GenRad

GR 2515

COMPUTER-AIDED TEST SYSTEM

OPERATING MANUAL

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GENERAL INFORMATION

The attached pages update the **GR2515 Computer-Aided Test System Operating Manual.** Please replace the applicable pages in your copy.

Since this change package includes a complete replacement Section V, change bars have not been included to identify changes to the text.

File this page at the end of your manual to provide a record of the change.

SUMMARY OF CHANGE

The enclosed Section V reflects RTA Program Version 2.0.

MANUAL CHANGE

DISTRIBUTION NOTICE

MANUAL IDENTIFICATION

GR 2515 Computer-Aided Test System Operating Manual
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GENERAL INFORMATION

The attached pages update the **GR 2515 Computer-Aided Test System Operating Manual.** Please replace the applicable pages in your copy (all of Section 2).

All changes to the text are indicated by a vertical bar in the outer margin of the page. Page A (List of Effective Pages) lists the pages changed or added by the current change.

File this page at the end of your manual to provide a record of the change.

SUMMARY OF CHANGE

Makes several technical corrections in Section 2.

RELEASE NOTES

2515 Computer-Aided Test System

RTA Data Acquisition Program

Version 2.0

8-MAR-85

*** Introduction ***

A detailed discussion of the RTA Data Acquisition Program is found in Section V of the 2515 Computer-Aided Test System Operation Manual, Publication Number 2515-0100. The Receiving Checkout Test is contained in Section II of the same manual.

The RTA Data Acquisition Program allows interactive acquisition of data controlled via the 2515 front panel. The MODAL storage format allows archiving of measured data in a format compatible with the SDRC MODAL and MODAL-PLUS analysis programs.

A panel setup named PAN2. SCR is included in the distribution diskette along with RTA version 2.0. This setup is used by GenRad field service engineers for diagnostic purposes only. The customer should not copy it onto his/her Winchester disk.

Make sure a copy of RTA Version 1.0 is saved somewhere. The new Version 2.0 of RTA should be loaded onto the Winchester disk DL0: or DL1: from the backup floppy. Running this program from the floppy drive is possible if one has booted to the DY: but response is sluggish.

Please note that if the following files exist on the system they NEED NOT BE DELETED before running the new Version 2.0 of RTA:

PANMEM. SCR
DATMEM. SCR

These are the scratch files into which the RTA V1.0 program stores and recalls Panel setups and MEMory data. RTA Version 2.0 program saves the same information into two new scratch files:

PAN2. SCR
DAT2. SCR

If you want to use the Version 1.0 scratch files with RTA V2.0, execute the following sequences first:

COPY PANMEM. SCR PAN2.SCR
COPY DATMEM.SCR DAT2. SCR

If RTA Version 1.0 is run again for any reason the old scratch files must be used. RTA Version 2.0 scratch files are NOT COMPATIBLE with the RTA Version 1.0 program. As the new files are automatically created by the program during its first run, it takes a long time to begin displays since it is creating the new scratch files.

***** New Features and Changes *****

The following enhancements to RTA Version 1.0 have been made in RTA Version 2.0.

- BLOCK MATH operations (5.10.8, p 5-62)
- HARMONIC and SIDEBAND cursor modes (5.11.2 to 5.11.6, pp 5-67 to 70)
- PROBABILITY Mode (5.8.1.1, p 5-16)
- AUXILIARY DELAY of Channels from Trigger Channel (5.8.8.6, p 5-42)
- STANDARD File Format Storage (5.12.1, p 5-74)
- INCREASE SIZE OF FILE File Allocation Function (5.12.4, p 5-77)
- MEMORY PANEL Directory Listing (5.12.8.3, p 5-86)
- ORBIT Function Display (5.10.4.3, p 5-53)
- CPM and ORDERS Frequency Units (5.10.7.2, p 5-61)
- Stored Panel Sequences (5.12.9, p 5-86)
- Burst Random Output Signal (5.13.1, p 5-89)
- Function files opened in MPLUS can be stored into in RTA.

NOTE: Storage to DY Device

Storage to the DY: device is not possible from the RTA program unless the DY: handler is loaded prior to running RTA.

.LOAD DY:

NOTE: MODAL Format Storage

Storage into a MODAL format file was limited to 500 function records in Version 1.0. In Version 2.0 up to 15,000 functions may be stored in one function file (MODAL or Standard format).

NOTE: Trigger Hysterisis

Paragraph 5.8.8.7 of the manual explains the effects of trigger hysterisis on impact type testing. On 2515 systems shipped after December 1984 trigger hysterisis has been disabled allowing the trigger level to be specified as low as 1% (instead of the 10% limit noted in the manual). The information regarding "Bandwidth" and "Trigger under ZOOM" still applies.

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SECTION I

DESCRIPTION AND GENERAL INFORMATION

This section provides an introductory description of the 2515 Computer-Aided Test System, its functions and features, its controls and connectors, and general information.

1.1 SCOPE AND RELATED DOCUMENTS

This manual is the basic user/operator guide for the 2515. It provides instructions for initial installation, a familiarization and basic operating procedure for new users, and comprehensive general operation and application descriptions for the basic data acquisition and signal analysis operating software. Also included are instructions for the use of the RT-11* software operating system in data file management operations.

Related manuals listed below are supplied with the system and include manuals provided for additional software.

2515 Computer-Aided Test System Service Manual	2515-0101
2515 Computer-Aided Test System Diagrams and Parts Lists	2515-0102
SDRC Modal Analysis User Manual	2515-0170
TSL2 Time Series Language for 2515 Systems	2515-0110

The service manual, Publication 2515-0101, contains hardware theory of operation, diagnostic and repair procedures, and the diagrams and parts lists manual, Publication 2515-0102, supports it. While the service and diagrams and parts lists manuals may be of interest to users, they are intended only for GenRad-qualified service personnel and are supplied so as to be on-site in case of service calls. Normal service philosophy is return to GenRad Service. All necessary installation and preventive maintenance procedures are contained in this user's manual.

*RT-11 is the Digital Equipment Corporation (DEC) single-user operating system for the microcomputer that controls the 2515. RT-11 is invisible to the user for general operation, but it is used directly for subsequent management of data files created during signal analysis operations.

1.2 PURPOSE AND FUNCTIONS

The 2515 is a portable multi-channel (4 channels standard, up to 16 channels optional), digital signal processing system for general purpose data acquisition and analysis. It provides numerous functions for spectrum and time series analysis, and includes several features for use in conjunction with SDRC MODAL software for structural mode shape analysis. MODAL software runs on the 2515 and can be called up directly from the basic panel operating program. The processing and versatile display functions, and miscellaneous functions, are summarized in table 1-1 along with hardware specifications and characteristics.

Although it is designed to be operated as an instrument from the front panel, and is fully self-contained for field portability, the 2515 is nonetheless a complete computer controlled and software driven system. It maintains the simplicity and directness of pushbutton operation, yet allows the flexibility of software control.

1.3 PHYSICAL DESCRIPTION

The 2515 consists of three separable units: a keyboard, a $5\frac{1}{4}$" mini-floppy disk drive, and the main chassis with control panel on the front and connector panel on the rear.

The keyboard is connected by cable to a rear panel connector. Functions available in the standard signal analysis software package (RTA) are all controlled from the pushbutton front panel. However, for users who may prefer keyboard operation, any front panel pushbutton function may be duplicated by entry of a two-character mnemonic code from the keyboard; or the keyboard and panel may be used together, for example by generally controlling operation from the panel but using the keyboard instead of the ENTRY section pushbuttons on the panel to make alphanumeric entries such as display labels and file names. The keyboard is required for operation of additional software packages such as MODAL analysis or TSL programming.

The floppy drive is also connected by cable to a rear panel connector. The floppy disk capability is included to provide access to external mass storage. It serves two principal purposes: (1) initial loading, reloading, and updating of basic operating programs (or diagnostic programs, which are not resident on the internal disk), and (2) external archiving (storage) of test data files and transfers of data files between systems.

The main cabinet mounts the front pushbutton control panel, rear connector panel, 7" display CRT, and permanently installed 10-Megabyte Winchester disk drive. Inside are the system power supply and card cage for the system electronics. Further descriptions of the internal components are given in the functional block diagram discussion which follows.

Table 1-1. List of Specifications

DIMENSIONS AND WEIGHT	
Main Chassis:	
Height	10.5 inches (18 cm)
Width	17.0 inches (43 cm)
Depth	24.0 inches (41 cm)
Weight	70.0 pounds (31.5 kg)
Floppy Storage Chassis:	
Height	4.0 inches (10 cm)
Width	6.0 inches (15 cm)
Depth	9.0 inches (23 cm)
Weight	3.2 pounds (1.45 kg.)
Keyboard Chassis:	
Height	1.5 inches (4 cm)
Width	19.0 inches (48 cm)
Depth	8.5 inches (22 cm)
Weight	5.6 pounds (2.52 kg)
Printer Chassis (Opt):	
Height	4.0 inches (10 cm)
Width	17.0 inches (43 cm)
Depth	17.0 inches (4.3 cm)
Weight	12 pounds (5.4 kg)
POWER REQUIREMENTS	
Voltage	120, 220, or 240 nominal
Frequency	50/60 Hertz
Power	500 Watts
ENVIRONMENT	
Temperature	10°C to 45°C, operating
Humidity	20% to 80% RH @ 40°C non-condensing
Safety Standard	UL 1244 specifications
Test Standard	GenRad Class 2

Table 1-1. List of Specifications (continued)

INPUT

Number of Baseband Mode Channels:	Four analog channels standard (optionally expandable to 16).
Number of Zoom Mode Channels:	Two channels standard (optionally expandable to 8).
Frequency Range:	DC to 25.6 kHz with alias protection on all channels.
Anti-Alias Filters:	15 selectable digital filter ranges below 25.6 kHz. One analog filter at 25.6 kHz.
Dynamic Range:	>70 dB with 12 bit A/D conversion.
Amplitude Flatness:	±0.25 dB over the entire frequency range.
Input Sampling:	Simultaneous sample and hold (all channels).
Channel-to-Channel Match:	±0.2 dB amplitude, <2.0 degrees phase to 10 kHz, <4.0 degrees phase to 20 kHz, <8.0 degrees phase to 25.6 kHz.
Input Impedance:	100K ohm shunted by <150 pf.
Input Coupling:	AC (-3 dB at 0.8 Hz), DC, PCB transducer bias source.
Sensitivity:	8 ranges (62.5 mV, 0.125 V, 0.25 V, 0.5 V, 1.0 V, 2.0 V, 4.0 V, 8.0 V peak input).
Maximum Operating Level:	10 V (full-scale sensitivity typically tolerates a 20% overrange).
Maximum Voltage:	Protected to 25 V.

BASEBAND ACQUISITION

Bandwidths:	15 selectable ranges from 1.28 Hz to 20.5 kHz, plus 25.6 kHz.
Frame Size:	6 selectable ranges from 256 to 8,192 points/channel.
Frequency Lines:	320 alias-free lines for every 1,024 input points in the frame.

Table 1-1. List of Specifications (continued)

ZOOM ACQUISITION	
Operation:	User-specified window in the range DC to 25.6 kHz.
Control:	Center frequency selectable to 1.0 Hz resolution anywhere in DC to 25.6 KHz range.
Bandwidth:	Selectable in factors of 2 from 2.5 Hz to 20.5 kHz.
Resolution:	Same as baseband mode.
TRIGGERING	
Acquisition Modes:	Free run or triggered.
Trigger Level:	Adjustable percentage of full scale.
Trigger Slope:	+ or -
Trigger Delay:	Pre-trigger and post-trigger delays
Pre-trigger:	$\leq$T (T is the time of one frame)
Post-trigger:	$\leq$32,000 t (t is sample interval)
Resolution:	$\pm\frac{1}{2}\ \Delta t$
External Trigger:	TTL level.
Overlapped Processing:	0%, 50%, Max.
STORAGE	
Capacity:	10 Mbytes on Winchester drive and 0.5 Mbytes on mini-floppy drive.

Table 1-1. List of Specifications (continued)

OUTPUT SIGNALS	
Sine Wave:	1 Hz to 25.6 kHz in 1 Hz increments. 4.5 Vrms maximum level.
Random Noise:	25.6 kHz fixed bandwidth. 1.0 Vrms maximum level.
Band Translated Random Noise:	Noise bandwidth concentrated in analysis band (including zoom bands). 1.0 Vrms maximum level.
Amplitude Adjustment (all signals):	Adjustable attenuation of output level.
DISPLAY	
Size:	7-inch (diagonal measure).
Resolution:	640 lines horizontal. 480 lines vertical.

Table 1-1. List of Specifications (continued)

RTA DATA ACQUISITION

Input

Number of Channels:	Four (to optional 16) in baseband mode. Two (to optional 8) in zoom mode.
Sensitivity:	8 ranges plus autoranging.

Baseband Resolution:

Maximum Resolution (lines):

Maximum Number of Frequency Lines (Cross-Channel Acquisition Mode)	Number of Channels	
	Standard Memory	Optional Memory
320	16	16
512	12	16
640	8	16
1280	4	16
2560	2	12

Processing

Measurements Performed:

Time domain:	Input time, averaged time, auto correlation, cross correlation, impulse response.
Frequency domain:	Input spectrum, frequency response function, coherence, auto power spectrum, linear spectrum, power spectral density, cross power spectrum, transmissibility, coherent output power.
Amplitude domain:	Probability density function, cumulative distribution function.
Block Arithmetic Operations:	+, -, x, ÷, integration (single or double), differentiation (single or double).

Table 1-1. List of Specifications (continued)

Averaging	
Types:	Additive, subtractive, exponential, peak hold.
Control:	Run, stop, resume, automatic reject, manual reject.
Weighting Windows:	Uniform, Hanning, flat top, special (Blackman-Harris), force (impact), response (impact), correlation (zero padding).
Triggering	
Acquisition Modes:	Free run, auto arm trigger, manual arm trigger.
Free Run:	New measurement initiated at completion of previous measurement.
Automatic or Manual:	New measurement initiated when signal into armed trigger channel meets specified threshold. Any channel may be used for trigger.
Storage	
Spectrum Recall:	Data can be stored and retrieved with calibration and annotation information.
Setup/Recall:	Multiple setup states can be stored and recalled.
Display	
Graphics:	Real-time displays of measurement data with interactive format and unit selections.
Formats:	Full screen, split screen (top/bottom), superimposed displays of measured functions.
Cursors:	
Single:	Main cursor and reference cursor for relative readouts.
Sideband:	Up to 7 on both sides of main cursor.
Harmonic:	Up to 15 at harmonics of main cursor.

1.4 FUNCTIONAL DESCRIPTION

Some knowledge of the internal components and the data acquisiton hardware may aid in understanding and taking full advantage of the functions described in the section on operation. Figure 1-1 is a simplified block diagram of the major functional sections. The following paragraphs provide a brief overview of their functions and relationships.

1.4.1 General Structure

The DEC LSI-11/23 Processor and GenRad 2501 Microprocessor (a bit- slice processor) provide a two processor architecture allowing parallel operations for high speed performance. Refer to figure 1-1.

Compatible interfacing of the major components is performed by two buses. These are the LSI-11 Q-Bus and the Microprocessor bus.

The standard LSI-11/23 Processor allows the integration of a Q-bus interface to the Memory Controller, a Winchester/Floppy interface which is connected to the Floppy Disk Drive and storage chassis, and a four port serial interface. The serial interface ports integrate the control panel and remote or auxiliary peripherals to the system.

The 2501 Microprocessor uses the microprocessor bus to control the data acquisition system, signal output system, graphics display, and arithmetic booster hardware. The devices are controlled as Q-bus interface devices and are implemented through device emulation by the 2501 Microprocessor.

Subordinate to the microprocessor bus and the Q-bus are the analog input FIFO, pseudo-Unibus, and channel control buses.

The analog input FIFO bus from the channel control board sends data and FIFO status to the memory controller.

The channel control board communicates with and controls the channel boards using a common channel control bus.

The pseudo-Unibus is used to interface the Unibus memory with rest of the system via the memory controller. The LSI-11/23 processor controls the pseudo-Unibus by controlling the status of two control lines.

An independent display monitor is also integrated into the system and is provided raster scan graphics with 480(x) by 640(Y) resolution by the microprocessor system.

1.4.1.1 LSI-11/23 Processor Board. The LSI-11/23 Processor is manufactured by Digital Equipment Corporation, supported by the RT-11 operating system, and features a 18-bit addressing range. The 2515 system is based on the DEC LSI-11/23 processor thus allowing a wide range of diagnostic software and peripherals to be compatibly integrated.

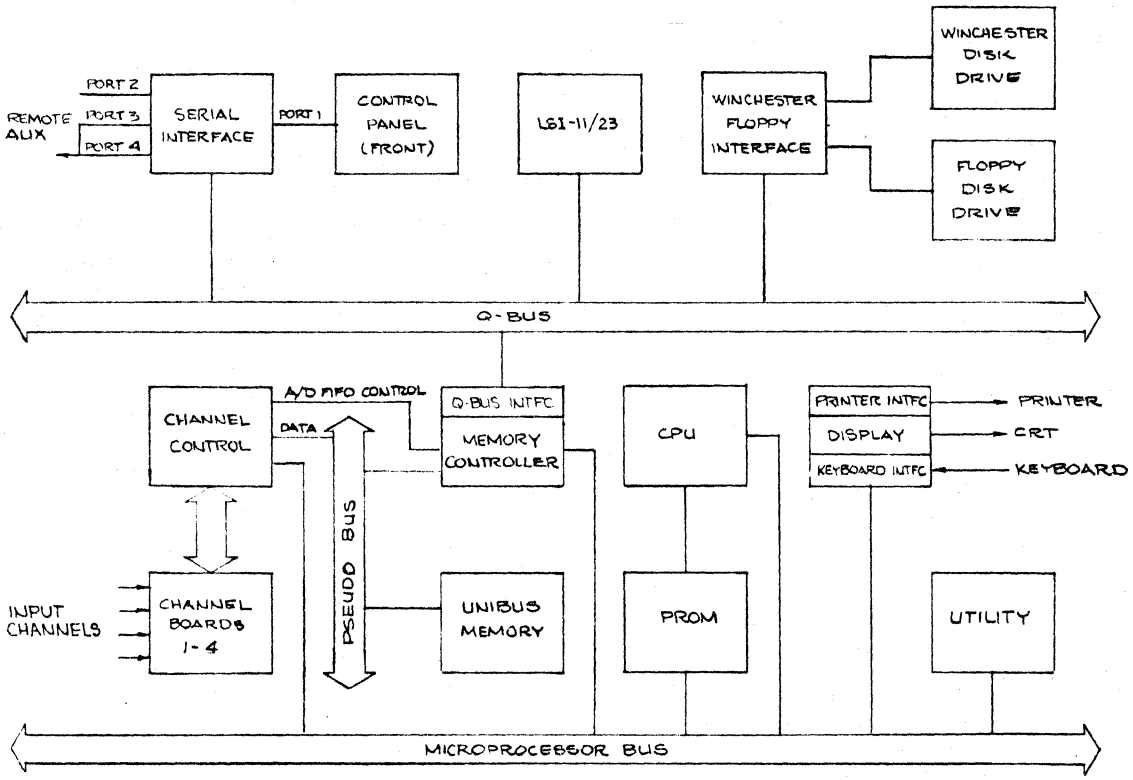


Figure 1-1. Simple Block Diagram, 2515 Computer-Aided Test System

The LSI-11/23 processor controls the 2515 by interfacing with the 2501 microprocessor and the main memory via the Q-bus interface on the Memory Controller board. The DEC KEF-11AA floating point and memory management unit (MMU) is also installed in the standard 2515 system.

1.4.1.2 Winchester/Floppy Interface Board (WINC05). The WINC05 is a Q-bus compatible board. It provides DEC RX02 emulation for the 5¼-inch floppy drive at a 0.5 megabyte capacity and emulation of two RL01 devices for the Winchester at 5.0 megabyte capacity each.

The LSI-11/23 sees the WINC05 as two fully transparent controllers, Winchester and floppy.

1.4.1.3 Winchester Disk Drive. This disk drive is supported by the WINC05 RL01 emulation and provides 10.0 megabyte formatted capacity.

1.4.1.4 Floppy Disk Drive. This 5¼" flexible (floppy) disk drive is integrated into the system by an input/output cable connection at the rear panel and is controlled by the LSI-11/23 processor through the WINC05 controller. The 5¼" disk is two-sided, removable, and provides standard 96 tracks per inch in double density recording, amounting to 0.5 megabyte total storage capacity.

1.4.1.5 Serial Line Interface Board. The PM-DLV11J is a 4-channel (four ports) asynchronous serial line interface between the LSI-11 Q-Bus and other devices. Port 1 is used to interface with the front control panel. Port 2 connects the LSI-11/23 with a remote serial interface. Port 3 and 4 are for use with auxiliary serial interfaces and are spares for customer selected expansion. The interface receives parallel data from the Q-bus, converts it to a serial word and transmits to the peripheral device. It will also receive serial data and convert it to parallel data to be sent to the central processor, LSI-11/23.

1.4.1.6 Control Panel Boards 1 and 2. Operator control and selected inputs can be accomplished with the pushbutton switches located on the control panel. There are 79 dedicated switch locations and an additional 22 available for future expansion (total 101). Fourteen LED indicators provide mode and entry verification and cursor status. A tone generator and speaker provide 15 different tones alerting the user to the status of the inputs. When a selection is entered (a pushbutton is pressed) the data is immediately transmitted serially via the serial interface board to the LSI-11/23 processor.

1.4.1.7 2501 CPU Board. The 2501 microprocessor is a special purpose, high speed computer constructed from approximately 140 integrated circuits (some of which are located on the PROM board). The microprocessor has 32-bit wide instruction paths and 16-bit wide data paths. The instructions are stored in PROM and typically take approximately 300 nanoseconds to execute.

The basic arithmetic capability of the microprocessor is contained within a 4-chip LSI arithmetic unit, Am2901. The CPU contains a scratchpad and stack memory consisting of 256-words by 16-bits addressable in several modes. The 256-word memory is used to provide a fast storage supplement to that included in the Am2901 unit.

The CPU also has a dedicated hardware stack (16 levels deep) that is used to supplement subroutine calls, returns, and interrupts.

Additional devices are interfaced to the microprocessor by the use of a general purpose, high speed microprocessor bus.

1.4.1.8 PROM Board. The PROM board contains the microinstructions that are read out and executed by the 2501 microprocessor. The PROM board also contains the scratchpad memory, real time clock, and fractional multiplier.

The scratchpad memory is 256 words x 16 bits and is actually part of the microprocessor but is located on the PROM board for ease of layout. See paragraph 1.4.1.7.

1.4.1.9 Memory Controller Board. The memory controller contains the logic necessary to sequence memory accesses among three ports. These ports are provided for the LSI-11/23 processor, 2501 microprocessor, and the analog input FIFO port.

The memory controller arbitrates the priority given to the three ports. FIFO status affects the priority structure in that if the FIFO is 1/2 full it will be given service priority.

The memory controller board also contains a Q-bus slave and interrupt vector interface. This allows the microprocessor to interrupt the LSI-11/23 and act as a slave for three sets of Q-bus hardware I/O page addresses. This is used to emulate Q-bus devices.

1.4.1.10 Unibus Memory Board. The main memory is a 256 kilobyte add-in MOS memory. Optional memory expansion is provided by replacing this board with a 1.0 megabyte MOS memory board.

Access to the Unibus memory is governed by the memory controller (which provides 21 bits of address) and it alone communicates directly with the memory using the pseudo-unibus lines. This allows use of higher data rate Unibus memory on a Q-bus based system.

1.4.1.11 Utility Board. This board contains an arithmetic booster, and test signal generator and interfaces with the 2501 microprocessor.

The booster processor enhances the speed of multiply/accumulate operations in windowing, filtering, and FFT calculations and performs the necessary arithmetic calculations in conjunction with the microprocessor.

The test signal generator is designed to generate sine wave and random signals. The generated test signal output is available at the front panel BNC connector.

1.4.1.12 25 kHz Channel Board. The standard 2515 system contains four 25 kilohertz channels (on one 6-wide board) and is expandable up to 16-channels (four 6-wide boards, each containing four channels).

The channel board acquires analog signals and processes them with a combination of analog and digital filtering under the direction of the channel control board.

The basic sampling rate for the 25 kHz system is 65.536 kHz which is a 15.25 microsecond interval. Each board is capable of processing four baseband channels or two Zoom channels during one 15.25 microsecond interval. On each channel board, three distinct processes happen concurrently under direction of the channel control board.

1) Simultaneous sampling of all channels and sequential analog to digital conversion of four channels per board;

2) Multiplication of analog/digital results by a cissoid (Zoom) or constant (Baseband);

3) Digital filtering of the multiplier output with a cascade of decimate-by-two filters.

1.4.1.13 Channel Control Board. The control board provides the necessary timing and data buffering for up to four 25 kilohertz channel boards.

The control board is interfaced with the CPU board via the microprocessor bus and to an access port on the memory controller board. Communication with each channel board is accomplished by a common channel bus.

Channel board filtering computations are sequenced and in step under direction of the control board. Results of the calculations are transmitted to the control board which stores them into memory. Selected data goes to the FIFO to be output to memory along with trigger status information. Overload conditions are also sent to the control board for access by the 2501 microprocessor.

1.4.1.14 Medium Resolution Display Board. The display board provides the interface between the 2501 microprocessor, the keyboard, the line printer, the vector generator and the associated display. The board includes a bidirectional serial TTL keyboard interface which can be optionally converted to parallel by the addition of one integrated circuit. It also includes a compatible printer interface.

The display format is 640 horizontal by 480 vertical pixels. Individual pixels may be read or written by the 2501 microprocessor. On command, hardware scrolling provides the capability of moving the display up or down two or more scan lines.

The display memory comprises two frame buffers, separately accessed and displayed, to improve animated displays. An additional mode, SUPERMODE, allows superimposing both frame buffers on the CRT.

Video output is standard TV (RS-170) capable of driving a 75 ohm line. Additional TTL level horizontal and vertical sync outputs are provided. The vertical rate, 50 or 60 Hz, is selectable.

The keyboard interface performs all the receiving and transmitting functions (serial and parallel) between the 2501 microprocessor and the keyboard.

The printer interface allows the 2501 microprocessor to transmit 8 bits of parallel data and a strobe to the printer and also receive status back from the printer.

1.4.1.15 Power Supply. The power supply provides four outputs of +5V, +12V, +15V, and -15V. Input voltage is 115/230 VAC, 50-60 Hz, and is switch selectable. Additional AC line filtering is provided by a 10 amp line filter.

1.4.1.16 Display Monitor (CRT). A 7" display monitor is integrated into the standard 2515 system.

1.4.1.17 Expansion Slots. There are three 2-wide expansion slots which can be used for Q-bus options. There are also three 6-wide slots which will allow the expansion to 16 channels. The slots are configured for three additional 25 kilohertz boards.

1.5 SOFTWARE SUPPLIED

All panel program operating software is pre-installed and ready to run on the internal Winchester disk drive. The following software is supplied on floppies:

1 ea. 2515-0605	RT-11 Runtime System
1 ea. 2515-0650	RTA Real Time Analyzer
2 ea. 2515-0690	XXDP Diagnostics
1 ea. 2515-0691	RT-11 Diagnostics

1.6 OPTIONS AND ACCESSORIES

Several hardware options and accessories are available for system expansion and general use. A GenRad representitive can provide detailed information and assistance in selecting any of the hardware options and accessories listed below.

2515-9400	Rack Mount Kit
2515-9401	Channels 5-8 (with 16 ch. BNC box)
2515-9402	Additional Four (4) Input Channels
2515-9403	Monitor, Large Screen
2515-9404	Extended Memory, 1 Mbyte total
2515-9405	Dual 8" Floppy Disk Drive
2515-9406	Printer/Plotter
2515-9407	Shipping Case, System Unit
2515-9408	Shipping Case, Monitor/Plotter
2515-9410	Paper, Printer/Plotter, 1 Case
2515-9411	Diskettes, Mini-Floppy, 1 Box of 10
2515-9412	Diskettes, 8" Floppy, 1 Box of 10

Although printer, paper and floppy diskettes are available from GenRad, HP92160C paper or equivalent and CDC 429 diskettes or equivalent may be used. For specific installation instructions for optional equipment, refer to Section II, paragraph 2.12.

Software options are also available:

2515-0610	TSL2
2515-9440	MODAL II
2501-9430-5	MODAL Plus
2515-9444	DataLink
2501-9464-5	OPTIMOD
2501-9431-5	SABBA
2501-9434-5	MODAL Plus & SABBA
2501-9462-5	MODAL Plus & OPTIMOD

1.7 CONTROLS, INDICATORS, AND CONNECTORS

Figures 1-2 and 1-3 and tables 1-2 and 1-3 summarize the functions of visible controls and connectors. Additional details on menu operations and connector wiring and functions are given in Sections II and III. The pushbuttons are only active when a program (such as RTA) that supports the use of the panel is being executed. Figure 1-4 illustrates the keyboard. Operation from the keyboard is discussed in Section III, paragraph 3.3.

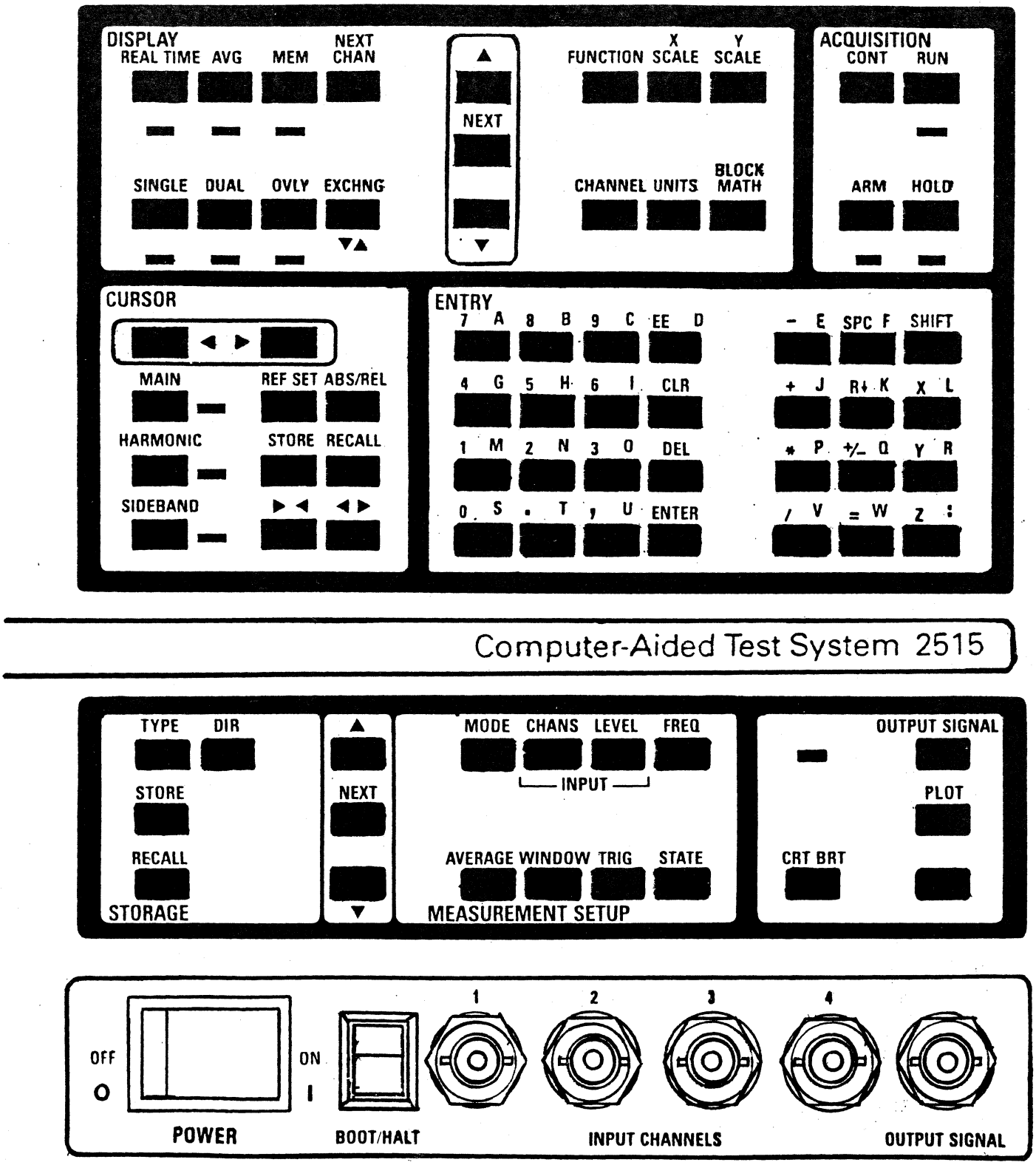


Figure 1-2. Front Panel Controls, Indicators, and Connectors

Table 1-2. Front Panel Controls, Indicators, and Connectors

Types: Immediate — causes an action
Menu — presents a menu of one or more pages for selection of functions
Entry -- requests or allows an alphanumeric entry

Name	Type	Function
DISPLAY Group		
REAL TIME	Immed	Displays instantaneous function of current input frame. FUNCTION menu provides choice of time domain, spectrum, all-channel levels, or orbit diagram of two channels.
AVG	Immed	Displays averaged auto or cross spectra, or functions computed from them as specified under FUNCTION.
MEM	Immed	Displays data retrieved from storage by the most recent RECALL.
NEXT CHAN	Immed	Sequences displays through the list of currently active channels or channel pairs for cross-channel functions.
SINGLE	Immed	Gives full screen to one display; allows presentation of setup summary on top two lines.
DUAL	Immed	Presents dual display (upper and lower) of two functions. Suppresses setup summary to allow room for both.
OVLY	Immed	Presents dual display of "lower" function overlaid on full grid and "upper" function, provided that the two displays are compatible.
EXCHNG	Immed	Exchanges upper and lower displays. Only the upper display is accessible for modification by other DISPLAY group functions.
NEXT	Immed	Turns "pages" to proceed through menus. NEXT also causes ENTER if there is a menu selection or an alphanumeric entry pending.
Δ (UP) ∇ (DOWN)	Immed	Move pointer to make menu selections or adjusts input channel level setting or Y axis scaling when no menu is present on the display.
FUNCTION	Menu	Presents menus for choices of function to be displayed and for complex fun tions the plotting format. Menus and available functions vary depending on current selections of auto or cross-channel mode, real time or averaged display, and mode of averaging in time or frequency domain.

Table 1-2. Front Panel Controls, Indicators, and Connectors (Continued)

Name	Type	Function
X SCALE	Menu	Presents menus for choices of X axis scale: linear or logarithmic, automatic or specified expansion, frequency scale in Hertz or cycles per minute or orders for rotating machinery.
Y SCALE	Menu	Presents menus for choices of Y axis scales: linear or logarithmic, automatic or expanded over specified ranges of values or decibel, and allows blanking of frequency response data (transfer function only) with coherence less than a specified level.
CHANNEL	Entry	Presents a prompt for entry of the number of the channel to be displayed, or a pair of channel numbers for cross-channel functions.
UNITS	Menu/ Entry	Presents menus for selection of units and normalization of units for Y axis of display. Provides choice of volts or user-specified engineering units, or dB units relative to either. Allows normalization of units to present readout in linear amplitude (units), power (units squared), power spectral density (units squared/Hz), or energy density (units squared seconds/Hz).
BLOCK MATH	Menu/ Entry	Provides access to arithmetic operations that may be performed on a spectrum or between two spectra. Includes add, subtract, multiply, divide, integrate, and differentiate. (This function is not presently implemented.)
ACQUISITION Group		
RUN	Immed	Starts and stops averaging accumulations. Press to start, press to stop and hold. Clears current average on start.
CONT	Immed	Continue an averaging run after stop. Does not clear average. In manual acceptance mode, indicates current frame is to be included.
ARM	Immed	Arms the trigger in manual mode. Indicator lights when trigger is armed, goes out when trigger event occurs.
HOLD	Indic	Lights when a new input frame is available. In manual acceptance mode, pressing the HOLD button rejects this frame. (Press CONT to accept the frame.)

Table 1-2. Front Panel Controls, Indicators, and Connectors (Continued)

Name	Type	Function
CURSOR Group		
< (left) > (right)	Immed	Moves main cursor. Cursor may also be initially positioned by pressing SINGLE and immediately ENTERing a numerical value for desired position entry.
MAIN	Immed	Turns off HARMONIC or SIDEBAND and prompts user for main cursor position.
HARMONIC	Immed	Displays additional cursor lines at harmonics of the main cursor frequency.
SIDEBAND	Immed	Displays additional cursor lines above and below the main cursor frequency to locate sidebands. Sideband cursors are spread or closed by the associated arrow buttons.
REF SET	Immed	Fixes a reference cursor at current location of main cursor. The ABS/REL function may be used to obtain cursor readout as ratios or differences between the main and reference cursors.
ABS/REL	Immed	When reference cursor is set, this function switches cursor readout between absolute values for main cursor or relative values between main and reference.
STORE	Entry	Stores current location of cursor for later recall. Up to 10 cursors may be stored, identified by reference numbers ENTER'ed after the STORE button is pressed.
RECALL	Entry	Restores a stored cursor, identified by number, to the display.
> < (dec) < > (inc)	Immed	Used to decrease and increase the sideband delta frequency during sideband cursor mode.
ENTRY Group		These buttons are used for alphanumeric entries and for arithmetic operations.
STORAGE Group		
TYPE	Menu/ Entry	Begins sequence of menus to create or open disk files, specify plotter setups, and select certain modes of operation. Also provides function deletion capability.
DIR	Menu/ Entry	Prints listings of records contained in the open file or in temporary storage memory buffers.

Table 1-2. Front Panel Controls, Indicators, and Connectors (Continued)

Name	Type	Function
STORE	Menu	Requests storage record identification and executes storage of AVG data.
RECALL	Entry	Requests entry of desired record identification and executes recall to MEM.
MEASUREMENT SETUP Group		
MODE	Menu	Selects basic operating mode of the system as follows: Auto-channel for individual channel operation; Cross-channel for reference-response pairs; Probability analysis; Exits program to Modal analysis (load MODAL software); Exits program to RT-11 operating system for file management.
CHANS	Menu	Presents tabular menu to select channels or cross-channel pairs to be active.
LEVEL	Menu	Presents menu for selection or entry of channel setup specifications such as: Full scale level for input; Channel coordinate (for use with MODAL program); Calibration factor for engineering units; AC/DC coupling; Channel label for displays.
FREQ	Menu	Presents menus for specification of frequency range (baseband or passband range), and resolution in terms of number of frequency lines.
AVERAGE	Menu	Presents menus to select averaging domain (time or frequency), mode (summation, subtraction, exponential discount, or peak hold), and number of frames to be processed. Includes specification of the frame acceptance mode for averaging: accept every frame, manual acceptance from HOLD, auto-reject of frames that do not meet certain conditions. Also controls pre-average auto ranging.
WINDOW	Menu	Presents menus for selection and specification of weighting windows to be applied to input frames, such as Hanning and impact response weighting.
TRIG	Menu	Presents menus for selection of triggering mode, source, level, slope, and delay.

Table 1-2. Front Panel Controls, Indicators, and Connectors (Continued)

Name	Type	Function
STATE	Print	Presents four-page printout of current status, including measurement setup, storage setup, upper and lower display setup. The state display begins with the most recently modified page and can be advanced to the other pages with the NEXT key.
MISCELLANEOUS		
CRT BRT		Increases CRT brightness in steps. The brightness can also be adjusted by using the keyboard SETUP key and keyboard UP-DOWN arrow keys.
OUTPUT SIGNAL		Presents sequence of menus to select sine wave or noise outputs and specify frequency and levels.
PLOT		Initiates output to thermal printer/plotter or optional digital plotters depending on STORAGE type plotter setup. (Not labeled on panel. First button below the OUTPUT SIGNAL button at lower right.)
BOOT/HALT		Manual boot if screen remains blank or system halts; automatically boots to RT-11 on power up. Push switch up to BOOT, down to HALT.
ON-OFF		Power switch, allows source voltage to be applied to or removed from system. Used to reinitialize system in event BOOT/HALT does not correct blank screen or system halt.
INPUT CHANNELS A, B, C, D	BNC Recept	Input channels 1 through 4, ±8 V peak maximum for calibrated analysis.
OUTPUT SIGNAL	BNC Recept	Sine wave or noise generator output.

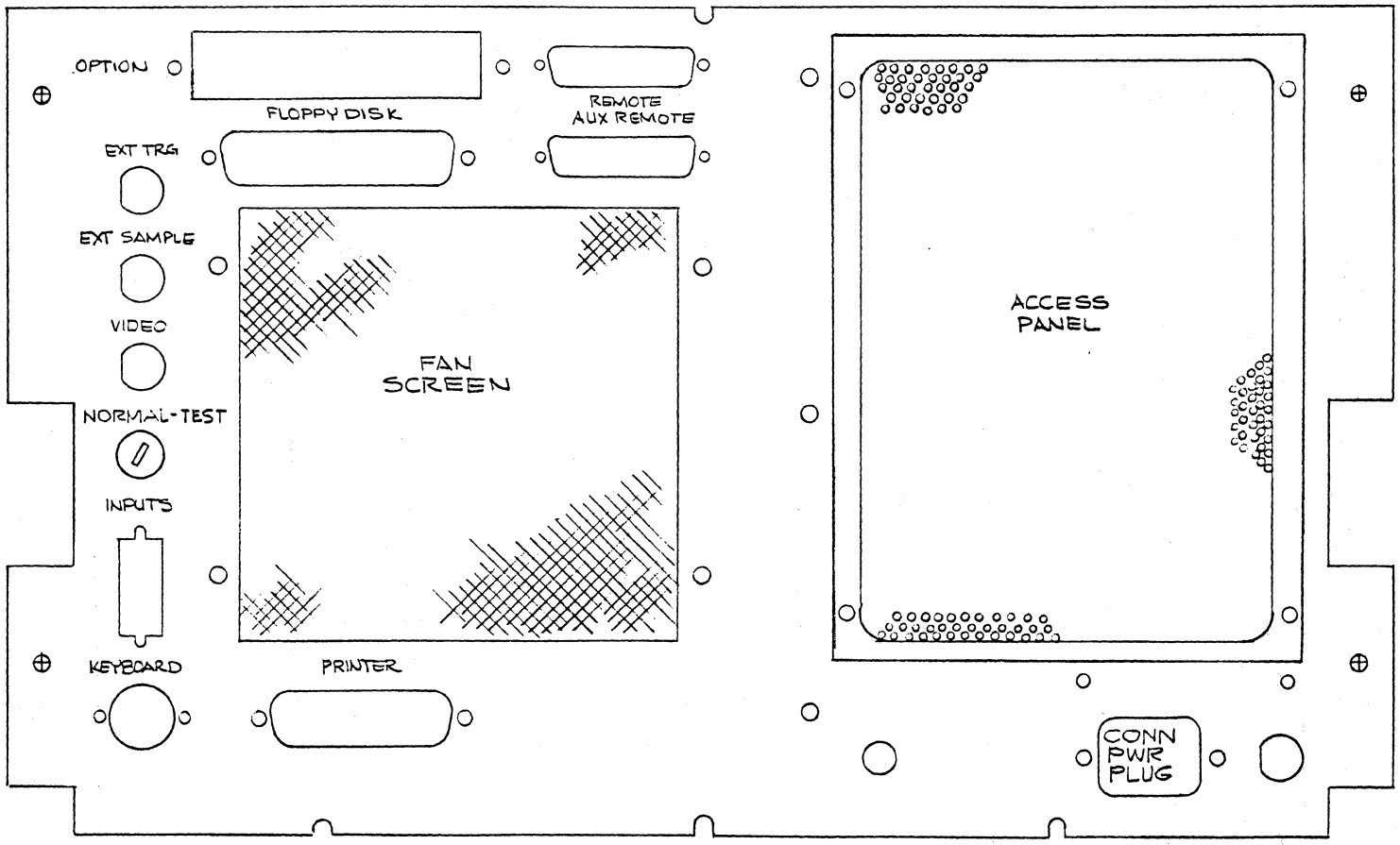


Figure 1-3. Rear Panel

Table 1-3. Rear Panel Connectors

Name	Type	Function
INPUTS	Coax	Channels 1 through 16 inputs, ±8 V peak maximum for calibrated analysis.
KEYBOARD	5-pin Recept	Mates with keyboard jack.
VIDEO	BNC Recept	Composite video output for external large-screen display monitor.
EXT SAMP	BNC Recept	Input for externally supplied sampling rate clock. TTL level, 0 to + 5 V maximum, 65,536 Hz maximum.
EXT TRIG	BNC Recept	Input for externally supplied digital trigger. TTL level, 0 to +5 V maximum.
FLOPPY DISK	50-pin	Mates with floppy disk drive cable.
REMOTE	25-pin	RS-232 port to LSI-11 bus (one channel, normally used for DATALINK remote file transfer).
AUX REMOTE	25-pin	RS-232 port to LSI-11 (two channels, one normally used for optional digital plotter, one spare).
PRINTER	36-pin	Mates with cable from thermal printer used for screen copy function.
OPTION	Blank	Reserved for future use.
120 V 220-240 V	3-cond	Power cord receptacle.

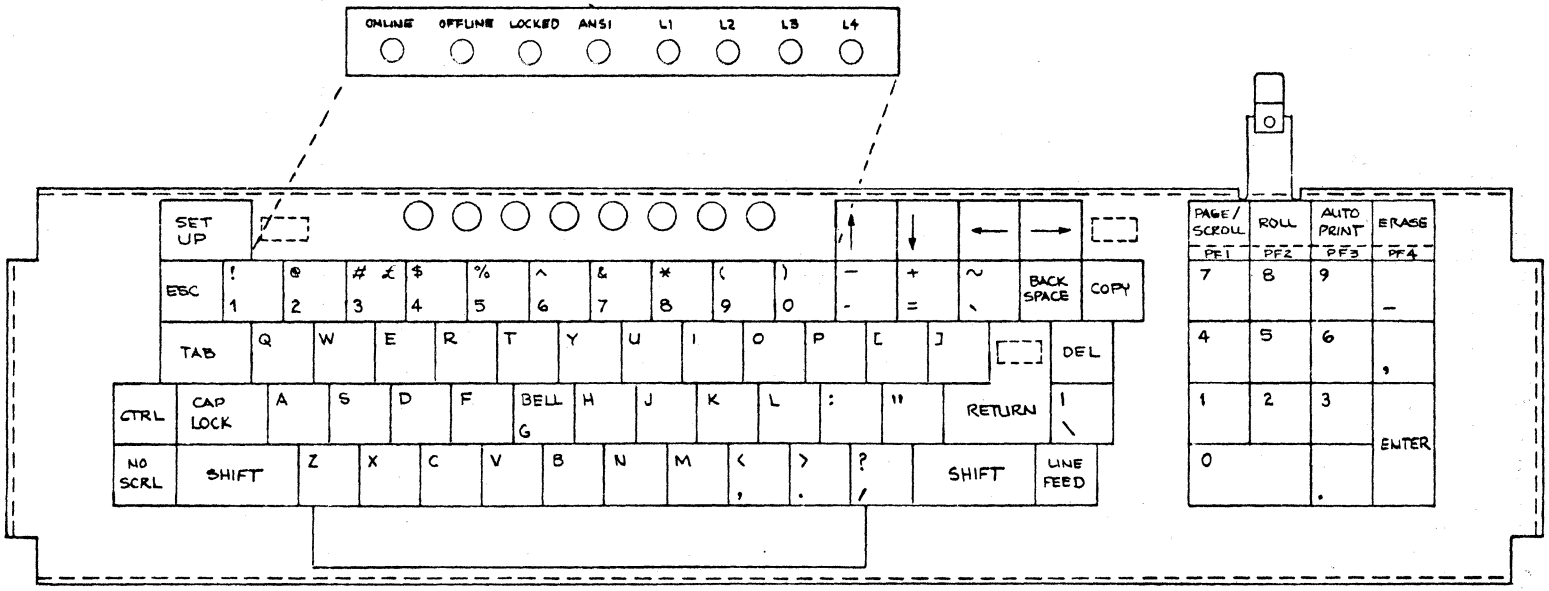


Figure 1-4. Keyboard

Table 1-4. Keyboard Special Function Keys

Name	Function
SETUP	Rolls screen up for two lines of special setup functions described in Section III. Also rolls screen back down.
COPY	Initiates output to thermal plotter-printer for screen copy. Not for optional digital plotters.
PAGE/ SCROLL (PF1)	Toggles display into PAGE mode where output is stopped when screen is full, or into SCROLL mode where old output is scrolled off the top of the screen as new output is added at the bottom. In PAGE mode, use ROLL or ERASE to continue. Intended for operating system use, not for RTA program.
ROLL (PF2)	Scrolls display up by six alphanumeric lines to allow continued output. For operating system use, not RTA analyzer program.
AUTO PRINT (PF3)	Toggles on/off. When on, the thermal plotter-printer copies alphanumeric information as it appears on the screen. For operating system use, not 2515 analyzer program.
ERASE (PF4)	Erases entire display.

1.8 PREVENTIVE MAINTENANCE

The air filters are the only components within the system requiring periodic preventive maintenance. These are located on the underside of the system. To clean the filters, remove the cover plate and pull the filters out. The filters may be vacuumed or washed with mild detergent to remove accumulated dust. Be certain to replace the filters with the arrow on the outside edge pointing in the proper direction: small filter air flow toward center; and large filter air flow toward rear of system. The filters should be checked at six month intervals.

SECTION II

INSTALLATION AND CHECKOUT TEST

This section provides instructions for installation, and a checkout test procedure to verify proper operation. The checkout test also serves as an introduction to acquaint new users with basic operation and to demonstrate some of the functions and features of the system.

2.1 WARRANTY CONSIDERATIONS

Installation and acceptance of the 2515 system are performed by the customer unless otherwise arranged in the terms of the sale. If GenRad Sales and Service is not notified to the contrary, acceptance, for the purpose of beginning the warranty period, will be assumed to occur 14 days after shipment (30 days after for international shipments). It is the customers' responsibility to perform the installation and checkout procedures in this section to verify proper operation as soon as possible after receipt of the equipment.

2.2 INITIAL INSPECTION

If there is any evident damage to shipping containers, request the carrier's agent to be present during unpacking. Inspect the cushioning materials for any signs of shipping damage. Unpack the equipment carefully and inspect the exterior for mechanical damage. If there is any damage or if the equipment fails to meet the operational test in this section or electrical specifications, notify the nearest GenRad Sales and Service field office immediately, and notify the carrier if applicable.

NOTE

Save the shipping containers and packing material for future use if it should become necessary to return the equipment to a GenRad service depot for repair.

2.3 LOCATION

The 2515 is intended to be mounted on a sturdy bench or table. (An optional rack mounting kit is available.) Two to three inches of space must be allowed at the rear for cable access and free air circulation. The peripheral units may be located anywhere within cable reach of the main cabinet. The main cabinet unit weighs approximately 70 pounds (35.1 kg). For overall dimensions of the principal units refer to Table 1-1.

2.4 RACK MOUNTING

Instructions for rack mounting are supplied with the optional rack mounting kit.

2.5 ENVIRONMENT

For environmental requirements refer to Table 1-1.

2.6 LINE POWER REQUIREMENTS

The 2515 requires either of the following power sources:

110V nominal:	95V min to 132V max
220 or 240V nominal:	190V min to 260V max

Frequency: 47 to 63 Hz

Power: 650 watts, standard system
800 watts, fully loaded system

All units are grounded through their three-conductor power cords. No external grounding connections are required.

WARNING

The power source must be adequately grounded in accordance with international safety standards and equipped with a three-conductor grounding receptacle.

2.7 SETTING THE POWER SUPPLY FOR LINE VOLTAGE

The system is designed to operate at 120 VAC nominal or 220 and 240 VAC nominal. Power setting will normally be performed prior to shipment according to destination. If after installation, should on site power requirements change the following steps are to be followed:

2.7.1 2515 Main Chassis Unit

Step 1. Switch power ON/OFF switch to OFF.

Step 2. Disconnect power cable from ac power source.

Step 3. Remove 6 socket-head screws from sides of top cover and carefully lift cover off unit.

Step 4. Looking from the rear, on right side of power supply enclosure, locate small rectangular opening. Visually inspect interior switch.

Step 5. Using a ¼" flat screwdriver, push switch up for 220-240V; push switch down for 120V.

Step 6. On rear panel, install fuse of appropriate rating: 120V, 8A slo blow, or 220V, 4A slo-blow.

Step 7. On rear panel locate the 120V versus 220-240V label and remove the two retaining screws.

Step 8. With new voltage setting facing outward, re-attach label.

Step 9. Replace cover and 6 screws.

Step 10. Before unit is connected to ac power source, be certain power cable plug is changed to accommodate the voltage setting.

2.7.2 Switch Settings For Optional Equipment

2.7.2.1 Large Screen Display Unit Option. On the rear panel, set the slide switch to the appropriate range: 89-127 or 178-250. It is not necessary to change the fuse.

2.7.2.2 Thermal Printer Option. On the rear panel there are two switches for ac line voltage range and an instruction label for switch settings and fuse ratings. Set the switches as appropriate and install the proper fuse as described in the manufacturer's instruction manual supplied with the equipment for further details.

2.8 FLOPPY PREPARATION

(1) The floppy disk drive is shipped with a cardboard card inserted in the disk slot to prevent motion of the heads and internal parts. Remove this card before powering up the unit.

CAUTION

Save this card and reinsert it before shipping the unit or transporting it to other locations.

NOTE: Brand new floppy diskettes must be hardware-formatted and then initialized for the RT-11 operating system before they can be used. Refer to the RT-11 instructions in Section IV for these procedures.

(2) To load paper in the optional thermal printer refer to the instruction manual supplied with the equipment or the instructions printed on the packaged paper.

2.9 UNIT INTERCONNECTIONS

All connections for auxiliary units are made at the rear panel. All connections are clearly marked for their associated units and none of the connectors are identical except for REMOTE and AUX REMOTE which carry the RS-232 serial line interface ports. (Note that the REMOTE connector is wired for only one port (number 2), whereas AUX REMOTE provides two ports (numbers 3 and 4). Port number 1 on the internal four-port interface board is used by the front panel.) Figure 2-1 shows the connections to be made for the standard external units and common options.

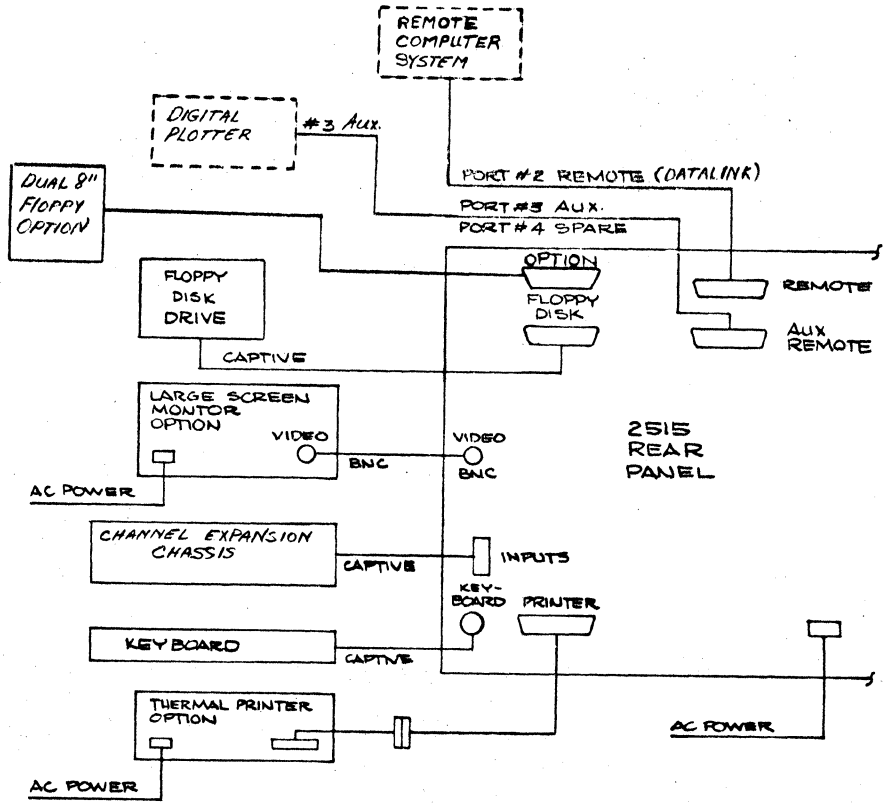


Figure 2-1. Unit Interconnections

2.10 SIGNAL CONNECTIONS

Input signals for the first four (standard) input channels are made through the front panel BNC connectors.

For more than four channels, the channels 5-8 option includes an external BNC connector panel chassis, with captive cable and connector for connection to the rear panel INPUTS connector as shown in figure 2-1.

Output from the internal sine wave and noise generator is supplied at a front panel BNC (OUTPUT SIGNAL).

Input connections for an external trigger pulse or an external sampling rate clock are made at the rear panel BNC's. Both of these inputs are applied to TTL circuitry and levels should be limited between 0 and +5 volts.

2.11 TEST AND FAMILIARIZATION PROCEDURE

The checkout test is performed in seven stages. Except for recall of the stored transfer function (which is tested later), stages 1-5 exercise most of the system hardware and, if successfully passed, give a good indication that the system software and hardware are operating properly. The remainder of this procedure is primarily exercises for new users to demonstrate typical procedures and some of the additional functions. These stages are as follows:

Stage 1. Power up and start up procedures to run the data acquisition (i.e., the panel) program are performed.

Stage 2. Recall a stored panel setup that is provided on the disk specifically for this test procedure. (Reference paragraph 2.11.4) This demonstrates the setup storage and recall feature and the STATE function summary of the setup. This quickly provides a known starting point for the first test.

Stage 3. Set up an output signal to be used as the input to both the reference and response channels. This demonstrates the output signal function and provides a known test signal without requiring the support or calibration of external equipment. (Reference paragraph 2.11.5.)

Stage 4. Execute a cross-channel analysis operation and average, and examine the transfer function result to verify proper operation of the arithmetic hardware and demonstrate some display function. (Reference paragraphs 2.11.6, .7, and .8.)

Stage 5. Store the transfer function result in a disk file. This demonstrates the basic procedure to open a file and tests that the system can write to the floppy disk hardware. (Reference paragraph 2.11.9.)

Stage 6. Change the setup. This demonstrates the typical measurement setup procedure, from beginning to end, to setup for measurement of a transfer function. It also exercises the other two input channels in the standard system. (Reference paragraph 2.11.10.)

Stage 7. Recall the stored transfer function. This demonstrates that the system can read from the disk, and illustrates the operation of the MEMory display functions. (Reference paragraph 2.11.11.)

The following paragraphs provide step-by-step procedures to check the system for proper operation, accompanied by descriptions for new users to demonstrate the basic operating rules and to exercise several of the system functions and features.

For use as a test procedure, all actions required by the user, such as buttons to be pressed or menu selections to be made, are printed in bold-face type for quick reference. To perform the test, just execute the required actions and check the resulting displays against the accompanying pictures or the described indications.

For new users, the procedural steps include a brief description of the operation being performed, indicating what is intended and what is happening. This procedure demonstrates basic operations as an introduction to the complete detailed descriptions in the later sections.

2.11.1 Test Equipment Required

These procedures use the built-in sine wave and noise generator output signals for test and calibration. The only equipment required is two BNC-to-BNC patch cables and a BNC tee connector.

2.11.2 Test Connections

Use the two BNC-to-BNC patch cables and tee connector to connect the front panel OUTPUT SIGNAL to front panel INPUT CHANNELS 1, the reference channel, and 2, the response channel.

2.11.3 Power-up and Program Start (Stage 1)

Step 1. **Set the POWER switch ON.** The system will take about 10 seconds to start the disk, execute a brief basic self-test diagnostic, and call the hardware bootstrap loader program. As the display CRT warms up, you will see a display similar to the following:

```
000002
000000
177760
177760
000000
000000

DEV>
```

The 6-digit numbers are the result of the microcode start-up diagnostic. The last number is the number of tests failed and should be 000000. "DEV> " is a prompt from the hardware bootstrap loader to enter the code for the device on which the system software is resident.

Step 2. **Press the RETURN key on the keyboard.** This is a default response to the DEV> prompt, telling the system to boot from the default device which is device DL0: (Note: You can boot from other devices as described in Section III.) If you do not respond (with a carriage return ⟨CR⟩) to the DEV prompt, the system will automatically boot DL0 in about 1-½ minutes.

The hardware loader will load and start the RT-11 operating system monitor, which in turn will execute a brief startup program that sets default devices or default program names for the system (e.g., .SET TT SCOPE) and then stops with a request for entry of the date and time such as follows:

```
 DEV>
RT-11SJ(GR0)V05.00
■

2515 System
Prom Revision - 1-Nov-83
Channels - 1-4
Memory Size:  128k Words
18-Jan-84  Change Date? --->
```

Step 3. Change Date? **Enter today's date** from the keyboard. The format for changing the date is as follows:

(CR):	Accept the current date as printed.
23(CR):	To change the day only.
19-Jan(CR):	To change the day and month only.
3-Jan-83(CR):	To change the complete date.

Step 4. Enter the time: **Press RETURN key** to omit the time. The format for entering the time (from the keyboard) is as follows:

HH:MM:SS

After date and time, the RT-11 monitor will return a prompting dot (.) indicating that it is ready for commands.

Step 5. Enter the command: **.R RTA (carriage RETURN).** R is a RUN command to the monitor. RTA is the file name of the 2515 panel program. It stands for Real Time Analyzer. The program will present a banner such as shown below for several seconds while it creates some "scratch" files that it uses for its own purposes.

GenRad

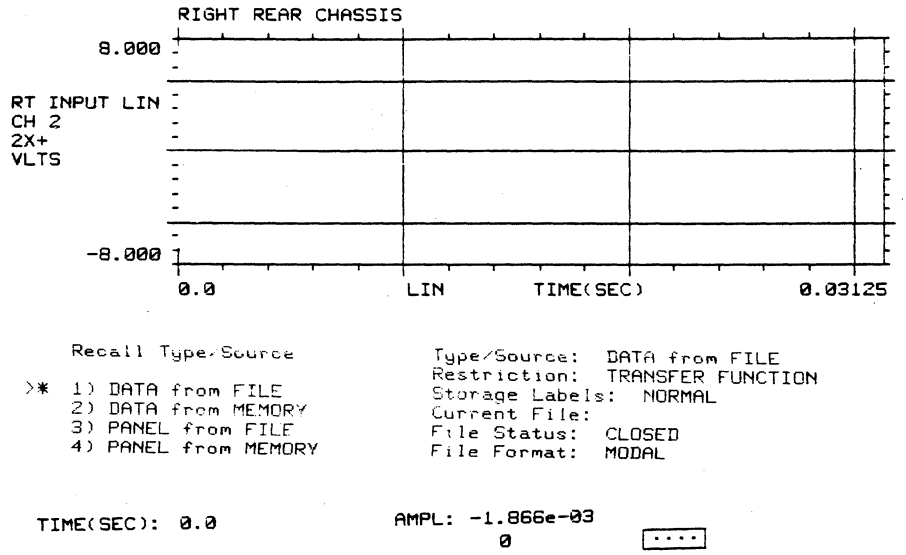
RTA Data Acquisition

Version X.X

The initial display is determined by the last panel setup. It is not significant for this procedure.

2.11.4 Load Stored Checkout Test Parameters (Stage 2)

Step 6. **Press the STORAGE RECALL button** at the lower left of the panel. The initial display will shrink to the upper half of the screen and the recall menu will appear as shown below:



The asterisk (*) at the left of the menu indicates the current selection. The pointer (>) is moved by the UP-DOWN arrow buttons to make a new selection. Note also the box containing four dots on the lower right. Each dot represents one channel and each box indicates one channel board (4 channels each) in the system.

Step 7. **Position the pointer at Panel from Memory,** using the UP-DOWN arrow buttons.

Step 8. **Press the ENTER button** (in the ENTRY group). The asterisk will move to indicate that the selection is now "PANEL from MEMORY", and this selection will be reflected in the summary list at the right of the screen.

NOTE: ENTER makes a selection without turning the menu page. The NEXT button also makes a selection the same as ENTER, but it also turns the menu page so you do not see the asterisk move. However, a NEXT selection will be reflected in the summary at the right.

Step 9. **Press the NEXT button** to turn the page for the following menu:

ENTER Memory Buffer #
* 0
> __

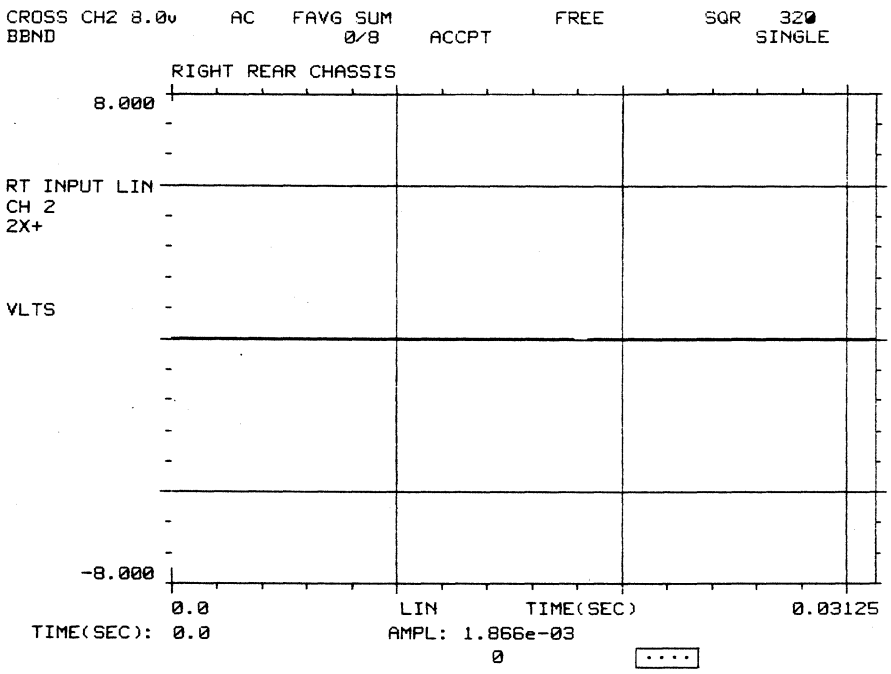
This is an entry-type menu. The asterisk indicates the current value, and the pointer is prompting for a new entry.

Step 10. In the ENTRY group, press:

0 ENTER

Panel Memory Buffer #0 contains the panel setup parameters for this checkout test, which take effect upon ENTER.

Step 11. **Press SINGLE.** This turns the final RECALL menu page and restores the full display, which should now appear as follows:



NOTE: The "missing" left edge line of the grid indicates that the cursor is there at time 0.0 seconds as indicated by the cursor readout line at the bottom of the screen.

2.11.5 Set Up Test Output Signal (Stage 3)

Step 12. Check that the front panel OUTPUT SIGNAL connector is connected to input CHANNEL 1 and 2.

Step 13. **Press the OUTPUT SIGNAL button.** The output signal menu will appear at lower left:

```
>*  1) OFF
    2) SINE WAVE
    3) RANDOM
```

Step 14. **Select RANDOM**, using UP-DOWN arrows, press ENTER.

Step 15. **Press NEXT** to make the selection and turn the page for the following menu:

```
ENTER the RMS Level of          Signal Level: 0.0
Output Signal                   Output Signal: RANDOM
(0-1.0V) Random                 Random Bandwidth: ACQUISITION
(0-4.5V) Sine                   Random Type: NON-REPEATING
*0.0                            Pattern #: 1
> __                            Burst Window: OFF
```

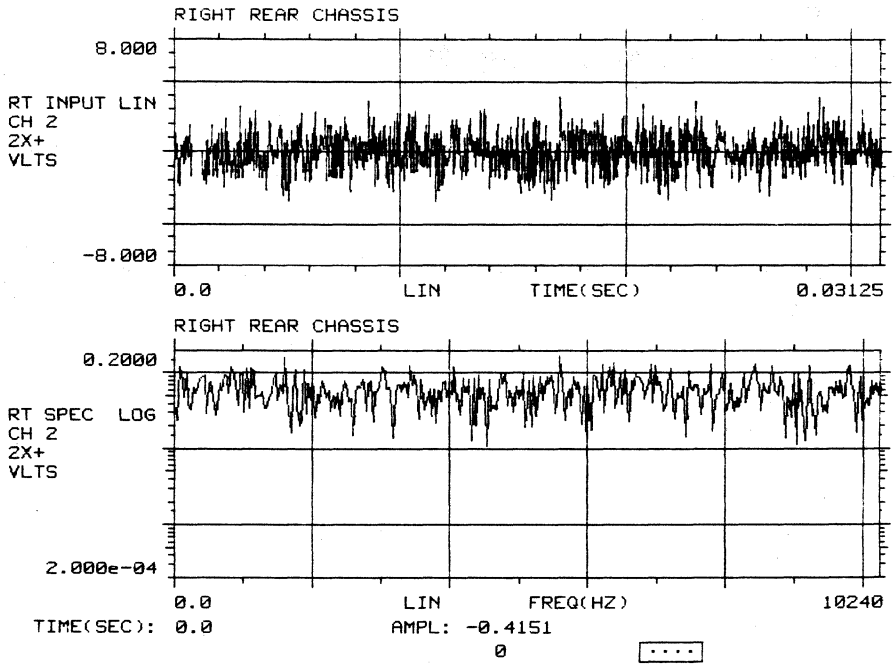
NOTE: Whenever the system is started, or a panel setup is recalled, the output signal level is not saved and is reset to 0.0 to avoid unexpected outputs that could damage connected external equipment.

Step 16. From the ENTRY group, enter the maximum value:

1.0 ENTER

The noise signal should appear in the upper display of Channel 2 input signal.

Step 17. **Press the DUAL button** in the DISPLAY group. The menu area will now be replaced by the "lower" display, which by startup default is the real-time, single-frame spectrum of the Channel 2 input. The display should now appear as follows:



NOTE: The spectrum display may occasionally be rescaled automatically to accommodate spikes in the changing spectrum. Scaling is described in sub-paragraphs 5.10.5 and 5.10.6.

2.11.6 Change Input Level and Test Overload (Stage 4)

When the upper display is a Real Time INPUT signal and there is no menu on the screen waiting for an input, the UP-DOWN arrow buttons may be used to change the maximum input level of the displayed channel directly, without going through the MEASUREMENT SETUP LEVEL button menus. Proceed as follows:

Step 18. **Press the DOWN-arrow button once.** Note that the upper (input) display range (and the maximum input level of the front end) change from ±8 V to ±4 V.

Step 19. **Press DOWN-arrow again.** Check that the range changes to ±2V and that there is an OVLD indication at lower right with a reverse video box in the channel 2 position. Note that channel 1, with the same input signal, does not overload, because its maximum input level has not been changed from the original ±8 V.

Step 20. **Press UP-arrow twice** to restore ±8 V range on channel 2.

2.11.7 Switch Displays and Compare Channels

Step 21. **Press NEXT CHAN** in the DISPLAY group. Both upper and lower displays will switch to channel 1, which should appear the same as channel 2 except for the channel number and MODAL coordinate (1X+) in the annotation at the left. (Channel 2 was first in this sequence because it is the first response channel.)

Step 22. **Press EXCHNG** in the DISPLAY group. The upper input and lower spectrum will swap positions.

Only the current upper display is accessible for modification by the panel controls.

Step 23. **Press CHANNEL** in the DISPLAY group. At the lower left in reverse video will appear the prompt:

Channel =

Step 24. In the ENTRY group, press:

2 ENTER

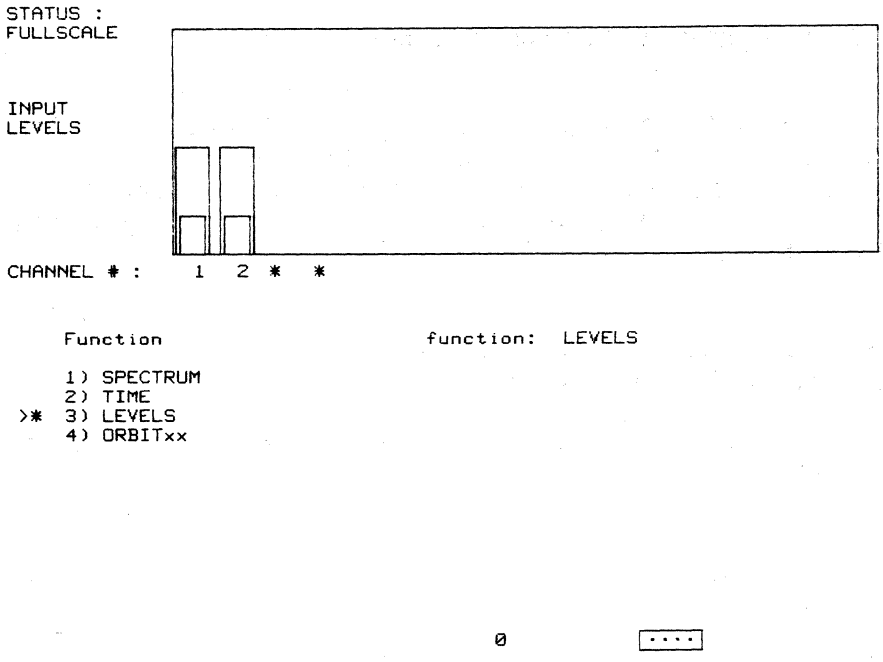
The CHANNEL button affects only the upper display, which should now be channel 2 spectrum.

