6600A SERIES

PROGRAMMABLE SWEEP GENERATORS,

MULTIBAND MODELS

OPERATION AND MAINTENANCE MANUAL

MODELS COVERED

6609A	6629A-40	6647A
6617A	6637A	6648A
6621A	6637A-40	6653A
6621A-40	6638A	6659A
6629A	6642A	

WILTRON

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1-6600A/MB-OMM
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WARRANTY

All products are warranted against defects in materials and workmanship for one year from the date of shipment except YIG-tuned oscillators, which have a two-year warranty period. Our obligation covers repairing or replacing products which prove to be defective during the warranty period and which shall be returned with transportation charges prepaid to WILTRON. Obligation is limited to the original purchaser. We are not liable for consequential damages.

MANUAL CHANGES

MULTIBAND 6600A OPERATION & MAINTENANCE MANUAL

CHANGE #1

Basic Frame	Serial Nos. (Inside; see pg.1-1)	Manual Printed
D-8000	210001 and above	October 1982

A. On page 6-50, Table 6-24, under CAPACITORS, make the following value changes:

C9	Ceramic Disc, 3 kV, .0047 uF	250-97
C10	Ceramic Disc, 3 kV, .0047 uF	250-97

PCO 2569
27 August 1982

CHANGE #2

Models	Serial Nos. Affected (Outside)	Manual Printed
6637A	All	October 1982
6637A-40	All	
6647A	All	
6647A-40	All	
6653A	All	
6653A-40	All	

A. On page 6-11, Index No. 4b., change the part number from 320-65 to 320-63.

B. On page 6-13, Index No. 15b., change the part number from 320-65 to 320-63.

PCO 2599
4 October 1982

CHANGE #3

Model	Serial Nos. Affected (Outside)	Manual Printed
6637A-40	201001 thru 201010	October 1982

A. On page 6-29, Table 6-9, change the value of $R41^6$ to 150 kΩ, and the part number to 110-150k-1.

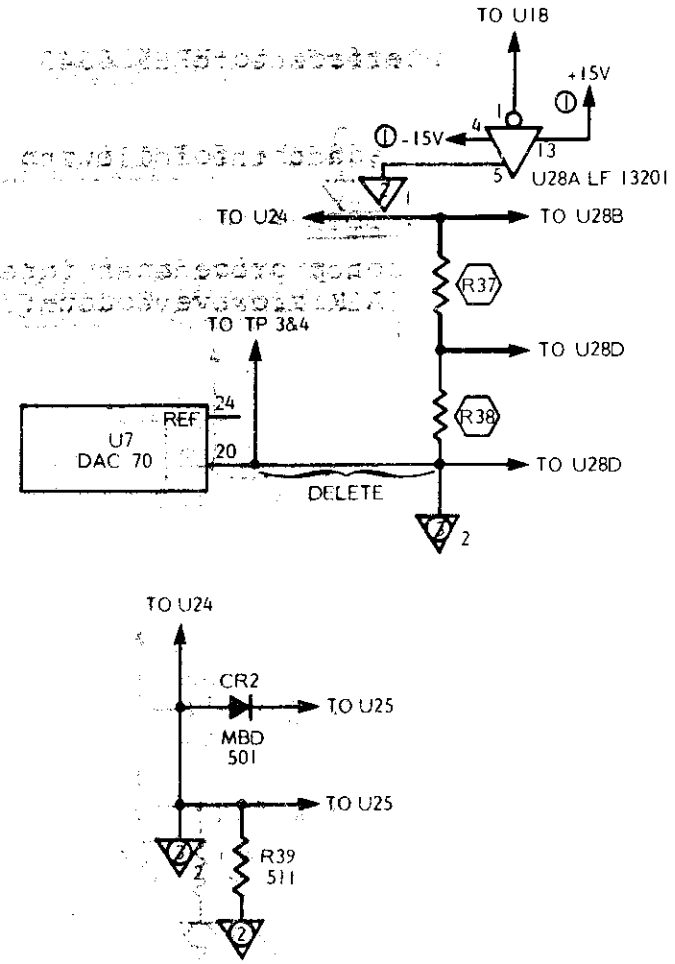
B. On page 7-116, Figure 7-66, change the value of R41 (Model 6640A) in the table to 150k.

TECO G875
30 September 1982

CHANGE #4

Basic Frame	Serial Nos. (Inside; see pg.1-1)	Manual Printed
D-8000	208001 and above	October 1982

A. On page 7-110, Figure 7-58, change the schematic as shown below.



PCO 2596
30 September 1982

CHANGE #5

Models	Serial Nos. (Outside; see pg.1-1)	Manual Printed
All	All	October 1982

A. On page 1-2, under Option 13, change the first two lines to read as follows:

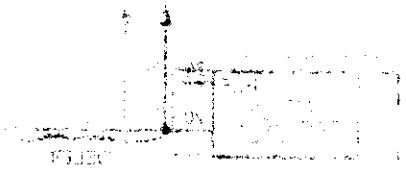
"Option 13, Hardware Interface to HP 5343A Microwave Counter."

