FINAL TECHNICAL REPORT
GT/GTRI PROJECT A-4291

NASA-JSC ANTENNA NEAR-FIELD MEASUREMENT SYSTEM

by:
W.P. Cooke, P.G. Friederich, B.M. Jenkins,
C.R. Jameson, and J. P. Estrada

Prepared for:
NASA
Lyndon B. Johnson Space Center
Houston, Texas 77058

OCTOBER 1988

GEORGIA INSTITUTE OF TECHNOLOGY
A Unit of the University System of Georgia
Atlanta, Georgia 30332
Final Technical Report

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Prepared by

Electromagnetic Effectiveness Division
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The work on the NASA-Johnson Space Center near-field antenna range described in this final technical engineering report was accomplished by personnel of the Georgia Tech Research Institute (GTRI) at the Georgia Institute of Technology, Atlanta, Georgia 30332. This program was supported by the Antenna Systems Section of NASA Lyndon B. Johnson Space Center, Houston, Texas 77058, under Contract No. NAS 9-17445. This program was designated by Georgia Tech as Project A-4291. Technical direction from the sponsor was provided by Ms. Sophia Tang, Mr. D. S. Eggers and Dr. G. D. Arndt. This report covers work performed from 1 May 1985 through 31 October 1988. Mr. W. P. Cooke served as the GTRI project director.

This work was performed under the general supervision of Dr. M. E. Cram, Chief, Electromagnetic Effectiveness Division and Mr. F. L. Cain, Director, Electronics and Computer Systems Laboratory (ECSL). In addition, the authors would like to acknowledge the support and helpful discussions provided by: (1) members of ECSL, Associate Director W. B. Warren and J. A. Woody, and (2) members of the Antenna Systems Section at NASA, including Dr. G. D. Arndt and Mr. D. S. Eggers. In addition, appreciation is extended to Mr. V. L. Daughtery for his administrative assistance and careful preparation of this manuscript.
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SECTION I
INTRODUCTION

A. Background

This report describes work performed by the personnel of the Electronics and Computer Systems Laboratory (ECSL), Georgia Tech Research Institute (GTRI) at the Georgia Institute of Technology for the Antenna Systems Section, NASA-Johnson Space Center (NASA-JSC). GTRI initiated efforts in February 1983 to assist NASA-JSC in the design of a large near-field range test facility to measure the response of thermal protection system (TPS) tile-covered antennas. The scope of the first phase near-field work was to evaluate suitable near-field measurement methods, analyze hardware needs and trade-offs, develop a preliminary algorithm, and recommend a near-field measurement system [1]. A baseline measurement system was developed with preliminary specifications and requirements for the system hardware. The rectangular measurement technique was recommended because it provided stationary antenna measurement and minimum algorithm implementation cost relative to the plane-polar method.

The second phase of this program began in May 1984. Work accomplished during this phase of the program included: (1) development of a range utilization procedure, (2) continued instrumentation receiver design, (3) control algorithm development, and (4) continued data processing algorithm development. One of the recommendations was fabrication of a near-field range receiver using a front-end down converter with a HP 8510 network analyzer for phase/amplitude detection [2].

Work on the third phase of this project began in May 1985. During this phase, efforts were focused primarily on: (1) final design and fabrication of the near-field range RF measurement system, (2) near-field range control software, (3) coordination of subsystem interfaces, and (4) mechanical consultations. In addition, GTRI updated the probe compensation capabilities of the data processing algorithm. The work accomplished during this third phase is summarized next.
B. Summary

Work was completed on the near-field range control software. The control software is menu driven with several features including: (1) full control of probe position and scanning, (2) selection of receiver parameters such as frequency and power level, and (3) real time data sampling, display and storage. The capabilities of the data processing software were expanded with the addition of probe compensation. In addition, the user can process the measured data from the same computer terminal used for range control. The design of the laser metrology system was completed. It provides precise measurement of probe location during near-field measurements as well as position data for control of the translation beam and probe cart. This topic is discussed further in Section II.C.

GTRI designed, fabricated and tested a near-field range measurement system, (in particular a near-field range receiver) that is capable of operating over the 1-26.5 GHz frequency band. With proper selection of down converter components (such as the mixers), the near-field range receiver is capable of operation up to 60 GHz. The near-field range measurement system is designed to capture 1000 data points per second. However, depending upon the data quality desired, the system is capable of even faster sampling. It has been operated on the laboratory bench at speeds up to 4,000 measurements per second. Another feature of the measurement system is the ability to measure the near-field distribution with the antenna-under-test in either a transmission or reception mode. The measurement system features an excellent noise figure for a receiver with a 1-26.5 GHz tunable bandwidth. Typically, the receiver has a 22 dB noise figure in the 1-6 GHz, a 32 dB noise figure in 6-18 GHz range, and a 39 dB noise figure in the 18-26.5 GHz frequency range. Also, the range measurement system is designed, to minimize the hardware changes needed to modify range configuration. Control of the measurement system is accomplished by the computer and control panels located in the control room. More information on this topic is presented in Section II. B.
SECTION II
System Description

A. Overall Facility

The NASA-JSC antenna near-field range operates over the frequency range 1 - 26.5 GHz. It consists of a mechanical scanner which drives a field probe over a planar measurement surface, a receiver subsystem to provide amplitude and phase information about electric fields on the measurement surface, a laser-based position monitoring subsystem to track the probe and provide control inputs to the drive motors, and an HP 1000 A-900 system controller for automation of the measurement process. An overall system block diagram is provided in Figure 1.

The mechanical scanner is capable of driving the probe over a raster scan approximately forty feet by forty feet. It consists of a translation beam, or "truss", which spans the structure approximately forty feet above the ground and travels either east or west along what has been designated the X-axis. Probes are interchangeable and will be selected based on a particular application, but each will mount in the probe carrier, or "cart", which traverses the truss in either a north or south direction along the designated Y-axis. An isometric view of the overall structure is provided in Figure 2.

The antenna under test (AUT) will be mounted on the AUT table, or "platform", which is attached to a hydraulic lift. The lift rises out of the floor from a point under the center of the scan plane. Thus the vertical separation between the probe and the AUT can be controlled along the Z-axis. In addition, the AUT table is supported on the lift by three jacks and monitored with two orthogonal inclinometers which the operator can use to level the AUT surface.

The system controller is a Hewlett Packard 1000 A-900 series mini-computer running under the RTE-A operating system. It communicates with the Laser metrology subsystem via three (Model HP12006) 16-bit parallel interface cards. The interface with the Receiver subsystem consists of three (Model HP12009) GPIB interface cards, two of which are dedicated to the HP 8510B network analyzers. The third is used for remote communications with the HP 8340 synthesized sources via HP 37204 HPIB Extenders. The bus extenders are necessary because the sources are located on
Figure 2. Isometric view of planar scanning structure.
the probe cart and AUT platform. The third GPIB interface card is also used for communications with the Hydraulic lift control interface and the Probe Position Control interface when necessary. The GPIB communications with the Probe positioning system is accomplished using two ICS Electronics Model 4833 GPIB to Parallel converters. These units provide a number of parallel I/O lines, several of which are used to trigger data collection by the HP 8510B's via the Trigger Control Electronics. Typically, the data can be collected at rates up to 1000 points per second for a total of up to 4096 points per row scanned. Documentation on the data collection software used for control of and communication with the various subsystems is presented in a later section (see Section IV) of this report.

The probe position control subsystem is provided by Texas Integrated Technologies (TIT). One drive motor is located at each end of the truss and one is located at the probe cart. The position sensing laser metrology subsystem provides an 18-bit error signal for each motor based on a destination provided by the system controller. The error signals are converted to analog and used to drive the servo amplifiers attached to each motor. Further information about this subsystem can be obtained from TIT's reports.

The phase/amplitude receiver subsystem and the laser-based position sensing subsystem (including the trigger control electronics) are each described in greater detail in the following subsections.
B. Receiver Subsystem

B.1 Description

The near-field range receiver is a 1–26.5 GHz superheterodyne, dual-conversion system which precisely measures the phase and amplitude of the test signal relative to a reference signal. It utilizes two parallel test channels to permit simultaneous measurement of two polarizations. An overall functional diagram of the receiver system is given in Figure 3. Generically, each channel consists of an RF stage, two IF stages, and an IF processor. Specifically, the RF down converter and first IF stage are custom designed, while an HP 8510B Network Analyzer provides the second IF and IF processor functions. In the custom designed section of each channel of the receiver, the RF signal is down converted to a 20-MHz IF and then routed through an IF Control Chassis to the network analyzer. The network analyzer down converts the 20-MHz IF to a 100-kHz IF and processes this signal to obtain phase and amplitude data.

The functional diagram in Figure 3 illustrates the major components and primary signal interfaces of the receiver. The RF and LO signals are provided by two HP 8340B Synthesized Signal Generators. The Reference Receiver Front-end Down Converter samples the RF signal routed to the transmitting antenna. It down converts the sampled RF to a 20-MHz IF reference signal (IF-REF) which is routed via the IF Control Chassis to the two network analyzers. The two RF test signals (RF-1 and RF-2) from the receiving antenna are down converted to two 20-MHz IF test signals (IF-1 and IF-2) by the Test Receiver Front-end Down Converter. These two IF signals are also routed via the IF Control Chassis to the two network analyzers.

B.1.1 Test Receiver Front-end Down Converter

The Test Receiver Front-end Down Converter is illustrated in Figure 4. This down converter includes two identical parallel channels -- one for each polarization. The RF input to each channel is first routed through an electromechanical, interlocked RF switch. This switch permits the selection of either the received RF signal, a 50-ohm termination, or a Built-In-Test (BIT) signal. The output of the switch is routed through a 3-dB attenuator to the RF input of the mixer. All 3-dB attenuators, used throughout the receiver, are for impedance matching purposes.
Figure 3. Functional Diagram of Near-Field Range Receiver.
Figure 4. Test Channel Receiver Front-End Down Converter
The LO signal for the mixer is derived from the LO IN port of the down converter. Specifically, the LO IN signal is coupled through a 10-dB directional coupler to the 1–6 GHz LO amplifier via a 20-dB attenuator. The amplifier output is divided by a two-way splitter for use by each of the two polarization channels. This LO signal is attenuated by 6 dB prior to being applied to the mixer. The two attenuators (6 and 20 dB) and the LO amplifier were selected to provide the appropriate LO signal level to the mixer. The "through signal" output of the directional coupler goes to the LO OUT port of the down converter. It is then sent to the Receiver Front-end Control Chassis via coaxial cable.

Since the receiver system covers the 1–26.5 GHz frequency range, the RF mixer must be operated in both fundamental and harmonic modes to accommodate the 1–6 GHz LO amplifier. The RF frequency bands and the associated mixer modes are as follows:

1. 1–6 GHz: fundamental harmonic
2. 6–18 GHz: third harmonic
3. 18–26.5 GHz: fifth harmonic

The 20-MHz IF output of the mixer is sent through the first IF stage of the receiver system. This IF stage consists of a 20-MHz bandpass filter and a low noise amplifier with appropriate impedance matching attenuators. The output of the amplifier is connected to one of the IF output ports on the Test Receiver Front-end Down Converter (IF-1 or IF-2 depending on polarization channel). This IF signal is then sent via coaxial cable to the IF Control Chassis.

B.1.2 Reference Channel Receiver Front-end Down Converter

The Reference Channel Receiver Front-end Down Converter is illustrated in Figure 5. The major components in this down converter are the same as those in the Test Channel Receiver Front-end Down Converter except it has only one channel. The RF input to this chassis is routed from the RF-IN port through a 10-dB directional coupler to the RF-OUT port. This RF output signal is sent to the transmitting antenna via a coaxial cable. The coupled RF signal from the directional coupler is attenuated by 20 dB and is then sent to the RF input of the mixer.
Figure 5. Reference Channel Receiver Front-End Down Converter.
The LO signal path from the LO IN port on the chassis to the LO input of the mixer consists of attenuators and an amplifier to obtain the appropriate level of LO signal for the mixer. The first IF stage connected to the IF output of the mixer is identical to the same stage in the Test Channel Receiver Front-end Down Converter. The output of the IF stage is connected to the IF-REF port which is then connected to the IF Control Chassis via a coaxial cable.

B.1.3 Front-end Receiver Control Chassis

The Front-end Receiver Control Chassis, which is diagrammed in Figure 6, has three functions. First, it conditions the LO signal as it passes from the Test Channel Receiver Front-end Down Converter to the Reference Channel Receiver Front-end Down Converter. It also amplifies the 10-MHz Time Base signal from the HP 83408 on the AUT platform and distributes it to the network analyzers and the other HP 83408 which is located on the probe carriage. Finally, it controls the DC power to both the Test and Reference Channel Receiver Front-end Down Converters and controls the RF switches in the Test Channel Receiver Front-end Down Converter.

B.1.4 IF Control Chassis

The IF Control Chassis conditions the IF signals from the down converters and sends the resulting signals to the network analyzers. A functional diagram of this chassis is given in Figure 7.

B.2 Configurations

The near-field range can be operated in one of two configurations: 1) the AUT can be operated in the transmit mode or 2) the AUT can be operated in the receive mode. The components of the near-field range receiver must be interconnected differently for each of these configurations and the locations of the two down converters (Test and Reference) must be interchanged. The two configurations for the receiver are illustrated in Figures 8 and 9. In both figures the cabling that must be changed is shown as dotted lines while the cabling that remains unchanged in both configurations is shown as solid lines. These figures also show the location of all receiver components (Control Room, Probe Carriage, or AUT Platform) and identifies the chassis connectors to which the cables interface.
Figure 6. Front-End Receiver Control Chassis
Figure 7. IF Control Chassis
Figure 8. Interconnection Diagram with Antenna-Under-Test in Transmit Mode
The LO cable which connects the down converter on the Probe Carriage with the Front-end Receiver Control chassis in the Control Room must flex as the Probe Carriage is moved. Phase noise due to this flexure is possible. Various system configurations to minimize the magnitude of this phase error were investigated. Although other configurations may offer lower phase noise, they are more complicated, expensive, and increase the weight on the Probe Carriage. The implemented configuration was selected after evaluating these tradeoffs. An additional feature of this configuration is flexibility. It can be modified if further reduction in phase modulation due to cable flexure is necessary.

Photographs of the major components of the receiver are given in Figures 10 through 15. Photographs of equipment fronts and backs are provided as necessary to show all interface connections and controls. The controls on the front of the Front-end Receiver Control Chassis are shown in Figure 12. The SYSTEM and RCVR POWER switches controls the DC power to this chassis and the two down converters. The RF SWITCH CONTROL is the 4-push button, interlocked switch diagrammed in Figure 6 that controls the two RF switches on the Test Channel Receiver Front-end Down Converter (See Figure 4). The LO SIGNAL ATTENUATOR (dB) control sets the level at the LO IN port of the Reference Channel Receiver Front-end Down Converter.

The controls on the front of the IF CONTROL CHASSIS are shown in Figure 14. The SYSTEM POWER switch controls the DC power to this chassis. The knobs labelled SIG CH1, SIG CH2, and REF CH control the attenuators that set the two Test Channel IF input levels and the Reference Channel IF input level, respectively, to the network analyzers.

B.3 Performance Characteristics

The measured sensitivity, noise figure, and dynamic range of the receiver system as a function of frequency are presented in Table I.

B.4 Maintenance Information

Wiring diagrams and component layout photographs for each chassis in the receiver system are provided in Appendix A. Specifications for major components on each chassis are also presented in that appendix.
Figure 10. Front View of Test Channel Receiver Front-End Down Connector.

Figure 11. Front View of Reference Channel Receiver Front-End Down Converter.
Figure 12. Front View of Front-End Receiver Control Chassis.

Figure 13. Rear View of Front-End Receiver Control Chassis.
Figure 14. Front View of IF Control Chassis.

Figure 15. Rear View of IF Control Chassis.
Table 1

**NASA NEAR-FIELD RECEIVER PERFORMANCE**

<table>
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<th>Parameter</th>
<th>Frequency (GHz)</th>
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<tr>
<td>Dynamic Range** (dB)</td>
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<td>63</td>
<td>64</td>
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<td>60</td>
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<tr>
<td>Channel-to-Channel Isolation (dB)</td>
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* S/N = 1 with 10 KHz Video Bandwidth and no averaging.

** Based on a minimum Signal-to-Noise ratio of 30 dB and a maximum HP 8510B input level of -10 dBm.
C. Laser Metrology Subsystem

The Laser Metrology Subsystem is used to precisely monitor the position of the probe cart within the measurement plane. This task can be divided into two separate functions. The first is to aid positioning of the probe at each sample point in the data collection grid. The position error signal derived from the laser electronics associated with this first function are used to drive the servo amplifiers responsible for motion of the probe cart and translation beam. The second function is to determine deviations from the ideal sampling positions of the probe caused by unavoidable rotations and lateral deflections of the moving bodies (probe cart and translation beam). Since the algorithm used to process near field data assumes regularly spaced points on a perfectly flat measurement plane, unwanted rotations and lateral deflections of the probe degrade the accuracy of the patterns derived from the near field data. As a future task, the position information derived from this second function can be used to mathematically correct for known probe position errors. Such a capability will become important when operation of the range is extended above 26.5 GHz. This topic is discussed further in Section V.

C.1 Theory of Operation

The laser metrology components used on the NASA-JSC antenna range comprise a hybrid of two Hewlett-Packard laser measurement systems. The basic system of a laser head, optical detector/receiver, measurement electronics, and linear optics is a version of the HP 5501 system. The angular and straightness measurement optics are added from the HP 5528 system. A summary of the measurement optics is presented next. A more complete explanation can be found in references 3 and 4.

The HP 5501 laser head uses a principle called Zeeman splitting to produce a beam with two slightly different frequency components, f1 and f2. Polarizing and collimating optics adjust the two components into orthogonal linear polarizations, one vertical and one horizontal. A portion of this combined beam is sampled and directed to the reference receiver internal to the laser head. Here the two components are combined to produce interference fringing at 1.8 MHz, which is supplied to the measurement electronics as the reference signal. The measurement
signal is produced when the dual component beam emitted from the head interacts with various measurement optics.

Figure 16 illustrates the operation of the linear measurement optics. A Doppler shift, caused by relative motion between the test retroreflector and the linear interferometer, produces a return beam at a frequency $f_2 + \Delta f_2$. When recombined with the $f_1$ component of the beam at the optical receiver, an interference fringe is produced at a slightly different frequency from the reference signal. By monitoring the difference in fringe counts, the measurement electronics (Counter or Fast Pulse Converter cards) produces a measure of the motion of the test retroreflector with respect to the linear interferometer.

Angular motion and lateral deflections can be measured by using different optical arrangements. Figure 17 illustrates the angular optics. In this case, a Doppler shift along the axis of the laser beam will affect both frequency components equally, and thus produce no change in the interference fringing. Rotation of the angular reflector, however, will produce a positive increment in one component and a negative increment in the other, thus resulting in a measurable change in the interference fringing. To measure lateral deflection (straightness), the optics illustrated in Figure 18 are used. The interferometer consists of a Wollaston prism, which causes the beam components to diverge at a specific angle. The straightness reflector has two mirrors, each perpendicular to one of the components. When either the interferometer or the reflector moves perpendicular to the mirror axis, the path length of one beam component lengthens while the path length of the other component shortens. This produces the required change in the frequency difference between the two components.
Figure 16. Linear Optics.
Figure 17. Angular Optics.
Figure 18. Straightness Optics.
C.2 Laser Optics on the NASA-JSC Range

These three types of measurement optics (linear, angular, and straightness), are used in combination to fulfill the measurement requirements of the system. All optics are mounted on laser platforms attached to the structure as shown in Figure 19. These optical benches occupy two elevation levels. On the upper level, fixed benches are located at the northwest and southwest corners of the structure. Three moving benches are found on this level, one at each end of the translation beam, and one which moves with the probe cart. On the lower level are one fixed bench located directly beneath the bench at the northwest corner, and one bench directly beneath the moving bench at the north end of the translation beam. There is also a spare bench located directly beneath the bench at the south end of the beam, but it is currently unused. In Figures 20 a - 20d, each group of measurement optics is identified on the benches it occupies.

The first measurement function listed above, that of positioning the probe at the points on the sample grid in the measurement plane, is accomplished using the linear optics groups illustrated in Figure 20a. Four laser heads (C, D, F, and I) supply the beams for four measurement signals. Receivers Xt and Xt' are used to monitor motion parallel to the X-axis of the south and north ends of the translation beams, respectively. Receiver Yc is used to monitor motion of the probe cart parallel to the Y-axis from north to south, and receiver Yc' is used for motion south to north. The motion of each end of the translation beam is monitored independently. The two signals used to monitor probe cart motion complement each other. However, a maximum speed for the probe cart of thirty inches/second was desired, which exceeds the maximum speed specified for the linear optics. Hewlett Packard representatives explained that this limit only applies to motion of the interferometer and retroreflector toward each other. Each set of probe cart optics can be used to monitor motion up to thirty inches/second in a direction which increases the separation, so probe cart motion may be characterized and controlled using two sets, each active for one direction only.
Figure 19. View of structure showing position of benches used to support laser optics.
Note: $\Theta_{ZT}$ is calculated from the quantities $X_T$ and $X'_T$.

Figure 20d. Angular Rotation Optics.
C.3 Probe Position Characterization

The remaining optics illustrated in Figure 20 can be used to fulfill the second function previously identified, namely, characterizing the actual position of the probe aperture as it deviates from the ideal sampling positions in the measurement plane. This function has not yet been implemented, although it will be necessary when operation of the range is extended to 60 GHz. To do this, the probe cart and translation beams are considered rigid bodies capable of motion with six degrees of freedom (three linear and three rotational). The linear motions monitored by the optics in Figure 20a are the desired motions. The optics in Figure 20b are used to monitor undesired deflections in the horizontal measurement plane. To this end, the beam from laser head B is split and one half used to detect Y-axis deflections of the truss as it traverses the structure (via receiver \(\Delta Yt\)). The other half is used to detect X-axis deflections of the cart as it traverses the truss (via receiver \(\Delta Xc\)).

Motion in the third linear degree of freedom is obtained from the optics configuration shown in Figure 20c. Laser head A serves double duty, supplying the energy to receivers \(\Delta Zt\) and \(\Delta Zc\). Receiver \(\Delta Zt\) provides information about the vertical deflection of the north end of the truss, while laser head E and receiver \(\Delta Zt'\) provide similar information about the south end. Together, information from the two ends yields both the vertical deflection of the truss and the rotation of the truss about the X-axis. Likewise, receiver \(\Delta Zc\) monitors the vertical deflection of the east side of the probe cart while laser head H and receiver \(\Delta Zc'\) yield the vertical deflection of the west side of the cart. Thus both the vertical motion of the cart and its rotation about the Y-axis can be determined.

In Figure 20d the use of the angular optics is shown. Laser head G supplies energy to receiver \(\theta xc\) via a vertical angular reflector, thus yielding the rotation of the cart around the X-axis. Laser G is also used with receiver \(\theta zc\) and a horizontal angular reflector to monitor rotation of the cart about the Z-axis. Rotation of the truss about the Y-axis is measured independently at each end. Laser head C and receiver \(\theta yt\) monitor the north end while laser head D and receiver \(\theta yt'\) are used at the south end. Together, information from the two receivers can be used to derive both the rotation and the twist in the truss. The last degree of freedom, rotation of the truss about the Z-axis, is obtained from receivers \(Xt\) and \(Xt'\), shown in Figure 20a.
Figure 21 shows how the signals from the laser optics are processed in the laser electronics. The actual counting of pulses in the reference and measurement signals is done in either a HP 10760 Counter card or a HP 10764 Fast Pulse Converter (FPC) card. The output of the Counter card is position information which is supplied to the system controller via the HP 10746 Binary Interface card. The output of the FPC card is supplied to a HP 10762 Comparator card. The Comparator card contains a destination register which can be loaded with a desired position from the system controller (again via the Binary interface card). The Comparator card compares position information input from the FPC card with the contents of its destination register and supplies an 18-bit digital error signal to an edge connector. The first function of the laser metrology system, that of aiding in the positioning of the probe cart and truss, is accomplished with the error signals derived from each of the receivers Xt, Xt', Yc, and Yc'. The error signals are each supplied to a Digital-to-Analog Converter driving a Controlled Motion Incorporated Servo Amplifier. One servo amp controls each drive motor in the system. Two motors drive the translation beam (one at each end) and one drives the probe cart. A multiplexer is used to select the appropriate error signal from receivers Yc and Yc' depending on the desired direction of travel of the probe.

The second function of the laser metrology system, that of characterizing probe positioning errors, should be implemented as a future task. For example, the characterization could be accomplished prior to performing an actual measurement. First the probe would be scanned along the truss approximately twenty times in each direction while monitoring the quantities associated with probe motion. An average value for each quantity as a function of the probe position along the truss would then be stored in a file. Next, the truss would be scanned approximately twenty times in each direction across the structure while monitoring the quantities associated with truss motion. An average value for each quantity as a function of the truss X-position would also be stored in the file. With a pre-determined knowledge of the (fixed) position of the probe aperture with respect to the optics mounted on the probe cart, in conjunction with the measured position errors of the truss and cart, the actual positioning errors of the probe aperture can be determined at each sample point and an appropriate correction applied to the collected data.
Figure 21. Laser Metrology System Block Diagram
D. Trigger control electronics

As part of its function to assist positioning of the probe, the laser metrology subsystem also provides a trigger pulse to the HP 8510’s at each point in the measurement grid to initiate sampling of data. The Trigger Control Electronics select and condition the trigger pulses according to commands from the system controller. The source of the trigger pulses is an extra pair of Comparator cards in the laser electronics. Each comparator card controlling a direction of motion of the probe cart has a sister card to generate the trigger pulses. While the first comparator card contains a destination at the end of the row to be scanned, its sister card contains the destination of the next point to be sampled. As each sample point is reached, the comparator card generates a trigger pulse for the HP 8510’s, the trigger control electronics set a status line to indicate the destination has been reached, and the system controller then loads the comparator card with the destination of the next sample point. The trigger control electronics also act as a multiplexer to select the trigger pulse output of the appropriate comparator card as determined by the direction of probe travel. A schematic can be found in Appendix B.
SECTION III
Near-Field Range Measurement Procedure

A. Introduction

This section is designed to assist the user of the NASA-JSC near field range by presenting a typical procedure for operation of the range. Although a particular application may require some variations, the basic steps outlined below are provided as a general guide.

B. Measurement Procedure

1. AUT Mounting

The AUT platform is supported by three hydraulic jacks which are under manual control of the operator via a panel in the control room. The platform is monitored by two inclinometers mounted perpendicular to each other on the platform with displays in the control room. Using the inclinometers and jacks, the operator should level the table after the AUT is mounted and in position.

2. Probe Selection

Probe selection will vary with the measurement application. This topic is explored in greater detail in a GTRI report [5].

3. Select Operating Mode

The near-field range can be operated with the AUT in either the transmit mode or the receive mode. The two configurations require different locations and interconnections of the receiver components. These are discussed in detail in Section II.B.2.
4. Initial Receiver System Set-Up

Turn system power on (See Section II.B.2) and allow several hours warmup time. Set attenuators and source power levels as required by operating frequency. A lookup table specifying these levels will be provided in the software at the time of installation.

5. Positioning the AUT Platform

The optimum separation distance between the scan plane of the probe aperture and the antenna under test is determined by the need to minimize multiple reflections. By moving the probe to a point of high signal level and monitoring the probe response as a function of separation distance, the operator can observe the minimum separation distance at which the multipath ripple becomes negligible. This separation distance should be confirmed at two or three distinct points in the measurement scan plane. A typical separation distance is 7-10 wavelengths.

6. Receiver Dynamic Range Alignment

Scan measurement plane to locate maximum signal level. Position probe at this point and adjust IF attenuators for signal level of -10 dBm at input to HP 8510B's. (See Section II.B.2) Note: In order to preserve relative signal levels between the two channels, both attenuators should be set to the same value.

7. Operation Under Software Control

Determine the desired scan plane dimensions and sample point spacing based on the size of the test antenna aperture and frequency of operation. Selection of a suitable aperture scan plane is described in Reference 2. Run the data collection program, program XYZ, and select the operations desired from the main menu. The program is described in greater detail in Section IV.
SECTION IV
Software Documentation

A. Introduction
This section describes both the control and data reduction software for the NASA-JSC near-field range. The control software (Program XYZ) is a menu driven algorithm. After initializing the equipment, the main menu is displayed and the user selects the required program functions. The control algorithm features are described in the next section. A listing of program XYZ is provided in Appendix C.

The data reduction software (Program NFFT) provides many options for data reduction and output format. The user prompts which describe these options are explained in detail in Section IV.C. Finally, Section IV.D provides information necessary for compiling and loading these programs. A listing of program NFFT is provided in Appendix D.

B. Program XYZ

Listed below with explanatory notes are the options available to the user from the main menu:

1. Set Source (SS)
   This selection allows the user to set the RF source power level (in dBm) and frequency (in GHz). Also prompts the user for the number of polarizations to be collected. It is the user's responsibility to set the power level and frequency for the RF source and receiver, using this option, before collecting any data.

2. Initialize Scan Parameters (IN)
   This selection sequentially prompts the user for the "scan parameters". The scan parameters define the scan plane over which data will be collected and also include other parameters to be stored in the data file's header record. The scan parameters must be defined before collecting any data.
3. **List and Change Scan Parameters (LC)**
   This selection displays current scan parameters and allows individual parameters to be modified. This differs from “IN”, where the user must step through the whole list.

4. **Examine a File (EF)**
   This selection allows the user to read a column of data into the data buffer from an existing data file. The data can then be listed or plotted on the CRT. **NOTE:** When “EF” is used, the scan parameters are modified to match those of the file being read in. This can be used as a quick way to modify the scan parameters if you already have a data file with the parameters you desire.

5. **Column Read (CR)**
   This selection collects a column of data and stores it in the buffer. If the number of polarizations specified in “SS” is equal to 2, then both polarizations will be collected. The user specifies which data column, with respect to the scan parameters, is to be read in. Once the data column has been collected, it can be listed or plotted by using the “CL” and “CP” options, respectively.

6. **Column List (CL)**
   This selection lists the column of data currently stored in the buffer. The data could have been read into the buffer by using the “EF”, “CR”, “AR” or “CD” options.

7. **Column Plot (CP)**
   This selection plots the column of data currently stored in the buffer.

8. **Move Probe (MO)**
   This selection allows the user to specify an (X,Y) destination in inches, and moves the truss and cart to the destination position.

9. **Add or Replace Columns (AR)**
   This selection allows the user to collect a subset (one or more columns) of a previously collected data set. The file name given here must correspond to an already existing file. Columns of data collected with this command will overwrite the corresponding columns in the existing data file. The scan
parameters do not need to be set for this option since they will be modified automatically to match those of the existing data set. If the number of polarizations specified in "SS" is equal to 2, then both polarizations will be collected.

10. Collect Data (CD)
This selection allows the user to collect a data set using the current scan parameters. The filename specified here must not already exist (overwrite protection). If the number of polarizations specified in "SS" is equal to 2, then both polarizations will be collected.

C. Program NFFT

This program performs the Fourier transform to obtain the far-field antenna pattern from the near-field measurement. User prompts provided by the program are denoted by boldface type. The exact sequence of prompts will be determined both by the data set(s) being processed and by prior responses. The program begins with the following message:

******** PROGRAM NFFT ********

Default responses are shown in parentheses. When a choice is displayed, the first response is the default. Defaults may be selected with the Return key.

1. How many polarizations will be analyzed? (1 or 2)

Here, the default choice is one polarization, which can be selected by merely pressing the return key. The program gives the user options to process co-polar and cross-polar data together or either polarization separately. If two polarizations are used, then the parameters entered in response to the following questions apply to both files.

If one polarization was selected, the next prompt is
2. For the aperture data to be analyzed - Enter data file name:

If two polarizations are to be analyzed, the next two prompts will be

2a. For the parallel pole aperture data - Enter data file name:

2b. For the cross pole aperture data - Enter data file name:

The name(s) of data file(s) should be entered in response to each prompt.

3. Enter row numbers for starting, ending X:

4. Enter row numbers for starting, ending Y:

These prompts allow the user to operate on a rectangular subset of the aperture data array. The default is the entire data set. The user should specify the index, or row number, of the desired rows, and not the physical position.

The program will read in data points starting and ending with the specified rows.

5. Enter X thinning increment: (1)

6. Enter Y thinning increment: (1)

Enter the increment, i. The program will read in every ith point in the given dimension, beginning with the starting point from question 3 or 4. Data thus thinned will be processed faster. As the thinning increment is increased, however, more information is lost from the higher spatial frequencies (at the edges of the spectrum).

Ready to normalize the aperture data.

7. Enter the reference amplitude and phase in dB and degrees. (Use the feedthrough values if available. Default is the maximum amplitude.)
Enter the amplitude in dB and the phase in degrees. The user can normalize to reference values or input power levels if the feedthrough values are available. The program can then compute a predicted gain for the antenna under test if an open-ended waveguide probe was used. Also, two separate data collections can be more directly compared after processing. The default values used are the amplitude and phase of the peak point. If both polarizations are being processed, the maximum of the co-polar file is used for both files.

8. Enter normalized wave numbers \((K_x, K_y)\) for the desired K-space translation: \((0., 0.)\)

This can be used to apply a phase taper to aperture data before processing.

9a. Would you like increased resolution on the X-axis? (N/Y)

9b. Would you like increased resolution on the Y-axis? (N/Y)

If the user selects either of these options, the aperture data set is padded with zeroes until the specified dimension reaches the next power of two. The result is increased resolution in the spectrum data. In effect, the FFT is used to interpolate more points in the spectrum data. The program will loop through these two questions until the user responds negatively for both dimensions. Each affirmative response will cause the specified dimension to be increased until the program limit of 4096 points is reached.

10. Does this data set contain independent column or row measurements? (N/Y)

If the user answers yes, the data set is treated as a set of single-dimensioned arrays which are processed with a one-dimensional FFT. Thus, a number of independent, single row measurements may be stored in the same file to save on file overhead.

11a. Would you like to examine a sector of the data with greater resolution? (N/Y)
The program allows the user to view a "close-up" of a rectangular subset of the spectrum data. If the user answers yes, the following prompts are received:

11b. Enter the sector limits for Kx: (-1..1.)

11c. Enter the sector limits for Ky: (-1..1.)

The responses, in normalized wave numbers, tell the program where to truncate the spectrum data in K-space. The specified region will be increased so that the number of data points in each dimension is equal to the smallest power of two which completely includes the specified region. Thus, if the specified sector is larger than half the size of the original data set in both dimensions, the user will end up with the same data set and no resolution enhancement will occur. If resolution enhancement is to be applied, the program will list the targeted resolution for each axis and the following prompts will appear next:

11d. Would you like increased resolution on the X-axis? (N/Y)

11e. Would you like increased resolution on the Y-axis? (N/Y)

The program will continue to loop through these prompts until the user responds negatively for both axes. Each affirmative response will cause the specified dimension to be doubled until the program limit of 4096 points is reached.

Ready for probe correction section.

12. What direction is the first polarization? Enter angle (degrees) from Y-axis toward minus X: (0.)

The requested direction is the angle of the polarization vector of the probe with respect to the Y-axis (counterclockwise rotation is positive angle). The default is zero degrees (parallel to the Y-axis). This information is used when the program generates a theoretical probe correction, or no probe correction at all. The theoretical correction assumes an open waveguide probe. The calculated pattern for the probe uses "vertical" (Y-axis) polarization, and this angle is used to rotate
the theoretical pattern. Uncorrected data is also assumed to be collected with a linearly polarized probe oriented at the given angle.

13a. Should a probe correction be used? (N/Y)

13b. Empirical or Theoretical? (E/T)

These questions are self-explanatory. A theoretical probe correction calculates the theoretical pattern of an open waveguide; an empirical probe correction requires the user to supply files containing the pattern of the probe.

13c. Enter the probe rotation: 1 for X into Y, or -1 for Y into X: (-1)

This refers to the rotation of the probe between data sets when the same probe is used in orthogonal orientations for two successive scans to collect data. "1" indicates a 90 degree rotation from the positive X-axis to the positive Y-axis; "-1" indicates a 90 degree rotation in the other direction.

13d. Enter the probe dimensions in inches. Enter large, small dimensions:

If a theoretical probe pattern is to be calculated, the program prompts the user for the probe dimensions (rectangular waveguide). The broad wall dimension is entered first.

13d. For the probe pattern (1st pole) - Enter data file name:

13e. For the probe pattern (2nd pole) - Enter data file name:

If an empirical probe correction is to be applied, the program prompts the user for the names of the files containing the probe patterns.

14a. Specify the type of output data desired:

To output the far-field pattern --

Enter "Y" for an azimuth/elevation system (conical about the Y-axis) rotated about the Z axis by a specified angle
Enter "H" for a Huygens system rotated by a specified angle
Enter "Z" for a theta/phi system (conical about the Z-axis) rotated about the Z axis by a specified angle
Or --
Enter "A" for a physical translation of the planar aperture data,
or Return to output the transverse spectrum data

After the data has been transformed and probe corrected, the user can output the results in one of three general forms. A carriage return will default to no further processing; i.e., the data will be stored as spectrum data. A response of "A" will direct the program to calculate the transverse fields on a plane parallel to the measurement aperture. Thus, for instance, one could determine the fields at the surface of a phased array for troubleshooting of element performance. Finally, a response of "Y", "H", or "Z" will direct the program to calculate the far field radiation pattern of the test antenna using one of the three polarization models. The domain of the pattern data remains direction cosines, however. A standard abcissa of rotational angle requires interpolation of corresponding pattern points.

14b. Would you like to output both polarizations? (N/Y)

If only one polarization of near-field data was collected; or in other words, if the cross polarized energy was considered negligible; the program will ask this question to allow the user the option of outputting both components of the far-field radiation pattern.

14c. Enter translation vector components in inches (X, Y, Z) : (0.,0.,0.)

14d. Enter low-pass filter radius in normalized wave-number units (Return for no filter)

These questions are asked only if a physical translation of aperture data was requested. A positive Z-component to the translation vector implies translation toward the test antenna. The filter is applied as a circle in the spectrum domain, so "low-pass" refers to spatial frequency. The default filter radius is the entire visible region, or an equivalent radius of one.
14c. What direction is the desired output polarization? Enter angle (degrees) from Y-axis toward minus X:

This is the "specified angle" referred to in question 14a. for responses "Y", "H", and "Z". The default value is the angle entered at question 12.

15. Do you want to apply a Blackman filter (N/Y)?

Ready to output spectrum data files.

16. This file contains ..........data. Enter data file name:

This prompt is used if there is only one polarization of output data. The two questions below are asked if the user will output both polarizations.

16a. The first file contains ..........data. Enter data file name:

16b. The second file contains ..........data. Enter data file name:

In all three of the prompts numbered 16, the ellipsis is replaced by a description of the data which is to be output into that particular file. The user then enters an appropriate file name, which is used in question 17:

17. The default title for file filename is:

..................................

Enter a new title, or RETURN to default:

This gives the user the option of adding a descriptive title of his choosing to the header record of a file. The question is asked once for each output file.

D. Compiling and Loading

All source code for the routines in these programs is written in FORTRAN and should be compiled with the FTN7X compiler. Files which contain the source code
for main routines or subroutines are distinguished by the extension "*.FTN". As an example, a typical compiler invocation for the file XYZ.FTN would be:

```
CI > FTN7X, XYZ,, -,, 5
```

The .FTN extension is implied; the hyphen directs the compiler to put relocatable code in default file XYZ.REL; and the "S" is for the debug option. This option, together with option "DE" when the program is linked, allows use of the system debugger for program diagnostics.

A list of the routines necessary for each program can be found in the load file (denoted by the extension "*.LOD"). The load file is the command file to be used when linking the compiled routines into an executable file. It may be necessary to modify the load files if the compiled routines are located in a different directory than expected. In addition, the load files assume that the HP graphics utility subroutines are available in a library called UPLIB__CDS.LIB. Finally, the graphics subroutines in program XYZ make use of device drivers supplied by HP. Appropriate drivers must be linked into a work station program for each device which is to be used for graphics. The supplied plotting routines assume that the work station program for the user's terminal is called WSP__CDS.RUN::PROGRAMS. If a different plotting device is desired, or a different name is used for the work station program, the subroutine PLOT.FTN will have to be modified accordingly.
Section V
Conclusions and Recommendations

A. Conclusions

Completion of this program represents the successful conclusion of three consecutive projects by GTRI to develop and implement a large near-field range for the NASA-Johnson Space Center. The forty foot by forty foot measurement structure features a scan plane of approximately 36 feet by 36 feet. The current RF measurement system has a tunable frequency range of 1-26.5 GHz. It has been designed so that, in the future, it can be extended up to 60 GHz. The receiver is able to obtain 1000 data points per second. Depending on data quality, it can possibly operate as high as 4000 measurements per second. The laser metrology subsystem will support probe velocities up to 30 inches per second.

B. Recommendations

The following is a list of recommendations based on the results of this program:

1. Expand data processing software to compensate for probe positioning errors.

The NASA-JSC near-field range is a planar scanner designed to measure the electric field parallel to the antenna aperture. The data processing algorithm assumes that the near-field measurements are sampled at regularly-spaced intervals on a perfectly planar rectangular lattice. However, the mechanical positioning system can not guarantee a perfectly flat or precisely spaced sampling lattice. It should be noted that the NASA-JSC near-field range has an excellent mechanical location accuracy of ±0.001 inch in the XY axis and ±0.005 inch in the Z-axis. However, the out-of-plane (z-axis) errors can become a significant source of error, particularly at millimeter wave frequencies. Methods to convert both out-of-plane errors as well as in-plane measurement errors (XY-axis) can be developed for use in the data processing software. It is recommended that software be developed to compensate for probe position errors. An example of one probe position error correction
technique is K-correction. The addition of this capability will improve the accuracy of the far-field patterns computed from the near-field measurements.

