP
115	S	G/T ERR-FLUX
116	E0	G/T ERR-FREQ
117	E2	G/T ERR-STAR SHAPE
118	E7	G/T ERR-SYSTEM RESPONCE

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

119	Y1	G/T ERR-Y factor (C8*Y5)
120	M	G/T RELATIVE
121	B7,B8	G/Ta(dB) ZENITH COEFF,CSC COEFF
122	X2	GAMMA,PARABOLIC FIT
123	A2	GAUSS CURVE FIT ERROR,% dT
124	C6	GHA TO ARIES @ 0 GMT (hrs)
125	L9	GHA TO ARIES(deg)
126	E	HOUR ANGLE(deg)
127	H	HOUR ANGLE OFFSET (deg)
128	I	HPBW
129	E7	HPBW FIT BY GAUSSIAN CURVE TO DRIFT CURVE
130	D2	HPBW UNCERTAINTY,%
131	B	HPBW#1(min of arc),AS MEASURED-NO KANDA CORRECTION
132	B0	HPBW(minutes) with Kanda correction
133	Q3	HPBW,ANTENNA ALONE(i.e. with KANDA CORRECTION)
134	N(I,J)	INPUT DATA CONST, SEE MATRIX LIST
135	T(N0,J)	INPUT STAR DATA: SEE MATRIX LIST
136	H5	INSTR PWR RESPONCE FACTOR
137	C9	INSTRUMENTAL POWER RESPONCE ERR,%
138	X4	K*S/2/k
139	K	K1*K2*...*K9
140	J1	K8 for POINT SOURCE
141	N4	LARGEST N3
142	I	LOOP VARIABLE
143	J1	LOOP VARIABLE
144	M1	LOOP VARIABLE
145	X1	LOOP VARIABLE
146	H$	MAIN PROGRAM HEADING
147	Y(I)	MATRIX USED IN CURVE FIT OR DUMMY
148	J	MAXIMUM FLUX IN F.U.
149	E6	MEASUREMENT # OF FIT GAUSSIAN CURVE TO DRIFT CURVE
150	M3	MEASUREMENT # @ MAXIMUM AMPLITUDE
151	N	MEASUREMENT NUMBER
152	E2,E3	MONTH, DAY
153	T6	N-6*(N7-1)
154	V7	N3 OF STAR MAX
155	N1	NO. OF STAR SOURCES
156	R5	NUMBER OF POINTS FIT TO PARABOLA

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

157	N9	NUMBER POINTS IN FIT
158	G4	OXYGEN ABSORPTION (dB/Km)
159	F6	P(ONT) @ +F: in C/kT meas
160	F5	P(ONT) @ -F: in C/kT meas
161	D6	P(ONT),mW=(F5+F6)/2: in C/kT MEAS
162	F2	P/Pa for LOWER FREQ ONT: in C/kT meas
163	N5	PAGE NUMBER
164	V5	PARABOLIC FIT PARAMETER h
165	I5	PLOT UNIT
166	P	POWER MEASURED,MILLIWATTS
167	U	POWER NORMALIZATION
168	Q3	POWER WITH NOISE ADD ON
169	S3	PREDICTED MEASUREMENT # FOR MAXIMUM STAR PWR
170	P5	PROJECT HEADING
171	N3	PWR MEASUREMENT # WITHIN A CUT
172	L9	PWR(mW) ON SAT SIGNAL
173	A8	RATIO #1 add/#2 add uses N(18,5 or 10)
174	R0	RATIO #1add/#2add @ 70 MHz, pgm uses N(18,10)
175	F	RECEIVER FREQ(GHz)
176	P1	RECEIVER GAIN SLOPE/mHz
177	K9	REFACTIVE ATTENUATION FACTOR
178	L6	REFRACTION CONST #1
179	L9	REFRACTION CONST #2
180	D9	REFRACTIVE ATTENUATION ERROR,%
181	L$	REMARKS
182	R	REMARKS: SEE REMARK LIST
183	R2	RESIDUALS FROM CURVE FIT
184	A0	REWORK #
185	N6	RUN #
186	T2	RUN/SET
187	J	SELECT FUNTION:19=C/T,20=G/TA,21=HPBW#1,22=#2,24=DECL,25=NLF,26=NUF
188	Z5	SERROR VARIABLE
189	N7	SET #
190	A(N7)	SET DATA: SEE MATRIX LIST
191	E	SIMULATED STAR NOISE(dB)
192	C0	SITE ELEV (Km)
193	C4,C5	SITE: W.LONG (deg), N. LAT (deg)
194	D0	SKY BACKGROUND ERR, 0.9/F^2

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

195	C1	SPACE LOSS
196	F1	SPACE LOSS: in C/kT MEAS
197	E7	STANT RANGE,10^6 Km
198	S(I,J)	STAR DATA: SEE MATRIX LIST
199	S$	STAR NAME
200	N0	STAR NUMBER, CURRENT
201	D1	STAR SHAPE ERR,%
202	K2	STAR SHAPE FACTOR
203	F1	STAR SHAPE ERROR,%
204	F9	STORE SET # OF SUMMARY OF REWORK DATA
205	X$	SUBROUTINE HEADING
206	M1	SUM ON P
207	V4	SUM ON P*X^2
208	V5	SUM ON P*X
209	V6	SUM ON P^2
210	M2	SUM ON X
211	V2	SUM ON X^2
212	V3	SUM ON X^3
213	V1	SUM ON X^4
214	M3	SUM ON Y
215	M(N7,J)	SUMMARY DATA: SEE MATRIX LIST
216	N8	SUMMARY DATA # = M(50,1) = N7+F4
217	A4,A5,A6	SYST CONSTS:PRGM USES N(1,4),N(1,5),N(1,6)
218	K7	SYSTEM RESPONCE FACTOR
219	F9	T(sky)/Ta: in C/kT meas
220	T	T(syst)
221	B6	T/TA CSC COEFF
222	B5	T/TA ZENITH
223	B5	TEMPERATURE(F)
224	E3	TIME DELAY TO SET ANTENNA (SEC)
225	T1	TIME OF 1st MEASUREMENT
226	E1	TIME OF STAR PEAK (hrs)
227	X	TIME VARIABLE, 2*I/N4-1
228	X1	TIME VARIABLE, 2*(N3-M3)/N4
229	S	TIME(hrs), CURRENT
230	E8	TIME(hrs)/(ARC deg)
231	E5	TIME/MEASUREMENT (hrs)
232	E4	TRANSMITTER POWER, WATTS

VARIABLES LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

233	V6	Tstar/Ta=EXP(X-F(2)*W1^2)
234	F0	VALUE OF C2 IN FNW
235	X2	VARIABLE IN FNG(N3)
236	W1	VARIENCE OF P(STAR)/P(ADD)
237	V	VOLTAGE ACROSS PWR BRIDGE
238	G5	WATER ABSORPTION,#1 CONST (db/Km)
239	G6	WATER ABSORTION, #2 CONST (dB/Km)
240	L7	WATER DENSITY (gm/m^3)
241	L5	WATER PATH LENGTH CONST#1
242	L6	WATER PATH LENGTH CONST#2, Km
243	X1	Xi = G/dT(star)
244	Y	Y-FACTOR
245	C8	Y-FACTOR ERR,%
246	Y5	Y/(Y-1)
247	E1	YEAR
248	E5	YEARS (JULIAN) SINCE 1900 /4
249	E6	YEARS SINCE 1977
250	Z1	ZENITH ATM ATTN, dB
251	R1	ZERO FOR GRAPH
252	Q5,Q6	dP(add) in C/kT meas: @ -F, @ +F
253	V9	dT(STAR)/TA PREDICTED
254	V7	dT(star)/TA

7.5 MATRIX LIST ALPHABETICAL BY MEANING

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
 1   D(T6, 3)*   # OF MEAS(N4)
 2   T(N0,14)s   AGE OF MOON (days)
 3   A( 3)       AMBIENT TEMP(F) *10

 4   N(13, 6)    ATTN OF 1dB prgm @ 70:#3=0.976,#4=0.947,#5=0.938,#6=0.973
 5   N(13, 7)    ATTN OF 2dB PRGM @70:#3=1.890,#4=1.95,#5=1.854,#6=1.957
 6   N(13, 1)    ATTN of 1db prgm @ 30MHz:#3=0.961

 7   N(13, 2)    ATTN of 2db prgm @ 30MHz:#3=1.881
 8   N(13, 3)    ATTN of 4dB prgm @ 30MHz:#3=3.947
 9   N(13, 8)    ATTN of 4dB prgm @ 70:#3=3.909,#4=3.87,#5=3.957,#6=3.924

10   N(13, 4)    ATTN of 8dB prgm @ 30MHz:#3=7.881
11   N(13, 9)    ATTN of 8dB PRGM @ 70:#3=7.896,#4=7.86,#5=7.845,#6=7.949
12   N(13, 5)    ATTN of STD RES 30MHz:#3=5.922,#6=4.779

13   N(13,10)    ATTN of STD @ 70:#3=5.966,#4=5.92,#5=6.11,#6=6.1
14   N( 1, 7)    ATTN+meter(dB/10) 5.3@70:#3=16.15,#4=17.3,#5=15.27,#6=-17.55
15   D(6,N3+2)x  ATTN,TOTAL: E2+E6

16   D( 1, 1)x   AZIMUTH:(Az(deg)-180)*100
17   D(T6, 1)*   AZIMUTH:(Az(deg)-180)*100
18   M(N8, 5)x   C/kT(dB)

19   A( 6)       CLOUD COVER * 100 + WIND(mph)
20   M(N8, 1)x   CODE + .07
21   A( 7)x      CODE(B1):0=SKY, 1=-F, 2=RCR @ F, 3=+F, 4=OTHER

22   N(24, 1)    D-DECL(deg) INTERCEPT
23   N(24, 2)    D-DECL(deg) ZENITH
24   N(24, 3)    D-DECL(deg) INTERCEPT 1S ERR

25   N(24, 4)    D-DECL(deg) ZENITH 1S ERR
26   N(24, 5)    D-DECL(deg) ELEV COEFF
27   N(24, 6)    D-DECL(deg) CSC COEFF

28   N(24, 7)    D-DECL(deg) ELEV COEFF ERR
29   N(24, 8)    D-DECL(deg) CSC COEFF ERR
30   N( 1, 5)    DAC REF volt:#3=6.313,#4=6.367,#5=6.284,#6=6.24

31   N( 1, 6)    DAC mult=-(chnl#9-#8)/#7:#3=0,3173,#4=0.32,#5=0.3187,#6=0.32
32   T(14,10)    DAYS(SOLAR EPIC) SINCE 1977=#DAYS SINCE 1900 - 28125
33   T(14, 9)    DAYS(STAR EPIC) SINCE 1977=#DAYS SINCE 1900 - 28125

34   D(T6, 5)*   DECL OFFSET FROM PREDICTED STAR CENTER: (B1+L1)deg *1000
35   A( 4)       DEW PT(F) *10
36   T(N0, 9)*   DISK SIZE (ARC MIN) * 100

37   M(N8, 7)x   EIRP(dBw)+G/TA(dB) = E
38   M(N8, 1)    ELEV(deg) + STAR#/100
39   D( 1, 2)x   ELEV(deg)*100

40   D(T6, 2)*   ELEVATION(deg)*100
41   N(15, 1)    FILT#1(2.5@30) NOISE BW:#3=3.915,#4=3.887,#5=3.643,#6=3.552
42   N(15, 2)    FILT#1(2.5@30)N1,MHz:#3=0.00938,#4=0.01526,#5=0.0178
```

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

43	N(15, 4)	FILT#1(2.5@30)LOSS,dB:#3=3.092,#4=2.711,#5=2.391,#6=2.560
44	N(15, 6)	FILT#2(1@70)NOISE BW:#3=1.193,#4=1.225,#5=1.23,#6=1.250
45	N(15, 7)	FILT#2(1@70)Nl,MHz:#3=-0.1043,#4=0.0817,#5=0.1271
46	N(15, 9)	FILT#2(1@70)LOSS,dB:#3=4.970,#4=4.910,#5=4.870,#6=5.634
47	N(16, 1)	FILT#3(2.5@70)NOISE BW:#3=2.808,#4=2.910,#5=2.937,#6=2.875
48	N(16, 2)	FILT#3(2.5@70)Nl,MHz:#3=-0.102,#4=0.0108,#5=-0.130
49	N(16, 4)	FILT#3(2.5@70)LOSS,dB:#4=5.78,#5=5.84,#6=5.814
50	N(16, 6)	FILT#4(5.3@70)NOISE BW:#3=5.734,#4=5.80,#5=5.856,#6=5.671
51	N(16, 7)	FILT#4(5.3@70)Nl,MHz:#3=-0.14,#4=-0.0782,#5=0.011
52	N(17, 6)	FILT#6(0.06@70MHz)NOISE BW,MHz:#6=0.083
53	N(17, 7)	FILT#6(0.06@70MHz)Nl,MHz:#6=0.00178
54	N(17, 9)	FILT#6(0.06@70MHz)INSER LOSS,dB:#6=4.719
55	L(3, 2)x	FILTER BANDWITH,MHz (W)*10
56	N(15, 3)	FILTER#1(2.5MHz @ 30MHz):2nd CONST
57	N(15, 8)	FILTER#2(1MHz @ 70MHz):2nd CONST
58	N(16, 3)	FILTER#3(2.5MHz @ 70MHz):2nd CONST
59	N(16, 8)	FILTER#4(5.3MHz @ 70MHz):2nd CONST
60	L(T6, 7)*	FIT MEAS # AT PEAK * 100
61	L(2, 1)x	FLAG C2: 0=NO STD ATTN WHEN NOISE ADD ON, 1=STD ATTN WHEN ...
62	T(N0,21)	FLAG: 0=STAR DATA, 1=SOLAR DATA
63	S(N0,4)	FLUX AT THE WORKING FREQ (F.U.)
64	T(N0,15)*	FLUX EPOCH, YEAR*10
65	T(N0, 8)*	FLUX ERR @ STD FREQ (%) * 10
66	T(N0,10)*	FLUX ERR @ F(%) * 10
67	M(N8, 6)	FREQ (GHz)
68	A(2)	FREQ(MHz)
69	M(N8, 2)*	G/T(dB)
70	N(19, 6)	G/T(dB) CSC COEFF
71	N(19, 8)	G/T(dB) CSC COEFF ERR
72	N(19, 5)	G/T(dB) ELEV COEFF
73	N(19, 7)	G/T(dB) ELEV COEFF ERR
74	N(19, 1)	G/T(dB) INTERCEPT
75	N(19, 3)	G/T(dB) INTERCEPT 1S ERR
76	N(19, 2)	G/T(dB) ZENITH
77	N(19, 4)	G/T(dB) ZENITH 1S ERR
78	N(20, 4)	G/TA ZENITH 1S ERR
79	M(N8, 3)*	G/TA(dB)
80	N(20, 6)	G/TA(dB) CSC COEFF

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
 81   N(20, 8)     G/TA(dB) CSC COEFF ERR
 82   N(20, 5)     G/TA(dB) ELEV COEFF

 83   N(20, 7)     G/TA(dB) ELEV COEFF ERR
 84   N(20, 1)     G/TA(dB) INTERCEPT
 85   N(20, 3)     G/TA(dB) INTERCEPT 1S ERR

 86   N(20, 2)     G/TA(dB) ZENITH
 87   D( 5, 2)x    GAIN SLOPE OF RCR (P1) * 1000
 88   T(N0,22)s    GHA/HR (deg) * 1000

 89   T(N0,11)s    GHA/hr * 1000
 90   T(N0,13)s    HORIZONTAL PARALLAX * 1000
 91   M(N8, 4)*    HPBW#1 (deg)

 92   N(21, 8)     HPBW#1 CSC COEFF ERR
 93   N(21, 2)     HPBW#1 ZENITH
 94   N(21, 1)     HPBW#1(deg) INTERCEPT

 95   N(21, 3)     HPBW#1(deg) INTERCEPT 1S ERR
 96   N(21, 4)     HPBW#1(deg) ZENITH 1S ERR
 97   N(21, 5)     HPBW#1(deg) ELEV COEFF

 98   N(21, 6)     HPBW#1(deg) CSC COEFF
 99   N(21, 7)     HPBW#1(deg) ELEV COEFF ERR
100   A(10)*       HPBW#1*10^4

101   M(N0, 5)*    HPBW#2 (deg)
102   N(22, 2)     HPBW#2 ZENITH
103   N(22, 1)     HPBW#2(deg) INTERCEPT

104   N(22, 3)     HPBW#2(deg) INTERCEPT 1S ERR
105   N(22, 4)     HPBW#2(deg) ZENITH ERR
106   N(22, 5)     HPBW#2(deg) ELEV COEFF

107   N(22, 6)     HPBW#2(deg) CSC COEFF
108   N(22, 7)     HPBW#2(deg) ELEV COEFF ERR
109   N(22, 8)     HPBW#2(deg) CSC COEFF ERR

110   D(5,N3+2)x   LGT(PWR METER VOLTAGE)*10^4
111   D(T6, 6)rw   LGT(cT/Tadd)*10^4
112   T(N0,11)*    LINEAR POLZ(%) * 10

113   T(N0,12)*    LINEAR POLZ ERR(%) * 10
114   D(T6, 6)*    LOG(((Tstar+Tsystem)/Tadd)/U)*10^4
115   D(T6,N3+7)   LOG(P/U)*10^4: P=PWR MEAS mW, U=PWR REF

116   N(16, 9)     LOSS,dB:#4=4.18,#5=3.14,#6=4.083
117   D( 2, 2)x    MANUAL ATTN SETTING,dB (E6)
118   T(N0,20)*    MAX FREQ (GHz)*100 WHERE FLUX CALC VALID
```

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
119   T(N0,19)*   MIN FREQ (GHz)*100 WHERE FLUX CALC VALID
120   T(N0,12)s   N. DEC./hr * 1000

121   T(N0,23)s   N. DEC./hr (deg) * 1000
122   M(N8, 8)*   NEF (kFU)
123   N(25, 6)    NEF(kFU) csc coeff

124   N(25, 8)    NEF(kFU) csc coeff err
125   N(25, 5)    NEF(kFU) elev coeff
126   N(25, 7)    NEF(kFU) elev coeff err

127   N(25, 1)    NEF(kFU) intercept
128   N(25, 3)    NEF(kFU) intercept 1S ERR
129   N(25, 2)    NEF(kFU) zenith

130   N(25, 4)    NEF(kFU) zenith 1S ERR
131   A( 9)x      NOT USED
132   M(N8, 9)*   NOF (kFU)

133   N(26, 6)    NOF(kFU) csc coeff
134   N(26, 8)    NOF(kFU) csc coeff err
135   N(26, 5)    NOF(kFU) elev coeff

136   N(26, 7)    NOF(kFU) elev coeff err
137   N(26, 1)    NOF(kFU) intercept
138   N(26, 3)    NOF(kFU) intercept 1S err

139   N(26, 2)    NOF(kFU) zenith
140   N(26, 4)    NOF(kFU) zenith 1S err
141   D( 3, 1)x   NUMBER OF MEAS(N4)

142   M(40, 1)    NUMBER OF SUMMARY SETS STORED IN MATRIX M
143   M(40, 3)    NUMBER OF FILES USED IN DISK STORAGE
144   M(N8, 8)C   NUMBER OF POINTS IN DIP CURVE

145   N( 1, 9)    NUMBER OF POINTS IN FIT
146   M(N8, 8)x   CNT/Taco: (F2+25)/2
147   D( 4, 1)x   P/Paca(ave of set):LGT(P/Paad)10^4

148   T(N0,13)*   POLZ ANG (deg) * 10
149   T(N0,14)*   POLZ ANG ERR (deg) * 10
150   N(I,J)      PROG CONSTS I<26:1, 1=A,2=B,etc;J, 1=1,...,10=0, 11=NO SUBSCRIPT

151   A( 7)*      PWR LEVEL, microwatts
152   A( 8)       PWR RATIO CHECK:microbells/10
153   D(1,N3+2)x  PWR WITH noise add OFF @ BOLO: LGT(PWR)*10^4

154   D( 6, 1)x   PWR due to NOISE ADD,mW:LGT(PWR#2-PWR#1)*10^4
155   M(N8, 4)x   PWR due to Ta (mW)
156   D( 5, 1)x   PWR#1,mW(ave,noise add OFF):LGT(PWR)*10^((L2+L6)/10)*10^4
```

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
157   M(N8, 3)x   PWR(mW)
158   D(2,N3+2)x  PWR(noise add ON): LGT(BOLO PWR)*10^4

159   M(N8, 2)x   PWR/Pa
160   D(3,N3+2)x  PWR/Padd:LGT(P/Padd)*10^4
161   M(N8, 9)x   Padd(mw): (P5+P8)/2

162   N( 1, 8)    RATIO #1 add/#2 add @ MICROWAVE FREQ
163   N(18, 5)    RATIO #1 add/#2 add @ 30MHz
164   N(18,10)    RATIO #1add/#2add @ 70:#4=0.515,#5=0.526,#6=0.2468

165   A( 5)       RELATIVE HUMIDITY(%) *10
166   N( 1,10)    REWORK #
167   A( 1)       RUN/SET = 100*N6+N7: N6=RUN#, N7=SET#

168   N(N8,10)    RUN/SET: N6+N7/100
169   T(N0,16)*   SECULAR DECAY of flux (%/Yr)*100
170   T(N0,17)*   SECULAR DECAY of flux ERR (%/Yr)*100

171   A(10)x      SLANT DIST(Km): LGT(E7)*1000
172   T(N0, 5)*   SPEC INDEX SECULAR EXPN UNCERTAINTY(%/Yr)*1000
173   T(N0, 4)*   SPECTRAL INDEX SECULAR EXPANSION(%/Yr)*1000

174   T(N0, 6)*   SPECTRAL INDEX * 1000
175   T(N0, 7)*   SPECTRAL INDEX ERR * 1000
176   M(N8, 1)d   STAR #/100

177   S(N0,1)     STAR FLUX (F.U.) @ STANDARD FREQ
178   T(N0, 1)    STAR/SOLAR NAME
179   S(N0,3)     STAR=N. DEC. (deg);  SOLAR=N. DEC. @ 0 GMT (deg)

180   S(N0,2)     STAR=RT ASC (deg);  SOLAR=GHA @ 0 gmt (deg)
181   T(N0,18)*   STD FREQ(GHz) * 100
182   N( 9&10,1)  STORE STRING P$

183   T( 9, 1)    STORE STRING P$
184   N( 1, 4)    SYSTEM # + (DATA REVISION #/100)
185   M(N8, 3)d   T/Ta CSC COEFF (B6)

186   M(N8, 2)d   T/Ta ZENITH (b5)
187   A( 8)rw     T/Ta*10^4
188   M(N8, 5)d   TEMPERATURE,F (A(3)/10)

189   D(T6, 4)*   TIME OF PREDICTED STAR MAX: E1*1000
190   M(N8, 4)d   TIME, DECIMAL HRS (FNT2)
191   D(4,N3+2)x  TIME,hrs(E1)*10^3

192   D( 4, 2)x   TRX PWR:LGT(E4)*10^4
193   A( 9)*      U*10^4: REFERENCE PWR
194   M(N8, 7)d   WATER DENSITY (L7)
```

MATRIX LIST # 9
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

195 M(N8, 7)* Y-factor

7.6 FUNCTION LIST ALPHABETICAL BY MEANING

NBS2.00 <NBS 9915, 0007> T6 & D5-F10

REVISION # 10

-1-

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
 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=ENTER DATA INPUT
 9   FNF0  8     A$= !....!....!....!....!....!....!....!....!....!

10   FNX 36      AC VOLTS (not installed)
11   FNC(Q)      ANS ROUTINE SEQUENCE
12   FNN(Q)      ANSWER ROUTINE:DISPLAYS Q, SPACE = NO CHANGE

13   FNA(N0)     ANT POINT:N0=STAR # IN:H,L1,B1,E1; OUT:A,L,L0 <NBS7411,7449,8339>
14   FNF0  0     ATTN SETTING, FILTER IDENTIFICATION HEADING
15   FNB(Q)      BEEP: Q=# OF BEEPS

16   FNF0  4     BEST FIT 5 CUTS
17   read SW Y   BIAND(ROT(REYTE4,Y)1)=1 IF SWITCH Y IS UP
18   KLYb  8     CALC:STAR FLUX @ f

19   KEYc 16     CHANGE # PTS IN PARABOLIC FIT ROUTINE
20   KLYc  5     CHANGE BIAS:HR ANG, DECL, AZ, ELEV
21   KEYc 15     CHANGE FREQ & calc new STAR FLUX

22   KEYc 14     CHANGE NOISE ADD SOURCES (C3):0=#1&#2,1=#1,2=#2,3=PWR(mW)
23   KEYa  1     CHANGE PRGM CONST & MODIFY CORRESPONDING N(I,J)
24   KEYc  9     CHANGE STD attn(C2):0=OUT when noise add ON, 1=IN

25   KEYc 17     CHANGE: G/TA(dB)
26   KEYc  8     CHANGE: T(syst)/Ta
27   KEYc  7     CHANGE: TA = ADDED NOISE,K

28   KEYc  6     CHANGE:input ATTN (dB), FILTER #
29   KEYe  3     CHECK CHANNEL VOLTAGES
30   KEYe  2     CHECK DVM

31   KEYe  1     CHECK LIST
32   KEYe  0     CHECK NOISE ADD STABILITY
33   KEYe  4     CHECK PRGM ATTENUATORS

34   KEYe  5     CHK PWR,TYPLIV & ATTN STABILITY
35   FNX105      CRYSTAL DIODE voltage: channel #6 = 110 1001
36   FNG(Q)      CURVE FIT:0=INIT,-99=CALC FIT (out:I,R2,W1,V5,G(I,J),Y(I))

37   FNX106      D/A OUTPUT:  channel #5 = 110 1010
38   FNX104      D/A REFERENCE voltage: channel #7 = 110 1000
39   FNX 32      DC FILTER OUT

40   FNX 33      DC FILTER IN
41   FNX109      DEW POINT:  channel #2 = 110 1101
42   FLAG 1      DISK STORAGE (F7) <prgm A>
```

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
43   FNI(Q)       DRAW LINE:1 -;2 --;3 ==;4 ##;5 @@
44   FNT(Q)       DUMMY USED IN ERROR PNT OUT IN DW63B

45   FNX 24       DVM AUTORANGE
46   KEYc  2      LIKP:START @ SET ?
47   KEYa  3      ENTER TEMP,A(3);AND DEW PT ,A(4) USED IN REWORK

48   read DVM     ENTER(2,*)A,B: A=FUNCTION, B=VOLTAGE
49   read CLOCK   ENTER(3,*)C,D:C=#1 THUMB SW,D=SW #2 #3 #4 HHMM.SS
50   FNE(NO)      ERROR CALC FOR G/T: NO=STAR #

51   FNVa  7      FIT #1 OF 5 CUTS
52   FNVa  8      FIT #2 OF 5 CUTS
53   FNVa  2      FIT X=EXP(V*(V2-W1)^2)

54   FLAG 2       G/T EPROPS CALCULATED FOR SPECIFIC FREQ & DATE
55   FNL 1.1      G/T err TABLE: no print variables
56   FNL 1.2      G/T err TABLE: print variables

57   FNL 1        G/T plot (J=19)
58   FNL 2.1      G/Ta err TABLE: no print variables
59   FNL 2.2      G/Ta err TABLE: print variables

60   FNL 2        G/Ta plot (J=20)
61   FNX111       GROUND DVM:  channel #0 = 110 1111
62   FLAG 9       HEADING:1=BYPASS DATE,FREQ,ATN DIAM,C,G/T,G/Ta

63   FNH(Q)       HEADINGS: 0=FIT #, 1=TAPE #
64   FNL 3        HPBW#1 plot (J=21)
65   FNL 4        HPBW#2 plot (J=22)

66   FNU(Q)       INIT HARDWARE: 0=VTVM,BRC,NOISE @ NOMINAL, 1=INIT PWR BRG
67   FNX100       J357 INPUT(e.g. ext pwr meter):channel #11 = 110 0100
68   FNK(NO)      K-FACTOR CALC,e.g. K1,K2,...,K9

69   FNJ(Q)       KEY SUB: Q=KEY #, SEE KEY LIST
70   KEYc 19      LAST MEASUREMENT:initiates storage steps
71   KEYa  2      LINT: 1=SITE PREP, 2=MEAS, 3=REWORK

72   KEYc 14      LIST CURRENT DATA  MAT D
73   KEYc 13      LIST G/T SUMMARY
74   FNM(Q)       METEOROLOGICAL INFO:0=INPUT DATA,1=PRT DATA,2=SELECT MAN/AUTO

75   FNX 76       NO RF to BOLOMETER (avoid - use FNX68)
76   FNL 7        NEP plot (J=25)
77   FNX 68       NO RF TO BOLOMETER

78   FNX 64       NO RF to BOLOMETER  &  STD PAD IN
79   FNX 72       NO RF to BOLOMETER & STD PAD IN (avoid-USE FNX64)
80   FNX 80       NOISE ADD #1 & #2 ON
```

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
 81   FNX 81      NOISE ADD #1 & #2 OFF
 82   FNX 82      NOISE ADD #1 ON

 83   FNX 83      NOISE ADD #1 OFF
 84   FNX 84      NOISE ADD #2 ON
 85   FNX 85      NOISE ADD #2 OFF

 86   FNX 88      NOISE ADD #1 & #2 ON (avoid - use FNX80)
 87   FNX 89      NOISE ADD #1 & #2 OFF (avoid - use FNX81)
 88   FNX 90      NOISE ADD #1 ON  (avoid - use FNX82)

 89   FNX 91      NOISE ADD #1 OFF  (avoid - use FNX83)
 90   FNX 92      NOISE ADD #2 ON  (avoid - use FNX84)
 91   FNX 93      NOISE ADD #2 OFF  (avoid - use FNX85)

 92   FNL 8       NUF plot (J=26)
 93   FNX 40      CRTS (not installed)
 94   FNX 96      OPENS MULTIPLEXER so can use front panel inputs

 95   FNX 97      OPENS MULTIPLEXER so can use front panel inputs
 96   FNX 98      OPENS MULTIPLEXER so can use front panel inputs
 97   FNX 99      OPENS MULTIPLEXER so can use front panel inputs

 98   FNC(Q)      PAGE HEADING: Q=# SPACES BEFORE PRT HEADING
 99   FNY(Q)      PLOT DATA: 1=PRT HEADING
100   FNX 48      PRGM ATTN =15dB

