(2)

DNA 6233F

CW ~~CM~~ MEASUREMENT SYSTEM
Operating Manual

EG&G Washington Analytical Services Center, Inc.
2450 Alamo Avenue SE
Albuquerque, New Mexico 87106

2 August 1982

Final Report for Period 27 May 1980—2 August 1982

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Firmware	CW	GPIB	
Structured Programming	Data Structure	IEEE 488 Bus	
EPROM	Global Flag	Logical Device	

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This document was prepared for the Defense Nuclear Agency under Contract DNA 001-80-C-0290 and submitted to satisfy CDRL item 4. This document contains the operating instructions for the Upgraded DNA Continuous Wave (CW) Measurement System. The CW Measurement System (originally manufactured by the Boeing Company) was modified to upgrade its performance capabilities by EG&G WASC, Inc., Albuquerque Op., Albuquerque, New Mexico. The CW Measurement System will be used to evaluate the electrical responses of communication facilities to electromagnetic environments.

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CONVERSION FACTORS FOR U.S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

To Convert From	To	Multiply By
angstrom	meters (m)	1.000 000 X E -10
atmosphere (normal)	kilo pascal (kPa)	1.013 25 X E +2
bar	kilo pascal (kPa)	1.000 000 X E +2
barn	meter^2 (m^2)	1.000 000 X E -28
British thermal unit (thermochemical)	joule (J)	1.054 350 X E +3
cal (thermochemical)/cm^2§	mega joule/m^2 (MJ/m^2)	4.184 000 X E -2
calorie (thermochemical)§	joule (J)	4.184 000
calorie (thermochemical)/g§	joule per kilogram (J/kg)*	4.184 000 X E +3
curie§	giga becquerel (GBq)+	3.700 000 X E +1
degree Celsius‡	degree kelvin (K)	$t_K = t°_C + 273.15$
degree (angle)	radian (rad)	1.745 329 X E -2
degree Fahrenheit	degree kelvin (K)	$t_K = (t°_F + 459.67)/1.8$
electron volt§	joule (J)	1.602 19 X E -19
erg§	joule (J)	1.000 000 X E -7
erg/second	watt (W)	1.000 000 X E -7
foot	meter (m)	3.048 000 X E -1
foot-pound-force	joule (J)	1.355 818
gallon (U.S. liquid)	meter^3 (m^3)	3.785 412 X E -3
inch	meter (m)	2.540 000 X E -2
jerk	joule (J)	1.000 000 X E +9
joule/kilogram (J/kg) (radiation dose absorbed)§	gray (Gy)*	1.000 000
kilotons§	terajoules	4.183
kip (1000 lbf)	newton (N)	4.448 222 X E +3
kip/inch^2 (ksi)	kilo pascal (kPa)	6.894 757 X E +3
ktap	newton-second/m^2 (N-s/m^2)	1.000 000 X E +2
micron	meter (m)	1.000 000 X E -6
mil	meter (m)	2.540 000 X E -5
mile (international)	meter (m)	1.609 344 X E +3
ounce	kilogram (kg)	2.834 952 X E -2
pound-force (lbf avoirdupois)	newton (N)	4.448 222
pound-force inch	newton-meter (N•m)	1.129 848 X E -1
pound-force/inch	newton/meter (N/m)	1.751 268 X E +2
pound-force/foot^2	kilo pascal (kPa)	4.788 026 X E -2
pound-force/inch^2 (psi)	kilo pascal (kPa)	6.894 757
pound-mass (lbm avoirdupois)	kilogram (kg)	4.535 924 X E -1
pound-mass-foot^2 (moment of inertia)	kilogram-meter^2 (kg•m^2)	4.214 011 X E -2
pound-mass foot^3	kilogram-meter^3 (kg/m^3)	1.601 846 X E +1
rad (radiation dose absorbed)§	gray (Gy)*	1.000 000 X E -2
roentgen§	coulomb/kilogram (C/kg)	2.579 760 X E -4
shake	second (s)	1.000 000 X E -8
slug	kilogram (kg)	1.459 390 X E +1
torr (mm Hg, 0° C)	kilo pascal (kPa)	1.333 22 X E -1

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NOTES:

(1) During use, this sensor must be supported by dielectric materials and positioned at least two sensor diameters from any conducting surfaces.

(2) A DLT-96 Balun is used to transform 100 ohms balanced output to 50 ohms unbalanced output for telemetry and recording.

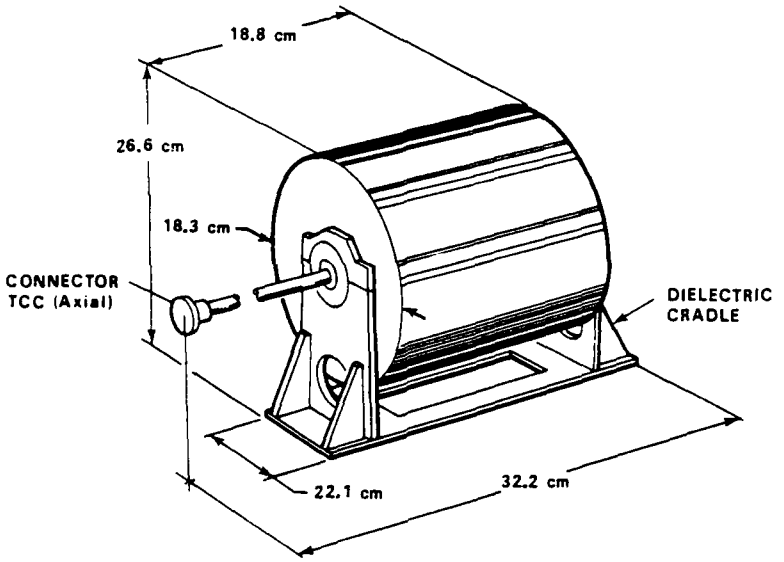


Figure 2. MGL-2(A) B-dot Sensor

Table 3. Electrical and physical characteristics for the EG&G MGL-2(A) field sensor

Specifications

Parameter	MGL-2
A_{eq} (m^2)	1×10^{-2}
Frequency Response (3 dB Point)	>300 MHz
Risetime	<1.2 ns
Maximum Output	±5 kV
Output Connector	TCC*
Mass	2.74 kg**

* 100 ohm Twinaxial Connector (Data Sheet 1340)

** Includes dielectric cradle.

Table 2. Singer current probes electrical and physical characteristics

Model	Window Size	Z_T Ohms	Z_t dB Reference 1 ohm	Sensitivity	Bandwidth
94430-2	3/4"	1.0	0 dB	1 mV/1mA	114 kHz to >115 MHz
91550-2	1-1/4"	1.0	0 dB	1 mV/1mA	36 kHz to >115 MHz
93686-3	2-5/8"	2.0	6 dB	2 mV/mA	80 kHz to 150 MHz
94456-3	4"	0.05	-26 dB	0.05 mV/mA	30 kHz to 100 MHz

2-2.2.3 EG&G MGL-2(A) B-dot Sensor - The EG&G MGL-2(A) is a light-weight portable sensor which measures the time rate of change of a magnetic field in free space. The sensor consists of four evenly spaced gaps forming a cylindrical loop. Cables internally feed gap votlages to a central summing node which drive the output twinax cable. See Figure 2 and Table 3 for further descripton of this sensor's characteristics.

2-2.2.4 EG&G DLT-96 Balun - The EG&G DLT-96 balun is used with the MGL series sensors to convert the balanced output on the twinax lines to an input for a 50-ohm unbalanced system. For this measurement system a balun is required for each MGL series sensor in use. The balun adds -6 dB gain regardless of frequency to the output of the sensor. See Table 4 for specifications.

2-2.2 Sensors

At the present time, the sensors used with the CW instrumentation system include Tektronix P6046 differential voltage probe system; Singer (Stoddart) current probes models 91550-2, 94430-2, 94456-3, and 93686-3; and the EG&G MGL-2(A) field sensor to convert the differential output of the probe to a single-ended signal.

2-2.2.1 Tektronix P6046 Differential Voltage Probe - The P6046 is an active, differential voltage probe designed for use with its own amplifier ("amplifier for P6046") or the Tektronix type 1A5 differential amplifier. Its features include high common-mode rejection due to its design, and calibrated vertical deflection factors from 1mV/div. (or -26 dB) by use of the clockstopped control on the P6046 amplifier. These deflection factors can also be increased by a factor of 10 by adding the dual attenuator head accessory. The probe and amplifier combination possess a 100 MHz bandwidth 5V common-mode operating range, and 25V maximum input (250V with the attenuator head in place). A complete description of the P6046 can be found in the Tektronix Instruction Manual P6046 Probe and Amplifier, pp. 1-1 to 1-9.

2-2.2.2 Singer (Stoddart) RF Current Probes - The Singer current probes are 'clamp-on' type RF current transformers. They provide a means of accurately measuring radio frequency current within a conductor (or group of conductors) without requiring direct connection to the conductor. The conductor is placed in the center of the probe (the 'window') and thus becomes a one turn primary winding. There is no limit to the voltage on the conductor, as long as there is adequate insulation between probe and conductor. The differences between the various probe models of this type include maximum current handling capability, transfer impedances and window size. Consult Table 2 to select the proper probe for the desired measurements.

STOP:

Momentary rocker switch. Aborts current test cycle.

RESET:

Red momentary rocker switch. Resets all hardware and software.

STEP MODE:

Rocker switch. When set to 'AUTO' the test frequencies are automatically stepped thru when the first start pulse is received. Subsequent start pulses are ignored. When set to 'MAN', frequency is stepped by repeatedly depressing the 'START' pushbutton.

START MODE:

Rocker switch. When set to 'REMOTE' this causes the test to start by a start pulse from the Data-Chron command link (i.e., when the synchronized clocks reach their predetermined start times). When set to 'LOCAL', the test starts by a depression to the 'START' pushbutton.

MEAS CYCLE:

Rocker switch. When set to 'MULTI', an automatic multicycle test begins consisting of an ambient noise measurement, a test measurement, and a pickup noise measurement. When set to 'SINGLE', a single test measurement is performed. The LED above the switch lights when the 'MULTI' position is selected.

HOLD:

Rocker switch. When switched on, this switch causes an indeterminate delay between the measurement cycles of an automatic test. Resynchronization may be necessary to continue the next cycle. The LED lights when the switch is on.

attenuation in 1 dB steps for both signal and reference channels.

2-2.1.3 Front Panel Controls - Both transmitter and receiver PCUs contain a control panel. A discussion of the switch settings follows:

POWER ON:

A backlit white pushbutton switch. Depressing this switch applies power to and resets the PCU.

ENABLE:

Keylock switch. Allows the program START switch and PLOT INITIATE switch to be sensed.

DECADE AND STEP SAMPLE SELECTION:

Six thumbwheel switches. Selects the number of samples per frequency decade. Note that, at present, the 'KFD' setting is illegal and will cause a test to be aborted.

PLOT FORMAT:

Thumbwheel switch. Selects the format for the plotter and also the type of test (response function or transfer function). The 'XXX' setting repeats the last format selected but suppresses the plot grid if the plotter is set up in backup configuration (see Section 3).

PLOT/INITIATE:

Momentary rocker switch initializes the PCU prior to beginning a test sequence. This sets all PCU software into a state to begin a test cycle and causes the PCU switch settings to be transmitted to the PDP 11/34.

START:

Momentary rocker switch. Starts a test cycle. Also causes frequency stepping if start mode switch is set to 'LOCAL'.

also controls the RF relay connecting the output of the synthesizer to input of the amplifier. The synthesizer is capable of generating frequencies from 100 Hz to 1000 MHz. The synthesizer output signal is fed to the broadband amplifier (0.01 MHz to 100 MHz). This amplifier produces a maximum power output of 500 watts into a 50-ohm load. The firmware for the transmitter PCU:

- Reads, interprets, and responds to the front panel switch settings.
- Responds to step pulses.
- Uses the IEEE 488 (GPIB) buss to control the transmitter synthesizer.
- Terminates the program at the end of test or at operator command.

Interpretation of front panel switches also includes automatic cycle restart if an automatic test sequence is selected.

2-2.1.2 Receiver Subsystem - The receiver subsystem consists of the PCU and associated hardware and firmware, two Systron-Donner 1702 frequency synthesizers, an HP-8407/ HP-8412 Network Analyzer, two Data Precision Digital Voltmeters (DVMs) and a Tektronix 4662 digital plotter. The VTO (Voltage Tuned Oscillator) synthesizer is offset from the test frequency and Reference synthesizer by 200 MHz. The Reference Synthesizer is used as a local RF source for calibrations, noise measurements, and where a radiated signal is unavailable. Both synthesizers are controlled by the PCU via the IEEE 488 buss. The DVMs take the analog outputs of the network analyzer and convert them to digital signals in BCD (Binary Coded Decimal) format for the PCU. The PCU formats data for transmission to the PDP-11/34 via the SBC 80/20-4 RS-232 I/O port. This function is not used in the transmitter.

In addition to this equipment, an RF patch panel is included in the receiver subsystem for signal conditioning. This panel allows for 20 dB amplification or up to 80 dB of

Table 1. CW Measurement System characteristics

Measurement Mode:	Radiated Direct Injection
	Direct Injection
Measurement Type:	Transfer Function
	Driving Point Impedance
	Ambient Noise
	Pick-up Noise
	Instrumentation Calibration
Frequency Range:	
Radiated	0.1 MHz to 100 MHz*
Direct Injection	.01 MHz to 100 MHz**
Sample Density	Decade Selectable - 25, 50, 100, 250, 500, 1000 points per decade.
Sample Spacing	Logarithmic
Transfer Function Range:	≥100 dB
Sensitivity:	-90 dBm or greater
Dynamic Range:	
Network Analyzer	80 dB
Fiber Optics Data Links	40 dB
Measurement Rate:	~1 frequency point each 0.7 second.

* Frequency Response is a function of antenna characteristics.

** Frequency Response is a function of injection method and standard HP 8407A Network Analyzer characteristics.

system: a transmitter subsystem and receiver system, the command link which synchronizes the two, sensors, power supplies and generator; and the data acquisition system; a PDP11/34A CPU, five asynchronous interfaces (RS-232), two megabyte disk drives, disk packs, a Tektronix plotter, system console and cassette tape subsystem. Each system will be discussed separately.

2-2 CW MEASUREMENT SYSTEM

The CW Measurement System operates in either direct injection or radiated mode, with proper antenna or injection couplers. Frequency coverage is 0.1 MHz - 100 MHz in the radiated test mode, and 0.01 MHz - 100 MHz in direct injection mode. Sufficient frequency sampling density is available to resolve reasonable response curves with a Q of 100. It takes approximately five minutes for the measurement system to sweep the frequency range with 400 sample points. Table 1 contains a summary of the system characteristics.

2-2.1 Program Control Unit (PCU)

The program control units (PCUs) are the "brains" of both the receiver and transmitter subsystems. Their functions are program initiation, frequency control, and termination. The transmitter and receiver PCUs are functionally identical and interchangeable and consist of an Intel SBC-80/20-4 Single Board Computer, Intel SBC-116 Combination Memory and I/O Expansion Board, Intel SBC 416 16K PROM/ROM Expansion Board, Intel chassis (SBC 660), a Zia Tech ZT 80 IEEE 488 Buss Controller card, an SBC-604/614 card cage, and custom built Boeing synchronizer card. Programs are stored in type 27089 EPROMS.

2-2.1.1 Transmitter Subsystem - The transmitter subsystem consists of the above mentioned PCU, a Systron-Donner 1702 synthesizer for generating RF signals and a broadband power amplifier. The system is synchronized to the receiver via a command link consisting of two precision clocks. The synchronizer gates control signals and timing signals to the PCU, and

SECTION 2
CW MEASUREMENT SYSTEM DESCRIPTION

2-1 GENERAL DESCRIPTION

The CW Measurement System consists of two subsystems - the Defense Nuclear Agency (DNA) Continuous Wave Measurement system designed by Boeing and modified by EG&G, and the Data Acquisition subsystem, consisting of a PDP11/34A computer system and software by EG&G. These two subsystems communicate with each other to produce, detect, display, and reduce CW data in the frequency range of .01 MHz to 100 MHz. The system is designed to test communications complexes either by radiation or direct injection, collecting the response function or transfer function data, removing the effects of the instrumentation involved, plotting the results and saving the data on cassette for archival storage or future processing. Figure 1 shows a block diagram of the CW Measurement System in a typical test configuration. The system modules consist of the measurement

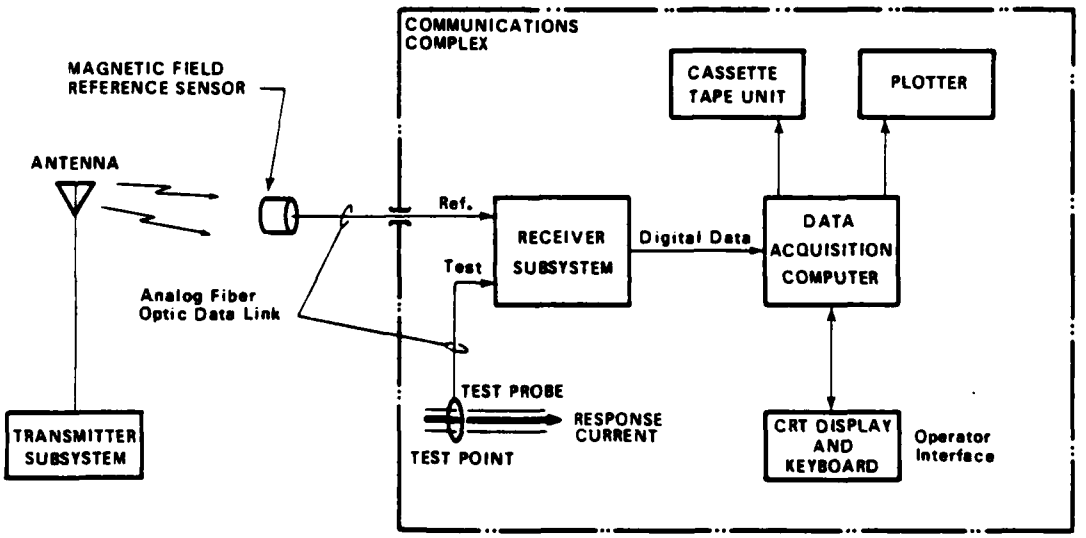


Figure 1. Block Diagram of CW Measurement System in a Typical Test Configuration

The CW Measurement System is versatile and can make a variety of measurements with a minimum of operator intervention. The following Sections describe system and operating procedures in detail.

The EPROM (erasable programmable read only memory) Programmer is used to program EPROMs for the PCUs that control deletion of test frequencies and output level of the transmitter.

The CW Measurement System can be set to automatically perform three tests (cycles) in succession with little operator intervention.

In the first test cycle, the ambient noise at the test point is measured. The Transmitter PCU sequences through the selected test frequencies, but its output is inhibited. This is necessary in order to keep the Receiver and Transmitter synchronized thru the multi-cycle test. After initiating the test, the operator is prompted to enter pertinent test parameters at the Graphics Terminal. When all entries have been made, the Graphics Terminal displays measurement data.

In the second test cycle, test point data are acquired and processed. The corrected raw data are displayed on the Graphics Terminal as acquired. Calculation of the inverse Fourier transform also proceeds as test point data are acquired.

When the test point measurement is complete, the system waits for a predetermined amount of time to allow the operator to move the test probe in preparation for the instrumentation noise measurement. Instrumentation noise is measured and displayed on the Graphics Terminal.

The PDP-11/34A begins to output the processed data to the plotter at the conclusion of the second test cycle. At the conclusion of the third measurement cycle, processed data are stored on magnetic tape.

A single 3-cycle test requires about 20 minutes to complete assuming 400 frequency points per measurement.

The CW Measurement System can also be operated in a single-cycle mode. This mode is used for instrumentation and probe calibration measurements or when noise measurements are not desired. The single cycle mode is essentially identical to the second cycle of a multi-cycle test sequence.

clocks are synchronized. The clocks are then used to initiate transmitter and receiver operation.

The Program Control Units (PCUs) are microprocessor controllers programmed to control the instruments in the transmitter and receiver. The PCUs are identical in hardware and software. Timing signals from the clocks cause the PCUs to sequence through a test synchronously. Measurement data are acquired and scaled by the Receiver PCU and sent to the Data Acquisition Computer.

The Measurement System is designed to operate in a backup configuration if the Data Acquisition Subsystem is not available. Unprocessed test data are plotted and stored on magnetic tape. The stored data can be read and processed by the Data Acquisition Subsystem at a later time.

The Data Acquisition Subsystem comprises a DEC PDP-11/34A processor with 128k words of parity memory and hardware floating point arithmetic; two DEC RL01 disk drives; a graphics terminal, tape drive, digital plotter and EPROM programmer. The software operates under DEC RSX-11M Real-Time Operating System. The Operating System, data processing routines and calibration data are stored on a single disk. One disk drive is used for the Operating System and processing software and the remaining disk drive is used for data storage.

Operator control of the Data Acquisition Subsystem is performed via an HP-2648A Graphics Terminal. Measurement data are also displayed by the Graphics Terminal.

The Cassette Tape Drive is used for archival storage of processed measurement data. Each side of a cassette can store up to four measurements of 400 frequency samples and their associated inverse transforms.

The Plotter generates hard copy plots of measurement data. Magnitude, phase and the time domain inverse Fourier transform can be plotted. Plots are automatically annotated with test parameters entered by the operator thru the Graphics Terminal.

can be electrically isolated with Fiber Optic Data Links to prevent undesirable coupling to the Receiver.

Reference and Test Channel signals are applied to the inputs of an HP8407/HP8412 Network Analyzer. The Network Analyzer is "tuned" in sequence with the Transmitter to the selected discrete test frequencies. The Network Analyzer produces two analog output signals proportional to magnitude and phase. The magnitude output signal is proportional to the ratio of the Test Channel input voltage to the Reference Channel input voltage expressed in dB. The phase output signal is proportional to the phase of the Test Channel input with respect to the Reference Channel input.

The analog output signals from the Network Analyzer are digitized and scaled. A digital data triplet representing the frequency, magnitude and phase is sent to the Data Acquisition Computer for each of the selected test frequencies. The computer corrects the raw measurement data to account for the frequency response characteristics of the test instrumentation and measurement probes/sensors. Corrected data are multiplied by the spectrum of the desired double exponential threat-waveform and the inverse Fourier transform is calculated yielding the time domain response of the test point to threat-waveform. When a measurement is completed, hard-copy plots of magnitude, phase and the inverse Fourier transform are generated by a digital plotter. The corrected data for each measurement are stored on magnetic tape.

Provisions have been made to allow the measurement system to delete selected test frequencies where interference with local communications is to be avoided.

The output level of the transmitter can be automatically varied with frequency to compensate for antenna roll-off at low frequencies.

Precise synchronization of the Receiver and Transmitter operating frequencies is obtained by using two temperature compensated crystal controller clocks. The time settings of the

SECTION 1
INTRODUCTION

Swept frequency continuous wave (CW) measurements can be used to easily determine complex transfer function (i.e., magnitude and phase as functions of frequency) of linear electrical systems. After a transfer function has been measured, the corresponding time domain response to an arbitrary stimulus can be determined mathematically using the inverse Fourier transform. This technique is particularly valuable in validating electromagnetic models used to analyze and predict the responses of various electrical systems to an electromagnetic pulse (EMP) environment.

The Defense Nuclear Agency (DNA) CW Measurement System, which was recently upgraded in capability by EG&G Washington Analytical Services Center, Inc., is an electronic data acquisition system that measures transfer functions and calculates time domain responses to a double exponential waveform.

This document describes the DNA CW Measurement System and presents operating procedures.

The DNA CW Measurement System is a portable electronic system which produces, detects, and displays and reduces CW data in the frequency range of 0.01 to 100 MHz. The CW Measurement System consists of three major subsystems: the Transmitter, the Receiver and the Data Acquisition Computer.

The Transmitter generates a sequence of CW signals at selected discrete frequencies and drives an appropriate antenna. The resulting radiated CW energy is applied to a reference field sensor and to the communications complex under test. The output signal from the Reference Sensor is proportional to the incident magnetic field strength at the reference sensor and is applied to the Reference Channel input of the Receiver. The output signal from the Test Probe is proportional to the response current at the test point and is applied to the Test Channel input of the Receiver. Both Reference and Test Channel signals

Table 4. EG&G DLT-96 balun physical and electrical characteristics

Specifications

Physical Specifications:

Size:	13 centimeters end-to-end. Balun body is 5 centimeters in diameter.
Weight:	0.6 kg
Connectors:	Locking TCC on balanced (100 ohm) end; GR874L on unbalanced (50 ohm) end.

Electrical Specifications:

Bandwidth (3 dB points)	10 kHz to 130 MHz
Bandpass ripple	±1 dB
Risetime (Nominal)	1.3 ns
Unbalanced end	50-ohms
Balanced end	100-ohms
Common mode rejection	36 dB at 100 MHz. (Minimum anywhere in bandpass.)
Insertion loss	6.0 dB
Volt second product	80 volt microseconds
Input Impedance	50-ohms
Load Impedance	>1 megohm, <10 pF
Maximum Input Voltage	5 kV peak for 100 nsec max.
Maximum CW Input Power	1 watt

2-2.2.5 EG&G RCI-1B Passive Integrator - The EG&G RCI-1B Integrator is a passive resistor-capacitor type integrator with RC time constants of 1, 5, 10, and 100 microseconds available. Its transfer function is

$$\frac{V_{out}(s)}{V_{in}(s)} = \frac{1}{sRC + 1}$$

where s = LaPlace operator. This transfer function is that of an integrator for sinusoidal varying voltage if frequency is large compared to

$$\frac{1}{2\ RC}$$

or for transients with times small compared to RC. Further specifications are found in Table 5.

Table 5. EG&G RCI-1B Passive Integrator transfer function accuracy

1 μsec	5% to 100 MHz 3 dB to 200 MHz
5 μsec	5% to 75 MHz 3 dB to 150 MHz
10 μsec	5% to 75 MHz 3 dB to 150 MHz
100 μsec	5 % to 75 MHz 3 dB to 40 MHz

Input and Output Connectors General Radio Type 874L

2-2.3 Data Link

Most test configurations using this system require that the transmitter be isolated from the receiver. Yet it is necessary that the output of the transmitter be sensed and that this sensor reading appear at the receiver as the reference. The link which delivers this reading must be non-conducting, for if it is conducting, the EM radiation may get into the reference conductor, voiding the reading and fouling the results. Therefore, fiber optic links are used to deliver the reference readings to the receiver system.

2-2.3.1 Optical Link Transmitter and Receiver - The Meret MDL 77841 fiber optic analog data link is used to isolate the receiver from any sensors which may come in contact with EM radiation. The link operates with 100 meters of fiber optic cable at approximately -20 dB gain over a frequency range of .01 MHz to 100 MHz. The signal output is 50 ohms, and signal input impedance is 50-ohm unbalanced, making a good match to a DLT-96 balun or other probe designed for a 50-ohm impedance.

2-2.3.2 Fiber Optic Link ("Light Pipe") - The data links, as mentioned, come with 100 meters of low-loss fiber optic cable. These non-conducting cables contain bundles of fine glass strands wrapped together, and covered with a protective sheath. Although the cables are relatively rugged, and can withstand normal handling, care should be taken to avoid kinking the cables, or mishandling them (walking on them, or running over them with a fork lift, for example) as this could break the glass strands, rendering the cable useless.

EG&G Optical Data Links - The CW-II system is furnished with EG&G Model ODL-5B optical data links. These are remotely-controllable units which consist of a sealed, self-contained transmitter unit with a detachable battery pack, fiber cables for control and data, and a receiver/controller unit with a built-in battery charger for the transmitter batteries.

The transmitters each have an unbalanced and a balanced input. An active integrator and a programmable attenuator can be switched by remote control into either input. The attenuation range is 0 to 79 dBm. The transmitter also includes a cal-pulse generator which provides a +100 mV bipolar cal pulse at approximately 10 KHz. Provision is also made to terminate the transmitter inputs (50 ohm terminations) for system noise measurements.

All of the transmitter functions may be selected from the receiver unit front panel or may be controlled via the IEEE-488 buss connector on the back of the receiver unit. The receiver provides status indicators for attenuation settings, transmitter power and verification, AC-power, and local or IEEE control selection. Please refer to the operations and maintenance manual, AG-1533, for the Model ODL-5B wideband optical data link, for more information.

2-3 DATA ACQUISITION SYSTEM

Figure 3 is a block diagram of the data acquisition subsystem components. The following sections describe each component in detail.

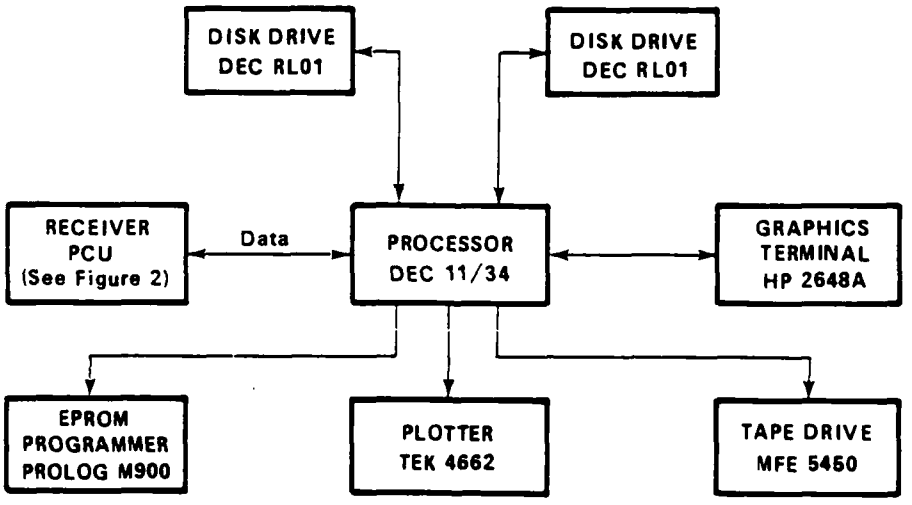


Figure 3. Block Diagram of Data Acquisition Subsystem

2-3.1 Hardware Configuration

PDP-11/34 CPU AND INTERFACES - The PDP-11/34 computer system used for data acquisition in the CW system contains 128 K words of parity MOS memory. It includes the following capabilities and equipment:

Central Processor
Parity Memory
Automatic bootstrap loader program in ROM memory
Operator's Console
Self Test diagnostics
Memory management relocation and protection
Floating point processor (FPP)
Extended instruction set (EIS)
Serial line interface clock

The Extended Instruction Set provides the capability of performing hardware fixed point arithmetic and allows direct implementation of multiply, divide and multiple shifting. A double-precision integer 32-bit word can be handled.

The FP-11 Floating Point Processor hardware extends the system's power and speed providing additional hardware and registers to do all floating point arithmetic, as well as long integer (32 bit signed) arithmetic. The FPP also provides instructions which convert all supported data formats (integer, long integer (32 bit), single precision and double precision floating point) to another format for calculations. This processor increases the efficiency and speed of all floating point operations.

Memory management hardware provides facilities necessary for memory management and protection. Memory is assigned to a user program and the user program is prevented from accessing memory outside its designated area. The user is thereby prevented from interference from any other user program or the system executive program.

Hardware implemented features enable the operating system to dynamically allocate memory upon demand while a program is running.

An individual program can only address memory up to 32k words, but the central processing unit (CPU) and UNIBUS can reference addresses up to 128k words. This capability provides the framework for expanding memory references.

In addition to the 128k word constraint on basic memory addressing space, the uppermost 4k words of address space are reserved for UNIBUS I/O device registers.

All memory in the PDP-11/34 system contains parity to enhance system integrity. Parity is generated and checked on all references between the CPU and memory, and any parity errors are flagged for resolution under program control. Module M7850 contains the parity control logic.

Module M9301 provides four functions for the computer system:

- It contains a read-only memory (ROM) that holds diagnostic routines for verifying computer operation.
- It contains, also in ROM, several bootstrap loader programs for starting up the system.
- It contains the Console Emulator Routine in ROM for issuing console commands from the terminal.
- It provides termination resistors for the UNIBUS.

The independent bootstrap programs can load programs into memory from selected peripheral devices under front panel control (depressing buttons marked CNTRL and BOOT simultaneously) or following power up. The computer directly executes a bootstrap, without the operator having to manually key in the initial program.

There are five DL11-W asynchronous serial interfaces in the PDP-11/34. Each provides two capabilities:

- Serial line interface to an ASCII terminal, the HP 2648A or other ASCII devices. This interface can handle speeds from 110 to 9600 baud and provides serial-to-parallel (and vice-versa) data conversion.

- Line frequency clock. This clock senses the line frequency for internal timing. Line frequencies of 50 or 60 Hz may be used. Only one DL11-W clock may be active in a system.

An IEC-11 IEEE-488 buss control module may be included in the system. This is a single board which occupies one hex slot in the PDP-11 backplane and which can function as the IEEE buss controller. It is used to control the EG&G optical data links furnished as part of the CW-II system, as well as the Hewlett-Packard Model 59307A VHF switching unit.

2-3.1.1 Operator's Console - The operator's console is the front panel link between the user and the computer. It contains a number of switches and lights. The console switches are:

POWER OFF

DC power is removed from the system; contents of MOS memory and fans are off.

DC ON

Power is applied to the computer.

STD BY

Standby; no DC power to the computer but DC power is applied to MOS memory (to retain data) and the fans remain on.

0,1,2,3,4,5,6,7

Allow the operator to enter data (octal digits) into the display.

LSR

Load Switch Register - A copy of the contents of the display are placed in Unibus address 777570.

LAD

Load Address - The contents of the display become the current address. The display is cleared when LAD is pressed.

DIS AD

Display Address - The current address is displayed. The next examine or deposit will occur at the address displayed.

CLR

Clear - The display is cleared in preparation for entry of new data via the number keys.

EXAM

Examine - A copy of the data contained in the location specified by the current address is placed in the display. This key is operative only if the processor is halted.

DEP

Deposit - A copy of the data being displayed is transferred to the location specified by the current address. This key is operative only if the processor is halted.

CNTRL

Control - The control key is used in conjunction with other keys to provide certain functions. The requirement of having both CNTRL and the second key pressed at the same time prevents accidental use of these functions.

The following pushbutton keys must be used in conjunction with the CNTRL key to provide the function described. In each case, the CNTRL key must be pressed first and held down while the second key is pressed.

INIT (with CNTRL)

Initialize - Causes BUS INIT L to be generated for 150 ms. Key is operative only if processor is halted.

HALT/SS (with CNTRL)

Halt/Single Step - Halts the processor if the processor is running. To single instruction step the processor, halt the processor, then press the HALT/SS key without pressing the CNTRL key. After

a halt, the display will contain the contents of R7 (program counter).

CONT (with CNTRL)

Continue - Allows the processor to continue from a halted state using its current program counter. The contents of the Switch register are displayed.

START(with CNTRL)

This key is operative only if the processor is halted. The function causes the program counter (R7) to be loaded with the current address. BUS INIT L is then generated and the processor is allowed to run. Switch register contents are then displayed.

BOOT (with CNTRL)

Causes the M9301 bootstrap/terminator to be activated if present in the system. Console will boot only if processor is halted.

NO. 7(with CNTRL)

When the No. 7 key and CNTRL key are both pressed, the current address plus the value presently being displayed plus 2 are added together. The result is then displayed. This function allows the console to calculate the correct offset address when mode 6 or 7, register 7 instructions are encountered. The required index must be in the display so that when the keys are pressed, the index will be added to the PC +2. The offset address is then displayed.

No. 6(with CNTRL)

When the No. 6 key and CNTRL key are both pressed, the contents of the Switch register are added to the value presently being displayed. The result is then displayed. This function allows the console to calculate the correct offset address when mode 6 or 7 instructions that do not use register 7 are encountered. To implement this

function, it is easiest to put the index in the Switch register, then examine the general register that contains the base address, thereby placing the base address in the display. Then, when the No. 6 key and CNTRL key are both pressed, the index and base address will be added and the correct offset address will be displayed.

No. 1(with CNTRL)

Maintenance Mode - This key combination puts the console in maintenance mode. When the console is in maintenance mode, normal console mode keypad functions are not available. (Refer to Appendix A for a description of the maintenance mode keypad functions.) The CLR key causes the console to exit from maintenance mode and enter console mode via a processor halt.

When the BOOT switch is released, the following action takes place:

- Basic CPU diagnostics are run.
- The contents of registers 0 (R0) and 4 (R4), the stack pointer, and the program counter (PC) at the time of power up are printed on the console terminals followed by an @ on the next line.
- The console emulator routine is entered, awaiting keyboard commands.
- When a device bootstrap command is issued, first the processor memory diagnostics are run, then the secondary bootstrap program is executed from the designated peripheral device.

INDICATORS

DC ON ON

DC power is applied to logic circuitry.

OFF

DC power is off.

RUN ON

A program is running

OFF

The program is stopped.

2-3.1.2 RL01 Disk Drive - There are two RL01 Disk Drives contained in the CW Data Acquisition system. The RL01 is a mass storage subsystem. This system consists of two RL01 disk drives connected in a daisy-chain configuration and an RL11 controller.

Basic functions of the disk drive are:

- To store and retrieve data in accordance with controller commands.
- To generate control and timing signals for transferring data between controller and drive.
- To generate status messages describing drive operational conditions.

Thebasic functions of the controller are:

- Interpreting and executing drive commands.
- Controlling the flow of data between the Unibus and the drives.
- Routing status information from the drives to the Unibus.
- Providing error flags and fault indications related to overall subsystem operation.
- Performing parallel/serial/parallel data conversion, error detection, and all the other control and timing functions related to random access data storage and retrieval.

Since the CW measurement system has been designed to be transportable, there are some precautions which must be observed prior to moving the disk drives. The most important consideration is blocking the heads. In order to do this the unit must be powered down, and the drive access cover must be opened. There is a safety interlock designed into the RL01 disk drive that inhibits opening the drive access cover when no power is available to the drive. A manual release is located on the

right side of the drive under a small access cover. This cover is attached by two screws which must be removed along with the cover. The cover must be reinstalled when done since it maintains the integrity of the absolute filtered air supply.

Removal of the small cover permits access to the drive access cover solenoid. Pulling down on the solenoid and operating the top release mechanism simultaneously will open the drive access cover.

Now, to block the head, loosen the head restraining bracket screw located on the positioner. Turn the bracket 90 degrees and retighten the screw. The bracket should then be in the position shown in Figure 4.

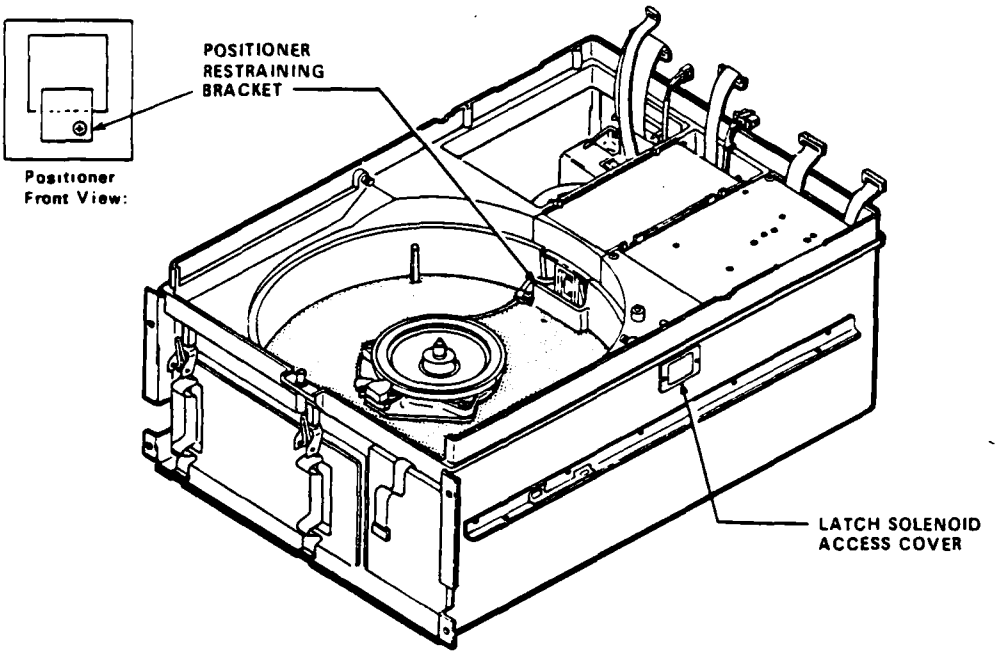


Figure 4. RL01 Disk Head Blocking

Four disk drive controls and indicators are located on the front of the disk drive. These are the Run/Stop Switch with the LOAD indicator, the UNIT SELECT switch with the READY

indicator, the FAULT indicator and the WRITE PROTECT switch and indicator.

The load indicator is a push/push alternating action switch which, when pressed, energizes the spindle providing the following conditions have been met:

- The RL01K disk cartridge has been installed.
- The cartridge protective cover is in place and the cartridge access door is closed.
- All ac and dc voltages are within specifications.
- The read/write heads are in the home position (retracted).
- The brushes are in the brush home position.

When this switch is released, the spindle drive motor is deenergized if the read/write heads are not loaded. If the heads are loaded, they are immediately retracted and the spindle drive motor is then deenergized. In the event of a main power interrupt and subsequent power restoration, the drive will recycle up if the switch is in the depressed state.

The LOAD indicator is illuminated whenever:

- The spindle is stopped,
- The read/write heads are home,
- The brushes are home, and
- The spindle drive motor is not energized.

The UNIT SELECT switch is a cam-operated switch that is actuated by inserting a numbered, cammed button (0,1). The switch contacts are binary encoded so the drive interface logic recognizes the matching controller-generated drive address code and the corresponding unit select number (0 or 1). The numbered indicator, when lit, indicates a drive READY condition. This condition exists when:

- The read/write heads are loaded, and
- The heads are positioned on a specific track.

The FAULT indicator is lit whenever the following fault or error conditions develop in the Disk Drive:

- Drive Select Error
- Seek Time Out Error

- Write current in Heads During Sector Time Error
- Loss of System Clock
- Write Protect Error
- Write Data Error
- Spin Error

Refer to the RL01 users guide for further information on these faults.

The WRITE PROTECT is a switch which when pressed sets the drive in write protect mode. The write protect mode will be removed immediately upon release of the switch.

The RL01K disk has a total storage capacity of approximately 2.62 million 16-bit data words. Each recording surface has a total of 256 tracks. Combining recording surface tracks yield 256 cylinders, labeled from 0 to 255 (decimal). Every track on a recording surface is subdivided into 40 equal length sectors, each of which is divided into 6 fields. A total of 140 words of 16 bits each are contained in each field. However, only 128 words contain data.

A disk cartridge is formatted at the factory where both servo and header information are pre-recorded in each sector. The servo information is contained in two pulse bursts that occur during the sector pulse. This information identifies the radial position of the heads relative to each of the tracks on the cartridge. Neither servo nor header information can be modified or rewritten in the field. Accidental change is prevented by drive protection circuitry.

Periodic cleaning of the disk cartridge is necessary. Professional cleaning is recommended every six months, or whenever practicable. Complete cartridge cleaning procedures must be performed by either qualified Digital Field Service personnel or by a professional cleaning service. Application of cleaning procedures (to the actual recording surfaces) by unqualified personnel may void not only the warranty on the serviced cartridge, but the warranty for any drive on which the cartridge is operated.

The keys in this group allow the user to control the position of the alphanumeric cursor on the screen. They also make it possible to scroll the alphanumeric display memory in order to display characters that have rolled off the screen. "ROLL UP" and "ROLL DOWN" are the keys which allow the user to move the screen through memory one line at a time. "NEXT PAGE" and "PREV PAGE" allow movement of the display 24 lines at a time forward or backward in alphanumeric display memory.

Movement of the alphanumeric cursor to any position on the screen can be accomplished using the →, ←, ↑, and ↓ keys. Each key stroke causes the cursor to step one position in the direction of the arrow.

Using the ↖ key "homes" the cursor to the left margin of the first line of alphanumeric display memory and displays the first page of memory. Holding the "CNTL" key while pressing ↖ causes the cursor to be moved just beyond the end of memory data.

The "CLEAR DSPLY" key clears all of the alphanumeric display memory from the present position of the cursor to the end of memory. To clear the portion of a line to the right of the cursor hold the "CNTL" key down and press "CLEAR DSPLY".

Terminal Control Group - These keys are used to select modes of operation to test the terminal, and to control functions like capital character lock and automatic line feed.

Pressing the "RESET TERMINAL" key once results in a "soft reset" which unlocks the keyboard, stops device and communication operations and clears some control settings. Pressing the key twice in rapid succession (within 0.5 seconds) causes the terminal to be set to the initial power up state: display and memory clear and cursor home.

The "TAPE/TEST" key performs a diagnostic test of the terminal. If a failure is detected, an error message may be displayed. If no error is found, a standard test pattern is displayed. In case of difficulty, failures during test or resets, refer to the HP 2648A User's Manual, Section 11.

with the "SHIFT" key executes the command labeled on the front of the key.

Graphics keys which will "repeat" if held down for more than 0.5 seconds are the "zoom in", "zoom out", <, >, ^, and v . Following is a list of the Graphics control keys and their functions that will be useful to the CWMS system user.

G CURSOR (Graphics Cursor)

Toggles the graphics cursor on and off.

^, ,<,> (Cursor Keys)

Move the graphics cursor in the indicated direction. Two keys pressed simultaneously can cause a diagonal motion.

CURSOR FAST

If pressed in conjunction with cursor keys, it speeds up the cursor movement.

ZOOM

Toggles zoom mode. The area about the graphics cursor is magnified by the amount set by the ZOOM IN/ZOOM OUT keys. Moving the graphics cursor changes the zoomed area.

ZOOM IN

Increments zoom magnification.

ZOOM OUT

Decrements zoom magnification.

SHIFT G DSP

Toggles the graphics display on and off. When off, it inhibits the graphics display without erasing it.

SHIFT A DSP

Toggles the alphanumerics display on and off.

SHIFT CLEAR

Erases the graphics image memory.

Display Control Group - This group of keys controls the display of alphanumeric memory. The screen can show a "page" which consists of 24 lines of up to 80 characters. The terminal can hold multiple pages depending on the number and type of characters used in each line.

Keyboard - The processor scans the keyboard at discrete intervals for a depressed key. Each key is assigned a position in a matrix of 16 columns and eight rows. This matrix provides a reference to a look-up table that the firmware uses to display the character and/or send the character code over the data communications line.

Character Set Group - The basic character set is made up of 128 characters. This includes upper and lower case alphabetic characters, punctuation and some commercial symbols. The "shift" key selects upper case or shifted characters and selects the graphics functions indicated on the front of the Graphic Control keys. "Backspace", "Tab", and "Return" keys are used in the same manner as on a typewriter. The "CNTRL" key can be used with some of the other keys to extend the operating functions of the terminal.

Following is a table of some extended functions using the "CNTRL" key.

CNTL TAB or BACK SPACE

Back tabs to previous tab position.

CNTL CLEAR TAB

Clears all previously set tabs.

CNTL CLEAR DSPLY

Clears lines from cursor position to end of line.

CNTL ↘

Cursor home down. Places cursor in next available line of display memory.

CNTL ←

Sets left margin.

CNTL →

Sets right margin.

CNTL G CURSOR

Displays graphics cursor coordinates.

Graphics Control Group - Each key in the Graphics Control Group has two functions. Pressing a key alone executes the command labeled on the top. Pressing a key simultaneously

4. Remove excess cleaner immediately with a clean dry swab. Transport components must be completely dry before reloading a cassette.

Refer to the MFE 5450 Instruction Manual for further details on cleaning.

2-3.1.5 Graphics Terminal - The Hewlett Packard 2648A Graphics Terminal is used in the Data Acquisition System for all operator keyboard input and for CRT Display plots.

The terminal uses a microprocessor under firmware control. Interactive graphic features are used under program control.

A choice of communications capability is provided. This system uses EIA RS232C serial asynchronous, ASCII, full duplex operation. It operates at speeds up to 9600 baud and transmits character-by-character as a fully interactive terminal.

There are three major mechanically independent sections that comprise the terminal; the keyboard, the CRT monitor and the mainframe.

Mainframe - The mainframe is the heart of the system and can be thought of as a microcomputer system. In the mainframe is the power supply and a bus-oriented logic system containing the microprocessor, program and alphanumeric memory, graphics control and graphics memory, video display subsystem, keyboard interface, and data communications interface. All mainframe modules are functionally, mechanically and electrically independent.

CRT Monitor - The CRT monitor section contains sweep and high voltage circuits, the high-resolution, low-profile cathode-ray tube, and fan.

A raster scan deflection method, similar to that used in television sets, is used in the terminal. There are 720 x 360 dots on the screen giving a capacity of 1920 characters, partitioned into 24 rows of 80 characters each.

The sequence may be terminated by the receipt of a RESET control code or by the operator depressing any front panel button.

Receive Error -

Parity error - If a bit is gained or dropped, a question mark will automatically be substituted. In a FULL DUPLEX transmission, the attached system is able to detect the substitution and react accordingly.