2. Automate the AUT Table Leveling Procedure

   Leveling of the AUT Table is accomplished manually by the range operator. This task can be automated by using the range control computer. The software can be expanded so that AUT Table leveling can be accomplished by the range operator at the near-field range control console.

3. Automate the Receiver IF Attenuators.

   Currently the receiver IF attenuators are manually operated. An improvement in the near-field range receiver alignment can be achieved by using computer-controlled attenuators. The range control computer could automatically set the dynamic range window to achieve the best receiver performance.

4. Add domain options to Pattern output data.

   The data reduction software currently calculates pattern points evenly spaced as a function of direction cosine. However, the pattern data points are not evenly spaced as a function of angle. This can cause poor resolution in the far-out sidelobes. By addition of an interpolation algorithm, the quality of the pattern plotted as a function of angle can be improved and provide better comparison with standard output from far-field range pattern measurements.
Section VI

References


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APPENDIX A

Receiver Wiring Diagrams and Component Specifications
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Figure A-1. Wiring Diagram of Test Channel Receiver Front-End Down Converter and Associated Power Supply.
Figure A.2: Wiring Diagram of Reference Channel Receiver Front-End Down Converter and Associated Power Supply.
Figure A-3. Front-End Receiver Control Chassis Wiring Diagram
Figure A-4. Wiring Diagram of IF Control Chassis
TABLE A-1
TEST CHANNEL RECEIVER FRONT-END DOWN CONVERTER COMPONENT IDENTIFICATION

<table>
<thead>
<tr>
<th>Photo Designator</th>
<th>Description</th>
<th>Manufacture</th>
<th>Model No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>RF Switch (2)</td>
<td>K&amp;L Microwave, Inc.</td>
<td>43136</td>
<td>A-13</td>
</tr>
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<td>A-2</td>
<td>50 Ohm Termination (4)</td>
<td>Florida RF Labs</td>
<td>12-002</td>
<td>-</td>
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<tr>
<td>A-3</td>
<td>2-Way Power Splitter</td>
<td>Hewlett Packard</td>
<td>11667B</td>
<td>A-14</td>
</tr>
<tr>
<td>A-4</td>
<td>IF Amplifier (2)</td>
<td>Tron-Tech</td>
<td>W 110H-2</td>
<td>A-15</td>
</tr>
<tr>
<td>A-5</td>
<td>IF 3 dB Attenuator (2)</td>
<td>Midwest Microwave</td>
<td>290-03</td>
<td>A-16</td>
</tr>
<tr>
<td>A-6</td>
<td>LO 20 dB Attenuator</td>
<td>Midwest Microwave</td>
<td>290-20</td>
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<td>A-7</td>
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<td>AFS5-010060-55-23P</td>
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<td>7812 CT</td>
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<td>LO Directional Coupler</td>
<td>KRYTAR</td>
<td>2610</td>
<td>A-23</td>
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* These designators identify the components shown in Figure A-5. When more than one component has the same designator, the number of the identical components is given in parenthesis in the description column.
Figure A-6. Reference Channel Receiver Front-End Down Converter Component Layout.
<table>
<thead>
<tr>
<th>Photo * Designator</th>
<th>Description</th>
<th>Manufacture</th>
<th>Model No.</th>
<th>Page No.</th>
</tr>
</thead>
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<td>2610</td>
<td>A-23</td>
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<td>4B51-20/X1-0/0</td>
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<td>B-10</td>
<td>IF Amplifier</td>
<td>TRON-TECH</td>
<td>W110H-2</td>
<td>A-15</td>
</tr>
</tbody>
</table>

* These designators identify the components shown in Figure A-6. When more than one component has the same designator, the number of identical components is given in parenthesis in the description column.
Figure A-7. Front-End Receiver Control Chassis Component Layout.
<table>
<thead>
<tr>
<th>Photo * Designator</th>
<th>Description</th>
<th>Manufacture</th>
<th>Model No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-1</td>
<td>RF Switch Control Power Supply</td>
<td>Power Products</td>
<td>HE 224</td>
<td>A-25</td>
</tr>
<tr>
<td>C-2</td>
<td>Time Base Amplifier Power Supply</td>
<td>Power Products</td>
<td>PM 365</td>
<td>A-26</td>
</tr>
<tr>
<td>C-3</td>
<td>LO Amplifier Power Supply</td>
<td>ACOPIAN</td>
<td>15EB60</td>
<td>A-27</td>
</tr>
<tr>
<td>C-4</td>
<td>LO 0-69 dB Step Attenuator</td>
<td>Midwest Microwave</td>
<td>1044</td>
<td>A-28</td>
</tr>
<tr>
<td>C-5</td>
<td>LO Amplifier</td>
<td>MITEQ</td>
<td>AF55-010060-55-2P</td>
<td>A-18</td>
</tr>
<tr>
<td>C-6</td>
<td>Time Base 4-Way Power Splitter</td>
<td>Mini-Circuits</td>
<td>ZFSC-4-3B</td>
<td>A-29</td>
</tr>
<tr>
<td>C-7</td>
<td>Time Base Amplifier</td>
<td>Mini-Circuits</td>
<td>ZFL-2000B</td>
<td>A-30</td>
</tr>
</tbody>
</table>

* These designators identify the components shown in Figure A-7.
Figure A-8. IF Control Chassis Component Layout.
### TABLE A-4
IF CONTROL CHASSIS COMPONENT IDENTIFICATION

<table>
<thead>
<tr>
<th>Photo * Designator</th>
<th>Description</th>
<th>Manufacture</th>
<th>Model No.</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1</td>
<td>IF 0-59 dB Step Attenuator (3)</td>
<td>Weinschel Engineering</td>
<td>3023-100</td>
<td>A-31</td>
</tr>
<tr>
<td>D-2</td>
<td>IF Amplifier (3)</td>
<td>TRON-TECH</td>
<td>W110H-2</td>
<td>A-15</td>
</tr>
<tr>
<td>D-3</td>
<td>IF 2-Way Power Splitter</td>
<td>KDI Electronics</td>
<td>PSK-211</td>
<td>A-32</td>
</tr>
<tr>
<td>D-4</td>
<td>IF Amplifier Power Supply</td>
<td>Power Products</td>
<td>PM317</td>
<td>A-26</td>
</tr>
</tbody>
</table>

* These designators identify the components shown in Figure A-8. When more than one component has the same designator, the number of identical components is given in parenthesis in the Description column.
**Table 1. Specifications**

**Frequency Range:** DC to 26.5 GHz

**Maximum Input Power:** +27 dBm (0.5W)

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency (GHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DC to 18</td>
</tr>
<tr>
<td>Input SWR</td>
<td>≤1.22</td>
</tr>
<tr>
<td>Equivalent Output SWR</td>
<td>≤1.22</td>
</tr>
<tr>
<td>(Leveling or ratio measurement)</td>
<td></td>
</tr>
<tr>
<td>Output Tracking</td>
<td>0.25 dB</td>
</tr>
<tr>
<td>(between output arms)</td>
<td></td>
</tr>
</tbody>
</table>

**Connectors:** Precision 3.5mm Female on all ports

**Dimensions:** 47 mm wide x 40 mm high x 10 mm deep (1.85 in x 1.57 in x 0.39 in)

**Shipping Weight:** 0.14 kg (4.94 oz.)

**Table 2. Supplemental Characteristics**

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency (GHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DC to 18</td>
</tr>
<tr>
<td>Phase Tracking</td>
<td>≤1.5°</td>
</tr>
<tr>
<td>(between output arms), typically:</td>
<td></td>
</tr>
</tbody>
</table>

**Typical insertion loss:**

**Leveling or ratio measurement source match:**
Insertion Loss (db)
**CUSTOMER:** Lockheed-McCulloch  
**MODEL NUMBER:** W110H-2  
**SERIAL NUMBER:** L74001  
**DATE:** 9/25/87

<table>
<thead>
<tr>
<th>CENT. FREQ.</th>
<th>SPEC'D.</th>
<th>MEASURED</th>
<th>VSWR IN</th>
<th>SPEC'D.</th>
<th>MEASURED</th>
<th>VSWR OUT</th>
<th>SPEC'D.</th>
<th>MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 dB B.W.</td>
<td>5-110MHz</td>
<td>SEE PLOT</td>
<td>2.5:1</td>
<td>SEE S11</td>
<td></td>
<td>2.5:1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 dB B.W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAIN</td>
<td>30 dB</td>
<td></td>
<td>20 dB</td>
<td></td>
<td></td>
<td>20 dB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLATNESS</td>
<td>±0.5 dB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±0.5 dB</td>
<td></td>
</tr>
<tr>
<td>NOISE FIG.</td>
<td>1.4 dB</td>
<td>1.4 dB</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**P.O. 1 dB COMP: +5 dBm +7 dBm**

**V.E. +12V 21.8 mA**

![Graphs and plots](image-url)
CUSTOMER: Lockheed-Emisco
MODEL NUMBER: W110 H-2
SERIAL NUMBER: L740 02

<table>
<thead>
<tr>
<th>SPEC'D.</th>
<th>MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENT. FREQ.</td>
<td></td>
</tr>
<tr>
<td>1 dB B.W.</td>
<td>5-110 MHz</td>
</tr>
<tr>
<td>3 dB B.W.</td>
<td></td>
</tr>
<tr>
<td>GAIN</td>
<td>30 dB</td>
</tr>
<tr>
<td>FLATNESS</td>
<td>± 5 dB</td>
</tr>
<tr>
<td>NOISE FIG.</td>
<td>1.4 dB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SPEC'D.</th>
<th>MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSWR IN</td>
<td>2:1</td>
</tr>
<tr>
<td>VSWR OUT</td>
<td>2:1</td>
</tr>
<tr>
<td>P/O @ 1 dB COMP.</td>
<td>+5 dBm</td>
</tr>
<tr>
<td>Ic e</td>
<td>+12 V</td>
</tr>
</tbody>
</table>

---

Diagram: Gain (dB)
REF LEVEL /DIV MARKER 20 000 000.000Hz MAG (UDF) 35.149dB
0.000dB 5.000dB MARKER 20 000 000.000Hz PHASE (UDF) -7.569deg
0.0deg 45.000deg

IF Amplifier
Model W11OH-2
S/N L74002

START 10 000 000.000Hz STOP 30 000 000.000Hz
AMPTD -35.0dBm
CUSTOMER: Lockheed-Emisco  
MODEL NUMBER: W1104-2  
SERIAL NUMBER: L74003  

<table>
<thead>
<tr>
<th>SPEC'D.</th>
<th>MEASURED</th>
<th>SPEC'D.</th>
<th>MEASURED</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSWR IN</td>
<td>2.51</td>
<td>VSWR OUT</td>
<td>2.51</td>
</tr>
<tr>
<td>P/O @ 1 dB COMP.</td>
<td>+5 dBm</td>
<td>7 dbm</td>
<td>7.7 dbm</td>
</tr>
<tr>
<td>Ic @ +12 V</td>
<td>22.1 mA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 1 dB B.W. | 5-110 MHz | See Plot |
| GAIN | 30 dB | |
| FLATNESS | ±0.5 dB | |
| NOISE FIG. | 1.4 dB | 1.4 dB |

Gain (dB) vs. f (MHz) graphs are provided.
REF LEVEL /DIV
0.000dB  5.000dB
0.0deg   45.000deg

MARKER 20 000 000.000Hz
MAG (UDF)  34.300dB
MARKER 20 000 000.000Hz
PHASE (UDF) -7.435deg

START 10 000 000.000Hz  STOP 30 000 000.000Hz
AMPTD -35.0dBm

IF Amplifier
Model W110H-2
S/N L74003
IF Amplifier
Model W110H-2
S/N L73601

REF LEVEL /DIV MARKER 20 000 000.000Hz
0.000dB 5.000dB MAG (UDF) 35.071dB
0.0deg 45.000deg MARKER 20 000 000.000Hz
PHASE (UDF) -8.754deg

START 10 000 000.000Hz STOP 30 000 000.000Hz
AMPTD -35.0dBm
THE MINIPAD:

MINIPAD DOUBLE FEMALE

MINIPAD DOUBLE MALE

DC TO 18 GHz HIGH PERFORMANCE SPECIFICATIONS
MODELS 290, 290M AND 290F
FREQUENCY RANGE: DC TO 18 GHz
CONNECTOR TYPE: STAINLESS STEEL
SMA PER MIL-C-39012
ATTENUATION VALUES: 1 THRU 30dB IN 1 dB INCREMENTS
ATTENUATION ACCURACY: 1 - 6dB ±0.3dB
7 - 20dB ±0.5dB
21 - 30 dB ±1.0dB
MAXIMUM VSWR: 1.07 +0.015GHz
MAXIMUM INPUT POWER: 2 WATTS AVERAGE AT +25°C DERATED LINEARLY TO 0.5 WATTS AT +125°C
OPERATING TEMPERATURE RANGE: -65°C TO +125°C

DC TO 12.4 GHz HIGH PERFORMANCE SPECIFICATIONS
MODELS 291, 291M AND 291F
FREQUENCY RANGE: DC TO 12.4 GHz
CONNECTOR TYPE: STAINLESS STEEL
SMA PER MIL-C-39012
ATTENUATION VALUES: 1 THRU 30dB IN 1 dB INCREMENTS
ATTENUATION ACCURACY: 1 - 6dB ±0.3dB
7 - 20dB ±0.5dB
21 - 30 dB ±1.0dB
MAXIMUM VSWR: 1.07 +0.015GHz
MAXIMUM INPUT POWER: 2 WATTS AVERAGE AT +25°C DERATED LINEARLY TO 0.5 WATTS AT +125°C
OPERATING TEMPERATURE RANGE: -65°C TO +125°C

* U.S. Patent number 3,824,506 applies to all Minipads.
REF LEVEL /DIV
0.000dB 10.000dB MAG (UDF) -2.377dB
0.0deg 90.000deg MARKER 19 986 789.600Hz
PHASE (UDF) 96.516deg

K & L Model 4851
Band Pass Filter
S/N 2

START 10 000 000.000Hz
STOP 30 000 000.000Hz

A-17b
REF LEVEL /DIV
0.000dB 10.000dB
0.0deg 90.000deg

MARKER 19 986 789.600Hz
MAG (UDF) -2.394dB
PHASE (UDF) 90.994deg

K & L Model 4851
Band Pass Filter
S/N 3

START 10 000 000.000Hz
STOP 30 000 000.000Hz
**Specifications:** At 23°C:

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>Gain (dB)</th>
<th>VSWR IN</th>
<th>VSWR OUT</th>
<th>Noise Figure (dB)</th>
<th>Output Power @ 1dB Gain Compression (dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>40.3</td>
<td>1.67</td>
<td>&lt;1.22</td>
<td>2.19</td>
<td>1.5-6 +23</td>
</tr>
<tr>
<td>2.0</td>
<td>42.2</td>
<td>1.78</td>
<td>&lt;1.22</td>
<td>2.26</td>
<td>1-1.5 +22</td>
</tr>
<tr>
<td>3.0</td>
<td>42.0</td>
<td>1.78</td>
<td>&lt;1.22</td>
<td>2.34</td>
<td>+23</td>
</tr>
<tr>
<td>4.0</td>
<td>40.7</td>
<td>1.78</td>
<td>&lt;1.22</td>
<td>2.36</td>
<td>+23</td>
</tr>
<tr>
<td>5.0</td>
<td>41.8</td>
<td>1.67</td>
<td>&lt;1.22</td>
<td>2.42</td>
<td>+23</td>
</tr>
<tr>
<td>6.0</td>
<td>40.4</td>
<td>1.92</td>
<td>&lt;1.22</td>
<td>2.56</td>
<td>+23</td>
</tr>
</tbody>
</table>

**Important:** Must use heat sink if case temperature exceeds 70°C.

**Note:** Test data taken with case temp. of 23°C.
**PROJECT No:** P21345  
**MODEL No:** AFS5-010060-55-23P-32  
**SERIAL No:** 131663  
**CUSTOMER:** LOCKHEED  
**PURCHASE ORDER No:** 0200118172

**IMPORTANT - MUST USE HEAT SINK IF CASE TEMPERATURE EXCEEDS 70°C**

**SPECIFICATIONS: AT 23°C:**

<table>
<thead>
<tr>
<th>FREQUENCY (GHz)</th>
<th>OUTPUT POWER @ 1dB GAIN COMPRESSION:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0 to 6.0</td>
<td>1-1.5 dBm +22 1.5-6 dBm +23 dBm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MIN. GAIN:</th>
<th>38 dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOLTAGE:</td>
<td>+15 VOLTS</td>
</tr>
<tr>
<td>MAX.GAIN FLATNESS:</td>
<td>+/- 1.5 dB</td>
</tr>
<tr>
<td>MEASURED CURRENT:</td>
<td>368 mA</td>
</tr>
<tr>
<td>MAX. VSWR INPUT:</td>
<td>2:1</td>
</tr>
<tr>
<td>MAX. VSWR OUTPUT:</td>
<td>2:1</td>
</tr>
<tr>
<td>HOUSING No:</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE: TEST DATA TAKEN WITH CASE TEMP. OF 23°C**

<table>
<thead>
<tr>
<th>FREQUENCY (GHz)</th>
<th>GAIN (dB)</th>
<th>VSWR</th>
<th>NOISE FIGURE (dB)</th>
<th>OUTPUT POWER (dBm) (@ 1dB GAIN COMPRESSION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>38</td>
<td>1.67</td>
<td>&lt;1.22</td>
<td>2.14 +22</td>
</tr>
<tr>
<td>2.0</td>
<td>40.0</td>
<td>1.67</td>
<td>&lt;1.22</td>
<td>2.21 +22</td>
</tr>
<tr>
<td>3.0</td>
<td>40.4</td>
<td>1.78</td>
<td>&lt;1.22</td>
<td>2.31 +23</td>
</tr>
<tr>
<td>4.0</td>
<td>40.1</td>
<td>1.78</td>
<td>&lt;1.22</td>
<td>2.23 +23.5</td>
</tr>
<tr>
<td>5.0</td>
<td>40.4</td>
<td>1.67</td>
<td>&lt;1.22</td>
<td>2.37 +23.5</td>
</tr>
<tr>
<td>6.0</td>
<td>38.2</td>
<td>1.92</td>
<td>&lt;1.22</td>
<td>2.57 +23.5</td>
</tr>
</tbody>
</table>

**TESTED BY:** Donald Maurice  
**DATE:** 04/28/88  
**(DONALD MAURICE)**
**PROJECT No:** P21345  
**MODEL No:** AFS5-010060-55-23P-32  
**SERIAL No:** 131664  
**CUSTOMER:** LOCKHEED  
**PURCHASE ORDER No:** 0200118172

**IMPORTANT** - MUST USE HEAT SINK IF CASE TEMPERATURE EXCEEDS 70°C

**SPECIFICATIONS: AT 23°C:**

<table>
<thead>
<tr>
<th>FREQUENCY:</th>
<th>1.0 to 6.0 GHz</th>
<th>OUTPUT POWER @ 1dB</th>
<th>1-1.5</th>
<th>+22 dBm</th>
<th>GAIN COMPRESSION:</th>
<th>1.5-6</th>
<th>+23 dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN. GAIN:</td>
<td>38 dB</td>
<td>VOLTAGE:</td>
<td>+15</td>
<td>VOLTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAX. GAIN FLATNESS:</td>
<td>+/- 1.5 dB</td>
<td>MEASURED CURRENT:</td>
<td>377</td>
<td>mA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAX. VSWR INPUT:</td>
<td>2:1</td>
<td>MAX. NOISE FIGURE:</td>
<td>5.5</td>
<td>dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAX. VSWR OUTPUT:</td>
<td>2:1</td>
<td>HOUSING No:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** TEST DATA TAKEN WITH CASE TEMP. OF 23°C

<table>
<thead>
<tr>
<th>FREQUENCY (GHz)</th>
<th>GAIN (dB)</th>
<th>VSWR</th>
<th>NOISE FIGURE (dB)</th>
<th>OUTPUT POWER (dBm) (@ 1dB GAIN COMPRESSION)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>41.4</td>
<td>1.67</td>
<td>&lt;1.22</td>
<td>2.24 (+22)</td>
</tr>
<tr>
<td>2.0</td>
<td>42.5</td>
<td>1.78</td>
<td>&lt;1.22</td>
<td>2.40 (+23)</td>
</tr>
<tr>
<td>3.0</td>
<td>41.9</td>
<td>1.92</td>
<td>&lt;1.22</td>
<td>2.35 (+23)</td>
</tr>
<tr>
<td>4.0</td>
<td>40.5</td>
<td>1.67</td>
<td>&lt;1.22</td>
<td>2.27 (+23.5)</td>
</tr>
<tr>
<td>5.0</td>
<td>40.8</td>
<td>1.58</td>
<td>&lt;1.22</td>
<td>2.34 (+24)</td>
</tr>
<tr>
<td>6.0</td>
<td>39.3</td>
<td>1.78</td>
<td>&lt;1.22</td>
<td>2.73 (+24)</td>
</tr>
</tbody>
</table>

**TESTED BY:** Donald Maurice  
(DONALD MAURICE)  
DATE: 04/28/88  
ORIGINAL PAGE IS OF POOR QUALITY
### Table 1. SWR Data Uncertainties

<table>
<thead>
<tr>
<th>Connector Type</th>
<th>Frequency Range (GHz)</th>
<th>DC to 12.4 GHz</th>
<th>12.4 to 18.0 GHz</th>
<th>18.0 to 26.5 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>APC 7 &amp; Male Type N</td>
<td>dc to 12.4</td>
<td>±0.025</td>
<td>±0.031</td>
<td>±0.050</td>
</tr>
<tr>
<td>Female Type N</td>
<td>dc to 8.0</td>
<td>±0.025</td>
<td>±0.021</td>
<td>±0.046</td>
</tr>
<tr>
<td>Male SMA</td>
<td>dc to 8.0</td>
<td>±0.031</td>
<td>±0.024</td>
<td>±0.071</td>
</tr>
<tr>
<td>Female SMA</td>
<td>dc to 8.0</td>
<td>±0.054</td>
<td>±0.054</td>
<td>±0.137</td>
</tr>
<tr>
<td>Male APC-3.5</td>
<td>dc to 10</td>
<td>±0.025</td>
<td>±0.025</td>
<td>±0.030</td>
</tr>
<tr>
<td>Female APC-3.5</td>
<td>dc to 10</td>
<td>±0.020</td>
<td>±0.025</td>
<td>±0.037</td>
</tr>
</tbody>
</table>

### Table 2. Coaxial Attenuator Calibration Frequencies* (MHz)

<table>
<thead>
<tr>
<th>Frequency (GHz)</th>
<th>HP 8491A</th>
<th>HP 8493A</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>4500</td>
<td>9000</td>
</tr>
<tr>
<td>500</td>
<td>5000</td>
<td>10000</td>
</tr>
<tr>
<td>1000</td>
<td>5500</td>
<td>11000</td>
</tr>
<tr>
<td>1500</td>
<td>6000</td>
<td>11500</td>
</tr>
<tr>
<td>2000</td>
<td>6500</td>
<td>12000</td>
</tr>
<tr>
<td>2500</td>
<td>7000</td>
<td>12500</td>
</tr>
<tr>
<td>3000</td>
<td>7500</td>
<td>13000</td>
</tr>
<tr>
<td>3500</td>
<td>8000</td>
<td>13500</td>
</tr>
<tr>
<td>4000</td>
<td>8500</td>
<td>14000</td>
</tr>
</tbody>
</table>

* dc to 12.4 GHz models include 26 frequencies, dc to 18 GHz models include 42 frequencies, dc to 26.5 GHz models include 57 frequencies (2 to 26.5 GHz).

### Table 3. Attenuation Data Uncertainties

<table>
<thead>
<tr>
<th>Attenuation (dB)</th>
<th>HP 8491A/2.3 Attenuation Data Uncertainty (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 to 2.0 GHz</td>
<td>2.0 to 6.0 GHz</td>
</tr>
<tr>
<td>6.0 to 12.4 GHz</td>
<td>12.4 to 18.0 GHz</td>
</tr>
<tr>
<td>18.0 to 26.5 GHz</td>
<td></td>
</tr>
<tr>
<td>3 dB</td>
<td>±0.07 ±0.06 ±0.06 ±0.11 ±0.15</td>
</tr>
<tr>
<td>6 dB</td>
<td>±0.07 ±0.07 ±0.07 ±0.11 ±0.15</td>
</tr>
<tr>
<td>10 dB</td>
<td>±0.08 ±0.08 ±0.07 ±0.12 ±0.15</td>
</tr>
<tr>
<td>20 dB</td>
<td>±0.12 ±0.11 ±0.11 ±0.15 ±0.18</td>
</tr>
<tr>
<td>30 dB</td>
<td>±0.15 ±0.14 ±0.14 ±0.21 ±0.25</td>
</tr>
<tr>
<td>50 dB</td>
<td>±0.23 ±0.23 ±0.23 ±0.34 n/a</td>
</tr>
<tr>
<td>60 dB</td>
<td>±0.50* ±0.48* ±0.90* ±0.90* n/a</td>
</tr>
</tbody>
</table>

*The uncertainties noted represent 99.7% probability values.

ORDERING INFORMATION

To order, basic model number and Option (specifies attenuation value) must be specified. Option 890 calibration data can also be ordered with the basic model number and attenuation value option.

Ordering example:

HP 8491A Option 003, Option 890

---

SPECIFICATIONS

Specifications describe the instruments warranted performance. Supplemental characteristics (shown in italics) are intended to provide information useful in applying the instrument by giving typical, but non-warranted, performance parameters.

FREQUENCY RANGE: HP 8491A and 8493A, dc-12.4 GHz
HP 8491B, 8493B and 8492A, dc-18 GHz
HP 8493C, dc-26.5 GHz

ATTENUATION ACCURACY:

<table>
<thead>
<tr>
<th>HP 8491A/3A</th>
<th>HP 8491B/3B/3A</th>
<th>HP 8493C</th>
</tr>
</thead>
<tbody>
<tr>
<td>dc-12.4 GHz</td>
<td>dc-12.4 GHz</td>
<td>dc-18</td>
</tr>
<tr>
<td>3 dB</td>
<td>±0.3 dB</td>
<td>±0.3 dB</td>
</tr>
<tr>
<td>6 dB</td>
<td>±0.6 dB</td>
<td>±0.6 dB</td>
</tr>
<tr>
<td>10 dB</td>
<td>±0.5 dB</td>
<td>±0.5 dB</td>
</tr>
<tr>
<td>20 dB</td>
<td>±0.5 dB</td>
<td>±1.0 dB</td>
</tr>
<tr>
<td>30 dB</td>
<td>±1.0 dB</td>
<td>±1.0 dB</td>
</tr>
<tr>
<td>HP 8491A only</td>
<td>HP 8491B/3A only</td>
<td>HP 8493C only</td>
</tr>
<tr>
<td>40 dB</td>
<td>±1.5 dB</td>
<td>±1.5 dB</td>
</tr>
<tr>
<td>50 dB</td>
<td>±1.5 dB</td>
<td>±1.5 dB</td>
</tr>
<tr>
<td>60 dB</td>
<td>±2.0 dB</td>
<td>±2.0 dB</td>
</tr>
</tbody>
</table>

SWR:

<table>
<thead>
<tr>
<th>HP 8491B/443B</th>
<th>HP 8492A</th>
<th>HP 8493C</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP 8491A/443A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>dc-0.6 GHz</td>
<td>6-12.4 GHz</td>
<td>6-12.4 GHz</td>
</tr>
<tr>
<td>3 dB</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>6 dB</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>10 dB</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>20 dB</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>30 dB</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>HP 8491B/443B only</td>
<td>HP 8492A only</td>
<td>HP 8493C only</td>
</tr>
<tr>
<td>40 dB</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>50 dB</td>
<td>1.2</td>
<td>1.2</td>
</tr>
<tr>
<td>60 dB</td>
<td>1.2</td>
<td>1.2</td>
</tr>
</tbody>
</table>
SPECIFICATIONS Cont’d

ENVIRONMENTAL
Temperature, non-operating: -55°C to +85°C.
Temperature, operating: 0°C to +55°C.
EMC: radiated interference is within the requirements of MIL STD. 461 method 202, VDE 0871 and CISPR Publication 11.

SUPPLEMENTAL CHARACTERISTICS
Temperature Stability: 0.0001 dB/db/°C (all except HP 8493C)
0.0002 dB/db/°C (HP 8493C)
Maximum input power: 2 W avg., 100 W peak
Power sensitivity: 0.001 dB/db/W (all except HP 8943C)
0.001 dB/W (HP 8493C)

EMC: radiated interference is within the requirements of Publication 11.

Temperature Stability: 0.0001 dB/dB/°C (all except HP 8493C)
0.0002 dB/dB/°C (HP 8493C)

CONNECTORS (50 Ω)

<table>
<thead>
<tr>
<th>TYPES</th>
<th>HP 8491A</th>
<th>HP 8493A</th>
<th>HP 8491B</th>
<th>HP 8493B</th>
<th>HP 8492A</th>
<th>HP 8493C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>N²</td>
<td>SMA</td>
<td>Type</td>
<td>N²</td>
<td>SMA</td>
<td>APC-7</td>
</tr>
<tr>
<td>mm</td>
<td>67 x 21</td>
<td>40 x 13</td>
<td>67 x 21</td>
<td>40 x 13</td>
<td>70 x 21</td>
<td>36.10, 20 dB</td>
</tr>
<tr>
<td>inches</td>
<td>27/16 x 3/8 Dia.</td>
<td>11/16 x 1/2 Dia.</td>
<td>27/16 x 3/8 Dia.</td>
<td>11/16 x 1/2 Dia.</td>
<td>24 x 1/4 Dia.</td>
<td>19/16 x 1/4 D</td>
</tr>
<tr>
<td>Net</td>
<td>110 g (4oz)</td>
<td>30 g (1oz)</td>
<td>110 g (4oz)</td>
<td>30 g (1oz)</td>
<td>110 g (4oz)</td>
<td>8.5 g (0.3oz)</td>
</tr>
<tr>
<td>Shipping</td>
<td>220 g (8oz)</td>
<td>220 g (8oz)</td>
<td>220 g (8oz)</td>
<td>220 g (8oz)</td>
<td>45 kg (1 lb)</td>
<td></td>
</tr>
</tbody>
</table>

1 As per USASI Committee C37.2 compatible with OSM, ARM, WPM, BRM, NPM, etc.
2 Mate with MIL-C-71 or MIL-C-39012 connectors.
3 At 20°C derated to 1.3 W avg. at 55°C.

ATTENUATOR SETS

HP 11581A/11582A/11583A/11583C
A calibrated set of four HP fixed coaxial attenuators (3, 6, 10, and 20 dB) is available. Each set includes a calibration report certified traceable to the National Bureau of Standards. The reports included with the HP 11581A, 11582A and 11583A indicate the accuracy of measurement and list the attenuation and reflection coefficient at each port of the attenuator at dc, 4, 8, 12, and 18 GHz. Calibrations at other frequencies are available on request.

The HP 11583C attenuator set includes Option 890 calibration data. This option is also available for the HP 11581A, 11582A, and 11583A but must be ordered separately.

The set of four attenuators is furnished in a handsome walnut accessory case. In addition to protecting the units when not in use, the case is also a convenient storage place for the attenuators and the calibration reports.

SPECIFICATIONS
ACCURACY OF INSERTION LOSS MEASUREMENTS (S₁₁, S₂₂):
Attenuator Sets HP 11581A/11582A
DC ± 0.01 dB
4 - 18 GHz ± 0.097 dB
Attenuator Set HP 11583A
DC ± 0.01 dB
4 - 18 GHz ± 0.085 dB

ACCURACY OF REJECTION COEFFICIENT MEASUREMENTS (S₁₂, S₂₁):
Attenuator Sets HP 11581A/11582A
4 - 18 GHz ∆Γᵣ < ± 0.035
Attenuator Set HP 11583A
4 - 18 GHz ∆Γᵣ < ± 0.030

Ordering Information
HP 11581A (3, 6, 10, 20 dB values HP 8491A)
HP 11582A (3, 6, 10, 20 dB values HP 8491B)
HP 11583A (3, 6, 10, 20 dB values HP 8492A)
HP 11583C (3, 6, 10, 20 dB values HP 8493C)
Three series of double balanced mixers with conventional IF's are offered on this page. The basic "DM" series, which utilizes a rugged cast aluminum housing, is specified as a down converter for octave and multioctave frequency ranges. The DMS1-26A is a high performance, low conversion loss, multioctave model specified as a down converter in the 1 to 26 GHz frequency range.

The models described above function well as up converters, third harmonic mixers, and phase detectors. The DMK2-18 is a special version of the DMS1-26A specified as a wideband biphase modulator. The DMK2-18 uses a special diode quad with diodes selected for switching rather than mixing capability and special IF decoupling networks to produce a high performance modulator covering 2 to 18 GHz (usable 1 to 26 GHz).

**SPECIFICATIONS:**

**DMS1-26A**
- **RF/LO Range:** 1 to 26 GHz
- **IF Range:** DC-500 MHz
- **Conversion Loss:** 1 to 2 GHz - 8 dB typical, 9.5 dB max.
- **18 to 26 GHz - 6.0 dB typical, 7.0 dB max.
- **LO VSWR:** 2.3:1 typical
- **Price:** $650

**SPECIFICATIONS:**

**DMK2-18**
- **Frequency Range:** 2 to 18 GHz
- **Carrier Suppression:** 20 dB
- **Switching Speed:** 3 nsec max.
- **Phase Balance:** ± 10° (from 180°)
- **Amplitude Balance:** ± 0.75 dB
- **Insertion Loss:** 4 dB
- **DC Current Required:** ± 10 mA
- **Price:** $765

**NOTES:** (When not otherwise specified)

1. LO Injection: +7 dBm to +10 dBm
2. RF/LO VSWR: 2.5:1 (typ)
3. LO/RF Isolation: 20 dB min.
4. IF Response: DC to 500 MHz.
5. Weight: DMS-10 g (0.4 oz) max.
   DMK-10 g (0.4 oz) max.
6. For outline drawings: See page 56.

**OPTIONS:** (Apply for DM and DMS series only, as noted)

1. For improved intermodulation performance use LO injection level of +13 to +16 dBm. Add suffix "H". $80 additional.
2. Low corner noise diodes (DM series only). Reduce 1/f noise for "zero IF" applications. Add suffix "B". $65 additional.

**ORIGINAL PAGE IS OF POOR QUALITY**
OMNI SPECTRA

POWER DIVIDERS
TWO-WAY • WILKINSON
ISOLATED • ULTRA BROADBAND

- Excellent Amplitude and Phase Balance
- High Isolation Between Output Ports
- Wideband Frequency Coverage
- Low Insertion Loss
- Low VSWR
- Power: 3.0 to 10 Watts Input Maximum, with Matched Terminations
- Meets MIL-E-5400 and MIL-E-16400 Environments

These two-way in-phase stripline power dividers demonstrate excellent performance across a broad frequency spectrum. The multi-octave power dividers exhibit high isolation, low VSWR and insertion loss, excellent amplitude balance and phase balance, all combined in a small package.

NOTE: All dimensions are ± .020, except mounting hole diameters (± .005) and mounting hole location (± .010).

SPECIFICATIONS

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>FIG.</th>
<th>FREQUENCY RANGE (GHz)</th>
<th>VSWR (max.)</th>
<th>ISOLATION dB (Min.)</th>
<th>INSERTION LOSS dB (max.)</th>
<th>OUTPUT UNBALANCE AMP. (dB)</th>
<th>PHASE (deg.)</th>
<th>MAXIMUM INPUT POWER* (watts)</th>
<th>WEIGHT oz.</th>
<th>g</th>
</tr>
</thead>
<tbody>
<tr>
<td>2089-6214-00</td>
<td>1</td>
<td>4.0-18.0</td>
<td>1.50**</td>
<td>18</td>
<td>0.9</td>
<td>0.3</td>
<td>8.0</td>
<td>3.0</td>
<td>.66</td>
<td>19.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>.03-50</td>
<td>2.00</td>
<td>3</td>
<td>0.8</td>
<td>0.5</td>
<td>1.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>.50-1.0</td>
<td>1.93</td>
<td>6</td>
<td>0.7</td>
<td>0.5</td>
<td>1.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.0-2.0</td>
<td>1.70</td>
<td>10</td>
<td>0.5</td>
<td>0.2</td>
<td>1.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.0-4.0</td>
<td>1.50</td>
<td>20</td>
<td>0.5</td>
<td>0.2</td>
<td>1.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.0-8.0</td>
<td>1.50</td>
<td>17</td>
<td>0.5</td>
<td>0.2</td>
<td>1.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.0-15.0</td>
<td>1.50</td>
<td>17</td>
<td>0.75</td>
<td>0.3</td>
<td>2.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>15.0-17.0</td>
<td>1.80</td>
<td>17</td>
<td>0.75</td>
<td>0.3</td>
<td>3.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>17.0-18.0</td>
<td>1.80</td>
<td>17</td>
<td>1.0</td>
<td>0.4</td>
<td>4.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>18.0-20.0</td>
<td>2.00</td>
<td>10</td>
<td>1.0</td>
<td>0.4</td>
<td>5.0</td>
<td>10.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Maximum input power with output loads of VSWR 2.0:1.
**Derate to 10% of listed value when arbitrarily terminated.
***1.7:1 from 4.0 to 5.0 GHz.
Power Splitter
Model 2089-6220-00
S/N 163
3-TERMINAL POSITIVE VOLTAGE REGULATORS

These voltage regulators are monolithic integrated circuits designed as fixed-voltage regulators for a wide variety of applications including local, on-card regulation. These regulators employ internal current limiting, thermal shutdown, and safe-area compensation. With adequate heatsinking they can deliver output currents in excess of 1.0 ampere. Although designed primarily as a fixed voltage regulator, these devices can be used with external components to obtain adjustable voltages and currents:

- Output Current in Excess of 1.0 Ampere
- No External Components Required
- Internal Thermal Overload Protection
- Internal Short-Circuit Current Limiting
- Output Transistor Safe-Area Compensation
- Output Voltage Offered in 2% and 4% Tolerance

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device</th>
<th>Output Voltage Tolerance</th>
<th>Temperature Range</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC7800KX</td>
<td>4%</td>
<td>-55 to +150°C</td>
<td>Metal Power</td>
</tr>
<tr>
<td>MC78XXAK</td>
<td>2%</td>
<td>-40 to +125°C</td>
<td>Metal Power</td>
</tr>
<tr>
<td>MC78XXBK</td>
<td>4%</td>
<td>-40 to +125°C</td>
<td>Metal Power</td>
</tr>
<tr>
<td>MC78XXCK</td>
<td>4%</td>
<td>0 to +125°C</td>
<td>Metal Power</td>
</tr>
<tr>
<td>MC78XXACK</td>
<td>2%</td>
<td>-55 to +150°C</td>
<td>Metal Power</td>
</tr>
<tr>
<td>MC78XXCT</td>
<td>4%</td>
<td>-40 to +125°C</td>
<td>Plastic Power</td>
</tr>
<tr>
<td>MC78XXACT</td>
<td>2%</td>
<td>-40 to +125°C</td>
<td>Plastic Power</td>
</tr>
<tr>
<td>MC78XXBT</td>
<td>4%</td>
<td>-40 to +125°C</td>
<td>Plastic Power</td>
</tr>
</tbody>
</table>

A common ground is required between the input and the output voltages. The output voltage must remain typically 2.0 V above the output voltage even during the low point on the input ripple voltage.

XX = these two digits of the type number indicate voltage

* = C10 is required if regulator is located an appreciable distance from power supply filter.

** = C0 is not needed for stability; however, it does improve transient response.

XX indicates nominal voltage

TYPE NO./VOLTAGE

<table>
<thead>
<tr>
<th>Type</th>
<th>Voltage</th>
<th>Case</th>
</tr>
</thead>
<tbody>
<tr>
<td>MC7805</td>
<td>5.0 Volts</td>
<td>MC7815</td>
</tr>
<tr>
<td>MC7806</td>
<td>6.0 Volts</td>
<td>MC7818</td>
</tr>
<tr>
<td>MC7808</td>
<td>8.0 Volts</td>
<td>MC7824</td>
</tr>
<tr>
<td>MC7812</td>
<td>12 Volts</td>
<td>MC7812</td>
</tr>
</tbody>
</table>
## Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range</strong></td>
<td>1-26.5 GHz</td>
</tr>
</tbody>
</table>
| **Coupling (with respect to output)** | Nominal: 10 ± 1 dB  
Frequency Sensitivity: ± 0.6 dB, 1-12.4 GHz  
± 0.8 dB, 1-26.5 GHz |
| **Directivity**               | > 14 dB, 1-12.4 GHz  
> 12 dB, 12.4-26.5 GHz |
| **Maximum VSWR (Any port)**   | 1.35, 1-12.4 GHz  
1.50, 12.4-26.5 GHz |
| **Insertion Loss**            | < 1.1 dB, 1-12.4 GHz  
< 1.6 dB, 12.4-26.5 GHz |
| **Power Rating (input)**      | Average: 20 W  
Peak: 3 kW |
| **Connectors**                | 3.5 mm Male or Female |
| **Weight (ounces)**           | 2.1 |
| **Price**                     | $825 |

## Dimensions

![Dimensions Diagram]
SMA COAXIAL attenuators
1 TO 30 dB • DC TO 18 GHz

A600M SERIES

<table>
<thead>
<tr>
<th>Series</th>
<th>&quot;L&quot; Dimension</th>
<th>Attenuation Increments</th>
</tr>
</thead>
<tbody>
<tr>
<td>A600M</td>
<td>0.86</td>
<td>1 - 10 dB</td>
</tr>
<tr>
<td></td>
<td>1.02</td>
<td>11 - 20 dB</td>
</tr>
</tbody>
</table>

HIGH PERFORMANCE
(SPACE QUALIFIED) (MEETS MIL-A-3933E)

GENERAL SPECIFICATIONS

Frequency Range: DC to 18 GHz
Impedance: 50 ohms
Attenuation Stability: 0.0001 dB/°C
Attenuation Accuracy: 1-10 dB - ±0.3 dB
11-20 dB - ±0.5 dB
21-30 dB - ±1.0 dB
VSWR (Max.): DC - 8 GHz - 1.15:1
8 - 12 GHz - 1.25:1
12 - 18 GHz - 1.35:1
Input Power: 2 watt @ 25°C, derate to 0.5 watts @ 125°C, 200 watts peak
Operating Temperature: -65°C - 125°C
Housing: Stainless Steel, Passivated per QQ-P-35
Connector: SMA, Stainless Steel per MIL-C-39012
Center Conductor: Beryllium Copper, Gold Plated per MIL-G-45204

ORDERING INFORMATION

The Coaxial Attenuators listed are available in 1 dB increments from 1 through 30 dB. When ordering, to specify the correct part number for the desired attenuation value, select from the two basic series and add the attenuation value desired to the basic series designation.