101   FNX 49      PRGM ATTN =14dB
102   FNX 50      PRGM ATTN =13dB
103   FNX 51      PRGM ATTN =12dB

104   FNX 52      PRGM ATTN =11dB
105   FNX 53      PRGM ATTN =10dB
106   FNX 54      PRGM ATTN = 9dB

107   FNX 55      PRGM ATTN = 8dB
108   FNX 56      PRGM ATTN = 7dB
109   FNX 57      PRGM ATTN = 6dB

110   FNX 58      PRGM ATTN = 5dB
111   FNX 59      PRGM ATTN = 4dB
112   FNX 60      PRGM ATTN = 3dB

113   FNX 61      PRGM ATTN = 2dB
114   FNX 62      PRGM ATTN = 1dB
115   FNX 63      PRGM ATTN = 0dB

116   FNQ(Q)      PRGM const(MAT N):1=LIST,2=correct,3=N(I,J) to variables
117   FLAG 7      PRT OUT ERR:1=W/0 CONSTS
118   KEYb 12     PRT: DLEV vs GMT
```

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
119   KEYb 11     PRT:LIST OF ALTERATE STAR ERR
120   KEYb  7     PRT:SITE  &  FLUX DATA

121   KEYb  9     PRT:TYPICAL G/T VALUES AND ERRORS
122   FNX103      PRW BRDG OUTPUT: channel #8 = 110 0110
123   FNP(Q)      PRW MEAS:0=#1&#2,1=#1,2=#2,3=PWR,mw (IN: A3,C2,E2,V,FND1)

124   FNU(Q)      PRW RATIO CHECK:  IN:C2,L2,C3  OUT:A(7),A(8)
125   FNX101      PWR BRDG vs FINE REF: channel #10 = 110 0101
126   FNX102      PWR BRDG vs REF VOLT, set fine volt:ch #9 = 110 0110

127   FNVd  5     Q=FNF2 & RETURN
128   FNX 34      RATIO: FILTER IN
129   read SW     RBYTE 4=INTEGER SUM OF BINARY SWITCHES

130   FNR(Q)      READ(ENTER DATA) DEVICE:2=DVM,3=CLOCK,4=BREAK SWITCHS
131   KEYc  3     RLFIT 5 CUTS: USED AFTER ONE OF THE CUTS IS RETAKEN
132   FNFd  0     RESTART

133   FNVd  0     RESTART
134   KEYa  0     RESTART
135   KEYd  1     RESTART @ N=?

136   KEYb  0     RESTART:0=RESTART,1=LINKMEAS,2=REWORK,3=KEY LIST
137   KEYe  0     RESTART:0=KEY LIST,1=AUTO CK,2=NO AUTO(F2=0)
138   KEYc  0     RESTART:0REWORK,1LOAD,2AUTO SEQ,3DLL,4G/T,5FIT,6PLT,7ERR

139   KEYc  0     RESTART:1SKY,2G/T,3EIRP,4LNK,5NEW TAPE,0MASTER RESTART
140   FNFa  1     REWIND INT CASSETTE
141   FNX 69      RF TO BOLOMETER

142   FNX 65      RF to BOLOMETER  &  STD PAD OUT
143   FNX 73      RF to BOLOMETER & STD pad OUT (avoid-USE FNX65)
144   FNX 77      RF to BOLOMETER (avoid - use FNX69)

145   FNFc  0     SET# CHANGE
146   FNFb  0     SITE: W. long, N. lat, alt
147   KEYd  5     SORT,FIT and LIST DATA

148   FNFc  1     SOURCE# CHANGE, RESET MAT A & MAT D
149   FNS(Q)      SPACE PAGE Q SPACES
150   KEYc  4     STAR FIX:routine to estab ANT BIAS

151   FLAG 1      STAR FLUX CALC FOR SPECIFIED FREQ & DATE
152   KEYc  1     STAR:RESTART @ N
153   FNX 66      STD ATTN IN

154   FNX 74      STD ATTN IN (avoid - use FNX66)
155   FNX 67      STD ATTN OUT
156   FNX 75      STD attn OUT (avoid - use FNX67)
```

FUNCTION, KEY, & FLAG LIST # 10
for NBS1X.02, NBS1A.01, NBS1B.02, NBS1C.01, NBS1D.02

```
157   FNVd 12     STORE  MAT M & MAT N
158   KEYc 10     STORE CUTS TAKEN

159   KEYc 11     STORE INT: MAT N,S,T and PRGM
160   KEYd  7     STORE MAT M & MAT N
161   KEYb 10     STORE: S,T,N

162   KEYc 12     STORE:MAT N(summary data),N(prgm consts) on ext CAS/DISK
163   FNX110      TEMP (F/100):  channel #1 = 110 1110
164   FNT(Q)      TIME,DECIMAL HRS:1=SET UP E1 (IN: E3,E5,N4)

165   KEYb  2     UPDATE: FREQ,BW,ANT PARAMETERS
166   KEYb 13     UPDATE: N(I,J)
167   KEYb  3     UPDATE:ANT POINTING ERROR

168   KEYb  1     UPDATE:RUN#,DATE,SITE
169   KEYb  6     UPDATE:SUN/MOON ALMANAC DATA
170   KEYb  4     UPDATE:T,G/T,Ta,PWR RESP

171   KEYb  5     UPDATE:TEMP, DEW PT
172   FNV(Q)      VOLTAGE READING:volt range + channel #/100
173   FNW(Q)      WAIT Q MILLISEC

174   FNX(N0)     Xi=FNK(N0)*C1*S(N0,4)*1E-26
175   FNL 6       Y-factor plot (J=24)
176   FNVc 13     calc E,E0,E2,G via E2,G-diff=C7,Ta=H9,E9

177   FNVd  9     calc Ta via G at zenith =E2*(D*F/0.313)^2,E2
178   FNTd(L)     calc: ANT HPBW#1(min of arc)
179   FNVd  1     calc: G/T,G/Ta,NEF,NUF errors

180   FNVd  3     calc: GRAPH RANGES for AUTO SEQ
181   FNVd  4     calc: LINEAR & CSC FIT PARAMETERS
182   KEYd  2     calc:STAR FLUX VALUES,Ta,eff area

183   FNFd  5     heading *HPBW #1 =...+...CSC L=... (ant HPBW =...)
184   FNFd  2     heading G/T,G/Ta,NEF,NUF,Y-factor
185   FNFd  3     heading K1,...K9,K.A-eff,R-eff,S,Xi

186   FNFd  6     heading: G(dB) G-diff T(K) Ta(K) Y-fac HPBWerr data fit c(1-K2) ....
187   FNVd 11     load PRIOR SUMMARY MAT M, MAT N
188   FNFd 10     prt A2,C9,D1,N(21,1),T(1,9),C8,D8,D9,J1,N(21,3),T(1,11),C2

189   FNFd  9     prt K1,K2,K3,K6,K8,K9,K,A-eff,R-eff,S,Xi
190   KEYd  4     prt: G/T DATA SUMMARY with page heading
191   KEYd  6     prt: G/T DATA SUMMARY (no heading)

192   FNFd  1     ques DATA ON TAPE/DISK,TAPE #
193   FNFd  7     ques: DATA SET#
194   KEYe  9     ques: NEW FREQ,BW,INPUT ATTN,SIML STAR NOISE

195   FNVd  6     read: RWRK#,SET,F,T/Ta@90,csc,HPBW@90,csc,Ta
196   FNVd 10     set FLAG F8 if REWORK# not integer
```

8. COMPUTER PROGRAM LISTINGS

In this section, the flow diagram for the computer program is 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 circled on the flow diagrams are the "R" numbers. For example, 405 corresponds to the location in the computer program of the line where R = 405 occurs. The purpose for the R numbers is to label program segments in the computer listings; and, in the case of a hardware or a software hangup, to be able to identify which part of the program was being executed at the time of the hangup. To obtain this identity, the current value of R is examined using the computer keyboard command R, "EXECUTE."

```
50 !I="%.08  D1-4  T. "
60 GOTO 3960
70 DEF FNX(0)
80 FORMAT B
90 WRITE (4,80)NBYTE(0
100 WAIT 100
110 RETURN 0
120 DEF FNP(0)
122 IF 0=4 THEN 142
124 WAIT 40
130 ENTER (0,,,01,0
140 RETURN 0
142 RETURN RBYTE
150 DEF FND(0)
160 IF 0 THEN 180
170 RETURN FNX68+FNX67*FN
180 0=FNX68+FNX28+FNX103+FNW460+FNR2
190 V=FNX68+FNX29+FNX103+FNW500+FNR2+FNT111+FNT27+FNW100
200 RETURN 0
210 DEF FNP(0)
220 IF E2 >=0 THEN 240
230 E2=0
240 IF E2<16 THEN 260
250 E2=15
260 IF 0>2 THEN 440
270 V7=FNX67+FNX68+FN
280 V8=FNX69+FNW460+FNR2
290 V9=FNX(67-C2)+FNX(C2+2*01+V7*FNW460+FNR2
300 V8=FNX(81+2*0)+FNX67+FNW460+(V8+FNR2)/2
310 IF ABS(V7+V8+V9)>1E+70 THEN 400
320 01=V8*(2*V-V8)
330 02=V9*(2*V-V9)
340 03=(1-C2+C2*A3)*02
350 IF 01>0.096 OR 02>0.096 THEN 370
360 E2=E2-1
370 IF 01<0.132 AND 02<0.132 THEN 390
380 E2=E2+1
390 RETURN 01*(03-01)
400 PRINT "RE2ERO"
410 E2=E2+1
420 01=FNV(65-E2)+FND0+FND1
430 GOTO 220
440 V7=FNX68+FNX101+FN
450 V8=FNX69+FNW460+FNR2
460 V9=FNX68+FNW460+FNR2
470 V=FNX103+FNX29+FNW
480 IF ABS(V7+V8+V9)<1E+70 THEN 490
490 01=(V7+V9)/2-V8
500 RETURN 01*(2*V-01)*5
```

```
510 DEF FNA(N0)
520 E9=24/360*COS(N0-.1)
540 E9=((E1+H-E8)/24-L1.0)%
550 IF T[N0,21]=0 THEN 580
560 E=S[N0,2]+(E1+H-T[N0,11])*6-.5
570 GOTO 650
580 E9=E9+06*24/360
590 IF E9 >= 24.06570 THEN 610
600 GOTO 630
610 E9=E9-24
620 GOTO 590
630 E9=E9+360/24
640 E=E9+060-S[N0,2]-04
650 IF E >= 360 THEN 670
660 GOTO 690
670 E=E-360
680 GOTO 650
690 O=S[N0,3]+T[N0,2]*E1-T[N0,1] 1920*L1+B1
700 L=SIN05*SIN0+COS05*COS0*COSE
710 L=ATN(L/SQR(1-L*L+1E-99))
720 A=SIN0/COS05/COSL-TAN05*TANL
730 A=ATN(SQR(1-A*A)/(A+1E-99))+2+ATN(1E+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[N0,21]=0 THEN 820
800 O=T[N0,13]/1000
810 L=L-ATN(COSL*SIN0/(1-SINL-SIN0))
820 O=L0=L
840 FOR I=1 TO 4
850 00=(L8/TAN0-L9/(TAN0*2.))/62
860 O=00+L
870 NEXT I
880 L=O
890 RETURN A
900 DEF FNB(O)
910 FOR I=1 TO O
920 BEEP
930 WAIT ABS(100*(I-4))
940 NEXT I
950 RETURN O
960 DEF FNN(O)
970 DISP "( =NO):";O;
980 INPUT B$
990 IF B$[1,1]=" " THEN 1010
1000 RETURN VAL(B$)
1010 RETURN O
1020 DEF FNI(O)
1030 A$="- - ---------####@@@@"
1040 A$=A$[4*O-3,4*O]
1050 A$[5]=A$
1060 A$[9]=A$
1070 FORMAT F5.1
1080 WRITE (15,1070)N$;A$;N$;O$;A$
1090 RETURN O
```

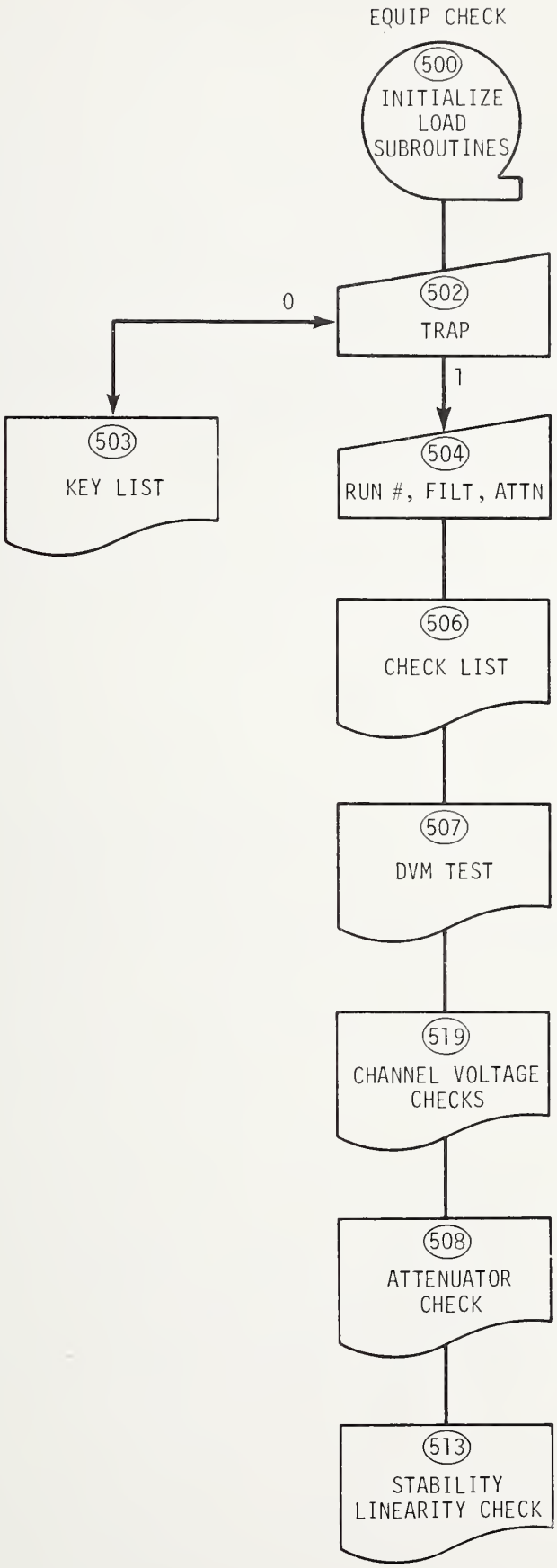
```
1100 DEF FNK(N0)
1120 L7=256*EXP(0.11[illegible]
1130 0=(0.9211*(1+0.[illegible]
1140 [illegible]
1150 G4=6.644E-03*(1-0.0[illegible]
1160 0=1-0.02215*(11.02-[illegible]
1170 L4=5.145/02*[illegible]
1180 0=(1+493.3/FT2*(1-493.3[illegible]
1190 G5=1.451E+05*(1-0.0225[illegible]
1200 L5=2.09+6.27*(1-0212)
1210 G6=2.529E-02*(1-0.0225[illegible]
1220 L6=2.17
1230 Z1=G4*L4+G5*L5+G6*L6
1240 L8=02*(0.9227*(1-0.022[illegible]
1250 L9=0.013
1260 K1=10T(-Z1/10/SIN[illegible]
1270 K4=293/02*(1-K1*1.0/[illegible]
1280 02=(T[N0,9]*100.-1.201*K[illegible]
1290 K2=(1-EXP(-02*)).0.1.0J
1300 K3=1
1310 0=(W/F/2E+03)T2
1320 K4=1
1330 K5=1
1340 K6=1
1350 K7=1
1360 J1=10T(-0.00011*[illegible]
1370 K8=1-(1-J1)*EXP(-0.46/*[illegible]
1380 0=1+(2.90*E-04)*[illegible]
1390 S=1/0
1400 K9=1-(1-S)*EXP(-0.4L/*[illegible]
1410 K=K1*K2*K3*K4*K5*[illegible]
1420 RETURN K
1430 DEF FNW(0)
1440 WAIT 0
1450 RETURN 0
1460 DEF FN2(N0)=FNK(N[illegible]
```

```
1470 DEF FNC(X)
1480 X5=X5+1
1490 C=FNC(X)
1500 IF STAT(3) THEN 1500
1510 C=FNA(3)
1520 IF X<10^3 THEN 1540
1530 PRINT
1540 DISP "OLDER ";E;F
1550 INPUT Q1
1560 GOTO 1450
1570 FORMAT 21X,"T" (F4.0,
1580 WRITE (15,1570)(1 IF I > 1 OR I < N-TW/100-100*I,T 1014
1590 W=23
1600 PRINT #4; :       %.4
1610 PRINT
1620 PRINT
1630 FORMAT 2F(X,F4.0,1X,"(",F3.0,"%)",5X,"RUN ",F1.0
1640 WRITE (15,1610)-X5,W(X)/W
1650 FORMAT "   (",F3.3,")"
1660 PRINT
1670 FORMAT 20 (1X,"POO   ",F1.0,1X,"
1680 WRITE (15,1670)F$(1,2,3)          ,F$[31]
1690 IF FLAG9 THEN 1?"
1700 PRINT TAB(Q);F$[1,1]"     "F$[2,2]" "F$[4,6]"   "F$[7,8]"
1710 WRITE (15,1667)Q
1720 FORMAT 1X,F6.3," LMS",F5.1,"  HT IISH"
1730 WRITE (15,1720)F,I
1740 IF FLAG5 THEN 1770
1750 FORMAT 1X,"S TO          (T  ,  ,  2.2," dE 1"",F7.1," SB.F"
1760 WRITE (15,1750)10^LOG( ),M1,"10",(I-G-T)
1770 PRINT
1780 RETURN 2
1790 DEF FNS(
1800 FOR I=1 TO 0
1810 PRINT
1820 NEXT I
1830 RETURN 2
```

X#	50	1600									
FNX	70	170	[illegible]			[illegible]0	180	180	160	190	190
	190	190	190	[illegible]	[illegible]	[illegible]70	270	270	270	280	290
	290	300	300	420	440	440	440	450	460	470	470
0	70	90	120	122	130	130	140	150	160	180	210
	260	270	290	300	[illegible]	700	700	720	800	810	810
	820	850	850	360	[illegible]	900	910	960	970	1010	1020
	1040	1040	1130	1150	1150	1170	1170	1180	1190	1310	1380
	1390	1430	1440	1470	1490	1490	1510	1520	1580	1580	1580
	1590	1700	1790	1800							
FNR	120	180	180	190	270	280	290	300	440	450	460
	470	1510									
01	130	320	350	370	390	390	420	490	500	500	1550
	1580										
FND	150	420	420								
FNW	180	190	190	270	280	290	300	440	450	460	470
	1430										
V	190	320	330	470	500						
FNP	210										
E2	220	230	240	250	270	360	360	380	380	410	410
	420										
V7	270	290	300	310	440	480	490				
V8	280	300	300	310	320	320	450	480	490		
V9	290	310	330	330	460	480	490				
C2	290	340	340								
02	330	340	350	370	1140	1150	1160	1170	1190	1190	1200
	1210	1240	1270	1290	1290	1290	1370	1400			
03	340	390									
A3	340										
FNA	510										
N0	510	530	550	560	560	640	690	690	690	790	800
	1100	1280	1460	1460	1460						
E8	530	540									
S[ ]	530	560	640	690	1460						
E9	540	580	580	590	610	610	630	630	640		
E1	540	560	690								
H	540	560									
T[ ]	550	560	690	690	790	890	1280				
E	560	640	650	670	670	700	740	750	760		

```
C4      560   640

C6      580

L1      690

E1      690

L       700   710   [illegible]   10   120   810   910   810   910
        820   960   [illegible]   1080  1380

C5      700   700   [illegible]

P       720   720   [illegible]   0   780   780   [illegible]

L0      830

I       840   870   [illegible]   700   1020

C0      850   860

L8      850   1240  [illegible]

L9      850   1250  1360

FNB     900

FNM     960

B$      960   990   1020

FNI     1020

A$      1000  1040  [illegible]   1050  1060  1070  1010  1000
        1080

FNJ     1100  1460

LT      1120  1180  1110  [illegible]   1040

A[ ]    1130  1120  1140

P       1130  1130  1130  [illegible]   1310  1310  1360  1740  1730

G4      1150  1230

C0      1150  1160  [illegible]

L4      1170  1230

G5      1190  1250

L5      1200  1230

G6      1210  1230

L6      1220  1230

D1      [illegible]   1260

P1      [illegible]   1270  [illegible]

B4      1270

E       1300
```

K2	1290	1410
K3	1300	1410
N	1310	
K4	1320	1410
K5	1330	1410
K6	1340	1410
K7	1350	1410
J1	1360	1370
K8	1370	1410
S	1390	1400
K9	1400	1410
K	1410	1420
FN2	1460	
C1	1460	
FNC	1470	
NS	1480	1480 1640
FNS	1490	1790
H$	1600	
HEX	1640	
N6	1640	
P$	1680	1680 1690 1700 1750 1700
C	1710	
D	1730	
G	1760	1760
H9	1780	
T	1760	


EQUIP CHECK
500
INITIALIZE LOAD SUBROUTINES
502
TRAP
0
1
503
KEY LIST
504
RUN #, FILT, ATTN
506
CHECK LIST
507
DVM TEST
519
CHANNEL VOLTAGE CHECKS
508
ATTENUATOR CHECK
513
STABILITY LINEARITY CHECK

```
3700 R=500
3890 DISP "PRGM:S=E4" [illegible]
3900 INPUT 0
3910 PRINT 0
3920 LOAD  KEY #0,2
3930 O=RES
3940 MERGE #0,4,50,50
3960 M$="MBS1E.13 :P5 :H   COUIE : :F :   T1-F0"
3965 LOAD  DATA #RES ,M
3967 REWIND #RES
3970 DIM A$[72],B$[11] [illegible]
3980 R=A=A1=A2=C=C2=C3=C4=C9=E=I=J=1=T  =F3=F4=F5=F6=F7=F9=0
3990 H=I=I5=I6=J=J1=N1=N1=N2=N3=N4=N5=N6=O3=O4=O
4000 P=P0=P1=P2=P3=P5=P7 [illegible]
4010 V=V1=V2=V7=V8=V9=0
4020 X2=X3=X4=Z=0
4022 A3=10↑(N[13,10]-10)
4024 A8=N[18,10]
4030 C8=70
4032 C9=5.3
4034 H=3.5
4040 F=7
4050 E2=1
4060 G=1014
4070 D=60
4080 T=100
4090 P$[1,12]=""
4100 SFLAG 9
4110 O=FNJ0
4120 STOP
4122 DEF FNF(0)
4126 GOTO 8500
4130 R=501
4140 DEF FNV(0)=FNX(SI-INT(0)+FNA.111 (0 INT0)*100)+FNW1000+FNR2
4150 R=502
4160 DEF FNJ,0,
4170 GOTO 0 OF 4520,4030,"[illegible]
4180 P$[13]="KEY 0:  CHECK LIST AND KEY LIST"
4190 O=FNS2
4200 R=503
4202 P2=0
4204 STANDARD
4210 DISP "0=KEY LIST,1=AUTO CK";
4220 O=FNE24FNN1
4230 GOTO O OF 4456
4240 PRINT
4250 PRINT
4260 A=18
4270 PRINT TABA"KEY 0: [illegible]
4280 PRINT TABA"KEY 1: CHECK LIST"
4290 PRINT TABA"KEY 2: CHECK SYN
4300 PRINT TABA"KEY 3: CHECK [illegible] VOLTAGES"
4310 PRINT TABA"KEY 4: CHECK ATTENUA[illegible]"
4320 PRINT TABA"KEY 5: CHECK PWR, TYPE IV & ATTEN STABILITY"
4322 PRINT TABA"KEY 6: CHECK NOISE AMB STABILITY"
4324 PRINT TABA"KEY 7: CHANGE STANDARD ATTENUATION VALUE"
4328 PRINT TABA"KEY 9: NEW FREQ, LW, INPUT ATTN, SIML STAT NOISE"
4330 O=FNS2
4340 GOTO 4210
```

```
4350 R=504
4370 DISP "RUN #";
4380 N6=FNB3+FNN6
4390 DISP "FILTER FRQ: 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:";A8;"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 ? Y/N (Y=NO)";
4469 INPUT Q
4470 IF Q=0 THEN 4478
4476 Q=FNJ1+FNS6+FNJ2
4478 Q=FNS4+FNJ3+FNS9+FNJ4+FNJ5.1+FNS6+FNJ5+FNJ6+FNJ5
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(ABS(N[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 "NOISE SOURCE CONNECTED TO RF INPUT";
4710 INPUT A$
4712 Q=FND0
4720 PRINT "RF UNIT: OUTPUT METER @ ";10*SGN(N[1,7])+(ABS(N[1,7])-6);" 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=5.7
4840 P$[1,3]="KEY
4850 Q=FNL+FND0+
4860 PRINT "DVM FUNCTION
4870 INPUT A$
4880 Q=FNS$3
4890 PRINT "DVM FUNCTION
4900 INPUT A$
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$(-1)+"RANGE #";7
4970 FOR I=1 TO 5
4980 PRINT
4990 NEXT I
5000 DISP "END";
5010 RETURN 0
5020 R=506
5030 P$[13]="KEY 4:
5040 Q=FND0
5050 F3=1
5060 N=3
5070 C2=1
5080 R=502
5090 IF F3 THEN 5130
5100 DISP "0=XTAL,1=
5110 F3=FNL4+FNN1+FNJ0
5140 DISP "# REPEAT
5150 N=FNB2+FNNN
```

```
5180 R=513
5190 GOSUB 5620
5200 P0=P
5210 Q=FNC3+FNS2+FNF0+FNL
5220 IF F3 THEN 5260
5230 FORMAT 3X,"CRYSTAL [illegible]= ",F4.1," VOLTS  + "F6.3" %"2X,"(",F3.0," MEAS "
5240 WRITE (15,5230)P0,S,N
5250 GOTO 5280
5260 FORMAT 3X,"NBS TYPE IV OUTPUT",F7.5," MW +-",F6.3," %",2X,"(",F3.0," MEAS "
5270 WRITE (15,5260)P0,S,N
5280 GOSUB 5800
5290 FORMAT 2X,"STD CK:",F6.1," 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 ",F1.0," DB",F1.5," +-",F5.2," %",F8.0," DB",F10.3," DB"
5540 WRITE (15,5530)E6-A1,P1-P2,10*LGT(P0/P1),10*LGT(P1/P2)
5550 FORMAT F13.0," DB",F13.3," +- ",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 VIHL 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(4.05)
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))/M
5790 RETURN
```

```
5800 P=512
5810 REM **** [illegible] IF DB CHECK [illegible] IF = 0
5820 Z=P
5830 O=FNX66
5840 GOSUB 5600
5850 O=FNX75-10*LGT( [illegible] )
5860 PSTUFN
5870 F=513
5880 P$[13]="KEY 5:  CHECK PWR/LINEARITY/STAB OF TYPE IV"
5882 F8=10+CO-INTC
5890 C3=3
5900 T1=FNP3
5910 O=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=PPT PWR/V/S, 2=GRAPH PWR RATIO";
6020 F1=FND3+FNNF1
6030 IF F1=0 THEN 6210
6040 DISP "PRW 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
```

```
6230 REM BYPASS NOISE [illegible]
6240 00=0
6240 GOTO 6270
6250 DISP "PWR VIA [illegible]
6260 00=PWR0
6270 C2=0
6280 P2=P1+00
6290 IF 00=0 THEN 6340
6300 DISP "ADD SOURCE[illegible]
6310 C2=PWRC3
6320 DISP "INSERT 2ND PWR[illegible]
6330 C2=PWRC2
6340 T0=0
6350 DISP "INPUT ATTEN [illegible]
6360 E6=PWRE6
6370 IF P1=2 THEN 6410
6380 DISP "SIMULATED STAR NOISE [illegible]
6390 H=PWRH
6400 FIXED 4
6405 DISP "STD=";10*LGTA3; "DB"
6410 A0=NL1,3]=PWRA3
6415 STANDARD
6420 DISP "IF FREQ MHZ"
6430 C8=PWRC8
6440 DISP "BANDWIDTH MHZ"
6450 C9=PWRC9
6480 R=515
6490 Q=PWC2+PWP0+PWS2
6540 IF P5>1 THEN 6880
6550 FORMAT "  N0, BRDG "        /7          V8          V9        PWR(MW)"
6560 WRITE (15,6550)"    I  E*R    SIGNA"
6570 PRINT
6580 Q=PWD1
6590 M1=M2=N=N1=N2=P3=V1=V2=S=S1=S2=0
6600 P=PWPC3
6602 IF P2 THEN 6650
6610 Q4=PWR3
6620 IF INT(Q4.10)-INT(T1.10)=0 THEN 6650
6630 Q=PWC2+PWD0+PWD1
6640 T1=Q4
6650 N=N+1
6660 IF N/2-INT(N/2) THEN 6710
6670 Q=PWY67
6680 N1=N1+1
6690 M1=M1+P
6700 V1=V1+P*P
6710 IF N1=1 THEN 6710
6720 S=SQR((V1-M1*M1/N1)/(N1-1))/M1*100
6730 GOTO 6810
6740 Q=PWX66
6750 N2=N2+1
6760 M2=M2+P
6770 V2=V2+P*P
6780 IF N2=1 THEN 6810
6790 S=SQR((V2-M2*M2/N2)/(N2-1))/M2*100
6800 FORMAT F4.0,F8.4,[illegible]F8.4,"DB",F7.2,"%"
6810 IF N=1 THEN 6830
6820 P2=P
6830 WRITE (15,6800)N,V1,V2,"DB",P,"  ";N*10+LGT(M2/P)-10*LGTA3,S
6840 P2=P
6850 IF N/2-INT(N/2) THEN 6870
6860 PRINT
6862 IF P2 AND N/27 THEN 6870
6870 GOTO 6600
6872 RETURN
```

```
6860 R=516
6870 REM **  -THRILL-  GAIN  *
6900 FORMAT 5X,"#1 LE  "  F  .0    DB  F.1   +",F2.0
6910 FORMAT F3.0,"DB +  "
6920 FORMAT F3.0," DB  "
6930 FORMAT 5X,"MEAS PLOT PT  "
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)N
7000 FORMAT 5X,"#2 LEVEL  "  .  .0  .1  +",F2.1
7010 FORMAT 5X,"UNIT  ="  F  .4,"  dB",F7.4
7020 WRITE (15,7000)F6
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,  ,F6.3,4X,F6.3,4X,F6.3,  ,F6.3,"  DB",F6.3
7100 WRITE (15,7090)-25,I5,-15,I5,-5,I5,5,I5,15,I5,25,I5
7110 A$="!....!....!....!....!....!....!....!....!....!....!"
7120 PRINT TAB3,A$
7130 N=1
7140 J1=0
7150 T3=FNR3
7160 GOSUB 7290
7170 R5=R2
7180 I6=R5
7190 FORMAT "#/TIME",/1X,"CEN=",F6.1," DB",22X," AVE   ",3X,"#1 PWR"
7200 WRITE (15,7190)T
7210 GOTO 7340
7220 R=517
7230 N=N+1
7240 IF N>36 AND F2=1 THEN 7350
7250 IF F7=0 THEN 7290
7260 J1=J1+1
7270 IF J1<16 THEN 7290
7280 J1=0
7290 Q=FNX(63-J1)
7300 IF N/30=INT(N/30) THEN  .  .0
7310 PRINT TAB3,A$
7320 GOSUB 7090
7330 R5=(9*F5+R2)/10
7340 X3=(R2-I6)/I5*2
7350 IF ABS(R5-I6)/I5  10 THEN  
7360 I6=R5
7370 WRITE (15,7190)T
7380 IF X3.0 OR X3>50 THEN 70  0
7390 ENTER (3,  )D,T4
7400 IF INT(T4/10)=INT(T  10  THEN  
7410 FORMAT F4.0,4X
7420 WRITE (15,7410)N
7430 D0=FND1
7440 GOTO 7480
```

```
7450 FORMAT F6.2,2X
7460 WRITE (15,7450)[illegible]
7470 T3=T4
7480 X4=INT(S/15)
7490 IF X4>1 THEN 7510
7500 X4=1
7510 IF (X3-X4)<0 AND [illegible] 50 THEN 7650
7520 IF (X3-X4)<0 THEN [illegible]
7530 IF (X3+X4)>50 THEN 7650
7540 PRINT TAB(X3-X4);"!";RPT$(X4,"+");TAB(X3+X4);"!";TAB50;
7550 GOTO 7630
7560 FORMAT 4X,"COFF S[illegible]",F8.4," DB +-",F7.4," DB",4X,F5.1
7570 WRITE (15,7560)R2,S
7580 GOTO 7630
7590 PRINT TABX3;"+";TAB(X3+.4);"!";TAB50;
7600 GOTO 7630
7610 PRINT TAB(X3-X4);"!";TAB(X3);"+";TAB50;
7620 FORMAT F10.4,"DB",F7.3,"MW",F6.4
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 0=FND1
7730 FOR I=1 TO N3
7740 0=FNX(63-A1+F6)
7750 P=FNPC3
7760 P6=P
7770 M1=M1+P6
7780 P=FNX(63-A2+F6)+FNP3
7785 IF P=0 THEN 7804
7790 IF (P6/P) <= 0 THEN 7[illegible]
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)))
7880 RETURN
7890 0=FNS6
7900 RETURN 0
```

```
7910 R=519
7920 P$[13]="KEY 5:  CHECK CHANNEL X-Y RANGES"
7930 Q=FNC3+FND0+FND1
7940 RESTORE 7940
7950 FORMAT 3X,"CHANNEL",2X,"VOLTAGE",3X,"STATUS",6X,"NOMINAL",10X,"+- RANGE
7960 WRITE (15,7950)
7970 Q=FNS2
7980 FOR J=0 TO 10
7990 READ A$,A1,A2
8000 GOTO INT(A1/100  OF 8020,8040,8060
8010 GOTO 8080
8020 A1=10+FNV7.09
8030 GOTO 8080
8040 A1=NC(1,5)
8050 GOTO 8080
8060 Q=FNV7.09
8070 A1=FNV7.08-NC(1,6)+FNV7.0"
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",11.9,0.1
8230 DATA "5=DAC OUTPUT",100,0.01
8240 DATA "6=XTAL DIODE",-0.0125,0.0125
8250 DATA "7=D/A REF",200,0.01
8260 DATA "8=BRDG OUTPUT",2.5,0.1
8270 DATA "9=SET FINE REF",300,0.005
8280 DATA "10=BRDG vs REF",0,0.01
8290 Q=FNS12
8300 RETURN 0
8500 R=520
8510 FORMAT 10X,"SIML STAT ATTN:",F4.1," dB",11X,"IF FREQ: ",F9.0," MHz"
8520 FORMAT 10X,"INPUT ATTN:",F8.0," dB",11X,"END#0:",F11.1," MHz"
8525 FORMAT 10X,"STD   ATTN:",F8.3," dB",11X,"#1 #2=#3:",F9.4
8530 WRITE (15,8510)H,C
8540 WRITE (15,8520)E6,L9
8545 WRITE (15,8525)10,LGTA2,n%
8550 RETURN 0
```

```
8560 R=521
8570 P$[13]="KEY 6:
8580 F8=10*(0-INT(0)
8590 N=3
8600 F4=1
8610 IF F2 AND  NOT F3 THEN 8720
8630 F4=2
8705 IF F2 THEN 8722
8710 DISP "1=SIMUL,2=ENTER (ENTER)"
8712 F4=FNB2+FNNF4
8714 DISP "#MEAS/SET":
8716 N=FNNN+FND0+FND1-FN
8722 C2=1
8724 P=FNP0
8726 IF Q/Q1>0.5 THEN 8740
8728 C2=0
8740 P$[21]="SIMULATEd NOISE ADD Fes"
8760 IF F4=1 THEN 8772
8770 P$[21]="EARTH TERMINAL TEST
8772 Q=FNC4+FNS1+FNP0+FN32
8776 P=FND0+FNX66+FNP3+A3
8778 P1=FNX82+FNP3*A2
8780 P2=FNX83+FNX84+FNP3+A3
8782 FORMAT "  P=",F7.4," mW",5X,"odd #1=",F7.4," mW",5X,"odd #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=FN32
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     STDev"
8815 FORMAT 76X,"dB"
8816 WRITE (15,8815)
8817 E2=-1
8820 N0=N1=N2=N3=N4=N5=N6=N7=N8=N9=M0=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*(Q6-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 02/01>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*(03-01)
9020 N4=N4+P2
9030 M4=M4+P2↑2
9040 N1=N1+5*01
9050 M1=M1+25*01↑2
9055 IF (F5+F6)=0 THEN 9210
9060 C2=1
9070 P=FNP0
9072 E2=F7
9080 IF 02/01>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+(03-01)
9140 M5=M5+(25*(03-01)↑2)
9150 N1=N1+5*01
9160 M1=M1+25*01↑2
9162 0=P1/P2
9170 06=06+0
9180 M6=M6+0*0
9190 N2=N2+5*02
9200 M2=M2+25*02↑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 0=10*LGT(P/P1)-10*LGTA3
9260 N0=N0+0
9270 M0=M0+0↑2
9275 NEXT A
9280 FORMAT 10F8.4
9282 0=(1+F5+F6+((F5+F6)#0))*N
9290 WRITE (15,9280)N1/0,N2/N,N3-n,N4 N,05/N,06/N,N7/N,N8/N,N9/N,N0/N
9300 FORMAT F6.2,"% ",F6.2,"% ",F6.2
9301 E=N-1
9302 01=(M1-N1↑2/0)/(0-1+(0=1))
9303 IF 01>0 THEN 9305
9304 01=1
9305 02=(M2-N2↑2/N)/E
9306 IF 02>0 THEN 9309
9307 02=1
9309 N2=N2+(N2=0)
9310 WRITE (15,9300)100*SQR01 N1-0,100*SQR02/N2+N,
9311 N3=N3+(N3=0)
9312 01=(M3-N3↑2/N)/E
9313 IF 01>0 THEN 9316
9314 01=1
9316 N4=N4+(N4=0)
9317 02=(M4-N4↑2/N)/E
```

```
9318 IF Q2>0 THEN 9320
9319 Q2=1
9320 WRITE (15,9300)10,[illegible] QR02 [illegible]
9322 O5=O5+(O5=0)
9323 Q1=(N5-O5*O5/N).E
9324 IF Q1>0 THEN 9326
9325 Q1=1
9326 O6=O6+(O6=0)
9327 Q2=(N6-O6*O6/N).E
9328 IF Q2>0 THEN 9330
9329 Q2=1
9330 WRITE (15,9300)10,[illegible] 5*10^N6,5QR02/O6^N
9332 N7=N7+(N7=0)
9333 Q1=(N7-N7*N7/N).E
9334 IF Q1>0 THEN 9336
9335 Q1=1
9336 N8=N8+(N8=0)
9337 Q2=(N8-N8*N8/N).E
9338 IF Q2>0 THEN 9340
9339 Q2=1
9340 WRITE (15,9300)10,[illegible] 5QR02/[illegible]
9341 N9=N9+(N9=0)
9342 Q1=(N9-N9*N9/N)/E
9343 IF Q1>0 THEN 9345
9344 Q1=1
9345 N0=N0+(N0=0)
9346 Q2=(N0-N0*N0/N)/E
9347 IF Q2>0 THEN 9350
9348 Q2=1
9349 FORMAT F6.2,"% ",F8.4
9350 WRITE (15,9349)10,[illegible]
9352 PRINT
9390 GOTO 6820
9400 RETURN 0
9500 R=522
9510 P$[13]="KEY 7:  CHANGE  MANUAL ATTENUATION VALUE
9515 FIXED 4
9520 PRINT "STD(";10*LGTA3;")";
9530 A3=N[1,3]=FNNA3
9570 GOTO 9515
9900 GOTO 9998
```