Step 25. **Press the FUNCTION button.** The lower display will be replaced by the display function menu for REAL TIME displays:

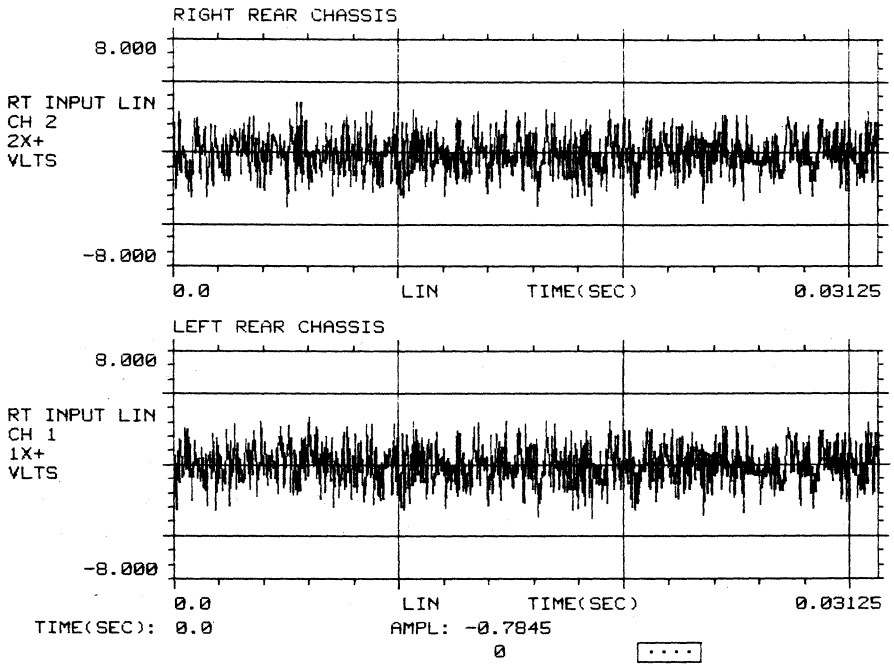
```
>*  1) SPECTRUM
    2) TIME
    3) LEVELS
    4) ORBIT
```

Step 26. **Select TIME and press ENTER.** Upper display is now channel 2 time domain input. FUNCTION menu remains in place of lower display.

Step 27. **Select LEVELS and press ENTER.** The levels display presents a bar chart of peak and rms levels for all active channels as shown below. Installed but inactive channels are indicated by asterisks.



Step 28. **Select TIME again and press NEXT.** This turns the last FUNCTION menu page and restores the DUAL display, which should be the identical noise input signal on channels 2 and 1:



2.11.8 Set Up Display and Run an Average for Transfer Function Measurement

Step 29. **Press AVG in the DISPLAY group.** Because no average has yet been run, the upper display will present the message:

AVERAGED FUNCTION IS NOT AVAILABLE

requested RESPONSE channel is 2

requested function: SPECTRUM

Step 30. **Press Y SCALE** in the DISPLAY group. The menu is:

1) LIN AUTO SCALE
2) LIN EXPAND
>* 3) LOG AUTO SCALE
4) LOG EXPAND

Step 31. **Select 3) LOG AUTO SCALE and press SINGLE** to make the entry and restore full screen display. The default AVG function display is the auto spectrum of the response channel. In the following step, observe the averaging count at the top and bottom of screen, and watch the "noise" spectrum flatten as more frames are averaged.

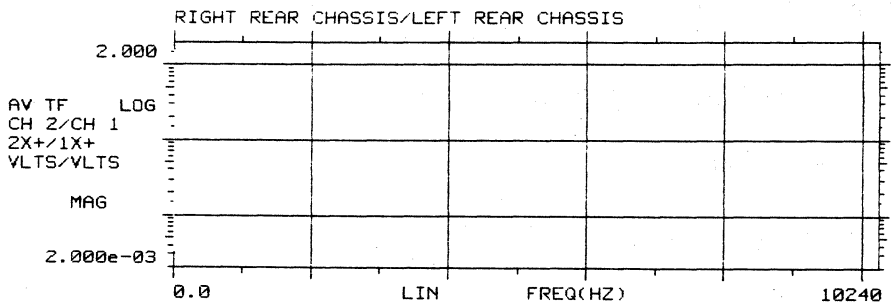
Step 32. **Press RUN** in the ACQUISITION group to start the average. (Repeat if desired.)

Step 33. **Press the FUNCTION button** for the menu of averaged function choices:

>* 1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORY

Step 34. **Select 3) TRANSFER FUNCTION and press NEXT.** This will advance the FUNCTION menu to the Format page, and switch display to Transfer Function. Check that the transfer function value is a straight line at magnitude 1.000 as shown below:

NOTE: If transfer function did not exceed a value of 1.000, the top line of the auto-sealed grid may be 1.00 instead of 2.000 as shown.



Format

1) BODE
>* 2) MAGNITUDE
3) PHASE
4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

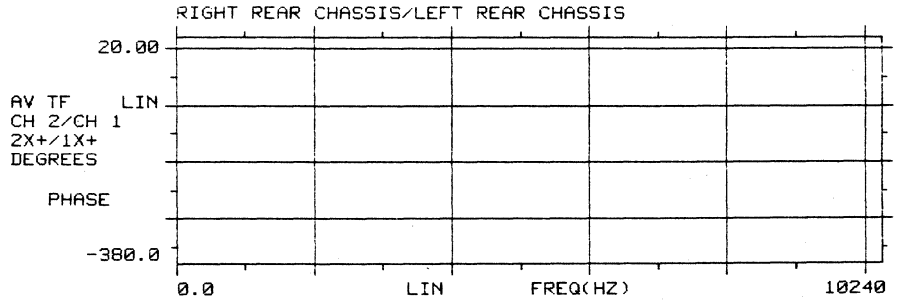
function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0

FREQ(HZ): 0.00

MAG: 1.001

8

Step 35. **Select 3) PHASE in the menu and press ENTER.** Check that the phase is a straight line at value 0 degrees as shown below.



Format

1) BODE
2) MAGNITUDE
>* 3) PHASE
4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

function: TRANSFER FUNCTION
CPX Function
format: PHASE
COH Blnk Level: 0.0

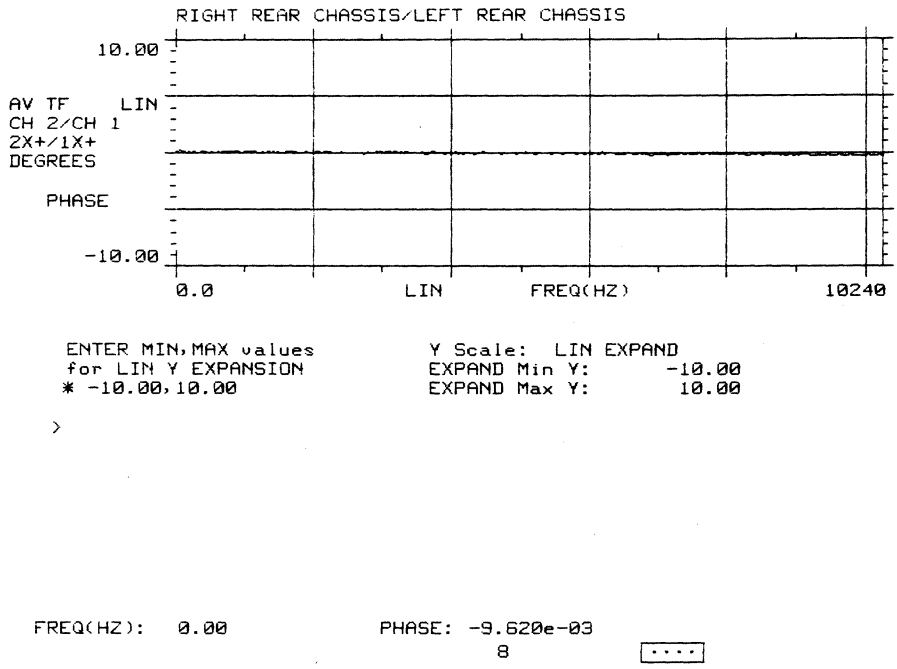
FREQ(HZ): 0.00

PHASE: -9.620e-03

8

NOTE: The auto-scale for phase extends from 20 degrees down to -380 degrees. The grid lines are at 0, -100, -200, and -300. If desired to better observe the phase display, proceed as follows:

a. Press Y SCALE
b. Select LIN EXPAND, press NEXT
c. For min, max values, in the ENTRY group press: -10,10ENTER
d. The display should be expanded as below

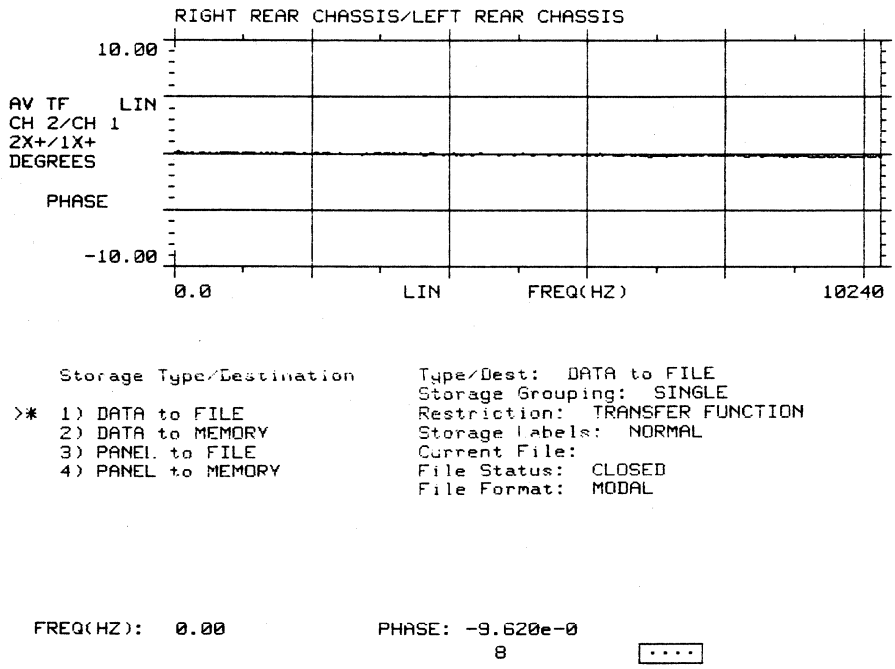


This procedure has exercised most of the system hardware and several of the software functions. If successfully completed, it provides a good indication that the software and hardware are operating properly and the system is ready for use. The following paragraphs provide further demonstrations of functions for operator introduction.

2.11.9 Storage Exercise (Stage 5)

2.11.9.1 STORE.

Step 36. **Press the STORAGE/STORE button** at the lower left of the panel. The STORE menu will appear as follows:



Step 37. **Move pointer to DATA to MEMORY,** using the UP-DOWN arrow buttons.

Step 38. **Press NEXT.** The following menu will appear:

```
ENTER RES COORD, REF COORD,
and SEQ#
*2x+, 1x+, 0
>
```

The pointer prompts for a new entry. An entry here would modify the coordinate labels before storing the function. The default values come from the function in the AVG display.

Step 39. **Press NEXT.** The following menu will appear:

```
ENTER Memory Buffer #
* 0
>
```

The pointer prompts for an entry. Enter 2 and press ENTER. The AVG data will be stored in MEMORY BUFFER #2 and verified by the "action succeeded" message.

2.11.9.3 DIR.

Step 40. If **STORAGE/DIR button is pressed** the following menu appears:

```
Directory
>*  1)  User Disk File
    2)  Memory
    3)  Memory Panel
```

Step 41. Select 2) Memory, **press NEXT** and the directory of memory buffers appears. Note that buffer 2 is filled.

2.11.9.4 RECALL. To recall the data to the display and to make sure it was properly stored, press EXCHNG. This moves the AVG display to the lower display buffer.

Step 42. **Press RECALL** and the following menu appears:

```
Recall Source/Type
>*  1)  DATA from FILE
    2)  DATA from MEMORY
    3)  PANEL from FILE
    4)  PANEL from MEMORY
```

Step 43. **Select 2) Data from memory** and **press NEXT.** The following menu appears:

```
Enter Memory Buffer #
* 2
>
```

Enter 2 and **press NEXT.** The display source changes to memory. Note that the screen now shows the stored data as it did before except that ME (memory) has replaced AV in the function type label.

For comparison of data, do the following:

Press EXCHNG, FUNCTION, NEXT, select 3, and press ENTER.
Press NEXT twice and press EXCHNG again.

Step 44. **Press DUAL.** The AVG data will appear in the lower display for comparison.

Step 45. **Press FUNCTION** and note that the Format menu appears since the function may not be modified for a recalled function.

Step 46. **Select BODE** and **press ENTER.**

Step 47. **Press EXCHNG, then NEXT** (to format menu).

Step 48. **Select Bode format. Press ENTER** again, **then DUAL.** Now the Bode displays may be compared, storing the displayed function, not format data. Note that storing and recalling functions into named user files is nearly identical to memory buffer storage except that the user must first open or create a file under the TYPE button before pressing STORE.

2.11.10 Measurement Setup Exercise (Stage 6)

Step 49. **Press CHANS.** The list on the right shows the current channel pair selections with asterisks (*) indicating the active channel pairs.

Step 50. Use the up and down arrows to move "@" sign. Move the @ symbol to pair 2, 1 and then **press 3, 4 ENTER.**

Step 51. **Press SINGLE.** The AVG display now says that "AVERAGED FUNCTION IS NOT AVAILABLE" since the setup information has been modified in such a way as to invalidate the current AVG data. There are other setup changes which will also cause this to occur.

Step 52. Move the BNC connections from input channels 1 to 4 and 2 to 3.

Step 53. **Press REAL TIME** data source.

Step 54. **Press FREQ, select Baseband, then press NEXT.** The following menu requests:

ENTER Maximum Frequency

Step 55. **Respond** by entering 5000 ENTER.

Note that the range actually appearing as the current value is 5120. User entries are converted to the next larger available hardware range.

Step 56. **Press TRIG** and, from the menu, **select 3) AUTO ARM EVERY FRAME** for auto-armed trigger mode. **Press ENTER.** Note that the ARM and HOLD lights alternately flash.

Step 57. **Press AVG, then RUN**, and observe the AVG again.

Step 58. **Press EXCHNG.**

Step 59. Recall memory buffer 2 to the upper display by **pressing RECALL, then NEXT**, then enter 2, and **press ENTER.**

Step 60. **Press DUAL.** Compare the differences in labelling.

2.11.11 Return to RT-11

Press MODE (measurement group).

Select 5), then press ENTER.

SECTION V

RTA PROGRAM OPERATION

This section contains detailed descriptions of the 2515 system operations using the RTA (Run-Time RT-11) program. Descriptions provided include measurement setups and operations, data storage operations, and display and cursor operations.

Before proceeding, new users should first perform the test and familiarization procedures presented in Section II.

5.1 STARTING THE RTA PROGRAM

To begin operation of the RTA program (also referred to as the 2515 program) first perform the power on instructions described in Section III.

Once power on is accomplished, a prompt (.) appears on the display. If the RTA Version 1.0 panel setup is to be used, an installation command must be performed at this time. To do this type:

```
COP     PANMEM.SCR      PAN2.SCR
COP     DATMEM.SCR      DAT2.SCR
```

The start up program may contain a command to automatically start the RTA program. If it does, a full display grid appears on the screen and the system is ready for panel operation.

If not, start the RTA program from the monitor. Type the command:

```
.R RTA
```

The R is a RUN command to the monitor. RTA (Real Time Analyzer) is the 2515 program file name.

5.2 RETURNING TO RT-11

At times during normal operation, you may want to stop the RTA program and return to the operating system. This is required mainly for manipulation of files that have been created on one or the other disk. RT-11 is not required to create files. That is done from the front panel by means of the STORAGE function. However, RT-11 does provide the means to obtain directories of the files that exist, to copy files from one device to the other, to rename files, to delete files, and to perform various other management operations. Descriptions and instructions for these operations are given in Section IV.

There are two methods to return to RT-11; one quick and one preferred.

Preferred Method:

1) Press the MEASUREMENT SETUP MODE button to obtain the mode menu.

2) Move the pointer to select EXIT TO RT-11.

3) Press the ENTER or NEXT button.

This method enters a shutdown routine that closes any open files, preserves the current panel setup information in memory buffer 16 (see Storage Functions), and erases the screen for a clean start with RT-11. Upon return to the 2515 program, the panel setup is restored from the memory buffer automatically.

Quick Method: Enter CTRL/C twice. (Hold the CTRL key and strike the C key.) This method aborts the 2515 program and immediately return control to the RT-11 monitor, which identifies itself by printing a prompting dot (.) at the left of the screen. This method is fast and convenient, but does not preserve any current setup information or any open data files.

5.3 RESTARTING THE RTA PROGRAM

In response to the RT-11 prompt (.), type the command:

.R RTA

The panel setup that was in effect upon the last "EXIT TO RT-11" from the 2515 program is automatically restored.

5.4 DISK DRIVE IDENTIFYING DEVICE NAME CODES

The RT-11 system uses fixed two-letter (or two-letters plus a number) codes followed by a colon (:) to identify peripheral devices such as the disk drives. In creating data or setup files from the front panel, you need these codes if you wish to specifically assign a file to one disk or the other. The applicable codes are:

SY: The system device; that is, the device from which the system programs have been loaded by the initial bootstrap operation. For the 2515, this is usually equivalent to device DL0:

DK: The system default device; that is the device that is assumed if no device code is included in a file reference. DK: is initially the same as SY:, but you may specifically assign it to another device if desired.

DL:
DL0:
DL1: The internal Winchester disk. The Winchester is organized and addressed as two separate devices, which may be specifically referred to as DL0: and DL1:. Plain DL: without a numeral refers to DL0:, which is ordinarily the system device (SY:) and the default device (DK:), unless you have booted from a different device or assigned the default to a different device as described in the next paragraph.

DY: The external floppy disk. This is a default for DY0: If additional floppy disks should be added to the system, they would be DY1:, DY2:, and DY3:. Note that this is not yet supported by the storage function. If files are to be created by RTA on DY:, load DY: before running RTA. If this is not done, no room (in lower memory) can be allocated for the DY: handler.

5.5 ASSIGNING THE DEFAULT DEVICE

When the system is started, the default code DK: is assigned to the SY: system device which is normally Winchester DL0:. This means that any time you refer to a file by its name without specifically including one of the other device codes (DL1: or DY0:) the file is placed on or searched for on DL0:. However, if you wish, you can assign the DK: default to one of the other devices by going to RT-11 and using its ASSIGN command. For example, if you want your data files to go to the floppy disk (DY:) without having to give a device code when you give the file name, the RT-11 command would be:

```
.ASSIGN DY: DK:
```

For convenience, you can assign logical device names to any of the disks. If you want to refer to them as A, B, and C, the commands would be:

```
.ASSIGN DL0: A:
.ASSIGN DL1: B:
.ASSIGN DY:  C:
```

Further descriptions of file and device names are given in a following paragraph on Storage Functions and in the RT-11 descriptions of Section IV.

5.6 DISPLAY FORMATS AND ANNOTATION

The display function is capable of maintaining two complete and independent data displays: an upper display and a lower display.

The upper display takes full screen when you select SINGLE display, and is the only one that is active or accessible for modification by the panel controls. To change the lower display function, you must use the EXCHNG button to swap the upper and lower displays. The upper display also governs in case of certain conflicts for combined displays, and the upper display is the one whose source is indicated by the REAL TIME, AVG, and MEM indicators. Also, for combined displays, the cursor readout applies only to the upper display.

The lower display is simply held in a separate memory area and is available for display in the DUAL or OVLY modes. All of its setup parameters are carried with it and it is independent of the upper display except for certain restrictions described in the following when in DUAL or OVLY modes:

NEXT CHAN — Increments both upper and lower displays.

X SCALE — Rescales both displays if they are of the same X-axis window type.

Y SCALE	Rescales both displays if they are of the same Y-axis window type.
UNITS	Changes X or Y axis units if they are the same on both upper and lower functions.
WINDOW	The window types are discussed in paragraph 5.8.7.1.

You may have both time and frequency domain displays on the screen at the same time, or real-time and averaging or memory displays at the same time.

The display format is basically selected by the DISPLAY group pushbuttons labeled:

SINGLE	Full screen display of one function.
DUAL	Dual upper and lower display of two functions.
OVLY	Dual superimposed (overlaid) display of two functions.
EXCHNG	Swaps upper and lower displays.

Figure 5-1 shows typical displays and annotation of each of these formats and of a display with a menu from one of the panel pushbuttons. The annotation that is not self-explanatory is described in the following paragraphs.

5.6.1 SINGLE Display, Full Annotation with Setup Summary

The following paragraphs list the functions, sources, and abbreviations of the display annotation shown in figure 5-1.

5.6.1.1 Measurement Setup Summary. The SINGLE display format allows space at the top of the screen for two lines that summarize the setup parameters described in the paragraphs on Measurement Setup functions, as follows:

a.	MODE Setup	AUTO	Auto-channel
		CROSS	Cross-channel
		PROB	Probability functions
b.	FREQ Setup, Basic Range (range in Hz on x-axis)	BBND	Baseband
		ZOOM	Passband

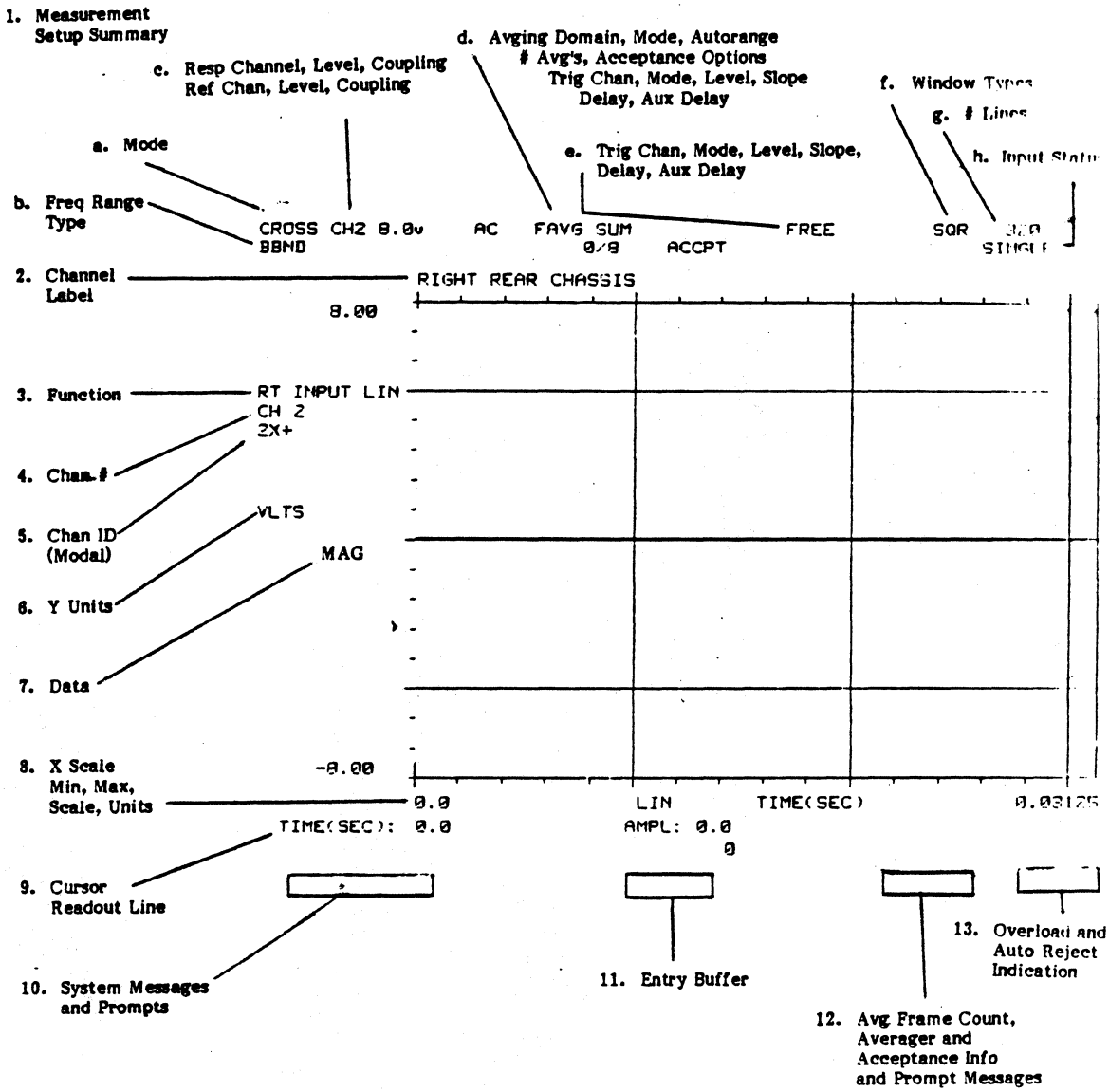


Figure 5-1. Display Formats and Annotation
(Sheet 1 of 2)

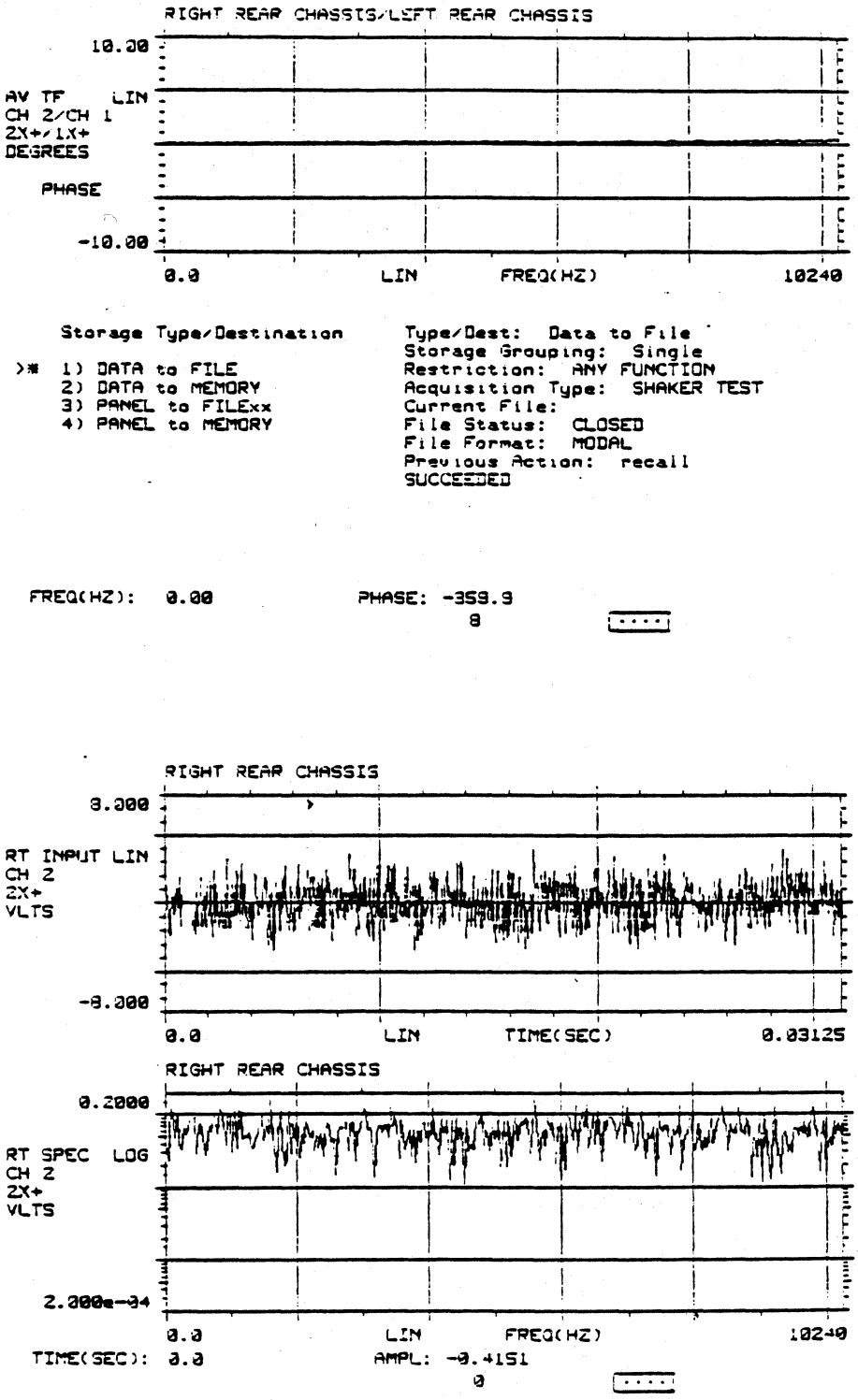


Figure 5-1. Display Formats and Annotation
(Sheet 2 of 2)

c.	CHANS/LEVEL Setup	Number, level, coupling, e.g.:	
	Resp Chan (top line)	CHx	Channel Number
	Ref Chan (2nd line, if Cross-channel display)	4.0V	Voltage range 0.0625 to 8.0
		AC	AC coupling
		DC	DC coupling
		ZERO	Zero input
		BIAS	2mA current for PCB
		DCR	Software DC removal
d.	AVERAGE Setup		
	Domain	FAVG	Frequency domain average
		TAVG	Time domain average
	Mode	SUM	Summation average
		DIF	Subtractive average
		EXP	Exponential average
		PEAK	Peak hold average
	Number of frames, processed/requested	e.g. 273/500	
	Auto range, if ON	AR/x (x = minimum percent full scale peak)	
	Acceptance options	ACCPT	Accept every frame
		MAN	Manual (CONT to accept)
		REJOV	Reject overload, underrange
		REJDH	Reject double hits
e.	TRIG Setup		
	Source Chan	CHx	Channel number
	Mode	FREE	Free run
		A1st	Auto arm 1st frame only
		AEVR	Auto arm, every frame
		MAN	Manual arm
	Level and Slope, e.g.:	20 P	+20%, Positive slope
		-40 N	-40%, Negative slope
	Delay, trig chan/aux	DLY ±a/b	Percent of frame length
f.	WINDOW Types	SQR	Square (none)
		HANN	Hanning
		FTOP	Flat top
		SPEC	Special
		CORR	Correlation
		IM	Impact
g.	FREQ Setup, number of lines of resolution, e.g.:	80, 160, 320, 512, 640, 1280, 2560	
h.	Overlap Process, Input Status	x%	If overlap (100, 50, MAX), or
		SINGLE	Single buffered
		DISC	Discontinuous

5.6.1.2 Channel Label. A channel label of up to 18 characters is optionally entered by you in the MEASUREMENT SETUP LEVEL menus. If one has been supplied it is printed directly over the top of the data display. Furthermore, if the display is a cross-channel function, the labels from the two channels are combined with a separator character indicating the type of operation. For example, a transfer function might be labeled:

RIGHT MOTOR MOUNT/LEFT CHASSIS (response/reference)

The cross-spectrum would be:

RIGHT MOTOR MOUNT * LEFT CHASSIS (response * reference)

5.6.1.3 Function. The function label indicates the type of function being displayed as shown in the following abbreviation list:

RT	Real Time
AV	Average
ME	Memory
INPUT	Time domain function
SPEC	Auto spectrum
CSPEC	Cross spectrum
TF	Transfer function
COH	Coherence function
TFCOH	Transfer function with coherence blanking
IMPUL	Impulse reponse
TRMIS	Transmissibility
COP	Coherent output power
ACOR	Auto correlation
XCOR	Cross correlation
TIME	Time history (time domain average)

5.6.1.4 Channel Number. The channel or channels being displayed are always indicated here. For cross-channel functions, the two channels are separated by an operator character. A transfer function for example might indicate:

AV TF
CH1/CH4 (i.e., response/reference)

5.6.1.5 Channel ID. The channel ID is provided for use in conjunction with MODAL analysis. Like the channel label, the channel ID is entered optionally in the LEVEL parameter menus of MEASUREMENT SETUP, and is used to identify MODAL channel reference and response locations and coordinates according to a scheme specified in the MODAL program. If used, the channel ID is printed where indicated, and if the display is cross-channel, both channel ID's are printed, separated by an operator character.

5.6.1.6 Y Units. The Y units annotation indicates the units of the scale as selected by the display UNITS function, such as volts (VLTS), volts-squared per Hertz (VOLTS/^{2}Hz), or decibels (dB), or corresponding engineering units if selected.

5.6.1.7 Y Data. Y data indicates the type of data being displayed when there is a choice for the function such as MAGnitude, PHASE, REAL, or IMAGinary.

5.6.1.8 X Min, Max, Scale, and Units. The X axis readout indicates the range of the scale, whether the scale is LIN or LOG, and the units, either TIME or as selected by the DISPLAY UNITS menu, which allows a frequency domain choice of Hertz or cycles per minute or orders for rotating machinery. Note that the minimum and maximum values refer to the ends of the scale, not to any nearby tick marks.

5.6.1.9 Cursor Readout Line. The cursor readout indicates the X position of the cursor in X axis units, and the Y amplitude in Y axis units. The cursor readout always refers only to the upper display.

5.6.1.10 System Messages and Prompts. This area is used to present system and error messages and prompts for the operator for panel buttons that require an entry but do not have menus, such as the display CHAN select. Error messages may be missed when they initially occur. Therefore, once they have occurred and have been printed, the system leaves them on the screen until they are acknowledged. If you are moving fast, the error message may refer to some step or operation prior to your most recent actions.

To erase an error message, press the CLR button (in the ENTRY group).

5.6.1.11 Entry Buffer. Alphanumeric entries from the ENTRY group buttons or the keyboard that do not appear directly in the menu area are echoed in this area until the ENTER button is pressed.

5.6.1.12 Average Frame Count, Averager and Acceptance Info and Prompt Messages. In addition to the setup summary lines at the top, the current count of frames averaged is also shown at lower right so it is visible in split or menu displays. This area is also used for the following prompting and information messages in conjunction with averaging operations:

ARNG	Auto-ranging is in progress.
ARM?	Waiting for ARM command in manual arm trigger mode.
REJ?	Waiting for RESUME or HOLD decision in manual acceptance mode. Waiting for ARM if in manual arm trigger mode.

5.6.1.13 Overload and Auto Reject Indication. These acquisition status indications are presented at the lower right of the screen in a row of from one to four rectangles, depending on the number of channels installed in the system. Each rectangle represents the four channels on one input circuit board, and normally contains four dots to indicate this. If an overload occurs in the input, or if the signal level is below the minimum percentage of full scale specified for auto-reject in averaging runs, the dot is replaced by a box of reverse video in the appropriate channel position, containing an up-arrow for overload or a down-arrow for underrange. A message area just left of the channel status boxes presents acquisiton status information as follows:

AREJ	The last frame was auto-rejected based on overload or under-range criteria.
DHIT	The last frame was auto-rejected based on double hit criteria.
OVLD	One of the channels has overloaded. This message is replaced by AREJ or DHIT during auto-reject averaging.
ORUN	The input FIFO has been overrun. Invalid data results.

In the ORUN conditon all the channel squares are shown in reverse video with no arrows. In RTA, V1.0, the ORUN conditions are seen if more than 12 channels are activated on the 20.48 kHz or 25.6 kHz bandwidths.

NOTE: Overload detection is performed by observing the peak input signal level, without regard to the setup bandwidth that the system is operating on. It is quite possible to have an overload of the input amplifier, and get a corresponding overload indication without any visible evidence of it in a display of the input waveform. An offending high-frequency component would be filtered out by the bandwidth anti-aliasing filters before the data reaches the display.

It is also possible to observe an apparent overload or clipping in an input waveform display without an overload indication. This can happen because the hardware design allows an "overload" range of approximately 20% beyond the selected levels of the input range. For example, if the system is set for the ±4 V peak input range, it can accept and correctly process a sine wave input up to approximately ±5 V peak (no offset) without clipping or distortion.

5.6.2 DUAL Display Format

The DUAL display shrinks the full display to the upper half of the screen and adds the second display in the lower half. Annotation for each display remains the same as for SINGLE with these exceptions:

- The setup summary lines at the top of the screen are not displayed.
- The cursor readout at the bottom of the screen refers only to the upper display.

5.6.3 OVLY Display Format

The OVLY display superimposes the lower display data on the upper full screen display. The format and annotation are the same as for SINGLE display with these notes and restrictions:

- The two displays must be the same type of x-axis window or the overlay is not allowed.
- The parts of the setup summary lines at the top of the screen that are not applicable to all functions and all channels refer only to the upper display.
- The cursor readout at the bottom refers only to the upper display.
- The channel number(s) and MODAL channel ID, if available, for the lower display are added to the left side annotation below the Y axis units and scale information.
- If the axis scales of the two displays are not the same ranges, the upper scales are used.

5.7 MENU OPERATIONS, SELECTIONS, AND ENTRIES

5.7.1 Selection by Pointer

Whenever a multiple choice menu appears on the screen, there are two symbols associated with it in the left margin. An asterisk (*) indicates the selection that is presently in force. A pointer (>), which you control with the UP-DOWN arrow buttons, indicates the next selection (the one that takes effect when you press ENTER or NEXT).

When the menu first appears, the pointer and the asterisk are in the same location, and the display in the upper half of the screen updates as usual. As soon as you begin to make a selection, that is, when you move the pointer away from the asterisk, the display stops and the message "PAUSE" appears at the lower left. This

allows the program to devote full attention to your menu operations and reduces response time to selections. Note that this pause is only for the display function and does not affect data acquisition or processing.

To complete the selection, press ENTER or NEXT. The current selection asterisk moves to the new pointer location, the selection takes effect, and the display starts again. Using the ENTER button leaves the current menu on the screen for further changes if desired. Using the NEXT button makes the entry and also turns the menu to the next page (or restores the full screen display from the last page of the menu).

5.7.2 Selection by Item Number

All items in multiple choice menus are numbered. Rather than using the UP-DOWN arrows and the pointer, you can also make selections by entering the item number (with the ENTRY group buttons) and then pressing ENTER or NEXT. This method is a little faster and is preferred by some operators when they are familiar with the menus. Numerical entries are echoed at the bottom center of the screen as they are made. Beginning an item number entry makes the display pause, the same as for pointer selections.

5.7.3 Alphanumeric Entries

Many of the menus request entry of a specific parameter value by the operator, rather than a multiple choice selection. These entry menus all begin with the word ENTER and, like the multiple choices, they use the asterisk and pointer symbols. The current value (if any) is printed next to the asterisk and the pointer in the left margin indicates that the system is ready for a new entry. For example:

```
ENTER MAXIMUM FREQUENCY
  * 5120

>_____________
```

When you begin an alphanumeric entry, the characters you enter appear next to the pointer and the display pauses until you complete the entry. To complete the entry, press ENTER or NEXT. Upon ENTER, the new value is transferred from the pointer to the asterisk to take effect, and the current menu remains in place. Upon NEXT, the entry takes effect and the menu proceeds to the next page.

5.7.4 Multiple and Null Parameter Entries

Several of the entry-requesting menus want two or more values; for example:

```
ENTER MIN, MAX VALUES
FOR LIN X EXPANSION
  *0.0,10240.0
> _____________
```

Each value entered must be separated from the following one by a comma character (,), without a space.

If you wish to leave one or more values unchanged or unspecified, you may simply enter the comma(s) to account for them, without entering any value. For example, to change only the maximum frequency for the expansion window above you could enter:

```
>,100
```

Entering only the first parameter leaves the second unchanged.

5.7.5 Keyboard Entries

You can make alphanumeric entries from the keyboard as well as from the ENTRY group buttons. The equivalent keys are:

Panel	Keyboard
ENTER	/ (backslash)
NEXT	RETURN
DEL	DEL
CLR	! (exclamation mark) For numerical entries only. For alpha entries, you must first press the semicolon (;) to identify a following character as a command, then press the exclamation mark.

If a menu with a prompt that requires a text string appears and you want to key in a comand (instead of replying to the prompt), enter a semicolon (;) first. If not, the command entered from the keyboard is taken as the text string for the prompt and results in an error.

5.8 MEASUREMENT SETUP FUNCTIONS

The following paragraphs describe the functions, features, and the setup menus controlled by the MEASUREMENT SETUP group of buttons. The list below also includes (in parentheses) two designations which represent the equivalent keyboard command.

The measurement setup determines the operations that are performed on the input data as it is being acquired, conditioned, processed, and averaged. Conditions controlled by the setup functions cannot be changed after an averaging run; that is, none of the setup functions are post-processing operations like the display functions that allow changes in the presentation of the data after it is acquired. Measurement setup includes the following controls:

MODE (MM)	Sets the basic system processing mode for auto-channel, cross-channel, or probability computations. Also controls exits to the optional MODAL analysis package or the RT-11 operating system.
CHANS (MC)	Selects the channels to be processed and specifies the reference and response channel relationships for cross-channel operations and allows MODAL coordinate input.
LEVEL (ML)	Sets the full scale voltage level range and selects input coupling for each channel. Also allows operator assignment of location and coordinate codes for MODAL analysis, specification of an engineering units-per-volt conversion factor, and assignment of a channel label to be printed on displays.
FREQ (MF)	Selects baseband or zoom processing, sets frequency range, and resolution in terms of number of frequency lines.
AVERAGE (MA)	Selects type of averaging, number of frames to be processed (or exponential discount factor), and modes of acceptance or rejection for individual frames. Also to invoke input level autoranging.
WINDOW (MW)	Selects weighting or shaping functions to be applied to input data, and overlapped processing for low frequency ranges.
TRIG (MT)	Sets trigger mode, source channel, level, and slope, and allows specification of delays for advanced or retarded trigger recognition.
STATE (MS)	Prints a summary report of the entire system setup status.

5.8.1 Notes on Processing Modes

There are two front panel setup functions that have significant effects on what functions can be obtained after processing. These are the choice of auto-channel vs. cross-channel mode, and time domain vs. frequency domain averaging. Both of these determine what functions of the input signals are accumulated during the data acquisition and averaging processes, and also affect the initial allocation of buffer areas in memory for the processing operations. This in turn affects the total memory space required, and at some point begins to restrict the number of lines of frequency resolution that can be obtained for a certain number of channels or channel pairs.

In AUTO-CHANNEL mode, the system operates as multiple single-channel spectrum analyzers. With frequency domain averaging in effect, the process is as follows: An input frame of time-domain signal data is acquired on all active "response" channels. A direct Fourier transform is performed on that frame to produce a linear complex spectrum (the DFT) consisting of voltage amplitude and phase data in a format of real (in-phase) part and imaginary (quadrature) part. The complex spectra cannot be averaged because phases vary randomly from frame to frame and the average tends to zero. Therefore the next step is to multiply each complex spectrum frame by its own self-conjugate. This produces a raw auto power spectrum consisting of sum-of-the-squares magnitude-squared information. The power spectrum no longer contains phase information, but it is non-complex and can be accumulated in multiple frame averages. Thus at the end of the process, the only data that remains is the real auto power spectrum for each channel. This data can be scaled in various ways for display, but the complex phase information and the time domain information can no longer be recovered. Therefore, the only choice of FUNCTION for AVG display is AUTO-SPECTRUM.

In time domain averaging for auto-channel mode, this is not the case. Time domain averaging is performed by accumulating a summation average of the several individual time-domain input frames. Time domain averaging is only appropriate for somewhat repeatable signals such as transients or signals with known periodic components, and the input frames must be synchronized by triggering or the average would tend to zero to some dc level.

At the end of the averaging run, the retained data is a conglomerate time record for each channel. This time record still contains phase information, and the display routines can still compute the linear complex spectrum as well as the auto-spectrum. Therefore, the display FUNCTION selector provides a choice of TIME HISTORY or SPECTRUM, and the SPECTRUM choice has a NEXT Menu that allows choice of the various complex formats such as Bode, magnitude or phase, real or imaginary, and Nyquist (imaginary versus real). The magnitude display is equivalent to the auto-spectrum display of frequency domain averaging.

In CROSS-CHANNEL mode (frequency domain averaging), the system must preserve relative phase information between the reference and response channels of each channel pair. To do this, it computes a cross power spectrum for each channel pair as well as the auto power spectrum for each active channel. To allocate memory buffer areas and locations for the cross spectra, the channel pairs must be known before processing starts.

For example, if you designate channel 1 as a reference channel and channels 2, 3, and 4 as response channels, the system computes and retains the spectra necessary to produce transfer functions for channel pairs 1-2, 1-3, and 1-4. But you cannot later obtain a transfer function between, for example, channels 2 and 3.

In processing, the system takes one frame of input signal data from all channels, performs the direct Fourier transforms to produce linear complex spectra, then computes and accumulates the auto power spectra as it does for auto-channel mode. It then computes and accumulates the complex cross power spectra for each designated channel pair.

The cross spectrum is the complex conjugate product of the two linear complex spectra. It represents the common power and the phase difference between the two channels and, although complex, it can be averaged in the frequency domain. Thus at the end of an averaging run, the system retains an averaged auto spectrum for each active channel, and an averaged cross spectrum for each designated channel pair.

The display routines compute the transfer function by dividing the complex cross spectrum by the real auto spectrum. All of the other functions that are available from display are similarly derived from the cross and auto spectra by mathematical operations, including the inverse Fourier transform, to produce the time domain functions such as the impulse response and the correlation functions.

5.8.1.1 Probability Mode. The PROBABILITY mode is used to compute the probability density and the cumulative distribution of each active channel. If this mode is selected, reference channels are disabled.

To obtain the probability density function (PDF) of a signal level, a fixed sample size of signal levels must be collected first.

The process of PDF averaging is similar to ASPEC averaging in that it allows summation and exponential modes, autoranging, and user specified number of averages.

The value of each element (data {i}) in the average buffer is obtained by:

(data {i} current) = (data {i} old) * (discount -1)/discount
+ PDF value * (1/discount).

When the cumulative density function (CDF) is desired, each data value is simply the summation of all the previous data values (after conversion to probability, instead of probability density) up to that data point. The last CDF data value should be unity. Use the following menu sequence:

a. Press MODE. The basic processing modes appear:

1) AUTO CHANNEL
2) CROSS CHANNEL
>*3) PROBABILITY
4) EXIT TO MODAL
5) EXIT TO RT-11

b. Press AVERAGE. (This menu is omitted when PROBABILITY is selected.)

```
  1)   FREQUENCY DOMAIN
>*2)   TIME DOMAIN
```

When you select PROBABILITY mode, FREQUENCY DOMAIN averaging and windows are not allowed. In this case, selection is always coerced to the TIME DOMAIN.

The AUTO ACCEPT menu appears. Disregard this menu and continue.

c. Press AVG.

d. Press FUNCTION.

```
>*1)   PROBABILITY DENSITY
  2)   CUMULATIVE DISTRIBUTION
```

Probability density or distribution functions may be stored in either MODAL or standard files. While coordinates may not be important for identifying data blocks, they are stored for MODAL recall.

To store a probability density function (PDF) or a cumulative distribution function (CDF) the file has to be opened with the capability of storing any function.

5.8.1.2 Memory Allocation. The RTA program allows a variety of acquisition processing and display modes. The memory requirements for each combination of these modes are different. The ability to modify the number of spectral lines and the number of channels especially require that buffer space be dynamically allocated during the setup process. You are generally aware of this process except for two reminders:

1) If there is not enough space to perform the desired operations a "not enough memory" message appears at the lower left. Data acquisiton stops when this occurs and does not resume again until the current (or some other) parameter is modified so that the memory size can accommodate the need.

2) Modification of parameters that cause memory to be re-allocated invalidate the data in the AVG buffers and a "...not available" message appears in a blank display function.

The parameters which cause memory allocation to occur when they are modified are listed below.

Processing mode	Frequency type
Trigger mode	Frequency range
Active channels	Number of lines
Averaging domain (time/freq)	

5.8.2 Mode Setup

The MODE button presents the following menu for choice of the basic processing mode:

AUTO CHANNEL
CROSS CHANNEL
PROBABILITY
EXIT TO MODAL ANALYSIS
EXIT TO RT-11

AUTO CHANNEL operation computes only the auto-spectrum (or time domain average) for all active channels. In auto-channel mode, all active channels are designated response channels in the INPUT CHANS function described in paragraphs 5.8.3 and 5.8.4.

CROSS CHANNEL operation computes the auto-spectrum (or time domain average) for all active channels, including reference channels, and additionally computes the cross spectrum between each reference-and-response channel pair that is designated in the INPUT CHANS setup (paragraph 5.8.3).

PROBABILITY mode computes an amplitude histogram and cumulative distribution for each active channel. See paragraph 5.8.1.1 for more description.

EXIT TO MODAL ANALYSIS mode exits from the 2515 data collection program directly to the optional MODAL or MODAL PLUS analysis program (if present). Certain file information is preserved and passed between these two programs as described in paragraph 5.8.2.1.

EXIT TO RT-11 makes a graceful exit from the 2515 panel program to the RT-11 operating system for file management operations.

When exiting to either MODAL ANALYSIS or RT-11, the current panel setup information is saved. This setup is restored when RTA is run again.

5.8.2.1 Exiting the 2515 Panel Program and Running the MODAL Analysis Program. One of the principal applications of the 2515 is for modal analysis investigations. In this application, the 2515 panel program performs the data collection functions, to create and fill a file of frequency reponse functions for the MODAL program; that is, the MODAL program's (H) Function file. If the 2515 data collection function is performed first, you can assign a name to this file that is appropriate for MODAL, and MODAL can subsequently find it when it is attached to the MODAL Project file.

On the other hand, if MODAL has been running previously and exits to the 2515 panel program, a project file will have been created. That project file in turn contains a reference to a Function (H) file. When MODAL exits to the 2515 panel, the Function (H) file specification automatically becomes the active file for the 2515 panel STORAGE function*, and the project file information is preserved in the 2515 program. Then, when 2515 exits back to MODAL, the project file information is passed back and the MODAL program, although restarted, comes back ready to run in essentially the same state it was before.

*You can change the active storage file if it is not desired to store into the MODAL Function file.

5.8.3 Input Channel Select Setup - CHANS

All of the following descriptions are for cross-channel mode. For auto-channel mode and probability mode, all of the individual channels are regarded as "response" channels, and there are no reference channels. The reference channel column in the table is blank, and reference channel entries are ignored if they are made.

5.8.3.1 Active Channels Setup. Pressing the (INPUT) CHANS button presents a tabular listing of all channel pair setups on the right side of the screen, and instructions for its use at the upper left of the screen as shown below. Unlike other menus, which leave the "upper" data display on the screen, this menu occupies the full screen. This allows listing of as many as 16 channel pairs (the maximum number of channels available) on the screen at one time, and it is assumed that if new channel setups are being made the current display data is of no interest.

	res chan	ref chan
Response, Reference channel pair assignments	@*2	*1
	3	1
* designates active channel	4	1
	1	1

To modify, use arrows to
move @ and ENTER new response,
reference channels

ENTER 0 to deactivate pairs

ENTER RESPONSE, REFERENCE
CHANNEL(S)
*2, 1
>____

The channel pair list contains as many lines and allows as many channel pair setups as there are channels physically installed, in the system. The example above assumes four channels. The pairs, and active channels are shown as they would appear when the checkout test parameters have been recalled from panel setup memory buffer #0. Otherwise, this channels list reflects the setup that was in force before the last "EXIT TO RT-11" operation. Note that it is not necessary that all installed channels are included in the list, and no particular order of channel numbers is required. You have complete freedom to assign channel pairs in any arrangement, the only restrictions being that the number of pairs is limited to the number of channels installed. Also note that the list always has as many lines as there are channels in the system, but not all channels listed must be active. In fact, you must specifically activate (or deactivate) channels by making entries in the list.

To activate a pair already entered in the list, use the UP-DOWN arrow buttons to move the @ symbol to the desired line in the list, then press ENTER or NEXT. Asterisks (*) appear next to the channel numbers in the list to indicate that they are now active.

The @ symbol at the left of the list marks the current line. The response and reference channels on that line are also shown below the entry menu at lower left, next to the asterisk that indicates the current value of parameters, i.e.:

ENTER RESPONSE, REFERENCE

CHANNEL(S)

* a, b	(resp, ref channels on current @ line)
>x, y	(enter new resp, ref if desired)

To change a line of the table and activate the new pair, move the @ symbol to the desired line. Then press the ENTRY group numeral buttons for the desired resonse channel, followed by a comma (,) followed by the reference channel (e.g., 3, 2). These entries are echoed at the new-value pointer below the entry menu. Then press ENTER. The new values are transferred to the current value in the menu, and to the current line in the table, with asterisks to indicate that they are active.

To deactivate a pair, move @ to the desired line, then enter 0 for the new value. The channel numbers remain in the table, but their associated asterisks are erased to indicate that they are no longer active as a pair. The physical channels remain active if they are part of some other active pair.

It is not possible to deactivate the last channel or channel pair. Also, deactivating the trigger channel when in a triggered mode of operation is not allowed.

5.8.3.2 ZOOM Effects. There are normally four input channels on each physical channel card that is installed in the system. However, when ZOOM processing is selected under the FREQ setup function, only two channels per card may be used. This usually requires some adjustments in the active channels table when the mode is switched from baseband to ZOOM.

To make the adjustment, the system searches the active channels table, line by line. It allows only the first two channels that it finds on each card to remain active, and adjusts any subsequent entries accordingly. For example, consider the following baseband table:

res chan	ref chan#
*1	*4
*2	*4
*3	*4
*4	*4
*5	*4
*6	*3
*8	*8

After switching to ZOOM, channels 1 and 4, the first pair, would remain active on channel card #1. Channels 2 and 3 would be disallowed. On the second card, channel 5 would remain active because its reference channel, 4, remains active on the first card. However, channel 6 would not be allowed because its reference channel, 3, is not available. Nor would channels 7 or 8 be allowed, because the combination would require three channels on the second card.

If you attempt to activate more channels or to change the channel setup while in ZOOM mode, the channel number entries are accepted into the table, but the channels are not activated except as adjustments are made to conform to the two-channels-per-card limitation as stated above.

The original baseband channel setup is preserved in a separate table and is returned to use whenever the system is returned from ZOOM mode to baseband mode.

5.8.3.3 Channel MODAL Coordinate Assignments. After the active channel setup above, press the NEXT button to turn to page 2 of the CHANS setup menus. This page presents a listing of only the active channels, together with the MODAL analysis coordinate codes that are currently assigned to them, as follows:

```
Active channels and their          CH #      COORD
Modal coordinate labels

                                     1         1X+
To modify, use arrows to             2         2X+
move @ to CH #, and ENTER            3         3X+
new label                            4         4X+


ENTER the New Coord
* 1X+
>
```

The order of channels may not always be the same since the reference channel(s) is always listed first.

This listing allows MODAL users to change any one or all channel coordinate assignments at one place, when making MODAL setup changes. To make a change, use the UP-DOWN arrow buttons to select a channel with the @ symbol, then enter the new coordinate.

Note that these same coordinate assignments can also be made one channel at a time in the channel LEVEL setup described in the next paragraph, or during a storage operation just before storing processed functions. All three of these coordinate assignment menus are interconnected; for example, changing a coordinate assignment during the storage operation carries back to be reflected in the CHANS listing above, and in the individual channel setups of the LEVEL function described below.

Note: MODAL/MODAL PLUS does not recognize coordinates in numerical part > 8000; RTA does not store function data for such cases (> = 8000), except for panel data which is designated by 8100Y+.

5.8.4 Input Channel LEVEL Setup

The LEVEL setup sets the input parameters for each channel. It also provides for the assignment of engineering unit conversion factors and channel labels for displays, and the assignment of a MODAL analysis location coordinate, which is required when the collected data is used for subsequent MODAL analysis. The LEVEL setup may be made for any installed channel, regardless of whether or not it is active under the preceding CHANS select setup.

Pressing the LEVEL button (and the NEXT button) presents a summary of the setup for the currently selected channel and the sequence of menus shown schematically below. Parentheses and underscoring indicate operator entries or variables. Details of these menus and their functions are described in the following paragraphs.

ENTER CHANNEL #
to be SET UP
* (current channel number)
> ____ (enter new chan #)

(NEXT)

Volts Full Scale
1) 8.0v
2) 4.0v
3) 2.0v
4) 1.0v
5) 0.5v
6) 0.25v
7) 0.125v
8) 0.0625v

(NEXT)

ENTER MODAL COORDINATE
in form nnX+
* (current coordinate)
> ____

(NEXT)

CAL FACTOR=(FACTOR) "UNITS"
PER 1.0 VOLT
ENTER (FACTOR)
* (current numerical factor)
> ____

(NEXT)

CAL FACTOR=(FACTOR) "UNITS"
PER 1.0 VOLT
ENTER "UNITS"
* (current units text)
> ____

(NEXT)

Setup Channel: (channel #)
Volts Full Scale: (e.g., 8.0)
MODAL Coordinate: (e.g., 42Y-)
Cal factor: (numerical value)
Cal units: (units text)
per 1.0 volt
Coupling: (e.g., AC)
Chan ID: (18 character label)

Coupling
1) AC
2) DC
3) ZERO
4) BIAS SOURCE
5) DCR: S/W DC REMOVAL

(NEXT)

ENTER CHANNEL I.D. LABEL
* (current label, if any)
> ____

(NEXT)

Returns to full display

5.8.4.1 Channel Number to be Set Up. Enter the number of any channel that is physically installed in the system. The summary information immediately reflects this channel, and all subsequent entries take effect on this channel.

5.8.4.2 Volts Full Scale. Select the smallest full scale input range that accommodates the signal without overloading.

> NOTE: If desired, you may select automatic input level ranging under the AVERAGE setup function. Autoranging then performs when you press the RUN button to begin an averaging run. When autoranging is to be used, you may select any arbitrary range here, and it adjusts automatically when you press RUN. The autoranging criteria are described in the paragraph on Average Setups.
>
> However, autoranging is not performed on the trigger channel. For triggered mode acquisition, you must still specifically set the input range for the trigger channel.
>
> NOTE: The input level range can also be changed "on-line" as follows: Whenever the active (upper) display is an input time domain function and no menu is present, you can increase or decrease the input level range for the channel being displayed by pressing the UP-ARROW (Δ) or DOWN-ARROW (∇) buttons.

5.8.4.3 MODAL Coordinate. This information is not required and may be skipped if the system is being used for general signal analysis. (A default value is supplied by the program.) However, it is required if data is being collected and stored in an "H" function file for subsequent use in MODAL analysis. The 2515 uses these coordinates for identifying frequency response functions within the file, and the MODAL program needs them for sorting and indexing the functions. The assignment of these coordinates is normally performed as part of the MODAL geometry setup and is familiar to users of the MODAL program. The entry is of the form:

nnnnX+

where nnnn is the numerical value between 1 and 8000 that identifies a location in the MODAL geometry definition.

X is one of the characters X, Y, or Z, specifying the axis of the transducer in the modal geometry.

\+ is one of the characters + or -, identifying the direction of the response relative to the reference.

Note that a MODAL coordinate entered here for a channel is also reflected in the all-channel coordinate listing of page 2 of the CHANS select menu described in the preceeding section. Conversely, a change of coordinate in that listing, or subsequently in a storage operation, automatically makes a corresponding change in each of these individual channel setups.

The MODAL coordinate is printed in display annotation along with the channel number. For cross-channel displays, the two MODAL coordinates are displayed together, with an appropriate separating operation character; for example, a transfer function display with channel 1 response and channel 4 reference might indicate:

```
CH1/CH4
17Y+/20Y-
```

5.8.4.4 Calibration Factor and Units. These two entries allow specification of a factor for conversion from the basic input calibration in volts to the engineering units of the application, such as g's, inches, or pounds. Whether or not these units are applied to displays is determined by a selection in the DISPLAY UNITS control function. If engineering units are turned on, then the displays are scaled with the units and conversion factor specified here.

The factor and units are entered separately in two entry-menus as shown in the menu summary at the beginning of this paragraph. Example: If you are using an accelerometer that produces 10 millivolts per g, and you want your results in g's, your calibration factor would be 1g/.010 volt = 100 g PER 1.0 VOLT, which you would enter as (FACTOR) = 100, "UNITS" = g. The "UNITS" text is restricted to 8 characters.

5.8.4.5 Coupling. The input coupling menu provides these choices:

AC	Capacitive input coupling which acts as a high pass filter to block dc and slowly varying offsets that might cause overranging (3 db at 0.8 Hz).
DC	Direct coupling to the input preamps.
ZERO	Grounds the input to the preamplifier in front of the analog filter for test or calibration purposes.
BIAS SOURCE	Provides a 2 mA current source at the input connectors for use of accelerometers such as the PCB-type that have built-in FET buffer amplifiers. These accelerometers can be connected directly without the need for external amplifiers. Coupling is forced to AC to block the dc offset that results from the current source.
DC: S/W DC REMOVAL	This selects dc coupling but uses a software algorithm to remove the dc component after each input frame is acquired. This operation occurs after the A/D converter and therefore does not help in overrange situations caused by dc bias. The algorithm determines the mean value of all the samples in the frame and then subtracts that mean value from each sample.

5.8.4.6 Channel ID Label. This final item in the INPUT LEVEL menus allows assignment of any desired label, up to 18 characters for each channel. These labels are printed just above the top line of the grid in the displays. For cross channel functions they are combined with the label of the other channel in the same way as the CHx identification and the MODAL coordinates as described above. The labels are also carried along with the data when functions are stored in memory or disk files. However, note that the storage function format can preserve and return only 14 of the 18 characters allowed.

5.8.5 Frequency Range and Resolution Setup

The FREQ button presents the summary setup listing and the series of menus and entry requests as shown below. Although these parameters appear simple and straightforward, there are several special cases and internal adjustments in frequency setups that are discussed in further detail in the following descriptions:

Frequency Type

1) BASEBAND
2) ZOOM

(NEXT)

(if BASEBAND):
ENTER MAXIMUM FREQUENCY
* (current value)
>____

(if ZOOM):
ENTER ZOOM MINIMUM, MAXIMUM
* (current min, max)
>____

(NEXT)

# of lines

1) 80
2) 160
3) 320
4) 512 *MODAL
5) 640
6) 1280
7) 2560

(NEXT)

External Sample
1) OFF
2) ON

(NEXT) restores full display

Frequency Type: (e.g. BASEBAND)
BASEBAND max freq: (e.g., 10240)
ZOOM min freq: (e.g., 160)
ZOOM max freq: (e.g., 340)
# of lines: (e.g., 320)
frame size: (e.g., 1024)
resolution: (e.g., 32.00)
sample interval: (e.g., 3.052e-05)

5.8.5.1 Summary List Information. The summary listing on the screen shows the exact values that are currently in force, after any necessary internal adjustments have been made to your entries. Note the following: (1) Both of the current BASEBAND and ZOOM frequency ranges are indicated in the list for reference. Which of these is currently in force is indicated by the first line, "Frequency Type". (2) The last three lines in the summary (frame size, resolution, and sampling

interval) are provided for reference. They are not made by operator entries, but are derived directly from your choice of frequency range and number of lines resolution. The frame size is determined from the selected number of lines.

The system operates on power-of-2 frame sizes from 256 points up to 8192 points. For an input frame size of N, the Fourier transform computes N/2 complex frequency line coefficients. However, the upper 3/8 of this range may be contaminated by aliased higher frequency components because of the roll-off of the anti-aliasing filters. That portion of the range is simply discarded after the Fourier computation. Taking the "standard" frame size of 1024 input points as an example, 512 frequency lines are computed, of which 5/8, or 320, are valid and are retained. Or, looking at it from the operator's point of view, selecting number of lines = 320 results in an input frame size of 1024.

The same ratio applies for all other resolution selections except the special case of "512 MODAL" which is described below. There is another special case, also described below, for the maximum frequency range of 25.6 kHz, in which additional frequency lines may be retained to provide additional bandwidth without decreased resolution. The indicated resolution in the summary listing is the indicated bandwidth divided by the number of lines. The derivation of the sampling interval is somewhat more complicated, but in all cases it is a power-of-2 multiple of the fastest sampling interval, which is (1/65536) second.

5.8.5.2 Frequency Type: Baseband or ZOOM. Baseband frequency range always begins at dc (0 frequency) and extends to the maximum frequency entered in the next menu. For baseband processing, all four channels on each installed channel card are available. ZOOM processing allows you to specify a passband frequency range with a minimum and maximum frequency to be processed, and thus to obtain better frequency resolution over narrower bands of interest. Note that when you select ZOOM processing, you are restricted to a maximum of two channels on each installed channel card. When you select ZOOM, the active channels table is modified accordingly, as described previously under "Input Channel Select Setup."

When ZOOM processing is in force, time domain displays of the input signal are no longer valid for the shape of the input waveform. Instead, they show the complex time domain function that is created after the input signal has been passed through the frequency-shifting multiplier and the decimating filters. This condition is indicated in the display by displaying two functions (the real part and the imaginary part[1]) using disconnected dots, rather than the continuous line trace that is used for real input waveforms. These displays are still valid for amplitude information.

[1] The sine wave shows up in the display even if the input signal is grounded. This is due to the dc offset in the analog circuit, which is normally removed by software. When ZOOM mode is chosen, the dc value is multiplied by sine and cosine of the center frequency required by the ZOOM process to shift the spectrum. This non-zero offset results in the sine wave displayed. This effect is only seen when the ZOOM band comes near or includes the dc line.

5.8.5.3 Frequency Ranges, Baseband. If you select baseband processing, the NEXT menu requests

ENTER MAXIMUM FREQUENCY

You may enter any number (in Hz) for the desired maximum frequency. If your entry is greater than the system maximum (25,600 Hz), it is adjusted downward. If it is within the system range, it is adjusted upward to the next higher range available from the hardware that includes the requested maximum. These adjustments are reflected in the entry menu and the summary listing. The available ranges are:

25600*
20480
10240
5120
2560
1280
640
320
160
80
40
20
10
5
2.5
1.25

NOTE: A different set of frequency ranges are used if you select 512-line resolution for use with the MODAL analysis program. They are listed in paragraph 5.8.5.5 which describes 512-line resolution under the number of lines menu which follows frequency range selection.

*The 25,600 Hz bandwidth is a special case that does not follow the factor-of-2 sequence of the other available ranges. It provides the same frequency resolution as the 20,480 Hz range. However, on these uppermost ranges, the system uses only the basic 25.6 kHz analog anti-alias filter and does not require any of the decimating digital filters used for lower ranges. The analog filter has somewhat sharper rolloff characteristics than the digital filters. This allows 400 alias-free frequency lines out of 512 computed, instead of the 320 out of 512 lines for lower ranges. If you select the 20,480 range, the system saves only 320 lines per 512 computed, in conformance with other ranges. But, if you select the 25,600 range, the system retains and displays all of the good 400 lines, thus providing the additional bandwidth. The additional lines at this bandwidth are reflected in the summary setup listing on the display. For example, if you select 640 lines in the following "# of lines" menu, the summary indicates that you are actually getting 800 lines.

In addition to numerical entry, you may also use the display cursor position to select a maximum frequency, as follows:

1) On a frequency function display, position the main cursor at the desired maximum frequency for the baseband analysis range.

2) Press the FREQ button, select BASEBAND, and press NEXT.

3) When the menu requests "ENTER MAXIMUM FREQUENCY", press the "equals" (=) button in the ENTRY group, to refer to the display cursor.

4) Press ENTER. The system selects the standard frequency range listed above that is next above the cursor position. That selection is reflected in the menu and the summary listing just as if it had been entered numerically.

5.8.5.4 Frequency Ranges, ZOOM. If you selected ZOOM processing in the first FREQ menu, the NEXT menu requests entry of both a minimum and a maximum frequency for the range:

ENTER ZOOM MINIMUM, MAXIMUM

____, ____

You may enter any two values (in Hz), separated by a comma, for this range, provided only that the difference between them must not be greater than the maximum ZOOM passband, which is 20,480 Hz. If you request a band greater than that, the entry is ignored and an error message appears at the lower left of the screen. The system adjusts your entries to the ranges available from the hardware as follows: First, it selects an available ZOOM passband large enough to cover the requested range. The available ZOOM passband ranges are the same as those listed for baseband ranges above, excluding the largest, 25600 Hz, and the smallest, 1.25 Hz. The selected passband is then centered on a frequency halfway between the requested minimum and maximum. Exception: If the requested band is too near the low or high end of the total system range, the ZOOM band is shifted up or down as necessary to keep it from extending below 0 or above 25600. Entering only the maximum or minimum value in this menu takes the other value from the current hardware setting, not the previous user entry.

Note that selecting 0 for the minimum frequency does not cancel the zoom processing mode. If you want baseband processing (four channels per card), you must return to the first page of the FREQ menu and specifically select it.

In addition to numerical entries, you may also use the display cursors to define and select a zoom range, as follows:

1) On a frequency function display, position the main cursor at the desired zoom minimum frequency.

2) Press (CURSOR) REF SET to mark the minimum.

3) Reposition the main cursor at the desired zoom maximum frequency.

4) Press the FREQ button, select ZOOM, and press NEXT.

5) When the menu requests "ENTER ZOOM MINIMUM, MAXIMUM", press the "equals" (=) button in the ENTRY group, to refer to the display cursors.

6) Press ENTER. The system selects the next broader standard zoom band and centers it on the range defined by the cursors. This selection takes effect immediately and is reflected in the menu and summary listing just as if it had been made by numerical entries.

5.8.5.5 Number of Lines of Resolution. After bandwidth, the FREQ setup function presents a NEXT menu for selection of frequency resolution within the band. The selection is made in terms of the number of frequency lines or filters across the band. Actually, it is setting the frame size and indicating how many valid non-aliased lines are available after the spectral computation. Note that additional lines are available for the maximum 25,600 Hz bandwidth, which uses only the initial analog anti-alias filter. The number of lines for 25,600 BW is not indicated in the selection menu, but is reflected in the summary listing if the 25,600 BW is in force. For example, if you select 320 lines, the summary list shows # of lines = 400. The choices and related values are:

# of Lines Menu	# of Lines If 25.6 kHz BW	Frame Size, # of Samples	# of Lines Computed by Fourier Transform
80	100	256	128
160	200	512	256
320	400	1024	512
512 MODAL	Not appl	2048	1024
640	800	2048	1024
1280	1600	4096	2048
2560	3200	8192	4096

Note: Any data set with greater than 5120 words cannot be stored in memory. But such data can be stored into Standard file. A recall of such data from Standard file has only a partial copy (5120 words) filled in the upper or lower MEM buffers. (See page 5-48.)

5.8.5.6 512 Lines for MODAL, A Special Case. The choice of 512 lines of resolution is provided to allow more efficient use of file storage space when collecting frequency response functions for use with the MODAL analysis program. The MODAL file storage format always uses and operates on blocks of 512 or less complex frequency points for its frequency response functions. Note that you are not required to use the 512 selection for MODAL.

You can just as well operate at lesser resolutions (e.g., 320 lines), which simply do not fill the MODAL file storage blocks, or at greater resolutions (e.g., 640 or 1280), which partially fill additional 512 element storage blocks and require the use of MODAL "sequence numbers" for file identification. However, the selection of 512-line resolution fully uses the 512-element storage blocks, and thus allows increased bandwidth over that which can be obtained using 320 line resolution.

To produce 512 lines, the system must set up and operate the same as it would for 640 lines, and it is constrained to the same set of sampling frequencies (and thus bandwidths) that are used in normal processing. The 512-line function is then obtained simply by truncating and discarding the highest 128 lines of the 640 line function. This truncation of valid lines that otherwise would be included in the normally available bandwidths results in an entirely different set of bandwidths for 512-line resolution. They are:

2 Hz	64 Hz	2048 Hz
4	128	4096
8	256	8192
16	512	16,384 Hz maximum
32	1024	

When you select 512-line resolution, the system takes the normal bandwidth that is currently in force and adjusts it to the next higher 512 line bandwidth as listed above; or, if 512 line resolution is already in force, operator-requested bandwidths are adjusted upward to the next frequency in the list above, rather than to one of the normal bandwidths listed previously under "Frequency Ranges." Data Acquisition then processes as if it were set up for 640 lines.

There is an exception. If the bandwidth selected is greater than the maximum bandwidth of 16,384 Hz that is allowed for 512 lines, then the bandwidth is reduced to the 16,384 maximum and the frequency resolution is improved by a factor of 2.

NOTE: A similar process of bandwidth adjustment occurs when you switch from 512 lines back to a normal resolution. That is, whenever it is necessary for the system to adjust the bandwidth for any reason, it always attempts to go higher to include the previous bandwidth. If, for example, you switch back and forth between 320 and 512 lines, the bandwidth continues to expand until it reaches maximums. In most cases, it is best to set the desired number of lines first, and then go back to enter the desired maximum frequency or frequency range for ZOOM.

5.8.5.7 External Sample OFF/ON. The final page in the FREQ setup menus provides for enabling an external sampling clock connected to the rear panel EXT SAMPLE input connector for special applications. (TTL level signal 0-5V.)

External sampling is switched OFF at start up of the RTA program to protect the system. If external sampling is to be used, it can be switched ON by using the FREQ setup menu sequences. An external signal has to be connected to the rear panel EXT SAMPLE connector or the system keeps waiting for the external sampling clock.

CAUTION

The maximum input frequency is 65,536 Hz. Any higher causes FIFO overflow. Note also calculations, for resolution and sampling intervals, assume the internal sample frequency of 65,536 Hz.

5.8.6 Averaging Setup

Pressing the AVERAGE button presents the following setup summary and starts the series of menus shown below and described in following paragraphs:

Averaging Domain

1) FREQUENCY
2) TIME

(NEXT)

Averaging Mode

1) SUMMATION
2) SUBTRACTION
3) EXPONENTIAL
4) PEAK HOLD

(NEXT)

ENTER # of Averages
* (current value)
> ____ (0 - 32767)

(NEXT)

Pre-average Autorange

1) OFF
2) ON

(NEXT)

Averaging Domain: (e.g., FREQUENCY)
Averaging Mode: (e.g., SUMMATION)
# of Averages: (e.g., 256)
Autorange: (e.g., OFF)
Acceptance: (e.g., MANUAL)
Accept Min Peak %: (e.g., 35)

Data Acceptance into Avg

1) ACCEPT EVERY FRAME
2) MANUAL ACCEPT (CONT)
3) AUTO REJECT
4) AUTO REJECT w/ DBL HITS

(NEXT)

ENTER MINIMUM % FULL SCALE
for an ACCEPTABLE SIGNAL LVL
* (current %)
> ____ (1 - 100%)

(NEXT) restores full display

NOTE: In PROBABILITY mode the Averaging Domain menu is skipped and only selections 1) and 3) of Averaging Mode are allowed.

3.5.6.1 Averaging Domain. FREQUENCY domain averaging accumulates the auto power spectra (and cross power spectra if in cross channel mode) that are produced after the direct Fourier transform processing has been applied to each successive input frame. TIME domain averaging accumulates a normalized summation of the time domain input frames before the Fourier processes are performed. Time domain averaging requires that the input must be triggered or somehow synchronized from frame to frame to preserve phase information and prevent the data from averaging away to zero or some dc level.