EXAMPLE: A6 Basic Series
10 Desired dB Value
M (SMA)
HE200 SERIES

- 75% Efficiency
- Wide Input Range
- Low Ripple and Noise
- OVP on 5-Volt Models

The HE200 series switching power supplies consists of ten models with both single and dual output voltages. These models employ 25 KHz, pulse-width modulated switching circuitry to achieve 75% efficiency at up to 100 Watts output power. The output voltages are adjustable and line regulation is from .02% to 0.1% with load regulation from .05% to 0.1%. Output ripple and noise is held to 10 mV to 20 mV peak to peak, maximum. All outputs are short circuit protected for an indefinite time period. In addition, the 5-volt outputs are over-voltage protected by means of a crowbar circuit and they have a remote sensing feature which compensates for line drops up to 0.3 volt. There are both U.S. and international versions of each model with wide input voltage ranges of 90 to 130 VAC or 180 to 260 VAC.

### ELECTRICAL SPECIFICATIONS

All Specifications Typical at Nominal Line, Full Load, and 25°C Unless Otherwise Noted.

#### INPUT SPECIFICATIONS

- Input Voltage Range, Standard ... 90 VAC to 130 VAC
- "E" Suffix ... 180 VAC to 260 VAC

#### OUTPUT SPECIFICATIONS

- Voltage Accuracy ............... Adjustable
- Voltage Tracking, Dual Outputs (HE215,215E) ... ±1.5%
- Temperature Coefficient .......... ±0.02%/°C, max.
- Tracking Temp. Coefficient ...... Dual Outputs (HE215,215E) ... ±0.005%/°C, max.
- Warm-Up Drift ..................... 15 mV
- Transient Recovery Time
  - 5-Volt Models, 50% Load to Full Load
    - HE237, to 0.2% of Final Value ... 300 μsec.
    - HE252, to 0.4% of Final Value ... 300 μsec.
  - All Other Models, No Load to Full Load
    - HE212, to 0.5% of Final Value ... 30 μsec.
    - HE215, 224, to 0.2% of Final Value ... 30 μsec.
- Hold-Up Time .................. 20 msec.
- Short Circuit Protection ........ Continuous
- Over Voltage Protection
  - 5V Outputs (HE237,252) .......... Crowbar
  - Remote Sensing*,
    - 5V Outputs (HE237,252) ... Up to 0.3V Drop

#### GENERAL SPECIFICATIONS

- Efficiency ......................... 75%
- Isolation Voltage ................. 900 VRMS
- Isolation Resistance .............. 50 megohms
- Switching Frequency .............. 25 KHz

#### ENVIRONMENTAL SPECIFICATIONS

- Operating Temperature Range ......... 0° to +71°C
- Derating, 50° to 71°C ................ 2.5%/°C
- Storage Temperature Range ........... -25°C to +85°C
- Humidity ....................... 20% to 95% R.H. (non-condensing)
- Cooling .......................... Free-Air Convection

#### PHYSICAL SPECIFICATIONS

- Dimensions, Case E ........... 6.5 x 4.5 x 3.19 inches
  (165 x 114 x 81 mm)
- Case D .................. 6.5 x 4.5 x 1.50 inches
  (165 x 114 x 38 mm)
- Weight, Case E ................ 3.25 lbs. (1456 g)
- Case D .................. 1.7 lbs. (762 g)
- Case Material ................ Black Anodized Aluminum

#### NOTE:

(1) For lines up to 60 feet. Sense leads should be twisted and a large capacitor added at sense point for switching loads.

### ADJUSTMENT RANGE

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OUTPUT RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HE237</td>
<td>4.5 to 5.3V</td>
</tr>
<tr>
<td>HE252</td>
<td>4.5 to 5.3V</td>
</tr>
<tr>
<td>HE212</td>
<td>12 to 15.5V</td>
</tr>
<tr>
<td>HE215</td>
<td>±12 to ±15.5V</td>
</tr>
<tr>
<td>HE224</td>
<td>24 to 31V</td>
</tr>
</tbody>
</table>

TWO-YEAR WARRANTY
### DC Cased Switchers

**Output Voltage** | **Output Current** | **OVP** | **Regulation** | **Ripple and Noise, Max.** | **Input Voltage** | **Model Number** | **Case**
---|---|---|---|---|---|---|---
5 VDC | 10 A | ✓ | ±0.1% | ±0.1% | 25 mV P-P (5 mV RMS) | 115 VAC | HE237 | D
5 VDC | 10 A | ✓ | ±0.1% | ±0.1% | 25 mV P-P (5 mV RMS) | 230 VAC | HE237E | D
5 VDC | 20 A | ✓ | ±0.1% | ±0.1% | 50 mV P-P (13 mV RMS) | 115 VAC | HE252 | E
5 VDC | 20 A | ✓ | ±0.1% | ±0.1% | 50 mV P-P (13 mV RMS) | 230 VAC | HE252E | E
12 VDC to 15 VDC | 3 A | ±0.02% | ±0.1% | 20 mV P-P (2 mV RMS) | 115 VAC | HE212 | D
12 VDC to 15 VDC | 3 A | ±0.02% | ±0.1% | 20 mV P-P (2 mV RMS) | 230 VAC | HE212E | D
24 VDC to 30 VDC | 1.5 A | ±0.02% | ±0.1% | 20 mV P-P (2 mV RMS) | 115 VAC | HE224 | D
24 VDC to 30 VDC | 1.5 A | ±0.02% | ±0.1% | 20 mV P-P (2 mV RMS) | 230 VAC | HE224E | D

**DUAL OUTPUT**

| ±12 VDC to ±15 VDC | ±1.5 A | ±0.02% | ±0.05% | 10 mV P-P (1.0 mV RMS) | 115 VAC | HE215 | D
| ±12 VDC to ±15 VDC | ±1.5 A | ±0.02% | ±0.05% | 10 mV P-P (1.0 mV RMS) | 230 VAC | HE215E | D

---

**ALL DIMENSIONS**

**IN INCHES (MM)**

**ORIGINAL PAGE IS OF POOR QUALITY**
PM300 SERIES
CHASSIS-MOUNTABLE
SINGLES, DUALS & TRIPLES

- Terminal Strip Connections
- Split-Bobbin Wound
- UL Recognized
- CSA Certified

These popular chassis-mountable linear power modules feature 16 single, dual and triple output models. This series is designed for special applications where mounting on a housing or metal chassis is required. Input/output connections are made to screw terminals on a barrier terminal strip and mounting is convenient by means of four threaded inserts in the bottom of each module. Most models are UL recognized and CSA certified. For maximum safety, all power transformers are split-bobbin wound, rather than layer wound, to give total isolation with low coupling capacitance between primary and secondary. Conservative design and rating of these power modules results in reliable operation and long life. Overvoltage crowbar protection is standard on all 5V outputs for protection of logic circuitry. Standard input voltage is 115 VAC at 50 to 400 Hz; other optional inputs are 100, 220, and 240 VAC. Input/output isolation voltage is 2500 VAC and output current limiting short circuit protection is standard.

2.5-15 Watt AC

ELECTRICAL SPECIFICATIONS
All Specifications Typical at Nominal Line, Full Load, and 25°C Unless Otherwise Noted.

INPUT SPECIFICATIONS
Input Voltage Range,
Standard Models .................. 105 VAC to 125 VAC
Other Models ..................... See Table
Frequency .......................... 50 to 400 Hz
Derating at 400 Hz .............. Consult Factory

OUTPUT SPECIFICATIONS
Voltage Accuracy ...................... ±2.0%, max.
Temperature Coefficient .......... ±0.02%/°C
Short-Circuit Protection .......... Short Term
Over-Voltage Crowbar, 5V Outputs .... 6.2V, nom.

GENERAL SPECIFICATIONS
Isolation Voltage ...................... 2500 VRMS
Isolation Capacitance .............. 50 pF.
Isolation Resistance .............. 50 megohms

ENVIRONMENTAL SPECIFICATIONS
Operating Temperature Range ...... -25°C to +71°C
Derating, 50°C to 71°C .......... 2.5%/°C
Storage Temperature Range ...... -25°C to +85°C
Humidity .............................. 20% to 95% R.H. (non-condensing)
Cooling ................................ Free-Air Convection

PHYSICAL SPECIFICATIONS
Dimensions, Case C1 .......... 4.0 x 2.7 x 1.45 inches
 ................................ (102 x 69 x 37 mm)
Case C2 ............................. 4.0 x 2.7 x 2.00 inches
 ................................ (102 x 69 x 51 mm)
Weight, Case C1 ................. 1.25 lbs. (567 g.)
Case C2 ............................. 1.80 lbs. (816 g.)
Case Material ............ Non-Conductive Black Plastic

NOTE: All models are available with four optional input voltage ranges designated by the suffixes shown in table. When ordering, specify the complete model number followed by the appropriate input voltage designation, if any. For example, PM342, PM342J, PM342D, etc.

<table>
<thead>
<tr>
<th>INPUT VOLTAGE</th>
<th>SUFFIX</th>
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<tbody>
<tr>
<td>115±10VAC</td>
<td>(NONE)</td>
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<tr>
<td>100±10VAC</td>
<td>J</td>
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<tr>
<td>220±20VAC</td>
<td>D</td>
</tr>
<tr>
<td>240±20VAC</td>
<td>K</td>
</tr>
</tbody>
</table>

Original Page is of Poor Quality
## DC Linear Modules

### SINGLE OUTPUT

<table>
<thead>
<tr>
<th>OUTPUT VOLTAGE</th>
<th>OUTPUT CURRENT</th>
<th>OVP</th>
<th>REGULATION</th>
<th>RIPPLE AND NOISE</th>
<th>UL</th>
<th>CSA</th>
<th>MODEL NUMBER</th>
<th>ALT PIN OUT</th>
<th>CASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 VDC</td>
<td>500 mA</td>
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<td>±0.05%</td>
<td>±0.1%</td>
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<td>±0.15%</td>
<td>✓</td>
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<tr>
<td>5 VDC</td>
<td>2000 mA</td>
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<td>±0.05%</td>
<td>±0.15%</td>
<td>✓</td>
<td>✓</td>
<td>PM345</td>
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<tr>
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<td>±0.05%</td>
<td>1.0 mV RMS</td>
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<td>±0.05%</td>
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<td>±0.05%</td>
<td>1.0 mV RMS</td>
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<td>PM368</td>
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### DUAL OUTPUT

<table>
<thead>
<tr>
<th>OUTPUT VOLTAGE</th>
<th>OUTPUT CURRENT</th>
<th>OVP</th>
<th>REGULATION</th>
<th>RIPPLE AND NOISE</th>
<th>UL</th>
<th>CSA</th>
<th>MODEL NUMBER</th>
<th>ALT PIN OUT</th>
<th>CASE</th>
</tr>
</thead>
<tbody>
<tr>
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<td>120 mA</td>
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<td>±0.05%</td>
<td>1.0 mV RMS</td>
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<td>±0.05%</td>
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<td>±0.05%</td>
<td>1.0 mV RMS</td>
<td>✓</td>
<td>PM337</td>
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<tr>
<td>±15 VDC</td>
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<td>±0.05%</td>
<td>1.0 mV RMS</td>
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<td>1.0 mV RMS</td>
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<td>±0.05%</td>
<td>1.0 mV RMS</td>
<td>✓</td>
<td>PM301</td>
<td>C2</td>
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<td>±15 VDC</td>
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<td>±0.05%</td>
<td>±0.05%</td>
<td>1.0 mV RMS</td>
<td>✓</td>
<td>PM396</td>
<td>C2</td>
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</table>

### TRIPLE OUTPUT

<table>
<thead>
<tr>
<th>OUTPUT VOLTAGE</th>
<th>OUTPUT CURRENT</th>
<th>OVP</th>
<th>REGULATION</th>
<th>RIPPLE AND NOISE</th>
<th>UL</th>
<th>CSA</th>
<th>MODEL NUMBER</th>
<th>ALT PIN OUT</th>
<th>CASE</th>
</tr>
</thead>
<tbody>
<tr>
<td>5V/±12 VDC</td>
<td>300/±180 mA</td>
<td>✓</td>
<td>±0.05%</td>
<td>±0.1%/±0.05%</td>
<td>1.0 mV RMS</td>
<td>✓</td>
<td>PM395</td>
<td>C1</td>
<td></td>
</tr>
<tr>
<td>5V/±12 VDC</td>
<td>500/±120 mA</td>
<td>✓</td>
<td>±0.05%</td>
<td>±0.1%/±0.05%</td>
<td>1.0 mV RMS</td>
<td>✓</td>
<td>PM391</td>
<td>C1</td>
<td></td>
</tr>
<tr>
<td>5V/±12 VDC</td>
<td>1000/±150 mA</td>
<td>✓</td>
<td>±0.05%</td>
<td>±0.1%/±0.02%</td>
<td>1.0/0.5 mV RMS</td>
<td>✓</td>
<td>PM392</td>
<td>C2</td>
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</tr>
<tr>
<td>5V/±15 VDC</td>
<td>300/±150 mA</td>
<td>✓</td>
<td>±0.05%</td>
<td>±0.1%/±0.05%</td>
<td>1.0 mV RMS</td>
<td>✓</td>
<td>PM394</td>
<td>C1</td>
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<tr>
<td>5V/±15 VDC</td>
<td>500/±100 mA</td>
<td>✓</td>
<td>±0.05%</td>
<td>±0.1%/±0.05%</td>
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<td>5V/±15 VDC</td>
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<td>±0.02%</td>
<td>±0.1%/±0.02%</td>
<td>1.0/0.5 mV RMS</td>
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<td>PM393</td>
<td>C2</td>
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</tr>
</tbody>
</table>

**NOTE:** (1) All Models CSA Certified (+) or Pending.

### CASE C

**ALL DIMENSIONS IN INCHES (MM)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>2.00 (50.8)</th>
<th>1.70 (43.2)</th>
<th>2.00 (50.8)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>1.05 (26.7)</td>
<td>2.50 (63.5)</td>
<td>4.00 (101.6)</td>
<td>75 (191)</td>
</tr>
</tbody>
</table>

**ALL DIMENSIONS IN INCHES (MM)**

### ORIGINAL PAGE 5 OF POOR QUALITY
MINIATURIZED REGULATED Terminal Strip Connections

ALL MODELS U.L. RECOGNIZED

Although small in size, these mini-modules offer high performance at modest prices. All models, with series regulated outputs ranging from 1 to 75 volts and as high as 2.5 amps, may be mounted in an area only 3.5" x 2.5". Dual output models are available with the ratings commonly required for driving op amps and other balanced loads. Terminal strip input/output connections eliminate all need for sockets or soldering. Short circuit protection, encapsulated construction, and conservative design assure long term reliability.

STANDARD FEATURES
• May be used in series
• No derating or heat sinking required
• Short circuit protected
• Small, lightweight

SPECIFICATIONS
Input Voltage: 105–125 VAC, 47 to 420 Hz, single phase.

Output Specifications: See tables.

Output Voltage Trim Adjustment: Outputs factory preset to ±2% (1 to 9 volt models) or ±1% (10 to 75 volt models) of nominal output voltage. Single output models may be trimmed to the nominal voltage rating with an external trim resistor.

Polarity: Either positive or negative terminal of a single output module may be grounded. Dual output modules have a positive/common/negative output terminal configuration.

Ambient Operating Temperature: −20 to +71°C. (Model 5EB150, 0 to +71°C.) No derating required.

Storage Temperature: −55 to +85°C.

Temperature Coefficient: From 9 to 75 volts, approximate TC is .015%/°C; 1 to 8 volts, .03%/°C.

Impedance: 0.07 ohms at 1 kHz and 0.2 ohms at 10 kHz (approx.).

Optional 230 Volt Input: All models can be alternately furnished for operation on an input of 210 to 250 VAC, 47-420 Hz. To order, add suffix "−230" to model number and $10.00 to price.
### SINGLE OUTPUT MODELS

<table>
<thead>
<tr>
<th>Output Voltage</th>
<th>Ripple mv RMS</th>
<th>Price</th>
<th>Model</th>
<th>Case Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>1.25</td>
<td>1</td>
<td>1.5E-5</td>
<td>EB-10</td>
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<td>1.50</td>
<td>1</td>
<td>1.75E-5</td>
<td>EB-10</td>
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<td>2.0E-5</td>
<td>EB-10</td>
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<td>4.0E-5</td>
<td>EB-10</td>
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<td>10.00</td>
<td>1</td>
<td>11.0E-5</td>
<td>EB-10</td>
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<tr>
<td>12.0</td>
<td>11.00</td>
<td>1</td>
<td>12.0E-5</td>
<td>EB-10</td>
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<tr>
<td>13.0</td>
<td>12.00</td>
<td>1</td>
<td>13.0E-5</td>
<td>EB-10</td>
</tr>
<tr>
<td>14.0</td>
<td>13.00</td>
<td>1</td>
<td>14.0E-5</td>
<td>EB-10</td>
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### DUAL OUTPUT MODELS

<table>
<thead>
<tr>
<th>Output Voltage</th>
<th>Regulation</th>
<th>Ripple mv RMS</th>
<th>Price</th>
<th>Model</th>
<th>Case Size</th>
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<tbody>
<tr>
<td>12</td>
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<td>$ 75</td>
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<td>EB-10</td>
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<td>EB-16</td>
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<td>1</td>
<td>95</td>
<td>DB12-20</td>
<td>EB-10</td>
</tr>
<tr>
<td>12</td>
<td>0.25</td>
<td>1</td>
<td>119</td>
<td>DB12-30</td>
<td>EB-13</td>
</tr>
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<td>12</td>
<td>0.30</td>
<td>1</td>
<td>125</td>
<td>DB12-35</td>
<td>EB-13</td>
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<td>0.35</td>
<td>1</td>
<td>145</td>
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<td>EB-20</td>
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<tr>
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<td>0.10</td>
<td>1</td>
<td>1</td>
<td>DB15-10</td>
<td>EB-10</td>
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<td>EB-15</td>
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<td>1</td>
<td>95</td>
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<td>EB-10</td>
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<tr>
<td>±15</td>
<td>0.30</td>
<td>1</td>
<td>119</td>
<td>DB15-30</td>
<td>EB-13</td>
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<tr>
<td>±15</td>
<td>0.35</td>
<td>1</td>
<td>125</td>
<td>DB15-35</td>
<td>EB-13</td>
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<tr>
<td>±15</td>
<td>0.50</td>
<td>1</td>
<td>145</td>
<td>DB15-50</td>
<td>EB-20</td>
</tr>
</tbody>
</table>
STEPATTENUATORS

BENCH TOP
0 TO 69 dB

O TO 69 dB SPECIFICATIONS

MODELS 1044-4, 1044-8, 1044-12 AND 1044-18

ACCURACY OF ATTENUATION:

<table>
<thead>
<tr>
<th></th>
<th>DC TO 4 GHz</th>
<th>DC TO 8 GHz</th>
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<tbody>
<tr>
<td>1-9</td>
<td>±0.3dB</td>
<td>±0.4dB</td>
</tr>
<tr>
<td>10-19</td>
<td>±0.8dB</td>
<td>±0.9dB</td>
</tr>
<tr>
<td>20-29</td>
<td>±1.0dB</td>
<td>±1.1dB</td>
</tr>
<tr>
<td>30-39</td>
<td>±1.2dB</td>
<td>±1.3dB</td>
</tr>
<tr>
<td>40-49</td>
<td>±1.3dB</td>
<td>±1.4dB</td>
</tr>
<tr>
<td>50-59</td>
<td>±1.4dB</td>
<td>±1.5dB</td>
</tr>
<tr>
<td>60-69</td>
<td>±1.5dB</td>
<td>±1.6dB</td>
</tr>
<tr>
<td>1-9</td>
<td>±0.4dB</td>
<td>±0.5dB</td>
</tr>
<tr>
<td>10-19</td>
<td>±1.0dB</td>
<td>±1.0dB</td>
</tr>
<tr>
<td>20-29</td>
<td>±1.2dB</td>
<td>±1.2dB</td>
</tr>
<tr>
<td>30-39</td>
<td>±1.4dB</td>
<td>±1.4dB</td>
</tr>
<tr>
<td>40-49</td>
<td>±1.5dB</td>
<td>±1.5dB</td>
</tr>
<tr>
<td>50-59</td>
<td>±1.6dB</td>
<td>±1.6dB</td>
</tr>
<tr>
<td>60-69</td>
<td>±1.8dB</td>
<td>±1.8dB</td>
</tr>
</tbody>
</table>

MAXIMUM VSWR: DC TO 4 GHz 1.35 ≤ 4 to 12.4 GHz 1.50 ≤ 12.4 TO 18 GHz 1.65

MAXIMUM ZERO POSITION INSERTION LOSS:

<table>
<thead>
<tr>
<th></th>
<th>DC TO 4 GHz</th>
<th>4 TO 12.4 GHz</th>
<th>12.4 TO 18 GHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.7dB</td>
<td></td>
<td>1.0dB</td>
<td>1.5dB</td>
</tr>
</tbody>
</table>

CONNECTOR TYPES: STAINLESS STEEL TYPE N, PRECISION 7MM OR SMA

MAXIMUM INPUT POWER: 2 WATTS AVERAGE

OPERATING TEMPERATURE RANGE: 0°C TO +55°C

SWITCHING REPEATABILITY: 0.05dB

SWITCHING LIFE: 1,000,000 OPERATIONS

MECHANICAL STOPS: CW AT MAXIMUM ATTENUATION ■ CCW AT MINIMUM ATTENUATION

MODEL NUMBERING SYSTEM:

MODEL 1044 IS 0 TO 69dB IN 1dB STEPS
THE MAXIMUM FREQUENCY RANGE IS SPECIFIED BY USING -4, -8, -12 OR -18
THE CONNECTOR TYPE IS SPECIFIED BY USING N, SMA OR 7MM

MODEL NUMBER EXAMPLE:

1044-18 7MM

0 TO 69dB DC TO 18 GHz 7MM CONNECTORS
## 4 WAY-O°

2 KHz to 4.2 GHz

### 50 ohms and 75 ohms

### MINI-CIRCUITS

**PSC-4**

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>FREQ. RANGE MHZ</th>
<th>ISOLATION dB</th>
<th>INSERTION LOSS dB</th>
<th>PHASE DEGREES</th>
<th>AMPLITUDE UNBALANCE</th>
<th>PRICE, $</th>
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<tr>
<td>PSC-4-1</td>
<td>0.1-200</td>
<td>33</td>
<td>20</td>
<td>30</td>
<td>27</td>
<td>20</td>
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<tr>
<td>PSC-4-1</td>
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<td>30</td>
<td>25</td>
<td>20</td>
<td>27</td>
<td>20</td>
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<tr>
<td>PSC-4-4</td>
<td>0.01-40</td>
<td>33</td>
<td>18</td>
<td>32</td>
<td>25</td>
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<td>21</td>
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<tr>
<td>PSC-4-4</td>
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<td>33</td>
<td>30</td>
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<td>27</td>
<td>20</td>
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<tr>
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<td>0.002-20</td>
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<tr>
<td>ZMSC-4</td>
<td>0.25-250</td>
<td>33</td>
<td>30</td>
<td>20</td>
<td>27</td>
<td>20</td>
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<tr>
<td>ZSC-4</td>
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<td></td>
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<tr>
<td>ZSC-4</td>
<td>0.1-200</td>
<td>33</td>
<td>30</td>
<td>20</td>
<td>27</td>
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<tr>
<td>ZSC-4</td>
<td>1-200</td>
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<td>ZA4PD</td>
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<td>16</td>
<td>25</td>
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<td>16</td>
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<td>ZB4PD</td>
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<td>16</td>
<td>23</td>
<td>16</td>
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<td>ZB4PD</td>
<td>3.74</td>
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<td>15</td>
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<td>24</td>
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</tbody>
</table>

### NOTES:

1. For quality control procedures, see Table of Contents.
2. For environmental specifications, see Table of Contents.
3. Absolute Maximum Ratings:
   - Matched power rating ZA4PD, ZA4PD, ZB4PD (10W).
   - Internal load dissipation:
     - all 3-way models (0.375W) all 4-way models (0.25W).
   - For connector types and case mounting options, see case style outline drawing.
   - Prices and specifications subject to change without notice.
4. All 3-way power dividers with exception of ZA4PD are licensed under U.S. Patent 3,428,920, reissued as RE 27,299.

---

**In Stock...Immediate Delivery**

A-29
# Power Amplifiers

## broadband linear

### up to 100mW (+20 dBm)

50 KHz to 2000 MHz

---

**ORIGINAL PAGE IS OF POOR QUALITY**

### case style selection

---

<table>
<thead>
<tr>
<th>MODEL NO.</th>
<th>FREQUENCY MHz</th>
<th>GAIN, dB</th>
<th>MAXIMUM POWER, dBm</th>
<th>DYNAMIC RANGE</th>
<th>VSWR</th>
<th>DC POWER</th>
<th>PRICE $</th>
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</thead>
<tbody>
<tr>
<td>ZFL ZFL-500</td>
<td>0.05-500</td>
<td>20</td>
<td>± 1.0</td>
<td>+9</td>
<td>5.3</td>
<td>+18</td>
<td>19</td>
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<tr>
<td>▲ ZFL-500LN</td>
<td>0-1-500</td>
<td>24</td>
<td>± 0.3</td>
<td>+5</td>
<td>2.9</td>
<td>+14</td>
<td>1.5</td>
</tr>
<tr>
<td>▲ ZFL-1000LN</td>
<td>0-1-1000</td>
<td>17</td>
<td>± 0.6</td>
<td>+2</td>
<td>2.9</td>
<td>+14</td>
<td>1.5</td>
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<tr>
<td>▲ ZFL-2000LN</td>
<td>0-2-2000</td>
<td>10</td>
<td>± 1.5</td>
<td>+2</td>
<td>2.9</td>
<td>+14</td>
<td>1.5</td>
</tr>
<tr>
<td>case 35° ZFL-1000G</td>
<td>10-1000</td>
<td>17</td>
<td>± 1.5</td>
<td>+3</td>
<td>0</td>
<td>1.2</td>
<td>+13</td>
</tr>
<tr>
<td>ZFL-1000U</td>
<td>0-1-1000</td>
<td>12</td>
<td>± 1.5</td>
<td>+3</td>
<td>0</td>
<td>1.2</td>
<td>+13</td>
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<tr>
<td>ZFL-2000U</td>
<td>10-2000</td>
<td>10</td>
<td>± 1.5</td>
<td>+1*</td>
<td>7.0</td>
<td>+25</td>
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<td>case 55° ZFL-1000H</td>
<td>10-1000</td>
<td>28</td>
<td>± 1.0</td>
<td>+20</td>
<td>5</td>
<td>+33</td>
<td>21</td>
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</tbody>
</table>

### NOTES:

- ± 15 dBm below 1000 MHz
- ZFL-1000 output VSWR 2.81:1 maximum over 750-1000 MHz.
- ZFL-1000 output VSWR 1.5 maximum from 0.1 to 0.2 MHz.
- Operating temperature is -55°C to +71°C except the ZFL-2000 is -55°C to +100°C. When models ZFL-1000U and ZFL-2000A are mounted to chassis using a thermocouple paste, the operating temperature range will be increased.
- With no load output, derate maximum input power (no damage) by 10 dB.
- Prices and specifications subject to change without notice.

---

**Mini-Circuits**

P.O. BOX 350166, Brooklyn, New York 11235-0003 (718) 934-4500

FAX (718) 332-4661 TELEX 6852844 or 620156

A-30
STEP ATTENUATORS
FOR OEM

1 WATT

MODEL 3000 SERIES
DC TO 2.5 GHz
DC TO 1.25 GHz

SMA FEMALE CONNECTORS

Available in 24 attenuation ranges/steps — see specifications table.

FEATURES

LOW VSWR — Typically ©1.10 to 2.5 GHz

HIGH RELIABILITY — Repeatability better than 0.1 dB over frequency range and life. Weinschel patented detent mechanism, tested to 1,000,000 operations at +75°C, operates dependably even down to -40°C.

PRODUCT UNIFORMITY — High volume fabrication techniques, including injection molding, stamping, broaching and thick film printing ensure a cost effective and uniform product.

LOW FREQUENCY SENSITIVITY — Typically 0.1 to 0.2 dB up to 2.5 GHz.

SHOCK RESISTANT — 100% spring contact system withstands mechanical and thermal shock and eliminates the need for epoxy or solder.

WIDE SELECTION — Wide choice of attenuation ranges and increments in standard stock models. Single and dual drum configurations available.

WEINSCHEL ENGINEERING

One Weinschel Lane, Gaithersburg, Maryland 20877

A-31a
SPECIFICATIONS

<table>
<thead>
<tr>
<th>MODEL</th>
<th>ATTENUATION RANGE/STEPS</th>
<th>FREQ. RANGE</th>
<th>STEP ANGLE</th>
<th>CONFIGURATIONS</th>
<th>VSWR</th>
<th>MAXIMUM INSERTION LOSS</th>
<th>ACCURACY OF INCREMENTAL INSERTION LOSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3001</td>
<td>0.50/10 dB</td>
<td>DC-2.5 GHz</td>
<td>32.7°</td>
<td>SINGLE</td>
<td>1:20:1</td>
<td>0.3 dB</td>
<td>±0.3 dB or 1/2° or 1°</td>
</tr>
<tr>
<td>3002</td>
<td>0.50/10 dB</td>
<td>DC-2.5 GHz</td>
<td>32.7°</td>
<td>SINGLE</td>
<td>1:20:1</td>
<td>0.3 dB</td>
<td>±0.3 dB or 1°</td>
</tr>
<tr>
<td>3003</td>
<td>0.70/10 dB</td>
<td>DC-2.5 GHz</td>
<td>32.7°</td>
<td>SINGLE</td>
<td>1:20:1</td>
<td>0.3 dB</td>
<td>±0.3 dB or 1° to 60 dB, 2° to 70 dB</td>
</tr>
<tr>
<td>3004</td>
<td>0.40/10 dB</td>
<td>DC-1.25 GHz</td>
<td>32.7°</td>
<td>SINGLE</td>
<td>1:20:1</td>
<td>0.2 dB</td>
<td>±0.3 dB or 1° to 60 dB, 2° to 80 dB</td>
</tr>
<tr>
<td>3005</td>
<td>0.90/10 dB</td>
<td>DC-1.25 GHz</td>
<td>32.7°</td>
<td>SINGLE</td>
<td>1:20:1</td>
<td>0.2 dB</td>
<td>±0.3 dB or 1° to 60 dB, 2° to 90 dB</td>
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<tr>
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<td>0.100/10 dB</td>
<td>DC-1.25 GHz</td>
<td>32.7°</td>
<td>SINGLE</td>
<td>1:20:1</td>
<td>0.2 dB</td>
<td>±0.3 dB or 1° to 60 dB, 2° to 100 dB</td>
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<tr>
<td>3007</td>
<td>0.10/1 dB</td>
<td>DC-2.5 GHz</td>
<td>32.7°</td>
<td>SINGLE</td>
<td>1:30:1</td>
<td>0.3 dB</td>
<td>±0.3 dB</td>
</tr>
<tr>
<td>3008</td>
<td>0.100/0.1 dB</td>
<td>DC-2.5 GHz</td>
<td>32.7°</td>
<td>SINGLE</td>
<td>1:30:1</td>
<td>0.3 dB</td>
<td>±0.3 dB to 10 dB, ±0.3 dB or 1°* to 60 dB</td>
</tr>
<tr>
<td>3009</td>
<td>0.80/1 dB</td>
<td>DC-2.5 GHz</td>
<td>32.7°</td>
<td>DUAL</td>
<td>1:35:1</td>
<td>0.7 dB</td>
<td>±0.3 dB to 10 dB, ±0.3 dB or 1°* to 60 dB</td>
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<tr>
<td>3010</td>
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<td>±0.3 dB to 10 dB, ±0.3 dB or 1°* to 70 dB</td>
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<td>32.7°</td>
<td>DUAL</td>
<td>1:30:1</td>
<td>0.5 dB</td>
<td>±0.3 dB to 10 dB, ±0.3 dB or 1°* to 60 dB</td>
</tr>
<tr>
<td>3012</td>
<td>0.90/1 dB</td>
<td>DC-1.25 GHz</td>
<td>32.7°</td>
<td>DUAL</td>
<td>1:30:1</td>
<td>0.5 dB</td>
<td>±0.3 dB to 10 dB, ±0.3 dB or 1°* to 60 dB</td>
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<tr>
<td>3013</td>
<td>0.100/1 dB</td>
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<td>32.7°</td>
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<td>0.5 dB</td>
<td>±0.3 dB to 10 dB, ±0.3 dB or 1°* to 60 dB</td>
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<td>32.7°</td>
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<td>1:35:1</td>
<td>0.7 dB</td>
<td>±0.3 dB to 10 dB, ±0.3 dB or 1°* to 60 dB</td>
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<tr>
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<td>0.01/0.1 dB</td>
<td>DC-2.5 GHz</td>
<td>32.7°</td>
<td>DUAL</td>
<td>1:35:1</td>
<td>0.7 dB</td>
<td>±0.3 dB to 10 dB, ±0.3 dB or 1°* to 60 dB</td>
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<td>DC-2.5 GHz</td>
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<td>SINGLE</td>
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<td>0.3 dB</td>
<td>±0.3 dB or 1°*</td>
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<td>36°</td>
<td>SINGLE</td>
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<td>0.3 dB</td>
<td>±0.3 dB or 1°*</td>
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<td>0.3 dB</td>
<td>±0.3 dB or 1°*</td>
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<td>±0.3 dB or 1°*</td>
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<td>SINGLE</td>
<td>1:30:1</td>
<td>0.3 dB</td>
<td>±0.3 dB</td>
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<td>36°</td>
<td>DUAL</td>
<td>1:35:1</td>
<td>0.7 dB</td>
<td>±0.3 dB to 9 dB, ±0.3 dB or 1°* to 50 dB</td>
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<tr>
<td>3024</td>
<td>0.60/1 dB</td>
<td>DC-2.5 GHz</td>
<td>36°</td>
<td>DUAL</td>
<td>1:35:1</td>
<td>0.7 dB</td>
<td>±0.3 dB to 9 dB, ±0.3 dB or 1°* to 50 dB</td>
</tr>
<tr>
<td>3025</td>
<td>0.70/1 dB</td>
<td>DC-2.5 GHz</td>
<td>36°</td>
<td>DUAL</td>
<td>1:30:1</td>
<td>0.5 dB</td>
<td>±0.3 dB to 9 dB, ±0.3 dB or 1°* to 50 dB</td>
</tr>
<tr>
<td>3026</td>
<td>0.80/1 dB</td>
<td>DC-1.25 GHz</td>
<td>36°</td>
<td>DUAL</td>
<td>1:30:1</td>
<td>0.5 dB</td>
<td>±0.3 dB to 9 dB, ±0.3 dB or 1°* to 50 dB</td>
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<tr>
<td>3027</td>
<td>0.90/1 dB</td>
<td>DC-1.25 GHz</td>
<td>36°</td>
<td>DUAL</td>
<td>1:30:1</td>
<td>0.5 dB</td>
<td>±0.3 dB to 9 dB, ±0.3 dB or 1°* to 50 dB</td>
</tr>
<tr>
<td>3028</td>
<td>0.90/0.1 dB</td>
<td>DC-2.5 GHz</td>
<td>36°</td>
<td>DUAL</td>
<td>1:35:1</td>
<td>0.7 dB</td>
<td>±0.3 dB to 9 dB, ±0.3 dB or 1°* to 50 dB</td>
</tr>
<tr>
<td>3045</td>
<td>0.70/10 dB</td>
<td>DC-2.5 GHz</td>
<td>45°</td>
<td>SINGLE</td>
<td>1:20:1</td>
<td>0.3 dB</td>
<td>±0.3 dB or 1°*</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>±0.3 dB or 1°*</td>
</tr>
</tbody>
</table>

*Whichever is greater.

**The change of insertion loss between adjacent positions of the 0.1 dB drum will be a minimum of 0.05 dB to a maximum of 0.15 dB to 0.2 dB maximum cumulative.

** IMPEDANCE: 50 ohms, nominal

** MAXIMUM RF POWER: 1 watt average, 100 watts peak with 5 μsec. maximum pulse width

** POWER COEFFICIENT: <0.006 dB/dB x W

** TEMPERATURE COEFFICIENT: <0.0001 dB/dB x °C

** TEMPERATURE RANGE: Operating: -40°C to +65°C
Non-Operating: -54°C to +85°C

** SWITCHING LIFE: 1,000,000 steps

** REPEATABILITY: ±0.1 dB over frequency range and rated life

** SHAFT ROTATION: ccw for increasing attenuation

** CONNECTORS: Stainless steel female SMA mates with male SMA per MIL-C-39012

** ROTATION STOPS: Supplied on 10 dB step drums.
(Not supplied on 1 dB and 0.1 dB drums.)

** INCREMENTAL PHASE SHIFT: -0.25° per dB x f (GHz)

** MATERIALS AND FINISHES: Shafting and external hardware and connector shells: CRES Type 303, PER QQ-S-764 Passivated per QQ-P-35.
Housing: AL ALLOY Gold Flash.

No fungus supporting nutrients used within or without.

Marking: Each unit individually marked with foil type nameplate giving model number and individual serial numbers.

Acceptance Tests: Each unit is individually tested to insure performance in accordance with specifications. (No test data is supplied.)
STEP ATTENUATORS
FOR OEM

SPECIFICATIONS (cont.)

STANDARD UNIT

SINGLE DRUM

KNOBS

WITH INDICATOR SWITCH OPTION

DUAL DRUM

SEALED PANEL OPTION

NOTES
Dimensions in inches (cont.)
For additional details not shown,
contact Weinschel Engineering
For details on panel and option,
contact Weinschel Engineering

SEATED PANEL OPTION

WITH INDICATOR SWITCH OPTION

WEINSCHEL ENGINEERING
One Weinschel Lane, Gaithersburg, Maryland 20877
TOROIDAL power dividers
CONNECTORIZED • 2-4 OUTPUTS • 0.01-1500 MHz

GENERAL SPECIFICATIONS
- VSWR: 1.30 Typical
- Impedance: 50 Ohms Nominal
- Matched Power Rating: 1 Watt Max.
- Weight: 5 Grams
- Connector Type: 42 Grams
- Temperature Range: -55 to 100°C (operating & storage)
- Finish: Grey Paint

ENVIRONMENTAL SPECS.
MIL-STD-202E
- Moisture Resistance: Method 106D
- Salt Spray: Method 101D
- Vibration High Frequency: Method 204C
- Shock Test: Method 213B
- Workmanship in Accordance with MIL-STD-454D
  Requirements 5 and 9

2-4 OUTPUTS

<table>
<thead>
<tr>
<th>No. of Outputs</th>
<th>Model</th>
<th>Frequency (MHz)</th>
<th>Ins. Loss (dB Max.)</th>
<th>Isolation (dB Min.)</th>
<th>Amp. Balance (±dB)</th>
<th>Phase Balance (±Deg.)</th>
<th>Outline</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>PSK-210</td>
<td>0.2-1200</td>
<td>1.8</td>
<td>20</td>
<td>0.3</td>
<td>9</td>
<td>110</td>
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<tr>
<td></td>
<td>PSK-211</td>
<td>0.01-100</td>
<td>0.6</td>
<td>20</td>
<td>0.1</td>
<td>1</td>
<td>110</td>
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<tr>
<td></td>
<td>PSK-212</td>
<td>10-1000</td>
<td>1.6</td>
<td>24</td>
<td>0.2</td>
<td>3</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>PSK-213*</td>
<td>40-400</td>
<td>0.5</td>
<td>30</td>
<td>0.1</td>
<td>2</td>
<td>117</td>
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<tr>
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<td>PSK-270**</td>
<td>45-500</td>
<td>0.5</td>
<td>25</td>
<td>0.1</td>
<td>1</td>
<td>110</td>
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<tr>
<td>3</td>
<td>PSK-310</td>
<td>0.25-500</td>
<td>1.2</td>
<td>20</td>
<td>0.4</td>
<td>4</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>PSK-311</td>
<td>0.01-25</td>
<td>0.5</td>
<td>20</td>
<td>0.2</td>
<td>1</td>
<td>111</td>
</tr>
<tr>
<td>4</td>
<td>PSK-410</td>
<td>0.5-1000</td>
<td>1.8</td>
<td>18</td>
<td>0.5</td>
<td>9</td>
<td>112</td>
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<tr>
<td></td>
<td>PSK-411</td>
<td>0.01-100</td>
<td>1.0</td>
<td>20</td>
<td>0.1</td>
<td>1</td>
<td>112</td>
</tr>
<tr>
<td></td>
<td>PSK-413</td>
<td>10-500</td>
<td>1.0</td>
<td>25</td>
<td>0.2</td>
<td>4</td>
<td>112</td>
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<tr>
<td></td>
<td>PSK-470**</td>
<td>55-65</td>
<td>1.0</td>
<td>25</td>
<td>0.1</td>
<td>1</td>
<td>112</td>
</tr>
</tbody>
</table>
APPENDIX B

Schematic Diagram for Trigger Control Electronics
This page intentionally left blank
1. Capacitors in CP
2. Resistors in ohms
3. Connector type is optional
   signal wire must be individually shielded
APPENDIX C

Program XYZ Listing
* Program XYZ
* Command file for linking loader
* 
* Last Revised: 28 Nov 88

EC
DE
RE XYZ.REL
RE CLSTAT.REL
RE COLLECT.REL
RE COLREAD.REL
RE DATETIME.REL::NASA
RE DEFINE.REL::NASA
RE DELAY.REL::NASA
RE DRWJ.REL
RE EFILE.REL
RE ENCODE.REL
RE ERRTRUSS.REL
RE GO_HOME.REL
RE GRIDREAD.REL
RE HEADER.REL::NASA
RE IERROR.REL
RE INIT.REL
RE LABJ.REL
RE LASER.REL
RE LISTBUFFER.REL
RE LISTCHANGE.REL::NASA
RE MAXMIN.REL
RE MCART.REL
RE MOVE.REL
RE MTRUSS.REL
RE NAMFILE.REL::NASA
RE NEGCOL.REL
RE PDEF.REL::NASA
RE PLOT.REL::NASA
RE POSCHECK.REL
RE POSCOL.REL
RE POSITION.REL
RE POSWATCH.REL
RE READWRITE.REL::NASA
RE RECTOPOL.REL::NASA
RE RESET.REL
RE RMULTFIND.REL::NASA
RE SCAN.REL
RE SETSOURCE.REL
RE SIDECHECK.REL
RE SOURCE.REL
RE STO_POSN.REL::NASA

RE SWIPE.REL::NASA
RE VOLIN.REL
RE WPTJ.REL
RE XINIT.REL

* Graphics Library
  SE UPLIB_CDS.LIB

* Set Priority
  PR 89

EN XYZ.RUN
This is the main program for data collection on the near field antenna range (sometimes called an XYZ range.)