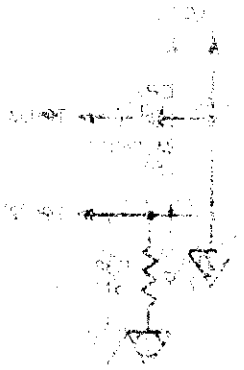
B. On page 1-2, under Option 13, add the following note:

"NOTE

Option 13 does not provide an interface with the HP 5342A Microwave Counter."

8 November 1982





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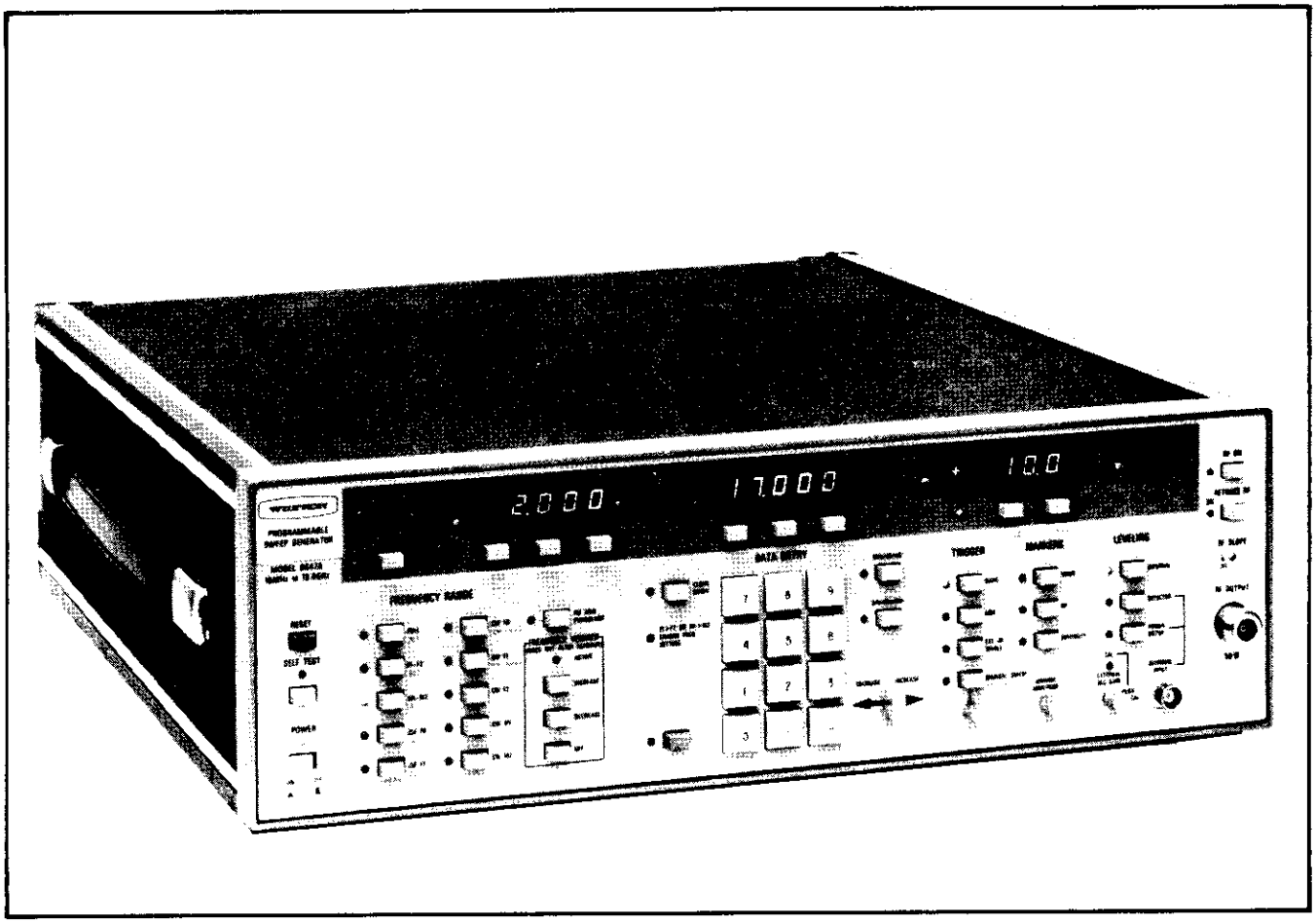


Figure 1-1. Model 6647A Programmable Sweep Generator

SECTION I

GENERAL INFORMATION

1-1 SCOPE OF THE MANUAL

This manual is the operation and maintenance (O&M) manual for the multiband models (paragraph 1-3) of the 6600A Series Programmable Sweep Generator. The manual provides general information, installation, operation, performance verification, calibration, replaceable parts, and maintenance/service information and instructions. Refer to the Table of Contents for the manual organization.