5.8.6.2 Averaging Mode. The system provides the following choices of averaging algorithms for frequency domain averaging. This menu does not appear for time domain.

a. SUMMATION. In the summation mode, all input frames are equally weighted. The averaging buffer is cleared when the RUN button is pressed to start a new average. The run stops when the number of frames processed equals the "# of Averages" parameter selected below. The average is normalized as it is accumulated, according to the following formula:

$$A_1 = A_0 (K-1)/K + SS^* (1/K)$$

A_1 is the new average.
A_0 is the previous average.
SS* represents the current frame of input auto or cross spectrum.
K is the number of the last frame processed for SUMMATION.
K is fixed by the "# of Averages" parameter selection for EXPONENTIAL discount averaging.

b. DIFFERENCE. The difference mode is the opposite of summation in that new frames are subtracted from the existing average. The average buffer is not cleared at the start of a RUN. This mode is useful in situations such as acoustic analysis of a machine that cannot be removed from a noisy environment. You can take a SUMMATION spectrum of the machine and background noise, then turn off the machine and use DIFFERENCE averaging to subtract out the spectrum of the background. Note that the average data is not normalized in the same way it was in additive averaging:

$$A_1 = A_0 - SS^* (1/K)$$

The results are really valid only after the number of averages K has been completed. This value should be equal to the number of averages previously accumulated in additive average mode.

c. EXPONENTIAL. The exponential mode discounts the weight of older data in the average for analysis of signals that may be changing with time. The discount factor is set by the "# of Averages" parameter below. The averaging buffer is cleared at the start of a RUN, and the run continues indefinitely until you press the RUN button again to stop it. The discount algorithm is the same as shown for summation above except that the factor K is fixed by the # of Averages parameter. The smaller the # of Averages selection, the faster the decay of older data and the greater the weight of the current frame. An exception is made for the first frame of a run. The first frame is not discounted at all, so that the averaged spectrum immediately assumes the full value of the input. Otherwise, the system would have to process a number of frames equal to the # of Averages selection before the average would approach the full value.

d. PEAK HOLD. (Not applicable for cross-channel mode or time domain averaging. If either is in force, this selection is not allowed in the averaging mode menu.) This mode compares the amplitude of each frequency line from each input spectrum to the corresponding line in the averaging buffer and retains the greater of the two. Thus at the end of the "average", the result spectrum shows the maximum amplitude that occured at each frequency during the run. The buffer is cleared when you press RUN, and the run continues indefinitely until you press RUN again to stop it. The "# of Averages" parameter is not used.

5.8.6.3 Number of Averages. For SUMMATION and DIFFERENCE modes, this parameter sets the number of frames to be processed and averaged before the run is automatically stopped. For EXPONENTIAL mode, this parameter sets the factor for exponential discounting as described above under Averaging Modes. Exponential runs continue indefinitely until you press RUN again. PEAK HOLD mode does not use this parameter, and also runs indefinitely until you press RUN again.

5.8.6.4 Pre-Average Autorange, OFF/ON. The full scale range for input levels is initally set up through a LEVEL button menu, selecting from the available ranges, ±8, 4, 2, 1, 0.5, 0.25, 0.125, and ±0.0625 volts. This pre-average autorange function, if selected, allows the system to automatically adjust the input level ranges at the start of an averaging run, according to the signal levels that are actually present at the inputs. Autoranging is performed as follows: When the RUN button is pressed, the system begins testing acquired time domain input frames for the following conditions:

a. No input hardware overload.

b. No value in the acquired frame exceeds 100% of the current full scale setting. For auto-ranging this condition is considered an overload condition. (This condition can occur without overload because the input hardware allows 25% signal over-ranging without clipping or data distortion.)

c. The peak value in the frame must be greater than the "Minimum % Full Scale" parameter that is specified in the last average setup query below, until the 0.0625 volt range is reached, at which point only overload is looked at.

The system acquires one input frame on all active channels at whatever input level range setting is currently in force for each channel. Any channel that shows an overload or that contains a value greater than full scale has its level setting increased (gain decreased) by one step. All other channels are checked for a peak value at least as great as the specified minimum percentage of full scale. Channels that do not meet that level have the level range decreased (gain increased) by one step. This process is repeated as necessary, with the following exceptions to prevent oscillation between two ranges.

If a channel has had its range increased (gain decreased) because of overranging on the previous frame, the range is not decreased if the current frame is below the minimum. Conversely, if the range has been decreased (gain increased) because of previous low signal, but the channel now overranges, the range is increased back to its previous level. In other words, if the signal characteristics and the specified minimum peak are such that the level setting might oscillate, the algorithm favors overload protection over low signal protection. If a channel continues to overload at its greatest range (±8V), the system does not allow an averaging start.

When a frame has been acquired that meets all conditions on all channels, the input levels are fixed and that frame is processed and placed in the averaging buffer to begin the averaging run. Note that autoranging does not continue through the run. If input signal levels change after the input level settings have been made, overranges and underranges may occur. However, you can use the autoreject option to reject such frames and omit them from the average.

Exception for Triggered Mode Acquisition: If triggered input acquisition is in effect, autoranging is not performed on the trigger channel. You must set an appropriate input level specifically for the trigger channel, under the LEVEL setup function. This simplifies the operation and avoids problems that may arise from complications such as highly variable impact test inputs or failure to trigger at all if the trigger level is set too high. Once an appropriate trigger channel setting has been found, all other channels autorange exactly as described above. Also, note that the autoreject option described below does operate on the trigger channel, so that once an averaging run is started, defective trigger channel frames can be omitted.

5.8.6.5 Data Acceptance into Average. This menu provides an option for continued examination of time domain input frames during an averaging run, and allows manual or automatic rejection of frames that do not fall within certain limits. The choices are:

a. ACCEPT EVERY FRAME. No tests are performed on the input frames. All frames are processed and passed to the average.

b. MANUAL ACCEPT (PRESS CONT). In this mode, each new set of input frames is held for you to examine them as desired. The HOLD Indicator lights when the frame has been acquired, and remains lighted until you have manually disposed of the frame as follows:

   1. To accept the frame, press CONT. The frame is processed to the average and the system returns to acquisition state. Note that if you are in TRIG-MAN ARM mode, you must also press ARM to re-arm the trigger for acquisition.

   2. To reject the frame:

      (a) In FREE-RUN or AUTO ARM trigger mode, press HOLD to reject the frame and allow the system to return to acquisition.

(b) In TRIG-MAN ARM mode, just press ARM to re-arm the trigger for new acquisition. The old frame is rejected if you did not press CONT.

c. AUTO REJECT. In this mode, the system automatically examines each new input frame on all channels and rejects them all if any one does not meet the following criteria:

1. No input hardware overload.

2. The peak value must be at least equal to the "Minimum % Full Scale" parameter specified below.

Note that this acceptance criteria is the same as autoranging, except that the average accepts frames containing values greater than 100% of full scale if they did not cause hardware overload. This acceptance algorithm also applies to the frame on the trigger channel (unlike autoranging which does not apply to the trigger channel).

d. AUTO REJECT w/ DBL HITS. This mode tests all channels for the same conditions as AUTO REJECT above, and additionally applies the following test to the trigger channel for impact testing, to detect double hits (i.e., second bounce impacts):

The criteria for a double hit on the trigger channel is to find the peak absolute value in the entire data frame. Move 1/64 of the frame size ahead in the frame and, from there to the end of the frame, search for another peak whose amplitude is greater than 10% of the maximum peak already recorded. If no such peak exists the frame is accepted.

5.8.6.6 Minimum % Full Scale. The final menu in the AVERAGE setup requests:

ENTER MINIMUM % FULL SCALE
FOR AN ACCEPTABLE SIGNAL LVL

This parameter sets the minimum acceptable peak signal level for autoranging and auto reject, specified as a percentage of the full scale LEVEL setting. For autoranging, the full scale range is decreased (gain increased) one step if the peak value in an acquired frame does not reach this minimum level (unless overloading occurs or previously occurred at the lower range). For auto reject, frames are rejected if the peak value does not reach this minimum level.

5.8.7 Windowing Setup

The discrete Fourier transform, performed on an input frame of finite length, tends to produce an effect known as spectral "leakage" or "smearing." In effect, the algorithm assumes the input frame to be one period of a continuous periodic signal. If all the frequency components of the input signal happen to be

exactly periodic in the length of the input frame (that is, if they fall exactly on one of the discrete frequency lines of the computed spectrum), then the computed spectrum would be exactly correct for the continuous input. In the more likely case that the input signal contains components that do not coincide with the discrete frequency lines (i.e., that are not periodic in the length of the input frame), then the spectral computation also produces and includes frequency components necessary to account for the discontinuities represented by the abrupt beginning and end of the frame. The effect is a spreading or smearing of the spectrum and reduction of the apparent amplitude of frequency components that fall between the discrete lines of the computed spectrum.

Various windowing or weighting functions may be applied to the signal to reduce or eliminate these effects. The type of window to be used depends on the nature of the input signal. The 2515 provides a choice of four window types for continuous input signals, plus two weighting functions for transient signals such as the impact and response signals of impact testing.

Pressing the WINDOW setup button presents the following window setup summary and menus. The window choices are described in the following paragraphs.

Window Type

1) SQUARE
2) HANN
3) FLAT TOP
4) SPECIAL
5) CORRELATION
6) IMPACT

(NEXT)

ENTER % FULL FRAME UNTIL
REFERENCE WINDOW TAPER
* (current value)
> ____

(NEXT)

ENTER # OF EXPONENTIAL
RESP WINDOWS TO APPLY

* (current value)
> ____

(NEXT)

Frame Overlap

1) NONE
2) 50%
3) MAX

(NEXT) restores full display

Window Type: (e.g., HANN)
Refr window start: (e.g., 200)
# of resp windows: (e.g., 10)
Frame Overlap: (e.g., NONE)

NOTE: The reference and response window summary lines above and the reference and response parameter queries at the left are only for the IMPACT window and appear only when IMPACT is the currently selected type.

NOTE: The frame overlap menu does not appear if triggered data acquisition is in effect. Overlapping is not appropriate for triggered acquisition.

5.8.7.1 Window Type. The system provides the following choice of window functions.

a. SQUARE. No weighting function is applied. In effect, the act of operating on a finite length input frame is a windowing operation where the continuous input signal is multiplied by a rectangular (time) function of unity value within the frame and zero value outside the length of the frame. This has sometimes been referred to as the "boxcar" window.

b. HANN. The HANN window is generally most appropriate for random-type signals. In the time domain, the Hann weighting function is a cosine-bell shape with period equal to the frame length. Multiplying the input frame by this function imposes a quasi-periodicity on the continuous input, in effect modulating it by a frequency equal to the lowest frequency line in the spectral result. In the frequency domain result, this has the effect of broadening the filter bandwidth of each spectral line by spreading the energy of a periodic component into three adjacent lines. This reduces the apparent amplitude of pure sinusoidal components, but also gives much greater roll-off of the "leakage" effect by eliminating the abrupt end-of-frame discontinuities.

   Application of the Hann function also reduces the total energy in the frame but this is corrected by a simple factor such that the total rms energy of the spectral result is the same as the total rms energy of the original input frame. Note, however, that this does not correct the amplitude of pure sinusoidal components, which is why the Hann window is appropriate for random signals but not for calibration or other absolute measurements using sinusoidal inputs. The windowing operation is actually performed by convolution in the frequency domain, so it is not visible in time domain displays of the input signal.

c. FLAT TOP. The flat top window is provided primarily for use with pure sinusoid inputs such as calibration signals. It is corrected such that a sine wave input at any frequency produces the same spectral amplitude that it would have if no window were applied and the sine frequency fell exactly on one of the computed discrete spectral lines. However, the main lobe of the flat top window equivalent filter shape is quite broad, spanning several spectral lines. This window is not suitable for resolving closely spaced components in the input signal. This window operation is performed by convolution in the frequency domain and is not visible in real-time displays of the time domain input signal.

d. SPECIAL. The special window contained within the program is a seven-term Blackman-Harris window, which is generally useful for both random and periodic or deterministic signals. The operation is performed by convolution in the frequency domain and is not visible in real-time displays of the time-domain input signal.

e. CORRELATION. The correlation window is required when the analysis is being performed to obtain correlation functions. Correlation functions are produced by performing an inverse Fourier transform of the auto or cross spectrums. Without this window, the implied periodicity of the input signal as represented by the computed spectrum causes an effect known as "wrap-around error." The windowing operation actually consists of filling only half of the input frame with samples of the input signal and zeroing the other half of the frame. This provides a half-frame separation between the implied periods of the input signal, and applies a known triangular weighting to the correlation function result rather than the unknown wrap-around effect. When the correlation window is applied, frequency domain results are somewhat corrupted. Conversely, if the correlation window is not applied, correlation functions may still be computed by the display, but they contain the wrap-around effect. The correlation window is performed on the time domain input, and can be seen in Real Time input displays because the display presents only the half frame of sampled data and does not include the half frame of zero values.

f. IMPACT. This impact selection provides two types of windows for use with transient inputs such as those obtained from impact testing with a force (impulse) hammer for the reference and accelerometers for response. The force window is applied only to the reference channel and is shaped to eliminate the measurement noise associated with small values toward the end of the impulse frame. The response window is applied to all response channels and is an exponential decay weighting to damp the response if it tends to ring longer than the time length of the frame. When IMPACT window is selected, the NEXT button presents the following two parameter requests to specify the windows as described below:

ENTER % FULL FRAME UNTIL
REFERENCE WINDOW TAPER

This parameter specifies the percentage of the frame length to contain unweighted samples from the beginning of the frame to the point where tapering begins. (Entering 0 disables the force window altogether, allowing use of the following response window alone.) The reference (force) window is a half-cycle cosine shape of length equal to 1/16 the length of the frame, with unity amplitude at the beginning, tapering down to a value of zero.

If the response window below is used, it is also applied to the reference channel. This is done to maintain a strictly correct transfer function measurement between reference and response.

ENTER # OF EXPONENTIAL
RESP WINDOWS TO APPLY

This parameter specifies the factor k in the window expression below; that is, the time constant of the decaying exponential, or the number of times a "standard" window is applied. The standard window is the one defined by SDRC for MODAL analysis data collection. This parameter is carried along with data stored for subsequent MODAL analysis. The MODAL program can correct for the window's contribution to damping. (Entering 0 disables this window altogether.) The window expression is:

$$x(n) = x(n) * W(n)$$
$$W(n) = (1 - .0002^{k.n})^{n}$$

where n is the index from the start of the frame,
x(n) is the time domain function,
W(n) is the window function,
k is the number of windows parameter entered above.

The exponential window always begins on the first point in the frame, so you should be careful about using trigger advance in capturing transients. If the initial response signal is delayed in the frame, its amplitude could be considerably reduced.

5.8.7.2 Frame Overlap Processing. Overlapped frame processing allows more frequent spectral updates when operating on low frequency ranges where the input frame acquisition time is significantly longer than the processing time. Without overlap, the system does not present a new display of the input, nor compute a new input spectrum until a complete new independent input frame is acquired. At the lowest frequency range, this can be as long as 256 seconds. With overlap, the system is allowed to operate on "interim" frames, consisting partially of the latest acquired input samples and partially of as many samples of the previous frame as are required to fill out the current frame size. A minimum overlap of 50% (one-half frame) is required. When acquisition time is less than twice the processing time, overlapping is disabled. The frequency range at which this occurs varies, since processing time for a set of frames varies with several factors such as the function selected and particularly the number of active channels. The actual percentage overlap is reported at the upper right corner of the screen in the setup summary lines of the FULL display. The overlap menu provides the following choices:

a. NONE. Disables overlap so that all new frames processed are independent of each other.

b. 50%. Sets fixed half frame overlap such that each processed frame (except the first) consists of N/2 new points and N/2 points from the previous frame, where N is the frame size, as long as the relationship of process time to acquisition time allows it. Overlap is disabled when 50% overlap cannot be achieved.

c. MAX. System processes the latest N points as fast as possible as soon as the previous process completes. Overlap processing is disabled if 50% overlap cannot be achieved.

NOTE: Overlapped processing is not appropriate for triggered data acquisition, which is discontinuous by nature. This menu does not appear if a TRIG mode has been selected.

NOTE: In Frequency domain averaging you cannot apply a window to the data after the average has been completed. You must set the window to the desired type before starting the average.

In Time domain averaging, the data may be displayed with different windows after the average but this change is limited to SQUARE, HANN, FLATTOP, and SPECIAL. The IMPACT and CORRELATION windows must be changed before averaging for valid results.

Stored data (MEM displays) cannot have the window type changed in either Time or Frequency domain averaging.

5.8.8 Trigger Setup

Pressing the TRIG setup button presents the summary of the current trigger setup as shown at the right below, and begins the following sequence of menus for modification of trigger conditions. Parentheses and underscoring indicate variables or operator actions:

Trigger

1) FREE RUN
2) AUTO ARM 1st FRAME
3) AUTO ARM EVERY FRAME
4) MANUAL ARM

(NEXT)

ENTER Trigger Channel #
(0 selects EXTERNAL TRIGGER)
* (current trigger channel)
> ____

(NEXT)

ENTER Trigger Level
% of Full Scale
* (current level)
> ____

(NEXT)

Slope
1) +
2) -

(NEXT)

ENTER TRIGGER DELAY
IN % of FRAME
(- Delay for Pre-Trig)
* (current delay)
> ____

(NEXT)

Trigger: (e.g., TRIG-MAN ARM)
Channel: (e.g., 4)
Trigger Level: (e.g., +20%)
Slope: (e.g., +)
Delay: (e.g., -20)
Aux Delay xx (e.g., 40)

ENTER AUXILIARY DELAY
IN % of FRAME
* (current value)
> ____

(NEXT) restores full display

5.8.8.1 Trigger Mode. The trigger mode menu provides these choices for triggered acquisition:

a. FREE RUN. No triggering is required for input acquisition. Acquisition of a new frame begins as soon as there is buffer space available for it. The input is double-buffered; that is, one buffer can be refilling while the previous buffer is being processed. This acquisition can be continuous until the system is set up for some combination of bandwidth and number of channels that causes total processing time to be greater than input buffer filling time. When you select FREE RUN, the remaining trigger setup menus appear but have no affect on acquisition until a triggered mode of operation (below) is selected.

b. AUTO ARM 1st FRAME. Input acquisition does not start until the specified trigger event occurs on the trigger channel. After the initial start, acquisition is continuous, the same as the free-run mode above.

NOTE: The trigger mode can thus be used as a remote start command for averaged data collection, where the start command is derived from the input data stream itself; that is, after pushing the RUN button, input acquisition, and the averaging RUN, does not start until the input signal again satisfies the trigger conditions.

Note also that this mode takes 50% more memory for the acquisition buffers than the other three modes. Selecting this mode might cause the "Not Enough Memory" message to appear in the bottom left of the screen. You must either not use this mode, use a smaller number of lines, or de-allocate some channels.

c. AUTO ARM EVERY FRAME. The specified trigger event is required to start acquisition of each new frame. However, as soon as each acquired frame is processed, the trigger circuitry is automatically re-armed to recognize a new trigger as soon as it occurs. The ARM indicator in the ANALYSIS controls light whenever the system is ready and is waiting for a trigger.

d. MANUAL ARM. The specified trigger event is required to start acquisition of each new frame. Furthermore, the trigger circuitry is not armed or re-armed until you press the ARM button in the ANALYSIS group. The ARM indicator remains lit until the trigger occurs.

5.8.8.2 Trigger Channel. The channel selected here for the trigger source must be an active channel under the current INPUT SELECT setup, or be a 0 for the rear panel EXT TRIG input. The external trigger event is a TTL high to low transition or a switch closure to ground. Although they are not applicable to external trigger, the following level and slope menus still appear, to get to the delay menus.

5.8.8.3 Trigger Level. The trigger level is specified as a percentage of the positive or negative full scale range that is specified for the trigger channel under the INPUT LEVEL setup. Example: If channel 1 is the trigger channel and channel 1 LEVEL is set for ±2.0 V, then entry of -40 for trigger level causes triggering when the signal passes through the -0.8 V level.

5.8.8.4 Trigger Slope. The + or - selection determines whether trigger occurs as the signal is rising or falling through the specified trigger level.

5.8.8.5 Trigger Channel Delay. The trigger channel delay parameter, specified as a percentage of the input frame length in time, refers to the time of the beginning of data frame acquisition on the trigger channel, relative to the time of the trigger event. The delay may be a positive number, meaning the data frame begins some time after the trigger event, or a negative number, meaning the start of data acquisition is advanced in time before the trigger event; that is, the trigger event itself is contained within the acquired frame. Negative delay (advance) is commonly used in impact testing to insure that the beginning of the reference excitation transient, from which acquisition is triggered, is captured in the acquired frame. The maximum negative delay (i.e., advance) is -100%, or one frame length.

The maximum positive delay is determined by a sample counter with a capacity of 32,767. The allowable positive delay therefore varies with frame size. As percentage of frame length it is approximately equal to (32,767/frame size) x 100.

5.8.8.6 Auxiliary Delay. The auxilliary delay parameter refers to the delay in percent of frame length for all other channels relative to the trigger channel. Only 0 or positive delays are allowed. Other channels cannot be advanced relative to the trigger channel. A delay of 0 here causes all channels to be collected at the same time. Positive delays are commonly used when triggering from an impact excitation channel on larger structures where there is a known or predictable propagation delay before the response appears at the response channels. The maximum delay is the same as shown above for the trigger channel.

5.8.8.7 Note on Effect of Hysteresis, Digital Filter, and Zoom on Triggered Impact Signal. You may encounter some problems when acquiring triggered data under certain conditions.

One problem involves the use of positive slope to trigger an impact signal. For negative slope triggering, it is easier to get the data, while it is somewhat more difficult to collect data using positive slope triggering without hitting the hammer very hard.

Another problem concerns bandwidth. In the case of low bandwidth, it is hard to obtain the signal. Conversely, high bandwidth eases the data collection.

Next, under ZOOM mode, the trigger is unreliable.

This note is intended to clarify these possible problems and to provide some suggestions to remove them.

Trigger Slope

RTA handles trigger with noise immunity in mind. In order to avoid triggering by noise, a 10% hysteresis is built in. As a result, for trigger to occur at a positive slope, the input signal has to increase from 10% (of the full scale) below the trigger level specified. For negative slope, the signal has to decrease from 10%

above the trigger level. This allows random noise on the signal of interest to be as large as 10% of full scale without allowing a false trigger on the wrong slope.

When an impact or any positive pulse signal which is normally at a 0 volt level occurs and trigger level is set to less than 10% of full scale and positive slope is chosen, the signal level cannot go below 0 volt level unless post-peak ringing occurs which brings the signal 10% below the trigger level and back up. Usually this does not occur on the hammer signal. For negative slope, however, the impact signal most likely has a chance to come from 10% above down to the trigger level, therefore fulfilling the requirement. Thus, it is easier to trigger the impact signal with a negative slope.

To reduce this difficulty, use a higher trigger level (greater than 10%) if permitted. Pre-trigger delay should be specified to recover data prior to the trigger point.

Note: The hysterisis circuit is disabled in systems shipped after December 1984 and the above restrictions will not apply.

Bandwidth

In an impact test, usually many response channels are attached to the mechanical structure, while the reference (or force) channel is from the roving hammer. The bandwidth of interest is usually determined by the measured bandwidth of the response channels. This bandwidth is often low. The force channel often spans a much higher bandwidth. A low bandwidth filter used on the trigger channel greatly attenuates this signal, hence the difficulty in triggering.

To avoid this situation, the first reaction is usually to increase the gain. Since the force channel has such a broad bandwidth and most of its amplitude is reduced by the filter, increasing the gain overloads the A/D converter in front of the digital filter.

One can approach this problem by sufficiently band-limiting the hammer signal either electrically or mechanically (using soft tip). This reduces the impact signal amplitude by reducing its bandwidth to a range comparable to that of the response signal. Since this reduction occurs prior to the amplifier stage, turning up gain without overload is now possible. Additionally, the attenuation of the impact signal due to digital filters is minimized because its energy is distributed well within the filter bandwidth.

Trigger Under ZOOM

Trigger under ZOOM is a bit limited. Briefly, the ZOOM action is accomplished by multiplying the signal by a complex exponential which shifts the center frequency of interest down to be centered around DC. This complex exponential is expressed in terms of sine (imaginary part) and cosine (real part). These two signals are then put through bandpass filters (ZOOM band), resampled, and complex Fast-Fourier transformed to yield the zoomed spectrum.

The trigger signal is derived from only the real part of the complex signal. This sinusoidally modulated signal certainly has a shape different from the original. The end result can be unpredictable triggering.

5.9 ACQUISITION FUNCTIONS (AVERAGER OPERATION)

The ACQUISITION group of pushbuttons controls spectrum averaging operations, in conjunction with the conditions specified by the measurement setup AVERAGE and TRIGGER functions. This group includes the following buttons, whose functions are below with their respective two-letter equivalent keyboard commands.

RUN
CONT
ARM
HOLD

RUN (AR)

The RUN button starts and stops the accumulation of averaged spectra. Pressing the button the first time clears the average buffers (except for DIFFERENCE mode averaging), clears the average count to 0, and turns on the RUN indicator. The actual start of new acquisition depends on the trigger mode setup. Note that if autoranging has been selected, the system may have to acquire and test several new frames before it begins processing and passing them to the average. The information message "ARNG" appears at lower right while auto-ranging is in progress. For SUMMATION or DIFFERENCE averaging modes, the run is stopped automatically when the specified frame count is reached. For other modes, the run continues indefinitely until it is manually stopped by pressing the RUN button again.

Pressing the RUN button while an averaging run is on stops the averager. The frame currently being processed is included in the average, but the frame curently being acquired is not.

CONT (AC)

The CONT button performs two different actions, dependent on the mode, as follows:

(1) Auto-accept mode: If averaging has been stopped, CONT restarts it. CONT has the same effect as RUN, except that it does not clear the average or reset the count. It does not include the frames that were being processed or acquired when it was pressed.

(2) Manual Acceptance Mode: The CONT button is used to accept input frames into the average. Each new input frame is held for examination. The HOLD indicator lights and the prompting message "REJ?" appears at lower right. Press CONT to accept the frame. Press HOLD to reject it.

NOTE: If an averaging run has been stopped in manual acceptance mode, pressing CONT the first time merely restarts acquisition for a new frame to be held. It does not accept the last real-time input frame that was acquired while averaging was stopped.

HOLD indicator

The HOLD indicator lights each time a new frame has been completely acquired. In real-time or auto-accept averaging it only flashes momentarily as the frame is passed to the process. In manual acceptance averaging, the HOLD indicator remains lighted until the frame is accepted by pressing CONT or rejected by pressing HOLD. (In manual ARM trigger mode it is not necessary to press HOLD to reject a frame. If you do not press CONT to accept the frame, pressing ARM to re-arm the trigger automatically rejects the previous frame.)

HOLD button (AH)

The HOLD button is used only to reject frames in manual acceptance averaging.

ARM indicator

When triggered acquisition is in effect, the ARM indictor lights when the trigger is armed and remains lighted until the trigger conditions are met to start acquisiton. If the ARM indicator is lighted, the system is idle, waiting for a trigger.

ARM button (AA)

The ARM button is used only for MANUAL TRIGGER mode or to re-send a pseudo-random output signal, if this feature is selected. It must be pressed to arm the trigger and allow the system to recognize a trigger event for acquisition. When manual arm is in effect, the prompting message "ARM?" appears at the lower right to remind you that you must press the button to start operations. (In manual ARM trigger mode it is not necessary to press HOLD to reject a frame. If you do not press CONT to accept the frame, pressing ARM to re-arm the trigger automatically rejects the previous frame.) During pseudo-random output and with triggering enabled, this re-sends the pseudo-random output. This is in case triggering misses the signal the first time due either to improper equipment connection or to incorrectly set trigger levels/slopes.

5.10 DISPLAY FUNCTIONS

The following paragraphs describe the functions, features, and parameters controlled by the DISPLAY group of pushbuttons.

Using the DISPLAY group, you may specify the source data to be displayed in the functions area of the display screen. Make the selections from the selections on the screen and immediate response buttons.

The DISPLAY group controls two parameter sets which are referred to as the Upper and Lower displays. The DISPLAY group buttons (and keyboard codes) are as follows:

REAL-TIME (DR)	FUNCTION (DF)
AVG (DA)	X SCALE (DX)
MEM (DM)	Y SCALE (DY)
NEXT CHAN (DN)	CHANNEL (DC)
SINGLE (DS)	UNITS (DU)
DUAL (DD)	BLOCK MATH (DB)
OVLY (DO)	
EXCHNG (DE)	

5.10.1 Modifying the Displays

You can modify the displays in a variety of ways dependent upon the current screen format. You can also exchange the positions of the displays (i.e., the upper display becomes the lower display and vice-versa).

5.10.1.1 Reversing Upper and Lower Displays. Press EXCHNG button to exchange the positions of the displays.

5.10.1.2 Screen Format Selection. Use one of the following buttons in the display to select screen format:

SINGLE	Provides a full screen display of one channel, one function.
DUAL	Provides dual upper and lower display of two functions.
OVLY	Provides dual superimposed display of two functions.

5.10.1.3 Modifying Upper Display Only. Regardless of screen format selection (see above 3.7.1.2), the following buttons affect the upper display only.

FUNCTION	REAL-TIME	MEM
CHANNEL	AVG	

If the screen format selected is SINGLE, then only the upper display is affected, meaning one channel/one function is modified. The following buttons may be additionally used to modify the display:

X SCALE	UNITS
Y SCALE	NEXT CHAN

5.10.1.4 Modifying Upper and Lower Displays/DUAL or OVLY Format. If the DUAL or OVLY formats are selected, both the upper and lower displays may be modified (and their associated menus) by using the following buttons:

X SCALE — Rescales both displays if they are of the same X-axis window type.

Y SCALE — Rescales both displays if they are of the same Y-axis window type.

UNITS — Changes X or Y axis units if they are the same on both upper and lower functions.

NEXT CHAN — Increments both upper and lower displays.

5.10.2 Selecting Data Source

The data source to be displayed is provided by one of three buttons: REAL TIME, AVG, OR MEM. Only one source is active at a given time. Accompanying LED indicators verify which mode is currently active on the display. If the display is in the DUAL screen format, the LEDs indicate the source of the upper display only, and because the lower display does not necessarily have the same source.

If any of the source buttons is pressed, any menu present on the screen is removed. This serves to remind you that a different set of parameters may be modified.

5.10.2.1 REAL TIME Source. The REAL TIME source button selects display of the REAL TIME input data; i.e., the unaveraged data that is used in the averaging computation. This data is available for display at all times and serves as the scope function for the instrument program. When data is "...not available" for displays, a blank function contains this message. This occurs at slow frame rates (low bandwidths) and when the trigger event has not yet occurred.

5.10.2.2 AVG Source. If AVG is pressed, the data source is the average buffers containing the averaging results. If the averager has never been run, there is no data in the average buffers. A blank function appears with a "...not available" message. Modifying certain setup parameters also invalidates the data in the average buffers. Refer to paragraph 5.8.1.1. This message also appears, once the RUN button has been pressed, until the first frame of data has been processed.

5.10.2.3 MEM Source. The MEM button selects the display data from recalled memory buffers or disk file data. Selection of this source indicates that the data is "...not available" if no function has been recalled. The menu interactions for display modification are somewhat different when MEM is the data source. STORE functions are of specific function types and cannot be changed to another function type after recall. You can change the format of complex functions much the same as for AVG data. You cannot change between VOLTS and EU units for MEM source displays since the channel EU factors are not saved. Modification of the processing window is ignored in MEM displays. Channel specification via CHANNEL or NEXT CHAN is also ignored.

There are two special MEM data buffers: "upper" and "lower". Each is filled separately when RACALL data goes into the upper display, a copy is made to the "upper" MEM data buffer. When RECALL data goes into the lower display (through EXCHANGE), the "lower" MEM data buffer is filled. Subsequent pushing of MEMory button transfers data from the MEM data buffer back to its corresponding display buffer.

5.10.3 Selecting Channels For Display

Two buttons are provided for specifying an active channel to be displayed:

CHANNEL and NEXT CHAN.

5.10.3.1 CHANNEL. When this button is pressed a query prompt is displayed:

Channel Pair = (for displayed CROSS CHANNEL data)

Channel = (for displayed AUTO-CHAN data)

The sequence of steps is as follows:

a. Press CHANNEL. "Channel Pair =" appears.

b. Enter the number of an active channel or channel pair (ENTRY area).

c. Press ENTER or NEXT to activate entry. The display channel changes to the selected channel. Note that if the channel number is entered not an active channel, the entry is ignored.

During AUTO channel mode, the response channel list is checked.

During CROSS channel mode, when an AUTO channel function is displayed, both reference and response channel entries are checked in the active channel list. The above step b. is modified as follows:

b. Enter response channel number, followed by reference channel number.

Example: 4, 1

If the reference channel is not entered, it remains the same and only a new response channel is changed, and vice-versa.

Example: 4

If a response channel is entered and the reference channel does not match with any of the active channel pairs, the channel pair displayed will be the first channel pair with the correct response channel in the active channel pair list. If only a response or a reference channel is entered and does not appear in the appropriate column of the channel pair list, the entry is ignored. The CHANNEL button entries always modify only the upper display.

5.10.3.2 NEXT CHAN. When the NEXT CHAN button is pressed, action taken is dependent upon screen format and channel function selections.

- PROBABILITY or AUTO Channel /SINGLE Format: A sequence is made through the list of active response channels.
- DUAL or OVLY Format: NEXT CHAN changes both the upper and lower displays.
- CROSS Channel /SINGLE Format: A sequence is made first through the list of active response channels, then through any active reference channels if an AUTO channel function is shown in the upper display. If a CROSS channel function is being displayed then the channel pair list is sequenced through.
- Mixed AUTO and CROSS Channel Functions/DUAL or OVLY Format: The channel pair list is sequenced through. The AUTO channel is then restricted to the response channel of the current channel pair.

5.10.4 Selecting FUNCTION Type

The FUNCTION button allows you to select the function type to be displayed. It also allows selection of certain format parameters. When you press FUNCTION, the following setup summary appears:

```
Function:
CPX Function:
Format:
COH Blnk Level:
ORBIT X Chan:
```

The menu that appears depends on which data source is currently selected: REAL TIME, AVG, or MEM. ORBIT appears if it is an orbit display.

5.10.4.1 REAL TIME Function Menu. The following menu appears if you press the REAL TIME button:

```
REAL TIME Function Type

> * SPECTRUM
  TIME
  LEVELS
  ORBIT
```

SPECTRUM	Selects the frequency domain representation of the input samples.
TIME	Selects the time domain sampled data.
LEVELS	Selects a special format display which shows the PEAK and RMS levels of all the active channels relative to full scale all on a single display.
ORBIT	Provides a time domain display which shows two channels relative to each other on the X and Y axis.

5.10.4.2 AVG Function Menus. If the current mode is AUTO CHANNEL and the data source selected is the AVG button, the following menu appears on the display:

```
> * SPECTRUM
  TIME HISTORY
```

SPECTRUM	This selection shows the averaged AUTO SPECTRUM data or the LINEAR SPECTRUM of the time averaged signal when time domain averaged data has been collected.
TIME HISTORY	This selection is available only if time domain averaging is being used. It shows the averaged time domain input data.

If the current mode is CROSS CHANNEL, and AVG is the data source, the following menu appears:

```
AVG Function Type

> * AUTO SPECTRUM
  CROSS SPECTRUM
  TRANSFER FUNCTION
  COHERENCE
  IMPULSE RESPONSE
  COHERENT OUTPUT POWER
  AUTO CORRELATION
  CROSS CORRELATION
  TIME HISTORY
```

If cross spectrum or transfer function is selected, the following menu appears. It is also displayed if time domain averaging is used and SPECTRUM is selected. The magnitude and phase information is usually lost in the averaged AUTO SPECTRUM calculation but is preserved in the TIME averaged data since it is processed in the time domain and the SPECTRUM selection performs the DFT (Direct Fourier Transform) to produce a complex result (LINEAR SPECTRUM). For block math results that have complex data format, this menu can also appear. No circle fit is done on block math result. If it is chosen, a Nyquist plot is presented.

CPX Function Format

> * BODE
MAGNITUDE
PHASE
REAL
IMAGINARY
MAGNITUDE vs. PHASE
NYQUIST
CIRCLE FIT

AUTO SPECTRUM

Provides the average of the squared spectrum magnitude, representing the mean power at each frequency.

$$G_{AA} = \overline{S_A \cdot S_A^*}$$

CROSS SPECTRUM

Provides the averaged complex product of spectrum A and spectrum B and indicates which frequencies match between A and B.

$$G_{AB} = \overline{S_B \cdot S_A^*} = |\overline{S_A' S_B}| \cos(\phi B - \phi A) + j|\overline{S_A \div S_B}| \sin(\phi B - \phi A)$$

TRANSFER FUNCTION

Presents the ratio of the cross spectrum of A and B to the input power spectrum of input A. It represents the gain and phase lag given by a system with input A and response B.

$$H_{AB} = \frac{G_{AB}}{G_{AA}} = \frac{\overline{S_B \cdot S_A^*}}{\overline{S_A \cdot S_A^*}}$$

*: Complex conjugate

COHERENCE

Indicates the linear cause and effect relationship between the input time function on A and the input time function on B.

$$\gamma^2 AB = \frac{G_{AB} \cdot G_{AB}^*}{G_{AA} \cdot G_{BB}}$$

$$= \frac{|G_{AB}|^2}{G_{AA} \cdot G_{BB}}$$

IMPULSE RESPONSE

Provides the time response of a system to an inpulse input and is the inverse transform of the transfer function.

$$IR = F^{-1} \{H_{AB}\}$$

COHERENT OUTPUT POWER

Represents the power spectrum in the output signal B that is coherent with the input signal A. The total power spectrum indicates the entire content of signal B while the coherent output power function indicates only that portion caused by signal A; i.e., only by A through a linear process.

$$COP = \frac{G_{AB} \cdot G_{AB}^*}{G_{AA}}$$

AUTO CORRELATION

Provides the time domain statistic by comparing similarities of the input time function of a channel (A or B) to replicates of itself, delayed by an artificially introduced time delay. As the time delay approaches zero, the statistic approaches the square of mean value. Oscillations in the time domain statistic indicate bandwidth and periodicity of the input time function signal of the channel.

$$R_{AA}(\tau) = F^{-1} \{G_{AA}\} = \frac{1}{P} \circ \int^{\rho} A(t) \cdot A(t+\tau) dt$$

CROSS CORRELATION

Compares the similarity of the input time function between two channels (A and B). The value of the artificially introduced time delay that maximizes the correlation indicates the time lag between signals A and B.

$$R_{AB}(\tau) = F^{-1} \{G_{AB}\}$$

$$= \frac{1}{P} \circ \int^{\rho} A(t) B(t+\tau) dt$$

*: Complex conjugate

CIRCLE FIT	Produces a least squares circle fit on displayed function data with a phase interpolation algorithm to obtain the modal frequency and damping factor.
TIME HISTORY	For time averaged data only; this selection shows the averaged time waveform for averaged time frames.

$$S_{\overline{A}} = F\ \{A(t)\}$$

The format selection menu is followed by a menu which allows the specification of a COHERENCE blanking level:

ENTER COHERENCE Blanking
Level (0.0 = OFF)

Displays of complex data types (for transfer function only) only show data for which the coherence is greater than the entered level. Data values below the coherence blanking level are not displayed.

If the current mode is PROBABILITY and AVG is selected as the data source, a choice of averaged functions is available on the following menu:

>* PROBABILITY DENSITY
CUMULATIVE DISTRIBUTION

5.10.4.3 ORBIT Display. If ORBIT is selected from the REAL TIME function menu (see paragraph 5.10.4.1) an "orbit plot" can be generated. The ORBIT display depicts the phase relationship between two signals which are, in certain vibration studies, collected with probes on a machine at two different angular positions (e.g., 0 and 90 degrees).

In the RTA program, these two signals can both be real-time input signals, or both averaged, or a real-time versus an averaged signal, as long as a certain set of conditions are met.

An ORBIT display is generated from two time domain data blocks, each having n elements. The source of each block can be RT, AVG, or MEM. The X, Y coordinates of the curve are taken, in time sequence order, from the beginning of the blocks. These two blocks must be placed in the upper and lower displays first and must meet the following requirements:

1. The current upper and lower displays must be time-domain functions.
2. The blocks must have an equal number of elements.
3. The blocks must have the same real-time duration.

If any of these conditions are violated, "INCONSISTENT DATA" appears at the system message area, but the display is not changed.

If ORBIT is selected and allowed there is no split screen. The display is coerced to SINGLE. This is because it takes both displays to specify one orbit, just as it takes both displays to specify the overlap displays.

Both displays' labels are present on the left hand side of the plot. If the menu is present, however, only the upper display label shows up. The upper labels correspond to the Y-axis and the lower labels correspond to the X-axis. Between the two sets of labels, ORBIT appears to denote the format.

Note that there is no storage or recall of an orbit function. However, when storage is requested, only the upper display time-domain data is stored. To reconstruct the orbit display, it is necessary to recall the correct constituent time-domain functions separately into the upper and lower displays.

Note also that there is no cursor and no way to perform block math, group storage, or log scale operations. The display defaults to linear in the event of an error.

The menu sequence is as follows:

For REAL-TIME orbit:

Step 1. Press REAL TIME.

REAL TIME Function Type

1) SPECTRUM
2) TIME
3) LEVELS
>*4) ORBIT

Select ORBIT. The data is processed based on the current upper and lower displays. The lower display may be any time-domain function of any source (e.g., RT, AVG, or MEM), so long as the previously mentioned conditions are met.

For AVG orbit:

Step 1. Press AVG.

AVG Function Type

1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENCE OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
>*10) TIME HISTORY

Select one of the four time-domain functions, numbers 5, 8, 9, or 10.

Step 2. Press NEXT.

Format

1) NORMAL
>*2) ORBIT

Press NEXT CHAN button to get the next pair. This changes both upper and lower, Y and X, simultaneously. There is no check for a valid channel pair.

For AUTO CORRELATION function in ORBIT, pressing NEXT CHAN increments through the active channel table.

For CROSS CORRELATION function in ORBIT, pressing NEXT CHAN increments through the active channel PAIR table.

When ORBIT is from mixed CROSS and AUTO functions, pressing NEXT CHAN does both of the above.

Whichever selection is made, NEXT CHAN in ORBIT mode writes the RES channel numbers of the constituent functions.

To change the upper channel: press CHANNEL, enter the channel number, and press ENTER.

To change the lower channel: press CHANNEL, enter a comma followed by the channel number, and press ENTER.

5.10.5 Y SCALE Function

The Y Scale button is used to select the type of scaling desired for the Y axis of the display. It has the following first menu and summary:

Y Scale	Y Scale:
	EXPAND Min Y:
LIN AUTO SCALE	EXPAND Max Y:
LIN EXPAND	LOG AUTO SCALE
LOG AUTO SCALE	dB Range: (if LOG AUTO SCALE)
LOG EXPAND	

LIN AUTO SCALE — The full scale value is selected through an autoscale algorithm which looks for the maximum value in the data block to be displayed and sets the full scale value to be the next largest value in a 1, 2, 5 sequence. For unipolar displays, the minimum Y value is always 0.0. For bipolar displays, the maximum and minimum values are set to be equal to the maximum absolute value. For time domain input displays, the maximum, minimum is fixed at plus or minus the maximum value of the input level range.

LIN EXPAND — This selection allows you to specify in the next menu the maximum and minimum values to be used in generating the display.

LOG AUTO SCALE — The full scale value is selected in the same way as for LIN except that the minimum value cannot be zero and must default to a user specified range of decibels. This may be entered in the menu which follows.

LOG EXPAND — As in LIN EXPAND, you specify a maximum and minimum value for the display parameters. The maximum and minimum choice is found in the menu which follows.

There are some functions for which LOG scaling is not meaningful. These displays default to LIN scaling but the choice between AUTO SCALE and EXPAND is still recognized.

The next menu in this tree depends upon the first selection made and is displayed as follows:

LIN AUTO SCALE is selected = No further menus appear.

LIN EXPAND is selected = The next menu is:

ENTER MIN,MAX values
for LIN Y EXPANSION

The desired upper and lower limits are entered in the currently displayed units.

LOG AUTO SCALE is selected = A decibel range is displayed for selection:

dB Range

120
100
80
>*60
40
20

LOG EXPAND is selected = The next menu prompts for the minimum and maximum expansion values in the current display units:

ENTER MIN,MAX values
for LOG Y EXPANSION

5.10.5.1 Modifying Scaling in AUTO SCALE Displays. You may scale the display vertical scale in AUTO SCALED displays using the ↑ and ↓ arrow buttons when there is no other menu active. In LIN AUTO SCALE the vertical scale is multiplied by 2**n every time the ↑ or ↓ arrow button is pressed. ↑ increments the value of n by 1 each time and ↓ decrements the value of n. In LOG AUTO SCALE, the vertical scale is modified by a 10 dB offset each time these buttons are pressed. ↑ adds 10 dB of offset to the display and ↓ subtracts 10 dB from the display maximum Y value and minimum Y value. (In LOG AUTO SCALE the limits are still multiplied and divided by 2. The plus and minus 10 dB is only for LOG AUTO SCALE with dB turned on.)

Initialization of this type of display modification is performed when any of the following parameters is changed:

Y Scale type
Function type
Function format
Data source
Y axis units
CHANNEL
EXCHNG
NEXT CHAN

In LOG, the decibel offset is set to 0 and in LIN, the gain factor is set to 1.

5.10.6 X SCALE Function

The X SCALE button allows the scaling of the X axis to be selected from the following menu and summary:

X Scale	X Scale: EXPAND Min X: EXPAND Max X:
LIN AUTO SCALE LIN EXPAND LOG AUTO SCALE LOG EXPAND	

LIN AUTO SCALE — This uses the maximum and minimum limits of the data block to be displayed to set the maximum, minimum limits of the display.

LIN EXPAND — This allows you to input specific limits for use in display generation. These limits are entered in the next menu to be displayed.

LOG AUTO SCALE — The maximum becomes the first positive frequency value in the block, i.e., 32 Hz.

LOG EXPAND This selection provides a LOG X axis display with user specified minimum and maximum values from the next menu.

LOG X scaling is not meaningful to some functions such as TIME. These displays default to LIN scaling but recognize the choice between AUTO SCALE and EXPAND. For AUTO CORRELATION and CROSS CORRELATION displays the first 10% and last 10% of the data is not displayed if AUTO SCALE is selected. Truncation of the frequency time domain causes "edge effects" which are not meaningful and, therefore, are not displayed. This data can be seen in EXPAND mode. For a similar reason, the last 10% of the Impulse Response function is not shown in AUTO SCALE mode.

If LIN or LOG AUTO SCALE is selected no menu follows.

If LIN EXPAND is selected the following menu appears:

ENTER MIN,MAX values
for LIN X EXPANSION

If LOG EXPAND is selected, the following menu appears:

ENTER MIN,MAX VALUES
for LOG X EXPANSION

5.10.6.1 X and Y Expansion Windows. To avoid having to specify the window repeatedly when changing the function type, a number of different windows are maintained for the X and Y limits of the displays. The following windows are saved separately for the function types listed:

Y-AXIS EXPANSION WINDOWS

Power Amplitude Window
- SPECTRUM (Real Time)
- AUTO SPECTRUM
- CROSS SPECTRUM*
- TRANSFER FUNCTION*
- TRANSMISSIBILITY
- COHERENT OUTPUT POWER
- AUTO CORRELATION
- CROSS CORRELATION
- LINEAR SPECTRUM*

(* in Bode, Magnitude, and Magnitude vs. Phase formats)

Real Amplitude Window (in Real format)
Imaginary Amplitude Window (in Imaginary, Nyquist and Circle Fit formats)
Phase Window (in Phase format)
- CROSS SPECTRUM
- TRANSFER FUNCTION
- LINEAR SPECTRUM

Amplitude (vs. Time) Window
- TIME
- TIME HISTORY
- IMPULSE RESPONSE
- ORBIT

Coherence Window
- COHERENCE

Probability Density Window
- PROBABILITY DENSITY

Cumulative Distribution Window
- CUMULATIVE DISTRIBUTION

X-AXIS EXPANSION WINDOWS

Time Window
- TIME
- TIME HISTORY
- IMPULSE RESPONSE
- AUTO CORRELATION
- CROSS CORRELATION

Freq Window
- SPECTRUM
- AUTO SPECTRUM
- LINEAR SPECTRUM
- TRANSFER FUNCTION
- COHRENCE
- TRANSMISSIBILITY
- COHERENT OUTPUT POWER

Real Window (in Nyquist and Circle Fit formats)
Phase Window (in Magnitude vs. Phase format)
- CROSS SPECTRUM
- TRANSFER FUNCTION
- LINEAR SPECTRUM

Orbit X window
- ORBIT

Probability X window
- PROBABILITY DENSITY
- CUMULATIVE DISTRIBUTION

When you make changes between Y SCALE modes you need to modify the magnitude and power vs. frequency windows. The following parameters apply:

a. The maximum values of these windows are preserved when the Y SCALE is changed.

b. The minimum value of the amplitude windows is initialized to zero when changing from LOG to LIN Y scale.

c. When changing from LIN Y scale to LOG Y scale the minimum values in these windows are changed as follows:

Power Amplitude Window
Min value = max value * 10**(-dBRange param/20)
Magnitude Window
Min value = max value * 10**(-dBRange param/10)

The remaining windows do not need to be changed when the Y scale is changed.

5.10.6.2 Window Units. The units of the window are the units of the current display. If new units are selected, the display window units are not modified and must be respecified.

5.10.7 UNITS Function

When you press this button, a menu of unit selections displays. The selections allow you to specify the units which are to be used in the display annotation. This first menu is as follows:

	Amplitude Units	Ampl Units:
		Ampl Normalization:
>*	V	Units Conversion:
	EU	
	dBV	Freq Units:
	dBEU	ORDER Reference:

V — This selection means "volts" which are the basic units of calibration of the input circuitry.

EU — These Engineering Units are the units specified by you for each of the input channels in the INPUT LEVEL menus. The text that is used is that which you entered. The relationship of the EUs to V is determined by a calibration factor which you also enter in the input range. If EU is selected, then the normal V calibration is modified by the scale factor (volts per engineering unit) and is displayed with the user entered text string. You may also specify an EU conversion factor which is selected in the menu that follows within this mode.

dBV These units are logarithm decibel units relative to a 1.0 volt reference. The amplitudes are read out in dBV units.

dBEU These units are logarithm decibel units relative to the user entered reference.

If a conversion is made to decibel units, the minimum/maximum limits for the appropriate window is automatically converted to decibel values (and vice-versa).

If memory is being displayed, the arrow only moves to valid selections. If storage is done with EU, only EU and dBEU may be selected. If storage is performed with V, only V and dBV may be selected.

5.10.7.1 Units Normalization Menu. The next menu in the units sequence is the specification of the units normalization of the selected units type. This normalization is only appropriate for power functions. This menu appears for all function types but only allows selection of units appropriate to the particular function, e.g., Transfer Function allows U or U2 only, ASPEC allows all possible normalizations.

```
Units Normalization

>* U
   U2
   U2/Hz
   U2*SEC/Hz
```

U This selection uses the exact units as specified in the menu.

U2 These are squared units which is the natural format for displays of power spectra.

U2/Hz The per Hertz normalization calibrates the spectral values in units of power spectral density (PSD).

U2*SEC/Hz Normalizes the readout for energy density measurements.

5.10.7.2 Frequency Units. The frequency units (along the X-axis) are specified in the third menu of the UNITS function. The menu is as follows:

```
Frequency Units

>* HZ
   CPM
   ORDERS
```

HZ — The normal units readout for the abscissa. This selection scales the frequency plots as cycles per second and labels the X-axis as FREQ(HZ).

CPM — This is cycles per minute and corresponds to a multiplication by 60 of the Hertz values (cycles per second); i.e., CPM scales frequency plots as cycles per minute and labels the X-axis as FREQ(CPM).

ORDERS — This is a readout of abscissa units relative to some frequency reference. It is useful when dealing with rotating machinery where the first order would be the fundamental rotational speed which would be the first order (units - 1.0). In this case the X-axis is labeled ORDERS(HZ/'#'), where "#" is the current user supplied parameter.

If ORDERS is selected then the order reference must be entered when the system prompts:

ENTER Order Reference
in Hz

The X-axis label is ORDERS(HZ/500) for frequency plots.

When the frequency units menu is changed, the X-expand limits are automatically updated to reflect the change. For example, if the setting was HZ and the X-expand limits were 0 to 10240, a change to CPMs would automatically change the X-expand limits to 0 to 6.144 e+5 (10240*60 = 6.144 e+5).

If storage is required, frequency domain functions are always stored as the current setup dictates. When recalled, they look the same as just before they were stored, with one exception. The reference in ORDERS is not saved. Although a recalled X-axis scale looks the same for a saved ORDERS function, the units label reads "ORDERS", and does not include a reference number. HERTZ and CPMs look the same.

When a function is recalled, the panel forces the frequency units menu to the saved state. Once a function has been recalled, the frequency units menu cannot be changed.

Note that the user entered reference of ORDERS is restricted to .00001 <= reference <= 99,999.

5.10.8 BLOCK MATH FUNCTION

A block math operation may involve the upper display and/or the lower display, or a complex number (a, b). Here a and b are the real and imaginary part, respectively, and a or b may be zero. In the following discussion, the blocks and the complex number are called "operand." Thus the block operations can be conveniently categorized into two types, namely, single operand and double operand. The upper display is always the first operand. The second operand can be the lower display or the complex number entered depending on the operation desired. The result of all block math operations always resides in the upper display buffer.

The single operand type includes integration; differentiation; taking reciprocal, square root, or square; taking the real part, the imaginary part, or the complex conjugate of the block. All single operand block math are menu driven. The menu selections are as follows (COMPLEX involves double operands):

If a time function is in the upper screen:

```
>* 1) INTEGRATE
   2) DIFFERENTIATE
   3) RECIPROCAL
   4) SQRT
   5) SQUARE
```

If a real frequency function:

```
>* 1) DIVIDE by (jw) SQUARED
   2) MULTIPLY by (jw) SQUARED
   3) RECIPROCAL
   4) SQRT
   5) SQUARE
   6) COMPLEX
```

If a complex function:

```
>* 1) DIVIDE by (jw)
   2) MULTIPLY by (jw)
   3) RECIPROCAL
   4) SQRT
   5) SQUARE
   6) CMPLX CONJUGATE
   7) REAL
   8) IMAGINARY
```

When the BLOCK MATH button is pushed, one of these menus appear depending on the function type. Detailed descriptions of these selections are tabulated later.

The double operand type includes forming a complex block; arithmatic operations (+, -, *, /) on two block operands, or on one block with a complex operand. All double operand block math (except COMPLEX) can be achieved by pushing +, -, *, or / button. A prompt to enter the operand number (#) appears in the lower left corner of the screen. If a number (complex or real) is entered, the upper display is operated on with this number (e.g., a+ib is added to each data point of the upper display.) If the ENTER button is pressed instead, the upper display is operated on with the lower display as the second operand (e.g., add lower to the upper display, leaving the result in the upper display while the lower display remains unchanged). For the menu selection, COMPLEX, both displays have to be real block. Then after the BLOCK MATH button is pushed with COMPLEX selected from the menu, a complex block is formed using upper display as real part and lower display as imaginary part.

Note that block math can only be done on memory or averaged data. It is done with no consideration of display format, but the resultant complex block, if any, may be displayed in different format (e.g., BODE).

Since all block math have to allocate working buffers, no operation is done if not enough space exists. For averaged data obtained in auto channel mode, multiplication by a complex number necessitates the doubling of the display buffer; therefore, is not allowed.

There is no block math on probability functions. Note also that CIRCLE FIT is not allowed on block math results. Pre-block math CIRCLE FIT is changed to a NYQUIST plot if block math is requested.

Descriptions of the operations:

INTEGRATE	For time data, use trapezoidal rule. For real frequency data, devide by (jw)**2. For complex frequency data, divide by jw.
DIFFERENTIATE	For time data, use central difference method. For frequency data, multiply by (jw)**2. For complex frequency data, multiply by jw.
RECIPROCAL	Takes the reciprocal of each data point of the display block.
SQRT	Takes the square root of each number in the block. Note that part of the phase curve may be off by 180 degrees. This is because taking square root depends on the arc-tangent function to find the phase angle, and only principal value is returned.
SQUARE	Squares each number in the block.
CMPLX CONJUGATE	Takes the complex conjugate of each number in the block (conj(x+iy) = x-iy).
COMPLEX	Creates a complex block by using the upper real block for the reals and lower real block for the imaginary.
REAL	Extracts reals from a complex block.
IMAGINARY	Extracts imaginary part from a complex block.

NOTE: UNITS - Whenever a complex result appears in the upper display, you may select linear or squared format (i.e., volts or volts**2). This is done through the units menu. This menu appears only if Y-axis is magnitude.

When a real result appears, no units change can be made.

DISPLAY - The display labels allow for each block math result:

1) BLOCK MATH
2) COMPLEX or REAL
3) MAGNITUDE or MAGNITUDE SQUARED (only if a complex function)

5.11 CURSOR FUNCTIONS

The following text describes the cursor functions controllable at the front panel. Eleven pushbuttons, used separately or in combination, provide three cursor modes and related readouts.

5.11.1 Front Panel Control of Cursor

The front panel contains the following buttons for control of the cursors:

CURSOR

( ) < > ( )

Main Ref Set Abs/Rel
( ) == ( ) ( )

Harmonic Store Recall
( ) == ( ) ( )

Sideband > < < >
( ) == ( ) ( )

The cursor display and readouts apply only to the upper display data. LEDs on the panel indicate which of three modes the cursor is in.

Single mode:	Main cursor and a settable reference cursor.
Harmonic mode:	Main cursor and its harmonics.
Sideband mode:	Main cursor with multiples and sub-multiples of a selectable delta frequency.

The cursor modes apply both in the frequency and time domain even though harmonic cursors in a time domain display may not be meaningful. The main and reference cursors are buffered between time and frequency displays for convenience.

5.11.2 Single Cursor Mode

5.11.2.1 MAIN Button. Pressing the MAIN button causes the cursor to enter single cursor mode.

5.11.2.2 < and > Buttons. The < and > buttons control the motion of the main single cursor. The main cursor only appears on data points in the buffer and cannot be placed between the data values. For example, the cursor jumps across the screen at low frequencies in a log x axis plot so that it only appear on valid data points.

If the entire data block is displayed on the screen the cursor wraps around to the other end when it reaches the last data point. If the display is expanded the cursor continues to move through the undisplayed portion of the data block and then wrap around.

5.11.2.3 MAIN xxx <ENTER>. Once the mode is set to single cursor mode the main cursor may also be positioned at your entered location. To do this, press the MAIN button and enter an X-axis value at the ENTRY section of the panel. This is terminated by pressing the ENTER button. Pressing any other button after the MAIN button disables this form of cursor entry. If ENTER is pressed immediately after MAIN with no value entered, the REF cursor disappears and the main cursor is moved to the left side of the display.

If the operator enters a value which is outside of the range of the data block, the cursor wraps around to the other side of the block.

5.11.2.4 REF SET Button. Pressing the REF SET button causes a reference cursor to appear at the current position of the main cursor. The main cursor can then be moved away from this position and the reference cursor remains there. The REF cursor appears as a broken vertical line. Each time the REF SET button is pressed, the reference cursor resets to the value of the current main cursor. The reference cursor is cleared whenever the MAIN button is pressed followed by ENTER.

Note that the main and reference cursors are buffered for time domain and frequency domain display modes so that you can switch between a time domain and a frequency display and still have the cursors at the same locations.

5.11.2.5 ABS/REL Button. The ABS/REL button allows the cursor readout values to be either absolute or relative. Relative cursor readout is only valid if there is a reference cursor set. The cursor readout is then a relative measure between the main and reference cursors. Pressing this button repeatedly toggles the cursor readout between the relative and absolute modes. More details of the actual readouts are in the cursor readout, paragraph 5.11.3.

5.11.2.6 STORE x <ENTER>. The STORE button followed by a numeric entry in the range 0 to 9 causes the current main cursor location in current X-axis units to be stored for later recall. The cursor itself is not affected by this action.

5.11.2.7 RECALL x <ENTER>. The RECALL button is used in conjunction with the STORE button to allow you to quickly move to preselected locations in the data block. Enter a numeric value between 0 and 9 (followed by <ENTER >) and the location stored there is made the current location of the main cursor.

There is no differentiation between units of the locations that are stored so that the time and frequency domain cursors may be mixed in these storage buffers. It is up to you to make sure that time domain cursors are not used to set the frequency domain cursor. This does not cause a problem except that the cursor value is truncated to be within the display block and on a data value.

5.11.2.8 > < and < > Buttons. These buttons are inactive in single cursor mode.

5.11.2.9 HARMONIC and SIDEBAND Buttons. These buttons get you to the harmonic and sideband cursor modes from single mode.

5.11.3 Single Cursor Mode Readout

The main cursor appears on the screen as a solid vertical line. The reference cursor appears on the screen as a broken vertical line. Text readout gives the cursor location in EU (engineering units) and the amplitude value at that location. If the reference cursor is set then the readout is relative to the reference cursor and is normally the arithmetic difference of the main and reference cursor values for time frequency and phase. The amplitude readout indicates the ratio of the main and reference values. The text readouts associated with this cursor mode are listed below:

	Absolute Units	Relative Units
Single Cursor	Main freq Main ampl val	Main freq Main ampl val
Single w/ref	Main freq Main ampl val	Main freq - ref freq Main ampl ÷ ref ampl
Single Cursor (Bode display)	Main freq Main magn Main phase	Main freq Main magn Main phase
Single w/ref (Bode display)	Main freq Main magn Main phase	Main freq - ref freq Main magn ÷ ref magn Main phase - ref phase

Note that relative readouts of ratios (e.g. main ampl ÷ ref ampl.) is actually a difference (main ampl - ref ampl) if dBV or dBEU units are selected.

5.11.4 Harmonic Mode

5.11.4.1 HARMONIC Button. Pressing HARMONIC causes the cursor to enter the harmonic mode. When the harmonic mode is entered the current main cursor location determines the location of the fundamental frequency for which the harmonics are displayed. No immediate mode entries are allowed as they are after pushing the MAIN button.

5.11.4.2 < and > Buttons. The < and > buttons are used as a fine adjust on the cursor for the harmonic mode. This adjustment moves the cursor within ±0.5 a data point to make up for the discrete nature of the samples so that the main cursor peak frequency can be specified more accurately. This allows the harmonic cursors to be lined up better since they are multiples of the main cursor.

When the ±0.5 point is passed, the main cursor on the display increments to the next line. In other words, in the harmonic mode the motion of the cursor is made much slower (finer). The frequency readout indicates interpolated values of frequency.

To move more quickly to a desired location, return to the main cursor mode, move the cursor, and then return to harmonic mode again. Note that the adjustment of the main cursor is not preserved when switching to single and then back. It is rounded to the nearest real location.

5.11.4.3 REF SET Button. There is no reference cursor in the harmonic mode, and the REF SET button is ignored.

5.11.4.4 ABS/REL Button. The ABS/REL button allows the cursor readout to go between relative and absolute modes. The relative readout is not referenced to the reference cursor as it was in the single mode. The only difference is that in relative mode the amplitude value represents the value of the main cursor divided by the sum of the amplitude values at all the displayed harmonic locations. See the cursor readout in paragraph 5.11.5.

5.11.4.5 STORE and RECALL Buttons. The STORE and RECALL buttons behave in the same way as they do in the single mode except that the actual interpolated frequency value is stored. If it is recalled in the harmonic mode it has the same location. If it is recalled in the single mode the location is truncated to the nearest actual data point. The adjusted harmonic cursor may be preserved using STORE and RECALL.

5.11.4.6 > < and < > Buttons. The MAIN and SIDEBAND buttons are inactive in harmonic mode.

5.11.4.7 MAIN and SIDEBAND Buttons. The MAIN and SIDEBAND buttons get the cursor out of harmonic mode.

5.11.5 Harmonic Mode Cursor Readouts

Up to 16 harmonics of the main cursor are displayed. The text readouts associated with this mode are as follows:

	Absolute Units	Relative Units
Harmonic Cursor	Interp main freq Main ampl val	Interp main freq Main/Sum of harm vals
Harmonic Cursor (Bode display)	Interp main freq Main magn Main phase	Interp main freq Main/Sum of harm vals Main phase

5.11.6 Sideband Cursor Mode

In sideband cursor mode, integer multiples (and sub-multiples) of the specified delta frequency surrounding the main cursor are displayed.

5.11.6.1 SIDEBAND Button. The SIDEBAND button sets sideband mode and restores the sideband cursor delta frequency to whatever it was set to the last time you were in sideband mode.

5.11.6.2 SIDEBAND xxx <ENTER> If a valid engineering unit (EU) value is entered immediately after the SIDEBAND button is pressed, this value is interpreted as a user entered delta frequency which is truncated as needed to make it a valid entry. The delta frequency is the difference between the main and the first sideband. Note that the innermost sideband cursors are restricted to both being within the data block being displayed. Note that if the cursor is not already in sideband mode the DELTAFREQ= prompt does not appear until the button is pressed the second time.

5.11.6.3 < and > Buttons. The < and > buttons are used to fine adjust the position of the main cursor in the same way it was adjusted in the harmonic mode. The main cursor does not move to the next line when the halfway point is reached as it did in the harmonic mode. Instead, the adjusted cursor wraps around about the same main cursor line.

5.11.6.4 REF SET Button. No reference cursor is allowed in sideband mode, and the REF SET button is ignored.

5.11.6.5 ABS/REL Button. The relative and absolute cursor modes are toggled with the ABS/REL button. Relative mode allows readout of the delta frequency value and the sum of the amplitudes between the innermost sideband cursors. See readout information that follows in paragraph 5.11.7.

5.11.6.6 STORE and RECALL Buttons. The STORE and RECALL buttons work as they did in sideband mode with the same restrictions noted in the harmonic mode.

5.11.6.7 > < and < > Buttons. The > < and < > buttons decrease and increase the sideband delta frequency. The sidebands stop moving when they collapse on the main cursor location and when either of the innermost sidebands reaches the limits of the data block (not just the limits of the displayed data).

5.11.6.8 MAIN and HARMONIC Buttons. The MAIN and HARMONIC buttons get the cursor out of the sideband mode.

5.11.7 Sideband Cursor Mode Readout

The text readouts associated with the sideband cursor mode are as follows:

	Absolute Units	Relative Units
Sideband Cursor	Interp main freq Main ampl val	Interp delta freq Sum of ampls between two innermost sideband cursors
Sideband Cursor (Bode display)	Interp main cursor Main magn Main phase	Interp delta freq Sum of ampls between two innermost sideband cursors Main phase

5.12 STORAGE FUNCTIONS

The STORAGE group pushbuttons provide the controls for storage of data or panel setups into temporary memory buffers or permanent external disk files. Screen copy and plotter operations are also controlled from this group, together with the PLOT button at lower right. The buttons and their associated sub-menus perform the following principal functions (equivalent two-letter keyboard codes are in parenthesis):

TYPE (ST)

Provides the preparatory setup functions to:

- Create new disk files.
- Re-open existing disk files.
- Specify file format, storage restrictions, and labelling conventions.
- Specify whether outputs to file are to be one function record (the upper display) or all available channel pair records.
- Manage files by deletion of records or increases of size of the file.
- Select type of plotter and specify plotter conditions.

STORE (SS)

Executes a storage operation, after determining whether the source is a data function record or a panel setup, and whether the destination is to be a file set up by TYPE or temporary storage in a memory buffer.

Note: The temporary "memory buffers" are actually in a "scratch" file on disk. Data and setups stored in "memory" continue to exist even after the system is stopped and re-started.

PLOT (^P)

Executes output to the plotter selected under the TYPE setup.

RECALL (SR)

Executes the recall operation after determining whether it is to read back a panel setup or a function record and whether it is from the current open file set up by TYPE or from a memory buffer.

DIR (SD)

Presents a directory listing of the function records in the currently open file or in the memory buffers as requested.

5.12.1 Creating a New File Under the TYPE Function

Before executing file storage or recall operations, you must create the file or open an existing file with the STORAGE/TYPE function. Pressing the TYPE button presents the following initial menu and setup summary:

```
Storage Mode                          Restriction: TRANSFER FUNCTION
                                      Storage Labels: NORMAL
>* 1) USER FILE                      Current File:
   2) PLOTTER SETUP                   File Status: CLOSED
                                      File Format: MODAL
```

The Plotter Setup selection is discussed in paragraph 5.12.5. Selecting "1) User File" starts the following sequence of setup menus to specify the file.

```
Storage Grouping

>* 1) STORE ONLY UPPER DISPLAY
   2) STORE ALL FUNCTIONS
```

This selection determines how many functions are stored upon an execution command from the STORE button. As indicated, the first choice writes into the file only the function currently being displayed in the upper display. The second choice causes the system to cycle through all active channels (pairs), writing one function for each channel (pair). For RECALL, function records may only be read one at a time.

If you select STORE ONLY UPPER DISPLAY, the following menu provides the function selection. (This menu is omitted when in probability mode.)

```
Storage Restriction

>* 1) TRANSFER FUNCTION ONLY
   2) ANY DISPLAYED FUNCTION
```

This menu is a convenience for you. Select option 1) to store transfer functions only. An error message appears if you attempt to store non-transfer function data. To store non-transfer functions, select option 2). For real functions, the number of elements doubles.

The menu following the storage restriction menu pertains to the MODAL coordinate labels that are applied to the functions when they are stored. (This menu is omitted when in probability mode.)

```
Storage Labels

>* 1) NORMAL
   2) SWAP REF & RESP
```

Selection 2) causes the reference and response labels that are stored into the data file to be swapped at the time that storage occurs. This selection does not alter the labels on the AVERAGE functions as they appear in the RTA program itself. If the stored functions are later recalled to the RTA program, they appear with their labels in the swapped form, but they are also labeled as MEMORY data.

Selection 2) is provided primarily for MODAL analysis using an impact hammer in conjunction with one or more fixed accelerometers. This type of testing generally produces a large number of frequency response functions with many different reference coordinates and a small number of (perhaps only one) response coordinates. The structure of the MODAL program is such that it is much more convenient to analyze data containing many response coordinates and a small number of reference coordinates. For linear time-invariant systems, the law of reciprocity tells us that a frequency response function measured, for example, from 10X to 15Y has the same magnitude and phase as a frequency response function measured from 15Y to 10X. This allows us to swap the labels at the time the functions are stored and interpret the functions as if they were made from a small number of reference sites and a large number of response sites. Usually, for impact testing it is important that, within the acquisition program itself, the force channel be identified as the reference channel. This assures that the frequency response function is calculated properly and that the results are dimensionally correct. Also, it should be clear that the process of swapping the reference and response labels has nothing to do with taking the reciprocal of the frequency response function itself; the resultant function is still interpreted as an acceleration response to a force input.

After pressing NEXT, the file allocation menu appears:

File Allocation

>* 1) SELECT EXISTING FILE
2) CREATE NEW FILE
3) DELETIONS FROM FILE
4) INCREASE SIZE OF FILE

This menu selects the file management operation to be performed. The following descriptions are for selection of "CREATE NEW FILE." The other operations are described later. The NEXT query is:

ENTER File Name
(Press NEXT)
* (current file, if one is open)
> ddn:filnam.typ

Here you assign the new file name or refer to an existing file. The file name is stated in the standard RT-11 operating system format:

ddn:filnam.typ

where ddn is the two-letter device code and one-digit unit number (DL0 or DL1)

filnam is up to six alphanumeric characters of your choosing (A-Z, 0-9 only)

.typ is a three-character file type extension

If ddn: is not specified, the file is placed on the system default device, DK. DK is initially the same device from which the system is booted, normally DL0, but note that the default can be assigned to any device as described earlier in this

section. Also, it is important to know that RT-11 handles file access requests by way of routines called device handlers. These are only copied into memory from the system storage device when they are needed. If an RTA user specifies a file storage device whose handler has not been loaded, there may not be enough room for the handler and the RTA program in memory. This results in the error message "No room for Handler." If .typ is not specified, the type .DAT (for data) is assigned by default. The filnam portion must be entered. Upon NEXT the system proceeds to:

ENTER File Label
* (current label, if any)
> enter up to 24 characters as desired

This entry is optional and is provided for use with the MODAL analysis program which prints it in file directory listings. It is not used elsewhere within the 2515 signal analysis program. Upon NEXT, the system requests:

File Format

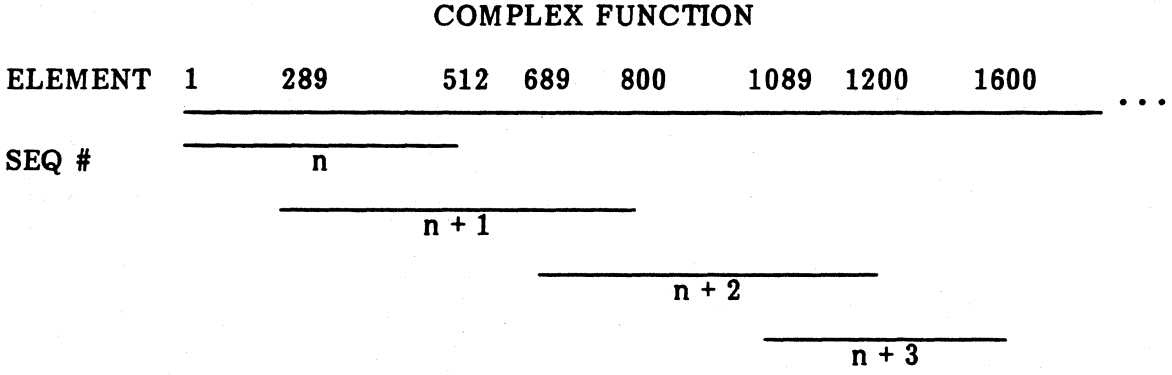
>* 1) MODAL
2) STANDARD

The MODAL format is provided for use with the MODAL program. It has the required format for a MODAL frequency response function ("H") file.

MODAL functions are stored in a block floating point format. Functions stored into a MODAL file are typically a complex data type such as a transfer function. If a real function such as an auto-spectrum is stored, the number of elements contained within each record doubles.

MODAL format stores functions in 512-element records. If higher resolution (more frequency lines) has been specified, this larger record is broken up into a series of overlapping 512-element records with successive directory sequence numbers.