The following subroutines are called from the main routine (where the entry point is different from the subroutine name, the subroutine name follows in parentheses):

COLREAD
EFILE
GEND (PLOT)
GINIT (PLOT)
GRIDREAD
INIT
LISTBUFFER
LISTCHANGE
MOVE
SCAN
SRC_PVR (SOURCE)
SRC_USER (SETSOURCE)
SWIPE
VWPTJ
XINIT

This list does not include system calls or subroutines from the system libraries.
COMMON /HP1B/ J4833, J4833, J8510, J8510, J8340, J8340
COMMON /USER/ IWRITE, IREAD
COMMON /LASER/ CTI, VOL, DPI, CPOS
COMMON /DATA_DIR/ DDIR

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER COM*2, DDIR*15

C Initialization

IWRITE=1 ! Default LU for user prompts
IRREAD=1 ! and input

CALL INIT ! Initialize other arrays and
          ! equipment

IMODE = 0
NPOL = 2
CALL XINIT (IMODE,1) ! Initialize Scan parameters

CPOS=0. ! Current cart position
IAxis=0 ! Data collection along Y-axis

ASP=0. ! Max aspect ratio
IASP=0
IDWORK=0 ! Plotting on terminal only
I3D=0 ! No 3-D plotting
CALL GINIT(IDWORK,I3D,ASP,IASP) ! Enable graphics

WRITE (1,*), 'Enter the directory name for data files ',
            + '(default = /XYZFILES):'
READ (1,'(A)') DDIR
IF (DDIR.LE. ' ') DDIR = '/XYZFILES'

C Enter command from user and execute (the command, not the user)

10 CALL SWIPE
WRITE (1,19)
19 FORMAT( 'Enter a two letter command: '/)

WRITE (1,99) ! IN
WRITE (1,699) ! LC
WRITE (1,299) ! SF
WRITE (1,1099) ! SP
WRITE (1,*)
WRITE (1,899) ! EF
WRITE (1,399) ! CR
WRITE (1,499) ! CL
WRITE (1,599) ! CP
WRITE (1,*)
WRITE (1,199) ! MO
WRITE (1,1199) ! AR

C-4
WRITE (1,799) ! CD
WRITE (1,*)
WRITE (1,1299) ! EX
WRITE (1,29)
29 FORMAT (/,'Command?')
READ (1,39) COM
39 FORMAT (A2)

IF (COM .EQ. 'IN' .OR. COM .EQ. 'in') GOTO 100
IF (COM .EQ. 'MO' .OR. COM .EQ. 'mo') GOTO 200
IF (COM .EQ. 'SF' .OR. COM .EQ. 'sf') GOTO 300
IF (COM .EQ. 'CL' .OR. COM .EQ. 'cl') GOTO 500
IF (COM .EQ. 'CP' .OR. COM .EQ. 'cp') GOTO 600
IF (COM .EQ. 'LC' .OR. COM .EQ. 'lc') GOTO 700
IF (COM .EQ. 'CD' .OR. COM .EQ. 'cd') GOTO 800
IF (COM .EQ. 'EF' .OR. COM .EQ. 'ef') GOTO 900
IF (COM .EQ. 'SP' .OR. COM .EQ. 'sp') GOTO 1100
IF (COM .EQ. 'AR' .OR. COM .EQ. 'ar') GOTO 1200
IF (COM .EQ. 'EX' .OR. COM .EQ. 'ex') GOTO 1300
GOTO 10
99 FORMAT ('"IN"--Initialize the scan parameters')
100 CALL SWIPE
   CALL XINIT (IMODE, 0)
   GO TO 10

199 FORMAT ('"MO"--MOve the probe to a specified position')
200 CALL SWIPE
   CALL MOVE
   WRITE (1,*) 'Hit RETURN to continue'
   READ (1,39) COM
   GO TO 10

299 FORMAT ('"SF"--Set Source power and frequency')
300 CALL SWIPE
   CALL SRC_USER (FREQ, IMODE, NPOL)
   GO TO 10

399 FORMAT ('"CR"--Read a Column of data into the buffer')
400 CALL SWIPE
   CALL COLREAD (IROW, IAXIS)
   GO TO 10

499 FORMAT ('"CL"--List the Column of data in the buffer')
500 CALL SWIPE
   CALL LISTBUFFER (IROW, IAXIS, ABUF, PBUF, IBUF)
   IF (NPOL .EQ. 2) THEN
      CALL SWIPE
      WRITE (1,WRITE,*) 'Second polarization: '
      CALL LISTBUFFER (IROW, IAXIS, ABUF2, PBUF2, IBUF2)
   END IF

C-5
GOTO 10

599 FORMAT ('"CP"--Plot the Column of data in the buffer')
600 CALL WPTJ (IROW, IAXIS, ABUF, PBUF)
READ (1,39) COM
IF (NPOL .EQ. 2) THEN
   CALL SWIPE
   WRITE (IWRITE,*) 'Second polarization:'
   CALL WPTJ (IROW, IAXIS, ABUF2, PBUF2)
   READ (1,39) COM
END IF
GOTO 10

699 FORMAT ('"LC"--List or Change the current scan parameters')
700 CALL SWIPE
CALL LISTCHANGE (IMODE)
GOTO 10

799 FORMAT ('"CD"--Collect a Data set using the scan parameters')
800 CALL SWIPE
CALL SCAN (IROW, IAXIS)
GOTO 10

899 FORMAT ('"EF"--Examine a File for plotting or listing')
900 CALL SWIPE
CALL EFILE (IROW, IAXIS)
CALL LISTCHANGE (IMODE)
GOTO 10

1099 FORMAT ('"SP"--Set Source power')
1100 CALL SWIPE
   WRITE (1,*) 'Which source (1 / 2)?'
   READ (1,*) ISRC
   IADR = 18340
   IF (ISRC.EQ.2) IADR = J8340
   WRITE (1,*) 'Enter the desired power level (dBm):'
   READ (1,*) PWR
   CALL SRC-PWR (IADR, PWR)
GOTO 10

1199 FORMAT ('"AR"--Add or Replace columns of an existing file')
1200 CALL GRIDREAD (IROW, IAXIS)
GOTO 10

1299 FORMAT ('"EX"--Exit the program')
1300 WRITE (1,*) 'Program complete.'
   CALL GEND (IDWORK)
   !DISABLE WORK STATION
END
$SCDS ON

!-------------------------------
! SUBROUTINE CLSTAT  Last Revised: 5/30/88
!-initializes 8510's to collect a row of data by putting
!them in the Fast CW mode (which also clears their
!data buffers.)
!
! Subroutines called:
! None
!
!
SUBROUTINE CLSTAT (NPOL)

COMMON /PICS/ IPIC1, IPIC2, IPIC3
COMMON /HPIB/ I4833, I4833, I8510, J8510, I8340, J8340

WRITE (I8510,*) 'CLES;'  ! Clear Status bytes and SRQ
WRITE (I8510,*) 'S1NP;FASC;'  ! Set up Single-point (Fast CW) mode

10 CALL STATS (I8510, ISTAT)
   IF (BTEST(ISTAT,2)) THEN  ! Wait for 8510 to be ready
      CALL TRIGR (I8510)  ! Send HPIB GET (External Trigger)
   ELSE
      GO TO 10  ! Not ready; sample again
   END IF

IF (NPOL .EQ. 2) THEN

WRITE (J8510,*) 'CLES;'  ! Clear Status bytes and SRQ
WRITE (J8510,*) 'S1NP;FASC;'  ! Set up Fast CW mode

20 CALL STATS (J8510, ISTAT)
   IF (BTEST(ISTAT,2)) THEN  ! Wait for 8510
      CALL TRIGR (J8510)  ! Send HPIB GET
   ELSE
      GO TO 20  ! Not ready
   END IF

END IF

RETURN
END
SUBROUTINE COLLECT (IBEG, IEND, IROW, NPOL, IPLOT)

COMMON /MINMAX/ AMIN, AMAX, PMIN, PMAX, MAXY, MAXX
COMMON /MINMAX2/ AMIN2, AMAX2, PMIN2, PMAX2, MAXY2, MAXX2
COMMON /BUFFER/ ABUF(4095), PBUF(4095), IBUF
COMMON /BUFFER2/ ABUF2(4095), PBUF2(4095), IBUF2
COMMON /POSN/ XPOS(4095), YPOS(4095)
COMMON /PICT/ IPIC1, IPIC2, IPIC3
COMMON /LASER/ CTI, VOL, DPI, CPOS

IAXIS=0  ! COLLECTING ALONG Y AXIS
IUNIT=3  ! PRIMARY POLE UNIT #
IUNITZ=4  ! SECONDARY POLE UNIT #

10 FORMAT(A)

DO IROW=IBEG,IEND
   CALL VOLIN (IPIC1, VOL, IERR)  !READ IN VOL COMP. #
   TPOS=XPOS(IROW)  !TRUSS POSITION
   CALL POSCHECK  !COMPARE AGAINST ENCODERS
   CALL MTRUSS (TPOS, O)  !MOVE TRUSS
   CALL SIDECHECK (IROW)  !COLLECT ROW OF DATA
   CALL WRITE_DATA (IUNIT, IROW, 2, ABUF, PBUF, IBUF, AMIN, AMAX, PMIN, + PMAX, MAXY, MAXX)
   IF (NPOL .EQ. 2) CALL WRITE_DATA (IUNITZ, IROW, 2, ABUF2, PBUF2, + IBUF2, AMIN2, AMAX2, PMIN2, PMAX2, MAXY2, MAXX2)
   IF (IPLOT .EQ. 1) CALL VWPTJ (IROW, IAXIS, ABUF, PBUF)  !PLOT DATA
END DO

IROW=IROW+1

RETURN
END
SUBROUTINE COLREAD (IROU, IAXIS)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /BUFFER/ ABUF(4096), PBUF(4096), IBUF
COMMON /BUFFER2/ ABUF2(4096), PBUF2(4096), IBUF2
COMMON /POSN/ XPOS(4096), YPOS(4096)
COMMON /PICS/ IPIC1, IPIC2, IPIC3
COMMON /USER/ IWRITE, IREAD
COMMON /LASER/ CTI, VOL, DPI, CPOS

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER ANS*4

IAXIS = 0 ! Collecting along Y axis
NROWS = RSCAN(3) ! Number of rows

C  Section to input row number from user

WRITE(IWRITE,*') 'Which column do you wish to read?'
10 READ (IREAD, '(A)') ANS
   IF (ANS .LE. 1) RETURN ! Default is to quit
   READ (ANS,*') IROW
   IF ( (IROW .LT. 1) .OR. (IROW .GT. NROWS)) THEN
       WRITE (1,*') 'Invalid column number! Try again...'
   GO TO 10
   END IF

C  Section to collect data

CALL VOLIN (IPIC1, VOL, IERR) ! READ VOL COMP. #
TPOS = XPOS(IROW) ! TRUSS POSITION
CALL POSCHECK ! COMPARE TO ENCODERS
CALL MTRUSS (TPOS,0) ! MOVE TRUSS

C-10
CALL SIDECHECK (IROW)  ! COLLECT COLUMN OF DATA
RETURN
END
SUBROUTINE DATETIME Last Revised: 6/01/88

This routine gets the current date and time from the system clock and returns them in two integer arrays as follows:

IDATE(1) = 2-digit year code
IDATE(2) = month code (1-12)
IDATE(3) = day (1-31)
ITIME(1) = hours (0-23)
ITIME(2) = minutes
ITIME(3) = seconds

Subroutines called:
None

SUBROUTINE DATETIME (IDATE, ITIME)

INTEGER IDATE(3), ITIME(3), ITIME11(5), IYEAR, IBUFF(15)
CHARACTER FBUFF*30, MONTH*4
EQUIVALENCE (FBUFF, IBUFF)

CALL EXEC (11, ITIME11, IYEAR) ! Numerical time
CALL FTIME (IBUFF) ! Formatted time

IDATE(1) = IYEAR - 1900
ITIME(1) = ITIME11(4)
ITIME(2) = ITIME11(3)
ITIME(3) = ITIME11(2)

READ (FBUFF,90) IDATE(3), MONTH

90 FORMAT (16X, I2, 2X, A4)

IF (MONTH .EQ. 'JAN.') IDATE(2) = 1
IF (MONTH .EQ. 'FEB.') IDATE(2) = 2
IF (MONTH .EQ. 'MAR.') IDATE(2) = 3
IF (MONTH .EQ. 'APR.') IDATE(2) = 4
IF (MONTH .EQ. 'MAY ') IDATE(2) = 5
IF (MONTH .EQ. 'JUNE') IDATE(2) = 6
IF (MONTH .EQ. 'JULY') IDATE(2) = 7
IF (MONTH .EQ. 'AUG.' ) IDATE(2) = 8
IF (MONTH .EQ. 'SEPT ') IDATE(2) = 9
IF (MONTH .EQ. 'OCT.' ) IDATE(2) = 10
IF (MONTH .EQ. 'NOV.' ) IDATE(2) = 11
IF (MONTH .EQ. 'DEC.' ) IDATE(2) = 12

RETURN
END
$ CDS ON

SUBROUTINE DEFINE Last Revised: 6/03/88

! Returns the scan parameters for a particular axis of the given data set. The scan parameters are the starting position (START), sample spacing (RINC), and number of points per row (NUMPTS). Set IAXIS = 0 for Y-axis cuts, 1 for X-axis cuts.

Subroutines called:
None

SUBROUTINE DEFINE (IAXIS, START, RINC, NUMPTS)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOI

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15

IF (IAXIS .EQ. 0) THEN  ! Y-axis scan parameters
    START = RSCAN(4)
    RINC = RSCAN(5)
    NUMPTS = RSCAN(6)
ELSE  ! X-axis scan parameters
    START = RSCAN(1)
    RINC = RSCAN(2)
    NUMPTS = RSCAN(3)
END IF

RETURN
END
SUBROUTINE DELAY Last Revised: 5/20/88

This subroutine kills time in a loop for the requested number of milliseconds (INTERVAL). The resolution is 10 msec.

Subroutines called:
None

SUBROUTINE DELAY(INTERVAL)

INTEGER *4 Itime,ElapsedTime

CALL ResetTimer  
ITIME=ElapsedTime()

DO WHILE (Itime .LT. INTERVAL)
   ITIME=ElapsedTime()
END DO

RETURN
END
SUBROUTINE DRUJ

Last Revised: 6/03/88

This subroutine does the actual plotting of the data in the buffer.

IGR = 0 - Plot amplitude data
= 1 - Plot phase data
NP - Number of points to be plotted

Subroutines called:

PDEF

SUBROUTINE DRUJ (IGR, IAXIS, NP, BUFR)

EMA BUFR(4096)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /POSN/ XPOS(4096), YPOS(4096)
COMMON /AMP/ VHI, VLO, YMAX, YMIN

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15

CALL JCOLR(IGR+2)
H=PDEF(IAXIS,1)  !STARTING PT
V=BUFR(1)       !STARTING VALUE
IF (IGR .EQ. 0 .AND. V .LT. VLO) V=VLO
CALL J2MOV (H,V) !MOVE TO FIRST PT
DO J=2,NP
   H=PDEF(IAXIS,J)  !HORIZONTAL VALUE
   V=BUFR(J)        !VERTICAL VALUE
   IF (IGR .EQ. 0 .AND. V .LT. VLO) V=VLO
   CALL J2DRU(H,V)  !DRAW LINE TO NEXT PT
END DO
RETURN
END
SUBROUTINE EFILE (IROW, IAXIS)

COMMON /PARAM/ RSCAN (7), CAXIS, POL, CSCAN, NAME, 
+ IDATE(3), ITIME(3), NPOL
COMMON /BUFFER/ ABUF(4096), PBUF(4096), IBUF
COMMON /BUFFER2/ ABUF2(4096), PBUF2(4096), IBUF2
COMMON /USER/ IWRITE, IREAD
COMMON /DATA_DIR/ DDIR

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER ANS*2, DDIR*15

IUNIT=3
CALL NAMFILE (IUNIT,0,DDIR) !OPEN OLD FILE
CALL HEADREAD (IUNIT,IRDAT)
CALL STO_POSN !STORE POSITION COORDINATES
IF (CAXIS .EQ. 'Y') THEN !STORED BY COLUMNS
NPTS=RSCAN(3)
IAXIS=0
ELSE
NPTS=RSCAN(6)
IAXIS=1 !STORED BY ROWS
ENDIF

10 IF (CAXIS .EQ. 'X') THEN
WRITE (IWRITE,*),'Enter row number (RETURN to stop)'

ELSE
WRITE (IWRITE,*),'Enter column number (RETURN to stop)'
END IF

READ (IREAD,'(A)') ANS
IF (ANS .LE. ' ' ) THEN
   CLOSE (IUNIT)
   RETURN
END IF
READ (ANS,*) IROU
IF (IROU.LT.1 .OR. IROU.GT.NPTS) THEN
   WRITE (1,*),'Invalid column number! Try again...
   GO TO 10
END IF

CALL READ_DATA(IUNIT, IROW, IRDAT, 2, ABUF, PBUF, IBUF) !READ IROW INTO BUFF

WRITE (IWRITE,*),'Enter 0 to Plot the data, '
WRITE (IWRITE,*), ' 1 to List the data on the terminal, or '
WRITE (IWRITE,*), ' 2 to do Both. '
WRITE (IWRITE,*),'RETURN defaults to 0'
READ (IREAD,20) ANS
ICHOOSE=0
IF (ANS .GT. ' ') READ (ANS,* ) ICHOOSE

IF (ICHOOSE.EQ.0 .OR. ICHOOSE.EQ.2) THEN
   CALL VMPTJ(IROW, IAXIS, ABUF, PBUF) !PLOT ROW
   READ (IREAD,20) ANS
   CALL WIPE
END IF

IF (ICHOOSE.EQ.1 .OR. ICHOOSE.EQ.2) THEN
   CALL LISTBUFFER(IROW, IAXIS, ABUF, PBUF, IBUF) !LIST ROW
END IF

GOTO 10

20 FORMAT (A)

END
SUBROUTINE ENCODE(CEPOS, TSEPOS, TNEPOS)

COMMON /PICS/ IPIC1, IPIC2, IPIC3
COMMON /HPIB/ 14833, J4833, 18510, J8510, 18340, J8340

INTEGER*4 DPOSN, DBUF(2), CEPOS, TSEPOS, TNEPOS
LOGICAL SIGN

C Read probe cart position

CALL EXEC (1, 14833, DBUF, -3)
CALL MVBITS (DBUF, 12, 18, DPOSN, 0)
SIGN = BTEST(DBUF(1), 30)
IF (SIGN) CEPOS = -1*DPOSN

C Read truss positions

CALL EXEC (1, J4833, DBUF, -5)
CALL MVBITS (DBUF, 12, 18, DPOSN, 0) ! Get North posn
SIGN = BTEST(DBUF(1), 30)
IF (SIGN) TNEPOS = -1*DPOSN

CALL MVBITS (DBUF(2), 24, 8, DPOSN, 0) ! Get South posn
CALL MVBITS (DBUF, 0, 10, DPOSN, 8)
SIGN = BTEST(DBUF(1), 10)
IF (SIGN) TSEPOS = -1*DPOSN

RETURN
END
SUBROUTINE ERRTRUSS (IERR, TEPOS, TPOS)

CHARACTER ANS*2

IF (IERR .EQ. 0 .OR. IERR .EQ. 5) THEN
    WRITE (1,*), 'WARNING: Laser position indicators do not agree'
    WRITE (1,*), 'with rotary encoders on position of'
    WRITE (1,*), 'translation beam!!'
    WRITE (1,*), 'Encoder = ', TEPOS
    WRITE (1,*), 'Laser = ', TPOS
    STOP
END IF

WRITE (1,*), 'WARNING: Laser Error ', IERR, ' occurred on read',
    ' of truss position at ', TPOS

WRITE (1,*), 'Hit RETURN to continue.'
READ (1,*), ANS

RETURN

END
SUBROUTINE GO_HOME

COMMON /USER/ IWRITE, IREAD
COMMON /PICS/ IPIC1, IPIC2, IPIC3

CALL TRUSS_CHECK  ! Compare with encoders
CALL VOLIN (IPIC1,VOL,IERR)  ! Read VOL compensation
CALL MTRUSS (0.,1)  ! Move truss

CALL ENCODE (CEPOS, TSEPOS, TNEPOS)

IF ( ABS (CPOS-CEPOS) .LE. .01 ) THEN
   CALL MCART (0., 0., 1)  ! Encoder agrees w/ expected
ELSE
   CPOS = CEPOS  ! Assume cart position not yet initialized
   CALL MCART (0., 0., 1)
ENDIF

RETURN
END
SUBROUTINE GRIDREAD

This subroutine is used to add or replace rows in an already existing data set. The scan parameters are read from the header record of the primary-pole data file. If two poles were collected, the user is prompted for the second file name and both poles are added or replaced.

NOTE: Program HILO should be run on any file modified with this subroutine to insure the max and min values are accurate.

Subroutines called:
- COLLECT
- DATETIME
- HEADREAD (HEADER)
- HEADWRITE (HEADER)
- MAXMIN
- NAMFILE

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /USER/ IWRITE, IREAD
COMMON /DATA_DIR/ DDIR
COMMON /BUFFER/ABUF(4096), PBUF(4096), IBUF
COMMON /BUFFERZ/ABUF2(4096), PBUF2(4096), IBUF2
COMMON /POSN/XPOS(4096), YPOS(4096)
CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER COM*1, DDIR*15

IAXIS=0 ! COLLECTING ALONG Y AXIS
IUNIT=3 ! PRIMARY POLE UNIT #
IUNIT2=4 ! SECONDARY POLE UNIT #

10 FORMAT(A)

WRITE (IWRITE,*) 'NOTE: Program HILO should be run on any file'
WRITE (IWRITE,*) 'updated with this subroutine. Would you like'
WRITE (IWRITE,*) 'to run HILO automatically? (Y/N)'
READ (IEREAD,10) COM
IHILO=1
IF (COM .EQ. 'N' .OR. COM .EQ. 'n') IHILO=0

CALL NAMFILE (IUNIT,0,DDIR) ! Open primary file
CALL HEADREAD (IUNIT,IRDAT) ! and read scan parameters
C
NPOL = 1
C
IPOL = ICHAR(POL) - 48
C
IF (IPOL.EQ.1 .OR. IPOL.EQ.2) NPOL=2
C
IF (NPOL .EQ. 2) THEN
CALL NAMFILE (IUNIT2,O,DDIR) ! OPEN SECONDARY POLE FILE
CALL HEADREAD (IUNIT2,IRDAT)
CALL DATETIME (IDATE,ITIME) ! READ DATE AND TIME
CALL HEADWRITE (IUNIT2,IRDAT) ! UPDATE DATE AND TIME
END IF
C
CALL HEADREAD (IUNIT,IRDAT) ! Get scan parameters from header
CALL DATETIME (IDATE,ITIME) ! READ DATE AND TIME
CALL HEADWRITE (IUNIT2,IRDAT) ! UPDATE DATE AND TIME
C
IPILOT=0
WRITE (IWRITE,*)'Should each row be plotted', + 'after it is collected? (N/Y)'
READ (IREAD,10) COM
IF (COM .EQ. 'Y' .OR. COM .EQ. 'y') IPILOT=1
C
IF (CAXIS .EQ. 'Y') THEN
NROWS=RSCAN(3) ! NUMBER OF DATA COLUMNS IN FILE
IAxis=0
ELSE
NROWS=RSCAN(6)
IAxis=1
END IF
C
WRITE (IWRITE,*)'Enter first data column to be collected:'
READ (IREAD,*,ERR=17) IBEG
IF (IBEG .LT. 1 .OR. IBEG .GT. NROWS) GOTO 17
C
WRITE (IWRITE,*)'Enter last data column to be collected:'
READ (IREAD,*,ERR=19) IEND
IF (IEND .LT. IBEG .OR. IEND .GT. NROWS) GOTO 19
C
CALL COLLECT (IBEG, IEND, IROU, NPOL, IPLOT)
C
IF (IHILLO .EQ. 1) CALL MAXMIN (IUNIT,1) IMAX AND MIN INFO. FOR PRIM.
CLOSE(IUNIT)
IF (NPOL .EQ. 2) THEN
IF (IHILLO .EQ. 1) CALL MAXMIN (IUNIT2,2) IMGET MAX AND MIN FOR SEC.
CLOSE(IUNIT2)
END IF
C
RETURN
END
SUBROUTINE HEADER Last Revised: 6/03/88

Entry points:
HEADREAD
HEADWRITE

This routine reads or writes the header record of a data file depending on which entry point is used.
IUNIT - Unit number of the data file.
IRDAT - Indicates whether amplitude and/or phase information is stored in the file.

Subroutines called:
None

SUBROUTINE HEADER

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /MINMAX/ AMIN, AMAX, PMIN, PMAX, MAXY, MAXX
COMMON /USER/ IWRITE, IREAD

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15

ENTRY HEADWRITE (IUNIT,IRDAT) ! To write the header record

INQUIRE(UNIT=IUNIT,IOSTAT=IERR,ERR=17,RECL=IRECLB) ! GET RECORD LENGTH
NDUM=(IRECLB-168)/2 INumber of dummy var. to write out
WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=17,REC=1) RSCAN,CAXIS,POL,CSCAN,
+ NAME,IDATE,ITIME,AMIN,AMAX,PMIN,PMAX,MAYY,MAXX,IRDAT,
+ NPOL,(IDUM,I=I,NDUM)
17 IF (IERR .GT. 0) THEN
WRITE(IWRITE,*) 'ERROR ',IERR,' WRITING HEADER'
PAUSE
END IF
RETURN

ENTRY HEADREAD(IUNIT,IRDAT) ! To read the header record

READ (UNIT=IUNIT,IOSTAT=IERR,ERR=27,REC=1) RSCAN,CAXIS,POL,CSCAN,
+ NAME,IDATE,ITIME,AMIN,AMAX,PMIN,PMAX,MAYY,MAXX,IRDAT,
+ NPOL
27 IF (IERR .GT. 0) THEN
WRITE(IWRITE,*,’ERROR ’,IERR,’ READING HEADER’
END IF
RETURN
END
FUNCTION IERROR (IERR, IPIC)

IF (IERR .LT. 240) THEN
  IERROR=0  ! Upper 4 bits <> 1111 (No error)
ELSE
  IERR=NOT(IERR)

  IF (BTEST(IERR,0)) THEN
    WRITE(1,'*') 'Measurement Error at LU ', IPIC, '!
    IERROR=1
  ELSE IF (BTEST(IERR,1)) THEN
    WRITE(1,'*') 'Reference Error at LU ', IPIC, '!
    IERROR=2
  ELSE IF (BTEST(IERR,2)) THEN
    WRITE(1,'*') 'Overflow Error' ! Recoverable error
    CALL EXEC(1,IPIC,1JUNK,1,0) ! Finish previous read
    CALL EXEC(2,IPIC,240,1,0) ! Reset error bits
    IERROR=3
  ELSE IF (BTEST(IERR,3)) THEN
    WRITE(1,'*') 'VOL Error'

END IF
CALL EXEC(1,IPIC,IJUNK,1,0)  ! Finish previous read
CALL EXEC(2,IPIC,240,1,0)    ! Reset error bits
IERROR=4

ELSE
  WRITE(1,*), 'Comparator match'
  CALL EXEC(1,IPIC,IJUNK,1,0)  ! Finish previous read
  CALL EXEC(2,IPIC,240,1,0)    ! Reset error bits
  IERROR=5                     ! Comparator within tolerance
END IF

END IF

RETURN

END
SUBROUTINE INIT

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /EXP85/ AEXP(0:255)
COMMON /PICS/ IPICI, IPIC2, IPIC3
COMMON /HPIB/ 14833, J4833, 18510, J8510, 18340, J8340
COMMON /USER/ IURITE, IREAD
COMMON /LASER/ CTI, VOL, DPI, CPOS
COMMON /DATA_DIR/ DDIR
COMMON /TITLE/ CTITL(10)

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER CBUF*76, CTITL*28

DIMENSION IBUF(40)

EQUIVALENCE (IBUF, CBUF)

C Initialize LU variables

14833 = 46
J4833 = 47
18510 = 29
J8510 = 35
18340 = 49
J8340 = 48

C See BLOCK DATA LASER for other variable initializations

C Initialize ICS 4833 HPIB-Parallel Interface Units

10 FORMAT ('M', 12, 'I', TB1, TP1, TH0, E1, I1, V0123456789ABCDEF, 00, '
+ 'LB0, LP1, LH0, S1, A0, BO, R1, K1, C1, MOD')

I=7
WRITE (CBUF, 10) I
CALL EXEC (2, 14833, IBUF, -76, 12)
I=10
WRITE (CBUF,10) I
CALL EXEC (2, J4833, IBUF, -76, 12)

C Reset laser system
CALL GO_HOME (CPOS)   ! Move to home position
CALL RESET(IPIC1)    ! Zero laser counters
CALL RESET(IPIC2)
CALL RESET(IPIC3)

C Set up exponent table for FORM1 (8510 internal format)
DO I=0,127
   AEXP(I)=2.**(I-15)
END DO
DO I=128,255
   AEXP(I)=2.**(I-271)
END DO

C Initialize titles
CTITL(1)='1. Starting X=
CTITL(2)='2. X increment=
CTITL(3)='3. # X Pts=
CTITL(4)='4. Starting Y=
CTITL(5)='5. Y increment=
CTITL(6)='6. # Y pts=
CTITL(7)='7. Freq.(GHz)=
CTITL(8)='8. # Poles to collect =
CTITL(9)='9. Polarization(8 char max)=
CTITL(10)='10. Title (70 char max)=
CAXIS = 'Y'    ! Scan axis

RETURN
END
SUBROUTINE LABJ

Last Revised: 6/03/88

This subroutine draws grids and labels on plots.

IPRT = 0 - Plot amplitude values
  = 1 - Plot phase values

IAXIS = 0 - Plot data from a Y-axis cut
  = 1 - Plot data from a X-axis cut

IROU - Row or column being plotted

PO - Starting position

P1 - Ending position

Subroutines called:

None

Subroutine called:

None

******************************************************************************

SUBROUTINE LABJ (IPRT, IAXIS, IROU, PO, P1)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME, +
  IDATE(3), ITIME(3), NPOL
COMMON /POSN/ XPOS(4096), YPOS(4096)
COMMON /AMP/ VHI, VLO, YMAX, YMIN

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER CROW*80, XLAB*6, YLAB*6, TEMP*80
INTEGER X(3), Y(3), LROW(2), ITITL(40)
EQUIVALENCE (TEMP, ITITL), (CROW, LROW), (XLAB, X), (YLAB, Y)

CALL JDFNT(2,0.0,19,19HFONT2.DAT::GRAPHICS,O)  !DEFINE FONT FILE
CALL JFONT(2)                                  !ACCESS FONT FILE
SPACE=(P1-PO)/10.                               !BREAK INTERVAL INTO TENTH
XSIZ=SPACE/8                                     !CHARACTER WIDTH
CTR=(P1+P0)/2                                    !CENTER OF CHART
POS=PO SPACE                                     !INITIAL POSITION
10 FORMAT(F6.1)                                  !FORMAT FOR LABELS
20 FORMAT(16)                                    !FORMAT FOR LABELS

C Section for drawing X-axis grid and labels for amplitude plots

CALL JJUST(.5,0.0)                               !JUSTIFIED BOTTOM CENTER
YSIZ=(VHI-VLO)/20.                               !CHARACTER HEIGHT
CGAP=XSIZ/5.
CALL JCSIZ(XSIZ,YSIZ,CGAP)
CALL JCOLR(7)
DO I=1,11
POS=POS+SPACE
CALL  J2MOV(POS,VHI)  IMOVE TO RIGHT PT ON X AXIS
CALL  J2DRW(POS,VLO) !DRAW GRID MARK
WRITE(XLAB,10) POS  IPUT VALUE IN XLAB
GAP=VHI+(VHI-VLO)/30
CALL  J2MOV(POS,GAP)  IMOVE TO LABEL PT
CALL  JTEXM(6,X)  IWRITE OUT LABELS
END DO
CALL  JJUST(-5.0.)  IJUSTIFIED BOTTOM CENTER
CALL  J2MOV(CTR,YMIN)  IBOTTOM CENTER OF VIEWPORT
CALL  JTEXM(22,22AMPLITUDE VS. POSITION) IAMPLITUDE TITLE

C Section for drawing Y-axis grid and labels for amplitude plots
RINC=(VHI-VLO)/9.  !BREAK UP INTO 10 INTERVALS
R=VHI+RINC
CALL  JJUST(1.0,.5)  IJUSTIFIED CENTER RIGHT
DO L=1,10
   R=R-RINC  IMAKE L REAL NO.
   CALL  J2MOV(P0,R)  IMOVE TO Y AXIS
   CALL  J2DRW(P1,R) !DRAW Y GRID LINE
   WRITE(YLAB,10) R  IPUT VALUE IN YLAB
   V=P0-XSI
   CALL  JZMOV(V,R) !LEAVE ROOM FOR ONE BLANK OFF AXIS
   CALL  JTEXM(6,Y) IWRITE OUT LABELS
   END DO
GOTO 200

C Section for drawing X-axis grid and labels for phase plots
100 CALL  JCOLR(7)
YSIZ=270./8.  !CHARACTER WIDTH
CGAP=YSIZ/5.
CALL  JCSIZ(YSIZ,YSIZ,CGAP) ISET CHARACTER SIZE
DO I=1,11
   POS=POS+SPACE  INCREASE X POSITION
   CALL  J2MOV(POS,-180.) IMOVE TO PT AT BOTTOM OF GRAPH
   CALL  J2DRW(POS,180.) !DRAW X GRID LINE
   END DO
CALL  JJUST(-5.0.) IJUSTIFIED BOTTOM CENTER
CALL  J2MOV(CTR,-230.) !BOTTOM CENTER
CALL  JTEXM(18,18PHASE VS. POSITION) IWRITE OUT PHASE TITLE

C Section for drawing Y-axis grid and labels for phase plots
CALL  JJUST(1.0,.5) IJUSTIFIED CENTER RIGHT
DO L=-180,180,90
   R=L IMAKE L REAL NO.
   CALL  J2MOV(P0,R) IMOVE TO PT ON Y AXIS
   CALL  J2DRW(P1,R) !DRAW Y GRID LINE
   WRITE(YLAB,20) L !PUT VALUE IN YLAB
V=PO-XSIZ  
CALL J2MOV(V,R) 
CALL JTEXM(6,Y)  
END DO

C Section for writing title

CALL JJUST(.5,0.)  
I3=INDEX(CSCAN,' ')  
IF (I3 .EQ. 0) I3=80  
I4=INDEX(NAME,' ')  
IF (I4 .EQ. 0) I4=15  
I=I3+I4+2  
TEMP=NAME(1:I4)//': '//CSCAN(1:13)  
CALL J2MOV(CTR,255.)  
CALL JTEXM(I,ITITL)  
CALL J2MOV(CTR,210.)  
IF (IAXIS .EQ. 0) THEN  
\quad CALL JTEXM(7,7HCOLUMN)  
ELSE  
\quad CALL JTEXM(4,4HROW)  
END IF  
CALL JJUST(0.,0.)  
WRITE (CROW,'(I4)') IROW  
WRITE (CROW,'(I4)') IROW  
CALL JTEXM(4,LROW)

200 RETURN
END
For use with HP 5501 laser metrology system.

This block data routine assigns values to instructions for the laser electronics cards in the three 10740A coupler boxes. It is assumed that the 10746A binary interface cards (BIC's) are set for positive logic (high = true). Each instruction is associated with a backplane card address in the 10740A coupler. The interpretation of the instruction may vary depending on the card located at that address. For example, suppose that in one coupler a counter card has been assigned address "A", while in a second coupler a comparator card has been assigned address "A". The instruction "3A" (which can be applied by outputting the value IA(3)) to the second coupler would cause the comparator card to load its destination register. The same instruction to the first coupler would have no effect, since instruction "3" is not implemented for the counter. A complete list of instructions, their values, and their meanings to different cards, can be found in the 5501A Laser Transducer System Operating and Service Manual, section 4.9. The manual shows each instruction as two characters, a numeral and a letter. The numeral indicates an operation to be performed and the letter indicates the card address. Thus, "5Z" represents operation 5 to be performed by card 2. In the software, the value of this instruction is stored in array element IZ(5). The other array elements are defined similarly.

Some commands require additional parameters (consult the manual). Address P will always correspond to the binary interface cards (10746A). The addresses of the remaining cards are as follows:

Coupler #1 ----- addressed via PIC at LU # 54

Counter #1 (10760)..............address X
  (Delta Zc')
Counter #2 (10760)..............address Y
  (Delta Zt')
Counter #3 (10760)..............address Z
  (Delta Zc, Delta Zt)
Counter #4 (10760)..............address A
  (Delta Xc, Delta Yt)
Counter #5 (10760)..............address B
  (Theta Xc)
Counter #6 (10760)..............address C
(Theta Zc)
Compensator interface (10755).....address V
(for Velocity of Light compensation)

Coupler #2 ...... addressed via PIC at LU # 55

Counter #1 (10760)..............address C
(Theta Yt)
Counter #2 (10760)..............address Z
(Theta Ytl)
Comparator #1 (10762)...........address A
(Xt - North end of truss)
Comparator #2 (10762)...........address X
(Xt' - South end of truss)
Fast pulse converter #1 (10764).....address A
(to Comparator #1)
Fast pulse converter #2 (10764).....address X
(to Comparator #2)

Coupler #3 ...... addressed via PIC at LU # 56

Comparator #1 (10762)...........address X
(Yc - Southbound Cart)
Comparator #2 (10762)...........address Y
(8510 Trigger for Southbound cart)
Comparator #3 (10762)...........address Z
(Yc' - Northbound Cart)
Comparator #4 (10762)...........address A
(8510 Trigger for Northbound cart)
Fast pulse converter #1 (10764).....address X
(to Comparator #1)
Fast pulse converter #1 (10764).....address Y
(to Comparator #2)
Fast pulse converter #2 (10764).....address Z
(to Comparator #3)
Fast pulse converter #2 (10764).....address A
(to Comparator #4)

********************List of variables***********************

IPIC1.....lu of PIC that communicates with coupler #1
IPIC2.....lu of PIC that communicates with coupler #2
IPIC3.....lu of PIC that communicates with coupler #3
J4833.....lu of ICS 4833 HPIB Adapter #1
J4833.....lu of ICS 4833 HPIB Adapter #2
IB510.....lu of primary pole 8510
J8510.....lu of secondary pole 8510
IB340.....lu of source #1
J8340.....lu of source #2

IA( )......array of binary values for instructions
to address A in the coupler (e.g., IA(1)=1A)
The other array variables are similar.

BLOCK DATA LASER

COMMON /ASSIGN/ IA(0:7), IB(0:7), IC(0:7), IP(0:7),
+  IV(0:7), IX(0:7), IY(0:7), IZ(0:7)
COMMON /PICS/ IPIC1, IPIC2, IPIC3
COMMON /HPIB/ I4833, J4833, I8510, J8510, I8340, J8340
COMMON /LASER/ CTI, VOL, DPI, CPOS

DATA IA /16,17,18,19,20,21,22,23/
DATA IB /32,33,34,35,36,37,38,39/
DATA IC /48,49,50,51,52,53,54,55/
DATA IP /0,1,2,3,4,5,6,7/
DATA IV /96,97,98,99,100,101,102,103/
DATA IX /128,129,130,131,132,133,134,135/
DATA IY /144,145,146,147,148,149,150,151/
DATA IZ /160,161,162,163,164,165,166,167/
DATA IPIC1, IPIC2, IPIC3 /54, 55, 56/
DATA CTI, DPI /6.23E-6, 0./

END
SUBROUTINE EFILE Last Revised: 6/06/88

This subroutine opens a data file and allows the user to specify one row or column at a time to be read into memory. Each row can then be plotted or listed on the terminal screen.