Write Error - If the MFE-5450 is unable to write a record on tape, it will automatically try two more writes. If unsuccessful, a write is attempted further down the tape and the fault light error sequence will take place (like that in cassette malfunction). The operator should examine for damaged tape and/or clean the recorder head prior to retransmission.

Send Error -

CRC Check - If the MFE-5450 is unable to read a record from the tape, an attempt to reread will be made up to three times. If unsuccessful, the SEND light switch will be left blinking. Prior to rerunning the transmission, the operator should examine for damaged tape and/or clean the recorder head.

Cleaning the MFE-5450 - The recorder head and tape handling components should be cleaned daily. Neglecting this daily care may result in excessive read/write errors or abnorml tape wear.

Required cleaning materials:

- soft cotton swabs
- brand name head cleaner or isopropyl alcohol
- camel hair brush

1. Raise dust cover and remove cassette.
2. Use dry camel hair brush to brush away accumulated dust or magnetic oxide from the EOT/BOT sensor.
3. Moisten a cotton swab with head cleaner and carefully clean the recorder head and exposed metal parts. DO NOT ALLOW the cleaner to contact the EOT/BOT sensor or any part of the plastic components in the transport.

achieved as in off-line terminal editing, except that all control codes are produced by the modem instead of by the data entry terminal. When operating in this mode do not attempt to transmit more than 5 lines/second.

In the on-line non-EDIT mode, modem data are recorded in complete text lines without "null" filler characters. Normal parity checking is performed.

When transmitting a tape written in the EDIT mode, trailing nulls are not transmitted. If transmission is made with EDIT on, one block is sent at a time.

Once the Start Send or Start Receive command is received from the modem or front panel switches, keyboard commands are no longer effective. To intervene at this point the operator must press the BREAK key.

The operator can communicate with the modem in the REC mode, but the system will record or act only upon data and commands received from the modem.

When in SEND mode and in HALF DUPLEX transmission, either during ON or OFF-LINE operation, transmission can only be disabled via receipt of a BREAK command.

Fault Conditions

System and Lamp Test -

Upon the application of power, the system executes a self test and initialization routine. First, the ON-LINE, SEND, RCV, and AUTO ANS will light simultaneously followed by the EDIT, BIN, RWND, and LOAD POINT light switches. If any of these switches fails to light, the bulb should be replaced.

If any light switches other than those depressed remain illuminated, the system failed the diagnostic.

Cassette Tape Malfunctions -

A continuous flashing of all front panel switches will signal to the operator that a tape malfunction has occurred. These might be:

- A tape jam
- A Receive, Send, Load Point or skip has reached the clear leader.

READY -

Power is ON, cassette is properly loaded and the system ready to execute a command.

BUSY -

A tape read, record or search operation in progress.

Control Codes - The MFE 5450 can be operated either manually from the front control panel or remotely via ASCII control codes generated by a terminal (off-line) or by an attached modem (on-line). Refer to the MFE-5450 manual for a description of these codes and their function.

Cassette Loading and Unloading - Use of any tape not supplied by MFE can cause equipment damage or improper operation and may void the warranty.

To properly load and unload cassette:

- Configure the write protect tab as desired. The write protect tab is located in the lower right corner of the cassette when label A is facing up. To inhibit write operations, open the recess hole by folding back or removing the tab. Close the recess hole to restore write operations.
- Raise the dust cover and hold the cassette with side A up.
- Insert top edge of cassette under the retaining fingers, then firmly press the cassette down into the bottom locking mechanism.
- To remove the cassette, depress the front panel RWND button and wait for the RWND indicator to go off. Press down on the eject lever and withdraw the cassette from the top retaining fingers.

Data Transmission and Reception - On line data transmission and reception can be conducted in various operational modes. Operating on-line in BIN mode inhibits interpretation of all control codes and disables all parity checks. All characters received, including control codes, are recorded. On-line EDIT or non-EDIT mode may also be selected. Data editing is

EDIT - ON

Automatically records modem data (on-line mode) whenever:

- A complete text line is received.
- A partial text line followed by a carriage return (CR) is received. The line will be filled with "null" characters to its entirety. LF and DC3 (Stop Send) can follow CR in same block.

- OFF

Inhibits partial text line recording functions. All data are recorded in full lines without "null" fillers.

BIN - ON

Disables interpretation of all remote control codes thereby allowing every character to be recorded or transmitted without regard to parity.

- OFF

Enables interpretation of all control codes and allows normal parity checks to be conducted.

RWND -

Rewinds tape to the starting leader.

LOAD POINT -

Rewinds tape then advances to the beginning of tape (BOT) marker; tape is now positioned at the start of the recording area.

The status indicator lights display the following:

EOT -

Cassette tape supply exhausted (BOT or EOT) or a tape malfunction has occurred.

DATA -

Data are being read or recorded on tape.

the respective switch indicator will blink. Lights on the bottom right side of the panel display various system status conditions. A brief explanation of the front panel switches follows.

ON LINE - ON

Allows operation via remote control codes from attached modem (via the "modem" connection).

- OFF

Allows operation via remote control codes from attached terminal (via the "terminal" connection).

- BLINKING

Indicates that the modem or terminal is improperly configured, attached or malfunctioning. Generally caused by the RS-232 handshaking not correctly completed.

SEND -

Manually enables transmission of recorded data to the attached modem (on-line mode) or terminal (off-line mode). If the EDIT switch is ON, then each depression of the SEND button will transmit one data record.

- BLINKING

Indicates a read error or that the tape has reached blank tape or clear leader.

RCV -

Manually enables recording of data received from attached modem (on-line mode) or terminal (off-line mode).

- BLINKING

- A write error has interrupted data recording;
- The tape has reached clear leader;
- The cassette is write-protected.

AUTO ANSWER -

Not supplied in this system.

The MFE 5450 is a self-contained stand-alone unit designed to be used in a variety of data collecting, editing and communications systems. This unit contains (1) a microprocessor controller, (2) an MFE 250B cassette tape Transport, and (3) two RS-232C interface circuits.

For proper system operation, only 100% digitally certified clear leader tape cassettes which contain a pre-recorded 1600 fci clock track (MFE DC-40FL) are used.

The data record can be up to 86 or 138 characters but it must leave room for the included CR (Carriage Return) and LF (Line Feeds).

The MFE 5450 is equipped with front and rear control panels. The rear panel switches are used to establish the initial system parameters, and are not normally charged thereafter. The rear panel switches and their functions are:

ON/OFF

Turns tape unit on and off.

FDX/HDX - FDX

Allows echo-back verification on all display screens of all keystroke characters when the 5450 is in the off-line mode.

- HDX

Inhibits all echo-back display functions.

EVEN/NONE/ODD

Selects odd, even or no parity as required by Terminal or CPU/Modem.

110-2400

Selects data transmit and receive (baud) rates as required by terminal or modem.

Front panel buttons allow the operator to manually select or change operational modes, as needed for day to day uses. Each of the pushbuttons contains an indicator lamp which illuminates when the button is depressed or a remote control code from the terminal or the attached modem. Once initiated, a function inhibits other conflicting functions until the selected function is completed. When a fault condition occurs

The 9105 option is implemented using the M302 plug-in adapter for the M900 parallel interface and an internal control program. The M302 hardware adapter converts the TTL parallel interface to a serial RS232C interface. The control program provides the operation sequence, character format, and line discipline. When the M900 Programmer is connected to a remote controller or computer through the RS-232 interface, the M900 assumes the role of a modem and signal response and operation is tested accordingly.

UV Erase Light - A model 9103 ultraviolet erase lamp is included with the PROM Programmer. It is designed to accommodate several UV-Eraseable EPROMS. The unit consists of a high intensity UV lamp mounted in an enclosed case with a hinged lid and safety interlock, a presettable 0 - 60 minute timer, ON and OFF controls and an AC power connector.

2-3.1.4 Cassette Tape Recorder - The CW Data Acquisition System uses the MFE-5450 Buffered Data Terminal to record data after a completed test run. This is accomplished using one of the following configurations in Figure 5.

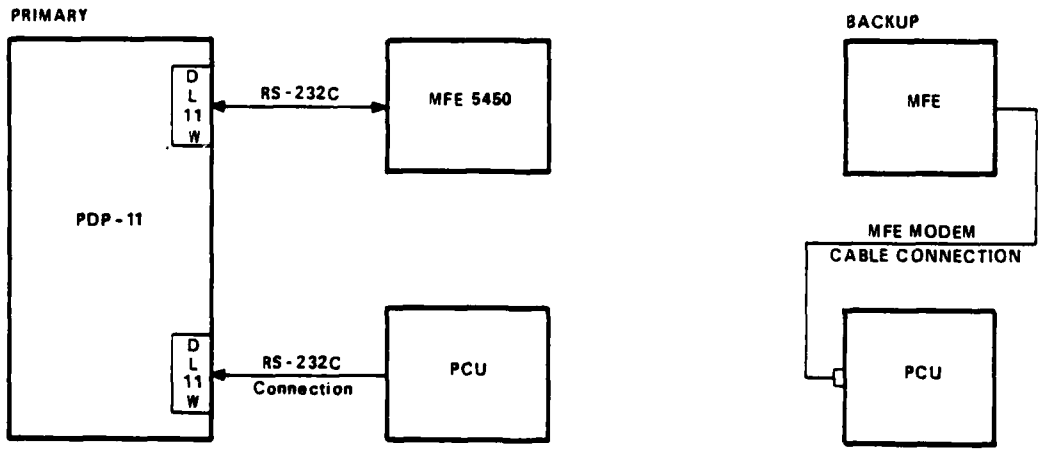


Figure 5. MFE-5450 Configuration

mounting plate; its ZIF socket is indexed the same way as the copy socket.

The handle on the personality module plate is for inserting and removing the module from the control unit.

When inserting the personality module, care should be taken to ensure that the D-type connector shells are mated properly before applying pressure to seat the module. When properly seated, the module plate is flat on the top of the control unit.

An RS232C interface allowing compatible connection to computers or terminals is provided with the 9105 option for the M900 Programmer. This option provides an industry standard interface and a control program to allow EPROM programming and listing operations by a remote controller.

Operating Procedure - Insert the EPROM to be programmed in the copy socket of the M900. Plug the M302 adapter into the parallel interface connector. Connect the PDP-11 to the M302 adapter via an RS-232 extension cable between the M302 and the M900 PROM Programmer port on the PDP-11 back panel.

Initialize the M900 with the RESET key on the keyboard. The M900 displays the character A if the M302 module is properly connected and the PDP-11 is powered-up and properly connected to the programmer. The manual keyboard will be inoperative when the RS-232 connection has been established.

When the remote controller sends the address field definition characters, the M900 updates the hex display of the programmer if a new field was defined.

Either the LIST mode (to read data from the COPY socket) or the PROGRAM mode (to send data to the copy socket) is selected by the PDP-11.

In the PROG mode the M900 makes a blank field check on the COPY socket. The NON BLANK indicator displays the blank check status. In both modes the address and data information are displayed as the operation progresses. When either operation is complete the M900 hex display indicates the first and last address in preparation for the next operating sequence.

Digital Field Service. Especially, do not put a good disk pack in a suspected bad drive.

- Each cartridge should be professionally cleaned every six months and/or when a specific cartridge is not operating properly.
- Cartridges are factory-repairable only. Disassembly in the field is not permitted, and such action will void warranty on a cartridge, as well as any drive on which the cartridge may be operated.

NOTE: Remove Power from drives before power is removed from console panel.

2-3.1.3 PROM Programmer - To burn the PROMs which contain the delete frequencies or antenna output levels, the data acquisition system uses the M900 EPROM Programmer, which is a portable intelligent EPROM Programming instrument with pluggable personality modules. The M900 is microprocessor controlled and features rapid and accurate EPROM programming.

Operating Panel Description - The operating panel has all the controls and indicators necessary for keyboard operation plus connectors for operating with remote control using the RS232C option.

A dedicated plug-in personality module is used. The dedicated module is configured to program one particular type of EPROM. The personality module interfaces with the control unit to provide the various voltages required to program and read a particular EPROM, accommodating the various interface options of the control unit automatically. The dedicated module plugs into the control unit, using three D-type connectors. One copy socket and one master socket is contained in the module. Located on the upper half of the module mounting plate is the copy socket. Pin 1 is located next to the locking lever on the zero insertion force (ZIF) socket. Lights located to the left of the copy socket display the contents of the copy EPROM. The master socket is located on the lower half of the module

External cleaning of the cartridge may be performed by the user. Using a lint-free wiper dampened with 91% isopropyl alcohol, wipe the outer sides of a completely assembled disk. The cartridge must not be saturated and all excess solvent must be removed with a dry wiper. This procedure is necessary to prevent solvent from entering the seams of the assembly and contaminating the disks. Water, trichloroethylene, or other solvents are not permitted.

To clean the spindle assembly, use a lint free wiper, dampened with the isopropyl alcohol solution (91%). Do not saturate the assembly. Remove all excess solvent with a dry wiper to prevent solvent from entering a loaded cartridge and contaminating the disk. Also, be sure the shroud is as free from lint and dust as possible before loading a cartridge.

In general,

- Keep cartridges clean.
- Use cartridges at computer room temperature only.
- Manipulate cartridges by top cover handle only.
- When the protection cover is removed (for loading), do not touch disk surfaces, hub center cone or surfaces.
- When protection cover is removed, interior metal hub surfaces must be clean.
- When protection cover is removed, ensure the disks are not moved or rotated since improper disk motion may generate plastic particles which can result in disk damage.
- When loading or unloading an RL01 drive, insert and remove cartridges gently. Do not use excessive force when manipulating the top cover handle.
- If, during operation, a cartridge makes rumbling or continuous tinging sounds, discontinue use of the cartridge. Use of a damaged cartridge on other drives may damage the drives resulting in damage to all other cartridges used thereafter. Do not use this drive again until it has been checked by

Placing the "REMOTE" key in the down position puts the terminal in communication with the computer.

The "AUTO LF" causes a line feed each time the "RETURN" key is pressed.

When a data link exists between the terminal and the computer, the transmit indicator will be on.

Alphabetical keys are locked to upper-case characters when the "CAPS LOCK" key is in the down position. The remaining numeric/symbol keys operate in the unshifted position.

Maintenance - The screen and keyboard can be cleaned to remove dust or grease. First, lightly dust using a damp, lint-free cloth. The cloth should be just damp enough to pick up dust, not wet. Avoid wiping dust or lint to keyboard area.

Smudges and fingerprints can be removed using most conventional cleaners. DO NOT use petroleum based cleaners, such as lighter fluid or cleaners containing benzene, trichloroethylene, dilute ammonia, ammonia, or acetone. These could harm the plastic surfaces. Avoid spraying between keys.

At this point the two tape drives in the HP terminal are not being utilized in the CW measurement system. If, however, they are used in the future, the read-record heads should be cleaned every 50 hours of cartridge tape operation or when read problems occur. The head cleaning kit provided contains all necessary items. The procedure is as follows:

- Dip one swab into bottle of head cleaning solvent to saturate swab.
- Hold tape unit door open with your finger and clean the head with a back-and-forth motion of the swab (not an up-and-down motion). The head is the shiny surface at the right rear of the drive.
- Take a dry swab and wipe the head clean with a back-and-forth motion.

Fifty Hertz Operation - The HP 2648A Graphics Terminal may be operated from either 115 or 230V, 60 Hz line voltage. It is also possible to operate from 230V, 50 Hz line voltage. If 50 Hz operation is desired, crystal Y1 on the Display Timing

Printed Circuit Assembly must be changed. The crystal for 50 Hz operation is provided and is available from Hewlett-Packard, part number 0410-0646. Refer to Section VII of the "Reference Manual for HP-2648A Graphics Terminal" for complete details on line voltage and frequency selection.

2-3.1.6 Tektronix Plotter - To obtain hard copy plots of data collected the data acquisition system uses a Tektronix 4662 Interactive Plotter that is digitally stepped and controlled. An RS-232 interface is used to connect the plotter with the PDP 11/34.

Each axis of the plotter is propelled by a four-phase stepping motor. Each motor pulley drives a plastic-covered cable that is attached to the pen carriage to move the carriage along the appropriate axis. Each motor step results in .005 inch of linear motion.

The 4662 will accept paper sizes up tc 11 inches (27.9 cm) by 17 inches (43.2 cm). The maximum plotting size is 10 inches (25.4 cm) by 15 inches (38.1 cm). There is a page scaling feature which allows the plot size to be easily adjusted from the front panel to fit the paper size being used. Paper is held in position by electrostatic attraction generated by the platten.

The 4662 can perform three basic types of operations. It can print alphanumeric characters, produce graphics, and act as a digitizer. coordinate position and the pen status (up or down) upon command. Other features of the 4662 include the ability to scale alphanumeric character sizes and to rotate the alphanumeric characters.

Front Panel Switches and Indicators -

POWER Switch - A rocker switch which applies power to the 4662.

POWER Indicator - Indicates that the 4662 is turned on.

PROMPT Indicator - An LED that may be turned on and off under external program control. It is usually used to issued a prompt to the plotter operator, indicating that the program is

expecting some operator action. When the PROMPT indicator is on, the automatic pen lift is inhibited for convenience in digitizing. In this system, the PROMPT light is on when the plotter is under PCU control, and is off when the plotter is under control of the PDP-11.

ERROR Indicator - An LED that indicates one of three conditions:

- A transmission error.
- An internal plotter error (none are currently defined).
- An external programming error, such as an illegal or undefined function.

The Error bits are reset and the ERROR indicator turned off by an external program Read Status Word 0 command or a Reset command. These bits can also be reset by cycling the power off and then on again, or by releasing the LOAD button.

LOAD Switch - Used when a new sheet of paper is to be loaded into the Plotter. When depressed, the Plotter will lift the pen from the plotting surface and move it to the upper-right corner of the platen. Also, the electrostatic paper hold-down is turned off to allow removal and replacement of paper.

When the LOAD switch is depressed, external communications of the interface are not disabled, but any commands in the input buffers are deleted and processing of motion commands is suppressed. Pressing the LOAD button does not clear the Plotter Output queue.

LOCAL Switch - Causes data communication to be between the Plotter and terminal only. Communication between the Plotter and modem is disabled. When the LOCAL button is released the Status Word error bits are cleared and the Error indicator turned off. Any action of the LOCAL button causes the commands currently in the input buffer to be deleted.

PEN Switch - When pressed, the up-down state of the pen is changed. If the Plotter is busy when the PEN button is pressed, it will be ignored.

CALL Switch - Used to store the current coordinate position of the pen for transmission when the button is pressed and placed into the output queue when released. If the output queue if full, the bell rings to indicate the coordinates were not accepted. If the CALL button is held down for about two seconds, the bell sounds twice and the Self-Test sequence is activated. On the system, the bell in the plotter has been disconnected.

SET Controls - Two push switches, LOWER LEFT and UPPER RIGHT. They are used to alter the plotting area. This can be accomplished by moving the pen to the desired boundary, using the joystick, and pressing the associated SET key. The SET key must be held down about two seconds.

LOCATE Controls - Two push buttons; LOWER LEFT and UPPER RIGHT. When pressed, the pen moves to the associated corner of the currently-defined page.

POSITIONING Control - A joystick that allows the operator to manually move the pen to any point on the plotting surface. Direction of pen motion is indicated by the direction the lever is tilted and pen velocity increases with displacement angle of the control lever.

The Plotter has internal self-testing features that perform two separate tests. One test occurs when the Plotter is powered up; it automatically performs internal checks on the RAM (buffers) and the ROM in which the controlling program is stored. In addition, the pen location is initialized by moving the pen to the lower-right corner; the selected interface is then enabled.

The other self-test feature is activated by holding the CALL button depressed about 2 seconds. When the CALL button is released, the self-test sequence will begin and is not interruptible. The test consists of a plot, shown in Figure 6, which may be examined to determine plotter integrity. Refer to the 4662 Interactive Digital Plotter Instruction Manual.

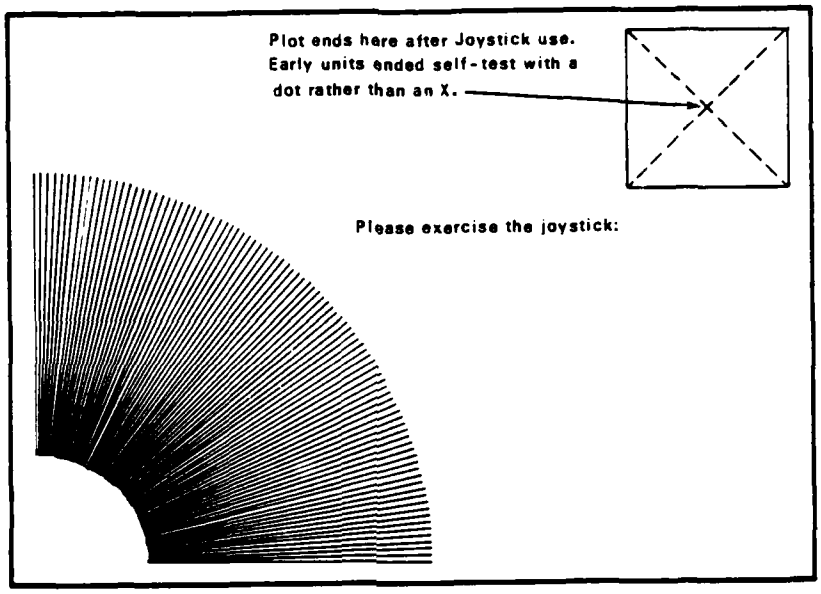


Figure 6. Test Pattern Produced by Self-Test Feature

On the rear of the plotter are four hex DIP switches. These switches are the address select switches, and determine whether the plotter will respond to the PCU or PDP-11. Table 6 contains the address select switch settings to configure the plotter to respond to the PDP-11 (primary configuration) or PCU (secondary configuration).

Table 6. Plotter address switch settings

Primary Configuration Plotter Connected to PDP 11/34		Secondary Configuration Plotter Connected to Receiver PCU	
Switch	Setting	Switch	Setting
A	0	A	1
B	1	B	0
C	A	C	0
D	3	D	4

Note: Cycle plotter power switch after changing address switches.

2-3.2 Software Configuration

To use the computerized data acquisition system, the RSX-11M operating system must be in place, and the real-time software must be installed. (See Paragraph 5-3.1.) Certain support facilities are also provided which may be used to set up for a test. These facilities are available on a non-real-time basis and can be called up during non-testing periods.

2-3.2.1 RSX-11M Operating System - RSX-11M is a real-time disk based multi-tasking operating system which runs on any UNIBUS PDP-11. The system can be configured to run on machines with a minimum of 16K words up to a PDP-11/70 with 1920K words of memory. The system uses the KT-11 Memory Management Unit included in the hardware, allowing memory mapping/protection for 124K words of memory in this configuration. Real-time interrupt response capability allows for up to 250 levels of software priority. The priority determines the task's eligibility to execute. A task can be fixed in memory so that it is always ready to execute or can be disk resident so that it only resides in memory when it is executing. The system also contains a checkpointing feature that causes a lower-priority task to be moved to disk to free memory for a higher-priority task.

The RSX-11M file system provides automatic space allocation and file structures for all block-structured devices. Features include file protection, sequential, random and relative file organizations (the latter is provided with the RMS-11 file management option), and device independence. In addition to the resident file services, the FCS (file control services) provides auxiliary file services on a per task basis. These services increase task size from 1K to 4K depending on the number of files open and the services requested by the task. This allows for a smaller executive and only expands those tasks which require these services.

Indirect command file support allows command streams to be pre-defined. These commands can then be invoked by calling the command file processor which automatically feeds the

executive commands to control the execution of tasks, operate the file system, invoke language processors, or execute any other executive function. The CW test software is started with such a file.

The system also provides such real-time functions as multi-task control, intertask communication, intertask and intratask synchronization, trap facilities, queued I/O, and subtasking--the ability of one task to load, start and control another task (or tasks).

2-3.2.2 EG&G-Supplied Real-Time Software System - The applications programs that control data acquisition and manipulation are supplied by EG&G. The system of programs is designed to acquire the raw data from the receiver PCU; remove the effects of sensors, amplifiers, signal delays, and the system itself, thereby correcting the data; and, if necessary, compute and plot the inverse Fourier transform. The system consists of six parts:

- An input module which monitors and accepts data from the PCU and distributes it to the other system tasks.
- A correction and buffering module which stores the raw data as it arrives and applies the system and sensor corrections.
- A CRT monitor task that handles the operator-system interface and generates quick-look plots of the corrected data.
- An inverse Fourier transform task for test phases which require such transforms.
- A plotting task which builds the hard-copy plots.
- A cassette tape controller task which builds the cassette tape copy of the test results for future reference and processing.

All these tasks use the real-time facilities supplied by the operating system. They also require, in some cases, data generated by off-line (or stand alone) tasks provided by EG&G.

2-3.2.3 Stand-Alone Software - These programs provide certain functions which are not needed in the real-time system, but are required for the proper functioning of the system in general. These programs include:

- A probe calibration program for probes with analytical transfer functions. Such probes include the EG&G MGL series of B-dot field sensors. Non-analytic probes are calibrated using the real-time system (see Paragraph 4.2 for a discussion of this procedure).
- A task to accept the definition of the Threat waveform and Butterworth Filter parameters. This is used by the inverse Fourier transform module in the real-time system.
- A task to program the PCUs EPROM for antenna output level adjustment during a test.
- A task to program the PCUs EPROMs for frequency deletion during a test.
- A utility supplied by Digital Equipment Corporation which is used to declassify or erase a disk.

These tasks are all used during a non-test phase when necessary.

SECTION 3
INSTALLATION

3-1 CW MEASUREMENT SYSTEM

The CW Measurement System consists of the following major assemblies: the Receiver, the Transmitter, the isolated power systems, fiber-optic data links, the antenna, direct-injection couplers and various probes and sensors. This section presents procedures for installing the measurement system prior to operation.

3-1.1 Measurement System Configurations

The measurement system can be set up in either of two basic configurations. In the primary configuration, the measurement system receiver is connected to the data acquisition system PDP 11/34 computer. Measurement data acquired by the receiver is passed to the data acquisition system for processing. Figure 7 shows a block diagram of the receiver system and the data acquisition system in the primary configuration. In the secondary or backup configuration, the receiver operates as a stand-alone system. Figure 8 shows a block diagram of the measurement system in the secondary configuration. Note that the plotter and the cassette tape recorder are under the control of the receiver in the secondary configuration. This allows raw measurement data to be displayed by the plotter and saved by the cassette tape recorder.

3-1.2 Program Control Units (PCU)

The program control units are based on the Intel 8080A microprocessor. One program control unit (PCU) is used in each of the transmitter and receiver systems. Both PCUs are identical and interchangeable between the transmitter and receiver systems. Each PCU is contained in a rack-mountable chassis and consists of the following components: an Intel SBC 80/20-4 single board computer, an Intel SBC 116 combination memory and I/O expansion board, an Intel SBC 416 16k PROM/ROM expansion

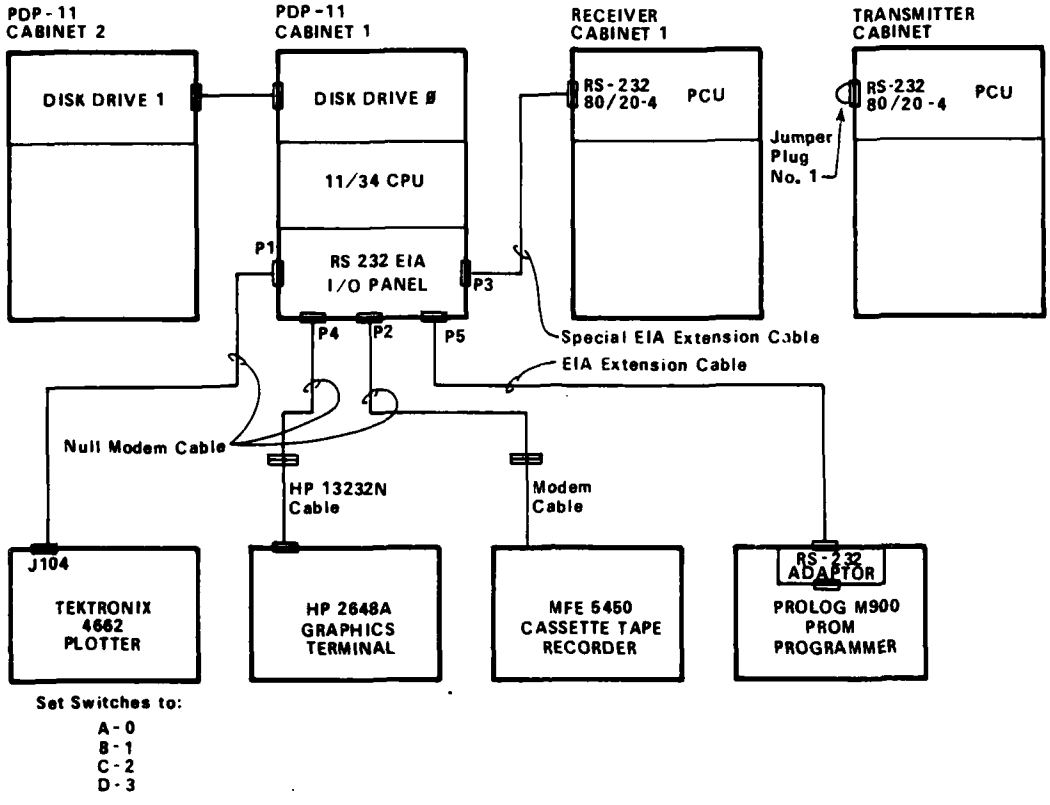


Figure 7. Block Diagram - Primary Configuration

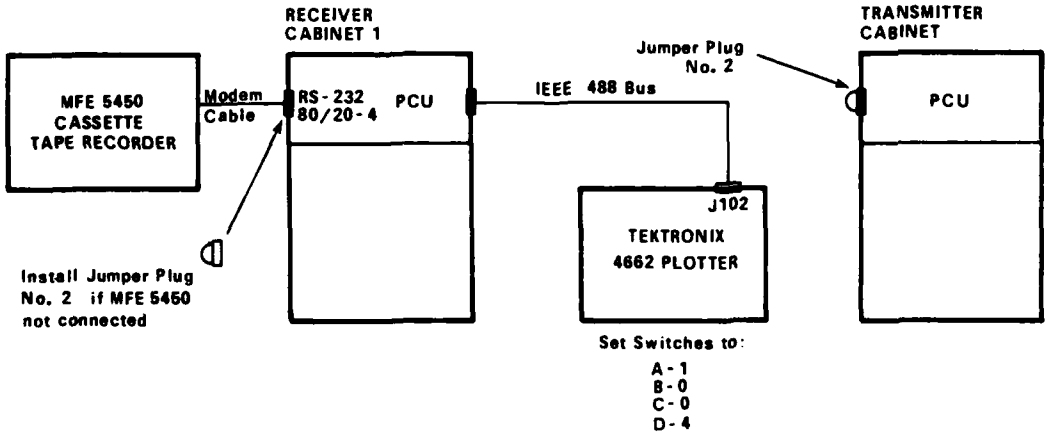


Figure 8. Block Diagram - Secondary Configuration

board, Intel chassis (SBC-660), a ZiaTech ZT 80 IEEE 488 buss controller card, a Boeing synchronizer board, a SBC 604/614 card cage, EPROM firmware, a power supply, a front control panel and interconnecting wiring harnesses.

The five circuit boards listed above are installed in the SBC-604/614 card cage within the PCU chassis. Table 7 lists the circuit boards and their corresponding slot locations in the card cage. Although the circuit boards are not normally removed from the card cage, they should be inspected prior to installation of the PCU chassis. Verify that all circuit boards are properly installed in the proper slots and are securely seated in their back plane connectors. Verify that all edge connectors are properly installed on the correct boards. All edge connectors are identified with labels indicating the board slot number and the connector designation. Each circuit board and the card cage contain jumpers and/or selector switches. These jumpers and switches must be correctly configured to insure proper operation of the PCUs. The settings of the jumpers and switches are not variable in normal operation. The following paragraphs summarize the correct configuration for each board and should be referred to if any doubt exists about whether a particular board is correctly configured.

Table 7. PCU circuit board card cage slot assignments

Circuit Board Name	SBC 604/614 Card Cage Slot
Intel SBC-80/20-4 single-board computer	A2
Intel SBC-116 combination I/O and memory expansion board	A4
Intel SBC-416 EPROM expansion board	A1
ZiaTech ZT-80 IEEE 488 bus controller board	A5
Boeing synchronizer board	A7

3-1.2.1 SBC 604/614 Card Cage - Table 8 summarizes the jumpers installed on the card cage back plane. Note that all logic levels on the card cage are active low or on high going low edge. Note also that Pin 15 or J3 on the SBC 614 is grounded at card cage slot A2 giving the SBC 80/20-4 control of the buss. The SBC 80/20-4 must be installed in slot A2 for this reason.

Table 8. SBC 604/614 card cage jumpers

Jumper - Jumper	Remarks
On SBC 614, A2 pin 15 to ground.	Grounds $\overline{\text{BPRN}}$ and gives 80/20-4 control of PCU bus.

Logic levels at card cage are active low or high going low.

3-1.2.2 SBC 80/20-4 Single Board Computer - The jumper configuration for the SBC 80/20-4 is summarized in Table 9. There are no switch selectable options on this board. Table 10 summarizes the I/O driver and terminator configuration for the SBC 80/20-4.

3-1.2.3 SBC 116 Combination Memory and I/O Expansion Board - The jumper settings for the SBC 116 are summarized in Table 11. Table 12 summarizes the selectable switch settings for the SBC 116. I/O drivers and terminators used on the SBC 116 are summarized in Table 13.

3-1.2.4 SBC 416 EPROM Expansion Board - The jumper configuration for the SBC 416 is shown in Table 14. Switch settings for the SBC 416 are shown in Table 15.

3-1.2.5 ZT 80 IEEE 488 Bus Controller - The jumper configuration for the ZT 80 are shown in Table 16 and the switch settings for the ZT 80 are shown in Table 17. Table 18 summarizes the IEEE 488 bus address assignments of the various instruments controlled by the IEEE bus.

Table 9. SBC 80/20-4 Board Jumpers

Jumper-Jumper	Signal	Remarks
24 - 43	IR0, INT0	System step pulses from synchronizer.
25 - 34	IR1	Timer interrupt from on-board timer.
26 - 49	IR2, INT6	Plot/Initiate from front panel pushbutton.
27 - 47	IR3, INT4	Start Pulse from synchronizer.
28 - 45	IR4, INT2	DVM 1 (Magnitude) interrupt.
29 - 46	IR5, INT3	DVM 2 (Phase) interrupt.
30 - 44	IR6, INT1	ZT 80 interrupt.
31 - 39 39 - 38 38 - 37	Not Used	Grounds Pins 37, 38, 39.
32 - 36	IR7, INT7	Serial I/O XMTR empty.
70 - 71	DIEN	Enables input at port E8.
51 - 52	DIEN	Enables input at port E4.
141 - 143	O1T0/CLK1	Cascades hardware timers
96 - 84	PORT EA, Bit 1; BRI/	
97 - 86	PORT EA, Bit 2; B DET/	
3 - 4	+12V	EIA voltage to RS-232;
9 - 10	-12V	EIA voltage to RS-232.

Table 10. SBC 80/20-4 I/O Drivers and Terminators

Port	Board Socket	Driver	Terminator*
E6 High	A3	SN7432	--
E6 Low	A4	----	SBC 901
E5 Low	A5	----	SBC 901
E5 High	A6	----	SBC 901
EA High	A9	SN7432	--
EA Low	A10	----	SBC 901
E9 Low	A11	----	SBC 901
E9 High	A12	----	SBC 901

* INTEL SBC 901 or Beckman 1899-746-0

Table 11. SBC 116 Board Jumpers

Jumper-Jumper	Signal	Remarks
53 - 54	DIEN	Enables input at port F8.
29 - 30	DIEN	Enables input at port F4.
89 - 90	Strobe	Select lower half of memory for RAM.
92 - 93	Strobe	Select lower half of memory for ROM.
87 - 88	High byte of address	Select upper half of I/O base address.
Switch S2 1 - 2	I/O address	Select base address of F0.
Remove 103 - 111		Prevents interrupts by SBC 116.

Table 12. SBC 116 Switch Settings

Switch Block S3			Switch Block S4		
Switch	State	Function	Switch	State	Function
1	On		1	On	
2	On		2	Off	Selects ROM
3	On		3	On	base address
4	On		4	On	to 1000H
5	Off	Selects RAM	5	On	
6	Off	base address	6	On	
7	Off	to 4000H.	7	On	
8	Off		8	On	

for all valid response other than 60 or a single carriage return, and 60 Hz for a response of 60 or a carriage return. This entry causes the system line frequency table to be set so that the system clock will run accurately. The second prompt is for the time and date. This is entered in the form HH:MM DD-MON-YY where HH,MM,DD and YY are 1- or 2-digit integers representing hours, minutes, day, and year respectively; and MON is the first 3 letters of the month. Which system is to be run is determined by the third prompt. If "Y" is the response to prompt to run the measurement system, the UIC is set to [2,2]. The system is ready to take a data measurement as described in paragraph 5-3 of this manual.

When the response is "N" to the above prompt the UIC is set to [7,1] and the analyst tasks are installed. Any of the analyst functions as described in Section 3 can be used.

The system is now operating.

Following is an example of the operator/machine interaction while starting the system. (The system (>) is the operating system prompt for the operator input.) User entries have been underlined in this example. (<CR> is a Carriage Return, and BBBBBB is a 6-digit octal number.)

EXAMPLE:

```
  RSX-11M   V3.2   BL26  124K MAPPED
>RED DL:=SY:
>RED DL:=LB:
>MOU DL:CWSYSTEM
>@DL:[1,2]STARTUP
>;
>;    DNA CW-II SYSTEM  VERSION 02   AUGUST 1, 1982
>;
>*ENTER LINE FREQUENCY IN HERTZ [D R:50-60. D:60.]:<CR>
>*PLEASE ENTER TIME AND DATE (HR:MN DD-MMM-YY)[S]:(9:55 19-JUL-82)
>TIM 9:55 19-JUL-82
>ACS 512.
>MOU DL1:/OVR
>ASN DL1:=CD:/GBL
```

into appropriate power. The peripheral devices should all be turned on. The circuit breakers on the computer bays power distribution panels located at the bottom rear of each cabinet, the breakers on the CPU chassis and both disk drives should be turned on. These breakers are accessible through the rear door of the cabinet. The CPU front panel switch, which up to now has been in the "DC OFF" position, may now be turned to the "DC ON" position.

3-2.1.2 Installing the Disk(s) - After the computer front panel switch is turned on, the two disk drives will go through their power-up procedure and the "load" lights will come on. The disk which is labeled CWMS SYSTEM DISK must be mounted on drive 0 (DLØ: indicated by Ø on the READY light). The disk desired to contain classified test data (labeled CWMS DATA PACK) should be mounted on drive 1 (DL1: indicated by a 1 on the READY light). See Paragraph 3-2.1.5 for disk mounting procedures.

3-2.1.3 System Bootstrap Load - When the procedures described in paragraph 3-2.1.1 and 3-2.1.2 are completed, the system may be "booted". If the terminal is powered on when the PDP-11 is powered on, "TERMINAL READY" will appear on the screen. If the terminal is powered off first insure that the terminal is powered up. Then simultaneously press 'CNTRL' and 'HLT/S' buttons on the CPU front panel. Next press the 'CNTRL' and 'BOOT' buttons simultaneously. This process is also done to re-boot if the system 'hangs' or crashes during operation. The system will be loaded into the computer's memory and executed. It is important to remember that all entries to the computer (excluding <CTRL Z> and <CTRL C>) must be terminated by a carriage return as shown in the examples.

As part of the startup procedure, the system will prompt the operator for two parameters necessary to run the system. The first prompt is for line frequency. The valid responses are integers between 50 and 60, and no response (i.e., a carriage return (<CR>) only). The frequency is set to 50 Hz

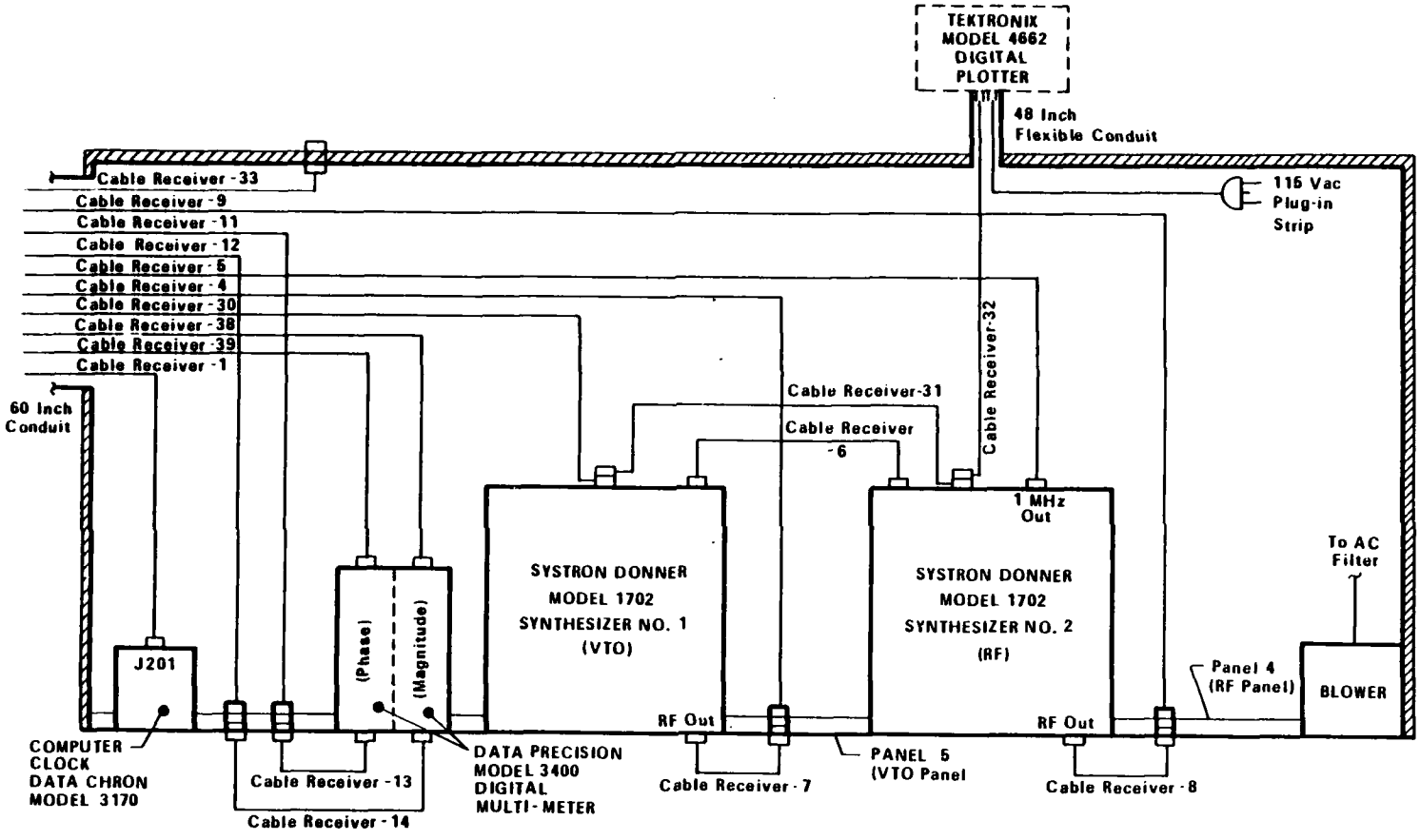


Figure 14. Receiver Cabinet No. 2 Component Cable Interconnections

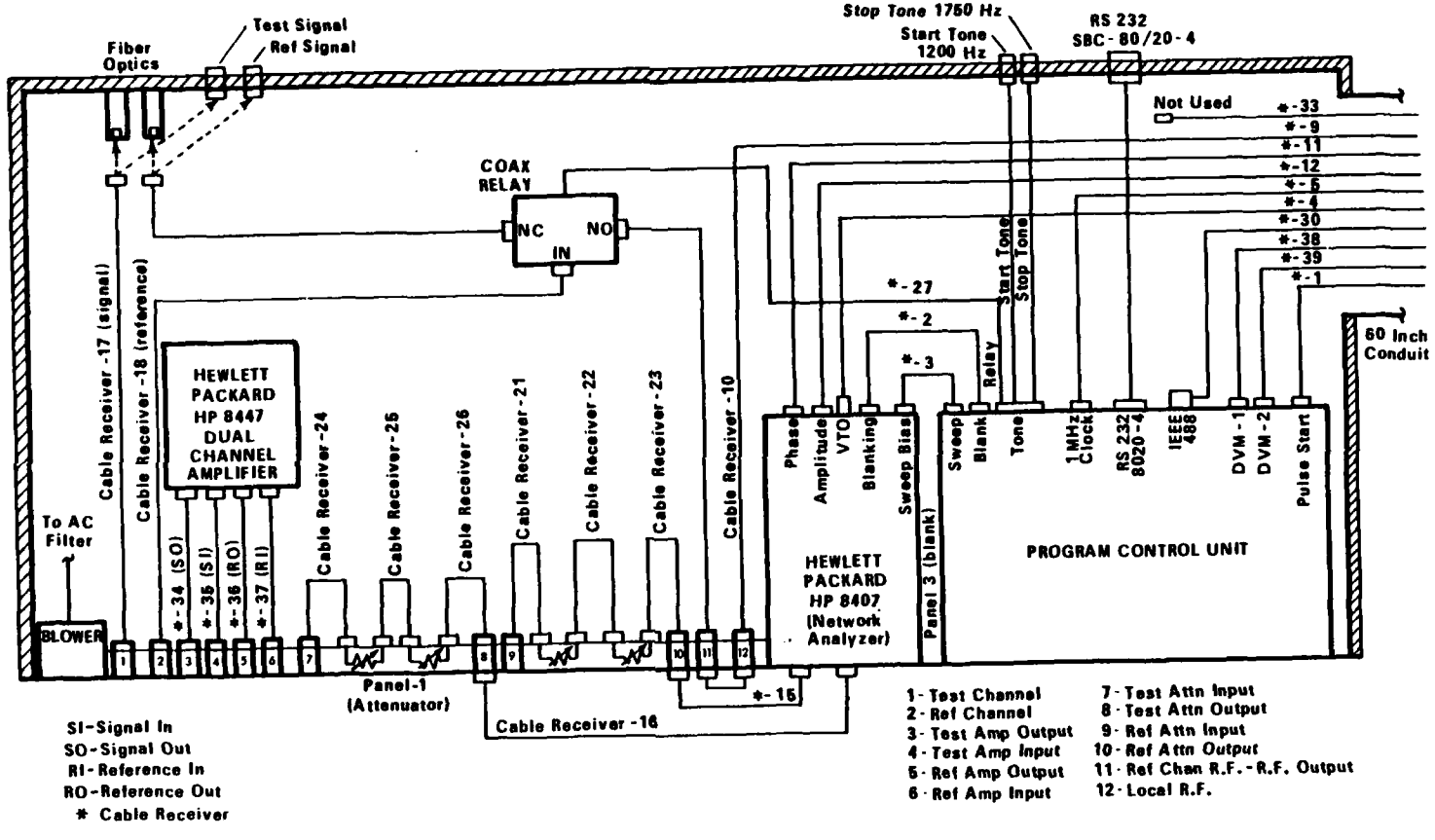


Figure 13. Receiver Cabinet No. 1 Component Cable Interconnections

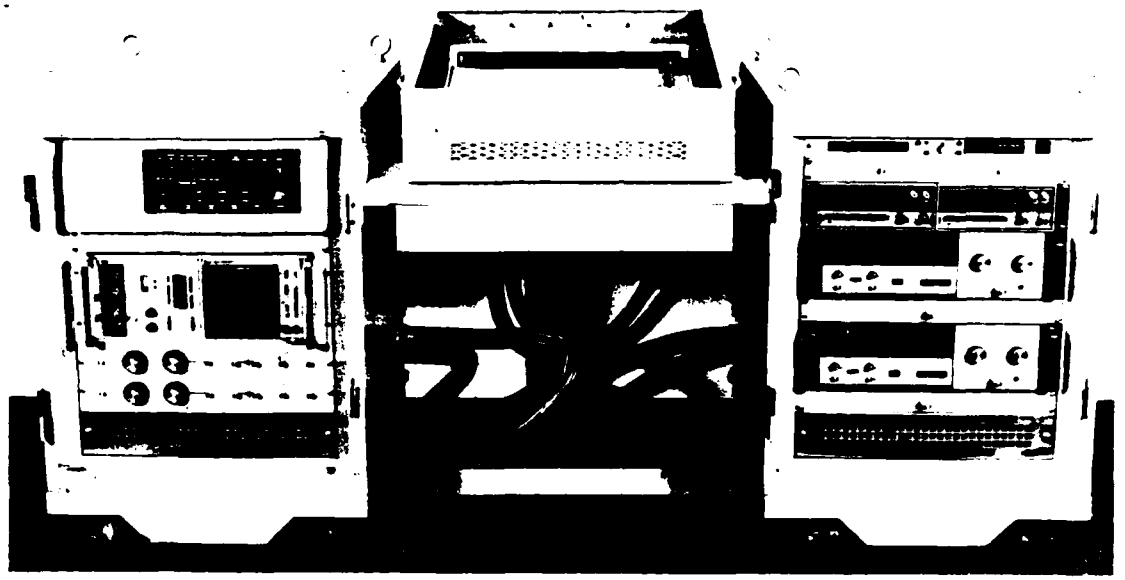


Figure 12. Receiver Subsystem

Verify that the plotter address switches located on the rear panel of the plotter are correctly set. Refer to Table 20 for the correct switch settings. Note that the switch settings depend upon whether the measurement system is used in the primary configuration or the secondary configuration.