1-2 INTRODUCTION

Section I provides a description, specifications, characteristics, and option information.

1-3 DESCRIPTION

The 6600A Series (Figure 1-1) is a family of microprocessor-based, pushbutton-controlled, GPIB-capable, broadband signal sources that generate swept and CW frequencies from 10 MHz to 40 GHz. This ever-expanding family of sweepers presently consists of 29 models. These 29 models are divided into single-band and multiband sweep generators, depending upon the number of internal bands used for frequency-range coverage. Single-band models use one YIG oscillator to span their range, whereas multiband models use two or more YIGs, or a combination consisting of a YIG (or YIGs) and a frequency down-converter.

1-4 IDENTIFICATION NUMBER

All WILTRON instruments are assigned a unique six-digit ID number, such as "205001." The first digit of this ID (2 in the example) represents the instrument's year-of-manufacture; the next two (05), its manufacturing "run;" and the last three (001), its serial number. Each 6600A Series sweep generator has two ID numbers assigned, one for the basic frame and one for the RF deck. The ID number for the RF deck, which provides primary identification, is affixed to the outside of the rear panel. The basic frame ID number appears on the inside of the rear panel. Please use the primary (outside) serial number when ordering parts or when corresponding with Customer Service.

1-5 OPTIONS

The following options are available for the 6600A Series sweep generators:

- **Option 1, Rack Mount.** Sweep generator comes equipped with mounting ears and chassis track slides that have a 90° tilt capability.
- **Option 2, 10 dB Step Attenuator.** Sweep generator comes supplied with a front panel or GPIB-programmable 10 dB step attenuator. Step attenuator has a 70 dB range.
- **Option 3, GPIB Interface.** Sweep generator is equipped to operate on the IEEE-488 (IEC-625) Interface Bus. With Option 3 installed, all front panel pushbuttons except POWER are bus-programmable. Option 3 may be installed in the field.
- **Option 9, Main RF Connector on Rear Panel.** Sweep generator comes supplied with an SMA female connector installed on the rear panel rather than on the front panel.
- **Option 10, Auxiliary RF Output Connector (Rear Panel).** Sweep generator comes equipped with a second RF connector (SMA female) installed on the rear panel.

Its output power level is approximately 25 dB below the main connector power level, and its Maximum Leveled Power specification is derated by 1.5 dB.

- **Option 12, RF Output Interface, Sweep Generator to Model 661 Tracking Sweeper Controller.** Sweep generator comes supplied with a rear panel SMA connector for supplying a 10 dB attenuated RF sample to the Model 661 Tracking Sweeper Controller.

- **Option 13, Hardware Interface to HP 5342 or HP 5343A Microwave Counter.** Sweep generator comes supplied with a rear panel BNC connector that allows the HP counter to be used to count the marker frequency(ies).

- **Option 14, Data I/O Rear Panel Connector.** Sweep generator comes supplied with a 37-pin Data I/O connector for interfacing the Model 661 Tracking Sweeper Controller with the IEEE-488 Interface Bus. Sweep generator must also have Option 3 .

1-6 SPECIFICATIONS

Guaranteed performance specifications for the multiband models of the 6600A Series Programmable Sweep Generator are provided in Figure 1-2.

1-7 CHARACTERISTICS

Operational characteristics, along with brief descriptions of input and output connectors for the 6600A Series sweep generator (all models), are given in Tables 1-1 and 1-2.

Table 1-1. "RESET" Output Power Level (Power Level Indicated on LEVEL Display when RESET is Pressed)

MODEL	POWER LEVEL (dBm)			
	Standard Model	With Opt. 2	With Opt. 10	With Opt. 2 & 10
6609A	13.0	12.5	11.5	11.0
6617A	10.0	9.0	8.5	7.5
6621A	10.0	8.7	8.5	7.2
6621A-40	16.0	14.7	14.5	13.2
6629A	10.0	8.2	8.5	6.7
6629A-40	16.0	14.2	14.5	12.7
6637A	10.0	8.2	8.5	6.7
6637A-40	16.0	14.2	14.5	12.7
6638A	7.0	5.2	5.5	3.7
6642A	0.0	N/A	N/A	N/A
6647A	10.0	8.2	8.5	6.7
6648A	7.0	5.2	3.5	3.7
6653A	6.0	2.0	3.5	0.5
6659A	6.0	2.0	4.5	0.5

SPECIFICATIONS
AL MODELS

EXTERNAL AM INP
impedance.
Sensitivity: 1 dB/V
Frequency Response (typi
Input Impedance: 10 kΩ
Amplitude Control Range:
Maximum Input: 20V

EXTERNAL FM AND
connector. 10k ohm imp
Sensitivity: – 6 MHz/V
Maximum Deviation for M
DC–100 kHz: ± 25 MH
100–250 kHz: ± 5 MH