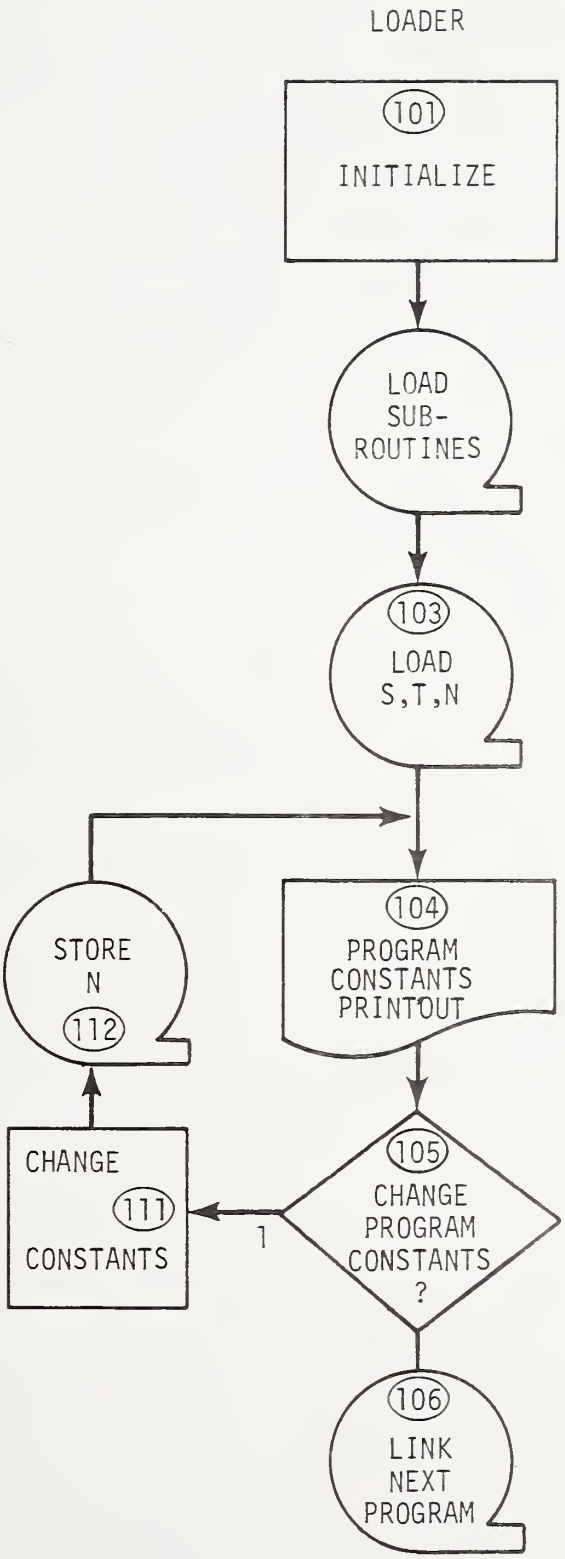
```
R       3700  3980  4130  4150  4400  4450  4466  4530  4830  5020  5080
        5180  5620  5800  5870  5900  6480  6880  7220  7690  7910  8560
        8560  9500

Q       3900  3910  3920  3930  3940  4000  4110  4122  4140  4140  4140
        4140  4160  4170  4180  4220  4230  4330  4469  4470  4476  4478
        4490  4500  4712  4830  5000  5040  5210  5300  5440  5480  5560
        5600  5660  5830  5850  5882  5882  5910  6490  6580  6630  6670
        6740  7290  7590  7720  7740  7990  7930  7970  8060  8080  8090
        8110  8110  8130  8170  8290  8580  8580  8726  8772  8790  9162
        9170  9180  9180  9250  9360  9270  9282  9290  9302  9302  9302
        9310

H$      3960  3970

NS[ ]   3965  3970  4022  4024  4405  4407  4655  4720  4720  6410  8040
        8070  9530

A$      3970  4550  4570  4590  4610  4630  4650  4670  4674  4690  4710
        4730  4750  4770  4870  4900  4940  7110  7120  7310  7990  8090
        8100  8120  8140

B$      3970

D$      3970

L$      3970

P$      3970  4090  4120  4840  5030  5880  7920  8570  8740  8770  9510

X$      3970

A       3980  4260  4270  4230  4290  4300  4310  4320  4322  4324  4328
        8830  9275

A1      3980  5390  5410  5420  5420  5420  5440  5540  5560  5590  5962
        6110  6150  6960  6980  7740  7990  8000  8020  8040  8070  8110
        8110  8140

A2      3980  5430  5480  5560  5560  5580  5964  6120  6150  7040  7060
        7780  7990  8110  8110  8140

C       3980

C2      3980  5070  6270  6330  6430  8722  8728  8840  8870  8950  8980
        9060  9090

C3      3980  5890  6310  6310  6600  7750

C8      3980  4030  4400  4400  4405  4407  6430  6430  8530

C9      3980  4032  4420  4420  6450  6450  8540

E6      3980  4440  4440  4655  4670  4720  5540  6360  6360  6940  7020
        8540

F1      3980  5920  5975  6020  6420  6630  6280  6370

F2      3980  4202  4467  5090  5400  6100  6602  6862  7240  8610  8705
        8826

F3      3980  5050  5110  5220  5450  5480
```

F4	3980	8600	8620	8712	8713	8760					
F5	3980	5920	5975	6280	6540	8786	8842	9055	9282	9282	
F6	3980	5940	6070	6100	6100	6130	6170	6950	7030	7740	7780
	8788	8945	9055	9280	9282						
F7	3980	5930	6050	6050	6060	7250	8824	8832	8852	8882	8962
	8992	9072	9102	9212	9242						
F9	3980										
H	3990	4034	4460	4460	6340	6390	8520				
I	3990	4910	4920	4920	4920	4920	4950	4970	4990	5670	5750
	7730	7830									
I5	3990	5950	6210	6210	7070	7100	7100	7100	7100	7100	7100
	7340	7350	7480								
I6	3990	7180	7200	7340	7350	7360	7370				
J	3990	7980	8080	8160							
J1	3990	7140	7260	7260	7270	7280	7290				
M	3990	5640	5730	5730	5760	5780	5780				
M1	3990	6590	6690	6690	6720	6720	6720	7710	7770	7770	7840
	8820	8940	8940	9050	9050	9160	9160	9230	9230	9302	
M2	3990	6590	6760	6760	6790	6790	6790	7710	7810	7810	7850
	7870	7870	8820	9200	9200	9305					
N	3990	5060	5150	5150	5240	5270	5670	5760	5770	5780	5780
	6590	6650	6650	6660	6660	6810	6830	6830	6850	6850	6862
	7130	7230	7230	7240	7300	7300	7420	8590	8716	8716	8784
	8830	9282	9290	9290	9290	9290	9290	9290	9290	9290	9290
	9301	9305	9310	9312	9317	9320	9320	9323	9327	9330	9330
	9333	9337	9340	9340	9342	9346	9350				
N1	3990	6590	6680	6680	6710	6720	6720	6720	8820	8930	8930
	9040	9040	9150	9150	9220	9220	9290	9302	9310		
N2	3990	6590	6750	6750	6780	6790	6790	6790	8820	9190	9190
	9290	9305	9309	9309	9309	9310					
N3	3990	5960	6190	6190	6990	7730	7840	7850	7860	7870	7870
	8820	8910	8910	9230	9311	9311	9311	9312	9320		
N5	3990										
N6	3990	4380	4380								
O5	3990	8820	9130	9130	9290	9322	9322	9322	9323	9323	9330
O6	3990	8820	9170	9170	9290	9326	9326	9326	9327	9327	9330
P	4000	5200	5460	5500	5720	5980	5820	5850	6090	6690	6700
	6700	6760	6770	6770	6820	6830	6830	6840	7690	7750	7760
	7780	7785	7790	7800	7804	7840	8724	8776	8784	8784	8784
	8785	8787	8850	8880	8940	8980	8960	8990	9000	9010	9070
	9100	9110	9120	9210	9220	9230	9250				
P0	4000	5200	5240	5270	5540						

P1	4000	5460	5540	5540	5540	8770	8784	8785	8808	8910	8920
	9162	9240	9250								
P2	4000	5500	5540	5540	6500	6820	6830	6840	8780	8784	8787
	9018	9020	9030	9162							
P3	4000										
P5	4000	5700	5730	5730	5740	5740					
P6	4000	7760	7770	7790	7800	7804					
00	4000	6230	6260	6260	6290	7130					
01	4000	8726	8860	8900	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									
02	4000	8860	8970	9080	9130	9200	9305	9306	9307	9310	9317
	9318	9319	9320	9327	9328	9329	9330	9337	9338	9339	9340
	9346	9347	9348	9350							
03	4000	8908	9018	9130	9140						
04	4000	6610	6620	6640							
R1	4000	7800	7810	7820	7820						
R2	4000	7170	7330	7340	7570	7630	7850				
R5	4000	7170	7180	7330	7330	7350	7360				
S	4000	5240	5270	5470	5510	5640	5780	6590	6720	6790	6830
	7480	7570	7670	7710	7870						
S1	4000	5470	5540	6590							
S2	4000	5510	5560	6590							
T0	4000	6340									
T1	4000	5900	6620	6640							
T2	4000										
T3	4000	7150	7400	7470							
T4	4000	7390	7400	7460	7460	7470					
V	4010	6830									
V1	4010	5640	5740	5740	5790	6790	6790	6790	6820		
V2	4010	6590	6770	6770	6790	7710	7820	7820	7870		
V7	4010	6830									
V8	4010	6830									
V9	4010	6830									
X2	4020										
X3	4020	7340	7390	7390	7410	7510	7520	7530	7540	7540	7540
	7590	7590	7610	7610	7610						

X4	4020	7480	7490	7500	7510	7510	7520	7530	7540	7540	7590
	7610										
Z	4020	5820	5850								
A3	4022	4405	5850	5405	6110	6410	6830	8545	8776	8778	8780
	9250	9520	9530	9530							
A8	4024	4407	8545								
F	4040										
E2	4050	8817	8824	8824	8826	8828	8832	8852	8882	8962	8992
	9072	9102	9212	9242							
G	4060										
D	4070										
T	4080										
FNJ	4110	4160	4476	4476	4478	4478	4478	4478	4478	4478	4500
	5110	8716									
FNF	4122	5210	6490	8772							
FNV	4140	4920	4960	5700	8020	8060	8070	8070	8080		
FNX	4140	4140	4850	4880	5440	5480	5830	5850	6670	6740	7290
	7740	7780	8776	8778	8780	8780	8840	9210	9240		
FNW	4140										
FNR	4140	5900	6610	7150							
FNS	4190	4330	4460	4476	4478	4478	4478	4500	4850	5210	5210
	5600	6490	7890	7970	8170	8290	8772	8772	8790		
FNB	4220	4380	4490	5110	5150	6020	8130	8712			
FNN	4220	4380	4400	4420	4440	4460	4490	5110	5150	6020	6050
	6100	6190	6210	6260	6310	6330	6360	6390	6410	6430	6450
	8712	8716	9530								
FND	4712	4850	5040	5660	5910	5910	6580	6630	6630	7430	7720
	7930	7930	8716	8716	8776	8840					
FNC	4850	5210	6490	6630	7930	8772					
FNP	5720	6600	7750	7780	8724	8776	8778	8780	8850	8880	8960
	8990	9070	9100	9210	9240						
F8	5882	5970	8580	8610							
N0	8820	9260	9260	9290	9345	9345	9345	9346	9346		
N4	8820	9020	9020	9290	9316	9316	9316	9317	9320		
N7	8820	8890	8890	9290	9332	9332	9332	9333	9333	9340	
N8	8820	9000	9000	9290	9336	9336	9336	9337	9337	9340	
N9	8820	9110	9110	9290	9341	9341	9341	9342	9342	9350	
M0	8820	9270	9270	9346							

M3	8820	8920	[illegible]							
M4	8820	9030	[illegible]							
M5	8820	9140	[illegible]							
M6	8820	9180	[illegible]							
M7	8820	8900	[illegible]							
M8	8820	9010	[illegible]							
M9	8820	9120	[illegible]							
E	9301	9305	[illegible]	[illegible]	[illegible]	[illegible]	9327	9333	9337	9342	9346


LOADER
101
INITIALIZE
LOAD
SUB-
ROUTINES
103
LOAD
S,T,N
104
PROGRAM
CONSTANTS
PRINTOUT
105
CHANGE
PROGRAM
CONSTANTS
?
1
CHANGE
111
CONSTANTS
STORE
N
112
106
LINK
NEXT
PROGRAM

```
10 COM D$[25
3700 PEM LINK
3705 DIM A$[72
3710 DIM L[2
3720 DIM T[14
3725 P=101
3730 CFLAG 1
3740 CFLAG 9
3752 DISP "PRINT ALL C
3753 INPUT Q
3754 GOTO 3790
3755 DISP "DISK STORAGE
3760 INPUT F7
3765 IF F7=0 THEN 3790
3770 SFLAG 1
3790 REM "TASK
3792 F1=0
3795 F6=3
3800 A$="REWORK"
3805 DISP A$;"SITE
3810 INPUT Q0
3815 DISP "PRGM CONST
3820 INPUT F4
3825 Q3=Q0+Q0+F6
3840 PRINT Q3
3915 IF F1=1 THEN 3960
3920 LOAD  KEY #
3940 MERGE #
3960 A$="NBS1A.05  LOADER
3970 DEG
3980 A=B6
3990 GOTO 4030
3995 P=102
4000 DEF FNJ
4010 GOTO 0 OF 4210,
4015 F1=1
4020 GOTO 3725
4030 P=103
4040 N5=0
4050 REM  ARMY
4065 Q3=PES
4070 Q=INT
4075 F6=INT
4080 F4=INT
4085 F7=1000
4120 LOAD  DATA #
4130 LOAD  DATA #
4150 LOAD  DATA #
4160 IF  NOT F4 THEN 4190
4170 DISP "RUN #"
4180
4190 P=104
4195 Q=FNQ3+FNC1
4200 IF  NOT F4 THEN
4210 P=105
4212 DISP "CHANGE ANY PRGM
4220 Q=FNB4
4230 IF Q=0 THEN 4260
4240 Q=FNQ2
4250 GOTO 4190
```

```
4260 P=10
4265 GOTO P6 OF 4.10
4270 DISP "LIN):I=SI
4280 INPUT P6
4300 GOTO 4260
4310 R=107
4315 LINK #(10-5*P7)
4320 P=106
4325 Q=5
4330 A1=2
4340 B5=0.2
4350 B7=10*LGT(0.49)
4360 C2=N0=Z=1
4370 E2=6
4380 E3=30/3600
4390 E5=6/3600
4400 E7=40.349
4410 N4=30
4420 R5=11
4460 LINK #(10-5*P7)
4470 R=109
4475 Q=5
4510 LINK #(10-5*P7)
4515 R=110
4520 DEF FNQ(Q)
4530 A$="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
4540 B$="1234567890"
4550 GOTO Q OF 5290
4560 GOSUB 4580
4570 RETURN Q
4580 DISP "N DATA VIA E=EXT
4590 INPUT Q
4610 MAT N=ZER(25,11)
4620 LOAD  DATA #0,10,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 B=NE 4,11]
4870 B0=NE 4,10]
4880 B1=NE 4,1]
4890 B2=NE 4,2]
4900 B3=NE 4,3]
4910 B4=NE 4,4]
4920 B5=NE 4,5]
4930 B8=NE 4,8]
4940 B9=NE 4,9]
4950 E=NE 5,11]
4960 F=NE 6,11]
4970 F0=NE 6,10]
4980 F1=0
5000 G=NE 7,11]
5010 G4=NE 7,4]
5020 G5=NE 7,5]
5030 G6=NE 7,6]
5040 H=NE 8,11]
5050 H1=NE 8,1]
5060 H5=NE 8,5]
5070 H9=NE 8,9]
5080 L=NE 12,11]
5090 L1=NE 12,1]
5100 L5=NE 12,5]
5110 L6=NE 12,6]
5120 L7=NE 12,7]
5130 L8=NE 12,8]
5140 L9=NE 12,9]
5150 M=NE 13,11]
5160 N=NE 14,11]
5170 N1=NE 14,1]
5180 N2=NE 14,2]
5190 N5=0
5200 N6=NE 14,6]
5210 N7=NE 14,7]
5215 O3=NE 15,3]
5220 T=NE 20,11]
5230 W=NE 23,11]
5240 TRANSFER TO 9,1] TO F4
5250 RETURN
5290 0=FNI5
5300 PRINT TAB(31,"PROG LOAD"
5310 A$="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
5320 01=0
5330 02=-10
5340 FOR I=1 TO 26
5350 FOR J=1 TO 11
5360 IF NE I,J]=0 THEN 5470
5370 01=01+1
5380 02=02+29
5390 IF 02<55 THEN 5410
5400 02=10
5410 IF 01#1 THEN 5440
5420 PRINT
5430 PRINT
5440 PRINT TAB(02,A$[I,I] ; I ; J] ; " NE I,J]
5450 IF INT(01/30)=01 3 THEN 5470
5460 PRINT
5470 NEXT J
5480 02=-10
5490 01=0
5500 NEXT I
5510 0=FNC2+FNI5
5520 RETURN 0
```

```
5530 R=111
5540 DISP "WHICH [illegible]
5550 INPUT [illegible]
5560 IF [illegible]
5570 I=POS(A$,[illegible]
5580 IF I=0 THEN 5540
5590 B$="1234567890
5600 J=POS(B$,S$[C,C])
5610 DISP "NEW VALUE: [illegible]
5620 INPUT NU I,J1
5630 GOSUB 4650
5640 GOTO 5540
5650 R=112
5655 DISP "STORE N: 0=no 5=2 [illegible]INT CASS";
5660 INPUT Q
5670 IF Q THEN 5690
5680 GOTO 5700
5690 STORE  DATA #0,10,N
5700 RETURN 0
5710 GOSUB 4650
5720 RETURN 0
8000 N=113
8010 M=8
8020 N=N+1
8030 M=M+1
8040 LOAD  DATA M
8050 STORE  DATA #5,N
8060 PRINT "DISK FILE #";N
8065 PRINT TAB15;"[illegible]
8070 PRINT TAB5;S$;P$; [illegible]
8080 PRINT
8085 PRINT
8090 GOTO 8020
```

F	1	4225	[illegible]	[illegible]	[illegible]	[illegible]	4260	4310	[illegible]	4470	4515
	5500	5650									
A	1	3980									
A1	1	4830	[illegible]								
A2	1	4660									
A3	1	4670									
B	1	4680									
B0	1	4682									
B1	1										
B2	1	4700									
B3	1	4710									
B4	1										
B5	1	4340									
B6	1	3980									
B7	1	4350	[illegible]								
B8	1	3980	[illegible]								
B9	1	4740									
C	1	4750									
C0	1	4760									
C1	1	4770									
C2	1	4360	[illegible]								
C3	1	3980	4790								
C4	1	4800									
C5	1	4810									
C6	1	4830									
C7	1	4850									
C8	1	4840									
C9	1	4850									
D	2	4860									
D0	2	4870									
D1	2	4880									

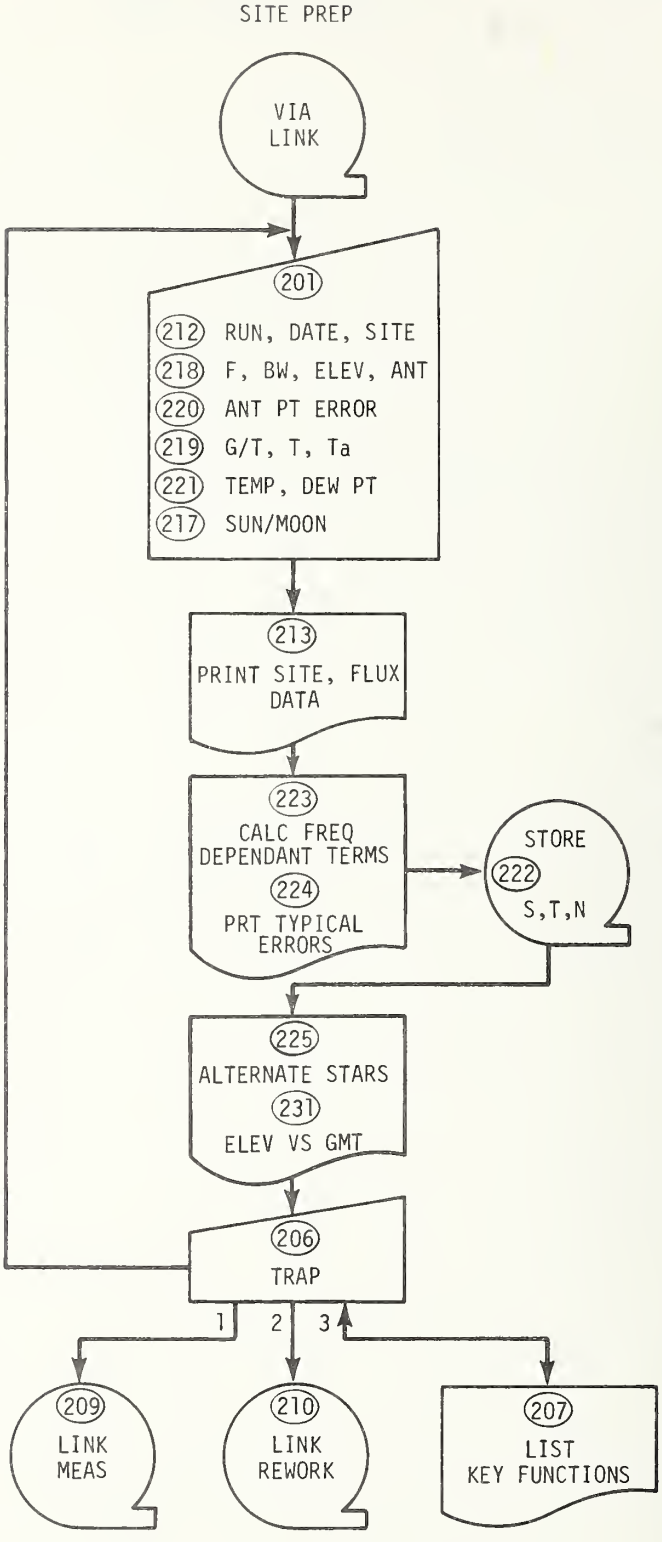
```
D2    2     4890
D3    2     4900
D4    2     4910
D5    2     4920
D8    2     4930
D9    2     4940
E     2     4950
E0    2     3920
E1    2
E2    2     3980  4070
E3    2     4080
E4    2     3980
E5    2     4090
E6    2     3960
E7    2     4400
E8    2
E9    2     3960
F     2     4960
F0    2     4970
F1    2     3790  [illegible]
F2    2     3980
F3    2     3980
F4    2     3830  [illegible]
F5    2     3980
F6    3     3795  [illegible]
F7    3     3760  [illegible]
F8    3     3980
F9    3
G     3     4350  5040
G4    3     5010
G5    3     5080
G6    3     5030
H     1     3930  10
H1    3     5000
```