Insure that all AC power cords from equipment within the cabinets are plugged into the distribution strips within the receiver cabinets.

3-2 DATA ACQUISITION SYSTEM

3-2.1 Center Processing Unit (CPU)

In order to bring the computer from power-off to functional condition the various parts of the system must be energized, the operating system, RSX-11M, must be "booted" and the data and time set.

3-2.1.1 Power-Up Procedures - Prior to turning on the Central Processing Unit front panel switch, the Hewlett Packard terminal, the Tektronix plotter, the MFE cassette recorder, the PROLOG prom programmer and the computer bays should be plugged

Plug in the AC power cords from the computer clock, the PCU and the synthesizer to the AC distribution strip located within the transmitter cabinet.

Move the transmitter cabinet and power amplifier to a location near the injection point. For example, when performing tests in the radiated mode, move the transmitter cabinet and power amplifier to a location near the antenna feed point. The transmitter equipment should be protected against extremes in temperature, humidity and vibration.

3-1.4 Receiver Installation

The receiver subsystem includes the following equipment: two portable shielded cabinets, the program control unit, the HP-8407/8412 Network Analyzer, the Wavetek attenuator patch panel, the HP-8447 dual wideband amplifier, the Datachron Model 3170 computer clock, two Data Precision Model 3400 digital volt meters, two Systron-Donner Model 1702 synthesizers, the Tektronix Model 4662 Digital Interactive Plotter and an MFE-5450 cassette tape recorder.

Install the PCU, the network analyzer, the Wavetek attenuator patch panel and the dual wideband amplifier in cabinet no. 1. In cabinet no. 2, install the computer clock, two Digital Volt Meters and two synthesizers. If the measurement system is to be operated in the secondary configuration, install the plotter in its shielded enclosure and place the digital tape recorder on cabinet no. 1. Figure 12 shows the receiver subsystem with all equipment installed. Interconnect the receiver equipment as shown in Figures 13 and 14.

Verify that the reference synthesizer address switches are set to respond to an address value of two. Switches 1, 3, 4 and 5 should be set to the 0 position while switch 2 is set to the 1 position. Verify that the VTO synthesizer address switches are set to respond to an address of 8. Switches 1, 2, 3 and 5 should be set to the 0 position, while switch 4 is set to the 1 position.

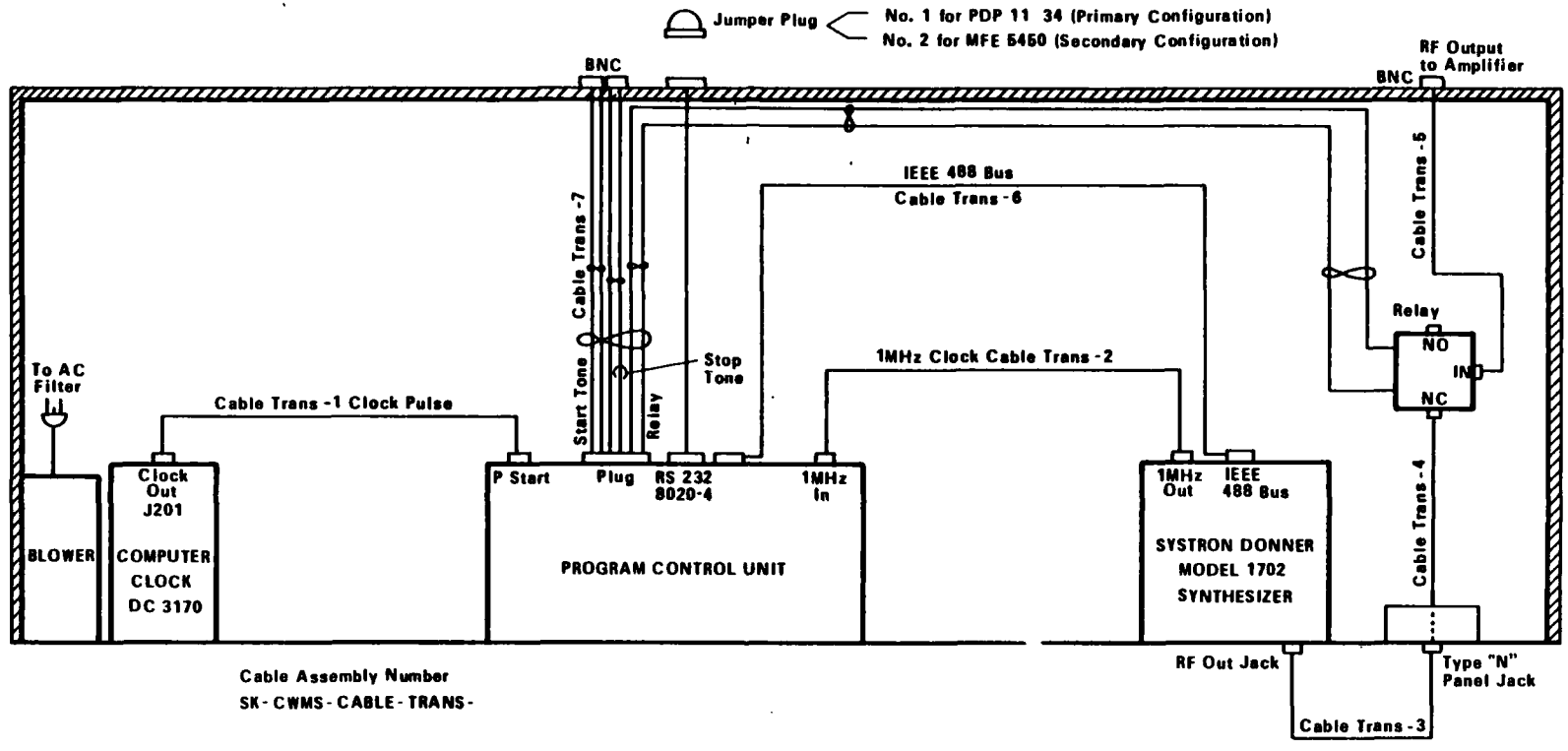


Figure 11. Transmitter Cable Interconnections

The Datachron computer clock, transmitter PCU and Systron-Donner Synthesizer are installed in the transmitter cabinet as shown in Figure 10. After placing the computer clock, the PCU and the synthesizer in the transmitter cabinet and with no AC power applied, interconnect the components of the transmitter cabinet as shown in Figure 11. All interconnect cables and their respective connections are labeled with appropriate nomenclature.

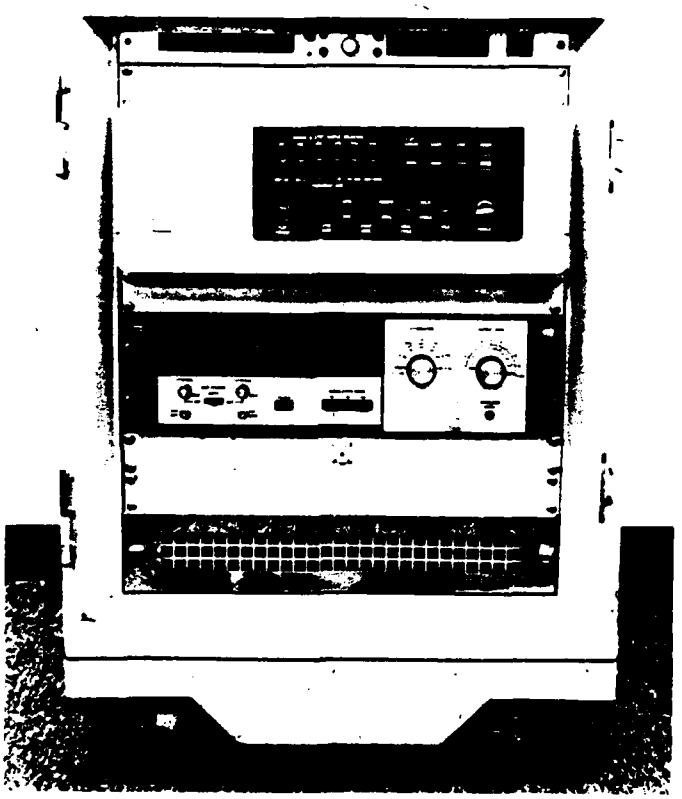


Figure 10. Transmitter Subsystem

Verify that the synthesizer's address selection switches located on the left side of the synthesizer's rear panel are set to respond to an address of 12. Switches 1, 2, and 5 should be set to the 0 position, while switches 3 and 4 are set to the 1 position.

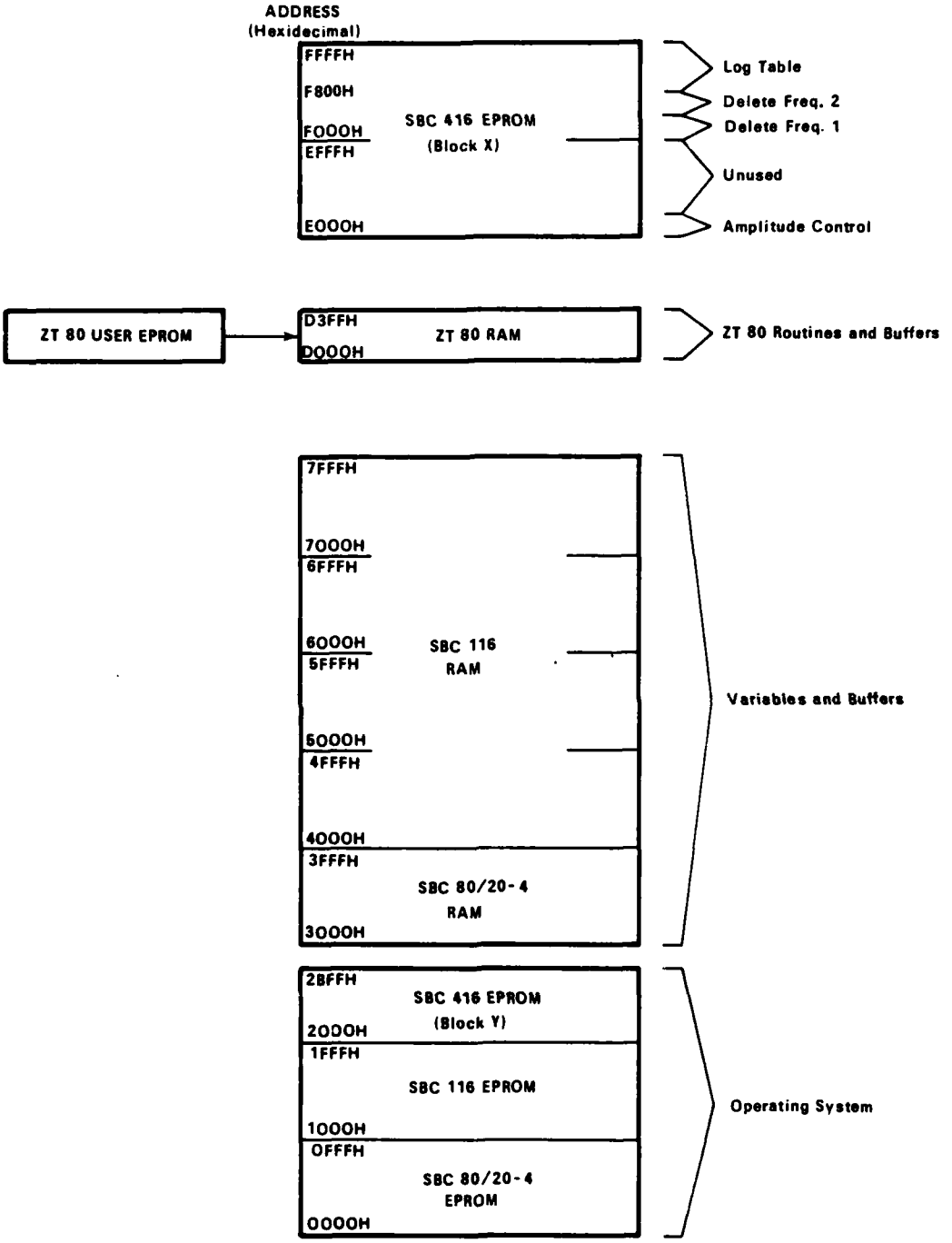


Figure 9. PCU Memory Map

Table 20. PCU EPROM irmware

EPROM	Board Location	Socket	Address Space	Checksum
Operating System EPROM 0	SBC 80/20-4	A79	0000 - 03FF	016CAE
Operating System EPROM 1	SBC 80/20-4	A64	0400 - 07FF	0188A4
Operating System EPROM 2	SBC 80/20-4	A51	0800 - 0BFF	01AF74
Operating System EPROM 3	SBC 80/20-4	A37	0C00 - 0FFF	016C66
Operating System EPROM 4	SBC 116	A34	1000 - 13FF	010B66
Operating System EPROM 5	SBC 116	A46	1400 - 17FF	011DC4
Operating System EPROM 6	SBC 116	A60	1800 - 1BFF	01B344
Operating System EPROM 7	SBC 116	A76	1C00 - 1FFF	017523
Operating System EPROM 8	SBC 416	A21	2000 - 23FF	014A37
Operating System EPROM 9	SBC 416	A13	2400 - 27FF	0192EB
Operating System EPROM 10	SBC 416	A8	2800 - 2BFF	03BA91
ZT 80 User EPROM	ZT 80	A2	D000 - D3FF	01672A
AMPLITUDE CONTROL EPROM	SBC 416	A23	E000 - E3FF	03DF9F
DELETE FREQUENCY EPROM 1	SBC 416	A22	F000 - F3FF	00076F*
DELETE FREQUENCY EPROM 2	SBC 416	A14	F400 - F7FF	
LOG TABLE EPROM 1	SBC 416	A09	F800 - FBFF	00CDB9
LOG TABLE EPROM 2	SBC 416	A03	FC00 - FFFF	015D92

* No Frequency Deletions

3-1.2.6 Boeing Synchronizer Board - The jumper configuration and switch settings for the Boeing synchronizer board are summarized in Table 19.

Table 19. Boeing synchronizer board jumpers and switch settings

Jumpers

Socket	Jumper-Jumper	Remarks
J1	Pin 3 to Pin 12	$\overline{\text{START}}$ to INT4 interrupt.
J1	Pin 5 to Pin 16	$\overline{\text{SYSTEM STEP}}$ to INT0 interrupt.
U4	Pin 7 to Pin 8	Disables 10 MHz phase-locked loop.
	Set 100mS switch to 7 Set 10mS switch to 0	Sets system step pulse rate

3-1.2.7 EPROM Firmware - The PCU firmware is contained in sixteen 2708 EPROMs. EPROM board and socket assignments as well as memory locations are summarized in Table 20. The delete frequency and amplitude control EPROMs are field-programmable and can be changed to meet the needs of a particular test. Paragraphs 6-3 and 6-4 describe the procedures for reprogramming the Delete Frequency and Amplitude Control EPROMs respectively. After programming new Delete Frequency and Amplitude Control EPROMs, install them in their assigned socket locations listed in Table 20.

Figure 9 shows a complete memory map of the PCU including all EPROM and RAM.

3-1.3 Transmitter Installation

The Transmitter subsystem includes the following equipment: the transmitter cabinet, the transmitter PCU, a Datachron Model 3170 Computer Clock, a Systron-Donner Model 1702 Synthesizer, Amplifier Research Model AR500L wideband power amplifier, an antenna and direct injection couplers.

Table 16. ZT 80 Board Jumpers

Jumper No.	Jumper Position	Function
J3	1	Parallel poll response = 1
J4	7	Bass address = D000H
J5	1	Selects interrupt 1
J6a	H	Selects block D000H to D3FFH
J6b	H	Selects block D000H to D3FFH

Table 17. ZT 80 Switch Settings

Switch A6

Switch	Value	State	Function
1	--	On	Selects ZT 80 as controller
2	--	On	and system controller
3	16	Off	
4	8	Off	
5	4	Off	Selects GPIB address to 1
6	2	Off	
7	1	On	

Table 18. IEEE 488 Bus Address Assignments

Instrument	Address
ZiaTech ZT 80 bus controller	1
S-D 1702 receiver reference synthesizer	2
Tektronix 4662 plotter	4
S-D 1702 receiver VTO synthesizer	8
S-D 1702 transmitter synthesizer	12

Table 15. SBC 416 Switch Settings

Switch Block 1

Switch	State	Function
1	On	A23 EPROM enabled
2	Off	A15 EPROM disabled
3	Off	A10 EPROM disabled
4	Off	A14 EPROM disabled
5	On	RAM not overlapped
6	On	A22 EPROM enabled
7*	Off	A14 EPROM disabled
8	On	A9 EPROM enabled
9	On	A3 EPROM enabled
10	On	RAM not overlapped

* Turn Switch 7 on if 2nd delete frequency EPROM is used.

Switch Block 2

Switch	State	Function
1	On	A21 EPROM enabled
2	On	A13 EPROM disabled
3	On	A8 EPROM disabled
4	Off	A2 EPROM disabled
5	On	RAM not overlapped
6	Off	A20 EPROM disabled
7	Off	A12 EPROM disabled
8	Off	A7 EPROM disabled
9	Off	A1 EPROM disabled
10	On	RAM not overlapped

Switch Block 3

Switch	State	Function
1	Off	These switches set
2	On	the memory access
3	Off	time code for 2708
4	Off	EPROMs.

Table 13. SBC 116 I/O Drivers and Terminators

Port	Board Socket	Driver	Terminator*
X6 upper	A3	SN7432	---
X6 lower	A4	----	SBC 901
X5 lower	A5	----	SBC 901
X5 upper	A6	----	SBC 901
XA upper	A9	SN7432	---
XA lower	A10	----	SBC 901
X9 lower	A11	----	SBC 901
X9 upper	A12	----	ABC 901

* INTEL SBC 901 or Beckman 1899-746-0

Table 14. SBC 416 Board Jumpers

Block X Bias Address Selection	Block Y Bias Address Selection
Jumper	Jumper
X1 to 1	Y1 to 0
X2 to 1	Y2 to 0
X3 to 1	Y3 to 0
Sets Block X Base Address to E000H	Sets Block Y Base Address to 2000H

```
>ASN DL1:=SY:/GBL
>LOA IE:/HIGH
>INS SY:[7,1]LON/TASK=...LON
>INS SY:[7,1]LOG/TASK=...LOF
>INS SY:[7,1]PLT/TASK=...PLT
>INS SY:[7,1]DED/TASK=...DED
>INS SY:[7,1]LOGTSK
>LON
USER LOGGED ON -- BEGIN ACTIVITY

>RUN SY:[7,1]MISNAM
>/
>@ <EOF>
>
ENTER MISSION FILE NAME (MAX. 9 CHARACTERS): (STLOUIS)
THE MISSION FILENAME IS: STLOUIS.MIS
IS THIS CORRECT?(Y/N) (Y)
>
```

Operator entries are shown in parentheses. This sequence is controlled by indirect command file STARTUP.CMD on DL: in UIC [1,2]. The file may be edited to modify its operation, add or delete functions, etc.
This causes the system to be loaded with a 60 Hz line frequency and the time set to 9:55 am on July 19, 1982.

3-2.1.4 Power-Down Procedure - If the operator needs to shut down the system, he must first ensure that all programs are stopped. See the RSX-11M Operator's Procedures Manual (Vol. 2A), the PAR command, to see how to do this. Next the disks must be dismounted by the operator typing DMO DL0:/DEV<CR> and DMO DL1:/DEV<CR> and waiting for the dismount complete messages. Then press the "LOAD" button, on both disk drives, leaving it in the up position. When the "LOAD" light comes on the operator must then choose whether to remove the disk packs or not. If the system is to remain stationary, the packs may remain in the drives. Before the system is transported the

disks must be removed and the heads blocked. See Paragraph 2-3.1.2.

To remove a disk pack, lift the access cover while sliding the hatch toward the rear of the cabinet. Remove the disk pack cover. Then, slide the white button on the handle of the pack to the left and lift the handle. Lift the disk out of the drive and place in the disk pack cover. Release the handle and close the access cover.

When both "LOAD" lights are on and any desired disks are removed, the power can be turned off by throwing the computer front panel switch from the "DC ON" position to the "DC OFF" position.

3-2.1.5 Installing the RL01 Disk Pack(s) - RL01K cartridge loading and RL01 disk drive cycle-up procedures are required to put the subsystem on-line. To perform the cycle-up procedures ac power must be available, the drive ac circuit breaker must be on, system power must be on, and the LOAD indicator on the drive control panel must be illuminated.

RL01K cartridge loading and drive startup procedure is as follows:

- Raise the cartridge access door by sliding the latch on top to the back and lifting on the door.
- Load an RL01K cartridge as follows:
  - Support the cartridge from beneath.
  - Lower the top cover handle and push the handle slide to the left. Raise the handle to its full upright position to release the protection cover.
  - Lift the cartridge from the protection cover and carefully seat it on the disk drive spindle with the top cover handle recess facing the rear of the machine.
  - Carefully rotate the top cover handle a little bit clockwise and counterclockwise to ensure that the spindle locating arms are seated properly within the cartridge housing detent slots.

Use care when seating the cartridge on the drive spindle. Rough handling of the cartridge may cause damage to the spindle or the cartridge interface which may cause excessive platter run-out and positioning errors.

- Gently lower the top cover handle to the horizontal position to engage the cartridge on the drive spindle.
- Place the protection cover on top of the cartridge.
- Close the cartridge access door.

- Start the RL01 disk drive as follows:
  - Press the Run, Stop switch (LOAD indicator) and note that the spindle starts turning. (Listen for a whirring noise in the drive - the spindle cannot be observed directly.)
  - When the drive has completed its start-up sequence and the read/write heads are positioned on cylinder 0, the READY indicator on the numbered UNIT SELECT switch will be illuminated.
  - If write protection is desired, press the WRITE PROTECT switch.

To unload an RL01K cartridge:

- Power down the RL01 disk drive as follows:
  - Press the Run/Stop switch and wait for the LOAD indicator to illuminate.
  - Raise the cartridge access door.
- Remove the RL01K cartridge as follows:
  - Remove the cartridge protection cover.
  - Push the top cover handle slide on the disk cartridge to the left before raising the handle.
  - Raise the top cover handle to the full upright position to release the cartridge from the drive spindle.
  - Carefully lift the cartridge up and out of the

drive and place it in the protection cover.

- Lower the top cover handle to the horizontal position to lock the protection cover in place.

• Close the cartridge access door.

3-2.2 Device Interconnection

Two interconnection configurations exist. One is the normal test configuration in which the PDP-11/34 is connected to the PCU and to a cassette recorder thru RS-232 ports; the other configuration has the PCU directly connected to the cassette recorder (the "backup" configuration).

3-2.2.1 Test Configuration - The normal configuration calls for the plotter, receiver PCU, and cassette drive all to be connected to the PDP-11. These connections are made via the back panel connectors on the PDP-11 cabinet. Each connection uses standard 25-pin male RS-232 connectors with a slide locking mechanism to secure the connections. The slide should be in the 'up' position to make the connection. Sliding the lock down (it will snap into position) secures the connector in place. Each connector is labeled with the name of the device which should be connected into that port.

The peripheral devices are connected to the PDP-11 using a cable assembly consisting of five dedicated cables. Three cable assemblies are supplied with the Data Acquisition Subsystem. The cable assemblies are functionally identical but are different lengths. Cable assemblies with lengths of 25 feet, 50 feet and 250 feet are provided. Each cable end is labeled with the name of the device it connects to. Refer to Figure 15 for details of the PDP-11 to peripheral interconnections.

To connect the HP 2648A terminal to the PDP-11, first located the special HP EIA cable. This cable has a male 25-pin connector on one end and a special edge connector assembly on the other. The edge connector is labeled 'HP EIA RS-232 CONNECTOR'. (A similar connector labeled HP CURRENT LOOP CONNECTOR

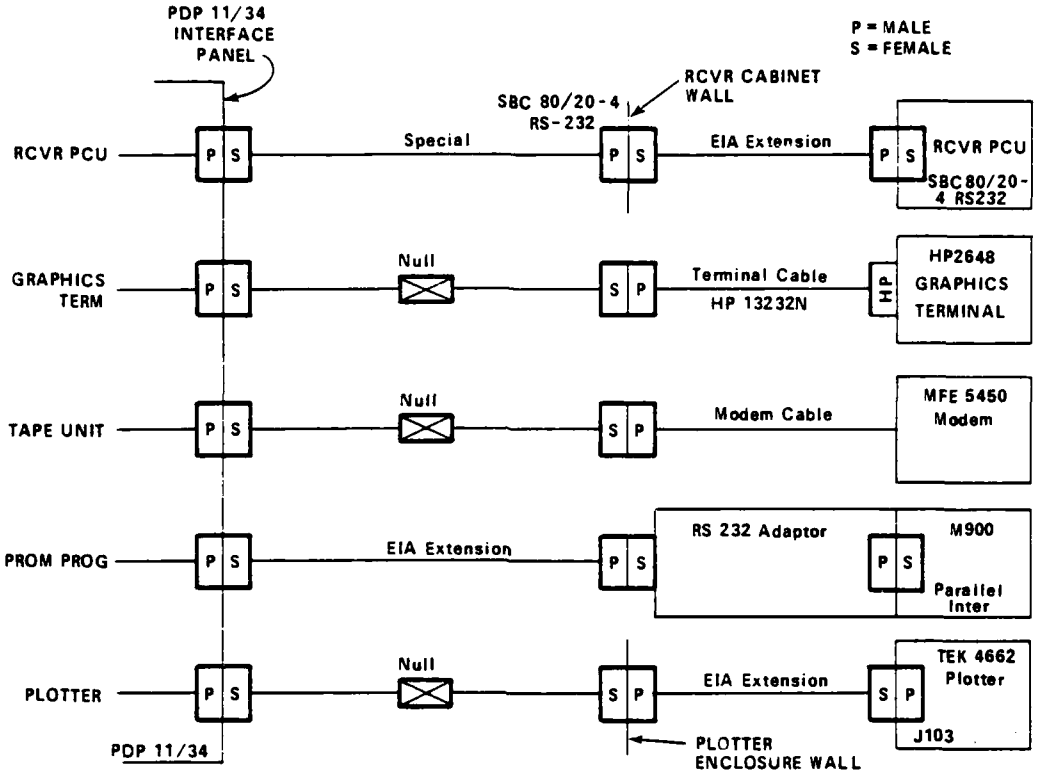


Figure 15. Receiver Subsystem Interconnections

is also supplied with the terminal. Do not use this connector.) The edge connector snaps on to the male edge connector which is second from the right (as one looks at the back of the terminal; the power switch is on the extreme right, the male edge connector which is the first on the right is the connector for the keyboard) so that the cable is protruding downwards from the connector. The 25-pin end is then connected to a "NULL MODEM" cable. A null modem cable is a cable which simulates a modem by swapping the transmit data and receive data lines and providing the handshaking signals required for RS-232 communications. Either end of the cable may be connected to the terminal. The other end of the null modem cable is then connected to the PDP-11 back panel 'GRAPHICS TERM H-P 2648A' connector and locked into place.

The receiver PCU subsystem is connected to the PDP-11 by a special dedicated cable. This cable is labeled 'RCVR PCU' and is connected to the receiver PCU connector labeled 'PCU RS-232 SBC 80/20-4' located on the left cabinet under the plotter table. The other end of this cable is connected to the PDP-11 back panel 'RCVR PCU' connector.

To connect the plotter, a "NULL MODEM" cable is required. This cable is labeled 'TEK 4662 Plotter' and is connected to the back of the screen box which houses the plotter. The other end of this cable is connected to the PDP-11 back panel 'PLOTTER TEK 4662' connector. The plotter is also connected to the receiver PCU. The device the plotter responds to is determined by the four address switches located in the rear panel of the plotter. Refer to table 20 for a list of the proper switch settings. Note that the switches are sensed only when power is applied to the unit, so that if the switch settings are changed, power must be removed and re-applied before the new settings become effective.

The MFE 5450 cassette unit is connected to the PDP-11 through the pigtail labeled 'MODEM' at the rear of the unit. This connector (a 25-pin male) is then connected to a 'NULL MODEM' cable. The null modem is then connected to the 'TAPE UNIT MFE 5450' connector on the PDP-11 back panel. The MFE settings should be 'NONE' parity, a baud rate setting of 2400, 'FDX', and the 'ON LINE' front panel button depressed.

Connecting the Pro-Log M900 PROM programmer to the PDP-11 requires an 'EIA Extension' cable. This cable is plugged into the M302 RS-232 adapter option of the programmer, which is then plugged into the 'PARALLEL INTERFACE' connector of the programmer itself.

WARNING

DO NOT PLUG THE CABLE DIRECTLY INTO THE 'PARALLEL INTERFACE' JACK WITHOUT USING THE M302 RS-232 ADAPTOR.

Doing so may damage the unit. The other end of the cable plugs into the PDP-11 'PROM PROGRAMMER PRO-LOG M900' back panel connector.

3-2.2.2 'Backup' Configuration - This configuration allows the measurement subsystem to be run without the PDP-11. Data is plotted on the TEKTRONIX 4662 plotter without corrections and optionally written on cassette for later processing. This configuration is shown in Figure 7.

To configure the system in the backup configuration, set up the plotter to take data from the receiver PCU. Refer to Table 20 for the proper plotter address switch settings. (Remember that the switches are sensed only on power-up.) If the data is to be written to cassette, plug the 'MODEM' pigtail of the MFE-5450 Tape Unit into the receiver's 'SBC 80/20-4 RS-232' jack, located on the left cabinet of the Receiver Subsystem under the plotter table (the jack normally used for the PDP-11 connection). Use an EIA expansion cable in this connection. The MFE 5450 back panel switches should be set to 'EVEN' parity, 'FDX', and 1200 baud. Only the 'ON LINE' button should be depressed initially; the 'EDIT' button must be off. Before depressing the 'PLOT/INITIATE' button on the PCU, press the 'RCV' front panel switch on the drive to enable data recording. When the measurement completes, release the 'RCV' button. Only one measurement may be put on each side of a cassette, but both sides of the cassette may be used. If data is not to be stored on cassette, install special "JUMPER PLUG NO. 2" into the PCU connector labeled 'SBC 80/20-4 RS-232'.

Since the data stored on cassette is in the same format as data transmitted to the PDP-11, the data can, if desired, be run through the PDP-11 as if the data were being sent from the PCU itself. The PDP-11 cannot tell the difference between the PCU and the Tape Unit. To process data stored on cassette, set up the system in the primary configuration (Paragraph 3-2.2.1) with the following modification: Plug the Tape Unit used to record the data from the PCU into the PDP-11 in place of the

receiver PCU. To do this, plug the MFE 5450 'MODEM' cable into a 'NULL MODEM' cable, and plug the other end of the null modem cable into the PDP-11 'RCV PCU' back panel connector. Do not connect the PCU to the PDP-11. Settings on the tape drive are the same as the initial settings when the data was recorded ('EVEN', 'FDX', 1200 baud, 'ON LINE' on, 'EDIT' off). Refer to Paragraph 5-3.2 for operating instructions. For this configuration, however, press the 'SEND' button on the cassette front panel when the instructions in Paragraph 5-3.2 direct to push the PCU 'PLOT/INITIATE' switch. (It is assumed that the cassette is already at 'LOAD POINT'.) All other operations are identical to a normal test in the primary configuration.

If only one MFE 5450 cassette is available, the data may still be processed on the PDP-11. In following the instructions in Paragraph 5-3.2, the operator prompt

DO YOU WANT TO SAVE DATA ON TAPE (Y/N) >

will appear on the operator's terminal. If data are not to be saved on tape, no problem occurs. However, if the data are to be saved, and only one cassette is available, special procedures are needed. Here's what to do. When this prompt appears, all data has been read. If the 'SEND' light on the cassette is still on, release the 'SEND' button and press the 'RWND' button. When the rewind is complete, disconnect the 'NULL MODEM' cable from the PDP-11 'RCVR PCU' connector and plug it into the PDP-11 'TAPE UNIT MFE 5450' connector instead. Remove the raw data cassette and insert the pre-initialized cassette selected in the menu for data output (refer to Paragraphs 5-3.2 and 6-5) into the cassette drive. Press the 'EDIT' button (only 'ON LINE' and 'EDIT' should be on at this point). Then return to the terminal and answer the prompt. The cassette drive is now configured for data output.

SECTION 4
MEASUREMENT SYSTEM OPERATION AND CALIBRATION

4-1 PRELIMINARY SET UP PROCEDURES

The following paragraphs describe procedures used to set up the CW Measurement System prior to operation. See Figure 16 for block diagram of Receiver and Transmitter subsystems.

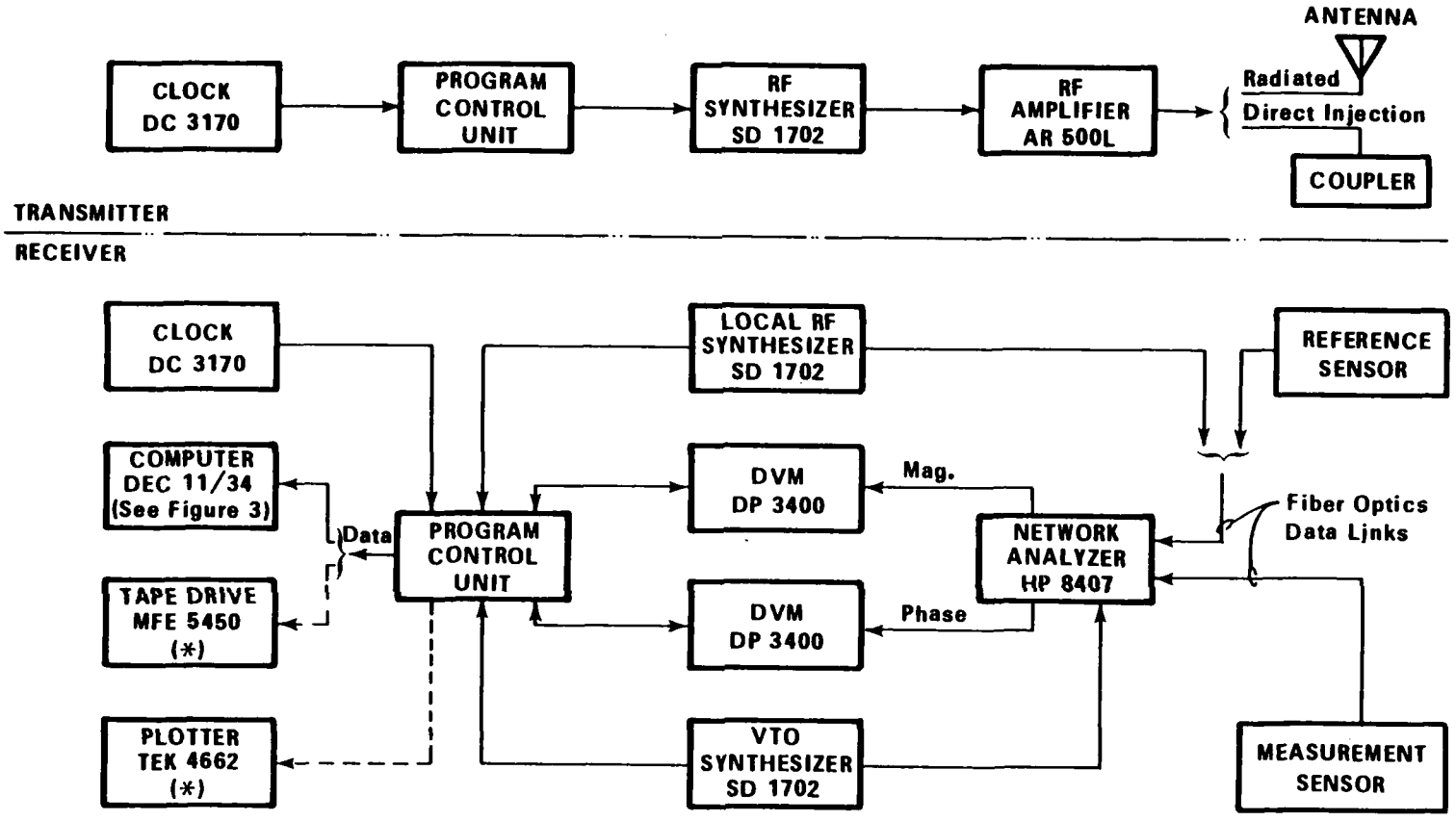
4-1.1 Receiver Subsystem

Before applying power to the receiver subsystem, verify that all receiver equipment is properly installed as described in paragraph 3-1.4. In the two receiver cabinets, verify that all cables and connectors are in sound working condition and that all equipment is properly interconnected. The receiver interconnect diagrams are shown in Figures 13 and 14.

Verify that the Frequency Delete and Amplitude Control EPROMs are installed in the receiver PCU as described in Paragraph 3-1.2.7. For calibration measurements and system checkout it is highly recommended that Delete Frequency and Amplitude Control EPROMs which have been programmed to the values shown in Table 21 be installed.

There is a rack-mounted blower and filter assembly in the lower portion of each receiver cabinet. Remove the front panels from the blower assemblies and inspect the air filters. Replace filter elements as required.

The receiver equipment requires 120 VAC, 60 Hz power for proper operation. (Equipment can be internally set for 240 VAC, 50 Hz operation.) Power can be obtained from standard wall receptacles or the receiver isolated power system. In many cases, including calibration measurements, system checkout and measurements performed in well isolated facilities, commercial wall power can be used with good results. However, when attempting to measure very low level signals in facilities that have marginal AC line isolation, the receiver isolated power system is recommended. Four batteries in the receiver isolated power system will provide power to operate the receiver



(*) Dashed lines show interconnections used in Backup Configuration.

Figure 16. Block Diagram of Receiver and Transmitter Subsystems

Table 21. Delete frequency and amplitude control EPROM programming for calibration and checkout

EPROM	PARAMETER	REMARKS
DELETE FREQUENCY	Single Deletions	Program for no deletions
	Multiple Deletions	Program for no deletions
AMPLITUDE	Reference Synthesizer	Program for 0dBm Output
	Transmitter Synthesizer	Program for 0dBm Output from 10 kHz to 100 MHz
	Time Delay Cycle 1-2	Program for 10 sec.
	Time Delay Cycle 2-3	Program for 20 sec.

subsystem for approximately two hours. When the batteries are discharged, remove them from the receiver power supply, place each on charge (five battery chargers are provided) and install freshly charged batteries in the receiver power supply. A complete schematic diagram of the receiver power supply, including battery wiring, is shown in Boeing Drawing SK-CWMS-PIV.

Separate battery power is required by three other receiver subsystem components. The Meret fiber optic transmitter is powered by a 12 volt 1Ah rechargeable battery. When fully charged this battery will operate the transmitter for five to six hours. The Meret fiber optic receiver requires both 120 VAC line power and 300 VDC battery power. Battery power for the receiver is supplied by a non-rechargeable Eveready battery. The 300 volt battery will operate the receiver for about 100 hours. The Data-Chron clock contains an internal rechargeable battery that maintains clock functions for about 12 hours when AC line power is unavailable. The battery is automatically recharged when AC power is applied to the clock. Place the battery switch located on the rear panel of the Data-Chron clock in the ON position. All other rechargeable batteries should be placed on charge when not in use.

Apply appropriate AC power to both receiver cabinets and check that the rack blowers are operating. Turn on all instrument power switches and verify that all equipment is operating. Set the receiver equipment control switches to the initial settings shown in Table 22. If the plotter is connected to the receiver subsystem, install paper and adjust the plot boundaries. Refer to the Plotter Instruction Manual, if necessary. If the MFE tape unit is connected to the receiver subsystem, install an initialized cassette, and press the "ON LINE" switch. (Refer to program CTP in Section 8.) Refer to the MFE Operation Manual for details on proper cassette installation in the MFE unit.

NOTE: The Systron Donner Synthesizers and Data-Chron computer clock contain temperature controlled ovens to maintain long-term frequency and time stability. After extended periods of non-use, these units require approximately 24 hours for their output signals to stabilize. During non-test periods, connect these units to commercial AC power to maintain temperature stability for accurate frequency and timing responses.

4-1.2 Transmitter Subsystem

Prior to applying power to the transmitter cabinet, verify that all transmitter equipment is properly installed and interconnected as described in Paragraph 3-1.3. Check that Delete Frequency and A. plitude Control EPROMs are installed in the transmitter PCU as described in Paragraph 3-1.2.7. For calibration measurements and system checkout, it is recommended that EPROMs which have been programmed as described in Table 21 be installed.

Inspect the blower air filter in the transmitter cabinet and replace if necessary. The transmitter subsystem requires 120 VAC 60 Hz power for equipment located in the transmitter cabinet and 208 VAC, 60 Hz, three phase power for the AR500L power amplifier. Power for the transmitter subsystem is provided by the ONAN 10 kW motor generator set. Plug the power cords from the transmitter cabinet and power amplifier

Table 22. Initial switch settings for receiver equipment

EQUIPMENT	SWITCH	SETTING	REMARKS
PCU	Enable	Clockwise	
	Decade 1	0	
	Decade 2	0	
	Decade 3	25	
	Decade 4	25	
	Decade 5	25	
	Decade 6	0	
	Plot Format	000	Manual Instrument Operation
	Step Mode	Auto	
	Start Mode	Local	
	Meas. Cycle	Single	
	Hold	OFF	
NETWORK ANALYZER	Ref. Chan Level	Lower	
	Ampl. Vernier	Middle	
	Phase Vernier	Middle	
	10 dB Display Reference	Middle	
	1 dB Display Reference	Middle	
PHASE - MAGNITUDE DISPLAY HP 8412A	BW(KHZ)	0.1	
	Mode	Amp	
	Amp DB/Div	10	
	Phase DEG/Div	45	
	Phase Offset	--	
	Degrees	180	
COMPUTER CLOCK DATACHRON 3170	Start/Stop	Stop	

Table 22. (Continued)

EQUIPMENT	SWITCH	SETTING	REMARKS
DIGITAL VOLTMETERS DATA PRECISION 3400	DCV	IN	
VTO SYNTHESIZER SYSTRON DONNER 1702	Frequency	210 MHZ	
	Mode	CW	
	Output Level	-10 dBm	
REF. SYNTHESIZER SYSTRON DONNER 1702	Frequency	10 MHZ	
	Mode	CW	
	Output Level	-10 dBm	

into the appropriate receptacles on the motor generator. Turn off all equipment power switches and open the circuit breakers in the rear of the power amplifier cabinet. Verify that the motor generator has adequate crank case oil and gasoline. Set the transmitter equipment controls to the initial values shown in Table 23. Connect the transmitter synthesizer output to the input of the power amplifier. Connect a suitable load to the output of the power amplifier.

CAUTION

The AR500L is a high gain amplifier capable of supplying over 500 watts RMS of output power to a matched 50 ohm load for an input of 0 dBm. 0 dBm is a power level of 1 milliwatt or 224 millivolts in a 50 ohm system. 500 watts is about 160 volts RMS across a 50 ohm load. Lethal voltages are present within the amplifier cabinet and at its output connector. Use caution when working near the power amplifier and under no circumstances attempt to operate the unit without first having thoroughly read the AR500L instruction manual.

Start the ONAN motor generator set in accordance with the procedures outlined in the ONAN operating manual. When the generator has stabilized, turn on the transmitter equipment and close the power amplifier circuit breakers. Verify that all equipment operates properly. Note that the computer clock and synthesizer are temperature stabilized units and must be powered continuously to insure accurate timing and frequency responses.

To operate the transmitter subsystem in the manual mode, first adjust the synthesizer frequency switches to the desired output frequency. Turn the PCU enable key switch to the clockwise position. With the plot format switch in the 000 position, press the PLOT/INITIATE switch. This allows front panel control of all synthesizer functions.

The power amplifier may be placed in the operate mode by pressing the OPERATE pushbutton after the STANDBY pushbutton has lighted. The amplifier output power can be varied by adjusting the synthesizer output controls and the amplifier gain

Table 23. Initial switch setting for transmitter equipment

EQUIPMENT	SWITCH	SETTING	REMARKS
PCU	Enable	Counterclockwise	Disables PCU
	Decade 1	0	
	Decade 2	0	
	Decade 3	25	
	Decade 4	25	
	Decade 5	25	
	Decade 6	0	
	Plot Format	000	
	Step Mode	Manual	
	Start Mode	Local	
	Meas. Cycle	Single	
	Hold	OFF	
COMPUTER CLOCK DATACHRON 3170	Start/Stop	Stop	
SYNTHESIZER SYSTRON-DONNER 1702	Frequency	0	
	Mode	CW	
	Output Level	-20 dBm	Approx. 5 watts output with AR500L control full CW.
POWER AMPLIFIER AR500L	Gain	CCW	Full attenuation Approx. 20 dB

control. Amplifier output power and frequency can be verified using appropriate test equipment.

4-1.3 Command Link Initialization

The Data-Chron clocks form the measurement system command link. The clocks must be accurately set to insure that the transmitter and receiver PCUs step together synchronously. To initialize the clocks, first remove the clock from the transmitter cabinet and place it near the receiver clock. Apply AC power to the transmitter clock and insure that the battery

switches are in the ON positions. Connect the two clocks with a short piece of coaxial cable as shown in Figure 17. Stop the receiver clock by momentarily pressing the Start/Stop switch to the STOP position. Set the HOURS, MINUTES, and SECONDS thumbwheel switches on the receiver clock to the local time of day plus one minute. Press the LOAD pushbutton on the reciever clock and verify that the preset time is loaded to the display. Press the Start/Stop switch on the receiver clock to the Start position to start the clock.

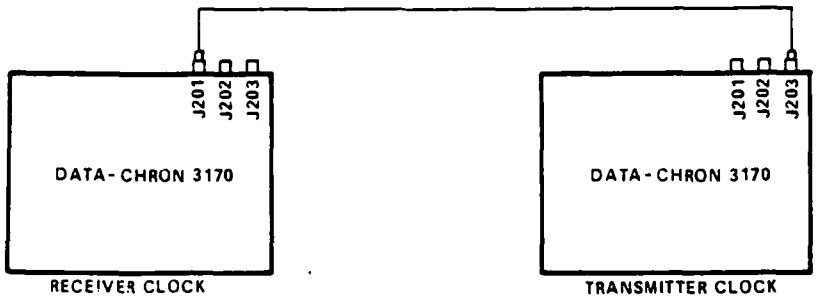


Figure 17. Command Link Initialization Setup

When the receiver clock is set and operating, set the HOURS, MINUTES, and SECONDS, thumbwheel switches of both clocks to an arbitrary future time (for example, one minute hence). On the receiver clock, press the ARM pushbutton. The ARM indicator light should illuminate. On the transmitter clock, first press the START/STOP switch to the STOP position, then press the LOAD pushbutton followed by the ARM pushbutton. When the receiver clock advances to the preset time, the transmitter clock will start at the preset time and both arm indicators will extinguish. The transmitter clock may now be moved and reinstalled in the transmitter cabinet. The clocks must be resynchronized as described above if the transmitter and receiver fail to step synchronously. This condition is indicated by failure of the Network Analyzer circuits to properly phase lock on the transmitter signal with erratic data results.

4-1.4 PCU Operation

The PCUs control the transmitter and receiver subsystems causing each to step through one measurement point cycle each 700 milliseconds. The PCUs may be started and run independently or started together by the command link causing the receiver and transmitter to step synchronously through the measurement cycle. The PCU front panel switches and their functions are summarized in Table 24.

Basic operation of the PCU is controlled by the following switches; the POWER On/Off switch, the key operated ENABLE switch, the PLOT/INITIATE switch, START, STOP and RESET switches. The POWER switch is an illuminated pushbutton that applies primary power to the PCU and causes it to automatically reset. The ENABLE switch in the clockwise position will allow the PCU to be started. This switch prevents unauthorized use of the measurement system. The PLOT/INITIATE switch initializes the PCU for operation depending upon the settings of the following switches: DECADE and STEP SAMPLE SELECTION, PLOT FORMAT, STEP MODE and MEASUREMENT CYCLE. The status of these switches is sent to the PCU RS232 port. In the Primary configuration, the data acquisition system reads the status of the switch settings. In the Secondary configuration, the MFE tape unit will record the status of the switch settings. In the Secondary configuration, PLOT/INITIATE causes the plotter to move to the lower left corner of the plotting grid and commence grid generation. The PLOT/INITIATE switch must always be asserted before the PCU can be started. The START switch starts the PCU when the Local Start mode is selected. The STOP switch halts PCU operation and sends an error message to the data acquisition system. In the Secondary configuration, asserting the STOP switch will cause the MID-PROGRAM STOP to be written on the plot. The RESET switch is used to reset the PCU.