A typical complex function storage in successive sequence numbers is shown below:



The STANDARD format is different from the MODAL file format in three specific aspects.

1. The record size can be varied.
2. Large frame data is not separated into subframes.
3. Data number format is preserved as floating point or integer.

STANDARD format is used to store floating point data (numbers) to provide greater accuracy. The entire function is always stored within one record and is not broken into overlapping 512-element records as is done in MODAL format.

The system next requests the amount of disk space to be reserved for the file with one of the following queries, depending on SDRC MODAL or STANDARD format:

ENTER # of Function Records (MODAL)

ENTER # of Storage Blocks (STANDARD)

For STANDARD files, the maximum number of records given total block size is determined internally by the program. The general file structure is the same as MODAL files. Four blocks per record is assumed. A two-word directory and 64-word function header is associated with each record. The space for the directory and function header is allocated within the file based on the maximum number of records calculated. If the actual data record is smaller than four blocks, the function header may be used up before all the data record space is filled up. Conversely, if the actual data is longer than four blocks, one may fill up with a few data records in the data area and some unused function header space. If the function header area is used up, "funct header space full" appears in the message area. If no data space is available, "no space to store funct" appears.

After records have been deleted, the reuse of the space works similar to a stack; that is, the last deleted record space gets reused first.

For MODAL files, enter the number of transfer function records you storing. The file size in terms of disk blocks is four times as great, plus several additional blocks for MODAL file header and directory information. Note that if you are using more than 512 lines of resolution for analysis, each transfer function requires more than one function record for storage.

At this point the system has all the information it needs to create a new file. Upon a NEXT command, it attempts to do so and briefly presents the message

Attempting to Open File

Normally after a few seconds, this is replaced with the message "Action SUCCEEDED" in the menu area, with a corresponding indication in the summary Previous Action item and the status item which indicates "File Status: OPEN."

If for some reason the file cannot be opened, you are presented with a "Previous Action FAILED" message. The reason for failure is shown in the system message area at lower left.

If the file name you have requested already exists on the disk, the operation has not yet failed. The following option menu appears:

File Name Already Used

>* 1) ATTACH TO EXISTING FILE
2) SELECT NEW NAME

"Attach" merely means re-open the existing file. This does not expand the file or chain between two separate files. If you select the new name option, the process described above is repeated, beginning at "ENTER File Name."

If the file format is flipped from one to the other, the current active file is closed with a message "File Format STD/MODAL Swapped." This prevents erroneous data storage or recall.

5.12.2 Opening an Existing File Under the TYPE Function

Function files are automatically closed by the RTA program whenever you exit from the RTA program or when he opens a new file. For the special case when you begin a project by running MODAL and selecting a project and function file and then exiting to the RTA program, the function file is automatically re-opened by the RTA program when it begins executing. Further, every time you exit to MODAL and back, the function file name is retained and the file is re-opened. Opening an existing file is performed under the TYPE function and the procedure is the same as described above for new files except that you will of course select item 2) SELECT EXISTING FILE, and the menu sequence ends with the request:

ENTER File Name
* (current file if one is open)
> ddn:filnam.typ

The default device DK: and default type .DAT are assumed if you do not enter them.

Upon NEXT, the system presents the message:

"Attempting to Open File"

This is followed in a few seconds by:

"Action SUCCEEDED" (or Previous Action FAILED)

When the file is opened, the summary at the right of the screen is updated to reflect the information about this new file. If the file cannot be opened, an error message appears at lower left. The most common is:

"filenam not found"

meaning that no file with the entered name exists on the device.

5.12.3 Deleting Records from a File Under the TYPE Function

After a file has been used to store function records, then individual function records, or a sequence of records, may be deleted from it. Deletions are performed only on the currently open file. If the file from which you wish to delete is not the currently open file, you must go through the TYPE function as described in the preceding paragraph to open the file that you want.

To delete records from the currently open file:

1. Press TYPE.
2. Select "1) USER FILE"
3. Answer the "Storage Grouping" query. The answer is irrelevant.
4. Select "3) DELETIONS FROM FILE"

The system then asks:

```
ENTER Range of Records
to Delete (n:m)
*
>_____
```

This entry is allowed to have the forms accepted in the DIRECTORY operations. See paragraph 5.12.8.

CAUTION

Deletions occur as soon as you press NEXT or ENTER.

To delete a single record, enter its number only and press NEXT. To delete a sequence of records, you may enter the first and last record number (inclusive), separated by a colon (:). If a range of record numbers is specified with other qualifiers, all the qualified records within the range are deleted. Upon NEXT, the system indicates:

Attempting to Delete Records

followed by the "Action SUCCEEDED" (or FAILED) message. Failure error messages appear at the lower left.

5.12.4 Increasing the Size of a File Under the TYPE Function

If a file becomes full, it can be expanded by the TYPE function. The file to be expanded must be the currently open file. If it is not open, you must go through the TYPE function as described in paragraph 5.12.2 using SELECT EXISTING FILE to open it and return through the TYPE function to select this operation.

To increase the size of an existing, currently open file, make selections from the following menu sequence:

1. Press TYPE. The system responds with

   Storage Mode

   >* 1) USER FILE
      2) PLOTTER SETUP

2. Select USER FILE and press NEXT. The system responds with

   Storage Grouping

   >* 1) STORE ONLY UPPER DISPLAY
      2) STORE ALL XFER FUNCTION

3. Select one of the options and press NEXT. The system responds with

   Storage Restriction

   >* 1) NORMAL
      2) SWAP REF & RESP

4. Select one of the options and press NEXT. The system responds with

   File Allocation

      1) SELECT EXISTING FILE
      2) CREATE NEW FILE
      3) DELETIONS FROM FILE
   >* 4) INCREASE SIZE OF FILE

5. Select INCREASE SIZE OF FILE and press NEXT. The system responds with

   Enter # of Blocks to Add
   * 0
   >_____

6. Before entering a number here, note that you must express the size of the increase in terms of disk blocks (one block being 256 16-bit words). For MODAL format files, each additional transfer function record requires four blocks. Also allow a few additional blocks for expansion of the header and directory portions of the file. Upon pressing NEXT, the system reports:

   Attempting to Open File

This is followed by the "Action SUCCEEDED" (or FAILED) message. Failure error messages appear at the lower left (system message area) to indicate "no space or directory full." If any other error occurs, an applicable message so indicates, such as "file renaming error" or "read or write pass eof."

The size increase operation is actually performed by creating a new larger file and then copying the data from the existing file into it. The old file's type is renamed as .BAC for back up. At this moment, "file type changed to BAC" appears in the message area. If an error occurs here, the file is closed and the message says so. Otherwise, the program goes on to open a new file with the type name .DAT. At this point, if no space is available for the size-increased file, the back up file resumes the extension .DAT and remains open. If successful, "open new file" shows up. At the time of copying data from old (.BAC) file to new file (.DAT), "COPYING..." blinks until completion. The deletion of the back up file is left to the operator. The deleted records (functions), if any, are squeezed out. This avoids the RT-11 operating system restriction that a file cannot be expanded unless there is empty space immediately following it.

5.12.5 Plotter Setups under the TYPE Function

The system supports three types of plotters, and more than one may be connected at the same time. Plot execution is controlled by the PLOT button at the lower right of the panel (located below OUTPUT SIGNAL), but before executing a plot you must use the STORAGE TYPE function to select the plotter and specify a pen speed.

Execute the STORAGE TYPE function as follows:

1. Press the TYPE button in the STORAGE group. The system displays

   Storage Mode

   1) USER FILE
   >* 2) PLOTTER SETUP

2. Select "Plotter Setup" and press the NEXT button. The system displays

   Plotter Type

   >* 1) SCREEN COPY
   2) HPGL
   3) TEK 4662

   "Screen Copy" refers to the standard option thermal printer (HP 2671G), which is connected to the rear panel PRINTER connector and is interfaced thorugh the 2515 display circuitry to print a dot-by-dot reproduction of the display on the screen.

   "HPGL" calls on plotting software for driving the family of Hewlett-Packard digital plotters that are controlled by the HP Graphic Language (HP-GL).

   "TEK4662" calls on plotting software for the Tektronix Model 4662 digital plotter.

3. Select the plotter type and press NEXT. The system displays

   ENTER % Pen Speed
   * (current setting)
   > _____

This parameter is for plotters that allow a reduction of their normal pen speeds. This is sometimes required for certain types of pens and for plotting on transparency media.

4. Enter a number from 1 to 100. 100 represents the plotter's normal maximum speed. The Tek 4662 without the multi-pen option does not allow remote speed selection. Fast and slow speed selection on plotter rear panel switch A must be used.

This completes the plotter setup. Plot outputs are directed to the selected plotter whenever you press the PLOT button, until the setup is changed.

5. Press NEXT. The system returns to the full display.

To abort a screen copy or digital plot, the PLOT button can be pressed a second time. However, a screen copy cannot be aborted until after the print head actually begins to move. There is typically a delay of about four seconds from the time that a screen copy is requested until the print head begins printing. During this time, a memory copy is being made of the current display. After this delay, you can resume interaction with the RTA program while the plot is proceeding. During a screen copy, the displays have a slightly degraded appearance because only one view plane is available for viewing. As soon as the screen copy is completed, the displays return to their normal form.

In order to clarify what action is taking place, the PLOT button produces a normal panel button beep when a plot is initiated but creates a 'warbling' sound when a plot is aborted.

Unlike the screen copy plots, the digital plotter operations interrupt the execution of the RTA program. The displays are re-drawn very slowly (the same rate at which they are transmitted to the digital plotter) and all panel buttons except the PLOT button are ignored while the plot proceeds. During this time, the program can still be interrupted by typing ^C at the keyboard. The RTA program does not produce digital plots of state banners or file directories.

For multi-pen plotters, three pens are used. These should be the first three pens. Single pen plotters are not affected. It is not necessary to select the first pen before beginning the plot.

5.12.6 Executing a Storage Operation with the STORE Function

The STORE button actually initiates storage of displayed data or panel setups into disk files or the temporary memory buffers (which, in fact, are actually in a pre-defined disk file). To store into your disk file, you must have previously defined the file under the TYPE function, and the file must be open when you attempt to STORE. Storage into the temporary memory buffers is controlled completely under this STORE function as described below and does not require any previous actions. "Storage" to a hard copy plotter does not involve this STORE function, and is controlled by the TYPE setup and the PLOT button.

1. To execute a storate operation, press the STORE button. The system responds with

Storage Type/Destination

>* 1) DATA to FILE
2) DATA to MEMORY
3) PANEL to FILE
4) PANEL to MEMORY

Descriptions of the selections are contained in sub-paragraphs 5.12.6.1 through 5.12.6.4.

5.12.6.1 Data to File. The Data to File selection stores data into the currently open user disk file. If the resolution is greater than 512 lines, the function occupies more than one record space in the file and MODAL sequence numbers are assigned automatically. At the present time, the RTA program contains no provisions for re-assembling these separated records, so they must be recalled and displayed separately. The storage of data frames longer than 512 lines is always handled in such a way as to provide at least one block (128 complex lines) of overlap coverage between adjacent records. This is essential for any parameter estimation or curve fitting procedures applied to the stored data. Upon selection of Data to File if STORE ONLY UPPER DISPLAY grouping was previously selected, the system requests:

ENTER RES COORD, REF COORD,
and SEQ #
* (current resp, ref from display, and seq # 0)
> _____

This query allows modification of the location coordinates in MODAL analysis surveys. These parameters comprise the directory entry for the current upper display function to be stored. The sequence number allows storage of multiple functions having the same coordinates. To revise the coordinates before storage, enter the change now. If the query is not answered (i.e., just press ENTER or NEXT), the assigned coordinates are those from the display, which in turn were assigned to the input channels in the MEASUREMENT SETUP. The precise way these coordinates are used is governed by the STORAGE LABEL selection described in paragraph 5.12.1.

If 2) STORE ALL FUNCTIONS is selected in the storage grouping menu (see page 5-72), a different coordinate modification menu appears here (like the one shown on page 5-21). The next menu allows for the modification of sequence numbers. If the file is in MODAL format and all large frame functions are stored, each function begins with the same sequence number.

Under this multiple storage mode, for auto channel acquisition, the active channel is looked up and the data in those channels are stored. If CROSS channel is selected, and the displayed function is a dual-channel function (e.g., transfer function), then the active channel pair is looked up and data is stored accordingly; if

the displayed function is a single-channel function (e.g., auto spectrum), then a table of active single channels is set up and data storage is according to this table, so that no data is repeatedly stored.

Immediately upon ENTER (or NEXT), the system attempts to write the data to file and presents the message:

Attempting to store

This is followed by "Action SUCCEEDED" (or FAILED). Failure messages are presented at the lower left. The most common reasons are:

file not found
AV TF function only
no space or directory full

If the STORE ALL TRANSFER FUNCTIONS grouping has been previously selected, the next menu to appear is the same one that appears to allow MODAL coordinate assignments under the CHANS button (see paragraph 5.8.3.2). Since multiple functions are stored, you are invited to modify any or all of the coordinate labels in case they have changed since the last set of functions was stored. Simply pressing NEXT leaves the coordinate labels (and the directory entries they produce) unchanged. The next menu to appear requests you specify a sequence number only. This allows storage of a distinguishable set of functions having the same coordinate identifiers.

In the event of resolution greater than 512 lines, the sequence number specified is the starting number for the series of ascending sequence numbers.

5.12.6.2 Data to Memory. The Data to Memory selection stores the data into the entered memory buffer. It also prompts for RES COORD, REF COORD, and SEQ # as described above.

ENTER Memory Buffer #
(Press NEXT)
* 1

>———

There are 16 data buffers (numbered 1 through 16) into which you may store averaged data from the upper display. Storage into these buffers always occurs one function at a time and is unaffected by the 'Storage Restriction' menu. Storage obeys the reference-and-response-swapping selection. Data stored into a buffer which already contains data wipes out the previous data. No warning message is provided.

In order to use disk space in an optimal manner, each buffer is only 20 blocks long. For transfer functions, therefore, the maximum block size that can be stored in a memory buffer is 1280 lines. A larger block size results in an error, and an error message appears.

Data stored into the memory buffers is not automatically displayed when MEM is selected as the data source. Data is displayed only when the data is recalled, as it is done for functions stored in your file. Functions containing large

numbers of lines are not broken up into a series of sequence numbers as they are when stored into a MODAL format user file. The floating point data is not converted to TSL format.

This data is actually stored in a data file called 'DAT2.SCR.' This file is retained when the power is switched off. If you delete or rename DAT2.SCR, the RTA program creates a new file named DAT2.SCR when it next begins executing.

5.12.6.3 Panel to File. The Panel to File selection stores the current panel setup into an open user file. This allows the setup information to be stored in the same file as the data for more complete documentation. Note that only one panel setup per file is allowed. 8100Y+ is used for reference and response coordinates to designate the panel in your disk file. When the directory of the file is listed, the panel record is labeled as "panel related."

5.12.6.4 Panel to Memory. This selection stores the current panel setup into one of the 15 available panel memory buffers. Storing panel setup information into memory allows setups to be recalled without the need to manually restore all the measurement setup parameters. The display selections are stored although the display is always forced to REAL TIME upon panel recall. The AVG and REAL TIME function scaling and format selections are stored. Most storage parameters are stored so that once your file is re-opened storage continues as it did when the setup was saved. However, your file is not automatically opened when the panel is recalled. AVG data is not preserved when panel recall is performed. You are asked for the buffer number by:

```
ENTER Memory Buffer #
* 0
> _____
```

Enter a buffer number from 1 to 15. Note that the default buffer 0 shown in the query is illegal. Buffer 0 is reserved for the fixed parameter set used in the checkout test. You can recall from it but not store into it. Also note that buffer 16 is used by the system to automatically store the current panel setup when you return to RT-11 or exit to MODAL or MODAL PLUS. It may be recalled only. This most recently stored panel setup buffer is recalled each time the RTA program begins to restore the state of the system when it was exited. This panel setup information is stored in a data file called PAN2.SCR which is recreated if deleted or renamed by you.

5.12.7 Recalling Stored Data with the RECALL Function

The RECALL function provides the reverse of the four STORE operations, to recall data records or panel setups from your files or the temporary memory buffer file. To recall from your file, the file must be currently opened by the TYPE function. Pressing the RECALL button presents the following menu to select one of these operations:

RECALL

Recall Source/Type

>* 1) DATA from FILE
2) DATA from MEMORY
3) PANEL from FILE
4) PANEL from MEMORY

All recalled functions are displayed as MEM data source. The display of MEM data is very similar to the display of AVG data. In addition to the fact that the MEM light is illuminated while recalled data is being displayed, the prefix, 'ME' appears in front of the function type label. Also, you will notice that certain of the display menu interactions are slightly different when the displayed data is MEM data rather than AVG data. For example, the FUNCTION menu is not provided for the obvious reason that it is not possible to alter the function type of recalled data. However, the FORMAT menu which normally follows the FUNCTION menu is provided for recalled data, and it is the first menu to appear when the FUNCTION button is pressed while displaying MEM data. There are two MEM data source buffers; one for the upper and one for the lower display. This allows comparison of two recalled functions.

Note that the units may be changed from VOLTS to dBV or EU to dBEU but changes from EU to V are not allowed. Changes in normalization are allowed for recalled functions.

5.12.7.1 Data from File. The Data from File selection recalls one function record from the currently open file. The data is placed in the MEM display buffer which is accessed by the MEM button. The display selection is forced to MEM to display the recalled data. The MEM button also replaces the AVG or REAL TIME data display with the most recently recalled data. Two additional buffers in DATMEM.SCR are used for this purpose: one corresponds to the upper display, the other to the lower display. The data in the buffer is simply a copy of data recalled through the RECALL sequence. If the recalled data is greater than 20 blocks, the excess part is not copied in this buffer type. But, for MODAL format, the recalled data is always 4 blocks at a time, so no problems occur. The excess part is not seen by pushing MEM, but is seen only through RECALL.

Upon NEXT, the system requests the specific data record with the query:

ENTER REC #, SEQ #, RES COORD,
and REF COORD
*
> _____

You may enter any one or all or a combination of these parameters to specify the particular record you want. Commas must be used to account for null arguments that you do not use. Record number alone is sufficient and usually simplest. If you enter an ambiguous parameter (for example a reference coordinate only) for which several records may exist, the system returns the first record in the file that satisfies the parameter. If you enter a non-existent combination, the system indicates "Action FAILED" and returns the message "record ____ does not exist." Use the DIR function to check the file content.

There is a particularly advantageous interaction between the ENTER button and the RECALL function. For the RTA program, the general definition of the ENTER button response is 'execute the selected action but do not proceed to the next menu.' This allows a succession of entries to be applied without re-initiating the entire menu sequence that led to the current menu. In the case of function recall, it is possible to recall a series of functions and view them in the upper display while retaining the function recall menu in the lower display. This allows rapid review of a large number of stored functions with a minimum number of button entries. Whenever NEXT is used following a function request, the recalled function appears as a full screen display and the RECALL function menu is erased.

5.12.7.2 Data from Memory. Upon NEXT, the system requests:

```
ENTER Memory Buffer #
 * 1
>_______
```

Recalling data from memory places the recalled function into the upper MEM display buffer and forces the MEM data source display. As noted in paragraph 5.12.7.1, there are some restrictions which apply to manipulations of this recalled data. The display changes specifically disallowed are:

a. V to EU units
b. Function type
c. Window type
d. Channel number

5.12.7.3 Panel from File. After selection of Panel from File, the stored panel setup is restored. If no setup has been stored in the file, the message "Pnl not in user file" appears in the lower left corner.

5.12.7.4 Panel from Memory. The Panel from Memory selection recalls panel setups from the temporary memory buffers. The system requests:

```
ENTER Memory Buffer #
   * 0
>_____
```

Enter a number from 0 through 15. Buffer number 0 is reserved for the checkout test setup and may be recalled but not written into. Buffer number 16 is used for EXIT to RT-11 or chaining to MODAL. It is the default panel and is read in at the program start up time.

5.12.8 DIR Function, Directory Operations

The directory function provides listings of the function record content of the currently open user disk file or of the temporary memory buffers. Pressing the DIR button presents the following initial menu for these operations:

DIR

Directory

```
>*   1)   User Disk File
     2)   Memory
     3)   Memory Panel
```

5.12.8.1 User Disk File. A file must have been opened under the TYPE function to obtain a directory. The directory prints a listing of the function records in the file in record number order. The directory includes the function frequency (x-axis) range, sequence number, response and reference coordinates, channel ID label, and date and time of creation. This selection is followed by the query:

```
ENTER
REC #, SEQ #, RES COORD,
and REF COORD
 *
> _____
```

If you do not answer (i.e., just press ENTER), the system prints a full directory of every record in the file. However, since a file frequently may contain hundreds of records, this query allows you to selectively obtain a directory of only certain sets of records of interest. You may enter any one or all or a combination of these parameters. Furthermore, for the REC # you may specify a range by entering first and last record numbers separated by a colon (:) character. The system lists all records that satisfy a parameter, but note that the parameters are logically ANDed; that is if you enter more than one, the directory includes only those records that satisfy all. For example, if you enter:

```
40:150,,,2X+
```

the system lists all records that have reference coordinate 2X+ and that also are in the range of record numbers 40 through 150. If the list is longer than a full page, the listing is suspended and PRESS NEXT appears in the system message area. Pressing NEXT resumes the listing. Pressing any other key aborts it.

5.12.8.2 Memory. The directory of data memory buffers lists all 16 buffers and includes the same information as disk file directories.

5.12.8.3 Memory Panel. A list of 15 buffers is displayed in the directory lines. NCHAN refers to the number of channels of the hardware setup at the time the panel was stored. If NCHAN is different from the actual hardware (i.e., memory board has been added or removed since the panel data being stored), a warning of incompatible panel is issued and some of the channel set up may not be preserved.

5.12.9 Panel Command Sequence, Storage and Recall

The keyboard must be used to store a panel command sequence in RTA program. Up to ten files (command sequences) numbered 0 to 9 can be stored. The file is named

seqX.~~pnt~~
PNL

where X represents a number between 0 and 9.

To represent each command, the two-letter codes entered at the keyboard are the same codes listed in paragraph 5.14.

One exception to this is the use of a <CR> (carriage return). The <CR> is entered into the file as a ')'. Every 40 characters, a <CR><LF> is placed into the file and consequently is not recognized.

Additionally, spaces are not recognized as commands but are used if text is being entered into a menu.

To initiate storage of a command sequence:

1. At the keyboard, press $. The display prompts for the sequence number that names the file.

2. Press a number (between 0 and 9) and then press ENTER. This names and creates the file. If the file already exists, the following prompt appears.

   ARE YOU SURE?

3. To indicate a YES answer, press Y, then ENTER. Any other key means NO.

   At this time, ASCII representation of all used keys are placed in the file. If the number of characters exceeds one block (256 words), the file is extended one more block. There is no limit to the size of the command file provided there is sufficient disk space. If the sequence goes beyond one block, an EXTENDING FILE prompt appears.

4. To end the sequence and close the file, press $.

   This is acknowledged by the displayed message

   SEQUENCE ENDED

5.12.9.1 Editing the Command File. The command file can be edited by using an RT-11 editor. The commands can be entered using the same characters that are entered on the keyboard. For example:

DY means Y SCALE menu
MF means FREQuency menu
< represents a down arrow
> represents an up arrow
@ represents DELETE
) represents NEXT <CR>

Comments are enclosed in quotations. Note that text strings cannot contain $,), or ;. These characters have specific command meanings.

5.12.9.2 Recalling the Command File. To recall a sequence, press the ROLL button or ↶ on the keyboard. This is followed by a prompt for a sequence number.

Press # (between 0 and 9) ENTER.

The corresponding file is opened and each character is put through the same code used in the keyboard entry.

Note that pressing the RECALL panel sequence button while recall is processing results in an abort.

5.13 OUTPUT SIGNAL FUNCTION

The following output signals are available from the OUTPUT SIGNAL BNC on the front panel:

Sine Wave	Sine wave is available with a resolution of 1 Hz. In ZOOM, the frequency is restricted to be at the band center but in baseband the frequency of the sine wave is user selectable.
25 kHz Random	A pseudo-random sequence generator creates a signal which is output at the 64 kHz sample rate and repeats every 2**24 samples. The bandwidth of this signal is fixed at 25 kHz. Unlike the other random signal selections, 25 kHz random produces a signal whose amplitude and spectral distribution are completely independent of the acquisition selections.
Non-Repeating	The bandwidth of this random signal is selected to yield the maximum amplitude within the passband of the measurement. This means that if ZOOM is used, the random sequence is reduced in bandwidth to match the measurement bandwidth and is then translated by the ZOOM center frequency.
Repeating Pattern	This type of excitation provides repeating psuedo-random signals. Twenty-two sequences are available. These sequences have approximately the same spectral properties as the Non-Repeating Signal.

Both repeating and non-repeating patterns can be gated by a user specified burst duration. The output signal is controlled via menus accessed by pressing the OUTPUT SIGNAL button on the lower panel.

5.13.1 OUTPUT Signal Button

The OUTPUT SIGNAL button allows the selection of the signal type, sine wave frequency, and adjustment of the signal amplitude. Pressing the OUTPUT SIGNAL button causes the following menu selections to display:

```
Output signal

>* 1) OFF
   2) SINE WAVE
   3) RANDOM
```

When ZOOM is enabled the sine wave frequency is restricted to the ZOOM center frequency since this signal is actually generated by the ZOOM twister modulation circuitry. If you are in ZOOM acquisition mode, this parameter is automatically set to the ZOOM frequency. You are not allowed to move the frequency since this corrupts the data. If ZOOM is set, the bandwidth menu (below) does not appear.

The first selection, 1) OFF, turns off all random signals. Choose either 2) or 3), press NEXT, and the following menu appears:

```
Output Signal

ENTER the RMS level of                  Signal Level:  4.5
Output Noise (0-1.0V)  Random           Type:  RANDOM
             (0-4.5V)  Sine             Bandwidth:  Acq. Band
*  .666                                 Random Type:  Repeated
                                        Pattern #:  5
                                        Burst Window:  OFF
>                                       Burst Duration:  20%
```

The maximum levels are different for the two signal types. They are restricted to be equal to or less than 4.5 volts for the sine wave and 1.0 volts for random signal types.

When RTA begins, the signal type and sine wave frequency parameters are set to values they had when the program was exited. The level parameters are initialized to 0.0 volts to avoid transients in externally connected equipment.

If 2) SINE WAVE has been selected, enter the level and, press NEXT to arrive at the next menu.

```
ENTER Sine Wave Frequency
with 1 Hz Resolution
*  5000

>
```

Enter the desired frequency and the sine wave signal appears.

If 3) RANDOM has been selected, enter the level and press NEXT.

Output Signal Bandwidth

```
>* 1) ACQUISITION BANDWIDTH
   2) 25 kHz
```

If 2) 25 kHz is selected, the next menu is the Burst Window menu. If 1) ACQUISITION BANDWIDTH is chosen, the signal repetition menu appears.

Random Signal Type

```
   1) NON-REPEATING
>* 2) REPEATED PATTERN
```

Selection 1) NON-REPEATING, specifies that the hardware random signal generator is used for the output signal. This signal is adjusted to have a power spectrum that is roughly constant throughout whatever data acquisition bandwidth the RTA program is currently set to. It does actually repeat, but the repetition period is so long (approximately 20 million samples) that it can usually be ignored.

Selection 2) REPEATED PATTERN, specifies that an output signal be calculated and stored in computer memory for repeated use. The output signal frame size is chosen to match the acquisition frame size currently in use. If the burst window (see below) is set to "Off", the output signal repeats with a repetition interval equal to the duration of the acquisition frame.

The advantage of this selection is that the spectrum of the test signal consists of a set of narrow lines that fall exactly on the analysis lines of the Fourier transform. As a result, Fourier leakage is minimized.

You should be aware that there are disadvantages to this selection, however. One of these is that the harmonic content of the repeated signal is significantly higher than that of the non-repeating signal. Another is that the RTA program may run out of memory because of the need to retain a copy of the output signal during acquisition. This limitation appears for large frame sizes or large numbers of channels. A third disadvantage is that, if the system being measured is non-linear, repeatedly averaging the response to the same signal fails to smooth the effects of the non-linearities. In order to alleviate this problem, the next menu is provided.

```
ENTER the random
Pattern # (1 to 22)
* 5
>
```

The patterns numbered 1 through 20 are statistically equivalent to each other. They are provided as a means of investigating the linearity of the system under test. If the system is linear, the measurement of its transfer function produces the same results for any of the twenty patterns. If discrepancies appear when different patterns are used, the system being tested is exhibiting non-linear behavior. A linearized estimate of the system transfer function can be obtained by averaging together measurements made using several different patterns.

Patterns 21 and 22 are "chirps" rather than random sequences. The ratio of the peak value to RMS value of a chirp is approximately 1:4. The peak-to-RMS ratio of the random signals produced by the RTA program is more than twice this amount. As a result, chirp signals may be used when measuring systems with limited dynamic range.

The next menu sequence allows a selection of burst window.

```
Burst Window

   1) OFF
>* 2) RECTANGLE
   #) HANNING
```

Selection 3) provides a random signal with Hanning filter applied. If 2) is selected the following menu appears:

```
ENTER the Burst Duration
* 20
>
```

REPEATED or NON-REPEATED random excitation provides a burst of excitation. The duration of the burst as a fraction of the acquisition frame is specified by the number (in %) entered.

5.13.2 Triggering With Output Signals

If the burst window is switched off, the output signal is continuous and independent of any trigger selections. With the burst window on and manual-arm triggering selected, an outout burst is produced every time the ARM button is pressed.

When the query, ARM? appears at the bottom of the screen, you may press the ARM button. This arms the triggering process and initiates the output burst. If a trigger signal is not detected, the trigger remains armed and you can produce additional output bursts by pressing the ARM button again.

When the burst window is switched on and acquisition pre-triggering has been selected, the sum of the pre-trigger interval and the output burst duration should not exceed the duration of the data frame. If this condition is not met, the trigger is not enabled before the burst begins and part of output signal occurs before the data frame.

5.13.3 Over-run Condition: Acquisition Rate Limitations Resulting From DMA Output

When you select either Repeated Pattern or Burst Window, the output signal process makes use of a memory buffer from which the 2501 microprocessor transfers the output data to the output port. Because the microprocessor also participates in the data acquisition processing, the maximum attainable acquisition rate is diminished when using these types of output signal. Failure to complete the

requested acquisition and output processing in the required time results in the message "ORUN" being written onto the screen adjacent to the over-load indication box at the lower right corner. In order to correct this situation, you should either select a smaller number of channels or diminish the acquisition bandwidth. Other factors that affect the attainable maximum acquisition rate include triggger selections, frame size, and auxiliary delay.

5.14 PANEL TO KEYBOARD MAPPING

Most menu and immediate type buttons on the panel are mapped to two-letter commands which are used by the other control interfaces. For keyboard operation, some single-key commands to control the cursor and menu entry are provided.

Panel Button	Keyboard Character Command
Display	
REAL TIME	DR
AVG	DA
MEM	DM
NEXT CHAN	DN
SINGLE	DS
DUAL	DD
OVLY	DO
EXCHNG	DE
FUNCTION	DF
X SCALE	DX
Y SCALE	DY
CHANNEL	DC
UNITS	DU
BLOCK MATH	DB
Acquisition	
RUN	AR
CONT	AC
ARM	AA
HOLD	AH
Cursor	
<	<- Key
>	-> Key
MAIN	CM
HARMONIC	CH
SIDEBAND	CS
REF SET	CR
ABS/REL	CA
STORE	SC
RECALL	RC
> <	< Key
< >	> Key

	Panel Button	Keyboard Character Command
Entry	(Most of these buttons have a counterpart on the keyboard and so they are passed through as ASCII without need for mapping.)	
	0 thru 9	0 thru 9 keys
	A thru Z	A thru Z keys
	EE	E
	CLR	!
	DEL	Delete
	ENTER	(backslash)
	-	-
	+	+
	x	*
	÷	/
	SPC	Space bar
	ROL	↶
	+/-	'
	=	=
	SHIFT	(Not required since keyboard has Alpha)
	:	:
	,	,
Menu Control		
	↑ (Up arrow)	↑ (Up arrow)
	↓ (Down arrow)	↓ (Down arrow)
	NEXT	Carriage return
Storage		
	TYPE	ST
	DIR	SD
	STORE	SS
	RECALL	SR
Measurement		
	INPUT CHANS	MC
	INPUT LEVEL	ML
	TRIG	MT
	FREQ	MF
	AVERAGE	MA
	WINDOW	MW
	MODE	MM
	STATE	MS

Panel Button	Keyboard Character Command
CRT Control	
CRT BRT	Provided by keyboard SETUP arrows
Output Signal	
OUTPUT SIGNAL	OS
Plot	
PLOT start	^P (Where ^ is CTRL, press ^ and P
PLOT stop	simultaneously.)

Note that the following ASCII characters are not allowed in strings since they are used for immediate control:

←
→
↑ (Up arrow)
↓ (Down arrow)
CR (Carriage return)
LF (Linefeed)
>
<
ς
'

It is sometimes useful to supply additional annotation to the display before a plot is made to the screen copy device. This can be done with the terminal set to local mode via the SETUP key. However, since the RTA program turns off the terminal cursor it must be turned on again by typing ^A before entering the local terminal mode.

As is common with most RT-11 system programs, the program may be aborted by typing ^C twice. Note that none of the setup information is preserved if the program is stopped in this way.

SECTION VI

OPTIONAL EQUIPMENT
GENERAL INFORMATION

This section will provide general information for available optional equipment for the GR 2515 system and is presented as a courtesy to GenRad customers. Pertinent information currently available is included at the time of this printing. Information relative to optional equipment may be inserted in this section by the customer for easy access.

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6.1 EXTENDED MEMORY (PN 2515-9404) INSTALLATION

Average time required to install the extended memory is one-half hour.

a. Visually inspect the extended memory board. Verify that memory jumpers are intact.

b. Remove top cover of system by removing the six pan head screws on the sides. Carefully lift cover up and off.

c. Remove the 256 kilobyte memory board from slot 5.

d. Install extended memory board into slot 5. Verify it is properly seated.

e. Reinstall top cover and six screws.

f. Test with microcode diagnostic using M1-M5.

g. Check system operations using RTA program, PN 2515-0650.

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6.2 CHANNELS 5-8 (PN 2515-9401) AND ADDITIONAL CHANNELS (PN 2515-9402) INSTALLATION

Average time required to install channels 5-8, 9-12, and 13-16 is one-half hour.

a. Remove top cover of system by removing the six pan head screws on the sides. Carefully lift cover up and off.

b. Install channels 5-8 board in slot 12.

c. Install channels 9-12 board in slot 13.

d. Install channels 13-16 board in slot 14.

e. Verify that each circuit board is properly seated.

f. Reinstall top cover and six screws.

g. Connect BNC (expansion chassis) box to connectors J3 through J8 for channels 5-16. See paragraph 6.3 for instructions.

h. Test operation by using RT-11 diagnostics, PN 2515-0691, ANLTST test.

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6.3 CHANNEL EXPANSION CHASSIS (PN 2515-3005)

The channel expansion chassis, also referred to as the BNC distribution box, is provided with the addition of channels 5-8 and accommodates up to sixteen channels. Channels 1-4 are provided on the expansion chassis and are connected in parallel with the front panel input BNCs.

The chassis is connected to the rear panel at the multiple coax connector labelled INPUTS.

Care should be exercised when installing this connector. The pins may become bent when the knurled fasteners are tightened if the connector is not aligned squarely.

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6.4 LARGE SCREEN MONITOR (PN 2515-9403) INSTALLATION

Install the monitor by connecting the supplied BNC coax cable from the real panel BNC marked VIDEO to the monitor rear BNC connector.

Adjustments for brightness and contrast are provided on the rear of the monitor.

A separate AC power cord is supplied.

Before turning power on, assure that the rear panel switches are set for the proper line voltage. Line voltage information is contained in Section II, paragraph 2.7.2.

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6.5 PRINTER/PLOTTER

6.5.1 Printer Installation

To install the printer, attach the supplied cable to the rear panel of the printer and to the 2515 rear panel connector marked PRINTER.

Consult the Printer Manual for instructions for installing the wire fanfold paper quide and the paper.

A separate AC power cord is supplied. Before turning power on, assure that the monitor is set for the proper line voltage. Refer to Section II, paragraph 2.7, for line voltage information.

Once installation has been accomplished, press the TEST button on the printer front panel to run a self-test.

6.5.2 Plotter Installation

Programs written for the 2515 system will support one or both of the following digital plotters:

Tektronix 4662 Plotter (with or without multi-pen option)

Hewlett Packard Plotters (Those supporting HP-GL and RS-232 I/F; HP 7470A and 7475A plotters are suggested for use with the 2515 system.)

Digital plotter commands are issued through the RS-232 serial port located on the 2515 rear panel labelled AUX REMOTE. Note that IEEE bus access to the plotters is not provided.

It is necessary to use a null modem cable to connect the 2515 to either of the two plotter types. This cable serves the purpose of interchanging the transmit and receive lines connecting the two devices. Without it, the 2515 transmit line will be connected to the plotter transmit line and no communication will occur.

Connect the HP 7470 by plugging the null modem cable into the HP interconnect cable on the side labelled COMPUTER.

Connect the Tek 4662 by plugging the null modem cable into the rear panel connector labelled COMPUTER.

6.5.3 Operation

The printer/plotter supports three types of hardware operations:

a. Screen Copy. The screen image is reproduced on the plotter as a pixel map of the screen. Details are provided in Section III, paragraph 3.3.2.

b. Autoprint. Terminal text is also echoed on the printer when the autoprint mode is enabled. See Section III, paragraph 3.3.5.

c. Line Printer. The printer will also serve as a line printer for the system. Directories and listings which are directed to the LP: (line printer) device in Rt-11 will appear on the printer. Consult the Printer Manual if special setup control sequences are desired.

6.5.3.1 HP 7470 Switch Setting. The switch which controls the RS-232 interface characteristics is located next to the serial connector at the back of the plotter. This switch should be set to 000010111. The setting selects a baud rate of 1200, disables parity checking, and sets the plotter to power up into the "programmed on" state. For the RTA program, the setting for the Y/D switch does not matter. Function plots for the MODAL Program, however, require that the switch be set to D.

6.5.3.2 Tektronix 4662 Switch Setting. Set the switch located on the Tek 4662 rear panel to 2-2-2-3. This setting selects copy-mode-scaling, no-parity-checking and 1200 baud.

6.5.3.3 Plotter Speed Setting. Programs supporting the digital plotter will usually allow selection of plotting speeds. Reduced plotting speed can be useful for improving the quality of the plots and for directly drawing transparencies. The HP and Tek 4662 plotters, with multi-pen options, will allow selection over a wide range of plotting speeds under program control. Without option 31 (Tek's multi-pen option), the plotter can only be switched from fast to slow by resetting switch A located on the plotter rear panel.

6.5.3.4 Pen Selection. Programs which attempt to use multiple pens will function properly on a single pen plotter. For multi-pen plotters, the pens must be loaded into the first pen positions. It is not necessary to manually select the first pen before beginning the plot.

6.6 RACK MOUNT KIT

The GR 2515 system is installed in the rack mount kit using the drawings supplied with this option.

APPENDIX A

This appendix contains the following RTA program menus and displays obtained by pressing pushbuttons on the front control panel.

Group		Page
Display Group 1	System Initialize	A-2
Display Group 2 DISPLAY	A. DUAL	A-3
	B. EXCHNG	A-3
	C. OVLY	A-4
	D. NEXT CHAN	A-4
	E. SINGLE	A-5
	F. FUNCTION/REAL TIME	A-5
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Display Group 3 CURSOR	Cursors	A-69
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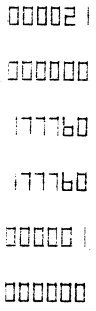
DISPLAY GROUP 1

System Initialize

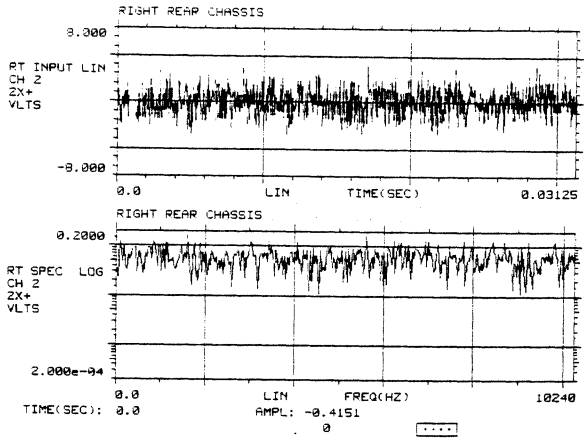


```
 DEV>
RT-11SJ(GR0)V05.00


2515 System
Prom Revision - 1-Nov-83
Channels - 1-4
Memory Size:  128k Words
19-Jan-84  Change Date? --->
Please Enter The Time:
00:00:00
```

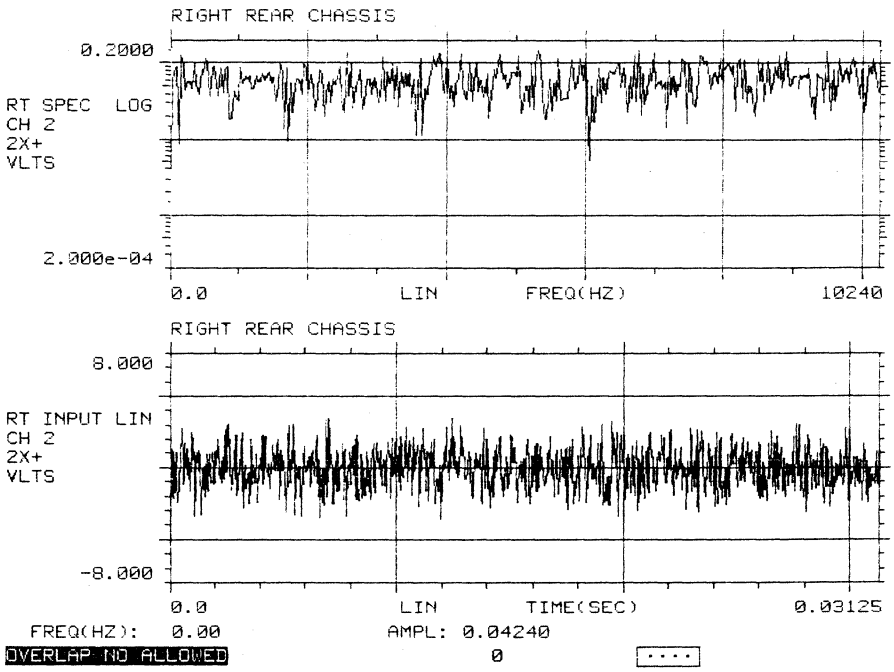
DISPLAY GROUP 2

DISPLAY Group Pushbuttons, Typical Displays and Menus

A. DUAL Pushbutton



B. EXCHNG Pushbutton

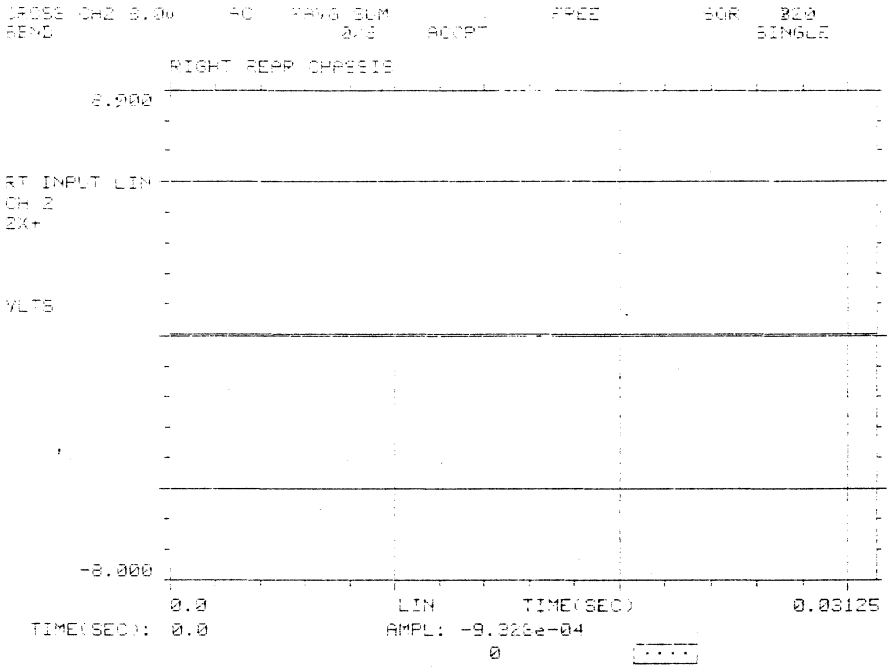


C. OVLY Pushbutton

Not available in this version.

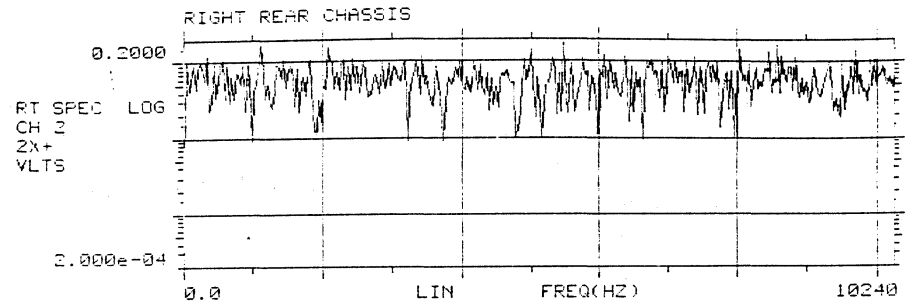
D. NEXT CHAN Pushbutton

E. SINGLE Pushbutton



F. FUNCTION Pushbutton, Menus and Typical Displays (REAL TIME)

1)



Function

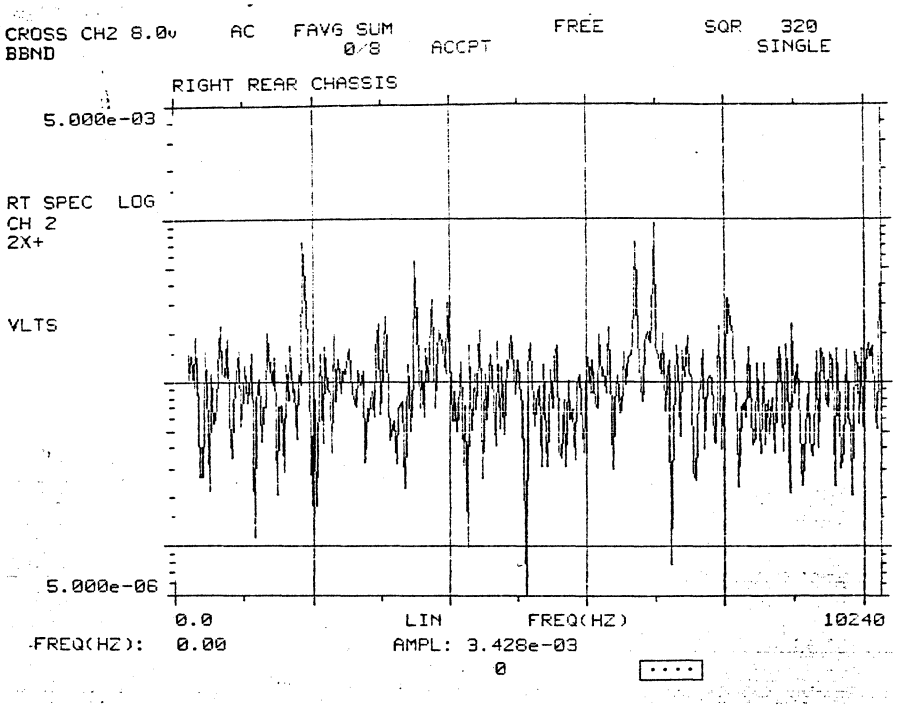
function: SPECTRUM

>* 1) SPECTRUM
2) TIME
3) LEVELS
4) ORBITxx

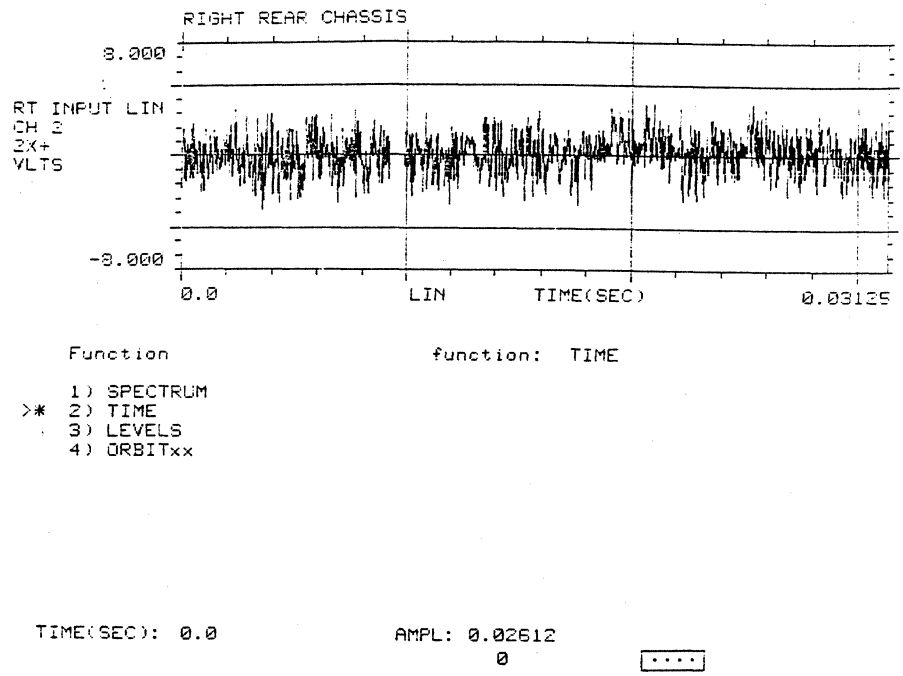
FREQ(HZ): 0.00

AMPL: 7.825e-03
0

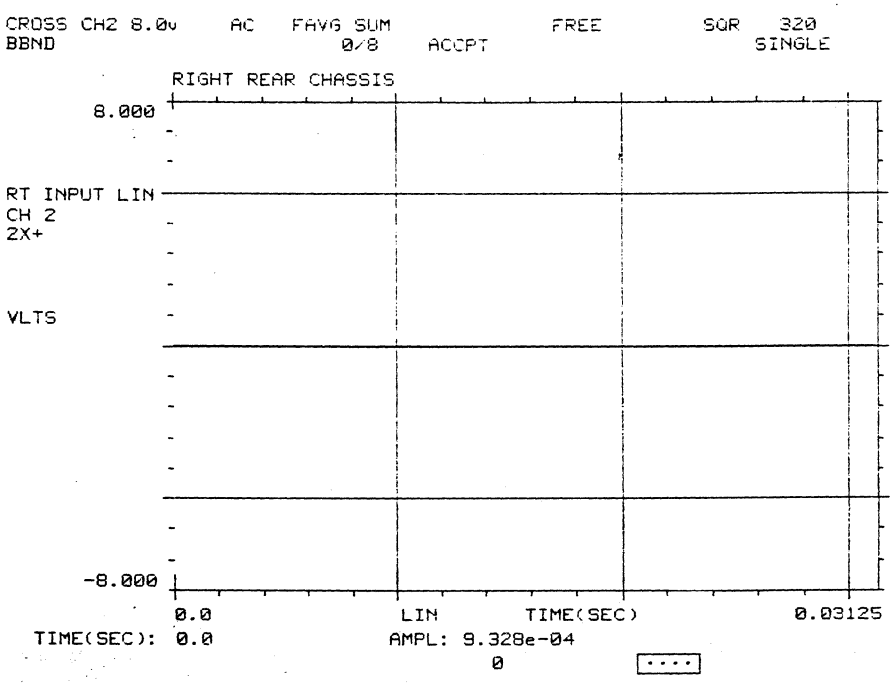
1a)


CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BBND 0/8 ACCPT SINGLE
RIGHT REAR CHASSIS
5.000e-03
RT SPEC LOG
CH 2
2X+
VLTS
5.000e-06
0.0 LIN FREQ(HZ) 10240
FREQ(HZ): 0.00
AMPL: 3.428e-03
0

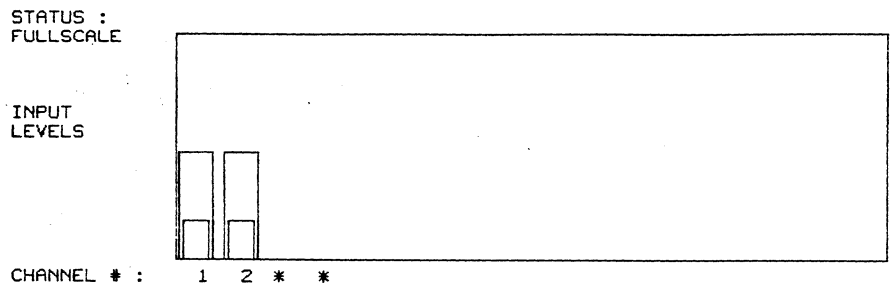
2)


RIGHT REAR CHASSIS
3.000
RT INPUT LIN
CH 2
2X+
VLTS
-3.000
0.0 LIN TIME(SEC) 0.03125
Function
function: TIME
1) SPECTRUM
>* 2) TIME
3) LEVELS
4) ORBITxx
TIME(SEC): 0.0
AMPL: 0.02612
0

2a)



3)

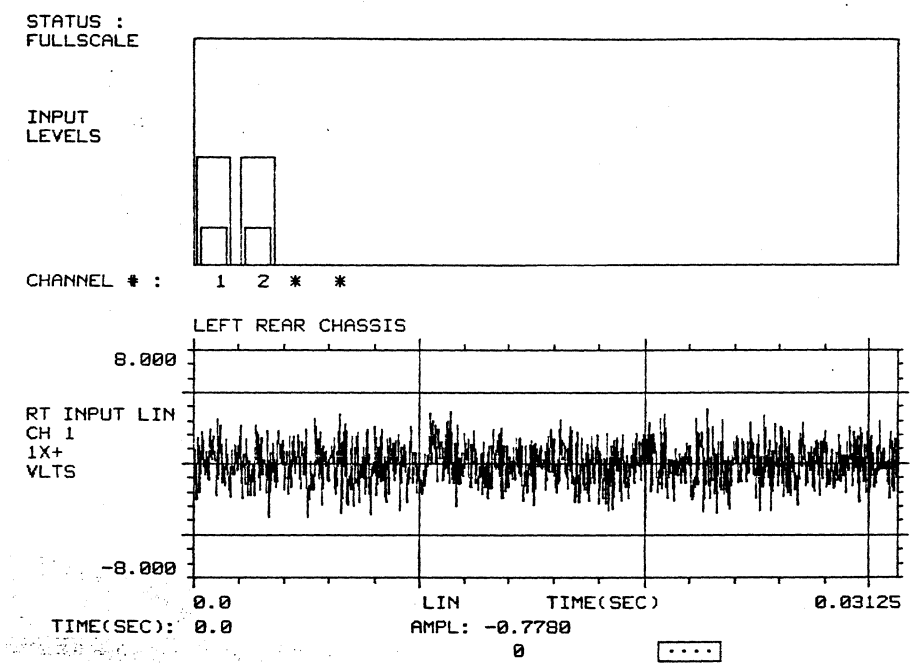


Function

1) SPECTRUM
2) TIME
>* 3) LEVELS
4) ORBITxx

function: LEVELS

3a)



G. AVG Pushbutton

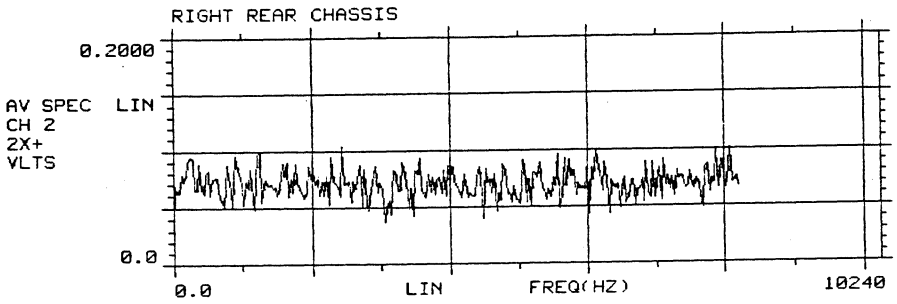
```
AVERAGED FUNCTION IS NOT AVAILABLE

requested RESPONSE channel is  2

requested function:  SPECTRUM
```

H. MEM Pushbutton

```
MEMORY  data is not available
```

I. Y SCALE Pushbutton Menus

1)



Y scale

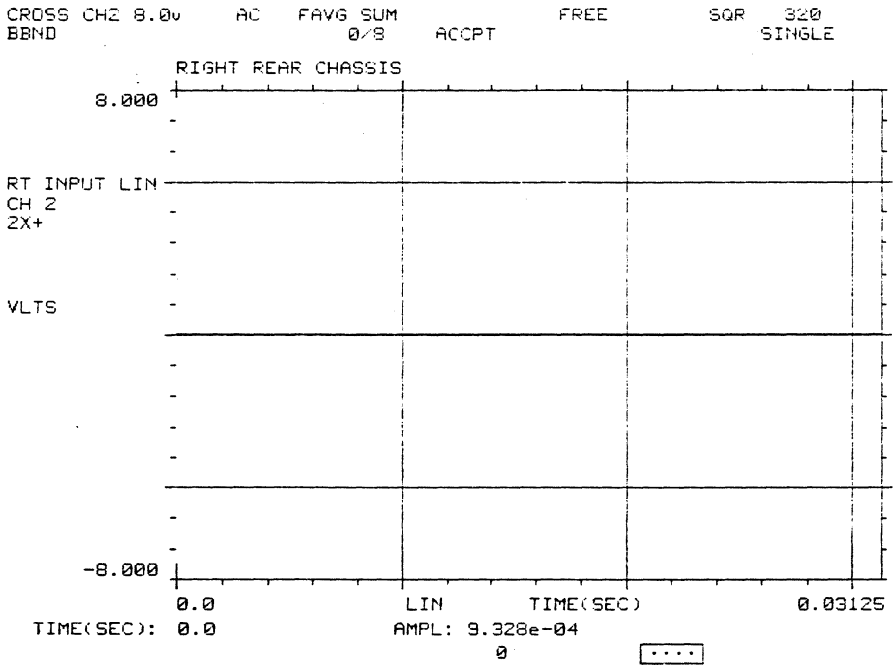
>* 1) LIN AUTO SCALE
2) LIN EXPAND
3) LOG AUTO SCALE
4) LOG EXPAND

Y Scale: LIN AUTO SCALE
EXPAND Min Y: -10.00
EXPAND Max Y: 10.00

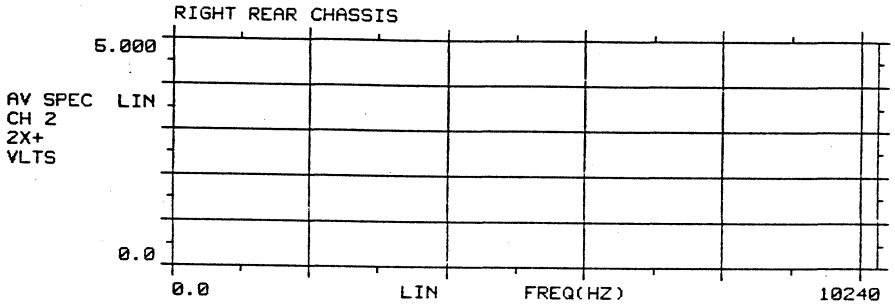
FREQ(HZ):

AMPL:
8

1a)



2)



Y scale

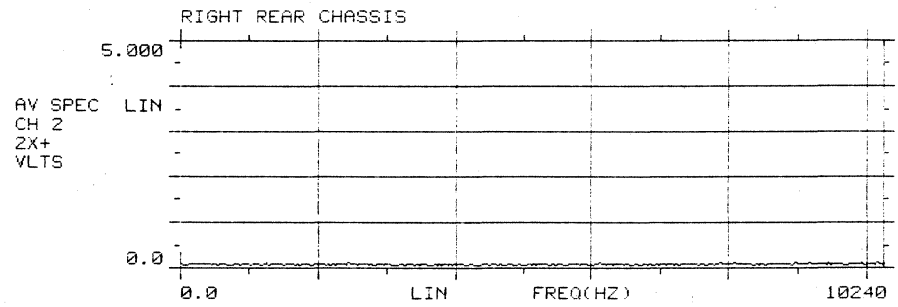
1) LIN AUTO SCALE
>* 2) LIN EXPAND
3) LOG AUTO SCALE
4) LOG EXPAND

Y Scale: LIN EXPAND
EXPAND Min Y: 0.0
EXPAND Max Y: 5.000

FREQ(HZ):

AMPL:
8

2a)



ENTER MIN,MAX values
for LIN Y EXPANSION
* 0.0,5.000

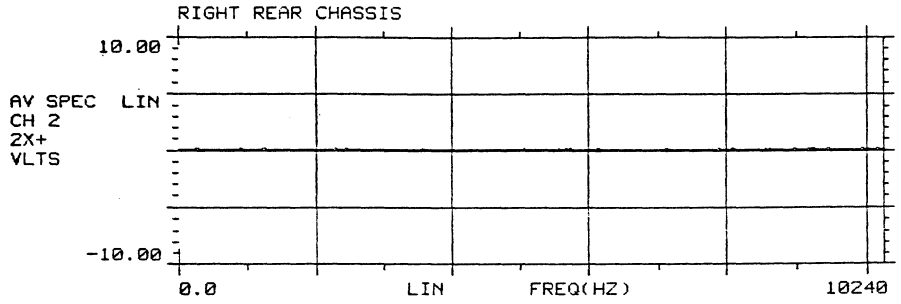
Y Scale: LIN EXPAND
EXPAND Min Y: 0.0
EXPAND Max Y: 5.000

>

FREQ(HZ): 0.00

AMPL: 0.02766
8

2b)



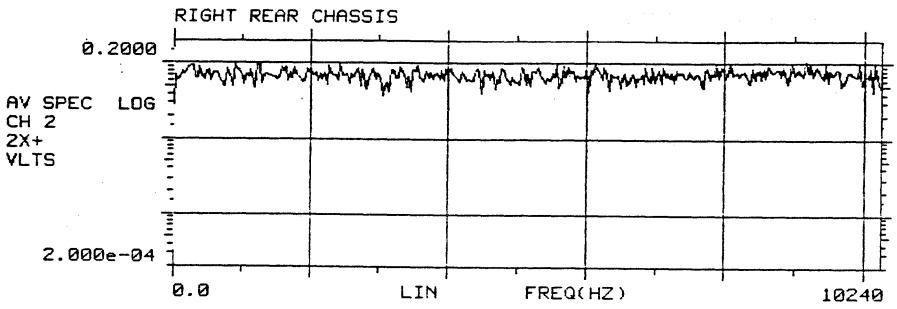
ENTER MIN,MAX values
for LIN Y EXPANSION
* -10.00,10.00

Y Scale: LIN EXPAND
EXPAND Min Y: -10.00
EXPAND Max Y: 10.00

>

FREQ(HZ): 0.00 AMPL: 0.02766
8

3)



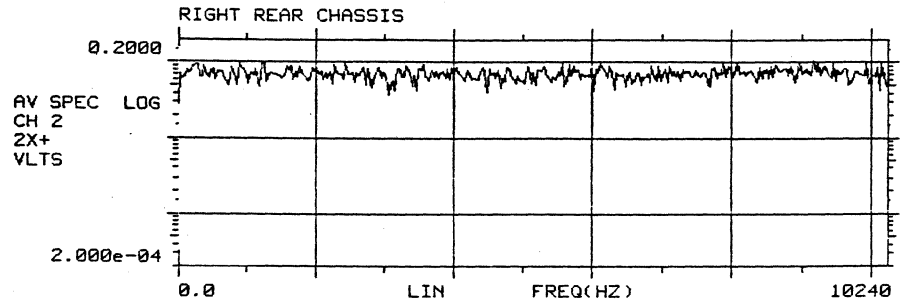
Y scale

1) LIN AUTO SCALE
2) LIN EXPAND
>* 3) LOG AUTO SCALE
4) LOG EXPAND

Y Scale: LOG AUTO SCALE
EXPAND Min Y: 0.0
EXPAND Max Y: 5.000
dB Range: 60

FREQ(HZ): 0.00 AMPL: 0.02766
8

3a)



Db Range

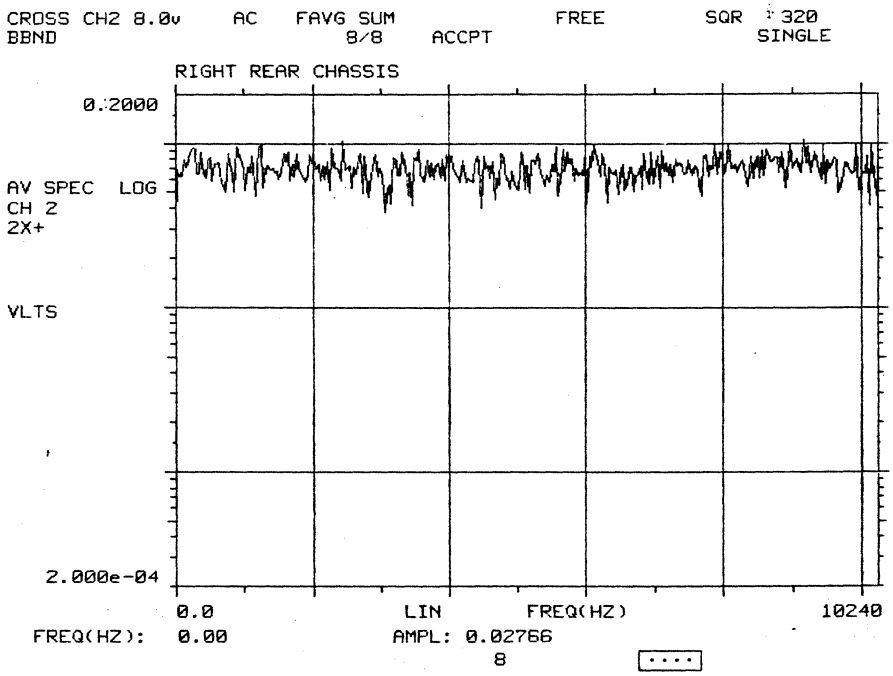
1) 120
2) 100
3) 80
>* 4) 60
5) 40
6) 20

Y Scale: LOG AUTO SCALE
EXPAND Min Y: 0.0
EXPAND Max Y: 5.000
dB Range: 60

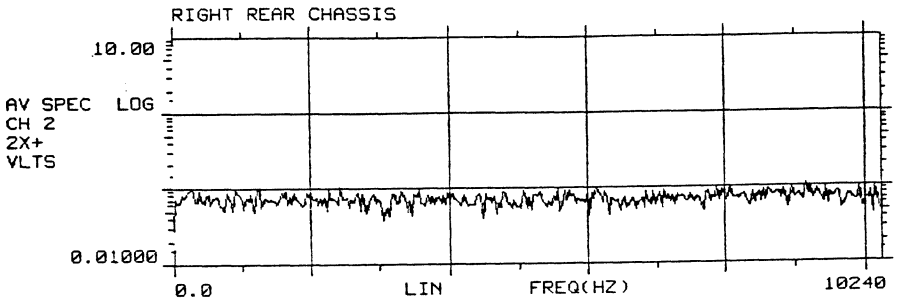
FREQ(HZ): 0.00

AMPL: 0.02766
8

3b)



4)



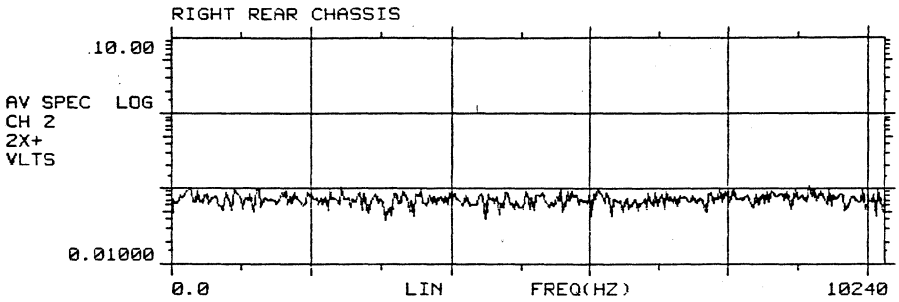
Y scale

1) LIN AUTO SCALE
2) LIN EXPAND
3) LOG AUTO SCALE
>* 4) LOG EXPAND

Y Scale: LOG EXPAND
EXPAND Min Y: -10.00
EXPAND Max Y: 10.00
dB Range: 60

FREQ(HZ): 0.00 AMPL: 0.02766
8

4a)



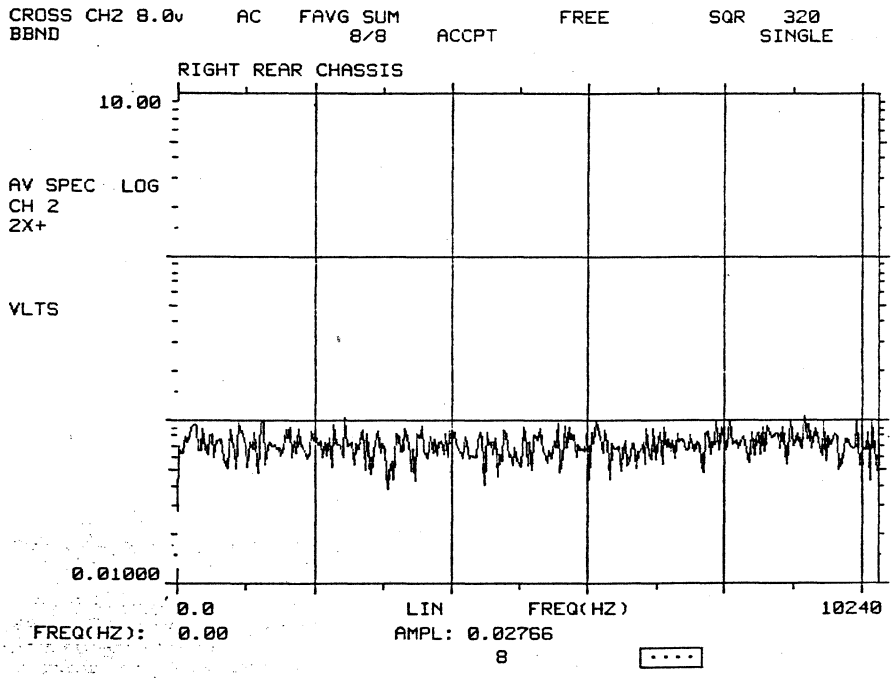
ENTER MIN,MAX values
for LOG Y EXPANSION
* -10.00,10.00

>

Y Scale: LOG EXPAND
EXPAND Min Y: -10.00
EXPAND Max Y: 10.00
dB Range: 60

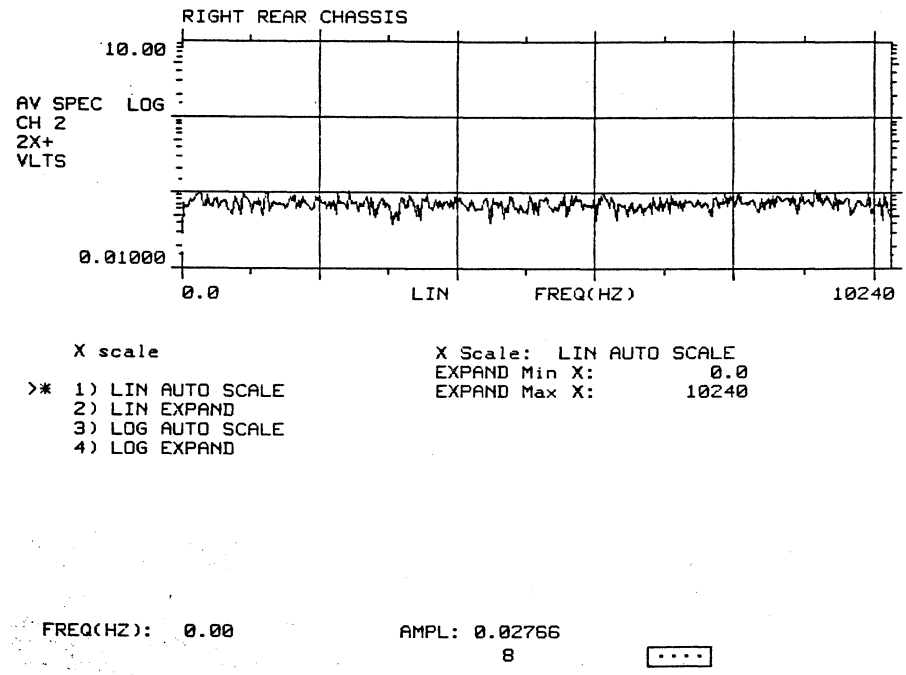
FREQ(HZ): 0.00 AMPL: 0.02766
8

4b)