IROW identifies the row of data currently in the buffer.
IAXIS specifies along which axis the data was collected (only Y-axis scans are implemented).

Subroutines called:
HEADREAD (HEADER)
LISTBUFFER
NAMFILE
READ_DATA (READWRITE)
STO_POSN
WIPE

Subroutine EFILE (IROW, IAXIS)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /BUFFER/ ABUF(4096), PBUF(4096), IBUF
COMMON /BUFFER2/ ABUF2(4096), PBUF2(4096), IBUF2
COMMON /USER/ IWRITE, IREAD
COMMON /DATA_DIR/ DDIR

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER ANS*2, DDIR*15

IUNIT=3
CALL NAMFILE (IUNIT,0,DDIR) !OPEN OLD FILE
CALL HEADREAD (IUNIT,IRDAT)
CALL STO_POSN !STORE POSITION COORDINATES
IF (CAXIS .EQ. 'Y') THEN !STORED BY COLUMNS
   NPTS=RSCAN(3)
   IAXIS=0
ELSE
   NPTS=RSCAN(6)
   IAXIS=1 !STORED BY ROWS
END IF

10 IF (CAXIS .EQ. 'X') THEN
WRITE (IWRITE,*) 'Enter row number (RETURN to stop)'
ELSE
    WRITE (IWRITE,*) 'Enter column number (RETURN to stop)'
END IF

READ (IREAD, 'A') ANS
IF (ANS .LE. ' ') THEN
    CLOSE (IUNIT)
    RETURN !QUIT
END IF
READ (ANS,*) IROW
IF (IROW.LT.1 .OR. IROW.GT.NPTS) THEN
    WRITE (IWRITE,*) 'Invalid column number! Try again...'
    GO TO 10
END IF

CALL READ_DATA (IUNIT, IROW,IRDAT,2,ABUF,PBUF,IBUF) !READ IROW INTO BUFF

WRITE (IWRITE,*) 'Enter 0 to Plot the data,'
WRITE (IWRITE,*) '  1 to List the data on the terminal, or'
WRITE (IWRITE,*) '  2 to do Both.'
WRITE (IWRITE,*) 'RETURN defaults to 0'
READ (IREAD, 20) ANS
ICHOICE=0
IF (ANS .GT. ' ') READ (ANS,*) ICHOICE

IF (ICHOICE.EQ.0 .OR. ICHOICE.EQ.2) THEN
    CALL WPTJ (IROW,IAXIS,ABUF,PBUF) !PLOT ROW
    READ (IREAD,20) ANS
    CALL SWIPE
END IF

IF (ICHOICE.EQ.1 .OR. ICHOICE.EQ.2) THEN
    CALL LISTBUFFER (IROW,IAXIS,ABUF,PBUF,IBUF) !LIST ROW
END IF
GOTO 10

20 FORMAT (A)

END
SUBROUTINE LISTCHANGE

COMMON /PARAM/RSCAN(7), CAXIS, POL, CSCAN, NAME, IDATE(3), ITIME(3)
COMMON /TITLE/CTITL
COMMON /USER/IWRITE, IREAD

CHARACTER CTITL(10)*28, CAXIS*1, POL*8, CSCAN*80, NAME*15, ANS*2

C Print out scan parameters

10 CALL SWIPE

WRITE(IWRITE,*') SCAN PARAMETERS
WRITE(IWRITE,*')

DO I=1,7
   WRITE(IWRITE,*') CTITL(I), RSCAN(I)
END DO

CAXIS = 'Y'

WRITE(IWRITE,*') CTITL(8), CAXIS
WRITE(IWRITE,*') CTITL(9), POL

WRITE(IWRITE,*') CTITL(10), CSCAN

WRITE(IWRITE,*')
WRITE(IWRITE,*')

C Get changes from user

WRITE(IWRITE,*') 'Enter the number of any parameter you wish to change (hit RETURN if everything is correct)'
WRITE(IWRITE,*')
READ(IREAD,20) ANS
IF (ICHAR(ANS) .EQ. 32) THEN
   CALL STO_POSN
   RETURN
ELSE
READ (ANS,*) IOPT
END IF

13 IF (IOPT .LE. 0 .OR. IOPT .GT. 10) THEN
    GOTO 10
ELSE
17    WRITE(IWRITE,*) CTITL(IOPT), '?'
    IF (IOPT .EQ. 9) READ(IREAD,20) POL  ! Polarization
    IF (IOPT .EQ. 10) READ(IREAD,20) CSCAN  ! Title
    IF (IOPT .LT. 8) THEN
        READ(IREAD,*) RSCAN(IOPT)  ! Read into real array
        IF (RSCAN(IOPT) .LT. 0) GOTO 17
        IF (IOPT .EQ. 3 .OR. IOPT .EQ. 6) THEN
            IF (RSCAN(IOPT) .NE. INT(RSCAN(IOPT))) GOTO 17
        END IF
    END IF
END IF
GOTO 10  ! Any more changes?

20 FORMAT (A)
END
SUBROUTINE MAXMIN (IUNIT, IPOL)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIMEU), NPOL
COMMON /MINMAX/ AMIN, AMAX, PMIN, PMAX, MAXY, MAXX
COMMON /MINMAXZ/ AMINZ, AMAXZ, PMINZ, PMAXZ, MAXYZ, MAXXZ
COMMON /BUFFER/ ABUF(4096), PBUF(4096), IBUF
COMMON /BUFFERZ/ ABUFZ(4096), PBUF2(4096), IBUFZ

CALL READ-DATA (IUNIT,irdat) ! GET OLD FILE AND READ HEADER

IF (CAXIS .EQ. 'X') THEN
  MAX1=RSCAN(3)
  MAX2=RSCAN(6) ! DATA STORED BY ROWS
ELSE
  MAX1=RSCAN(6) ! DATA STORED BY COLUMNS
  MAX2=RSCAN(3)
END IF

IF (IPOL.EQ.1) THEN

  AMAX=-100.
  AMIN=100.
  PMAX=-180.
  PMIN=180.

  DO IROW=1,MAX2 ! Check row-by-row
    CALL READ-DATA (IUNIT,IROW,IRDAT,IRDAT,ABUF,PBUF,IBUF)
    DO I=1,MAX1
      IF (ABUF(I) .GT. AMAX) THEN
        AMAX=ABUF(I) ! highest amplitude
        IF (CAXIS .EQ. 'Y') THEN
          MAXY=IROW ! Position coordinates of
          MAXX=I    ! data point with
        END IF
      END IF
    END DO
  END DO

C-40
ELSE
    MAXY=I
    MAXX=IROW
    END IF
END IF

IF (ABUF(I) .LT. AMIN) AMIN=ABUF(I)
    ! lowest amp
ELSE ! the highest amplitude
    MAXY=I
    MAXX=IROW
    END IF
END IF

IF (PBUF(I) .LT. PMIN) PMIN=PBUF(I)
    ! lowest phase
END IF

IF (PBUF(I) .GT. PMAX) PMAX=PBUF(I)
    ! highest phase
END IF

END DO

END DO

ELSE

AMAX2=-100.
AMIN2=100.
PMAX2=-180.
PMIN2=180.

DO IROW=1,MAX2
    ! Check row-by-row
    CALL READ_DATA (IUNIT, IROW, IRDAT, IRDAT, ABUF2, PBUF2, IBUF2)

    DO I=1,MAX1
        IF (ABUF(I) .GT. AMAX) THEN
            AMAX=ABUF(I)
            IF (CAXIS .EQ. 'Y') THEN
                MAXY2=IROW
                MAXX2=I
                ELSE
                MAXY2=I
                MAXX2=IROW
            END IF
        END IF
        IF (ABUF(I) .LT. AMIN) AMIN=ABUF(I)
        IF (PBUF(I) .LT. PMIN) PMIN=PBUF(I)
        IF (PBUF(I) .GT. PMAX) PMAX=PBUF(I)
    END DO
END DO

END IF

CALL HEADWRITE(IUNIT, IRDAT)
    ! Update header record

RETURN
END
SUBROUTINE MCART

Parameter definitions:
- DCPOS--Desired cart position
- CPOS--Current cart position
- TPOS--Truss position
- IDIS = 1 Display position on terminal
- = 0 No display

Subroutines called:
- POSOUT (POSITION)
- POSWATCH

Subroutine to move probe cart to desired position.

SUBROUTINE MCART(DCPOS,TPOS,IDIS)
COMMON /ASSIGN/ IA(O:7), IB(O:7), IC(0:7), IP(0:7),
+ IV(0:7), IX(O:7), IY(O:7), IU(0:7)
COMMON /PICS/ IPIC1, IPIC2, IPIC3
COMMON /HPIB/ 14833, 14833, 18510, J8510, J8340, J8340
COMMON /LASER/ CTI, VOL, DPI, CPOS

IDIR=SIGN(1.,DCPOS-CPOS) ! +1 FOR SOUTH TRAVEL,-1 FOR NORTH
POFF=ABS(DCPOS-CPOS) ! OFFSET FROM CURRENT POSITION
IF (IDIR .EQ. 1) THEN
  BADR=IX(0) ! MOVING SOUTH
ELSE
  BADR=IZ(0) ! MOVING NORTH
END IF
CALL EXEC (2,IPIC3,BADR,1,0) !RESET COMPARATOR
CALL POSOUT (IPIC3,POFF,15) !OUTPUT POS. TO BIC
CALL EXEC (2,IPIC3,BADR+3,1,0) !LOAD UP CART DEST. REGISTER
CALL EXEC (2,IPIC3,BADR+1,1,0) !SAMPLE TO START DIGITAL DIFF.

C Section to switch trigger MUX and enable motion

IF (IDIR .EQ. 1) THEN
  WRITE (14833,* ) '01' ! SWITCH MUX TRIGGER SOUTH BOUND
  WRITE (14833,* ) '11' ! ENABLE CART MOTION
ELSE
  WRITE (14833,* ) '02' ! SWITCH MUX NORTH BOUND
  WRITE (14833,* ) '12' ! ENABLE CART MOTION
END IF

C Section to monitor position
CALL POSWATCH(IPIC3,BADE,BPOS,DCPOS,1,IDIS,IERR)
IF (IERR .NE. 0 .AND. IERR .NE. 5) GOTO 10

CPOS=DCPOS !UPDATE CURRENT CART POSITION
WRITE (14833,*) '0' !DISABLE CART MOTION

RETURN
END
SUBROUTINE MOVE

COMMON /USER/ IWRITE, IREAD
COMMON /PICS/ IPIC1, IPIC2, IPIC3

10 WRITE (IWRITE,*) 'Enter desired X position: '
   READ (IREAD,*,ERR=10) TPOS
20 WRITE (IWRITE,*) 'Enter desired Y position: '
   READ (IREAD,*,ERR=20) DCPOS

   CALL POSCHECK ! Compare with encoders
   CALL VOLIN (IPIC1,VOL,IERR) ! Read VOL compensation
   CALL MTRUSS (TPOS,1) ! Move truss
   CALL MCART (DCPOS,TPOS,1) ! Move cart

   WRITE (IWRITE,*) 'X= ',',TPOS, ',', Y= ',',DCPOS

RETURN
END
SUBROUTINE MTRUSS (TPOS, IDIS)

COMMON /ASSIGN/ IA(0:7), IB(0:7), IC(0:7), IP(0:7), 
+ IV(0:7), IX(0:7), IY(0:7), IZ(0:7)
COMMON /PICS/ IPIC1, IPIC2, IPICS
COMMON /HP1B/ I4833, J4833, I8510, J8510, I8340, J8340

C Section to load up comparators

10 CALL POSOUT (IPIC2,TPOS,15)  ! Output position to BIC
CALL EXEC (2,IPIC2,IA(3),1,0)  ! Load truss north end
CALL EXEC (2,IPIC2,IX(3),1,0)  ! Load truss south end
CALL EXEC (2,IPIC2,IA(1),1,0)  ! Sample to start digital diff.
CALL EXEC (2,IPIC2,IX(1),1,0)  !

WRITE (14833,*') '2'  ! Enable truss

C Section to monitor truss position. Looks for null on north end of truss first, then checks south end.

CALL POSWATCH(IPIC2,IA(0),TPOS,TPOS,0,IDIS,IERR)
IF (IERR .NE. 0 .AND. IERR .NE. 5) GOTO 10
CALL POSWATCH(IPIC2,IX(0),TPOS,TPOS,0,IDIS,IERR)
IF (IERR .NE. 0 .AND. IERR .NE. 5) GOTO 10

WRITE (14833,*') '0'  ! Disable truss

30 RETURN
END
$CDS ON

******************************************************************************
!* SUBROUTINE NAMFILE Last Revised: 6/03/88 *
!* ! This subroutine opens a datafile for subsequent reads or ! writes. IUNIT is the unit number to be associated with ! the file. ISTATUS is the status of the file: 
!* ISTATUS = 0 - New file 
!* = 1 - Old file 
!* = 2 - Status unknown 
!* DDIR is the data directory, if other than 
!* =:XYZFILES 
!* ! LGBUF is a library subroutine to enlarge I/O buffer size. ! NOTE: the buffer array LBUF must not be in EMA under any ! circumstances. ! NOTE: if CDS is used, then either the common block ! /RECBUFF/ must be declared in the main program and ! this subroutine, or the call to LGBUF must be made ! in the main program (in which case /RECBUFF/ is not ! required. )
!* ! Subroutines called:
!* DATETIME
!* ! ! ! ! ! ! ! ! ! ! ! !

C SUBROUTINE NAMFILE (IUNIT, ISTATUS, DDIR)
SUBROUTINE NAMFILE (IUNIT, ISTATUS)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /RECBUFF/ LBUF(8200)
COMMON /USER/ IWRITE, IREAD

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER DDIR*16, INFILE*30, STAT*7

C NP = PCOUNT() ! Number of parameters passed
C IF (NP .LT. 3) DDIR = '/XYZFILES '
C ID = INDEX (DDIR, ' ') - 1 ! Length of string
C IF (ID .LE. 0) ID=16
C WRITE (IWRITE,*) 'Enter data file name:'
READ (IREAD,20) NAME
20 FORMAT(A)
C INFILE = DDIR(1:ID)// '/' // NAME
INFILE = NAME//'::XYZFILES'
IF (ISTATUS .EQ. 0) STAT='OLD '
IF (ISTATUS .EQ. 1) STAT='NEW '
IF (ISTATUS .EQ. 2) STAT='UNKNOWN'

IF (STAT .EQ. 'NEW') THEN
   NPTS=RSCAN(6)
   IF (CAXIS .EQ. 'X') NPTS=RSCAN(3)
   IRECLB=(NPTS*4)+2 !RECORD LENGTH(BYTES)--AMP OR PHASE AND STATUS
   IF (IRECLB .LT. 180) IRECLB=180 !INSURE ENOUGH ROOM FOR HEADER REC.
   CALL DATETIME (IDATE,ITIME)
   ELSE
   INQUIRE(FILE=INFILE,IOSTAT=IERR,ERR=65,RECL=IRECLB) !READ RECORD LTH
   END IF
   OPEN(UNIT=IUNIT,FILE=INFILE,ACCESS='DIRECT',FORM='UNFORMATTED',
       RECL=IRECLB,IOSTAT=IERR,ERR=65,STATUS=STAT)

   65 IF (IERR .GT. 0) THEN
      WRITE(IWRITE,*) 'ERROR: ',IERR,' ON OPENING FILE'
      GOTO 5
   ELSE
      CALL LGBUF (LBUF,IRECLB/2) !ENLARGE I/O BUFFER TO #BYTES/2
   END IF
   RETURN
END
C Section to set up the "motion Comparator" to control the probe scan by
C loading the destination register with the location of the last point.

C LAST REVISED 8/5/88

SUBROUTINE NECCOL (IROW)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /BUFFER/ ABUF(4096), PBUF(4096), IBUF
COMMON /BUFFER2/ ABUF2(4096), PBUF2(4096), IBUF2
COMMON /POSN/ XPOS(4096), YPOS(4096)
COMMON /EXP85/ AEXP(0:255)
COMMON /ASSIGN/ IA(0:7), IB(0:7), IC(0:7), IF(0:7),
+ IV(0:7), IX(0:7), IY(0:7), II(0:7)
COMMON /PICS/ IPIC1, IPIC2, IPIC3
COMMON /HPIB/ I4833, J4833, I8510, J8510, I8340, J8340
COMMON /LASER/ CTI, VOL, DPI, CPOS

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
COMPLEX CDAT

DIMENSION I

INTEGER CLASS1, CLASS1W, CLASS2, CLASS2W, AREG, BREG

ICONT1 = I8510+100b ! Control words for 8510 EXEC calls. 100b
ICONT2 = J8510+100b ! is the code for normal binary format
NP = RSCAN(6) ! # of points to be sampled in data column
IFC1 = I8510 + 5100b ! Control code for a
IFC2 = J8510 + 5100b ! 10 msec IFC on HPIB

10 DCPOS = YPOS(NP) ! Start at last point
CALL MCART (DCPOS,0.,0) ! Move cart to start

C-48
CALL EXEC (2, IPIC3, IZ(0), 1, 0)  ! Reset motion comparator
DEST = ABS(CP05-YP0S(1))  ! Offset to beginning of data row
CALL POSOUT (IPIC3, DEST, 15)  ! Output destination to BIC
CALL EXEC (2, IPIC3, IZ(3), 1, 0)  ! Load destination to motion Comp.
CALL EXEC (2, IPIC3, IZ(1), 1, 0)  ! Start generating digital difference

C Section to prepare "Sample Comparator" and 8510(s) for data collection.
C The destination register of the sample comparator is loaded with the
C location of the next data point to be sampled. As each point is
C reached the comparator's null output automatically triggers the
C 8510(s) (via the Trigger Control Electronics) to sample a data point.
C A Class Read is used to get data from 8510's so this program does not
C monitor the 8510's during a scan. The null line from the comparator
C is monitored so the program knows when to load the location of the
C next data point to be sampled.

CALL EXEC (2, IPIC3, IA(0), 1, 0)  ! Reset sample Comparator

CALL EXEC (3, IFC1, 1)  ! Clear both interface cards
CALL EXEC (3, IFC2, 1)  !

CLASSW = 0  ! Initialize Class Numbers
CLASSZW = 0

CALL CLRQ (1, CLASSUW)  ! Reserve class numbers from the system
CALL CLRQ (1, CLASSZW)  ! for 8510 class reads

CLASSW = IBSET(CLASSW, 13)  ! Set "Save Class Number" bit
CLASSZW = IBSET(CLASSZW, 13)

CLASS1 = IBSET(CLASS1W, 15)  ! Set "No Wait" bit
CLASS2 = IBSET(CLASS2W, 15)

CALL CLSTAT (NPOL, IB510, JIB510)  ! Set 8510's in Fast CW mode

CALL EXEC (17, ICONT1, IDBUF1, NP*3, 0, 0, CLASS1)  ! Do Class Read
CALL ABREG (AREG, BREG)  ! and check for
LOCATION=1  ! errors
IF (AREG.NE.0) GO TO 999

IF (NPOL .EQ. 2) THEN
   CALL EXEC (17, ICONT2, IDBUF2, NP*3, 0, 0, CLASS2)  ! Ditto, for
   CALL ABREG (AREG, BREG)  ! 2nd 8510
   LOCATION=2
   IF (AREG.NE.0) GO TO 999
END IF

C Section to do the actual data collection

WRITE (IWRITE,*) 'Collecting data for Column ', IROW
WRITE (14833,*) '02'  ! Select Northbound

C-49
WRITE (14833,*) '12' ! Enable motion

DO I=NP,1,-1
    POFF = ABS(CPOS-YPOS(1)) ! Offset to sample point
    CALL POSOUT (IPIC3,POFF,15) ! Output dest. to BIC
    CALL EXEC (2,IPIC3,IA(3),1,0) ! Load up Sample Comparator
    CALL EXEC (2,IPIC3,IA(1),1,0) ! Start digital difference
    CALL POSWATCH (IPIC3, IA(0), 0, DEST, 1, 0, IERR) ! Wait
    IF (IERR .NE. 0 .AND. IERR .NE. 5) THEN
        WRITE (IWRITE,*) 'Error reading Laser position. Move to'
        WRITE (IWRITE,*) 'Home position and start over.'
        STOP
    END IF
    NULL = .FALSE.
    DO WHILE (.NOT. NULL)
        CALL EXEC (1, 14833, INULL, -1) ! Read null from Sample comp.
        NULL = BTEST (INULL, 7) ! Null line at bit 7
    END DO
END DO

C Section to check for successful completion of column scan

CALL POSWATCH (IPIC3, IZ(0), 0, DEST, 1, 0, IERR)
IF (IERR .NE. 0 .AND. IERR .NE. 5) THEN
    WRITE (IWRITE,*) 'ERROR in scan of colm # ', IROW
    CALL CLRQ (2, CLASSIW)
    CALL CLRQ (2, CLASSZW)
    GO TO 10
END IF

WRITE(14833,*)'0' ! Disable motion
CPOS=YPOS(1) ! New cart position

C Section to get the last point(s) from the Class Reads

CALL EXEC (21, CLASSIW, IDBUF1, NP*3) ! Class Get
CALL ABREG (AREG, BREG)
LOCATION =3
IF (AREG .LT. 0) GO TO 999

IF (NPOL .EQ. 2) THEN
    CALL EXEC (21, CLASS2W, IDBUF2, NP*3) ! Class Get
    CALL ABREG (AREG, BREG)
    LOCATION =4
    IF (AREG .LT. 0) GO TO 999
END IF

C Section to convert data to amplitude/phase format
DO I=1,NP
   J = NP-I+1
   EX = AEXP( IAND( IDBUF(3,1), 255 ) ) ! Exponent
   RE = IDBUF(2,1)*EX ! Real part
   RIM = IDBUF(1,1)*EX ! Imaginary part
   CDAT = CMPLX(RE,RIM) ! Convert to complex form and
   CALL RECTOPOL(CDAT,AMP,PHSE) ! then to amplitude, phase
   ABUF(J) = AMP ! Store in buffers
   PBUF(J) = PHSE !
   IF (NPOL .EQ. 2) THEN
      EX = AEXP( IAND( IDBUF2(3,1), 255 ) ) ! Do the same
      RE = IDBUF2(2,1)*EX ! for the
      RIM = IDBUF2(1,1)*EX ! second
      CDAT = CMPLX(RE,RIM) ! pole data
      CALL RECTOPOL(CDAT,AMP,PHSE)
      ABUF2(J)=AMP !
      PBUF2(J)=PHSE !
   END IF
END DO
RETURN

999 WRITE (IWRITE,*), 'ERROR on Class Read or Get at location ',
     + LOCATION
STOP
END
FUNCTION PDEF (LBUF, IPT)

COMMON /POSN/ XPOS(4096), YPOS(4096)

IF (LBUF .EQ. 0) PDEF=YPOS(IPT)
IF (LBUF .EQ. 1) PDEF=XPOS(IPT)

RETURN
END
SUBROUTINE PLOT Last Revised: 5/19/88

Entry Points:  GINIT
              GEND

This subroutine affects the work station for graphics output via AGP. If entry point GINIT is used, the work station is initialized; if entry point GEND is used, the work station is disabled. IDWORK may take the following values:

IDWORK = 0  Terminal only
         = 1  Plotter only
         = 2  Terminal and plotter

If IDWORK = 2, the user will be prompted for possible rotation of the logical display limits. The other arguments have the following meanings:

I3D = 1   enable 3-D graphics
         = 0   no 3-D graphics

IASP = 0 prompt user for no distortion
       = 1 use given aspect ratio

ASP = 0  use the maximum aspect ratio
        <>0  set aspect ratio for no distortion

Subroutines called:
None

SUBROUTINE PLOT

COMMON /USER/IURITE,IREAD

CHARACTER C*1,CP*1

ENTRY GINIT(IDWORK,I3D,ASP,IASP)  !INITIALIZE WORK STATION

10 FORMAT(A)

CALL JBEGN  !INITIALIZE AGP
IF (IDWORK .GT. 0) THEN
    WRITE(IWRITE,*) 'ENTER PAPER SIZE(A=SMALL,B=LARGE)',
    'CR DEFAULTS'
    READ (IREAD,10) CP
    IF (CP .NE. 'B' .AND. CP .NE. 'b') THEN
WRITE(53,*), 'PS A'   !SET SMALL PAPER SIZE
CP='A'
ELSE
WRITE(53,*), 'PS B'   !SET LARGE PAPER SIZE
CP='B'
END IF
WRITE(IWRITE,*), 'WOULD YOU LIKE TO ROTATE THE COORDINATE',
+ ' SYSTEM OF THE PLOTTER(N/Y)?'
READ(IREAD,10) C
IROTATE=0
IF (C .EQ. 'Y' .OR. C .EQ. 'y') IROTATE=IBSET(IROTATE,8)
END IF
IF (IASP .NE. 1) THEN   !DETERMINE ASPECT RATIO
IF (ASP .LE. 0) THEN   !USE DEFAULTS
 IF (IDWORK .EQ. 0) THEN
 ASP=.762793   !ASPECT RATIO FOR TERMINAL
 ELSE
 IF (CP .EQ. 'B') THEN
 ASP=.6229   !FOR LARGE PAPER
 IF (BTEST(IROTATE,8)) ASP=1./.6229
 ELSE
 ASP=.75   !FOR SMALL PAPER
 IF (BTEST(IROTATE,8)) ASP=1./.75
 END IF
 END IF
 ELSE
 WRITE(IWRITE,*), 'WOULD YOU LIKE TO SET THE ASPECT RATIO',
+ ' FOR NO DISTORTION(N/Y)?'
 READ (IREAD,10) C
 IF (C .NE. 'Y' .AND. C .NE. 'y') ASP=.762793
END IF
END IF
IF (ASP .LT. 1.0) THEN
XSIZE=1.0
YSIZE=ASP
ELSE
XSIZE=1./ASP
YSIZE=1.0
END IF
CALL JASPK(XSIZE,YSIZE)   !SET ASPECT RATIO
IF (I3D .EQ. 1) CALL JHAND(1)   !MAKE IT A RIGHT-HANDED COORD. SYS.
IF (IDWORK .NE. 1) THEN
 CALL JDINT(1,22,22HWP_CDS.RUN::PROGRAMS ,1,0) IWP FOR 2397A
 CALL JIERR(ERR,ILEV,IND,INFO)   !SEE IF ERROR OCCURED
 IF (ERR .GT. 0) THEN   !IF SO ,CHANGE WSP
 CALL JDINT(1,24,24HWSP23_CDS.RUN::PROGRAMS ,1,0) IWP FOR 2623A
 END IF
 CALL JWON(1)   !ENABLE GRAPHICS OUTPUT
DO I=1,6
 CALL JEDEV(1,I,1)   !ENABLE LOGICAL DEVICES
END DO
IF (IDWORK .GT. 0) THEN
    CALL JDINT(2,24,24HWSPPEN_CDS.RUN::PROGRAMS,53,1ROTATE)
    CALL JWOFF(2) ! FOR PLOTTER
END IF

RETURN

C

ENTRY GEND(IDWORK) ! DISABLE WORK STATION

IF (IDWORK .NE. 1) THEN
    DO I=1,6 ! FOR TERMINAL
        CALL JDDEV(I,1) ! DISABLE LOGICAL DEVICES
    END DO

    CALL JWOFF(1) ! DISABLE GRAPHICS OUTPUT
    CALL JWEND(1) ! DISABLE WORK STATION
END IF

IF (IDWORK .GT. 0) THEN
    CALL JWOFF(2)
    CALL JWEND(2) ! DO SAME FOR PLOTTER
END IF

CALL JEND

RETURN
SUBROUTINE POSCHECK

COMMON /ASSIGN/ IA(0:7), IB(0:7), IC(0:7), IP(0:7),
+ IV(0:7), IX(0:7), IY(0:7), IZ(0:7)
COMMON /PICT/ IPIC1, IPIC2, IPIC3
COMMON /LASER/ CTI, VOL, DPI, CPOS

CHARACTER ANS*2

CALL VOLIN(IPIC1,VOL,IERR) ! Read VOL compensation
CALL ENCODE(CEPOS,TSEPOS,TNEPOS) ! Read encoder positions

IF (ABS(CEPOS-CPOS) .GT. .01) THEN
   WRITE (1,*) 'WARNING: Encoder reading disagrees with ',
   'expected cart position!'
   WRITE (1,*) 'Hit RETURN to accept encoder ',
   'reading and continue...'
   READ (1,*) ANS
   CPOS = CEPOS
END IF

GO TO 10 ! Skip redundant reads

ENTRY TRUSS_CHECK

CALL VOLIN(IPIC1,VOL,IERR) ! Read VOL compensation
CALL ENCODE(CEPOS,TSEPOS,TNEPOS) ! Read encoder positions
10 CALL EXEC(2,IPIC2,IA(1),1,0)  
CALL EXEC(2,IPIC2,IA(2),1,0)   ! Sample truss North end  
CALL POSIN(IPIC2,TNPOS,IERR)   ! and input position  
  IF (IERR .NE. 0 .AND. IERR .NE. 5  
+ .OR. ABS(TNEPOS-TNPOS) .GT. .01) THEN  
    CALL ERRTRUSS (IERR, TNEPOS, TPOS)  
    GO TO 10  
END IF  
20 CALL EXEC(2,IPIC2,IX(1),1,0)   ! Sample truss South end  
CALL EXEC(2,IPIC2,IX(2),1,0)   
CALL POSIN(IPIC2,TPOS,IERR)    ! and input position  
  IF (IERR .NE. 0 .AND. IERR .NE. 5  
+ .OR. ABS(TSEP0S-TSPOS) .GT. .01) THEN  
    CALL ERRTRUSS (IERR, TSEP0S, TPOS)  
    GO TO 20  
END IF  
RETURN  
END
SUBROUTINE POSCOL Last Revised: 6/03/88

Collects data in a positive direction (probe moving southbound).

Subroutines called:
- CLSTAT
- MCART
- POSW (POSITION)
- POSWATCH
- RECTOPOL

C LAST REVISED 8/5/88

SUBROUTINE POSCOL (IROU)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /BUFFER/ ABUF(4096), PBUF(4096), IBUF
COMMON /BUFFER2/ ABUF2(4096), PBUF2(4096), IBUF2
COMMON /POSN/ XPOS(4096), YPOS(4096)
COMMON /EXP85/ AEXP(O:255)
COMMON /ASSIGN/ IA(O:7), IB(O:7), IC(O:7), IP(O:7),
+ IV(O:7), IX(O:7), IY(O:7), IZ(O:7)
COMMON /PICS/ IPICI, IPIC2, IPIC3
COMMON /HPIB/ 14833, 4833, 18510, J8510, J8340, 08340
COMMON /LASER/ CTI, VOL, DPI, CPOS

CHARACTER CAXIS*I, POL*8, CSCAN*80, NAME*15
COMPLEX CDAT
DIMENSION IDBUF (3,4096), DBUF2(3,4096)
LOGICAL NULL
INTEGER CLASS1, CLASS1W, CLASS2, CLASS2W, API, BREG

ICONT1 = I8510*100b ! Control words for 8510 EXEC calls. 100b
ICONT2 = J8510*100b ! is the code for normal binary format
NP = RSCAN(6) ! # of points to be sampled in data column
IFC1 = I8510 + 5100b ! Control code for a
IFC2 = J8510 + 5100b ! 10 msec IFC on HPIB

DCPOS = YPOS(1) ! Start at first point
CALL MCART (DCPOS,0.,0) ! Move cart to start
C loading the destination register with the location of the last point.

CALL EXEC (2, IPIC3, IX(0), 1, 0)  ! Reset motion comparator
DEST = ABS( CPOS - VPOS(NP) )    ! Offset to end of data row
CALL POSOUT (IPIC3, DEST, 15)    ! Output destination to BIC
CALL EXEC (2, IPIC3, IX(1), 1, 0)  ! Load destination to motion Comp.
CALL EXEC (2, IPIC3, IX(1), 1, 0)  ! Start generating digital difference

C Section to prepare "sample Comparator" and 8510(s) for data collection.
C The destination register of the sample comparator is loaded with the
C location of the next data point to be sampled. As each point is
C reached the comparator's null output automatically triggers the
C 8510(s) (via the Trigger Control Electronics) to sample a data point.
C A Class Read is used to get data from 8510's so this program does not
C monitor the 8510's during a scan. The null line from the comparator
C is monitored so the program knows when to load the location of the
C next data point to be sampled.

CALL EXEC (2, IPIC3, Y(0), 1, 0)  ! Reset sample Comparator

CALL EXEC (3, IFC1, 1)           ! Clear both interface cards
CALL EXEC (3, IFC2, 1)           !

CLASS1W = 0                      ! Initialize Class Numbers
CLASS2W = 0                      !

CALL CLRQ (1, CLASS1W)           ! Reserve class numbers from the system
CALL CLRQ (1, CLASS2W)           ! for 8510 class reads

CLASS1W = IBSET( CLASS1W, 13 )   ! Set "Save Class Number" bit
CLASS2W = IBSET( CLASS2W, 13 )   !

CLASS1 = IBSET( CLASS1W, 15 )    ! Set "No Wait" bit
CLASS2 = IBSET( CLASS2W, 15 )    !

CALL CLSTAT (NPOL, 18510, J8510) ! Set 8510's in Fast CW mode

CALL EXEC (17, ICONT1, IDBUF1, NP*3, 0, 0, CLASS1) ! Do Class Read
CALL ABREG (AREG, BREG)           ! and check for
LOCATION=1                       ! errors
IF (AREG.NE.0) GO TO 999         !

IF (NPOL .EQ. 2) THEN
  CALL EXEC (17, ICONT2, IDBUF2, NP*3, 0, 0, CLASS2) ! Ditto, for
  CALL ABREG (AREG, BREG)                     ! 2nd 8510
  LOCATION=2
  IF (AREG.NE.0) GO TO 999
END IF

C Section to do the actual data collection

WRITE (IWRITE,*) 'COLLECTING DATA FOR COLUMN ', IROW
WRITE (I4833,*) '01' ! Select Southbound
WRITE (I4833,*) '11' ! Enable motion

DO I=1,NP
    POFF = ABS(CPOS-YPOS(I)) ! Offset to sample point
    CALL POSOUT (IPIC3,POFF,15) ! Output dest. to BIC
    CALL EXEC (2,IPIC3,IY(3),1,0) ! Load up Sample Comparator
    CALL EXEC (2,IPIC3,IY(1),1,0) ! Start digital difference

C CALL POSWATCH (IPIC3,IY(0),0.,POFF,1,0,IERR) ! Wait
C IF (IERR .NE. 0 .AND. IERR .NE. 5) THEN
    WRITE (IWRITE,*) 'Error reading laser position. Move to'
    WRITE (IWRITE,*) 'Home position and start over.'
C STOP
C END IF

NULL = .FALSE.
DO WHILE (.NOT. NULL)
    CALL EXEC (1, I4833, INULL, -1) ! Read null from Sample comp.
    NULL = BTEST (INULL, 7) ! Null line at bit 7
END DO

END DO

C Section to check for successful completion of column scan
CALL POSWATCH (IPIC3,IX(0),0.,DEST,1,0,IERR)
IF (IERR .NE. 0 .AND. IERR .NE. 5) THEN
    WRITE (IWRITE,*) 'ERROR in scan of colm #', IROW
    CALL CLRQ (2, CLASS1W)
    CALL CLRQ (2, CLASSZW)
END IF

WRITE (I4833,*) '0' ! Disable motion
CPOS = YPOS(NP) ! New cart position

C Section to get the last point(s) from the Class Reads
CALL EXEC (21, CLASS1W, IDBUF1, NP*3) ! Class Get
CALL ABREG (AREG, BREG)
LOCATION =3
IF (AREG .LT. 0) GO TO 999

IF (NPOL .EQ. 2) THEN
    CALL EXEC (21, CLASSZW, IDBUF2, NP*3) ! Class Get
    CALL ABREG (AREG, BREG)
    LOCATION =4
    IF (AREG .LT. 0) GO TO 999
END IF

C Section to convert data to amplitude/phase format

C-60
DO I = 1, NP
  EX = AEXP( IAND( IDBUF3(I), 255 ) ) ! Exponent
  RE = IDBUF2(I)*EX ! Real part
  RIM = IDBUF1(I)*EX ! Imaginary part
  CDAT = CMPLX(RE, RIM) ! Convert to complex form and
  CALL RECTOPOL(CDAT, AMP, PHSE) ! then to amplitude, phase
  ABUF(I) = AMP ! Store in buffers
  PBUF(I) = PHSE
END IF
END DO

RETURN

999 WRITE (IWRITE,*), 'ERROR on Class Read or Get at location ', LOCATION
STOP

END
SUBROUTINE POSITION

Entry points:

POSIN

POSOUT

Subroutine to read/write position information from/to binary interface card in the laser system (10746 BIC) via the 12006 PIC in the A900 controller. Entry POSIN is used for a position read, entry POSOUT for a destination write.

IPIC -- I/O of the PIC to be used
CTI -- conversion factor, wavelengths to inches (depends on resolution)
VOL -- velocity of light compensation factor
DPI -- deadpath in inches
DPW -- deadpath in wavelengths
POS -- compensated position value in inches
IWL -- number of wavelength counts; binary value of bits 0-27 of interface card (32-bit integer)
ITOL -- tolerance value for bits 28-31
IDEC -- decimal data extracted from bits 28-31
RDEC -- recovered decimal point information
IERR -- 0 if no error or recoverable error occurred
1 if irrecoverable error occurred

Subroutines called:

IERROR

ENTRY POSIN (IPIC, POS, IERR)

CALL EXEC (2,IPIC,3,1,0) ! Set BIC for data output to computer
CALL EXEC (1,IPIC,IBUF,1,0) ! Read most significant word
IERR=ISHFT(IBUF,-8) ! Extract error information
IERR=ERROR(IERR,IPIC) ! Do error check
IF (IERR .NE. 0) RETURN ! Irrecoverable error occurred or destination reached

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IDEC=ISHFT(IBUF,-12)  ! Get decimal information
RDEC=2-IDEC

IWL=0              ! Initialize
CALL MVBITS (IBUF,0,12,IWL,16)  ! Move 12 data bits into upper word
CALL EXEC (1,IPIC,IBUF,1,0)   ! Read least significant word
CALL MVBITS (IBUF,0,16,IWL,0)  ! Combine with upper bits

DPW = DPI/CTI             ! Deadpath in wavelengths
WLTOIN = (IWL-160)*(10.**RDEC) ! Subtract 160 and apply decimal info.
POS = (DPW+WLTOIN)*(VOL*CTI)-DPI    ! Convert to inches

RETURN

ENTRY POSOUT(IPIC, POS, ITOL)

CALL EXEC (2,IPIC,4,1,0)  ! Prepare BIC to input data from computer
DPW = DPI/CTI              ! Deadpath, in wavelengths
IWL = (POS+DPI)/(VOL*CTI)-DPW +160 ! Convert to wavelengths
CALL MVBITS (ITOL,0,4,IWL,28) ! Specify tolerance
CALL MVBITS (IWL,16,16,IBUF,0) ! Load upper 16 bits for output
CALL EXEC (2,IPIC,IBUF,1,0) ! Output upper word
CALL MVBITS (IWL,0,16,IBUF,0) ! Load lower 16 bits for output
CALL EXEC (2,IPIC,IBUF,1,0) ! Output lower word
CALL EXEC (2,IPIC,2,1,0)    ! Transfer BIC data to backplane

RETURN

END
SUBROUTINE POSWATCH

Last Revised: 6/04/88

Subroutine to "watch the position". Monitors the comparator at address BADR of the coupler associated with LU IPIC until the probe cart or translation beam reaches its destination (within the specified tolerance.)