All measurement cycles are begun by first depressing the PLOT/INITIATE switch. If the plotter must generate a grid, time must be allowed for the plotter to complete the grid. In the primary configuration, the plot display and menu entry

Table 24. PCU front panel switch settings and functions

Switch	Setting	Functional Description
DECADE AND STEP SAMPLE SELECTION	0 25 50 100 250 500 1000	Selects the number of logrithmically spaced frequency points for each of six decades covering frequencies of from 1 kHz to 1 GHz. Decades with non-zero selections must be contiguous. Network Analyzer frequency range limited to 10 kHz to 110 MHz.
	KFD	Invalid setting. Do not use.
PLOT FORMAT	000	Allows front panel control of instruments normally controlled by PCU.
	TFA TFB TFC RFA RFB RFC	Selects the grid and axis label format on which data are plotted when operating in the secondary configurations. The six grid formats are shown in Figures 18 thru 23, respectively.
	XXX	Used to suppress grid plotting for overlaying data plots. Assumes previously set plot format (except *000*) unless *RESET has been asserted*. After a RESET, XXX assumes TFA format.
STEP MODE	MANUAL	Causes PCU to step to next frequency point each time START switch is asserted. First frequency point is set on second assertion of START switch.
	AUTO	Causes PCU to step to next frequency point each 700 msec automatically.
START MODE	REMOTE	Starts PCU upon receipt of start pulse from Data-Chron clock.
	LOCAL	Starts PCU when START switch asserted.
MEAS. CYCLE	SINGLE	Selects single measurement cycle.
	MULTI	Selects a three measurement cycle sequence. LED indicator lites for MULTI cycle operation. First cycle used for ambient noise measurement. Second cycle used for data measurement. Third cycle used for pickup noise measurement. Time delays between

Table 24. (Continued)

SWITCH	SETTING	FUNCTIONAL DESCRIPTION
		cycles 1 and 2, and cycles 2 and 3 are software controlled in the Amplitude Control EPROM.
HOLD	ON	Used in conjunction with MULTI cycle operation to defer start of next cycle. If HOLD switch is ON at end of intercycle time delay, PCU must be manually restarted. State of HOLD switch is not sampled by PCU until end of time delay.
ENABLE	CCW	Disables PCU operation.
RESET	Momentary	Resets PCU. A Reset is automatically performed when PCU is powered up. If plotter connected to RECEIVER, RESET causes plotter bell to sound and pen to move to home position.
PLOT/INITIATE	Momentary	Initates PCU to present front panel switch settings. Starts grid plotting if Plotter connected to Receiver. Enables start command and must always precede a start command.
START	Momentary	Starts PCU when in LOCAL Start Mode. Enables Start from Data-Chron Clock when in REMOTE Start Mode. Must be preceded by PLOT/INITIATE. Enables STOP command.
STOP	Momentary	Stops PCU. Enabled by START. If Plotter connected to PCU and STOP is asserted after PLOT/INITIATE and before grid plotting is complete, plotting will continue until plotter buffer is empty. If STOP is asserted during a measurement cycle, error message is sent to PDP 11/34 in Primary Configuration: "MID PROGRAM STOP" is plotted in Secondary Configuration.
POWER	Illuminated Pushbutton	Applies primary power to PCU and resets PCU.

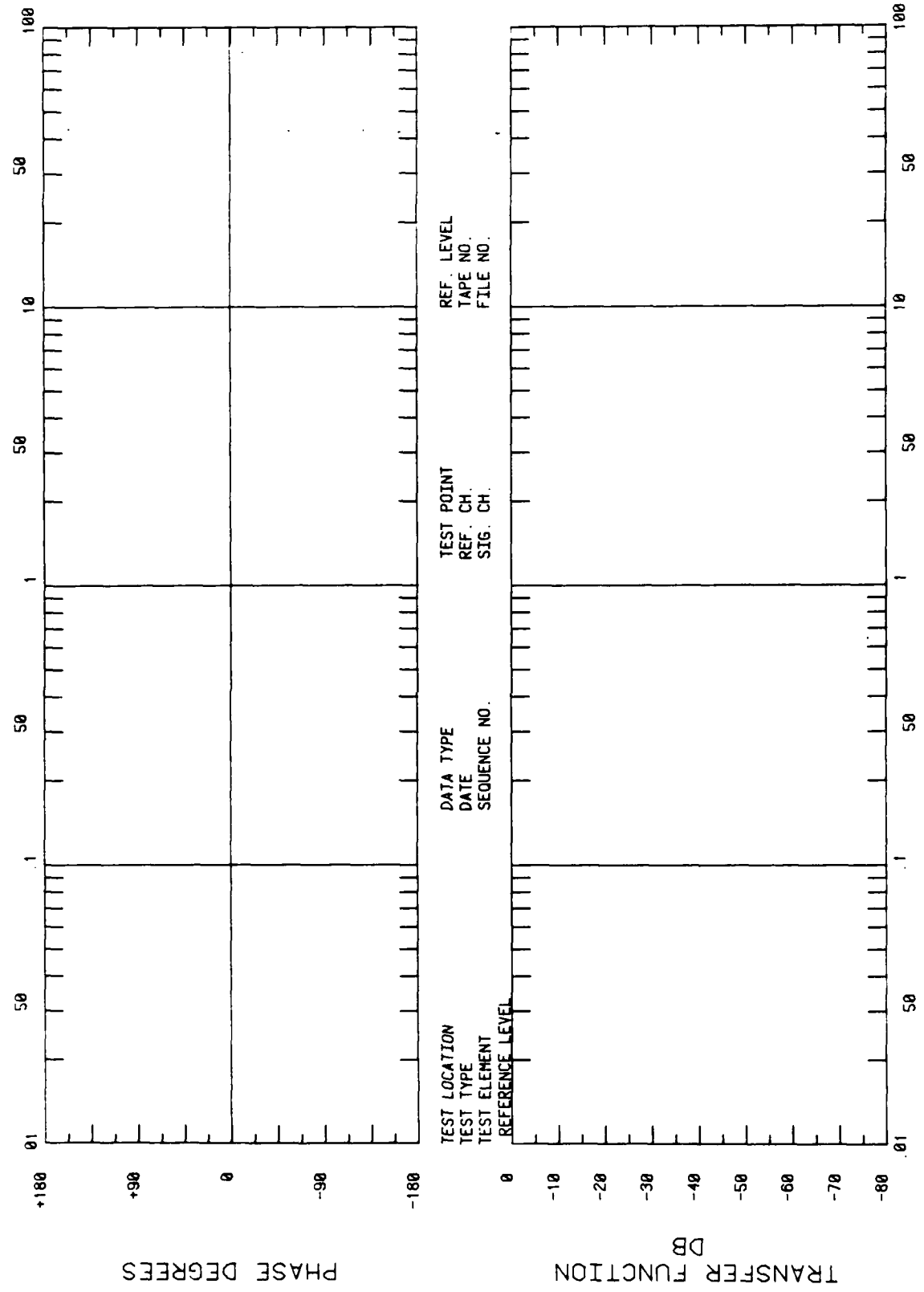


Figure 18. TFA Plot Format

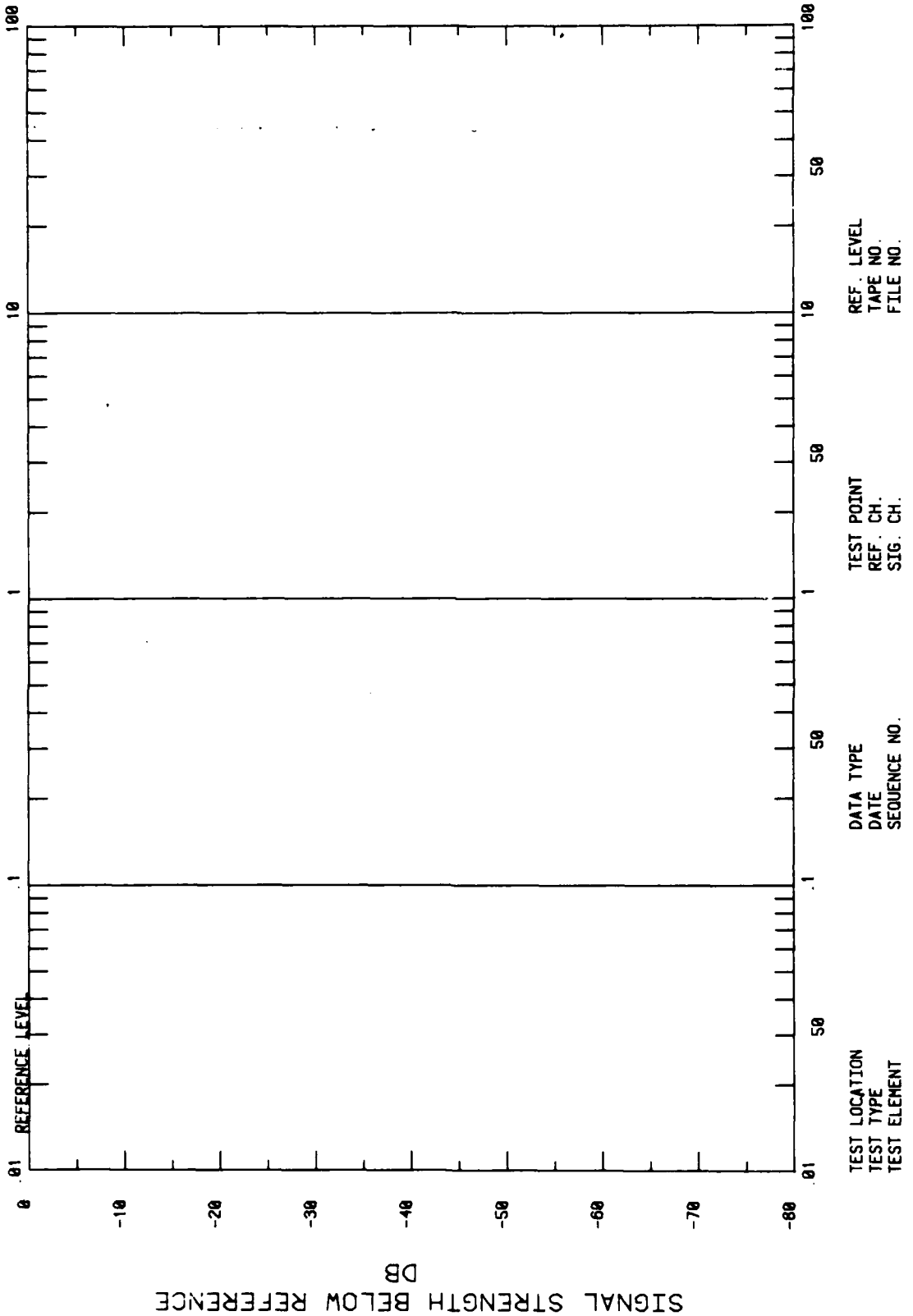


Figure 19. TFB Plot Format

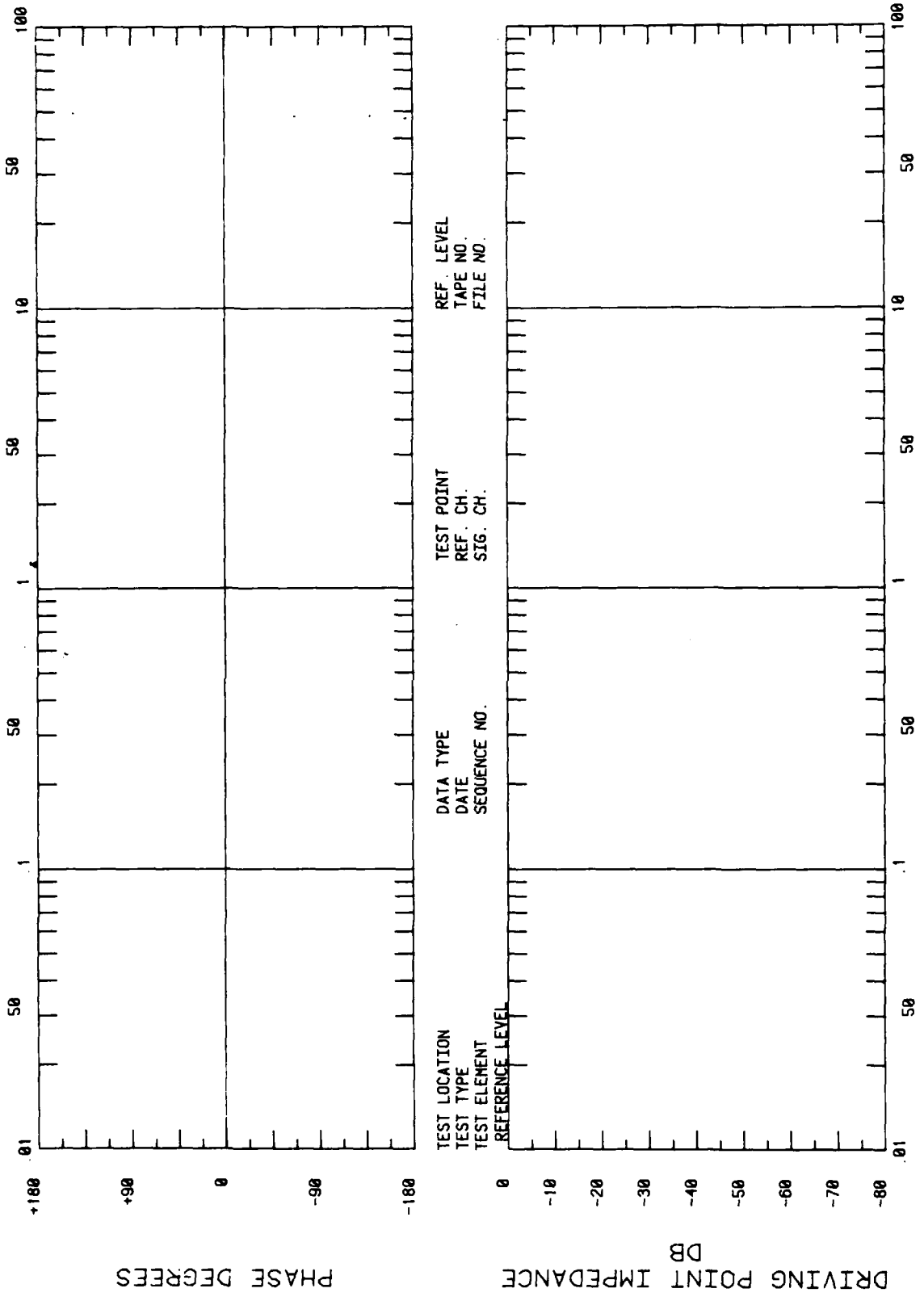


Figure 20. TFC Plot Format

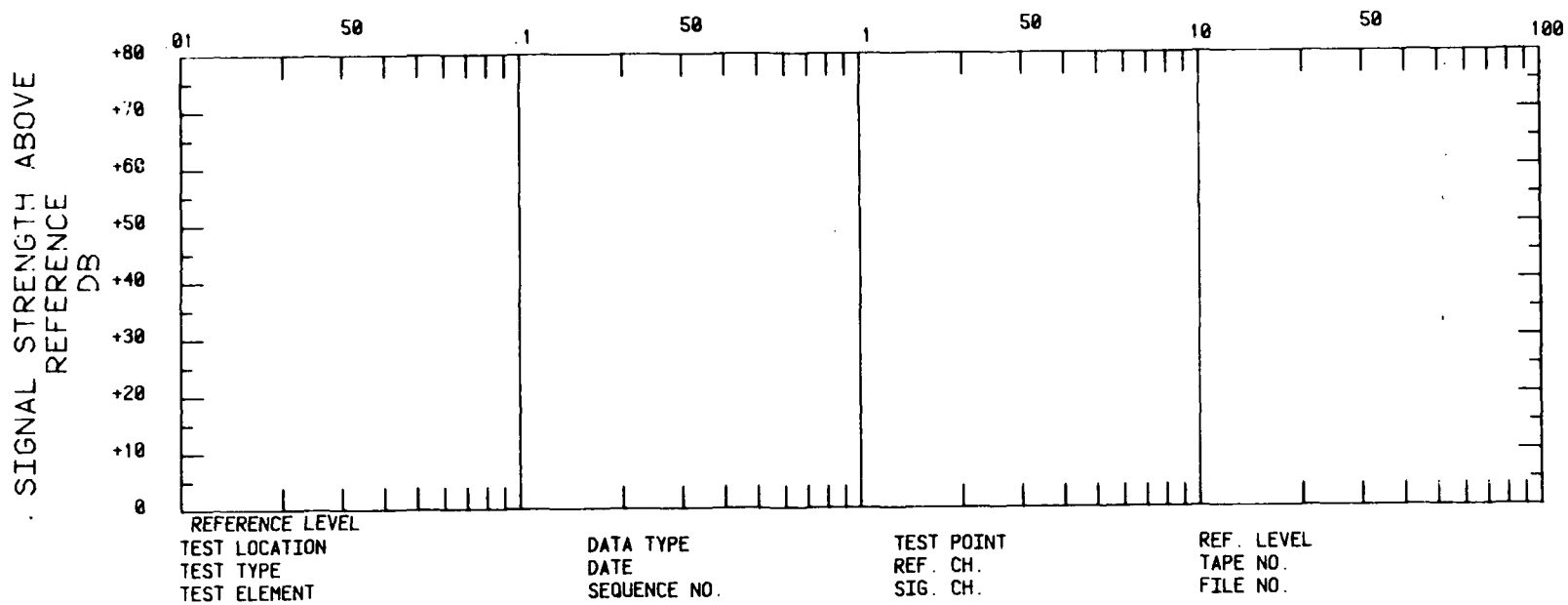


Figure 21. RFA Plot Format

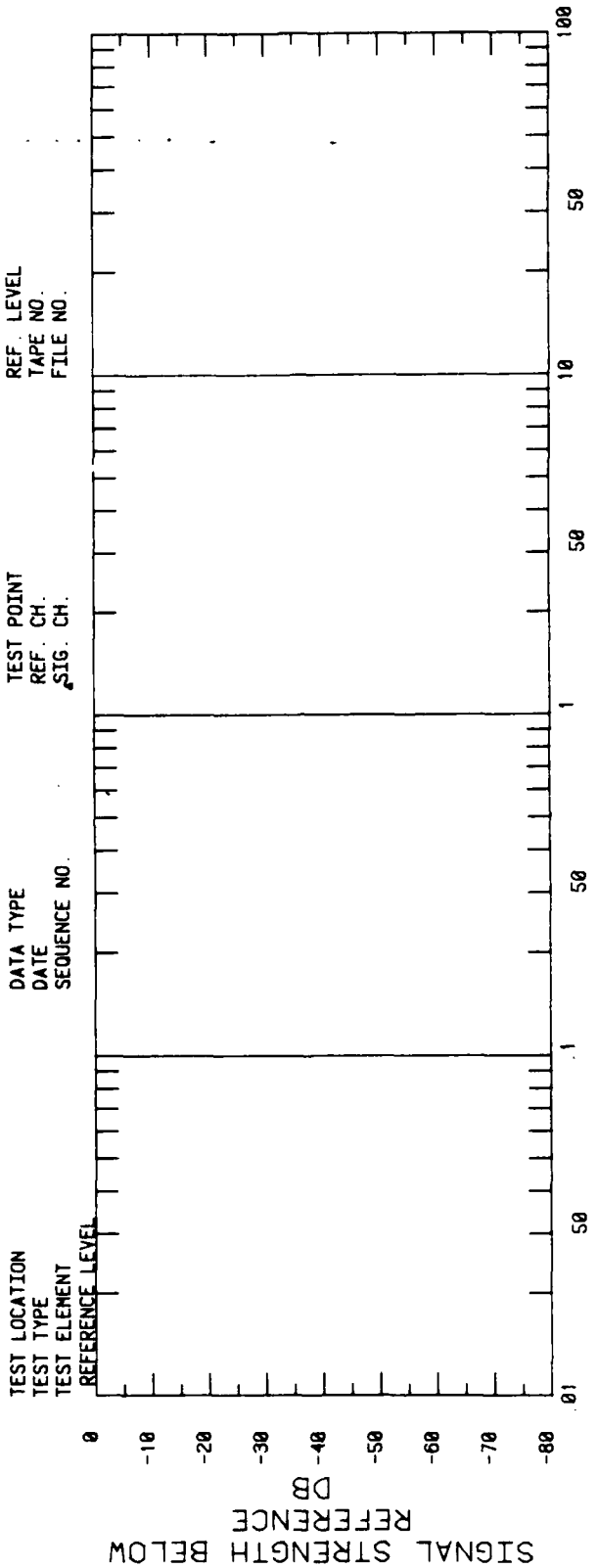


Figure 22. RFB Plot Format

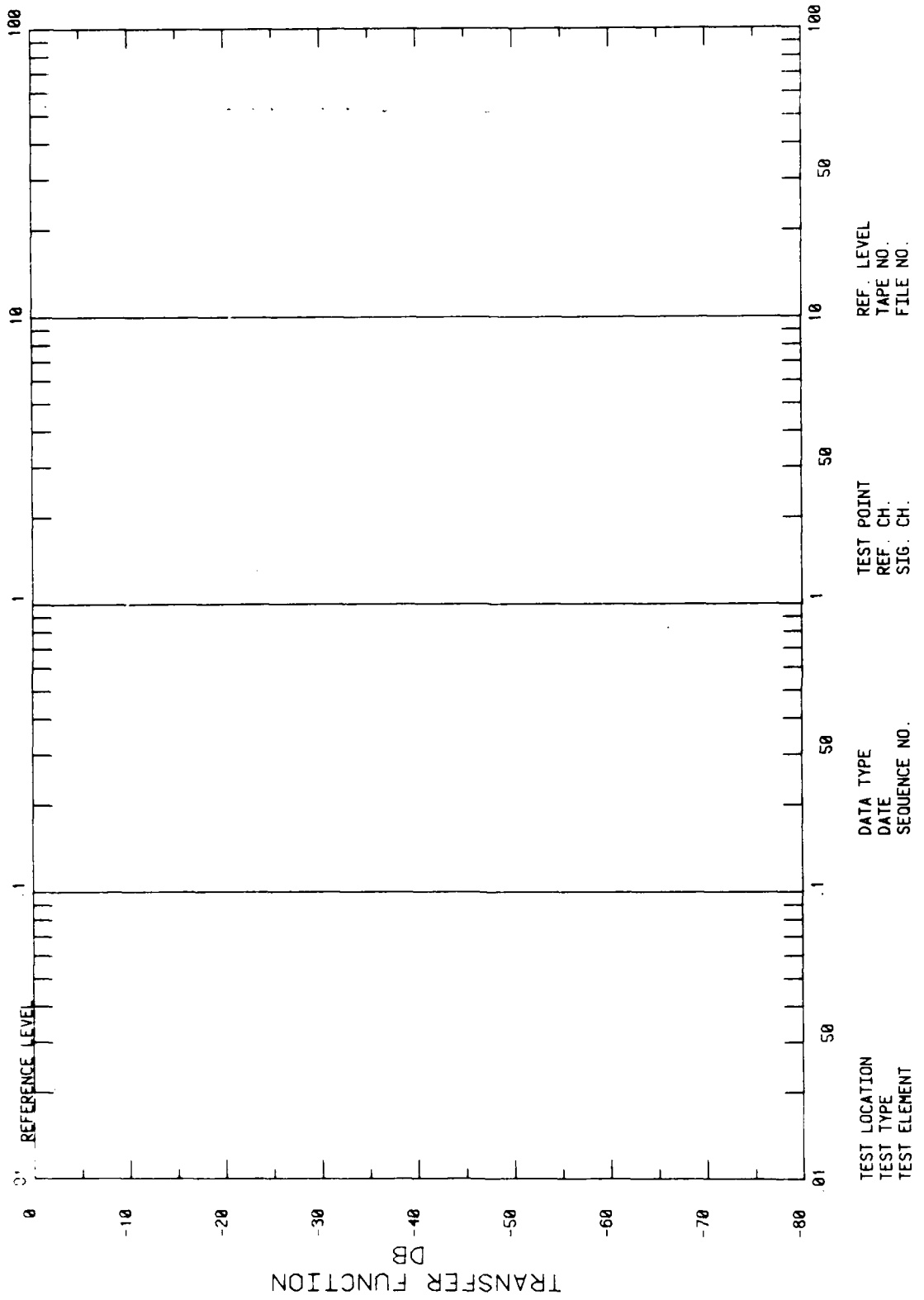


Figure 23. RFC Plot Format

4-2.8 Probe Identifier Conventions

Because pieces of the software subsystem require knowledge of the units measured by probes, the following conventions are used for naming probes. Probes are given names (or identifiers) when they are calibrated. This identifier is the response to the

SIGNAL PROBE>

prompt in the primary menu which appears during calibration of a non-analytic probe (see Section 5-3.2 for more information about menu entries), or in response to the

ENTER PROBE ID>

prompt which appears when calibrating an analytic probe using the APROBE program (see Section 6-2). When this probe is used during testing, this identifier is entered in response to either the

SIGNAL PROBE>

or

REFERENCE PROBE>

prompts, depending on which channel the probe is used in.

The names of the probes can be up to 9 alphanumeric characters long. Special characters (including all punctuation marks) are not permitted in probe identifiers. The conventions require that the first character of the probe identifier indicate the units. Presently, these characters indicate the associated units:

1st Character of Probe Name	Units Measured	Probe Types
I	Amps	Stoddart (Singer) current probes
V	Volts	Tek (and others) voltage probes
B	Teslas	EC&G MGL B-dot sensors
U	--	'Unity' sensor

All other characters cause the software to ignore the units generated by the sensor. Should additions to this list become

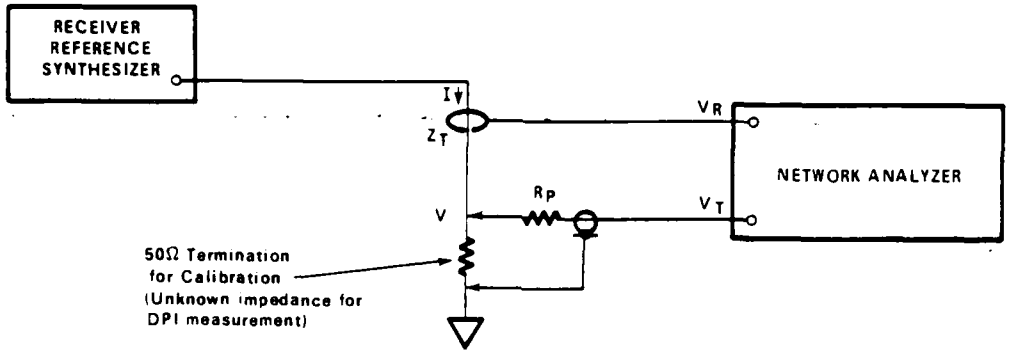


Figure 29. Driving Point Impedance Calibration and Measurement Setup

Derivation of the Network Analyzer output as a function of the measured DPI proceeds as follows:

Let R = Network Analyzer output in dB

then $R = 20 \log_{10} \frac{V_T}{V_R}$

where $V_R = I \cdot Z_T$

and $V_T = \frac{50}{50 + R_p} V$, where R_p = resistance of voltage probe

therefore $R = 20 \log_{10} \frac{\frac{50}{50 + R_p}}{\frac{Z_T}{I}} V$

but $\frac{V}{I}$ = DPI (for $R_p + 50 =$ unknown impedance)

so $R = 20 \log_{10} \left[\frac{\frac{50}{50 + R_p}}{Z_T} \right]$ (DPI)

or $DPI = R + 20 \log_{10} (50 + R_p) - 34 + 20 \log_{10} Z_T$

Sample point density of 100 points per decade in the 2nd, 3rd, 4th and 5th decades will provide sufficient resolution. Perform calibration measurement.

4-2.7 Driving Point Impedance Measurement

Driving Point Impedance (DPI) measurements can be made using the Measurement System. The system must be calibrated using a known impedance. One good standard impedance that can be used for calibration is a 50-ohm terminator.

In order to measure an unknown impedance, voltage and current measurements must be made and the ratio of the voltage to current determined. Since the HP8407A Network Analyzer is a ratio measuring instrument, DPI measurements are easily realized.

A simple voltage probe for DPI measurements can be made using a 1/4 or 1/2 watt carbon composition resistor with a resistance between 1k-ohm and 10k-ohms. One end of the resistor is soldered to the center conductor of a piece of coaxial cable. The shield of the coax cable is used as the return or common connection of the voltage probe. A Singer current probe is recommended for the current measurement.

The DPI calibration measurement test setup is shown in Figure 29. Reference and test channel instrumentation must have matched electrical lengths for accurate phase measurements. To calibrate the DPI instrumentation, perform a calibration measurement using the same procedures described above for current probe calibration and the setup shown in Figure 29. The Network Analyzer output in dB will correspond to an impedance of 50 ohms for the calibration measurement. Subsequent DPI measurements of unknown impedances are referenced to 50-ohms and will be in dB above or below this reference.

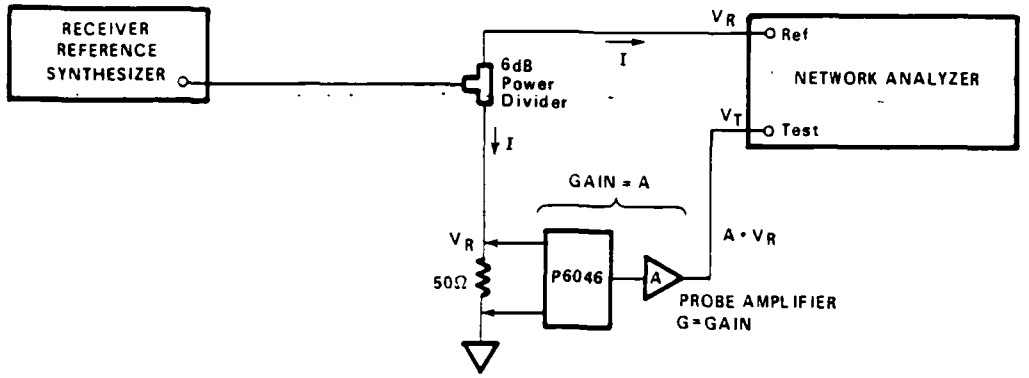


Figure 28. Setup for P6046 Voltage Probe Calibration

Let R = Network Analyzer output in dB

then $R = 20 \log_{10} \frac{V_T}{V_R}$

but $V_T = (A) \times (V_R) = AV_R$ where A = P6046 + Amplifier Gain

so $20 \log_{10} \frac{V_T}{V_R} = R = 20 \log_{10} A$

or $A = 10 \frac{R}{20}$

To perform voltage probe calibration, set the Receiver PCU switches for a single cycle TFC measurement. Perform calibration measurement by:

1. Entering PCAL in response to the TEST/CAL prompt.
2. Adjusting the Network Analyzer Display Reference controls to place the probe calibration measurement within the display area.
3. Entering the appropriate value for the Network Analyzer Display Reference.
4. Entering the desired voltage probe ID code in response to the 'SIGNAL PROBE' prompt.
5. Entering 'SYN' in response to the 'REFERENCE PROBE' prompt.

Solving for Z we obtain

$$Z_T = 10^{\frac{34 + R}{20}}$$

or $$20 \log_{10} Z_T = R + 34$$

To calibrate a current probe, set up the Receiver subsystem equipment as shown in Figure 27 and as described above. Set the Receiver PCU switches for a single cycle TFC measurement. Sample point density of 100 points per decade in the 2nd, 3rd, 4th and 5th decades will provide sufficient resolution for most probes. Perform calibration measurement by:

1. Entering 'PCAL' in response to the TEST/CAL prompt.
2. Adjusting the Network Analyzer Display Reference controls to place the probe calibration measurement within the display area.
3. Entering the appropriate value for the Network Analyzer Display Reference (+34 dB).
4. Entering the desired current probe ID code in response to the 'SIGNAL PROBE' prompt.
5. Entering 'SYN' in response to the 'REFERENCE PROBE' prompt.

4-2.6 Voltage Probe Calibration

Voltage probes can be calibrated using the Receiver subsystem using procedures similar to those for calibrating current probes. Calibration of the P6046 Differential Voltage Probe is described in the following paragraphs.

Set up the Receiver equipment and the P6046 Voltage Probe as shown in Figure 28. As in the case of current probe calibration, reference and test channel electrical lengths must be matched for accurate phase measurements. Derivation of the Network Analyzer output as a function of the measured voltage probe calibration is as follows:

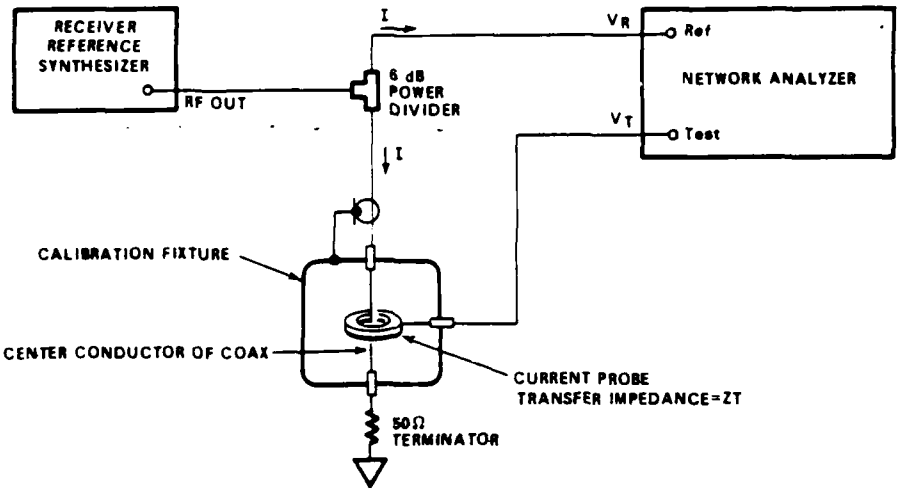


Figure 27. Current Probe Calibration Setup

The objective of performing a current probe calibration is to determine the probe's transfer impedance Z . The transfer impedance is a measure of the probe's sensitivity and is the ratio of the probe's output voltage into 50 ohms and the current required to produce the output voltage. Derivation of the Network Analyzer's output as a function of the probe's transfer impedance proceeds as follows:

Network Analyzer output in dB = R

$$R = 20 \log_{10} \frac{V_T}{V_R}$$

and

$$V_R = I \cdot 50 \qquad V_T = I \cdot Z_T$$

Therefore

$$R = 20 \log_{10} Z_T - 20 \log_{10} 50$$

$$= 20 \log_{10} Z_T - 34$$

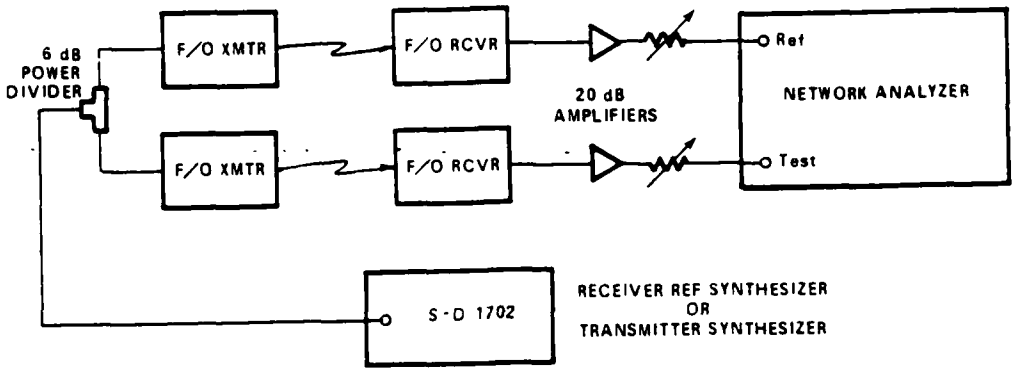


Figure 26. End-to-End Instrumentation Calibration Setup

coax cable. Use the procedure described above for a TCAL measurement but enter 'RCAL' in response to the TEST/CAL> prompt of the Primary Menu (see Paragraph 5-3.2). Note that Phase data are not stored for a RCAL.

4-2.5 Current Probe Calibration

Current transformer type current probes can be easily calibrated using the Receiver subsystem. When the measurement system is used in the Primary configuration, current probe calibration data can be passed to the Data Acquisition System and stored in a probe calibration file. When a data measurement is performed using a particular current probe, the calibration data for the probe are used to correct the raw data for the probe's response. In the Secondary configuration, calibration data are plotted and stored on tape cassettes.

The test setup for calibrating current probes is shown in Figure 27. A suitable calibration fixture in which the center conductor of the coaxial signal cable is broken out must be used. The electrical length of the reference channel cable connecting the reference channel input of the Network Analyzer to the power divider must equal the electrical length of the cable connecting the test channel input of the Network Analyzer to the current probe plus the electrical length of the cable from the power divider to the current probe measurement point to obtain accurate phase calibration data.

To perform an "end-to-end" TCAL instrumentation calibration measurement, disconnect the reference and test probes at the probes. All cable between sensors and Fiber Optics Transmitters must be included in the calibration measurement. Fiber optic data links, if used, should be in both test and reference channels. Set up the instrumentation and measurement system as shown in Figure 26. The RF test signal for this measurement may be obtained from either the receiver reference synthesizer or the transmitter synthesizer. Adjust the HP8447A amplifier and the WAVETEK attenuators on the receiver RF patch panel so that the test channel and reference channel input levels are approximately -10 dBm. Verify that all synthesizer MODULATION MODE switches are set to CW. Synchronize the Data-Chron clocks if necessary. Set the DECADE AND STEP SAMPLE SELECTION switches on the PCUs to the desired settings. Selection of 100 points per decade in the 2nd, 3rd, 4th and 5th decades is sufficient in most cases. Verify that the ENABLE switches are in the clockwise position. Set the PLOT FORMAT switch to the 'TFC' position. Set the STEP MODE switch to AUTO and the MEASUREMENT CYCLE switch to SINGLE. Set the HOLD switch OFF. If the Transmitter synthesizer is being used as the RF source, set the START MODE switch to REMOTE. If the Receiver synthesizer is used, set the START MODE switch to LOCAL. If in the Secondary configuration, install paper on the plotter and verify that the MFE tape unit is ready. Press the PLOT/INITIATE switch. The plotter will generate a TFC grid format if connected to the receiver. If in the Primary Configuration, enter 'TCAL' in response to the TEST/CAL> prompt of the Primary Menu (see 5-3.2). Start the PCU(s) using the Data-Chron clocks or START switch as required by the particular set up. The measurement system will now measure the "end-to-end" instrumentation calibration.

To perform an TCAL measurement, set up the instrumentation and measurement system as shown in Figure 26 but bypass the Fiber Optic system in the Reference Channel using a suitable

The RCAL measurement is the ratio of the Test Channel instrumentation effects to a constant RF level applied directly to the Reference Channel input of the Network Analyzer. The RCAL data is used to correct TFB, RFA, RFB and RFC test data for the effects of the Test Channel instrumentation. RCAL data is also used to correct the ambient noise measurement when operating in the Multi-Cycle Mode. Both RCAL and TCAL measurements are made with the 'PLOT FORMAT' thumbwheel set to 'TFC'.

When operating the measurement system in the Primary configuration, calibration data are passed to the Data Acquisition system where they are recorded. The calibration data are used to correct raw measurement data for the effects of instrumentation. When operating in the Primary configuration, the test channel and reference channel instrumentation may be of unequal electrical length provided that the total phase difference between them never exceeds 180 degrees. At 100 MHz, this corresponds to approximately 40 inches (102 cm) of RG-58 or RG-223 coaxial cable. The Data Acquisition System will store the calibration data and correct raw measurement data. If the test channel or reference channel instrumentation is changed after instrumentation calibration data have been stored by the Data Acquisition System, measurement can be performed provided that changes in gain/attenuation and instrumentation phase delays are known and entered into the primary menu. If these changes cannot be accounted for, a new instrumentation calibration measurement must be performed and stored before performing TFA or TFC measurements.

When operating in the Secondary configuration, no automatic correction of raw data for the effects of instrumentation is available. In this case, the electrical lengths of test channel and reference channel instrumentation must be well matched if accurate phase data is required. Calibration data in this case can be plotted and stored for future use. In addition, the operator must fill in a separate log form containing the information normally entered for the primary and secondary menus.

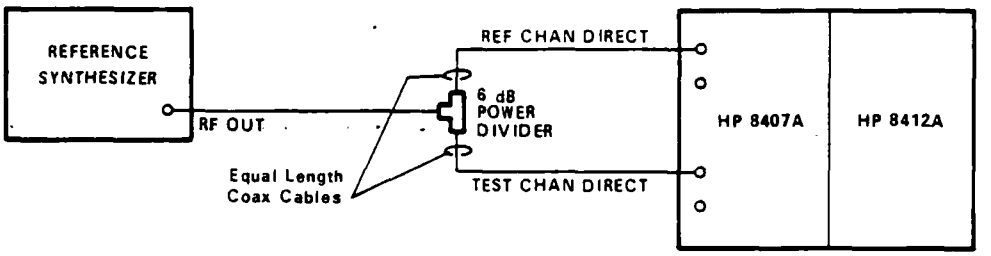


Figure 25. Network Analyzer Calibration Setup

input and verify the reading on the magnitude DVM of 0.00 volts then adjust the PHASE VERNIER control to obtain a reading of 0.0 volts on the phase DVM. The Network Analyzer is now zeroed and calibrated. If operating in the Primary configuration, adjust the DISPLAY REFERENCE CALIBRATION switches on the Network Analyzer so the 00 shows in the indicator windows. If operating in the Secondary configuration readjust the DISPLAY REFERENCE switches and the AMPLITUDE VERNIER control to obtain a reading of +2.00 volts on the magnitude DVM. Set the DISPLAY REFERENCE CALIBRATION switches so that 00 shows in the display windows.

4-2.4 "End-to-End" Instrumentation Calibration

"End-to-End" calibration measurements of the CW instrumentation must be performed prior to making test measurements. There are two calibration measurements that can be performed - TCAL (for transfer function calibration) and RCAL (for response function calibration). TCAL and RCAL calibration data are stored in separate data files by the Data Acquisition system when operating in the Primary configuration.

The TCAL measurement is the ratio of the Test Channel instrumentation effects to the Reference Channel instrumentation effects. Magnitude and phase data are measured and recorded in the TCAL measurement. The TCAL data stored by the Data Acquisition system is used to correct TFA, or TFC test data for the effects of instrumentation used in the Test and Reference Channels.

4-2.2 Operation in the Secondary Configuration

Install the measurement probes and instrumentation and adjust the attenuators and network analyzer controls and described in Paragraph 4-2.1. Load the plotter with a clean sheet of paper. If the MFE tape unit is being used, install a new tape cassette in the drive, depress 'LOAD POINT' and insure that the unit is ON LINE. Verify that the RECEIVE data indicating pushbutton is lit. If the RECEIVE data indicator is not lit, press the RECEIVE data pushbutton. This enables the MFE tape unit to accept measurement data from the receiver. Set the PCU front panel switches for the desired test conditions. Press the PLOT/INITIATE switch. Allow the plotter to complete grid generation activities before asserting the START switch. The magnitude component of the raw data will be plotted as the data is acquired. The phase component of the raw data will be plotted at the conclusion of the test cycle when appropriate. The MFE tape unit will record raw data in blocks of five measurement points for transfer function measurement functions and in blocks of seven data point measurements for response function measurements.

4-2.3 Network Analyzer Calibration

The Network Analyzer must be adjusted and calibrated prior to making measurements. Connect the Network Analyzer to the receiver Reference Synthesizer as shown in Figure 25. Set the Reference synthesizer controls for a 10 MHz, CW output with a level of -10 dBm. Set the VTO Synthesizer controls for a 210 MHz CW output at -10 dBm. Set the PCU PLOT FORMAT switch to the '000' position. Press the PLOT/INITIATE switch to place the Synthesizers and DVMs in local control mode. Adjust the DISPLAY REFERENCE switches and the AMPLITUDE VERNIER control on the Network Analyzer to obtain a reading of 0.00 volts on the amplitude DVM. Move the test channel cable to the attenuated input and adjust the AMPLITUDE CALIBRATION control on the 8412A phase magnitude display to obtain a reading of -2.00 volts on the magnitude DVM. Replace the test channel cable to the direct

automatically start the next cycle. However, if the HOLD switch is on, the PCUs must be manually restarted using the Data-Chron clocks.

In the single cycle test mode, the receiver and transmitter subsystems perform a cycle 2 measurement.

The synthesizers and Digital Voltmeters, normally under control of the PCUs, can be released from PCU control by setting the PLOT FORMAT switch to '000' and asserting the PLOT/INITIATE switch. When released from the control of the PCU, these instruments function is accordance with their front panel control settings. This mode of operation is useful for initial system setup and checkout. Pressing the RESET switch will restore the instruments to PCU remote control.

4-2 RECEIVER OPERATION AND CALIBRATION

4-2.1 Operation in the Primary Configuration

In the Primary configuration, measurement data is passed asynchronously from the Receiver Subsystem to the Data Acquisition Subsystem. To operate the receiver in the primary Configuration, place the measurement probes at the test points of interest and route the fiber optic data links or coaxial cable instrumentation from the test probes to the Receiver Subsystem. Connect the instrumentation to the measurement probes and to the Network Analyzer input via the RF Patch Panel. Adjust the reference channel and test channel attenuators and amplifier so that the reference channel and test channel signals are within the range of the Network Analyzer. Adjust the DISPLAY REFERENCE switches on the Network Analyzer to place the measurement within the 80 dB dynamic range of the Network Analyzer. Refer to Hewlett Packard Application Note 121-1, "Network Analysis With The HP8407A," for detailed information on performing measure- ments with the 8407A Network Analyzer. Set the PCU Front Panel switches for the desired test conditions (e.g., DECADE AND STEP SAMPLE SELECTION, PLOT FORMAT, and MEASUREMENT CYCLE switches) and press the PLOT/INITIATE switch. Pressing the START switch will commence the measurement cycle.

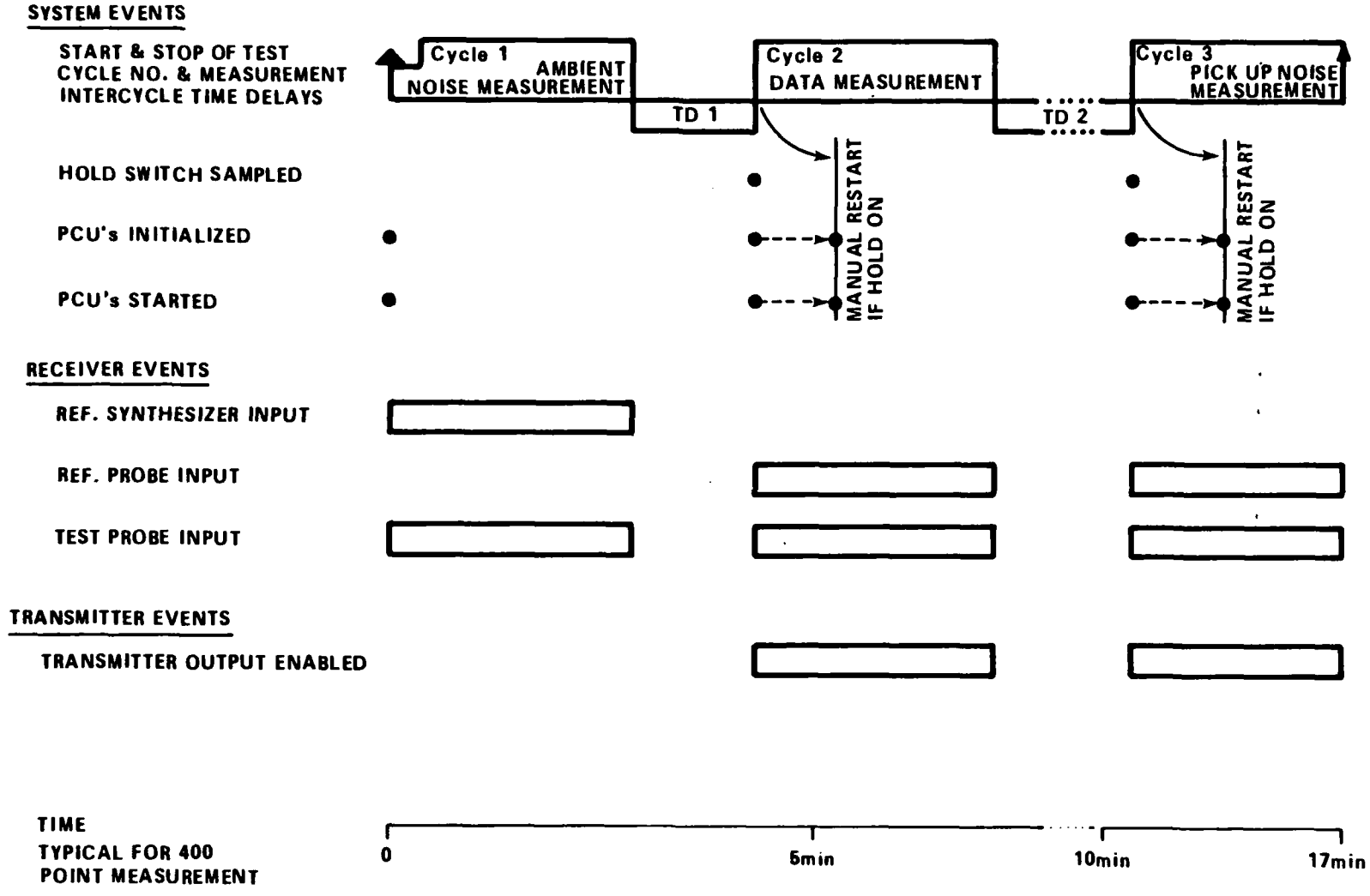


Figure 24. Multi Cycle PCU Operation

queries must be answered before acquiring data. Data acquisition is started by depressing the PCU start switch. When starting the PCU in the Remote Start mode, the START switch must be depressed before the PCU can accept a start pulse from the Data-Chron clock. The PCU will start at the time preset into the Data-Chron clock. If the Manual Step mode is selected, each start pulse, whether from the START switch or the Data-Chron clock, will cause the PCU to execute one data point cycle. Note that the first data point cycle occurs with the second start pulse.