SOURCE SWR (50Ω)	SOURCE SWR WITH OPTIONS 2 AND 9
1.3	1.5
1.4 (≤ 2 GHz) 1.2 (> 2 GHz)	1.5
1.3 (≤ 8 GHz) 1.5 (> 8 GHz)	2.0
1.5	2.0
1.2 (≤ 8 GHz) 1.4 (> 8 GHz)	2.0
2.0 (18–26.5 GHz) N/A (26.5–40 GHz)	N/A
1.4 (< 2 GHz) 1.2 (2–8 GHz) 1.4 (> 8 GHz)	2.0
1.5 (≤ 18 GHz) 1.7 (> 18 GHz)	2.0

MODEL	FREQUENCY RANGE (GHz)	OUTPUT POWER (25°C		FREQUENCY STABILITY			MODEL
		INTERNALLY LEVELED MAXIMUM (dBm)	WI 0% OPT. 2, ATTEN GE (dB GE)	WITH 10 dB POWER LEVEL CHANGE (kHz)	WITH 3:1 LOAD SWR (kHz)	WITH TIME, 10 MINUTES TYPICAL [4] (kHz)	
6609A	.01-2	> 13	> 1	± 100	± 10	± 200	6609A
6617A	.01-8	> 10	>	± 100	± 100	± 200	6617A
6621A	2-12.4	> 10	>	± 500	± 300	± 200	6621A
6621A-40	2-12.4	> 16	> 1	± 500	± 300	± 200	6621A-40
6629A	8-18.6	> 10	>	± 500	± 300	± 200	
6629A-40	8-18.6	> 16	> 1	± 500	± 300	± 200	6629A-40
6637A	2-18.6	> 10	>	± 500	± 300	± 200	6637A
6637A-40	2-18.6	> 16	> 1	± 500	± 300	± 200	6637A-40
6638A	2-20	> 10 (≤ 18 GHz) > 7 (> 18 GHz)	> 8.2 (≤ > 5.2 (>	± 500	± 300	± 200	6638A
6642A	18-40	> 5 (18-26.5 GHz) > 0 (26.5-40 GHz) [1]	N/	± 500	± 300	± 400	6642A
6647A	.01-18.6	> 10	>	± 500	± 300	± 200	6647A
6648A	.01-20	> 10 (≤ 18 GHz) > 7 (> 18 GHz)	> 8.2 (≤ > 5.2 (>	± 500	± 300	± 200	6648A
6653A	2-26.5	> 10 (≤ 18 GHz) > 6 (> 18 GHz)	> 7 (≤ > 2 (>	± 500	± 300	± 200	6653A
6659A	.01-26.5	> 10 (≤ 18 GHz) > 6 (> 18 GHz)	> 5 (≤ > 1 6 (>	± 500	± 300	± 200	6659A

[1] *External leveling only.*
[2] *Excluding 5% band edges where specification is > 20 dBc*
[3] *Measured in 30 Hz–15 kHz bandwidth.*
[4] *After 30 minutes warmup at selected CW frequency.*

Figure 1-2. Specifications

Table 1-2. Characteristics, 6600A Series Sweep Generators

SWEEP TIME: Continuously adjustable from .01 to 99 seconds, displayed on front panel LED readout.

SWEEP MODES:

Full Sweep: Sweeps full band in one continuous frequency sweep. The high- and low-end frequency points are displayed on the front panel.

F1 to F2 Sweep: Sweeps between user-selected frequencies (F1 and F2), which are displayed on the front panel.

M1 to M2 Sweep: Sweeps between user-selected frequencies (M1 and M2), which are displayed on the front panel.

ΔF F0 Sweep: Sweeps symmetrically about a center frequency (F0) that is user-selected. F0 frequency and sweep-width frequency range are simultaneously displayed on the front panel.

ΔF F1 Sweep: Sweeps symmetrically about a center frequency (F1) that is user-selected. F1 frequency and sweep-width frequency range are simultaneously displayed on the front panel.

CONTINUOUS WAVE (CW) MODES:

CW F0, **CW F1**, **CW F2**, **CW M1**, **CW M2**: Fixed frequency CW output at the respective F0, F1, F2, M1, or M2 frequency point. The frequency of the CW signal is displayed on a front-panel LED readout.

FINE-FREQUENCY CONTROL:

Frequency Vernier controls are available and may be used with a microwave counter to finely adjust (1) the output frequency in any CW mode or (2) the center frequency in either ΔF sweep mode. Without changing the frequency appearing on the applicable numeric display, these pushbuttons will change the output frequency by up to ±10 MHz for all models except the 6642A, 6653A, and 6659A. For these three models, the output frequency can be changed by up to ±25 MHz.

TRIGGER MODES:

Automatic: Sweep recurs automatically.

Line: Sweep recurs in sync with the line frequency or in sync with multiples of the line frequency.

External or Single: Sweep recurs when triggered. Triggering can be accomplished either from the front panel or by applying an external pulse to the rear panel.