H5	3	5060
H9	3	4850
I	3	5340
I5	3	
J	3	5350
J1	3	
K	3	
K1	3	
K2	3	
K3	3	
K4	3	
K5	3	
K6	3	
K7	3	
K8	3	
K9	3	
L0	4	
L1	4	3980
L4	4	
L5	4	5100
L6	4	5110
L7	4	5120
L8	4	5130
L9	4	5140
M	4	5150
M1	4	
M2	4	
M3	4	
N	4	3980
N0	4	10
N1	4	5170
N2	4	5180
N3	4	
N4	4	4410

N5	4	4040	5190								
N6	4	5200									
N7	4	3980	5210								
N8	4										
N9	4										
P	5										
P1	5	3980									
Q	5	3753	4090	4100	4110	4175	4120	4130	4150	4195	4220
	4230	4240	4320	4425	4570	4650	4590	4620	5290	5510	5660
	5670	5690									
Q0	5	3810	3825								
Q1	5	5320	5370	5370	5410	5450	5450	5490			
Q2	5	5330	5360	5300	5410	5400	5440	5480			
Q3	5	3792	3825	3825	3840	4065	4070	4075	4020	4080	4085
	4085	5215									
Q4	5										
Q5	5										
Q6	5										
Q7	5										
R1	5										
R2	5										
R5	5	4420									
S	5										
S3	5										
T	5	5220									
T1	5										
T2	5										
T6	5										
T9	5										
U	5										
U1	5										
V	5										
V1	5										
V2	5										
V3	5										

```
V4      6
V5      6
V6      6
V7      6
V8      6
V9      6
W       6       5230
W1      6
X       6
X1      6
X2      6
X5      6
X6      6
Y       6
Y1      6
Y5      6
Z       6       3980  4530
Z1      6       8
Z5      7
FNA     7
FNB     7       4180  4230
FNC     7       4195
FND     7
FNE     7
FNF     7
FNG     7
FNI     7       5290  5510
FNJ     7       4000
FNK     7
FNL     7
FNM     7
FNN     7       4180  4230
FNP     7
FNQ     7       4195  4245  5290  5510  4
```

```
FNR    8

FNS    8      4195

FNT    8

FNU    8

FNW    8

FNX    8

FNY    8

FNZ    8

AI[ ]  9      10

B[ ]   9      3710

C[ ]   9      3710

DI[ ]  9      10

F[ ]   9      3710

G[ ]   9      3710

MS[ ]  9      3710

NS[ ]  9      3710
       4680   4700
       4800   4810
       4910   4920
       5040   5050
       5150   5160
       5610   5620

SS[ ]  9      3710

TI[ ]  9      3720

X[ ]   9

D$     10     8060

H$     10     3960

P$     10     5240

S$     10     5550

W$     10

E$     10

A$     3705   3800

L$     3705

B$     3705   4040

Y[ ]   3720

Z1[ ]  3720

L      5060
```


SITE PREP
VIA LINK
201
212 RUN, DATE, SITE
218 F, BW, ELEV, ANT
220 ANT PT ERROR
219 G/T, T, Ta
221 TEMP, DEW PT
217 SUN/MOON
213
PRINT SITE, FLUX DATA
223
CALC FREQ DEPENDANT TERMS
224
PRT TYPICAL ERRORS
STORE
222
S,T,N
225
ALTERNATE STARS
231
ELEV VS GMT
206
TRAP
1
2
3
209
LINK MEAS
210
LINK REWORK
207
LIST KEY FUNCTIONS

```
3700 H$="NBS1B.08  SITE PREP   [1=+1   ·2-F12"
3705 DEG
3708 CFLAG 9
3710 A[3]=803
3715 A[4]=462
3720 F2=0
3725 R=201
3730 0=FNJ1+FNJ2+FNJ3·FNJ4·FNJ5+FNJ6·FNJ7+FNJ8+FNJ9+FNJ10+FNJ11+FNJ12
3735 GOTO 3975
3740 R=202
3745 DEF FNE(N0)
3750 REM <NBS 9913>
3755 E0=0
3760 E1=50*(1/K1-1)
3765 IF B<14 THEN 3780
3770 02=0
3775 GOTO 3795
3780 00=4.73*(5.9-B0)+5.39*SQR((5.9-B0)12+0.479)
3785 01=(7.12-B0)·ABS(.7,12-B0·-2.04*SQR((00/1.79)↑2-1)
3790 02=0.15+0.354*(00+01)
3795 P1=2*SQR(Q2↑2+13*D2↑2)
3800 E2=((1-K2)*P1+D1)
3805 E3=(W/F/2E+03)↑2*50
3810 E4=0.4*B0*B0/K1/K2/J[N0·4]/K8·K9
3815 02=60*D5*2.784/B
3820 E5=(1-(SIN(02*100·PI`.09·↑2)*100
3825 E6=0.023*T[N0,11]
3830 Y=1+FNZN0*G/T
3835 Y5=Y/(Y-1)
3840 E7=SQR((C9*Y5)↑2+A2↑2)
3845 E8=100*D8*(1/K8-1)
3850 E9=100*D9*(1/K9-1)
3855 RETURN 0
3860 R=203
3865 DEF FNQ(Q)
3870 DISP "( =NC)NOW: "%A$%
3875 INPUT L$
3880 IF L$=" " THEN 3890
3885 A%=L$
3890 RETURN 0
3892 DEF FNF(Q)
3893 GOTO 0 OF 4170
3894 GOTO 4870
3895 R=204
3900 DEF FNJ(Q)
3905 GOTO 0 OF 4190,5190,5765,5415,5685,4915,4450,5960,6040
3910 GOTO 0-9 OF 5740,6385,7570,6095
3915 GOTO 3975
3920 R=205
3925 DEF FNT(Q)
3930 FOR %1=1 TO %2
3935 J=A[%1]
3940 V=M[J,0]
3945 WRITE (15,%C7)V·100
3950 M[J,6]=M[J,6]+V*100
3955 M[J,7]=M[J,7]+(V*100/N
3960 NEXT %1
3965 PRINT
3970 RETURN 0
```

```
3975 P=206
3980 PRINT
3985 DISP "0=PSTRT;1 [illegible] WORK;KEYS LIST";
3990 0=FNB3+FNH0
3995 GOTO 0 OF 4055,4145,4005
4000 GOTO 3725
4005 R=207
4010 0=FNS2
4015 PRINT TAB30,"KEYS"
4020 PRINT
4025 PRINT " 0=MAIN OPTIONS  1=RUN#,FILE,LOC    2=F,B,ANT     3=ANT PT ERR"
4030 PRINT " 4=G'T,T,Ta,PWP  5=TEMP, NEW PT     6=SUN/MOON    7=PRT STAR & LOC"
4035 PRINT " 8=CALC FLUX     9=PRT T/P VALUES  10=STORE S,T,N 11=PRT ALT STARS"
4040 PRINT "12=ELEV vs GMT  13= NEW N(i,J)"
4045 0=FNS2
4050 GOTO 3975
4055 R=208
4065 0=5+FNF1
4070 A1=2
4075 B5=0.2
4085 C2=N0=Z=1
4090 E2=6
4095 E3=30/3600
4100 E5=5^3E00
4105 E7=40.349
4110 N4=30
4115 R=209
4120 P5=11
4125 IF F7 THEN 4140
4130 DISP "DATA TAPE IN PLACE";
4135 0=FNB5+FNH1
4140 LINK #(10-5*F7),"[illegible]"
4145 P=210
4150 GOSUB 4170
4155 DISP "DATA REWORK TAPE DISK IN PLACE";
4160 0=FNB5+FNH1
4165 LINK #(10-5*F7),12+4+F7,50,30
4170 R=211
4175 IF STAT10 >= 4 THEN 4185
4180 REWIND
4185 RETURN 0
```

```
4190 R=212
4195 E=T[14,5]+2.125
4200 DISP "CHANGE RUN [illegible]
4205 D=PNE3+PNN3
4210 IF D NOT 0 THEN 4-4
4215 DISP "RUN NUMBER ";
4220 N$=PN$3+PNN$
4225 DISP "YEAR";
4230 P$=P$[9,12]
4235 D=PN05
4240 P$[9,12]=A$
4245 E1=VAL(A$)
4250 DISP "MONTH";
4255 A$=P$[4,5]
4260 D=PN05
4265 P$[4,5]=A$
4270 A$= JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC
4275 E2=(POS(A$,P$[4,6])+2
4280 IF E2=2/3 THEN 4250
4285 P$[4,6]=P$[3*E2-2,3*E2+1]
4290 DISP "DAY OF MONTH";
4295 A$=P$[7,8]
4300 D=PN05
4305 P$[7,8]=A$
4310 E3=VAL(A$)
4315 D=(E1-1900)/4
4320 D1=INT(D
4325 D2=4*(D-D1)
4330 J=INT(D2+E3+31*(E2-1)-(7/4)*(E2+(E2>2)-1)-.75*(INT(E1/100)+1)+J1+J*(D2+365+(D2=4)-(D1=365).25)
4360 T[14,3]=E-32125
4365 E5=E/365.25-4
4370 C6=0.030757+01+3*(.00+(E-INT(E5)*365.25)+99.5)*2
4375 C6=C6/360
4380 C6=3*0+(C6-INT(C6))*10
4385 DISP "DAY OF WEEK";
4390 A$=P$[1,3]
4395 D=PN09
4400 P$[1,3]=A$
4405 DISP "PROJ # ";
4410 P$=P$[13,20]
4415 D=PN09
4420 P$[13,20]=A$
4425 DISP "LOCATION"
4430 A$=P$[21,40]
4435 D=PN39
4440 P$[21,40]=A$
4442 D=PNP0
4445 RETURN 0
```

```
4450 R=213
4455 C=1900+T[14,9],81/5,  ,5,
4457 DISP "PRT SITE/5(NO DATA 0=NO  "
4458 0=FNN1
4459 IF 0=0 THEN 4795
4460 0=FNC3+FNI5+FNS1
4465 FORMAT 5X,"SITE: N. LAT"3D"-",N. LNT",10X,"ALTITUDE",5X
4470 WRITE (15,4465)"LOAD TO MASS  = 0 LNT"
4475 FORMAT 3F13.3,2F16.3
4480 WRITE (15,4475)L43" deg",C5," deg",C0," km",C6," deg"
4485 0=FNS2+FNI5
4490 PRINT TAB34,"FLUX DATA"
4495 FORMAT F2.0,F8.0," +-",F5.1," %  @",F4.0," GHz",F4.0," TO",F5.0
4500 FORMAT F8.2,F8.3," +-",F0.3
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",6X,"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 (15,4435)I,"  ",S$[1,8],T[I,8] 10,T[I,10]/100,T[I,19],T[I,20],
4555 WRITE (15,4500)T[I,3] 100," ",T[I,6]/100,T[I,7] /900
4560 IF ABST[I,4]+ABS[[I,5]+ABSIL[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 4500
4585 PRINT
4590 NEXT I
4595 0=FNS1+FNI1
4600 PRINT TAB30,"PROG CONST:"
4605 FORMAT " N  T(N,1)   S(N,1)  T(N,8)    T(N,18)  "
4610 WRITE (15,4605)"T/N,19,20)  T(N,9)  T(N,6)   T(N,7)"
4615 FORMAT 4X,"T(N,15)  T(N,16)  T(N,17)",32X,"T(N,4)   T(N,5)"
4620 WRITE (15,4615)
```

```
4625 R=214
4630 Q=FNS2+FNI3
4635 PRINT TAB30;"LOCATION & MISC DATA"
4640 PRINT
4645 FORMAT "  STAR EPOCH  (DAYS AFTER 1977.0)",5X
4650 WRITE (15,4645)"SOLAR EPOCH    (DAYS AFTER 1977.0)"
4655 FORMAT F11.3,F13.0,F2...,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  N.DEC @ 0",5X,"GHA/Hr",5X,"N.DEC/Hr ",5X
4695 WRITE (15,4690)"HOR PRLX   PHASE"
4700 Q=FNS1
4705 FOR I=1 TO N1
4710 TRANSFER T[I,1] TO S$[1,5]
4715 FORMAT F2.0,F9.2," deg",F8.2," deg"
4720 WRITE (15,4715)I,"  ",S$,S[I,2],S[I,3],
4725 IF T[I,21]=0 THEN 4750
4730 FORMAT F10.3," deg",F8.3," deg",F8.3," deg",F4.0," day"
4735 WRITE (15,4730)T[I,11]/1000,T[I,12]/1000,T[I,13]/1000,T[I,14]
4740 GOTO 4755
4745 FORMAT F8.1,"   +-",F7.1," %",F10.1,"   +-",F5.1," DEG"
4750 WRITE (15,4745)T[I,11]/10,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
4770 Q=FNS1+FNI1
4775 PRINT TAB31;"PROG CONSTS"
4780 FORMAT " N  T(N,1)     S(N,2)      S(N,3)",6X,"T(N,11)    T(N,12)",5X
4785 WRITE (15,4780)" ",T(N,13)    T(N,14)
4790 Q=FNS2+FNI3+FNS4
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 -730,350.578,299.654,83.256,85.315,58.6812,40.6516,21.9988,-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=FNNC4
4885 DISP "SITE:N.LAT";
4890 C5=FNNC5
4895 DISP "SITE:ALT(KM)";
4900 C0=FNNC0
4905 RETURN 0
```

```
4915 R=217
4920 DISP "ENTER SUN,MOON ALC'NAP  DATA(1=YES)";
4925 0=FNN0
4930 IF  NOT 0 THEN 5175
4935 T[14,10]=T[12,10]
4940 SERROR 0;4945
4945 N0=5+FNS2
4950 PRINT "FOLLOWING INPUTS ARE IN';" PARTS:1st=deg,2nd=min"
4955 PRINT "IF DEC IS South: enter deg and min NEGATIVE"
4960 0=FNS1+FNB8
4965 TRANSFER T[N0,1] TO S$
4970 DISP S$;":GHA @ 0 GMT";
4975 0=FNNS[N0,2]
4980 DISP "MIN";
4985 00=FNN0
4990 S[N0,2]=0+00/60
4995 DISP S$;":GHA @ 12 GMT";
5000 0=FNN(S[N0,2]+0.012*T[N0,11])
5005 DISP "MIN";
5010 00=FNN0
5015 01=0+00/60
5020 IF 01>SL[N0,2] THEN 5030
5025 01=01+360
5030 T[N0,11]=1000*(01-SL[N0,2])/12
5035 DISP "N.DEC @ 0 GMT";
5040 0=FNNS[N0,3]
5045 GOTO 5050
5050 DISP "MIN";
5055 00=FNN0
5060 IF SGN0 >= 0 THEN 5080
5065 00=-ABS00
5070 S[N0,3]=0+00/60
5075 DISP "N.DEC @ 12 GMT";
5080 0=FNN(S[N0,3]+0.012*T[N0,12])
5085 GOTO 5090
5090 DISP "MIN";
5095 00=FNN0
5100 IF SGN0 >= 0 THEN 5110
5105 00=-ABS00
5110 T[N0,12]=1000*(0+00/60-S[N0,3]) 12
5115 IF N0=5 THEN 5180
5120 DISP "HOR PARALLAX";
5125 0=FNN(T[N0,13]/1000)
5130 IF 0<2 THEN 5150
5135 DISP "ERROR:HOR PARALLAX >2 DEG"
5140 0=FNB8+FNC1
5145 GOTO 5120
5150 DISP "MIN";
5155 00=FNN0
5160 T[N0,13]=1000*(0+00/60
5165 DISP "AGE (DAYS)";
5170 T[N0,14]=FNNT[N0,14]
5175 RETURN 0
5180 N0=6
5185 GOTO 4965
```

```
5190 R=218
5195 DISP "NEW F/BW/ELEV/ANT CONF=1-7[E-7";
5200 Q=FNN0
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
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 DISP "1=APR EFF,2=ANT HPBW,3=CNVL HPBW";
5280 Q=FNN0
5285 GOTO Q OF 5290,5310,5350
5287 GOTO 5380
5290 DISP "APERTURE EFFICIENCY";
5295 B2=FNNB2
5300 B0=3035/D/F*SQR(B3/B2)
5305 GOTO 5325
5310 DISP "ANT HPBW(DEG)";
5315 Q=FNN(B0/60)
5320 B0=60*Q
5325 B=B0
5330 IF B>14 THEN 5380
5335 Q=4.248-1.1468*B0+0.10259*B0↑2-0.0030247*B0↑3
5340 B=B0+Q/(2.1468-0.20518*B0+0.0090741*B0↑2)
5345 GOTO 5380
5350 DISP "CNVL HPBW(DEG)";
5355 Q=FNN(B/60)
5360 B=60*Q
5365 B0=B
5370 IF B>14 THEN 5380
5375 B0=-4.248+2.1468*B-0.10259*B↑2+0.0030247*B↑3
5380 B2=B3/(B0*D*F/3035)↑2
5385 G=B2*(D*F/0.313)↑2
5390 B9=2*C1*1.38054E-23*L
5395 B0=3035/D F*SQR(B3/B2)
5400 DISP "HPBW ERR(15,%)";
5405 D2=FNND2
5410 RETURN 0
```

```
5415 R=219
5435 DISP "CHANGE:1=[illegible] 2=T(DB)"
5440 Q=FNN0
5445 GOTO Q OF 5450,5470
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=FNN0
5485 M=10^(Q/10)
5490 T=G/M
5515 DISP "CHANGE:1=G/TA, 2=TA";
5520 Q=FNN0
5525 GOTO Q OF 5530,5550
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
5585 DISP "ANT PT ERR:1=DEG, 2=%HPBW";
5590 Q=FNN0
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+E5/10U)
5650 PRINT
5655 PRINT "ANT PT ERR corresponds to G/T data fit (3+1S/SQR(#PTS) of";H1;"dB"
5660 PRINT
5665 DISP H1;"DB:0=TRY AGAIN";
5670 Q1=FNN1
5675 IF Q1=0 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;Q=NO.(1-2,7,15-INT";
5750 Q=FNB2+FNN0
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]=B0
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]=C0
5805 N[3,11]=C
5810 N[4,1]=D1
5815 N[4,2]=D2
5820 N[4,3]=D3
5825 N[4,10]=D0
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]=F0
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 #0,0,2
5935 TRANSFER P# TO T[9,1]
5940 STORE  DATA #0,0,1
5945 STORE  DATA #0,10,N
5950 PCWIND #0
5955 RETURN 0
```

```
5960 R=223
5965 MAT M=ZER(10,10)
5970 FOR I=1 TO N1
5975 O=C-T(I,15)/10
5980 S=T(I,6)*1E+03+(I-1)*(I-1)*(I-1)
5985 Q2=EXP(-T(I,16)*1E+04/(I+273.15))*(F*T(I,18)*100)↑2
5990 I5=S(I,1)*T(I,8)*10↑(-Q/10)
5995 N=S+((F/T(I,18)*100)^2-1)*T(I,18)*100(1/2)+(T(I,7)*1E+03+T(I,5)*1E+05)
6000 N3=F+(N-Q)-(N<N+1,F,0)
6005 Q=EXP(-T(I,16)/1E+01*Q)*I5*(N3/T(I,18)*100)↑N
6010 T(I,10)=(Q-Q2)/Q2*10↑5
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"
6065 Q=FNS2
6070 FORMAT "    G          T       APER EFF    RAD EFF    "
6075 WRITE (15,6070)"ANT HPBW     CONVL HPBW    EFF AREA"
6080 FORMAT F6.2,F8.1," L",F9.4,F10.2,F11.4," deg",F10.4," deg",F9.1," m↑2"
6085 WRITE (15,6080)10*LOG(G," dB",1,B2,B3,B0/60,B/60,B9
6088 FORMAT /,"Antenna Ele. =",F3.1," deg"/
6090 WRITE (15,6088)L
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 (15,6130)"Tant  ="$(Y-1)*T," K"
6135 FORMAT 10X,2E10.3
6140 WRITE (15,6135)"Y    ="$(Y-1)*T(G," K"
6145 WRITE (15,6275)"Y    Y-FACTOR              "$Y,C8,C8*Y5
6150 WRITE (15,6220)"Y (dB) ="$10*LOG(Y)," dB"
6155 FORMAT 16X,F6.1,2F6.2
6160 Q=SQR(E1↑E1+E8↑E3↑E9↑E9)
6165 Q=K1*K8*K9
6170 WRITE (15,6275)"1.1  ATM ATTENUATION FACTOR"$K1,E1,E1
6175 WRITE (15,6235)"Atmospheric Temp.="$G4*L3" dB"
6180 WRITE (15,6235)"Water Vapor   "$G5*L3*G6*L6" g/cm↑3"
6185 FORMAT 10X,2F5.1
6190 WRITE (15,6185)"Water Vapor="$L7$" gm/m↑3"
6195 WRITE (15,6185)"Cloud Extinction="$L4$" K"
6200 WRITE (15,6220)"Cloud Liquid  ="$F0," cm"
6210 WRITE (15,6185)"Amb Temp  ="$(E3-32)*5/9," F"
6215 WRITE (15,6185)"Dew Point  ="$(E4-32)*5/9," F"
6220 FORMAT 10X,2F7.2
6225 WRITE (15,6205)"1.2  DIFFUSE Temp="$"DK"$(1+K8-1)"$K8,E8,"K"
6230 WRITE (15,6305)"K9  MISMATCH="$"DM"$(1+K9-1)"$K9,E9,E9
6235 FORMAT 10X,2F7.4
6240 WRITE (15,6235)"Ant Cond="$L3
6245 WRITE (15,6235)"Ohmic Loss="$L7
6250 WRITE (15,6275)"1.3  Line Loss (dB)  =  (N-1)  "$L2,E2,E2
6255 FORMAT 10X,"+-(",F5.1,"+-(",I,"*(",F6.1,"))",
6260 WRITE (15,6255)P1,N1
6265 FORMAT 10X,"HPBW +-",F5.2,"°,"
6270 WRITE (15,6265)N_
```

```
6275 FORMAT 5X,F11.3," +-",F6.3," %  15%,"+-",F6.2," %"
6280 WRITE (15,6275)"K3  BANDWIDTH FACTOR "&K3,E3,E3
6285 FORMAT 5X,F11.1," +-",F6.1," %",15X,"+-",F6.2," %"
6290 PRINT "          bandwidth = "&G$" MHz"
6295 FORMAT 10X,2F6.2
6300 Q2=T*(Y-1)
6305 FORMAT 5X,F5.2,F10.3," +-",F6.2," %",15X,"+-",F5.2," %"
6310 WRITE (15,6275)"K4  DIFF SYSTEM TEMP      "&K4,E4,E4
6315 FORMAT 5X,F7.4,F7.3," +-",F6.2," %",14X," +-",F6.2," %"
6320 WRITE (15,6315)"K5  ANT POINT(+-"&D5$" 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 RESPONCE FACT "&K7,E7,E7
6340 WRITE (15,6295)"instr pwr resp (+-",C9,"%)"
6345 WRITE (15,6285)"Y/(Y-1)=",Y5
6350 WRITE (15,6295)"gauss curve fit +-",A2,"%)"
6355 WRITE (15,6285)"To  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(ST2+(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=235
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=FNC1+FNS5
6420 PRINT "     STAR"TAB14"FLUX in F.U."&TAB31&"T(ant)";
6425 PRINT TAB43&"K2"&TAB50&"Y-factor"&TAB62&"Y(dB)";
6430 FORMAT 6X,"W1(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",S12.3
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
6500 WRITE (15,6465)A," ",S$,S[1,4],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 19%,"G/T or G/Tn  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;
6715 M[X1,6]=M[X1,5]+Q
6720 M[X1,7]=M[X1,7]+Q^2
6725 NEXT X1
6730 PRINT
6735 RETURN
```

```
6740 FOR X1=1 TO X2
6745 I=A[X1]
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]
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 REFRC      ";
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 O=FNO(
7005 GOTO 3970
7010 R=228
7015 DEF FNO(C)
7020 A$="ABCDEFGH
7025 B$="1234567890
7030 GOTO O OF 7035,7045,7050
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 CON ( )"
7345 A$="ABCDEFGHIJKLMNOPQRSTUVW"
7355 Q1=0
7360 Q2=-10
7365 FOR I=1 TO 26
7370 FOR J=1 TO 11
7375 IF N[I,J]=0 THEN 7435
7380 Q1=Q1+1
7385 Q2=Q2+20
7390 IF Q2<55 THEN 7400
7395 Q2=10
7400 IF Q1#1 THEN 7420
7405 PRINT
7410 PRINT
7420 PRINT TAB(Q2,A$[I,1];6+(J-1)*3;":";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=STOPE/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=FN03
7520 GOTO 7470
7525 R=230
7530 DISP "STORE N: 0=NO,5=EXT CNS,,10=INT CNS";
7535 Q=FNW10
7540 IF Q=0 THEN 7553
7545 STORE  DATA #0,10,N
7550 GOTO 7525
7553 Q=FN01
7555 RETURN 0
7560 GOSUB 7035
7565 RETURN 0
```

```
7570 R=0.1
7575 DISP "ELEV vs GMT POINT OUT(1-YES)";
7580 Q=FNG3+FNN0
7585 IF  NOT Q THEN 7750
7590 B1=H=0
7595 Q=FNC3
7600 D$="%.4,.2o"
7605 FOR I=1 TO N1
7610 TRANSFER T[I,1] TO X#
7615 PRINT D$[I,I];" = ";S.F,
7630 NEXT I
7625 PRINT
7630 FORMAT 27%,"SOUPLE ELEV(deg)",/,F1.0,9F5.0
7635 WRITE (15,7630)0,10,20,30,40,50,60,70,80,90
7640 FORMAT 9"!....","!"
7645 OUTPUT (A$,7640)"",
7650 WRITE (15,7745)" GMT(hrs)    ",A$,"  CAS:   EL       AZ"
7655 E1=-0.5
7660 E1=E1+0.5
7665 IF E1>24 THEN 7750
7670 A$[1,63]=""
7675 A$[13,13]="!"
7680 A$[58,58]="!"
7685 FOR N0=6 TO 1 STEP -1
7690 IF S[N0,2]=0 THEN 7715
7695 Q=FNAN0
7700 IF L<0 THEN 7715
7705 Q=L*2+13
7710 A$[Q,Q]=D$[N0,N0]
7715 NEXT N0
7720 FORMAT F4.0
7725 IF E1=INTE1 THEN 7740
7730 OUTPUT (A$[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)L,H
7755 GOTO 7660
7760 A$[1,72]=""
7765 OUTPUT (A$[1,],7640)"",
7770 WRITE (15,7745)A$
7775 Q=FNS3
7780 RETURN 0
9000 GOTO 9999
```

R	1	3725	[illegible]	[illegible]	[illegible]	[illegible]20	3975	4005	4055	4115	4145
	4170	4190	4450	[illegible]	[illegible]00	4470	4915	5150	5415	5565	5685
	5740	5960	6004	[illegible]	[illegible]15	[illegible]995	7010	7485	7525	7570	
A	1	6450	6455	[illegible]	[illegible]	6480	6485	6490	6500	6500	6500
	6505	7750									
A1	1	4070	5760	7025							
A2	1	3840	5765	[illegible]550	7040						
A3	1	7045									
B	1	3765	3815	5125	[illegible]140	[illegible]740	5355	5360	5365	5370	5375
	5375	5375	5625	5770	[illegible]005	7050					
B0	1	3780	3780	3785	[illegible]785	3810	3810	5300	5315	5320	5325
	5335	5335	5335	[illegible]340	[illegible]740	5740	5365	5375	5380	5395	5620
	5630	5772	6085	7052							
B1	1	7055	7530								
B2	1	5295	5295	5300	5380	5385	5395	6085	7060		
B3	1	5300	5330	5395	6085	7065					
B4	1	6195									
B5	1	4075									
B6	1										
B7	1	7070									
B8	1	7075									
B9	1	5090	5725	[illegible]005	[illegible]490						
C	1	4455	5805	5970	7085						
C0	1	4480	4950	4900	[illegible]990	[illegible]00	7090				
C1	1	5225	5340	[illegible]700	7095						
C2	1	4085	7100								
C3	1	7105									
C4	1	4480	[illegible]830	[illegible]830	[illegible]775	7110					
C5	1	4480	4890	4890	[illegible]790	7115					
C6	1	4370	[illegible]375	[illegible]475	[illegible]700	4380	4380	4480	5795	7120	
C7	1	7125									
C8	1	6145	[illegible]145	[illegible]375	[illegible]775	7130					
C9	1	3840	[illegible]840	7135							
D	2	5270	[illegible]270	[illegible]	[illegible]800	[illegible]085	5385	5830	7140		
D0	2	[illegible]270	[illegible]270	7145							
D1	2	[illegible]800	[illegible]	[illegible]	[illegible]150						

D2	2	3795	5405	5405	5815	6270	7155				
D3	2	5820	6355	6355	6940	7160					
D4	2	7165									
D5	2	3815	5620	5620	5620	5630	5630	5635	5835	6320	7170
D8	2	3845	6225	7175							
D9	2	3850	6230	7180							
E	2	4195	4355	4360	4365	4820	4860				
E0	2	3755	6110	6690							
E1	2	3760	4245	4315	6160	6160	6170	6170	6370	6820	7655
	7660	7660	7665	7725	7725	7730	7735				
E2	2	3800	4090	4275	4280	4285	4285	4335	4355	4355	6250
	6250	6370	6485								
E3	2	3805	4095	4310	4355	6280	6280	6370	6845		
E4	2	3810	6310	6310	6370	6480					
E5	2	3820	4100	4365	4370	4370	5640	5645	6320	6320	6370
	6870										
E6	2	3825	4820	4835	4840	6330	6330	6370	6885		
E7	2	3840	4105	6335	6335	6370	6490				
E8	2	3845	6160	6160	6225	6225	6370	6910			
E9	2	3850	6160	6160	6230	6230	6370	6925			
F	2	3805	5220	5220	5225	5230	5300	5380	5385	5395	5840
	5985	5995	5995	6000	6110	7185					
F0	2	5240	5240	5875	6000	6110	7190				
F1	2	5210	7195								
F2	2	3720									
F3	2										
F4	2										
F5	3										
F6	3										
F7	3	4125	4140	4140	4165	4165					
F8	3										
F9	3	7200									
G	3	3830	5385	5390	5460	5490	5535	5540	5645	6085	6140
	6500	7205									
G4	3	5850	6175	7210							
G5	3	5855	6180	7215							

