8756A
SCALAR NETWORK ANALYZER

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SECTION III

OPERATING INFORMATION

3-1. INTRODUCTION

3-2. This subsection provides complete information necessary for the correct set-up and operation of the Model 8756A Scalar Network Analyzer. For specific information on operating the 8756A with the Model 8350B Sweep Oscillator, please refer to the Operating Note BASIC NETWORK MEASUREMENTS USING 8756A SCALAR NETWORK ANALYZER AND 8350B SWEEP OSCILLATOR, #8756A/8350B/0000-99, which follows this manual. For additional information on using the 8756A over the Hewlett-Packard Interface Bus (HP-IB), please refer to the 8756A Programming Notes, also included in this section.

3-3. OPERATING CHARACTERISTICS

3-4. The Model 8756A Scalar Network Analyzer is a microprocessor based receiver. It is capable of making scalar (magnitude only) reflection and transmission measurements at RF (radio frequency) and microwave frequencies. The Model 8756A is programmable over the Hewlett-Packard Interface Bus (HP-IB). Whether or not the Model 8756A is being controlled over HP-IB, it can control a specific plotter and/or sweep oscillator through the 8756 SYSTEM INTERFACE. A measurement with the instrument requires the connection of detector(s) and/or directional bridge(s) to the A, B, or R detector inputs on the front panel, and the use of a compatible RF/microwave source.

3-5. The 8756A uses the AC detection technique in conjunction with its detectors. This technique provides very stable measurements even with temperature variations and RF interference. An RF or microwave signal is amplitude modulated with a 27.8 kHz square wave, providing the stimulus to the test device. When a signal is then detected by a compatible detector, the 8756A filters, shapes, digitizes, and displays the response. The 8756A provides the necessary 27.8 kHz modulation drive from any one of three rear panel Modulator Drive BNC outputs. They may be used to drive the external AM input of the RF or microwave source or an external modulator for a source without internal amplitude modulation capability.

3-6. The 8350B Sweep Oscillator provides the 27.8 kHz with its internal square wave modulation. All 83500 series plug-ins and most 86200 series plug-ins with the 11869A Adapter are compatible with this internal modulation. (The Models 86220A, 86230B, 86241A, 86242A, 86250A, 86250B, 86260A, 86260B, 86260C plug-ins require an external modulator for compatibility with the 8756A.)

3-7. OPERATING INSTRUCTIONS

3-8. The following describe the operation of the 8756A:

* FRONT PANEL: Fig. 3-1.
* SOFT KEYS: Fig. 3-2 and Appendix A.
* REAR PANEL: Fig. 3-3.
* HP-IB: Fig. 3-4.
* CRT GRAPHICS: Fig. 3-5.

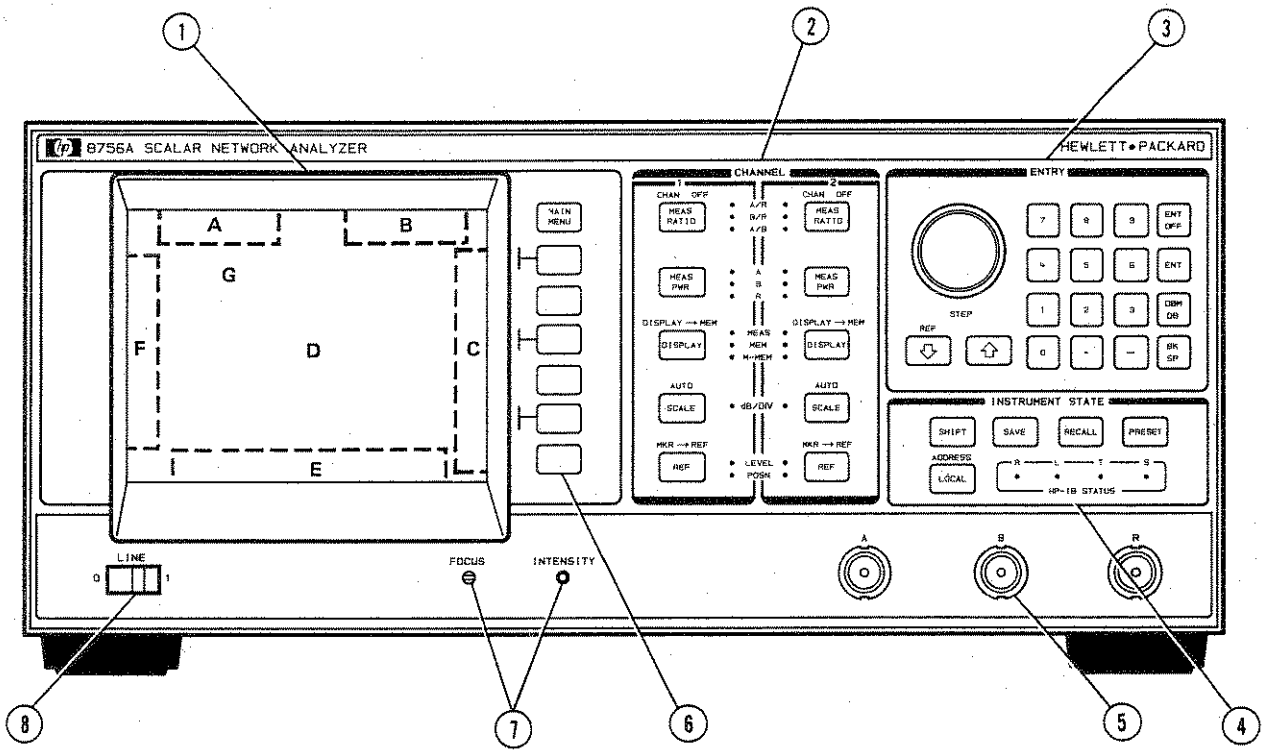
3-9. OPERATOR'S CHECKS

3-10. The Operator's Checks (see Fig. 3-6) verify that the 8756A is functioning correctly. It does not thoroughly check all specifications to their limits, but is an appropriate test for daily instrument verification, incoming inspection, or verification after repair or replacement of **digital** circuits.

3-11. ERROR MESSAGES

3-12. Error Messages are shown in the ACTIVE ENTRY AREA of the CRT display when conditions indicate a problem with the 8756A. For more information on these messages, refer to Section VIII Service.

FRONT PANEL OPERATING FEATURES



1. **CRT Display** of measurement annotation, soft key labels, data traces, and other information.

2. **CHANNEL** determines the measurement, display, scale, and reference line functions.

3. **ENTRY** provides Data Entry for the SCALE, REF, and soft keys by means of the Knob, the STEP keys, or the Keypad.

4. **INSTRUMENT STATE** provides information on the instrument and allows inputs to alter the state.

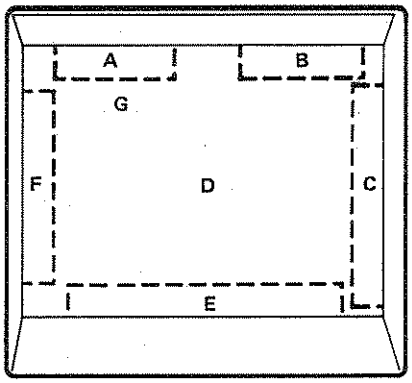
5. **DETECTOR INPUTS** allow connection of 8756A compatible detectors and/or bridges.

6. **SOFT KEYS** provide additional functions for the 8756A.

7. **CRT DISPLAY CONTROLS.**

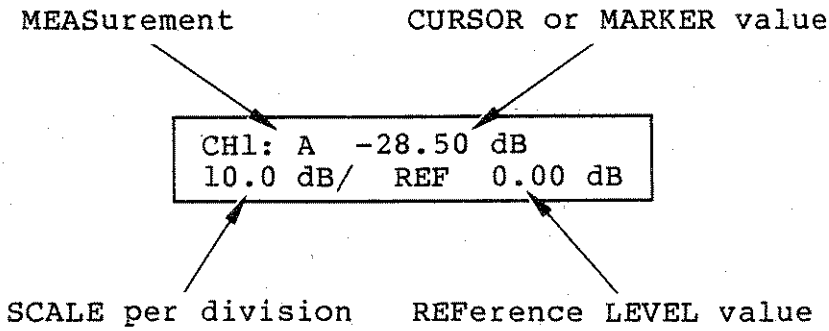
8. **LINE** controls AC power to the 8756A. 1 = ON, 0 = OFF.

Figure 3-1. Front Panel Operating Features (1 of 11)



1. CRT Display. The display for the 8756A is divided into several information sections, described below.

A and B — MODE LABELS. The ratio or power measurement, the CURSOR (or Model 8350B/8340A Active Marker) amplitude, the scale per division, and the reference level value are displayed. The Channel 1 LABEL is shown in area A; Channel 2 in area B. The Active Channel is shown with higher display intensity.



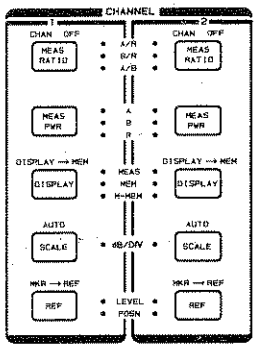
C — SOFT KEY LABELS. The menu of available soft key selections are annotated. A particular menu or function is chosen by pressing the soft key to the right of the soft key label.

D — DATA DISPLAY AREA. The data trace(s) are displayed depending on the soft key or CHANNEL functions selected.

Figure 3-1. Front Panel Operating Features (2 of 11)

E	FREQUENCY LABELS. The Start, CURSOR or Active Marker (CURSOR takes precedent), Stop Frequencies, and the Alternate Sweep frequencies (if that function is selected) are annotated when the Model 8350B Sweep Oscillator or 8340A Synthesized Sweeper HP-IB is connected to the 8756 SYSTEM INTERFACE on the Rear Panel. The 8350B or 8340A must have their HP-IB address set to 19 decimal.
F	Reference Line Positions for channel 1 and 2 are denoted on the left margin of the graticule grid. The Reference Line lies on major graticule lines only.
G	ACTIVE ENTRY AREA. The last entry or HP-IB command function selected is denoted here. Exceptions are PRESET, MEAS RATIO, and MEAS PWR.

Figure 3-1. Front Panel Operating Features (3 of 11)



2. CHANNEL. This area selects the measurement, display, scale, and reference line functions of the 8756A. Each channel has identical column of independent keys. The function selection for each key is denoted by the corresponding lamp (LED), located in the center of the CHANNEL area, and is selected by repeated pressing of that key. Selection of a function (except CHAN OFF) designates that channel the Active Channel and is indicated by a higher intensity MODE LABEL. Trace data is displayed for that channel. Labels are also displayed, unless the soft key function LABELS ON/OFF has selected labels OFF.

CHAN OFF

MEAS RATIO

- A/R
- B/R
- A/B

Selects MEASurement of detector signal RATIOs A/R, B/R, or A/B. When A/R is selected, the displayed data is the measured value of A in dBm (decibel power ratio compared to one milliwatt) minus the measured value of R in dBm. Since the values are in dBm, a logarithmic subtraction equals the linear division A/R. The displayed units for the measurement are dB (decibels). Similar operation occurs for B/R and A/B.

The shift function of this key shuts off labels and data for the channel selected. The channel is turned back on by selecting any other function referring to that channel.

MEAS PWR

- A
- B
- R

Selects MEASurement of detector power A, B, or R in dBm.

Figure 3-1. Front Panel Operating Features (4 of 11)

DISPLAY → MEM

DISPLAY

- MEAS
- MEM
- M-MEM

Selects DISPLAY of a MEASured ratio or power, the stored MEMory, or the MEASurement minus MEMory (normalized) data. The horizontal display resolution of the 8756A is 401 points.

The shift function of this key places the current MEASurement DISPLAY data into internal memory. MEMory data is always stored at the highest resolution (.003 dB for MEAS PWR and .006 dB for MEAS RATIO) regardless of the DISPLAY, SCALE per division, or REFerence LEVEL value set.

AUTO

SCALE

- dB/DIV

Allows selection of 20, 10, 5, 2, 1, 0.5, 0.2, or 0.1 dB vertical resolution per division, using the ENTRY area.

The shift function of this key performs an AUTO SCALE of the MEASurement and DISPLAY selected. AUTO SCALE adjusts the REFerence LEVEL value and SCALE per division values so that the entire trace of data can be seen on the display.

MKR → REF

REF

- LEVEL
- POSN

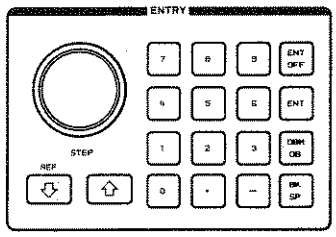
Provides selection of either the REFerence LEVEL or REFerence POSN (position) of the reference line. REF POSN may be set to any of the major horizontal graticule lines using the KNOB or STEP keys.