Manual: Frequency may be swept manually between upper and lower frequency limits, using the front-panel MANUAL SWEEP control.

MARKERS:

Video: Positive video pulse(s). Markers appear at frequencies M1, M2, and F0, depending upon sweep mode. In the FULL, F1-F2, and ΔF F1 modes, three markers are available. In the ΔF F0 mode, two markers (M1 and M2) are available. And, in the M1-M2 mode, one marker (F0) is available. The frequency and amplitude of the marker(s) may be controlled from the front panel.

RF: Negative RF pip(s). Markers appear at frequencies M1, M2, and F0, as described for Video above. The frequency and amplitude of the marker(s) may be controlled from the front panel.

Intensity: Intensity dot(s) are created when the sweep is made to dwell momentarily at the marker frequency(ies). No connection between the sweep generator and the CRT Z-axis is

Table 1-2. Characteristics, 6600A Series Sweep Generator (Continued)

required. Markers appear at frequencies M1, M2, and F0, as described for "Video" above. The frequency of the marker(s) may be selected from the front panel.

LEVELING MODES:

Internal: The output power is sampled internally and used to provide leveled RF power at the RF OUTPUT connector.

Detector: The output power may be sampled externally using a coupler and detector, and used to provide leveled RF power at the device under test.

Power Meter: The output power may be sampled externally using a coupler and a power meter, and used to provide leveled RF power at the device under test.

SHIFTED FUNCTIONS:

Alternating Sweep: Sweep generator alternates between any two of the five frequency-sweep ranges: Full, F1-F2, M1-M2, ΔF F0, ΔF F1. When used with a compatible network analyzer, such as the WILTRON 560A, this function allows two sweeps to be input into the same channel through a single RF detector or SWR Autotester.

CW Filter, Enable-Disable: Provides for switching the CW filter out of the YIG oscillator tuning circuit. This filter is automatically inserted for CW and narrow (≤50 MHz) sweep modes.

CW Ramp, On-Off: Provides a 0-10V horizontal sweep ramp during CW modes. When the sweep generator is used with the WILTRON Model 560 or 560A Scalar Network Analyzer, this sweep ramp causes the network analyzer to display a trace (rather than a dot) when the sweep generator outputs a CW frequency.

External Sweep: Provides for sweeping the output frequency using an externally supplied sweep ramp, which is input via the rear panel EXT SWEEP connector.

SELF TEST: Diagnostic self-test routines are accomplished each time the unit is turned on and when the front-panel SELF TEST pushbutton is pressed. In the event of a self-test failure, an error code is displayed on front-panel LED readouts. If the unit passes, the word PASS is indicated on an LED readout.

EXTERNAL LEVELING CONTROL (ALC):

The gain of the external leveling input (detector or power meter) may be calibrated from the front panel for all models except 6642A; the use of an external indicating device such as an oscilloscope is not necessary.

RESET: Sweep generator operation in either the local (front panel) or remote (GPIB) operational mode can be reset to a predetermined state by pressing the front panel RESET pushbutton.

GPIB OPERATION: All front-panel pushbuttons except POWER can be programmed over the IEEE-488 Interface Bus (GPIB). Front-panel indicators light when:

1. the sweeper is under GPIB (remote) control.
2. Local Lockout is programmed.
3. a Service Request (SRQ) is initiated.
4. the sweeper is addressed to either Talk or Listen.

A chart showing GPIB subset capability is given in Figure 3-30.

Table 1-2. Characteristics, 6600A Series Sweep Generators (Continued)

INPUT/OUTPUT CONNECTORS:

Horizontal Output: 0 to 10 volts during all sweep and CW modes (if CW RAMP is activated). <100Ω impedance.

Seq Sync Output: Positive TTL-level pulse during sweep retrace.

Retrace Blanking (+) Output: +5 volt, TTL-compatible pulse during retrace blanking.

Retrace Blanking (–) Output: -5 volt pulse during retrace blanking.

Marker Output: 0 to +5 volt pulse when video marker is selected. Pulse amplitude depends upon front panel MARKERS AMPLITUDE control. 1 kΩ impedance.

Bandswitch Blanking Output: ±5 volts, depending upon BANDSWITCH BLANKING switch, during oscillator bandswitching. <100Ω impedance. Not used in Single-Band models.

1V/GHz Output: 1 volt per GHz of output frequency (.5V/GHz for 6636A and 6640A). <100Ω impedance.

Penlift Output: Normally-open relay contacts for lifting recorder pen during retrace. Internal jumper available for normally-closed contacts.

Sweep Trigger Input: When TRIGGER–EXT OR SINGLE pushbutton is engaged, an externally applied clock pulse with the below-listed characteristics triggers a sweep upon closure-to-ground.

Amplitude: 4 to 25 Vpk
Pulse Width: >1 μs
Fall Time: <5 μs
Polarity: Low true

Sweep Dwell Input: +5V (maximum) TTL pulse causes frequency sweep to dwell. Provides interface for HP 8410 Network Analyzer.