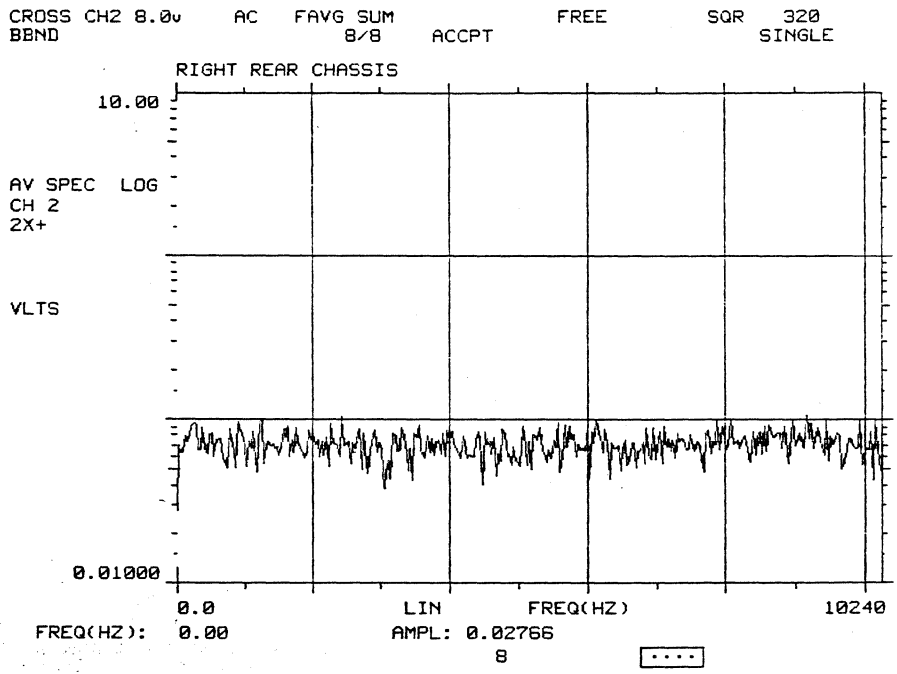


J. X SCALE Pushbutton Menus

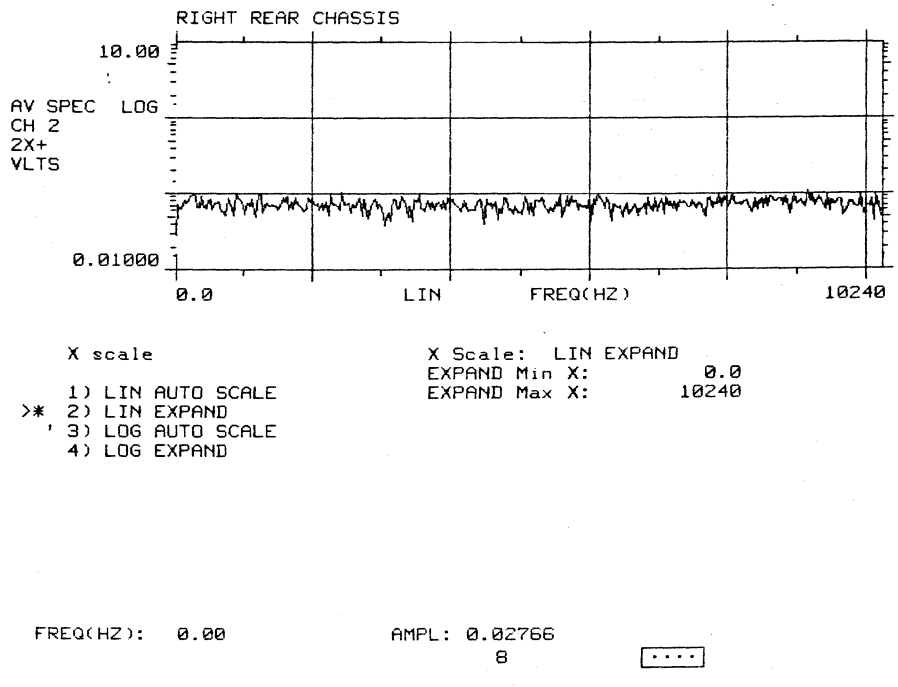
1)



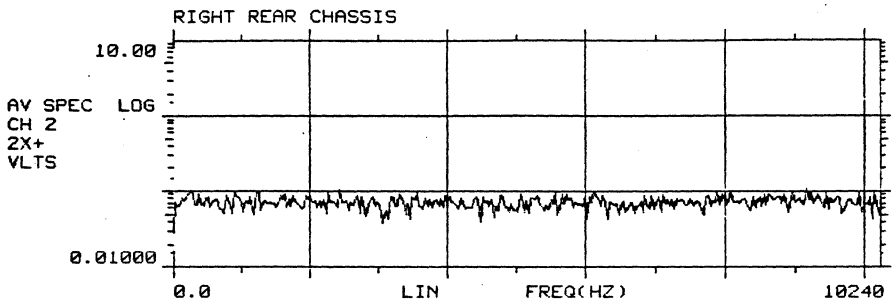
1a)


CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BBND 8/8 ACCPT SINGLE
RIGHT REAR CHASSIS
10.00
AV SPEC LOG
CH 2
2X+
VLTS
0.01000
0.0
LIN
FREQ(HZ)
10240
FREQ(HZ): 0.00
AMPL: 0.02766
8

2)


RIGHT REAR CHASSIS
10.00
AV SPEC LOG
CH 2
2X+
VLTS
0.01000
0.0
LIN
FREQ(HZ)
10240
X scale
1) LIN AUTO SCALE
>* 2) LIN EXPAND
' 3) LOG AUTO SCALE
4) LOG EXPAND
X Scale: LIN EXPAND
EXPAND Min X: 0.0
EXPAND Max X: 10240
FREQ(HZ): 0.00
AMPL: 0.02766
8

2a)



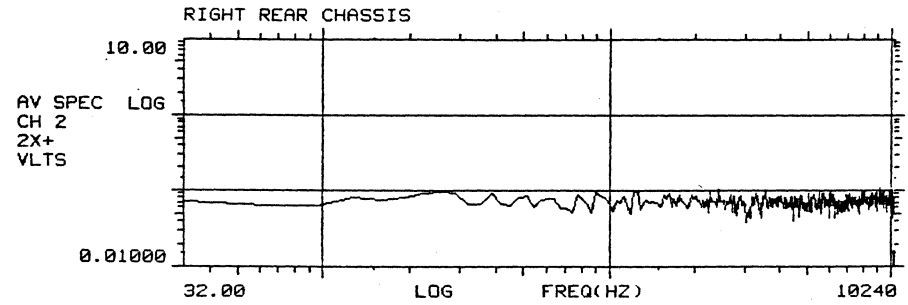
ENTER MIN,MAX values
for LIN X EXPANSION
* 0.0,10240

X Scale: LIN EXPAND
EXPAND Min X: 0.0
EXPAND Max X: 10240

>

FREQ(HZ): 0.00 AMPL: 0.02766
8

3)



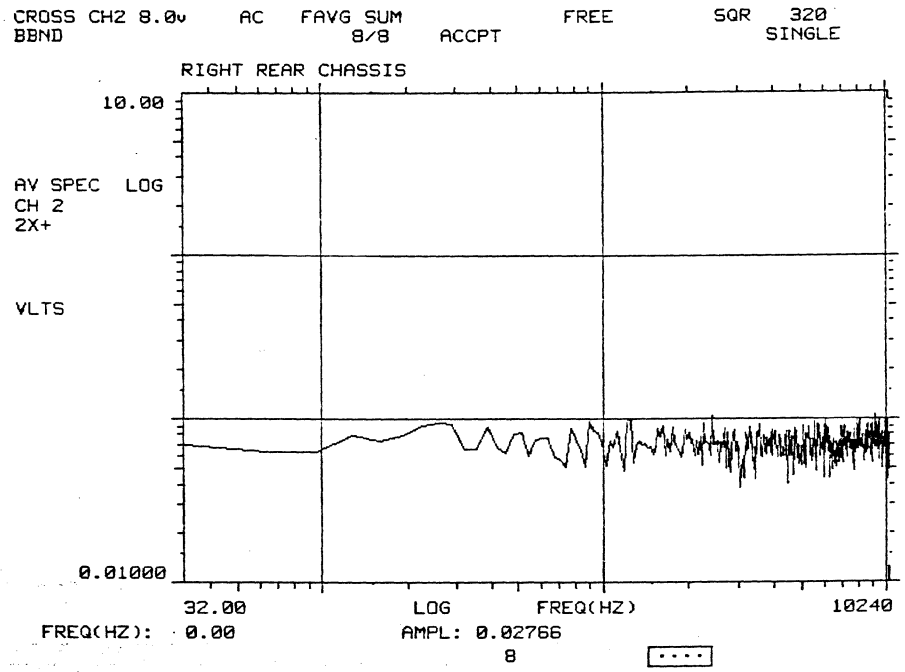
X scale

1) LIN AUTO SCALE
2) LIN EXPAND
>* 3) LOG AUTO SCALE
4) LOG EXPAND

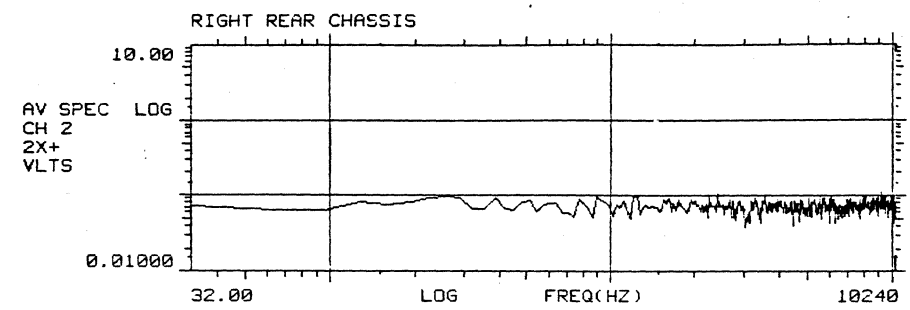
X Scale: LOG AUTO SCALE
EXPAND Min X: 0.0
EXPAND Max X: 10240

FREQ(HZ): 0.00 AMPL: 0.02766
8

3a)



4)



X scale

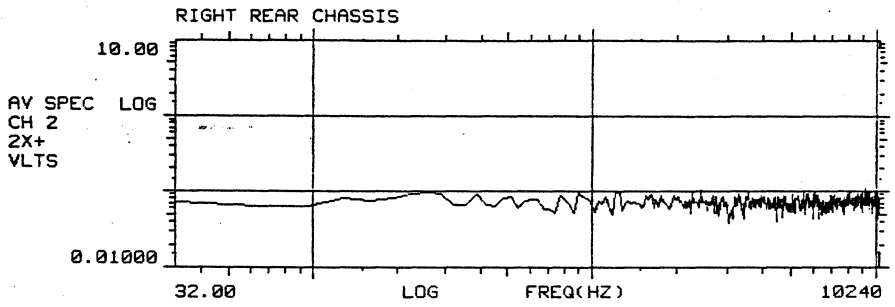
1) LIN AUTO SCALE
2) LIN EXPAND
3) LOG AUTO SCALE
>* 4) LOG EXPAND

X Scale: LOG EXPAND
EXPAND Min X: 0.0
EXPAND Max X: 10240

FREQ(HZ): 0.00

AMPL: 0.02766
8

4a)



ENTER MIN,MAX values
for LOG X EXPANSION
* 0.0,10240

X Scale: LOG EXPAND
EXPAND Min X: 0.0
EXPAND Max X: 10240

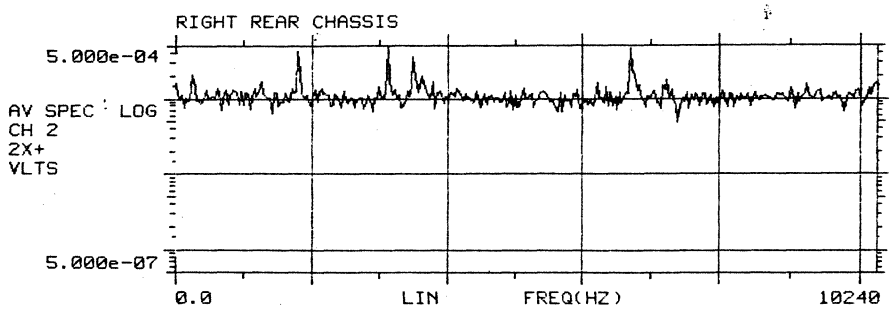
>

FREQ(HZ): 0.00 AMPL: 0.02766

8

K. FUNCTION Pushbutton Menus and Typical Displays (AVERAGE)

1)



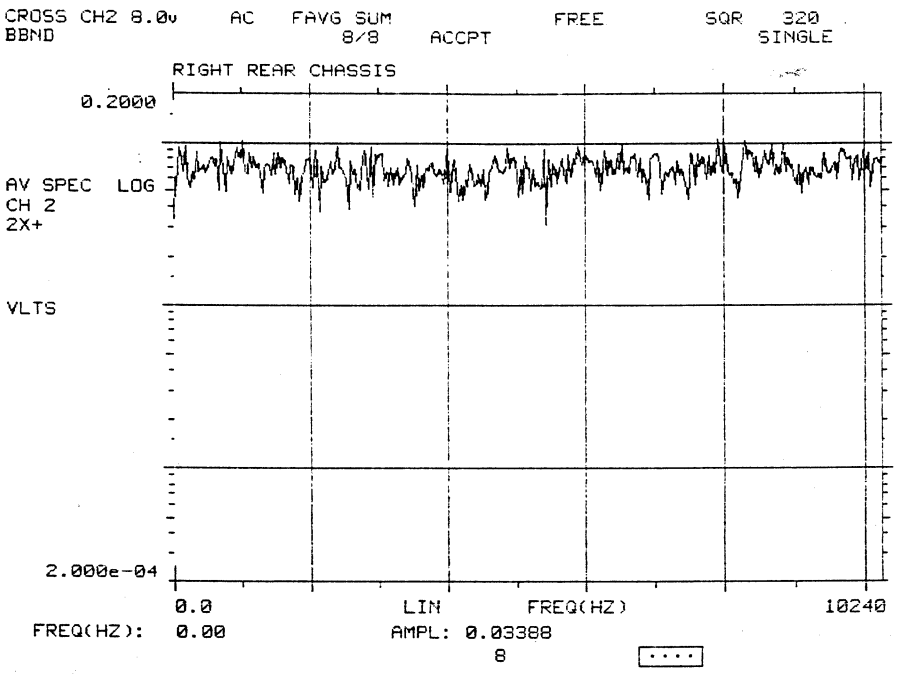
Function

>* 1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORYxx

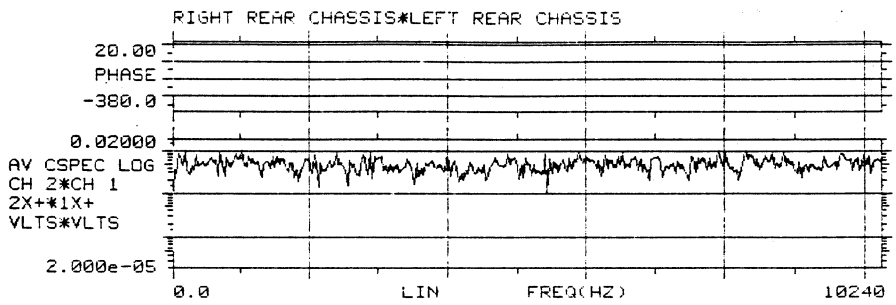
function: AUTO SPECTRUM
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0

FREQ(HZ): 0.00 AMPL: 1.568e-04

1a)



2)



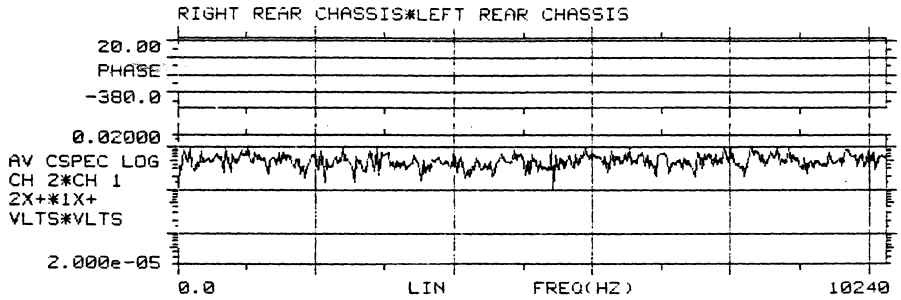
Function

1) AUTO SPECTRUM
>* 2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORYxx

function: CROSS SPECTRUM
CPX Function
format: BODE
COH Blnk Level: 0.0

FREQ(HZ): 0.00 AMPL: 1.100e-03 PHASE: -360.0
8

2.1)



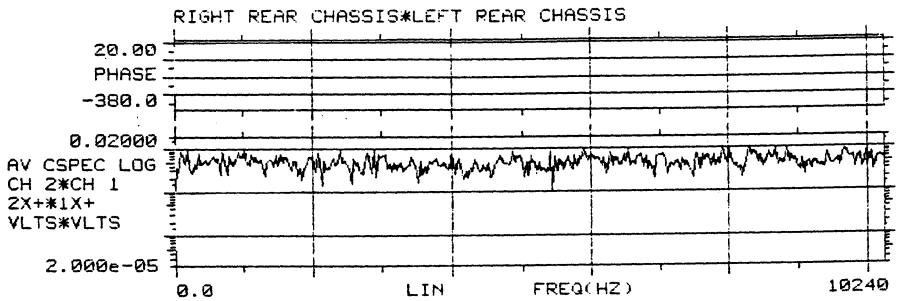
Format

>* 1) BODE
2) MAGNITUDE
3) PHASE
4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

function: CROSS SPECTRUM
CPX Function
format: BODE
COH Blnk Level: 0.0

FREQ(HZ): 0.00 AMPL: 1.100e-03 PHASE: -360.0
8 ....

2.1a)



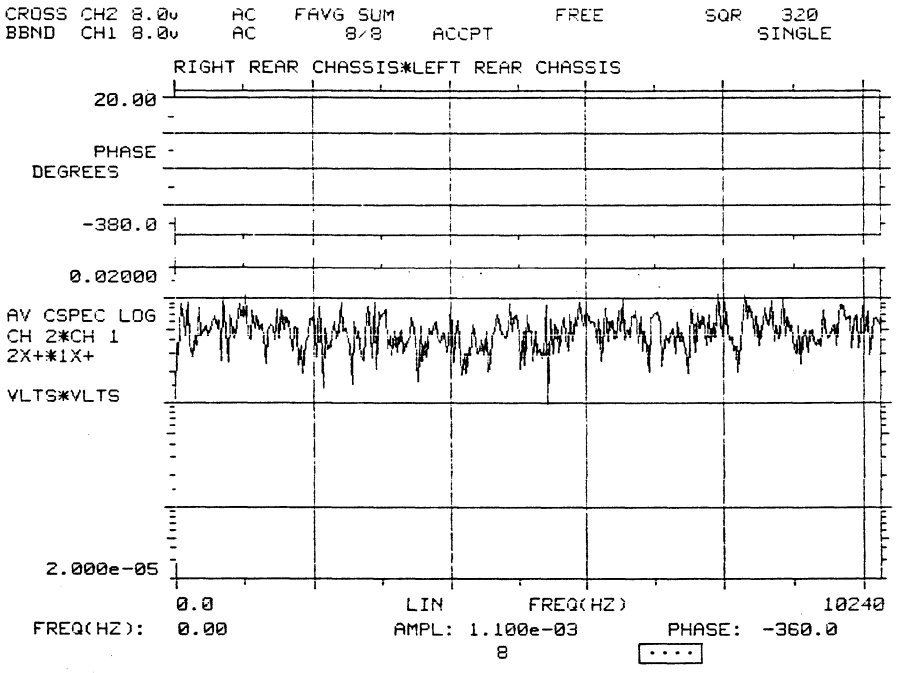
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

>

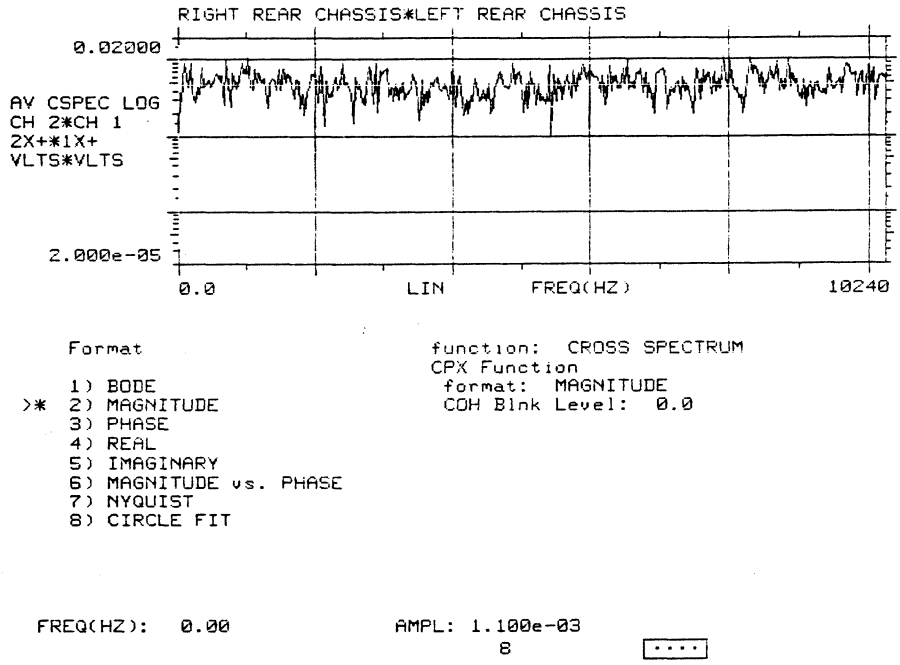
function: CROSS SPECTRUM
CPX Function
format: BODE
COH Blnk Level: 0.0

FREQ(HZ): 0.00 AMPL: 1.100e-03 PHASE: -360.0
8 ....

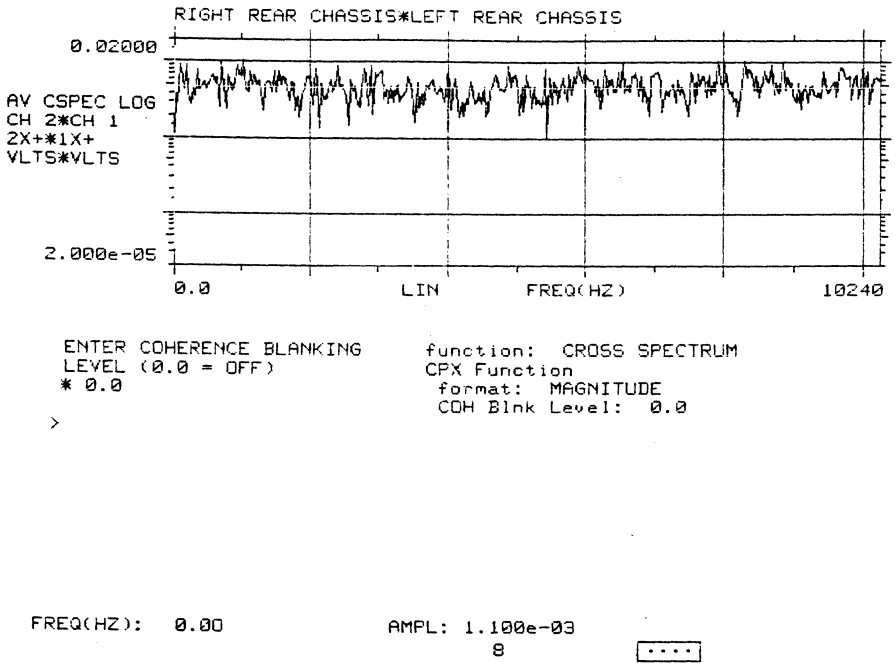
2.1b)


CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BBND CH1 8.0v AC 8/8 ACCPT SINGLE
RIGHT REAR CHASSIS*LEFT REAR CHASSIS
20.00
PHASE
DEGREES
-380.0
0.02000
AV CSPEC LOG
CH 2*CH 1
2X+*1X+
VLTS*VLTS
2.000e-05
0.0
LIN
FREQ(HZ)
10240
FREQ(HZ): 0.00
AMPL: 1.100e-03
PHASE: -360.0
8

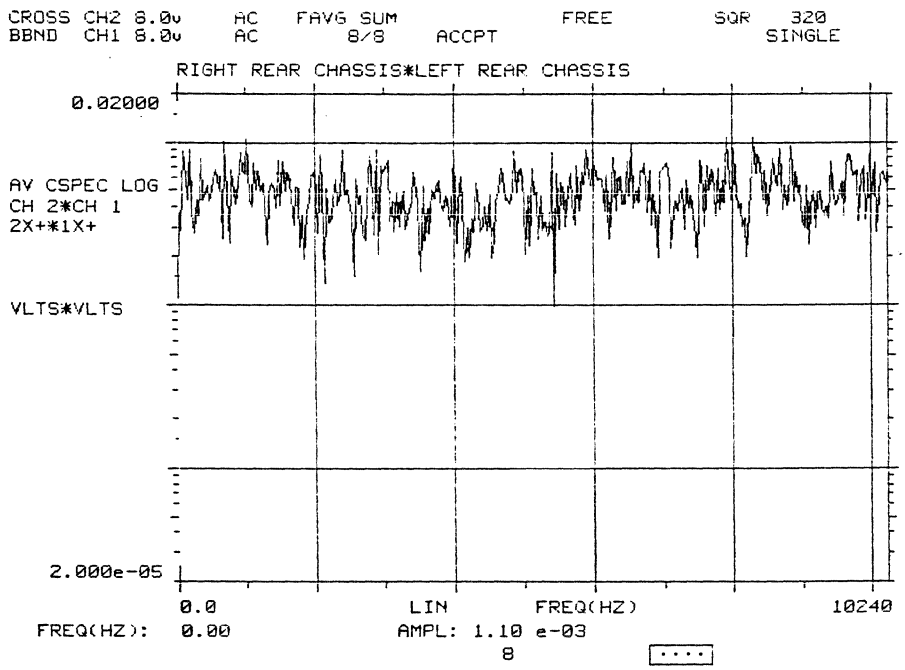
2.2)


RIGHT REAR CHASSIS*LEFT REAR CHASSIS
0.02000
AV CSPEC LOG
CH 2*CH 1
2X+*1X+
VLTS*VLTS
2.000e-05
0.0
LIN
FREQ(HZ)
10240
Format
1) BODE
>* 2) MAGNITUDE
3) PHASE
4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT
function: CROSS SPECTRUM
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0
FREQ(HZ): 0.00
AMPL: 1.100e-03
8

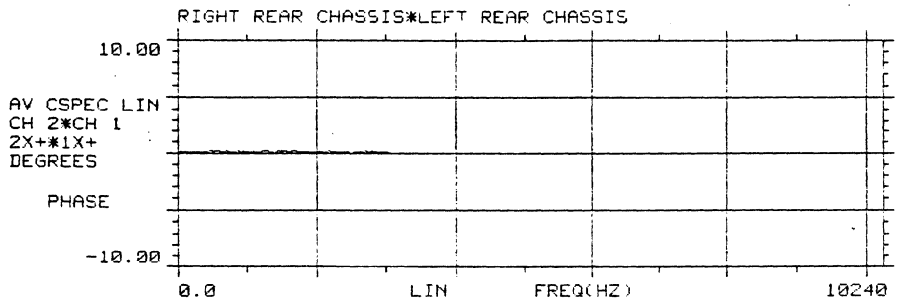
2.2a)


RIGHT REAR CHASSIS*LEFT REAR CHASSIS
0.02000
AV CSPEC LOG
CH 2*CH 1
2X+*1X+
VLTS*VLTS
2.000e-05
0.0
LIN
FREQ(HZ)
10240
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0
>
function: CROSS SPECTRUM
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0
FREQ(HZ): 0.00
AMPL: 1.100e-03
8

2.2b)


CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BBND CH1 8.0v AC 8/8 ACCPT SINGLE
RIGHT REAR CHASSIS*LEFT REAR CHASSIS
0.02000
AV CSPEC LOG
CH 2*CH 1
2X+*1X+
VLTS*VLTS
2.000e-05
0.0
LIN
FREQ(HZ)
10240
FREQ(HZ): 0.00
AMPL: 1.10 e-03
8

2.3)



Format

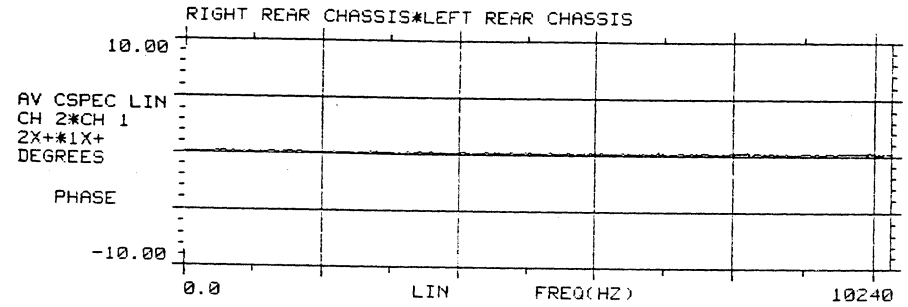
1) BODE
2) MAGNITUDE
>* 3) PHASE
4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

function: CROSS SPECTRUM
CPX Function
format: PHASE
COH Blnk Level: 0.0

FREQ(HZ):

PHASE:
8

2.3a)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

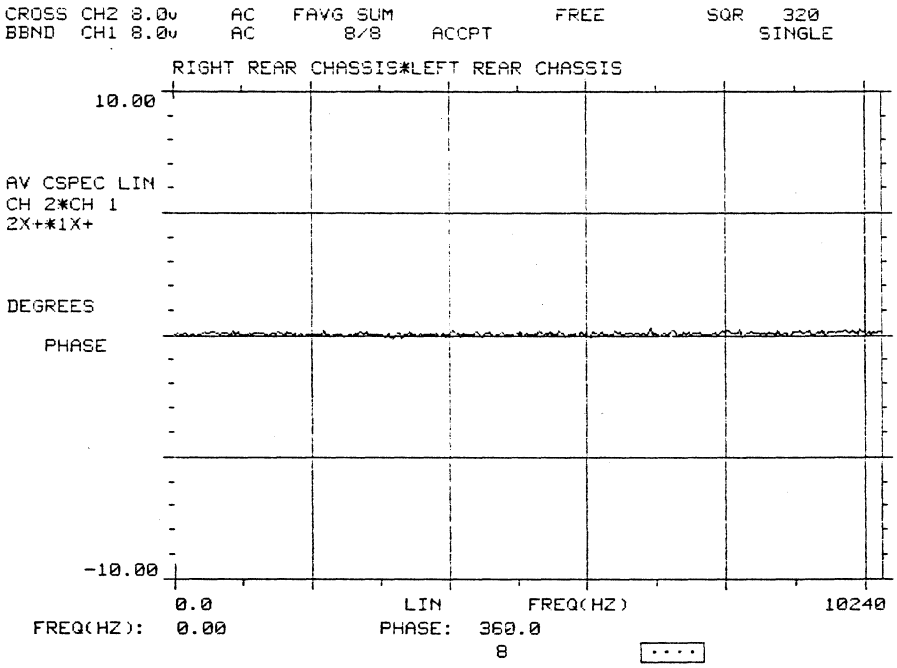
>

function: CROSS SPECTRUM
CPX Function
format: PHASE
COH Blnk Level: 0.0

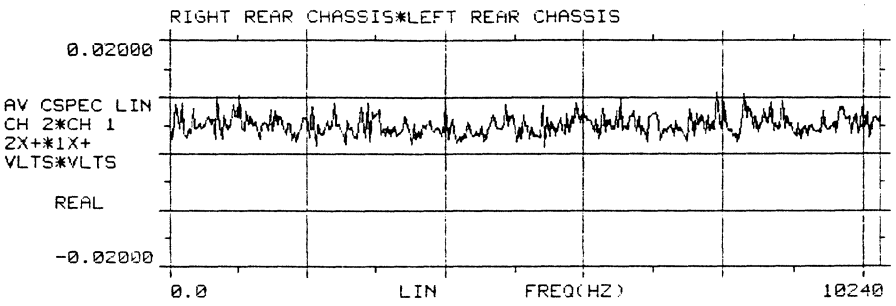
FREQ(HZ): 0.00

PHASE: -360.0
8

2.3b)



2.4)



Format

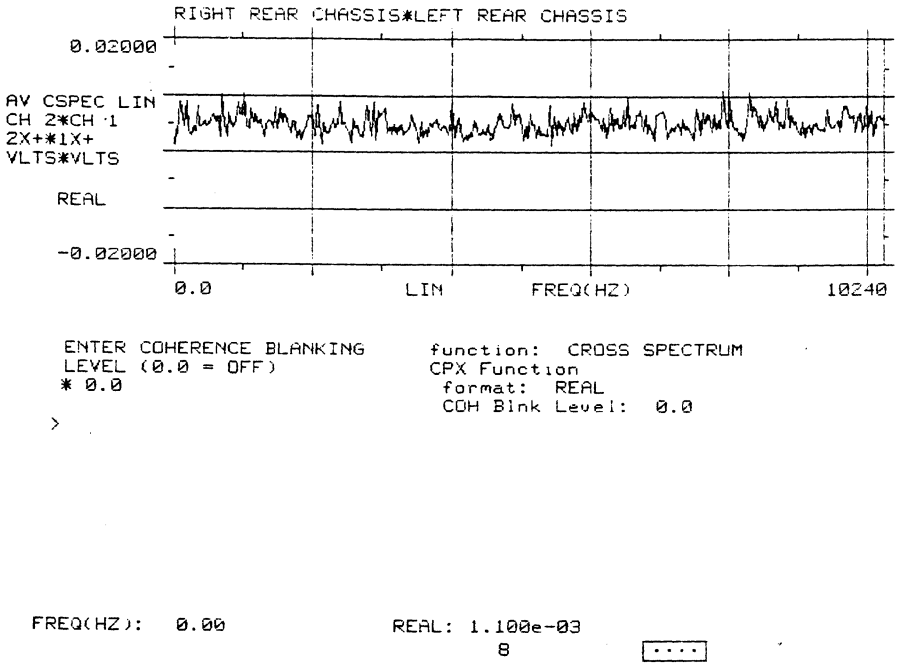
1) BODE
2) MAGNITUDE
3) PHASE
>* 4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

function: CROSS SPECTRUM
CPX Function
format: REAL
COH Blnk Level: 0.0

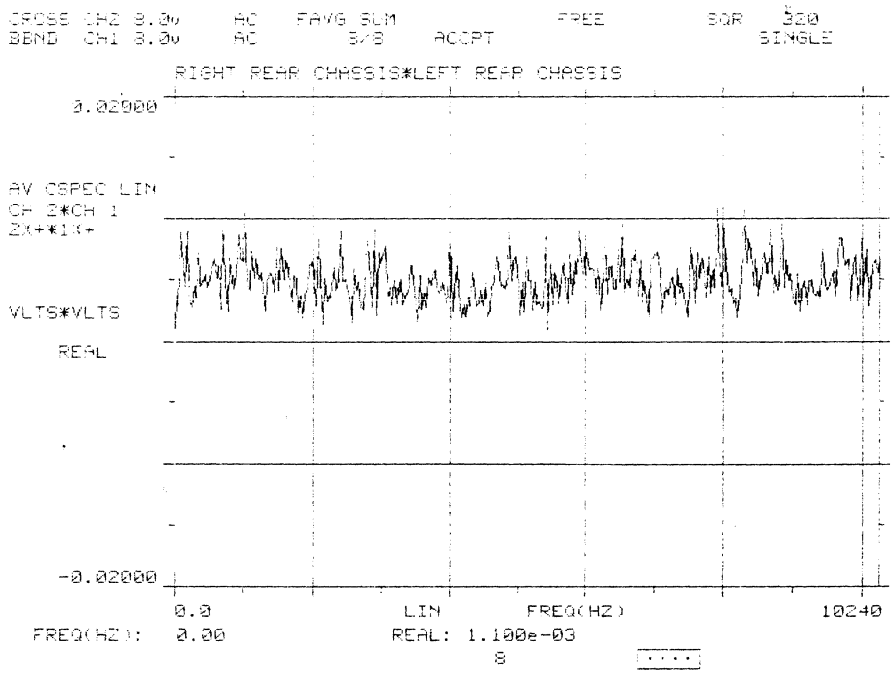
FREQ(HZ):

REAL:
8

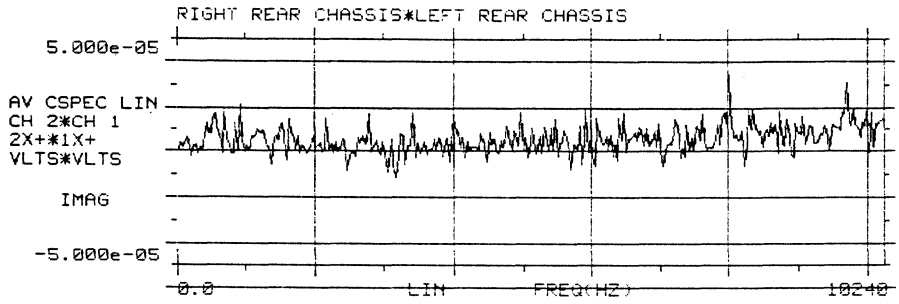
2.4a)


RIGHT REAR CHASSIS*LEFT REAR CHASSIS
0.02000
AV CSPEC LIN
CH 2*CH 1
2X+*1X+
VLTS*VLTS
REAL
-0.02000
0.0
LIN
FREQ(HZ)
10240
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0
>
function: CROSS SPECTRUM
CPX Function
format: REAL
COH Blnk Level: 0.0
FREQ(HZ): 0.00
REAL: 1.100e-03
8

2.4b)


CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BAND CH1 8.0v AC S/B ACCPT SINGLE
RIGHT REAR CHASSIS*LEFT REAR CHASSIS
0.02000
AV CSPEC LIN
CH 2*CH 1
2X+*1X+
VLTS*VLTS
REAL
-0.02000
0.0
LIN
FREQ(HZ)
10240
FREQ(HZ): 0.00
REAL: 1.100e-03
8

2.5)



Format

1) BODE
2) MAGNITUDE
3) PHASE
4) REAL
>* 5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

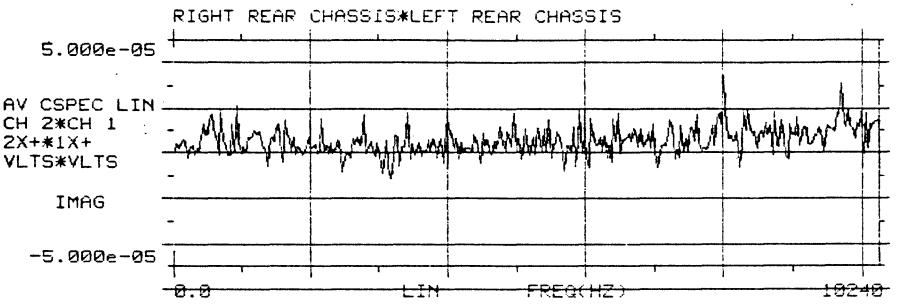
function: CROSS SPECTRUM
CPX Function
format: IMAGINARY
COH Blnk Level: 0.0

FREQ(HZ): 0.00

IMAG: 4.172e-07

8

2.5a)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

>

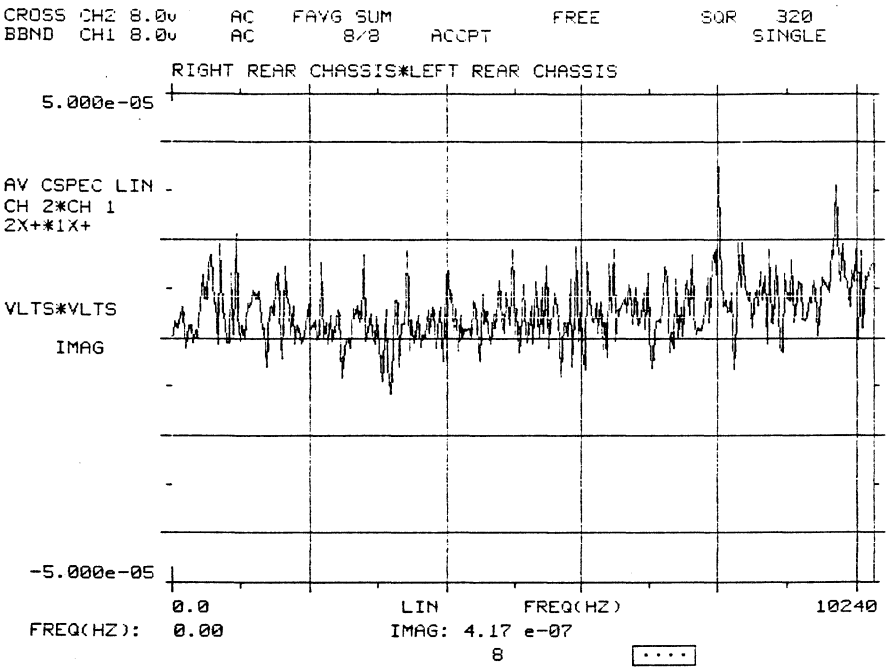
function: CROSS SPECTRUM
CPX Function
format: IMAGINARY
COH Blnk Level: 0.0

FREQ(HZ): 0.00

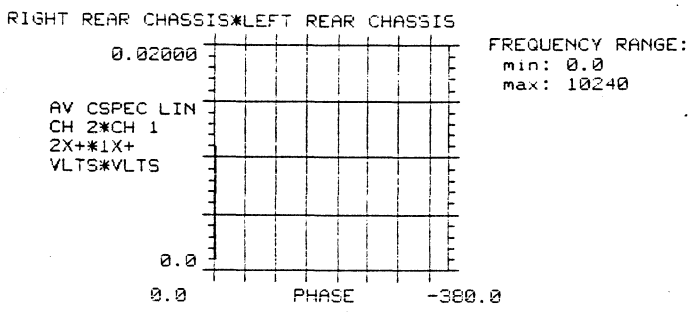
IMAG: 4.172e-07

8

2.5b)



2.6)



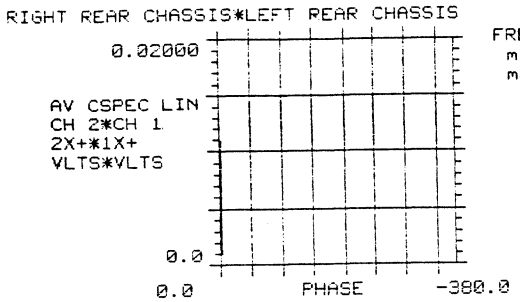
Format

1) BODE
2) MAGNITUDE
3) PHASE
4) REAL
5) IMAGINARY
>* 6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

function: CROSS SPECTRUM
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

8

2.6.1)



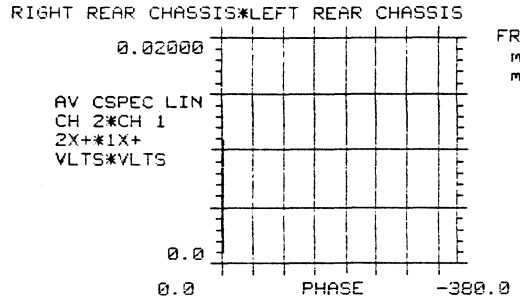
Frequency Scale

>* 1) AUTOSCALE
2) EXPAND

function: CROSS SPECTRUM
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

8

2.6.1a)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

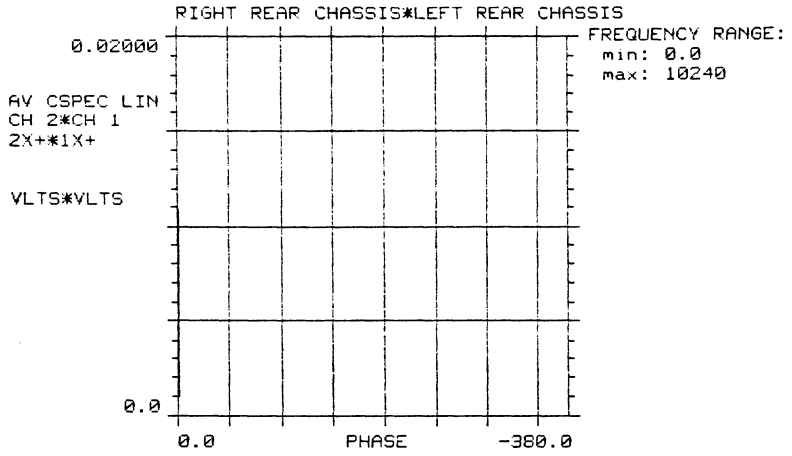
>

function: CROSS SPECTRUM
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

8

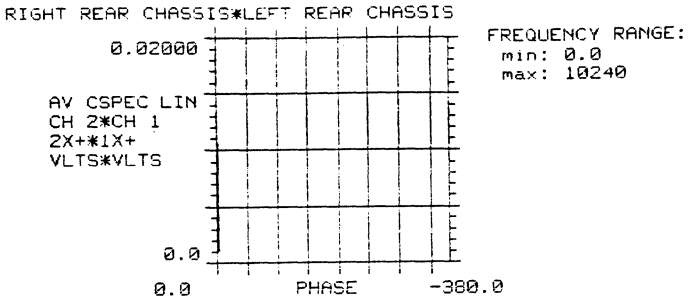
2.6.1b)

```
CROSS CH2 8.0v     AC   FAVG SUM              FREE        SQR   320
BBND  CH1 8.0v     AC        8/8    ACCPT                    SINGLE
```



8 ····

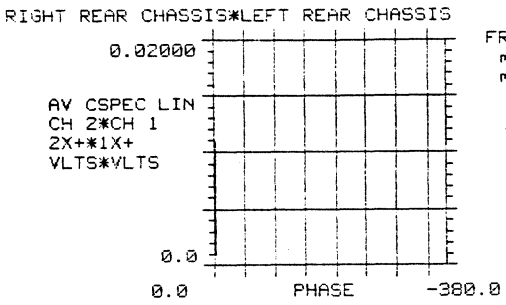
2.6.2)




```
   Frequency Scale                 function:  CROSS SPECTRUM
                                   CPX Function
   1) AUTOSCALE                     format:  MAGNITUDE vs. PHASE
>* 2) EXPAND                        COH Blnk Level:  0.0
```

8 ····

2.6.2a)



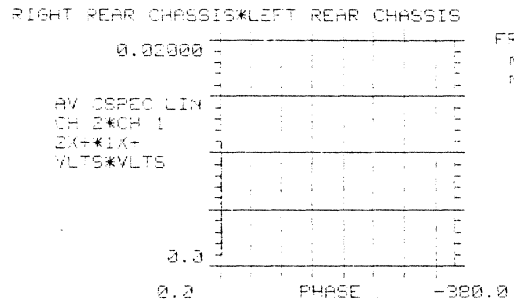
ENTER MIN,MAX for
for Frequency Expansion
* 0.0,10240

function: CROSS SPECTRUM
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

>

8

2.6.2b)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

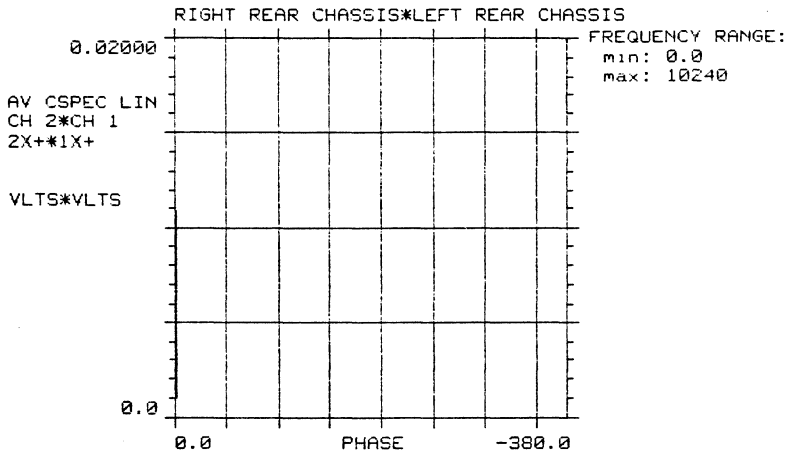
function: CROSS SPECTRUM
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

>

8

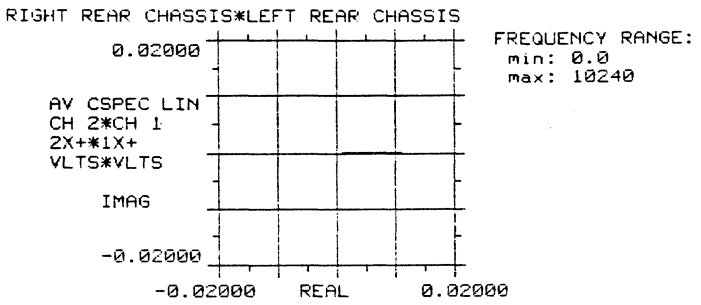
2.6.2c)

```
CROSS CH2 8.0v     AC   FAVG SUM              FREE        SQR   320
BBND  CH1 8.0v     AC        8/8    ACCPT                    SINGLE
```



8 ····

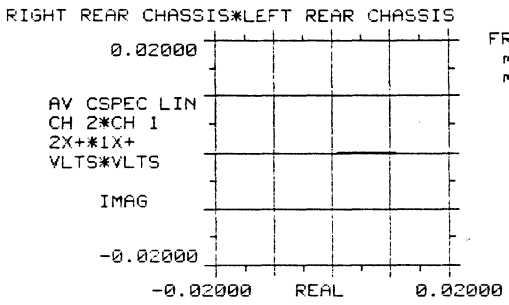
2.7)




```
Format                          function:  CROSS SPECTRUM
                                CPX Function
                                 format:  NYQUIST
                                 CGH Blnk Level:  0.0
   1) BODE
   2) MAGNITUDE
   3) PHASE
   4) REAL
   5) IMAGINARY
   6) MAGNITUDE vs. PHASE
>* 7) NYQUIST
   8) CIRCLE FIT
```

8 ····

2.7.1)



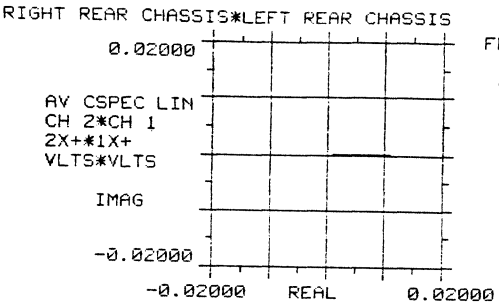
Frequency Scale

>* 1) AUTOSCALE
2) EXPAND

function: CROSS SPECTRUM
CPX Function
format: NYQUIST
COH Blnk Level: 0.0

8

2.7.1a)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

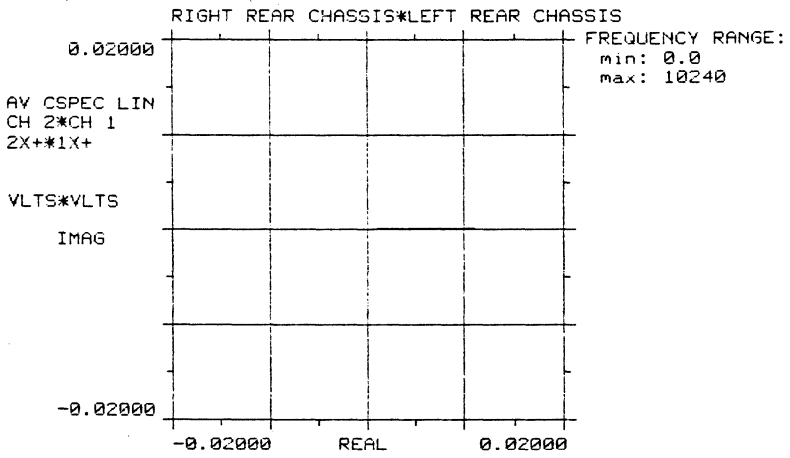
>

function: CROSS SPECTRUM
CPX Function
format: NYQUIST
COH Blnk Level: 0.0

8

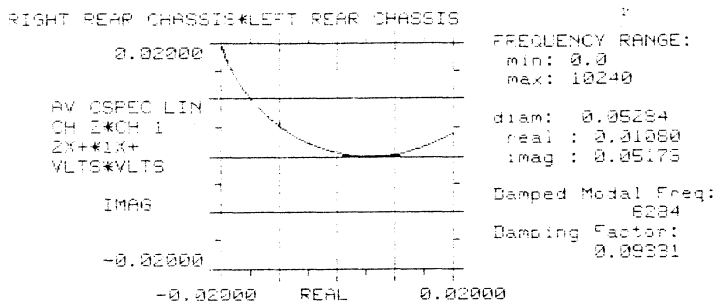
2.7.1b)

```
CROSS CH2 8.0v     AC   FAVG SUM              FREE        SQR   320
BBND  CH1 8.0v     AC        8/8    ACCPT                  SINGLE
```



8 ····

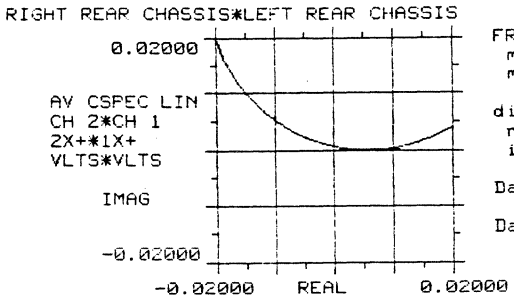
2.8)




```
Format                              Function:  CROSS SPECTRUM
                                    CPX Function
 1) BODE                             format:  CIRCLE FIT
 2) MAGNITUDE                        COH Blnk Level:  0.0
 3) PHASE
 4) REAL
 5) IMAGINARY
 6) MAGNITUDE vs. PHASE
 7) NYQUIST
>* 8) CIRCLE FIT
```

8 ····

2.8.1)



FREQUENCY RANGE:
min: 0.0
max: 10240

diam: 0.05284
real : 0.01080
imag : 0.05173

Damped Modal Freq:
6284
Damping Factor:
0.09331

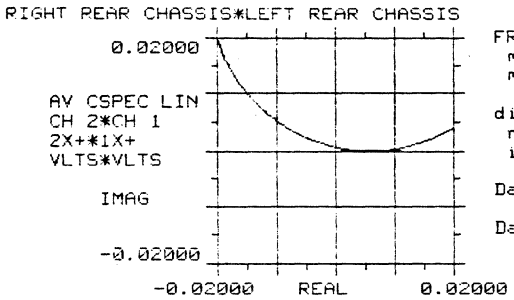
Frequency Scale

>* 1) AUTOSCALE
2) EXPAND

function: CROSS SPECTRUM
CPX Function
format: CIRCLE FIT
COH Blnk Level: 0.0

8

2.8.1a)



FREQUENCY RANGE:
min: 0.0
max: 10240

diam: 0.05284
real : 0.01080
imag : 0.05173

Damped Modal Freq:
6284
Damping Factor:
0.09331

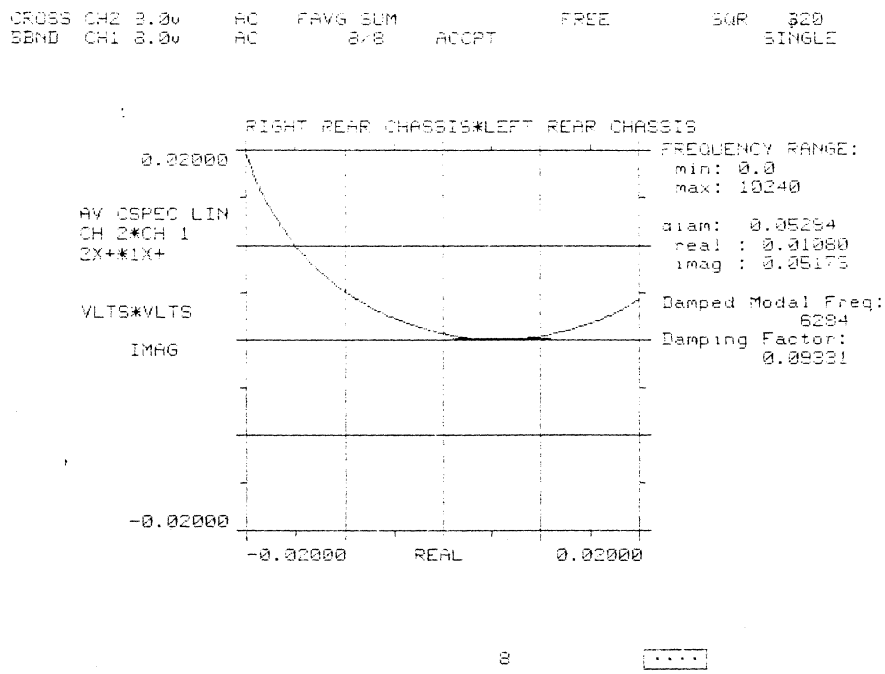
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

>

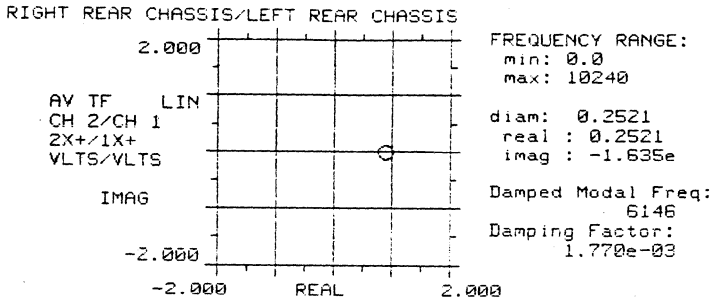
function: CROSS SPECTRUM
CPX Function
format: CIRCLE FIT
COH Blnk Level: 0.0

8

2.8.1b)



3)



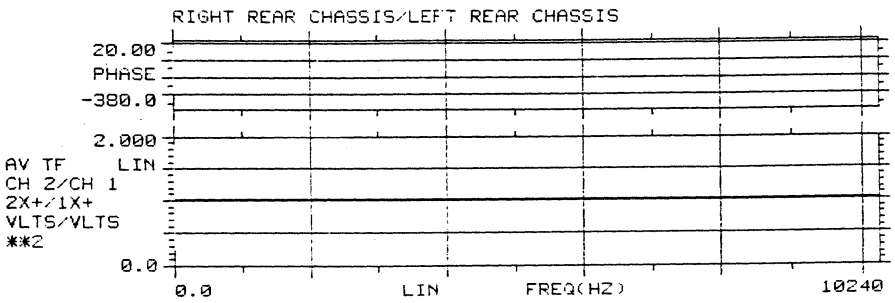
Function

1) AUTO SPECTRUM
2) CROSS SPECTRUM
>* 3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORYxx

function: TRANSFER FUNCTION
CPX Function
format: CIRCLE FIT
COH Blnk Level: 0.0

8

3.1)



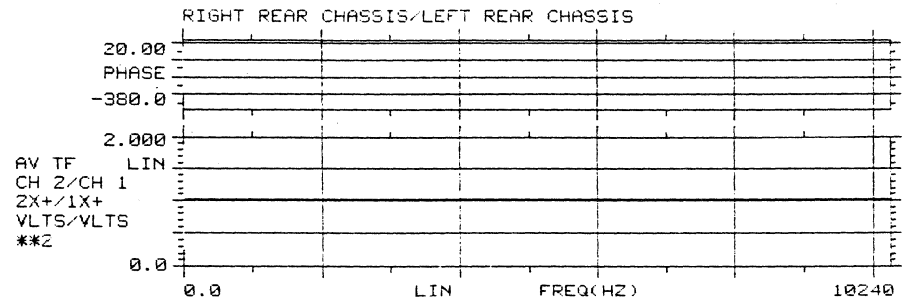
Format

>* 1) BODE
2) MAGNITUDE
3) PHASE
4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

function: TRANSFER FUNCTION
CPX Function
format: BODE
COH Blnk Level: 0.0

FREQ(HZ): 0.00 MAG SQ.: 0.9991 PHASE: -360.0
8 ....

3.1a)



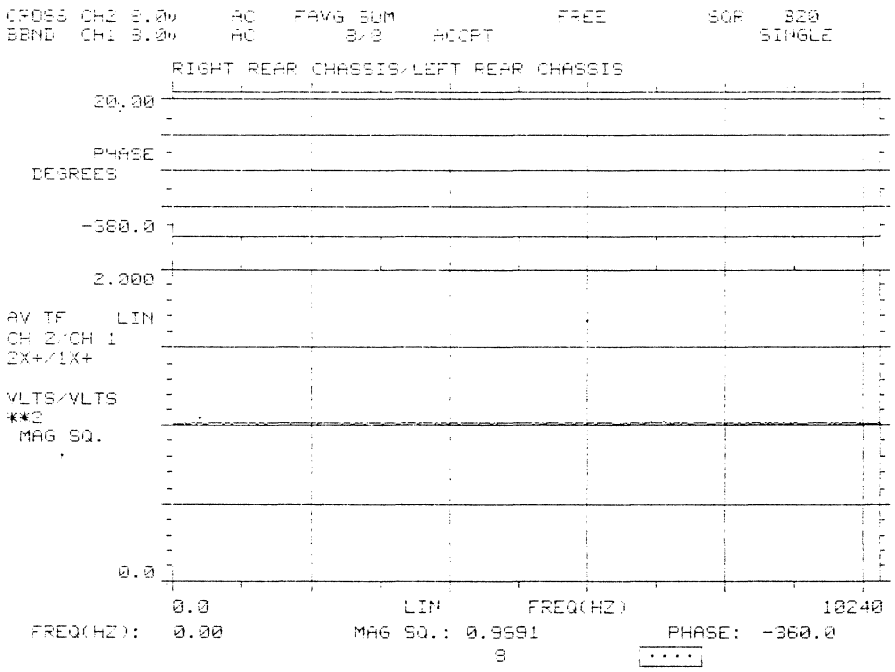
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

>

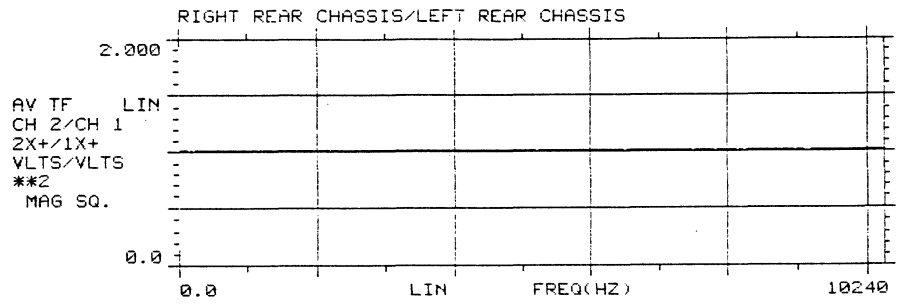
function: TRANSFER FUNCTION
CPX Function
format: BODE
COH Blnk Level: 0.0

FREQ(HZ): 0.00 MAG SQ.: 0.9991 PHASE: -360.0
8 ....

3.1b)



3.2)



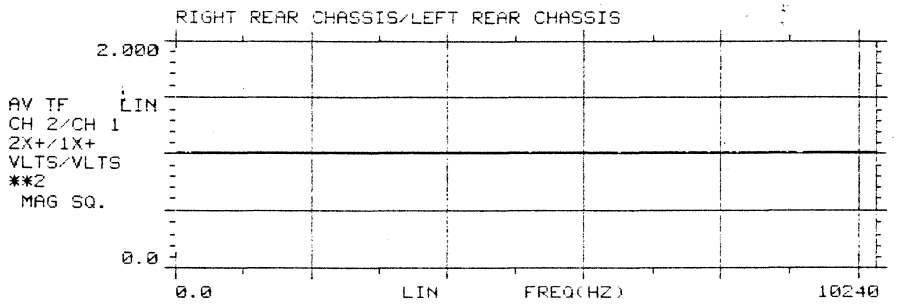
Format

1) BODE
>* 2) MAGNITUDE
3) PHASE
4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0

FREQ(HZ): 0.00 MAG SQ.: 0.9991
8

3.2a)



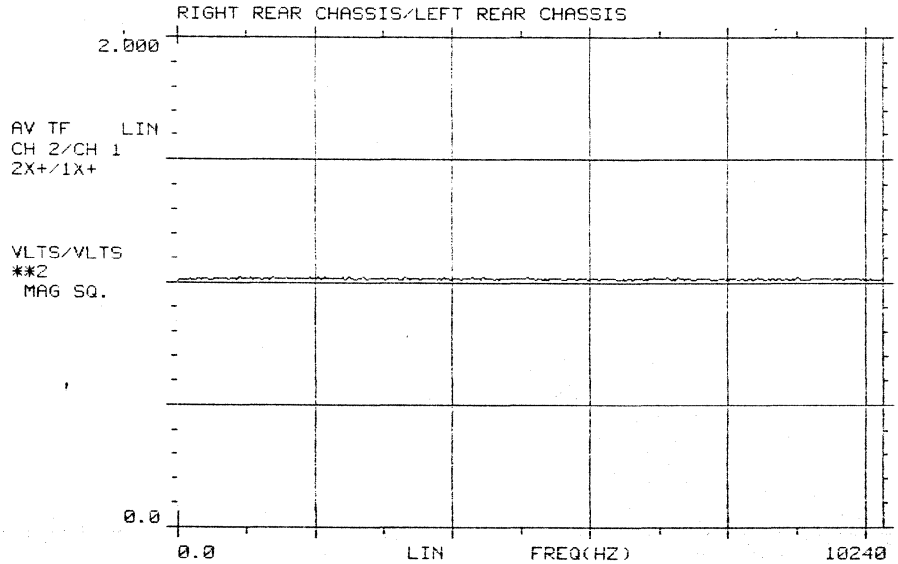
ENTER COHERENCE BLANKING LEVEL (0.0 = OFF)
* 0.0

function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0

FREQ(HZ): 0.00 MAG SQ.: 0.9991
8

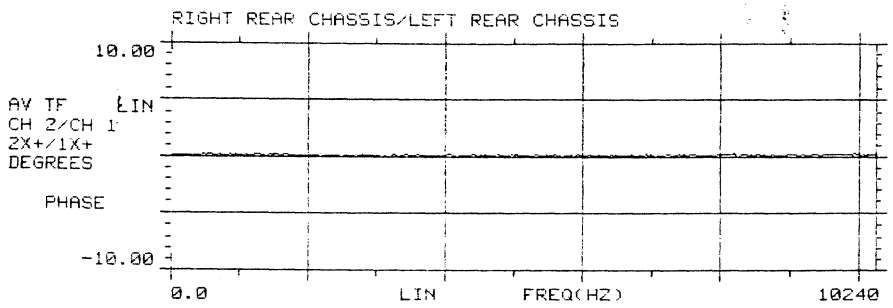
3.2b)

CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BBND CH1 8.0v AC 8/8 ACCPT SINGLE



FREQ(HZ): 0.00 MAG SQ.: 0.9991
8

3.3)



Format

1) BODE
2) MAGNITUDE
>* 3) PHASE
4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

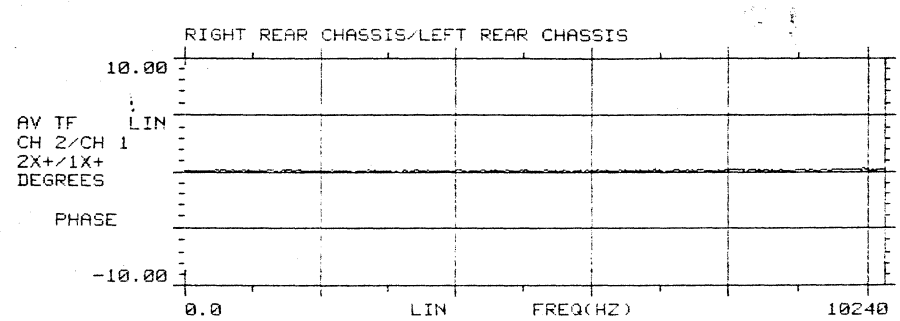
function: TRANSFER FUNCTION
CPX Function
format: PHASE
COH Blnk Level: 0.0

FREQ(HZ): 0.00

PHASE: -360.0

8

3.3a)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

>,

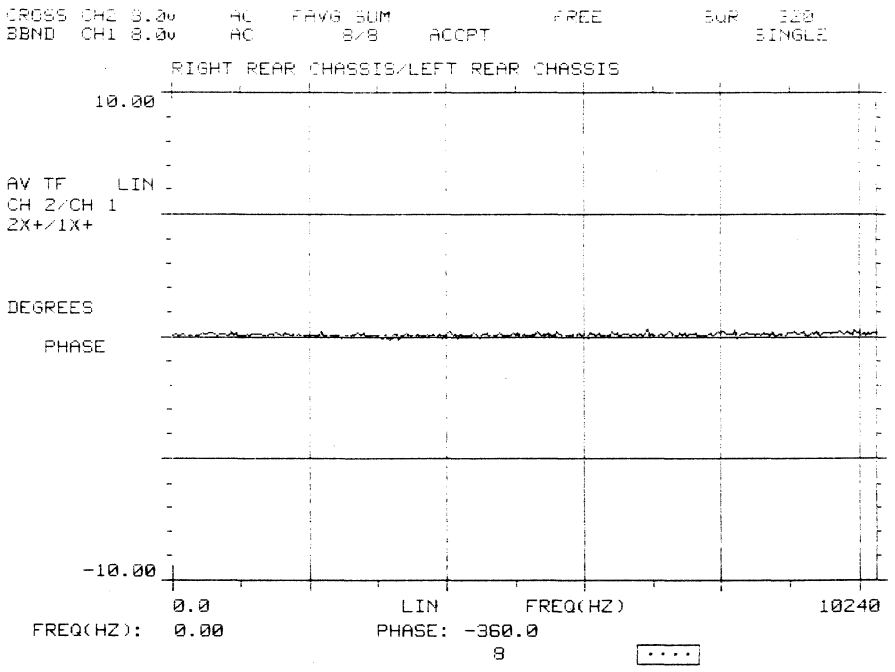
function: TRANSFER FUNCTION
CPX Function
format: PHASE
COH Blnk Level: 0.0

FREQ(HZ): 0.00

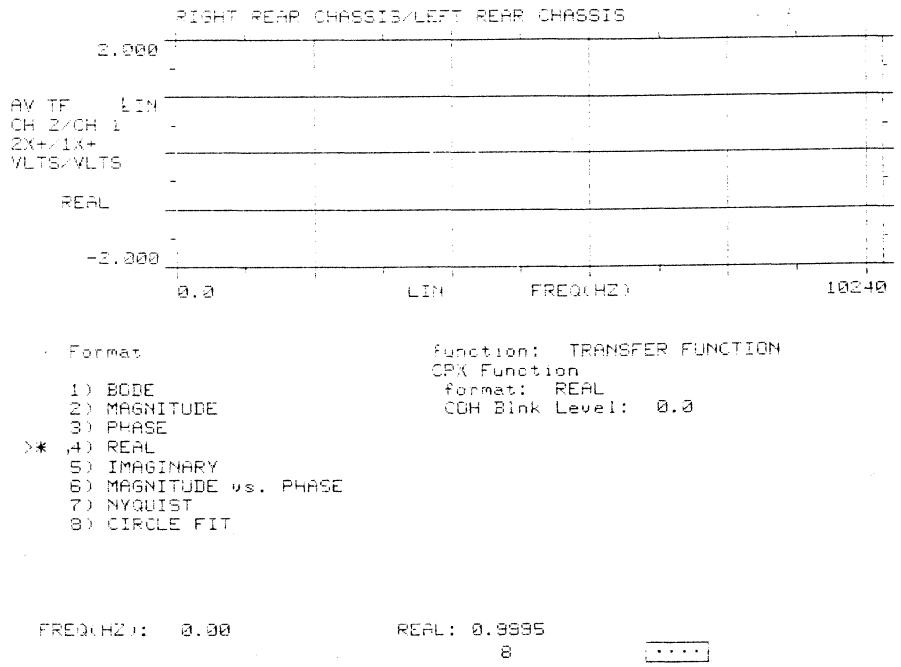
PHASE: -360.0

8

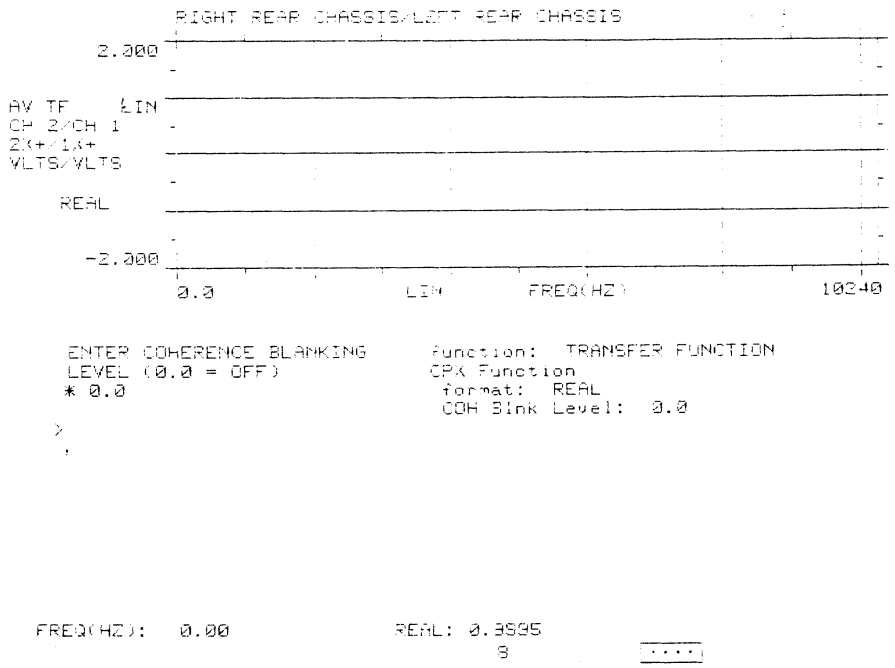
3.3b)


CROSS CH2 8.0v AC FAVG SUM FREE SGR 320
BBND CH1 8.0v AC 8/8 ACCPT SINGLE
RIGHT REAR CHASSIS/LEFT REAR CHASSIS
10.00
AV TF LIN
CH 2/CH 1
2X+/1X+
DEGREES
PHASE
-10.00
0.0
LIN
FREQ(HZ)
10240
FREQ(HZ): 0.00
PHASE: -360.0
8

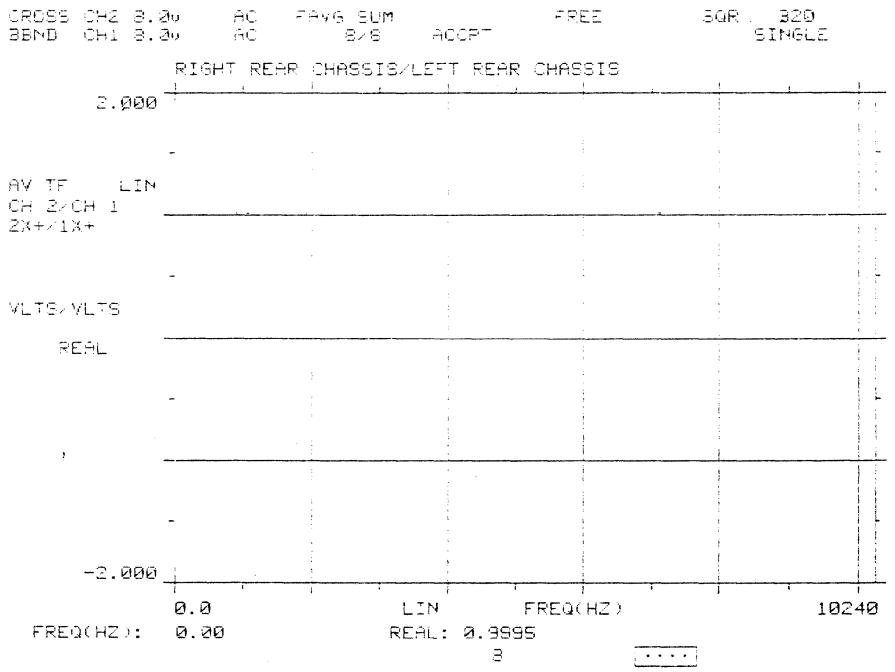
3.4)