IPIC -- LU for communication with the coupler box containing the comparator
BADR -- Base address of the comparator
BADR+1 -- Instructs the comparator to load counter contents into its output buffer
BADR+2 -- Instructs the comparator to write its output buffer to the coupler backplane
TPOS -- Current truss position (inches)
CPOS -- Current cart position (inches)
DPOS -- Desired position along axis of motion
IMOVE = 0 for truss motion (x-axis)
= 1 for cart motion (y-axis)
IDIS = 1 display position on terminal screen
= 0 no display

Subroutines called:
POSIN (POSITION)
POSCHECK

SUBROUTINE POSWATCH (IPIC, BADR, TPOS, DPOS, IMOVE, IDIS, IERR)

COMMON /HPIB/ 14833, J4833, 18510, J8510, 18340, J8340
COMMON /LASER/ CTI, VOL, DPI, CPOS

FORMAT ('X= ',F7.3,10X,'Y= ',F7.3)
IDIR=SIGN(1.,DPOS-CPOS) !ONLY SIGNIFICANT FOR CART MOTION

CALL EXEC (2,IPIC,BADR+1,1,0) !SAMPLE POSITION
CALL EXEC (2,IPIC,BADR+2,1,0)
CALL POSIN (IPIC, POS, IERR)

IF (IERR .EQ. 5) THEN
RETURN !COMPARATOR W/IN TOLERANCE
ELSE IF (IERR .EQ. 0) THEN

IF (IDIS .EQ. 1) THEN
IF (IMOVE .EQ. 0) THEN
POST=POS !TRUSS POSITION
POSC=CPOS !CART POSITION
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ELSE

    POST=TPOS  !TRUSS POSITION
    POSC=CPOS+(IDIR)*POS  !CART POSITION
END IF

WRITE(1,17) POST,POSC  !DISPLAY POSITION
END IF

GOTO 10  !KEEP WATCHING

ELSE

    WRITE (14833,*), '00'  ! Disable any motion

    IF (IMOVE .EQ. 1) THEN
        WRITE (1,*), 'ERROR ',IERR,' on read of probe cart laser!'
    ELSE
        CALL POSCHECK  ! Try once more
    END IF

END IF

RETURN
END
SUBROUTINE READWRITE

ENTRY READ-DATA (IUNIT, IROW, IRDAT, IDATA, ABUF, PBUF, IBUF)

IF (CAXIS .EQ. 'X') THEN
    IDATA COLLECTED ALONG X AXIS
    NPTS=RSCAN(3)  I# X PTS
ELSE
    IDATA COLLECTED ALONG Y AXIS
    NPTS=RSCAN(6)  I# Y PTS
END IF

C Section for reading data from a file

IF (IDAT .NE. 2) THEN
    IDAT DATA COLLECTED ALONG X AXIS
    I# X PTS
ELSE
    IDATA COLLECTED ALONG Y AXIS
    I# Y PTS
END IF

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+ IREC) (ABUF(M),M=1,NPTS),IBUF
+ IF (IDATA .EQ. 1) READ(UNIT=IUNIT,IOSTAT=IERR,ERR=99,REC=
+ IREC) (PBUF(M),M=1,NPTS),IBUF
ELSE
  IAMPLITUDE AND PHASE STORED
  IREC=2+2*(IROW-1) !RECORD #
  IF (IDATA .NE. 1) READ(UNIT=IUNIT,IOSTAT=IERR,ERR=99,REC=IREC)
+ (ABUF(M),M=1,NPTS),IBUF
  IF (IDATA .NE. 0) READ(UNIT=IUNIT,IOSTAT=IERR,ERR=99,REC=IREC+1) (PBUF(M),M=1,NPTS),IBUF
END IF
RETURN
C
ENTRY WRITE_DATA (IUNIT, IROW, IRDAT, IDATA, ABUF, PBUF, IBUF,
+ AMIN, AMAX, PMIN, PMAX, MAXY, MAXX)

IF (CAXIS .EQ. 'XI ) THEN !DATA COLLECTED ALONG X AXIS
  NPTS=RSCAN(3) !# X PTS
ELSE
  NPTS=RSCAN(6) !# Y PTS
END IF

C Section to determine maximum and minimum amplitudes and phases

IF (IROW .EQ. 1) THEN
  AMIN=100.
  AMAX=-100.
  PMIN=180. !INITIALIZE THE MAX AND MINS
  PMAX=-180.
END IF
DO I=1,NPTS
  IF(ABUF(I) .GT. AMAX) THEN
    AMAX=ABUF(I) !AMPLITUDE MAX
    IF (CAXIS .EQ. 'XI') THEN
      MAXY=IROW
      MAXX=1
    ELSE
      MAXY=IROW
      MAXX=1
    END IF
  END IF
  IF (ABUF(I) .LT. AMIN) AMIN=ABUF(I)
END DO

C Section for writing data to a file

IF (IRDAT .NE. 2) THEN !ONLY AMP OR PHASE STORED
  IREC=I+IROW !RECORD #
IF (IRDAT .EQ. 0) WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=98,REC= 
  IREC) (ABUF(M),M=1,NPTS),IBUF
  IF (IRDAT .EQ. 1) WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=98,REC= 
  IREC) (PBUF(M),M=1,NPTS),IBUF
  ELSE !AMPLITUDE AND PHASE STORED
    IREC=2+2*(IROW-1) !RECORD #
    IF (IDATA .NE. 1) WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=98,REC= 
      IREC) (ABUF(M),M=1,NPTS),IBUF
    IF (IDATA .NE. 0) WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=98,REC= 
      IREC+1) (PBUF(M),M=1,NPTS),IBUF
  END IF

RETURN

C Section for error messages

98 WRITE (IWRITE,*): 'ERROR ',IERR,' WRITING ROW ',IROW,' TO FILE ', NAME
  RETURN

99 WRITE (IWRITE,*): 'ERROR ',IERR,' READING ROW ',IROW,' FROM FILE ', NAME
  RETURN

END
SUBROUTINE RECTOPOL

Last Revised: 5/30/88

Converts a complex number in rectangular form (DATA) into equivalent amplitude and phase. Amplitude (AMP) is returned in dB and phase (PHASE) is returned in degrees.

SUBROUTINES called:
None

SUBROUTINE RECTOPOL (DATA, AMP, PHASE)

COMPLEX DATA

PI=3.1415927

X = REAL(DATA)
Y = AIMAG(DATA)
AMP = SQRT(X**2 + Y**2)

IF (AMP .EQ. 0.) THEN
    PHASE = 0.
ELSE
    PHASE = ATAN2(Y,X) ! Phase in radians
ENDIF
PHASE = PHASE * 180./PI ! Phase in degrees

IF (AMP .LE. 0.00001) THEN
    AMP = -100.
ELSE
    AMP = 20. * ALOG10(AMP) ! Amplitude in dB
ENDIF
RETURN
END
SUBROUTINE RESET (IPIC)

IPRAM1 = 63
ICNT = IPIC + 40006
CALL EXEC (3,ICNT,IPRAM1) !CONFIGURE PIC CONTROL REGISTER

CALL EXEC (2,IPIC,0,1,0) !SEND RESET COMMAND TO BINARY
CALL EXEC (2,IPIC,0,1,0) !INTERFACE CARD

RETURN
END
FUNCTION RMULTFIND()

ENTRY RMULTUP (RVAR, FACTR)

RMULTUP = RVAR

IF (RVAR / FACTR .NE. INT(RVAR / FACTR)) THEN
   IF (RVAR .GE. 0) THEN
      RMULTUP = INT((RVAR + FACTR) / FACTR) * FACTR  ! FOR POSITIVE #S
   ELSE
      RMULTUP = INT(RVAR / FACTR) * FACTR  ! FOR NEGATIVE #S
   END IF
END IF

RETURN

ENTRY RMULTDOWN (RVAR, FACTR)

RMULTDOWN = RVAR

IF (RVAR / FACTR .NE. INT(RVAR / FACTR)) THEN
   IF (RVAR .GE. 0) THEN
      RMULTDOWN = INT((RVAR / FACTR) * FACTR)  ! FOR POSITIVE #S
   ELSE
      RMULTDOWN = INT((RVAR - FACTR) / FACTR) * FACTR  ! FOR NEGATIVE #S
   END IF
END IF

RETURN

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END
SUBROUTINE SCAN

This subroutine is used to collect a whole data set according to the scan parameters and store the data in a file.

IROU - Counter indicating which row is currently stored in the buffer
IAXIS = 0 for data collection along Y-axis (only mode currently implemented)
CPOS - current cart position
NPOL - number of poles to be collected (1 or 2)

Subroutines called:
COLLECT
DATETIME
HEADREAD (HEADER)
HEADWRITE (HEADER)
NAMFILE

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
                             IDATE(3), ITIME(3), NPOL
COMMON /MINMAX/ AMIN, AMAX, PMIN, PMAX, MAXX, MAXY
COMMON /MINMAXX/ AMIN2, AMAX2, PMIN2, PMAX2, MAXY2, MAXX2
COMMON /BUFFER/ ABUF(4096), PBUF(4096), IBUF
COMMON /BUFFERZ/ ABUF2(4096), PBUF2(4096), IBUF2
COMMON /POSN/ XPPOS(4096), YPOS(4096)
COMMON /PICS/ IPIC1, IPIC2, IPIC3
COMMON /HPIB/ 14333, J4333, I8510, J8510, I8340, J8340
COMMON /USER/ IWRITE, IREAD
COMMON /LASER/ CTI, VOL, DPI, CPOS

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER COM*2

IAXIS=0
IUNIT=3
IUNIT2=4
FORMAT(A)

CALL DATETIME (IDATE, ITIME)    !READ DATE AND TIME
CALL NAMFILE (IUNIT, 1)        !OPEN PRIMARY FILE
CALL HEADWRITE (IUNIT, 2)      !STORE HEADER INFO.
AMIN1=100.
AMAX1=-100.
PMIN1=180. !INITIALIZE PRIMARY MAX AND MINS
PMAX1=-180.

IF (NPOL .EQ. 2) THEN
  CALL NAMFILE (IUNIT2,1) !OPEN SECONDARY POL FILE
  WRITE (IWRITE,*), 'Enter label for 2nd polarization:'
  READ (IREAD,10) POL
  CALL HEADWRITE (IUNIT2,2) !STORE HEADER INFO.
  AMIN2=100.
  AMAX2=-100.
  PMIN2=180. !INITIALIZE MAX AND MINS
  PMAX2=-180.
END IF

IWRITE=0
WRITE (IWRITE,*), 'Should each row be plotted?',
+ 'after it is collected? (N/Y)'
READ (IREAD,10) COM
IF (COM .EQ. 'Y') OR. COM .EQ. 'y') IWRITE=1

IF (CAXIS .EQ. 'y') THEN
  NROWS=RSCAN(3) !NUMBER OF DATA COLUMNS TO COLLECT
  IAXIS=0
ELSE
  NROWS=RSCAN(6)
  IAXIS=1
END IF

CALL COLLECT (1, NROWS, IROW, NPOL, IWRITE)

CALL HEADREAD (IUNIT,IRDAT) !GET PRIM. FILE NAME AND POL.

AMIN=AMIN1
AMAX=AMAX1
PMIN=PMIN1 !UPDATE MIN AND MAX INFO.
PMAX=PMAX1
MAXY=MAXY1
MAXX=MAXX1

CALL HEADWRITE(IUNIT,2) !STORE CORRECT MAX AND MIN INFO.
CLOSE(IUNIT)

IF (NPOL .EQ. 2) THEN
  CALL HEADREAD(IUNIT2,IRDAT) !GET SECONDARY FILE NAME AND POL.

  AMIN=AMIN2
  AMAX=AMAX2 !MAX AND MINS
  PMIN=PMIN2
  PMAX=PMAX2
  MAXY=MAXY2
  MAXX=MAXX2

  CALL HEADWRITE(IUNIT2,2) !STORE CORRECT MAX AND MIN INFO.
  CLOSE(IUNIT2)
END IF

RETURN

END
SUBROUTINE SETSOURCE Last Revised: 6/06/88

This subroutine sets the frequency and power level of the two sources. The arguments are:

- FREQ = Operating frequency
- IMODE = 0 Probe receiving
- 1 Probe transmitting
- NPOL = Number of poles being collected (1 or 2)

Subroutines called:

SOURCE

SUBROUTINE SETSOURCE (FREQ, IMODE, NPOL)
COMMON /HPIB/ 14833, J4833, 18510, J8510, 18340, J8340
COMMON /PICS/ IPIC1, IPIC2, IPIC3
COMMON /USER/ IWRITE, IREAD
CHARACTER CSTRING*40, ANS*1

10 FORMAT('CEN1 ',F8.5,' GHz;USER1;CHAN1')
15 FORMAT(A)
GO TO 100 ! Skip user prompts

ENTRY SRC_USER (FREQ, IMODE, NPOL)
90 WRITE (1,*) 'Enter the desired operating frequency (GHz): '
READ (1,*) FREQ
WRITE (1,*) 'Will the TEST Antenna be transmitting or receiving'
+ ', (T/R)?'
READ (1, '(A1)') ANS
IMODE = 0
IF (ANS.EQ.'R' .OR. ANS.EQ.'r') IMODE = 1

IF (FREQ .LT. 1.0) THEN
  WRITE (1,*) 'WARNING: System not set up to operate below 1.0 GHz!'
  GO TO 90
ELSE IF (FREQ .LE. 6.0) THEN
  RF_PWR = 10.0
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LO_PWR = -20.0
LO_FPR = (FREQ-.02)

ELSE IF (FREQ .LE. 18.0) THEN
   RF_PWR = 10.0
   LO_PWR = -20.0
   LO_FPR = (FREQ-.02) / 3.

ELSE IF (FREQ .LE. 26.5) THEN
   RF_PWR = 10.0
   LO_PWR = -20.0
   LO_FPR = (FREQ-.02) / 5.

ELSE IF (FREQ .GT. 26.5) THEN
   WRITE (1,*), 'WARNING: System not set up to operate above ',
   + '26.5 GHz!'
   GO TO 90
END IF

IF (IMODE.EQ.0) THEN
   CALL SOURCE (14830, RF_PWR, FREQ)
   CALL SOURCE (J4830, LO_PWR, LO_FPR)
ELSE
   CALL SOURCE (J4830, RF_PWR, FREQ)
   CALL SOURCE (14830, LO_PWR, LO_FPR)
END IF

WRITE (CSTRING,10) FREQ
WRITE (18510,*), CSTRING
IF (NPOL .EQ. 2) WRITE (J8510,*), CSTRING

RETURN
END
SUBROUTINE SIDECHECK (IROU)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+    IDATE(3), ITIME(3), NPOL
COMMON /POSN/ XPOS(4095), YPOS(4095)
COMMON /LASER/ CTI, VOL, DPI, CPOS

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15

NPTS = RSCAN(6) ! # of pts in column to be collected
DSTART = ABS( CPOS-YPOS(1) ) ! Distance to start of data column
DEND = ABS( CPOS-YPOS(NPTS) ) ! Distance to end of data column

IF (DSTART .LE. DEND) THEN
    CALL POSCOL (IROU) ! Scan forward from first pt.
ELSE
    CALL NEGCOL (IROU) ! Scan backward from last pt.
END IF

RETURN
END
SUBROUTINE SOURCE

Last Revised: 6/04/88

Entry points:
SOURCE
SRC_PWR

This subroutine sets the CW frequency and power level for an HP 8340 synthesizer. If entry point SRC_PWR is used, just the power level is set. The arguments have the following meaning:
IADDR = LU of the source to be set
PWR = desired power level from source (dBm)
FREQ = operating frequency of source (GHz)

Subroutines called:
None

SUBROUTINE SOURCE (IADDR, PWR, FREQ)

CHARACTER CFREQ*12, CPWR*10

WRITE (CFREQ,'("CW",F8.5, "GZ")') FREQ
WRITE (IADDR,'(A)',ERR=999) CFREQ

ENTRY SRC_PWR (IADDR, PWR)

WRITE (CPWR,'("PW",F6.2,"DB")') PWR
WRITE (IADDR,'(A)',ERR=999) CPWR

RETURN

999 WRITE (1,*) 'WARNING: Error setting source', IADDR
PAUSE
RETURN
END
SUBROUTINE STO_POSN

COMMON /PARAM/ RSCAN(71), CAXIS, POL, CSCAN, NAME,
               IDATE(3), ITIME(3), NPOL
COMMON /POSN/ XPOS(4096), YPOS(4096)

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15

DO I=1,RSCAN(3)
   XPOS(I)=RSCAN(1) + (I-1)*RSCAN(2) ! X coordinates
END DO

DO I=1,RSCAN(6)
   YPOS(I)=RSCAN(4) + (I-1)*RSCAN(5) ! Y coordinates
END DO

RETURN
END
SCDS ON

SUBROUTINE WIPE Last Revised: 5/19/88

This subroutine clears the terminal display.

Subroutines called:
None

SUBROUTINE WIPE

CHARACTER*4 A,G,U

A=CHAR(27)//'W'//CHAR(27)//'J' !Clear Alpha display
G=CHAR(27)//'*dat' !Clear Graphics display
U=CHAR(27)//'&jC41' !Clear User Keys display

WRITE(1,5) A,G,U

5 FORMAT (3A4)

RETURN
END
SUBROUTINE VOLIN

Last Revised: 5/20/88

Subroutine to read temp. compensation coefficient via the PIC.

IPIC -- LU of the PIC to be read from
IDATA -- binary value of data bits 0-27 from interface card (32-bit integer)
IDEC -- binary value of the decimal data extracted from bits 28-31
IERR -- 0 if no error or recoverable occurred.
1 if irrecoverable error occurred.
VOL -- Velocity-of-light compensation calculated from IDEC and IDATA

Subroutines called:
DELAY

SUBROUTINE VOLIN(IPIC,VOL,IERR)

INTEGER*4,IDATA

CALL EXEC(2,IPIC,98,1,0) !TAKE NEW READING
CALL DELAY(500) !WAIT FOR MEAS. TO BE COMPLETE
CALL EXEC(2,IPIC,98,1,0) !SAMPLE COMP. READING
CALL EXEC(2,IPIC,3,1,0) !PREPARE PIC TO OUTPUT DATA
CALL EXEC(1,IPIC,IBUF,1,0) !READ MOST SIGNIFICANT WORD IN IDATA=0 !INITIALIZE
IERR=ISHFT(IBUF,-8) !EXTRACT ERROR INFORMATION
IERR=IERROR(IERR,IPIC) !GO TO ERROR CHECKING ROUTINE
IF (IERR .EQ. 4) GOTO 10 !VOL ERROR
IDEC=ISHFT(IBUF,-12) !GET DECIMAL INFORMATION
RDEC=2-IDEC
CALL MVBIT$(IBUF,0,12,IDATA,16) !MOVE 12 DATA BITS INTO UPPER WORD
CALL EXEC(1,IPIC,IBUF,1,0) !READ LEAST SIGNIFICANT WORD IN
CALL MVBIT$(IBUF,0,16,IDATA,0) !STORE IN ONE WORD
VOL=IDATA*(10.**RDEC)

RETURN
END

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SUBROUTINE WPTJ (IROW, IAXIS, ABUF, PBUF)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /AMP/ VHI, VLO, YMAX, YMIN

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
REAL AR(2)

CALL SWIPE
CALL JNEWF
CALL JIWS(1,254,0,2,IDUM,AR)

VMAXX=1.0
VMAXY=1.0
IF (AR(1) .LT. 1.0) THEN
  VMAXY=AR(1)
ELSE
  VMAXX=1.0/AR(1)
END IF

YLOW=VMAXY/8*5

CALL DEFINE(IAXIS,START,RINC,NP) !GET # OF PTS.
PO=PDEF(IAXIS,1) !GET STARTING PT.
P1=PDEF(IAXIS,NP) !GET ENDING PT.
SPACE=(P1-PO)/10. !BREAK INTO TENTHS
XMIN=PO+SPACE
XMAX=P1+SPACE
VHI=-1000.
VLO=1000.  !INITIAL VALUES

DO I=1,NP
   IF (ABUF(I) .GT. VHI) VHI=ABUF(I)  !HIGHEST AMP VALUE
   IF (ABUF(I) .LT. VLO) VLO=ABUF(I)  !LOWEST AMP VALUE
END DO

VHI=RMULTUP(VHI,5.)  !ROUND UP TO NEAREST 10 DB
VLO=VHI-45.  !LOWEST AMP VALUE

YMIN=VLO-((VHI-VLO)*.1)
YMAX=VHI+((VHI-VLO)*2)

C Section for setting viewport and window for amplitude plot
CALL JWIN(D,XMIN,XMAX,YMIN,YMAX)  !LIMITS FOR AMP PLOT
CALL JVIEW(0.,VMAXX,0.,YLOW)  !SET VIEWPORT TO LOWER 5 EIGHTHS
CALL LABJ(0,IAXIS,IROW,PO,P1)  !DRAW GRID AND LABELS FOR AMP
CALL DRWJ(0,IAXIS,NP,ABUF)  !DRAW PLOT FOR AMP

C Section for setting viewport and window for phase plot
CALL JWIN(D,XMIN,XMAX,-270.,300.)  !LIMITS FOR PHASE PLOT
CALL JVIEW(0.,VMAXX,YLOW,VMAXY)  !UPPER 3 EIGHTHS
CALL LABJ(1,IAXIS,IROW,PO,P1)  !DRAW GRID AND LABELS FOR PHASE
CALL DRWJ(1,IAXIS,NP,PBUF)  !DRAW PLOT FOR PHASE

CALL JMCUR  !MAKE PICTURE CURRENT

RETURN
END
This subroutine initializes the scan parameters after prompting the user to input desired values. The position buffer is updated and the sources are set via calls to STO_POSN and SETSOURCE, respectively.

Subroutines called:
LISTCHANGE
SETSOURCE
STO_POSN

SUBROUTINE XINIT (IMODE, INIT)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /USER/ IWRITE, IREAD
COMMON /TITLE/ CTITL(10)

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER ANS*8, CTITL*28

C If called from initialization routine, ask user

IF (INIT .NE. 0) THEN
   WRITE (IWRITE,*), 'Do you wish to set the scan parameters?',
   '(N/Y)
   READ (IREAD,*), ANS
   IF (ANS .NE. 'Y') RETURN
END IF

C Get scan parameters from user

DO I=1,7
   WRITE (IWRITE,*), CTITL(I), '?'
   READ (IREAD,*), RSCAN(I)
   IF (RSCAN(I) .LT. 0) GOTO 13
   IF (I .EQ. 3 .OR. I .EQ. 6) THEN
      RSCAN(I) = INT(RSCAN(I))
   END IF
END DO

WRITE (IWRITE,*), CTITL(8), '?'
READ (IREAD,*), NPOL

WRITE (IWRITE,*), CTITL(9), '?'
READ (IREAD,10), POL

C-85
WRITE (IWRITE,*) CTITL(10),'?"' ! data set description
READ (IREAD,10) CSCAN ! (80 chars)

WRITE (IWRITE,*) 'Will the TEST Antenna be Transmitting or',
+ 'Receiving (T/R)?'
READ (IREAD,10) ANS
IMODE = 0
IF (ANS.EQ.'R' .OR. ANS.EQ.'r') IMODE = 1

10 FORMAT (A)
C Call routines to store position coordinates in buffer /POSN/
C and set freq, power levels on sources

FREQ = RSCAN(7)
CALL SETSOURCE (FREQ, IMODE, NPOL)
CALL STO_POSN !COMPUTE POSITION BUFFERS
CALL LISTCHANGE (IMODE) !EXAMINE PARAMETERS

RETURN
END
APPENDIX D

Program NFFT Listing
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Load file for Program NFFT

Last Revision: 14 NOV 88

EC
DE

RE NFFT.REL

RE ARRAY_DUMP.REL
RE ARRAY_FILL.REL
RE BLACKMAN.REL
RE BLOWUP.REL
RE CONVERT.REL

RE CORREC.REL
RE DATETIME.REL::NASA
RE DUMP_FILTER.REL
RE EEU.REL
RE EHU.REL

RE EXPAND.REL
RE FFT2.REL
RE GOWAVGD.REL
RE GETPAT.REL
RE GRIDSET.REL::NASA

RE HEADER.REL::NASA
RE NAMFILE.REL::NASA
RE NFNORM.REL
RE PCALC.REL
RE PCORR.REL

RE POLAR.REL
RE POWRT.REL
RE READWRITE.REL::NASA
RE S10T01.REL
RE SEPARATE.REL

RE SEPRTRANS.REL
RE S1NX.REL
RE SWIPE.REL::NASA
RE TESTP2.REL
RE TRANSLATE.REL

RE XTHUY.REL
RE XYTYCON.REL
RE XYTZCON.REL
RE XYZOPEN.REL::NASA

LI %FRPLS::FTN7X
LI $FCDSS::VCPLUS

EMA 1022
VM,65000
WS,1022
This program reduces two-dimensional near field data.

Written by J.P. Montgomery Feb 1976
Extensively modified starting Mar 1986
by P.G. Friederich and V.K. Tripp

Program Last Revised: 05 AUG 1988

References for this program (especially the probe

correction section):

Kerns, D.M., Plane-wave Scattering-Matrix Theory of
Antennas and Antenna-Antenna Interactions, NBS
Monograph 162, June 1981.

Montgomery, J.P., "Near-Field Measurement Equation and

Tripp, V.K., "Probe Correction of Arbitrary Polarization",

COMPLEX SDATA(4096)
COMPLEX DATA(4096,4096),DATA2(4096,4096),BFILT(4096,4096)
EMA DATA,DATA2,DUMMY,BFILT,SDATA
COMPLEX CJ,DUMMY,AO
CHARACTER*80 TITLE,CANS,TEMP,CTIT,CTIT2
CHARACTER*15 INPUT,COF,FNAME,FNAME2
CHARACTER*1 CFILT
INTEGER DBUFF(15)
LOGICAL REPEAT
LOGICAL SINGLE

COMMON /PARAM/ RSCAN(7),CAXIS,POL,TITLE,NAME,IDATE(3),ITIME(3)
COMMON /MINMAX/ AMIN,AMAX,PMIN,PMAX,JMAX,IMAX
COMMON /BUFFER/ABUF(4096),PBUF(4096),IBUF
COMMON /USER/ IWRITE,IREAD
COMMON /WVGE/ A,B,AKO
COMMON /LIMIT/ NX0,NX1,NY0,NY1
COMMON /TRANS/TX,TY,TZ,FILTER,SXINC,SYINC
COMMON /RECBUFF/LBUF(8200)

INTEGER*4 TIME0,TIME1,TIME2,TIME3,TIME4,TIME5
INTEGER*4 ElapsedTime
CHARACTER NAME*15,CAXIS*1,POL*8,CO cocaine*8,XPOL*8,BELL*1

CALL ResetTimer
C
C Unit numbers for files:
C
C Unit 2 - Aperture data, 1st probe rotation
C Unit 3 - Aperture data, 2nd probe rotation
C Unit 4 - Spectrum data, 1st probe rotation
C Unit 5 - Spectrum data, 2nd probe rotation
C Unit 6 - Output file for debugging information
C Unit 8 - Pattern data for probe correction (1st rotation)
C Unit 9 - Pattern data for probe correction (2nd rotation)
C Unit 11 - Input file for unattended run
C Unit 13 - Output file for aperture Blackman filter
C Unit 14 - Output file for spectral Blackman filter

OPEN (UNIT=6, FILE='Output_junk')

IF (INPUT.EQ.'1') THEN
    IREAD=1
    IWRITE=1
ELSE
    IREAD=11
    OPEN (UNIT=11, FILE=INPUT)
    IWRITE=6
END IF

BELL=CHAR(7)
P1=ACOS(-1.)
CJ=(0., 1.)
DR=PI/180
RD=180./PI

CALL DateTime(IDATE,ITIME)
CALL FTIME (DBUFF)
CALL SWIPE
WRITE (1,('3A1')) CHAR(10),CHAR(10),CHAR(10)
WRITE (1,4)
WRITE (1,('/20X,15A2')) DBUFF
WRITE (6,5) (IDATE(I),I=1,3),(ITIME(I),I=1,3)

4 FORMAT ( 20X,
+
' * * * * * PROGRAM NFFT * * * * * '
)+5 FORMAT (' ** ** PROGRAM NFFT **** '1X,2(I2,':',12))

WRITE (1,97)
WRITE (1,* ) ' Default responses are shown in parentheses. When'
+WRITE (1,* ) ' a choice is'
WRITE (1,* ) ' displayed, the first response is the default.'
WRITE (1,* ) ' Defaults may be selected with the Return key.'
WRITE (1,97)
99 FORMAT ( A80 ) ! For user inputs with CANS
98 FORMAT ( A ) ! For use with BELL
97 FORMAT ( /// )
Input the test data

WRITE (1,98) BELL
WRITE (IWRITE,*) '1. How many polarizations will be analyzed?'
WRITE (IWRITE,*) ',(1 or 2)'
READ (IREAD,99) CANS
NPOL=1
IF (CANS .EQ. '2') NPOL=2
WRITE (IWRITE,*) 'NPOL = ',NPOL

WRITE (IWRITE,*)
IF (NPOL.EQ.2) THEN
  WRITE (IWRITE,*) '2a. For the parallel pole aperture data -'
ELSE
  WRITE (IWRITE,*) '2. For the aperture data to be analyzed -'
END IF
CALL NAMFILE(2,0)
COFILE=NAME
WRITE (6,110) NAME
IF (NPOL.EQ.2) THEN
  WRITE (IWRITE,*)
  CALL NAMFILE(3,0)
  XFILE=NAME
  WRITE (6,110) NAME
END IF

CALL HEADREAD(2,IRDAT)
TEMP=TITLE
COPOL=POL
NX=INT(RSCAN(3))
NY=INT(RSCAN(6))
CANS=CAXIS

IF (NPOL.EQ.2) THEN
  CALL HEADREAD(3,IRDAT)
  IF (NX.NE.RSCAN(3)) .OR. (NY.NE.RSCAN(6)) .OR.
  (CANS.NE.CAXIS)) THEN
    WRITE (IWRITE,*) '*** File mismatch - program aborted ***
    STOP
  END IF
  XPOL=POL
END IF

WRITE (6,112) TEMP
IF (NPOL.EQ.2) WRITE (6,112) TITLE

NX0=1
NY0=1
NX1=NX
NY1=NY
WRITE (IWRITE,*)
WRITE (IWRITE,*) '3. Enter row numbers for starting, ending X:
+ \(1, NX, \)'
READ (IREAD,99) CANS
IF (CANS .GT. 1) READ (CANS,*) NXO, NX1

WRITE (IWRITE,*)
WRITE (IWRITE,*) '4. Enter row numbers for starting, ending Y:
+ \(1, NYO, NY1, \)'
READ (IREAD,99) CANS
IF (CANS .GT. 1) READ (CANS,*) NYO, NY1

IXINC=1
IYINC=1

WRITE (IWRITE,*)
WRITE (IWRITE,*) '5. Enter X thinning increment: (1)'
READ (IREAD,99) CANS
IF (CANS .GT. 1) READ (CANS,*) IXINC

WRITE (IWRITE,*)
WRITE (IWRITE,*) '6. Enter Y thinning increment: (1)'
READ (IREAD,99) CANS
IF (CANS .GT. 1) READ (CANS,*) IYINC

WRITE (1,*) 'Data set to be analyzed: '
WRITE (1,*) 'X points \(1, NXO, \) through \(1, NX1, \), every \(1, IXINC, \)th point;'
WRITE (1,*) 'Y points \(1, NYO, \) through \(1, NY1, \), every \(1, IYINC, \)th point.'

WRITE (6,*) 'Data set to be analyzed: '
WRITE (6,*) 'X points \(1, NXO, \) through \(1, NX1, \), every \(1, IXINC, \)th point;'
WRITE (6,*) 'Y points \(1, NYO, \) through \(1, NY1, \), every \(1, IYINC, \)th point.'

Time0 = ElapsedTime0

MX = 1 + (NX1-NXO)/IXINC
MY = 1 + (NY1-NYO)/IYINC
AMIN = 100.
AMAX = -100.

CALL ARRAY_FILL(DATA, NXO, NYO, MX, MY, IXINC, IYINC, 2, 1)
IF (NPOL .EQ. 2) THEN
   CALL ARRAY_FILL(DATA2, NXO, NYO, MX, MY, IXINC, IYINC, 3, 2)
END IF

NX = MX
NY = MY
RSCAN(3) = NX
RSCAN(6) = NY
RSCAN(2) = RSCAN(2)*IXINC
RSCAN(5) = RSCAN(5)*IYINC
In this routine, the DATA arrays are one-dimensional. They are re-dimensioned in the subroutines for compactness of data storage. In the subroutines, a row represents a scan of constant Y; a column, a scan of constant X. (The first subscript represents the row number.) In other words, all data is stored in locally packed form with the first subscript varying fastest.

NX Number of pts. per row - the extent of the first index
NY Number of rows - the extent of the second index
XINC Spacing of data along the X axis (inches)
YINC Spacing of data along the Y axis (inches)
FREQ Frequency in GHz

Time1 = ElapsedTime()

FREQ = RSCAN(7)
ALAM = 11.80283/FREQ \* Wavelength
AKO = 2. * PI / ALAM \* Wave Number
XINC = RSCAN(2)
IF (NX.EQ.1) XINC = 2. * PI
YINC = RSCAN(5)
IF (NY.EQ.1) YINC = 2. * PI

NORMALIZE NF DATA

WRITE (1,*) ' Ready to normalize the aperture data.'
WRITE (1,*)

First, get the feed through level for reference

WRITE (iWRITE,*)
WRITE (1,98) BELL
WRITE (iWRITE,*) 7. Enter the reference amplitude and phase, ' +', in dB and degrees.'
WRITE (iWRITE,*) (Use the feedthrough values if available.)'
WRITE (iWRITE,*) (Default is the maximum amplitude.)'
READ (IREAD,99) CANS
IF (CANS .GT. 1.0) READ (CANS,*) AMAX,PMAX
AO = CMPLX(AMAX,PMAX)

Next, translation in wave-number space

AKX = 0.
AKY = 0.
WRITE (IWRITE,*)
WRITE (IWRITE,*) ' 8. Enter normalized wave numbers (Kx,Ky) for '
WRITE (IWRITE,*)' the desired K-space translation: (0.,0.) '
READ (IREAD,99) CANS
IF (CANS .GT. 1.) READ (CANS,*) AKX,AKY
WRITE (IWRITE,*) 'New pattern origin at ',AKX,AKY
AKX = AKX*AKO
AKY = AKY*AKO
CALL NFNORM (DATA, NX, NY, AKX, AKY)
IF (NPOL.EQ.2) CALL NFNORM (DATA2, NX, NY, AKX, AKY)
WRITE (6,290) AMAX, PMAX
290 FORMAT (' Near field normalization: ', F10.5, ' dB, ', + F10.5, ' deg.' / )
C Pad input for desired resolution enhancement
CALL TESTP2(NX, ISXP2)
CALL TESTP2(NY, ISYP2)
CALL POWRT(NX, NXPZ, ISXP2)
CALL PWRT(NY, NYPZ, ISYPZ)
REPEAT = .TRUE.
DO WHILE (REPEAT)
  REPEAT = .FALSE.
  SNXRES = ALAM / (XINC*NXP2)
  SNYRES = ALAM / (YINC*NYP2)
  IF (SNXRES .GT. 1.) THEN
    SNXRES = 1.
    WRITE (IWRITE,*)
    WRITE (IWRITE,*) ' WARNING: X scan less than a wavelength'
    WRITE (IWRITE,*) ' Potential error at '
    WRITE (IWRITE,*) ' resolution enhancement. '
  END IF
  IF (SNYRES .GT. 1.) THEN
    SNYRES = 1.
    WRITE (IWRITE,*)
    WRITE (IWRITE,*) ' WARNING: Y scan less than a wavelength'
    WRITE (IWRITE,*) ' Potential error at '
    WRITE (IWRITE,*) ' resolution enhancement. '
  END IF
  ANXRES = ASIN(SNXRES) * RD
  ANYRES = ASIN(SNYRES) * RD
  WRITE (IWRITE,220) NXPZ,SNXRES,ANXRES, NYPZ,SNYRES,ANYRES
220 FORMAT (' Dimension Resolution Main-beam Angular Res. ', / + ',16,' ,F8.4,' ',F8.4,' deg.' / )
WRITE (IWRITE,*)
WRITE (1,98) BELL
WRITE (IWRITE,*) ' 9a. Would you like increased resolution on'
WRITE (IWRITE,*) '  the X-axis ? (N/Y)'
READ (IREAD,99) CANS
IF (CANS .EQ. 'Y' .OR. CANS .EQ. 'y') THEN
   NXPZ=NXP2*2
   IF (NXP2.GT.4096) NXP2 = NXPZ/2
   REPEAT = .TRUE.
END IF
WRITE (IWRITE,*)
WRITE (IWRITE,*) ' 9b. Would you like increased resolution on'
WRITE (IWRITE,*) ' the Y-axis ? (N/Y)'
READ (IREAD,99) CANS
IF (CANS .EQ. 'Y' .OR. CANS .EQ. 'y') THEN
   NYPZ=NYP2*2
   IF (NYP2.GT.4096) NYP2 = NYPZ/2
   REPEAT = .TRUE.
END IF
END DO
END IF
IF (NX.NE.NXPZ .OR. NY.NE.NYPZ) THEN
   CALL EXPAND (DATA,NX,NY,NXPZ,NYPZ)
   IF (NPOL.EQ.2) CALL EXPAND (DATA2,NX, NY, NXPZ, NYPZ)
END IF
WRITE (6,*) ' Old Dimensions = ',NX,NY
WRITE (6,*) ' New Dimensions = ',NXPZ,NYPZ
NX = NXPZ
NY = NYPZ

C FFT Section, including resolution enhancement for a sector

WRITE (1,*) ' Ready for the FFT section.'
WRITE (1,*)
WRITE (IWRITE,*)
WRITE (1,98) BELL
WRITE (IWRITE,*) ' 10. Does this data set contain independent '
WRITE (IWRITE,*) '  column or row measurements? (N/Y)'
READ (IREAD,99) CANS
SINGLE = .FALSE.
IF (CANS.EQ.'Y' .OR. CANS.EQ.'y') SINGLE = .TRUE.
Time2 = ElapsedTime()
IF (SINGLE) THEN
   CALL SEPARATE(XINC,YINC,NPOL,NX,NY,DATA,DATA2,CAXIS)
ELSE
   DA = XINC * YINC / (4. * PI**2)
   CALL FFT2 (1, NX, NY, DA, DATA)
   IF (NPOL.EQ.2) CALL FFT2 (1, NX, NY, DA, DATA2)
END IF
C For area factor in FFT (DA) see Kerns, 3.1-3, p. 87

Time3 = ElapsedTime()

SXINC = ALAM / (NX*XINC)  ! X increment for spectrum data
IF (XINC.EQ.0) SXINC=0
SYINC = ALAM / (NY*YINC)  ! Y increment for spectrum data
IF (YINC.EQ.0) SYINC=0
SXO = -(NX/2)*SXINC
SYO = -(NY/2)*SYINC
RSCAN(1) = SXO
RSCAN(2) = SXINC
RSCAN(3) = NX
RSCAN(4) = SYO
RSCAN(5) = SYINC
RSCAN(6) = NY
RSCAN(7) = -FREP  ! Negative to indicate spectrum data

WRITE (1,981) BELL
WRITE (IWRITE,*)
WRITE (IWRITE,*), ' 11a. Would you like to examine a sector of the data with greater resolution? (N/Y)'
READ (IREAD,99) CANS
IF (CANS.EQ.'Y'.OR. CANS.EQ.'y') THEN
   SXL = -1
   SXU = 1
   WRITE (IWRITE,*), ' 11b. Enter the sector limits for Kx :', ' (-1., 1.)'
   READ (IREAD,99) CANS
   IF (CANS.GT.' ') READ (CANS,*) SXL, SXU
   IF (SXL.GT.SXU) THEN
      SWAP = SXL
      SXL = SXU
      SXU = SWAP
   END IF
   IL = (SXL-SXO)/SXINC + 1
   RIU = (SXU-SXO)/SXINC + 1.
   IU = RIU
   IF (FLOAT(IU).LT.RIU) IU = IU+1
   SYL = -1
   SYU = 1
   WRITE (IWRITE,*), ' 11c. Enter the sector limits for Ky :', ' (-1., 1.)'
   READ (IREAD,99) CANS
   IF (CANS.GT.' ') READ (CANS,*) SYL, SYU
   IF (SYL.GT.SYU) THEN
      SWAP = SYL
      SYL = SYU
      SYU = SWAP
D-10
SYU = SYL
END IF
JL = (SYL-SYO)/SYINC + 1
RJU = (SYU-SYO)/SYINC + 1.
JU = RJU
 IF (FLOAT(JU) .LT. RJU) JU = JU+1
NXSECT = IU - IL + 1
NYSECT = JU - JL + 1
CALL TEST2 (NXSECT,NXSECT)
CALL TEST2 (NYSECT,NYSECT)
IF (NXSECT.GT.NX) NXSECT = NX
IF (NYSECT.GT.NY) NYSECT = NY

IF (NXSECT.GE.NX) AND (NYSECT.GE.NY) THEN
  WRITE (IWRITE,*) ' *WARNING: Sector size is the entire data set. No resolution'
  WRITE (IWRITE,*) ' enhancement applied.'
ELSE
  NXP = NXSECT ! Old sector size
  NYP = NYSECT ! (power of 2)
  IUP = IU + (NXP - IU + IL - 1)/2
  IF (IUP.GT.NX) IUP = NX
  IF (IUP.LT.NXP) IUP = NXP
  ILP = IUP - NXP + 1 ! Index of 1st sector point
  SXO = SXO + (ILP-1)*SXINC ! Coord.
  JUP = JU + (NYP - JU + JL - 1)/2
  IF (JUP.GT.NY) JUP = NY
  IF (JUP.LT.NYP) JUP = NYP
  JLP = JUP - NYP + 1 ! Index of 1st sector point
  SYO = SYO + (JLP-1)*SYINC ! Coord.