External AM Input: Provides for amplitude modulation of the output signal. 10 kΩ input impedance and 1V/dB input sensitivity.

External FM and Phase Lock Input: Provides for frequency modulation of the output signal. 10 kΩ input impedance and -6 MHz/V input sensitivity.

External Square Wave Input: TTL-compatible input that allows a ±10 volt (maximum) square wave to modulate the RF output signal. Input square wave frequency from dc to 50 kHz.

External Sweep Input: Allows a 0 to 10 volt external sweep ramp to sweep the output frequency. 10 kΩ input impedance.

NONVOLATILE STORAGE: Front-panel control settings are retained in an internal memory (storage) when the ac power is turned off. When the ac power is turned on again, the previously-stored control settings are returned. The internal memory is powered by a rechargeable battery. Battery charge will last approximately 20 days when the sweeper is turned off and will be automatically recharged when the sweeper is turned on again.

INPUT POWER: 100, 115-120 Vac (+5%, -10%) at 2.0A rms or 220, 230-240 Vac (+5%, -10%) at 1.0A rms, 44-68 Hertz.

OPERATING TEMPERATURE RANGE: 0 to 50 degrees centigrade.

PHYSICAL:

Height: 13.34 cm (5.25 inches)
Width: 43.18 cm (17 inches)
Depth: 47.6 cm (18.75 inches)
Weight: 15.08 kg (33.5 pounds)

SECTION II

INSTALLATION

2-1 INTRODUCTION

This section provides information on initial inspection, preparation for use, and General Purpose Interface Bus (GPIB) interconnections. Also included is information concerning reshipment and storage of the sweep generator.

2-2 INITIAL INSPECTION

Inspect the shipping container for damage. If the container or cushioning material is damaged, retain until the contents of the shipment have been checked against the packing list and the instrument has been checked for mechanical and electrical operation.

If the sweep generator is damaged mechanically, notify your local sales representative or WILTRON Customer Service. If either the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier as well as WILTRON. Keep the shipping materials for carrier's inspection.

2-3 PREPARATION FOR USE

Preparation for use consists of checking that the sweep generator is set for the correct line voltage. The line-voltage module on rear panel enables the sweep generator to be used with any of four international line voltages: 100, 115/120, 220, or 230/240. Before leaving the factory, each sweep generator is preset and tagged for the line voltage present in the customer's area. If the actual line voltage is different from that stated on the tag, the following procedure gives instructions for changing the line-voltage selector card.

a. Refer to Figure 2-1. Disconnect the power cord from the voltage selector module (1) and slide cover (2) down to gain access to the fuse compartment.

b. To select a different line voltage:

1. Pull on FUSE PULL (3) and remove line fuse (4) and PC board (5).

NOTE

The PC board is tightly secured within the module housing. It may be necessary to use needle-nose pliers or a similar tool as a pry.

2. Using the example for 115/120 Vac operation (Figure 2-1) as a guide, reinstall the PC board. For the correct installation of this board, the desired line-voltage callout should be located:

   a. adjacent to the input receptacle and

   b. facing toward the BNC connector-bank.

3. Push the FUSE PULL back to its normal position and insert a fuse of the proper value (as indicated on the right side of the module) into the fuse holder.