The reference line LEVEL on the display is the dB or dBm value to which measurements are compared, and serves as the horizontal line about which the display is expanded when the SCALE per division is decreased. The REF LEVEL value is changed using the ENTRY area. Varying this level allows easy measurement of any point on the display trace.

The shift function of this key sets the REFerence LEVEL value to that of the CURSOR. This is useful when higher resolution is desired about the CURSOR position.

When the 8350B Sweep Oscillator or the 8340A Synthesized Sweeper HP-IB (address 19 decimal) is connected to the 8756 SYSTEM INTERFACE on the Rear Panel of the 8756A, and the CURSOR is off, the REFerence LEVEL value will be set to that of the 8350B or 8340A Active Marker amplitude value.

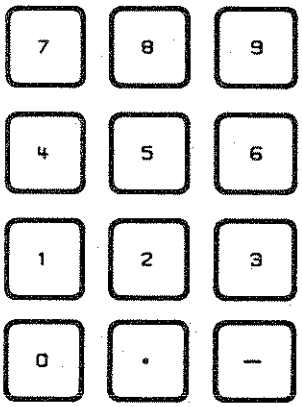
Figure 3-1. Front Panel Operating Features (5 of 11)



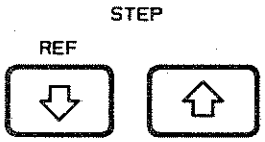
3. ENTRY. Data Entry for the SCALE, REF, and soft keys is provided by means of the Knob, the STEP keys, or the Keypad.

ENT OFF	Clears the ACTIVE ENTRY AREA.
ENT	Terminates the AVG FACTOR (under AVERAGE menu) and ADDRESS (in the INSTRUMENT STATE area) Keypad entries.
DBM dB	Used to terminate keypad entries for SCALE, REF LEVEL, STEP REF, and DET OFFSET (under CAL menu) functions.
BK SP	Allows backspace to delete of the last digit(s) entered.

Figure 3-1. Front Panel Operating Features (6 of 11)

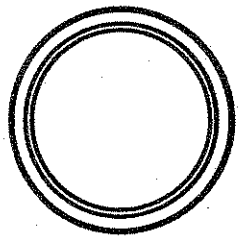


Keypad allows selection of digits, sign, and decimal point for numerical value functions (except CURSOR functions). A terminator (ENT or dBm/dB) is required, except for SAVE and RECALL.



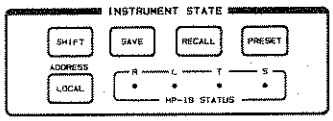
Increments or decrements the numerical value of a function (except CURSOR functions) to the next allowed value.

The shift function of the STEP DOWN key provides for setting the REFERENCE LEVEL step size when using the STEP keys with REF LEVEL. After selecting this function, enter the value desired, and terminate with the dBm/dB key.



Allows easy entry of CURSOR, SCALE, REF LEVEL, REF POSN, AVG FACTOR, or DET OFFSET (under CAL menu) functions.

Figure 3-1. Front Panel Operating Features (7 of 11)



4. INSTRUMENT STATE. This area provides information on the instrument and allows inputs to alter the state.

SHIFT — Enables the shift (blue) functions of the front panel keys.

SAVE — Allows retention of the current front panel settings. Up to 9 settings may be stored by pressing this key followed by a single digit (1 through 9) on the Keypad. No terminating key is needed. The stored DISPLAY MEMory for each channel is not saved along with the Instrument State.

RECALL — Allows recovery of up to 9 front panel settings which have been previously retained in storage registers using the SAVE key. The front panel setting desired is selected by depressing this key followed by a single digit (1 through 9). No terminating key is needed.

NOTE

When the Model 8350B Sweep Oscillator or the Model 8340A Synthesized Sweeper HP-IB (address 19 decimal) is connected to the 8756 SYSTEM INTERFACE, SAVE and RECALL are performed on both the sweep oscillator and the 8756A. Additionally, the Alternate Sweep feature of these sweep oscillators may be enabled by selecting Alternate N, where N is the register for the alternate sweep and front panel settings desired. N must be selected on the sweep oscillator keypad.

Figure 3-1. Front Panel Operating Features (8 of 11)

PRESET

Presets conditions on the 8756A and the 8756 SYSTEM INTERFACE. A self test of the 8756A is first performed, indicated by the lighting of all LED's on the front panel and clearing of the CRT display. Then the following actions take place:

1. Both Channels turned ON:
   a. MEAS PWR A on Channel 1.
   b. MEAS PWR B on Channel 2.
   c. DISPLAY MEAS.
   d. SCALE 20 dB/div.
   e. REF LEVEL 0 dB for all DISPLAY's (MEAS, MEM, M-MEM).
   f. AVERAGING OFF
   g. AVERAGING FACTOR = 8.
   h. CURSOR OFF.
   i. LABELS ON.
   j. MAIN MENU soft keys.
   k. Channel 1 set as ACTIVE channel.
   m. Modulation drive ON.

2. When the 8350B Sweep Oscillator or 8340A Synthesized Sweeper HP-IB (address 19) is connected to the 8756 SYSTEM INTERFACE, the following actions are performed on that source:

   a. Instrument Preset.
   b. Sweep time set to 200 ms.
   c. 8350B Square wave modulation ON; RF Output ON/OFF depending on plug-in internal switch setting.
   d. 8340A PULSE Modulation Input ON; RF Output ON.

3. If a 9872C or 7470A Plotter (HP-IB address set to 05 decimal) is connected to the 8756 SYSTEM INTERFACE, the following actions are performed on the plotter:

   a. Abort plot if in progress.
   b. Return pen to holder.
   c. The position of P1 and P2 are left unchanged.
   d. Default conditions for other features.

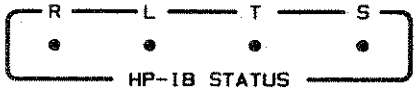
Figure 3-1. Front Panel Operating Features (9 of 11)

The following are not changed during a PRESET or on receipt of the "IP" command over HP-IB:

REF POSN, MEMory, RECALL registers, instrument HP-IB addresses.

Returns the 8756A to LOCAL operation from the remote operation state unless a Local Lockout command has been received over HP-IB.

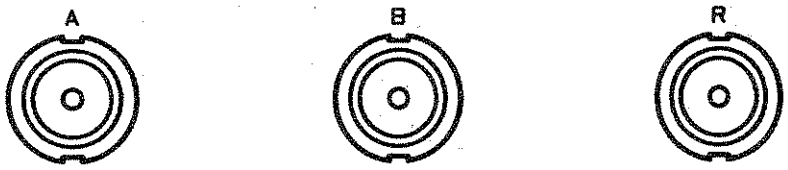
The shift function of this key causes the HP-IB address for the 8756A to be displayed in the ACTIVE ENTRY AREA. The address may be changed, if desired, using the keypad and terminated with the ENT key. Allowable values are 1 through 29 decimal; 0, 30, and 31 decimal are not accessible.



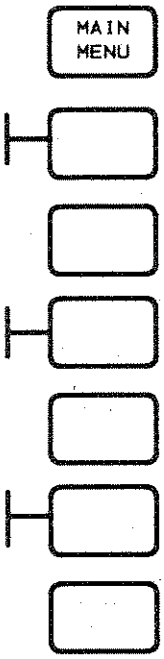
This area displays the current HP-IB status of the 8756A, where:

R = Remote operation
L = Listen mode
T = Talk mode
S = Service request (SRQ) asserted

Figure 3-1. Front Panel Operating Features (10 of 11)



5. DETECTOR INPUTS. Each input has identical characteristics and allows connection of 8756A compatible detectors and/or bridges. **A** is typically used for the connection of a reflectometer bridge for reflection measurements. **B** is typically used for the connection of a detector for transmission measurements. **R** is typically used for the reference detector input when making ratio measurements.



6. SOFT KEYS. These keys provide for additional functions of the 8756A beyond that of the Front Panel keys discussed above. Related functions are grouped into a soft key menu. A particular function on the menu displayed in the SOFT KEY LABEL area is selected by pressing the key to the immediate right of the label. The MAIN MENU key displays and restores the MAIN MENU to the SOFT KEY LABEL area. More details on the soft key menus and functions are discussed in the Fig. 3-2, SOFT KEY OPERATING FEATURES.

7. CRT DISPLAY CONTROLS.

INTENSITY

Allows for adjustment of the CRT display brightness.

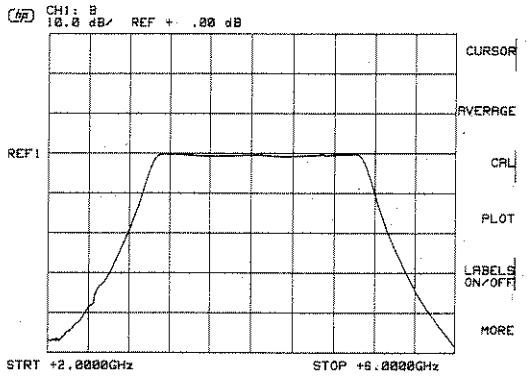
FOCUS

Allows for screwdriver adjustment of the focus of the CRT display.

Figure 3-1. Front Panel Operating Features (11 of 11)

SOFT KEY OPERATING FEATURES

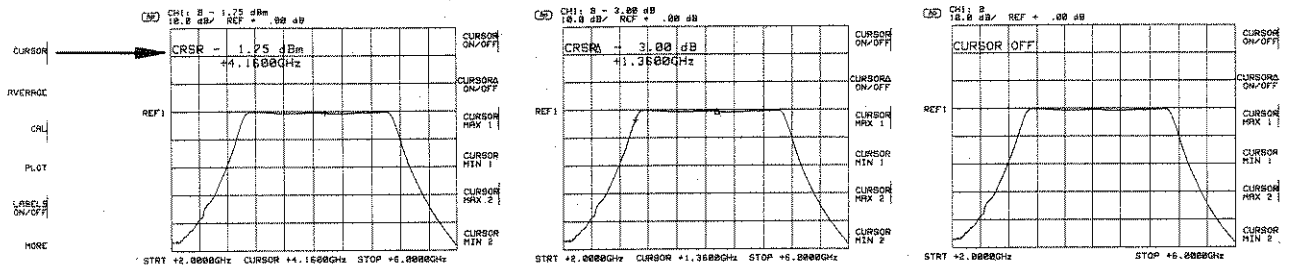
MAIN MENU



The MAIN MENU is the primary means of selecting all of the Soft Key functions and menus. When the MAIN MENU or PRESET key is pressed, the MAIN MENU of Soft Keys is always displayed. A particular soft key menu or function is selected by then pressing the key to the immediate right of the label on the CRT display. Selection of MAIN MENU does not alter any previously selected function parameter, either from the Front Panel or Soft Key. The following pages describe each Soft Key menu or function listed in the MAIN MENU.

Figure 3-2. Soft Key Operating Features (1 of 10)

CURSOR Menu



(a) (b) (c)

When CURSOR is selected on the MAIN MENU, the CRT will appear as shown in (a), with the CURSOR (+ symbol) turned ON.

CURSOR ON/OFF alternately turns the CURSOR ON, as shown in (a), and OFF, as shown in (c). When ON, the CURSOR appears on any of the active data traces. The Knob is used to move the CURSOR to any point on the data traces. The amplitude of the measurement for a selected channel appears in the upper right corner of the MODE LABEL, and also appears in the ACTIVE ENTRY AREA for the Active Channel. This amplitude is always the selected MEASurement and DISPLAY reading, resolved to 0.01 dB, regardless of the SCALE per division or REFerence LEVEL value.

If either the 8350B Sweep Oscillator or the 8340A Synthesized Sweeper HP-IB is connected to the 8756 SYSTEM INTERFACE, the CURSOR frequency value appears in the FREQUENCY LABELS and also in the ACTIVE ENTRY AREA for the Active Channel. When Alternate Sweep is selected, both CURSOR frequencies will appear for each sweep in the FREQUENCY LABELS.

Figure 3-2. Soft Key Operating Features (2 of 10)

CURSOR/△ ON/OFF alternately turns the CURSOR/△ ON, as shown in (b), and OFF, as shown in (a). When ON, the last set position of the CURSOR (regardless of whether the CURSOR was ON or OFF) is marked by the △ symbol.

Rotating the Knob moves the CURSOR (+ symbol), and the amplitude readings in the MODE LABELS and ACTIVE ENTRY AREA are now relative to the △ symbol position.