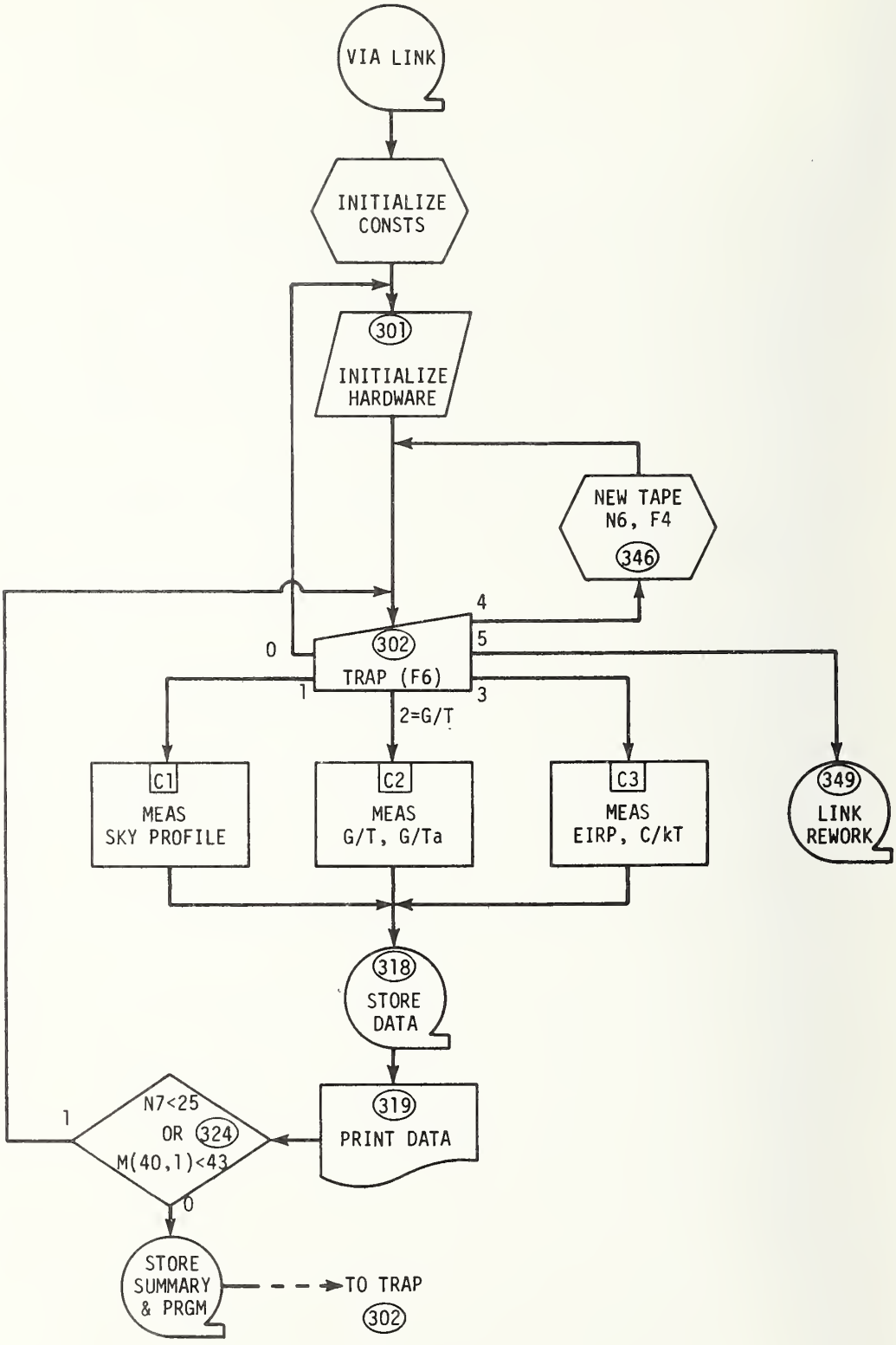
G6	3	5860	[illegible]								
H	3	7225	[illegible]								
H1	3	5645	[illegible]								
H5	3	7235									
H9	3	5535	5540	[illegible]							
I	3	4540	[illegible]								
	4555	4560	[illegible]								
	4580	4590	[illegible]								
	4735	4735	[illegible]								
	4835	4835	[illegible]								
	5980	5985	[illegible]								
	6005	6005	[illegible]								
	6640	6645	[illegible]								
	7450	7485	[illegible]								
I5	3	5990	6005								
J	3	3935	[illegible]								
	7370	7375	[illegible]								
J1	3	4840	4850	4850							
K	3										
K1	3	3760	[illegible]								
K2	3	3800	3810	[illegible]							
K3	3	6280									
K4	3	6310									
K5	3	6320									
K6	3	6330									
K7	3	6335									
K8	3	3810	[illegible]								
K9	3	3810	[illegible]								
L0	4	6045									
L1	4	7250									
L4	4	6175									
L5	4	5880	[illegible]								
L6	4	5885	[illegible]								
L7	4	5890	[illegible]								
L8	4	5895	[illegible]								
L9	4	5900	[illegible]								
M	4	5460	[illegible]								
M1	4										

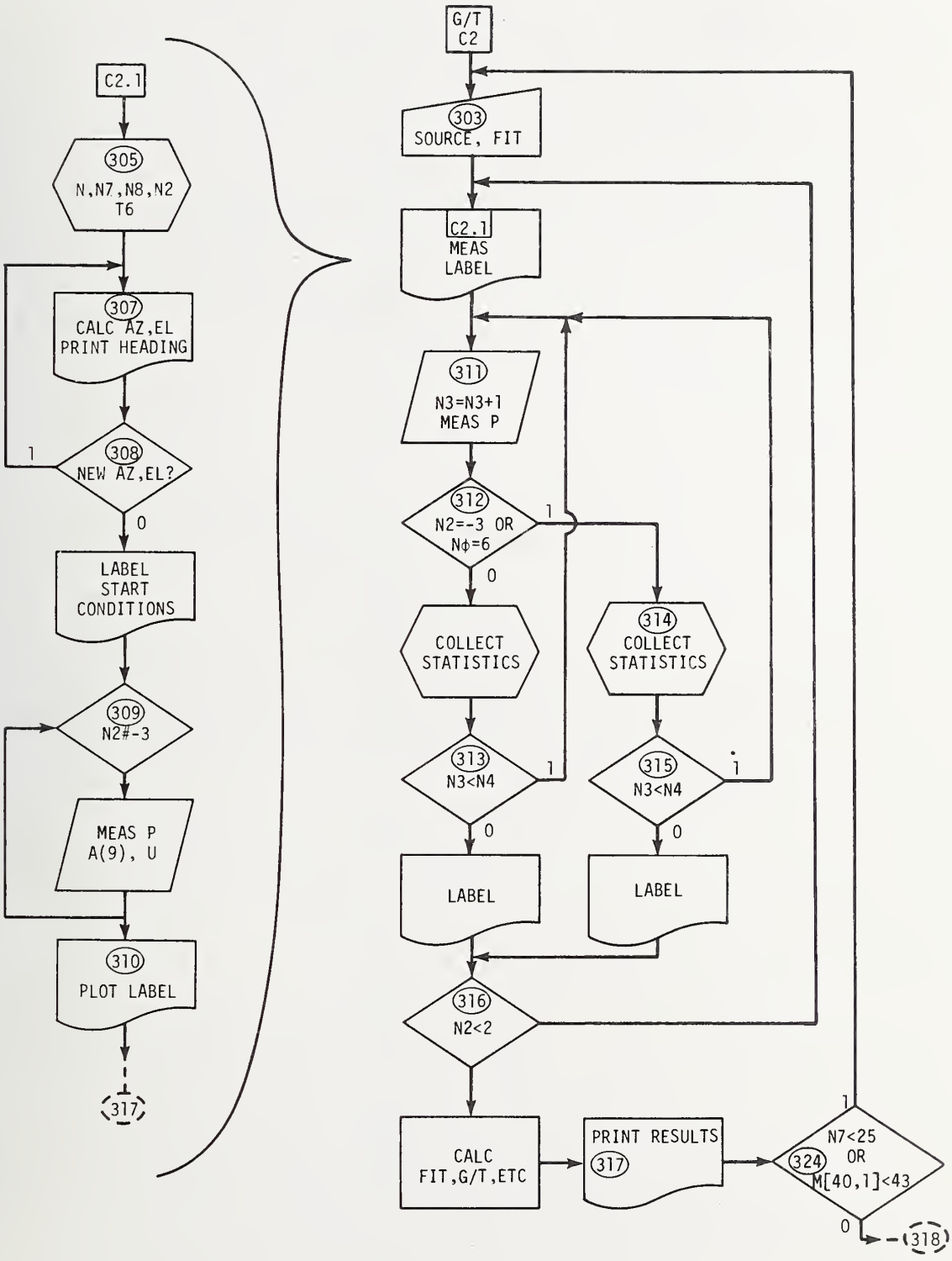
M2	4										
M3	4										
N	4	5995	6000	[illegible]	[illegible]	[illegible]					
N0	4	3745	3810	[illegible]	[illegible]	4085	4445	4965	4975	4990	5000
	5000	5020	5040	[illegible]	[illegible]	5070	5030	5050	5110	5110	5115
	5125	5160	5170	5170	5190	6450	7695	7690	7695	7710	7710
	7715										
N1	4	4540	4705	4825	5070	6450	7290	7605			
N2	4										
N3	4	6000	6005								
N4	4	4110									
N5	4	7295									
N6	4	4220	4220	5910	7300						
N7	4	7305									
N8	4	6520	6975								
N9	4	6525	6980								
P	5										
P1	5	3795	3800	6260							
0	5	3730	3865	3890	[illegible]	[illegible]	3900	3905	3910	3925	3940	3990
	3995	4010	4045	4065	4135	4160	4205	4210	4235	4260	4300
	4315	4320	4325	4395	4415	4435	4442	4458	4475	4480	4485
	4565	4570	4595	4620	4660	4670	4675	4700	4770	4790	4835
	4845	4925	4930	4940	4960	4975	4990	5000	5015	5040	5060
	5070	5080	5100	5110	5125	5130	5140	5160	5200	5205	5280
	5285	5315	5320	5325	5340	5355	5360	5440	5445	5475	5480
	5480	5485	5520	5525	5535	5540	5550	5595	5600	5620	5620
	5625	5710	5715	5725	5730	5750	5755	5930	5940	5945	5950
	5975	5980	5985	6005	6005	6010	6055	6065	6105	6140	6165
	6360	6375	6395	6440	6410	6415	6460	6470	6510	6525	6580
	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	7545	7553	7580	7585	7595	7645	7705	7710
	7710	7775									
00	5	3780	3785	3790	4965	4990	5010	5015	5355	5065	5065
	5070	5095	5105	5105	5110	5155	5160				
01	5	3785	3790	4320	4325	4355	4370	4665	4670	4840	4850
	5015	5020	5025	5075	5230	5270	5675	7350	7380	7380	7400
	7425	7425	7445								
02	5	3770	3790	3795	3915	3920	3820	4325	4360	4395	5335
	5640	5640	5945	6010	6010	6515	6300	6495	6500	6500	7360
	7385	7385	7390	7395	7420	7440					
03	5										
04	5										
05	5										

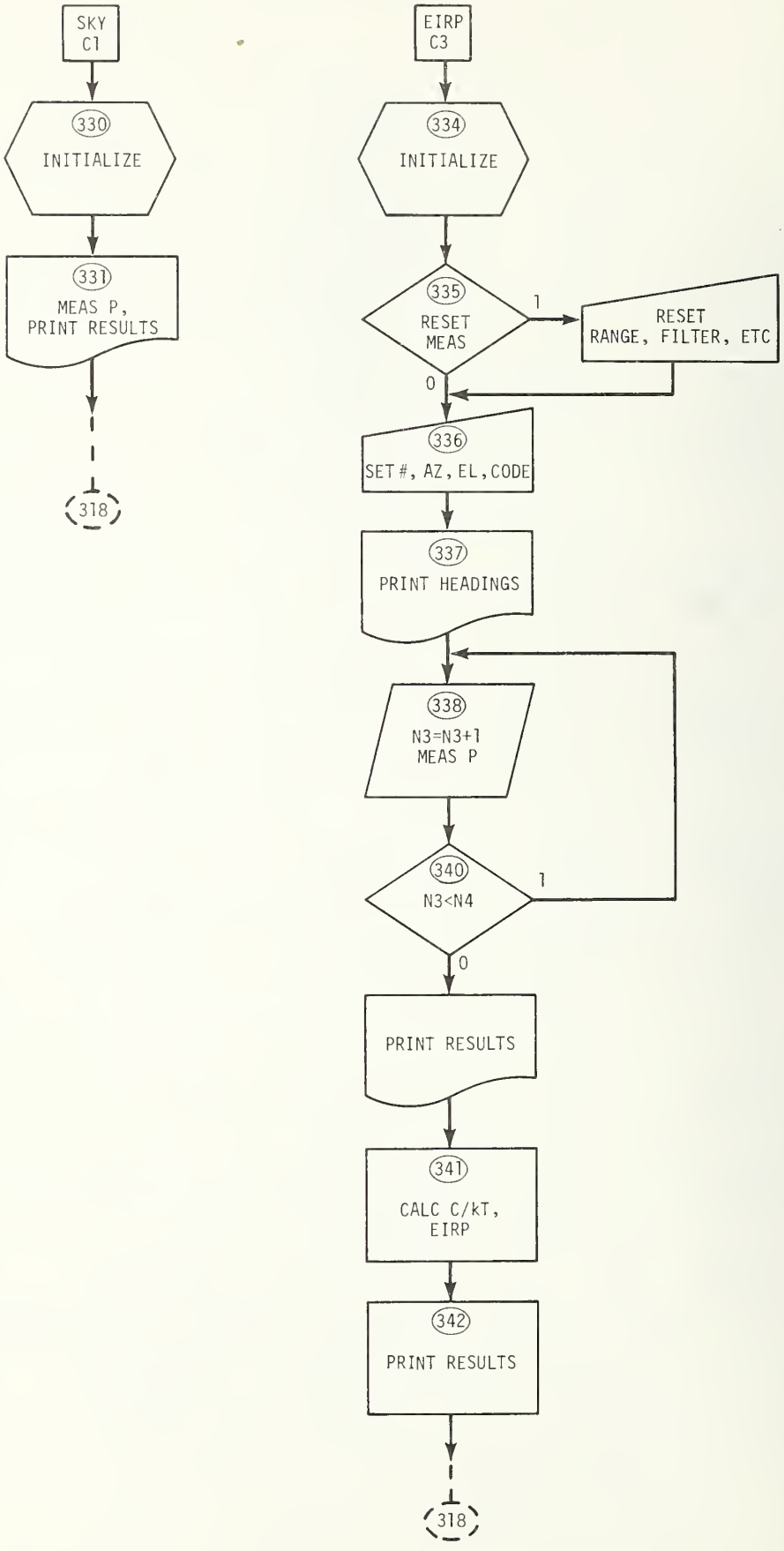
Q6	5										
Q7	5										
R1	5										
R2	5										
R5	5	4120									
S	5	5980	5985	5995	6015	6120	6120	6170			
S3	5										
T	5	3830	5455	5495	5460	5490	5920	6025	6130	6140	6300
	6495	7315									
T1	5										
T2	5										
T6	5										
T9	5										
U	5										
U1	5										
V	5	3940	3945	3950	3955						
V1	5										
V2	5										
V3	5										
V4	6										
V5	6										
V6	6										
V7	6										
V8	6										
V9	6										
W	6	3805	5250	5250	5925	6290	7320				
W1	6										
X	6										
X1	6	3930	3935	3960	6635	6640	6650	6655	6665	6715	6715
	6720	6720	6725	6740	6745	6755	6785	6790	6800		
X2	6	3930	6555	6560	6560	6565	6570	6635	6705	6740	6755
X5	6										
X6	6										
Y	6	3830	3835	3845	6130	6140	6145	6150	6160	6495	6500
	6500										

1	6										
Y5	6	3835	[illegible]								
Z	6	4085									
21	6	8									
25	7										
FNA	7	7695									
FNB	7	3990	[illegible]								
FNC	7	4460	6075	[illegible]							
FND	7										
FNE	7	3745	6105	[illegible]							
FNF	7	3892	4045	[illegible]							
FNG	7										
FNI	7	4460	4495	[illegible]							
	7455										
FNJ	7	3730	3730	[illegible]							
	3730	3730	3900	[illegible]							
FNK	7	6105									
FNL	7										
FNM	7										
FNN	7	3990	4175	[illegible]							
	4975	4985	5005	5010	5040	5055	5060	5065	5125	5155	5170
	5200	5220	5240	5250	5260	5270	5280	5295	5315	5355	5405
	5440	5455	5480	5520	5535	5555	5590	5620	5670	5710	5725
	5750	7535	7600								
FNP	7										
FNQ	7	7000	7015	7515	7555						
FNR	8										
FNS	8	4010	4045	[illegible]							
	4790	4945	4960	5140	6055	6065	6375	6415	6510	6985	7455
	7775										
FNT	8	3925	6640	6775	6835	6860	6900				
FNU	8										
FNW	8										
FNX	8										
FNY	8										
FNZ	8	3830									
NC 1	9	3710	[illegible]								
	6525	6550	[illegible]								
	6630	6640	[illegible]								

```
B[ ]   9

C[ ]   9

D[ ]   9

F[ ]   9

G[ ]   9

M[ ]   9      3940   2650   [illegible]   [illegible]   455   5965   6025   6075   6400   6485
       6490   6595   6705   [illegible]   [illegible]   720   6720   6750   6795

N[ ]   9      5760   5770   [illegible]   [illegible]   5775   5780   5785   5790   5795   5800
       5805   5810   5815   [illegible]   [illegible]   5830   5835   5840   5845   5850   5855
       5860   5865   5870   [illegible]   [illegible]   5885   5890   5895   5900   5905   5910
       5920   5925   5945   [illegible]   [illegible]   7045   7050   7052   7055   7060   7065
       7070   7075   7080   [illegible]   [illegible]   7095   7100   7105   7110   7115   7120
       7125   7130   7135   [illegible]   [illegible]   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   7275   7420   7505   7510   7545

S[ ]   9      3810   4550   4720   4730   4810   4810   4810   4810   4810   4810
       4810   4810   4805   4810   4840   4845   4845   4850   4850   4975   4990
       5000   5020   5030   5040   5070   5080   5110   5930   5955   5950   5990
       6015   6120   6500   7640

T[ ]   9      3825   4195   4300   4405   4545   4550   4550   4550   4550   4555
       4555   4555   4560   4565   4520   4560   4560   4565   4570   4570   4570
       4570   4660   4665   4670   4670   4710   4725   4735   4735   4735   4735
       4750   4750   4750   4750   4810   4520   4830   4860   4935   4935   4965
       5000   5030   5040   5115   5125   5160   5170   5170   5535   5940   5975
       5980   5980   5965   5990   5990   5995   5995   5995   5995   6005   6005
       6010   6020   6115   6485   6500   6645   7325   7610

X[ ]   9

H#     3700

FNO    3865   4235   4260   4300   4395   4415   4435

A#     3870   3885   4230   4240   4245   4255   4265   4270   4275   4285   4295
       4305   4310   4230   4405   4410   4420   4430   4440   7040   7345   7420
       7485   7645   7600   7670   7675   7680   7710   7730   7735   7740   7760
       7765   7770

L#     3875   3880   3985

P#     4230   4240   4255   4265   4275   4265   4295   4305   4310   4400   4410
       4420   4430   4440   5935   7345

S#     4545   4550   4710   4720   [illegible]   70   4395   6455   6540   6617   6650
       7475   7480   7485   7500   7610   7615

L      5260   5264   6045   6054   6504   7245   7700   7705   7750

B#     7025   7420   7445   7504

D#     7000   7615   7710
```


VIA LINK
INITIALIZE CONSTS
301
INITIALIZE HARDWARE
NEW TAPE N6, F4
346
4
0
302
TRAP (F6)
5
1
3
2=G/T
C1
MEAS SKY PROFILE
C2
MEAS G/T, G/Ta
C3
MEAS EIRP, C/kT
349
LINK REWORK
318
STORE DATA
319
PRINT DATA
1
N7<25 OR 324 M(40,1)<43
0
STORE SUMMARY & PRGM
TO TRAP 302


C2.1
305
N,N7,N8,N2
T6
307
CALC AZ,EL
PRINT HEADING
308
NEW AZ,EL?
1
0
LABEL
START
CONDITIONS
309
N2#-3
MEAS P
A(9), U
310
PLOT LABEL
317
G/T
C2
303
SOURCE, FIT
C2.1
MEAS
LABEL
311
N3=N3+1
MEAS P
312
N2=-3 OR
Nϕ=6
1
0
COLLECT
STATISTICS
314
COLLECT
STATISTICS
313
N3<N4
315
N3<N4
LABEL
LABEL
316
N2<2
CALC
FIT,G/T,ETC
PRINT RESULTS
317
324
N7<25
OR
M[40,1]<43
318