Placing the MEASUREMENT CYCLE switch in the 'MULTI' position causes the PCU to perform three successive measurement cycles. Time delays may be incorporated between the end of cycle 1 and the beginning of cycle 2 and between the end of cycle 2 and the beginning of cycle 3. The time delays are independent and can be varied to meet the needs of a particular test. The time delay values may be changed by reprogramming the Amplitude Control EPROM (see Paragraph 6-4). The time delay values are stored in the EPROM in unit of seconds. A minimum of 5 seconds is required for each time delay to insure proper PCU operation. Figure 24 shows the sequence of events in a multi-cycle test. During cycle 1, the receiver coaxial relay connects the output of the Reference Synthesizer to the reference input of the Network Analyzer. The transmitter coaxial relay connects the output of the Reference Synthesizer to the reference input of the Network Anlyzer. The transmitter coaxial relay disconnects the Transmitter Synthesizer output from the Power Amplifier input. During cycles 2 and 3, the receiver coaxial relay connects the reference probe output to the reference channel input of the Network Analyzer. The transmitter coaxial relay connects the transmitter synthesizer output to the power amplifier input.

The HOLD switch may be used in the multi-cycle test mode to extend the intercycle delay time. The HOLD switch status is determined by the PCU at the end of the time delay intervals. If the HOLD switch is off, the PCU will

necessary, the software will be modified to include these additions.

4-3 TRANSMITTER OPERATION AND CALIBRATION

4-3.1 Basic Transmitter Operation

Since the Transmitter subsystem is a subset of the Receiver subsystem, operation of the Transmitter is essentially identical to the Receiver except there is no measurement instrumentation in the Transmitter. When the Transmitter is operated synchronously with the Receiver, the Transmitter and Receiver PCU switch settings must be identical. In addition, the Delete Frequency and Amplitude Control EPROMs installed in the PCUs must be programmed to the same values. Operation of the Transmitter PCU is the same as the Receiver PCU.

4-3.2 Transmitter Calibration

The output level of the Transmitter synthesizer can be controlled to vary with frequency by programming the Amplitude Control EPROM and installing the EPROM in the PCU. Variations in the antenna field strength with frequency can be compensated to provide a more uniform field level by measuring the antenna's response and using the response data to program the Amplitude Control EPROM with the inverse of the antenna response curve.

To measure the antenna response as a function of frequency, set up the Measurement System as shown in Figure 30 with the Receiver in the Secondary configuration. In both PCUs, install Amplitude Control EPROMs that have been programmed for uniform output level of the Transmitter synthesizer. Set the PCU switches for a TFB, single cycle measurement. Set the DECADE and STEP SAMPLE SELECTION switches to provide the necessary resolution. More sample points will be required in the higher decades than in the lower decades. Perform the Antenna Response measurement, plotting the results. The resulting data can be used to program an Amplitude Control EPROM that will compensate for antenna responses and maintain a uniform field.

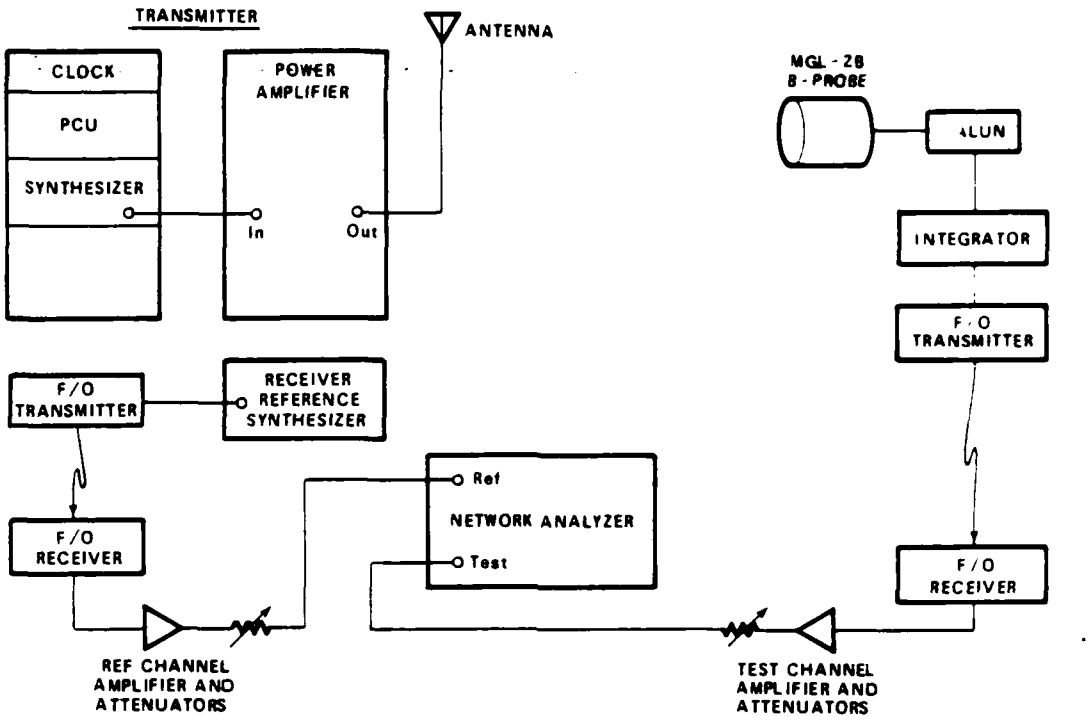


Figure 30. Antenna Response Test Setup

Note that the inverse of the antenna response curve can be plotted directly by simply interchanging the TEST and REFERENCE channel inputs shown in Figure 30 at the Network Analyzer. The resulting plot will be the shape of the required compensation curve required to level the antenna's field response as a function of frequency.

4-3.3 Reference Sensor Response Function Measurement

The reference sensor response function is the ratio of the reference sensor output to a constant over the frequency range of interest. This data is saved in an analyst-compatible file and used to calculate the signal-to-noise ratio during data acquisition.

To measure the reference sensor response curve, set the CW system up as shown in Figure 30A, with the receiver in the primary configuration. In both PCUs, install the same amplitude control PROMs that will be used during data acquisition. Set the PCU switches for a single-cycle 'RFA' measurement. Set the DECADE and STEP SAMPLE SELECTOR switches for the required resolution. If an amplitude control EPROM is to be generated, set the transmitter gain control to maximum. Acquire the reference sensor response data as described in Section 5, Test Procedures. Answer the primary menu entries as follows:

TEST/CAL> 'RFSN'
SIGNAL PROBE> enter the reference sensor cal file ID
REFERENCE PROBE> 'SYN'
TEST POINT ID> n/a
DATA FILE ID> data tape number
REFERENCE GAIN ADDED> -10
SIGNAL GAIN ADDED> as appropriate
SIGNAL DELAY ADDED> 0
REFERENCE DELAY ADDED> 0
NETWORK ANALYZER DISPLAY REFERENCE> as appropriate

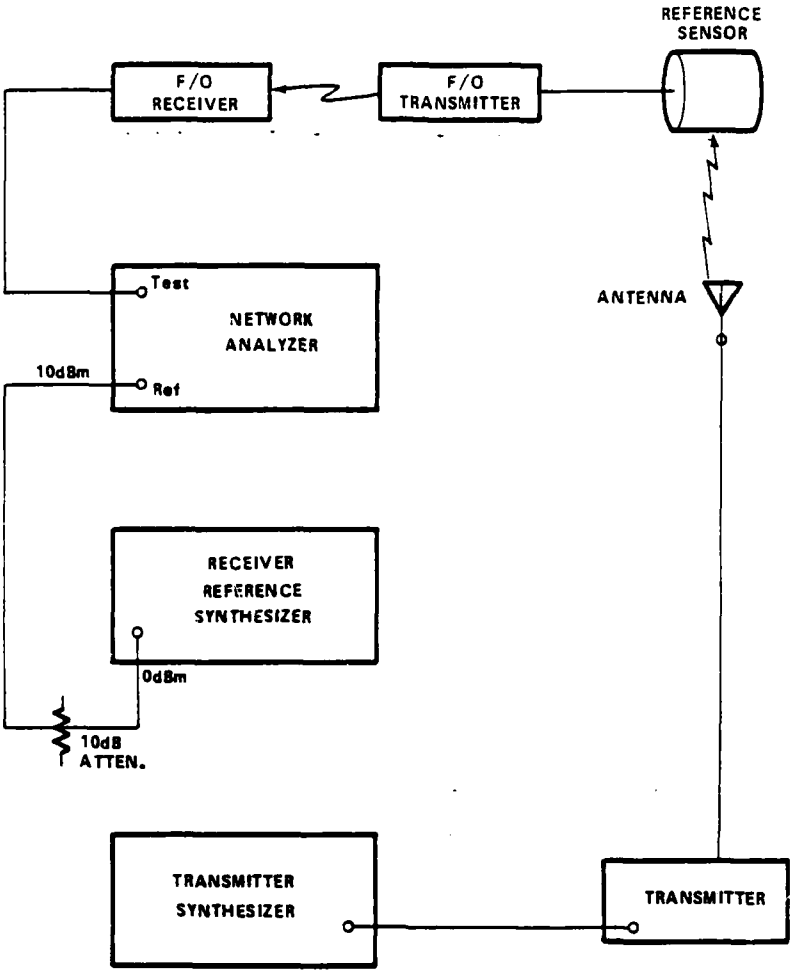


Figure 30A. Reference Sensor Response Setup

SECTION 5
TEST PROCEDURES

5-1 SYSTEM CONFIGURATION FOR TESTING

To acquire data using the complete system, the components should be configured in the "Test Configuration" as described in Paragraph 3-2.2.1. Sensors to be used should have been calibrated and calibrations should be stored as described in Paragraph 4-2. The system cals should already have been acquired and stored as described in Paragraph 4-2.3. If desired, connect the spare MFE5450 cassette drive to the PCU input connection port in the back of the PDP-11 and run the Integrity test as described in Section 7, and reconnect the PCU when completed. (Note: this is not necessary, but can be done if there are any questions about system performance and should be done after moving the PDP-11).

5-2 TRANSFER FUNCTION TESTING

The Measurement System electronics setup is diagrammed in Figure 16. The PCU Plot format selector should be set to TFA, TFB, or TFC on both receiver and transmitter PCUs. The TFA setting acquires transfer function data and generates an inverse Fourier transform. The TFB setting is identical to the TFA setting except that phase data and the inverse transform are suppressed. TFC is used to measure test circuit driving point impedance, and to do calibrations.

5-2.1 Response Function Testing

Response function tests are done by rotating the PCU Plot format switch on the receiver and transmitter PCUs to RFA, RFB, or RFC. In the backup configuration (with the PDP-11 out of the system, see Paragraph 3-2.2.2) the RFA setting causes plots to be plotted on the upper half of the plot page, RFB causes plotting on the lower half, and RFC causes plotting on the entire page. In the primary configuration, RFA, RFB and RFC

settings all cause the phase portion of the plot to be suppressed.

5-2.2 Receiver - Transmitter Synchronization

To synchronize the PCUs, the "Command Link" is used. This Command Link consists of the two Data-Chron clocks and the synchronizer logic boards in the PCUs. To synchronize the clocks, connect jack 'J201' on the back of the receiver PCU clock to jack 'J203' on the transmitter PCU clock. These connections are made using a cable. Set a "synchronization time" on the thumbwheels of both receiver and transmitter PCUs. This synchronization time is the time of day at which both clocks will be set. On the transmitter PCU, press the Stop switch, then the 'LOAD' pushbutton. The LED display on the transmitter PCU should read out the synchronization time, but should not be counting. The transmitter is ready for synchronization. On the receiver PCU, press the 'ARM' pushbutton and observe that the ARM LED is on, and the LED time display is running. When the receiver time counter (the LED display) reaches the synchronization time, a pulse is sent from receiver 'J201' to transmitter 'J203' starting the transmitted LED time display and extinguishing the receiver PCUs 'ARM' LED. Observe that both displays are in sync. Disconnect the cable between 'J201' and 'J203'. Reconnect the coax cable from the receiver PCU to J201 on the receiver PCU clock.

To start a test using the Data-Chron clocks, set the start time on the thumbwheels on both receiver and transmitter PCUs, and press the 'ARM' pushbuttons. Also, insure that the 'START MODE' switch is in the 'REMOTE' position and the 'STEP MODE' switch is in the 'AUTO' position on both PCUs. Press 'PLOT INITIATE' and 'START' on both PCUs. When the start time is reached, the test will begin automatically.

5-2.3 Frequency Deletion

Should frequency deletion be required for a test, a frequency deletion EPROM must be placed in each of the PCUs.

This EPROM (one for the transmitter, and an identical one for the receiver) is programmed by the frequency deletion stand alone program in the PDP-11 using the PROLOG EPROM programmer. See Section 6-3 for details of this program. Once the EPROM is programmed, remove power from the PCU, then carefully remove the EPROM occupying ROM socket A22 on the top board of the PCU logic chassis and insert the frequency deletion EPROM in its place. The PCU may then be powered up. This will cause the deleted frequencies to be skipped during a frequency sweep.

The output level EPROM is installed in a similar fashion, except that socket A23 is used instead of socket A22. See Paragraph 6-4 for details of the PDP-11 output level EPROM program. An output level EPROM must be installed in each PCU.

5-3 DATA ACQUISITION SYSTEM

5-3.1 Starting the PDP-11 and Data Acquisition Software

Starting of the PDP-11 is explained explicitly in Paragraph 3-2.1.1 of this manual. The general procedure is as follows:

- Be sure computer and peripherals are plugged into appropriate power.
- Turn on the peripheral devices (Terminal, Plotter, cassette recorder, prom programmers, etc.).
- Be sure proper breakers are switched on. (Power distribution panels, CPU and disk drives.)
- Turn on CPU front panel switch by turning to "DC ON".
- When the "LOAD" light turns on, install the disk labeled CWMS OPERATIONAL SYSTEM into drive 0 (DL0:). Push the "LOAD" button.
- Install the disk labeled CWMS DATA PACK into drive 1 (DL1:). Push the "LOAD" button.
- When prompted for line frequency, enter 50 or 60 as appropriate. (Note: If 60 Hz is required, only a <CR> is necessary.)

- Type in the date and time when requested. Enter them in the format: HH:MN DD-MMM-YY<CR>.
- The operating system will go through a start-up sequence.
- When prompted, enter the mission filename. From 1 to 9 characters should be entered. The file extension (.MIS) will be automatically appended to the input string. If the requested mission file does not exist, a new mission file will be created. After each completed measurement, an entry containing nine menu files will be made in the mission file. The mission file can be listed to the terminal using the MIS program (Section 8-15).

Now the PDP-11 is started, booted and the disks are mounted and ready for use.

To begin the data acquisition, type @UP <CR>.

The procedures in this section must be completed prior to the beginning of a test or calibration sequence to ensure proper synchronization of the data acquisition system and the measurement system.

The system can, if necessary, be run with only one disk functioning, although no classified data can be acquired in a single disk configuration. To use the system in a single disk configuration, mount the CWMS OPERATIONAL SYSTEM disk pack into the one drive to be used. Place the '0' command button in the ready light socket of the unused drive (see Paragraph 2-3.1.2 for details on the RL01 drives). Boot the system as directed above. When the '@<EOF>' message appears, enter

@1DISK <CR>

and wait for another '@<EOF>' message. The system is now configured for one disk operation. This must be done each time the system is booted and a single-disk configuration is desired. Classified data must not be taken in this configuration as the data will be written onto the system disk. De-classification will subsequently wipe out all data, as well as the system software.

To return to dual disk operation after configuration in single disk operation, boot the system and, once the '@<EOF>' appears, enter

@2DISK <CR>

and wait for the '@<EOF>' message.

5-3.2 Operator/Machine Interface

Once the system is started and the "@UP" command given, the test can begin. Wait for the "@<EOF>" message on the CRT, then depress the 'PLOT INITIATE' switch on the Receiver PCU front panel. If there are no ODLs to set up, the 'START' switch may then be pressed. Otherwise, wait until all the desired ODL transmitter lights have been turned on. When this is done the CRT will prompt for the types of plots to be overlaid on the CRT. The prompts are conditional upon the type of test being done. Some tests can only have one type of plot (the response function tests, for example). The program will prompt:

ANSWER IF PLOT IS TO BE DISPLAYED (Y/N)

followed by the possible types of plots which can be overlaid in this test. The prompts are:

AMBIENT NOISE>
PICKUP NOISE>
AMPLITUDE>
PHASE>
S/N RATIO>

The CRT waits for the character "Y" followed by a carriage return (<CR>) if the plot is desired. Any other character (including just the <CR>) is considered to be a negative response and the corresponding plot is suppressed.

Once the types of plots to be generated are determined, the menu entries must be generated. The "menu" in this context consists of information needed to acquire and process the raw data, or comments and descriptions about the test. There are three types of menus - the "OLD" menu consisting of the data link setup information, the "primary" menu consisting of data which is necessary for processing the data into its final form;

and the "secondary" menu, which consists of descriptions of the test. For each menu, the current contents of the menu are displayed in full, followed by the prompt:

ARE THE MENU ENTRIES CORRECT (Y/N)>

Again the CRT waits for a response. A 'Y' followd by a <CR> indicates an affirmative response, and all other responses are considered negative. If an affirmative response to the prompt is given, the entries are considered correct. If a negative response is given, the system prompts for the menu entries one at a time for corrections. If the entry prompted for is not to be changed, enter a <CR> in response to the prompt. If the entry is to be changed, enter the correction followed by a <CR> When all the entries have been prompted for, the CRT will again display all entries and prompt:

ARE THE MENU ENTRIES CORRECT (Y/N)>

This sequence will continue for each menu until the above question is answered 'Y'. This allows for corrections to the menu until the operator is satisfied. If no data ODLs are included in the system or none are turned on, the ODL menu will not be given. After the ODL menu has been approved, processing will halt for about five seconds while the ODL-5Bs are automatically setup. The menu entries and their descriptions follow:

ODL MENU ENTRIES

DATA ODL:

This determines which ODL-5B is set up to transfer data. Enter 1, 2, 3, or 4 for the desired ODL.

ODL CHANNEL/CAL:

This prompt allows the operator to select the data path. An "A" will transmit data along the normal, that is, without the use of the balun or integrator, configured into the ODL-5B transmitter. A "B" will cause the ODL-5B to transmit data via the B channel which is the normal data path with the Balun configured

into it. "C" causes the ODL-5B to transmit its calibration.

ODL ATTENUATION:
This entry sets the ODL-5B transmitter's remote attenuator. The attenuator setting can be from 0 to 79 dB.

DATA INTEGRATOR:
This entry controls the placement of the integrator into or out of the data path. Selecting the integrator is independent of whether channel A or B is selected. Enter IN if the integrator should be placed into the data path. Enter OT if the integrator should be out of the data path.

DATA VIN=0:
This entry connects the transmitter input to a 50-ohm termination and removes the integrator from the data path. If a noise shot is desired, enter Y to set VIN=0. Enter N to set up the ODL for taking data on the desired channel.

REFERENCE ODL:
If the reference ODL-5B is to be used to acquire reference data, this entry should be Y, otherwise it should be N.

REFERENCE CHANNEL/CAL:
This entry can be either A, B, or C. See the above discussion on ODL CHANNEL/CAL.

REFERENCE ATTENUATION:
This entry sets the attenuation for the referenced ODL-5B transmitter. It can be between 0 and 79 dB.

REFERENCE INTEGRATOR:
This entry controls the placement of the integrator in the reference ODL-5B data path. See the above discussion on ODL ATTENUATION.

REFERENCE VIN=0:
This entry sets Vin=0 on the reference ODL-5B. See the above discussion on DATA VIN=0.

VHF SWITCH A:
This entry controls which of the four switches is selected on channel A of the VHF SWITCH. Enter 1, 2, 3, or 4 for the desired switch. If channel A isn't desired, enter 0.

VHF SWITCH B:
This entry controls which of the four switches is selected on channel B of the VHF switch. Enter 1, 2, 3 or 4 to select or enter 0 if channel B isn't used.

All ODL menu entries are a maximum of two characters long.

PRIMARY MENU ENTRIES

TEST/CAL>
This determines the type of measurement; system calibration, probe calibration or test measurement. If this is a system response function calibration, enter 'RCAL'; enter 'TCAL' for a system transfer function calibration (see Paragraph 4-2.4); enter 'PCAL' for a nonanalytic probe cal (see Paragraphs 4-2.5 and 4-2.6); 'TEST' indicates that a test measurement is to be done.

SIGNAL PROBE>
This prompt appears only if the TEST/CAL prompt was not answered with 'RCAL' or 'TCAL'. This entry identifies the probe used in the signal channel, or the probe

being calibrated if the TEST/CAL prompt was answered with 'PCAL'. Only the first nine characters of the name are inspected. The name must contain only alphanumeric characters; special characters are not allowed. If this is a test measurement, the file containing the probe information is accessed. If this access fails, a message indicating that the probe is uncalibrated will be displayed, and the prompt will be re-issued until the identifier of a calibrated probe is entered.

REFERENCE PROBE>

This prompt appears if the TEST/CAL prompt was not answered with 'TCAL', 'RCAL', or 'PCAL'. This entry identifies the probe used in the reference channel. Only the first nine characters of this name are inspected, and only alphanumeric characters are allowed. If there is no reference probe (that is, if the RF from the synthesizer is driving the reference channel directly), enter 'SYN' in response to the prompt. This entry is checked for validity the same way the SIGNAL PROBE prompt is.

TEST POINT ID>

This is the name or code given by the test engineer to the test point. It is meaningless for calibrations.

DATA TAPE NO.>

This identifies the tape which will contain the data from the test. The entry should be a four-digit number. Leading zeroes are required, i.e., 0014.

INPUT WAVEFORM ID>

This prompt appears only if the PLOT FORMAT thumbwheel is set to 'TFA' (or 'XXX' and the previous setting was 'TFA') when the 'PLOT INITIATE' switch was pressed.

This entry contains the filename of the threat waveform to be used in generating the inverse Fourier transform. Only the first nine characters entered are used. This entry is checked for validity in the same way as entries made in response to the SIGNAL PROBE prompt.

REFERENCE GAIN ADDED (DB)>
This entry contains the gain added to the reference channel in dB. Attenuation is considered to be a negative gain.

SIGNAL GAIN ADDED (DB)>
This entry contains the gain added to the signal channel in dB. Attenuation is considered to be a negative gain.

SIGNAL DELAY ADDED (NS)>
This entry contains any delay added to the signal channel in nS after the system was calibrated.

REFERENCE DELAY ADDED (NS)>
This entry contains any delay added to the reference channel in nS after the system was calibrated.

NETWORK ANALYZER DISPLAY REFERENCE (DB)>
This entry corresponds to the "DISPLAY REFERENCE" slider switch found on the front panel of network analyzer of the receiver PCU after the system was calibrated. (See Paragraph 4-2.3 for a description of calibrating this control.)

TRANSFER FUNCTION SCALING, X-AXIS IN USEC>
This prompt appears only if the 'PLOT FORMAT' thumbwheel is set to 'TFA' (or 'XXX', if the previous setting was 'TFA'). This entry allows the operator to enter the highest value of the time base in

represents the ratio of the signal at the reference sensor (S_R) to a constant reference (K_1). Then, (in dBm)

$$A_3 + A_1 - A_2 = (S_t - S_R) + (S_R - K_1) - (S_n - K_2)$$
$$= S_t - S_n - K_1 + K_2$$

What is wanted is $S_t - S_n$.

$$S_t - S_n = A_3 + A_1 - A_2 + K_1 - K_2$$

This is the signal-to-noise data that is calculated and plotted. A_2 and A_3 are the corrected ambient noise and test data. K_1 is the reference gain when the reference sensor response function cal file is generated, and K_2 is the reference gain when the multi-cycle test is run.

During the multi-cycle test, the maximum and minimum signal-to-noise ratios and their associated frequencies are displayed on the operator's terminal. This is done before the operator is prompted for comments, so that appropriate mentions can be made if desired.

The signal-to-noise ratio is always plotted. It is a magnitude-only plot, and is spooled before the test data plot. The signal-to-noise data may optionally be saved in an analyst-compatible file on the data disk or on tape. The filename will be the same as the test data file (i.e., the test facility code, sequence number and Julian date). The extension will be the same as the test data except that the last letter will be one before the last letter of the test data extension, i.e., if the signal-to-noise file extension is 'CMA' then the test data extension will be 'CMB'.

5-3.5 Recording Data Onto Cassette

To record data from the PDP-11 during a test, the recorder should be connected to the CPU as described in Paragraph 3-2.2.1. The cassette is loaded into the drive with the 'open' side (where the tape is) facing toward the top. The tape should be initialized (see Paragraph 6-5) with the tape number entered in the primary menu file. Make sure the write

09:36:10 24-JUN-82		MINIMUM FREQUENCY	1.00000E+05	SIGNAL PROBE ID	FLAT
TEST SEQUENCE #	0002	MINIMUM MAGNITUDE	-6.26000E+00	SIG GAIN ADDED(DB)	-40
TEST LOCATION	ALAMO	MINIMUM PHASE	0.00000E-01	SIG DELAY ADDED(NS)	0
TEST POINT	SOME FILTER	MAXIMUM FREQUENCY	9.12000E+07	REF PROBE ID	FLAT1
TEST TYPE	TEST	MAXIMUM MAGNITUDE	5.00200E+01	REF GAIN ADDED(DB)	-10
TEST DESCRIPTION	SNR TEST	MAXIMUM PHASE	0.00000E-01	REF DELAY ADDED(NS)	0
TEST ENGINEER	ARCHIE	PARSEVAL TIME VALUE		INPUT WAVEFORM ID	BUTTERWTH
TEST ELEMENT	PATIENCE	PARSEVAL FREQ VALUE		INPUT WAVEFORM SCALE	1.
NET ANAL DISP REF	-40	PARSEVAL RATIO		MULTI/SINGLE	MULTI
LOG ID				TAPE FILE ID	0101X0002175
PLOT FORMAT	TFA	T.F. CAL FILE ID	0100	R.F. CAL FILE ID	0100
PHASE UNWRAP DELAY					
MINIMUM SNR (DB)	-6.26000E+00	MIN S/N FREQ (MHZ)	7.58600E+01	FUNCTION CODE/DATE	ONL24-JUN-82
MAXIMUM SNR (DB)	5.00200E+01	MAX S/N FREQ (MHZ)	1.73800E-01		
TEST COMMENTS	MULTICYCLE TEST TEST				

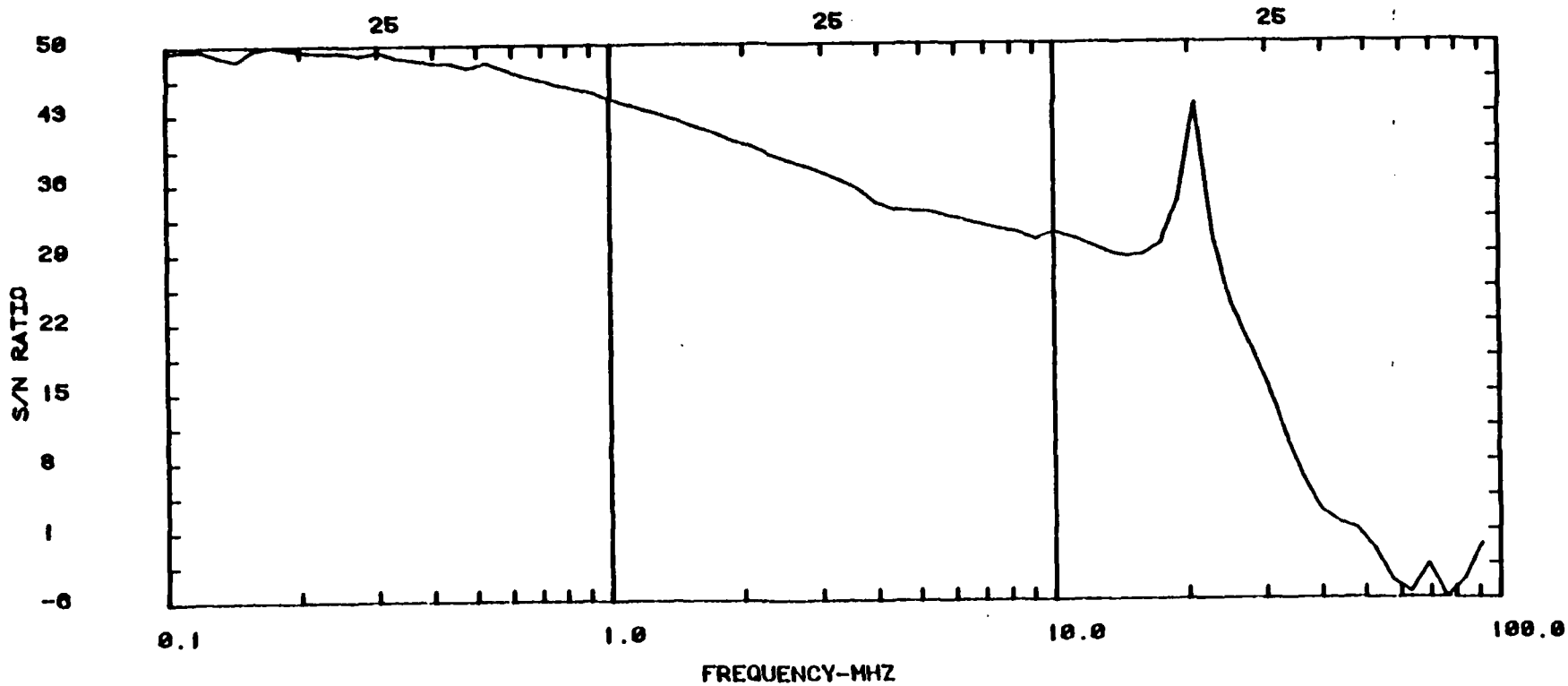


Figure 35. Signal-to-Noise Ratio Plot

16:15:38 10-JUN-82		MINIMUM FREQUENCY	1.00000E+07	SIGNAL PROBE ID	TSTPR
TEST SEQUENCE #	0001	MINIMUM MAGNITUDE	-1.26600E+01	SIG GAIN ADDED(DB)	-10
TEST LOCATION	E G & G	MINIMUM PHASE	-1.53000E+02	SIG DELAY ADDED(NS)	0
TEST POINT	EGG CP	MAXIMUM FREQUENCY	9.12000E+07	REF PROBE ID	SYN
TEST TYPE	TEST	MAXIMUM MAGNITUDE	-3.46000E+00	REF GAIN ADDED(DB)	0
TEST DESCRIPTION	TEST	MAXIMUM PHASE	1.48100E+02	REF DELAY ADDED(NS)	0
TEST ENGINEER	M & M MOUSE	PARSEVAL TIME VALUE		INPUT WAVEFORM ID	BUTTERWTH
TEST ELEMENT	GOLD	PARSEVAL FREQ VALUE		INPUT WAVEFORM SCALE	1.
NET ANAL DISP REF	-40	PARSEVAL RATIO		MULTI/SINGLE	SINGLE
LOG ID	REDWOOD			TAPE FILE ID	0100E0001161
PLOT FORMAT	TFC	T.F. CAL FILE ID	0100	R.F. CAL FILE ID	0100
PHASE UNWRAP DELAY					
				FUNCTION CODE/DATE	ONL10-JUN-82

TEST COMMENTS TFC TEST PLOT

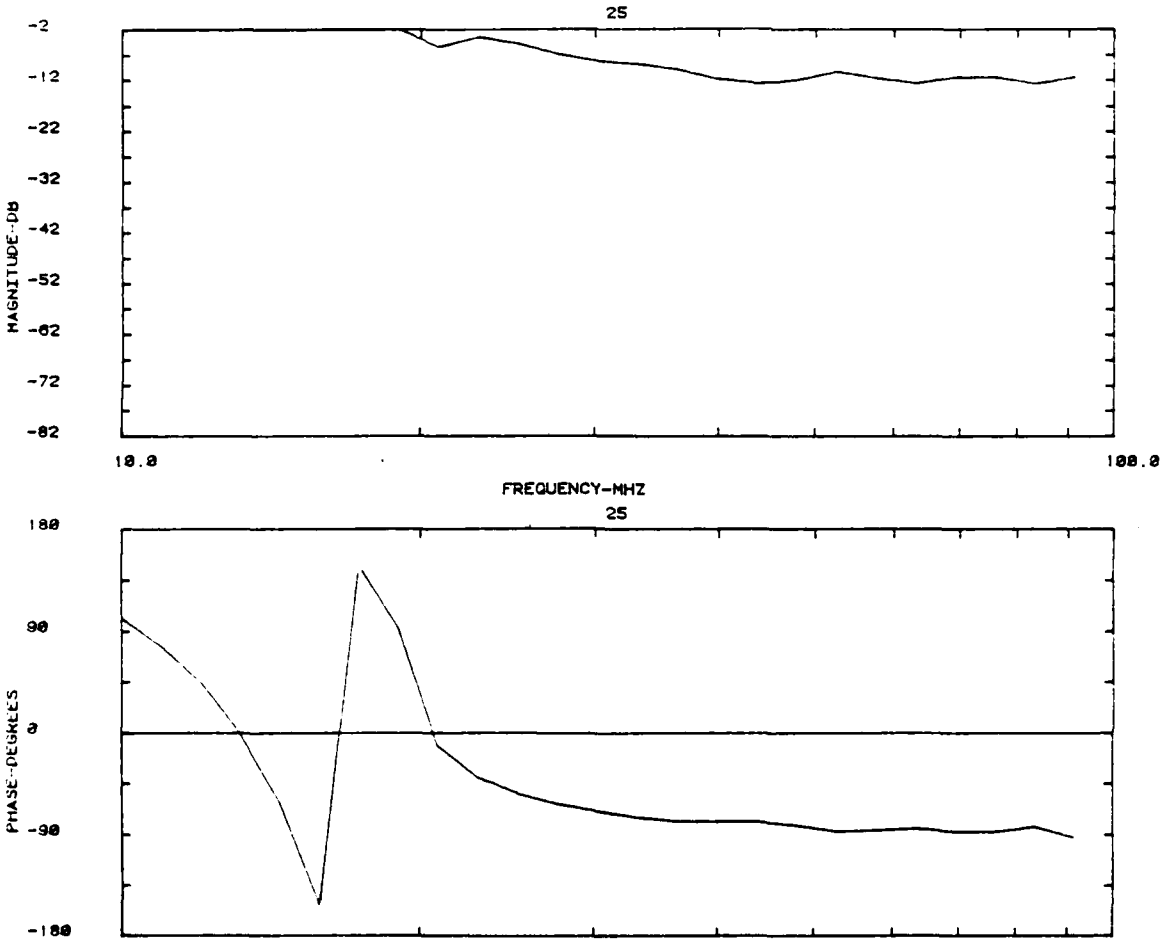


Figure 34. Hard-Copy Plot - Amplitude and Phase Grids (TFC Measurements)

16:14:26 10-JUN-82		MINIMUM FREQUENCY	1.00000E+07	SIGNAL PROBE ID	TSTPR
TEST SEQUENCE #	0001	MINIMUM MAGNITUDE	-1.26400E+01	SIG GAIN ADDED(DB)	-10
TEST LOCATION	E G & G	MINIMUM PHASE	0.00000E-01	SIG DELAY ADDED(NS)	0
TEST POINT	EGG CP	MAXIMUM FREQUENCY	9.12000E+07	REF PROBE ID	SYN
TEST TYPE	TEST	MAXIMUM MAGNITUDE	-3.44000E+00	REF GAIN ADDED(DB)	0
TEST DESCRIPTION	TEST	MAXIMUM PHASE	0.00000E-01	REF DELAY ADDED(NS)	0
TEST ENGINEER	M & M MOUSE	PARSEVAL TIME VALUE		INPUT WAVEFORM ID	BUTTERWTH
TEST ELEMENT	GOLD	PARSEVAL FREQ VALUE		INPUT WAVEFORM SCALE	1.
NET ANAL DISP REF	-40	PARSEVAL RATIO		MULTI/SINGLE	SINGLE
LOG ID	REDWOOD			TAPE FILE ID	0100E0001161
PLOT FORMAT	TFB	T.F. CAL FILE ID	0100	R.F. CAL FILE ID	0100
PHASE UNWRAP DELAY					
				FUNCTION CODE/DATE	ONL10-JUN-82
TEST COMMENTS	TFB TEST PLOT				

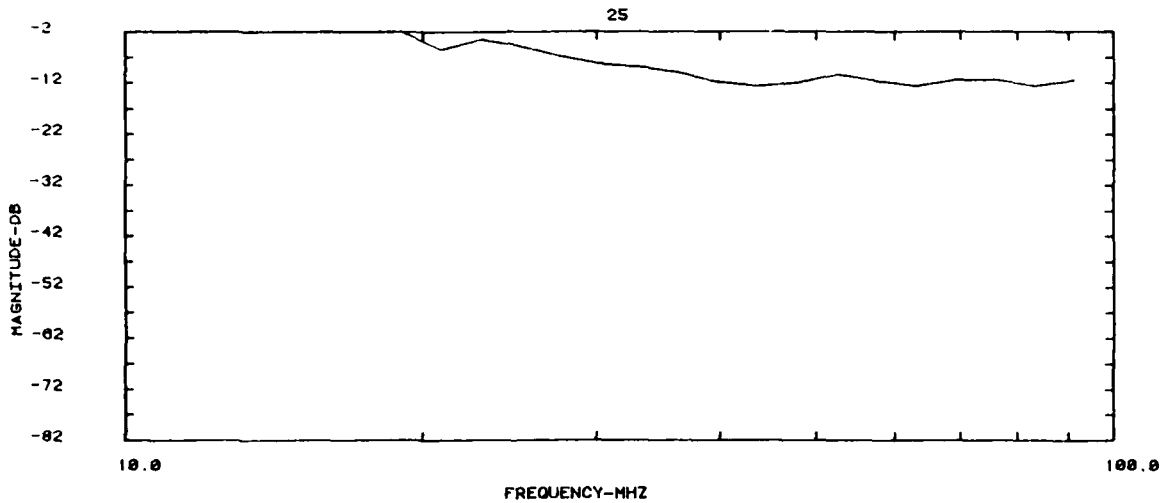


Figure 33. Hard-Copy Plot - Amplitude Grid Only
(RF Measurements, TFB Measurements)

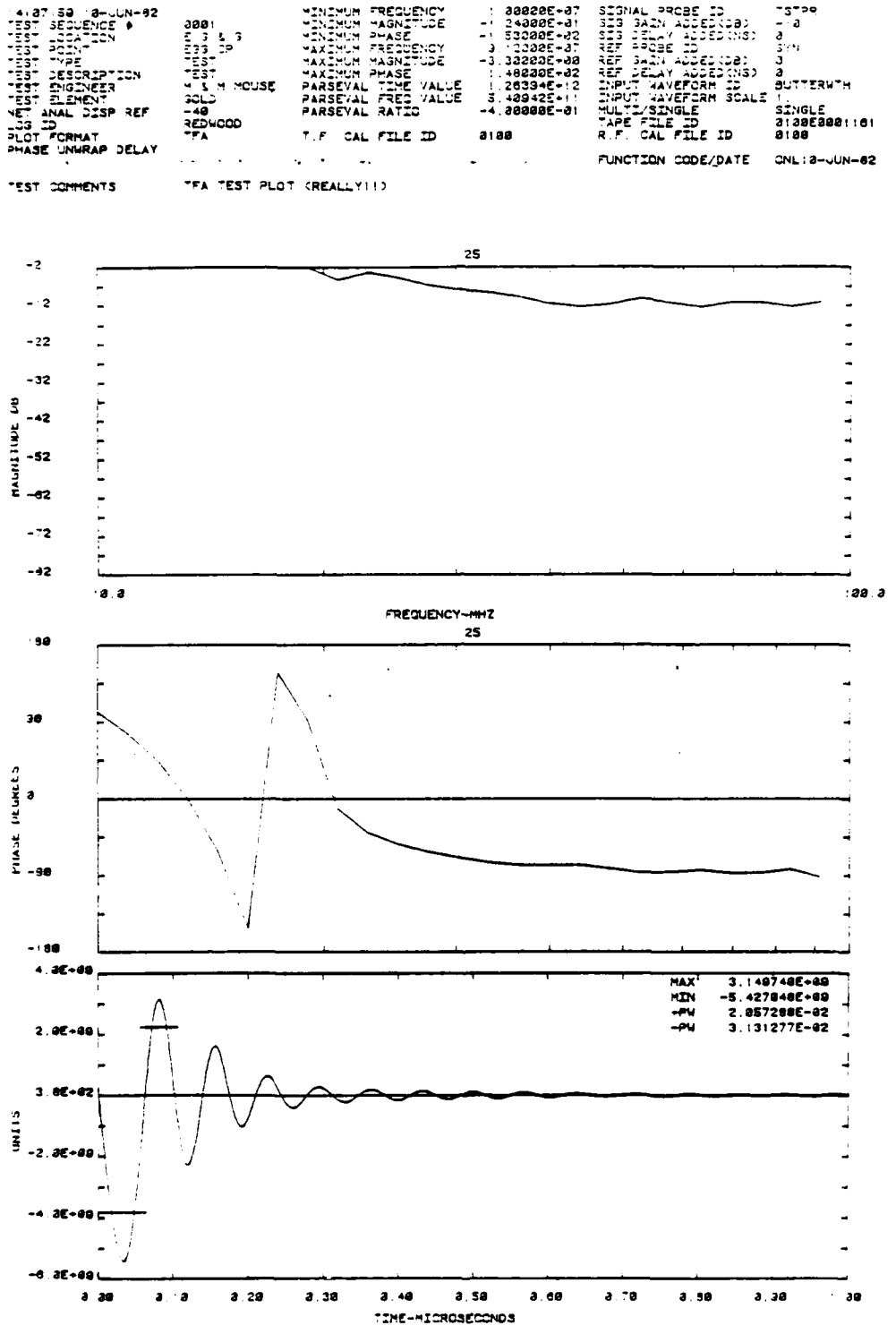


Figure 32. Hard-Copy Plot - Phase, Amplitude and Time Domain Grids (TFA Measurements)

Next, the operator must ensure that the plotter boundaries are set correctly for the page size. This can be done as follows:

- Press LOCATE UPPER RIGHT. The pen will move to its present upper right setpoint.
- If the boundary point is not at the proper location, use the joystick to position the pen to the proper upper-right boundary. Then press and hold the SET UPPER RIGHT button for about one second.
- Press LOCATE LOWER LEFT. The pen will move to its present lower-left setpoint.
- If the boundary point is not at the proper location, use the joystick to position the pen to the proper lower-left boundary. Then press and hold the SET UPPER LEFT button for about one second.

From this point the plotter is upgraded by program control. Make sure the plotter address switches are properly configured, as shown in Table 6.

Figures 32, 33, and 34 are examples of what the hard copy plots will look like.

5-3.4.3 Signal-to-Noise Ratio Plots - The signal-to-noise ratio plot (see Figure 35) is generated whenever a multi-cycle test is done. The plot indicates the magnitude, in dB, of the test data above the ambient noise, corrected by the reference sensor response function.

The procedure is as follows:

The test data (A_3) represents the ratio of the signal at the instrumentation probe (S_t) to the signal at the reference sensor (S_R). The ambient noise data (A_2) represents the ratio of the ambient noise at the instrumentation probe (S_n) to a constant reference (K_2). What is wanted is the ratio of the signal at the instrumentation probe to the ambient noise at the instrumentation probe. In order to retrieve S_t from A_3, the reference probe response function (A_2) is characterized (for the test configuration) and stored in a file (RFSNS.CAL). This

pen will move to the upper-right corner of the platen.

- To load the paper, depress the LOAD button. The pen will raise and move to the LOAD position, and the electrostatic paper hold-down will be disengaged. Carefully lift the pen holder to the 45 or 90 degree detent position.
- Remove any paper in the plotter. Position a new sheet of paper (11" x 17") on the platen. The bottom edge of the paper should lie evenly along the paper guide.
- Release the LOAD button. If "bubbles" appear between the paper and the platen, smooth the paper across the surface with your hand.
- Lower the pen to the "ready to plot" position.

If at any time it is necessary to install a new pen, use the following procedure.

- Press the LOAD button.
- Manually lift the pen holder to the 45 or 90 detent position to avoid accidentally marking on the plotting surface.
- Remove the pen by turning it one-quarter turn counterclockwise. This will align the tabs on the pen with the slots on the pen holder and the pen may be removed. Place the pen cap over the tip for storage.
- Align the tabs on the new pen with the slots on the pen holder and install the pen in the holder. Turn the pen one-quarter turn clockwise to lock it into place.
- Ready the pen for plotting by removing the protective cap and lowering the pen into the "ready to plot" position.
- Release the LOAD button.

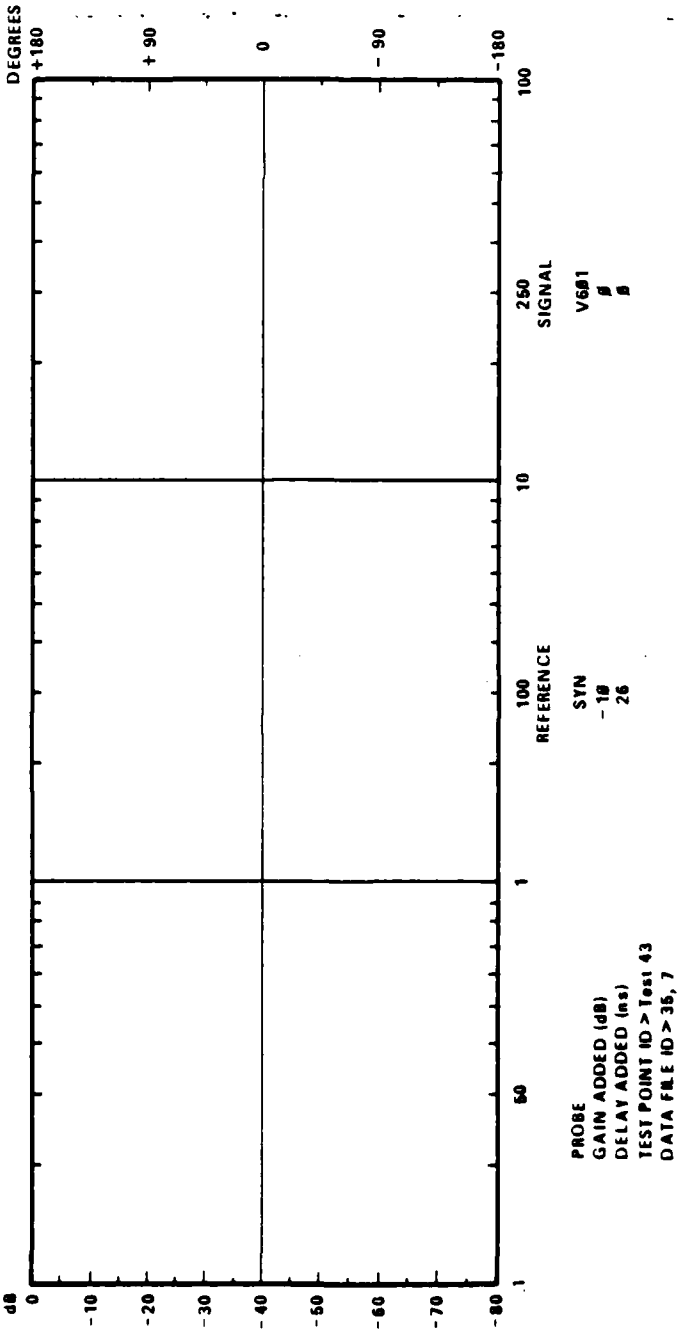


Figure 31. Typical CRT Corrected Data Format

appear, or if the operator answers all plot prompts negatively, no plots will be made.