If either the 8350B Sweep Oscillator or the 8340A Synthesized Sweeper HP-IB is connected to the 8756 SYSTEM INTERFACE, the absolute value frequency difference between the △ symbol position and the + symbol position are annotated in the FREQUENCY LABELS and also in the ACTIVE ENTRY AREA. When Alternate Sweep is selected, both CURSOR/△ frequencies will appear for each sweep in the FREQUENCY LABELS.

CURSOR MAX 1 positions the CURSOR (+ symbol) to the maximum value point on the Channel 1 trace.

CURSOR MIN 1 positions the CURSOR (+ symbol) to the minimum value point on the Channel 1 trace.

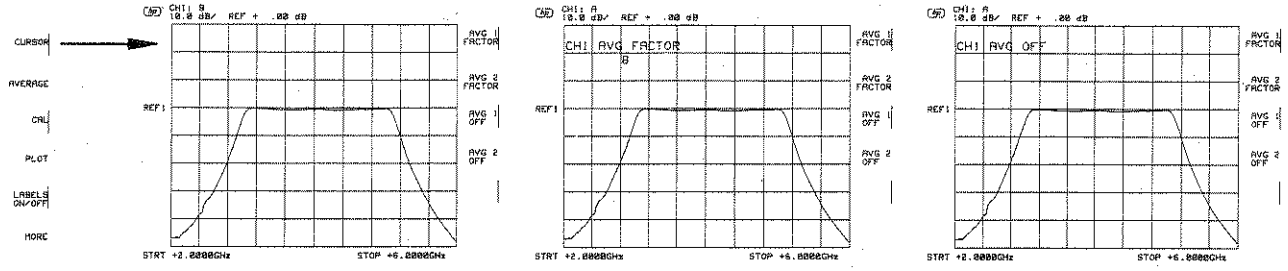
CURSOR MAX 2 positions the CURSOR (+ symbol) to the maximum value point on the Channel 2 trace.

CURSOR MIN 2 positions the CURSOR (+ symbol) to the minimum value point on the Channel 2 trace.

Both the MAX and MIN functions may be used with either CURSOR or CURSOR/△ selected.

Figure 3-2. Soft Key Operating Features (3 of 10)

AVERAGE Menu



(a) (b) (c)

When AVERAGE is selected on the MAIN MENU, the AVERAGE Menu appears, as shown in (a).

AVG 1 FACTOR turns averaging ON for Channel 1. The Averaging Factor last set is displayed in the ACTIVE ENTRY AREA, as shown in (b). (The PRESET value is 8.) This factor may be changed at this time using the ENTRY area.

AVG 2 FACTOR turns averaging ON for Channel 2. The Averaging Factor last set is displayed in the ACTIVE ENTRY AREA, as shown in (b), except that Channel 2 is the Active Channel. (The PRESET value is 8.) This factor may be changed at this time using the ENTRY area.

The Averaging Factors allowed are 1 (no averaging), 2, 4, 8, 16, 32, 64, 128, and 256.

The averaging technique used is exponential averaging, with data displayed using the following formula:

$$\text{CURRENT DISPLAYED DATA} = \frac{(AF-1)}{AF} * \text{LAST DISPLAYED DATA} + \frac{1}{AF} * \text{CURRENT MEASURED DATA}$$

where AF=Averaging Factor.

AVG 1 OFF turns averaging OFF for Channel 1; this condition is indicated as shown in (c).

AVG 2 OFF turns averaging OFF for Channel 2; this condition is indicated as shown in (c), except that Channel 2 is the Active Channel.

Figure 3-2. Soft Key Operating Features (4 of 10)

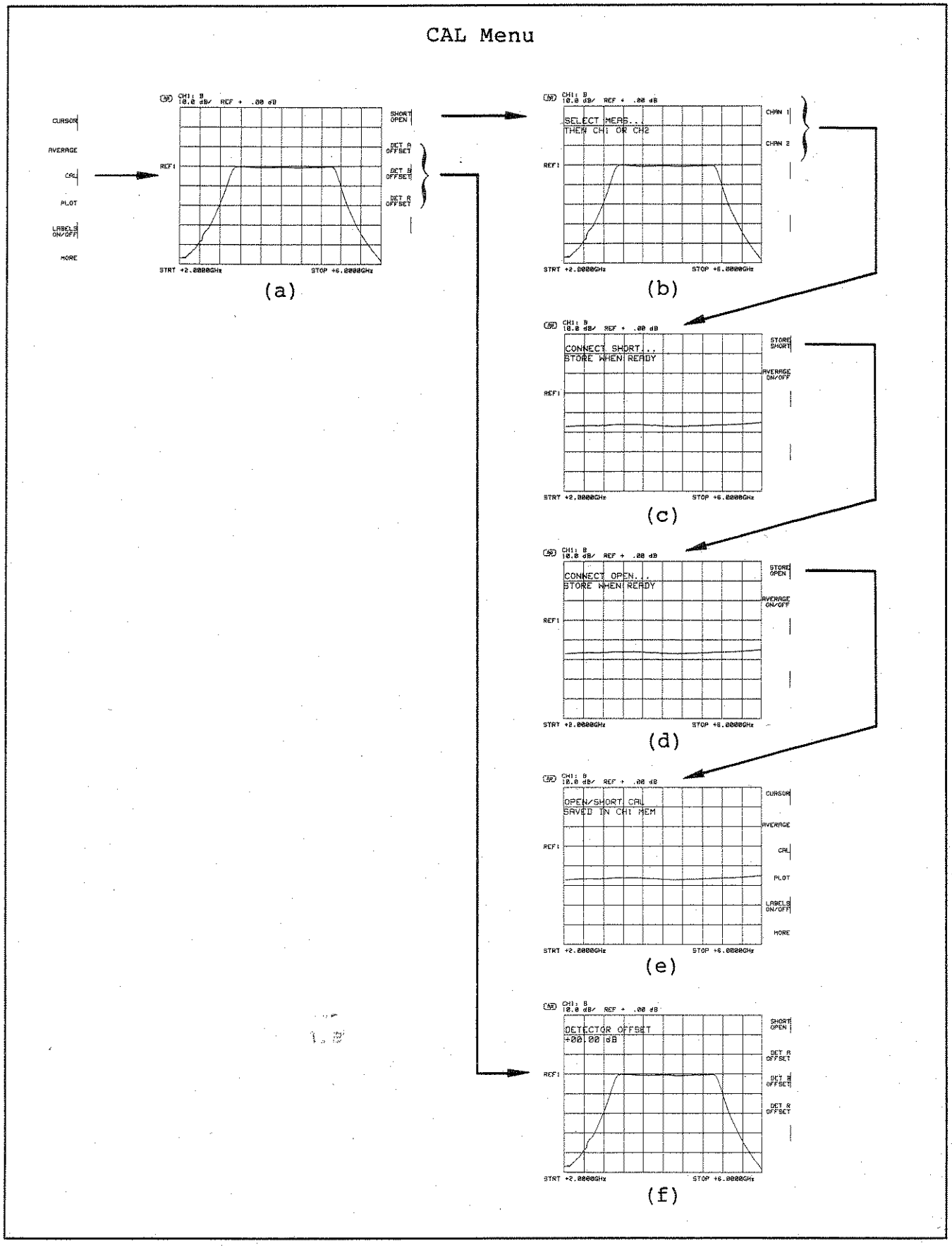


Figure 3-2. Soft Key Operating Features (5 of 10)

When CAL is selected on the MAIN MENU, the CAL Menu appears, as shown in (a).

SHORT OPEN begins the Open/Short Calibration, useful for making accurate reflection measurements. Through a series of prompts, the user performs an open & short circuit average, which in turn, is stored into MEMory for calibration of the Channel desired.

The user is first prompted, as shown in the ACTIVE ENTRY AREA of (b), to SELECT MEAS...THEN CH1 or CH2. At this point, the user selects MEAS RATIO or MEAS PWR on Channel desired.

When ready, the soft key CHAN1 or CHAN2 is pressed, depending on which Channel was selected for making the reflection measurement. This action displays the next prompt CONNECT SHORT...STORE WHEN READY, as shown in the ACTIVE ENTRY AREA of (c). At this point, a short circuit should be connected to the test port of the directional bridge/coupler. If desired, averaging may be turned ON/OFF with the AVERAGE ON/OFF soft key to reduce noise on the trace. (The Averaging Factor is whatever value last set.)

When the short circuit trace data is displayed as desired, STORE SHORT is depressed. This action displays the next prompt CONNECT OPEN...STORE WHEN READY, as shown in the ACTIVE ENTRY AREA of (d). At this point, an open circuit (a shielded open is recommended) to the test port. As with the short circuit, averaging may be turned ON/OFF with the AVERAGE ON/OFF soft key to reduce noise on the trace.

When the open circuit trace data is displayed as desired, STORE OPEN is depressed. The ACTIVE ENTRY AREA now indicates the action taken: OPEN/SHORT CAL SAVED IN CH1 (or 2) MEM, as shown in (e). This acknowledges that the open/short calibration is now stored in MEMory for the Channel selected. Selection of DISPLAY M-MEM for that Channel shows the trace data relative to the calibration.

DET A OFFSET displays the current value of offset entered for the **A** detector input, as shown in (f).

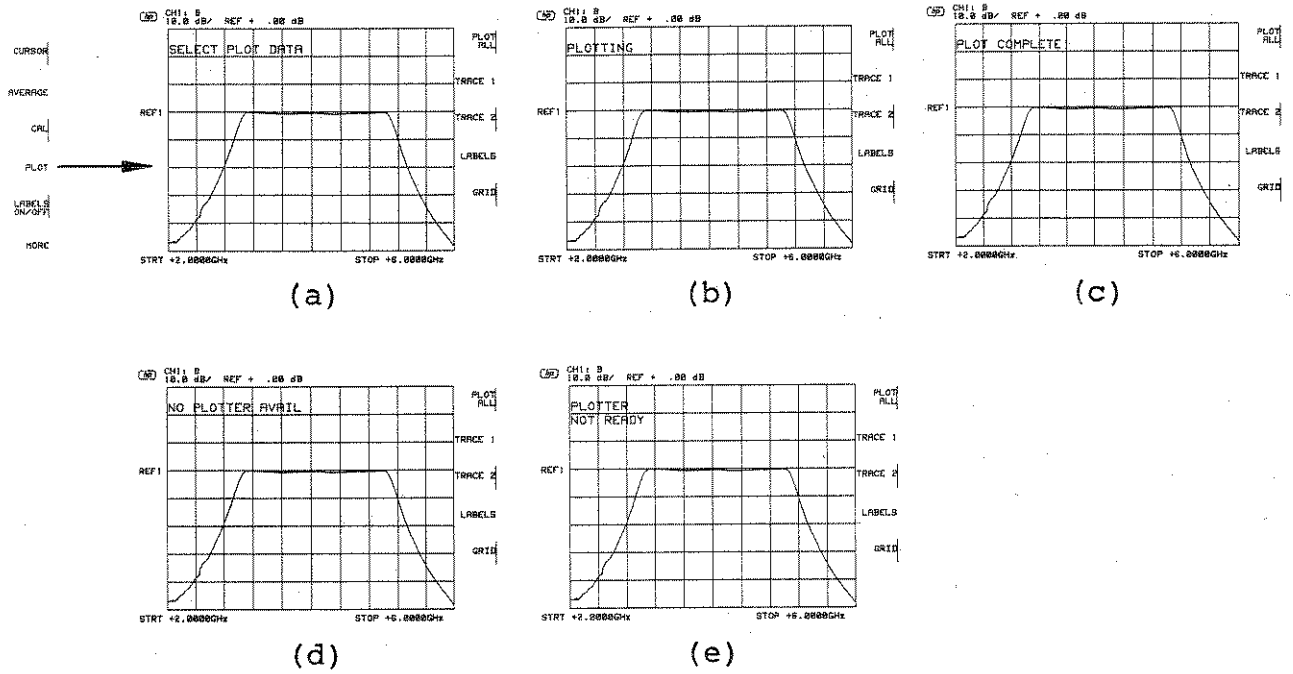
DET B OFFSET displays the current value of offset entered for the **B** detector input.

DET R OFFSET displays the current value of offset entered for the **R** detector input.

The value of OFFSET may be changed using the ENTRY area. The OFFSET is useful for entering the difference between the reading on the 8756A with a specific detector and the reading with a power meter; this provides better accuracy. The OFFSET is also useful for entering the value of attenuation used when an attenuator is connected in front of a detector (padding).

Figure 3-2. Soft Key Operating Features (6 of 10)

PLOT Menu



When PLOT is selected on the MAIN MENU, the PLOT menu appears, as shown in (a). The prompt SELECT PLOT DATA is shown in the ACTIVE ENTRY AREA. This menu allows for plots to be made onto the HP-IB Plotter (either the 7470A or 9872C) connected to the 8756 SYSTEM INTERFACE. The Plotter address switches must be set to 00101 binary or 05 decimal for proper operation. The P1 and P2 positions (bottom left limit and upper right limit, respectively) will be the Plotter's default values, but may be changed by the user at any time after powering on the Plotter. Refer to the Plotter Operating Manual for the procedure on changing P1 and P2.