SKY
C1
330
INITIALIZE
331
MEAS P,
PRINT RESULTS
318
EIRP
C3
334
INITIALIZE
335
RESET
MEAS
1
RESET
RANGE, FILTER, ETC
0
336
SET#, AZ, EL, CODE
337
PRINT HEADINGS
338
N3=N3+1
MEAS P
340
N3<N4
1
0
PRINT RESULTS
341
CALC C/kT,
EIRP
342
PRINT RESULTS
318

```
3700 A$="N=$#[#.##  MLR  ###.###"
3710 PRINT USING A$,N,MLR
3715 MAT N=ZER[40,10]
3720 R1=4
3730 B1=X5=XE=0
3735 B5=0.008
3740 E6=65
3745 P5=11
3750 N=N7=0
3755 U=1+FNS3
3760 CPL5G 1
3765 CPL5G 5
3770 FORMAT "IF HARDWARE HANDSHAKE OF - , , (1)STOP+1(0P"  ,"  2)KE) 0",
3775 WRITE (15,3770) (3*0 ,P5,"PT
3780 0=FNS2+FNB0
3785 GOTO 4700
3790 DEF FNF(Q)
3800 GOTO C OF 7730
3805 GOTO 7765
3810 DEF FNY(N3)
3820 IF N3 THEN 3990
3825 IF N0=6 THEN 3845
3830 X1=FNZ(N0)
3835 P=A[9]*10↑4+EXP(LOG(A[0])/10↑4
3840 GOTO 3855
3845 Q=FNKN0
3850 X1=200+K1/G
3855 Y=1+X1+G/T
3860 R1=T/H9
3865 I5=(Y-1)+R1/50
3870 IF N2#-3 THEN 3880
3875 I5=I5/5
3880 PRINT "ZERO LEVEL  [#]  [#]  [#]  [#]  [#]  [#]  [#]  [#]  [#]  [#]"
3885 WRITE (15,3880)I,B[1,3],  D  T  T  To
3890 FORMAT F7.4,"+To",F8.4," -To",2F8.3,F8.1,F7.0,2F7.1
3895 WRITE (15,3890)R1,I+R1,I,I,10*LGT(X1+G-S[N0,4]),T,H9
3900 PRINT
3905 PRINT
3910 FOR I=0 TO 5
3915 PRINT TAB(10*I+5)
3920 IF N2=-3 OR N0=0 THEN 3925
3925 PRINT 20+I;
3930 GOTO 3940
3935 PRINT 4+I-10;
3940 NEXT I
3945 PRINT "(%)"
3950 FORMAT 10"!.... , "
3955 A$=""
3960 OUTPUT (A$,3950)"
3965 FORMAT "N3",4X
3970 WRITE (15,3965)P5,  "NP"#1  "NP#2  P/P0"
3975 IF N3)=0 THEN 3985
3980 R1=R1-25/I5
3985 GOTO 4120
3990 Q=INT((P-R1)/I5+0.5)+1
3995 P=INT(10↑5+P+0.5)/10↑5
4000 IF ABS(N3-S3)>R5 OR N  .  .0  .20
4005 N3=-N3
```

```
4010 B$="#"
4015 GOTO 4025
4020 B$="+"
4025 Q2=0
4030 A$=""
4035 A$[1,72]=""
4040 A$[33,32]="!"
4045 FORMAT F3.0
4050 FORMAT F8.4,
4055 OUTPUT (A$[1,2],404,)N2
4060 OUTPUT (A$[57,64],40%d,-%,  ,+,)C,
4065 OUTPUT (A$[65,72],405N),5,V9,-%V-V5),
4070 IF Q<1 OR Q>68 THEN 4080
4075 A$[Q,Q]=B$[1,1]
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=FNP3
4140 Q=INT(100*Q/3600-100*INT(Q/10^4)-3/3+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]
4325 W1=SQR(R2/(N9-2))*.6
4330 IF V4*(Z-Q) <= 0 THEN 4340
4335 I=SQR(8.7*V4*(Z-Q))*N4*E5/2*E3
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]/10-10.[illegible]1.00)*0.11)^1.232
4405 GOTO 4425
4410 A[3]=1000+(FNX110+FNX28+FNB3)
4415 A[4]=1000+(FNX109+FNB2)
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=FNN0
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/HUMID:0=AUTO,1=MANL ";
4510 F3=FNB3+FNNF3
4515 RETURN 0
4520 DEF FNU(Q)
4530 I=C2
4535 E0=E2
4540 P=FNPC3
4545 IF E2#E0 THEN 4535
4550 A[7]=5000*Q1
4555 J=5*V9*(2*V-V9)
4560 E0=E2
4565 IF C2 THEN 4580
4570 C2=1
4575 GOTO 4590
4580 C2=0
4585 E2=E2+5
4590 Q=FNPC3
4595 C2=I
4600 E2=E0
4605 Q=V9*(2*V-V9)/Q1*A[7]/1000/J
4610 IF Q>1 THEN 4620
4615 Q=1/0
4620 A[8]=10^4*LGT(Q/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",F9.0,F11.4,3F6.0,"dB",F9.4,"dB",F5.0,
4640 WRITE (15,4635)A[7]/1000,J,F2,M2,C2,E6,"dB",E2,A[8]^200,P1
4642 Q=1000+J/A[7]
4645 IF E2>0 AND E2<11 AND Q<1 AND Q>4 AND ABS(A[8])<500 THEN 4670
4650 DISP "NOT NORMAL(1=ADJ)";
4655 Q=FNB8+FNN0
4660 IF Q=0 THEN 4670
4665 Q=FND0+FND1+FNJ8+FNJ1*,FNJ9(FNL)*FNU1
4670 RETURN Q
```

```
4675 DEF FNJ(X)
4680 GOTO 0 OF 4700,
4690 GOTO
4695 GOTO 4750
4700 R=301
4705 DISP "SUM THFE E/T
4710 Q=FNE4+FNN1
4735 F4=0
4740 DISP "SET ANT DE
4745 Q=FNB2+FNN0
4750 IF Q THEN 4740
4755 DISP "ADD 24hrs To
4760 Q=FNN0
4765 CFLAG 5
4770 IF Q=0 THEN 4785
4775 SFLAG 5
4780 T1=24
4785 Q=FND0+FNX69+FND
4790 R=302
4795 DISP "1
4800 F6=FNB2+FNN1
4805 GOTO F6 OF 6
4810 GOTO 4750
4815 R=303
4820 Q=FNF1+F
4822 DISP "# MeMS PTs"
4823 N1=FNNN
4825 R=304
4826 DISP "# PTS IN
4830 R5=FN04+FNN05
4835 IF R5 2-INT
4840 R5=R5+1
4855 IF N4
4860 DISP "ERR:#PTS
4865 Q=FNB10+FNW2000
4870 GOTO 4822
4875 IF N4
4880 DISP "ERR: #MEAS
4885 Q=FNB10+FNW3000
4890 DISP
4895 GOTO 4822
```

```
4900 [illegible]
4905 [illegible]
4910 DISP "N  @ SET# [illegible]
4915 O=FNL(4,FNN(N,1))
4920 N=N-1
4925 N=N+1
4930 N7=INT(N-1)*6+1
4935 N8=N7+F4
4940 [illegible]
4945 N2=P+J-E+N7
4950 T6=N7+4
4955 B1=N2*0.240
4960 IF N2=3 THEN 4[illegible]
4965 DISP "SAT OFFSET ADJ"
4970 B1=FNL5+FNN2
4975 R=306
4980 E3=FNR4-3600
4985 S=FNT1
4990 A=FNA(N0)+M5
4995 L=L+M6
5000 T=(B5+B6*SINL)*H
5005 E9=2*C1*1.38054E-23*T
5010 R=307
5015 Q=FNM0+FNC2+FNM1+FN[illegible]
5020 PRINT
5025 FORMAT " MEAS    HR:M[illegible]    OFFSET     AZIMUTH     ELEV    "
5030 WRITE (15,5025)"[illegible]
5035 FORMAT F2.0,"sec",[illegible],F10.5,"deg",F10.2,F10.2,F6.0,3F5.0
5040 WRITE (15,5035 [illegible]
5045 FORMAT /,22X,"[illegible],F5.5,"*CSC L",/
5050 WRITE (15,5045)B5,D
5055 DISP "GO :1=NEW AZ,E"
5060 Q=FNE1+FNN300+FNB1+FNU0+[illegible]
5065 R=308
5070 IF Q THEN 4975
5075 J=FNT2
5080 S3=(E1-J)*E5
5085 WAIT (S3-INT(S3))*E3
5090 S3=INT(S3)
5095 FORMAT " ELAPSE     [illegible]    PTS  [illegible]    HR BIAS[illegible]
5100 WRITE (15,5095)"DEL BIAS"       AZ BIAS       EL BIAS"
5105 FORMAT F4.0,2F8.0,3F11.4," deg",F11.4,"deg"
5110 WRITE (15,5105)J-S,(J-S)/3600,"sec",S3,INT((E3+S-J)/E5),H,"deg",L1,"deg",M5,M6
5115 V1=M1=0
5120 PRINT
5125 PRINT
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]=(E1+L1)*1000
5170 A[1]=N7*100+M6
5175 A[2]=10000+F
5180 R=309
5185 IF N2#-3 THEN 5190
5190 Q=FNB0+FNB1+FNU1
5195 P=FNP0
5200 A[9]=P*1014
5205 U=A[9]*1014
5210 R=310
5215 Q=FNT0+FNB1
```

```
5220 R=311
5225 N3=N3+1
5230 T2=FNP3
5235 IF FNR3<T2 THEN 5235
5240 IF INT(T2/0.02)-I2 0.02 THEN 5.40
5245 P=FNPC3
5250 D(T6,N3+7)=LOG(P/U)*10^4
5255 Q=FNY(N3)
5260 R=312
5265 IF N2=-3 OR N0=6 THEN ...
5270 01=N3-S3+R5/2+0.5
5275 X=2+(N3-33)/N4
5280 X2=X^2
5285 IF 01<1 OR 01>R5 THEN 5295
5290 Q=FNGN9
5295 IF N3<N4 THEN 5220
5300 R=313
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/E9
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)=I
5350 Q=1
5355 PRINT
5360 FORMAT "#FIT    AMT MPBW        T"
5365 WRITE (15,5360)%T$    %R mmm OFFSET    PEAK#    LEVEL:    "$$
5370 FORMAT F3.0,F10.3," deg",F10.4,"+-",F6.2,"%"
5375 WRITE (15,5370)N8,L,P,Q0,W1
5380 FORMAT F11.4," deg",F10.3,2F5.1
5385 WRITE (15,5380)Q0,D(T6,7),100,100*(P-R1)/R1/(Y-1),"%"
5390 Q=FNS4
5395 PRINT TAB20,"increase #8 BIAS if peak before PEAK#"
5400 PRINT TAB20,"decrease DELL BIAS if 1st cut too deep"
5405 GOTO 5490
5410 R=314
5415 M1=M1+P
5420 V1=V1+P^2
5425 R=315
5430 IF N3<N4 THEN 5220
5435 Z=M1/N3
5440 PRINT
5445 PRINT
5450 FORMAT 9%,"I",9%,"E",9%,"STDEV",9%,"MEAN",8%,"#PTS",9%,"T",9%,":"
5455 WRITE (15,5450)$
5460 Q=100*SQR((V1-M1^2/N3)/(N3-1))/Z
5465 FORMAT F16.4,F14.2," ",F11.2," ",F9.0,F13.1
5470 WRITE (15,5465)Z,Q,Q/SQR(N3-1),N3,Z*N9
5475 PRINT
5480 IF N2#-3 THEN 5490
5485 B5=2-B6/SIN(
5490 Q=FNS(21-N4+65*IN1(N4-.7)/65)
```

```
5495 R=316
5500 IF N2<2 THEN 4960
5505 Q1=N8=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[N8,4]/2/(1.4e05[illegible]+03
5560 M[N2,8]=Q4/(Y-1  Q4/E3
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(1/V7-2)/X1)
5590 M[N8,7]=V5
5595 R=317
5600 Q=FNC1+FNM1+FNI5+FNS1
5605 PRINT TAB22,"BEST FIT FOR THE 5 CUTS    To="%N3;"K"
5610 PRINT
5615 Q=I*E8/N4/E5*2
5620 M[N8,5]=0
5625 WRITE (15,5360)S$;"  /To      DECL OFFSET   T/To     ELEV    RUN  SET"
5630 WRITE (15,5370)N9,0,V7,100*W1
5635 FORMAT F10.3," deg",F4.4,"K",F6.1,"deg",F4.0,F5.0
5640 WRITE (15,5635)V5,2,M[N8,1],N6,N7
5645 Q=FNS2
5650 FORMAT 10X,"G",17X,"G T",18X,"NEF",15X,"NUF",/,2F12.2,F5.2,2F12.3," K/M↑2"
5655 Q=M[N8,3]+10*LGTH9
5660 Q2=ABS((Y-1)/X1-M) M=10/LOG10
5665 WRITE (15,5650)Q," dB",M[N8,2]," +- ",Q2," dB",M[N8,6]," K/M↑2",M[N8,9]
5670 Q=FNS2+FNI5
5675 PRINT TAB23,"100*(D(1)-FIT) /MAX dT("%S$")/To)"
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 N CUT: 1) KEY 1 then (2) KEY 1up"
5740 R=318
5745 PRINT
5750 DISP "REMARKS:"
5755 Q=FNB5
5760 INPUT A$
5762 D$=A$[1,25]
5764 E$=A$[26,33]
5765 PRINT
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",F2.0,15X,"EXT FILE",F3.0,15X,"EXT SET#",F3.0,
5790 WRITE (15,5785)0,Q0,M[40,1]
5795 STORE  DATA 0
5800 STORE  DATA #5,Q0
```

```
6100 R=326
6101 DISP "TA/K";
6105 H9=FNNH9
6110 GOTO 4900
6115 R=327
6116 DISP "HR ANG BIA
6120 H=FNNH
6125 DISP "DECL BIAS(D
6130 L1=FNNL1
6135 DISP "  AZ BIAS\DE
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 O=FNF1+FNF0
6220 N9=X=0
6225 DISP "SKY:GMT(HRS
6230 INPUT I5,N3,J1
6235 R=331
6240 O=FND0+FND1+FNM0
6245 O=FNS2
6250 PRINT TAB30,"SET #
6255 O=FNS2
6260 PRINT "AZ","EL",
6265 PRINT
6270 FOR E1=I5 TO N3 S
6275 PRINT FNA(N0),L;
6280 DISP "READY";
6285 INPUT A$
6290 E0=E2
6295 P=FNPC3
6300 IF E0-E2 THEN 62
6305 PRINT TAB45,E1,P
6310 X=L
6315 X2=1 SINL
6320 O=FNGN9
6325 NEXT E1
6330 O=FNG(-99,
6335 B6=Y[1]-G[1,1]
6340 B5=(N3-E6+M1)/N9
6345 FORMAT
6350 WRITE (15,
6355 O=FNS(38-3+N9+5,
```

```
6360 R=332
6365 M[N8,1]=N0/100
6370 M[N8,2]=B5
6375 M[N8,3]=B6
6380 M[N8,4]=FNT2
6385 M[N8,5]=A[3]*10
6390 M[N8,6]=F
6395 M[N8,7]=L7
6400 M[N8,8]=INT(.N3*I+.5)*J1+1
6405 M[N8,10]=N6+N7/100
6410 GOTO 5740
6415 R=333
6420 FORMAT /,8X,"BIRD   CODE   P Pa     PWR      dPadd",,,"RUN/SET STAR   ELEV
6435 WRITE (15,6420)" G/T      G/To    HPBW#1 HPBW#2  FREQ  DECL     NEF      NUF"
6440 PRINT
6445 FORMAT F6.2,F5.1,F8.3,2F5.3,4F7.3,F8.3
6450 I=0
6455 I=I+1
6460 IF I>39 THEN 6525
6465 Q=M[I,1]
6470 IF Q=0 THEN 6455
6475 Q0=M[I,6]
6480 Q1=M[I,7]
6485 Q2=M[I,8]
6490 J=M[I,9]
6495 Q3=ABS(Q
6500 TRANSFER T[100*Q3-10*(INT(.10*Q)),1] TO S#
6505 WRITE (15,6445)M[I,10],'  ",S#,Q,M[I,2],M[I,3],M[I,4],M[I,5],Q0,Q1,Q2,J
6510 IF INT(I/3)-I/3 THEN 6520
6515 PRINT
6520 GOTO 6455
6525 RETURN 0
6530 R=334
6535 N0=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=FNN0
6590 IF Q#1 THEN 6685
6595 F9=F2=F5=05=E9=Z5=F0=Q6=0
6600 IF FLAG1=0 THEN 6630
6605 PRINT TAB15,"MEAS RESET"
6610 Q=FNS1+FNJ13+FNS2
6630 DISP "SLANT RANGE(INCHES)=";Q
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 U=FNJ18
```

```
6685 R=336
6690 N3=0
6695 Q=FNF0+FNM0
6700 Q=FNX68+FNX67
6705 L$="CODE:0=SKY,1=-F, 2=NOR @ F, 3=+F,4=OTHER
6710 DISP L$;
6715 B1=FNNB1+FNJ3+FNJ15+FNJ5
6720 T=(B5+B6*(1/SINL-1))*N3
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+FNX1
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[0,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[0,Q0],N[0,Q0+1],N[0,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
6900 D[1,N3+2]=LGT(5*Q1)*1E+04
6905 D[2,N3+2]=LGT(5*Q3)*1E+04
6910 IF P>0 THEN 6920
6915 P=1
6920 D[3,N3+2]=LGTP*1E+04
6925 Q=E1
6930 IF E1<32 THEN 6940
6935 Q=E1-24
6940 D[4,N3+2]=Q*1E+03
6945 D[6,N3+2]=E2+E6
6950 FORMAT F5.0,F13.5,2F13.2,F6.0," dB",F6.0," dB",F12.5
6955 IF Q0=0 THEN 6965
6960 D[5,N3+2]=LGT(ABS(Q0)*1E-04
6965 Q1=5*Q1*10↑((E2+E6)/10)
6970 Q3=5*Q3*10↑((E2+E6)/10)
6975 WRITE (15,6950)N3,P,Q1,Q3,E5,E2,E1
6980 IF N3/3-INT(N3/3) THEN 6990
6985 PRINT
```

```
6990 R=333
6995 M1=M1+P
7000 M2=M2+D1
7005 M3=M2+(D3-D1)
7010 V1=V1+P12
7015 V2=V2+D1↑2
7020 V3=V3+(D3-D1)↑2
7025 R=340
7030 IF N3<N4 THEN 6605
7035 Z=M1/N3+FNS3
7040 FORMAT "#PTS"+10Z "P-P"+4.0F "  "+1 "+"PWR#1"+.N "+10+"+"PWR#2-PWR#1"+.mW"
7045 WRITE (15,7040)"   DONE"
7050 FORMAT F3.0+F13.5+" +- "+F5.1+" "+F13.5+" +-"+F5.1+F3.0
7055 D1=100+60R((V1-M1↑2/N3)/(N3-1))↑.5/N3
7060 D2=100+60R((V2-M2↑2/N3)/(N3-1))↑.5/N3
7065 D=100+60R((V3-M3↑2/N3)/(N3-1))↑.5/N3
7070 WRITE (15,7050)N3,M1/N3,01," "+M2/N3,D2,M3/N3,D," %",B1
7075 Q=FNS(25-4*N4/3+65*IN7((4*N4/3+25)/65))
7080 R=341
7085 GOTO B1 OF 7100,7120,7130
7090 F9=M1/N3
7095 GOTO 7145
7100 F2=M1/N3
7105 F5=M2/N3
7110 Q5=M3/N3
7115 GOTO 7145
7120 E9=M2/N3
7125 GOTO 7145
7130 Z5=M1/N3
7135 F8=M2/N3
7140 Q6=M3/N3
7145 A[1]=100+N6+N7
7150 A[2]=F*1000
7155 A[7]=B1
7160 A[9]=0
7165 A[10]=LGTE7*100+
7170 D[1,1]=(A-180)*100
7175 D[2,1]=C2
7180 D[3,1]=N4
7185 D[4,1]=LGT(M1/N3)*1E+04
7190 D[5,1]=LGT(M2/N3)*1E+03
7195 IF M3>0 THEN 7205
7200 M3=N3
7205 D[6,1]=LGT(M3/N3)*1E+03
7210 D[1,2]=L*100
7215 D[2,2]=E6
7220 D[3,2]=W*10
7225 D[5,2]=P1*1E+04
7230 M[N8,1]=B1+0.07
7235 M[N8,6]=F
7240 B8=(F5+F8)/2
7245 Q7=(Q5+Q6)/2
7250 IF F5 AND F8 THEN 7265
7255 B8=F5+F8
7260 Q7=Q5+Q6
7265 M[N8,4]=E9
7270 Q=(F2+Z5)/2
7275 IF F2 AND Z5 THEN 7295
7280 Q=F2+Z5
7285 M[N8,2]=M1/N3
7290 M[N8,3]=M2/N3
7295 M[N8,4]=M3/N3
7300 M[N8,8]=Q
7305 M[N8,9]=Q7
7310 M[N8,10]=N6+N7/100
```

```
7315 E=1
7318 F1=.4E+07*PI*E7
7320 IF B8=0 OR E9=0
7330 E=(E9-B8)/Q7*1.
7335 M(N8,5)=10*LGT(
7340 M(N8,7)=10*LGT(E
7345 R=342
7350 Q=FNC0+FNM1+FNI5+FNS1
7355 FORMAT F6.3,"
7360 WRITE (15,7355)J1,S,B8,
7365 Q=FNS2
7370 FORMAT "SPACE LOSS
7375 WRITE (15,7370)"
7380 FORMAT F7.2," dB",3F10.4,F10.2," dBW",F11.2," dB
7385 Q=0
7390 IF F9=0 THEN 7400
7395 Q=M(N8,8)/F9
7400 WRITE (15,7380)10*LGTF1,-9,M(N8,8),0,10*LGTE,M(N8,5),N6,N7
7405 Q=FNS2+FNI5
7410 GOTO 5740
7415 R=343
7420 DISP "FREQ(MHZ)";
7425 Q=FNB2+FNN(F*1000)
7430 IF Q/1000=F THEN 7510
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)*(1-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,4)
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
7495 Q=(1-T(I,16)/1E+04)*(1-T(I,15)/10)*I5*(N3/T(I,18)*100)↑A
7500 T(I,10)=(Q-Q2)/Q2*1000
7505 S(I,4)=Q2
7510 NEXT I
7515 RETURN 0
7520 R=344
7521 DISP "NOISE ADD/Q=#1&#2/(1=#1,2=#2)";
7525 C3=FNNC3
7530 RETURN 0
7535 R=345
7536 DISP "INSERT 5DB WHEN READY";
7540 C2=FNNC2
7545 RETURN 0
7550 R=346
7555 DISP "STORE PRGM & RUN 0 TO
7560 Q=FNN1
7565 IF Q=0 THEN 7570
7570 Q=FNJ11
7575 DISP "NEW TAPE 1:Q=DATA,1
7580 Q=FNN0
7590 N=N7=0
7595 DISP "RUN #";
7600 M(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=200,2=100,3=2070,4=5070";
7635 A1=FNNA1
7640 DISP "MANL ATN(dB):";
7645 E6=FNNE6
7650 RETURN 0
7655 R=348
7656 DISP "STAR#";
7660 N0=FNNN0
7665 B1=0
7670 TRANSFER T[N0,1] TO S$
7675 FORMAT "AZ=",F7.2,"    EL=",F7.2,"    BIAS:HR,DLC,AZ,EL ",5F7.3
7680 E1=FNT0+3.3600
7685 WRITE (15,7675)FNANN0+X5,L+X6,A,B1,X5,X6," "S$,
7690 DISP "AZ="A"  EL="L
7695 WAIT 2000
7700 PRINT
7705 GOTO 7680
7710 R=349
7715 DISP "RWRK TP IN PLACE";
7720 Q=FNB2+FNN1
7725 LINK #(10-5*F7),12+4*F7,50,50
7730 R=350
7735 MAT A=ZER
7740 MAT D=ZER[6,75]
7742 TRANSFER T[N0,1] TO S$
7743 Q=N0
7745 DISP "SOURCE:";S$;
7750 N0=FNB3+FNNN0
7755 IF Q#N0 THEN 7742
7760 RETURN 0
7765 R=351
7770 N7=N7+1
7775 DISP S$;":  SET#";
7780 N7=FNNN7
7785 N=6*N7
7790 N8=N7+F4
7795 N2=-3
7800 RETURN 0
```

R	1	4700	4790	4815	4830	4900	4975	5010	5065	5180	5210
	5220	5260	5300	5420	5425	5495	5585	5740	5805	5835	5920
	5945	5990	6035	6075	6100	6115	6160	6180	6205	6235	6360
	6415	6530	6570	6685	6750	6965	6990	7025	7080	7345	7415
	7520	7535	7550	7685	7655	7710	7730	7765			
R	1	4990	5040	5130	6653	6655	6795	7170	7485	7490	7490
	7495	7690									
R1	1	3720	4640	6820	6825	6825	6840	7635	7635		
R2	1										
R3	1	4620	4640								
B	1	4955	5040	7465							
B0	1										
B1	1	3730	4955	4970	5040	5165	6715	6715	6795	7070	7085
	7155	7230	7665	7685							
B2	1	7455									
B3	1										
B4	1	5560									
B5	1	5000	5050	5485	6185	6185	6340	6350	6370	6720	
B6	1	3735	5000	5050	5485	6195	6195	6335	6240	6350	6375
	6720										
B7	1	6165	6165	6170							
B8	1	7240	7255	7320	7330	7335	7360				
B9	1	5005	5560	5565	7460						
C	1	7475	7495								
C0	1										
C1	1	5005	7445	7460							
C2	1	4530	4565	4570	4600	4595	4640	7175	7540	7540	
C3	1	4540	4540	4640	5195	5245	6295	6890	7525	7525	
C4	1										
C5	1										
C6	1										
C7	1										
C8	1										
C9	1										

D	2	7455	[illegible]								
D0	2	7450									
D1	2										
D2	2										
D3	2										
D4	2										
D5	2										
D8	2										
D9	2										
E	2	7315	[illegible]								
E0	2	4535	4545	4560	4600	6290	6300				
E1	2	4165	5040	5020	5145	5150	5155	6270	6295	6325	6875
	6925	6930	6935	6975	7680						
E2	2	4535	4545	4560	4585	4585	4600	4640	4645	4645	6290
	6300	6545	6885	6895	6945	6965	6970	6975			
E3	2	4165	4980	5110							
E4	2	6675									
E5	2	4165	4535	5040	5060	5085	5110	5320	5615		
E6	2	3740	4640	6945	6965	6970	6975	7215	7645	7645	
E7	2	6635	6635	6795	7165	7318	7360				
E8	2	4235	5320	[illegible]							
E9	2	6595	7120	7265	7320	7330	7335				
F	2	5175	5540	6790	6795	7150	7235	7315	7425	7430	7435
	7445	7450	7455	7465	7475	7485	7485	7490			
F0	2	7490									
F1	2	7315	7330	7400							
F2	2	6595	7100	7270	7275	7280					
F3	2	4365	4510	4510							
F4	2	4735	4935	5615	7790						
F5	3	7595	7105	7240	7250	7255					
F6	3	4800	4805	[illegible]	6945						
F7	3	5780	5950	[illegible]	7225						
F8	3	6595	7105	7240	7250	7255					
F9	3	6595	6980	7150	7245	7400					
G	3	3850	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	

G4	3										
G5	3										
G6	3										
H	3	5110	5320	[illegible]	[illegible]	6450	7685				
H1	3										
H5	3										
H9	3	3860	[illegible]	[illegible]	[illegible]	5605	5655	6105	6105	6170	[illegible]
	7340										
I	3	3910	3915	3925	3975	3940	4125	4160	4335	4530	4585
	5345	5375	5615	5645	5740	5705	5710	5715	5360	5875	5900
	6450	6455	6455	6460	6465	6475	6480	6485	6490	6505	6505
	6505	6505	6505	7510	6510	6980	7470	7475	7475	7475	7475
	7475	7480	7480	7480	7485	7485	7485	7485	7495	7495	7495
	7500	7505	7510								
I5	3	3865	3875	3885	3900	3990	6230	6270	6400	7480	7495
J	3	4555	4605	4640	4642	5075	5080	5110	5110	5870	5875
	5880	5880	5890	6490	6505						
J1	3	5510	5515	5525	5535	6230	6270	6400	7330	7360	
K	3	3895	5555								
K1	3	3850	5565								
K2	3										
K3	3										
K4	3										
K5	3										
K6	3										
K7	3										
K8	3										
K9	3										
L0	4										
L1	4	5110	5165	[illegible]	[illegible]	[illegible]					
L4	4										
L5	4										
L6	4										
L7	4	4485	[illegible]	[illegible]							
L8	4										
L9	4										
M	4	5570	[illegible]	[illegible]	[illegible]						

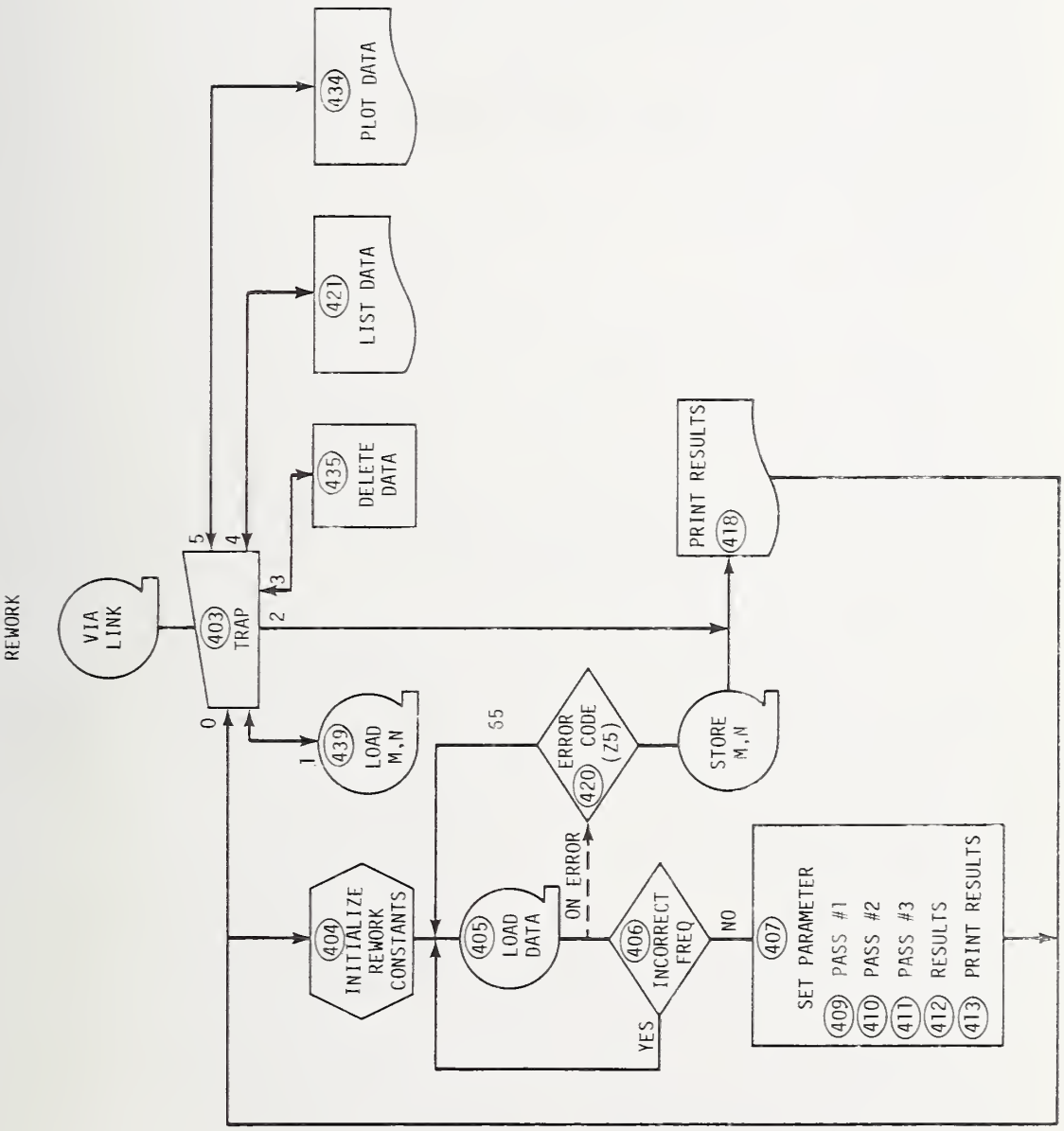
M1	4	4200	4210	[illegible]	4.[illegible]	4.[illegible]	4280	4300	5115	5415	5415
	5435	5460	6340	[illegible]	[illegible]	6995	7035	7055	7055	7070	7090
	7100	7130	7185	7295							
M2	4	4200	4215	4230	4.[illegible]	4.70	4235	4240	5005	7000	7000
	7060	7060	7070	7105	71.0	7135	7150	7250			
M3	4	4200	4220	4250	4.00	4285	4290	4300	6340	6800	7005
	7005	7065	7065	7070	7110	7140	7195	7200	7205	7295	
N	4	3750	4910	4915	4920	4925	4925	4930	4945	5040	6085
	7590	7785									
N0	4	3825	3830	3845	3895	3920	4950	5265	5335	5550	5555
	5810	6090	6275	6375	6535	7660	7690	7670	7685	7742	7743
	7750	7750	7755								
N1	4	7470									
N2	4	3870	3980	3975	4405	4945	4950	4955	4960	5040	5185
	5265	5330	5480	5500	7725						
N3	4	3810	3820	4000	4600	4005	4035	4055	4085	4085	4100
	4905	5225	5225	5250	5205	5270	5275	5295	5430	5435	5460
	5460	5470	5470	6275	6275	6400	6540	6690	6880	6870	6670
	6900	6905	6920	6940	6945	6960	6975	6980	6980	7030	7085
	7055	7055	7055	7060	7060	7060	7065	7065	7065	7070	7070
	7070	7070	7090	7100	7105	7110	7130	7130	7135	7140	7185
	7190	7200	7205	7285	7290	7295	7490	7495			
N4	4	4100	4165	4335	4880	4823	4855	4875	5140	5275	5295
	5310	5320	5325	5420	5490	5490	5615	5870	5905	6730	6730
	6735	7030	7075	7075	7180						
N5	4										
N6	4	4940	5040	5170	5640	6405	6795	7145	7310	7400	7600
	7600										
N7	4	3750	4930	4935	4940	4945	5040	5170	5640	5775	6040
	6085	6250	6405	6795	7145	7310	7400	7590	7770	7770	7780
	7780	7785	7790								
N8	4	4935	4940	5015	5240	5145	5560	5565	5575	5585	5590
	5630	5640	5695	5665	5770	6165	6250	6305	6370	6375	6380
	6385	6390	6395	6400	6405	7230	7215	7265	7285	7290	7295
	7300	7305	7310	7335	7340	7395	7400	7400	7790		
N9	4	4200	4205	4205	4260	4265	4270	4280	4295	4290	4300
	4325	4905	5290	5375	5505	5630	5630	6220	6320	6340	6355
	6355										
P	5	3835	3990	3995	3995	4095	4220	4240	4245	4250	4540
	5195	5200	5245	5250	5305	5315	5375	5385	5415	5420	5525
	5705	5710	6295	6305	6690	6910	6915	6920	6975	6995	7010
P1	5	6645	6645	6870	6830	6840	7225				
Q	5	3780	3790	3800	3845	3090	4070	4070	4075	4075	4120
	4135	4140	4140	4140	4140	4140	4150	4165	4165	4170	4170
	4175	4190	4195	4315	4325	4330	4335	4340	4350	4350	4375
	4380	4390	4395	4435	4440	4450	4455	4480	4490	4520	4590
	4605	4610	4615	4615	4620	4642	4645	4605	4655	4660	4665
	4670	4675	4685	4670	4710	4745	4750	4760	4770	4785	4820
	4865	4885	4915	4925	5015	5060	5170	5175	5185	5195	5150
	5215	5255	5290	5350	5500	5460	5470	5470	5480	5530	5500

	5615	5620	5630	5645	5675	5665	5670	5735	5755	5775	5790
	5795	5815	5825	5855	5905	5910	5930	5935	5950	5975	5985
	5970	6055	6065	6210	6240	6245	6255	6320	6330	6355	6405
	6470	6495	6505	6535	6590	6610	6680	6695	6700	6745	6765
	6775	6805	6820	6830	6840	6830	6840	6843	6840	6845	6860
	6925	6935	6940	7005	7070	7075	7270	7280	7300	7350	7365
	7385	7395	7400	7405	7425	7430	7435	7495	7500	7560	7565
	7570	7580	7602	7720	7743	7755					
00	5	5320	5385	5780	5790	5800	6475	6505	6825	6830	6850
	6830	6840	6840	6840	6855	6960					
01	5	4550	4605	5270	5285	5285	5535	5955	5965	5975	6480
	6505	6900	6965	6965	6975	7000	7005	7015	7020	7055	7070
02	5	4025	5600	5665	6405	6505	7060	7070	7475	7500	7500
	7505										
03	5	6495	6500	6590	6905	6970	6970	6975	7205	7020	
04	5	5555	5560	5565							
05	5	6595	7110	7245	7260						
06	5	6595	7140	7245	7260						
07	5	7245	7260	7305	7330						
R1	5	3860	3865	3895	3895	3980	3980	3990	5385	5385	
R2	5	4320	4325								
R5	5	3745	4000	4830	4930	4835	4835	4840	4840	4875	5270
	5285	6885	6895								
S	5	4985	5110	5110	7330	7 60					
S3	5	4000	4800	5080	5085	5085	5090	5090	5110	5270	5275
	5325										
T	5	3855	3860	3895	5900	6720					
T1	5	4150	4165	4170	4780						
T2	5	5230	5235	5240	5240						
T6	5	3835	4950	5130	5135	5140	5160	5165	5250	5310	5315
	5325	5385									
T9	5										
U	5	3755	5205	5250	5315	5525	5705				
U1	5										
V	5	4060	4065	4555	4085						
V1	5	4200	4225	4225	4260	5115	5420	5420	5460	6800	7010
	7010	7055									
V2	5	4200	4230	4230	4270	6600	7015	7015	7060		
V3	5	4200	4235	4235	4265	6800	7020	7020	7065		
V4	6	4200	4240	4240	4280	4305	4310	4315	4330	4335	5710
V5	6	4200	4245	4245	4285	4710	4715	5320	5775	5590	5640
	5710										