  DXSECT = SXINC
  DYSECT = SYINC
  XTENT = DXSECT*NXSECT
  YTENT = DYSECT*NYSECT

  REPEAT = .TRUE.
  DO WHILE (REPEAT)
    REPEAT = .FALSE.
    IF (DXSECT.GT.1.) THEN
      DXSECT = 1.
      WRITE (IWRITE,*)
      WRITE (IWRITE,*) ' WARNING: Kx spacing > 1. '
      'Potential error at sector enhancement.'
      WRITE (IWRITE,*)
    END IF
    IF (DYSECT.GT.1.) THEN
      DYSECT = 1.
      WRITE (IWRITE,*)
      WRITE (IWRITE,*) ' WARNING: Ky spacing > 1. '
      'Potential error at sector enhancement.'
      WRITE (IWRITE,*)
  END IF
D-11
END IF
ADXS = ASIN(DXSECT)*RD
ADYS = ASIN(DYSECT)*RD
WRITE (IWRITE,220) NXSECT,DXSECT,ADXS,
+ NYSECT,DYSECT,ADYS
WRITE (IWRITE,*)
WRITE (IWRITE,*) ' 11d. Would you like increased ',
+ 'resolution on the X-axis ? (N/Y)'
READ (IREAD,99) CANS
IF (CANS .EQ. 'Y' .OR. CANS .EQ. 'y') THEN
  NXSECT = NXSECT*2
  IF (NXSECT.GT.4096) NXSECT = NXSECT/2
  DXSECT = XTENT/NXSECT
  REPEAT = .TRUE.
END IF
WRITE (IWRITE,*)
WRITE (IWRITE,*) ' 11e. Would you like increased ',
+ 'resolution on the Y-axis ? (N/Y)'
READ (IREAD,99) CANS
IF (CANS .EQ. 'Y' .OR. CANS .EQ. 'y') THEN
  NYSECT = NYSECT*2
  IF (NYSECT.GT.4096) NYSECT = NYSECT/2
  DYSECT = YTENT/NYSECT
  REPEAT = .TRUE.
END IF
END DO

DSA = SXINC * SYINC
CALL BLOWUP (DATA,NX,NY,NXP,NYP,ILP,JLP,NXSECT,NYSECT,
+ ALAM,DSA)
IF (NPOL.EQ.2) CALL BLOUUP (DATA2,NX,NY,NXP,NYP,ILP,JLP,
+ NXSECT,NYSECT,ALAM,DSA)
RSCAN(1) = SX0
RSCAN(4) = SY0
RSCAN(2) = SXINC * NXSECT / NXP
RSCAN(5) = SYINC * NYSECT / NYP
RSCAN(3) = NXSECT
RSCAN(6) = NYSECT
SXINC = RSCAN(2)
SYINC = RSCAN(5)
NX = RSCAN(3)
NY = RSCAN(6)
WRITE (6,*)' Results of sector enhancement:'
WRITE (6,*)' Old Dimensions = ',NX,P,NYP
WRITE (6,*)' New Dimensions = ',NXSECT,NYSECT
END IF
END IF
C
C PROBE CORRECTION & OUTPUT CONVERSION
C

WRITE (1,*) ' Ready for probe correction section.'
WRITE (1,*)

WRITE (1,98) BELL
WRITE (1WRITE,*)
WRITE (1WRITE,*) ' 12. What direction is the first polarization?
WRITE (1WRITE,*) Enter angle (degrees) from Y-axis toward
WRITE (1WRITE,*) minus X: (0.) '
READ (IREAD,99) CANS
IF (CANS .EQ. '1') THEN
   POLY=0.
ELSE
   READ (CANS,*) POLY
END IF

WRITE (1WRITE,*) ' First polarization at ',POLY,' degrees.'
WRITE (1WRITE,*)
WRITE (1WRITE,*)
WRITE (1WRITE,*) ' 13a. Should a probe correction be used? (N/Y)'
READ (IREAD,99) CANS
ICORR=1
IF (CANS.EQ.'Y' .OR. CANS.EQ.'y') THEN
   WRITE (1WRITE,*) ' 13b. Empirical or Theoretical? (E/T)
   READ (IREAD,99) CANS
   ICORR=1
   IF (CANS.EQ.'T' .OR. CANS.EQ.'t') ICORR=0
   IPRBR = -1
   WRITE (1WRITE,*) ' 13c. Enter the probe rotation -'
   WRITE (1WRITE,*) ' 1 for X into Y, or '
   WRITE (1WRITE,*) ' -1 for Y into X : (-1) '
   READ (IREAD,99) CANS
   IF (CANS .EQ. '1') IPRBR=1
   WRITE (1WRITE,*) ' Second polarization at ',
   POLY + IPRBR*90,' degrees.'
END IF

IF (ICORR.EQ.0) THEN
   A = ALAM/1.6
   B = A/2
   WRITE (1WRITE,*) ' 13d. Enter the probe dimensions in inches.'
   WRITE (1WRITE,*) Enter large, small dimensions: ',
   '('A','B',')'
   READ (IREAD,99) CANS
   IF (CANS .GT. ' ') READ (CANS,*) A,B
   WRITE (1WRITE,*)
   IF (ICORR .EQ. 0) THEN
      WRITE(IWRITE,*)'Correcting for probe size ',A,' x ',B,'
   ELSE
      WRITE(IWRITE,*)'Gain calc. for probe size ',A,' x ',B,'
D-13
END IF
END IF
IF (ICORR.GT.0) THEN
WRITE (IWRITE,*)
WRITE (IWRITE,*) ' 13d. For the probe pattern (1st pole)
CALL NAMFILE(8,0)
WRITE (6,110) NAME
CALL HEADREAD(8,IRDAT)
WRITE (6,112) TITLE
IF ( (NX.NE.RSCAN(3)) .OR. (NY.NE.RSCAN(6)) ) THEN
  WRITE (IWRITE,*) '** File mismatch - program aborted **
  STOP
END IF
WRITE (IWRITE,*)
WRITE (IWRITE,*) ' 13e. For the probe pattern (2nd pole)
CALL NAMFILE(9,0)
WRITE (6,110) NAME
CALL HEADREAD(9,IRDAT)
WRITE (6,112) TITLE
IF ( (NX.NE.RSCAN(3)) .OR. (NY.NE.RSCAN(6)) ) THEN
  WRITE (IWRITE,*) '** File mismatch - program aborted **
  STOP
END IF
END IF
WRITE (IWRITE,*)
WRITE (IWRITE,*) ' 14a. Specify the type of output data desired:
WRITE (IWRITE,*)
WRITE (IWRITE,*) ' To output the far-field pattern --
WRITE (IWRITE,*) ' Enter "Y" for an azimuth/elevation system (conical about the Y-axis)
WRITE (IWRITE,*) ' rotated about the Z axis by a specified angle
WRITE (IWRITE,*) ' Enter "H" for a Huygens system rotated by a specified angle,
WRITE (IWRITE,*) ' Enter "Z" for a theta/phi system
WRITE (IWRITE,*) ' system (conical about the Z-axis)
WRITE (IWRITE,*) ' entered
WRITE (IWRITE,*) ' or Return to output the transverse spectrum data
READ (IREAD,99) CANS
NPOUT=0
NTRANS=0
IF (CANS.EQ.'y' .OR. CANS.EQ.'Y') NPOUT=1
IF (CANS.EQ.'H' .OR. CANS.EQ.'h') NPOUT=2
IF (CANS.EQ.'Z' .OR. CANS.EQ.'z') NTRANS=3
IF (CANS.EQ.'A' .OR. CANS.EQ.'a') NTRANS=1
IF (NPOL.EQ.1) THEN
WRITE (IWRITE,*): '14b. Would you like to output both ',
+ 'polarizations? (N/Y)'
READ (IREAD,99) CANS
IF (CANS.EQ."Y" .OR. CANS.EQ."Y") NPOL=0
WRITE (IWRITE,*): 'Output ',2-NPOL,' polarizations.'
END IF

IF (NTRANS .NE. 0) THEN
TX=0.
TY=0.
TZ=0.
WRITE (IWRITE,*): '14c. Enter translation vector components' WRITE (IWRITE,*): in inches (X, Y, Z) : (0.,0.,0.)'
READ (IREAD,99) CANS
IF (CANS .GT. ' ') READ (CANS,*): TX,TY,TZ
FILTER=0.
WRITE (IWRITE,*): '14d. Enter low-pass filter radius in '
WRITE (IWRITE,*): 'normalized wave-number units '
WRITE (IWRITE,*): (Return for no filter)'
READ (IREAD,99) CANS
IF (CANS .GT. ' ') READ (CANS,*): FILTER
WRITE (IWRITE,*): 'Data origin translated to (',TX,TY,TZ,')'
WRITE (IWRITE,*): 'Filter applied at Kt = ',FILTER
END IF

POLOUT = POLY

IF (NPOUT.NE.0) THEN
WRITE (IWRITE,*): '14c. What direction is the desired output ' write (IWRITE,*): 'polarization? Enter '
WRITE (IWRITE,*): angle (degrees) from Y-axis toward ',
+ 'minus X: (',POLY,')'
READ (IREAD,99) CANS
IF (CANS .GT. ' ') READ (CANS,*): POLOUT
WRITE (IWRITE,*): 'Output pole referenced to ',POLOUT,
+ ' degrees. '
WRITE (IWRITE,*): END IF

POLY = POLY*DR ! Convert to radians
POLOUT = POLOUT*DR

IF (SINGLE) THEN
IF (CAXIS.EQ."R") THEN
RSCAN(4) = 0.
RSCAN(5) = 0.
ELSE
RSCAN(1) = 0.
RSCAN(2) = 0.
END IF

D-15
DO YOU WANT TO APPLY A ' 'BLACKMAN FILTER (N/Y)?'
READ (IREAD,99) CANS
IBM=0
IF (CANS.EQ.'Y'.OR. CANS.EQ.'y') IBM=1
IF (CANS.EQ.'Y'.OR. CANS.EQ.'y') THEN
CFILT=''
CTIT=''
CTIT2=''
IBM=1
WRITE(IWRITE,*) '15a. Enter output form for filter, S for ' 'SPACE DOMAIN, W for wave number, B for ' 'BOTH, CR for none.'
READ(IREAD,13) CFILT
IF (CFILT .EQ. 'S'.OR. CFILT .EQ. 'B'.OR.
CFILT .EQ. 'w'.OR. CFILT .EQ. 'b') THEN
WRITE(IWRITE,*) '15b. Give name for spatial filter ', 'output file.'
CALL NAMFILE(13,1)
FNAME=NAME
WRITE(IWRITE,*) '15c. Default title is ',TITLE
WRITE(IWRITE,*) 'Enter alternate title(CR to default)'
READ(IREAD,99) CTIT
END IF
IF (NPOL.NE.1) THEN
CALL PCORR (DATA, NX, NY, DATA2, NX, NY, ICORR, IPRBR,
+ NPOL, NPOUT, POLY, POLWT)
ELSE
CALL PCORR (DATA, NX, NY, DUMMY, 1, 1, ICORR, IPRBR,
+ NPOL, NPOUT, POLY, POLOUT)
END IF
IF (NPOL .NE. 1) THEN
CALL PCORR (DATA, NX, NY, DATA2, NX, NY, ICORR, IPRBR,
+ NPOL, NPOUT, POLY, POLOUT)
ELSE
CALL PCORR (DATA, NX, NY, DUMMY, 1, 1, ICORR, IPRBR,
+ NPOL, NPOUT, POLY, POLOUT)
END IF
IF (POLOUT.EQ.0) THEN
    COPOL = 'El.'
    XPOL = 'Az.'
ELSE
    WRITE (COPOL, '(F4.0,1E1)') POLOUT*RD
    ! "Elevation" pole relative to Y-axis
    ! rotated by angle POLOUT
    WRITE (XPOL, '(F4.0,1A1)') POLOUT*RD
    ! "Azimuth" pole relative to Y-axis
    ! rotated by angle POLOUT
END IF
ELSE IF (NPOL.EQ.2) THEN
    WRITE (COPOL, '(F4.0,1A1)') POLOUT*RD
    ! Huygens pole "A" relative to Y-axis
    ! rotated by angle POLOUT
    WRITE (XPOL, '(F4.0,1A1)') POLOUT*RD
    ! Huygens pole "B" relative to Y-axis
    ! rotated by angle POLOUT
ELSE IF (NPOL.EQ.1) THEN
    IF (POLOUT.EQ.0) THEN
        COPOL = 'Theta'
        XPOL = 'Phi'
    ELSE
        WRITE (COPOL, '(F4.0,1A1)') POLOUT*RD
        ! "Theta" pole relative to Z-axis
        ! rotated by angle POLOUT
        WRITE (XPOL, '(F4.0,1A1)') POLOUT*RD
        ! "Phi" pole relative to Z-axis
        ! rotated by angle POLOUT
    END IF
    ELSE IF (ICORR.EQ.0 .AND. NPOL.EQ.0) THEN
        COPOL = 'Ver. (Y)'
        XPOL = 'Hor. (X)'
    END IF
END IF
TR = ABS(TX) + ABS(TY) + ABS(TZ) + ABS(FILTER)

IF (TR .NE. 0.) THEN
    IF (SINGLE) THEN
        CALL SEPTRANS(XINC,YINC,NPOL,NX,NY,DATA,DATA2,CAXIS)
    ELSE
        CALL TRANSLATE (DATA,NX,NY,TX,TY,TZ,FILTER)
        IF (NPOL.EQ.2) CALL TRANSLATE (DATA2,NX,NY,TX,TY,TZ,
            + DSA = SXINC * SYINC*AKO**2
            CALL FFTZ (-1, NX, NY, DSA, DATA)
            IF (NPOL.EQ.2) CALL FFTZ (-1, NX, NY, DSA, DATA2)
        END IF
        XINC = ALAM / (NX*SXINC)
        IF (SXINC .EQ. 0) XINC=0
        YINC = ALAM / (NY*SYINC)
IF (SYINC .EQ. 0) YINC=0
RSCAN(7) = FREQ
RSCAN(1) = -(NX/2) * XINC
RSCAN(2) = XINC
RSCAN(4) = -(NY/2) * YINC
RSCAN(5) = YINC
END IF

IF (RSCAN(2) .EQ. 0) RSCAN(2)=RSCAN(5) IIF 0, ARBITRARILY SET
IF (RSCAN(5) .EQ. 0) RSCAN(5)=RSCAN(2) Inc1=INC2

CC
CC OUTPUT DATA
CC

WRITE (1,*), ' Ready to output spectrum data files.'
WRITE (1,*),

CALL CONVERT (DATA, NX, NY)
IF (NPOL.NE.1) CALL CONVERT (DATA2, NX, NY)

POLOUT = POLOUT * RD

IF (NPOL.EQ.0) THEN
XFILE = 'for 2nd pole ' 
TITLE = ' Second output polarization.'
END IF

WRITE (1,981) BEL
WRITE (1WRITE,*)
201 FORMAT (///,5X, 'Ready to output results from file', 4A)
IF (NPOL.EQ.1) THEN
WRITE (1WRITE,201), COFILE
ELSE
WRITE (1WRITE,201) 's COFILE,' and ',XFILE
END IF
IF (NTRANS.EQ.1) THEN
IF (NPOL.EQ.1) THEN
202 FORMAT ('/ 16. This file contains data translated by ',
 + 3F7.2,') )
WRITE (1WRITE,202) TX,TY,TZ
WRITE(IWRITE,*), 'Enter data file name:'
READ(IWRITE,98) COFILE
ELSE
203 FORMAT ('/ 16,A, The ',A, 'pole ' 
 + ',translated data.')
WRITE (IWRITE,203) 'a', 'first', COPOL
WRITE(IWRITE,*), 'Enter data file name:'
READ(IWRITE,98) COFILE
WRITE (IWRITE,203) 'b', 'second', XPOL
WRITE(IWRITE,*), 'Enter data file name:'
READ(IWRITE,98) XFILE
END IF

D-18
ELSE IF (NOUT.EQ.0) THEN

204 FORMAT (/A, ' file contains ', A, ' polarized spectrum data. ')
   IF (NPOL.EQ.1) THEN
      WRITE (IWRITE,204) '16. This', COPOL
      WRITE (IWRITE,*) 'Enter data file name:'
      READ (IREAD,98) COFILE
   ELSE
      WRITE (IWRITE,204) '16a. The first', COPOL
      WRITE (IWRITE,*) 'Enter data file name:'
      READ (IREAD,98) COFILE
      WRITE (IWRITE,204) '16b. The second', XPOL
      WRITE (IWRITE,*) 'Enter data file name:'
      READ (IREAD,98) XFILE
   END IF
   ELSE
205 FORMAT (/'16', A, ' file contains pattern data which is ', A, ' polarized', '//', A, ' relative to the Y-axis', ' rotated ', I, ' degrees. ')
   IF (NPOL.EQ.1) THEN
      WRITE (IWRITE,205) '1. This', ' elevation', POLOUT
      WRITE (IWRITE,*) 'Enter data file name:'
      READ (IREAD,98) COFILE
      WRITE (IWRITE,205) 'a. The first', ' elevation', POLOUT
      WRITE (IWRITE,*) 'Enter data file name:'
      READ (IREAD,98) COFILE
      WRITE (IWRITE,205) 'b. The second', ' azimuth', POLOUT
      WRITE (IWRITE,*) 'Enter data file name:'
      READ (IREAD,98) XFILE
   END IF
   ELSE
   END IF
   WRITE (6,110) COFILE, 'I', XFILE

206 FORMAT (/'17', A, ' The default title for file ', A, ' is:', A80, ' Enter a new title, or RETURN to default: ')
   IF (NPOL.EQ.1) THEN
      WRITE (IWRITE,206) '1.', COFILE, TEMP
      READ (IREAD,99) CANS
      IF (CANS.GT.1) TEMP = CANS
      WRITE (6,112) TEMP
   ELSE
       WRITE (IWRITE,206) 'a.', COFILE, TEMP
       READ (IREAD,99) CANS
       IF (CANS.GT.1) TEMP = CANS
       WRITE (6,112) TEMP
       WRITE (IWRITE,206) 'b.', XFILE, TITLE
       READ (IREAD,99) CANS
       IF (CANS.GT.1) TITLE = CANS
       WRITE (6,112) TITLE
   END IF

WRITE (IWRITE,*) '17. New data file dimensions are (', NY, ' x ', NX, ')
   WRITE (IWRITE,*) 'Would you like to change the file dimensions',
+ '(Y/N)?'
READ(IREAD,99) CANS
IF (CANS .EQ. 'Y' .OR. CANS .EQ. 'y') THEN
  CALL GRIDSET(4096,0,1STARTX,1STARTY,MX,MY,NXO,NYO,IXINC,IYINC)
  RSCAN(1)=RSCAN(1) + (1STARTX-1)*RSCAN(2)
  RSCAN(2)=RSCAN(2)*IXINC
  RSCAN(3)=MX
  RSCAN(4)=RSCAN(4) + (1STARTY-1)*RSCAN(5)
  RSCAN(5)=RSCAN(5)*IYINC
  RSCAN(6)=MY
ELSE
  1STARTX=1
  1STARTY=1
  NXO=NX
  NYO=NY
  IXINC=1
  IYINC=1
END IF

CALL XYZOPEN(COFILE,4,1) !OPEN FILE FOR 1ST POL
IF (NPOL .EQ. 2) THEN
  CALL XYZOPEN(XFILE,5,1) !OPEN FILE FOR 2ND POL
END IF

Time4 = ElapsedTime()

CALL DateTime (IDATE,ITIME)

IF (NPOL .EQ. 1) THEN
  NAME = XFILE
  POL = XPOL
  CALL ARRAY_DUMP (DATA2,NX,MY,NXO,NYO,IXINC,IYINC,
   + 1STARTX,1STARTY,5)
  CALL HEADWRITE (5,IRDAT)
  WRITE(1,'(A)') 'MAXIMUM FOR CROSS-POL FILE IS',AMAX
END IF

NAME = COFILE
POL = COPOL
TITLE = TEMP
CALL ARRAY_DUMP (DATA,NX,MY,NXO,NYO,IXINC,IYINC,
 + 1STARTX,1STARTY,4)
CALL HEADWRITE (4,IRDAT)
WRITE(1,'(A)') 'MAXIMUM FOR COPOL FILE IS',AMAX

Time5 = ElapsedTime()

WRITE (6,*)
WRITE (6,*) 'Time to input data: ',TIME1-TIME0,' ms'
WRITE (6,*) 'Condition for FFT: ',TIME2-TIME1,' ms'
WRITE (6,*) 'Perform FFT: ',TIME3-TIME2,' ms'
WRITE (6,*) 'Output data: ',TIME5-TIME4,' ms'
WRITE (6,*)
WRITE (6,*) '*** NORMAL TERMINATION ***'
WRITE(1,98) BELL
WRITE (1,*) ' *** NORMAL TERMINATION ***'
END
$CDS ON
$SEMA /BUFFER/
    SUBROUTINE ARRAY_DUMP(CBUF,NX,NY,NXO,NYO,IXINC,IYINC,
                        +
                        ISTARTX,ISTARTY,IUNIT)

C LAST REVISED: 8/5/88

CHARACTER CSCAN*80,CAXIS*I,NAME*15,POL*8
COMPLEX CBUF(NX,NY)
COMMON /PARAM/ RSCAN(7),CAXIS,POL,CSCAN,NAME,IDATE(3),ITIME(3)
COMMON /BUFFER/ ABUF(4096),PBUF(4096),IBUF
COMMON /MINMAX/ AMIN,AMAX,PMIN,PMAX,MAXY,MAXX
EMA CBUF

C SUBROUTINE TO WRITE AMP, PHASE TO DISK FILE

AMIN = 100.
AMAX = -100.
PMIN = 180.
PMAX = -180.
MAXY=0
MAXX=0
IBUF=0

IF (CAXIS.EQ.'Y') THEN
  IROW=1
  DO J=ISTARTX,NXO,IXINC
     IPT=1
     DO I=ISTARTY,NYO,IYINC
        ABUF(IPT) = REAL(CBUF(J,I))
        PBUF(IPT) = AIMAG(CBUF(J,I))
        IPT=IPT+1
     END DO
     CALL WRITE_DATA (IUNIT,IROW,2,2,ABUF,PBUF,IBUF,AMIN,AMAX,
                        +
                        PMIN,PMAX,MAXY,MAXX)
     IROW=IROW+1
  END DO
ELSE
  IROW=1
  DO J=ISTARTY,NYO,IYINC
     IPT=1
     DO I=ISTARTX,NXO,IXINC
        ABUF(IPT) = REAL(CBUF(I,J))
        PBUF(IPT) = AIMAG(CBUF(I,J))
        IPT=IPT+1
     END DO
     CALL WRITE_DATA (IUNIT,IROW,2,2,ABUF,PBUF,IBUF,AMIN,AMAX,
                        +
                        PMIN,PMAX,MAXY,MAXX)
     IROW=IROW+1
  END DO
END IF

RETURN
END
SUBROUTINE ARRAY_FILL(CBUF,NXO,NYO,MX,MY,IXINC,IYINC,IUNIT,IPOL)

C LAST REVISED: 8/5/88

CHARACTER CAXIS*1,NAME*15,POL*8,CSCAN*80
COMPLEX CBUF(MX,MY)
COMMON /PARAM/ RSCAN(7),CAXIS,POL,CSCAN,NAME,IDATE(3),ITIME(3)
COMMON /BUFFER/ ABUF(4096),PBUF(4096),IBUF
COMMON /MINMAX/ AMIN,AMAX,PMIN,PMAX,MAXX,MAXY
END C

END SUBROUTINE

C ARRAY_FILL fills the data array in memory from the data file
C on disk.

NX=INT(RSCAN(3))
NY=INT(RSCAN(6))

IF (CAXIS.EQ.'Y') THEN
DO I=1,MX
IROU = NXO + (I-1)*IXINC
CALL READ_DATA(IUNIT,IROU,2,2,ABUF,PBUF,IBUF) !READ FROM FILE
DO J=1,MY
JN = NYO + (J-1)*IYINC
IF (IPOL.EQ.1) THEN
IF (ABUF(JN) .GT. AMAX) THEN
AMAX = ABUF(JN)
PMAX = PBUF(JN)
MAXX = I
MAXY = J
END IF
END IF
IF (ABUF(JN) .LT. AMIN) AMIN=ABUF(JN)
CBUF(I,J)=CMPLX(ABUF(JN),PBUF(JN))
END DO
END DO
ELSE
DO J=1,MY
IROU = NYO + (J-1)*IYINC
CALL READ_DATA(IUNIT,IROU,2,2,ABUF,PBUF,IBUF) !READ FROM FILE
DO I=1,MX
IN = NXO + (I-1)*IXINC
IF (IPOL.EQ.1) THEN
IF (ABUF(IN) .GT. AMAX) THEN
AMAX = ABUF(IN)
PMAX = PBUF(IN)
MAXX = I
MAXY = J
END IF
END IF
IF (ABUF(IN) .LT. AMIN) AMIN=ABUF(IN)
CBUF(I,J)=CMPLX(ABUF(IN),PBUF(IN))
END DO
END DO

END
END IF
RETURN
END
SUBROUTINE BLACKMAN(NPOL, ALAM, NX, NY, BFILT, DATA, NX2, NY2, DATA2, +
CTIT, CTIT2, CANS, FNAME, FNAME2)

CHARACTER CANS*1, C1*1, CAXIS*1, POL*B, NAME*15, CSCAN*80
CHARACTER FNAME*15, FNAME2*15, CTIT*80, CTIT2*80, TEMP*80
COMPLEX CJ, TVAR, BFILT(NX, NY), DATA(NX, NY), DATA2(NX2, NY2)
EMB BFILT, DATA, DATA2
COMMON /PARAM/RSCAN(7), CAXIS, POL, CSCAN, NAME, IDATE(3), ITIME(3)
COMMON /USER/IWRITE, IREAD

SUBROUTINE TO APPLY BLACKMAN FILTER

CJ=(0., 1)
PI=ACOS(-1.)
RD=180. / PI
DR=PI/180.
NUM=NX*NY
DELY=RSCAN(2)
DELY=RSCAN(5)

XINC=ALAM/(DELY*NX)
YINC=ALAM/(DELY*NY)
XMIN=-NX*XINC/2
YMIN=-NY*YINC/2

KXLPB=PI/XINC
KYLPB=PI/YINC
TX=3*PI/KXLPB
TY=3*PI/KYLPB

AKXMIN=-ALAM/(2*XINC)
AKYMIN=-ALAM/(2*YINC)
AKXDEL=ALAM/(NX*XINC)
AKYDEL=ALAM/(NY*YINC)

HBMAX=0.

DO I=1,NY
    Y=YMIN+(I-1)*YINC
    ARGY=PI*Y/TY
    DO J=1,NX
        X=XMIN+(J-1)*XINC
        IF(ABS(X) .GT. TX .OR. ABS(Y) .GT. TY) THEN
            HBXY=0.
        ELSE
            ARGX=PI*X/TX
            HBXY=0.42+.5*COS(ARGX) + 0.08*COS(2*ARGX)
            HBXY=HBXY*(0.42+.5*COS(ARGY) + 0.08*COS(2*ARGY))
            HBMAX=AMAX1(HBMAX, HBXY)
        END IF
        BFILT(J, I)=CMPLX(HBXY, 0.0)
    END DO
END DO

D DO
DO J=1,NX
    BFILT(J,I)=BFILT(J,I)/HBMAX
END DO
END DO

DO I=1, NY
DO J=1, NX
    TVAR=BFILT(J,I)
    CALL POLAR(TVAR,RE,AI)
    IF (RE .LE. 0) THEN
        RE=-99.
    ELSE
        RE=20*ALOG10(RE)
    END IF
    BFILT(J,I)=CMPLX(RE, AI*RD)
END DO
END DO

IF (CANS .EQ. 'S' .OR. CANS .EQ. 'B') THEN
    TEMP=CSCAN
    IF (CTIT .GT. I) CSCAN=CTIT
    CALL DUMP_FILTER(BFILT, NX, NY, 13, FNAME)
    CSCAN=TEMP
END IF

DO I=1, NY
DO J=1, NX
    RE=REAL(BFILT(J,I))
    RE=10.**(RE/20.)
    AI=AIMAG(BFILT(J,I))
    BFILT(J,I)=RE* CEXP(CJ*AI*DR)
END DO
END DO

CALL FFTZ(1, NX, NY, 1., BFILT)
HBMAX=0.

DO I=1, NY
DO J=1, NX
    HBMAX=AMAX1(CABS(BFILT(J,I)), HBMAX)
END DO
END DO

DO I=1, NY
AKY=AKYMIN + (I-1)* AKYDEL
DO J=1, NX
    AKX=AKXMIN + (J-1)* AKXDEL
    BFILT(J,I)=BFILT(J,I)/HBMAX
    IF (CABS(BFILT(J,I)) .LT. 0.03162) THEN
        DATA(J,I)=CMPLX(0.0,0.0)
        IF (NPOL .NE. 1) DATA2(J,I)=CMPLX(0.0,0.0)
    ELSE
        DATA(J,I)=DATA(J,I)/BFILT(J,I)
        IF (NPOL .NE. 1) DATA2(J,I)=DATA2(J,I)/BFILT(J,I)
    END IF
IF ((AKX*AK0)**2+(AKY*AK0)**2 .GT. KYLPB**2+KXLPB**2) THEN
  DATA(J,I)=CMPLX(0.0,0.0)
  IF (NPOL .NE. 1) DATA2(J,I)=CMPLX(0.0,0.0)
END IF
TVAR=BFILT(J,I)
CALL POLAR(TVAR,RE,AI)
IF (RE .LE. 0) THEN
  RE=-99.
ELSE
  RE=20*ALOG10(RE)
END IF
BFILT(J,I)=CMPLX(RE,AI*RD)
END DO
END DO
IF (CANS .EQ. 'U' .OR. CANS .EQ. 'B') THEN
  TEMP=CSCAN
  IF (CTITZ .GT. 'I') CSCAN=CTITZ
  CALL DUMP_FILTER(BFILT,NX,NY,14,FNAMEZ)
  CSCAN=TEMP
END IF
RETURN
END
SUBROUTINE BLOWUP (DATA, NX, NY, NXP, NYP, ILP, JLP, NXSECT, NYSECT,
+ ALAM, DSA)

LAST REVISED: 7 OCT 86

Replaces sector of data at beginning of array, transforms to
space domain and zero-fills to increase resolution, then
transforms back to wave-number domain.

EMA DATA

COMPLEX DATA(NX*NY)
INTEGER*4 K, KP

NX, NY Dimensions of original array
NXP, NYP Dimensions of sector before resolution enhancement
NXSECT,
NYSECT Dimensions of sector after enhancement
ILP, JLP Starting indices of sector within original array
ALAM Wavelength
DSA Area factor for FFT from spectrum to aperture
(In general, DSA = DSX * DSY = Kx/Ko * Ky/Ko )
DA Area factor for FFT from aperture to spectrum
(In general, DA = DX * DY / 4*PI**2)

Download sector:

DO J=1,NYP
   DO I=1,NXP
      KP = (J-1)*NXP + I
      K = (JLP+J-2)*NX + ILP+I-1
      DATA(KP) = DATA(K)
   END DO
END DO

Zero-fill in space domain:

CALL FFTZ (-1, NXP, NYP, DSA, DATA)

(NEW) DX = ALAM / (NXP*DSX)
(NEW) DY = ALAM / (NYP*DSY)

CALL EXPAND (DATA, NXP, NYP, NXSECT, NYSECT)

Return to wave-number domain:

DA = ALAM**2 / (NXP*NYP*DSA) / (4. * PI**2)
CALL FFTZ (1, NXSECT, NYSECT, DA, DATA)

(NEW) DSX = ALAM / (NXSECT*DX)
(NEW) DSY = ALAM / (NYSECT*DY)

RETURN
END
SUBROUTINE CONVERT (DATA, NX, NY)

C LAST REVISED: 11 OCT 1986

C

C Converts the complex array DATA passed in rectangular form to
C polar form, with the phase in degrees and the amplitude in dB
C with a floor of -200 dB.

COMPLEX DATA(NX, NY)

EMA DATA

PI = ACOS(-1.)
RD = 180 / PI

DO J=1, NY
   DO I=1, NX
      X = REAL(DATA(I, J))
      Y = AIMAG(DATA(I, J))
      PHASE = ATAN2(Y, X) * RD ! PHASE IN DEGREES
      AMP = SPRT(X**2 + Y**2)
      IF (AMP .LE. 1.E-10) THEN
         AMP = -200.
      ELSE
         AMP = 20 * ALOG10(AMP) ! AMP IN dB
      END IF
      DATA(I, J) = CMPLX(AMP, PHASE)
   END DO
END DO
RETURN
END
SUBROUTINE CORREC(R01X1, R01Y1, R01X2, R01Y2, S1OX, S1OY, D1, D2)

C LAST REVISED: 6 OCT 86

C Performs probe correction for two polarization measurement in
C X,Y coordinates.

COMPLEX R01X1, R01X2, R01Y1, R01Y2, S1OX, S1OY, D1, D2, DEL

DEL = R01X1 * R01Y2 - R01Y1 * R01X2
S1OX = (D1 * R01Y2 - D2 * R01Y1) / DEL
S1OY = (D2 * R01X1 - D1 * R01X2) / DEL
RETURN
END
SUBROUTINE DATETIME (IDATE, ITIME)

INTEGER IDATE(3), ITIME(3), ITIME11(5), IYEAR, IBUFF(15)
CHARACTER FBUFF*30, MONTH*4
EQUIVALENCE (FBUFF, IBUFF)

CALL EXEC (11, ITIME11, IYEAR) ! Numerical time
CALL FTIME (IBUFF) ! Formatted time

IDATE(1) = IYEAR - 1900
ITIME(1) = ITIME11(4)
ITIME(2) = ITIME11(3)
ITIME(3) = ITIME11(2)

READ (FBUFF, 90) IDATE(3), MONTH

90 FORMAT (16X, I2, 2X, A4)

IF (MONTH .EQ. 'JAN.') IDATE(2) = 1
IF (MONTH .EQ. 'FEB.') IDATE(2) = 2
IF (MONTH .EQ. 'MAR.') IDATE(2) = 3
IF (MONTH .EQ. 'APR.') IDATE(2) = 4
IF (MONTH .EQ. 'MAY ') IDATE(2) = 5
IF (MONTH .EQ. 'JUNE') IDATE(2) = 6
IF (MONTH .EQ. 'JULY') IDATE(2) = 7
IF (MONTH .EQ. 'AUG.') IDATE(2) = 8
IF (MONTH .EQ. 'SEPT') IDATE(2) = 9
IF (MONTH .EQ. 'OCT.') IDATE(2) = 10
IF (MONTH .EQ. 'NOV.') IDATE(2) = 11
IF (MONTH .EQ. 'DEC.') IDATE(2) = 12

RETURN
END
SUBROUTINE DUMP_FILTER(BFILT, NX, NY, IUNIT, FNAME)

CHARACTER CAXIS*1, CSCAN*80, NAME*15, POL*8, CTEMP*1, CI*1, FNAME*15

COMMON /PARAM/RSCAN(7), CAXIS, POL, CSCAN, NAME, IDATE(3), ITIME(3)

COMMON /BUFFER/ABUF(4096), PBUF(4096), IBUF

COMMON /MINMAX/AMIN, AMAX, PMIN, PMAX, MAXROW, MAXCOL

COMMON /USER/IWRITE, IREAD

C SUBROUTINE TO DUMP FILTER OUT TO FILE

CTEMP=CAXIS

CAXIS='R'

NAME=FNAME

AMIN=100.

AMAX=-100.

PMIN=180.

PMAX=-180.

CALL DATETIME(IDATE, ITIME)

DO I=1, NY
    DO J=1, NX
        ABUF(J)=REAL(BFILT(J, I))
        PBUF(J)=AIMAG(BFILT(J, I))
    END DO
    IROW=I
    CALL WRITE_DATA(IUNIT, IROW, 2, 2)
END DO

CALL HEADWRITE(IUNIT, 2)

CLOSE(UNIT=IUNIT, IOSTAT=IERR)

IF (IERR .GT. 0) THEN
    WRITE(1,*) 'ERROR ON CLOSING FILE'
END IF

RETURN

END
SUBROUTINE EEU(U,ETE)

C LAST REVISED: 6 OCT 86

C Theoretical probe pattern in E-plane (F2 in memo).

COMMON /WVGE/ A,B,K
REAL K
COMPLEX ETE,ARGC

IF (U*U .GT. 1) THEN
   ETE = (0.,0.)
   ARG = K * U * B / 2
   ETE = SQRT(SINX(ARG))
   ARGC = CSQRT(CMPLX(1.0 - U * U,0.0))
   ARGC = -K * B * 0.25 * (1.0 - ARGC)
   ETE = ETE * CEXP(ARGC)
ELSE
   END IF

RETURN
END
SUBROUTINE EHU(U,ETH)

C LAST REVISED: 6 OCT 86

C Theoretical probe pattern in H-plane (F1 in memo)

COMMON /WVGE/ A,B,K
REAL K
COMPLEX ETH

PI = 3.141592654
IF (U*U .GE. 1.) THEN
   ETH = (0.,0.)
   ARG1 = K * U * A / 2.
   ARG2 = K * U * A / PI
   ARG2 = 1.0 - ARG2 * ARG2
   IF (ABS(ARG2) .LE. .0001) THEN
      ETH = PI / 4.
   ELSE
      ETH = COS(ARG1) / ARG2
   END IF
ELSE
   ETH = PI / 4.
END IF

RETURN
END
SUBROUTINE EXPAND(DATA,MX,MY,NX,NY)

C LAST REVISED: 6 OCT 86

C EXPAND moves the old data array (DATA(MX,MY)) into the
C center of a larger array (DATA(NX,NY)) and zeros the extra
C elements (0.,0.).

EMA DATA
COMPLEX DATA(NX,NY),TEMP
INTEGER*4 K,II,JJ,I,J,IO,JO

MX1 = (NX-MX+1)/2
MY1 = (NY-MY+1)/2
MX2 = MX1 + MX
MY2 = MY1 + MY

DO J=NY,1,-1
  JO = J-MY1
  ! J COORD. IN OLD ARRAY
  DO I=NX,1,-1
    IF (J.LE.MY1 .OR. J.GT.MY2) THEN
      DATA(I,J) = (0.,0.)
    ELSE IF (I.LE.MX1 .OR. I.GT.MX2) THEN
      DATA(I,J) = (0.,0.)
    ELSE
      IO = I - MX1
      ! I COORD. IN OLD ARRAY
      K = (JO-1)*MX + IO
      ! ABSOLUTE (1-DIM.) POSITION
      JJ = (K-1)/NX + 1
      ! OLD ELEMENT POSITION IN
      II = K - (JJ-1)*NX
      ! NEW ARRAY
      DATA(I,J) = DATA(II,JJ)
    END IF
  END DO
  END DO

RETURN
END
SUBROUTINE FFT2 (ISN, NX, NY, DA, DATA)

LAST REVISED: 6 OCT 86

Routine to calculate the Fast Fourier Transform or the
inverse FFT of an input two-dimensional, complex array
(DATA). Returns result in the same array.

NX and NY are the dimensions of the array DATA and must
be non-negative integer powers of 2.

ISN is the control variable equal to +1 or -1.
(ISN is the sign of the exponent.)

DA is an area correction factor.

The origins of both input and output coordinate systems are
located at the (NX/2+1,NY/2+1) point of the array.

EMA DATA

COMPLEX DATA(NX,NY),T1,T2
REAL PI2,SO,CO,SI,CI,SN,CS,SOISN
COMMON /USER/ IWRITE,IREAD

IF(IABS(ISN).NE.1)GO TO 24

WRITE(1,*)('DA= '+DA,
PI2=2.*ACOS(-1.)