Figure 3-2. Soft Key Operating Features (7 of 10)

PLOT ALL draws the grid, labels, trace data, CURSOR, and markers on the HP-IB plotter. Graphics written to the CRT over the HP-IB of the 8756A will not be drawn on this plot; however, the user may access the plotter by means of passing through commands (see HP-IB Operating Features, Fig. 3-4).

TRACE 1 draws the trace data, CURSOR, and markers for Channel 1.

CURSOR is denoted as ⟡ , the CURSOR△ AS △, and the markers as ◇ .

TRACE 2 draws the trace data, CURSOR, and markers for Channel 2.

CURSOR is denoted as ⟡ , the CURSOR△ AS △, and the markers as ◇ .

LABELS draws the MODE LABELS, reference line position labels, and the FREQUENCY LABELS.

GRID draws the grid (or graticule) lines.

If the HP-IB Plotter has its address switches set to 05 decimal, and its HP-IB is properly connected to the 8756 SYSTEM INTERFACE, the CRT Display is frozen, the plotter begins plotting, and the ACTIVE ENTRY AREA appears as shown in (b) when any of the PLOT Menu soft keys are pressed. When the plot is finished, the CRT display appears as shown in (c).

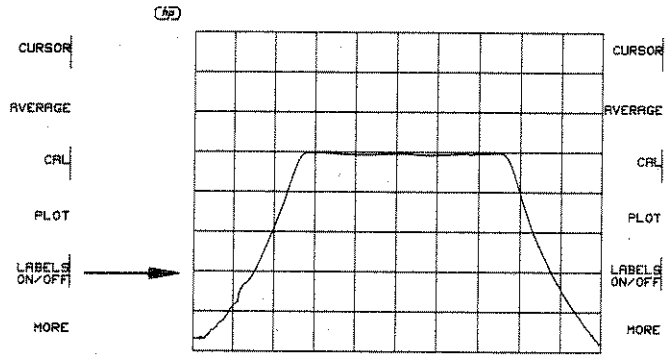
If the HP-IB Plotter is improperly connected (or not connected at all) to the 8756 SYSTEM INTERFACE, the CRT display appears as shown in (d).

If the HP-IB Plotter is not ready (paper not loaded, error message, etc.), but is properly connected to the 8756 SYSTEM INTERFACE, the CRT display appears as shown in (e).

When the 8350B Sweep Oscillator or 8340A Synthesized Sweeper HP-IB is also connected to the 8756 SYSTEM INTERFACE, annotation of Start, Stop, and CURSOR (if ON) frequencies will also appear on the bottom of the plots when PLOT ALL or LABELS is pressed. If the CURSOR is off and a marker or markers are on, the Active Marker will appear in the frequency annotation and will be shown on the trace data as a ◇ .

Figure 3-2. Soft Key Operating Features (8 of 10)

LABELS ON/OFF



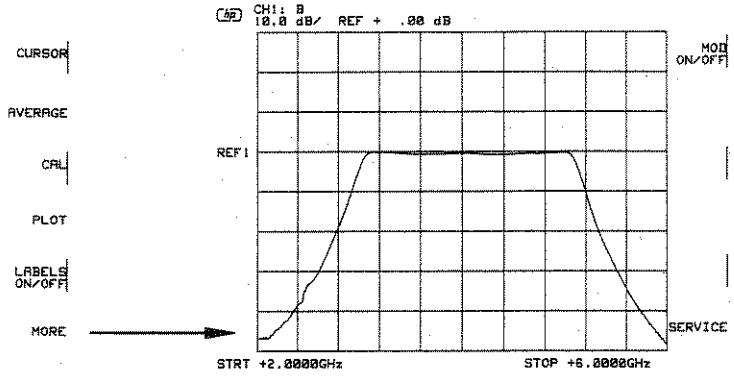
(a)

When LABELS ON/OFF is selected on the MAIN MENU, the MODE LABELS, and Reference Line Position labels are alternately turned OFF, as shown in (a), and ON.

When the 8350B Sweep Oscillator or the 8340A Synthesized Sweeper HP-IB is connected to the 8756 SYSTEM INTERFACE, the FREQUENCY LABELS will be alternately turned OFF and ON also.

Figure 3-2. Soft Key Operating Features (9 of 10)

MORE Menu



(a)

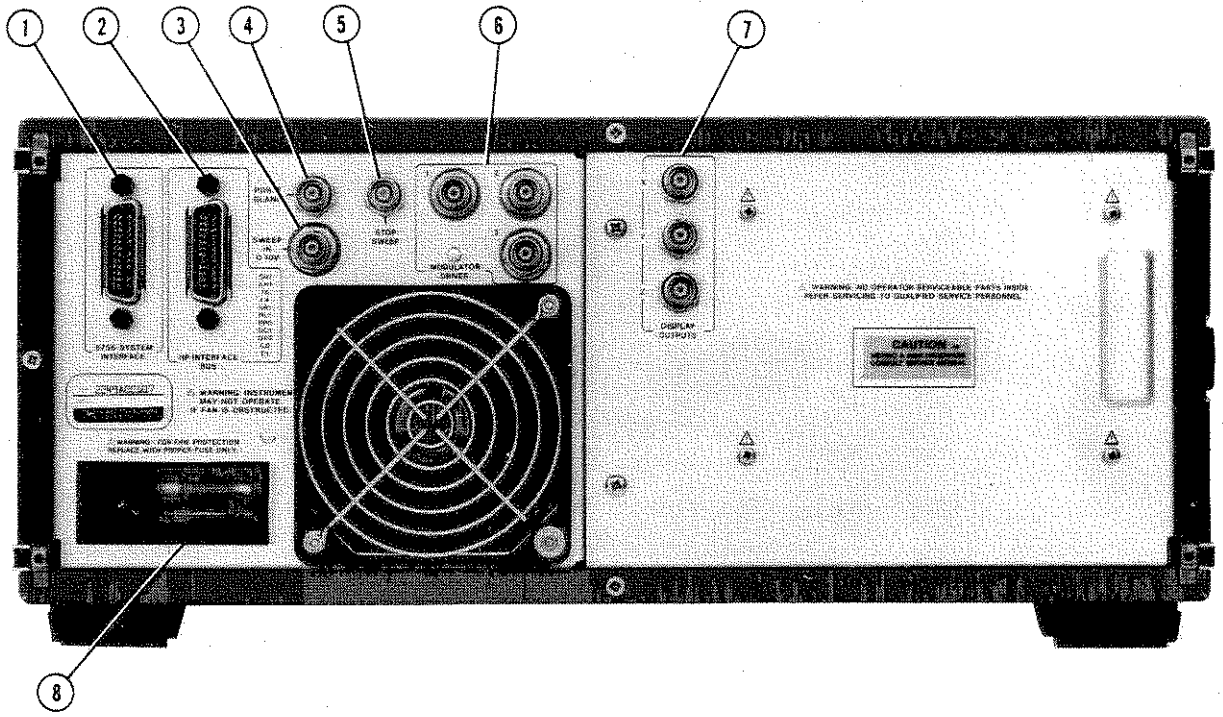
When MORE is selected on the MAIN MENU, the MORE menu appears, as shown in (a).

MOD ON/OFF turns the 27.8 kHz square wave output from the MODULATOR DRIVES, located on the rear panel of the 8756A, ON and OFF. When OFF, the MODULATOR DRIVES provide the power necessary to hold an external modulator in the minimum insertion loss mode.

SERVICE provides for enabling the built-in serviceability routines (see Section VIII Service).

Figure 3-2. Soft Key Operating Features (10 of 10)

REAR PANEL OPERATING FEATURES



1. 8756 SYSTEM INTERFACE
   Input/Output connector provides control of the HP 8350B Sweep Oscillator or the HP 8340A Synthesized Sweeper and the HP-IB Plotters, Model 7470A or 9872C, through their respective HP-IB connectors. This control is accomplished without the use of an external HP-IB controller. The 8350B or the 8340A address must be set to 19 decimal; the 7470A or 9872C address must be set to 05 decimal.

   The 8756 SYSTEM INTERFACE control of the 8350B or the 8340A provides frequency annotation shown in the FREQUENCY LABELS of the CRT display, SAVE, RECALL, and PRESET (pressed on either instrument) of both instruments, and Alternate Sweep capability.

   The 8756 SYSTEM INTERFACE control of the 7470A or the 9872C provides for hard copy plots, using the PLOT Menu of the Soft Keys, and PRESET to default values for the plotter.

2. HP INTERFACE BUS
   Input/Output connector allows interfacing to HP-IB controllers. The HP-IB address is set at the factory to 16 decimal, which may be changed using the ADDRESS function (SHIFT LOCAL). Other instruments may be connected to the HP-IB, but must be set to a different address value.

Figure 3-3. Rear Panel Operating Features (1 of 2)

3. SWEEP IN 0-10V
Input BNC connector accepts the 0 to +10 volt sweep ramp signal from the sweep oscillator.

4. POS Z BLANK
Input BNC connector accepts retrace and bandswitch blanking and accepts negative Intensity Marker (Z-axis modulation) signals. The signal levels sensed on this input are +5 volts for blanking, 0 volts for display, -4 volts for markers, and -8 volts for the Active Marker.

5. STOP SWEEP
Output BNC connector provides the interface signal to stop the sweep on the 8350B Sweep Oscillator or the 8340A Synthesized Sweeper, used only when these are controlled by the 8756 SYSTEM INTERFACE.

NOTE

Connection of the SWEEP IN 0-10V and the POS Z BLANK from a sweeper or source are the minimum requirements needed for proper operation of the 8756A. When the 8350B Sweep Oscillator or the 8340A Synthesized Sweeper is connected to the 8756 SYSTEM INTERFACE, connection of STOP SWEEP is mandatory.

6. MODULATOR DRIVES
Output connectors, each providing 27.8 kHz square wave signals (nominally +/- 6 volts, unloaded), for driving external HP 11665B modulators or the external Amplitude Modulation of a sweep oscillator. When using the 8340A Synthesized Sweeper, this modulator drive should be connected to the PULSE MODULATION INPUT.

7. DISPLAY OUTPUTS
Output connectors providing X, Y, and Z outputs for driving another peripheral such as a large screen display (for example, Model 1310B). The added peripheral should have a bandwidth of 5 MHz or greater. The open circuit amplitude of the X and Y axis outputs range from 0 to 1 volt from a source impedance of about 340 ohms. The Z axis output has the same voltage range, but a source impedance of about 250 ohms. A 0 volt Z axis output corresponds to display mode, 1 volt output corresponds to blanking mode. These output circuits are designed for use with Hewlett-Packard large screen displays with 10 K ohms impedances, and cannot drive impedances less than 600 ohms. Cable lengths to this display should not exceed 6 feet (1.83 meters).

8. POWER LINE MODULE
Input connector accepts line voltage. Line voltage selection of 100, 120, 220, or 240 volts is chosen by correctly inserting the printed circuit selector board. Refer to Fig. 2-1 in Section II Installation for instructions.

Figure 3-3. Rear Panel Operating Features (2 of 2)

HP-IB OPERATING FEATURES

Remote operation of the HP 8756A Scalar Network Analyzer is accomplished using the Hewlett-Packard Interface Bus, HP-IB, which is the Hewlett-Packard implementation of IEEE standard 488 dated 1978 and IEC 625-1. For more information on the HP-IB, refer to the Tutorial Description of the Hewlett-Packard Interface Bus, Literature No. 5959-0156, and Condensed Description of the Hewlett-Packard Interface Bus, Part No. 59401-90030.

NOTE

Remote operation of the HP 8756A applies to operations with the HP INTERFACE BUS (HP-IB) connector on the rear panel of the HP 8756A. Do not connect an HP-IB controller to the 8756 SYSTEM INTERFACE connector; HP-IB control of the instruments connected to this port is described in the 8756 SYSTEM INTERFACE section below.

PROGRAMMING COMMANDS

The HP 8756A accepts specific programming commands (LISTEN mode) for selecting front panel key functions, soft key functions, and special HP-IB only functions. It outputs data from a designated channel measurement trace or memory trace in one of two formats specified by the user, as well as other TALK functions. Also, the HP 8756A can pass through HP-IB commands to either the HP 8350B Sweep Oscillator or the HP 8340A Synthesized Sweeper and the HP 7470A or 9872C plotter connected to the 8756 SYSTEM INTERFACE.

All of these codes are described in these tables.