V6	6	4200	[illegible]			4990	4990				
V7	6	5540	[illegible]			5730	5710	5710			
V8	6	4060	[illegible]								
V9	6	4065	[illegible]			4965					
W	6	6795	[illegible]			7325	[illegible]				
W1	6	4335	[illegible]								
X	6 6220	4215 6310	4230	[illegible]	5275	5280	5515	[illegible]	5700	5710	
X1	6	3830	3850	[illegible]	4895	5550	5570	[illegible]	5660		
X2	6	4210	4225	[illegible]	4300	4315	5280	[illegible]	6315		
X5	6	3730	4950	5110	[illegible]	6140	7685	7685			
X6	6	3730	4995	5110	[illegible]	6150	7685	7685			
Y	6 5660	3855	3865	[illegible]	5085	5545	5560	[illegible]	5570	5580	
Y1	6										
Y5	6										
Z	6 5640	4330 5710	4335 7935	[illegible]	[illegible]	5470	5470	5485	5545	5580	5585
Z1	6	8									
Z5	7	6595	[illegible]			7280					
FNA	7	4990	[illegible]								
FNB	7 4865 7720	3780 4885 7750	4375 4915	4435 [illegible]	4510 5060	4655 5755	4710 6065	4745 6730	[illegible]	4800 6745	4830 7425
FNC	7	5015	5600	[illegible]		7150					
FND	7 6860	4665	[illegible]			5190	5215	6240	6240	6765	6765
FNE	7										
FNF	7	3790	4820	[illegible]	6210	6695					
FNG	7	4175	5230	[illegible]	5540	5540	6520	6330			
FNI	7	5015	5640	[illegible]	5705	5905	6240	[illegible]	7350	[illegible]	
FNJ	7 6055	4665 6055	[illegible]	[illegible]	[illegible]	[illegible]	4735	[illegible]	4820	5815	[illegible]
FNK	7	3845	[illegible]								
FNL	7										
FNM	7	4350	[illegible]	[illegible]	[illegible]	[illegible]	6240	[illegible]	[illegible]	[illegible]	[illegible]

```
FNN   7     4375  4390  4435  4450  4510  4655  4710  4745  4760  4900
      4823  4830  4915  4970  5020  6065  6105  6120  6130  6140  6150
      6165  6185  6195  6585  6635  6645  6655  6665  6715  6720  7425
      7525  7540  7560  7580  7600  7635  7645  7660  7720  7750  7780

FNP   7     4540  4590  5135  5245  6295  6890

FNQ   7

FNR   8     4135  4410  4415  4740  4980  5230  5235  6880

FNS   8     3755  3780  4605  5060  5190  5490  5600  5645  5670  5725
      5815  5825  5910  6055  6240  6245  6255  6355  6610  6610  6765
      6765  6775  6805  6845  6860  7035  7075  7350  7365  7405

FNT   8     4125  4985  5075  6080  6875  7680

FNU   8     4520  4665  5130  6240  6765

FNW   8     4865  4885  5060  6745

FNX   8     4410  4410  4415  4785  6700  6700  6880  6880

FNY   8     3810  5215  5255

FNZ   8     3830  5550

A[ ]  9     3835  4375  4380  4390  4395  4400  4400  4400  4410  4415
      4420  4420  4420  4435  4440  4455  4455  4480  4480  4485  4485
      4490  4490  4490  4490  4550  4605  4620  4640  4640  4642  4645
      5170  5175  5200  5205  6385  6560  7145  7150  7155  7160  7165
      7735

B[ ]  9

C[ ]  9     3710  4275  4295

D[ ]  9     3835  5130  5135  5140  5160  5165  5250  5310  5315  5325
      5385  5515  5525  5700  5705  5875  6565  6900  6905  6920  6940
      6945  6960  7170  7175  7180  7185  7190  7205  7210  7215  7220
      7225  7740

F[ ]  9     3710  4295  4300  4300  4305  4310  4320  4320

G[ ]  9     3710  4260  4265  4265  4270  4275  6335

M[ ]  9     3715  4940  5335  5340  5345  5560  5565  5575  5585  5590
      5620  5640  5655  5665  5665  5665  5770  5770  5780  5790  5905
      5970  6040  6090  6365  6370  6375  6380  6385  6390  6395  6400
      6405  6465  6475  6480  6485  6490  6505  6505  6505  6505  6505
      7230  7235  7265  7285  7290  7295  7300  7305  7310  7335  7340
      7395  7400  7400  7610

N[ ]  9     5975  6020  6830  6830  6830  6840  6840  6840  7600

S[ ]  9     3895  5555  6010  7475  7480  7480  7505

T[ ]  9     6015  6500  7475  7475  7475  7475  7480  7485  7485  7485
      7485  7495  7495  7495  7500  7670  7742

X[ ]  9

H#    3700

Y[ ]  3710  4280  4295  4295  4370  5720  5690  5710  5710  5720  5720
      5720  5720  5730  6335
```

```
S$      3885  5365  5265  [illegible]  5475  6250  6500  6505  6555  7670
        7685  7742  7745  [illegible]

A$      3955  3960  3970  [illegible]  4040  4055  4060  4065  4075  4080
        4105  4110  4115  [illegible]  5764  6090  6285

B$      4010  4020  4075

L       4995  4995  5000  [illegible]  5485  6275  6310  6315  6665
        6665  6720  6795  [illegible]  6890

I$      5762

E$      5764

L$      6705  6710  6770
```


REWORK
VIA LINK
(403) TRAP
0
1
2
3
4
5
(439) LOAD M,N
(404) INITIALIZE REWORK CONSTANTS
(405) LOAD DATA
ON ERROR
(406) INCORRECT FREQ
YES
NO
55
ERROR CODE (Z5)
(420)
STORE M,N
(407) SET PARAMETER
(409) PASS #1
(410) PASS #2
(411) PASS #3
(412) RESULTS
(413) PRINT RESULTS
PRINT RESULTS (418)
(435) DELETE DATA
(421) LIST DATA
(434) PLOT DATA

```
50 L$="N8S1D.4S  REWORK    J1-F16  I1-F12"
52 MAT M=ZER(40,10)
55 B5=S3
60 B6=30.9
61 F3=F7=H9=V8=0
62 F5=F9=1
63 M(21,2)=0.136
64 F=7.5
65 O=FNJ2
66 GOTO 1395
200 DEF FNA(L)=(M(21,2)+ML(1,6)-2)*INL+60
275 DEF FNB(Q)
280 FOR I=1 TO Q
285 BEEP
290 WAIT ABS(100*(I-4))
295 NEXT I
300 RETURN 0
305 DEF FNN(O)
310 DISP "( =NC):";O;
315 INPUT B$
320 IF B$="" THEN 330
325 RETURN VAL(B$)
330 RETURN 0
335 DEF FNI(O)
340 A$="- - ----====########"
345 A$=A$[4*O-3,4*O]
350 A$[5]=A$
355 A$[9]=A$
360 FORMAT F5.1
365 WRITE (15,360)A$;A1;A2;A3;A$
370 RETURN 0
375 DEF FNK(N0)
385 L7=256*EXP(0.111*(A(41,10)*D...)*(L*(A(3)-10-3)*9+2)^3.16)
390 Q=(0.9211/(1+0.2512/F12^5.10*(1-596/F12)/(1-3596/F12)^2)
395 Q2=293/(A(3)-10-32)*5/9+273.15)
400 G4=6.644E-03*(1-0.02252*Q)^10.52*Q2^2.75*Q
405 V=1-0.02215*(11.02-Q)*Q2
410 L4=5.145/Q2*(1-0*8.775)+3.172*Q*7.775
415 Q=(1+493.3/F^2)/(1-493.3/F12*12*L7)*(1+0.0046*L7)
420 G5=1.451E+05*(1-0.0225Z*Q)^5.262*EXP(-644*Q2/293)/(1-Q2*293)^3*Q
425 L5=2.09+0.37*(1-Q2^2)
430 G6=2.529E-02*(1-0.02252*Q)^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*(0.9227*(1-0.02252*Q)^5.262+0.0202*L7)
450 L9=0.013
455 K1=10^(-Z1*10/SINL)
460 B4=293/Q2*(1-K1)/1.071
465 IF B<14 THEN 480
470 B0=B
475 GOTO 485
480 B0=-4.248+2.1468*B-0.14259*B^2+0.0030247*B^3
485 Q2=(T[N0,9]-100)/(1.8*L*BU)^2
490 K2=(1-EXP(-Q2))/Q2/1.001
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=14/2.909E-04)*(L8-Q*L9)*TANL+(F/INL)^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 K
```

```
560 DEF FNZ(N)=FN
565 DEF FNO(O)
570 N5=N5+1
575 O=FN5(O)
580 PRINT #1;"
585 IF STAT3=0 THEN 610
590 ENTER 3;*;O;O1
595 IF O1.10^9 THEN 620
600 PRINT
605 DISP "CLOCK RESET";
610 INPUT O1
615 GOTO 575
620 FORMAT "
625 WRITE (15,620)O*10^3+I
630 O=20
635 PRINT
640 PRINT
645 FORMAT 25X,F4.0,"-
650 WRITE (15,645)-N5,N6
655 FORMAT "
660 PRINT
665 FORMAT 20X,"PROG
670 WRITE (15,665)P$[13,20],"
675 PRINT TAB(0),P$[1,2]";
680 WRITE (15,655)C
685 FORMAT 19X,F6.3," CHz, ",F5.1," Ft DISH"
690 WRITE (15,685)F,D
695 PRINT
700 RETURN 0
705 DEF FN3(0)
710 FOR I=1 TO 0
715 PRINT
720 NEXT I
725 RETURN 0
730 DEF FNE(N0)
740 E0=0
745 E1=50*(1.K1-1)
750 IF B<14 THEN 765
755 02=0
760 GOTO 780
765 00=4.73+(3.9-80)+
770 01=(7.12-80)/ABS(7.12-10
775 02=0.15+0.354*(00+01
780 D2=.00+NC(2),3)/NC(1,1)
785 P1=3+SQR(02^2+13+D^
790 E2=((1-K2)+P1^01,
795 E3=(W*F/3E+03)^2+50
800 E4=0.4+E0+E0 K1,^2
810 E5=(10^(H1/10)-1)*10
815 E6=0.003*T[N0,11]
820 Y=1+FNZN0+G/T
825 Y5=Y/(Y-1)
830 E7=SQR((09+Y5,^2+N
835 E8=100-D8+(1-K8-1)
840 E9=10.-D9*(1-K9-1)
845 RETURN 0
```

```
865 DEF FNM(Q)
870 Q=FN3Q
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)^10.78-(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 0 OF 930
920 PRINT TAB31,"FIT TO  ";N[1,9];"DATA"
925 RETURN 0
930 PRINT "TAPE";V8"data";F9;L$;
935 FORMAT 5X,"REWORK",F6.2
940 WRITE (15,935)N[1,10]
945 PRINT TAB15,D$;E$
950 RETURN 0
955 DEF FNY(N3)
965 IF N3 THEN 1155
975 IF F2 THEN 1085
980 X1=FNZ(N0)
985 Y=1+X1*G/T
990 R1=T/H9
995 I5=(Y-1)*R1/250
1000 IF N2=-3 THEN 1055
1005 I5=(Y-1)*R1/50
1010 GOTO 1060
1020 R=401
1026 FORMAT "    K1    K2    K3    K6    K8    K9    K    APR-eff   "
1030 WRITE (15,1026)"R-eff  S(FU)    X1(K)"
1035 FORMAT F7.3,6F6.3,F8.4,F7.2,F8.1,E11.3
1040 WRITE (15,1035)K1,K2,K3,K6,K8,K9,F,B2,B3,S[N0,4],FNZ(N0)
1045 PRINT
1050 RETURN 0
1055 Q=FNF3
1060 FORMAT " ZERO LEVEL",4X,"100% LEVEL",4X,"Y(DB)",5X
1065 WRITE (15,1060)" K-FACTOR    I("$$*[1,3];")    S(Jm)      TA"
1070 FORMAT F7.4,"*TA",F11.4,"*TA",F11.4,F11.3,F11.2,F9.1,F9.1
1075 WRITE (15,1070)R1,Y*R1,10*LGT(Y),I5,X1*G,S[N0,4],H9
1080 PRINT
1085 PRINT
1090 FOR I=0 TO 5
1095 PRINT TAB(10*I+6),
1100 IF N2=-3 THEN 1115
1105 PRINT 20*I;
1110 GOTO 1120
1115 PRINT 4*I-10;
1120 NEXT I
1125 PRINT "(%)"
1130 Q=FNF8
1135 PRINT " N3    ";A$;TAB(8,"PWR PWR(ADD)"
```

```
1140 IF N2>-3 THEN 1150
1145 R1=R1-25*I5
1150 GOTO 1245
1155 IF F2=0 THEN 1165
1160 P=P-(X+F[2]*X1+F[1]*X2)
1165 Q=INT((P-R1)/I5+0.5)+8
1170 P=INT(10↑5*P+0.5)/10↑5
1180 A$[1,72]=""
1185 A$[33,33]="!"
1190 FORMAT F3.0
1195 OUTPUT (A$[1,4],1190)N3,
1200 FORMAT F9.5
1205 OUTPUT (A$[60,69],1200)P,
1210 IF Q<1 OR Q>72 THEN 1220
1215 A$[Q,Q]="*"
1220 WRITE (15,1190)A$
1230 IF N3<N4 THEN 1245
1232 Q=FNF8
1235 PRINT TAB7;A$
1240 PRINT
1245 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)
1374 GOTO Q OF 4985,4815,1020,5320,5574,5624,5008,5690,5600,5633
1376 GOTO 1395
1378 DEF FNO(Q)
1380 Q=FNNQ
1382 RETURN 0
1383 DEF FNV(Q0)
1384 GOTO Q0 OF 4570,2140,4430,4480,4548,5800,5130,5230,5642,5660,5020,3025,5648
1385 GOTO 1395
```

```
1387 DEF FNJ(0)
1390 GOTO 0 OF 3165,4[illegible]5075,[illegible]3030,3255,3010
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,2NUIO,3:DEL,4G/T,5PLT,ERR";
1415 0=FNB3+FNN0
1420 GOTO 0 OF 5017,3110,4863,3225,4047
1425 R=403
1440 0=FNF1
1442 DISP "GRAPH DATA(0=NO/";
1444 F1=FNN0
1455 RESTORE
1460 DISP "START @ REC#";
1465 M[1,10]=FNB3+FNN0[1,10]-0.1
1470 0=FNV6
1600 R=404
1639 IF F8=0 THEN 1645
1640 0=FNV11+FNV9
1642 MAT M=ZER
1643 M[1,10]=A0
1645 R=405
1650 SERROR 25,3195
1655 F2=H=L1=N4=T6=0
1660 E5=6/3600
1665 F4=F4+1
1670 N8=M[40,1]+1
1675 0=F4+8+F7+33
1680 LOAD  DATA #(10-5+F7),0
1685 PRINT "FILE";0;F$,"RUN/SET";A[1]/100
1690 PRINT TAB5,S$,H$,'FREQ";M[2]/1000
1695 0=FNS2
1700 IF N0/5 OR D[1,2]=0 THEN 1645
1705 Q3=A[2]/1000
1710 0=F3-Q3
1715 R=406
1720 IF F3 AND 0 THEN 1645
1725 IF F=Q3 THEN 1740
1730 F=Q3
1735 0=FNJ2
1740 N7=(A[1]/100-INT(A[1]/100))/100
1741 N6=INT(A[1]/100)
1742 E8=24/360/COS(N0,3)
1743 N=6+(N7-1)
1745 IF F8=0 THEN 1750
1746 0=FNF4+FNF5+FNF9+N320
1747 M[40,1]=M[40,1]+1
1748 GOTO 1645
1750 R=407
1755 N3=N9=0
1760 N=N+1
1765 SERFOR 25,3195
1770 N7=INT((N-1)/6)+1
1775 N2=N+2-6*N7
1780 T6=N2+4
1785 N4=D[T6,3]
1790 IF T6=1 THEN 1800
1795 N4=D[2,3]
1800 V7=D[T6,7]/100
1805 E1=D[T6,4]/1000
1810 B1=D[T6,5]/1000
1825 A=D[T6,1]/100+1
1830 L=D[T6,2]/100
1835 IF F1=0 AND N2# [illegible]
```

```
1840 R=408
1845 Q=FNH1+FNC1+FNKN0*FNN1*FNI3
1850 PRINT
1855 FORMAT " MEAS    AZIMUTH      DK  DA    TIME*H*3)    OFFSET       ELEV
1860 WRITE (15*1855)"CUT  RUN  S.F   N"
1865 FORMAT F2.0*"sec"*F11.2*F10.4*F11.3*F9.3*" dea"*F9.2*F6.0*3F5.0
1870 B=FNOL
1875 V9=FNZ(N0)*G/H9
1880 WRITE (15*1865)C(N1*E5*A*B/S0*F1*B1*L*N2*N6*N7*N
1885 TRANSFER T[N0*1] TO S#
1890 V1=W1=0
1895 PRINT
1900 IF N2>-2 AND F1=0 THEN 1910
1905 FORMAT "dT="*F6.3*17X*"T TA = *F7.4*" +"*F8.5*"*CSC L"*18X*F5.1
1910 WRITE (15*1905)V9*NL18*2]*NL18*6]*S#
1915 PRINT
1920 R=409
1925 P=U=A[9]/10↑4
1930 T=(N[18*2]+N[18*6]/SINL)*H9
1935 IF N2#0 THEN 1945
1940 Z=T/H9
1945 IF N2=-3 THEN 2448
1950 V=LOG(0.5)*4/(E5/S0*E8/E5/N4)↑2
1955 Q1=F1
1960 W1=F1=0
1965 F1=FNV2+01
1990 S3=X
1995 W1=F[1]
2000 FORMAT "PASS #FIT  DET(C)      *APEX        T/To       DT("
2005 WRITE (15*2000)S#"))/TA    PEAK #   SLOPE  T-FIT"
2010 FORMAT F2.0*F6.0*F9.3*8X*"-"*F13.4*F9.4*" +-"*F6.2*"%"*F7.2*F7.2*"%"*2F6.1
2015 Q=100*SQR(R2/N9)/F[2]
2020 A=100*(S3-N[18*2]-N[18*6]/SINL)/V9
2025 WRITE (15*2010)1*N9*DET(C)*S3*F[2]*Q*V7*W1*200/S3*A*"%"
2030 R=410
2035 N[18*2]=S3-N[18*6]/SINL
2040 T=(N[18*2]+N[18*6]/SINL)*H9
2045 N9=0
2050 Q=B/120*E8/E5+1
2055 FOR N3=V7-Q TO V7+Q
2060 IF N3<1 THEN 2090
2065 P=U+EXP(D[T6*N3+7]/10↑4)
2070 X1=2+(N3-V7)/N4
2075 X2=X1*X1
2080 P=LOG(P-S3-W1*X1)
2085 Q=FNGN9
2090 NEXT N3
2095 P=FNG(-9)
2100 V=F[1]
2105 W1=-F[2]/F[1]/2
2110 E6=V7+W1*N4/2
2115 FORMAT F2.0*F6.0*F9.3*F6.3*"D"*F7.3*"-"*F11.4*F6.2*"%"*F7.2*5X*"-"*6X*"-
2130 E7=E5/E8*N4*SQR(100.0/V)
2125 Q=EXP(X-F[1]*W1↑2)
2130 WRITE (15*2115)2*N9*DET(C)*F*Q*" +-"*100*SQR(R2/N9)/Q*E6
2135 D[T6*7]=100*E6
2136 GOTO 2208
```

```
2140 R=411
2145 N9=0
2150 IF F1=0 THEN 2165
2155 Q=FNY0
2160 FOR N3=1 TO N4
2165 P=U*EXP(DCT6,N3+7)/10↑4)
2170 IF F1=0 THEN 2180
2175 Q=FNYN3
2180 X2=2*(N3-V7)/N4
2185 X1=EXP(V+(X2-W1)↑2)
2190 Q=FNGN9
2195 NEXT N3
2205 P=FNG(-9)
2206 RETURN 0
2208 R=412
2209 Q=FNV2
2210 IF F[2]<1.8E+03 AND F[2]>5.3E-04 THEN 2230
2215 PRINT "UNDERFLOW"
2220 DCT6,6]=-32700
2225 GOTO 2235
2230 DCT6,6]=LGT(F[2])*1014
2235 IF N2#0 THEN 2260
2240 Z=X
2245 AC8]=Z*1E+04
2255 AC10]=E7*1E+04
2258 R=413
2260 IF F1=0 THEN 2280
2265 PRINT
2270 WRITE (15,2000)CHR$(7) TAB  FNR$  SLOPE  T-FIT"
2275 FORMAT F2.0,F6.0,F9.,F9.3,"d=0",F10.4,F9.4," +-",F6.2,"%",2F7.2,"%",2F6.1
2280 Q=100*SQR(P2-N9)-F[2]
2285 A=100*(X-AC18,2]-NF1)/AC18,6]-SINL)/"%
2290 WRITE (15,2275)B,N9,DCT(L),E7,X,F[2],Q,E6,F[1]*200/X,A,"%"
2295 Q=2
2300 IF N2#2 THEN 2310
2305 Q=5
2310 Q=FNI(Q)
2435 GOTO 2540
2440 R=414
2445 M1=V1=0
2450 IF F1=0 THEN 2460
2455 Q=FNY0
2460 FOR N3=1 TO N4
2465 P=U*EXP(DCT6,N3+7)/10↑4)
2470 IF F1=0 THEN 2480
2475 Q=FNYN3
2480 M1=M1+P
2485 V1=V1+P*P
2490 NEXT N3
2492 N3=N3-1
2495 Z=M1/N3
2500 FORMAT 11X,"T/TH",10X,"SIGMA",9X,"MEAN",8X,"#PTS",9X,"T"
2505 WRITE (15,2500)
2510 FORMAT F16.4,F14.,," ",F11.2," ",F9.0,F13.1
2515 Q=100*SQR((V1-M1↑2/N3)/(N3-1))/2
2520 WRITE (15,2510)Z,0,0/SQR(N3-1),N3,Z*H9
2525 PRINT
2530 AC18,2]=Z-AC18,6]-SINL
2535 Q=FNI3
2540 IF N2<2 THEN 1750
```

```
2950 V5=M2
2960 J=V2
2960 0=FNF4+FNF5+FNF9+FN620
2962 M2=V5
2964 V2=J
2975 STORE  DATA #(10-5+F7),"+ " r|+ "
2980 M[40,1]=M[40,1]+1
2985 GOTO 1645
2990 P=415
2995 0=N8+1
3000 M[0,2]=M[0,3]=M[0,4]=M[0,5]-?[0,6]=0
3005 0=FNI5
3010 0=FN65
3015 GOTO 1555
3018 P=416
3020 DISP "STORE MAT N%N[0=N0,"
3021 0=FNB2+FNN1
3022 IF 0=0 THEN 3024
3023 0=FNV12+FNS10
3024 RETURN 0
3025 P=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[9,I]=T[9,I]
3045 N[10,I]=T[9,I+10]
3050 NEXT I
3055 0=10-5+F7
3060 01=4+F9-3+17+F7
3065 STORE  DATA #0,01,M
3070 STORE  DATA #0,01+2,N
3075 FORMAT "    FREE",10%,"M FILE ",7%,"N FILE",8%,"TAPE",7%,"SUMMARY SET",4%
3080 WRITE (15,3075)"REWORK"
3085 FORMAT F9.3,4F13.0,F15.2
3090 WRITE (15,3085)F,01,01+2,V8,F9,N[1,10]
3095 0=FNS30
3100 RETURN 0
3118 P=418
3120 0=FNJ3
3125 F5=0
3128 DISP "REWORK #"
3130 N[1,10]=FNNN[1,10]
3135 F6=N0=1
3136 IF F#0 THEN 3140
3138 F=7.5
3139 0=FNJ2
3140 0=FNJ4+FNJ5+FNL7+FNL6+FNL5+FNL4+FNL3+FNL2+FNL1+FNL0+FNL8.4+FNL7.3+FNL6.2+FNL1.3+FNL0.2
3142 IF F5 THEN 3148
3144 0=FNJ7
3146 GOTO 1395
3148 0=FNV12+FNV10+FNV6
3150 GOTO 1600
3165 P=419
3170 DISP "RESTART @ N="
3175 INPUT 0
3180 F3=0
3185 N=0-1
3190 GOTO 1750
```

```
3195 R=420
3200 WAIT 1000
3205 Q=FNS6
3210 IF Z5=56 THEN 1645
3215 IF Z5#61 THEN 1645
3216 Q=FNV12
3217 IF F6=0 THEN 1345
3218 IF F5=0 THEN 3185
3219 SENSOR Z5,3221
3220 GOTO 3195
3221 Q=FNV6
3222 GOTO 1600
3225 R=421
3226 D$=""
3228 IF F6 THEN 3240
3240 Q=FNS6+FNH1+FNC1+FN46
3244 RETURN 0
3255 R=422
3285 FORMAT /,'RUN/SET STAT     ELEV     S/T     G/TH  HPBW#1 HPBW#2 '
3290 WRITE (15,3285)" FREQ    Y-toc     REF     NUF"
3295 FORMAT F6.2,F7.1,2F8.3,6F7.3
3300 I=0
3305 I=I+1
3310 Q=M[I,1]
3315 IF Q-INTQ=0 THEN 3375
3325 Q0=M[I,6]
3330 Q1=M[I,7]
3335 Q2=M[I,8]
3340 J=M[I,9]
3345 E=ABSQ
3350 TRANSFER T[100*E-10*INT(10*E),1] TO S$
3355 WRITE (15,3295)M[I,10]," "+S$+Q,M[I,2],M[I,3],M[I,4],M[I,5],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
3382 N0=0=1
3384 A[3]=10*B5
3386 A[4]=10*B6
3405 REDIM M[M[40,1],10]
3410 SORT M,C,0
3415 Q=FNS3+FNH1+FNC1+FN34
3420 REDIM M[40,10]
3425 IF M[40,1]<3 THEN 3505
3430 FOR J=19 TO 25
3435 IF J=23 THEN 3550
3440 I=N=0
3445 I=I+1
3450 IF M[I,1]=0 THEN 3445
3455 M[J,9]=M[J,10]=M[I,J-17]
3460 FOR I=1 TO M[40,J]
3465 X1=M[I,1]
3470 IF X1 <= 0 THEN 3510
3475 X2=1/SIN(X1)
3480 P=M[I,J-17]
3485 Q=FNQN9
3490 IF P<M[J,9] THEN 3500
3495 M[J,9]=P
3500 IF P>M[J,10] THEN 3510
3505 M[J,10]=P
3510 NEXT I
```

```
3515 J=FNV4
3520 IF J>19 THEN 3545
3525 PRINT TAB35; # FT; = ";J
3530 NC1,9]=N9
3535 PRINT
3540 Q=FNV5
3545 Q=FNS3
3550 NEXT J
3555 Q=FNS10
3560 RETURN 0
3565 DEF FNL(QQ)
3570 R=424
3575 D$=""
3580 J=INT(QQ)
3585 L0=10+(60-J)
3590 J=J+18
3595 IF NCJ,9]#0 THEN 3610
3600 PRINT "DATA NOT FIT IN";FNB6
3605 RETURN 0
3610 IF L0 THEN 4190
3615 F2=FNV3
3620 IF F6 THEN 3660
3625 DISP "FIT:0=LOG, 1=LIN";
3630 F2=FNB2+FNN0
3635 IF NCJ,9]=0 THEN 3590
3640 DISP "ZERO(MIN="&NCJ,9]&"MAX= "&NCJ,10]&")";
3645 INPUT R1
3650 DISP "FULL SCALE (MAX="&NCJ,10]&")";
3655 INPUT Q
3660 I5=Q-R1
3665 IF F1 <= NCJ,9] AND F1+I5 >= NCJ,10] THEN 3690
3670 BEEP
3675 DISP "RANGE TOO SMALL"
3680 WAIT 1000
3685 GOTO 3640
3690 I5=I5/50
3692 L=30
3695 Q=FNS3+FNN1+FNC1+FNA1+FNN1+FN15
3700 PRINT ". = FIT";
3705 D$="#@@+.#X"
3710 FOR I=1 TO N1-2
3715 TRANSFER TCI,1] TO Z
3720 PRINT D$[I,I]&" = "&Z$;
3725 NEXT I
3730 Q=FNS3+FNN0+FNF1
3735 FORMAT "+UNIT=",F",4,"
3740 PRINT
3745 FIXED 3
3750 FOR I=0 TO 5
3755 PRINT TAB(10*I+6),R1+.2*I-I/5
3760 NEXT I
3765 STANDARD
3770 WRITE (15,3735),5
3775 Q=FNF8
3780 PRINT " ELEV      ";Q;"
3785 FORMAT 4X,"VALUE    DX   IT"
3800 WRITE (15,3785)
3805 FORMAT F5.1
3810 I=N2=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 (15,3885)L1;
3940 A$=""
3945 A$[1,52]=""
3947 IF X>52 THEN 3955
3950 A$[X,X]="."
3955 A$[Q,Q]=B$
3975 FORMAT F9.4,F8.2
3980 WRITE (15,3975)"      ",A$,J1,T2
3985 GOTO 3820
3990 E=N[J,4-F2]
3995 T1=N[J,2-F2]+N[J,6-F2]*((F2=0)/SINL+(F2=1)*L)
4000 IF J=21 OR J=22 OR J=24 THEN 4010
4005 E=FNV1+(C2=1)*10*LGT(1+E/100)+(C2#1)*E*T1/100
4010 Q=INT(E/I5+0.5)
4015 IF Q>1 THEN 4045
4020 Q=1
4045 X=INT((T1-R1)/I5+0.5)+2
4050 PRINT L;
4060 FORMAT " ",51"-"
4065 OUTPUT (A$,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$[X+Q,X+Q]="!"
4150 FORMAT F10.4," <-",F7.4
4152 A$=A$[1,52]
4155 WRITE (15,4150)"   ",A$,T1,E
4160 L=L+5
4165 GOTO 3885
4170 Q=FNF8
4172 PRINT TAB10,A$
4175 D$=""
4180 Q=FNS36
4185 RETURN 0
```

```
4190 R=426
4195 REDIM Y[3]
4200 Y[1]=10
4205 Y[2]=50
4210 Y[3]=10
4215 IF F6 THEN 4260
4220 A$="G/T:"
4225 IF J=19 THEN 4235
4230 A$="G/To:"
4235 DISP A$;"0=CSC ;1=LINEAR"
4240 F2=FNB2+FNN0
4245 REDIM Y[3]
4250 DISP "ELEV(DEG):START,STOP,STEP";
4255 INPUT Y[1],Y[2],Y[3]
4260 R=427
4265 Q=FNS1+FNH1+FNC0+FNK1+FNN1+FNI3+FNS1+FNH0+FNF2+FNS1
4270 PRINT TAB24,"+ = LINEAR CONTRIBUTION"
4275 Q=FNS2
4280 FOR L=Y[1] TO Y[2] STEP Y[3]
4285 TRANSFER T[INT((J+2)/2),1+20*(J/2-INT(J/2))] TO B$
4290 B$[10]="="
4300 FORMAT F5.1,"deg:",13X,F7.3," +-",F5.2," dB    (",F6.1," %)",4X,F6.3," GHZ"
4315 N0=1+FNV1
4335 WRITE (15,4300)L,B$,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 F5.2,"%",12F6.2,"%"
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
4415 Q=FNS10
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]*N1)/N0
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=N[J,4-F2]-3.
4576 IF J=19 OR J=20 THEN
4578 H1=10*LGT(1+N[J,4-F2]*NL
4580 Q=(F2=0)*SINL+(F2-1)*L
4585 M=N[19,2-F2]+N[19,6-F2]*0
4600 T1=N[J,2-F2]+N[J,
4602 C2=1+((J=25)*(J=
4610 M=10↑(M-10)
4615 G=10↑((N[20,2-F2]+N[20,6-F2]=0)*10+FNV9
4617 T=G/M
4620 Q=FNV13+FNE1
4635 Y1=C8*Y5
4640 S=T[N0,10]/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,F8.4," +-",F7.4,"  +  (",F9.5," +-",2F8.5
4835 TRANSFER T[INT(J+2)*20+1,20+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
4847 R=434
4848 PRINT "PLT:IG/T,2G/To,3HPBW#1,4HPBW#2,6Y-FAC,7NEF,8NUF"
4849 PRINT "%.1=ERR TABLE, %.2= +VALUE LIST"
4850 Q=FNB2+FNS1+FNN1
4851 Q=FNLO
4852 GOTO 1395
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,10,0,01
4885 M[01,1]=-M[01,1]
4890 GOTO 4864
4895 R=436
4900 C1=2.997925E+08*(8*PI)^.5*(4E-7*(F*1E+9)↑2)
4905 D0=0.9/F↑2
4910 G=R2*(D*F^0.313)↑2
4915 B9=2*C1*1.380654E-
4920 B=3035/D/F*SQR(D3 D2)
4925 FOR I=1 TO N1
4930 Q=C-T[I,15]/10
4935 Q3=T[I,6]/1E+03*(I
4940 Q2=EXP(-TL[I,16]/(E+01*Q
4945 I5=S[I,1]+T[I,8]
4950 A=Q3*((F/T[I,10]*100
4955 N3=F*((A/B)-(A<0)*
4960 Q=EXP(-TL[I,16]/1E+04*Q)*T5*N3^(T[I,18]*100)↑N
4965 T[I,10]=(Q-Q2)/Q2*1000
4970 S[I,3]=Q2
4975 NEXT I
4980 RETURN 0
```

```
4995 S=137
4996 F2=0
5020 DISP  SAD TIME =";
5005 M3=FNA(
5006 RETURN 0
5008 R=438
5010 DISP "DATA SET:";A;" ";B;" ";C
5015 F9=F+NF
5016 RETURN 0
5017 R=438
5018 Q=P%*P1+P%*T+FNW(
5019 GOTO 1385
5020 R=442
5022 Q=-10-5-F7
5025 Q1=4+F9-.17+F7
5030 LOAD  DATA =0;0;
5035 LOAD  DATA #0;0;
5040 F=NC(6,11)
5041 IF F#0 THEN 5042
5042 F=7.3
5043 Q=FNJ2
5045 FOR I=1 TO 10
5050 T[9,I]=NC(9,I)
5055 T[9,I+10]=NC(10,I)
5060 NEXT I
5065 TRANSFER T[9,1] TO #8
5070 RETURN 0
5075 R=441
5080 DISP "TEMP(F)";
5085 B5=FNB2+FNW(A[3],10)
5090 A[3]=10*B5
5095 DISP "DEW PT F ";
5100 B6=FNW(A[4],10)
5105 A[4]=B6*10
5110 RETURN 0
5130 R=442
5135 L=DC(4,2),100
5140 F2=N2=3
5155 N9=0
5160 B=FNDL
5165 FOR J=2 TO 6
5170 X1=DC(J,5)/16.667-8
5175 X2=X1^2
5180 P=LOG(10^(DC(J,6)-10*H))
5185 Q=FNGN9
5190 NEXT J1
5195 Q=FNC(-9,
5200 W1=-F[2]*F[1],2
5205 W8=E^(P%*-F[1]+W1*)
5210 V=F[1]
5215 E9=60P(A2,N9)
5220 RETURN 0
```

```
5230 R=44
5240 N9=0
5245 FOR J1=2 TO 6
5250 X2=D[J1,5]-16.667-0
5255 X1=EXP(4*LOG0.5*(X2^2 ^ 1.2)
5260 P=10^(D[J1,6]-10^4)
5265 Q=FNGN9
5270 NEXT J1
5275 Q=FNG(-9)
5280 V6=F[2]+X
5285 M3=V6+Z
5290 Y=M3/Z
5295 X1=FNZH0
5300 M=(Y-1)/X1
5310 E9=SQR(R2/N9)/V6
5315 RETURN 0
5320 R=444
5321 M[N8,1]=INT(D[4,2]-10+0.5)-10+N0-100
5322 Z=A[8]*1E-04
5323 Q=FNV7
5324 M[N8,4]=AL10]+1E-04
5325 M[N8,5]=E7=2*SQR(LOG0.5-F[1]^2/60
5326 M[N8,6]=F
5327 Q5=W1*B/60
5331 M[N8,10]=N6+N7/100
5332 Q=FNS2+FNN1+FNC1+FNB(N0)+FNM$+FNS1+FNI5
5333 PRINT TAB30,"BEST FIT FOR 5 OCTS"
5334 PRINT
5335 FORMAT "REWORK FILE TAPE  TIME(Hrs)  EFF AREA   To(K)  SKY BRIGHT  "
5340 WRITE (15,5335)"ELE"deg"  AZM  SET"
5345 FORMAT F5.1,F5.0,F5.0,F10.3,F9.1," mi2",F7.1,F8.2," K",F10.1,F7.0,F5.0
5350 WRITE (15,5345)M[1,10],2*N8+7,V2,D[4,4]*1000,D9,H9,B4,M[N8,1],N6,N7
5355 Q=FNS2
5370 WRITE (15,2000)S$:"  To       DECL OFFSET: "S$
5375 FORMAT F2.0,F6.0,F9.3,F9.5,"deg",F10.4,F9.4," +-",F6.2,"%",F11.3,"deg"
5380 WRITE (15,5375)1,N9,DET(C),E7,2,V6,100*E9,05
5385 Q=FNV8
5450 M[N8,2]=10*LGTM
5452 M[N8,3]=10*LGT((M3-Z)/X1)
5460 Q=K*S[N0,4]/(Y-1)/1000
5463 M[N8,7]=Y
5465 M[N8,8]=Q-(B4+3)/B9*1.38054
5470 M[N8,9]=Q/K1-3/B9*1.38054
5480 WRITE (15,5375)2,N9,DET(C),E7,2,V6,100*E9,05
5485 Q=FNS2
5490 FORMAT "  *HPBW#1     Y-FACTOR    T(K)     DT("
5495 WRITE (15,5490)S$:"    G(dB)    G/T(dB)     NEF       NUF"
5500 Q=M[N8,3]+10*LGTH9
5505 FORMAT F6.3,"deg",F10.4,F9.2,F9.2," K",2F9.2,F8.3,F7.3,"kFU"
5510 WRITE (15,5505)M[N8,4],Y,2*H9,V6*H9,Q,M[N8,2],M[N8,8],"kFU",M[N8,9]
5515 Q=FNS1+FNI5+FNS1
5520 PRINT TAB23,"10%(DUAL FIT)(NAC IS("S$:")/TA)"
5525 FORMAT /,10X,"CUT",5F10.0,/,F24.2,"%",5F9.2
5530 REDIM Y[5]
5535 FOR I=2 TO 6
5540 X2=D[I,5]/16.667-0
5545 X1=EXP(4*LOG0.5*(X2^W1)^2)
5550 Y[I-1]=100*(1-(D[I,6]/10^4)-(F[2]*X1+F[1]*X2+X))/V6)
5555 NEXT I
5560 WRITE (15,5525)-2,-1,0,1,2,Y[1],Y[2],"%",Y[3],"%",Y[4],"%",Y[5],"%"
5565 Q=FNS2
5570 REDIM Y[2]
5572 RETURN 0
```

```
5574 R=445
5575 X1=FNZN0
5580 FORMAT S1,"=NPB",#1 ,"=F7.3,"  =D1.2," DSD =",F7.4,
5585 WRITE (15,5580)N[21, 3,N[1,3,3,6,60,60,"
5590 0=FNS1+FNF3
5595 RETURN 0
5600 R=446
5605 FORMAT " SITE ELE'
5610 WRITE (15,5605)"
5615 FORMAT F7.3," km",F10.5," dB",F5.4," dB/dens",F6.4," d2",F5.3,F1
5620 WRITE (15,5615)C0,G4,L4,C5,L5,G6,L6,Z1,L8,L9,0," t"
5622 RETURN 0
5624 R=447
5626 FORMAT " G(dB)  G-dir  T(K)  Ts(K)  Y-foc
5628 WRITE (15,5626)"
5630 FORMAT F6.3,F7.3,F7.1,F5.1,F8.4,F7.2," %",F7.3," dB",F7.2,"
5631 WRITE (15,5630)10*LGTG,C7,T,H9,1,D2,H1,P1,B4," ",B9
5632 RETURN 0
5633 R=448
5634 FORMAT /,F5.2,"=A2",F6.2,"=C9",F5.1,"=D1",F9.5,"=N(21,1)",F5.0,2F3.4
5636 WRITE (15,5634)A2,C9,01,N[21,1],T[1,9]"=T(1, 9,",J1"=J1'
5638 FORMAT F5.2,"=D8",F6.2,"=09",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])↑2*26117/10↑((N[20,2]+N[20,6])/10)
5646 RETURN H9
5648 R=450
5650 B=FNQL
5651 0=FNK1
5653 B2=B3/(B0+D+F/3025)↑2
5655 C7=10*LGT(G/B2/(D+F+0.213)↑2)
5657 B9=2*C1*1.38054E-23*G
5658 RETURN 0
5660 R=451
5665 F8=1
5670 IF N[1,10]-INTN[1,10] THEN 5600
5675 F8=0
5680 RETURN 0
5690 R=452
5695 A$=""
5700 FORMAT 10"!....',"!"
5705 OUTPUT (A$,5700.""
5710 RETURN 0
5800 R=453
5810 SERROR 25,5856
5815 MAT M=ZER
5820 REDIM Y[2]
5825 F4=0
5830 F6=F5=1
5835 0=N[1,10]
5845 READ N[1,10],F9,
5850 IF N[1,10] <= 0 THEN
5852 A0=N[1,10]
5855 RETURN FNA10
5856 0=FNJ0
6000 REM 1=RWRK#,2=duro
6010 DATA 12.2,2,7.32
```