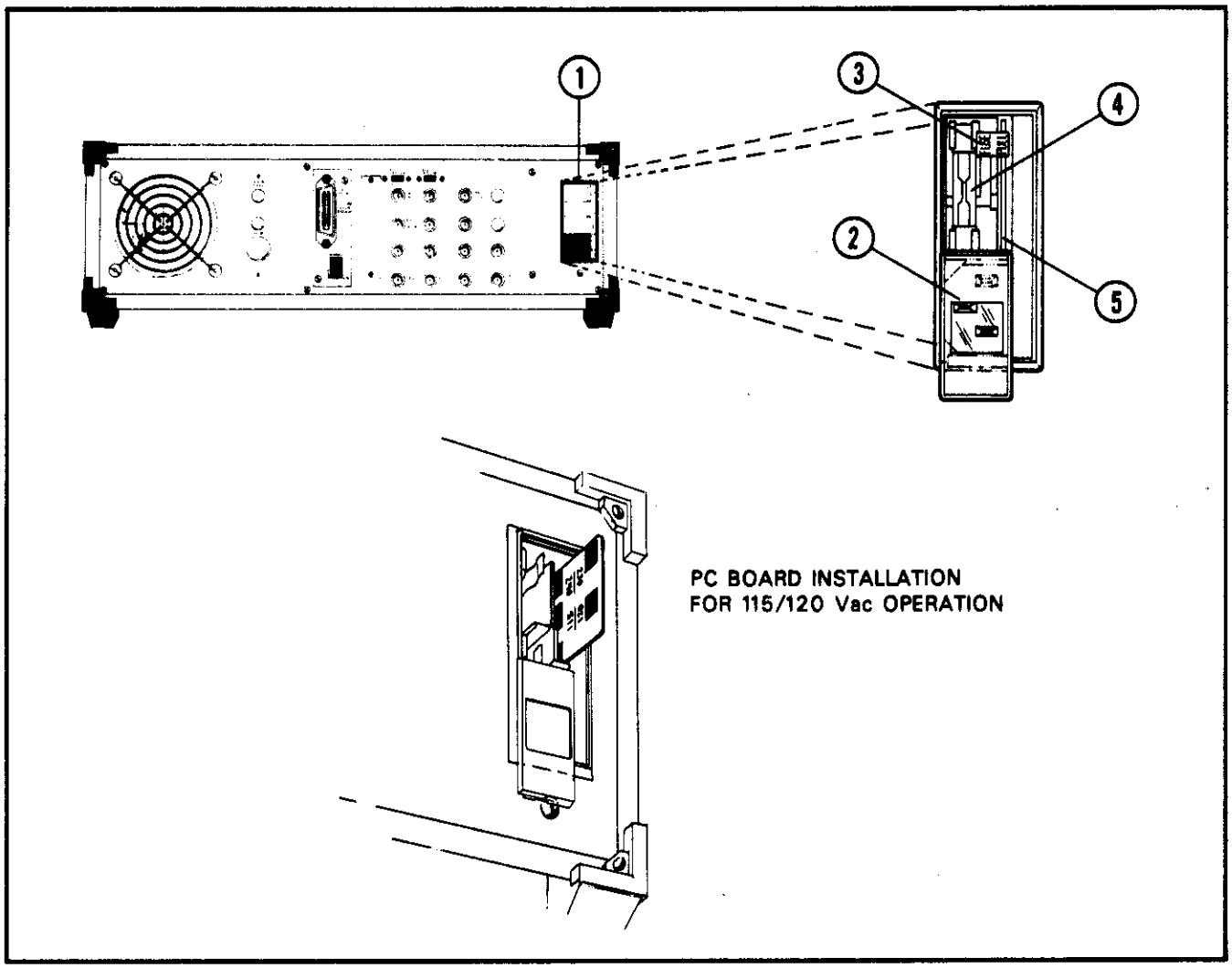


Figure 2-1. Line Voltage Selector Module

2-4 GPIB SETUP AND INTERCONNECTION

With Option 3 installed, the sweep generator is capable of providing automated microwave measurements via the GPIB. Specific GPIB information – including interface connections, cable requirements, and addressing instructions – is contained in the following paragraphs.

2-4.1 Interface Connector

Interface between the sweep generator and other devices on the GPIB is via a 24-wire interface cable. The interface cable is specifically constructed with each end containing a connector shell with two connector faces. These double-faced connectors allow for parallel connection of two or more cables to a single device. Figure 2-2 shows the pin assignments for the Type 57 GPIB connector, installed on the rear panel.

2-4.2 Cable Length Restrictions

The GPIB system can accommodate up to fifteen instruments at any one time. To achieve design performance on the bus, the proper timing and voltage level relationships must be maintained. If either the cable length between separate instruments or the accumulated cable length between all instruments is too long, the data and control lines