Table 3-1. Function Select Commands.
Table 3-2. Output Mode Commands and Formats.
Table 3-3. Cross Reference of Tables 1 and 2.

For more information on the front panel key functions, see Figure 3-1; on the soft key functions, see Figure 3-2. These perform the same function whether under remote or local.

INPUT COMMAND SYNTAX

The 8756A commands may be sent as upper and/or lower case ASCII characters. Variable length commands (two characters followed by two or more digits) and all commands beginning with the letter "O" must be terminated with a semicolon ";", a carriage return, line feed "[cr][lf]", a "[lf]", a "DB;", a "db;", a "DB[cr][lf]", or a "db[cr][lf]". The latter four are useful for improving legibility of programs.

NOTE

Commands and characters enclosed in quotation marks " " refer to the standard ASCII Character Set.

Figure 3-4. HP-IB Operating Features (1 of 7)

FORMATS OF NUMERICAL INPUTS

Throughout Tables 3-1 and 3-3, numerical inputs are appended to some commands. These are:

Format/Values

m 0 = Function Off.
1 = Function On.

d Variable length parameter, including sign and decimal point, if desired. These parameters require the terminators ";", "[cr][lf]", "[lf]", "DB;", "db;", "DB[cr][lf]", or "db[cr][lf]". **When the value of d does not correspond to the function's resolution or range, d will be rounded and assigned the closest allowable value.**

n Decimal integers 1 through 9.

q Values unique to the particular function and explained under COMMAND DESCRIPTION or NOTES.

HP-IB ONLY FUNCTIONS

HP-IB only functions are shown in Table 3-1.

The Blank CRT Display Features commands provide for blanking the entire CRT display or restoring the display to its normal, power on condition.

The Clear Status command clears (sets to zero) both Status Bytes.

The Format Data commands are useful for outputting data, as shown in Table 3-2. The Format Data ASCII, "FD0" command, will output data in the format of ASCII signed digits, as shown in the table. The Format Data Binary, "FD1" command, will output data in the form of two bytes, the most significant byte sent first, when using the Output Cursor, Output Data, or Output Value commands. If these are read as a 16 bit word, and converted to a decimal value, the following formulas may be used to scale the data:

MEAS RATIO or M-MEM:
dB value = (decimal value)* 180 / 32767 - 90

MEAS PWR
dBm value = (decimal value) * 90 / 32767 - 70

The Pass Through command is discussed under the 8756 SYSTEM INTERFACE. Request Mask is explained under SERVICE REQUEST & STATUS BYTES.

Figure 3-4. HP-IB Operating Features (2 of 7)

The Set Cursor Position command is useful for setting the CURSOR on a data trace at a specific frequency. Given the Start and Stop frequencies, the CURSOR may be set to a Frequency using the formula:

Set Cursor Position value = (Frequency - Start)*400/(Stop - Start)

Non Swept Mode stops the update of data traces with the 0 to 10 volt sweep ramp, and is used to hold data for taking the measurement and outputting the data. Swept Mode causes the data traces to update with the sweep ramp, and should be received by the 8756A to restore normal swept frequency displays.

Take Sweep is used to take a specific number of sweeps, then hold data on the display. This is useful for controlling the 8756A in normalization (M-MEM) and averaging applications.

Write Key is used to put user defined labels on the Soft Keys. The "WK" command is followed by the soft key number in ASCII, range 1 through 6. Then, this is followed by "[ASCII label]" for a single line label or "[ASCII label][term],[ASCII label][term]" for a two line label. The ASCII label must be seven characters or less and terminated as shown by [term] = [cr][lf] or semicolon ; .

Write Memory is used to write to a particular channel memory with 401 points of data. After receiving the "WM" command, the 8756A expects 401 values in the format ("FD1" or "FD0") previously selected. These values, in turn, are written to the Channel Memory previously designated ("C1" or "C2").

HP-IB OUTPUT COMMANDS

Data is output from the 8756A by first sending one of the "O" commands listed in Table 3-2. Output Cursor, Output Data, and Output Value are used to obtain measurement data, in either ASCII format ("FD0") or Binary format ("FD1"), where the most significant byte is sent first.

Refer to Table 3-2 for Output Identity and Output Keycode. The Output Status command is explained under SERVICE REQUEST & STATUS BYTES.

HP-IB ERROR MESSAGES

Any alphanumeric sequence which is not a recognized 8756A command will be noted on the CRT in the ACTIVE ENTRY Area as "UNKNOWN CMD-" followed by the last one or two characters received by the 8756A over HP-IB. The 8756A will not lock out further HP-IB traffic, and will execute any subsequent valid command. Further, a syntax error service request (SRQ) will be sent if that SRQ bit has been enabled in the Request Mask (see SERVICE REQUEST & STATUS BYTES below). If there are many errors in the alphanumeric sequence, only the last error is displayed in the ACTIVE ENTRY AREA.

Figure 3-4. HP-IB Operating Features (3 of 7)

CAPABILITY IDENTIFICATION CODE

The 8756A has the following capability code, in conformance with IEEE 488-1978:

SH1: Source handshake
AH1: Acceptor handshake
T6: Basic talker; Serial Poll; Unaddress to talk if addressed to listen
L4: Basic listener; Unaddressed to listen if addressed to talk
SR1: Service Request
RL1: Remote; Local
PP0: No Parallel Poll
DC1: Device Clear
DT0: No Device Trigger
C0: No Controller (Take or Pass Control)
E1: Open collector bus drivers

DEFAULT ADDRESS

The HP-IB address for the HP 8756A is set at the factory to decimal 16. The current address value may be easily determined by depressing the ADDRESS (SHIFT LOCAL) key on the front panel and observing the ACTIVE ENTRY AREA on the CRT display. It may be changed, if desired, by keying in the digits, using the Keypad in the ENTRY area, range 01 to 29 decimal, followed by pressing the ENT key. (Remember that most HP-IB controllers use address 21 decimal; thus, use of address 21 decimal should be avoided. Further, see 8756 SYSTEM INTERFACE below.) This address will become the address and remain unchanged even if power is turned off, or "IP" is received.

8756 SYSTEM INTERFACE

The 8756 Rear Panel has another control port called the 8756 SYSTEM INTERFACE. This connector is physically the same as that defined for the Hewlett-Packard Interface Bus, but is specifically used to control an HP-IB Sweep Oscillator (HP 8350B or 8340A) or an HP-IB plotter (HP 7470A or 9872C) through their respective HP-IB. Sweep Oscillator or Plotter HP-IB commands are **passed through** the HP 8756A's HP-IB to the 8756 SYSTEM INTERFACE.

The transfer of commands and data is performed by first sending a Pass Through "PTd" command to the HP 8756A, where d is 19 decimal for passing through to the HP-IB Sweep Oscillator or 05 decimal for passing through to the HP-IB Plotter.

Subsequent addressing of the 8756 SYSTEM INTERFACE address will pass through commands to the instrument selected. The "PTd" command may be sent at any time.

The address of the 8756 SYSTEM INTERFACE is determined by complementing the least significant bit of the current HP 8756A

Figure 3-4. HP-IB Operating Features (4 of 7)

address. For example, since the HP 8756A default address is 16 decimal = 10000 binary, the default 8756 SYSTEM INTERFACE address is 17 decimal = 10001 binary. As another example, if the HP 8756A address is 7 decimal = 111 binary, then the SYSTEM INTERFACE address becomes 6 decimal = 110 binary.

An example of pass through commands to the HP-IB Sweep Oscillator with address 19 decimal using the default HP 8756A address is:

1. Address device 16 (the HP-IB of the HP 8756A); send the characters "PT19;" or "PT19[cr][lf]".

2. Address device 17 (the 8756 SYSTEM INTERFACE); send sweeper HP-IB commands.

3. Address device 16. This returns the HP 8756A to its normal HP-IB operation.

4. Subsequent addressing of device 17 will send commands to the HP-IB Sweep Oscillator.

An example of pass through commands to the HP-IB Plotter with address 05 decimal using the default HP 8756A address is:

1. Address device 16 (the HP-IB of the HP 8756A); send the characters "PT05;" or "PT05[cr][lf]".

2. Address device 17 (the 8756 SYSTEM INTERFACE); send HP-GL commands to the Plotter.

3. Address device 16. This returns the HP 8756A to its normal HP-IB operation.

4. Subsequent addressing of device 17 will send commands to the HP-IB plotter.

RESPONSE TO UNIVERSAL COMMANDS

ABORT

The HP 8756A responds to the ABORT message (IFC, Interface Clear line set to TRUE) by stopping all Listener or Talker functions.

CLEAR

The DCL (Device Clear) and SDC (Selective Device Clear) messages clear all status bytes, the Request Mask, the HP-IB of the HP 8756A and the 8756 SYSTEM INTERFACE. The current front panel settings are unchanged.

Figure 3-4. HP-IB Operating Features (5 of 7)

PASS CONTROL

The HP 8756A does not respond to the TCT (Take Control) message; thus it cannot take or pass control of the HP-IB.

REMOTE/LOCAL/LOCAL LOCKOUT

The HP 8756A is in remote mode when the REN (Remote Enable) line on the interface goes low (TRUE) **and** it receives its Listen Address. This condition is indicated when the "R" (Remote) and "L" (Listen) LED's are lit in the INSTRUMENT STATE area of the front panel. When the HP 8756A receives its Talk Address, the "T" (Talk) LED is lit and the "L" LED goes out. Under remote, only the LINE switch and the LOCAL key are enabled. On receipt of the LLO (Local Lockout) message, the LOCAL key is disabled.

The state of the REN line is also sensed by the 8756 SYSTEM INTERFACE; an instrument on this interface, designated as the pass through instrument on the 8756 SYSTEM INTERFACE with the PT command, is placed in remote or local depending on the state of this line. When the 8756A is placed in Local Lockout, the HP-IB Sweep Oscillator is also placed in Local Lockout.

The HP 8756A will return to local mode when it receives the GTL (Go To Local) message or when the REN line goes high (FALSE). It will also return to local when the LOCAL key is pressed unless the LLO message was previously received. On power on, the HP 8756A is in local mode.

When the 8756A is first placed in Remote, the instrument state front panel settings are unchanged. Those functions not specifically programmed are also not changed, unless the "IP" command is received.

PARALLEL POLL & STATUS BIT

The HP 8756A does not respond to the PPC (Parallel Poll Configure) or PPU (Parallel Poll Unconfigure) messages.

TRIGGER

The HP 8756A does not respond to the GET (Group Execute Trigger) message.

SERVICE REQUEST & STATUS BYTES

The HP 8756A can initiate a Service Request (SRQ) message when one of the following conditions exists:

1. A Service Request (SRQ) has been initiated by the instrument designed as the pass through instrument.
2. HP-IB Command Syntax Error.
3. End of Operation (sweep or plot completed).

Figure 3-4. HP-IB Operating Features (6 of 7)

4. Self Test failed.
5. Any front panel key pressed.
6. Numeric Entry completed (HP-IB or front panel).
7. Soft key only pressed.
8. Battery voltage low (for nonvolatile memory).

The actual condition may be determined by executing a Serial Poll and then reading the Status Byte. A Serial Poll operation consists of sending the HP 8756A its Talk address, sending the SPE (Serial Poll Enable) message, reading the Status Byte on the bus, and sending the SPD (Serial Poll Disable) message.

Both the Status Byte and Extended Status Byte are obtained by sending the Output Status "OS" command and by immediately reading the two byte values, respectively. The Status Bytes of the HP 8756A are described in Table 3-6. The SRQ is cleared only by executing a Serial Poll, Device Clear (DCL), Selective Device Clear (SDC), PRESET, or sending the CS or OS commands.

The Request Mask function "RM" can be used to select a particular set of condition(s) for initiating a Service Request (SRQ). The mask value is determined by summing the decimal values of each selected condition that needs to be determined. The default Request Mask is zero (no SRQ's are initiated), which is reset to this value at power on.

PRESET

A self test is first performed when the "IP" command is received by the HP 8756A, followed by presetting conditions as described under INSTRUMENT STATE, PRESET in Figure 3-1.

Figure 3-4. HP-IB Operating Features (7 of 7)

CRT GRAPHICS

INTRODUCTION

The HP 8756A CRT Graphics are also controlled by the 8756 SYSTEM INTERFACE. The Graphics commands are mostly a subset of the Hewlett-Packard Graphics Language (HP-GL), shown in Table 3-4. This HP-GL subset allows the HP 8756A to understand most HP desktop computer plotter output commands. The HP 8756A CRT Graphics characters used for labeling are shown in Table 3-5, HP 8756A Modified ASCII Code Conversion Table. These modified ASCII characters are available only when using the "LB" command explicitly; most desktop computer plotter commands use the Standard ASCII Code character set.