RIGHT REAR CHASSIS/LEFT REAR CHASSIS
2.000
AV TF LIN
CH 2/CH 1
2X+/1X+
VLTS/VLTS
REAL
-2.000
0.0
LIN
FREQ(HZ)
10240
Format
1) BODE
2) MAGNITUDE
3) PHASE
>* 4) REAL
5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT
Function: TRANSFER FUNCTION
CPX Function
format: REAL
CGH Blnk Level: 0.0
FREQ(HZ): 0.00
REAL: 0.9995
8

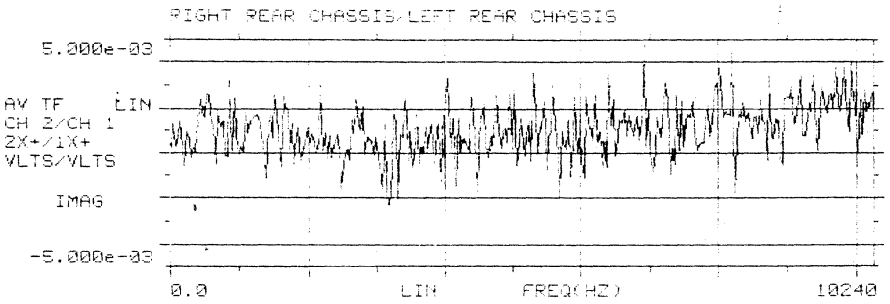
3.4a)


RIGHT REAR CHASSIS/LEFT REAR CHASSIS
2.000
AV TF LIN
CH 2/CH 1
2X+/1X+
VLTS/VLTS
REAL
-2.000
0.0
LIN
FREQ(HZ)
10240
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0
Function: TRANSFER FUNCTION
CPX Function
format: REAL
COH Blnk Level: 0.0
FREQ(HZ): 0.00
REAL: 0.9995
B

3.4b)


CROSS CH2 8.0v AC FAVG SUM FREE BQR 320
BBND CH1 8.0v AC B/8 ACCPT SINGLE
RIGHT REAR CHASSIS/LEFT REAR CHASSIS
2.000
AV TF LIN
CH 2/CH 1
2X+/1X+
VLTS/VLTS
REAL
-2.000
0.0
LIN
FREQ(HZ)
10240
FREQ(HZ): 0.00
REAL: 0.9995
B

3.5)



Format

1) BODE
2) MAGNITUDE
3) PHASE
4) REAL
>* 5) IMAGINARY
6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

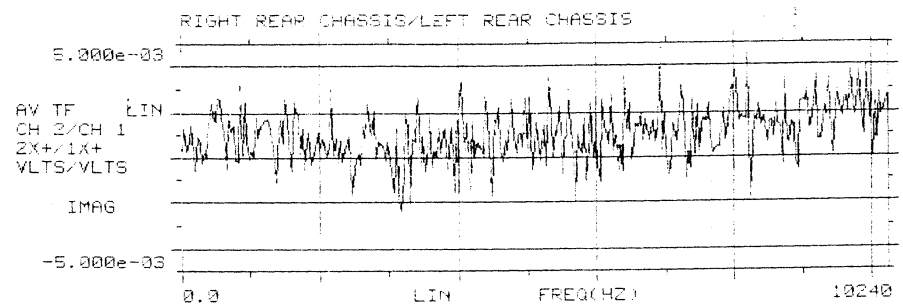
Function: TRANSFER FUNCTION
CPX Function
format: IMAGINARY
COH Blnk Level: 0.0

FREQ(HZ): 0.00

IMAG: 3.791e-04

8

3.5a)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

>

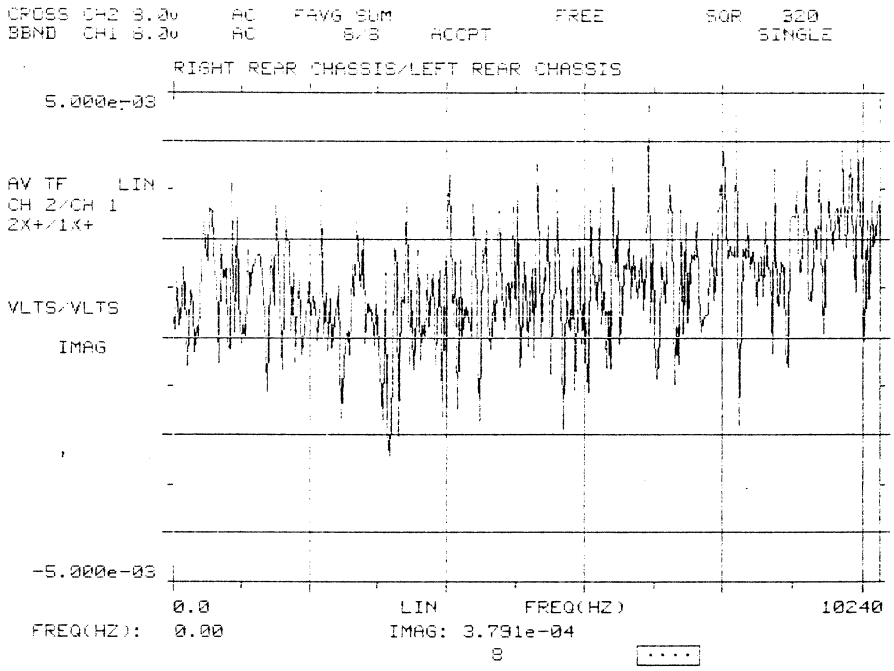
Function: TRANSFER FUNCTION
CPX Function
format: IMAGINARY
COH Blnk Level: 0.0

FREQ(HZ): 0.00

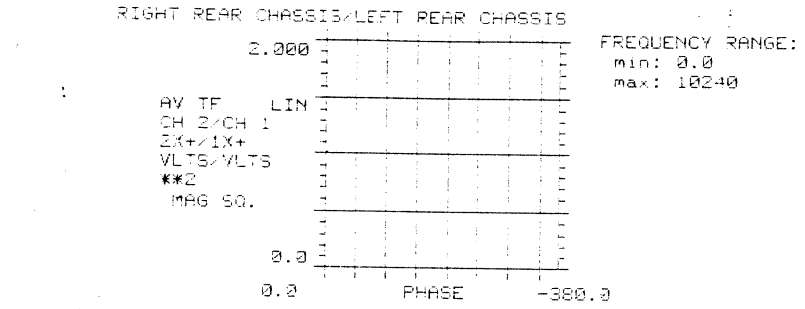
IMAG: 3.791e-04

8

3.5b)



3.6)



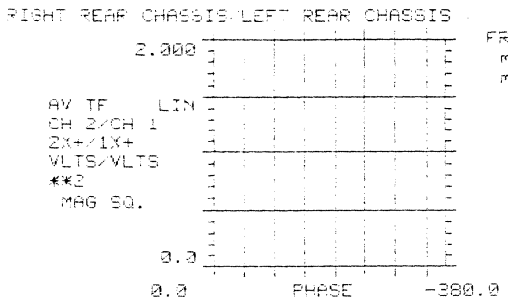
Format

1) BODE
2) MAGNITUDE
3) PHASE
4) REAL
5) IMAGINARY
>* 6) MAGNITUDE vs. PHASE
7) NYQUIST
8) CIRCLE FIT

function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

9

3.6.1)



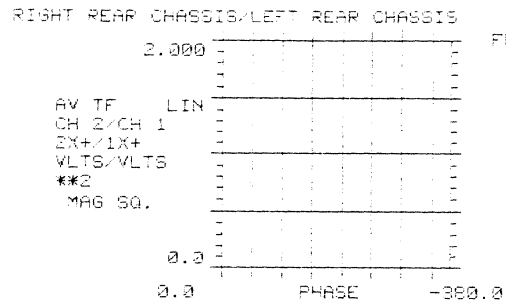
Frequency Scale

>* 1) AUTOSCALE
2) EXPAND

function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

8

3.6.1a)



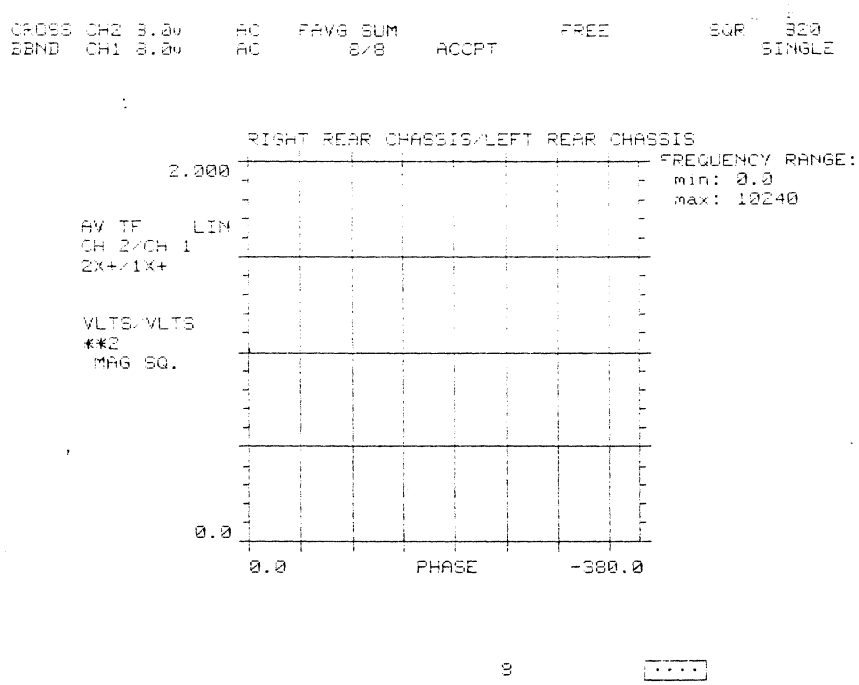
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

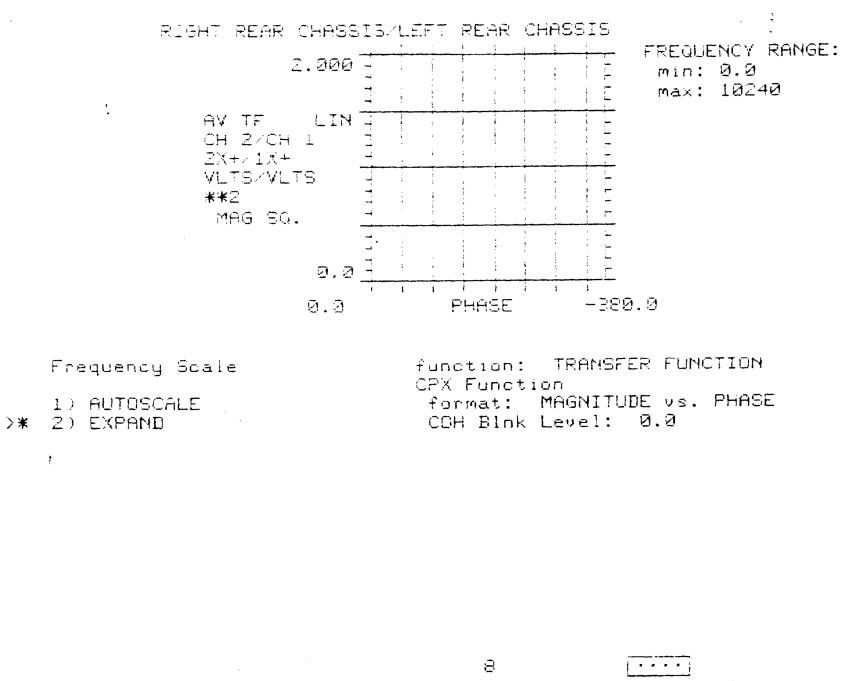
>,

8

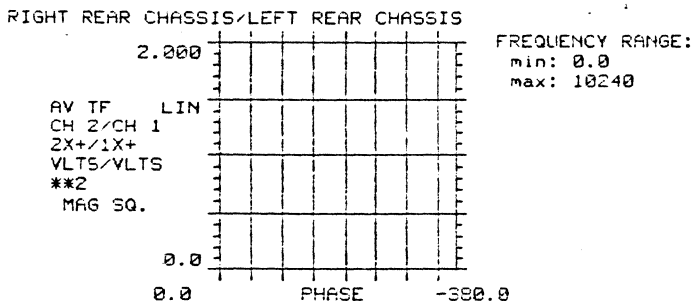
3.6.1b)


CROSS CH2 3.0v AC FAVG SUM FREE SQR 320
BBND CH1 8.0v AC 8/8 ACCPT SINGLE
RIGHT REAR CHASSIS/LEFT REAR CHASSIS
FREQUENCY RANGE:
min: 0.0
max: 10240
2.000
AV TF LIN
CH 2/CH 1
2X+/1X+
VLTS/VLTS
**2
MAG SQ.
0.0
0.0
PHASE
-380.0
8

3.6.2)


RIGHT REAR CHASSIS/LEFT REAR CHASSIS
FREQUENCY RANGE:
min: 0.0
max: 10240
2.000
AV TF LIN
CH 2/CH 1
2X+/1X+
VLTS/VLTS
**2
MAG SQ.
0.0
0.0
PHASE
-380.0
Frequency Scale
1) AUTOSCALE
>* 2) EXPAND
function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0
8

3.6.2a)



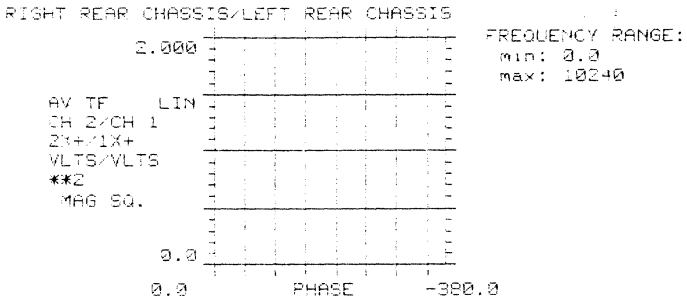
ENTER MIN,MAX for
for Frequency Expansion
* 0.0,10240

function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

>

8

3.6.2b)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

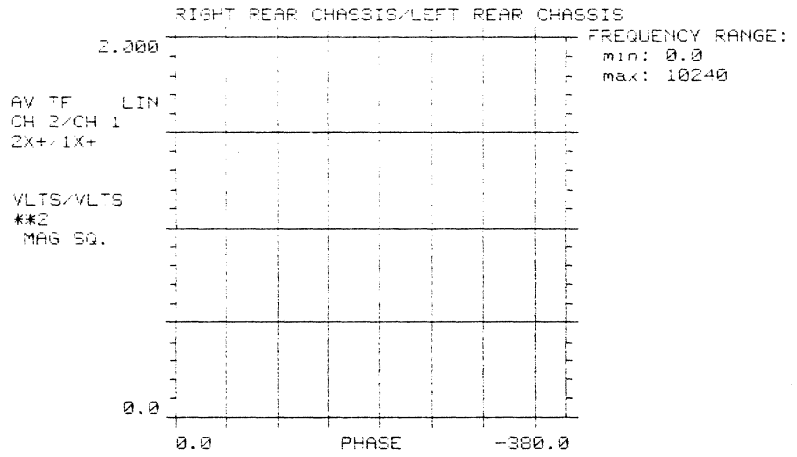
function: TRANSFER FUNCTION
CPX Function
format: MAGNITUDE vs. PHASE
COH Blnk Level: 0.0

>

8

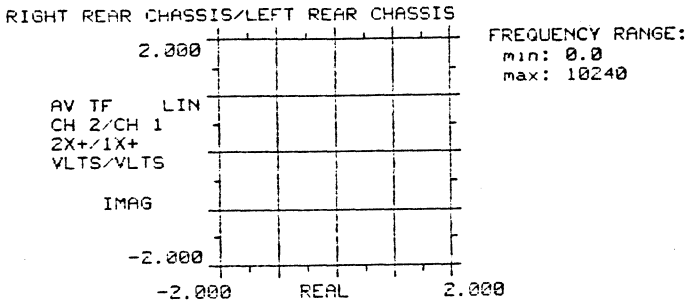
3.6.2c)

```
CROSS CH2 8.0v    AC   FAVG SUM              FREE          SQR   320
BBND  CH1 8.0v    AC       8/8    ACCPT                        SING E
```



8

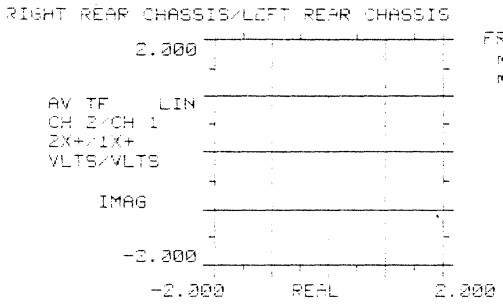
3.7)




```
Format                                  function:  TRANSFER FUNCTION
                                        CPX Function
  1) BODE                                format:  NYQUIST
  2) MAGNITUDE                           COH Blnk Level:  0.0
  3) PHASE
  4) REAL
  5) IMAGINARY
  6) MAGNITUDE vs. PHASE
>*7) NYQUIST
  8) CIRCLE FIT
```

8

3.7.1)



FREQUENCY RANGE:
min: 0.0
max: 10240

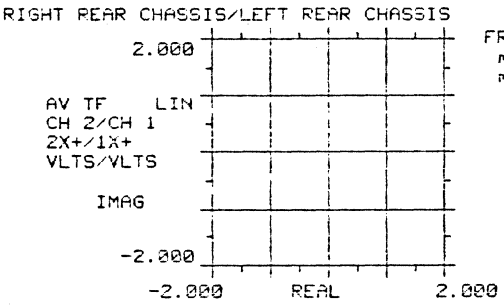
Frequency Scale

>* 1) AUTOSCALE
2) EXPAND

Function: TRANSFER FUNCTION
CPX Function
format: NYQUIST
COH Blnk Level: 0.0

3

3.7.1a)



FREQUENCY RANGE:
min: 0.0
max: 10240

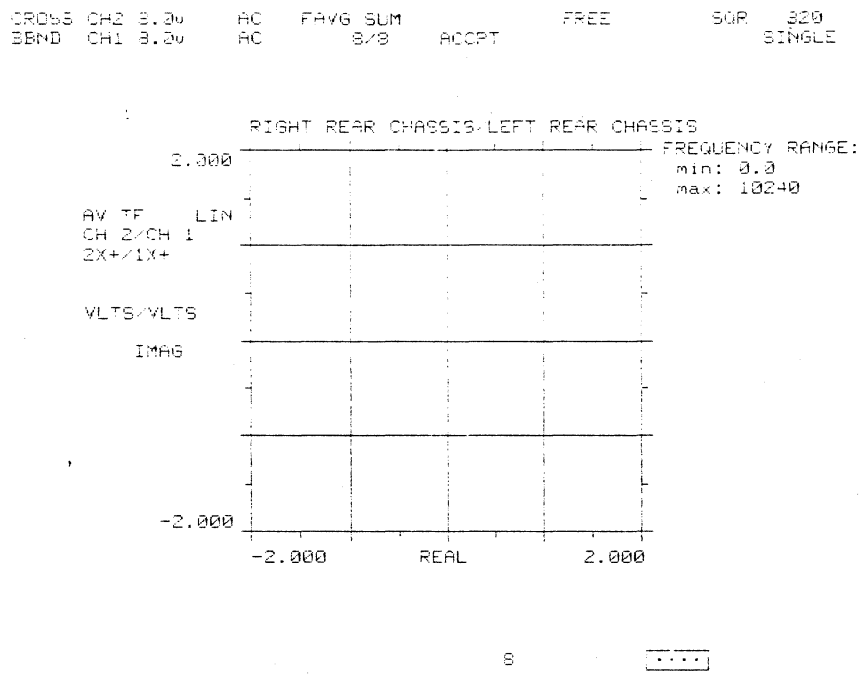
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

>

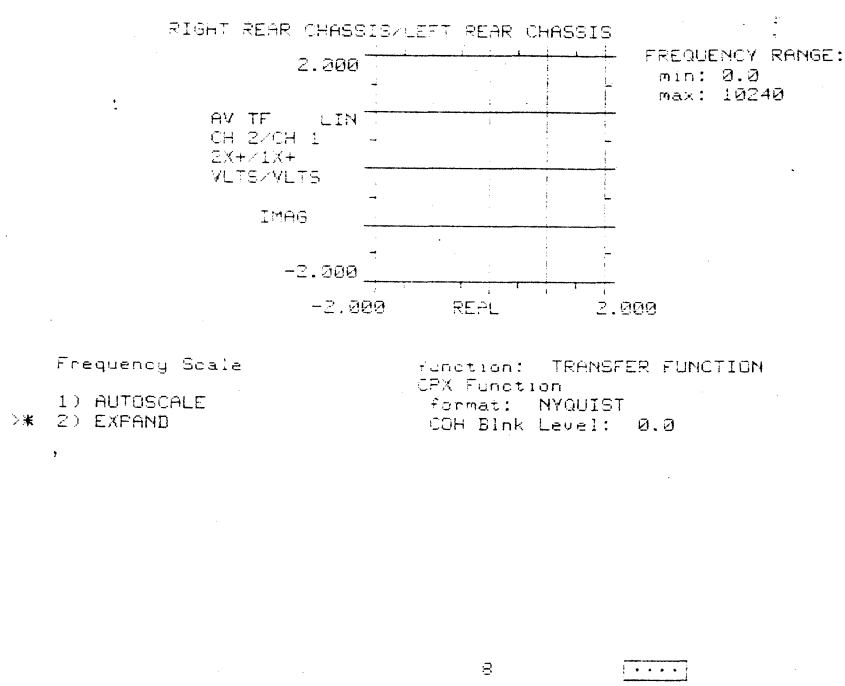
function: TRANSFER FUNCTION
CPX Function
format: NYQUIST
COH Blnk Level: 0.0

8

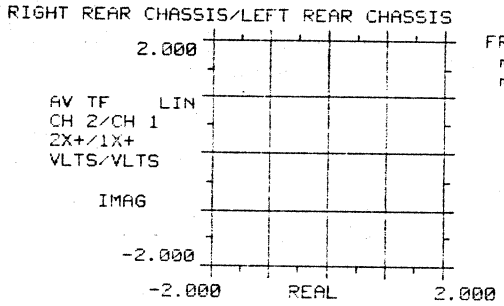
3.7.1b)


CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BBND CH1 8.0v AC 8/8 ACCPT SINGLE
RIGHT REAR CHASSIS/LEFT REAR CHASSIS
FREQUENCY RANGE:
min: 0.0
max: 10240
2.000
AV TF LIN
CH 2/CH 1
2X+/1X+
VLTS/VLTS
IMAG
-2.000
-2.000
REAL
2.000
8

3.7.2)


RIGHT REAR CHASSIS/LEFT REAR CHASSIS
FREQUENCY RANGE:
min: 0.0
max: 10240
2.000
AV TF LIN
CH 2/CH 1
2X+/1X+
VLTS/VLTS
IMAG
-2.000
-2.000
REAL
2.000
Frequency Scale
1) AUTOSCALE
>* 2) EXPAND
function: TRANSFER FUNCTION
CPX Function
format: NYQUIST
COH Blnk Level: 0.0
8

3.7.2a)



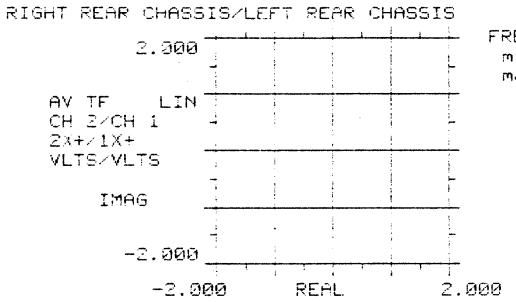
ENTER MIN,MAX for
for Frequency Expansion
* 0.0,10240

>

function: TRANSFER FUNCTION
CPX Function
format: NYQUIST
COH Blnk Level: 0.0

8

3.7.2b)



ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

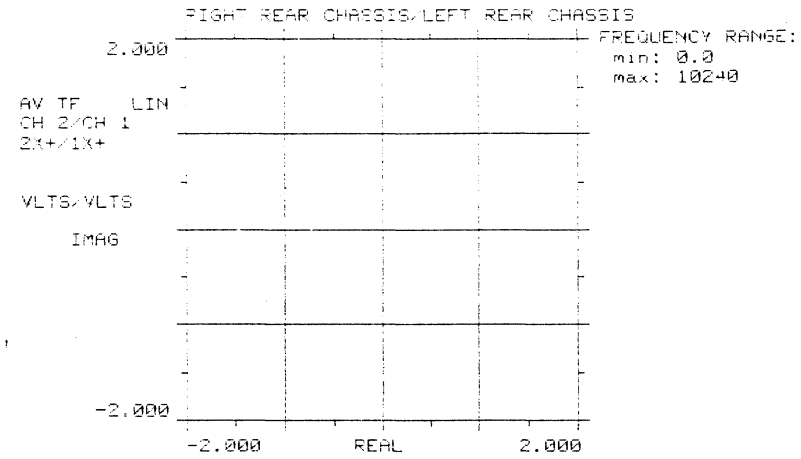
>

function: TRANSFER FUNCTION
CPX Function
format: NYQUIST
COH Blnk Level: 0.0

8

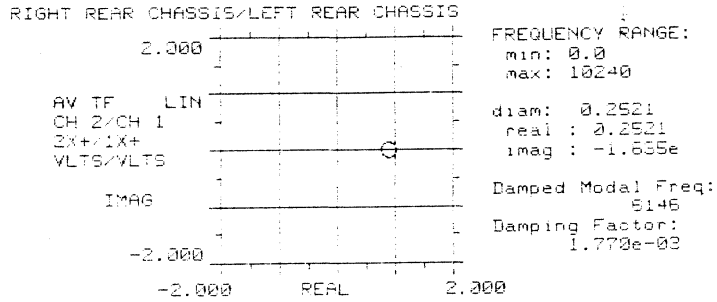
3.7.2c)

```
CROSS CH2 8.0v     AC    FAVG 8LM              FREE          SQR   320
BEND  CH1 8.0v     AC         8/8    ACCPT                     SINGLE
```



8

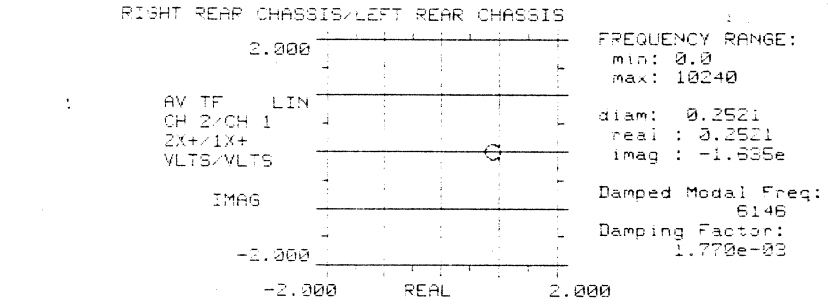
3.8)




```
Format                          Function:  TRANSFER FUNCTION
                                CPX Function
 1) BODE                         format:  CIRCLE FIT
 2) MAGNITUDE                    COH Blnk Level:  0.0
 3) PHASE
 4) REAL
 5) IMAGINARY
 6) MAGNITUDE vs. PHASE
 7) NYQUIST
>* 8) CIRCLE FIT
```

8

3.8a)



ENTER COHERENCE BLANKING LEVEL (0.0 = OFF)
* 0.0

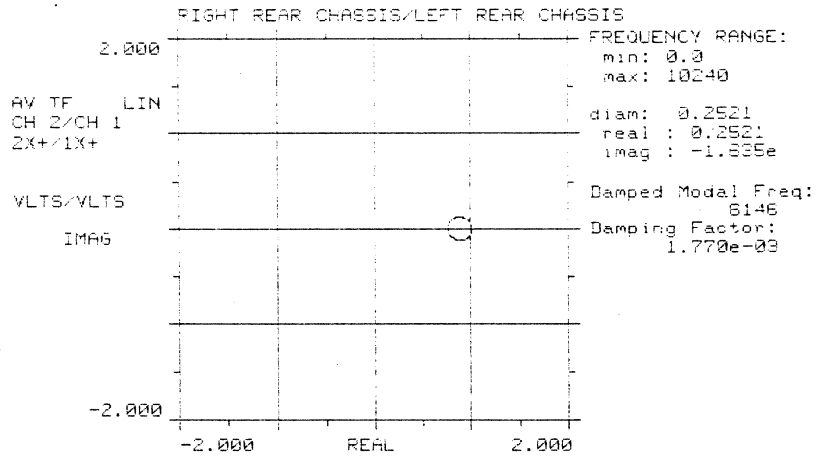
Function: TRANSFER FUNCTION
CPK Function
format: CIRCLE FIT
COH Blnk Level: 0.0

>

8

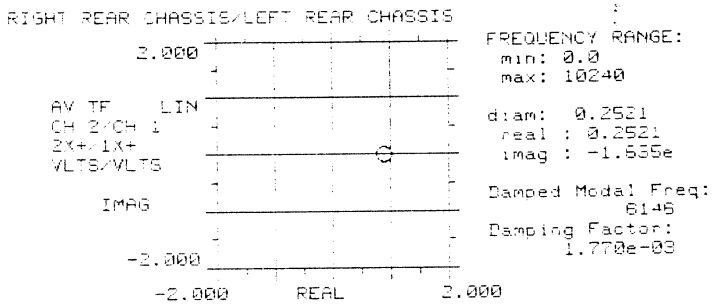
3.8b)

CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BBND CH1 8.0v AC 8/8 ACCPT SINGLE



8

3.8.1)

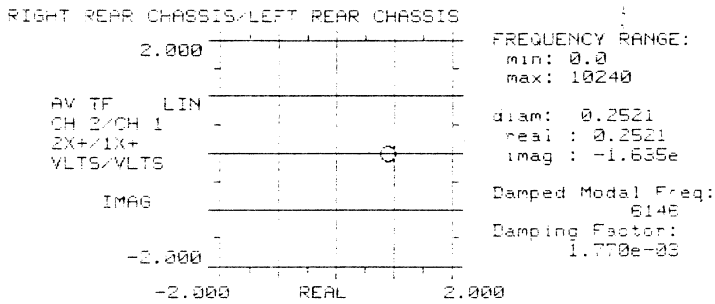


Frequency Scale
>* 1) AUTOSCALE
2) EXPAND

function: TRANSFER FUNCTION
CPX Function
format: CIRCLE FIT
COH Blnk Level: 0.0

8

3.8.2)

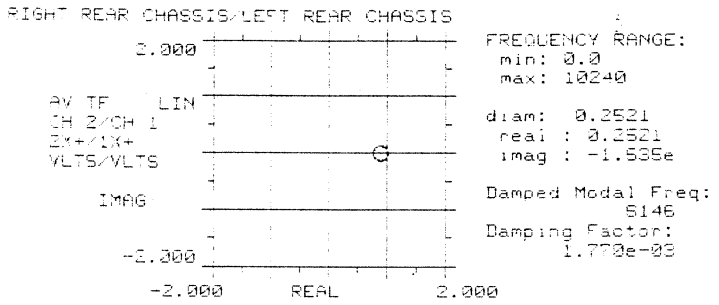


Frequency Scale
1) AUTOSCALE
>* 2) EXPAND

function: TRANSFER FUNCTION
CPX Function
format: CIRCLE FIT
COH Blnk Level: 0.0

8

3.8.2a)



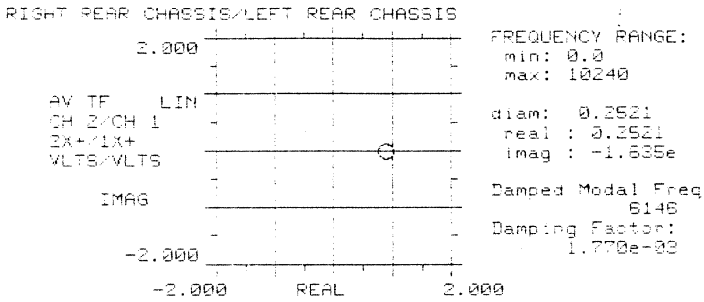
ENTER MIN,MAX for
for Frequency Expansion
* 0.0,10240

function: TRANSFER FUNCTION
CPX Function
format: CIRCLE FIT
COH Blnk Level: 0.0

>

8

3.8.2b)



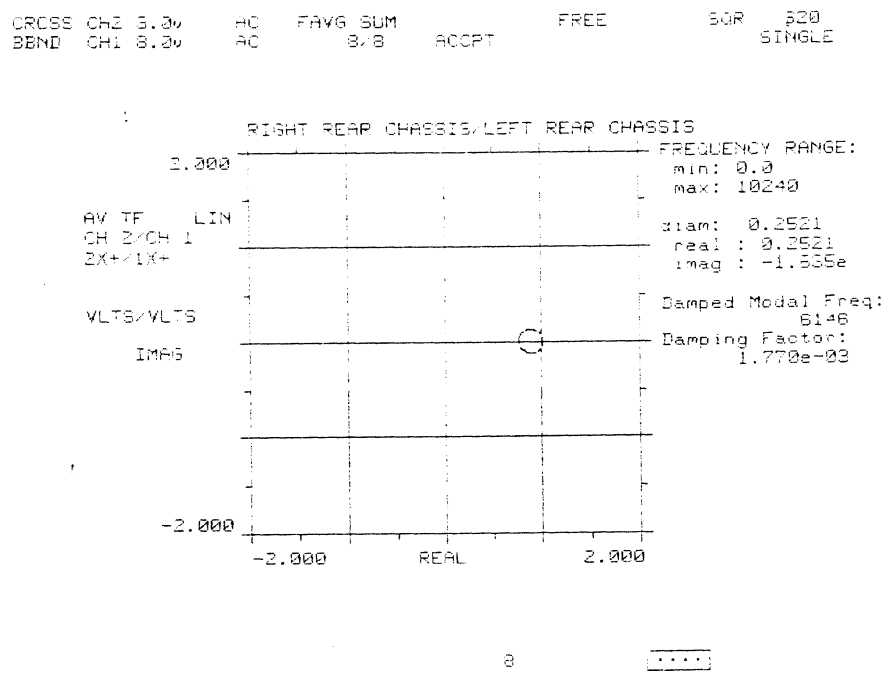
ENTER COHERENCE BLANKING
LEVEL (0.0 = OFF)
* 0.0

function: TRANSFER FUNCTION
CPX Function
format: CIRCLE FIT
COH Blnk Level: 0.0

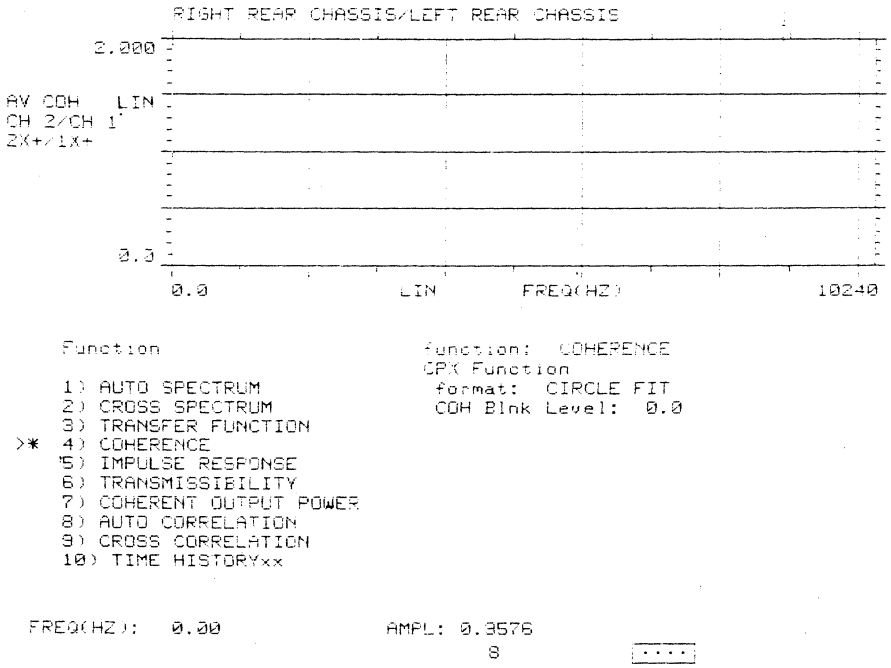
>

8

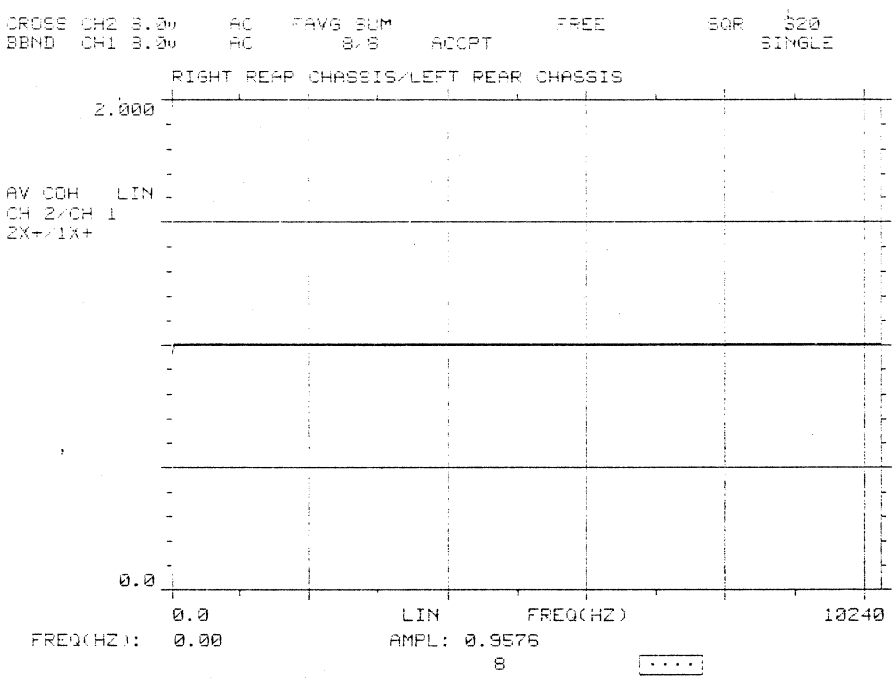
3.8.2c)


CROSS CH2 5.0v AC FAVG SUM FREE 50R 320
BBND CH1 5.0v AC 8/8 ACCPT SINGLE
RIGHT REAR CHASSIS/LEFT REAR CHASSIS
2.000
AV TF LIN
CH 2/CH 1
2X+/1X+
VLTS/VLTS
IMAG
-2.000
-2.000
REAL
2.000
FREQUENCY RANGE:
min: 0.0
max: 10240
diam: 0.2521
real : 0.2521
imag : -1.335e
Damped Modal Freq:
6146
Damping Factor:
1.770e-03
8

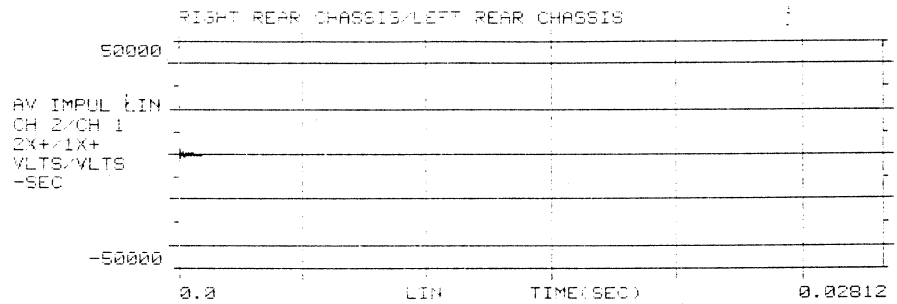
4)


RIGHT REAR CHASSIS/LEFT REAR CHASSIS
2.000
AV COH LIN
CH 2/CH 1
2X+/1X+
0.0
0.0
LIN
FREQ(HZ)
10240
Function
1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
>* 4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORYxx
Function: COHERENCE
CPX Function
format: CIRCLE FIT
COH Blnk Level: 0.0
FREQ(HZ): 0.00
AMPL: 0.3576
8

4a)



5)



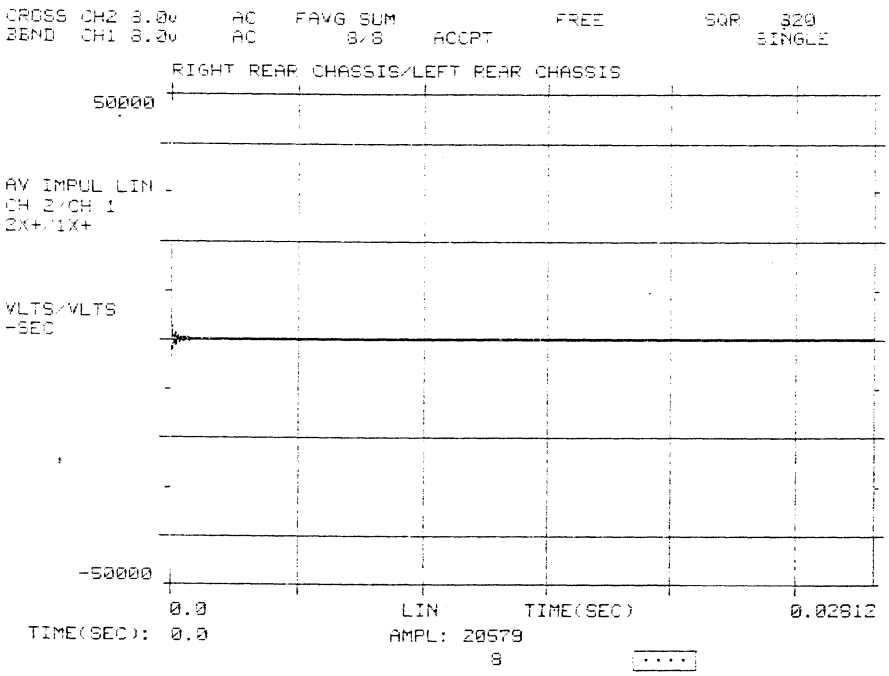
Function

1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
>* 5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORYxx

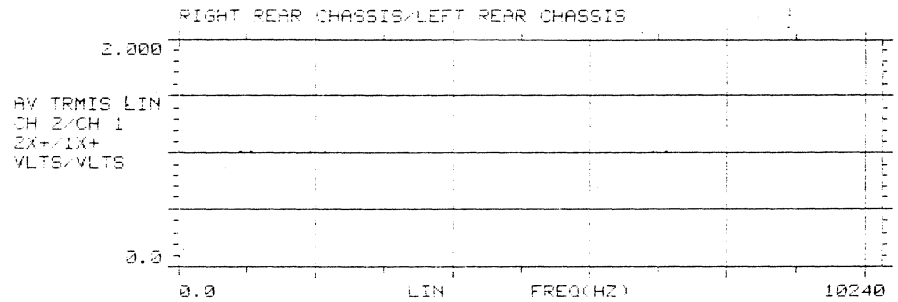
Function: IMPULSE RESPONSE
CPX Function
format: REAL
COH Blnk Level: 0.0

TIME(SEC): 0.0 AMPL: 20579
8

5a)



6)



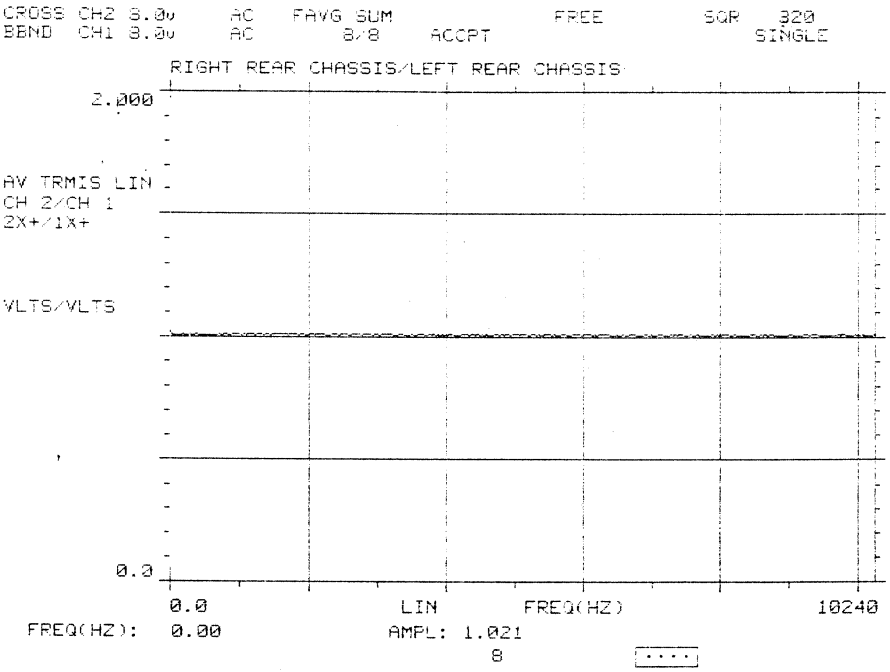
Function

1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
>* 6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORYxx

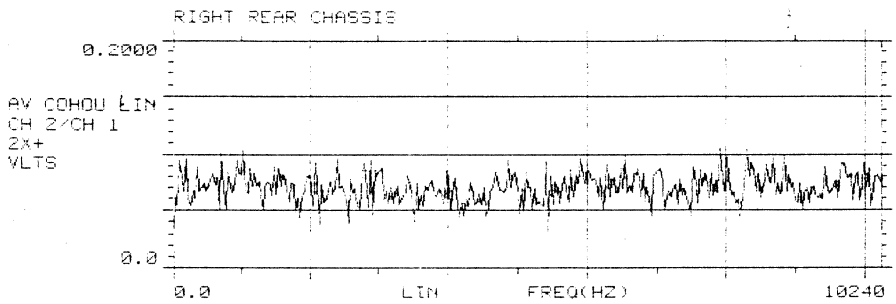
Function: TRANSMISSIBILITY
CPX Function
format: REAL
COH Blnk Level: 0.0

FREQ(HZ): 0.00 AMPL: 1.021
8

6a)



7)



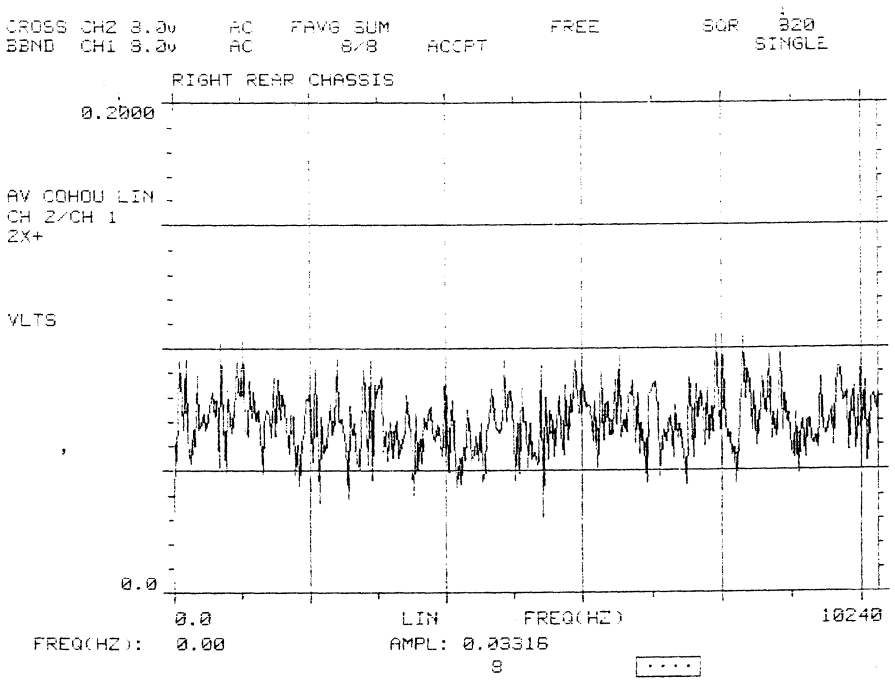
Function

1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
>* 7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORYxx

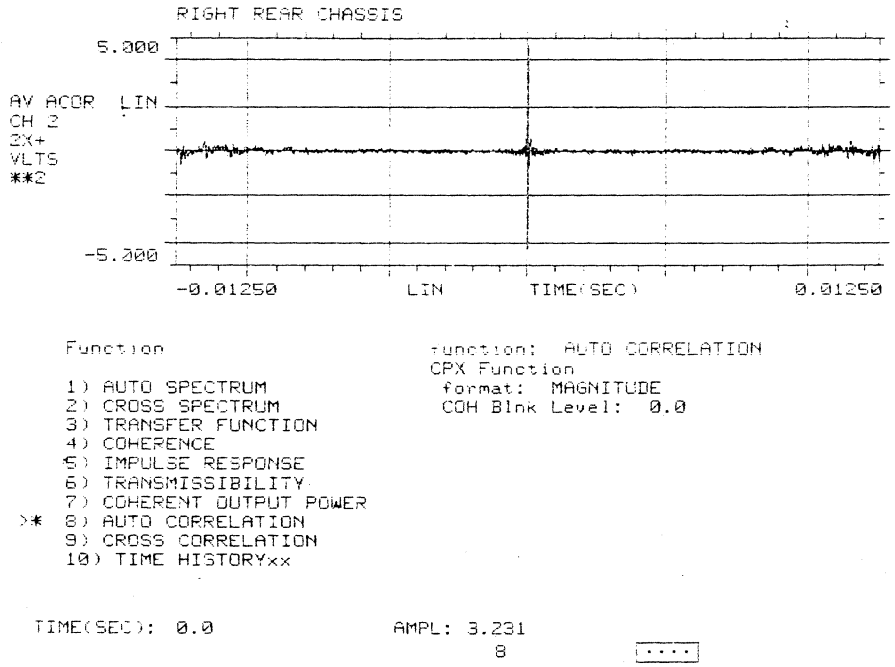
function: COHERENT OUTPUT POWER
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0

FREQ(HZ): 0.00
AMPL: 0.03316
8

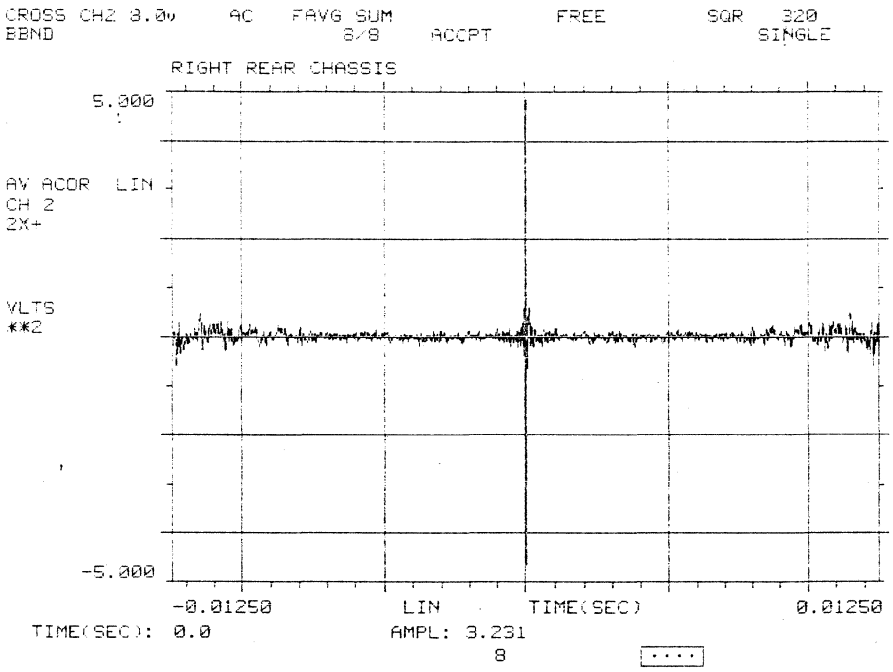
7a)


CROSS CH2 8.0v AC FAVG SUM FREE SQR 320
BBND CH1 8.0v AC 8/8 ACCPT SINGLE
RIGHT REAR CHASSIS
0.2000
AV COHOU LIN
CH 2/CH 1
2X+
VLTS
0.0
0.0 LIN FREQ(HZ) 10240
FREQ(HZ): 0.00 AMPL: 0.03316
8

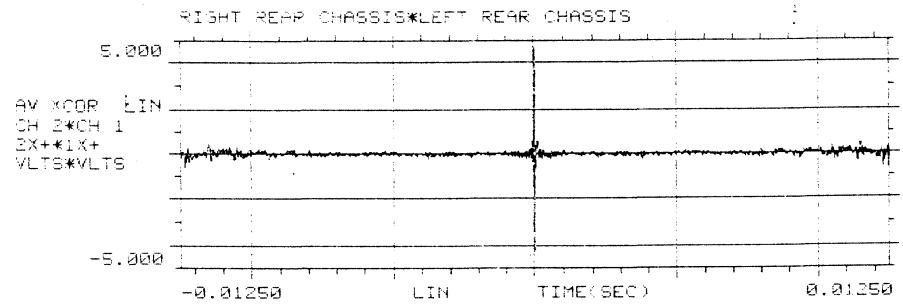
8)


RIGHT REAR CHASSIS
5.000
AV ACOR LIN
CH 2
2X+
VLTS
**2
-5.000
-0.01250 LIN TIME(SEC) 0.01250
Function
1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
>* 8) AUTO CORRELATION
9) CROSS CORRELATION
10) TIME HISTORYxx
Function: AUTO CORRELATION
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0
TIME(SEC): 0.0 AMPL: 3.231
8

8a)



9)



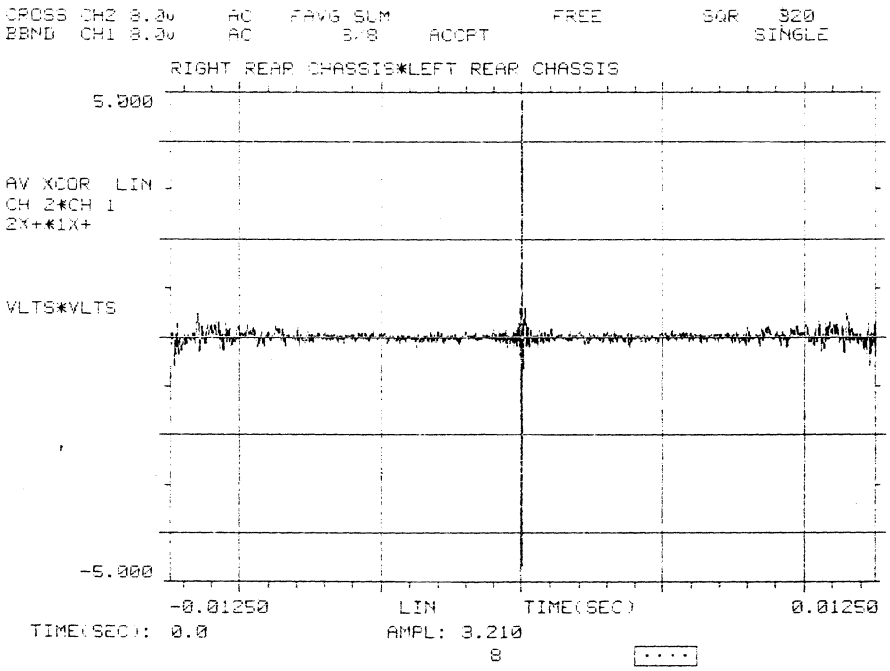
Function

1) AUTO SPECTRUM
2) CROSS SPECTRUM
3) TRANSFER FUNCTION
4) COHERENCE
5) IMPULSE RESPONSE
6) TRANSMISSIBILITY
7) COHERENT OUTPUT POWER
8) AUTO CORRELATION
>* 9) CROSS CORRELATION
10) TIME HISTORYxx

function: CROSS CORRELATION
CPX Function
format: MAGNITUDE
COH Blnk Level: 0.0

TIME(SEC): 0.0 AMPL: 3.210
8

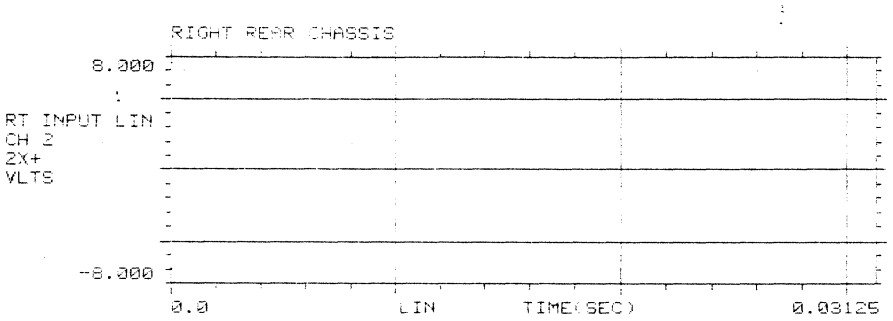
9a)



10) Not available in this version.

L. UNITS Pushbutton Menus and Typical Displays

1)



Amplitude Units

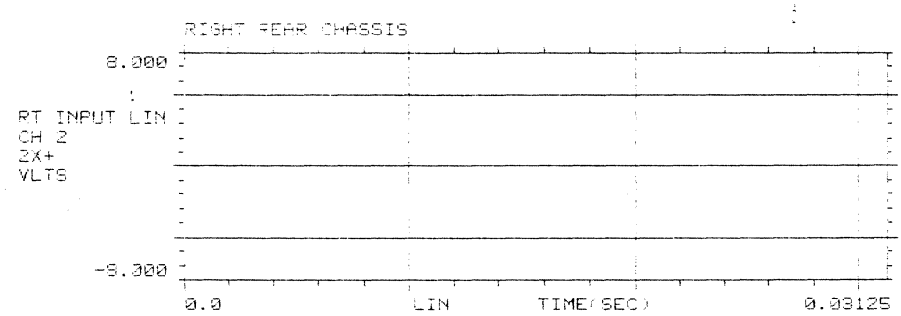
>* 1) V
2) EU
3) dBV
4) dBEU

Ampl Units: V
Ampl Normalization: U
Freq Units: Hz

TIME(SEC): 0.0

AMPL: 0.0
0

1.1)



Normalization

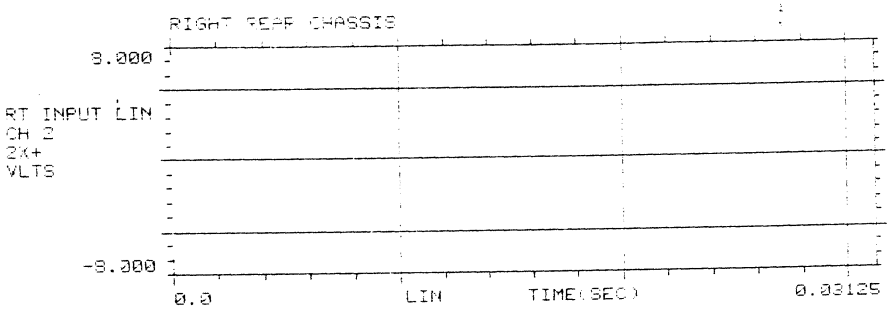
>* 1) U
2) U2
3) U2/Hz
4) U2-SEC/ Hz

Ampl Units: V
Ampl Normalization: U
Freq Units: Hz

TIME(SEC): 0.0

AMPL: 1.866e-03
0

1.1.1)



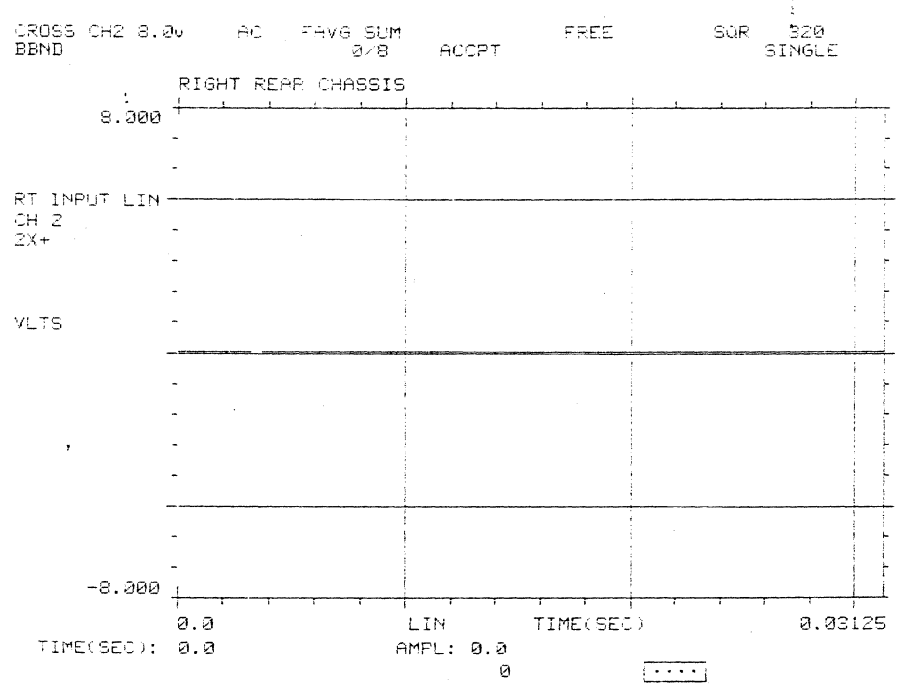
Frequency Units

>* 1) Hz
2) CPMxx
3) ORDERSxx

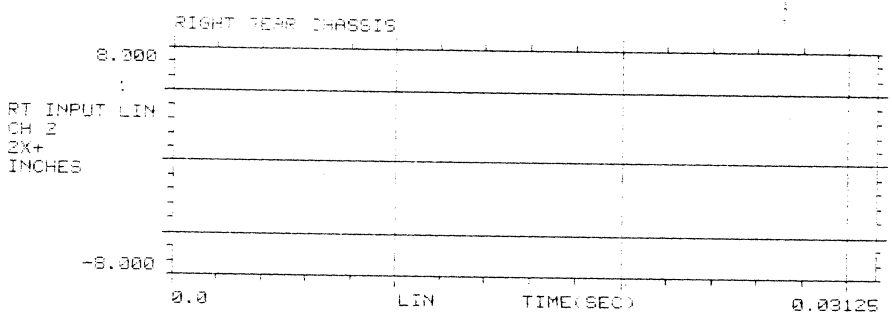
Ampl Units: V
Ampl Normalization: U
Freq Units: Hz

TIME(SEC): 0.0 AMPL: 1.866e-03
0

1.1.1a)



2)



Amplitude Units

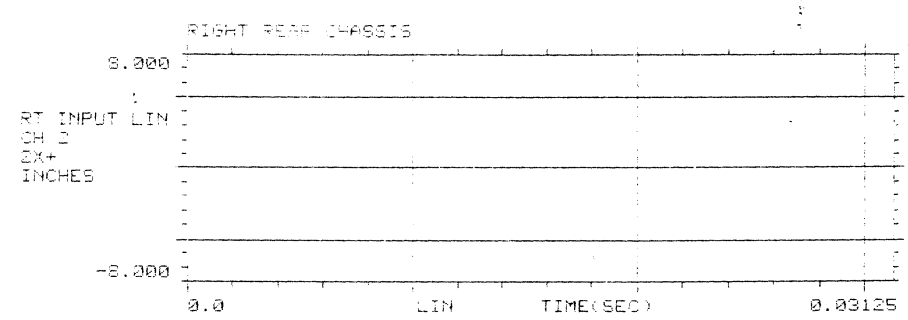
1) V
>* 2) EU
3) dBV
4) dBEU

Ampl Units: EU
Ampl Normalization: U
Freq Units: Hz

TIME(SEC):

AMPL:
0

2.1)



Normalization

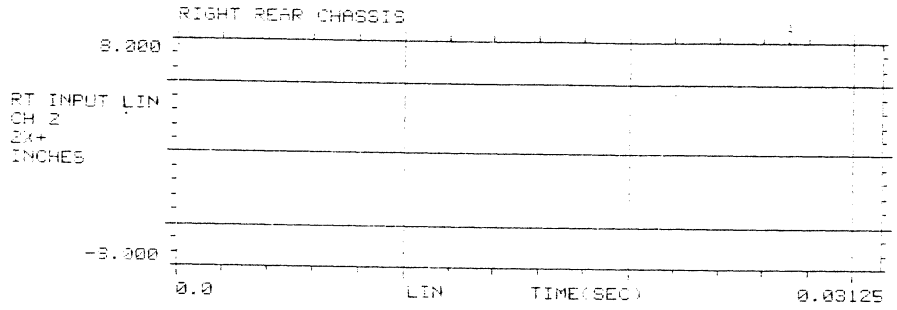
>* 1) U
2) U2
3) U2/Hz
4) U2-SEC/ Hz

Ampl Units: EU
Ampl Normalization: U
Freq Units: Hz

TIME(SEC): 0.0

AMPL: -1.866e-03

2.1.1)



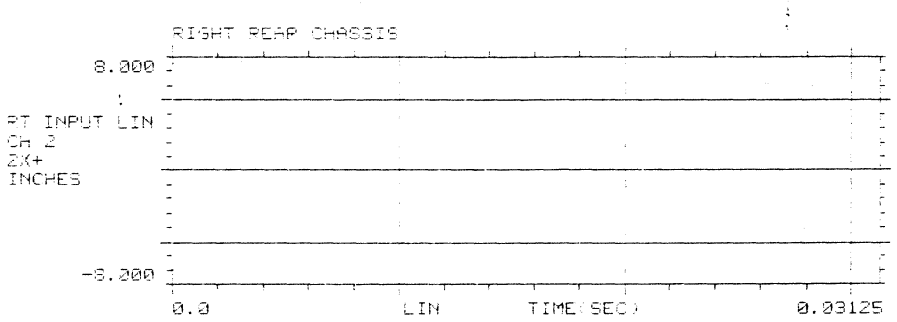
Frequency Units

>* 1) Hz
2) CPMxx
3) ORDERSxx

Ampl Units: EU
Ampl Normalization: U
Freq Units: Hz

TIME(SEC): 0.0 AMPL: -3.731e-03

2.1.2)



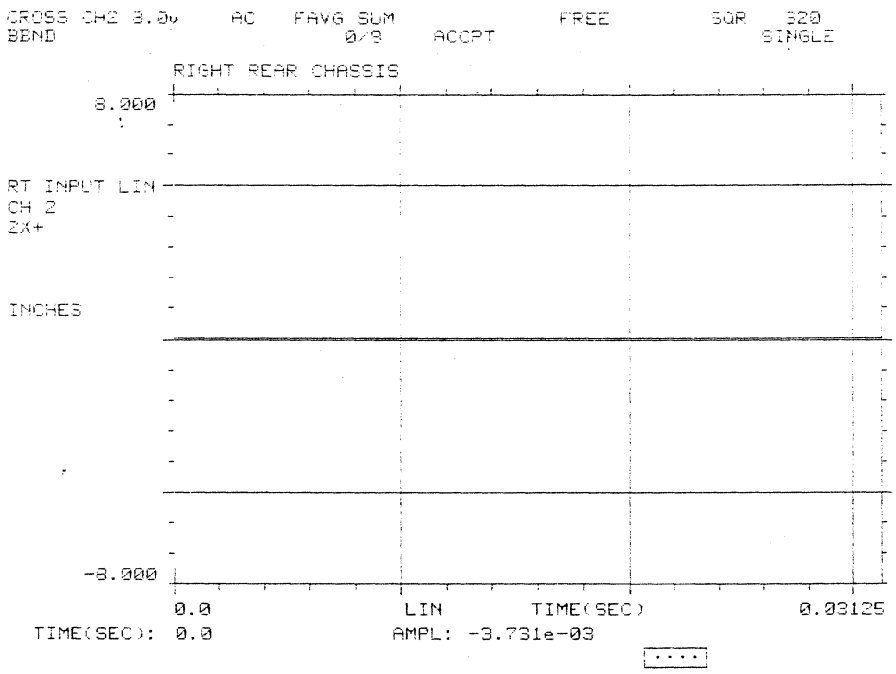
Frequency Units

1) Hz
>* 2) CPMxx
3) ORDERSxx

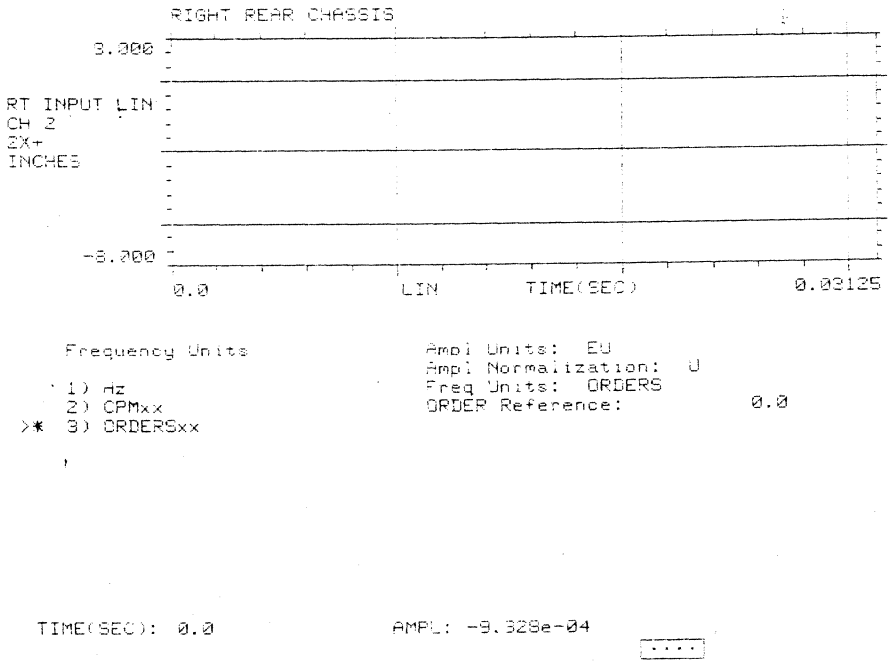
Ampl Units: EU
Ampl Normalization: U
Freq Units: CPM

TIME(SEC): 0.0 AMPL: -1.868e-03

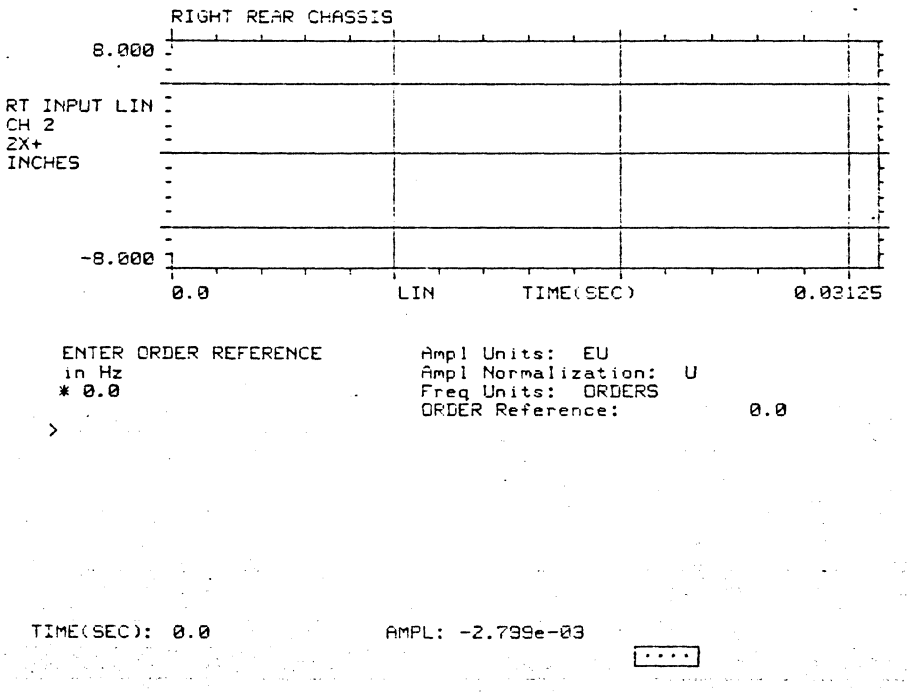
2.1.2a)


CROSS CH2 3.0v AC FAVG SUM FREE SQR 320
BEND 0/3 ACCPT SINGLE
RIGHT REAR CHASSIS
8.000
RT INPUT LIN
CH 2
ZX+
INCHES
-8.000
0.0
LIN
TIME(SEC)
0.03125
TIME(SEC): 0.0
AMPL: -3.731e-03

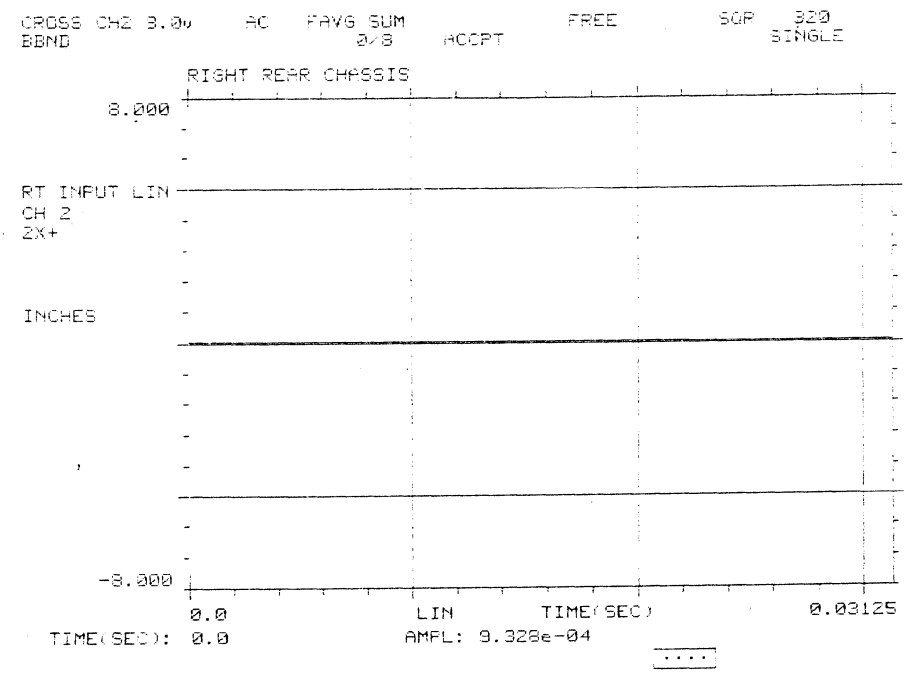
2.1.3)


RIGHT REAR CHASSIS
3.000
RT INPUT LIN
CH 2
ZX+
INCHES
-3.000
0.0
LIN
TIME(SEC)
0.03125
Frequency Units
1) Hz
2) CPMxx
>* 3) ORDERSxx
Ampl Units: EU
Ampl Normalization: U
Freq Units: ORDERS
ORDER Reference: 0.0
TIME(SEC): 0.0
AMPL: -9.328e-04

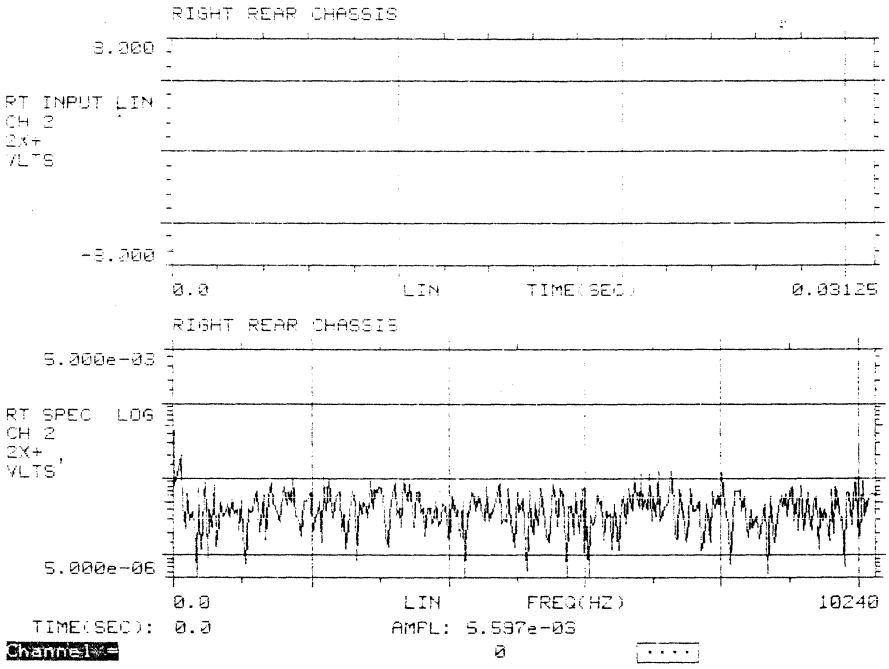
2.1.3a)


RIGHT REAR CHASSIS
8.000
RT INPUT LIN
CH 2
2X+
INCHES
-8.000
0.0
LIN
TIME(SEC)
0.03125
ENTER ORDER REFERENCE
in Hz
* 0.0
>
Ampl Units: EU
Ampl Normalization: U
Freq Units: ORDERS
ORDER Reference: 0.0
TIME(SEC): 0.0
AMPL: -2.799e-03

2.1.3b)


CROSS CH2 3.0v
BBND
AC
FAVG SUM
0/8
ACCPT
FREE
SGP
320
SINGLE
RIGHT REAR CHASSIS
8.000
RT INPUT LIN
CH 2
2X+
INCHES
-8.000
0.0
LIN
TIME(SEC)
0.03125
TIME(SEC): 0.0
AMPL: 9.328e-04

M. CHANNEL Pushbutton



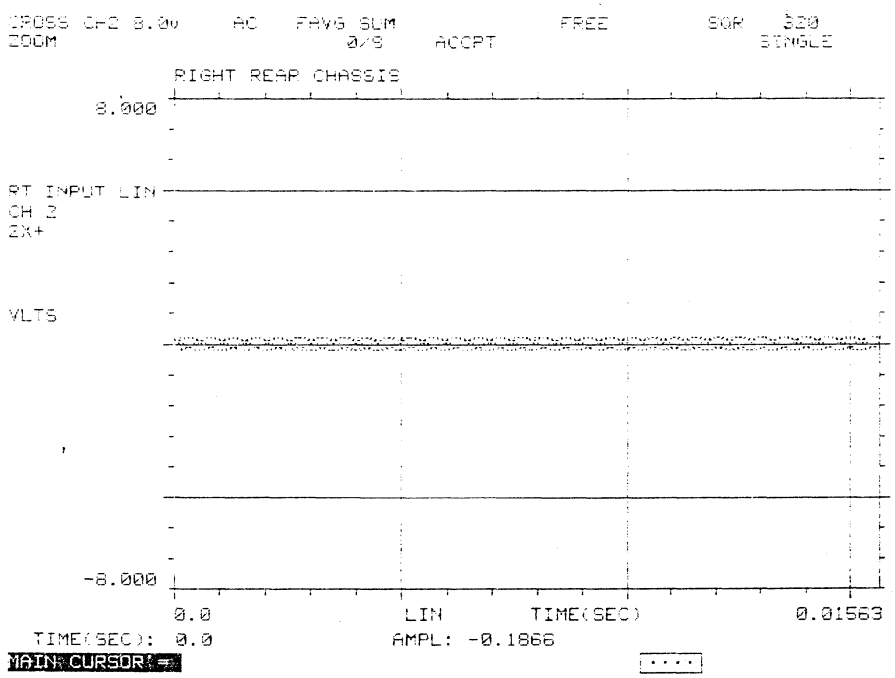
N. BLOCK MATH Pushbutton

Not available in this version.