After the menu entries are complete, if any plots have been selected the plot grid is drawn. The frequency scale is the X axis, labeled on the bottom but drawn on both the top and the bottom. Amplitude, if requested, will be on the left-hand Y axis and phase will be on the right-hand Y axis.

Using the most recent entries of the menu, text will be written at the bottom of the grid describing the test environment for the plot.

When the grid and the text are ready, the data is plotted. Ambient noise amplitude (if requested) will be plotted first. This plot will consist of a line with an 'A' above the plot at evenly spaced intervals.

Test data will be plotted next. If both amplitude and phase have been requested, each will be plotted alternately, a point at a time. The amplitude plot is drawn with an 'M' appearing above it at evenly spaced intervals. Phase is plotted with an 'F' appearing above the plot at evenly spaced intervals. Finally, the pick up noise is plotted, if requested, with a 'P' appearing at evenly spaced intervals.

Figure 31 is an example of the CRT grid display as it appears before the plots are drawn.

5-3.4.2 Hard-Copy Plots - Hard-copy plots for the CW measurement system will be produced on the Tektronix 4662 interactive digital plotter. The operator will be required to prepare the plotter before each test run, as follows:

- Be sure the plotter has power.
- Apply power. The POWER indicator will light and the following sequence of events will occur: (a) the pen carriage will move from its present location to the right boundary; (b) the pen will move to the lower-right corner where it will stop; (c) if the LOAD switch is depressed when power is applied, the

result in the graphics and alpha displays being superimposed on one another. This condition is of no consequence. Next, enter <CTRL C> and wait for the

MCR>

prompt. (A <CR> may be necessary if the MCR> prompt doesn't appear promptly.) Enter

@UP<CR>

in response to the prompt, and also hit the PCU 'RESET' button. This causes all the tasks of the software subsystem to be aborted and re-loaded, making the system ready for the next test.

NOTE: If the test is aborted in this way and the menu entries are being verified when the decision to abort is made, complete the menu verification before entering <CTRL C>. Failure to do so will cause the menu file currently being accessed to be 'locked' (a condition in which the file is not available for access of any kind) and cause subsequent errors. This restriction does not apply to tests aborted by the PCU 'STOP' button as described above. Locked files may be unlocked with the PIP /UN switch.

5-3.4 Plots

5-3.4.1 CRT Plots - Before making menu entries as described in the previous section, the operator will be prompted for the plots to be displayed, as follows. If the MEAS CYCLE switch is set in the 'MULTI' position, the first prompt will ask if the operator wants to see a plot of the ambient noise. Operator response should be 'Y' for yes or 'N' for no. Next, the system will ask if the operator wants to see a plot of the pickup noise. Again, a 'Y' or 'N' response must be made. Then prompts for amplitude and phase plots are made the same way.

If the test type is TFA or TFC, prompts for amplitude and signal-to-noise ratio plots will be made. If no prompts

4.	Date	The Gregorian date on which the mission file entry was made
5.	Time	the time the entry was made
6.	Type	the test type; "TEST", "TCAL", "RCAL", "PCAL", or "RFSN"
7.	Test Point ID	
8.	Location	usually the field test location, i.e., "North Pole"
9.	Engineer	the test engineer's name or initials
10.	Test comments	sixty characters of comment, description and opinion.

5-3.3 Aborting a Test

If an error condition occurs, or an erroneous response to a prompt is given which causes the data being acquired to be useless, it may become necessary to abort a test. There are several ways to abort a test, some of which require knowledge of operating system functions which are not covered in this manual. The best way to abort a test depends on the current state of the test.

If the PCU is acquiring data (this is the most common time a decision to abort is made) the best way to abort is to press the PCU 'STOP' button. If this method is successful, the operator terminal will switch to the alpha display (if it is in graphics mode) and the message

TEST ABORTED VIA ABORT CODE 13

will appear (refer to Appendix A for a list of abort codes). This message indicates that all tasks have gone to end-of-task and the system is ready to be restarted.

If this method is unsuccessful (for example, if the PCU has already accepted all the data or if the PCU is waiting for the Data-Chron clock in a remote start configuration) a more complicated abort sequence is required. First, the terminal must be placed in an alpha mode (if it is not already) by simultaneously depressing <SHIFT> and <A DSP> keys. This may

return the previous display to the screen. The system will display a message on the screen when the spooling of the desired files to the plotter and the tape handler is completed. These messages may appear almost anytime. The requested screen plot will disappear as soon as data acquisition completes. The plot may be redisplayed by entering graphic display mode. To switch from graphic display to alphanumeric display or vice-versa, depress the <SHIFT> and <A DSP> or <G DSP> keys simultaneously to toggle the alphanumeric display. These keys do not transmit any data to the PDP-11; they merely control the display. It is possible to have both displays on or off simultaneously by depressing the <SHIFT> and <A DSP> and <G DSP>.

The cassette tape task contains checks for tape full and wrong tape mounted. If one of these conditions occurs, a message is printed informing the operator of the problem. The operator should remedy the situation (mount a new tape, or the correct tape) and, when the problem is corrected, press <CR>.

Pressing <TERMINAL RESET> twice rapidly causes both alphanumeric display and graphic display to be cleared.

Each completed measurement is logged into a file known as the mission file. This file is located on the classified data disk (CD:) in UIC [200,2]. The filename is specified by the operator when the system is booted (refer to Paragraph 3-2.1.3). The entries in the file consist of selected items from the file header of each measurement data set. These include the following:

1. Test sequence number
2. Filename — this is the name by which the test data file is known on disk or tape. It is constructed by concatenating th· ·st facility code, the test sequence number and the Julian date
3. Tape — This is the tape number on which the data file is archived.

TFC>

This entry identifies the test facility code for the test in progress, one character from 'A' to 'Z' and '0' through '9'.

All secondary menu entries can be up to 32 characters long.

When all the menus are approved by the operator, the alphanumeric display of the CRT is suppressed and the grid for the plots is drawn. The plots are then drawn. When the plotting is finished, the alphanumeric display replaces the graphic display for further prompting. If the test is a single cycle test, the prompt:

DO YOU WANT A HARD-COPY PLOT (Y/N)>

appears. This is answered with a 'Y' if affirmative, and anything else for negative followed by a <CR> (just like the plot selecting prompts). If this prompt is answered negatively, and if the 'PLOT FORMAT' thumbwheel switch is set to 'TFA' on the receiver PCU, the Parseval values are displayed followed by the prompt

DO YOU WANT TO SEE THE INVERSE TRANSFORM PLOT (Y/N)>

This allows the operator, if the response to this prompt is affirmative, to get a quick-look plot of the inverse Fourier transform. Note that selecting this option erases the frequency domain plot generated on the CRT during the test. The system will next prompt with:

ENTER UP TO SIXTY CHARACTERS OF COMMENTS>

This allows annotation of any special comments or additional data about the test on the tape or on the analyst compatible files. The remarks are terminated by a <CR>, which can appear as the first character if no remarks are desired. After the comments are entered, the ODL-5B transmitters will be turned off and the system will prompt for files to be saved on disk and tape. There is a variable number of these prompts depending on the type of test. Answer 'Y' to the questions for the files you want saved; otherwise answer 'N'. At this point, the Tektronix 4662 plotter and the MFE 5450 cassette begin their functions, if selected. The terminal will either generate the inverse plot or

microseconds for the inverse Fourier transform. (2.55 is the minimum value this entry can have.)

THREAT WAVEFORM SCALING FACTOR>
This prompt appears only if the PLOT FORMAT thumbwheel is set to 'TFA' (or 'XXX' is the previous setting was 'TFA'). This entry contains a value in FORTRAN E format which is used during inverse transform calculations to convert from reference field measurements to E-field values.

All primary menu entries are maximum 16 characters long.

SECONDARY MENU ENTRIES

TEST LOCATION>
This entry contains the location of the facility under test.

TEST TYPE>
This entry contains a description of the testing being done at the location.

TEST ELEMENT>
This entry describes the particular element under test.

LOG ID>
This entry cross references the data taken to an externally maintained test log.

TEST ENGINEER>
This entry contains the test engineer's name.

SEQUENCE NO>
This entry contains a test sequence number.

protect tab is closing the hole in the lower right-hand corner. See that the 'ON LINE' button is ON. The drive is now ready to acquire data.

During testing the tape drive is completely under CPU control. Do not press any buttons during tape operation or errors will result.

When a tape is full, the write protect tab should be removed to prevent accidental overwriting.

To record data from the PCU onto cassette, the 'null modem' cable is attached to the PCU as described in Paragraph 3-2.2.2. Insert the cassette as for a normal test. Set the 'ON LINE' switch on, and the 'EDIT' switch off. Press the 'LOAD POINT' switch to get the tape on the load point, then press 'RCV' until the light under the button lights. The drive is now ready to acquire data. When the test is completed, press 'RCV' again to extinguish the receiver lamp then press 'RWND' to rewind the tape. When the 'RWND' lamp goes out, remove the tape from the drive. Only two data runs may be placed on a cassette in this configuration, one on each side.

5-3.6 Test Modes

The measurement system can be configured for many different types of CW measurements. The configurations follow.

5-3.6.1 Automatic (Sequential) Cycle - This configuration allows the automatic cycling of three test runs. The first run is the ambient noise test, with the necessary instrumentation in place but the output of the transmitter suppressed. The second run is the actual test, and the last phase is "pick-up" noise; the transmitter is active but the probe is not attached to the test point, it is placed nearby. To run such a test, set the switches as follows:

DECADE SWITCHES

determine the number of points for each frequency decade (note: "KFD" is always illegal and "0" is the only legal setting for decade 6).

PLOT FORMAT:
set to describe the type of measurement desired

STEP MODE:
should be set to 'AUTO' for an automatic cycle. If set to "MAN", the frequencies must be stepped by repeated depressions of "START".

START MODE:
should be set to "REMOTE" if it is desired to have the synchronizers control the test; if set to local, the "START" button will start the test.

MEAS CYCLE
must be set to "MULTI" for this type of test.

Press "PLOT INITIATE" to prepare the test. Synchronize the transmitter and receiver if both are to be used for this test. (See Paragraph 5-2.3.) Press the "START" button to enable the test start by the synchronizers or to start it if synchronizers are not used. The test starts when the synchronizer start time is reached (or by depressing the "START" button if the switches are so set). When the first cycle completes, the transmitter is engaged, and the second cycle is run. After a pre-determined delay (see Paragraph 6-4 on how to set this delay), the third cycle is run. This delay is to allow the operator to remove the probe from the test point. If the operator needs more time betwen any two test cycles than was set into the PROMs, the operator must activate the "HOLD" switch on both receiver and transmitter PCUs. The "HOLD" switch allows the next cycle of the test to be delayed. To resume a held cycle, receiver and transmitter PCUs must be restarted, and automatic cycling will continue. This will include resynchronization and re-arming (see Paragraph 5-2.3). The "HOLD" switch is only sensed at the end of an inter-cycle delay, which means that once the "HOLD" switch is turned on, it may be turned off

before the delay period expires without any effect. Once sensed, it may be switched off at any time. The cycle can only be resumed by a test restart. (Note: if synchronization is not being done, as, for example, when the receiver synthesizer is driving the reference channel, then a start pulse is necessary to resume a held test. This start pulse can come from the receiver clock using the synchronizer if the "START MODE" switch is set to "REMOTE" or from the "START" switch if the "START MODE" switch is set to "LOCAL". See Paragraph 2-2.1.3 for a description of the front panel switches, their function and interrelations.)

5-3.6.2 Manual - This mode is selected by setting the "PLOT FORMAT" switch to "000". This disables the GPIB, effectively placing all instruments in local mode. This setting is useful for PCU Testing or single frequency measurements. Note that no data is transmitted from the PCU in this mode.

5-3.6.3 Single Cycle - This test mode is equivalent to the second cycle (test cycle) of the automatic test. The switches are set thus:

DECADE COUNTERS
determine the number of points per decade desired. (Note: KFD is always illegal, and only "0" is legal in decade 6.)

PLOT FORMAT
set to describe the type of measurement desired

STEP MODE
set to "AUTO"

START MODE
should be set to "REMOTE" if using the synchronizers. If a test using the receiver synthesizer as the reference is desired, the switch may be set to "LOCAL".

The "LOCAL" setting implies that the test is to be started by the "START" switch.

MEAS CYCLE
set to "SINGLE".

HOLD
has no effect on this test mode, but should be left off.

Once the test is started, a complete frequency sweep is completed. This mode is useful when a response function test is desired witnout noise measurements, or for generating a system cal or probe cal.

SECTION 6
THREAT WAVEFORM FILES

6-1 BUILDING THE THREAT WAVEFORM FILES

To perform an inverse Fourier transform on the frequency domain data to produce a time domain plot, three pieces of data are needed. The corrected data from the test point are multiplied by the spectrum of the threat waveform in the frequency domain (which is equivalent to convolution in the time domain). The product is then mathematically filtered by a ninth-order Butterworth bandpass filter. Since the mathematics involved is essentially a multiplication, these 3 functions can be applied in any order. Since the correct data is received in real time, the threat waveform and application of Butterworth filtering can be done ahead of time and applied to the corrected data as a product. This precomputation is the purpose of the THRTWV task.

The threat waveform is a double-exponential function described by two values, alpha and beta. These values are obtained from the test engineer. The Butterworth filter function is a bandpass filter described by a low-frequency cutoff and a high-frequency cutoff. All of these values are entered by the operator in scientific notation with a range of not less than 0.29×10 nor larger than 1.7×10 in absolute magnitude. For example, to enter the value 4.76×10 , type 4.76E8<CR>. (<CR> stands for a carriage return.) The standard format is a single decimal digit, followed by a decimal point, followed by an optional fractional part, followed by the letter E, followed by an optional sign, followed by an integer decimal number.

The file in which the data is stored is specified by an up to nine character filename. The data is stored on the classified data disk. If the disk is de-classified (see Paragraph 6-6), the data is lost; it is therefore necessary to rebuilt the threat waveform files each time the disk is de-classified.

To build a threat waveform file, make sure the classified data disk is mounted on drive DL1:. (In a single

disk operation (see Paragraph 5-3.1) there is no classified data disk -- all data generated by this program will go onto the system disk on DL0:. Please note that classified data must not be generated in the single disk configuration!) Then enter:

RUN THRTWV<CR>

The CRT will display the prompt:

ENTER THE THREAT WAVE ALPHA VALUE>

Enter a value as described above. The prompt:

ENTER THE THREAT WAVE BETA VALUE>

will be displayed. Enter the value. The CRT will then prompt:

ENTER THE NAME FOR THE FILE (9 CHARS MAX.)>

Up to nine alphanumeric characters can be entered. A file with the entered name, an extension of .WAV and a version of 1 will be built on the classified data disk in user file directory [200,1]. (All newly acquired data are maintained in UFD [200,1] on either the system disk or the classified data disk, as appropriate.) If a file with that name already exists, the old file is deleted, and a new file created. The entered name is later used to specify the file in response to a primary menu prompt (see Paragraph 5-3.2 about menu entries). The system will now prompt:

ENTER THE LOW-FREQUENCY BUTTERWORTH CUTOFF>

The response to this prompt is followed by the prompt:

ENTER THE HIGH-FREQUENCY BUTTERWORTH CUTOFF>

When this prompt is answered, the system starts to build the file. The only visible activity to confirm this is the flickering of the DL1: "READY" lamp on the front of the drive. When the file is built, the message:

STOP -- THREAT WAVEFORM BUILT ON CD:

will appear. This indicates the task's successful completion.

To read this file, a file dump utility designed to dump files in the format used by the system has been developed. (This was done because DECs file dump utility, DMP, will not dump files correctly in this format.)

To dump a file to the system console, enter:

RUN FYLDMP

in response to any '>' prompt. The system responds with:

ENTER FILENAME (UIC = [200,1]):

Follow the colon (:) with the filename and extension desired. (The version is unnecessary since all files are version 1 - this is the default.) The system then dumps the file in triplets consisting of frequency in Hertz (Hz), amplitude in decibels (dB) and phase in degrees. The inverse transform file, if selected, is dumped in doublets consisting of time in seconds followed by magnitude in units. To temporarily stop the display scrolling, enter <CTRL S>; this freezes the display until a <CTRL Q> is entered. To abort the dump, enter <CTRL C>. When the

>

prompt appears, enter

ABO<CR>

The system will display a message indicating a dump is aborted and issue another

>

prompt.

6-2 ENTERING THE CALIBRATION FOR ANALYTIC SENSORS (APROBE)

The purpose of this program is to create analytic transfer functions for sensors whose derivative transfer functions are constant over all frequencies.

Certain sensors (.e.g., MGL type B dot sensors) are calibrated analytically rather than emperically. They belong to a class which when appended by an RC integrator have a transfer function of the form:

$$\frac{\text{Volts}}{\text{Integrated Field Units}} = k \frac{j\omega}{1 + j\omega RC}$$

where

- k = equivalent area A_{eq} of the sensor
- $(j)^2$ = -1
- ω = 2π x (frequency in Hz)
- RC = integrator time constant in seconds

Therefore, for a given sensor calibration over a previously defined frequency range, the only operator inputs needed are the sensor ID, k, and RC.

The following sample dialog between the operator and PDP 11/34 demonstrates operation of this progam. Operator entries are underlined.

```
>RUN APROBE<CR>
 ENTER PROBE ID
>B201<CR>          (See Note 1)
 ENTER SCALING CONSTANT
>.01<CR>
 ENTER INTEGRATOR TIME CONSTANT (MICROSECONDS)     (See Note 2)
>10.<CR>
```

Note 1: After this entry, the program checks for the existence of the probe ID in its library. If it already exists, the operator is advised by the display:

```
PROBE ID B201 ALREADY STORED.  DO YOU WISH TO REDEFINE PROBE?
```

If the operator answers Y <CR>, the program continues, superseding the existing .CAL file. Any other response terminates the program.

Note 2: If no integrator is used, the operator should enter 0.<CR>. Entry must include decimal point.

Note that all analytical sensors calibrated by this utility require the use of a balun. The balun's transfer function is -6 dB across the entire frequency spectrum served by this system. The effects of the balun are not accounted for by the calibration utility. Therefore, when such a probe is used in the system, care must be taken to enter the -6 dB gain in response to the signal or reference gain added prompt (depending upon which channel the probe is used in) of the primary menu.

6-3 THE DELETE FREQUENCY EPROM GENERATION PROGRAM ('DEL')

In the course of sweeping the frequency spectrum, it may be necessary to delete certain frequencies from the spectrum, as radiation from the CW testing may interfere with necessary communications at certain frequencies. Therefore, the

CW transmitter and receiver subsystems are equipped with the capability to delete frequencies from the test spectrum. The frequencies to be deleted are placed in tabular form on a 2708 EPROM. The PDP-11 utilities include a program to create the delete-frequency EPROM via operator interaction. The program prompts the operator for the frequencies, and programs this data into an EPROM on the M900 programmer. This EPROM, when placed into the PCU, causes the selected frequencies to be skipped during a sweep.

6-3.1 Operation

To program a delete frequency EPROM, first connect the M900 PROM programmer to the PDP-11 as explained in Paragraph 2-3.1.3 and press the PROM Programmer RESET key. If all is properly connected, the display on the M900 will show the letter 'A'.

Next, the DEL program is started up. To do this enter:

RUN DEL<CR>

on the operator's terminal. The program will respond with the prompt:

ENTER TEST SITE LOCATION>

Enter up to 20 characters. This data appears on the plots when the system is in the secondary configuration. Single frequencies, ranges of frequencies, or both, can be programmed. The system prompts for single frequency deletions first, issuing the message:

SINGLE FREQUENCY DELETION: (<CTRL Z> ENDS ENTRIES)

followed by the prompt:

FREQUENCY (MHZ)>

Enter the desired single frequency deletion(s), in ascending order, in response to the above prompt. Note that the frequency is in megahertz and must contain a decimal point. The prompt is repeated until the operator enters a <CTRL Z> character to terminate the entries. If no single frequency deletions are desired, enter <CTRL Z> in response to the first prompt.

When the single frequency deletions are terminated, frequency range deletion begins. The system displays:

FREQUENCY RANGE DELETIONS: (<CTRL Z> ENDS ENTRIES)

then prompts with

FREQUENCIES (MHZ)>

Enter the frequency range(s) in response to the above prompt. The range must have the first entry less than the second entry. Ranges must be in ascending order, and cannot overlap. Entries are in megahertz and must contain decimal point, and the two entries are separated by a comma. No inbedded blanks are allowed. An example of a range entry (user response is underlined):

FREQUENCIES (MHZ)> 6.391,7.213<CR>

When the last response is made, terminate responses with a <CTRL Z>. If no range deletions are desired, enter <CTRL Z> in response to the first range prompt.

When all data are entered, the program gives the operator a chance to correct any errors made during the entry operations. The system displays:

ENTRY VERIFICATION: (<CR> BY ITSELF INDICATES NO CHANGE)

then follows with:

TEST SITE = XXX...XXX OK?

where XXX...XXX is the up to 20 character entry made earlier. For this and all other verification prompts, entering a <CR> by itself indicates that the data are satisfactory. To change an entry, the entire entry must be re-entered, after which the new value is displayed for approval again. This continues until the entry is accepted. Once the test site data are accepted, the message

SINGLE FREQUENCY DELETIONS:

appears followed by the verification prompt:

FREQUENCY = XXXX OK?

where XXXX is the entry made earlier. This prompt only appears if at least one sngle frequency deletion was made and continues until all single frequency deletions are verified. If the entry is acceptable, enter <CR> to the prompt; otherwise correct the

entry. When all single frequency deletions are verified, the system displays:

FREQUENCY RANGE DELETIONS:

followed by the verification prompt:

FREQUENCIES FROM XXXX TO YYYY OK?

where XXXX and YYYY are entries made earlier, XXXX < YYYY. Again, this prompt only appears if at least one frequency range deletion was made and continues until all range deletions are verified. If the range is correct, enter <CR> in response to the prompt. If the entry is in error, the operator may re-enter the entire range in the same format as the original entry. However, if only one value of the range is incorrect, the operator can re-enter only the faulty entry without affecting the other part of the range. Here's how: If the first part of the entry is incorrect, re-enter that value (remember, the decimal point is mandatory) followed by a <CR>. If the second part of the entry is faulty, type a comma followed by the correct entry. As an example, if the operator wished to delete a range from 873.2 kHz to 951.0 kHz, but entered 961.0 kHz as the second value by mistake, the verification prompt would look like this:

FREQUENCIES FROM .87320 TO .96100 OK?

(Note that the frequencies are in MHz.) To correct this entry the operator enters (operator entries underlined):

,.9510<CR>

to which the system responds:

FREQUENCIES FROM .87320 TO .95100 OK?

To operator enters a <CR> and the next verification prompt (if more ranges were entered) is displayed.

The verification process can be aborted at any time by entering <CTRL Z> in response to any verification prompt. This causes the EPROM programming phase to begin.

Once all entries are verified the programming phase begins. The initial handshaking between the PDP-11 and the M900 is completed under program control and the message

PROM PROGRAMMING BEGUN

appears on the terminal. The programming can be verified by watching the M900 display. Handshaking takes place between the PDP-11 and m900 on each byte written to the programmer. If this handshaking fails, the system displays a message -

"message"

TO CANCEL TASK, ENTER <CRTL Z>

TO RETRY WRITING, CORRECT ERROR CONDITION, THEN ENTER <CR>

where "message" is an error message, discussed in Paragraph 6-3.2 below. The message indicates the problem. If the problem can be corrected, do so and enter a <CR>. This causes the programming phase to be restarted. If the error cannot be corrected easily, then enter <CTRL Z> to abort the task.

6-3.2 Error Messages

The following messages are generated during frequency entry and verification phases:

***FREQUENCY LESS THAN PREVIOUS ENTRY. RE-ENTER

A single frequency deletion entry was entered that was not greater than the previous entry. Entry is ignored.

***LOW END OF RANGE LESS THAN HIGH END OF PREVIOUS RANGE. RE-ENTER RANGE.

The lower entry of a frequency range was lower in value than the higher entry of a previously entered range. The entire range is ignored. Note that if the range as entered has the higher value of the range entered first, the program automatically swaps the values so the lower value appears first.

***ENTRY XXXX LESS THAN PREVIOUS HIGH END ENTRY

During verification of range deletions, a value was entered to correct an entry and the correction was less than the high value entry of the previous range. The correction is ignored and the old

range is reprompted for verification. XXXX contains the offending entry.

The following messages appear on errors during the programming phase:

ERRORM900 DOES NOT ANSWER

The M900 did not answer its initial handshaking correctly, or did not answer at all. Probable causes include M900 not powered up, not connected to PDP-11, not RESET correctly, Personality module not connected, or M900 internal error.

ERRORPROM NOT ERASED

An attempt was made to write to a non-blank EPROM.

ERROR INCORRECT STARTING SEQUENCE FROM M900

The starting sequence from the M900 concluding the initial handshaking was garbled.

ERRORBAD OR MISSING ACKNOWLEDGEMENT

The acknowledgement from the M900, that a byte was correctly received from the PDP-11, was missing, indicating a loss of connection between the M900 and the PDP-11 or an internal M900 error; or was a <NAK>, indicating faulty transmission between the PDP-11 and the M900; or, if the error occured during the 100-pass programming attempt, a bad EPROM or a programming error by the M900.

Errors of this type are followed by the message

TO CANCEL TASK, ENTER <CTRL Z>

TO RETRY WRITING, CORRECT ERROR CONDITION, THEN ENTER <CR>

which is discussed in the previous section.

6-4 THE AMPLITUDE EPROM PROGRAM ('AMPL')

Using an antenna to generate a radiated CW sweep over a wide frequency range can cause problems due to the fact that any single antenna radiates different frequencies with different

efficiencies. The output of the antenna is therefore not constant with frequency, given a constant input drive level. To remedy this, the CW system is equipped to generate different drive levels at difference frequencies. This is accomplished by having the PCU read a table, maintained in EPROM, which determines the drive levels at different frequencies. The following utility, using the M900 EPROM programmer, builds this table.

6-4.1 Operation

To build an amplitude control EPROM, first connect the M900 EPROM programmer to the PDP-11 as described in Paragraph 2-3.1.3. Power it on and press 'RESET'. The display should contain the letter 'A'. Once this is done and a blank EPROM is placed in the M900 'COPY' socket, start the program by entering

RUN AMPL<CR>

on the operator's terminal.

The first two prompts request information about the time interval between cycles of a multi-cycle test. The prompts are:

CYCLE 1 TO 2 INTERVAL (SECONDS)>

and

CYCLE 2 TO 3 INTERVAL (SECONDS)>

Answer both prompts by entering integer values in the range 5 - 9999 seconds. A minimum of five seconds is required for proper PCU operation. Do not enter a decimal point. When these prompts are answered, the system prompts

REF SYN OUT (DBM)>

which asks for the output level of the receiver PCU reference synthesizer in dBm. Enter an integer value in the range of -127 to +13.

Once these three entries are made, the amplitude vs frequency table is generated. The system writes the message:

ENTER AMPLITUDE/FREQUENCY PAIRS AS PROMPTED. NOTE THAT AMPLITUDE ENTERED IS VALID UP TO FREQUENCY ENTERED. (<CTRL Z> TERMINATES INPUT)

where SID is the switch identifier and parm.list is the list of parameters. Note that the parm.list is preceded by a colon (":") and may or may not appear, depending upon whether parameters are required by the switch. If a switch requires more than one parameter in its parm.list, each parameter is separated by a colon. An example of a switch with a parm.list of 6 parameters is given below:

/SID:p1:p2:p3:p4:p5:p6

Switches can be applied to a command's input.list or output.list (or both), depending again on what is appropriate for a given process and switch.

Processes can use the information in the command line to complete the process, or can optionally prompt for more information, data, etc.

Processes generally work with disk or tape based data files. A file is identified by a fully qualified name of up to eight characters and an extension of up to three characters. Within the IAP, a convention has been established for filenames and extensions. The convention provides a means of identifying the source of the data and the date of creation of the file.

A general rule of thumb will be followed in naming a data file and its extension. If it is adhered to, fewer problems and file duplications will be encountered by the operator.

Each measurement taken will produce a set of data files. It is important that these files receive a unique name. The following scheme will be used to accomplish this.

A file will have an eight character name with a three character extension which will be in the following form:

FSEQNJDT.EXT

where:

F--- - is a character A-Z or 0 - 9 respresenting a code to identify the test facility.

SEQN - is 4 integer numbers defining a unique test sequence number.

SECTION 8
CW II INTERACTIVE ANALYST PACKAGE COMMAND SUMMARY

8-1 INTRODUCTION

This section summarizes the command repertoire and syntax for the Interactive Analyst Package (IAP) software for the DNA CWII measurement system.

When the operator wants to use the analyst package, enter the following command. The proper tasks will be installed. (The operator should have set his terminal to a privileged UIC, usually [2,2].) UIC set to [7,1].

@ ANAL <CR>, where <CR> is carriage return

The commands used in the IAP are designed to give the analyst a flexible set of operations to manipulate data taken by the real-time Data Acquisition Software supplied in CWII. The IAP provides commands to display data and perform various mathematical manipulations upon the data. The commands are structured using a syntax very similar to that of the standard DEC RSX-11M system utilities and language processors, like PIP (Peripheral Interchange Program) and FORTRAN IV-PLUS.

The command syntax uses the concept of a process acting upon a source of input, yielding an output. The basic command syntax is as follows:

PRC output.list=input.list

where PRC is a three-character process name, input.list is a list containing specifier(s) of input source(s), and output.list is a list containing specifier(s) of the output(s) of the process. These lists can contain filenames, terminal or device specifiers, and process modifiers (called "switches") in various combinations, depending on what is valid for the process. Switches are indicators by which the process can be signalled of special conditions or of changes in the normal processing that the operator requires. Switches consist of a slash ("/") followed by a switch identifier and an optional list. The switch syntax is illustrated below:

/SID:parm.list

5. Inspect the end of data block. If bad or missing data, this points to an error in the PCU and processing.

FYLDMP utility and dump file SYSTF.CAL. The file output should match that of the dump in Appendix B. If they don't, a software problem may exist in task CORECT. If they do match, but the plot is incorrect, there may be software problems in the HCPLOT task or the plotter may be malfunctioning. Run the plotter self test. If it succeeds, then the trouble is probably in the HCPLOT software.

This completes the PDP-11 check. To test the integrity of the receiver PCU subsystem:

1. Connect the plotter and a working cassette tape drive to the PCU receiver in the Secondary configuration (as per Paragraph 3-2.2.2). Set the receiver to run a transfer function system calibration (see Paragraph 4-2.4). Inspect the resulting plot. If the plotter does not plot, and the connections are all properly made, this indicates a possible PCU problem in the I/O subsection. If the plot looks bad, it could indicate a problem in the I/O subsection or in the plot generation logic.
2. When the test completes, regardless of how the plot looks, connect the tape to the terminal and dump the tape to the terminal in edit mode. Inspect the first record. It should resemble the prototype PDB record as described in the section of the Software Maintenance Manual. If it doesn't, this indicates a possible logic problem in the PCU panel sensing logic or in the PDB generation logic.
3. Inspect all data records for numeric data, and that each record starts with a "#". If non-numeric data appears, ('+' and '-' are ok), the DVMs may be bad, or the input port of the DVMs may have failed. If the data does not conform to the format, the PCU data generation logic may be at fault.
4. If an Error Status Block occurs (first character of record = '&') refer to Appendix A for an explanation of the associated code.

11. At this point, the terminal should prompt for the plots desired. If the tape is working properly but the prompts do not appear, either the drive or the DL-11W interface on the drive port is malfunctioning, or the cassette is misconfigured.

12. Answer the prompts:

    Answer 'Y' to all plot prompts.

    When the primary menu is displayed, answer 'N' to the question 'ARE THESE ENTRIES CORRECT?'. Answer the ensuing prompts this way:

    TEST/CAL>TCAL
    TEST POINT ID>INT. CHECK
    TAPE FILE NO>"##", ("##" is the tape number mounted
    REFERENCE GAIN ADDED>0 in the output cassette drive)
    SIGNAL GAIN ADDED>0
    SIGNAL DELAY ADDED>0
    REFERENCE DELAY ADDED>0
    NETWORK ANALYZER DISPLAY ADDED>-30

    Only these prompts should appear on the primary menu. Accept the primary and secondary menu. The plot grid should appear and data should be plotted. Compare the CRT plot to the prototype in Appendix B. Any grand differences can be attributed to software problems. Any error messages occuring during this run from the FORTRAN OTS should be looked up and traced to the software, as there should be no such messages during this test.

13. Answer 'Y' to the hard copy plot prompt appearing after the plot is generated on the terminal. When the prompt for remarks appears, make up something original. The CRT prompt should then reappear on the terminal, the output tape drive should start and hard-copy plotting should begin.

14. When the plotting completes, compare the plot generated to the prototype in Appendix B. In Appendix B, those header entries with stars (*) by them are optional and do not have to match. If there are differences in the plots, run the

5. Connect the terminal to the PDP-11 'HP2648A' port and press the 'REMOTE' button. Apply power to the PDP-11 CPU. Observe the 'LOAD' pushbuttons on the RL01 disk drives illuminate (this may take up to 15 seconds or so). If a disk 'load' light fails to illuminate, check out the disk drive power and data connections. If any of the other indicators fails to appear as described above, check out the CPU power and the cable connection to the terminal. Verify that the MFE 5450's 'ON LINE' light has stopped flashing.
6. Mount the system and classified data disks into their proper drives (see Section 5). If the drives fail to spin up, check them out.
7. Boot the system and compare the output to the list in Paragraph 3-2.1.3. If the boot fails, this may indicate that the wrong disk is mounted in drive DL0:. If this is not the case, the bootstrap ROM card may be defective, the CPU may be malfunctioning, or the disk drive may be malfunctioning.
8. Issue the @UP<CR> command. Enter ACT to obtain a list of all active tasks. Tasks INPUT, CORECT, CRT, and INVERS should appear in the list along with MCR... If these tasks do not appear in the list, a problem with the CPU, the operating system, or the indirect command processor task may exist.
9. Apply power to the TEKTRONIX 4662 plotter and connect it to the PDP-11 'TEK 4662 PLOTTER' port. Adjust the plotter address switches to read '01A3' (see Table 6). Press the 'LOAD POINT' button on the MFE5450 input cassette. It should light while the tape drive searches for the beginning of the data section. Verify that the light goes on and the tape moves during this operation. Failure may indicate a drive problem.
10. Once the load point is found, press the 'SEND' button on the input tape drive. The button should light up, and the tape should move. Failure here indicates a drive problem.

SECTION 7
INTEGRITY TESTING

The CW Measurement System consists of many parts. These parts must all function properly for the system to properly process the data. This test sequence is designed to isolate a faulty part or parts. Also included are places where software components are checked. The test requires the use of a pre-recorded cassette containing known data which should generate reproducible results comparable to the data contained in Appendix B. If the test is completed successfully, the system is functioning properly.

THE TEST

1. Plug in and turn on both cassette tape drives. Verify that both drives power up properly. If either drive fails to come up, check out that drive. Press 'ON LINE' on both drives. The lamp under the button should blink if not connected to a powered up PDP-11.
2. Connect the 'modem' connector of one drive to the PDP-11 'Receiver PCU' port. Load the test cassette into this drive. Connect the other drive to the MFE5450 port and load a pre-initialized cassette into it. (See Paragraph 6-5.) The 'ON LINE' light should stop blinking when the PDP-11 is powered up.
3. Turn on the HP 2648A terminal. When the cursor appears on the screen, press 'RESET' twice rapidly. The screen should display the words 'TERMINAL READY' in the upper left hand corner, and the LED above the 'TRANSIT/BREAK' button should be the only LED on. If this is not the case, the terminal is not functioning properly.
4. Take the terminal off line (the locking 'REMOTE' button should be up) and press the 'TAPE/TEST' button on the console. Observe that all LEDs light up and the test proceeds as described in the HP 2648A manual. Any failure indicates a terminal problem.

6-7 DECLASSIFYING A DISK PACK

The operator can destroy all information on the disk in drive 1 (DL1:) by invoking the DEC utility, BAD. BAD accomplishes this by writing a pattern of 1s or 0s over the entire disk while scanning for bad blocks. Any information previously written on the disk is written over and destroyed.

To invoke BAD the operator types:

>DMO DL1:/DEV<CR> (to dismount the disk)

>BAD DL1:<CR>

If any error messages appear, refer to the DEC RSX-11M Manuals, Volume 4, Utilities Chapter 9.

For safety, the operator should depress the 'WRITE PROT' (write protect) pushbutton on DL0: before starting, and release it afterward.

is re-issued. When the file is found, its attributes are inspected. If each record contains only two entries, it is considered to be a file of inverse transform data (all frequency domain files contain three entries: frequency, amplitude, and phase; while time domain (inverse) files contain only time point and magnitude entries.) If the file is an inverse file, the prompt

MAXIMUM X VALUE IS X.XXXE+NN. IS THIS ACCEPTABLE (Y/N)?

will appear. X.XXXE+NN is the maximum value the X axis contains, as found in the file. It may be that only a portion of an inverse file is of interest. If this is the case, answer the prompt negatively. This causes the prompt

ENTER NEW MAXIMUM X VALUE>

will appear. Enter the desired value.

At this point, the alpha display will be replaced by a graphic display and the plot will be generated.

Notice that the yellow LED above the yellow special function button on the terminal is flashing. This indicates that the terminal is in auto-plot mode. When the LED stops flashing, the plotting has completed. To continue the program after inspecting the plot, press <SHIFT> and <G DSP> simultaneously, then <SHIFT> and <A DSP> simultaneously. The graphic display will be replaced with the alpha display. If the utility was invoked by the software subsystem, the message

STOP - QUICK-LOOK COMPLETE

will appear. If the utility was invoked by the operator, another prompt will appear.

ENTER FILENAME (UIC [200,1])>

As many plots as desired can be generated. To end the program, enter <CTRL Z> to this prompt. This causes the message

STOP - BY OPERATOR REQUEST

to appear and the task to complete.

called CTP (refer to section 8). To initialize a cassette, place the cassette in the MFE 5450 drive and connect the drive to the MFE 5450 port on the PDP-11, as it would be connected for normal use. Place the unit ON-LINE. At the operator console, enter

CTP /TP:nnnn/new

where nnnn is a four-digit tape number. This tape number corresponds to the menu entry tape number. The tape is initialized with this tape number, and, when finished the system issues the message

TAPE INITIALIZED

The tape can then be removed from the drive for use later. Both sides of a tape may be used. Each side should be initialized with a unique tape number.

6-6 AUTOPLOT PROGRAM

The AUTOPLOT program is a utility which uses the HP 2648 terminal's auto-plotting facility to generate a plot of a data file on the terminal. This utility is also called in response to an affirmative response to the

DO YOU WANT TO SEE THE INVERSE TRANSFORM PLOT (Y/N)>

prompt for a quick-look at the inverse transform. Any file in UFD [200,1] may be plotted.

To run the task enter

RUN AUTPLT<CR>

to a '>' system prompt. The systm will response with

ENTER FILENAME (UIC = [200,1])>

to which the operator responds with the name of the file to be plotted. (NOTE: If this utility is invoked by the software subsystem for a quick-look at the inverse transform, the above prompt will not appear. The inverse transform file will be automatically selected. For a list of files in the UFD, refer to the SYSTEM MAINTENANCE MANUAL.) At this point the file is searched for on both the system and classified data disk. If the file is not on either disk, a message is printed on the console informing the operator of this condition and the prompt

message appears during verification phase, the second message doesn't appear, and only the frequency entry is ignored.

These messages appear only during the programming phase.

ERRORM900 DOES NOT ANSWER

The M900 did not answer its initial handshaking correctly, or did not answer at all. Probable causes include M900 not powered up, not properly connected to PDP-11, not RESET correctly, Personality module not connected, or M900 internal error.

ERRORPROM NOT ERASED

An attempt was made to write to a non-blank EPROM.

ERRORBAD OR MISSING ACKNOWLEDGEMENT

The ackowledgement part of the handshaking from the M900, indicating that a byte was correctly received from the PDP-11 was missing, which may indicate a loss of connection between the M900 and the PDP-11 or an internal error; or was a <NAK>, indicating faulty communication between the PDP-11 and the M900; or, if the error occured during the 100-pass programming attempt, indicated a bad EPROM or programming error by the M900.

Errors of this type are followed by the message

TO CANCEL TASK, ENTER <CTRL Z>

TO RETRY WRITING, CORRECT ERROR CONDITION, THEN ENTER <CR>

which is discussed in the previous section.

6-5 TAPE INITIALIZATION

Before a cassette can be used for data storage by the software system TAPE program, a directory data structure must be initialized on the cassette. This can be done by the program

and start sending data, one byte at a time, to the programmer. After each byte, the M900 handshakes with the PDP-11 to verify that the M900 received the byte correctly. If at any time any of this handshaking breaks down, the system prints a message of the form

"message"

TO CANCEL TASK, ENTER <CTRL Z>

TO RETRY WRITING, CORRECT ERROR CONDITION, THEN ENTER <CR>

where "message" is an error message of the form discussed in Paragraph 6-4.2. Entering a <CTRL Z> in response to this message aborts the task. If the error is recoverable, however, the programming phase may be restarted without having to re-enter the data. Correct the error condition and enter a <CR>. The system will retry the programming step from the beginning. When the programming successfully completes, the message

PROM FINISHED

will appear on the console, and the task completes.

6-4.2 Error Messages

These messages may appear during the data entry or verification phases.

***AMPLITUDE OUT OF RANGE (-127 <=AMPL<= 13)
The amplitude entered must be between -127 dBm and +13 dBm. The entry is ignored.

***FREQUENCY LESS THAN PREVIOUS FREQUENCY ENTRY
A frequency was entered which was less than a previous entry, i.e., frequency was not in ascending order. If this appears during the data entry phase, it will be followed by the message

***RE-ENTER THIS FREQUENCY/AMPLITUDE PAIR
Indicating that both the frequency and amplitude entries just made are ignored. If the first

AMPLITUDE = NNNN FREQUENCY = NNNN OK?

where NNNN and XXXX are the amplitude and frequency entered earlier. (Note: amplitude is an integer; frequency is a real value.) Entering <CR> by itself approves both; if an error exists, the entire pair may be re-entered as an integer value, followed by a comma, followed by a frequency in megahertz which must contain a decimal point. However, if only one value is erroneous, the offending value can be replaced without replacing the valid entry. Here's how: to replace the amplitude value only, enter an integer followed by a <CR>. For example, if the operator wished to enter an amplitude of -10 dBm up to 150 MHz, but erroneously entered -110 dBm instead, the verification prompt would be

AMPLITUDE = -110 FREQUENCY = 150.00 OK?

To modify the amplitude, the operator enters (entries underlined)

-10<CR>

The system repeats all verification prompts which have changes made, so it would respond with

AMPLITUDE = -10 FREQUENCY = 150.00 OK?

to which the operator enters a <CR>. The system then responds with the next frequency/amplitude pair (if there is one).

The operator can abort the verification process at any time by entering a <CTRL Z> to any verification prompt. This causes the program to immediately enter the EPROM programming stage.

Note that if the entire spectrum (1 kHz - 1 GHz) is not covered by the operator, any remaining part of the spectrum is automatically programmed to an amplitude of -127 dBm from the last entered frequency to 1 GHz.

Once all entries are verified (or verification is aborted, as noted above) the programming phase begins. After initial handshaking between the PDP-11 and the M900, the PDP-11 will write the message

PROM PROGRAMMING BEGUN

on the terminal, followed by the first of a pair of prompts:

AMPLITUDE (DBM)>

Answer this prompt with an integer in the range of -127 to +13. When this is done, the system prompts:

FREQUENCY (MHZ)>

Answer this prompt with a frequency in megahertz. A decimal point is required for this entry. Frequencies must be in ascending order, i.e., each frequency must be greater than the previous one. Amplitudes entered are in effect from the previous frequency up to and including the frequency entered (or from 1 kHz up to the frequency entered if this is the first entry). Frequencies less than 1 kHz or greater than 1 GHz are ignored. The system repeats the prompt pairs until a <CTRL Z> is entered in response to an

AMPLITUDE (DBM)> prompt.

After the <CTRL Z> is entered, the verification phase begins. This allows correction of errors entered during the previous phase. The system writes the message:

ENTRY VERIFICATION:

<CR> BY ITSELF IMPLIES NO CHANGE

on the operator's console and follows that with the prompt:

CYCLE 1 TO 2 = NNNN OK?

where NNNN is the integer value entered earlier. To this and all other prompts issued in the verification phase, a <CR> by itself indicates that the value is correct. If the value is incorrect, correct the entry by re-entering in the same format as the original entry. Once corrected, the system reissues the same prompt with the new value for verification. This continues until the value is accepted. Following the approval of the above prompt, the system prompts

CYCLE 2 TO 3 = NNNN OK?

(NNNN is the previously entered value.) When this is accepted, the system then prompts with

REF SYN OUT = NNNN OK?

After this prompt is satisfied, the system prompts for approval of the amplitude/frequency pairs with the prompt

JDT- - is 3 integer numbers defining the Julian Date of the measurement. This value is appended to the facility code and sequence number by the software.

EXT- - is the 3 character extension where:

E - is one of the following 6 characters:

A - indicating ambient noise
U - indicating pick up noise
C - indicating CW measured test data
T - indicating time data
P - indicating pulse measured test data
F - indicating frequency data

X - is one of the following 3 characters:

C - indicating calculated data
D - indicating defined data
M - indicating measured data

T - is an "A" except in the case of converted CW1 data where a sequence number was used for more than one measurement. In this case, the last character will be incremented through the alphabet as many times as necessary.

The entire extension is also appended by the software. Calibration files saved for analyst use are an exception to the above convention. They will be named using the five-character sensor name found in the header. The Julian Date and extension will be used as described above.

When an analyst is naming a file to be created by any operation, the first five characters can be used in any way as an identifier. These five characters must be unique from those used to name another file. The Julian Date and an extension will be appended to the five characters as above.

It will be up to the operators to keep a complete log book of file names used to avoid any duplications. Checking for duplicates on disk will be done by the software but it is not infallible due to the possibility that files saved on tape may be deleted from disk.

The IAP software will store the data on disk to a device named CD:. This device is usually assigned to DL1:, and is used for data storage only. The software will assure that the data is stored on CD: so the operator need not specify this device name.

The IAP contains processes, each with its own process name and set of valid input lists, output lists, and switches. The processes and associated process names contained in the IAP are as follows:

Name	Process
CTP	Cassette tape transfer process. Transfers data from cassette to the CD: disk for subsequent manipulation. Also transfers data from the CD: disk to the cassette.
FTR	Forward Fourier Transform process. Performs a forward transform using the Guillemin algorithm.
ITR	Inverse Fourier Transform process performs an inverse transform using the Guillemin algorithm.
MUL	Multiplication process. Performs a multiplication of two data sets in frequency or time domain.
DIV	Division process. Performs a division of two data sets in frequency or time domain.
ADD	Addition process. Performs an addition of two data sets in frequency or time domain.
SUB	Subtraction process. Performs a subtraction of two data sets in frequency or time domain.
SCL	Scaling Process. Performs scalar arithmetic on either time or frequency domain data files.
PLT	Plot process. Plots a specified data set.

ANL - Analytical Waveform process. Generates a time domain waveform based upon operator entries of coefficients of an analytical expression. This process issues subsequent prompts.

LON - Log-on process. Logs the user onto the system and allows the operation of the other IAP processes.

LOF - Log-off process. Logs the user off of the system and allows the deletion or preservation of all or selected files created during the processing sequence. When no processing has been done LOF allows deletion of previously created data files.

DED - Data Edit process. Performs editing on the data by allowing corrections, insertions, deletions and appendages to the data. DED will also accept entries in a tabular form for data in both frequency and time domain. Data can also be listed from an existing file using this process.

LHD - List header process. List all records of the header for a specified file.

TPC - Tape copy process. Copy all of a cassette tape into a disk file. Primarily used for the conversion of old format tapes.

CVT - Convert tape process. To convert tape files copied onto disk by TPC from the CW1 file format to CWII file format.

AHD -Add header process. Add header to time and frequency domain files for CWII compatibility

MIS - Mission file listing process. To list the contents of a requested mission file on the screen.

The variations on the standard syntax, including switch specifications, are included following this discussion. The specifications include some notation with which the reader may not be familiar. This notation is discussed below:

[ ] - items found within square brackets are optional and are not required in the indicated position.

infile - outfile - filename — these items refer to file specifiers. A file specifier consists of a filename (eight characters max) and an optional extension. An extension consists of a period (".") followed by a one to three character string.

Items listed in brackets { } denote a list of choices of which only one may be selected. For example:

{DIV, MUL, ADD, SUB} indicates that one of DIV, MUL, ADD, or SUB is selected, but not more than one.

Following are details of the IAP command syntaxes.

8-2 CASSETTE TAPE TRANSFER (CTP)

Purpose: To transfer data files to and from cassette volumes to the data disk for subsequent plotting and other manipulations.