IX=-1
M=0
DO WHILE (NX .GT. M)
   IX=IX+1
   M=2**IX
   IF (NX .LT. M) THEN
      WRITE (IWRITE,*)('FFT ERROR: NX must be a power of 2.'
      STOP
   END IF
END DO

IY=-1
M=0
DO WHILE (NY .GT. M)
   IY=IY+1
   M=2**IY
   IF (NY .LT. M) THEN
      WRITE (IWRITE,*)('FFT ERROR: NY must be a power of 2.'
      STOP
   END IF
END DO

NX2=NX/2
NY2=NY/2
DO I=1,NX2,1
II=I+NX2
DO J=1,NY,1
   T1=DATA(I,J)
   DATA(I,J)=DATA(I1,J)
   DATA(I1,J)=T1
END DO
END DO

DO J=1,NY2,1
J1=J+NY2
DO I=1,NX,1
   T2=DATA(I,J)
   DATA(I,J)=DATA(I1,J1)
   DATA(I1,J1)=T2
END DO
END DO

NXBIT=16-IX
NX1=NX-2
DO I=1,NX1,1
   IFLIP=0
   DO J=NXBIT,15,1
      M=NXBIT-J
      N=N+15
      IFLIP=2*IFLIP+1AND(ISHFTC(I,N+1,16),1)
   END DO
   IF(I.GT.IFLIP) THEN
      I1=I+1
      I2=IFLIP+1
      DO J=1,NY,1
         T1=DATA(I2,J)
         DATA(I2,J)=DATA(I1,J)
         DATA(I1,J)=T1
      END DO
   END IF
END DO

NYBIT=16-IY
NY1=NY-2
DO J=1,NY1,1
   JIFLIP=0
   DO I=NYBIT,15,1
      M=NYBIT-I
      M=M+15
      JIFLIP=2*JIFLIP+1AND(ISHFTC(J,M+1,16),1)
   END DO
   IF(J.GT.JIFLIP) THEN
      J1=J+1
      J2=JIFLIP+1
      DO I=1,NX,1
         T2=DATA(I,J2)
         DATA(I,J2)=DATA(I,J1)
         DATA(I,J1)=T2
      END DO
   END IF
END DO
END DO
END IF
END DO

DO I=1,IX,1
NEL=2**I
NEL2=NEL/2
NSET=NX/NEL
SI=SIN(PI2/NEL)
CI=COS(PI2/NEL)
DO K=1,NSET,1
  INCR=(K-1)*NEL
  SO=0.0
  CO=1.0
  DO L=1,NEL2,1
    I1=L+INCR
    I2=I1+NEL2
    DO J=1,NY,1
      T1=DATA(I1,J)
      SI0SN=SO*(FLOAT(ISN))
      T2=DATA(I2,J)*CMPLX(CO,SOISN)
      DATA(I1,J)=T1+T2
      DATA(I2,J)=T1-T2
    END DO
    SN=SO*CI+CO*SI
    CS=CO*CI-SO*SI
    CO=CS
    SO=SN
  END DO
END DO
END DO

DO J=1,IY,1
NEL=2**J
NEL2=NEL/2
NSET=NY/NEL
SI=SIN(PI2/NEL)
CI=COS(PI2/NEL)
DO K=1,NSET,1
  INCR=(K-1)*NEL
  SO=0.0
  CO=1.0
  DO L=1,NEL2,1
    I1=L+INCR
    I2=I1+NEL2
    DO I=1,NX,1
      T1=DATA(I1,I)
      SI0SN=SO*(FLOAT(ISN))
      T2=DATA(I2,I)*CMPLX(CO,SOISN)
      DATA(I1,I)=T1+T2
      DATA(I2,I)=T1-T2
    END DO
    SN=SO*CI+CO*SI
    CS=CO*CI-SO*SI
    CO=CS
    SO=SN
  END DO
END DO
DO I=1,NX2,1  
   I1=I+NX2  
   DO J=1,NY,1  
      T1=DATA(I,J)  
      DATA(I,J)=DATA(I1,J)  
      DATA(I1,J)=T1  
   END DO  
END DO  

DO J=1,NY2,1  
   J1=J+NY2  
   DO I=1,NX,1  
      T2=DATA(I,J)  
      DATA(I,J)=DATA(I,J1)  
      DATA(I,J1)=T2  
   END DO  
END DO  

IF (DA .NE. 1.) THEN  
   DO J=1,NY  
      DO I=1,NX  
         DATA(I,J)=DATA(I,J)*DA  
      END DO  
   END DO  
END IF  
RETURN  
C 24 CONTINUE  
C WRITE(6,*) ' SN IS NOT +1 OR -1 IN FFT2'  
C RETURN  
END
REAL FUNCTION GOWAVGD()  

COMMON /UVGE/ A, B, AKO

C INITIALIZATION

EPS = .001  
STANDARD = .01  
PI = ACOS(-1.)  
ALAM = 2.*PI / AKO  
BETA0 = SQRT(1. - (PI / (AKO * A))**2)  
G01=0.  
N = 62

C REPEAT

10 N = N * 2  
DELTHETA = PI / (N - 1)  
GO2 = G01  
AMAXTHE = 7.*PI / 12  
D = 0.  
I = 0

20 I = I + 1  
THETA = (I - 1) * DELTHETA  
IF (THETA .LE. AMAXTHE) THEN  
   DD1 = (1. + BETA0) * AKO * B / 2. * SIN(THETA)  
   DN1A = 1. + BETA0 * COS(THETA)  
   DN1B = SIN(AKO * B / 2.*SIN(THETA))  
   DN1 = DN1A * DN1B  
   D1 = (DN1 / DD1)**2  
   IF (ABS(SIN(THETA) - (ALAM / (2. * A))) .LT. EPS) THEN  
      D2 = (PI * COS(THETA) / 2)**2  
   ELSE  
      DD2 = (PI / 2.)**2 - (AKO * A / (2. * SIN(THETA)))**2  
      DN2 = COS(THETA) * COS(AKO * A / 2. * SIN(THETA))  
      D2 = ((PI / 2.)**2 * (DN2 / DD2))**2  
   ENDIF  
END IF  
D = (D1 + D2) * SIN(THETA) * DELTHETA + D  
IF (((THETA + DELTHETA) .LT. (PI - EPS)) GOTO 20  
GO1 = 4 / D  
DIFF = ABS(G02 - GO1) / GO1  
IF (((DIFF .GT. STANDARD) .AND. (N .LE. 1000)) GOTO 10  
IF (N .GT. 1000) THEN  
   WRITE (1,*) 'WARNING: Probe gain fails to converge.'  
ENDIF  
GOWAVGD = G01  
RETURN  
END
SUBROUTINE GETPA1 (J, NY, AMP1X, PHASE1Y, AMP2X, PHASE2Y)

DIMENSION AMP1X(4096), PHASE1Y(4096), AMP2X(4096), PHASE2Y(4096)

EMA AMP1X,AMP2X,PHASE1Y,PHASE2Y

DTOR = ACOS(-1.)/180. ! degrees to radians

CALL READ-DATA (8, J, 2, 2, AMP1, PHASE1, JUNK)
CALL READ-DATA (9, J, 2, 2, AMP2, PHASE2, JUNK)

DO J=1, NY
   AMP = 10.**(AMP1X(J)/20.)
   PHASE = PHASE1Y(J)*DTOR
   AMP1X(J) = AMP*COS(PHASE)
   PHASE1Y(J) = AMP*SIN(PHASE)

   AMP = 10.**(AMP2X(J)/20.)
   PHASE = PHASE2Y(J)*DTOR
   AMP2X(J) = AMP*COS(PHASE)
   PHASE2Y(J) = AMP*SIN(PHASE)
END DO

RETURN

END
SUBROUTINE GRIDSET(MAXPTS, ITIT, ISTARTX, ISTARTY, MX, MY, NX, NY, + IXINC, IYINC)
    CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15, CSTEP*10, TEMP*80
    COMMON /PARAM/RSCAN(7), CAXIS, POL, CSCAN, NAME, IDATE(3), ITIME(3)
    COMMON /USER/IWRITE, IREAD
    "LAST UPDATED: 4/2/87"

    "SUBROUTINE TO PROMPT USER FOR OPTIONS TO DETERMINE GRID OF DATA"
    "TO BE USED FOR PLOTTING OR LISTING."

    "MAXPTS---SUPPLIED BY CALLING ROUTINE. DETERMINES MAXIMUM NO. OF"
    "PTS TO BE PLOTTED OR LISTED"

    "ITIT---SUPPLIED BY CALLING ROUTINE. DETERMINES IF USER IS PROMPTED"
    "FOR TITLE"

    "ALL FOLLOWING VALUES ARE RETURNED BY GRIDSET"

    "ISTARTX---STARTING X PT TO BE PLOTTED"
    "ISTARTY---STARTING Y PT TO BE PLOTTED"
    "MX--- THE NUMBER OF X PTS TO BE PLOTTED"
    "MY--- THE NUMBER OF Y PTS TO BE PLOTTED"
    "NX--- THE LAST X PT TO BE PLOTTED"
    "NY--- THE LAST Y PT TO BE PLOTTED"
    "IXINC--- THE X THINNING INCREMENT"
    "IYINC--- THE Y THINNING INCREMENT"

    NX=RSCAN(3)
    NY=RSCAN(6)

    WRITE(IWRITE,*)
    + 'ENTER CARR. RET. TO DEFAULT THE FOLLOWING QUESTIONS'
    WRITE(IWRITE,*)

    IF (ITIT .EQ. 1) THEN
        WRITE(IWRITE,*) 'THE CURRENT TITLE IS:'
        WRITE(IWRITE,*) CSCAN
        WRITE(IWRITE,*) 'ENTER THE TITLE YOU WOULD LIKE TO PRINT'
        READ(IREAD,10) TEMP
        IF (TEMP .GT. ' ') CSCAN=TEMP
    END IF

    WRITE(IWRITE,*)
    + 'ENTER X AXIS STARTING, ENDING PT. TO BE PLOTTED(1, ',NX, ',')'
    READ(IREAD,10) CSTEP
    IF (CSTEP .GT. ' ') THEN
        READ(CSTEP,*) ISTARTX,IENDX
        IF (ISTARTX .LT. 1 .OR. ISTARTX .GT. IENDX) GOTO 3
        IF (IENDX .GT. NX) GOTO 3
    ELSE
        ISTARTX=1
        IENDX=NX
    END IF

    D-43
WRITE(IWRITE,*), 'ENTER Y AXIS STARTING, ENDING PT. TO BE PLOTTED(1, NY, 1)'
READ(IREAD,10) CSTEP
IF (CSTEP .GT. 1)
    READ(CSTEP,*), ISTARTY, IENDY
    IF (ISTARTY .LT. 1 OR. ISTARTY .GT. IENDY) GOTO 4
    IF (IENDY .GT. NY) GOTO 4
ELSE
    ISTARTY=1
    IENDY=NY
END IF

XSTEP=(IENDX-ISTARTX+1)/FLOAT(MAXPTS)
YSTEP=(IENDY-ISTARTY+1)/FLOAT(MAXPTS)

IF (XSTEP .LE. 1)
    IXINC=1
ELSE IF (XSTEP .NE. INT(XSTEP))
    IXINC=INT(XSTEP+1.)
ELSE
    IXINC=INT(XSTEP)
END IF

IF (YSTEP .LE. 1)
    IYINC=1
ELSE IF (YSTEP .NE. INT(YSTEP))
    IYINC=INT(YSTEP+1.)
ELSE
    IYINC=INT(YSTEP)
END IF

16 WRITE(IWRITE,*), 'ENTER X AXIS THINNING INCREMENT(INTEGER .GE. ',IXINC,')'
READ(IREAD,10) CSTEP
IF (CSTEP .GT. 1)
    READ(CSTEP,*), IX
    IF (IX .LT. IXINC) GOTO 16
    IXINC=IX
END IF

18 WRITE(IWRITE,*), 'ENTER Y AXIS THINNING INCREMENT(INTEGER .GE. ',IYINC,')'
READ(IREAD,10) CSTEP
IF (CSTEP .GT. 1)
    READ(CSTEP,*), IY
    IF (IY .LT. IYINC) GOTO 18
    IYINC=IY
END IF

MX=1 + ((IENDX-ISTARTX)/IXINC) !# OF X PTS
MY=1 + ((IENDY-ISTARTY)/IYINC) !# OF Y PTS
NX=ISTARTX+(MX-1)*IXINC !LAST X PT
NY=ISTARTY+(MY-1)*IYINC !LAST Y PT
10 FORMAT(A)

RETURN
END
SUBROUTINE HEADER

Last Revised: 6/03/88

Entry points:

HEADREAD
HEADWRITE

This routine reads or writes the header record of a data file depending on which entry point is used.

UNIT - Unit number of the data file.
IRDAT - Indicates whether amplitude and/or phase information is stored in the file.

Subroutines called:

None

SUBROUTINE HEADER

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /MINMAX/ AMIN, AMAX, PMIN, PMAX, MAXY, MAXX
COMMON /USER/ IWRITE, IREAD

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15

ENTRY HEADWRITE (IUNIT,IRDAT) ! To write the header record

INQUIRE(UNIT=IUNIT,IOSTAT=IERR,ERR=17,RECL=IRECLB) ! GET RECORD LENGTH
NDUM=(IRECLB-168)/2 ! NUMBER OF DUMMY VAR. TO WRITE OUT
WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=17,REC=1) RSCAN,CAXIS,POL,CSCAN,
+ NAME,IDATE,ITIME,AMIN,AMAX,PMIN,PMAX,MAXY,MAXX,IRDAT,
+ NPOL,(IDUM,I=1,NDUM)

17 IF (IERR .GT. 0) THEN
   WRITE(IWRITE,*') 'ERROR ',IERR,' WRITING HEADER'
   PAUSE
END IF
RETURN

ENTRY HEADREAD(IUNIT,IRDAT) ! To read the header record

READ (UNIT=IUNIT,IOSTAT=IERR,ERR=27,REC=1) RSCAN,CAXIS,POL,CSCAN,
+ NAME,IDATE,ITIME,AMIN,AMAX,PMIN,PMAX,MAXY,MAXX,IRDAT,
+ NPOL

27 IF (IERR .GT. 0) THEN
WRITE(IWRITE,*),'ERROR ',IERR,' READING HEADER'
END IF

RETURN

END
SUBROUTINE NAMFILE

This subroutine opens a datafile for subsequent reads or writes. IUNIT is the unit number to be associated with the file. ISTATUS is the status of the file:
- ISTATUS = 0 - New file
- ISTATUS = 1 - Old file
- ISTATUS = 2 - Status unknown
DDIR is the data directory, if other than "::XYZFILES"

LGBUF is a library subroutine to enlarge I/O buffer size. NOTE: the buffer array LBUF must not be in EMA under any circumstances.

NOTE: if CDS is used, then either the common block /RECBUFF/ must be declared in the main program and this subroutine, or the call to LGBUF must be made in the main program (in which case /RECBUFF/ is not required.)

Subroutines called:
- DATETIME

SUBROUTINE NAMFILE (IUNIT, ISTATUS, DDIR)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME, + IDATE(3), ITIME(3), NPOL
COMMON /RECBUFF/ LBUF(8200)
COMMON /USER/ IWRITE, IREAD

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15
CHARACTER DDIP*16, INFILE*30, STAT*7

C NP = PCOUNT() ! Number of parameters passed
C IF (NP .LT. 3) DDIR = '/XYZFILES'
C ID = INDEX (DDIR, ' ') - 1 ! Length of string
C IF (ID .LE. 0) ID=16

5 WRITE (IWRITE,*) 'Enter data file name:
READ (IREAD,20) NAME
20 FORMAT(A)
C INFILE = DDIR(1:ID)// '/' // NAME
INFILE = NAME//'::XYZFILES'

IF (ISTATUS .EQ. 0) STAT='OLD'
IF (ISTATUS .EQ. 1) STAT='NEW'
IF (ISTATUS .EQ. 2) STAT='UNKNOWN'

IF (STAT .EQ. 'NEW') THEN
    NPTS=RSCAN(6)
    IF (CAXIS .EQ. 'X') NPTS=RSCAN(3)
    IRECLB=(NPTS*4)+2 !RECORD LENGTH (BYTES)--AMP OR PHASE AND STATUS
    IF (IRECLB .LT. 180) IRECLB=180 !ENSURE ENOUGH ROOM FOR HEADER REC.
    CALL DATETIME (IDATE,ITIME)
ELSE
    INQUIRE(FILE=INFILE,IOSTAT=IERR,ERR=65,RECL=IRECLB) !READ RECORD LTH
END IF

OPEN(UNIT=IUNIT,FILE=INFILE,ACCESS='DIRECT',FORM='UNFORMATTED',
+ RECL=IRECLB,IOSTAT=IERR,ERR=65,STATUS=STAT)

65 IF (IERR .GT. 0) THEN
    WRITE(IWRITE,*) 'ERROR ',IERR,' ON OPENING FILE'
    GOTO 5
ELSE
    CALL LGBUF (LBUF,IRECLB/2) !ENLARGE I/O BUFFER TO #BYTES/2
END IF

RETURN

END
SUBROUTINE NFNORM (DATA, NX, NY, AKX, AKY)

C LAST REVISED: 6 OCT 86

CHARACTER CSCAN*80, CAXIS*1, POL*8, NAME*15
COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME, IDATE(3), ITIME(3)
COMMON /MINMAX/ AMIN, AMAX, PMIN, PMAX, MAXX, MAXR
COMPLEX DATA(NX, NY), CJ

CJ = (0., 1.)
DR = ACOS(-1.) / 180.
XINC = RSCAN(2)
YINC = RSCAN(5)
MX = NX/2 + 1
MY = NY/2 + 1

C NORMALIZE AND CONVERT TO RECTANGULAR FORM

DO J=1, NY
    PY = (J-MY)*YINC*AKY
    DO I=1, NX
        PX = (I-MX)*XINC*AKX
        AMP=10.***((REAL(DATA(I, J))-AMAX)/20.)
        PHS= (AIMAG(DATA(I, J))-PMAX)*DR
        DATA(I, J)=AMP*CEXP(CJ*(PHS + (PX+PY)))
    END DO
END DO

RETURN

END
FUNCTION PCALC (GAM, SX, SY, S1OX, S1OY)

LAST REVISED: 14 Mar 86

Incremental calculation used to accumulate total power sum.

COMPLEX S1OX, S1OY, B1, B2

PCALC = 0.

IF (GAM.EQ.0) THEN
  PCALC = CABS(S1OX)**2 + CABS(S1OY)**2
  SZ = SQRT(1 - GAM)
ELSE IF (GAM.LT. 0.9999) THEN
  B1, B2 are b-sub-q (m,k), scalar spectral density functions (p. 55)
  B1 = (SX*S1OX + SY*S1OY)
  B2 = (-SY*S1OX + SX*S1OY)
  PCALC = CABS(B1)**2/SZ + CABS(B2)**2*SZ
END IF

RETURN

END
SUBROUTINE PCORR (DATA, NX, NY, DATA2, NX2, NY2, ICORR, IPRBR, NPOL, + NPOUT, POLIN, POLOUT)

C Subroutine to do probe correction, accumulate power sum, and C convert to desired output polarization.
C
C Last Revised: 10 Aug 88
C
COMMON /USER/ IWRITE,IREAD
COMMON /WVGE/ A,B,AKO
COMMON /PARAM/ RSCAN(7),CAXIS,POL,CSCAN,NAME,IDATE(3),ITIME(3)
COMPLEX D1,D2
COMPLEX DATA(NX,NY),DATA2(NX2,NY2),F1A,F1B,F2A,F2B,FA,FB
COMPLEX SD1X,SD1Y,SD2X,SD2Y,SD1XR,SD1YR,SD2XR,SD2YR,S10X,S10Y
DIMENSION PPAT1X(4096),PPAT1Y(4096),PPAT2X(4096),PPAT2Y(4096)
CHARACTER CAXIS*1,POL*8,CSCAN*80,NAME*15
EMA,DATA,DATA2,PPAT1X,PPAT1Y,PPAT2X,PPAT2Y

ZO is characteristic impedance of transmission line to probe.

ZO = 50 ! 50 Ohms
PI = ACOS(-1.)
ALAM = 2. * PI / AKO
SX0 = RSCAN(1)
SY0 = RSCAN(4)
SXINC = RSCAN(2)
SYINC = RSCAN(5)
POWER = 0.
CPOLI = COS(POLIN)
SPOLI = SIN(POLIN)
CPOLO = COS(POLOUT)
SPolo = SIN(POLOUT)

GMAX is the probe gain on axis.

ALAMGP2 = 1. / (1 - (ALAM / (2 * A))**2)
IF (ALAMGP2 .GT. 0) THEN
ZPRIME = SQRT(ALAMGP2)
PTRANS = 4. * ZPRIME / (1 + ZPRIME)**2
ELSE
ZPRIME = 1.
WRITE (IWRITE,*) 'WARNING: Probe dimensions too small ',
in subroutine PCORR.'
PTRANS = 1.
END IF
GMAX = PTRANS * 32 * A * B / (PI * ALAM**2)
IF (ICORR.EQ.0) THEN
    GMAX=GOWAVGD()
    SMAX = .0164*ALAM*SQRT(GMAX)
ELSE
    SMAX=1
END IF

C
C SMAX is the probe spectrum peak as defined by Kerns 1.6-19
C and 1.6-21a, page 76-77.
C
C SMAX = SQRT(GMAX)*(4*PI*AKO**2*377/20)**-0.5

(Where 20 is transmission line impedance to the probe - 50 ohms)

C
C For gain relative to available power, use the factor
C
C SQRT ( 4 * PI * ZO*AKO**2 / 377 )

(See Kerns, 1.6-6, p. 74)

GAINFAO=SQR(4.*PI*AKO**2*20/377)

IF (ICORR .GE. 0) THEN

C Probe correction (Polarizations are A and B):

DO J=1,NY
    SY=SYO+(J-1)*SYINC
    IF (ICORR.GT.0) CALL GETPAT (J, NY, PPATIX, PPATIY,
                                  PPATZX, PPATZY)
END IF

DO I=1,NX
    SX=SXO+(I-1)*SXINC

    D1 = DATA(I,J)
    IF (NPOL.EQ.2) THEN
        D2=DATA2(I,J)
    ELSE
        D2=(0.,0.)
    END IF

    GAM = SX*SX + SY*SY
    IF (GAM.GE..9999) THEN
        D1=(0.,0.)
        D2=(0.,0.)
    ELSE
        UA = -CPOLI*SX + SPOLI*SY ! Aperture position relative
        VA = SPOLI*SX + CPOLI*SY ! to probe orientation.
        UB = -VA * IPRBR ! Ditto, after probe rotation
        VB = UA * IPRBR !

    IF (ICORR.EQ.0) THEN
        CALL EHU(UA, F1A) ! Theoretical probe pattern
        CALL EEU(VA, F2A) ! for principal planes
        CALL EHU(UB, F1B) !
        CALL EEU(VB, F2B) !

D-53
An electric source spectrum is assumed. Huygens must be converted before using

\[ FA = F_{1A} * F_{2A} * S_{MAX} \]
\[ FB = F_{1B} * F_{2B} * S_{MAX} \]
\[ SD1X = FA * S_{POLI} \]
\[ SD1Y = FA * C_{POLI} \]
\[ SD2X = -FB * C_{POLI} * I_{PRBR} \]
\[ SD2Y = FB * S_{POLI} * I_{PRBR} \]

\[ SD1X = PPAT1X \]
\[ SD1Y = PPAT1Y \]
\[ SD2X = PPAT2X \]
\[ SD2Y = PPAT2Y \]

ELSE
\[ SD1X = PPAT1X (I) \]
\[ SD1Y = PPAT1Y (I) \]
\[ SD2X = PPAT2X (I) \]
\[ SD2Y = PPAT2Y (I) \]
END IF

Convert transmit probe spectra to receive spectra:
CALL SITO1(SD1X,SD1Y,SX,SY,SD1XR,SD1YR)
CALL SITO1(SD2X,SD2Y,SX,SY,SD2XR,SD2YR)

Probe correction:
CALL CORREC(SD1XR,SD1YR,SD2XR,SD2YR,S10X,S10Y,
D1,D2)
D1 = S10Y
D2 = S10X

Accumulate total power sum:
IF (ICORR.EQ.0)
POWER = POWER + PCALC(GAM,SX,SY,S10X,S10Y)
ENDIF

Convert to output polarization:

IF (NPOUT.EQ.1) CALL XYTYCON(SX,SY,S10X,S10Y,SPOLO,
CPOLO,D1,D2)
IF (NPOUT.EQ.2) CALL XYTHUY(SX,SY,S10X,S10Y,
SPOLO,CPOLO,D1,D2)
IF (NPOUT.EQ.3) CALL XYTZCON(SX,SY,S10X,S10Y,SPOLO,
CPOLO,D1,D2)

IF (NPOUT.NE.0) THEN
D1 = D1 * GAINFAC
D2 = D2 * GAINFAC
ENDIF
ENDIF

DATA(I,J) = D1
IF (NPOL.NE.1) DATA2(I,J) = D2
END DO
END DO
ELSE
C No probe correction:

DO J=1, NY
     SY = SYO + (J-1)*SYINC
DO I=1, NX
     SX = SXO + (I-1)*SXINC

D1 = DATA(I,J)/SMAX
IF (NPOL.EQ.2) THEN
     D2 = DATA2(I,J)/SMAX
ELSE
     D2 = (0.,0.)
END IF

GAM = SX*SX + SY*SY
IF (GAM.GE.9999) THEN
     D1 = (0.,0.)
     D2 = (0.,0.)
ELSE
     Notice that D1 is Y-component if no rotation
     SI0X = (-D2*CPOLI*IPRBR + D1*SPOLI)
     SI0Y = (D2*SPOLI*IPRBR + D1*CPOLI)
     D1 = SI0Y
     D2 = SI0X
     IF (NPOUT.EQ.1) CALL XYTYCON(SX,SY,SI0X,SI0Y,
                                   SPOLO,CPOLO,D1,D2)
     + IF (NPOUT.EQ.2) CALL XYTHUY(SX,SY,SI0X,SI0Y,
                                   SPOLO,CPOLO,D1,D2)
     + IF (NPOUT.EQ.3) CALL XYTZCON(SX,SY,SI0X,SI0Y,
                                   SPOLO,CPOLO,D1,D2)
     IF (NPOUT.NE.0) THEN
     D1 = D1*GAINFAC
     D2 = D2*GAINFAC
     END IF

     POWER = POWER + PCALC(GAM,SX,SY,SI0X,SI0Y)
END IF

DATA(I,J) = D1
IF (NPOL.NE.1) DATA2(I,J) = D2

END DO
END DO
END IF

C DELK=AKO**2*SYINC*SXINC
C POWER=POWER*DELK/(240.*PI)
C POW=20.*ALOG10(POWER)
C WRITE(1,*,'TOTAL RADIATED POWER IS ',POWER)

RETURN
SUBROUTINE POLAR (DATA, AMP, PHA)

C LAST REVISED: 9 OCT 86

COMPLEX DATA

X = REAL(DATA)
Y = AIMAG(DATA)

AMP = SQRT(X**2 + Y**2)
PHA = ATAN2(Y, X)

RETURN
END
SUBROUTINE POWRT(N,NPZ,NADD)

C LAST REVISED: 6 OCT 86

NPZ= ALOG( FLOAT(N) )/0.69314718+0.001
NPZ=NPZ+NADD
NP2=2**NP2
RETURN
END
SUBROUTINE READWRITE

EMA ABUF(4096), PBUF(4096)

COMMON /PARAM/ RSCAN(7), CAXIS, POL, CSCAN, NAME,
+ IDATE(3), ITIME(3), NPOL
COMMON /USER/ IWRITE, IREAD

CHARACTER CAXIS*1, POL*8, CSCAN*80, NAME*15

ENTRY READ_DATA (IUNIT, IROW, IRDAT, IDATA, ABUF, PBUF, IBUF)

IF (CAXIS .EQ. 'X') THEN !DATA COLLECTED ALONG X AXIS
    NPTS=RSCAN(3) !# X PTS
ELSE !DATA COLLECTED ALONG Y AXIS
    NPTS=RSCAN(6) !# Y PTS
END IF

C Section for reading data from a file

IF (IRDAT .NE. 2) THEN !ONLY AMP OR PHASE STORED
    IF (IDATA .NE. IRDAT) WRITE(IWRITE,*) 'WARNING-----',
+ 'DATA REQUESTED WAS NOT RECORDED'
    IREC=1+IROW !RECORD #
    IF (IDATA .EQ. 0) READ(UNIT=IUNIT, IOSTAT=IERR, ERR=99, REC=
+ IREC) (ABUF(M),M=1,NPTS), IBUF
+ IF (IDATA .EQ. 1) READ(UNIT=IUNIT,IOSTAT=IERR,ERR=99,REC= IREC) (ABUF(M),M=1,NPTS), IBUF
ELSE IAMPLITUDE AND PHASE STORED
+ IREC=2+2*(IROW-1) IRECORD #
+ IF (IDATA .NE. 1) READ(UNIT=IUNIT,IOSTAT=IERR,ERR=99,REC=IREC)
+ (ABUF(M),M=1,NPTS), IBUF
+ IF (IDATA .NE. 0) READ(UNIT=IUNIT,IOSTAT=IERR,ERR=99,REC=IREC+1) (PBUF(M),M=1,NPTS), IBUF
END IF

RETURN

C

ENTRY WRITE_DATA (IUNIT, IROW, IRDAT, IDATA, ABUF, PBUF, IBUF,
+ AMIN, AMAX, PMIN, PMAX, MAXY, MAXX)

IF (CAXIS .EA. 'XI') THEN !DATA COLLECTED ALONG X AXIS
  NPTS=RSCAN(3) !# X PTS
ELSE !DATA COLLECTED ALONG Y AXIS
  NPTS=RSCAN(6) !# Y PTS
END IF

C Section to determine maximum and minimum amplitudes and phases

IF (IROW .EQ. 1) THEN
  AMIN=100.
  AMAX=100.
  PMIN=180.
  PMAX=-180.
  !INITIALIZE THE MAX AND MINS
END IF

DO I=1,NPTS
  IF(ABUF(I) .GT. AMAX) THEN
    AMAX=ABUF(I) !AMPLITUDE MAX
    IF (CAXIS .EQ. 'XI') THEN
      MAXY=IROW
      MAXX=I
    ELSE
      MAXY=I
      MAXX=IROW
    END IF
  END IF
  IF (ABUF(I) .LT. AMIN) AMIN=ABUF(I) !AMP MIN
END DO

C Section for writing data to a file

IF (IRDAT .NE. 2) THEN !ONLY AMP OR PHASE STORED
  IREC=1+IROW IRECORD #
  D-60
IF (IRDAT .EQ. 0) WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=98,REC= + IREC) (ABUF(M),M=1,NPTS),IBUF
   IF (IRDAT .EQ. 1) WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=98,REC= + IREC) (PBUF(M),M=1,NPTS),IBUF
ELSE
   !AMPLITUDE AND PHASE STORED
   IREC=2+2*(IROW-1) !RECORD #
   IF (IDATA .NE. 1) WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=98,REC= + IREC) (ABUF(M),M=1,NPTS),IBUF
   IF (IDATA .NE. 0) WRITE(UNIT=IUNIT,IOSTAT=IERR,ERR=98,REC= + IREC+1) (PBUF(M),M=1,NPTS),IBUF
END IF

RETURN

C Section for error messages

   98 WRITE (IWRITE,*) 'ERROR ',IERR,' WRITING ROW ',IROW,' TO FILE ', + NAME
   RETURN

   99 WRITE (IWRITE,*) 'ERROR ',IERR,' READING ROW ',IROW,' FROM FILE ', + NAME
   RETURN

END
SUBROUTINE S10T01(S10X,S10Y,UX,UY,S01X,S01Y)

C LAST REVISED: 6 OCT 86

C Uses reciprocity to convert S10 to S01 in Cartesian coordinates
C for a direction Ux, Uy. Note that S01X and S01Y are at -K and
C S10X and S10Y are at K.

COMPLEX S10X,S10Y,S01X,S01Y,GAM,ET1,ET2,A(2,2)
REAL KTSP

KTSP = UX * UX + UY * UY
IF (KTSP .EQ. 0.) THEN
  A(1,1) = (1.0,0.0)
  A(1,2) = (0.0,0.0)
  A(2,1) = (0.0,0.0)
  A(2,2) = (1.0,0.0)
ELSE
  GAM = CSQRT(CMPLX(1.0 - KTSP,0.0))
  ET1 = 1.0 / GAM
  ET2 = GAM
  A(1,1) = (ET1 * UX*UX + ET2*UY*UY) / KTSP
  A(1,2) = (ET1 - ET2) * UX * UY / KTSP
  A(2,1) = A(1,2)
  A(2,2) = (ET1 * UY * UY + ET2 * UX * UX) / KTSP
END IF

S01X = A(1,1) * S10X + A(1,2) * S10Y
S01Y = A(2,1) * S10X + A(2,2) * S10Y

RETURN
END
SUBROUTINE SEPARATE(XINC,YINC,NPOL,NX,NY,DATA,DATAZ,CAXIS)

COMPLEX DATA(NX,NY),DATA2(NX,NY),SDATA(4096)
CHARACTER CAXIS*1
EMA DATA,DATA2,SDATA

PI = ACOS(-1.)

IF (CAXIS.EQ.'R') THEN
   DA = XINC / 2./PI
   DO J=1,NY
      CALL FFT2(1,NX,1,DA,DATA(1,J))
      IF (NPOL.EQ.2) CALL FFT2(1,NX,1,DA,DATA2(1,J))
   END DO
ELSE
   DA = YINC / 2./PI
   DO I=1,NX
      DO J=1,NY
         SDATA(J) = DATA(I,J)
      END DO
      CALL FFT2(1,1,NY,DA,SDATA)
      CALL FFT2(1,1,NY,DA,SDATA)
      DO J=1,NY
         DATA(I,J) = SDATA(J)
      END DO
   END DO
IF (NPOL.EQ.2) THEN
   DO I=1,NX
      DO J=I,NY
         SDATA(J) = DATA2(I,J)
      END DO
      CALL FFT2(1,1,NY,DA,SDATA)
      DO J=1,NY
         DATA2(I,J) = SDATA(J)
      END DO
   END DO
END IF
END IF

RETURN
END
$scs on

SUBROUTINE SEPRENS(XINC,YINC,NPOL,NX,NY,DATA,DATA2,CAXIS)

COMPLEX DATA(NX,NY),DATA2(NX,NY),SDATA(4096)
COMPLEX DATA,DATA2,SDATA
CHARACTER CAXIS*1
COMMON /UVGE/A,B,AKO
COMMON /TRANS/TX,TY,TZ,FILTER,SXINC,SYINC

PI=ACOS(-1.)

IF (CAXIS.EQ.'R') THEN
  DO J=1,NY
    CALL TRANSLATE (DATA(I,J), NX, 1, TX, TY, TZ,FILTER)
    DA=SXINC*AKO
    CALL FFTZ (-1, NX, 1, DA, DATA(I,J))
    IF (NPOL.EQ.2) THEN
      CALL TRANSLATE (DATA2(I,J),NX,1,TX,TY,TZ,FILTER)
      CALL FFTZ (-1, NX, 1, DA, DATA2(I,J))
    END IF
  END DO
ELSE
  DO I=1,NX
    DO J=1,NY
      SDATA(J) = DATA(I,J)
    END DO
    CALL TRANSLATE (SDATA, 1, NY, TX, TY, TZ,FILTER)
    DA=SYINC*AKO
    CALL FFTZ (-1, 1, NY, DA, SDATA)
    DO J=1,NY
      DATA(I,J) = SDATA(J)
    END DO
  END DO
ENDIF

IF (NPOL .EQ. 2) THEN
  DO I=1,NX
    DO J=1,NY
      SDATA(J) = DATA2(I,J)
    END DO
    CALL TRANSLATE (SDATA, 1, NY, TX, TY, TZ,FILTER)
    CALL FFTZ (-1, 1, NY, DA, SDATA)
    DO J=1,NY
      DATA2(I,J) = SDATA(J)
    END DO
  END DO
ENDIF

END IF

RETURN
END
FUNCTION SINX(X)

C LAST REVISED: 6 OCT 86

IF (ABS(X).GE.1.E-06) THEN
    SINX=SIN(X)/X
ELSE
    SINX=1.-X*X/6
END IF

RETURN
END
SUBROUTINE SWIPE

CHARACTER*4 A,G,U

A=CHAR(27)//'H'//CHAR(27)//'J'
G=CHAR(27)//'*da'
U=CHAR(27)//'&j@

WRITE(1,5) A,G,U

5 FORMAT (3A4)

RETURN
END
SUBROUTINE TESTP2(N,ISP2)

C LAST REVISED:  6 OCT 86

C TESTS N FOR POWER OF TWO. IF N IS A POWER OF TWO,
C ISP2=0; IF NOT, ISP2=1.

C

XTRY=ALOG(FLOAT(N))/0.69314718
XDEL=XTRY-INT(XTRY+.001)
ISP2=0
IF(ABS(XDEL) .GT. 1.E-5) ISP2=1
RETURN
END
SUBROUTINE TRANSLATE (DATA, NX, NY, X, Y, Z, FILTER)

LAST REVISED: 6 OCT 86

Performs a translation of the data set in physical space using the vector \( R = (X,Y,Z) \). The data set domain is assumed to be \( K \)-space and the multiplier is \( \exp(-j K \cdot R) \).

An ideal low-pass filter can also be applied. The FILTER parameter is a radius (in normalized wave-number units).

Data points beyond this distance from the wave-number origin are zeroed. A value of FILTER=0. implies no filtering.

COMPLEX DATA(NX,NY), CFACT, CJ
CHARACTER CAXIS*1,POL*8,CSCAN*80,NAME*15
EVA DATA
COMMON /PARAM/ RSCAN(7),CAXI
S,POL,CSCAN,NAME,DATE(3),ITIME(3)
COMMON /WVGE/ A,B,AKO

CJ = (0.,1.)
XKINC = RSCAN(2)*AKO  ! X axis spacing
YKINC = RSCAN(5)*AKO  ! Y axis spacing
XKO = RSCAN(1)*AKO    ! Initial X-axis point
YKO = RSCAN(4)*AKO    ! Initial Y-axis point

IF (FILTER.EQ.0.) FILTER = 1. ! Same as no filter
R2 = (FILTER*AKO)**2       ! Filter radius

DO J=1,NY
  YK = YKO + (J-1)*YKINC
  YK2 = YK**2
  DO I=1,NX
    XK = XKO + (I-1)*XKINC
    XK2 = XK**2
    IF ((XK2+YK2) .GT. R2) THEN
      DATA(I,J) = (0.,0.)
    ELSE
      ZK2 = AKO**2 * XK2 - YK2
      CFACT = CEXP(-CJ * (X*XK+Y*YK))
      IF (ZK2 .GT. 0.) THEN
        ZK = -SORT(ZK2)
        CFACT = CFACT * CEXP(-CJ * Z2K)
      ELSE IF (ZK2 .LT. 0.) THEN
        ZK = -SORT(-ZK2)
        CFACT = CFACT * EXP(Z2K)
      END IF
      DATA(I,J) = DATA(I,J) * CFACT
    END IF
  END DO
END DO
RETURN
END
SUBROUTINE XYTHUY(UX, UY, SX, SY, SK, CK, SA, SB)

C LAST REVISED: 6 OCT 86

C COMPONENTS IN ORTHOGONAL DIRECTIONS A AND B.

COMPLEX SX, SY, SZ, SA, SB

ST = SQRT(UX**2 + UY**2)
CT = SQRT(1.-ST**2)
SZ = -(UX*SX + UY*SY)/CT

IF (ST .LT. .0001) THEN
    HBX = CK
    HBY = SK
    HBZ = 0.
    HAX = -SK
    HAY = CK
    HAZ = 0.
ELSE
    CP = UX/ST
    SP = UY/ST
    CPB = CK*CP + SK*SP
    SPB = -SK*CP + CK*SP
    CPA = -SPB
    SPA = CPB
ENDIF

C This is Huygens unit polarization pattern for X electric field.

HX = SPB**2 + CPB**2*CT
HY = SPB*CPB*(CT-1.)
HZ = -CPB*ST
HBX = CK*HX - SK*HY
HBY = SK*HX + CK*HY
HBZ = HZ
HX = SPA**2 + CPA**2*CT
HY = SPA*CPA*(CT-1.)
HZ = -CPA*ST
HAX = -SK*HX - CK*HX
HAY = CK*HX - SK*HY
HAZ = HZ
ENDIF

SA = SX*HAX + SY*HAY + SZ*HAZ
SB = SX*HBX + SY*HBY + SZ*HBZ

RETURN
END
SUBROUTINE XYTYCON (UX, UY, SX, SY, SPOL, CPOL, SEL, SAZ)

C LAST REVISED: 13 MAY 88

C Converts X, Y components of transformed spectrum (Sx, Sy) to azimuth, elevation components (conical about Y-axis) including a possible rotation about the Z-axis by angle POLOUT, where

C CPOL = COS(POLOUT)
C SPOL = SIN(POLOUT)

C Components are computed for a direction Ux, Uy.

COMPLEX SX, SY, SAZ, SEL, SZ, GAM, CB, SA, CA, C SQRT

GAM = CSQRT(CMPLX(1. - UX*UX - UY*UY, 0.0))
SZ = -(UX * SX + UY * SY) / GAM
SB = UY  ! SIN EL
CB = CSQRT(CMPLX(1. - SB*SB, 0.0))  ! COS EL
SA = UX / CB  ! SIN A2
CA = GAM/ CB  ! COS A2
SEL = ((CPOL * (-SB * SA) + SPOL * CB) * SX +
+ (SPOL * SB * SA + CPOL * CB) * SY +
+ (-SB * CA) * SZ) * GAM
SAZ = ((CA * CPOL * SX) - (CA * SPOL * SY) - (SA * SZ)) * GAM

RETURN
END
SUBROUTINE XYTZCON (UX, UY, SX, SY, SPOL, CPOL, S10TH, S10PH)

C LAST REvised: 13 MAY 88

C Converts X,Y components of transformed spectrum (Sx, Sy) to spherical
C components (theta, phi - conical about Z-axis) including a possible
C rotation about the Z-axis by angle POLOUT, where
C
C CPOL = COS(POLOUT)
C SPOL = SIN(POLOUT)
C
COMPLEX SX, SY, S10TH, S10PH, SZ, GAM, CTH, STH, CPH, SPH

GAM = CSQRT(CMPLX(1. - UX*UX - UY*UY, 0.0))
SZ = -(UX * SX + UY * SY) / GAM
CTH = GAM ! COS THETA
STH = CSQRT(1. - GAM*GAM) ! SIN THETA
SPH = UY / STH ! SIN PHI
CPH = UX / STH ! COS PHI
S10TH = CTH*(CPH*CPOL - SPH*SPOL)*SX + CTH*(SPH*CPOL + CPH*SPOL)*SY
+ -STH*SZ
S10PH = (CPH*CPOL - SPH*SPOL)*SY - (SPH*CPOL + CPH*SPOL)*SX

RETURN
END
SUBROUTINE XYZOPEN(FNAME, IUNIT, ISTATUS)

LAST REVISION: 4/2/87

CHARACTER CAXIS*1, POL*8, CSCAN*8, NAME*15, INFILE*25, STAT*7, FNAME*15
COMMON /RECBUFF/LBUF(8200)
COMMON /PARAM/RSCAN(7), CAXIS, POL, CSCAN, NAME, IDATE(3), ITIME(3)
COMMON /USER/IWRITE, IREAD

XYZOPEN opens a data file.

LBUF is a library subroutine to enlarge I/O buffer size. NOTE:
the buffer array LBUF must not be in ENA under any circumstances.
NOTE: if CDS is used, then either the call to LBUF must be made in
the main program (in this case common block RECBUFF is not required),
or common block RECBUFF must be declared in the main program and
this subroutine. If CDS is not used then the call can be made from
this subroutine without using common block RECBUFF.

NAME = FNAME
GOTO 77

WRITE(IWRITE,*) 'Enter data file name:'
READ (IREAD, 20) NAME
FORMAT(C)

INFILE = NAME//':XYZFILES'

IF (ISTATUS .EQ. 0) STAT = 'OLD'
IF (ISTATUS .EQ. 1) STAT = 'NEW'
IF (ISTATUS .EQ. 2) STAT = 'UNKNOWN'

IF (STAT .EQ. 'NEW') THEN
  NPTS = RSCAN(6)
  IF (CAXIS .EQ. 'X') NPTS = RSCAN(3)
  IRECLB = (NPTS*4) + 2 ! RECORD LENGTH (BYTES) - AMP OR PHASE AND STATUS
  IF (IRECLB .LT. 180) IRECLB = 180 ! INSURE ENOUGH ROOM FOR HEADER REC.
  CALL DATETIME(IDATE, ITIME)
ELSE
  INQUIRE(FILE=INFILE, IOSTAT=IERR, ERR=65, RECL=IRECLB)
  IREAD RECORD LTH
END IF

OPEN(UNIT=IUNIT, FILE=INFILE, ACCESS='DIRECT', FORM='UNFORMATTED',
+ RECL=IRECLB, IOSTAT=IERR, STATUS=STAT)

WRITE(IWRITE, 10) NAME
GOTO 5
ELSE
  CALL LBUF(LBUF, IRECLB/2) ! ENLARGE I/O BUFFER TO #BYTES/2
END IF

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RETURN

END