The address of the CRT Graphics is the HP 8756A address minus 1; since the default address of the HP 8756A is 16 decimal, the default address of the CRT is 15 decimal. An example of addressing the CRT Graphics using the default addresses is:

1. Address device 16 (the HP-IB of the HP 8756A); send the characters "PT15;" or "PT15[cr][lf]".

2. Address device 17 (the 8756 SYSTEM INTERFACE); send Table 4 commands.

3. Address device 16. This returns the HP 8756A to its normal HP-IB operation.

4. Subsequent addressing of device 17 will send commands to the CRT Graphics.

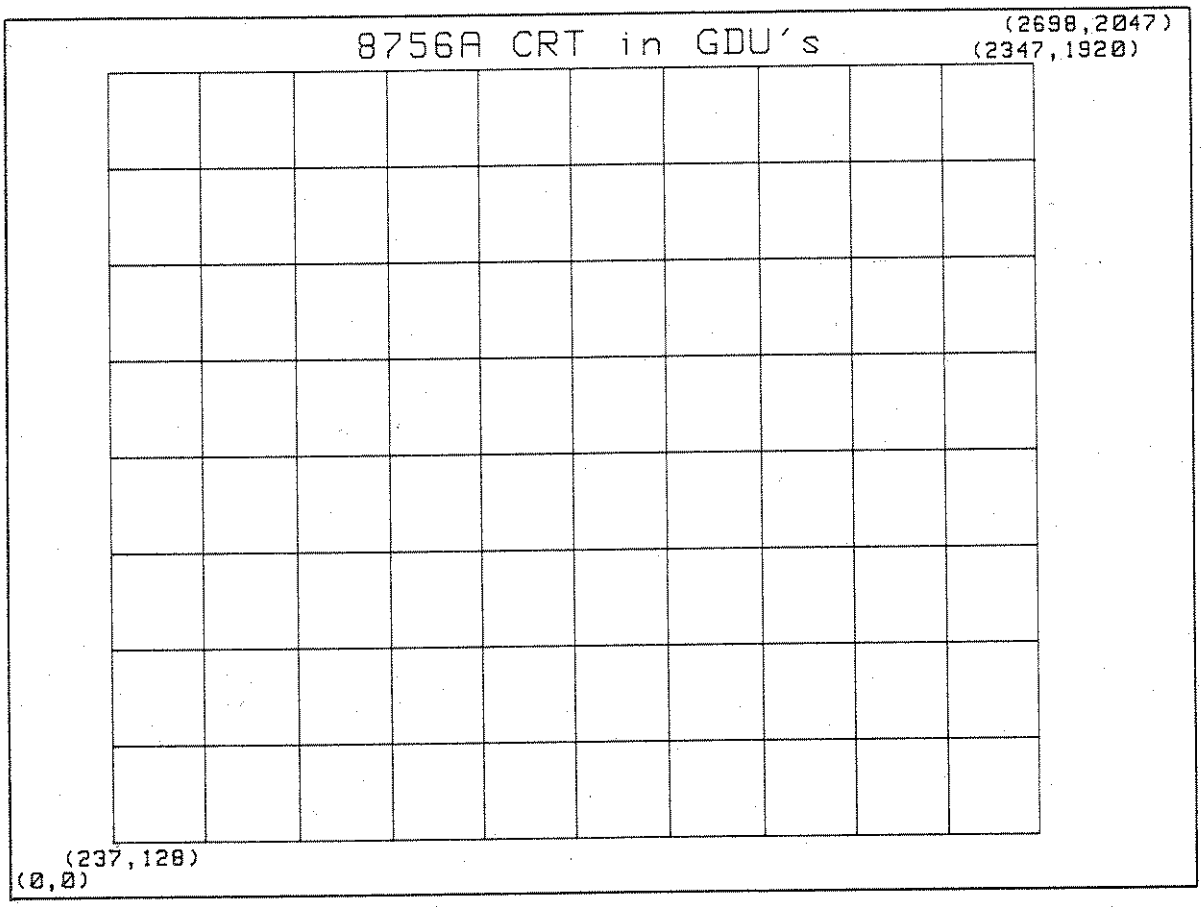
NOTE

All CRT Graphics Commands must be terminated with a semicolon ";" or a "[lf]"; the character "[cr]" is ignored. For the syntax examples shown below, [term] = either of these terminators.

Figure 3-5. CRT Graphics (1 of 6)

PLOTTING

The plotting area defined on the CRT display is divided into graphics display units (GDU's) where one GDU is approximately 0.05 mm. The plotting area and the location of the graticule are shown below:



The scaling points for bottom left and for top right are set at P1 = (0,0) and P2 = (2698,2047), respectively.

ERASE PAGE COMMAND EP

The Erase Page Command EPn erases graphics memory page n.

Syntax:

```
EP n [term]
  or
EP [term]
```

where n = 1 to 5. EP with no parameters erases all five pages.

Figure 3-5. CRT Graphics (2 of 6)

SELECT GRAPHICS PAGE COMMAND GP

The Select Graphics Page Command GP turns a graphics memory page on or off.

Syntax:

GP n,m [term]
or
GP [term]

where n = 1 to 5 and m = 1 = On and m = 0 = Off. Each page is 500 16 bit words. GP without parameters selects and turns on page 1. To begin writing to a particular Graphics Page, the GP command is used. If over 500 words are written to that page, the overflow will be written into the next Graphics Page.

NOTE

Care should be exercised when writing to Graphics Page 5 so to avoid exceeding the 500 word limit. Overflow will change the normal display on the CRT. If this happens, normal conditions may be restored by sending the "IP" command or returning to Local and pressing PRESET.

PLOT ABSOLUTE COMMAND PA

The Plot Absolute Command PA allows for movement of the beam to the point specified in plotter units by the X and Y coordinate parameters that complete the command.

Syntax:

PA X_1 coordinate, Y_1 coordinate (,X_2 coordinate, Y_2 coordinate, ... , ... , X_n coordinate, Y_n coordinate) [term]

A PA command requires that both the X and Y coordinates (a coordinate pair) be specified. The X coordinate parameter specifies the absolute X location in GDU's where the beam is to move. The Y coordinate parameter specifies the absolute Y location in GDU's where the beam is to move.

Any number of coordinate pairs may be listed after the PA instruction, separated by commas, but the maximum user graphics memory is 2500 16 bit words. The beam will move to each point in the order given.

If the point specified by a PA command lies off the plotting area, a line is draw to the plotting area limit, and the beam is turned off. The beam remains off until a point on the plotting area is specified.

Figure 3-5. CRT Graphics (3 of 6)

PEN COMMANDS PD AND PU

The Pen Down Command PD turns the CRT beam ON; the Pen Up Command PU command turns the CRT beam OFF. Both do not move the beam to a new location.

Syntax:

```
PU [term]
PD [term]
```

Neither command requires nor permits any parameters; both require the terminator [term]. The beam will always retain the beam state (on or off) of the last received Pen Command.

LETTERING

LABEL COMMAND LB

The Label Command LB allows lettering of text, experssions, or string variables on the CRT display.

Syntax:

```
LB character string [ETX]
```

The Label mode can be terminated only by sending the ASCII character ETX (the byte value = 0000 0011 or decimal 3) at the end of the character string.

Before using the Label Command, the beam should be moved to the location where labeling is to begin by using the PU command followed by the PA command. This point will be the lower left corner of the first character. After lettering a character, the beam stops at the lower left corner of the next character space.

ABSOLUTE DIRECTION COMMAND DI

The Absolute Direction Command DI specifies the direction in which characters are lettered.

Syntax:

```
DI run, rise [term]

  run, rise allowable values are:
     1, 0 for 0 degrees
     0, 1 for 90 degrees
    -1, 0 for 180 degrees
     0,-1 for 270 degrees
```

Figure 3-5. CRT Graphics (4 of 6)

or
DI [term]

Run and rise values are in decimal and specify the direction according to the relationship:

$$\text{angle} = \arctan \frac{\text{rise}}{\text{run}}$$

where rise is the vertical value, run is the horizontal value, and angle is the value relative to the positive horizontal axis in the cartesian (x-y) coordinate system.

A DI command with no parameters selects the DI 1,0 values (horizontal, 0 degrees).

ABSOLUTE CHARACTER SIZE COMMAND SI

The Absolute Character Size Command SI specifies the size of characters in centimeters.

Syntax:

SI width, height [term]

width, height values allowed are
0.14 , 0.17 Smallest size (MODE LABELS & SOFT KEY LABELS)
0.21 , 0.25 . (ACTIVE ENTRY AREA)
0.28 , 0.34 .
0.35 , 0.42 Largest size
or
SI [term]

An SI command with no parameters selects the smallest size.

GRAPH ENHANCEMENT

SELECT PEN COMMAND SP

The Select Pen Command SP allows selection of beam intensity.

Syntax:

SP n [term]

n values allowed are:
0 Beam off
1 Brightest Intensity
2 .
3 .
4 Lowest Intensity

The value of n must be an integer in the range of 0 through 4. When the SP command is received, the beam remains at the last set position. Subsequent PA commands will be executed with the new intensity.

Figure 3-5. CRT Graphics (5 of 6)

LINE TYPE COMMAND LT

The Line Type Command LT specifies the type of line that will be used with the PA command.

Syntax:

LT y, z [term]

where the z value (pattern length) is ignored.
and where the y values allowed are:
0 solid line
1 solid line
2 short dashes
3 long dashes

After receiving the LT command, all subsequent PA commands with the beam on (PD command) will draw the specified pattern. An LT command with no parameters will draw a solid line.

SCALING

OUTPUT P1 AND P2 COMMAND OP

The Output P1 and P2 Command OP outputs the current coordinates of the scaling points P1 and P2 in GDU's.

Syntax:

OP [term]

The format of the output is the following:

$P1_x$, $P1_y$, $P2_x$, $P2_y$ [cr] [lf]

where $P1_x$ = lower left P1 x value
$P1_y$ = lower left P1 y value
$P2_x$ = upper right P2 x value
$P2_y$ = upper right P2 y value, all in GDU's.

ADDITIONAL GRAPHICS CONTROL

DEFAULT COMMAND DF

The Default Command DF sets certain graphics functions to a predefined state.

Syntax:

DF [term]

The following conditions are set when DF is received:

DI 1,0	Lettering orientation 0 degrees--horizontal
LT 1	Solid line
SI 0.14,0.17	Smallest size

Figure 3-5. CRT Graphics (6 of 6)

Table 3-1. Function Select Commands (1 of 3)

FRONT PANEL KEYS		
	HP-IB COMMAND	**COMMAND DESCRIPTION**
Channel Selection	C1	Channel 1 selected; all subsequent commands will apply to Chan. 1 until Chan. 2 is selected.
	C2	Channel 2 selected; all subsequent commands will apply to Chan. 2 until Chan. 1 is selected.
CHAN OFF	C0(Zero)	Turn off channel.
MEAS RATIO • A/R • B/R • A/B	AR	A detector/R detector Ratio Measurement
	BR	B detector/R detector Ratio Measurement
	AB	A detector/R detector Ratio Measurement
MEAS PWR • A • B • R	IA	A detector Absolute Power Measurement
	IB	B detector Absolute Power Measurement
	IR	R detector Absolute Power Measurement
DISPLAY->MEM	SM	Store Measured Data in Memory
DISPLAY • MEAS • MEM • M-MEM	ME	Display Measured Data
	MY	Display Memory Data
	M-	Display Measured - Memory Data
AUTO SCALE • dB/DIV	AS	Autoscale Data on CRT
	SDd	Set Scale per Division; d set to 20, 10, 5, 2, 1, .5, .2, or .1.
MKR->REF	MR	Moves the Cursor (or Active Marker if no Cursor) and trace to the reference line.
REF • LEVEL • POSN	RLd	Reference Level value in dB or dBm; value d must be in the range of MEAS RATIO or M-MEM: +90 to -90 dB. MEAS PWR: +20 to -70 dBm.
	RPq	Reference Position setting on CRT, where q has values from 0 to 8 corresponding to the major horizontal graticule lines: 0 = bottom graticule line 4 = center graticule line 8 = top graticule line

Table 3-1. Function Select Commands (2 of 3)

FRONT PANEL KEYS		
	HP-IB COMMAND	COMMAND DESCRIPTION
STEP REF 	UP DN	Increment Active Parameter. Decrement Active Parameter.
	SVn	Save Front Panel key settings.
	RCn	Recall Front Panel key settings.
	IP	Presets the 8756A and the 8756 System Interface.
	MM	Restore Main Menu soft key labels and functions.