R	1	1020	1395	1425	1600	1645	1715	1750	1840	1920	2030
	2140	2205	2255	2440	2790	3018	3025	3115	3165	3195	3225
	3255	3380	3570	3815	4130	4260	4365	4430	4480	4548	4570
	4615	4847	4863	4895	4905	5008	5017	5030	5075	5130	5230
	5320	5574	5600	5624	5633	5642	5648	5680	5690	5800	
A	1	1825	1880	2020	2025	2285	2290	4950	4955	4955	4960
A1	1										
A2	1	830	5636								
A3	1										
B	1	465	470	480	480	480	750	1870	1880	1950	2050
	4920	5160	5170	5250	5325	5327	5540	5585	5650		
B0	1	470	480	485	765	765	770	770	800	800	5585
	5653										
B1	1	1810	1030	4050	4645	4650					
B2	1	1040	4910	4920	5653	5655					
B3	1	1040	4920	5644	5653						
B4	1	460	4602	5350	5465	5631					
B5	1	55	3384	5085	5090						
B6	1	60	3386	5100	5105						
B7	1										
B8	1										
B9	1	4602	4915	5350	5465	5470	5631	5657			
C	1	680	3410	4880	4930						
C0	1	400	405	420	430	445	5620				
C1	1	560	4900	4915	5657						
C2	1	4005	4005	4356	4602	4650	5640				
C3	1										
C4	1										
C5	1										
C6	1										
C7	1	5631	5655								
C8	1	4635	5640								
C9	1	830	5636								
D	2	690	4010	4020	5120	5653	5655				
D0	2	4005									
D1	2	790	5636								

D2	2	780	795	5631							
D3	2	4645									
D4	2										
D5	2										
D8	1	935	5640								
D9	2	840	5640								
E	2 4335	3845 4650	3950	3960	3990	4005	4005	4005	4010	4155	4335
E0	2	740	4360	4650							
E1	2	745	1805	1830	4360	4650					
E2	2	790	4360	4650							
E3	2	795	4360	4650							
E4	2	800	4360	4650							
E5	2	810	1660	1880	1950	2050	2120	4360	4650		
E6	2	815	2110	2130	2135	2290	4360	4650			
E7	2	830	2120	2130	2255	2290	4360	4650	5325	5380	5480
E8	2	835	1742	1950	2050	2120	4360	4650			
E9	2	840	4357	4650	5215	5310	5380	5480			
F	2 690 4910 5655	64 795 4920	390 1725 4940	390 1730 4950	390 2026 4950	415 2090 4955	415 3136 5040	430 3138 5041	500 4335 5042	525 4900 5326	525 4905 5683
F0	2	4955									
F1	2 2470	1444	1835	1900	1955	1960	1965	2150	2170	2260	2450
F2	2 3990 4580 4845	975 3995 4580 4845	1155 3995 4585 5140	1655 3995 4985	3130 4005 4240 4600	3615 4240 4550 4600	3630 4550 4563 4615	3915 4563 4575 4615	3915 4575 4578 4840	3915 4578 4820 4845	3915 4820 4840 4845
F3	2	61	1710	1720	5645						
F4	2	1665	1855	1875	2975	5825					
F5	3	62	3125	3142	3210	4030					
F6	3	1400	3135	3217	3228	3720	4215	5330			
F7	3	61	1675	1830	2975	2975	3035	3060	4985	5075	5085
F8	3	1639	1745	5665	5675						
F9	3	62	900	3060	3070	1015	5015	5025	5845		
G	3 5657	820	985	1075	1275	4615	4617	4815	4915	5631	5655

G4	3	400	440	5620							
G5	3	420	440	5630							
G6	3	430	440	5620							
H	3	1655									
H1	3	810	4575	4578	5631						
H5	3										
H9	3	61	930	1075	1675	1930	1940	2040	2520	3028	5350
	5500	5510	5510	5631	5644	5646	5845				
I	3	280	293	295	710	720	1090	1095	1105	1115	1120
	3035	3040	3040	3045	3045	3050	3300	3305	3305	3310	3325
	3330	3335	3340	3355	3355	3355	3355	3355	3360	3360	3440
	3445	3445	3450	3455	3460	3465	3480	3510	3710	3715	3720
	3720	3725	3750	3755	3755	3760	3810	3820	3820	3825	3830
	3835	3885	4925	4930	4935	4935	4940	4940	4940	4945	4945
	4945	4950	4950	4950	4950	4960	4960	4965	4970	4975	5045
	5050	5050	5055	5055	5060	5535	5540	5550	5550	5555	
I5	3	995	1005	1145	1165	3060	3665	3690	3690	3755	3770
	3895	3930	4010	4045	4945	4960					
J	3	2560	2564	3310	3385	3430	3435	3455	3455	3455	3480
	3490	3495	3500	3505	3520	3550	3580	3585	3590	3590	3595
	3635	3640	3640	3650	3665	3665	3885	3915	3915	3990	3995
	3995	4000	4000	4000	4025	4285	4285	4285	4435	4435	4435
	4435	4435	4435	4435	4440	4445	4450	4455	4455	4495	4500
	4500	4505	4510	4515	4520	4525	4525	4530	4535	4540	4575
	4576	4576	4578	4578	4600	4600	4602	4602	4835	4835	4835
	4845	4845	4845	4845							
J1	3	525	530	3885	3895	3980	5165	5170	5180	5190	5245
	5250	5260	5270	5636							
K	3	550	555	1040	1075	5460					
K1	3	455	460	550	745	800	1040	5470			
K2	3	490	550	790	800	1040					
K3	3	495	550	1040							
K4	3	505	550								
K5	3	505	550								
K6	3	505	550	1040							
K7	3	505	550								
K8	3	530	550	800	835	1040					
K9	3	545	550	800	840	1040					
L0	4	3585	3610	4370							
L1	4	1655	3830	3840	3865	3890	3900	3900	3915	3915	3935
L4	4	410	440	5630							
L5	4	425	440	5620							

L6	4	435	410	5630							
L7	4	385	415	415	420	430	445	900			
L8	4	445	535	5620							
L9	4	450	535	5620							
M	4	3410	4585	4610	4610	4617	4800	5300	5450		
M1	4	1270	1280	1280	1330	1340	1345	1366	1890	2445	2480
	2480	2495	2515	4525							
M2	4	1270	1285	1285	1335	1345	1350	1366	2550	2962	4560
M3	4	1270	1290	1290	1330	1335	1365	1366	4490	4500	4525
	5285	5290	5452								
N	4	1743	1760	1760	1770	1775	1880	3185			
N0	4	375	485	560	560	500	730	800	815	820	930
	1040	1040	1075	1700	1742	1845	1875	1885	3135	3382	4515
	4640	5295	5321	5332	5460	5575					
N1	4	3710	4925								
N2	4	1000	1100	1140	1775	1780	1835	1880	1900	1935	1945
	2235	2300	2540	5140							
N3	4	955	965	1195	1230	1755	2055	2060	2065	2070	2090
	2160	2165	2175	2180	2195	2460	2465	2475	2490	2492	2492
	2495	2515	2515	2520	2520	3810	3845	3845	3850	3850	3860
	4955	4960									
N4	4	1230	1655	1785	1795	1950	2070	2110	2120	2160	2180
	2460										
N5	4	570	570	650							
N6	4	650	1741	1880	5331	5350					
N7	4	1740	1743	1770	1775	1880	5331	5350			
N8	4	1670	2995	5321	5324	5325	5326	5331	5350	5350	5450
	5452	5463	5465	5470	5500	5510	5510	5510	5510		
N9	4	1270	1275	1275	1330	1335	1340	1345	1350	1365	1366
	1755	2015	2025	2045	2085	2130	2130	2145	2190	2280	2290
	3440	3485	3525	3530	4490	4500	4585	4525	4530	5155	5165
	5215	5240	5265	5310	5350	5480					
P	5	1160	1160	1165	1170	1170	1205	1290	1310	1315	1320
	1925	2065	2080	2080	2085	2165	2205	2465	2480	2485	2485
	3480	3490	3495	3500	3505	5180	5260				
P1	5	785	790	5631							
Q	5	65	275	280	305	310	330	335	345	345	390
	400	405	410	410	415	420	500	535	540	565	575
	575	590	625	630	675	705	710	865	870	870	895
	900	910	915	1055	1130	1165	1210	1210	1215	1215	1232
	1245	1250	1260	1265	1370	1374	1378	1380	1380	1387	1390
	1415	1420	1440	1470	1640	1675	1680	1685	1695	1710	1720
	1735	1746	1845	2015	2025	2050	2055	2055	2085	2105	2130
	2130	2155	2175	2190	2200	2280	2290	2295	2305	2310	2310
	2455	2475	2515	2520	3520	2535	2960	2995	3000	3000	3000

	3000	3000	3005	3010	3021	2022	3023	3055	4005	3070	3095
	3120	3139	3140	3144	3145	3175	3195	3205	3215	3221	3240
	3310	3315	3315	3345	3375	3375	3382	3410	3415	3425	3515
	3540	3545	3555	3655	3660	3695	3730	3775	3852	3895	3935
	3955	4010	4015	4040	4070	4075	4080	4080	4090	4095	4140
	4100	4170	4180	4265	4275	4340	4356	4357	4358	4360	4360
	4360	4360	4360	4360	4360	4360	4360	4360	4360	4360	4405
	4415	4445	4450	4455	4470	4470	4455	4555	4580	4585	4670
	4615	4630	4850	4851	4851	4865	4870	4875	4800	4900	4905
	4940	4960	4960	4965	5010	5022	5030	5065	5043	5105	5145
	5865	5275	5325	5332	5355	5385	5460	5405	5470	5485	5500
	5510	5515	5525	5590	5631	5835	5850	5856			
00	5	765	770	775	1383	1384	3325	3355	3565	3580	3585
	4357	4360									
01	5	590	595	610	625	625	625	770	775	1955	1965
	3060	3065	3070	3080	3090	3330	3355	4358	4360	4435	4440
	4440	4445	4445	4800	4885	4685	5025	5030	5035		
02	5	395	400	405	410	420	420	425	430	445	460
	485	490	490	530	545	755	775	785	3535	3555	4940
	4965	4965	4970								
03	5	1705	1710	1725	1730	4935	4940	4950			
04	5										
05	5	5327	5380	5480							
06	5										
07	5										
R1	5	990	995	1005	1075	1575	1145	1145	1165	3645	3660
	3665	3665	3755	3855	3930	4045	4440	4450	4455	4460	4460
R2	5	1365	2015	2120	2280	4490	4505	4550	5215	5310	
R5	5										
S	5	540	545	4360	4505	4510	4515	4640	4650		
S3	5	1990	2020	2025	2025	2035	2080	4530	4535	4540	
T	5	820	985	990	1930	1940	2040	4617	5631		
T1	5	3995	4005	4045	4155	4335	4600	4602			
T2	5	3835	3960								
T6	5	1655	1730	1795	1790	1800	1805	1810	1825	1830	2005
	2135	2155	2220	2230	2405						
T9	5										
U	5	1925	2065	2105	2405						
U1	5										
V	5	1950	2100	2135	2135	5210					
V1	5	1270	1295	1795	1340	1990	2445	2435	2485	2515	
V2	5	1270	1300	1308	1350	2560	2964				
V3	5	1270	1305	1305	1345						

V4	6	1270	1310	1310	[illegible]						
V5	6	1270	1315	1315	1[illegible]						
V6	6	1270	1320	1320	1[illegible]	4490	5[illegible]	5280	52[illegible]	5310	5380
	5480	5510	5530								
V7	6	1800	2025	2055	2[illegible]	2070	2110	2180			
V8	6	61	930	3090	5005	5005	5150				
V9	6	1875	1910	2020	2545						
W	6	500	735								
W1	6	1960	1995	2025	3080	2105	2110	2125	2185	3915	3930
	5200	5205	5255	5327	5545						
X	6	1160	1360	1990	2145	2240	2285	2290	2290	3900	3905
	3905	3930	3947	3950	3990	4045	4070	4075	4080	4080	4085
	4085	4090	4095	4100	4100	5205	5280	5550			
X1	6	980	985	1075	1160	1285	1300	1305	1315	2070	2075
	2075	2080	2105	3465	3470	3475	5170	5175	5255	5295	5300
	5452	5545	5550	5575							
X2	6	1160	1200	1295	1305	1310	2075	2180	2185	3475	5175
	5250	5255	5540	5545	5550						
X5	6										
X6	6										
Y	6	820	825	825	985	995	1005	1075	1075	5290	5300
	5460	5463	5510	5631							
Y1	6	4360	4635	4650							
Y5	6	825	830	2550	2962	4635					
Z	6	1940	2240	2245	2495	2515	2520	2520	2530	5285	5290
	5322	5380	5452	5480	5510						
Z1	6	8	440	455	5620						
Z5	7	1650	1765	3210	3215	3219	5010				
FNA	7										
FNB	7	275	1415	1485	3821	3600	3630	4240	4350	4865	5085
FNC	7	565	1845	3240	3415	3695	4265	5322			
FND	7										
FNE	7	730	4620								
FNF	7	1055	1130	12[illegible]	1370	1440	1746	1746	1746	2960	2960
	2960	3730	3775	3852	4170	4265	4300	4380	4380	4380	4555
	5018	5018	5590								
FNG	7	1250.	2085	2[illegible]	2140	2205	3485	4485	5185	5195	5265
	5275										
FN1	7	335	1845	2310	2535	3005	3605	4265	4380	4380	5332
	5515										

FNJ	7	65	1387	1735	3120	3139	3140	3140	3144	3240	5043
	5856										
FNK	7	375	560	1845	3695	4265	5332	5651			
FNL	7	3140	3140	3140	3140	3140	3140	3140	3140	3140	3140
	3140	3565	4851								
FNM	7	865	1845	3605	4205	5332					
FNN	7	305	1380	1415	1444	1465	3021	3130	3630	4240	4850
	5005	5015	5085	5100							
FNP	7										
FNQ	7	200	1870	5160	5050						
FNR	8										
FNS	8	575	705	870	1615	1746	2960	3013	3023	3095	3205
	3240	3375	3415	3415	3545	3555	3695	3730	4180	4265	4265
	4265	4275	4340	4380	4405	4415	4850	5332	5332	5355	5485
	5515	5515	5565	5590							
FNT	8										
FNU	8										
FNW	8										
FNX	9										
FNY	8	955	2155	2175	2455	2475					
FNZ	8	560	820	980	1040	1875	5295	5575			
A[ ]	9	385	385	395	890	890	890	895	895	900	900
	900	900	1685	1690	1705	1740	1740	1741	1925	2245	2255
	3384	3386	5085	5090	5100	5105	5322	5324			
B[ ]	9										
C[ ]	9	1355	1360	1405	2025	2130	2290	5380	5480		
D[ ]	9	1700	1735	1795	1800	1805	1810	1825	1830	2065	2135
	2165	2220	2230	2465	5135	5170	5180	5250	5260	5321	5350
	5540	5550									
F[ ]	9	1160	1160	1360	1365	1365	1366	1366	1405	1995	2015
	2025	2100	2105	2105	2125	2210	2210	2230	2280	2290	2290
	5200	5200	5205	5210	5280	5325	5550	5550			
G[ ]	9	1340	1345	1345	1350	1355	1405	4495	4515	4520	4540
M[ ]	9	52	1405	1642	1670	1747	1747	2980	2980	3000	3000
	3000	3000	3000	3065	3310	3325	3330	3335	3340	3355	3355
	3355	3355	3355	3405	3405	3420	3425	3450	3455	3460	3465
	3480	3825	3830	3835	3885	4885	4885	5030	5321	5324	5325
	5326	5331	5350	5450	5452	5463	5465	5470	5500	5510	5510
	5510	5510	5815								

```
N[ ]   9     63    200   700   790   790   930   940   1465  1465  1640
       1910  1910  1930  1930  2030  2030  2035  2035  2040  2040  2285
       2285  2530  2530  2625  3030  3040  3045  3070  3040  3130  3130
       3455  3455  3480  3495  3500  3505  3530  3565  3635  3640  3640
       3650  3665  3665  3915  3915  3990  3995  3995  4440  4445  4455
       4455  4495  4500  4500  4505  4510  4515  4520  4525  4525  4530
       4535  4540  4575  4575  4578  4578  4578  4585  4585  4600  4600
       4615  4615  4845  4840  4845  4845  5035  5040  5050  5055  5350
       5585  5585  5634  5640  5644  5644  5644  5644  5670  5670  5835
       5845  5845  5845  5845  5845  5850  5852

S[ ]   9     560   800   1040  1075  1742  4940  4945  4945  4970  5460

T[ ]   9     485   815   1885  2030  3040  3045  3350  3715  4285  4640
       4835  4840  4920  4935  4985  4940  4940  4945  4950  4950  4950
       4950  4960  4960  4965  5050  5055  5065  5636  5640

X[ ]   9

L$     50    930

L      200   200   455   525   535   535   1830  1870  1880  1930  2020
       2035  2040  2285  2530  3692  3865  3870  3870  3875  3875  3890
       3995  3995  4050  4160  4160  4280  4335  4410  4580  4580  5135
       5160  5650

B$     315   320   325   3905  3955  4285  4290  4335  4825  4840  4845

A$     340   345   345   350   350   355   355   365   365   365   365
       365   1135  1180  1185  1195  1205  1215  1220  1235  3730  3855
       3940  3945  3950  3955  3980  4065  4075  4080  4085  4095  4100
       4152  4152  4155  4172  4220  4230  4235  4820  4835  4845  5695
       5705

H$     580   1690

X$     580

P$     670   670   675   675   675   675   1685  3030  5065

FNH    910   1845  3240  3415  3695  3730  4265  4265  5332

D$     945   3226  3575  3705  3720  3905  4175

E$     945

S$     1065  1690  1885  1910  2005  2270  3350  3355  3715  3720  5370
       5370  5495  5520

Y[ ]   1330  1335  1360  1365  1365  1405  4195  4200  4205  4210  4245
       4255  4255  4255  4280  4280  4280  4420  4495  4505  4520  4530
       5530  5550  5560  5560  5560  5560  5560  5570  5820

FNO    1378

FNV    1383  1470  1640  1640  1965  2209  3023  3148  3148  3148  3216
       3221  3515  3540  3615  4005  4315  4615  4620  5018  5323  5385
       5855

A0     1643  5052
```

ACKNOWLEDGMENTS

The (success of the, existence of the) Earth Terminal Measurement System (ETMS) has been due to the close cooperation of many people, especially William C. Daywitt, who was largely responsible for the theory and for checking the computed results; Lanny D. Driver, who wrote the star finding routines and checked these results; Gerome R. Reeve; John P. Wakefield; and Thomas H. Bremer, who designed and constructed the ETMS hardware and made many critical comments about the "human engineering" of the software. Special thanks to William Verno at the Camp Roberts Earth Terminal for many helpful discussions and to the many other people within the Defense Communications Agency and the U.S. Army Satellite Communications Agency for patiently answering our many questions.

REFERENCES

[1] Wait, D. F., Daywitt, W. C., Kanda, M., and Miller, C. K. S, A study of the measurement of G/T using Cassiopeia A, Nat. Bur. Stand., NBSIR 74-382, 187 (June 1974).

[2] Dent, W. A., Aller, H. D., Olsen, E. T., The evolution of the radio spectrum of Cassiopeia A, The Astrophysical Journal, 188, L11-13 (Feb. 1974). Except for the constant S_o, equation (2) on p. L12 of this paper was used to transfer Cas A flux density in time and frequency. The value used for S_o was 3154 F.U. in order for the flux value to agree with Frieley, A. J., Batelian, P. D., Bathker, D. A., Absolute density calibrations of radio sources: 2.3 GHz, Technical Memorandum 33-806, Jet Propultion Laboratory, California (Dec. 1, 1977).

[3] Daywitt, W. C., Error equations used in the NBS precision G/T measurement system, Nat. Bur. Stand. NBSIR 76-842 (Sept. 1976).

[4] Daywitt, W. C., Error equations used in the NBS Earth Terminal Measurement System, Nat. Bur. Stand., NBSIR 78-869 (Dec. 1977).

[5] Larsen, N. T., A new self-balancing dc-substitution rf power meter, IEEE Transactions on Instrumentation and Measurement, IM-25, No. 4, 343-347 (Dec. 1976).

[6] Kanda, M., An error analysis for absolute flux density measurement of Cassiopeia A, IEEE Transactions on Instrumentation and Measurements, IM-25, No. 3, 173-182 (Sept. 1976). Kanda, K., Study of errors in absolute flux density of Cassiopeia A, Nat. Bur. Stand., NBSIR 75-822,30 (Oct. 1975).

[7] Wakefield, J. P., Earth Terminal Measurement System maintenance manual, Nat. Bur. Stand., NBSIR in preparation.

[8] The Fahrenheit temperature scale is used instead of the Celcius scale because it is easier to implement a temperature scale which is non-negative over the measurement range.

NBS-114A (REV. 7-73)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET	1. PUBLICATION OR REPORT NO. NBSIR 78-879	2. Gov't Accession No.	3. Recipient's Accession No.

4. TITLE AND SUBTITLE

Earth Terminal Measurement System Operations Manual

5. Publication Date April 1978

6. Performing Organization Code 723

7. AUTHOR(S) David F. Wait

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No. 7235266

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address (Street, City, State, ZIP)

Commanding General
United States Army Communications Command
Fort Huachuca, Arizona 85613

13. Type of Report & Period Covered

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

16. 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 and satellite parameters such as figure of merit (G/T), antenna gain relative to a reproducible reference level, satellite effective isotropic radiated power (EIRP), and ratio of carrier power to the operating noise temperature (C/kT). Because of difficulties of using the standard earth terminal parameters to precisely characterize the earth terminal, the parameters noise equivalent flux (NEF) and noise ulterior flux (NUF) are introduced. NEF characterizes the earth terminal hardware, and it is defined so that it is largely independent of frequency and antenna elevation angle. Thus, it is easier to evaluate the "reasonableness" of a particular set of results in light of the other results taken at various frequencies and elevation angles. This manual includes the theory of the measurements, measurement procedures, measurement troubleshooting, interpretation of the results, and a discussion of the ETMS software.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

Earth terminal; effective isotropic radiated power; figure of merit; measurement procedure; noise temperature; satellite communication.

18. AVAILABILITY

[X] Unlimited

[ ] For Official Distribution. Do Not Release to NTIS

[ ] Order From Sup. of Doc., U.S. Government Printing Office Washington, D.C. 20402, SD Cat. No. C13

[X] Order From National Technical Information Service (NTIS) Springfield, Virginia 22151

19. SECURITY CLASS (THIS REPORT) UNCLASSIFIED

21. NO. OF PAGES 266

20. SECURITY CLASS (THIS PAGE) UNCLASSIFIED

22. Price $10.75

USCOMM-DC 29042-P74

☆ U.S. GOVERNMENT PRINTING OFFICE:1978—777-067 / 1250