Command: (to transfer data from disk to tape)

CTP /TP:number[/NEW]=infile.ext

Command: (to transfer data from tape to disk)

CTP [outfile]=infile.ext/TP:number

infile.ext -this is the name of the tape file to be read, or the name of the disk file to be written to tape, depending on the form used. The filename to be written on tape must be unique to the tape. If is is not unique the operator will be given the option to place the file in a different name on that tape, change the tapes or quit. To place the file in a different name, the operator must specify a unique 5 character name to which the current Julian date will be appended. (Must be a fully specified name.)

/TP:number - cassette tape number identifying the tape from (or to) which the transfer is to be effected.

/NEW..... - optional switch which specifies that the cassette is to be initialized as the specified cassette number. May only be used on the disk to tape form. If used with an infile specification, the cassette is initialized and the file is written. If the file specification is omitted, the tape is only initialized.

outfile... - this is the name of the disk file to be written - the filename will be checked for uniqueness. (If the name is not unique the program will exit.) When not specified, the outfile will be named from the tape directory entry. (5 characters, no extension.)

CTP can also be used to list a cassette directory. The command form to do this is as follows:

Command: CTP [TI:]/DIR

[TI:] - optional device (LP: is the line printer and TI: the users terminal) to which the directory is written. Default is

/DIR... - switch that indicates a directory list request. Directory of tape currently mounted in the drive will be listed.

The directory listing will appear as follows:

```
TAPE NUMBER:  XXXX
FILENAME      SIZE
filename.ext  XXXX
filename.ext  XXXX
(etc., up to eight files per tape)
```

where: XXXX is a four digit number

Note: The operator can view the header information of any file on tape by copying the file to disk and using the LHD command.

8-3 FORWARD FOURIER TRANSFORM PROCESS (FTR)

Purpose: To perform a Fourier transform.

Command: FTR outfile[/PPD:i:j:k:l:m:n]=infile.ext

outfile - name of file to contain frequency domain data set. (five characters, no extension)

[/PPD:i:j:k:l:m:n] - optional number of frequency points in each frequency decade.

i -	number of points	1	- 10 KHz
j -	" "	10	- 100 KHz
k -	" "	100	- 1000 KHz
l -	" "	1	- 10 MHz
m -	" "	10	- 100 MHz
n -	" "	100	- 1000 MHz

Any positive integer value is accepted but there is a maximum value of 1000 points in a decade and an overall maximum number of points of 1000.

The default is:

0:100:100:100:100:0

infile.ext - name of time domain data set on which transform is to be performed. (Must be a fully qualified name.)

8-4 INVERSE FOURIER TRANSFORM PROCESS (ITR)

Purpose: To perform inverse Fourier transform.

Command: ITR outfile[/PTS:n][/MTM:t]=infile.ext

outfile -- name of the file to contain time domain data set. (five characters, no extension)

[/PTS:n] - optional number of time points to be produced in outfile with a maximum of 1000 points. Default: 500.

[/MTM:t] - optional maximum time in outfile.

t - floating point value in seconds.

default based on range of frequency data set.

Note: Number of points and maximum time must be consistent with the Nyquist criteria, meaning data beyond t max = N/(2 * fmax) and data when t (sampling rate) > 1/(2 * fmax) may be invalid. N = number of time points.

infile.ext - name of file containing frequency domain data set. (Must be a fully qualified name.)

8-5 MULTIPLICATION PROCESS

Purpose: To perform multiplication, division, addition or subtraction of two data sets in either frequency or time domain.

Command: {DIV / MUL / ADD / SUB} outfile [/PPD:i:j:k:l:m:n] =infile1.ext[,infile2.ext] [/TIM:t]

outfile - name of new file containing results of the multiplication, division, addition or subtraction operation. The file name must be unique (five characters, no extension).

[/PPD:i:j:k:l:m:n] - number of frequency points in each frequency decade

i -	number of points	1 -	10 KHz
j -	" "	10 -	100 KHz
k -	" "	100 -	1000 KHz
l -	" "	1 -	10 MHz
m -	" "	10 -	100 MHz
n -	" "	100 -	1000 MHz

If this parameter is not specified for a frequency domain data set, the output file will contain the same points per decade as infile1. The total number of points specified cannot exceed 1000. Empty decades may be specified between non-empty decades.

Note: Decades for which no data is available in both input files will be made empty independent of the number specified for that decade.

[/TIM:t] - the time interval between samples in the time domain. This value may not result in more than 1000 samples. t is a real number expressed in nanoseconds, i.e. 2.5,etc.

default: t is calculated using the minimum and maximum data values. t is a real value. Calculate to give 500 time domain samples.

infile1 - the first data set in frequency or time domain. unique. [infile2]- optional second data set in the same domain as infile1. (Must be a fully qualified name.)

Note: If this file is not specified, infile1 is copied to the output file (except for possible

modification of numbers of points per decade or number of time samples).

Input files, are interpolated where necessary in order to perform the requested computation.

Note: It is left up to the operator to perform operations which will result in meaningful data.

The operator will be prompted for up to 60 bytes (characters) of comments to be entered into the file header:

> ENTER 60 BYTES OF COMMENTS:

This entry can be used by the operator to aid in tracing the data operations performed to achieve the new data set.

The file(s) specified in the command line and the operation performed will be saved in records five through seven of the header.

infile2 is subtracted <u>from</u> infile1; infile 1 is divided <u>by</u> infile2.

Note: In order to view the header entries the operator may use the LHD command.

8-6 SCALING PROCESS (SCL)

Purpose: To perform scalar arithmetic on either time or frequency data files.

Command: SCL Outfile $\left\{\begin{matrix}\text{ADD}\\\text{SUB}\\\text{MUL*}\\\text{DIV*}\end{matrix}\right\}$ = Infile.ext /val: <value>

Outfile - Name of the new file containing results of the operation performed. The outfile name must be unique (5 characters, no extension).

Infile -- The data input on which the desired operations is to be performed.

[/VAL] -- The scalar value to be applied (required) (In FORTRAN floating point format)

Note: The operations performed by this scalar routine are:

a) Time domain -/ADD Time domain -/SUBTRACT Time domain -/MULTIPLY Time domain -/DIVIDE

b) Frequency Domain -/ADD Frequency Domain -/SUBTRACT

The units of input scalar (VAL) must be the same as the input file. These are:

Time - Engineering Units
Frequency - dB

* Frequency domain MULTIPLY and DIVIDE are not provided. (No operations are provided on phase information).

8-7 PLOT PROCESS (PLT)

Purpose: To operate the plotting program.

Command:

```
PLT TI: [/HDR][/OVL]=infile1.ext{[/AMP[:f1:f2][:a1:a2]][/PHS[:f1:f2]]}
    PL:                         {[/TIM[:t1:t2][:a1:a2]]               }

        [,infile2.ext][,infile3.ext]...[up to 6 files]
```

Note: As many files as can fit on one command line of 80 characters can be overlayed, to a maximum of six.

```
PLT TI:  [/HDR]=infile1.ext{[/AMP[:f1:f2][:a1:a2]][/PHS[:f1:f2]]}
    PL:                    {[/TIM[:t1:t2][:a1:a2]]}

         [,infile2.ext{[/AMP[...]][/PHS[...]]}
                      {[/TIM[...]]           }
```

where each plot type (/AMP, /PHS, /TIM) can be requested only once per PLT command line.

TI: - device on which the plot is to be drawn.
TI: specifies the users terminal,
PL: PL: specifies the plotter.

[/AMP[:f1:f2][:a1:a2]] - optional amplitude plot specification
or
[/NOAMP]

f1 and f2 specify frequency bounds of the selected plots. Default is full range available data.

a1 and a2 specify the magnitude bounds of the selected plots. Default is full range of available data. Note: To set the magnitude bounds but autoscale the frequency bounds (or time bounds for TIM) enter only the colons for the first two parameters followed by a blank i.e. /AMP: : :10:100

default: autoscale (rounded)

/NOAMP - specifies no plotting of amplitude data.

default: /AMP

[/PHS[:f1:f2]] - optional phase plot specification
or
[/NOPHS]

f1 and f2 same as /AMP - except - if :f1:f2 is specified for/AMP

default: autoscale (rounded)

/NOPHS - specifies no plotting of phase data.

default - /PHS

[/TIM[t1:t2][:a1:a2]] - optional time domain plot specification

or [/NOTIM]	t1 and t2 specify starting and ending times for selected plot; default is full range of available data. Units are microseconds. a1 and a2 same as in /AMP. Note: To set the magnitude bounds but autoscale the frequency bounds (or time bounds for TIM) enter only the colons for the first two parameters followed by a blank i.e. /AMP: : 10:100 default: autoscale (rounded) /NOTIM - specifies no plotting of time domain data. default - /TIM
[/HDR] or [/NOHDR]	specifies whether full header data is to be included on the plot. default: /HDR (full header)
[/OVL] or [/NOOVL]	specifies whether multiple input files are to be overlay plotted or drawn separately. Default: /NOOVL
infile1-infilen -	names of files from which data to be plotted is taken. (Must be fully qualified names)

Note: Scaling for overlayed plots is controlled by the first file in the list.

Examples of common PLT requests:

- To get a hard copy of the overlay of three time domain plots with autoscaling.

```
PLT PL:/OVL=TEST1071.TCA, TEST2063.TCA, TEST3121.TCA
```

- To plot on the terminal a CW measured data file and its inverse after the threatwave has been applied.

```
PLT TI:=C7341066.CMA, C7341066.TCA
```

- To get a hard copy plot of one area of a phase plot expanded:

```
PLT PL: = CWTST060.FCA/NOAMP/PHS:10.:100.
```

- To plot on the terminal and prescale both the frequency and the magnitude.

```
PLT TI:=E1234111.CMA/AMP:1:100.:0:-80
```

- To plot on the terminal and prescale the amplitude only

```
PLT TI:=W5555213.TDA/TIM: : :4.E-5:-4.E-5
```

8-8 ANALYTICAL WAVEFORM PROCESS (ANL)

Purpose: To produce analytical waveform in time domain.

Command: ANL outfile[/PTS:n][/MTM:t]

This program prompts the user for the constant coefficients and angles for the following equation:

$$f(t) = A\,[B \quad + Dt \quad + Ee \quad (\cos(2 \quad Gt - H)) + J]$$

The result is a time domain file which can be transformed to the frequency domain.

outfile - name of new file containing results of the analytical waveform. The filename must be unique (5 characters, no extension). /PTS:n - a switch specifying the desired number of points. default: 500

/MTM:t - a switch specifying the maximum time value. default: 5.0 microseconds

In the equation:

A is the overall scaling factor
B is the exponent amplitude factor for the first term
C & F are a time value in seconds -1 or 1/seconds
D is the exponent amplitude factor for the second term
E is the sinusoid amplitude factor
G is a frequency value in seconds -1 or 1/seconds
H is the angle in radians
J is the D. C. bias value

The constant A can be used to scale the entire expression within the brackets.

The constant J can be used to add (or subtract) a D. C. offset.

The operator will be prompted for the test sequence number as follows:

ENTER TEST #(1-9999):

Following are several examples of various waveforms obtained by using the analytical equation above.

EXAMPLE 1

Using the first term and setting all others to zero a single exponential will be generated. The equation becomes:

$$f(t) = ABe^{Ct}$$

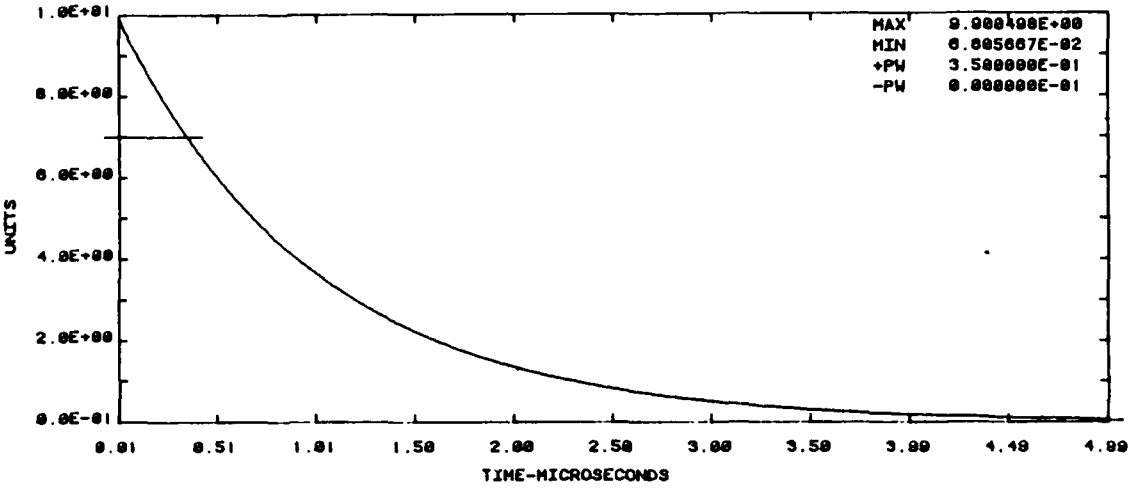
let:

A = 1.0
B = 1.0
C = -1.0E6
D,E,F,G,H,J = 0.0
MTM, PTS = default values

then

$$f(t) = 1.00e^{-10E6}$$

will produce



The same result can be obtained by using the third term alone i.e. let B = D = 0.0,

$$f(t) = A[Ee^{Ft} (\cos(2\pi Gt - H)]$$

with G = H = 0.0

the resulting equation is

$$f(t) = AEe^{Ft}$$

EXAMPLE 2

A double exponential can be formed by combining the two equations above.

Set D = 0
G = 0
H = 0
J = 0

resulting in

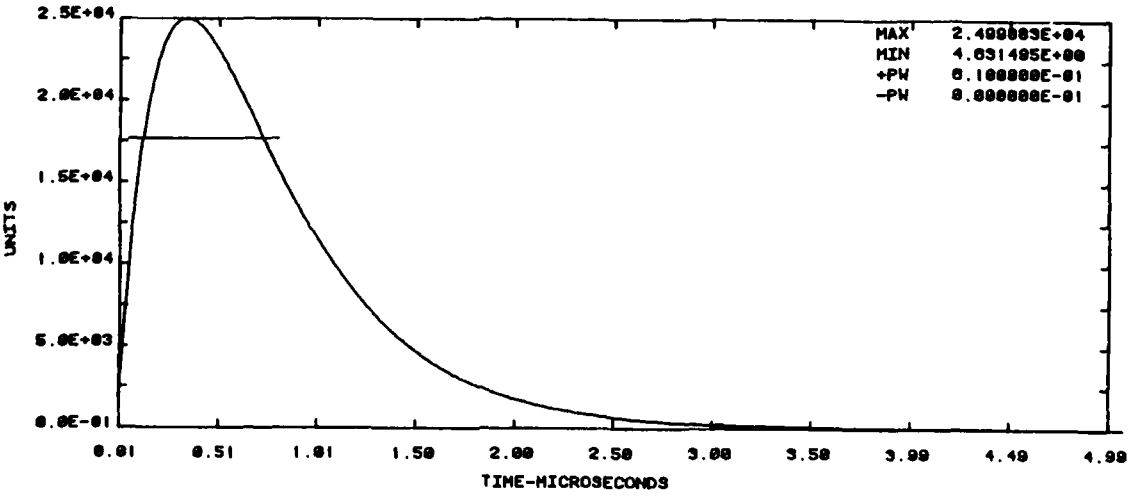
$$f(t) = A\,[Be^{Ct} + Ee^{Ft}]$$

and using MTM, PTS = default values

Let
A = 1.0E5
B = 1.0
C = -2.0E6
E = -1.0
F = -4.0E6

$$f(t) = 10\,[e^{-2.10^6 t} - e^{-4.10^6 t}]$$

will produce



EXAMPLE 3

A double exponential with critical damping occurs when the first two terms are used since C is the same for both. The equation is of the form:

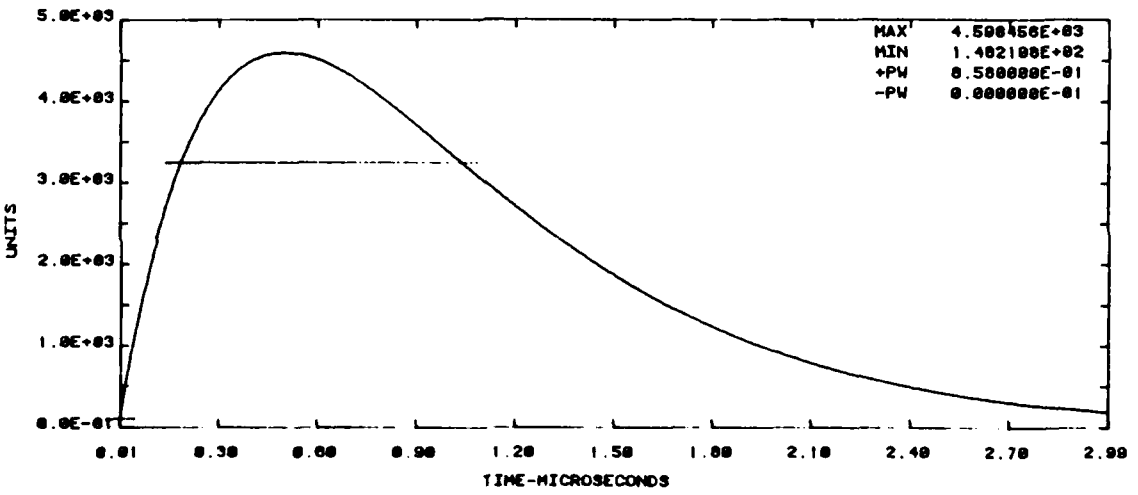
$$f(t) = A\,[Be^{Ct} + Dte^{Ct}]$$

let

A = 5.0E4
B = 0.0
C = -2.0E6
D = 5.0E5
E, F, G, H, J = 0

then

$$f(t) = 5.10\ \ [5.10^{5}te^{-2.10^{6}t}]$$



EXAMPLE 4

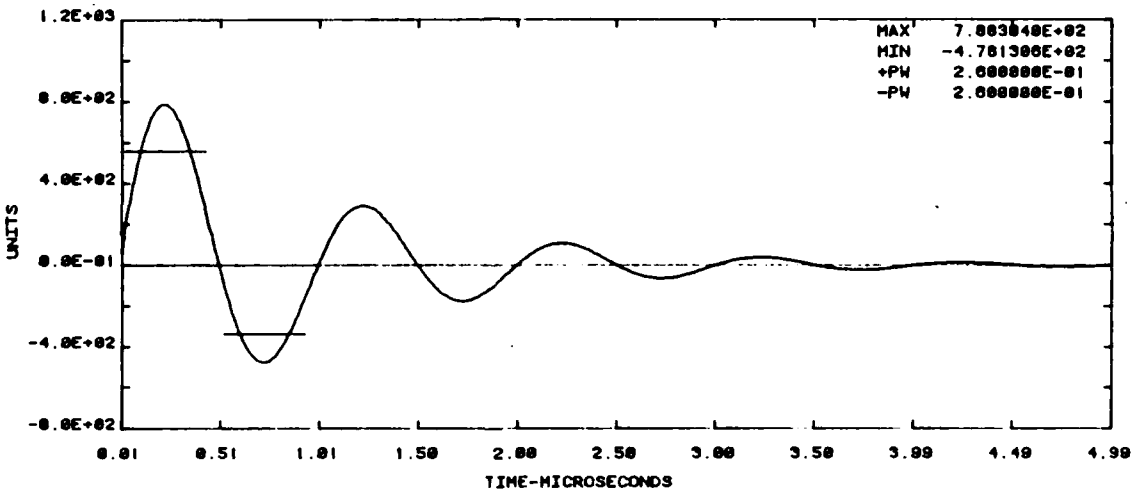
A damped sine wave can be generated using the given equation by the following form.

$$f(t) = A\,[Ee^{Ft}(\cos(2\pi Gt - H))]$$

Since a sine wave is desired set $H = \frac{\pi}{2}$. This uses the trig. identity $\sin(t) = \cos(t - \pi/2)$ The frequency is set by the variable G.

Let:

A = 1.0E3
E = 1.0
F = - 1.0E6
G = 1.0E6
H = w = 1.570796
B, C, D, J = 0



8-9 LOG-ON PROCESS (LON)

Purpose: To log the operator onto and off of the system allowing full use of the analyst package.

Command: LON
or
LOF

When LON is entered the operator is informed if the log-on is successful.

USER LOGGED ON - BEGIN ACTIVITY

When LOF is entered the user will be asked if any files are to be saved.

DO YOU WISH TO SAVE ALL FILES CREATED THIS SESSION?

"This session" means since the LON command was last issued. The following actions occur with the indicated responses -

'Y' -USER LOGGED OFF is displayed and control is returned to to the operating system.

'N' -the operator is prompted for file deletion

DO YOU WISH TO DELETE ALL FILES CREATED THIS SESSION?

'Y' -Care should be taken in responding Yes to this prompt. All files created via analyst functions since the last LON command are deleted then USER LOGGED OFF is displayed and control returned to the operating system.

'N' -the user is prompted to delete each file created individually.

DO YOU WISH TO DELETE CD:[200,2]FILENAME.EXT?

'Y' - the file is deleted and the operator is prompted to delete the next file in the list in the same way. If there are no more files in the list the log-off is completed.

USER LOGGED OFF

'N' - the operator is prompted to delete the next file in the same way. If there are no more files, log-off is completed.

USER LOGGED OFF

There exists a problem when files are not deleted frequently. All available space will be used on the disk and no more files

can be created. The LON and LOF commands have been designed in such a way that the entire data file storage area can be cleaned out when no new fles have been created since the last LON command was issued. The following prompts will also occur if analyst functions which create no files are the only ones used during this session. After LOF is entered the operator is prompted to delete previously created files (ones prior to this session).

DO YOU WISH TO DELETE PREVIOUSLY CREATED FILES?

'N' -USER LOGGED OFF is displayed and control returns to the operating system.

'Y' -the user is prompted with:

DO YOU WISH TO DELETE ALL THE FILES?

'Y' -Extra care must be taken before responding with Yes to this prompt. All files which have been made available for analyst use will be deleted. Then log-off is completed as before.

USER LOGGED OFF

'N' -The operator is prompted to delete each file individually which is stored in the analyst data file area.

DELETE FILE DL1:[200,2]FILENAME.EXT?

'Y' -The file named is deleted and the operator is prompted as before, to delete the next file in the storage area. If there are no more files log-off is completed.

USER LOGGED OFF

'N' -The operator is prompted, as before, to delete the next file. Otherwise, log-off is completed.

USER LOGGED OFF

8-10 DATA EDIT PROCESS (DED)

Purpose: To edit data in a specified file or provide tabular input of data points for operator defined data.

Command: DED outfile/CR (for tabular input)
DED infile.ext (for data editing)

outfile - a specified filename which will contain frequency or time domain data entered by the user. The operator must insure the name was not previously assigned to a different data file. (5 characters, no extension)

/CR - a switch to indicate the creation of a new file.

infile.ext - a specified filename which contains the data to be modified or listed (must be a fully qualified name).

During file creation mode the operator will be prompted for a test sequence number to be entered into the file header:

```
>ENTER TEST # (4 CHAR):
```

After all data values are entered the operator will be prompted to enter the number of points for each decade.

```
ENTER POINTS FOR DECADE 1
ENTER POINTS FOR DECADE 2
  .
  .
  .
ENTER POINTS FOR DECADE 6
```

When data edit mode is entered the operator will be requested to enter the function desired:

```
>ENTER DESIRED PROCESS:
 (1) LIST
 (2) APPEND
 (3) INSERT
 (4) MODIFY
 (5) DELETE
 (6) EXIT
```

The integer value for the selected process should be entered. i.e. 1-6. A numbering scheme will be used to reference each triplet or doublet in a data file. The number associated with each data group can be seen by selecting the LIST option. These numbers will also be used in options 2 through 5 to selected data values for editing. The following example shows how list will display these numbers.

```
.
.
.
127      8.879E+02     -9.134E+02
128      1.432E+03      8.844E+02
.
.
.
```

Numbers 127 and 128 would be used to locate these data values within the file. Note that these numbers are likely to change after any one process (2-5) has completed.

Note: Simultaneously depressing the CNTL key and the S key (<CNTL S>) will termporarily suspend the printing of the data. <CNTL Q> resumes the data printing. The ROLL UP/DOWN keys on the console can be used to see data outside the physical screen display.

When option 2, APPEND, is selected the operator is prompted to:

ENTER ITEM # TO APPEND TO

The operator should enter the integer number, as found in LIST, corresponding to the data set (doublet or triplet) positioned immediately before the desired point of entry. Data sets can be entered until the operator signals completion by simultaneously typing CNTL and Z (<CNTL Z>) in response to the first value of a data set. More appending (using the same process) may be done at a point further in the file from the present position if the operator so chooses.

Option 3, INSERT, works in a similar fashion to option 2. The only difference is the integer number entered in response to the prompt for the item # corresponds to the data set immediately following the point of insertion.

To MODIFY a data set, option 4 should be selected. The integer number corresponding to the exact data set to be changed should be entered in response to the prompt:

ENTER ITEM # TO MODIFY

The operator is then prompted to enter each value of the data set, a <CR> will cause that entry to remain as it was. This allows minimal typing when only one value of a data set is to change. Modifications can be made to data sets with a higher item # if requested by the operator.

Option 5, DELETE, allows for the deletion of one (or more - if consecutive) data set(s) from the file when prompted with:

ENTER ITEM # TO DELETE

the operator responds with the integer number corresponding to the first data set to be deleted. The operator is then prompted with:

ENTER THE NUMBER OF CONSECUTIVE ITEMS TO BE DELETED

The DELETE process can be repeated on data sets with a higher item number as often as desired by the operator.

NOTE: When options 1 through 5 are completed the operator is again shown the menu and prompted for a desired process. If more than one of the functions, 2-5, are to be performed on a single data file, it is advised for the operator to select the LIST option between each operator. Using this method the operator will know the correct item numbers to select.

EXITING the program via option 6 discloses several options for the naming of the file to adhere to the conventions defined for the CW2 system.

If the create mode was used, the file created is named using the characters entered in the command line. The current Julian date, a period ('.') and an extension ('FDA' or 'TDA' - depending on the data type) are appended.

When only option 1, LIST is selected there are no changes made to the file so the name entered in the command line remains the same.

Options 2 through 5 leave the operator with an original file and a modified file. First, the operator is prompted to delete the original file. If the original file is deleted the modified file can be named with the original file name if the operator so chooses. When the operator chooses not to delete the original file or not to use the original name for the modified file a prompt is given to enter up to 5 unique characters for the file name. The Julian date and extension are appended to result in the full name for the modified file. The new file is then placed in the LOG of analyst files created.

Note: For frequency domain data, the points must be entered in frequency, magnitude and phase triplets (monotonically increasing in positive frequency). For time domain data the points must be entered in time and amplitude doublets (monotonically increasing in positive time). There can be no duplicate time or frequency entries. Data must be entered as a floating point value. For example, 8.879E+02 or 887.9 are both acceptable. The operator will be prompted for each value to be entered in a triplet or doublet.

Note: DED will force the entry of a new time or frequency value to be greater than the previous value. It cannot, however, control what is beyond the new values. Therefore, if a file does not have monotonically increasing time or frequency values a new file will be created but the operator will be informed of the inconsistancies.

Note: The points per decade will be preserved from the header of the original file. Therefore, if any points are added or deleted the points per decade stated in the header may not be precise. The values are maintained due to the requirements to use other analyst functions.

8-11 LIST HEADER PROCESS (LHD)

Purpose: To allow viewing the header of a specified file.

Command: LHD infile.ext

infile - a specified filename which contains the header information to be viewed. (Must be a fully qualified name.)
ext....- three letter extension of the file. Will be one of the following:

AMA - Ambient noise measured data
UMA - Pick Up noise measured data
CMA - CW Measured test data
TCA - Time (transformed) calculated data
TDA - Time (transformed) defined data
PMA - Pulse measured test data
FCA - Frequency calculated data
FDA - Frequency defined data

The following pages give examples of the header d ay seen using LHD.

- A measured CW frequency domain file

```
                HEADER FOR CD:[200,2]W1267296.CMA
CW FILE                          FREQUENCY DOMAIN FILE
DATE:  23-OCT-81  TIME: 13:53:35   TEST DESCRIPTION:  CURRENT-R
TEST #: 1267      TEST LOCATION:  HDL   TEST ENGINEER:  GALLACHER
FILE ORIGIN:
COMMENTS:
TEST POINT ID: 00,56,--T   TEST ELEMENT: A19A11DV   LOG ID: 001
TYPE OF TEST: TEST          TEST CYCLE: SINGLE     TAPE IS: 303,WOOD
SIG. GAIN ADDED <DB>: -36          SIG. DELAY ADDED <NS>: 0
FILE OF SIG. PROBE: I550540        FILE OF THREAT WAVEFORM: THR.VOLT
THREAT WAVE SCALING FACTOR: 377.          FILE OR REF. PROBE: B201
REF. GAIN ADDED <DB>; -12            REF. DELAY ADDED <NS>: 0
N.W. ANALYZER DISPLAY REF. <DB>: -30       PLOT FORMAT: TFA
MINIMUMS: 1.00000E+05              -5.80142E+01       -1.78631E+02
MAXIMUMS: 9.90800E+07               1.04701E+00        1.79900E+02
TRANSFER FUNC. SYSTEM CAL:         RESPONSE FUNC. SYSTEM CAL:
POINTS IN DECADE 1:   0             POINTS IN DECADE 2:   0
POINTS IN DECADE 3:  50             POINTS IN DECADE 4: 100
POINTS IN DECADE 5: 250             POINTS IN DECADE 6:   0
TRANSFER FUNC. CAL TAPE FILE: 293,WOOD
RESPONSE FUNC. CAL TAPE FILE: 292,WOOD
TIME DOMAIN DELTA T <IF APPLICABLE>:
```

- A time domain file from a measured frequency domain file

```
                HEADER FOR CD:[200,2]W1266296.TCA
CW FILE                TIME DOMAIN FILE
DATE:  23-OCT-81    TIME:  13:47:16    TEST DESCRIPTION:  CURRENT
TEST #:  1266        TEST LOCATION:  HDL     TEST ENGINEER:  GALLACHER
FILE ORIGIN:
COMMENTS:
TEST POINT ID:   00,56,--T   TEST ELEMENT:  A19A11DV   LOG ID: 001
TYPE OF TEST:  TEST       TEST CYCLE:  SINGLE    TAPE IS:  303,WOOD
SIG. GAIN ADDED <DB>:  -36          SIG. DELAY ADDED <NS>:  0
FILE OF SIG. PROBE:  I550549        FILE OF THREAT WAVEFORM:  THRTVOLT
THREAT WAVE SCALING FACTOR:  377            FILE OF REF. PROBE:  B201
REF. GAIN ADDED <DB>:  -12             REF. DELAY ADDED <NS>:  0
N.W ANALYZER DISPLAY REF. <DB>:  -30         PLOT FORMAT:  TFA
MINIMUMS:  5.26402E-09             -1.157093+01
MAXIMUMS:  1.02000E-06              1.07656E+01
TRANSFER FUNC. SYSTEM CAL:       RESPONSE FUNC. SYSTEM CAL:
POINTS IN DECADE 1:    0          POINTS IN DECADE 2:    0
POINTS IN DECADE 3:   50          POINTS IN DECADE 4:  100
POINTS IN DECADE 5:  250          POINTS IN DECADE 6:    0
TRANSFER FUNC. CA TAPE FILE:  293,WOOD
RESPONSE FUNC. CAL TAPE FILE:  292,WOOD
TIME DOMAIN DELTA T <IF APPLICABLE>:   -1.0
```

```
;
.ASKS FUNC ENTER SCALAR FUNCTION (ADD)
;
;START THE SCALAR ROUNTINE
;
.SCL 'RNAME'/'FUNC' = 'SNAME'/VAL:'VAL'
;
;NOW WE DON'T NEED THE FILE TO WHICH THE SCALAR
;WAS APPLIED SO DELETE IT.
PIP CD:[200,2]'SNAME';1/DE
;
;EXIT THE INDIRECT COMMAND FILE WITH ONLY THE
;RESULTING FILE ON DISK
/
```

Other special symbols as well as commands not mentioned in this document, and further explanations of those that were can be found in the DEC RSX-11M MCR OPERATIONS manual.

In order for an operator to create a command file the systems text editor (EDI) must be used. Following is a brief explanation of some of the necessary EDI commands for creating an indirect command file. Further explanations and other commands can be found in the DEC RSX-11M UTILITIES manual. The editor works using an imaginary pointer which is positioned at the beginning of the current line. A file being edited is handled in pages of 36 lines. To invoke the editor enter:

EDI FILENAME.CMD <CR>

Where - FILENAME is up to 8 characters naming the indirect command file
- .CMD are the characters '.CMD'
- <CR> denotes (here and throughout this document) a carriage return

If this is the first time FILENAME has been used, EDI will respond with the following prompt

```
[CREATING NEW FILE]
INPUT
```

to be executed. This label is designated .XXX: on the appropriate line. Control is returned back to the line following the GOSUB statement when the

.RETURN command is encountered.

.GOTO XXX transfers control to statement label XXX.

There are several special symbols which the indirect command file automatically uses. These are designated with by the symbol name being enclosed in angle brackets (<>). The above example uses <STRLEN> which is assigned the length of the string entered in response to the last .ASKS command. <EXSTAT> is also used. Upon exiting a program <EXSTAT> will be set to 1 if the program completed successfully. If it doesn't, the above example will cause the indirect command file to exit.

Some processes defined by an indirect command file may create a large number of intermediate files. These files may not be of any use after the analyst function. It is a good idea to delete these files to avoid filling the disk too quickly. The following example indicates a method using the system utility PIP to delete these unwanted intermediate files. Items in parentheses are user responses.

```
.ENABLE SUBSTITUTION
;
;ASK FOR THE FILENAME TO SCALE
;
.ASKS SNAME ENTER FULLY QUALIFIED NAME (TEST1.FCA)
;
;ASK FOR RESULT FILENAME
;
.ASKS RNAME ENTER 5 CHARACTER NAME (SCAL1)
;
;GET THE SCALAR VALUE
;
.ASKN VAL ENTER SCALAR VALUE (2.31)
;
;GET FUNCTION NAME
```

Other variations of this command are:

.ASK which prompts for an entry for a logical symbol. The value assigned is true for a Y response or false for an N response.

.ASKN prompts for a numerical entry for the designated symbol.

.SETS assigns the designated string symbol the value in the command line. If the actual string is in the command it must be enclosed in quotes ('""'). For example, the first occurance of SETS puts a blank string (denoted " ") into the symbol PPD, strings can also be denoted by the concatenation of other strings and or string symbol. This is represented by a plus sign ('+') between the strings. The assignment of the maximum number of points switch and parameters for the ITR command illustrates this concept in the above indirect command file.

i.e. .SETS POINT "/PTS:"+PTS

Other variations of the SET command are explained below:

.SET assigns a logical value (true or false) to the designated symbol.

.SETN assigns a numeric value to the symbol. A symbol value can be tested using IF commands

.IFT or.IFF tests if the named symbol is set to true or false, respectively,

.IF determines if a symbol satisfies one of several conditions. The example seen is:

.IF L NE 0 The conditional operators are:

EQ or = - equal to
NE or < > - not equal to
GE or >= - greater than or equal to
LE or <= - less than or equal to
GT or > - greater than
LT or < - less than

.GOSUB XXX transfers control in the indirect command file to statement labeled XXX which begins a section of commands

```
;SKIP AROUND THE FOLLOWING SUBROUTINE
;
.GOTO 200
;
;THIS IS THE SUBROUTINE TO DETERMINE THE NUMBER OF POINTS
;FOR EACH OF THE 6 DECADES
;
.100:
.ASKS DEC1 ENTER POINTS FOR DECADE 1
.ASKS DEC2 ENTER POINTS FOR DECADE 2
.ASKS DEC3 ENTER POINTS FOR DECADE 3
.ASKS DEC4 ENTER POINTS FOR DECADE 4
.ASKS DEC5 ENTER POINTS FOR DECADE 5
.ASKS DEC6 ENTER POINTS FOR DECADE 6
.SETS PPD "/PPD:'DEC1':'DEC2':'DEC3':'DEC4':'DEC5':'DEC6'"
.RETURN
.200:
/
```

Now for a brief explanation of the commands used and some of the syntax conventions followed. All commands which are functions of the indirect command file begin with a period ('.'). Any line beginning with a semi-colon (';') is a comment line and is used for documentation. The analyst functions begin in the left column with the process named entered as though it were being invoked in response to a system prompt.

.ENABLE SUBSTITUTION allows the replacement of a symbol name with the actual "value" entered by the operator. For example, in line 11 the symbol MNAME is replaced by the five character string entered by the operator in response to this command.

.ASKS prompts the operator to make a string entry and substitutes the string entered into the symbol name declared after ASKS. All the operator sees is the actual prompt. For example,

ENTER UP TO 5 CHARACTER FILE NAME

```
;THEN THE MAX TIME
;
.SETS MAXT ""
.ASKS MTM ENTER MAX TIME:  DEFAULT BASED ON FREQ. DATA
.SETN L <STRLEN>
.IF L NE 0 .SETS MAXT "/MTM:"+MTM
;
;ISSUE THE ITR COMMAND.   THE NUMBER OF POINTS AND THE
;MAX TIME ARE OPTIONAL SWITCHES.   THE FILE ON THE RIGHT
;OF THE '=' IS THE FILE THE ITR IS PERFORMED ON
;
ITR 'INAME''POINT''MAXT' = 'MNAME''JDATE'.FCA
.WAIT ITR
;
;CHECK IF ITR COMPLETED SUCCESSFULLY
;
.SETN Q <EXSTAT>
.IF Q NE 1 .GOTO 200
;
;PLOT THE CW MEASURED DATA AND THE ITR RESULT
PLT TI: = 'MEAS', 'THRT'
.WAIT PLT
;
;CHECK IF PLT COMPLETED SUCCESSFULLY
;
.SETN Q <EXSTAT>
.IF Q NE 1 .GOTO 200
;
;PROMPT OPERATOR TO LOG OFF
;
.ASK OFF DO YOU WANT TO LOG OFF
.IFF OFF .GOTO 200
LOF
.WAIT LOF
;
```

```
;THEN THE POINTS PER DECADE
;
.ASK DEF DO YOU WANT TO DEFINE POINTS PER DECADE
.SETS PPD ""
.IFT DEF .GOSUB 100
;
;ISSUE THE MUL COMMAND;  PPD IS AN OPTIONAL SWITCH
;THE FACTORS FOR THIS EXAMPLE WILL BE A CW MEASURED
;FILE AND THE THREAT WAVE FILE
;
MUL 'MNAME''PPD'='MEAS', 'THRT'
.WAIT MUL
;
;CHECK IF MUL COMPLETED SUCCESSFULLY
;
.SETN Q <EXSTAT>
.IF Q NE 1 .GOTO 200
;
;PROMPT FOR THE JULIAN DATE
;
.ASKS JDATE ENTER 3 CHARACTER JULIAN DATE
;
;DETERMINE THE PARAMETERS NEEDED FOR THE 'ITR' FUNCTION
;
;THE FILE NAME FOR THE RESULT IS FIRST
;
.ASKS INAME ENTER UP TO 5 CHARACTER FILE NAME
;
;NEXT IS THE NUMBER OF POINTS
;
.SETS POINT ""
.ASKS PTS ENTER NUMBER OF POINTS  : 500 DEFAULT
.SETN L <STRLEN>
.IF L NE 0 .SETS POINT "/PTS:"+PTS
;
```

8-16 INDIRECT COMMAND FILES

Any of the analyst functions can be combined in an RSX-11M indirect command file to form a continuous set of processes. The user invokes an indirect command file by specifying an 'at' sign (@) followed by the filename containing the set of commands in response to a system prompt. The use of indirect command files is not new to the CW system - the CW data acquisition function is invoked via an indirect command file. The @ UP command indicates to the system that a file named UP.CMD is to be read for a series of commands.

Following is an example of an indirect command file which will multiply a specified measured CW file by a specified threat wave file. An inverse transform is then done on the multiplication result. The measured frequency domain and phase plots are drawn as is the resulting time domain plot.

```
.ENABLE SUBSTITUTION
;
;LOG THE USER ON
LON
.WAIT LON
;
;DETERMINE THE PARAMETER NEEDED FOR THE 'MUL' COMMAND
;
;THE FILE NAME FOR THE RESULT IS FIRST
;
.ASKS MNAME ENTER UP TO 5 CHARACTER FILE NAME
;
;THE FIRST FACTOR IS NEXT
;
;ASKS MEAS ENTER MEASUREMENT FILE NAME
;
;NOW THE THREAT FILE NAME
;
.ASKS THRT ENTER THREAT FILE NAME
;
```

8-15 MISSION FILE LISTING PROCESS (MIS)

Purpose: To list the contents of a specified mission file.

Command: MIS file

infile - this is the name of the mission file to be listed. Infile can be up to nine characters in length.

MIS will list the contents of INFILE on the operator's console in lines of 80 characters. The ROLL UP and ROLL DOWN keys on the terminal can be used to view contents out of the present screen range. As the list is being displayed MIS can be stopped by simultaneously pressing the CNTL key and the S key <^S> and started again using a CNTL Q <^Q>.

The format of the mission file printout is two lines per entry. The first line contains the test sequence number, the data filename, the data tape number, the Gregorian date on which the mission file entry was made, the time the entry was made, the test type, the test point ID, the test location, and the test engineer's name. The second line contains the comments from the test data file header.

8-14 ADD HEADER PROCESS (AHD)

Purpose: To add headers to time and frequency domain files to make them compatible with other analyst data files.

Command: AHD OUTFILE (/TIM[/PTS:n] or /FRE[/PPD:i:j:k:l:m:n]) = INFILE.EXT

OUTFILE - - name of the output file. (5 characters, no extension)

/TIM - - specifies a time domain file. The output file extension will be .TDA

/PTS - - specifies the number of time domain data points in the output file. If the /PTS switch is not specified the default value is 500 points. The output data will be linearly interpolated to evenly - spaced output data points spread across the range of the input data.

/FRE - - specifies a frequency domain file. The output file extension will be .FDA unless the input file extension is .CAL, in which case the output file extension is .FCA

/PPD - - specifies the number of points per frequency domain decade. If this switch is not specified the default values are 0, 0, 50, 100, 250, 0. The output data will be interpolated to frequencies calculated in the same manner as for AHD, DIV, MUL and SUB.

8-13 CONVERT TAPE PROCESS (CVT)

Purpose: To convert the files from a CW1 tape into files of a CW2 format so they can be processed using other analyst functions.

Command: CVT

The operator is prompted for the tape number.

```
ENTER TAPE NUMBER TO CONVERT
```

Up to 6 characters are entered corresponding to the number previously assigned to the tape being converted. The number entered here is the same used in TPC. Next the operator is prompted for a one character facility code which applies to a specific file on the tape being converted.

```
ENTER TEST FACILITY CODE (1 CHAR) FOR SEQUENCE#
    XXXX DATED DD-MMM-YY
```

The date and sequence number are obtained from the file header.

The operator is then informed of the file name where the converted data is stored on disk.

```
FILE CD:[200,2]FXXXXJDT.EXT IS NOW BEING CREATED
```

where:

F	is the 1 character facility code
XXXX	is the sequence # from the header
JDT	is a 3 character Julian date calculated from the header date.
EXT	is a 3 character extension identifying the type of file i.e. CMA, TCA etc.

Beginning with the facility code prompt, the process is repeated automatically for each file contained in the specified tape file.

8-12 TAPE COPY PROCESS (TPC)

Purpose: To copy an entire cassette tape onto the disk. (Used prior to CVT for CW1 format tapes.)

Command: TPC

The operator is prompted for the tape number.

```
ENTER NUMBER OF TAPE TO COPY
```

Up to six characters should be entered. These characters correspond to the number previously assigned to the cassette. When the tape copy is complete the operator is informed of the file name containing the data on disk.

```
THIS TAPE IS STORED IN DISK FILE CD:[200,2]TAPENO.OTP
```

where:

TAPENO is the tape number entered by the operator concatenated onto as many zeros as necessary to obtain 6 characters.