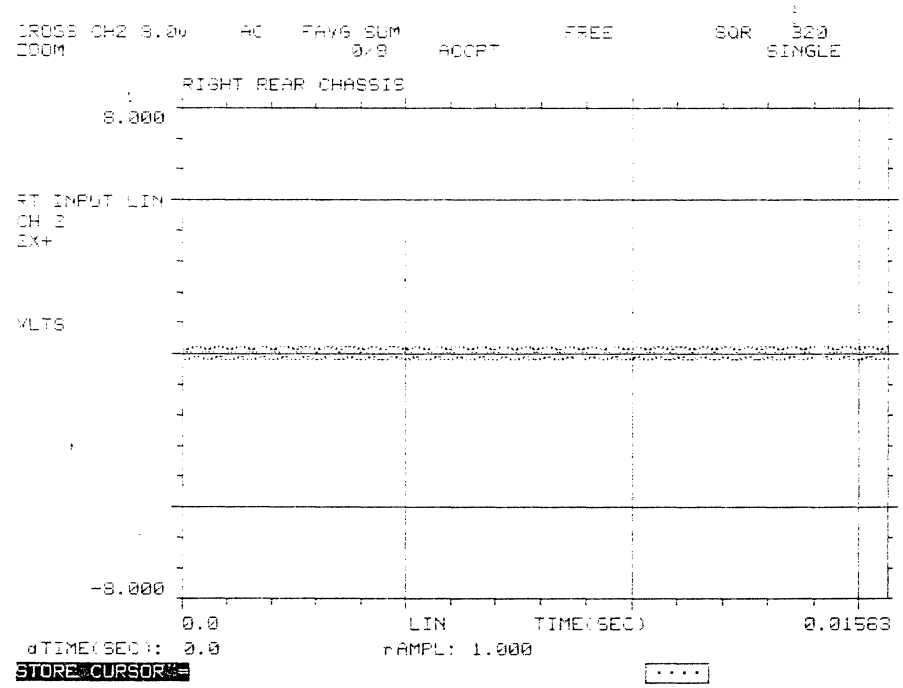
DISPLAY GROUP 3

CURSOR Group Pushbuttons, Typical Displays and Menus

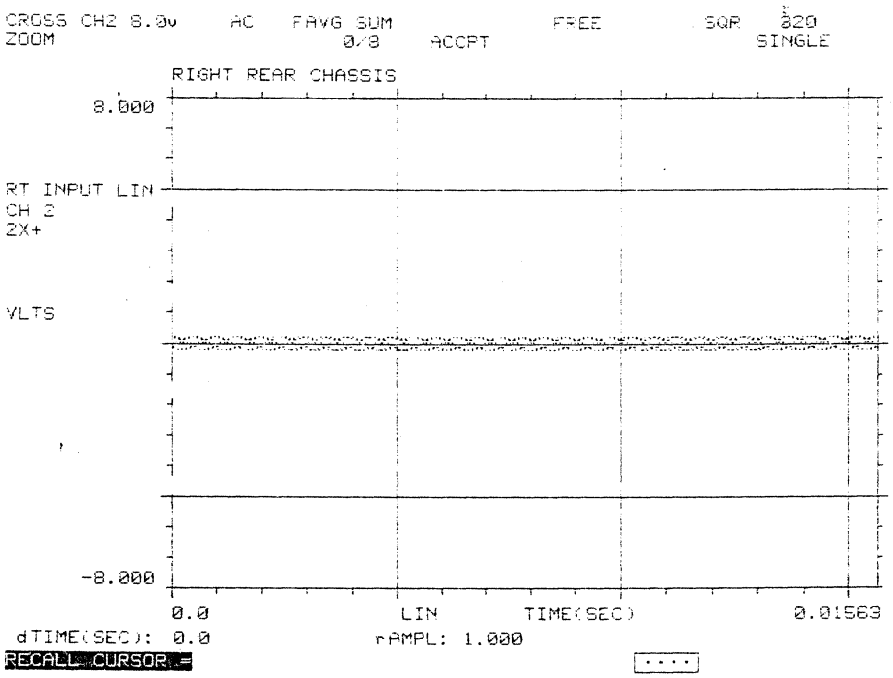
A. MAIN Pushbutton



B. STORE Pushbutton



C. RECALL Pushbutton



DISPLAY GROUP 4

STORAGE Group Pushbuttons, Typical Displays and Menus

A. TYPE Pushbutton

1)

```
   Storage Mode
>* 1) USER FILE
   2) PLOTTER SETUP
   '
```

```
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  create
FAILED
```

1.1)

```
   Storage Grouping
>* 1) STORE ONLY UPPER DISPLAY
   2) STORE ALL XFER FUNCTIONS
   '
```

```
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  create
FAILED
```

1.1.1)

```
   File Allocation
>* 1) SELECT EXISTING FILE
   2) CREATE NEW FILE
   3) DELETIONS FROM FILE
   4) INCREASE SIZE OF FILExx
```

```
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:  JLL
File Status:  OPEN
Label:  JLL2
Size:  7 Blocks
File Format:  MODAL
Previous Action:  deletion
FAILED
```

1.1.1a)

```
   ENTER FILE NAME
   Press Next
   * JLL
   >'
```

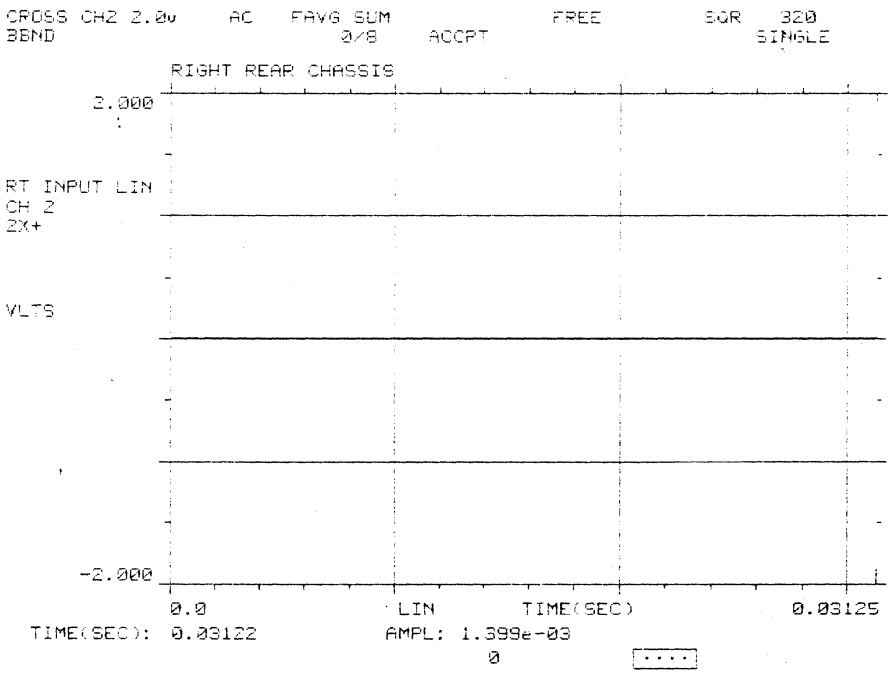
```
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:  JLL
File Status:  OPEN
Label:  JLL2
Size:  7 Blocks
File Format:  MODAL
Previous Action:  open
SUCCEEDED
```

1.1.1b)

```
Action SUCCEEDED
*

,
```

```
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:  JLL
File Status:  OPEN
Label:  JLL2
Size:  7 Blocks
File Format:  MODAL
Previous Action:  open
SUCCEEDED
```

1.1.1c)



1.1.2)

```
File Allocation

  1) SELECT EXISTING FILE
>* 2) CREATE NEW FILE
  '3) DELETIONS FROM FILE
  4) INCREASE SIZE OF FILExx
```

```
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:  JLL
File Status:  OPEN
Label:  JLL2
Size:  7 Blocks
File Format:  MODAL
Previous Action:  open
SUCCEEDED
```

1.1.2a)

```
ENTER FILE NAME                 Restriction:  TRANSFER FUNCTION
Press Next                      Acquisition Type:  SHAKER TEST
* LEG                           Current File:  LEG
                                File Status:  CLOSED
>                               File Format:  MODAL
'                               Previous Action:  open
                                SUCCEEDED
```

1.1.2b)

```
ENTER FILE LABEL                Restriction:  TRANSFER FUNCTION
*                               Acquisition Type:  SHAKER TEST
                                Current File:  LEG
>                               File Status:  CLOSED
                                File Format:  MODAL
                                Previous Action:  open
'                               SUCCEEDED
```

1.1.2.1)

```
File Format                     Restriction:  TRANSFER FUNCTION
                                Acquisition Type:  SHAKER TEST
>* 1) MODAL                    Current File:  LEG
   2) STANDARDxx                File Status:  CLOSED
                                File Format:  MODAL
                                Previous Action:  open
'                               SUCCEEDED
```

1.1.2.1a)

```
ENTER # of Function Records     Restriction:  TRANSFER FUNCTION
* 0                             Acquisition Type:  SHAKER TEST
                                Current File:  LEG
>                               File Status:  CLOSED
                                File Format:  MODAL
                                Previous Action:  open
'                               SUCCEEDED
```

1.1.2.1b)

```
Attempting to Open File        Restriction:  TRANSFER FUNCTION
*                              Acquisition Type:  SHAKER TEST
                               Current File:  LEG
                               File Status:  CLOSED
                               File Format:  MODAL
                               Previous Action:  open
                               SUCCEEDED
```

1.1.2.1c)

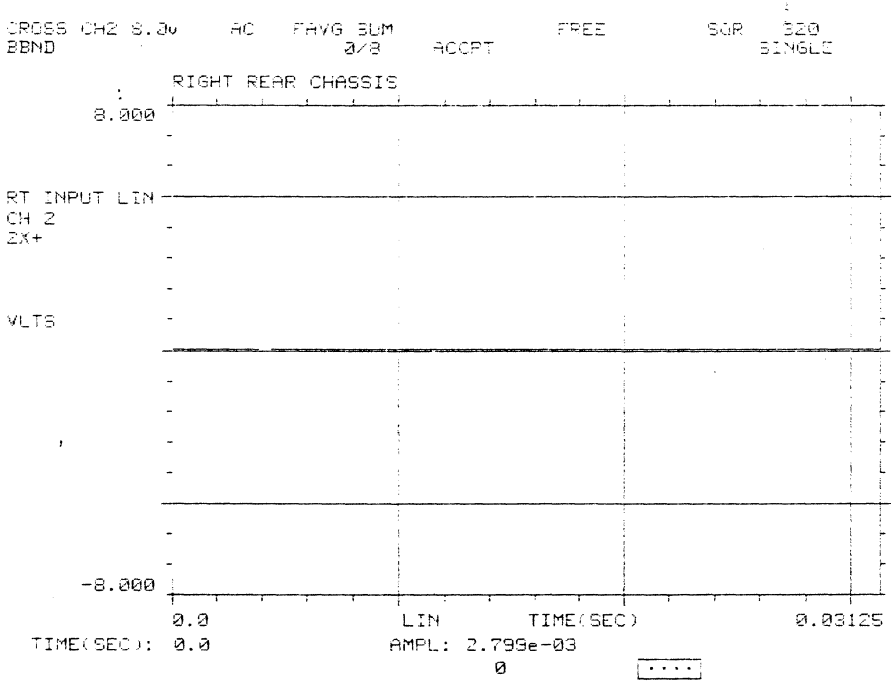
```
Action SUCCEEDED               Restriction:  TRANSFER FUNCTION
*                              Acquisition Type:  SHAKER TEST
                               Current File:  LEG
                               File Status:  OPEN
                               Label:  SHILOH
                               Size:  7 Blocks
                               File Format:  MODAL
                               Previous Action:  create
                               SUCCEEDED
```

1.1.2.1d)

```
Previous Action FAILED         Restriction:  ANY FUNCTION
*                              Acquisition Type:  SHAKER TEST
                               Current File:
                               File Status:  CLOSED
                               File Format:  MODAL
                               Previous Action:  create
                               FAILED
```

```
TIME(SEC): 0.03122          AMPL: 0.01283
no file name given                0
```

1.1.2.1e)



1.2)

```
    Storage Restriction

    1) TRANSFER FUNCTION ONLY
>*  2) ANY DISPLAYED FUNCTION
```

```
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:  JLL
File Status:  OPEN
Label:  JLL2
Size:  7 Blocks
File Format:  MODAL
Previous Action:  create
SUCCEEDED
```

1.2.1)

```
    Acquisition Type

>*  1) SHAKER TEST
    2) IMPACT TEST
```

```
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:  JLL
File Status:  OPEN
Label:  JLL2
Size:  7 Blocks
File Format:  MODAL
Previous Action:  create
SUCCEEDED
```

1.2.2)

```
   File Allocation                 Restriction:  ANY FUNCTION
                                   Acquisition Type:  SHAKER TEST
    1) SELECT EXISTING FILE        Current File:  JLL
>*  2) CREATE NEW FILE             File Status:  OPEN
    3) DELETIONS FROM FILE         Label:  JLL2
    4) INCREASE SIZE OF FILExx     Size:  7 Blocks
                                   File Format:  MODAL
                                   Previous Action:  create
                                   SUCCEEDED
```

1.2.2a)

```
   ENTER FILE NAME                 Restriction:  ANY FUNCTION
   Press Next                      Acquisition Type:  SHAKER TEST
   * JLL                           Current File:  JLL
                                   File Status:  OPEN
  >                                Label:  JLL2
                                   Size:  7 Blocks
                                   File Format:  MODAL
                                   Previous Action:  create
                                   SUCCEEDED
```

1.2.2b)

```
   ENTER FILE LABEL                Restriction:  ANY FUNCTION
   * SHILOH                        Acquisition Type:  SHAKER TEST
                                   Current File:  JLL
  >                                File Status:  OPEN
                                   Label:  SHILOH
                                   Size:  7 Blocks
                                   File Format:  MODAL
                                   Previous Action:  create
                                   SUCCEEDED
```

1.2.2.1)

```
   File Format                     Restriction:  ANY FUNCTION
                                   Acquisition Type:  SHAKER TEST
>*  1) MODAL                      Current File:  JLL
    2) STANDARDxx                  File Status:  OPEN
                                   Label:  SHILOH
                                   Size:  7 Blocks
                                   File Format:  MODAL
                                   Previous Action:  create
                                   SUCCEEDED
```

1.2.2.1a)

```
ENTER # of Function Records          Restriction:  ANY FUNCTION
* 1                                  Acquisition Type:  SHAKER TEST
>                                    Current File:  JLL
                                     File Status:  OPEN
'                                    Label:  SHILOH
                                     Size:  7 Blocks
                                     File Format:  MODAL
                                     Previous Action:  create
                                     SUCCEEDED
```

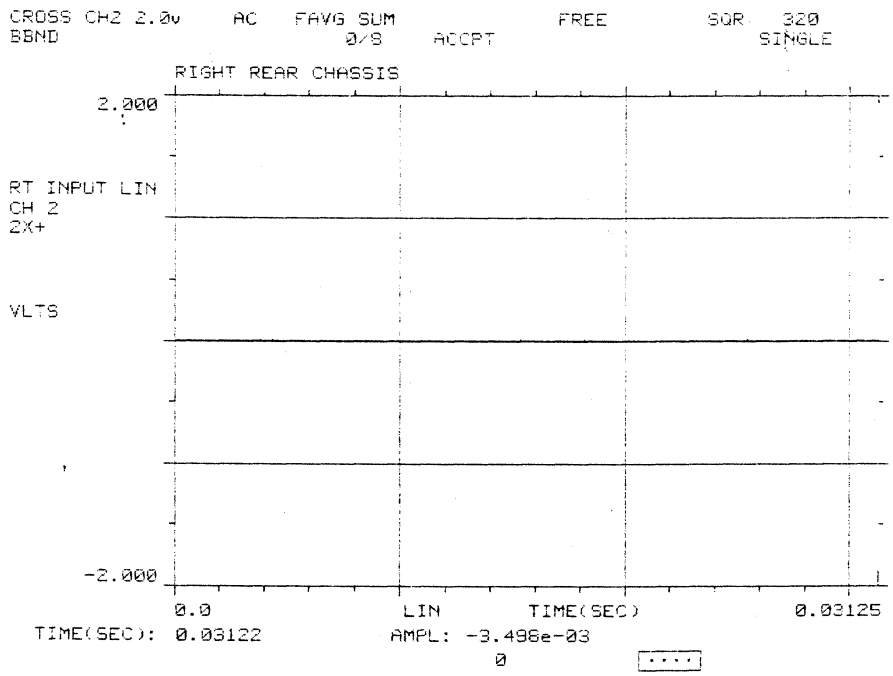
1.2.2.1b)

```
File Name Already Used               Restriction:  ANY FUNCTION
                                     Acquisition Type:  SHAKER TEST
>* 1) Attach to Existing File        Current File:  JLL
   2) Select New Name                File Status:  CLOSED
                                     File Format:  MODAL
'                                    Previous Action:  create
                                     FAILED
```

1.2.2.1c)

```
Action SUCCEEDED                     Restriction:  ANY FUNCTION
*                                    Acquisition Type:  SHAKER TEST
                                     Current File:  JLL
                                     File Status:  OPEN
                                     Label:  JLL2
'                                    Size:  7 Blocks
                                     File Format:  MODAL
                                     Previous Action:  open
                                     SUCCEEDED
```

1.2.2.1d)



1.2.3)

```
   File Allocation                  Restriction:  TRANSFER FUNCTION
                                    Acquisition Type:  SHAKER TEST
    1) SELECT EXISTING FILE         Current File:  LEG
    2) CREATE NEW FILE              File Status:  OPEN
>*  3) DELETIONS FROM FILE          Label:  SHILOH
    4) INCREASE SIZE OF FILExx      Size:  7 Blocks
                                    File Format:  MODAL
                                    Previous Action:  create
                                    SUCCEEDED
```

1.2.3a)

```
   ENTER Range of Records           Restriction:  TRANSFER FUNCTION
   to Delete (n:m)                  Acquisition Type:  SHAKER TEST
   (Press Next)                     Current File:  LEG
   *                                File Status:  OPEN
                                    Label:  SHILOH
  >,                                Size:  7 Blocks
                                    File Format:  MODAL
                                    Previous Action:  create
                                    SUCCEEDED
```

1.2.3b)

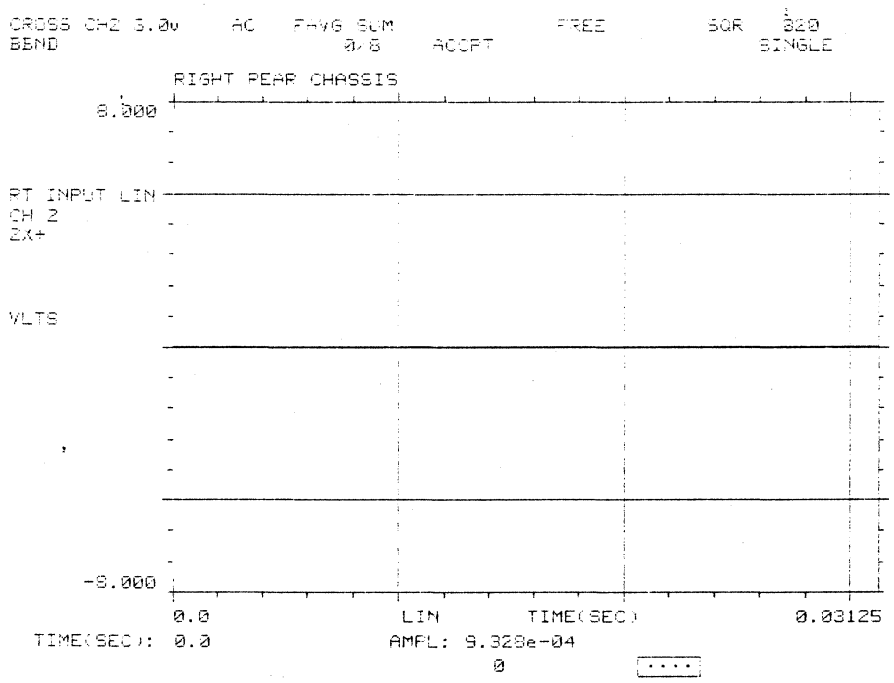
```
Attempting to Delete Records Restriction:  TRANSFER FUNCTION
*                            Acquisition Type:  SHAKER TEST
                             Current File:  LEG
                             File Status:  OPEN
                             Label:  SHILOH
                             Size:  7 Blocks
                             File Format:  MODAL
                             Previous Action:  create
                             SUCCEEDED
```

1.2.3c)

```
Action SUCCEEDED             Restriction:  TRANSFER FUNCTION
*                            Acquisition Type:  SHAKER TEST
                             Current File:  LEG
                             File Status:  OPEN
                             Label:  SHILOH
                             Size:  7 Blocks
                             File Format:  MODAL
                             Previous Action:  deletion
                             SUCCEEDED
```

1.2.4) Not available in this version

1.2.4a)



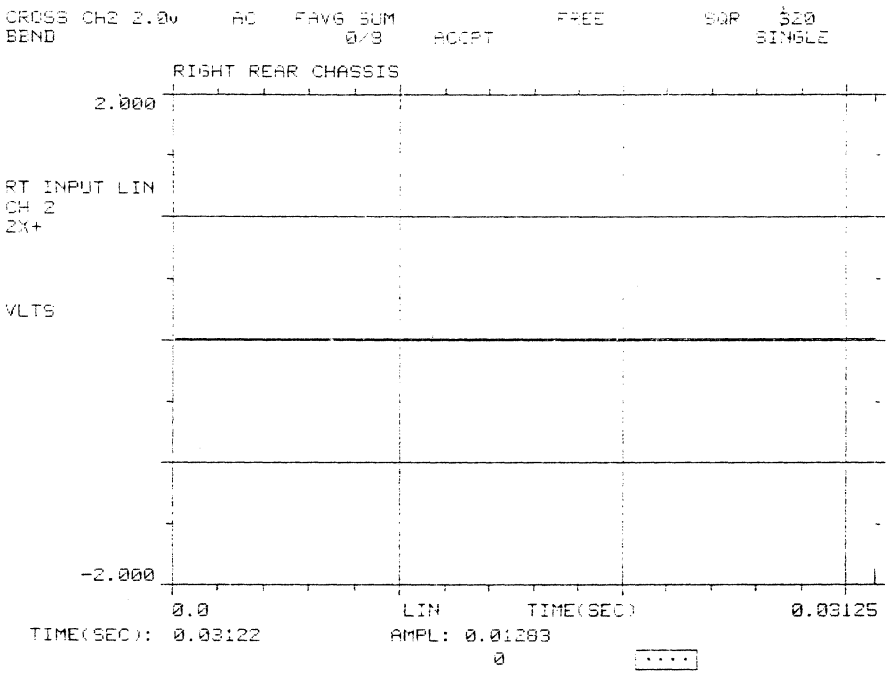
2)

```
   Storage Mode                    Plotter Type:  SCREEN COPY

    1) USER FILE
>*  2) PLOTTER SETUP
```

2.1)

```
   Plotter Type                    Plotter Type:  SCREEN COPY

>*  1) SCREEN COPY
    2) HPGL
    3) TEK 4662
```

2.1.a)



2.2)

```
   Plotter Type
   1) SCREEN COPY
>* 2) HPGL
   3) TEK 4662
```

```
Plotter Type:  HPGL
Pen Speed:  100
```

2.2a)

```
   ENTER % Pen Speed
   * 100

>
```

```
Plotter Type:  HPGL
Pen Speed:  100
```

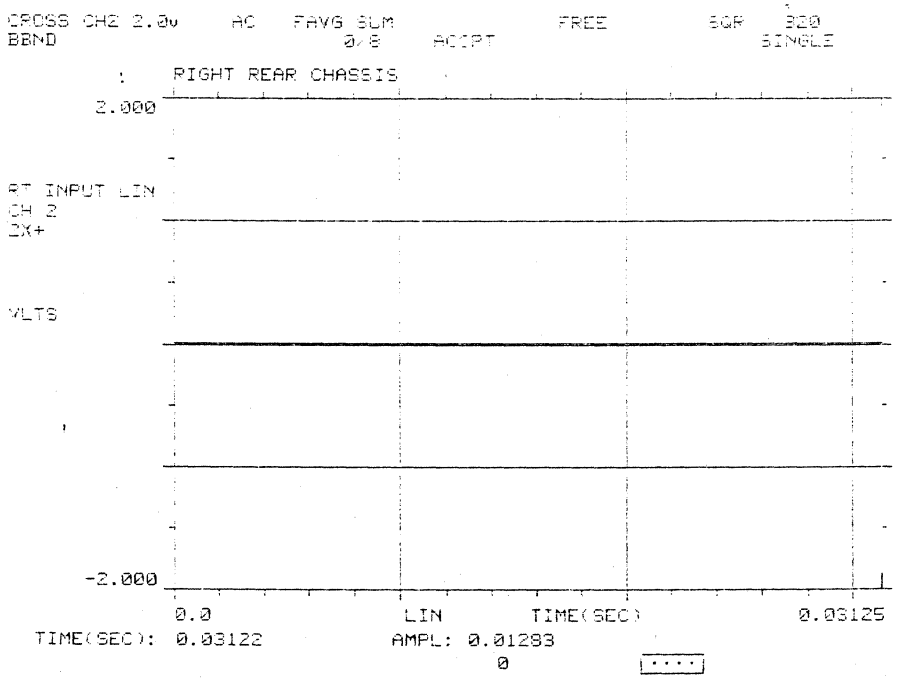
2.3)

```
   Plotter Type                    Plotter Type:  TEK 4662
                                   Pen Speed:  100
   1) SCREEN COPY
   2) HPGL
>* ,3) TEK 4662
```

2.3a)

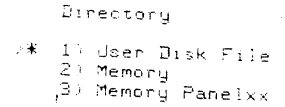
```
 ENTER % Pen Speed                 Plotter Type:  TEK 4662
 * 100                             Pen Speed:  100

>
```

2.3b)

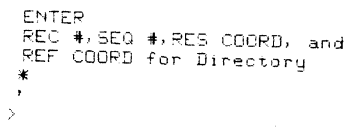


B. DIR Pushbutton

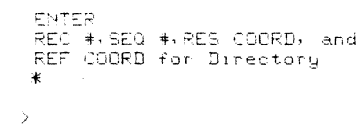
1)



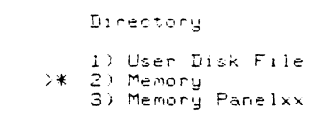
1a)



1b)



2)



2a)

```
B# x-change          B#  resp    ref     labels          date      time

 1    -----empty buffer-----
 2    -----empty buffer-----
 3    -----empty buffer-----
 4    -----empty buffer-----
 5    -----empty buffer-----
 6    -----empty buffer-----
 7    -----empty buffer-----
 8    -----empty buffer-----
 9    -----empty buffer-----
10    -----empty buffer-----
11    -----empty buffer-----
12    -----empty buffer-----
13    -----empty buffer-----
14    -----empty buffer-----
15    -----empty buffer-----
16    -----empty buffer-----
```

3) Not available in this version.

C. STORE Pushbutton

1)

```
   Storage Type/Destination
>* 1) DATA to FILE
   2) DATA to MEMORY
   3) PANEL to FILExx
   4) PANEL to MEMORY
   '
```

```
Type/Dest:  Data to File
Storage Grouping:  Single
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
SUCCEEDED
```

1a)

```
ENTER RES COORD, REF COORD,
and SEQ #
* 2X+,    1Y+,    0

>
'
```

```
Type/Dest:  Data to File
Storage Grouping:  Single
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
SUCCEEDED
```

1b)

```
ENTER RES COORD, REF COORD,
and SEQ #
* 2X+,    1Y+,    0

>
```

```
Type/Dest:  Data to File
Storage Grouping:  Single
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  store
FAILED
```

1c)

```
Attempting to store

*

'
```

```
Type/Dest:  Data to File
Storage Grouping:  Single
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  store
FAILED
```

1d)

```
ACTION FAILED
Previous Action FAILED

*

,
```

```
Type/Dest:  Data to File
Storage Grouping:  Single
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  store
FAILED
```

2)

```
Storage Type/Destination

 1) DATA to FILE
>* 2) DATA to MEMORY
 3) PANEL to FILExx
 4) PANEL to MEMORY
```

```
Type/Dest:  Panel to Memory
Storage Grouping:  Multiple
Restriction:  ANY FUNCTION
Acquisition Type:  IMPACT TEST
Current File:  LEGRAND
File Status:  CLOSED
File Format:  MODAL
Previous Action:  store
FAILED
```

2a)

```
ENTER RES COORD, REF COORD,
and SEQ #
* 2X+,    1Y+,    0

>
```

```
Type/Dest:  Panel to Memory
Storage Grouping:  Single
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  store
FAILED
```

2b)

```
ENTER Memory Buffer #
(Press Next)
* 0

>
,
```

```
Type/Dest:  Panel to Memory
Storage Grouping:  Single
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  store
FAILED
```

2c)

```
Attempting to store

*

'
```

```
Type/Dest:  Panel to Memory
Storage Grouping:  Multiple
Restriction:  ANY FUNCTION
Acquisition Type:  IMPACT TEST
Current File:  LEGRAND
File Status:  CLOSED
File Format:  MODAL
Previous Action:  store
FAILED
```

2d)

```
ACTION FAILED
Previous Action FAILED

*

'
```

```
Type/Dest:  Panel to Memory
Storage Grouping:  Multiple
Restriction:  ANY FUNCTION
Acquisition Type:  IMPACT TEST
Current File:  LEGRAND
File Status:  CLOSED
File Format:  MODAL
Previous Action:  store
FAILED
```

3) Not available in this version.

```
   Storage Type/Destination

   1) DATA to FILE
   2) DATA to MEMORY
>* 3) PANEL to FILExx
   4) PANEL to MEMORY
```

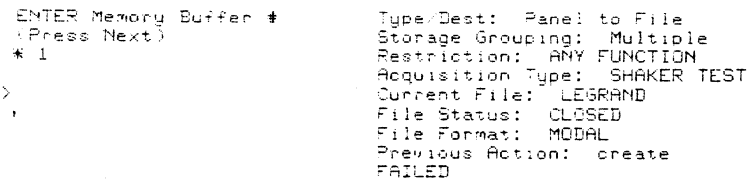
```
Type/Dest:  Data to Memory
Storage Grouping:  Multiple
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:  LEGRAND
File Status:  CLOSED
File Format:  MODAL
Previous Action:  create
FAILED
```

4)

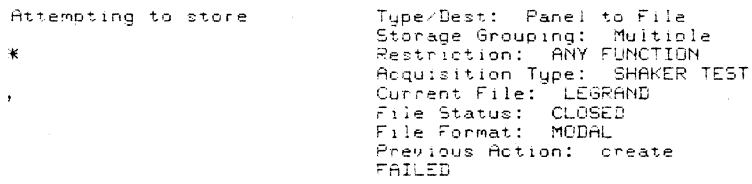
```
   Storage Type/Destination

   1) DATA to FILE
   2) DATA to MEMORY
   3) PANEL to FILExx
>* 4) PANEL to MEMORY

'
```

```
Type/Dest:  Panel to File
Storage Grouping:  Multiple
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:  LEGRAND
File Status:  CLOSED
File Format:  MODAL
Previous Action:  create
FAILED
```

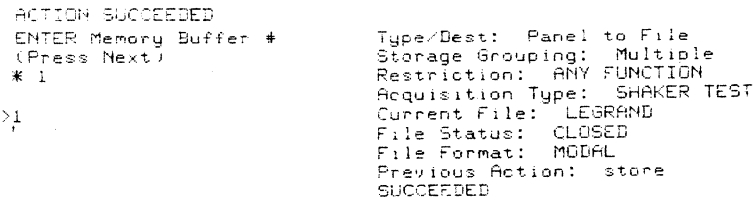
4a)


ENTER Memory Buffer #
(Press Next)
* 1
>
Type/Dest: Panel to File
Storage Grouping: Multiple
Restriction: ANY FUNCTION
Acquisition Type: SHAKER TEST
Current File: LEGRAND
File Status: CLOSED
File Format: MODAL
Previous Action: create
FAILED

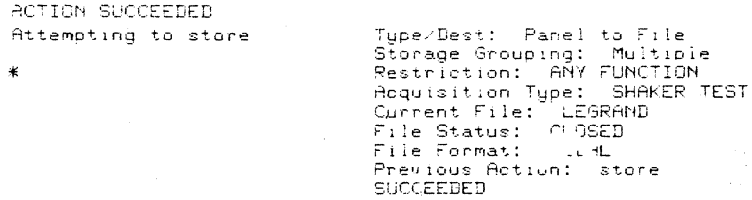
4b)


Attempting to store
*
Type/Dest: Panel to File
Storage Grouping: Multiple
Restriction: ANY FUNCTION
Acquisition Type: SHAKER TEST
Current File: LEGRAND
File Status: CLOSED
File Format: MODAL
Previous Action: create
FAILED

4c)


ACTION SUCCEEDED
ENTER Memory Buffer #
(Press Next)
* 1
>1
Type/Dest: Panel to File
Storage Grouping: Multiple
Restriction: ANY FUNCTION
Acquisition Type: SHAKER TEST
Current File: LEGRAND
File Status: CLOSED
File Format: MODAL
Previous Action: store
SUCCEEDED

4d)


ACTION SUCCEEDED
Attempting to store
*
Type/Dest: Panel to File
Storage Grouping: Multiple
Restriction: ANY FUNCTION
Acquisition Type: SHAKER TEST
Current File: LEGRAND
File Status: CLOSED
File Format: MODAL
Previous Action: store
SUCCEEDED

D. RECALL Pushbutton

1)

```
   Recall Type/Source
>* 1) DATA from FILE
   2) DATA from MEMORY
   3) PANEL from FILExx
   4) PANEL from MEMORY
```

```
Type/Souce:  Data from Memory
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
```

1a)

```
   ENTER REC #,SEQ #,RES COORD
   and REF COORD
   *

,>
```

```
Type/Souce:  Data from Memory
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
```

2)

```
   Recall Type/Source

   1) DATA from FILE
>* 2) DATA from MEMORY
   3) PANEL from FILExx
   4) PANEL from MEMORY
```

```
Type/Souce:  Panel from Memory
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
FAILED
```

2a)

```
   ENTER Memory Buffer #
   * 0

,>
```

```
Type/Souce:  Panel from Memory
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
FAILED
```

3) Not available in this version.

```
   Recall Type/Source

    1) DATA from FILE
    2) DATA from MEMORY
>*  3) PANEL from FILExx
    4) PANEL from MEMORY
```

```
Type/Souce:  Data from Memory
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
FAILED
```

3a)

```
   ENTER Memory Buffer #
   * 0

  >
```

```
Type/Souce:  Data from Memory
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
FAILED
```

3b)

```
   Previous Action FAILED

   *
```

```
Type/Souce:  Panel from Memory
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
FAILED
```

4)

```
   Recall Type/Source

    1) DATA from FILE
    2) DATA from MEMORY
    3) PANEL from FILExx
>*  4) PANEL from MEMORY
```

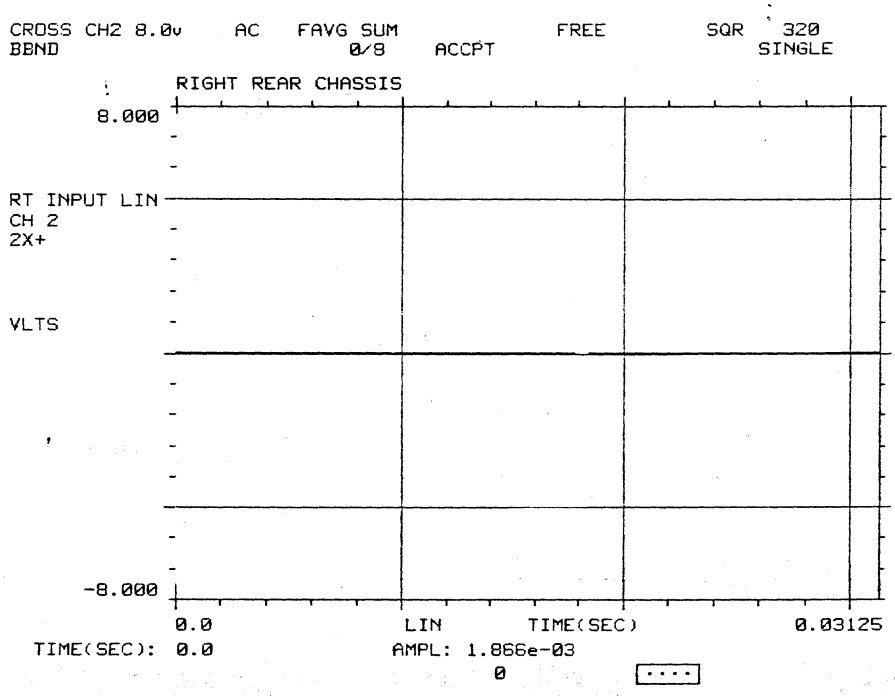
```
Type/Souce:  Panel from File
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
FAILED
```

4a)

```
Recall Type/Source

  1) DATA from FILE
  2) DATA from MEMORY
  3) PANEL from FILExx
>* 4) PANEL from MEMORY
```

```
Type/Souce:  Panel from File
Restriction:  ANY FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
FAILED
```

4b)



DISPLAY GROUP 5

MEASUREMENT SETUP Group Pushbuttons, Typical Menus and Displays

A. AVERAGE Pushbutton

1)

```
Averaging Domain
>*  1) FREQUENCY
    2) TIMExx
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.1)

```
Averaging Mode
>*  1) SUMMATION
    2) SUBTRACTION
    3) EXPONENTIAL
    4) PEAK HOLD
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.1a)

```
ENTER # of Averages
* 8
>
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.1.1)

```
Pre-average Autorange
>*  1) OFF
    2) ON
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.1.1.1)

```
   Data Acceptance into Avg
>* 1) ACCEPT EVERY FRAME
   2) MANUAL ACCEPT(CONTINUE)
   3) AUTO REJECT
   4) AUTO REJECT w/ DBL HITS
```

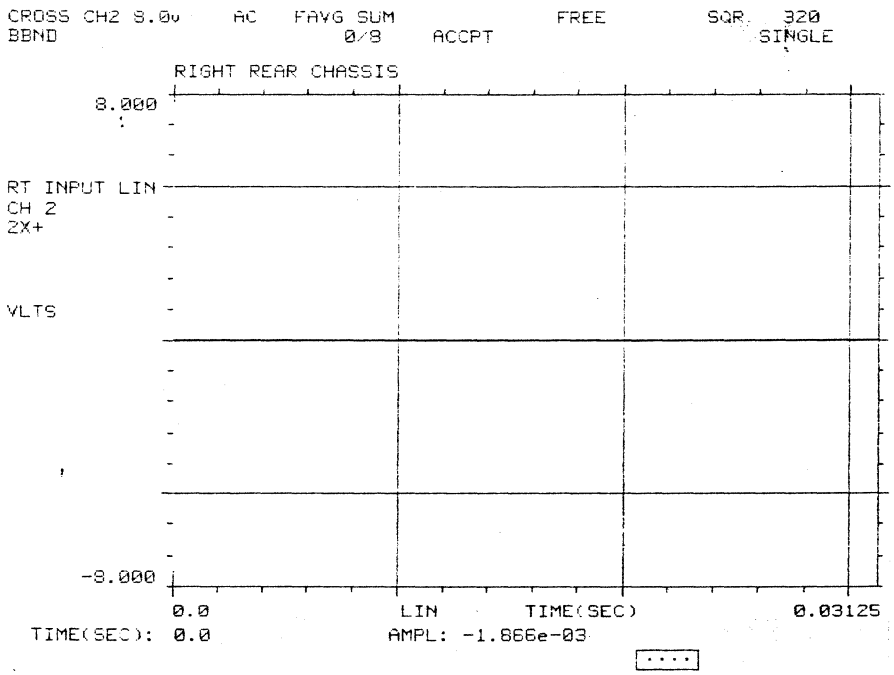
```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.1.1.1a)

```
ENTER MINIMUM % FULL SCALE
for an ACCEPTABLE SIGNAL LVL
* 35

>
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.1.1.1b)



1.1.1.2)

```
   Data Acceptance into Avg

   1) ACCEPT EVERY FRAME
>* 2) MANUAL ACCEPT(CONTINUE)
   3) AUTO REJECT
   4) AUTO REJECT w/ DBL HITS
```

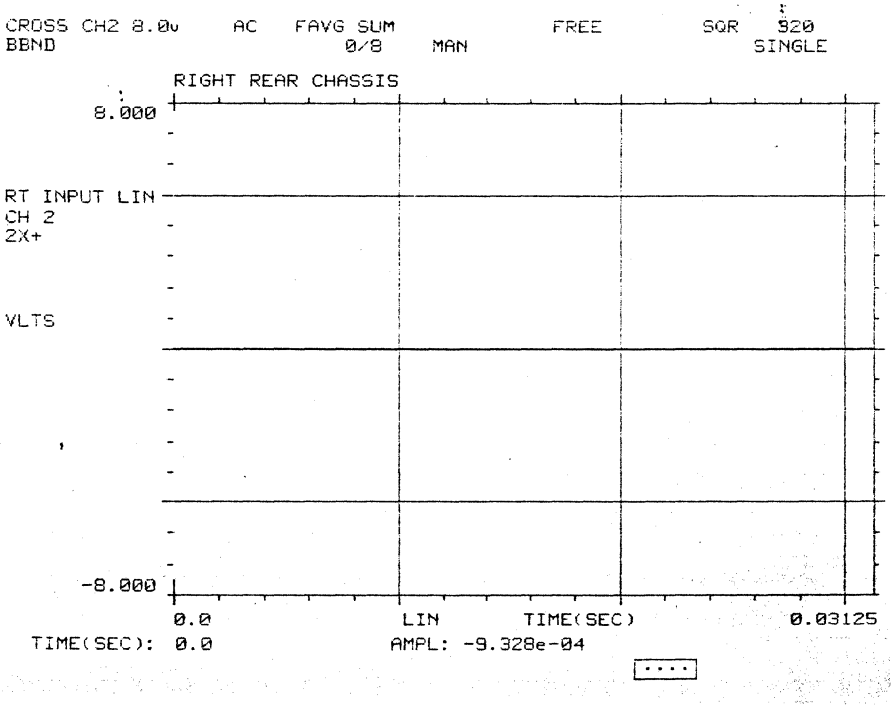
```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  MANUAL
Accept Min Peak %:  35
```

1.1.1.2a)

```
ENTER MINIMUM % FULL SCALE
for an ACCEPTABLE SIGNAL LVL
* 35
>
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  MANUAL
Accept Min Peak %:  35
```

1.1.1.2b)



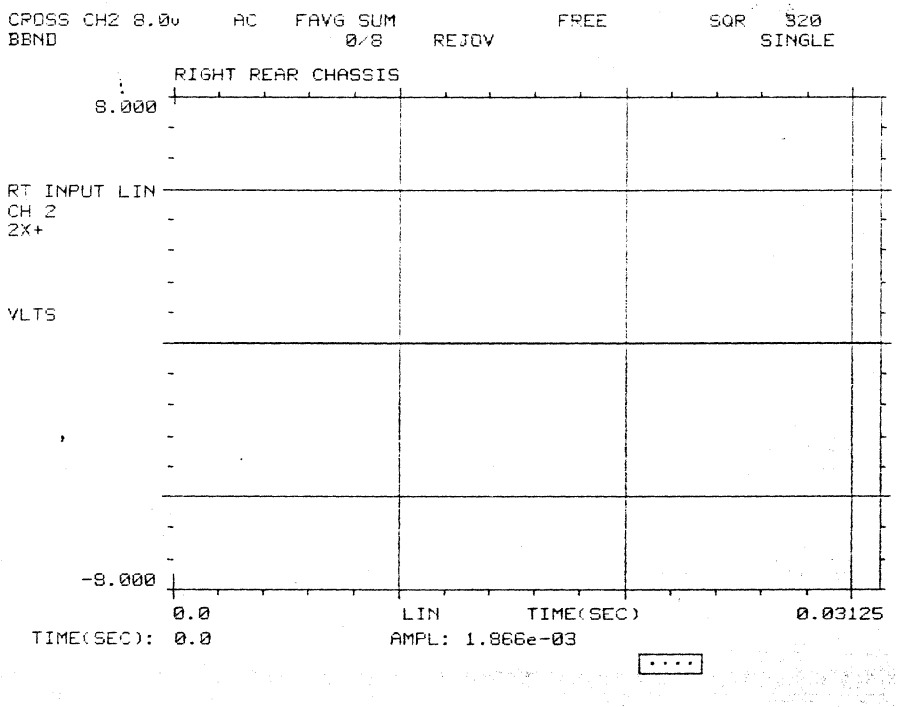
1.1.1.3)

```
   Data Acceptance into Avg          Averaging Domain:  FREQUENCY
                                     Averaging Mode:  SUMMATION
   1) ACCEPT EVERY FRAME             # of Averages:  8
   2) MANUAL ACCEPT(CONTINUE)        Autorange:  OFF
>* 3) AUTO REJECT                    Accept:  AUTO REJ O/L
   '4) AUTO REJECT w/ DBL HITS       Accept Min Peak %:  35
```

1.1.1.3a)

```
   ENTER MINIMUM % FULL SCALE        Averaging Domain:  FREQUENCY
   for an ACCEPTABLE SIGNAL LVL      Averaging Mode:  SUMMATION
   * 35                              # of Averages:  8
                                     Autorange:  OFF
 >,                                  Accept:  AUTO REJ O/L
                                     Accept Min Peak %:  35
```

1.1.1.3b)



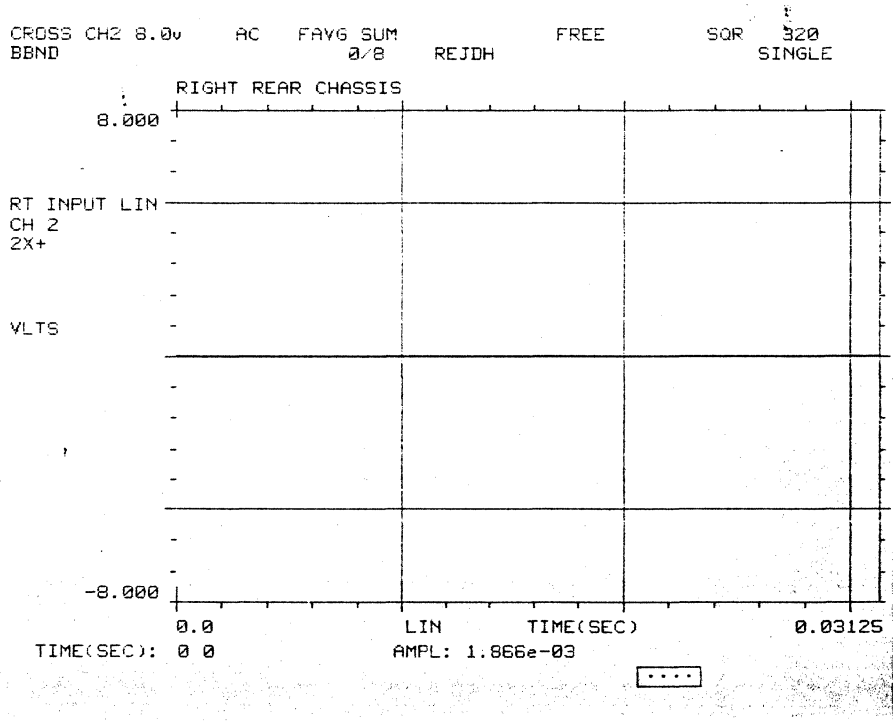
1.1.1.4)

```
   Data Acceptance into Avg          Averaging Domain:  FREQUENCY
                                     Averaging Mode:  SUMMATION
   1) ACCEPT EVERY FRAME             # of Averages:  8
   2) MANUAL ACCEPT(CONTINUE)        Autorange:  OFF
   3) AUTO REJECT                    Accept:  AUTO REJ O/L & DBL HIT
>* 4) AUTO REJECT w/ DBL HITS        Accept Min Peak %:  35
```

1.1.1.4a)

```
ENTER MINIMUM % FULL SCALE           Averaging Domain:  FREQUENCY
for an ACCEPTABLE SIGNAL LVL         Averaging Mode:  SUMMATION
* 35                                 # of Averages:  8
                                     Autorange:  OFF
>                                    Accept:  AUTO REJ O/L & DBL HIT
                                     Accept Min Peak %:  35
```

1.1.1.4b)



1.1.2)

```
    Pre-average Autorange

     1) OFF
>*   2) ON
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  ON
Accept:  AUTO REJ O/L & DBL HIT
Accept Min Peak %:  35
```

1.1.2.1)

```
    Data Acceptance into Avg

>*  1) ACCEPT EVERY FRAME
    2) MANUAL ACCEPT(CONTINUE)
    3) AUTO REJECT
    4) AUTO REJECT w/ DBL HITS
    '
```

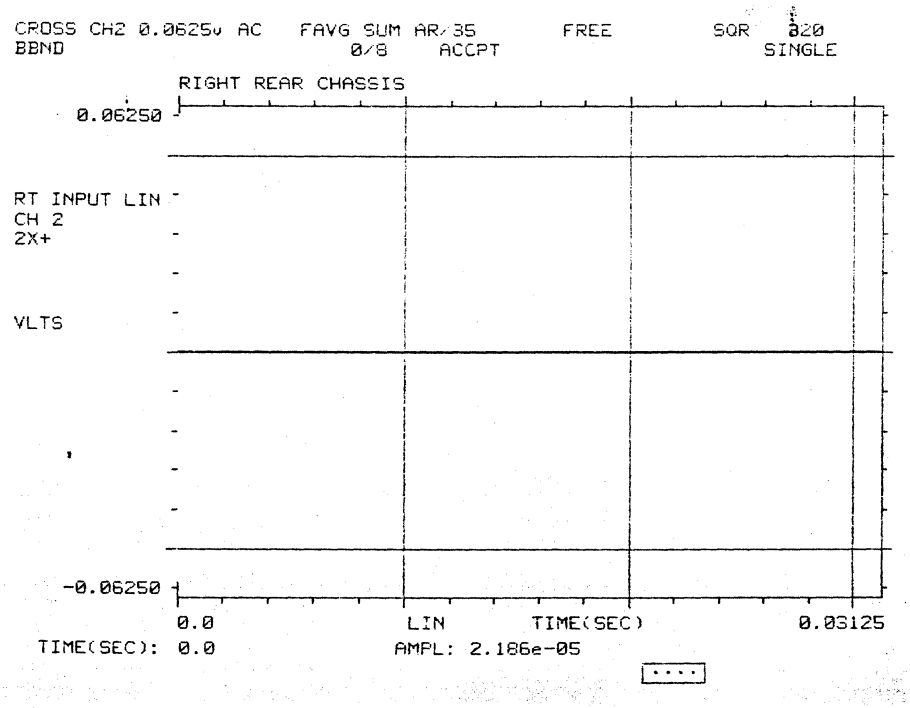
```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  ON
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.1.2.1a)

```
ENTER MINIMUM % FULL SCALE
for an ACCEPTABLE SIGNAL LVL
* 35

>
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  ON
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.1.2.1b)



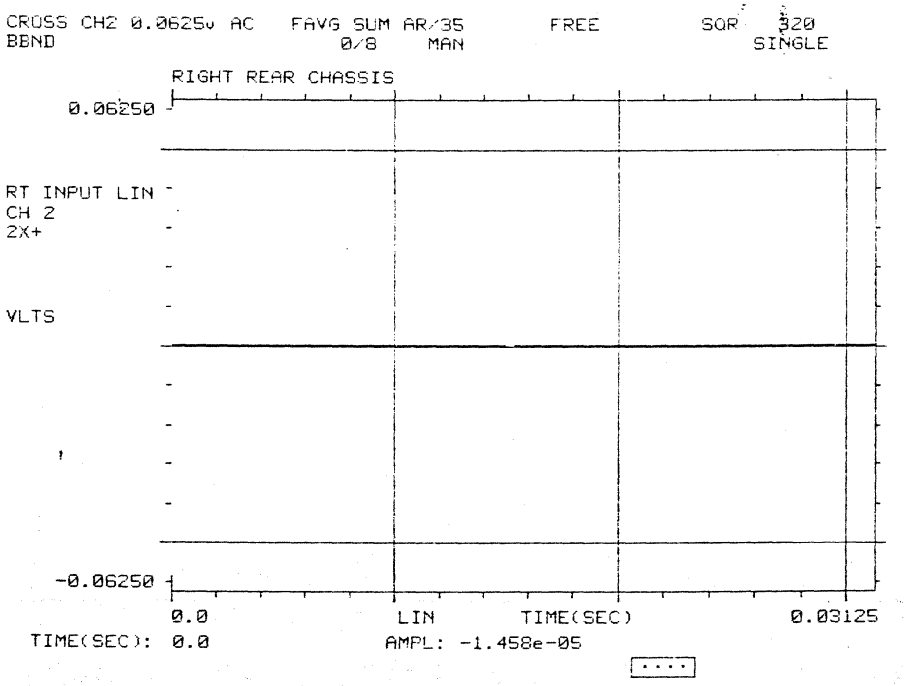
1.1.2.2)

```
   Data Acceptance into Avg          Averaging Domain:  FREQUENCY
                                     Averaging Mode:  SUMMATION
   1) ACCEPT EVERY FRAME             # of Averages:  8
>* 2) MANUAL ACCEPT(CONTINUE)        Autorange:  ON
   3) AUTO REJECT                    Accept:  MANUAL
   4) AUTO REJECT w/ DBL HITS        Accept Min Peak %:  35
   '
```

1.1.2.2a)

```
   ENTER MINIMUM % FULL SCALE        Averaging Domain:  FREQUENCY
   for an ACCEPTABLE SIGNAL LVL      Averaging Mode:  SUMMATION
   * 35                              # of Averages:  8
                                     Autorange:  ON
   >                                 Accept:  MANUAL
   '                                 Accept Min Peak %:  35
```

1.1.2.2b)



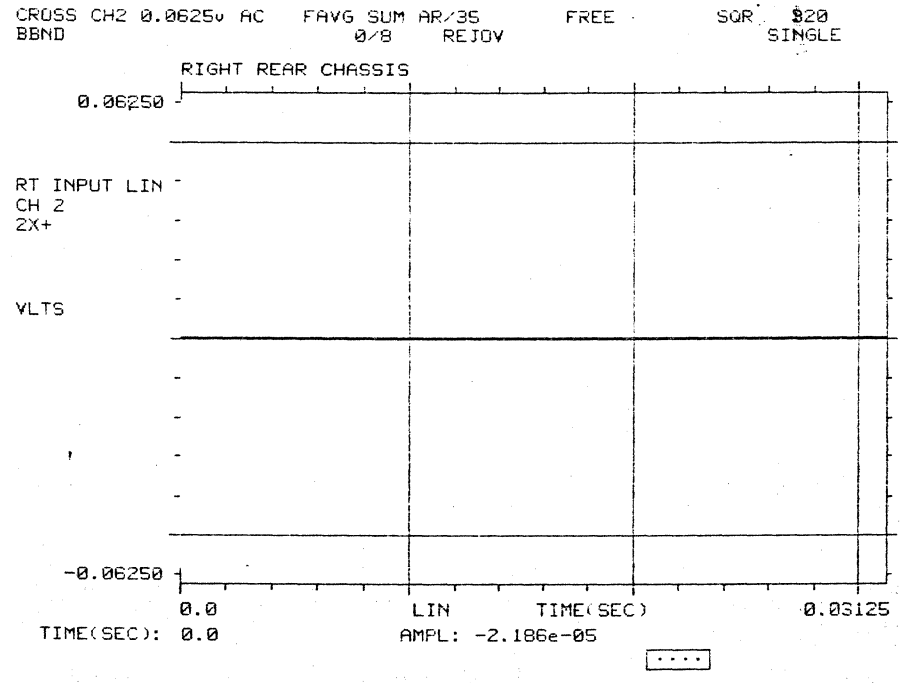
1.1.2.3)

```
   Data Acceptance into Avg        Averaging Domain:  FREQUENCY
                                   Averaging Mode:  SUMMATION
   1) ACCEPT EVERY FRAME           # of Averages:  8
   2) MANUAL ACCEPT(CONTINUE)      Autorange:  ON
>* 3) AUTO REJECT                  Accept:  AUTO REJ O/L
   4) AUTO REJECT w/ DBL HITS      Accept Min Peak %:  35
```

1.1.2.3a)

```
 ENTER MINIMUM % FULL SCALE        Averaging Domain:  FREQUENCY
 for an ACCEPTABLE SIGNAL LVL      Averaging Mode:  SUMMATION
 * 35                              # of Averages:  8
                                   Autorange:  ON
>                                  Accept:  AUTO REJ O/L
                                   Accept Min Peak %:  35
```

1.1.2.3a)



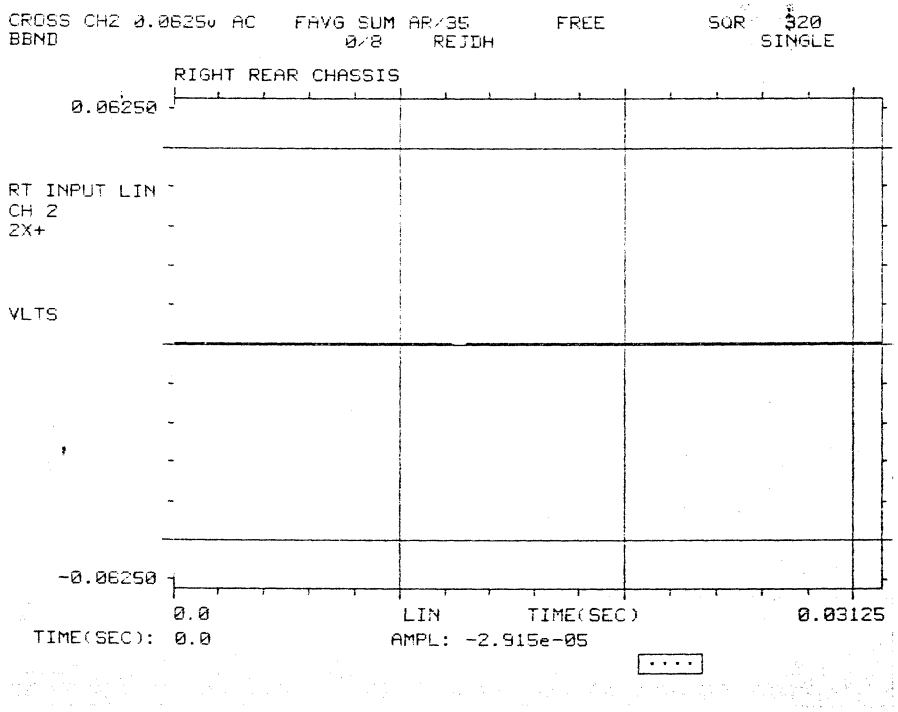
1.1.2.4)

```
   Data Acceptance into Avg        Averaging Domain:  FREQUENCY
                                   Averaging Mode:  SUMMATION
   1) ACCEPT EVERY FRAME           # of Averages:  8
   2) MANUAL ACCEPT(CONTINUE)      Autorange:  ON
   3) AUTO REJECT                  Accept:  AUTO REJ O/L & DBL HIT
>* '4) AUTO REJECT w/ DBL HITS     Accept Min Peak %:  35
```

1.1.2.4a)

```
 ENTER MINIMUM % FULL SCALE        Averaging Domain:  FREQUENCY
 for an ACCEPTABLE SIGNAL LVL      Averaging Mode:  SUMMATION
 * 35                              # of Averages:  8
                                   Autorange:  ON
 >                                 Accept:  AUTO REJ O/L & DBL HIT
                                   Accept Min Peak %:  35
```

1.1.2.4b)



1.2)

```
   Averaging Mode

    1) SUMMATION
>*  2) SUBTRACTION
    3) EXPONENTIAL
    4) PEAK HOLD
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUBTRACTION
# of Averages:  8
Autorange:  OFF
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.2a)

```
 ENTER # of Averages
 * 8

>
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUBTRACTION
# of Averages:  8
Autorange:  OFF
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.2.1)

```
    Pre-average Autorange          Averaging Domain:  FREQUENCY
                                   Averaging Mode:  SUBTRACTION
>*  1) OFF                        # of Averages:  8
    2) ON                          Autorange:  OFF
                                   Accept:  EVERY FRAME
                                   Accept Min Peak %:  35
```

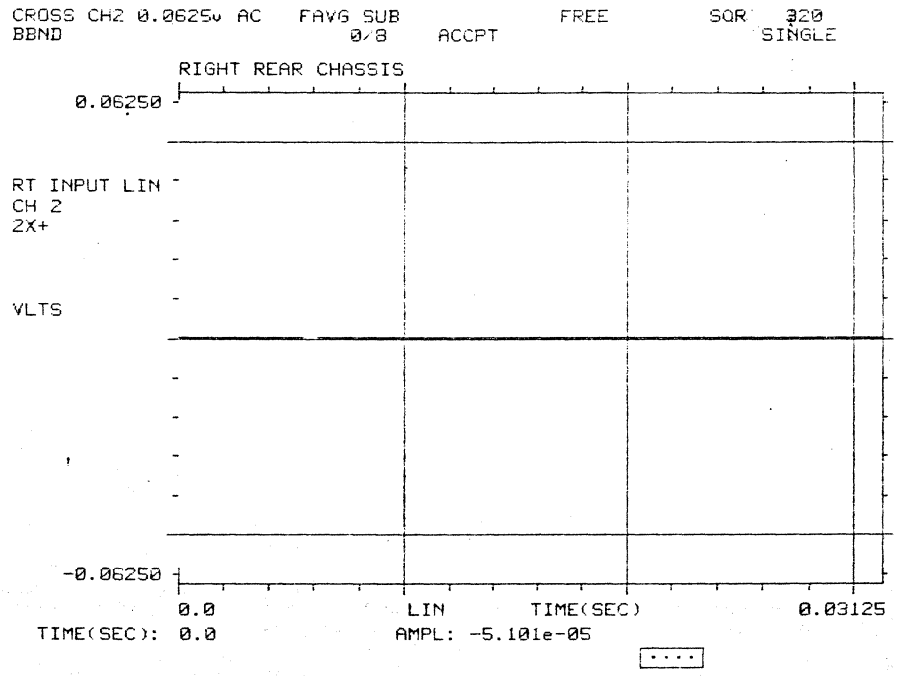
1.2.1.1)

```
    Data Acceptance into Avg       Averaging Domain:  FREQUENCY
                                   Averaging Mode:  SUBTRACTION
>*  1) ACCEPT EVERY FRAME         # of Averages:  8
    2) MANUAL ACCEPT(CONTINUE)     Autorange:  OFF
    3) AUTO REJECT                 Accept:  EVERY FRAME
    4) AUTO REJECT w/ DBL HITS     Accept Min Peak %:  35
```

1.2.1.1a)

```
    ENTER MINIMUM % FULL SCALE     Averaging Domain:  FREQUENCY
    for an ACCEPTABLE SIGNAL LVL   Averaging Mode:  SUBTRACTION
    * 35                           # of Averages:  8
                                   Autorange:  OFF
  >                                Accept:  EVERY FRAME
                                   Accept Min Peak %:  35
```

1.2.1.1b)



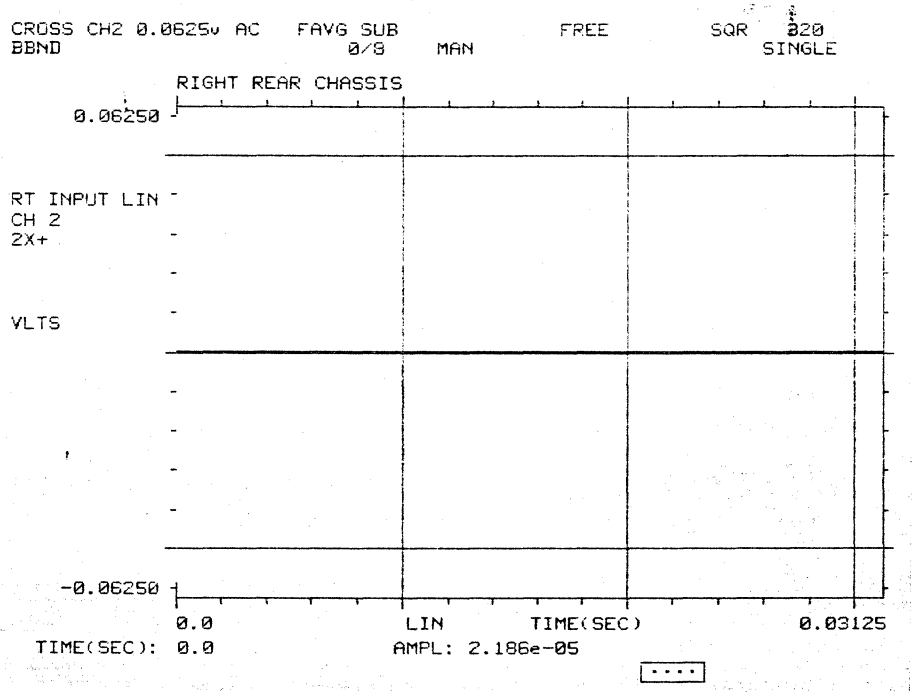
1.2.1.2)

```
   Data Acceptance into Avg        Averaging Domain:  FREQUENCY
                                   Averaging Mode:  SUBTRACTION
   1) ACCEPT EVERY FRAME           # of Averages:  8
>* 2) MANUAL ACCEPT(CONTINUE)      Autorange:  OFF
   3) AUTO REJECT                  Accept:  MANUAL
   4) AUTO REJECT w/ DBL HITS      Accept Min Peak %:  35
```

1.2.1.2a)

```
  ENTER MINIMUM % FULL SCALE       Averaging Domain:  FREQUENCY
  for an ACCEPTABLE SIGNAL LVL     Averaging Mode:  SUBTRACTION
  * 35                             # of Averages:  8
                                   Autorange:  OFF
 >,                                Accept:  MANUAL
                                   Accept Min Peak %:  35
```

1.2.1.2b)



1.2.1.3)

```
   Data Acceptance into Avg

   1) ACCEPT EVERY FRAME
   2) MANUAL ACCEPT(CONTINUE)
>* 3) AUTO REJECT
   4) AUTO REJECT w/ DBL HITS
```

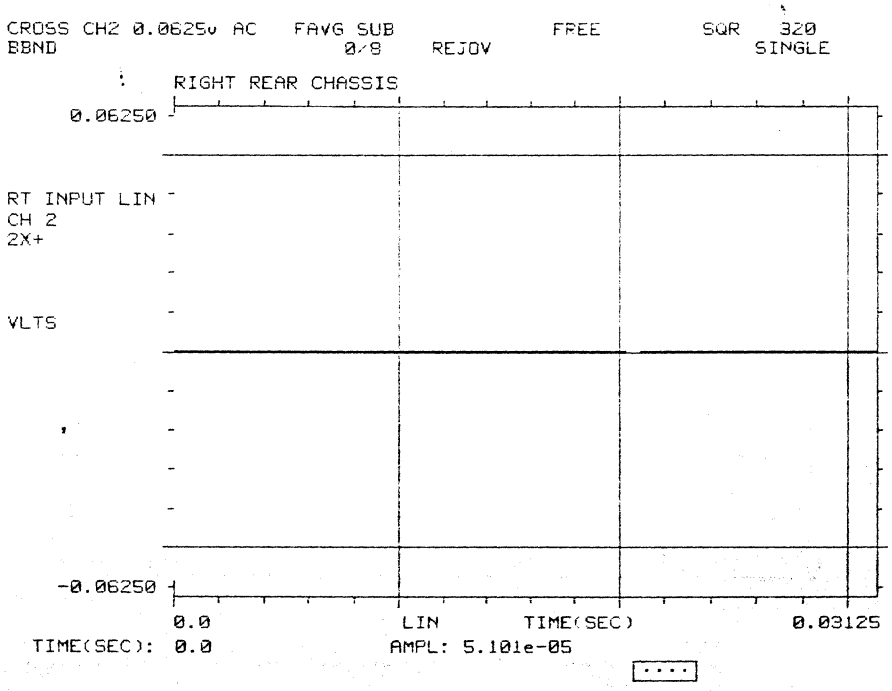
```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUBTRACTION
# of Averages:  8
Autorange:  OFF
Accept:  AUTO REJ O/L
Accept Min Peak %:  35
```