SOFT KEYS		
	HP-IB COMMAND	COMMAND DESCRIPTION
CURSOR ON/OFF	CUm	Turns Cursor On/Off.
CURSOR MAX	CX	Moves Cursor to maximum for active channel.
CURSOR MIN	CN	Moves Cursor to minimum for active channel.
CURSOR △ ON/OFF	CDm	Turns Cursor △ On/Off.
AVERAGING OFF	A0 (zero)	Turns averaging off.
AVERAGING FACTOR	AFd	Sets the averaging factor; d is set to 2,4,8,16,32, 64, 128, or 256.*
PLOT ALL	PA	Plot entire display (except user graphics) on external plotter.
PLOT LABELS	PC	Plot only characters/labels on external plotter.
PLOT GRID	PG	Plot only grid on external plotter.
PLOT TRACE 1	P1	Plot only trace 1 data on external plotter.
PLOT TRACE 2	P2	Plot only trace 2 data on external plotter.
MOD ON/OFF	MDm	Square wave modulation from rear panel outputs On/Off.

* Averaging is turned on when AFd is received. AF; or AF0; turns averaging on with previously set factor.

Table 3-1. Function Select Commands (3 of 3)

HP-IB only FUNCTIONS		
	HP-IB COMMAND	**COMMAND DESCRIPTION**
Blank CRT Display Features (CRT graphics not affected)	BL0 (zero) BL5	Restore display to normal. Blank All.
Clear Status	CS	Clear both Status Bytes.
Format Data ASCII	FD0 (zero)	ASCII Format for data with the WM, OD, OC, and OV commands; units are dBm or dB, and output in [±DD.DD] format, where D = ASCII digit.
Format Data Binary	FD1	Binary Format for data with the WM, OD, OC, and OV commands; two bytes are output in the following scale: Two Byte value (decimal) / MEAS RATIO or M-MEM / MEAS PWR 32767 / +90 dB / +20 dBm 0 / -90 dB / -70 dBm
Pass Through	PTd	Designates the pass through address for the 8756 System Interface.
Request Mask	RMd	Mask selected bits of the Status Byte; d is a decimal integer from 0 to 255.
Set Cursor Position	SCd	Places Cursor at horizontal position d. Range: 0 to 400 decimal.
Non Swept Mode	SW0 (zero)	Stop tracking sweep ramp; freeze data on display.
Swept Mode	SW1	Continuously track sweep ramp voltage and update display.
Take Sweep	TSd	Take d sweeps of data, then hold display.
Write Key	WKq	Write soft key label for a particular soft key; q is an ASCII string; the first character is the soft key number, range 1 to 6. This is followed by "[ASCII label][term]" or "[ASCII label][term],[ASCII label][term]" where the [ASCII label] <= 7 characters and [term] = [cr][lf] or ; .
Write Memory	WM	Write Memory trace data; the # of data points is 401; the format must be previously set by the FDm command.

Table 3-2. Output Commands

	HP-IB COMMAND	COMMAND DESCRIPTION	FORMAT FD0	FD1
Output Cursor	OC	Output Cursor or Cursor△ amplitude and horizontal position; format set by FDm command.	[+DD.DDD][,] [DDD][lf]	[BB][DDD] [EOI]
Output Data Output Memory	OD OM	Output MEAS Data or MEM data; # of data points is 401; format set by FDm command.	400 [+DD.DDD,] [+DD.DDD][lf]	401[BB][EOI]
Output Value	OV	Output current measurement value; usually for CW measurements. Nonswept mode SW0 and format FDm must be previously set.*	[+DD.DDD][lf]	[BB][EOI]
Output Identity	OI	Output the 8756A identity.	The character string output is "8756A[cr][lf]".	
Output Keycode	OK	Output keycode for last key pressed. Refer to Table 7.	[DD][lf]	
Output Status	OS	Output Status Bytes; the status byte is sent first followed by the extended status byte. Then both bytes will be cleared.	[BB][EOI]	

NOTES

D = ASCII digit
B = 8 bit byte
, = comma
EOI = End or Identify HP-IB line TRUE
cr = carriage return
lf = line feed

* If Averaging ON, measured data is averaged over a period of (Averaging Factor) * 10 milliseconds; this averaged value is then outputted.

Table 3-3. Cross Reference of Tables 3-1 and 3-2

A0	Averaging Off
AB	A/B Ratio Measurement
AFd	Averaging On and Factor d
AR	A/R Ratio Measurement
AS	Autoscale
BL0	Restore CRT to normal mode
BL5	Blank All (except user CRT graphics)
BR	B/R Ratio Measurement
C0	Channel Off
C1	Select Channel 1 On
C2	Select Channel 2 On
CDm	Cursor Delta On/Off
CN	Cursor to Minimum
CS	Clear Status Bytes
CUm	Cursor On/Off
CX	Cursor to Maximum
DN	Step Down/Decrement
FD0	Format Data Binary
FD1	Format Data ASCII
IA	Absolute Power A Measurement
IB	Absolute Power B Measurement
IP	Preset
IR	Absolute Power R Measurement
MDm	Modulation On/Off
ME	Display Measurement
MM	Restore Main Soft Key Menu
MR	Cursor (or Marker) to Reference Line
MY	Display Memory
M-	Display Measurement - Memory
OC	Output Cursor Value and Position
OD	Output Trace Data
OI	Output Identity
OK	Output Keycode of last key pressed
OM	Output Memory
OS	Output Status Bytes
OV	Output Current Measurement Value
P1	Plot trace 1 on external plotter
P2	Plot trace 2 on external plotter
PA	Plot all on external plotter (except user CRT graphics)
PC	Plot labels on external plotter
PG	Plot grid on external plotter
PTd	Pass Through to address d
RCn	Recall Register n
RLd	Reference Level set to d
RMd	Service Request Mask
RPq	Reference Position on vertical division q = 0 to 8
SCd	Set Cursor to horizontal position d
SDd	Scale per Division set to d
SM	Store Measurement into Memory
SVn	Save Register n
SWm	Sweep update display On/Off
TSd	Take d sweeps, then hold display
UP	Step up/increment
WKq	Write Soft Key label
WM	Write to Memory trace data

NOTE

For the WKq command, q is an ASCII string; the first character is the soft key number, range 1 through 6. This is followed by [ASCII label][term][,][ASCII label][term] or [ASCII label][term], where the [ASCII label] is no more than 7 characters and [term] = [carriage return][line feed] or ; .

Table 3-4. CRT Graphics Commands (1 of 2)

HP-GL subset.	
HP-IB COMMAND	COMMAND DESCRIPTION
DF	Default; sets default values.
DI run,rise	Absolute Character Direction; run,rise allowable values are: 1, 0 = 0 degrees 0, 1 = 90 degrees -1, 0 = 180 degrees 0,-1 = 270 degrees
LB[text][ETX]	Label text. Character set is shown in Table 5, 8756A Modified ASCII Character Set.
LTy,z	Line Type; the y = pattern number 1 to 4; z = pattern length which is ignored. For y = 0 or 1 = solid line 2 = short dashes 3 = long dashes
OP	Output P1 and P2 positions.
PA x1, y1 (,x2, y2, ..., ..., xN, yN)	Plot Absolute; x and y are integers and are in Graphics Display Units (GDU's).
PD	Pen Down.
PU	Pen Up.
SI w, h	Absolute Character Size; w = width; h = height. Values allowed are: 0.14, 0.17 Smallest size 0.21, 0.25 0.28, 0.34 0.35, 0.42 Largest size
SP n	Select pen; n = 0 to 4; 0 Pen up 1 Brightest Intensity 2 3 4 Lowest Intensity
The following HP-GL commands will be accepted but their functions are not implemented and no error will be noted: IM (Input SRQ Mask), IP (Input P1 and P2), IW (Input Window), OC (Output Current Position), OE (Output Error), and PG (Output Page), SL (Character Slant), SR (Size Relative for characters).	

Table 3-4. CRT Graphics Commands (2 of 2)

NON HP-GL COMMANDS		
	HP-IB COMMAND	COMMAND DESCRIPTION
Erase Page	EPn	Erase Page n, where n = 1 to 5; if no n value is given, all pages are erased.
Select Graphics Page On/Off	GPn,m	Turn graphics page n (1 to 5) On/Off (m = 1 or 0). Each page may use up to 500 16 bit words. GP without parameters selects and turns on page 1.
NOTE All Graphics Commands must be terminated with a semicolon ";" or a "[linefeed]" (the character [carriage return] is ignored).		

Table 3-5. HP 8756A Modified ASCII Character Set

8756A MODIFIED ASCII CODE CONVERSION TABLE

		MOST SIGNIFICANT CHARACTER							
		Ø	1	2	3	4	5	6	7
	Ø		centered *	SP	Ø	@	P	`	p
	1	HP logo	centered o	!	1	A	Q	a	q
	2	β	↑	"	2	B	R	b	r
	3		←	#	3	C	S	c	s
	4	upper-half tic	↓	$	4	D	T	d	t
LEAST	5	lower-half tic	→	%	5	E	U	e	u
SIGNIFICANT	6	left-half tic	√	&	6	F	V	f	v
CHARACTER	7	right-half tic	π	'	7	G	W	g	w
	8	back space	Δ	(	8	H	X	h	x
	9	1/2 shift down	μ	)	9	I	Y	i	y
	A	line feed	° (degree)	*	:	J	Z	j	z
	B	inv. line feed	Ω	+	;	K	[	k	{
	C	1/2 shift up	ρ	,	<	L	\	l	¦
	D	carriage return	Γ	-	=	M	]	m	}
	E	horizontal tic	θ	.	>	N	^	n	~
	F	vertical tic	λ	/	?	O	—	o	►

EXAMPLES:

HP logo	=	Ø1
A	=	41
i	=	69
√	=	16
►	=	7F
line feed	=	Ø9

(Note: These characters are output only when the LB command is used directly)

Table 3-6. HP 8756A Status Byte Descriptions

STATUS BYTE (#1)								
Bit #	7	6	5	4	3	2	1	0
Decimal Value	128	64	32	16	8	4	2	1
Function	SRQ on 8756 System Interface SRQ	Request Service (SRQ)	SRQ on HP-IB Syntax Error	SRQ on Operation Complete (Sweep or Plot)	SRQ on Soft Key Only Pressed	SRQ on Change in Extended Status Byte	SRQ on Numeric Entry Completed (HP-IB or Front Panel)	SRQ on Any Front Panel Key Pressed
EXTENDED STATUS BYTE (#2)								
Bit #	7	6	5	4	3	2	1	0
Decimal Value	128	64	32	16	8	4	2	1
Function							SRQ on Low Battery Voltage	SRQ on Self Test Failure

Table 3-7. Front Panel Keycodes

```
MAIN MENU = 24
Soft Key 1 = 32
Soft Key 2 = 8
Soft Key 3 = 0
Soft Key 4 = 16
Soft Key 5 = 14
Soft Key 6 = 38

CHANNEL 1:
MEAS RATIO = 10
MEAS PWR = 2
DISPLAY = 37
SCALE = 18
REF = 13

CHANNEL 2:
MEAS RATIO = 27
MEAS PWR = 30
DISPLAY = 34
SCALE = 21
REF = 5

ENTRY:
STEP DOWN = 22
STEP UP = 6
0 KEY = 20
1 KEY = 4
2 KEY = 3
3 KEY = 7
4 KEY = 12
5 KEY = 11
6 KEY = 15
7 KEY = 36
8 KEY = 35
9 KEY = 39
. KEY = 19
- KEY = 23
ENT OFF = 9
ENT = 1
DBM DB = 33
BK SP = 17

INSTRUMENT STATE:

SHIFT = 25
SAVE = 28
RECALL = 26
LOCAL = 29
```

(Values are in decimal)

OPERATOR'S CHECKS

The Operator's Checks verify that the 8756A is functioning correctly. It does not thoroughly check all specifications to their limits, but is an appropriate test for daily instrument verification, incoming inspection, or verification after repair or replacement of digital circuits.

EQUIPMENT

Scalar Network Analyzer	HP 8756A
HP-IB Cable	HP 10833A/B/C/D*
Sweep Oscillator	*
Detector	HP 11664A/B*
Microwave Test Device	20 dB Attenuator (HP 8491)*

***NOTE**

These three components are necessary to perform the A, B, and R Detector Input Checks. The Sweep Oscillator is any RF or microwave source capable of outputting at any frequency within the frequency range of the 11664A Detector (10 MHz to 18 GHz) or the 11664B Detector (10 MHz to 26.5 GHz), and also capable of outputting a 0 to 10 volt sweep ramp and positive z blanking. The Sweep Oscillator also must be able to accept an external 27.8 kHz AM modulation input. If an external AM input is not available, an external modulator, such as the HP 11665B Modulator, should be connected to the RF output of the Sweep Oscillator. Modulator Drive is available from any of 3 BNC output connectors on the Rear Panel of the 8756A. (The HP 8350A/B Sweep Oscillator has internal 27.8 kHz square wave modulation of the RF output.) The Microwave Test Device used should be kept exclusively for these Operator's Checks, so that future comparisons will be valid.