- A file resulting from an FTR function

```
                HEADER FOR CD:[200,2]E1266076.FCA
CW FILE                              FREQUENCY DOMAIN FILE
DATE:  23-OCT-881     TIME:  15:35:08     TEST DESCRIPTION:  CURRENT
TEST #:  1266      TEST LOCATION:  HDL          TEST ENGINEER:  GALLACHER
FILE ORIGIN:  W1266296.TCA              FTR17-MAR-82
COMMENTS:
TEST POINT ID:  00,56,--T     TEST ELEMENT:  A19A11DV    LOG ID:  001
TYPE OF TEST:  TEST      TEST CYCLE:  SINGLE     TAPE IS:  303,WOOD
SIG. GAIN ADDED <DB>:  -36        SIG. DELAY ADDED <NS>:  0
FILE OF SIG. PROBE:  I550540     FILE OF THREAT WAVEFORM:  THRTVOLT
THREAT WAVE SCALING FACTOR:  377.       FILE OF REF. PROBE:  B201
REF. GAIN ADDED <DB>:  -12        REF. DELAY ADDED <NS>:  0
N.W. ANALYZER DISPLAY REF. <DB>:  -30       PLOT FORMAT:  TFA
MINIMUMS:  1.0000E+03      0.0000E-01          -1.7980E+02
MAXIMUMS:  9.7327E+07     -8.3795E+01           1.8000E+02
TRANSFER FUNC. SYSTEM CAL:      RESPONSE FUNC. SYSTEM CAL:
POINTS IN DECADE 1:  100            POINTS IN DECADE 2:  100
POINTS IN DECADE 3:  100            POINTS IN DECADE 4:  100
POINTS IN DECADE 5:  100            POINTS IN DECADE 6:    0
TRANSFER FUNC. CAL TAPE FILE:  293,WOOD
RESPONSE FUNC. CAL TAPE FILE:  292,WOOD
TIME DOMAIN DELTA T (IF APPLICABLE):  -1.0
```

- A file resulting from an ITR function

```
                HEADER FOR CD:[200,2]ITRHD077.TCA
CW FILE                               TIME DOMAIN FILE
DATE:  23-OCT-81    TIME:  13:29:44     TEST DESCRIPTION:  CURRENT-R
TEST #:  1268    TEST LOCATION:  HDL      TEST ENGINEER:  GALLACHER
FILE ORIGIN:  W1258296.CMA          ITR18-MAR-82
COMMENTS:
TEST POINT ID:  00,56,--T    TEST ELEMENT:  A19A11DH    LOG ID:  001
TYPE OF TEST:  TEST        TEST CYCLE:  SINGLE        TAPE IS:  303,WOOD
SIG. GAIN ADDED <DB>:  -36          SIG. DELAY ADDED <NS>:  0
FILE OF SIG. PROBE: I550540      FILE OF THREAT WAVEFORM:  THRTVOLT
THREAT WAVE SCALING FACTOR:  377        FILE OF REF. PROBE:  B201
REF. GAIN ADDED <DB>:  -12         REF. DELAY ADDED <NS>:  0
N.W. ANALYZER DISPLAY REF. <DB>:  -30        PLOT FORMAT:  TFA
MINIMUMS:  0.00000E-01           -7.90398E+06
MAXIMUMS:  5.03632E-06            8.57948E+06
TRANSFER FUNC. SYSTEM CAL:       RESPONSE FUNC. SYSTEM CAL:
POINTS IN DECADE 1:          POINTS IN DECADE 2:
POINTS IN DECADE 3:          POINTS IN DECADE 4:
POINTS IN DECADE 5:          POINTS IN DECADE 6:
TRANSFER FUNC. CAL TAPE FILE:  293,WOOD
RESPONSE FUNC. CAL TAPE FILE:  292,WOOD
TIME DOMAIN DELTA T <IF APPLICABLE>:   1.00929E-08
```

- A file resulting from the edit of a file using DED

```
                HEADER FOR CD:[200,2]HDRED075.TDA
CW FILE                              TIME DOMAIN FILE
DATE:  23-OCT-81     TIME:  13:59:25     TEST DESCRIPTION:  CURRENT-R
TEST #:  1268      TEST LOCATION:   HDL     TEST ENGINEER:  GALLACHER
FILE ORIGIN:  DEDHD074.TDA                  DED16-MAR-82
COMMENTS:  TESTING HEADER ENTRY IN   MUL
TEST POINT ID:  00,56,--T    TEST ELEMENT;  A19A11DH    LOG ID:  001
TYPE OF TEST:  TEST        TEST CYCLE:  SINGLE    TAPE IS:   303,WOOD
SIG. GAIN ADDED <DB>:  -36     SIG. DELAY ADDED <NS>:  0
FILE OF SIG. PROBE:  I5550540     FILE OF THREAT WAVEFORM:  THRTVOLT
THREAT WAVE SCALING FACTOR:  377.        FILE OF REF. PROBE;  B201
REF. GAIN ADDED <DB>:  -12           REF. DELAY ADDED <NS>:  0
N.W. ANALYZER DISPLAY REF. <DB>:  -30       PLOT FORMAT:  TFA
MINIMUMS:  6.67992E-09              -1.78199E+01
MAXIMUMS:  5.00001E-06               1.57892E+01
TRANSFER FUNC. SYSTEM CAL:       RESPONSE FUNC. SYSTEM CAL:
POINTS IN DECADE 1:    0       POINTS IN DECADE 2:    0
POINTS IN DECADE 3:  100       POINTS IN DECADE 4:  250
POINTS IN DECADE 5:  500       POINTS IN DECADE 6:    0
TRANSFER FUNC. CAL TAPE FILE:    293,WOOD
RESPONSE FUNC. CAL TAPE FILE:    292,WOOD
TIME DOMAIN DELTA T <IF APPLICABLE>:    -1
```

- A file resulting from a MUL of two time domain files

```
                HEADER FOR CD:[200,2]HDRT5074.TCA
CW FILE                                    TIME DOMAIN FILE
DATE:  23-OCT-81      TIME:  13:59:25    TEST DESCRIPTION:  CURRENT-R
TEST #:  1268     TEST LOCATION:  HDL      TEST ENGINEER:  GALLACHER
FLE ORIGIN:  W1268296.TCA  TEST1071.TCA  MUL15-MAR-82
COMMENTS:  TESTING HEADER ENTRY IN   MUL
TEST POINT ID:  00,56,--T    TEST ELEMENT:  A19A11DH    LOG ID:  001
TYPE OF TEST:  TEST        TEST CYCLE:  SINGLE      TAPE IS:  303,WOOD
SIG. GAIN ADDED <DB>:  -36      SIG. DELAY ADDED <NS>:  0
FILE OF SIG. PROBE:  I550540   FILE OF THREAT WAVEFORM:  THRTVOLT
THREAT WAVE SCALING FACTOR:  377.         FILE OF REF. PROBE:  B201
REF. GAIN ADDED <DB>:  -12             REF. DELAY ADDED <NS>:  0
N.W. ANALYZER DISPLAY REF. <DB>:  -30        PLOT FORMAT:  TFA
MINIMUMS:  6.67992E-09             -1.78199E+01
MAXIMUMS:  5.00001E-06             1.57892E+01
TRANSFER FUNC. SYSTEM CAL:            RESPONSE FUNC. SYSTEM CAL:
POINTS IN DECADE 1:                   POINTS IN DECADE 2:
POINTS IN DECADE 3:                   POINTS IN DECADE 4:
POINTS IN DECADE 5:                   POINTS IN DECADE 6:
TRANSFER FUNC. CAL TAPE FILE:    293,WOOD
RESPONSE FUNC. CAL TAPE FILE:    292,WOOD
TIME DOMAIN DELTA T (IF APPLICABLE):    1.00067E-08
```

- A file created using the ANL function

```
                    HEADER FOR CD:[200,2]TEST1071.TCA
CW FILE                      TIME DOMAIN FILE
DATE:  12-MAR-82     TIME:  11:00:55     TEST DESCRIPTION:  TEST WAVE
TEST #:  1234        TEST LOCATION:      TEST ENGINEER:  OPERATOR
FILE ORIGIN:  1.00000E+00   2.00000E+00  ANL12-MAY-82
COMMENTS:  4.00000E+00   5.00000E+00   6.00000E+00   7.00000E+00  8.0000E+00
TEST POINT ID:      TEST ELEMENT:          LOG ID:
TYPE OF TEST:  TEST     TEST CYCLE:     TAPE IS:
SIG. GAIN ADDED <DB>:  -1     SIG. DELAY ADDED <NS>:  -1
FILE OF SIG. PROBE:       FILE OF THREAT WAVEFORM:
THREAT WAVE SCALING FACTOR:  0.00000E-01     FILE OF REF. PROBE:
REF. GAIN ADDED<DB>:  -1          REF. DELAY ADDED <NS>:  -1
N.W. ANALYZER DISPLAY REF. <DB>:  -1          PLOT FORMAT:
MINIMUMS:  0.00000E-01      1.02725E+01
MAXIMUMS:  5.00000E-06      1.02736E+01
ANL FUNCTION VALUE C:  3.00000E+00  ANL FUNCTION VALUE J:  9.00000E+00
POINTS IN DECADE 1:            POINTS IN DECADE 2:
POINTS IN DECADE 3:          POINTS IN DECADE 4:
POINTS IN DECADE 5:          POINTS IN DECADE 6:
TRANSFER FUNC. CAL TAPE FILE:
RESPONSE FUNC. CAL TAPE FILE:
TIME DOMAIN DELTA T <IF APPLIC>:  1.00000E-08 UNWRAP DELAY TIME:
PARSEVAL TIME:       FREQUENCY:                RATIO:
```

- A file created by DED using operator inputs

```
                    HEADER FOR CD:[200,2]TSTER075.FDA
CW FILE                      FREQUENCY DOMAIN FILE
DATE:  16-MAR-82     TIME:  08:28:01     TEST DESCRIPTION:  TEST WAVE
TEST #:  666         TEST LOCATION:    TEST ENGINEER:  OPERATOR
FILE ORIGIN:  CREATED         VIA       DED16-MAR-82
COMMENTS:
TEST POINT ID:      TEST ELEMENT:                LOG ID:
TYPE OF TEST:  TEST     TEST CYCLE:      TAPE IS:
SIG. GRIN ADDED <DB>:  -1       SIG. DELAY ADDED <NS>:  -1
THREAT WAVE SCALING FACTOR:  0.00000E-01   FILE OF REF. PROBE:
FILE OF SIG. PROBE:       FILE OF THREAT WAVEFORM:
REF. GAIN ADDED <DB>:          REF. DELAY ADDED <NS>:
N.W. ANALYZER DISPLAY REF. <DB>:          PLOT FORMAT:
MINIMUMS:  1.00000E+00         1.00000E+00            1.00000E+00
MAXIMUMS:  1.00000E+01         1.00000E+00            1.00000E+01
TRANSFER FUNC. SYSTEM CAL:  RESPONSE FUNC. SYSTEM CAL:
POINTS IN DECADE 1:    0       POINTS IN DECADE 2:    0
POINTS IN DECADE 3:   25       POINTS IN DECADE 4:  100
POINTS IN DECADE 5:  250       POINTS IN DECADE 6:    0
TRANSFER FUNC. CAL TAPE FILE:
RESPONSE FUNC. CAL TAPE FILE:
TIME DOMAIN DELTA T (IF APPLICABLE):    -1
```

The editor is now in an insert mode and the operator can begin entering the desired lines for the indirect command file. A <CR>, not preceded by any characters on that line, terminates the insert mode and prompts the operator for further EDI commands with an asterisk ('*'). If a file already exists named FILENAME, EDI responds with:

```
[000nn LINES READ IN]
PAGE 0]
*
```

The editor is now waiting for the operator to begin issuing EDI commands and explanations. These are used only when the operator is prompted by EDI with an asterisk ('*'). Each command line is terminated with a <CR>.

- <CR> - when entered as a response to '*', prints the next line and moves the line pointer
- <ESC> - escape key, when entered in response to '*', moves the line pointer back one line and prints the line
- I - initiates insert mode which can be used with one of two methods
  1) line by line insertion - begin typing the line to be inserted after the I and end with a <CR>. An EDI prompt appears on the next line.
  2) block insertion - follow the I immediately with a <CR>. The editor expects lines for insertion until a <CR>, with no preceding characters on the line, is entered.
- LIST - lists the present page
- P - prints the line currently pointed to
- T - places the line pointer in front of the first line of the current page (moves to the top)
- TOF - places the line pointer in front of the

first line of the file (moves to the top of the File)
NOTE: Everytime this command is executed a new copy (new version) of the file is made. This can lead to a problem with disk space.

D - deletes the line currently pointed to

C/STR1/STR2 - changes the first occurance, beyond the current pointer but on the same page, of Str1 to Str2.

REN - moves the line pointer to the first line of the next page (renews the page)

EX - exits the editor

EDX - exits the editor and deletes the previous version of the file if one exists.

Here is a short example of using EDI to create an indirect command file. Statements placed in parenthesis are explanatory comments and the editor responses are underlined.

```
>EDI TEST.CMD
[CREATING NEW FILE]
INPUT
 .ENABLE SUBSTITUTION <CR>   (immediately begin entries)
 .ASKS A ENTER A <CR>
 .AAK B ENTER B <CR>
 <CR>
 *LIST<CR>                   (terminates insert mode)
 .ENABLE SUBSTITUTION
 .ASKS A ENTER A
 .ASK B ENTER B
 * <ESC>                     (back up one line)
```

```
.AAK B ENTER B
* C/AAK/ASK <CR>              (fix typo)
.ASK B ENTER B
*I/<CR>                       (insert a '/' on the last line)
*EX<CR>
>                             (Control returns to operating
                               system)
```

APPENDIX A
SOFTWARE SYSTEM ERROR CODES

Should the software system or the PCU receiver subsystem detect an error, an error message appears on the CRT and all tasks currently executing immediately go to end-of-task. All files are closed and the message

TEST ABORTED VIA ABORT CODE nn

appears on the operator's console. nn is the code number of the error. The list of error codes and their meaning follows.

Errors detected by PCU

nn	meaning
00	Undefined format switch setting sensed by panel block logic.
01	Undefined decade switch setting sensed by panel block logic.
02	Data link busy on request by panel block logic.
03	Data link busy on request by data message logic.
04	Data link busy on request by end of data message logic.
05	Break point frequency not found in amplitude/frequency table.
06	Frequency exponent not found in amplitude/frequency table.
07	Invalid amplitude found in amplitude/frequency table.
08	Invalid intercycle interval in ROM table.
10	Invalid reference synthesizer amplitude in ROM table.
11	Invalid VTO synthesizer amplitude in ROM table.
12	Invalid transmitter synthesizer amplitude in ROM table.
13	Receiver abort via operator depressing stop button.

Errors detected by software system

96	Operator changed switch settings between cycles of multicycle test.
97	Decade 6 (100 - 1000 MHz) set to value other than 0 or a decade switch set to 'KFD'.

98 Attempt to process data in decade below minimum or above maximum calibration decade.

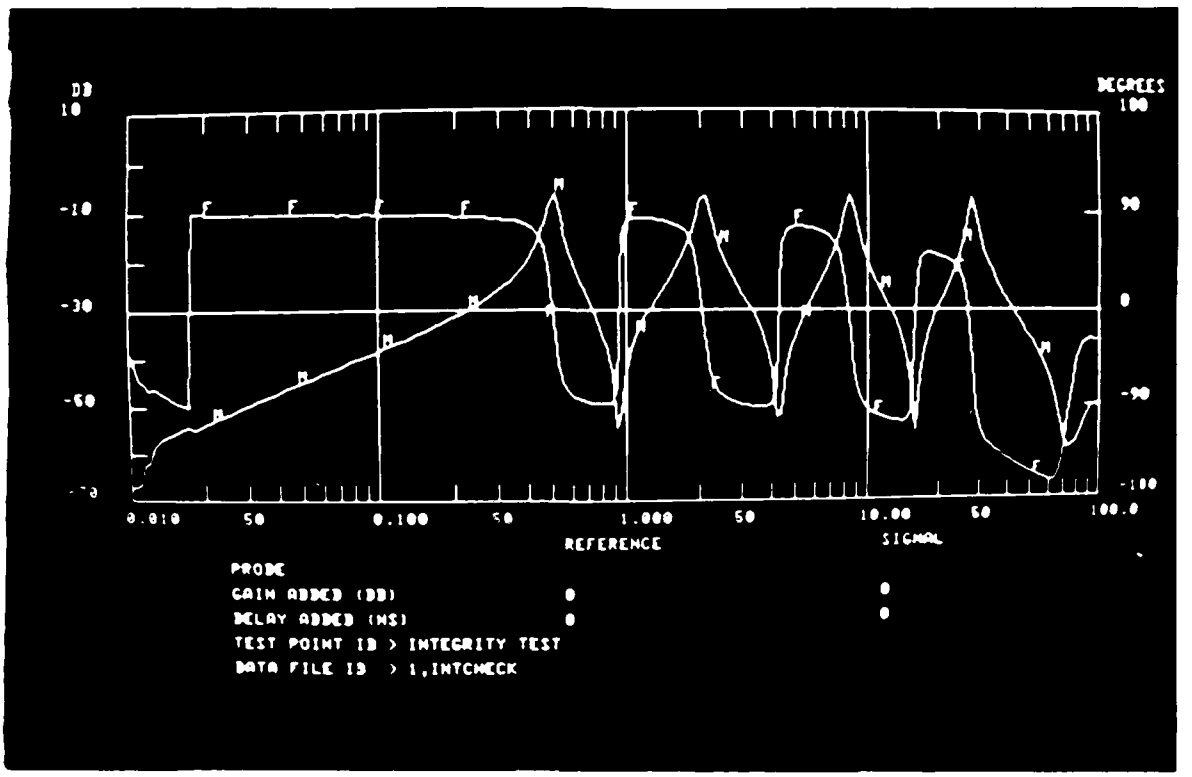
99 Bad data descriptor generated within software system due to breakdown of intertask communications.

APPENDIX B

PDP-11/34A PROTOTYPE TEST RESULTS

Here are the prototype results of the PDP-11 Integrity Test. Compare the results obtained from the test to these:

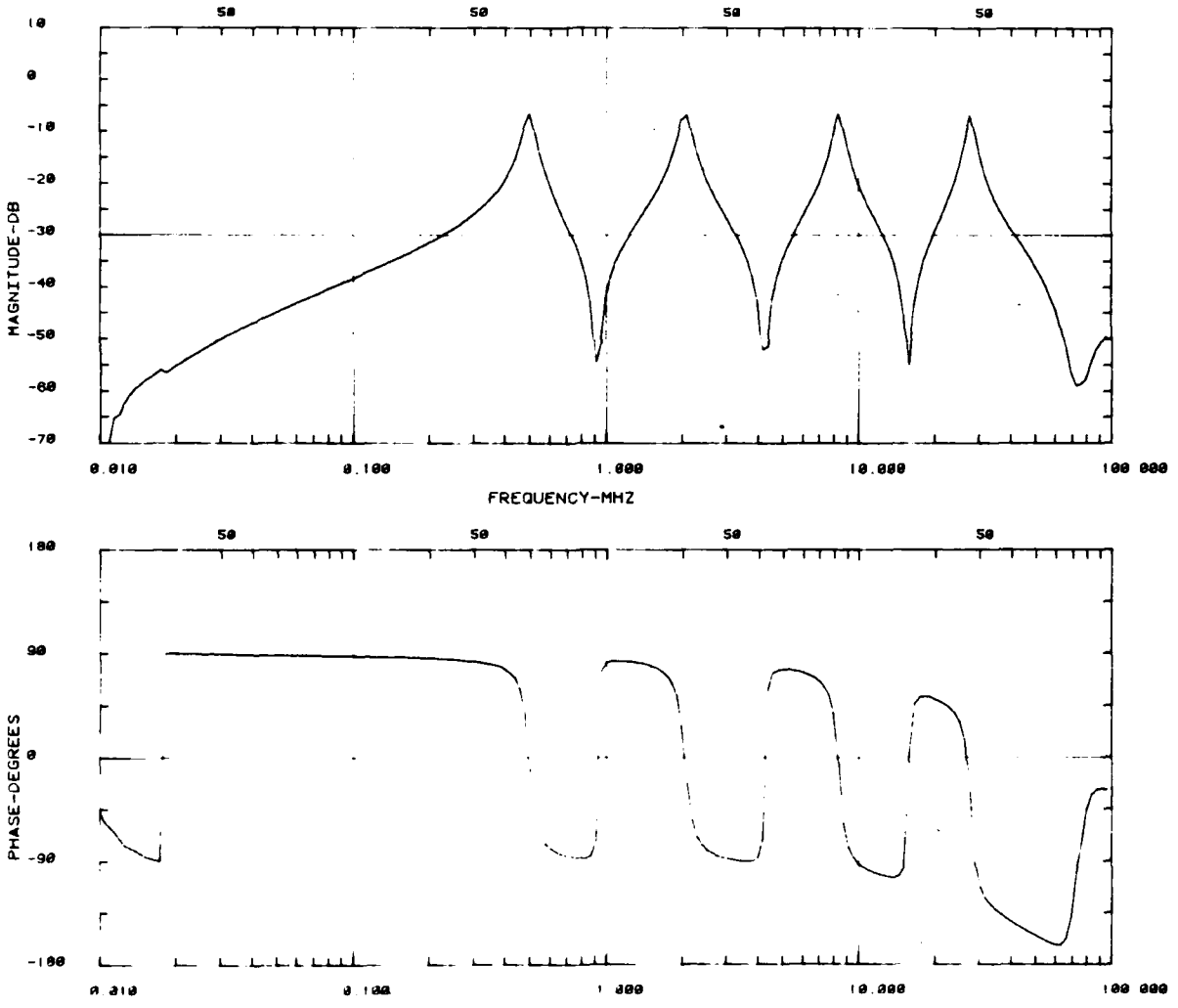
1. CRT display: Disregard any deviations between 10 and 20 kHz.



2. Hard-copy plot: Text entries marked with a star do not have to match. These entries are time and date, and secondary menu entries.

TEST POINT:	INTEGRITY TEST	*TEST LOCATION:	<ANY ENTRY WILL DO IN THIS SLOT>
*DATE:	03-APR-80	*TEST SEQUENCE #:	NOT APPLICABLE
*TIME:	16:45:50	*TEST ENGINEER:	<YOUR NAME GOES HERE>
AUTO/MANUAL:	MANUAL	*TEST ELEMENT:	PDP-11
RUN TYPE:	TCAL - TFC	*TEST TYPE:	PDP-11 SOFTWARE INTEGRITY TEST
TAPE FILE:	1,INTCHECK	*LOG ID:	<NONE>
INPUT WAVEFORM ID:	N/A	NET ANAL DISP REF:	-30
TF CAL FILE ID:	1,INTCHECK	*RF CAL FILE ID:	1,INTCHECK

	REFERENCE:	SIGNAL:
PROBE ID:	N/A	N/A
GAIN ADDED(DB):	0	0
DELAY ADDED(NS):	0	0



3. Tape file output: When dumping to CRT, the numeric entries will 'wrap' a line, and extra lines will appear between text entries. This is due to the difference between the CRT record length (80 characters) and a tape record length (86-characters). Text entries marked with a star do not have to match.

```
%1 INTCHECK%
PLOT FORMAT    TEK
NUMBER OF POINTS IN DELAYE 1      0
NUMBER OF POINTS IN DELAYE 2     501
NUMBER OF POINTS IN DELAYE 3     501
NUMBER OF POINTS IN DELAYE 4     501
NUMBER OF POINTS IN DELAYE 5     501
NUMBER OF POINTS IN DELAYE 6      0
CYCLE MODE OF TEST    SINGLE
*TEST DATE    1-MAR-80
*TEST TIME    16:45:00
TEST TYPE    TDR
SIGNAL PROBE ID    NOT APPLICABLE
REFERENCE PROBE ID    NOT APPLICABLE
TEST POINT ID    INTEGRITY TEST
TAPE FILE ID    1,INTCHECK
THREAT WAVEFORM ID    NOT APPLICABLE
REFERENCE GAIN ADDED (DB)    0
SIGNAL GAIN ADDED (DB)    0
SIGNAL DELAY ADDED (NS)    0
REFERENCE DELAY ADDED (NS)    0
NETWORK ANALYZER DISPLAY REFERENCE (DB)    -30
TRANSFER TIME BASE (US)    NOT APPLICABLE
CONVERSION FACTOR FOR E-FIELD CORRECTIONS    NOT APPLICABLE
TRANSFER FUNCTION TYPE CAL TAPE FILE ID    1,INTCHECK
*RESPONSE FUNCTION TYPE CAL TAPE FILE ID    1,INTCHECK
*TEST LOCATION    <ANY ENTRY WILL DO IN THIS SLOT>
*TEST TYPE    PDP-11 SOFTWARE INTEGRITY TEST  LOT>
*TEST ELEMENT    PDP-11
*LOG ID    <NONE>
*TEST ENGINEER    <YOUR NAME GOES HERE>
*SEQUENCE NUMBER    NOT APPLICABLE
*REMARKS    <SOMETHING ORIGINAL!
%3 TEST DATA
  1.000000E+04 -7.450000E+01 -4.620000E+01  1.040000E+04 -7.320000E+01 -5.470000E+01
  1.090000E+04 -7.490000E+01 -5.980000E+01  1.140000E+04 -6.510000E+01 -6.390000E+01
  1.200000E+04 -6.440000E+01 -7.060000E+01  1.250000E+04 -6.230000E+01 -7.570000E+01
  1.310000E+04 -6.050000E+01 -7.840000E+01  1.380000E+04 -5.940000E+01 -8.070000E+01
  1.440000E+04 -5.874000E+01 -8.250000E+01  1.510000E+04 -5.796000E+01 -8.540000E+01
  1.580000E+04 -5.726000E+01 -8.720000E+01  1.660000E+04 -5.658000E+01 -8.900000E+01
  1.730000E+04 -5.596000E+01 -8.970000E+01  1.820000E+04 -5.650000E+01  9.070000E+01
  1.900000E+04 -5.588000E+01  9.100000E+01  1.990000E+04 -5.520000E+01  9.060000E+01
  2.080000E+04 -5.456000E+01  9.050000E+01  2.180000E+04 -5.394000E+01  9.040000E+01
  2.290000E+04 -5.334000E+01  9.020000E+01  2.390000E+04 -5.276000E+01  9.050000E+01
  2.510000E+04 -5.214000E+01  8.980000E+01  2.630000E+04 -5.158000E+01  8.990000E+01
  2.750000E+04 -5.106000E+01  9.000000E+01  2.880000E+04 -5.052000E+01  8.970000E+01
  3.020000E+04 -5.000000E+01  8.970000E+01  3.160000E+04 -4.948000E+01  8.980000E+01
  3.310000E+04 -4.898000E+01  8.960000E+01  3.460000E+04 -4.850000E+01  8.950000E+01
  3.630000E+04 -4.800000E+01  8.950000E+01  3.800000E+04 -4.754000E+01  8.940000E+01
  3.980000E+04 -4.706000E+01  8.920000E+01  4.160000E+04 -4.660000E+01  8.910000E+01
  4.360000E+04 -4.614000E+01  8.900000E+01  4.570000E+04 -4.568000E+01  8.910000E+01
  4.780000E+04 -4.526000E+01  8.910000E+01  5.010000E+04 -4.480000E+01  8.910000E+01
  5.240000E+04 -4.438000E+01  8.890000E+01  5.490000E+04 -4.392000E+01  8.870000E+01
  5.750000E+04 -4.348000E+01  8.890000E+01  6.020000E+04 -4.306000E+01  8.880000E+01
  6.310000E+04 -4.262000E+01  8.870000E+01  6.600000E+04 -4.220000E+01  8.860000E+01
  6.910000E+04 -4.176000E+01  8.840000E+01  7.240000E+04 -4.134000E+01  8.850000E+01
```

7.5800000E+04	-4.0920000E+01	8.8400000E+01	7.9400000E+04	-4.0480000E+01	8.8200000E+01		
8.3100000E+04	-4.0860000E+01	8.8200000E+01	8.7100000E+04	-3.9620000E+01	8.8200000E+01		
9.1200000E+04	-3.9200000E+01	8.8200000E+01	9.5500000E+04	-3.8760000E+01	8.8100000E+01		
1.0000000E+05	-3.8340000E+01	8.8200000E+01	1.0470000E+05	-3.7900000E+01	8.7800000E+01		
1.0960000E+05	-3.7460000E+01	8.7900000E+01	1.1480000E+05	-3.7020000E+01	8.7700000E+01		
1.2020000E+05	-3.6580000E+01	8.7500000E+01	1.2590000E+05	-3.6140000E+01	8.7500000E+01		
1.3180000E+05	-3.5700000E+01	8.7400000E+01	1.3800000E+05	-3.5240000E+01	8.7300000E+01		
1.4450000E+05	-3.4800000E+01	8.7200000E+01	1.5140000E+05	-3.4340000E+01	8.7200000E+01		
1.5850000E+05	-3.3860000E+01	8.7000000E+01	1.6600000E+05	-3.3380000E+01	8.6800000E+01		
1.7380000E+05	-3.2900000E+01	8.6700000E+01	1.8200000E+05	-3.2420000E+01	8.6700000E+01		
1.9050000E+05	-3.1900000E+01	8.6400000E+01	1.9950000E+05	-3.1400000E+01	8.6100000E+01		
2.0890000E+05	-3.0880000E+01	8.6000000E+01	2.1880000E+05	-3.0320000E+01	8.5700000E+01		
2.2910000E+05	-2.9820000E+01	8.5500000E+01	2.3990000E+05	-2.9260000E+01	8.5300000E+01		
2.5120000E+05	-2.8640000E+01	8.5100000E+01	2.6210000E+05	-2.8040000E+01	8.4800000E+01		
2.7540000E+05	-2.7340000E+01	8.4200000E+01	2.8840000E+05	-2.6660000E+01	8.4700000E+01		
3.0200000E+05	-2.5900000E+01	8.3400000E+01	3.1620000E+05	-2.5080000E+01	8.2600000E+01		
3.3110000E+05	-2.4200000E+01	8.2000000E+01	3.4670000E+05	-2.3240000E+01	8.1100000E+01		
3.6310000E+05	-2.2140000E+01	8.0100000E+01	3.8020000E+05	-2.0900000E+01	7.8700000E+01		
3.9810000E+05	-1.9440000E+01	7.6500000E+01	4.1690000E+05	-1.7680000E+01	7.3700000E+01		
4.3650000E+05	-1.5460000E+01	6.9800000E+01	4.5710000E+05	-1.2520000E+01	6.0100000E+01		
4.7860000E+05	-8.6400016E+00	2.4200000E+01	5.0120000E+05	-6.5200000E+00	-4.7000000E+00		
5.2480000E+05	-1.0380000E+01	-5.1100000E+01	5.4950000E+05	-1.4600000E+01	-6.7600000E+01		
5.7540000E+05	-1.7940000E+01	-7.5200000E+01	6.0260000E+05	-2.0680000E+01	-7.4100000E+01		
6.3100000E+05	-2.3080000E+01	-8.2000000E+01	6.6070000E+05	-2.5280000E+01	-8.3900000E+01		
6.9180000E+05	-2.7400000E+01	-8.7200000E+01	7.2440000E+05	-2.9600000E+01	-8.6000000E+01		
7.5860000E+05	-3.1900000E+01	-8.8900000E+01	7.9430000E+05	-3.4600000E+01	-8.7100000E+01		
8.3180000E+05	-3.6800000E+01	-8.7100000E+01	8.7100000E+05	-4.1000000E+01	-8.6000000E+01		
9.1200000E+05	-5.4500000E+01	-7.2500000E+01	9.5500000E+05	-5.0600000E+01	7.5100000E+01		
1.0000000E+06	-4.2120000E+01	8.2400000E+01	1.0470000E+06	-3.7940000E+01	8.1700000E+01		
1.0960000E+06	-3.5100000E+01	8.3900000E+01	1.1480000E+06	-2.9840000E+01	8.3800000E+01		
1.2020000E+06	-3.0980000E+01	8.3400000E+01	1.2590000E+06	-2.9360000E+01	8.2900000E+01		
1.3180000E+06	-2.7780000E+01	8.2300000E+01	1.3800000E+06	-2.6260000E+01	8.1.0000E+01		
1.4450000E+06	-2.4760000E+01	8.0200000E+01	1.5140000E+06	-2.3180000E+01	7.8800000E+01		
1.5850000E+06	-2.1520000E+01	7.7200000E+01	1.6600000E+06	-1.9660000E+01	7.4400000E+01		
1.7380000E+06	-1.7520000E+01	7.1100000E+01	1.8200000E+06	-1.4940000E+01	6.5200000E+01		
1.9050000E+06	-1.1620000E+01	5.4000000E+01	1.9950000E+06	-7.7000016E+00	2.7200000E+01		
2.0890000E+06	-6.9800016E+00	-2.2000000E+01	2.1880000E+06	-1.0700000E+01	-5.5100000E+01		
2.2910000E+06	-1.4300000E+01	-6.9300000E+01	2.3990000E+06	-1.7140000E+01	-7.6400000E+01		
2.5120000E+06	-1.9500000E+01	-8.0500000E+01	2.6210000E+06	-2.1540000E+01	-8.3100000E+01		
2.7540000E+06	-2.3380000E+01	-8.5300000E+01	2.8840000E+06	-2.5140000E+01	-8.6800000E+01		
3.0200000E+06	-2.6840000E+01	-8.8000000E+01	3.1620000E+06	-2.8600000E+01	-8.8800000E+01		
3.3110000E+06	-3.0380000E+01	-8.9500000E+01	3.4670000E+06	-3.2440000E+01	-9.0000000E+01		
3.6310000E+06	-3.4880000E+01	-9.0100000E+01	3.8020000E+06	-3.7940000E+01	-8.9700000E+01		
3.9810000E+06	-4.2500000E+01	-8.7300000E+01	4.1690000E+06	-5.1980000E+01	-7.1500000E+01		
4.3650000E+06	-5.1320000E+01	5.9200000E+01	4.5710000E+06	-4.2200000E+01	7.3200000E+01		
4.7860000E+06	-3.7720000E+01	7.5800000E+01	5.0120000E+06	-3.4600000E+01	7.6300000E+01		
5.2480000E+06	-3.2160000E+01	7.6200000E+01	5.4950000E+06	-3.0040000E+01	7.5500000E+01		
5.7540000E+06	-2.8160000E+01	7.4600000E+01	6.0260000E+06	-2.6320000E+01	7.3400000E+01		
6.3100000E+06	-2.4500000E+01	7.1800000E+01	6.6070000E+06	-2.2560000E+01	6.9700000E+01		
6.9180000E+06	-2.0380000E+01	6.6800000E+01	7.2440000E+06	-1.7840000E+01	6.2400000E+01		
7.5860000E+06	-1.4740000E+01	5.4900000E+01	7.9430000E+06	-1.0540000E+01	5.1.8300000E+01		
8.3180000E+06	-6.6200016E+00	-5.6000000E+00	8.7100000E+06	-9.5200000E+00	-5.7500000E+01		
9.1200000E+06	-1.3900000E+01	-7.8500000E+01	9.5500000E+06	-1.7340000E+01	-8.7500000E+01		
1.0000000E+07	-2.0060000E+01	-9.2600000E+01	1.0470000E+07	-2.2340000E+01	-9.5900000E+01		
1.0960000E+07	-2.4400000E+01	-9.5000000E+01	1.1480000E+07	-2.6380000E+01	-1.0050000E+02		
1.2020000E+07	-2.8340000E+01	-1.0210000E+02	1.2590000E+07	-3.0360000E+01	-1.0320000E+02		
1.3180000E+07	-3.2660000E+01	-1.0410000E+02	1.3800000E+07	-3.5440000E+01	-1.0450000E+02		
1.4450000E+07	-3.7220000E+01	-1.0510000E+02	1.5140000E+07	-4.0620000E+01	-9.5100000E+01		
1.5850000E+07	-5.4980000E+01	-3.5000000E+00	1.6600000E+07	-4.3520000E+01	4.6600000E+01		
1.7380000E+07	-3.8020000E+01	5.2100000E+01	1.8200000E+07	-3.4420000E+01	5.2700000E+01		
1.9050000E+07	-3.1660000E+01	5.1300000E+01	1.9950000E+07	-2.9360000E+01	5.0200000E+01		
2.0890000E+07	-2.7220000E+01	4.8300000E+01	2.1880000E+07	-2.4980000E+01	4.6200000E+01		
2.2910000E+07	-2.2800000E+01	4.1000000E+01	2.3990000E+07	-1.9880000E+01	3.8400000E+01		
2.5120000E+07	-1.8540000E+01	3.0200000E+01	2.6210000E+07	-1.4020000E+01	1.5400000E+01		
2.7540000E+07	-6.9800016E+00	-3.1000000E+01	2.8840000E+07	-1.0200000E+01	-9.1800000E+01		
3.0200000E+07	-1.5050000E+01	-1.1340000E+02	3.1620000E+07	-1.8540000E+01	-1.2290000E+02		
3.3110000E+07	-2.1180000E+01	-1.2850000E+02	3.4670000E+07	-2.3360000E+01	-1.3250000E+02		

```
 1 611000E+07 -2 522000E+01 -1 357000E+02  1 802000E+07 -2 686000E+01 -1 192000E+02
 2 981000E+07 -2 848000E+01 -1 422000E+02  4 164000E+07 -3 000000E+01 -1 451000E+02
 4 365000E+07 -3 146000E+01 -1 479000E+02  4 571000E+07 -3 296000E+01 -1 504000E+02
 4 786000E+07 -3 454000E+01 -1 528000E+02  5 012000E+07 -3 618000E+01 -1 551000E+02
 5 248000E+07 -3 788000E+01 -1 575000E+02  5 495000E+07 -3 978000E+01 -1 597000E+02
 5 754000E+07 -4 192000E+01 -1 616000E+02  6 026000E+07 -4 442000E+01 -1 631000E+02
 6 310000E+07 -4 754000E+01 -1 630000E+02  6 607000E+07 -5 166000E+01 -1 575000E+02
 6 918000E+07 -5 676000E+01 -1 387000E+02  7 244000E+07 -5 906000E+01 -1 002000E+02
 7 586000E+07 -5 854000E+01 -7 550000E+01  7 941000E+07 -5 750000E+01 -4 610000E+01
 8 318000E+07 -5 418000E+01 -3 250000E+01  8 710000E+07 -5 184000E+01 -2 840000E+01
 9 120000E+07 -5 040000E+01 -2 740000E+01  9 550000E+07 -4 964000E+01 -2 840000E+01
%% END OF FILE
```

4. Corrected data file dump (FYLDMP utility): Since this run is set up as a Transfer function calibration, the file dumped is SYSTF.CAL.

END OF FILE SY:[200,1]SYSTF.CAL

1.000000E+04	-7.456000E+01	-4.620000E+01	2.754000E+05	-2.714000E+01	8.420000E+01
1.040000E+04	-7.220000E+01	-5.470000E+01	2.884000E+05	-2.666000E+01	8.370000E+01
1.090000E+04	-7.002000E+01	-5.880000E+01	3.020000E+05	-2.590000E+01	8.340000E+01
1.140000E+04	-6.516000E+01	-6.340000E+01	3.162000E+05	-2.508000E+01	8.260000E+01
1.200000E+04	-6.440000E+01	-7.060000E+01	3.311000E+05	-2.420000E+01	8.200000E+01
1.250000E+04	-6.222000E+01	-7.570000E+01	3.467000E+05	-2.324000E+01	8.110000E+01
1.310000E+04	-6.050000E+01	-7.940000E+01	3.631000E+05	-2.214000E+01	8.010000E+01
1.380000E+04	-5.946000E+01	-8.070000E+01	3.802000E+05	-2.090000E+01	7.870000E+01
1.440000E+04	-5.874000E+01	-8.280000E+01	3.981000E+05	-1.944000E+01	7.650000E+01
1.510000E+04	-5.726000E+01	-8.540000E+01	4.169000E+05	-1.768000E+01	7.300000E+01
1.580000E+04	-5.726000E+01	-8.720000E+01	4.365000E+05	-1.546000E+01	6.900000E+01
1.660000E+04	-5.670000E+01	-8.900000E+01	4.571000E+05	-1.252000E+01	6.010000E+01
1.770000E+04	-5.526000E+01	-8.910000E+01	4.786000E+05	-7.640001E+00	4.320000E+01
1.820000E+04	-5.650000E+01	9.070000E+01	5.012000E+05	-6.520000E+00	-3.700000E+00
1.900000E+04	-5.550000E+01	9.100000E+01	5.248000E+05	-1.026000E+01	-5.110000E+01
1.990000E+04	-5.520000E+01	9.060000E+01	5.495000E+05	-1.460000E+01	-6.760000E+01
2.080000E+04	-5.456000E+01	9.070000E+01	5.754000E+05	-1.794000E+01	-7.520000E+01
2.180000E+04	-5.344000E+01	9.040000E+01	6.026000E+05	-2.068000E+01	-7.910000E+01
2.290000E+04	-5.234000E+01	9.020000E+01	6.310000E+05	-2.306000E+01	-8.200000E+01
2.390000E+04	-5.276000E+01	9.050000E+01	6.607000E+05	-2.528000E+01	-8.340000E+01
2.510000E+04	-5.214000E+01	8.980000E+01	6.918000E+05	-2.740000E+01	-8.520000E+01
2.630000E+04	-5.156000E+01	8.990000E+01	7.244000E+05	-2.960000E+01	-8.600000E+01
2.750000E+04	-5.106000E+01	9.000000E+01	7.586000E+05	-3.190000E+01	-8.690000E+01
2.880000E+04	-5.052000E+01	8.970000E+01	7.943000E+05	-3.460000E+01	-8.710000E+01
3.020000E+04	-5.000000E+01	8.970000E+01	8.318000E+05	-3.800000E+01	-8.710000E+01
3.160000E+04	-4.948000E+01	8.960000E+01	8.710000E+05	-4.300000E+01	-8.690000E+01
3.310000E+04	-4.846000E+01	8.960000E+01	9.120000E+05	-5.450000E+01	-7.250000E+01
3.460000E+04	-4.850000E+01	8.950000E+01	9.550000E+05	-5.060000E+01	1.510000E+01
3.630000E+04	-4.800000E+01	8.970000E+01	1.000000E+06	-4.212000E+01	8.240000E+01
3.800000E+04	-4.754000E+01	8.940000E+01	1.047000E+06	-3.794000E+01	8.370000E+01
3.980000E+04	-4.706000E+01	8.920000E+01	1.096000E+06	-3.510000E+01	8.390000E+01
4.160000E+04	-4.660000E+01	8.910000E+01	1.148000E+06	-3.284000E+01	8.380000E+01
4.360000E+04	-4.614000E+01	8.900000E+01	1.202000E+06	-3.098000E+01	8.340000E+01
4.570000E+04	-4.566000E+01	8.910000E+01	1.259000E+06	-2.936000E+01	8.290000E+01
4.780000E+04	-4.526000E+01	8.900000E+01	1.318000E+06	-2.778000E+01	8.210000E+01
5.010000E+04	-4.480000E+01	8.910000E+01	1.380000E+06	-2.626000E+01	8.110000E+01
5.240000E+04	-4.436000E+01	8.880000E+01	1.445000E+06	-2.476000E+01	8.020000E+01
5.490000E+04	-4.392000E+01	8.870000E+01	1.514000E+06	-2.318000E+01	7.880000E+01
5.750000E+04	-4.346000E+01	8.890000E+01	1.585000E+06	-2.152000E+01	7.720000E+01
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6.310000E+04	-4.262000E+01	8.870000E+01	1.738000E+06	-1.752000E+01	7.110000E+01
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9.120000E+04	-3.920000E+01	8.820000E+01	2.512000E+06	-1.950000E+01	-8.050000E+01
9.550000E+04	-3.876000E+01	8.810000E+01	2.630000E+06	-2.154000E+01	-8.220000E+01
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1.148000E+05	-3.702000E+01	8.770000E+01	3.162000E+06	-2.860000E+01	-8.880000E+01
1.202000E+05	-3.658000E+01	8.750000E+01	3.311000E+06	-3.042000E+01	-8.950000E+01
1.259000E+05	-3.614000E+01	8.750000E+01	3.467000E+06	-3.244000E+01	-9.000000E+01
1.318000E+05	-3.570000E+01	8.740000E+01	3.631000E+06	-3.488000E+01	-9.010000E+01
1.380000E+05	-3.524000E+01	8.720000E+01	3.802000E+06	-3.794000E+01	-8.970000E+01
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1.585000E+05	-3.386000E+01	8.700000E+01	4.365000E+06	-5.112000E+01	5.320000E+01
1.660000E+05	-3.338000E+01	8.650000E+01	4.571000E+06	-4.220000E+01	7.120000E+01
1.738000E+05	-3.290000E+01	8.670000E+01	4.786000E+06	-3.772000E+01	7.580000E+01
1.820000E+05	-3.242000E+01	8.670000E+01	5.012000E+06	-3.460000E+01	7.610000E+01
1.905000E+05	-3.190000E+01	8.640000E+01	5.248000E+06	-3.216000E+01	7.620000E+01
1.995000E+05	-3.140000E+01	8.610000E+01	5.495000E+06	-3.004000E+01	7.550000E+01
2.089000E+05	-3.088000E+01	8.600000E+01	5.754000E+06	-2.816000E+01	7.460000E+01
2.188000E+05	-3.032000E+01	8.570000E+01	6.026000E+06	-2.622000E+01	7.340000E+01
2.291000E+05	-2.982000E+01	8.550000E+01	6.310000E+06	-2.450000E+01	7.180000E+01
2.399000E+05	-2.926000E+01	8.510000E+01	6.607000E+06	-2.256000E+01	6.970000E+01
2.512000E+05	-2.864000E+01	8.510000E+01	6.918000E+06	-2.018000E+01	6.680000E+01
2.630000E+05	-2.804000E+01	8.460000E+01	7.244000E+06	-1.784000E+01	6.240000E+01

```
 7.586000E+06   -1.474000E+01    5.490000E+01
 7.943000E+06   -1.054000E+01    3.830000E+01
 8.318000E+06   -6.620001E+00   -5.600000E+00
 8.710000E+06   -9.520000E+00   -5.750000E+01
 9.120000E+06   -1.190000E+01   -7.850000E+01
 9.550000E+06   -1.734000E+01   -8.750000E+01
 1.000000E+07   -2.005000E+01   -9.260000E+01
 1.047000E+07   -2.234000E+01   -9.590000E+01
 1.096000E+07   -2.440000E+01   -9.850000E+01
 1.148000E+07   -2.636000E+01   -1.005000E+02
 1.202000E+07   -2.814000E+01   -1.021000E+02
 1.259000E+07   -2.976000E+01   -1.032000E+02
 1.318000E+07   -3.126000E+01   -1.041000E+02
 1.380000E+07   -3.264000E+01   -1.045000E+02
 1.445000E+07   -3.392000E+01   -1.033000E+02
 1.514000E+07   -4.562000E+01   -9.510000E+01
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 1.660000E+07   -4.352000E+01    4.660000E+01
 1.738000E+07   -3.802000E+01    5.210000E+01
 1.820000E+07   -3.442000E+01    5.270000E+01
 1.905000E+07   -3.166000E+01    5.190000E+01
 1.995000E+07   -2.936000E+01    5.020000E+01
 2.089000E+07   -2.722000E+01    4.810000E+01
 2.188000E+07   -2.498000E+01    4.620000E+01
 2.291000E+07   -2.260000E+01    4.300000E+01
 2.399000E+07   -1.988000E+01    3.840000E+01
 2.512000E+07   -1.654000E+01    3.090000E+01
 2.630000E+07   -1.202000E+01    1.540000E+01
 2.754000E+07   -6.980001E+00   -3.100000E+01
 2.884000E+07   -1.020000E+01   -9.180000E+01
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 4.786000E+07   -3.454000E+01   -1.528000E+02
 5.012000E+07   -3.618000E+01   -1.551000E+02
 5.248000E+07   -3.788000E+01   -1.575000E+02
 5.495000E+07   -3.978000E+01   -1.597000E+02
 5.754000E+07   -4.192000E+01   -1.616000E+02
 6.026000E+07   -4.442000E+01   -1.631000E+02
 6.310000E+07   -4.754000E+01   -1.639000E+02
 6.607000E+07   -5.166000E+01   -1.635000E+02
 6.918000E+07   -5.676000E+01   -1.387000E+02
 7.244000E+07   -5.300000E+01   -1.002000E+02
 7.586000E+07   -5.854000E+01   -7.550000E+01
 7.943000E+07   -5.750000E+01   -4.610000E+01
 8.318000E+07   -5.418000E+01   -2.260000E+01
 8.710000E+07   -5.184000E+01   -2.840000E+01
 9.120000E+07   -5.040000E+01   -2.740000E+01
 9.550000E+07   -4.964000E+01   -2.840000E+01
-1.000000E+00    0.000000E-01    0.000000E-01
END OF FILE REACHED
```

APPENDIX C
CWII DATA FILES

CWII calibration and test measurement data may be saved on disk or on cassette tape. In either case the data files are exactly the same; only the file format is different.

Data saved on disk is stored in UICs [200,1] or [200,2] on pseudo devices CD: or SY: depending on the type. The data file name reflects the type of measurement and the Julian date on which the data was acquired, as follows:

- Data acquired from the reference sensor for signal-to-noise ratio calculations or amplitude control prom programming (test type = 'RFSN') is stored under the name 'CD:[200,2]INREFjjj.FMA', where jjj is the current Julian date.
- System response function cal data (test type = 'RCAL') is always stored in file 'SY:[200,1]SYSRF.CAL'. This data may also be saved for analyst use. The analyst filename will be 'CD:[200,2]SYSRFjjj.FMA', where jjj is the current Julian date.
- System transfer function cal data (test type = 'TCAL') is always stored in file 'SY:[200,1]SYSTF.CAL'. The data may also be saved for analyst use. The analyst filename will be 'CD:[200,2]SYSTFjjj.FMA', where jjj is the current Julian date.
- Probe calibration files (test type = 'PCAL') are always stored in file 'SY:[200,1]probeID.CAL', where 'probeID' is the identifier entered by the operator during the probe calibration sequence. These files may also be saved for analyst use. The analyst filename will be 'CD:[200,2]probejjj.FMA', where 'probe' is the first five characters of the probe identifier mentioned above, and jjj is the current Julian date.
- Test data files may include ambient noise, pickup noise, measurement data and inverse transform data.

None of these is saved unless specifically requested by the operator. The files are saved as follows:

Ambient noise: the data is saved in filename 'CD:[200,2]TSEQNjjj.AMA', where 'T' is the test facility code, 'SEQN' is the test sequence number and jjj is the current Julian date.

Pickup noise: as above except the file extension is '.UMA'.

Test data: as above except the extension is '.CMA'.

Inverse transform data: as above, except the extension is '.TCA'.

Any or all of the above files may be also sent to cassette tape. The file identifiers are the same on the tape as they are for the disk data files, with the exception that the device and UIC specifications are eliminated.

There are also some files which are created when plots are made and when files are spooled to tape. These files are normally deleted after a plot is completed or after spooling finishes; however, if the system is shut down, or crashes, or some other problem occurs before the files are deleted, the files will be left on disk. These files are identified as follows:

1. Plot files: these files are in UIC [200,1] on the classified data disk. They are named 'NNNNNJJJ.FP(X)', where NNNNNJJJ are the five-character sequence number and the Julian date of the corresonding data file, F denotes a frequency-domain file (this character is T for time-domain file), P denotes a plot file, and (X) is A...Z, for different files with the same name.

2. Tape files; these files are also in UIC [200,1] on the classified data disk. These files have exactly the same name as the corresponding data file. They are, however, formatted into eight-six character ASCII records.

APPENDIX D
USING DISK STORAGE FOR TEST DATA RETENTION

There are a number of problems associated with the use of the MFE cassette drives for test data storage. Briefly, these are:

1. The media are not very reliable. They are prone to a lot of read-write errors.
2. The tape storage process is slow.
3. The media are expensive, approximately four to five times as much as RL01 disks for the same storage capacity.
4. There is no provision for backup. Files can be backed up, one at a time, by transferring them to disk and then to another tape, but there is no provision for bulk data backup.

Since it is now possible to store the test data directly on disk during data acquisition, there is no longer any need to use the tape for data storage. Approximately 400 test data sets will fit on one RL01 disk pack, with their associated inverse transforms. If the inverse transforms are not saved, approximately 900 test data sets will fit on one disk.

In order to save test data on disk, it is necessary to be able to transfer data from the classified data disk to the backup disks without using the system disk as an intermediary. This is to avoid having classified data on the system disk, thus making it classified too. Probably the easiest way to do this is to just keep an attenuated operating system on the classified data disk. The system plus the required ancillary tasks will occupy little more than a thousand blocks of disk storage, leaving plenty free for data acquisition, processing and analysis. When it is desired to transfer data to the backup disks, the classified data disk may be simply booted, the system disk removed, and the data disk installed in its place. PIP may then be used to transfer the data from one disk to another. From experience, I feel it's best to keep two backup data disks.

The attenuated system kept on the classified data disk should include the following files:

.UIC[1,2] STARTUP.CMD - This is a special command file used by the system when it boots up.

.UIC[1,54] RSX11M.SYS

.UIC[1,54] RSX11M.STB

.UIC[1,54] MOV.TSK

.UIC[1,54] DMO.TSK

.UIC[1,54] IND.TSK

.UIC[1,54] LOR.TSK

.UIC[1,54] PIP.TSK

.UIC[1,54] SAV.TSK

.UIC[1,54] TKN.TSK

.UIC[1,54] TTDRV.TSK

.UIC[1,54] TTDRV.STB

.UIC[1,54] MCR.TSK

.UIC[1,54] UFD.TSK

.UIC[1,54] UNL.TSK

The system should be SAVed with these tasks installed. This will prevent a lot of unnecessary and confusing messages from being generated when the abbreviated system is bootstrapped. Remember that this system, in general, only supports PIP. The results of trying to run anything else are not predictable.

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