1.2.1.3a)

```
ENTER MINIMUM % FULL SCALE
for an ACCEPTABLE SIGNAL LVL
* 35

>
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUBTRACTION
# of Averages:  8
Autorange:  OFF
Accept:  AUTO REJ O/L
Accept Min Peak %:  35
```

1.2.1.3b)



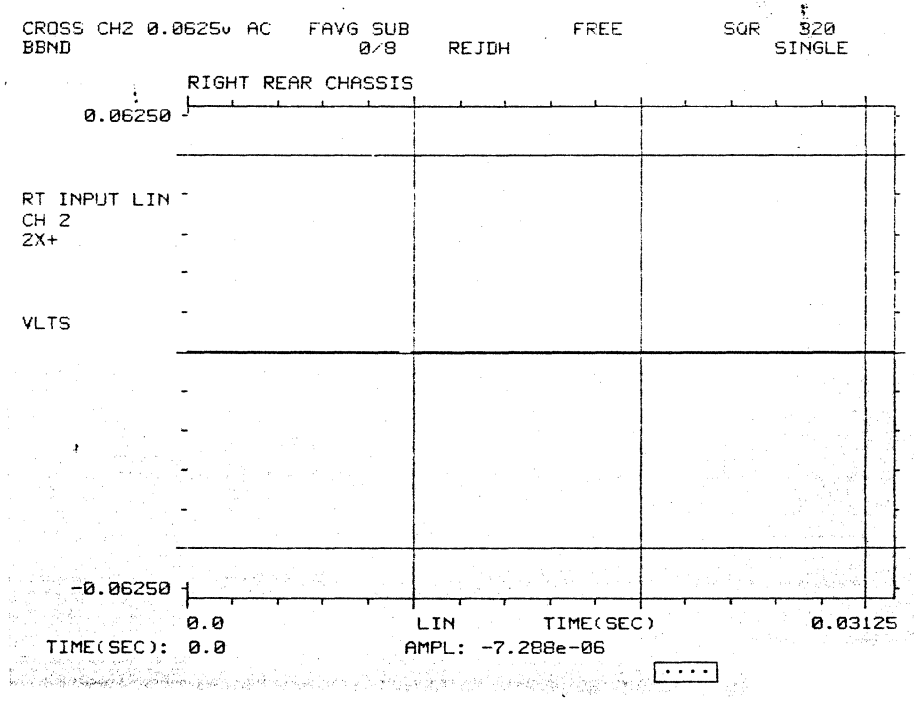
1.2.1.4)

```
   Data Acceptance into Avg        Averaging Domain:  FREQUENCY
                                   Averaging Mode:  SUBTRACTION
   1) ACCEPT EVERY FRAME           # of Averages:  8
   2) MANUAL ACCEPT(CONTINUE)      Autorange:  OFF
   3) AUTO REJECT                  Accept:  AUTO REJ O/L & DBL HIT
>* 4) AUTO REJECT w/ DBL HITS      Accept Min Peak %:  35
```

1.2.1.4a)

```
 ENTER MINIMUM % FULL SCALE        Averaging Domain:  FREQUENCY
 for an ACCEPTABLE SIGNAL LVL      Averaging Mode:  SUBTRACTION
 * 35                              # of Averages:  8
                                   Autorange:  OFF
>,                                 Accept:  AUTO REJ O/L & DBL HIT
                                   Accept Min Peak %:  35
```

1.2.1.4b)



1.2.2)

```
   Pre-average Autorange

    1) OFF
>*  2) ON
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUBTRACTION
# of Averages:  8
Autorange:  ON
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.2.2.1)

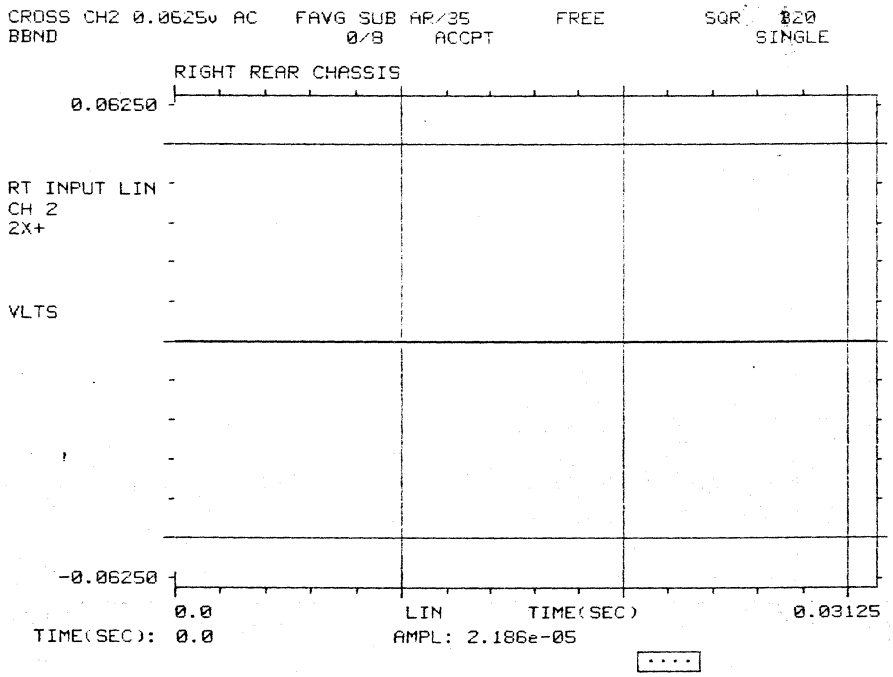
```
   Data Acceptance into Avg

>*  1) ACCEPT EVERY FRAME
    2) MANUAL ACCEPT(CONTINUE)
    3) AUTO REJECT
    4) AUTO REJECT w/ DBL HITS
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  SUBTRACTION
# of Averages:  8
Autorange:  ON
Accept:  EVERY FRAME
Accept Min Peak %:  35
```

1.2.2.1a)

```
ENTER MINIMUM % FULL SCALE   Averaging Domain:  FREQUENCY
for an ACCEPTABLE SIGNAL LVL Averaging Mode:  SUBTRACTION
* 35                         # of Averages:  8
                             Autorange:  ON
>,                           Accept:  EVERY FRAME
                             Accept Min Peak %:  35
```

1.2.2.1b)



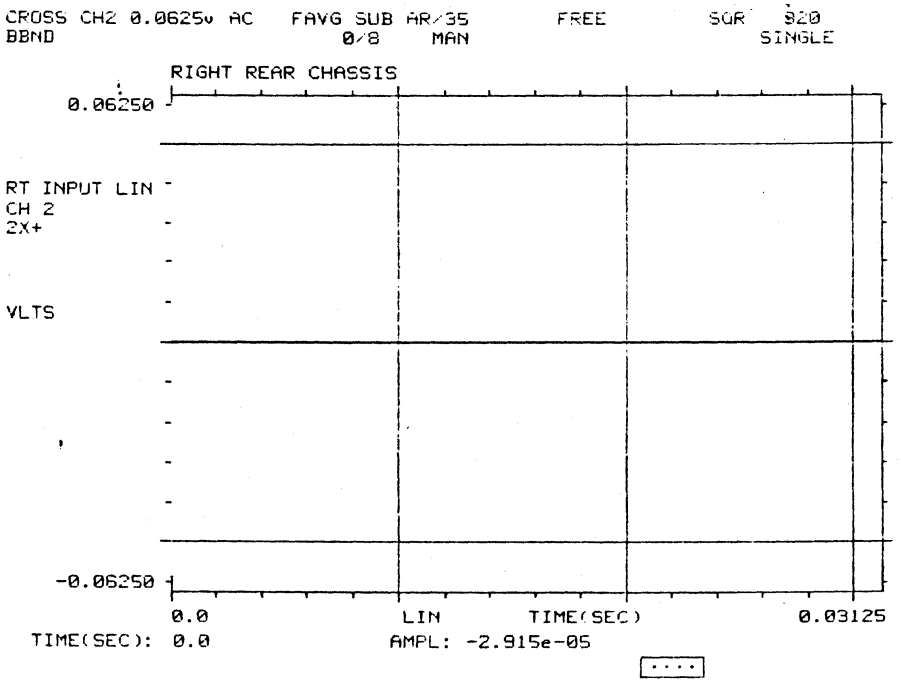
1.2.2.2)

```
   Data Acceptance into Avg     Averaging Domain:  FREQUENCY
                                Averaging Mode:  SUBTRACTION
   1) ACCEPT EVERY FRAME        # of Averages:  8
>* 2) MANUAL ACCEPT(CONTINUE)   Autorange:  ON
   3) AUTO REJECT               Accept:  MANUAL
   *4) AUTO REJECT w/ DBL HITS  Accept Min Peak %:  35
```

1.2.2.2a)

```
ENTER MINIMUM % FULL SCALE   Averaging Domain:  FREQUENCY
for an ACCEPTABLE SIGNAL LVL Averaging Mode:  SUBTRACTION
* 35                         # of Averages:  8
                             Autorange:  ON
>,                           Accept:  MANUAL
                             Accept Min Peak %:  35
```

1.2.2.2b)



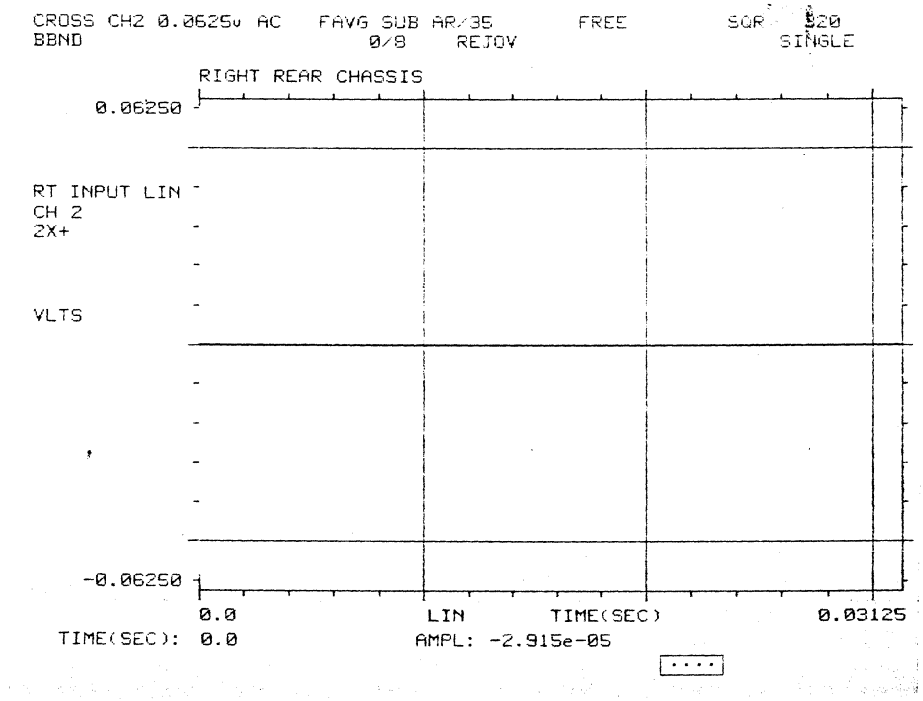
1.2.2.3)

```
   Data Acceptance into Avg     Averaging Domain:  FREQUENCY
                                Averaging Mode:  SUBTRACTION
   1) ACCEPT EVERY FRAME        # of Averages:  8
   2) MANUAL ACCEPT(CONTINUE)   Autorange:  ON
>* 3) AUTO REJECT               Accept:  AUTO REJ O/L
   4) AUTO REJECT w/ DBL HITS   Accept Min Peak %:  35
```

1.2.2.3a)

```
ENTER MINIMUM % FULL SCALE   Averaging Domain:  FREQUENCY
for an ACCEPTABLE SIGNAL LVL Averaging Mode:  SUBTRACTION
* 35                         # of Averages:  8
                             Autorange:  ON
>,                           Accept:  AUTO REJ O/L
                             Accept Min Peak %:  35
```

1.2.2.3b)



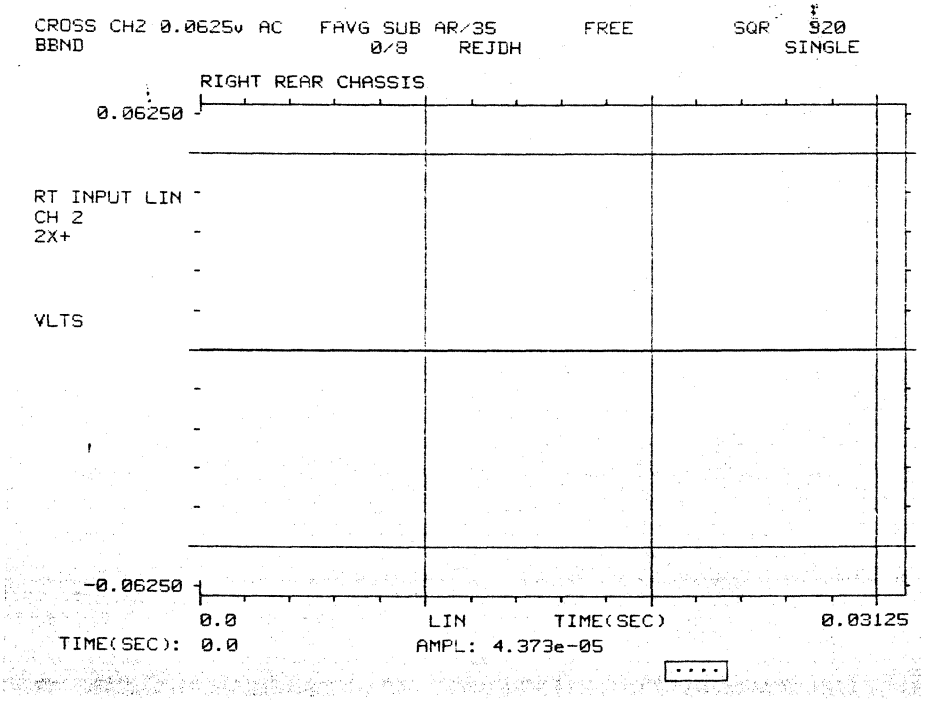
1.2.2.4)

```
   Data Acceptance into Avg      Averaging Domain:  FREQUENCY
                                 Averaging Mode:  SUBTRACTION
   1) ACCEPT EVERY FRAME         # of Averages:  8
   2) MANUAL ACCEPT(CONTINUE)    Autorange:  ON
   3) AUTO REJECT                Accept:  AUTO REJ O/L & DBL HIT
>* 4) AUTO REJECT w/ DBL HITS    Accept Min Peak %:  35
```

1.2.2.4a)

```
 ENTER MINIMUM % FULL SCALE      Averaging Domain:  FREQUENCY
 for an ACCEPTABLE SIGNAL LVL    Averaging Mode:  SUBTRACTION
 * 35                            # of Averages:  8
                                 Autorange:  ON
>'                               Accept:  AUTO REJ O/L & DBL HIT
                                 Accept Min Peak %:  35
```

1.2.2.4b)



1.3)

```
Averaging Mode

 1) SUMMATION
 2) SUBTRACTION
>* 3) EXPONENTIAL
  4) PEAK HOLD
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  EXPONENTIAL
# of Averages:  8
Autorange:  ON
Accept:  AUTO REJ O/L & DBL HIT
Accept Min Peak %:  35
```

1.3a)

```
ENTER # of Averages
* 8

>
```

```
Averaging Domain:  FREQUENCY
Averaging Mode:  EXPONENTIAL
# of Averages:  8
Autorange:  ON
Accept:  AUTO REJ O/L & DBL HIT
Accept Min Peak %:  35
```

1.3.2)

```
    Pre-average Autorange          Averaging Domain:  FREQUENCY
                                   Averaging Mode:  EXPONENTIAL
    1) OFF                         # of Averages:  8
>*  2) ON                          Autorange:  ON
                                   Accept:  AUTO REJ O/L & DBL HIT
    '                              Accept Min Peak %:  35
```

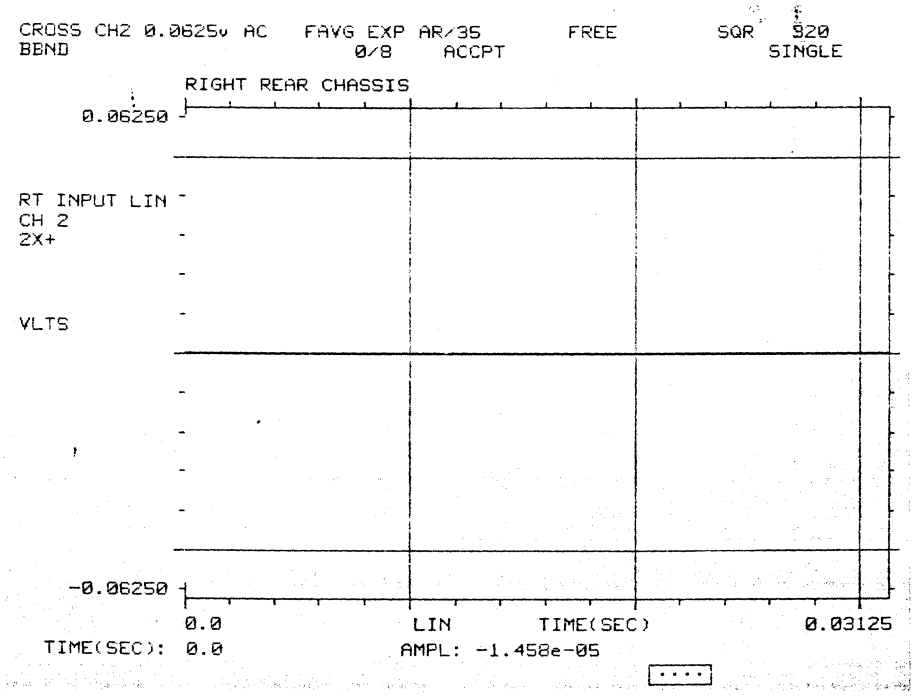
1.3.2.1)

```
    Data Acceptance into Avg       Averaging Domain:  FREQUENCY
                                   Averaging Mode:  EXPONENTIAL
>*  1) ACCEPT EVERY FRAME          # of Averages:  8
    2) MANUAL ACCEPT(CONTINUE)     Autorange:  ON
    3) AUTO REJECT                 Accept:  EVERY FRAME
    4) AUTO REJECT w/ DBL HITS     Accept Min Peak %:  35
```

1.3.2.1a)

```
    ENTER MINIMUM % FULL SCALE     Averaging Domain:  FREQUENCY
    for an ACCEPTABLE SIGNAL LVL   Averaging Mode:  EXPONENTIAL
    * 35                           # of Averages:  8
                                   Autorange:  ON
  >'                               Accept:  EVERY FRAME
                                   Accept Min Peak %:  35
```

1.3.2.1b)



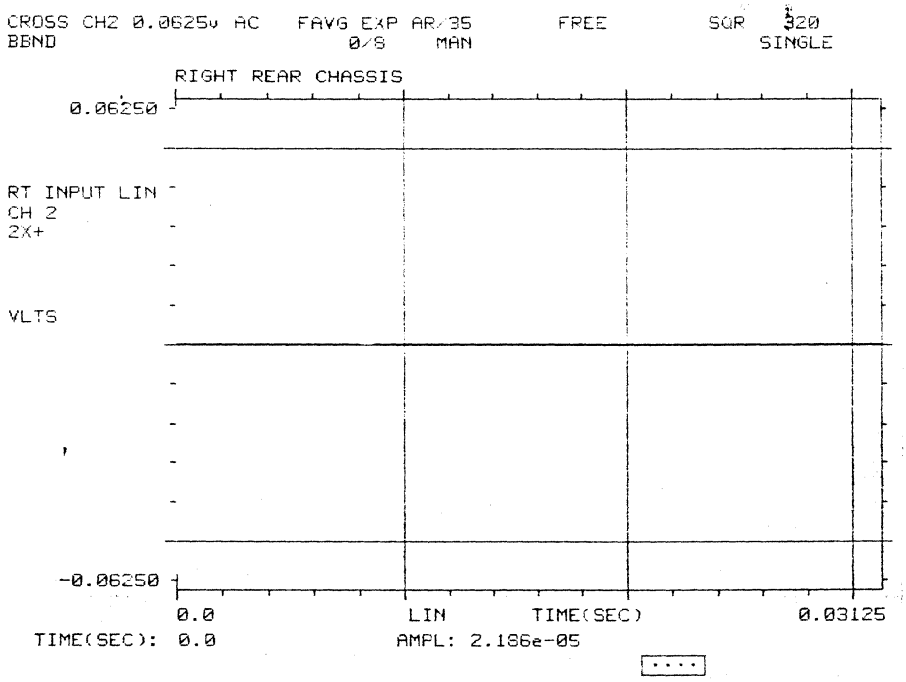
1.3.2.2)

```
   Data Acceptance into Avg          Averaging Domain:  FREQUENCY
                                     Averaging Mode:  EXPONENTIAL
    1) ACCEPT EVERY FRAME            # of Averages:  8
>*  2) MANUAL ACCEPT(CONTINUE)       Autorange:  ON
    3) AUTO REJECT                   Accept:  MANUAL
    4) AUTO REJECT w/ DBL HITS       Accept Min Peak %:  35
```

1.3.2.2a)

```
 ENTER MINIMUM % FULL SCALE    Averaging Domain:  FREQUENCY
 for an ACCEPTABLE SIGNAL LVL  Averaging Mode:  EXPONENTIAL
 * 35                          # of Averages:  8
 '                             Autorange:  ON
>                              Accept:  MANUAL
                               Accept Min Peak %:  35
```

1.3.2.2b)



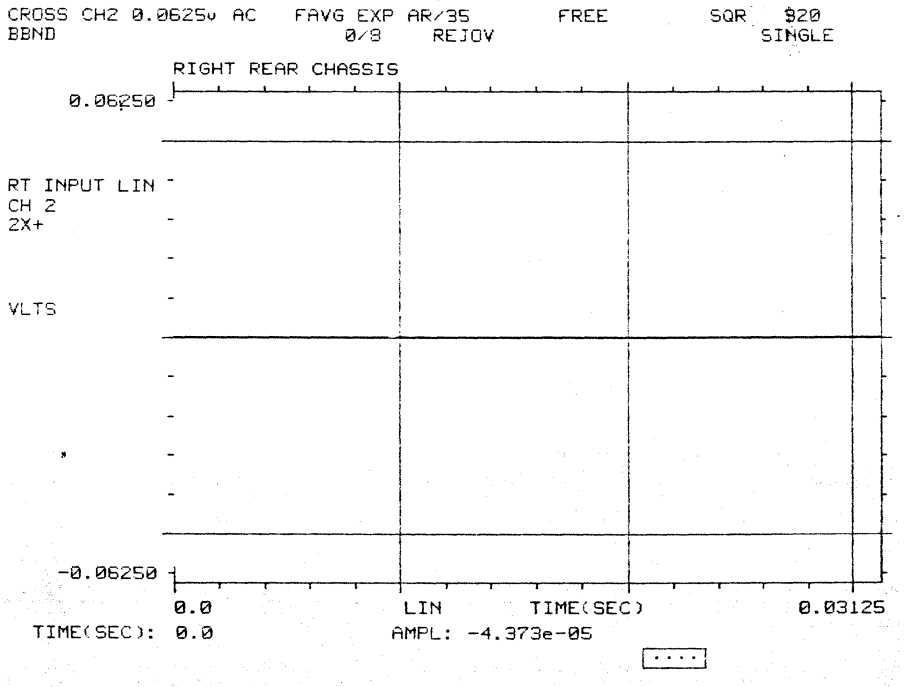
1.3.2.3)

```
   Data Acceptance into Avg        Averaging Domain:  FREQUENCY
                                   Averaging Mode:  EXPONENTIAL
   1) ACCEPT EVERY FRAME           # of Averages:  8
   2) MANUAL ACCEPT(CONTINUE)      Autorange:  ON
>* 3) AUTO REJECT                  Accept:  AUTO REJ O/L
   4) AUTO REJECT w/ DBL HITS      Accept Min Peak %:  35
```

1.3.2.3a)

```
   ENTER MINIMUM % FULL SCALE      Averaging Domain:  FREQUENCY
   for an ACCEPTABLE SIGNAL LVL    Averaging Mode:  EXPONENTIAL
   * 35                            # of Averages:  8
                                   Autorange:  ON
  >                                Accept:  AUTO REJ O/L
                                   Accept Min Peak %:  35
```

1.3.2.3b)



1.4) Not available in this version.

2) Not available in this version.

```
   Averaging Domain

   1) FREQUENCY
>* 2) TIMExx
```

```
Averaging Domain:  TIMExx
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  AUTO REJ O/L & DBL HIT
Accept Min Peak %:  35
```

B. WINDOW Pushbutton

1)

1a)

2)

2a)

3)

```
    Window Type

     1) SQUARE
     2) HANN
>*   3) FLAT TOP
     4) SPECIAL
     5) CORRELATION
     6) IMPACT
```

```
Window Type:  FLAT TOP
Frame Overlap:  50%
```

3a)

```
    Frame Overlap

>*   1) NONE
     2) 50%
     3) MAX
```

```
Window Type:  FLAT TOP
Frame Overlap:  NONE
```

4)

```
    Window Type

     1) SQUARE
     2) HANN
     3) FLAT TOP
>*   4) SPECIAL
     5) CORRELATION
     6) IMPACT
```

```
Window Type:  SPECIAL
Frame Overlap:  NONE
```

4a)

```
    Frame Overlap

     1) NONE
     2) 50%
>*   3) MAX
```

```
Window Type:  SPECIAL
Frame Overlap:  MAX
```

5)

```
Window Type

 1) SQUARE
 2) HANN
 3) FLAT TOP
 4) SPECIAL
>* 5) CORRELATION
 6) IMPACT
```

```
Window Type:  CORRELATION
Frame Overlap:  MAX
```

5a)

```
Frame Overlap

>* 1) NONE
 2) 50%
 3) MAX
```

```
Window Type:  CORRELATION
Frame Overlap:  NONE
```

6)

```
Window Type

 1) SQUARE
 2) HANN
 3) FLAT TOP
 4) SPECIAL
 5) CORRELATION
>* 6) IMPACT
```

```
Window Type:  IMPACT
Refr Window strt:  0
# of Resp Windows:  0
Frame Overlap:  NONE
```

6a)

```
ENTER % FULL FRAME UNTIL
REFERENCE WINDOW TAPER
* 0

>
```

```
Window Type:  IMPACT
Refr Window strt:  0
# of Resp Windows:  0
Frame Overlap:  NONE
```

6b)

```
ENTER # OF EXPONENTIAL
RESP WINDOWS TO APPLY
* 0

>
```

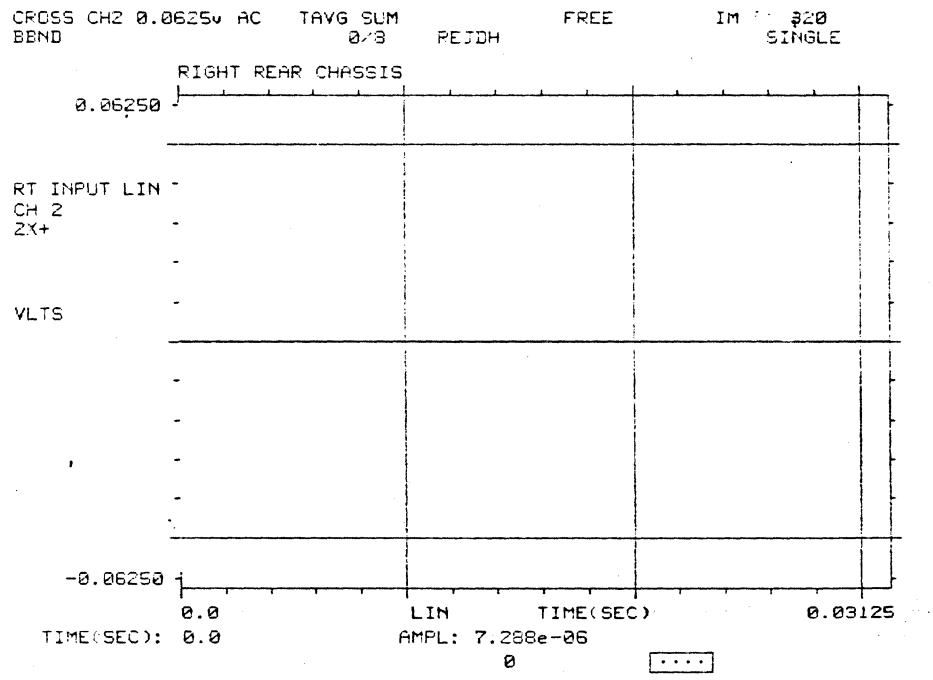
```
Window Type:  IMPACT
Refr Window strt:  0
# of Resp Windows:  0
Frame Overlap:  NONE
```

6c)

```
Frame Overlap

>* 1) NONE
   2) 50%
   3) MAX
```

```
Window Type:  IMPACT
Refr Window strt:  0
# of Resp Windows:  0
Frame Overlap:  NONE
```

6d)



C. TRIG Pushbutton

1)

```
   Trigger                          Trigger:  FREE RUN
                                    Channel:  1
>*  1) FREE RUN                     Trigger Level:  0
    2) AUTO ARM 1st FRAME           Slope:  +
    3) AUTO ARM EVERY FRAME         Delay:  0
    4) TRIG-MAN ARM                 Aux Delay:  0
```

1a)

```
   ENTER Trigger Channel #          Trigger:  FREE RUN
   (0 selects EXTERNAL TRIGGER)     Channel:  1
   * 1                              Trigger Level:  0
                                    Slope:  +
  >                                 Delay:  0
   '                                Aux Delay:  0
```

1b)

```
   ENTER Trigger Level              Trigger:  FREE RUN
   % of Full Scale                  Channel:  1
   * 0                              Trigger Level:  0
                                    Slope:  +
  >                                 Delay:  0
   '                                Aux Delay:  0
```

1.1)

```
   Slope                            Trigger:  FREE RUN
                                    Channel:  1
>*  1) +                           Trigger Level:  0
    2) -                            Slope:  +
    '                               Delay:  0
                                    Aux Delay:  0
```

1.1a)

```
ENTER TRIGGER DELAY
IN % of FRAME
(- Delay for Pre-Trig)
* 0

>
```

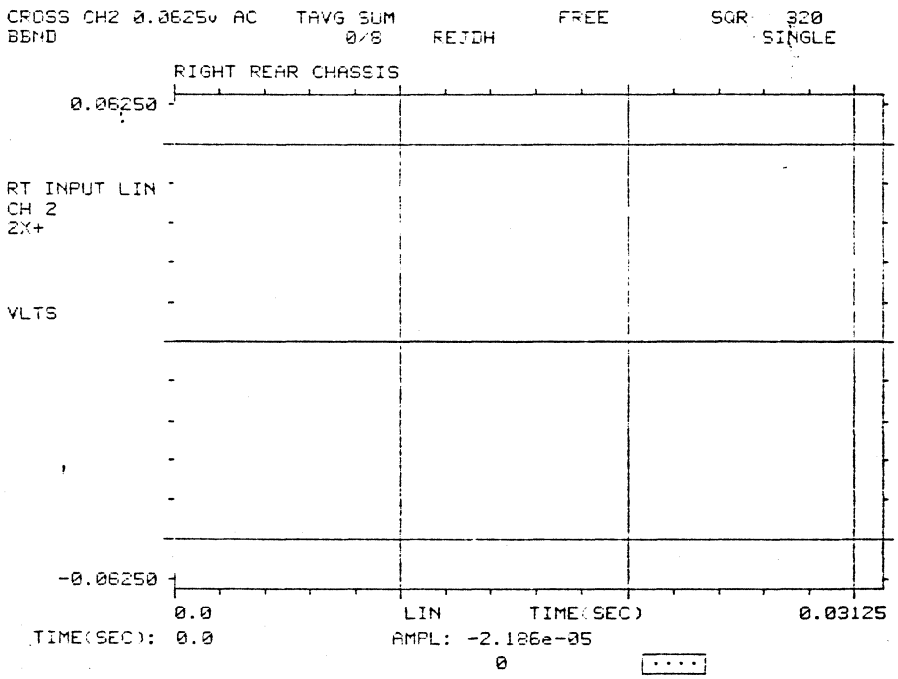
```
Trigger:  FREE RUN
Channel:  1
Trigger Level:  0
Slope:  +
Delay:  0
Aux Delay:  0
```

1.1b)

```
ENTER AUXILIARY DELAY
IN % of FRAME
* 0

>
```

```
Trigger:  FREE RUN
Channel:  1
Trigger Level:  0
Slope:  +
Delay:  0
Aux Delay:  0
```

1.1c)



2)

```
   Trigger                          Trigger:  AUTO ARM 1st FRAME
                                    Channel:  1
    1) FREE RUN                     Trigger Level:  0
>*  2) AUTO ARM 1st FRAME           Slope:  +
    3) AUTO ARM EVERY FRAME         Delay:  0
    4) TRIG-MAN ARM                 Aux Delay:  0
```

3)

```
   Trigger                          Trigger:  AUTO ARM EVERY FRAME
                                    Channel:  1
    1) FREE RUN                     Trigger Level:  0
    2) AUTO ARM 1st FRAME           Slope:  +
>*  3) AUTO ARM EVERY FRAME         Delay:  0
    4) TRIG-MAN ARM                 Aux Delay:  0
```

4)

```
   Trigger                          Trigger:  TRIG-MAN ARM
                                    Channel:  1
    1) FREE RUN                     Trigger Level:  0
    2) AUTO ARM 1st FRAME           Slope:  +
    3) AUTO ARM EVERY FRAME         Delay:  0
>*  4) TRIG-MAN ARM                 Aux Delay:  0
```

D. STATE Pushbutton
1)

```
Storage Setup

Storage Grouping:  Single
Restriction:  TRANSFER FUNCTION
Acquisition Type:  SHAKER TEST
Current File:
File Status:  CLOSED
File Format:  MODAL
Previous Action:  recall
SUCCEEDED
```

```
Output Signal Setup

Signal:  Off
Signal Level:     0.0
Frequency Type:  Baseband
```

```
Digital Plotter

Plotter Type:  SCREEN COPY
```

1a)

```
mode:  CROSS CHANNEL
Frequency Setup

Frequency Type:  BASEBAND
BASEBAND max freq:    10240
ZOOM min freq:          0.0
ZOOM max freq:        10240
# of Lines:  320
External Sample:  OFF
frame size:  1024
resolution:        32.00
sampling interval:    3.052e-05
```

```
Trigger Setup

Trigger:  TRIG-MAN ARM
Channel:  1
Trigger Level:  0
Slope:  +
Delay:  0
Aux Delay:  0
```

```
Averaging Setup

Averaging Domain:  TIMExx
Averaging Mode:  SUMMATION
# of Averages:  8
Autorange:  OFF
Accept:  AUTO REJ O/L & DBL HIT
Accept Min Peak %:  35
```

```
Window Setup

Window Type:  SQUARE
Frame Overlap:  NONE
```

1b)

UPPER DISPLAY

function: TIME

Source: REAL TIME
Chan: 2

X Scale: LIN AUTO SCALE
EXPAND Min X: 0.0
EXPAND Max X: 1.000

Y Scale: LIN AUTO SCALE
EXPAND Min Y: -8.000
EXPAND Max Y: 8.000

Ampl Units: V
Ampl Normalization: U
Freq Units: ORDERS
ORDER Reference: 0.0

LOWER DISPLAY

function: SPECTRUM

Source: REAL TIME
Chan: 2

X Scale: LIN AUTO SCALE
EXPAND Min X: 0.0
EXPAND Max X: 1.000

Y Scale: LIN AUTO SCALE
EXPAND Min Y: -8.000
EXPAND Max Y: 8.000

Ampl Units: V
Ampl Normalization: U
Freq Units: Hz

1c)

CHAN	VOLTS	COORD	CAL FACTOR	UNIT/VOLT	CPL	CHAN ID
1	8.0v	1X+	1.000	INCHES	AC	LEFT REAR CHASSIS
2	8.0v	2X+	1.000	INCHES	AC	RIGHT REAR CHASSIS
3	8.0v	3X-	1.000	INCHES	AC	LEFT MOTOR MOUNT
4	8.0v	4X-	1.000	INCHES	AC	RIGHT MOTOR MOUNT

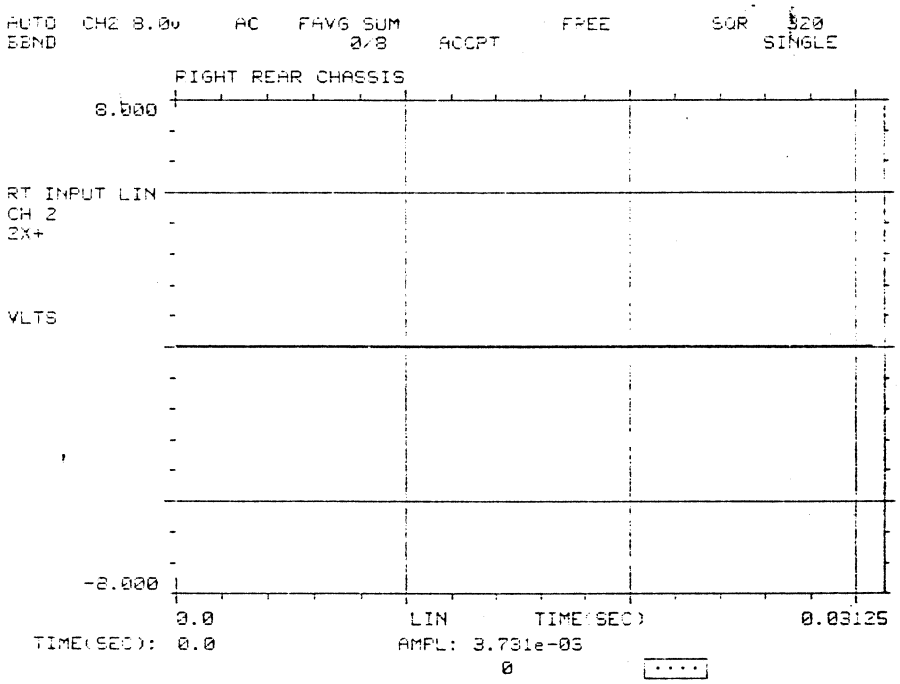
res chan	ref chan
2*	*1
3	1
4	1
1	1

E. MODE Pushbutton

1)

```
mode

>*  1) AUTO CHANNEL
    2) CROSS CHANNEL
    3) PROBABILITYxx
    4) EXIT TO MODAL ANALYSIS
    5) EXIT TO RT-11
```

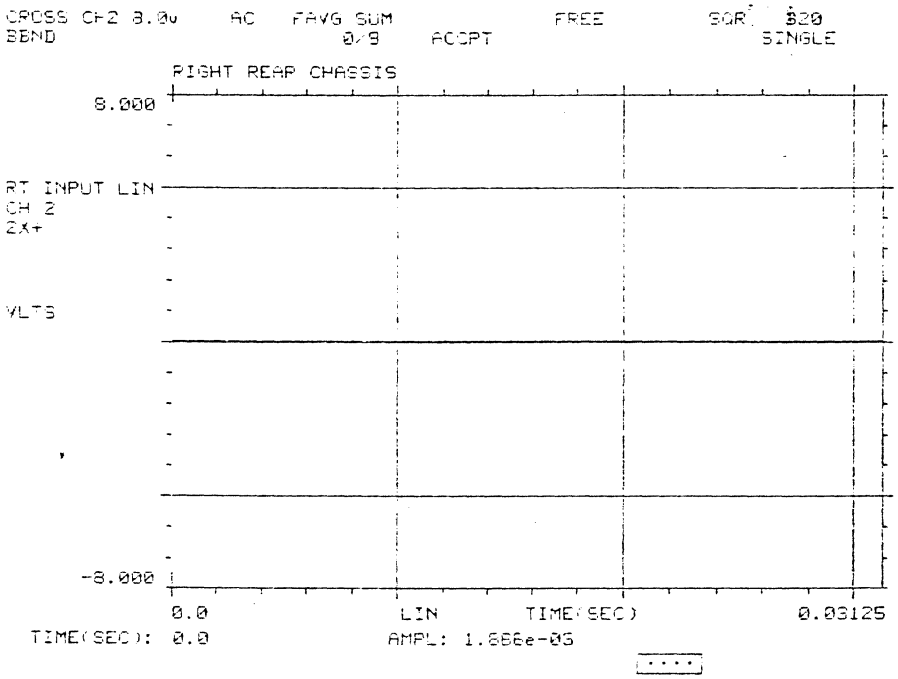
1a)



2)

```
mode

    1) AUTO CHANNEL
>*  2) CROSS CHANNEL
    3) PROBABILITYxx
    4) EXIT TO MODAL ANALYSIS
    5) EXIT TO RT-11
```

2a)

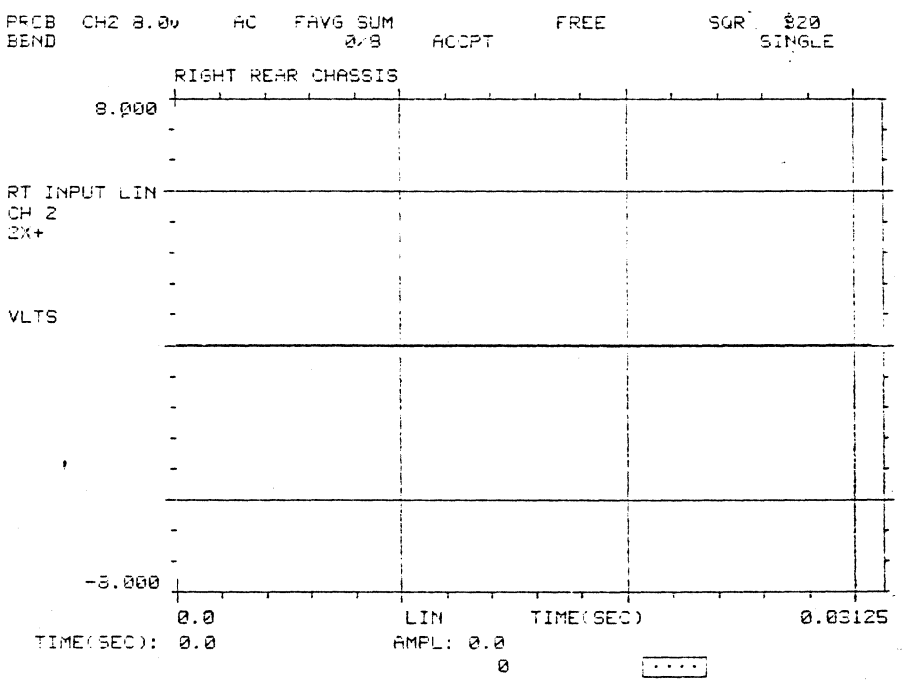


3)

mode

1) AUTO CHANNEL
2) CROSS CHANNEL
>* 3) PROBABILITY××
4) EXIT TO MODAL ANALYSIS
5) EXIT TO RT-11

3a)



4) Exit RTA

5) Exit RTA

F. CHANS Pushbutton

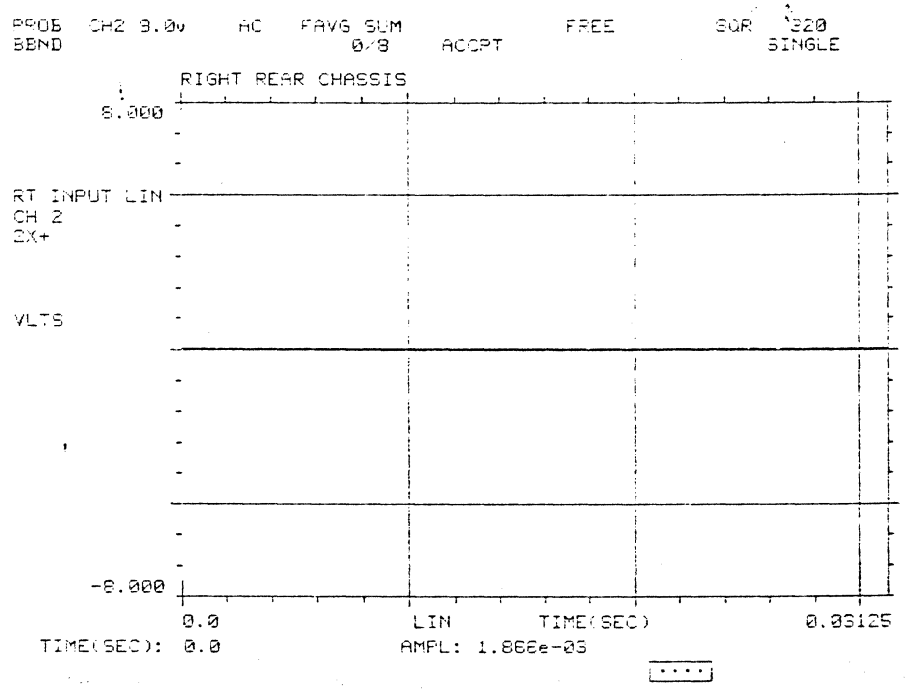
1)

```
Response channel assignments        res chan
                                    2*2
* designates active channel           3
                                      4
To modify, use arrows                 1
to move @ and ENTER new
response channels

ENTER 0 to deactivate channels


 ENTER RESPONSE CHANNEL

 * 2

>
```

1a)

```
Active channels and their          CH #     COORD
Modal coordinate labels
                                   @ 2        1X+
To modify, use arrows
to move @ to CH #, and
ENTER new label


 Move @ to Channel and
 ENTER the New Coord
 * 1X+

>
```

1b)



G. LEVEL Pushbutton

1)

```
ENTER CHANNEL #
to be SET UP
* 1

>
,
```

```
Setup Channel:  1
Volts Full Scale:  8.0v
MODAL coord:  1X+
Cal factor:        1.000
Cal units:  INCHES
                per 1.0 volt
Coupling:  AC
Chan ID:  LEFT REAR CHASSIS
```

1.1)

```
  Volts Full Scale

>*  1) 8.0v
    2) 4.0v
    3) 2.0v
    4) 1.0v
    5) 0.5v
    6) 0.25
    7) 0.125
    8) 0.0625
```

```
Setup Channel:  1
Volts Full Scale:  8.0v
MODAL coord:  1X+
Cal factor:        1.000
Cal units:  INCHES
                per 1.0 volt
Coupling:  AC
Chan ID:  LEFT REAR CHASSIS
```

1a)

```
ENTER MODAL COORDINATE
in form nnX+
* 1X+

>,
```

```
Setup Channel:  1
Volts Full Scale:  8.0v
MODAL coord:  1X+
Cal factor:        1.000
Cal units:  INCHES
                per 1.0 volt
Coupling:  AC
Chan ID:  LEFT REAR CHASSIS
```

1b)

```
CAL FACTOR=<FACTOR> "UNITS"
            PER 1.0 VOLT
ENTER <FACTOR>
* 1.000

>'
```

```
Setup Channel:  1
Volts Full Scale:  8.0v
MODAL coord:  1X+
Cal factor:        1.000
Cal units:  INCHES
                per 1.0 volt
Coupling:  AC
Chan ID:  LEFT REAR CHASSIS
```

1c)

```
 CAL FACTOR=<FACTOR> "UNITS"      Setup Channel:  1
          PER 1.0 VOLT            Volts Full Scale:  8.0v
 ENTER <UNITS>                    MODAL coord:  1X+
 * INCHES                         Cal factor:       1.000
>'                                Cal units:  INCHES
                                             per 1.0 volt
                                  Coupling:  AC
                                  Chan ID:  LEFT REAR CHASSIS
```

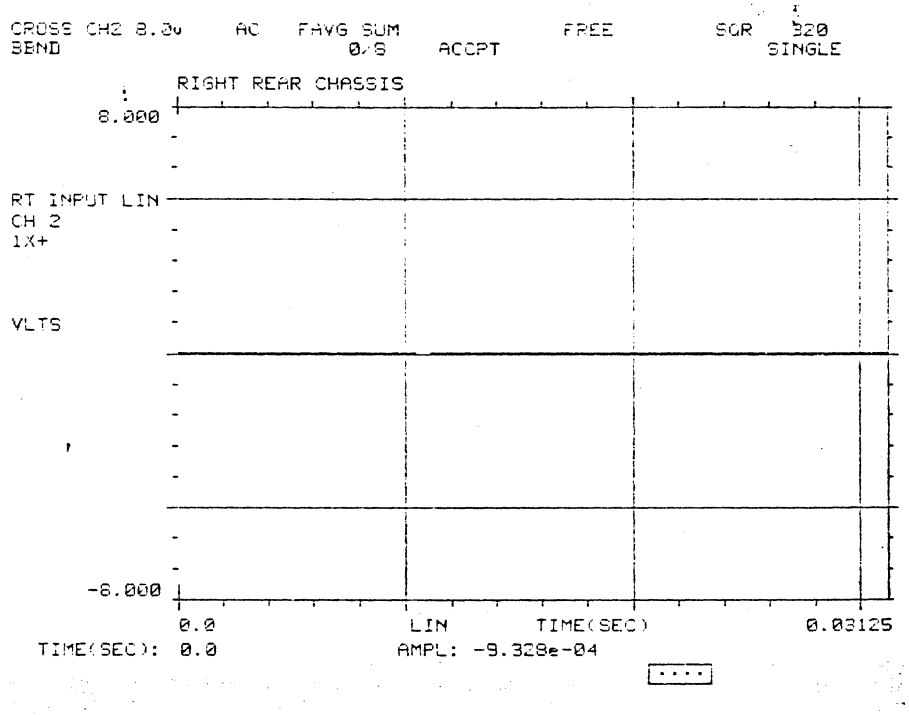
1.1.1)

```
   Coupling                       Setup Channel:  1
                                  Volts Full Scale:  8.0v
>* 1) AC                         MODAL coord:  1X+
   2) DC                          Cal factor:       1.000
   3) ZERO                        Cal units:  INCHES
   4) BIAS SOURCE                            per 1.0 volt
   5) DCR:S/W DC REMOVAL          Coupling:  AC
                                  Chan ID:  LEFT REAR CHASSIS
```

1.1.1a)

```
  ENTER CHANNEL I.D. LABEL        Setup Channel:  1
  * LEFT REAR CHASSIS             Volts Full Scale:  8.0v
                                  MODAL coord:  1X+
 >                                Cal factor:       1.000
                                  Cal units:  INCHES
  '                                          per 1.0 volt
                                  Coupling:  AC
                                  Chan ID:  LEFT REAR CHASSIS
```

1.1.1b)



1.1.2)

```
   Coupling

   1) AC
>* 2) DC
   3) ZERO
   4) BIAS SOURCE
   5) DCR:S/W DC REMOVAL
```

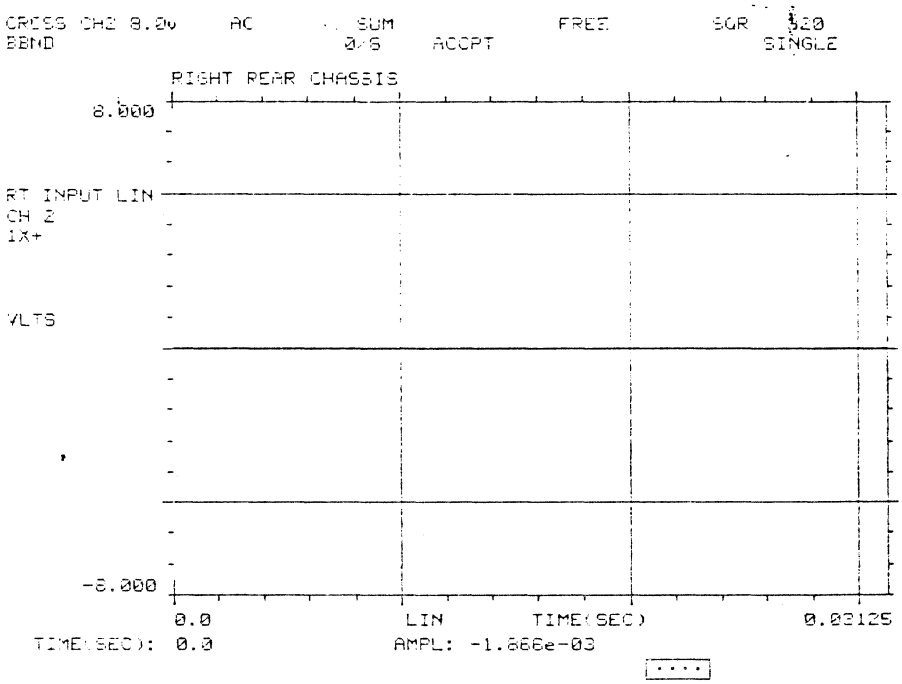
```
Setup Channel:  1
Volts Full Scale:  8.0v
MODAL coord:  1X+
Cal factor:        1.000
Cal units:  INCHES
             per 1.0 volt
Coupling:  DC
Chan ID:  LEFT REAR CHASSIS
```

1.1.2a)

```
 ENTER CHANNEL I.D. LABEL
 * LEFT REAR CHASSIS

>
```

```
Setup Channel:  1
Volts Full Scale:  8.0v
MODAL coord:  1X+
Cal factor:        1.000
Cal units:  INCHES
             per 1.0 volt
Coupling:  DC
Chan ID:  LEFT REAR CHASSIS
```

1.1.2b)



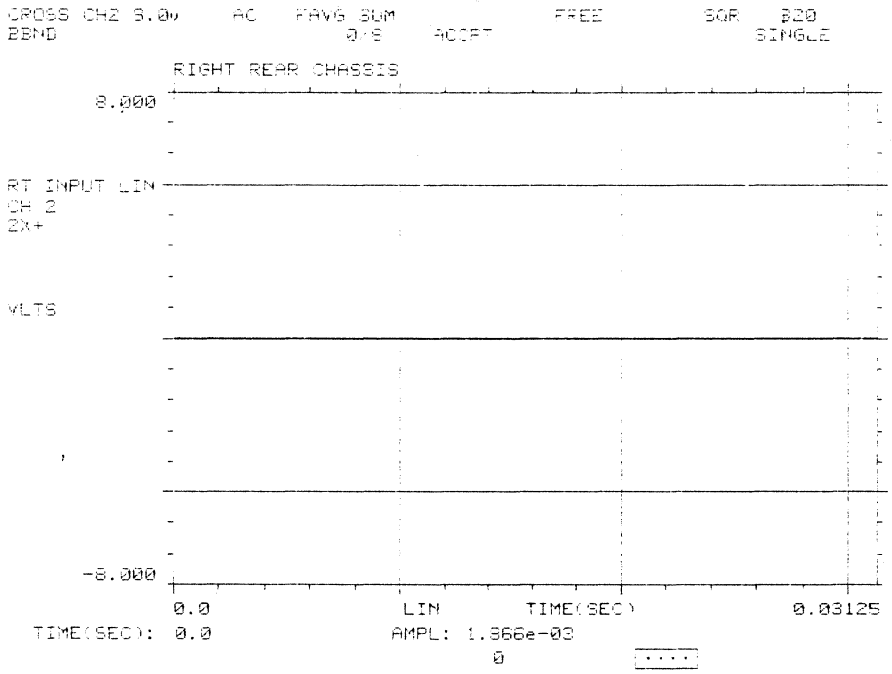
1.1.3)

```
   Coupling                          Setup Channel:  1
                                     Volts Full Scale:  8.0v
   1) AC                             MODAL coord:  1X+
   2) DC                             Cal factor:        1.000
>* 3) ZERO                           Cal units:  INCHES
   4) BIAS SOURCE                                 per 1.0 volt
   5) DCR:S/W DC REMOVAL             Coupling:  ZERO
                                     Chan ID:  LEFT REAR CHASSIS
```

1.1.3a)

```
   ENTER CHANNEL I.D. LABEL          Setup Channel:  1
   * LEFT REAR CHASSIS               Volts Full Scale:  8.0v
                                     MODAL coord:  1X+
                                     Cal factor:        1.000
                                     Cal units:  INCHES
                                                   per 1.0 volt
                                     Coupling:  ZERO
                                     Chan ID:  LEFT REAR CHASSIS
```

1.1.3b)



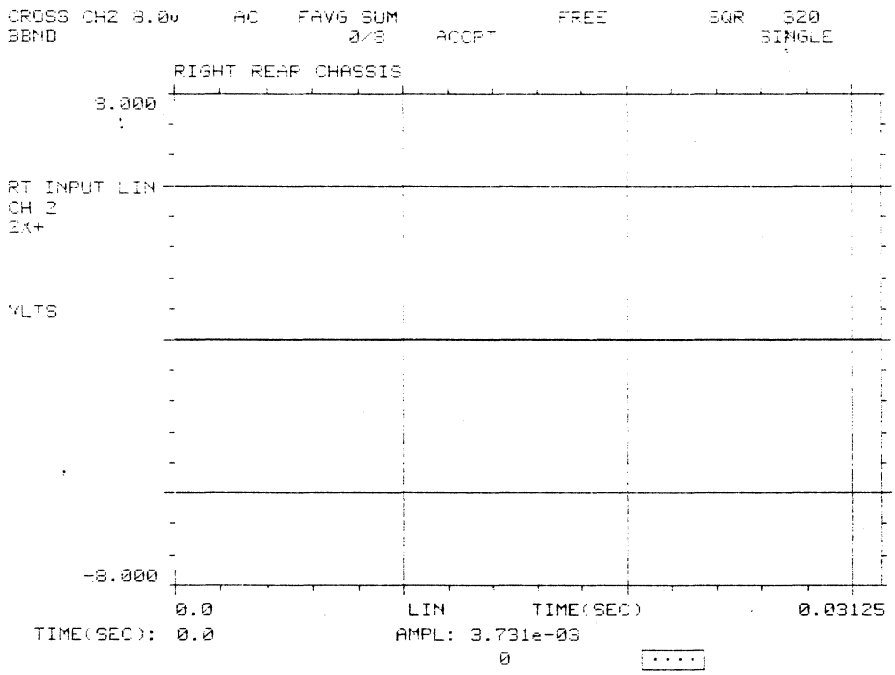
1.1.4a)

```
   Coupling                          Setup Channel:  1
                                     Volts Full Scale:  8.0v
   1) AC                             MODAL coord:  1X+
   2) DC                             Cal factor:       1.000
   3) ZERO                           Cal units:  INCHES
>* 4) BIAS SOURCE                                per 1.0 volt
   5) DCR:S/W DC REMOVAL             Coupling:  BIAS SOURCE
                                     Chan ID:  LEFT REAR CHASSIS
```

1.1.4b)

```
   ENTER CHANNEL I.D. LABEL          Setup Channel:  1
   * LEFT REAR CHASSIS               Volts Full Scale:  8.0v
                                     MODAL coord:  1X+
>                                    Cal factor:       1.000
                                     Cal units:  INCHES
                                                 per 1.0 volt
                                     Coupling:  BIAS SOURCE
                                     Chan ID:  LEFT REAR CHASSIS
```

1.1.4c)



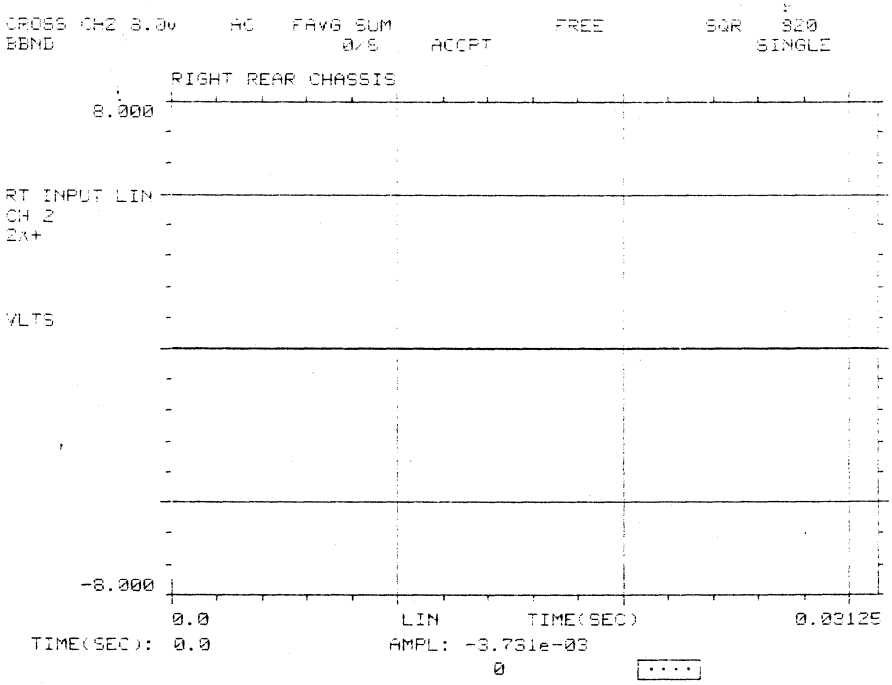
1.1.5)

```
   Coupling                          Setup Channel:  1
                                     Volts Full Scale:  8.0v
   1) AC                             MODAL coord:  1X+
   2) DC                             Cal factor:       1.000
   3) ZERO                           Cal units:  INCHES
   4) BIAS SOURCE                                per 1.0 volt
>* 5) DCR:S/W DC REMOVAL             Coupling:  DCR:S/W DC REMOVAL
                                     Chan ID:  LEFT REAR CHASSIS
```

1.1.5a)

```
   ENTER CHANNEL I.D. LABEL          Setup Channel:  1
   * LEFT REAR CHASSIS               Volts Full Scale:  8.0v
                                     MODAL coord:  1X+
  >                                  Cal factor:       1.000
                                     Cal units:  INCHES
                                                 per 1.0 volt
   ,                                 Coupling:  DCR:S/W DC REMOVAL
                                     Chan ID:  LEFT REAR CHASSIS
```

1.1.5b)



H. FREQ Pushbutton

1)

```
   Frequency Type
>* 1) BASEBAND
   2) ZOOM
```

```
Frequency Type:  BASEBAND
BASEBAND max freq:    10240
ZOOM min freq:          0.0
ZOOM max freq:        10240
# of Lines:  320
External Sample:  OFF
frame size:  1024
resolution:          32.00
sampling interval:    3.052e-05
```

1a)

```
   ENTER MAXIMUM FREQUENCY
   * 10240
```

```
Frequency Type:  BASEBAND
BASEBAND max freq:    10240
ZOOM min freq:          0.0
ZOOM max freq:        10240
# of Lines:  320
External Sample:  OFF
frame size:  1024
resolution:          32.00
sampling interval:    3.052e-05
```

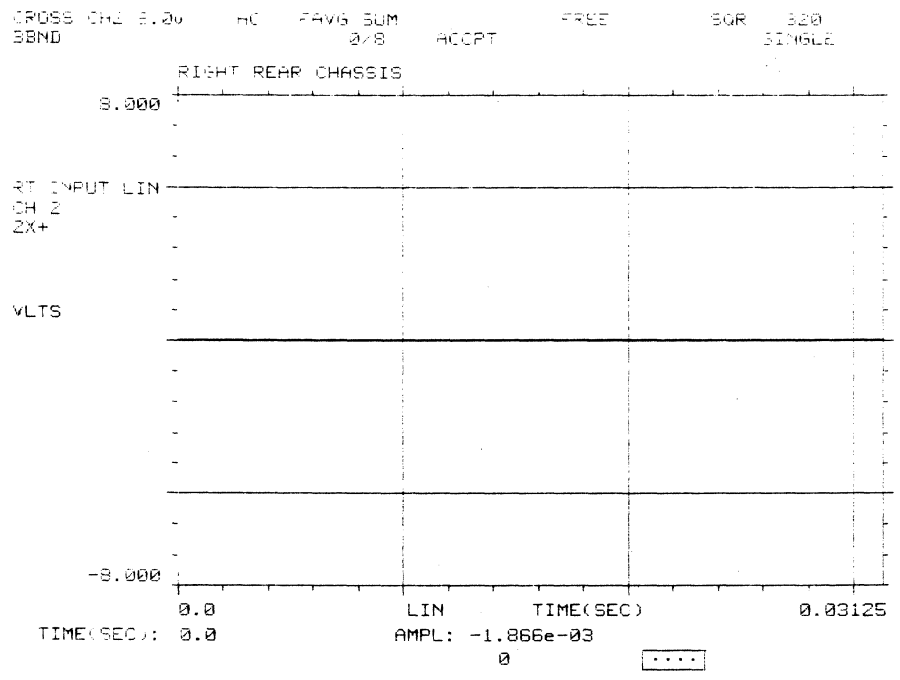
1b)

```
    # of Lines                      Frequency Type:  BASEBAND
                                    BASEBAND max freq:   10240
    1) 80                           ZOOM min freq:         0.0
    2) 160                          ZOOM max freq:       10240
>*  3) 320                          # of Lines:  320
    4) 512   *MODAL                 External Sample:  OFF
    5) 640                          frame size:  1024
    6) 1280                         resolution:        32.00
    7) 2560                         sampling interval:  3.052e-05
```

1c)

```
    External Sample                 Frequency Type:  BASEBAND
                                    BASEBAND max freq:   10240
>*  1) OFF                          ZOOM min freq:         0.0
    2) ON                           ZOOM max freq:       10240
                                    # of Lines:  320
                                    External Sample:  OFF
                                    frame size:  1024
                                    resolution:        32.00
                                    sampling interval:  3.052e-05
```

1d)



1f)

```
External Sample

 1) OFF
>* 2) ON
```

```
Frequency Type:  BASEBAND
BASEBAND max freq:    10240
ZOOM min freq:          0.0
ZOOM max freq:        10240
# of Lines:  320
External Sample:  ON
frame size:  1024
resolution:          32.00
sampling interval:  EXTERNAL
```

2)

```
Frequency Type

 1) BASEBAND
* 2) ZOOM
```

```
Frequency Type:  ZOOM
BASEBAND max freq:    10240
ZOOM min freq:          0.0
ZOOM max freq:        10240
# of Lines:  320
External Sample:  OFF
frame size:  1024
resolution:          32.00
sampling interval:   3.052e-05
```

2a)

```
ENTER ZOOM MINIMUM, MAXIMUM
* 0.0,10240
```

```
Frequency Type:  ZOOM
BASEBAND max freq:    10240
ZOOM min freq:          0.0
ZOOM max freq:        10240
# of Lines:  320
External Sample:  OFF
frame size:  1024
resolution:          32.00
sampling interval:   3.052e-05
```

2b)

```
# of Lines

 1)  80
 2)  160
*3)  320
 4)  512   *MODAL
 5)  640
 6)  1080
 7)  2560
```

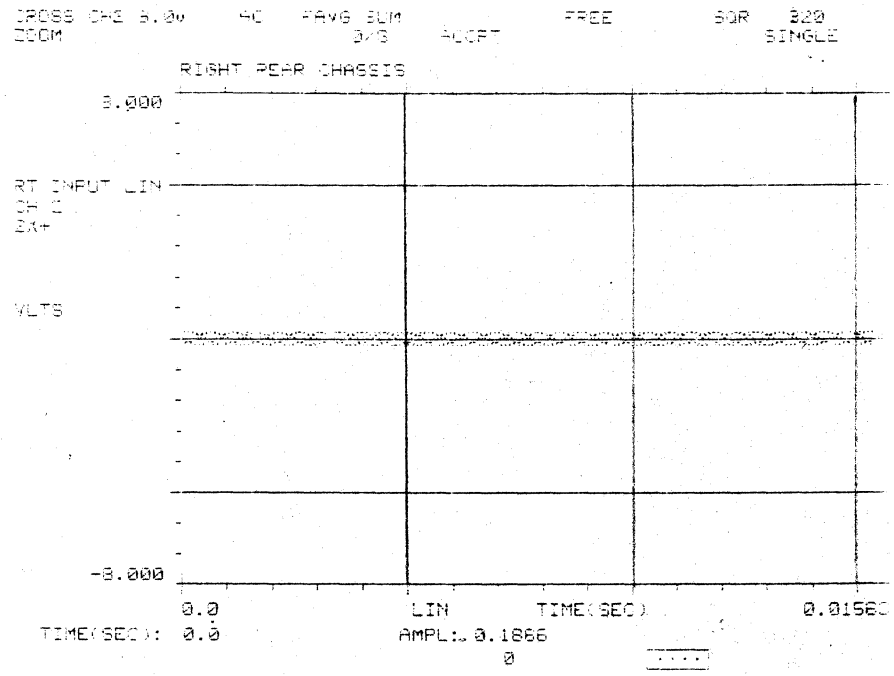
```
Frequency Type:  ZOOM
BASEBAND max freq:    10240
ZOOM min freq:          0.0
ZOOM max freq:        10240
# of Lines:  320
External Sample:  OFF
frame size:  1024
resolution:          32.00
sampling interval:   3.052e-05
```

2c)

```
   External Sample
>* 1) OFF
   2) ON
```

```
Frequency Type:  ZOOM
BASEBAND max freq:    10240
ZOOM min freq:            0.0
ZOOM max freq:        10240
# of Lines:  320
External Sample:  OFF
frame size:  1024
resolution:          32.00
sampling interval:   3.052e-05
```

2d)



DISPLAY GROUP 6

Miscellaneous Pushbuttons

A. OUTPUT SIGNAL

1)

```
    Output Signal
>*  1) OFF
    2) SINE WAVE
    3) RANDOM NOISE
    4) BAND RANDOM
```

```
Signal:  Off
Signal Level:    0.0
Frequency Type:  Baseband
```

2)

```
    Output Signal
    1) OFF
>*  2) SINE WAVE
    3) RANDOM NOISE
    4) BAND RANDOM
```

```
Signal:  Sine Wave
Signal Level:    0.0
SINE freq:  5000
Frequency Type:  Baseband
```

2a)

```
ENTER Sine Wave Frequency
with 1 Hz Resolution
* 5000
>
```

```
Signal:  Sine Wave
Signal Level:    0.0
SINE freq:  5000
Frequency Type:  Baseband
```

2b)

```
ENTER the RMS Level of
Output Sine Wave (0-4.5V)
* 0.0
>
```

```
Signal:  Sine Wave
Signal Level:    0.0
SINE freq:  5000
Frequency Type:  Baseband
```

3)

```
   Output Signal                    Signal:  Random Noise
                                    Signal Level:     0.0
   1) OFF                           Frequency Type:  Baseband
   2) SINE WAVE
>* 3) RANDOM NOISE
   4) BAND RANDOM
```

3a)

```
   ENTER the RMS Level of           Signal:  Random Noise
   Output Noise (0-1.0V)            Signal Level:     0.0
   * 0.0                            Frequency Type:  Baseband

   >
```

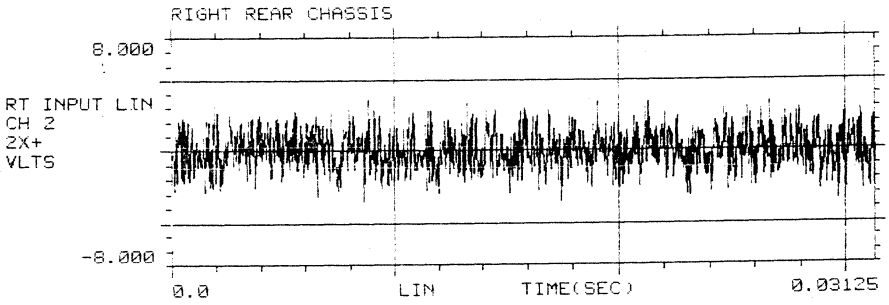
4)

```
   Output Signal                    Signal:  Band Random Noise
                                    Signal Level:     0.0
   1) OFF                           Frequency Type:  Baseband
   2) SINE WAVE
   3) RANDOM NOISE
>* 4) BAND RANDOM
```

4a)

```
   ENTER the RMS Level of           Signal:  Band Random Noise
   Output Noise (0-1.0V)            Signal Level:     0.0
   * 0.0                            Frequency Type:  Baseband

   >
```

4b)



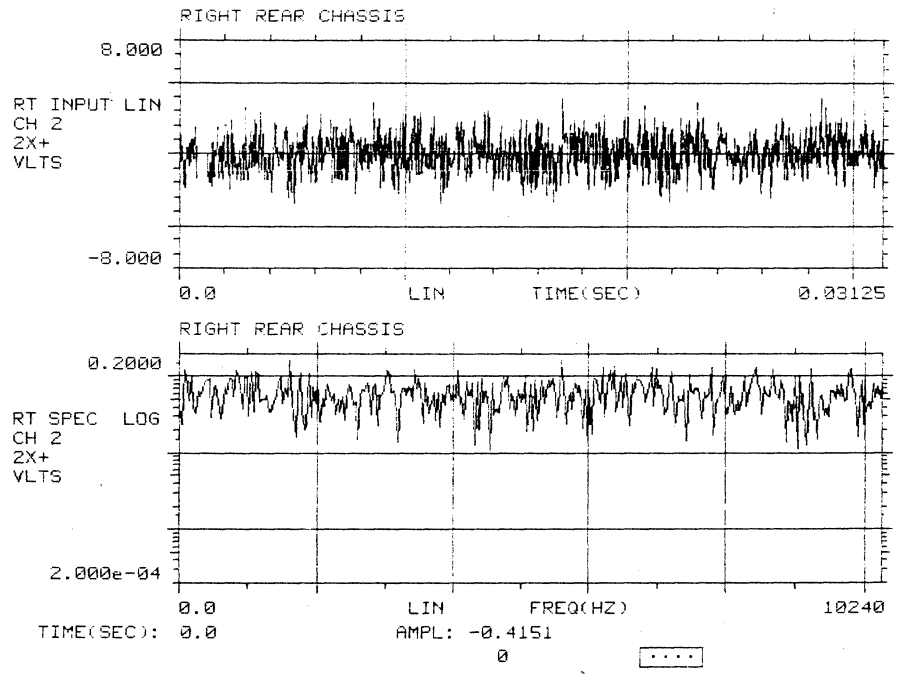
ENTER the RMS Level of
Output Noise (0-1.0V)
* 1.000

Signal: Band Random Noise
Signal Level: 1.000
Frequency Type: Baseband

>

TIME(SEC): 0.0 AMPL: 0.05504
0

4c) Dual Display of OUTPUT Signal



TIME(SEC): 0.0 AMPL: -0.4151
0