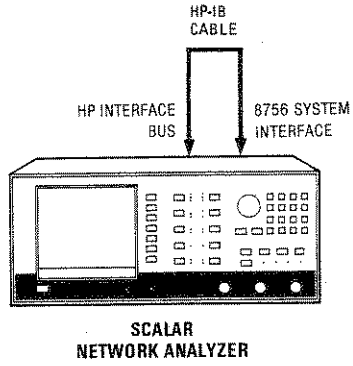
Figure 3-6. Operator's Check (1 of 5)

PROCEDURE

The following Procedure assumes a working familiarity with the 8756A front panel controls. Refer to Fig. 3-1 for more information on operating the 8756A Front Panel, if necessary. Refer also to the Sweep Oscillator Operating & Service Manual for its operation.

Self-Test, HP INTERFACE BUS, and 8756 SYSTEM INTERFACE Checks

1. Set up the equipment as shown below.



Operator's Setup for Self-Test, HP-IB, and 8756 SYSTEM INTERFACE Checks

2. Turn on the 8756A. Press **[PRESET]** to start the built-in Self-Test routine. If the Self-Test passes, the graticule, MODE LABELS, and MAIN MENU will appear on the display. If the Self-Test fails, an error message will be displayed in the ACTIVE ENTRY AREA.

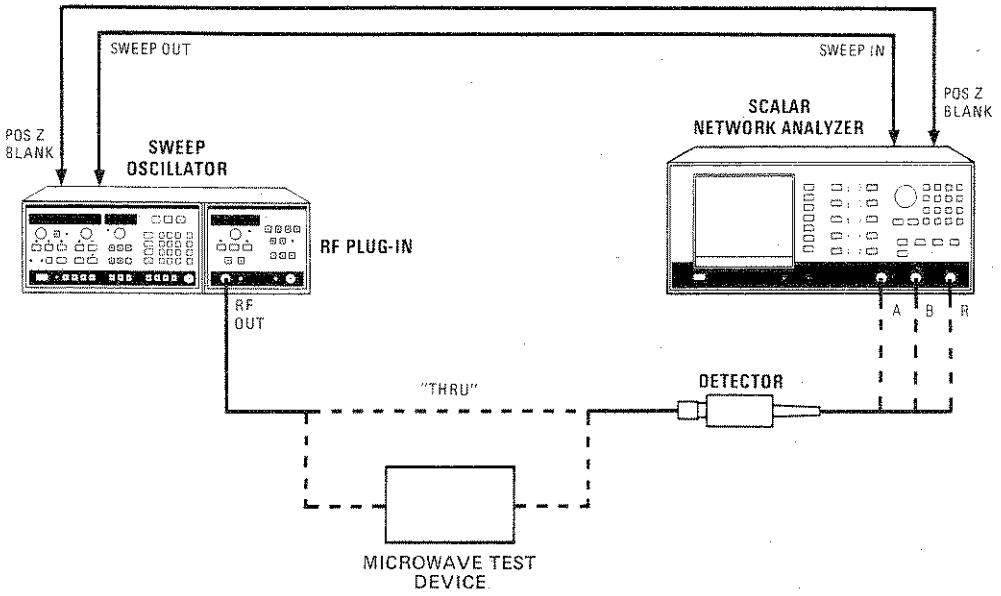
3. On the 8756A, press the Soft Keys **[MORE] [SERVICE] [A6 HPIB]**. Press the Soft Key **[HPIB LSTN]** to begin the first HP-IB test. If this test passes, the message "HPIB LSTN PASS" will appear in the ACTIVE ENTRY AREA. If this test fails, a FAIL message will appear. Press **[MAIN MENU]** to end this test.

4. Press the Soft Key **[A6 HPIB]** again to run the second HP-IB test, then press the Soft Key **[HPIB TALK]**. If this test passes, the message "HP TALK PASS" will appear in the ACTIVE ENTRY AREA. If this test fails, a FAIL message will be displayed. Press **[PRESET]** to end this test, and remove HP-IB cable.

Figure 3-6. Operator's Check (2 of 5)

A, B, and R Input Checks

5. Set up the equipment as shown below.



Operator's Check Setup for A, B, and R Input Checks

Turn on the Sweep Oscillator. Set Sweep time to approximately 500 milliseconds. Adjust the Start and Stop frequencies to include the frequency range of the Microwave Test Device or the full range of the Sweep Oscillator. Turn RF on. Record the Start and Stop frequencies for future reference. Connect the Detector output to the A Detector Input of the 8756A. On the 8756A, press **[PRESET]**. Press Channel 1 **[SHIFT]** **[MEAS RATIO]** (CHAN OFF) to turn Channel 2 off.

6. Connect Detector input to the RF output of the Sweep Oscillator for a "thru" (0 dB insertion loss) connection. On the 8756A, press Channel 1 **[SHIFT]** **[SCALE]** (AUTOSCALE) to put the trace on the display, then press **[MAIN MENU]**, the Soft Key **[CURSOR]** to turn CURSOR on, and finally Soft Key **[CURSOR MAX 1]** to find the trace maximum. Note the CURSOR value displayed in the ACTIVE ENTRY AREA. If the CURSOR value is less than +10.00 dBm, increase the RF power level on the Sweep Oscillator until the CURSOR value reads +10.00 dBm. This value is the upper limit of the dynamic range of the 8756A. On Channel 1 of the 8756A, press **[SHIFT]** **[DISPLAY]** (DISPLAY-->MEM) to store the trace in memory.

Figure 3-6. Operator's Check (3 of 5)

NOTE

If the Sweep Oscillator is operating properly, but the CURSOR value is not reading the correct absolute power value, check to see that the 27.8 kHz modulation has been correctly applied. If +10.00 dBm cannot be achieved, the upper level of dynamic range will not be tested.

7. Disconnect the Detector from the RF output of the Sweep Oscillator. Then, on the 8756A, press Channel 1 **[SHIFT]** **[SCALE]** (AUTOSCALE) to put the trace on the display. Press the Soft Key **[AVERAGE]** then **[AVG 1 FACTOR]** to turn averaging on with a factor of 8. Wait about 20 seconds to allow averaging to settle. Then press **[MAIN MENU]** followed by **[CURSOR]** and **[CURSOR MAX 1]**. The Cursor value should display -50.00 dBm or lower. This is the noise floor power level. Note this information for future reference. It is normal for this value to change ±1 dB; however, the noise floor should always be -50.00 dBm or lower.

8. Insert the Microwave Test Device between the RF output of the Sweep Oscillator and the Detector. On the 8756A, press Channel 1 **[DISPLAY M-MEM]** and then **[SHIFT SCALE]** (AUTO-SCALE). Wait about 20 seconds to allow averaging to settle. Press **[CURSOR MAX 1]** to find the trace maximum. The CURSOR value in the ACTIVE ENTRY AREA now displays the insertion loss of the Microwave Test Device. Note this value for future reference. If a HP 7470A or 9872C HP-IB plotter is available, make a hardcopy plot of the display for future reference. (Refer to Fig. 3-2 for more information on outputting to the plotter.) If a compatible plotter is not available, sketch the display, noting Start and Stop frequencies, noise floor, and insertion loss. This plot or sketch will be used for comparison during future Operator's Checks of the A Detector Input. The characteristics of the Microwave Test Device should not vary significantly from one comparison to the next.

Figure 3-6. Operator's Check (4 of 5)

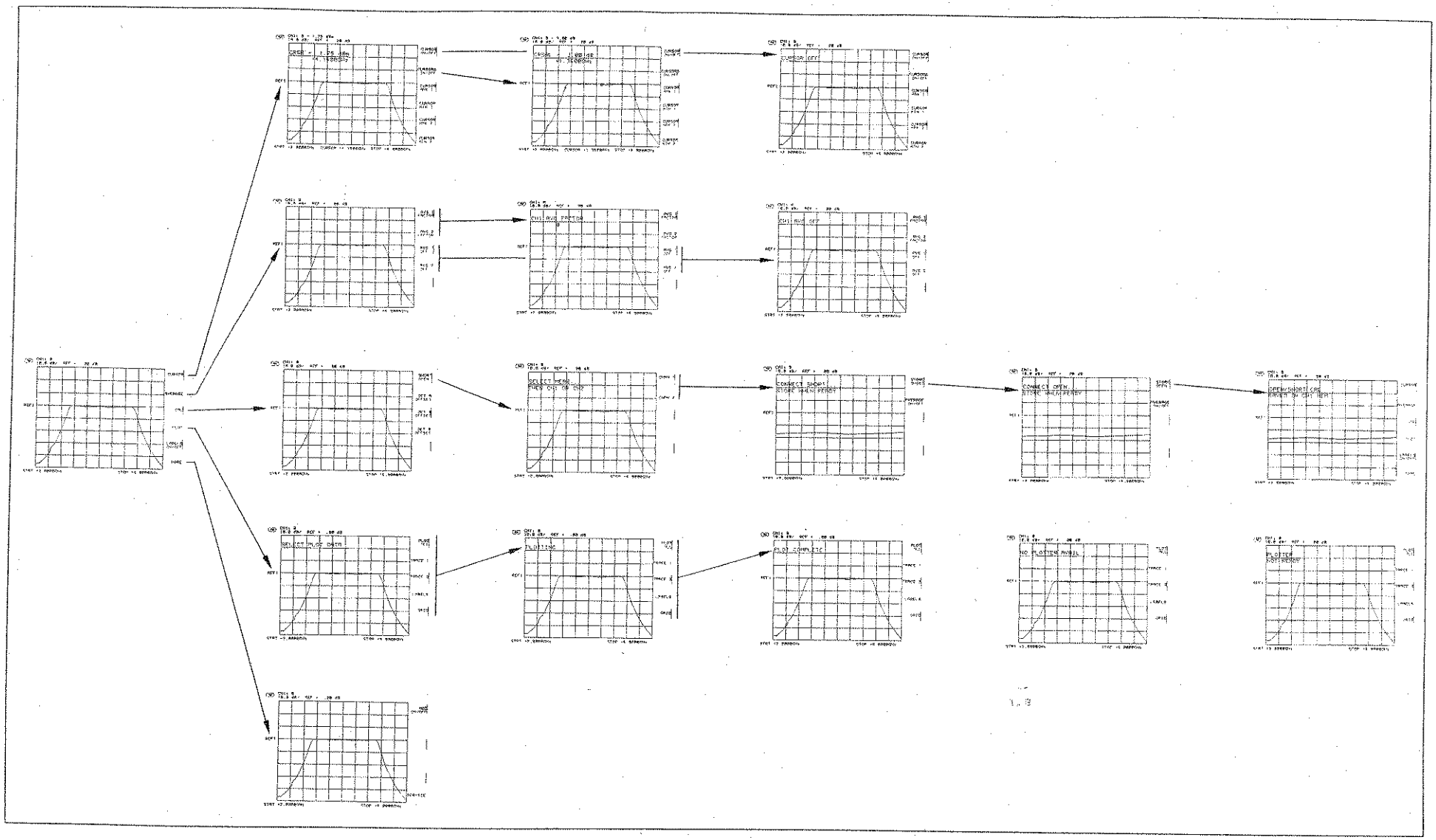
9. Connect the Detector input to the B input of the 8756A. On the 8756A, press **[PRESET]**, Channel 1 **[SHIFT]** **[MEAS RATIO]** (CHAN OFF) to turn Channel 2 off, and select Channel 1 **[MEAS PWR]** to B. Repeat Steps 6 through 8 for the B Detector Input.

10. Connect the Detector input to the R input of the 8756A. On the 8756A, press **[PRESET]**, Channel 1 **[SHIFT]** **[MEAS RATIO]** (CHAN OFF) to turn Channel 2 off, and select Channel 1 **[MEAS PWR]** to R. Repeat Steps 6 through 8 for the R Detector Input.

11. If any test fails, or Microwave Test Device measurements do not reasonably match previous measurements, refer to the Performance Tests in Section IV.

12. When finished with the Operator's Checks, reconnect the 8756A with the cabling configuration necessary for correct operation with your Sweep Oscillator (the HP 8340A and 8350B require additional connections).

Figure 3-6. Operator's Check (5 of 5)


SELECT MEAS
PRESS CAL TO CONT
CONNECT SHORT
STORE MEAS READY
CONNECT OPEN
STORE MEAS READY
PLOTTING
PLOT COMPLETE
NO PLOTTER FOUND

SUBJECT INDEX