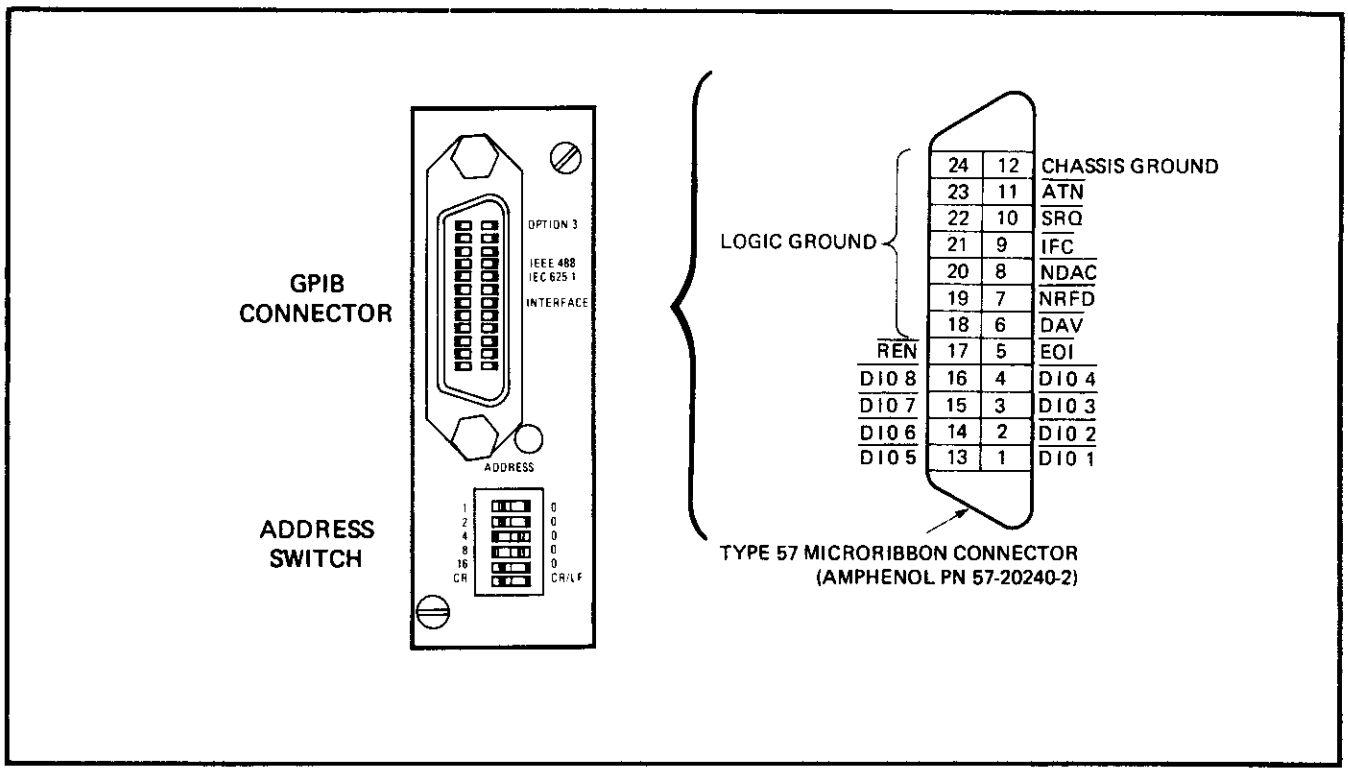


Figure 2-2. Option 3 Panel (ADDRESS Switch and GPIB Connector)

cannot be driven properly and the system may fail to perform. Cable length restrictions are as follows:

- No more than 15 instruments may be installed on the bus.
- Total accumulative cable length in meters may not exceed 2 times the number of bus instruments, or 20 meters – whichever is less.

2-4.3 GPIB Interconnection

The only interconnection required for GPIB operation is between the sweep generator and the controller. To accomplish this interconnection, a special cable is required. This cable – WILTRON Part No. 2000-1, -2, or -4 (1, 2, or 4 meters in length) – is available from the factory.

2-4.4 GPIB Address

The sweep generator is shipped from the factory preset to address 5. If a different address is desired, the ADDRESS switches on the Option 3 panel (Figure 2-2) provide for the selection of any address number between 0 and 30. Figure 2-3 provides a tabulation of the available address numbers, and Figure 2-4 provides an example of how an address number is selected.

2-4.5 Data Delimiting (CR-CR/LF Switch)

On the GPIB, data delimiting is accomplished using either the carriage return (CR) or both the carriage return and the line feed (CR/LF) ASCII characters, depending upon the requirements of the instrument used as system controller. For example, the PET 2001 requires CR. The HP 9825A requires CR/LF, while the WILTRON 85 and the Tektronix 4051 can use either CR or CR/LF.

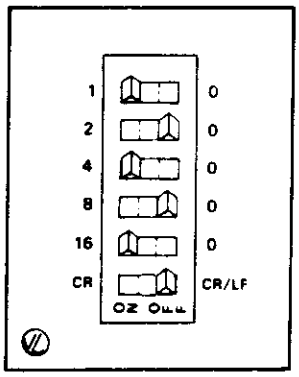
To provide ease in selecting the proper data-delimiting character for the controller in use, a switch is provided on the rear Option 3 panel. To use this switch, simply press the rocker arm to the position of the required delimiting character (Figure 2-4).

Decimal Address	ASCII Character	(MSB) 16	8	4	2	(LSB) 1
0	Space	0	0	0	0	0
1	!	0	0	0	0	1
2	"	0	0	0	1	0
3	#	0	0	0	1	1
4	$	0	0	1	0	0
5	%	0	0	1	0	1
6	&	0	0	1	1	0
7	'	0	0	1	1	1
8	(	0	1	0	0	0
9	)	0	1	0	0	1
10	*	0	1	0	1	0
11	+	0	1	0	1	1
12	,	0	1	1	0	0
13	-	0	1	1	0	1
14	.	0	1	1	1	0
15	/	0	1	1	1	1

Decimal Address	ASCII Character	(MSB) 16	8	4	2	(LSB) 1
16	0	1	0	0	0	0
17	1	1	0	0	0	1
18	2	1	0	0	1	0
19	3	1	0	0	1	1
20	4	1	0	1	0	0
21	5	1	0	1	0	1
22	6	1	0	1	1	0
23	7	1	0	1	1	1
24	8	1	1	0	0	0
25	9	1	1	0	0	1
26	:	1	1	0	1	0
27	;	1	1	0	1	1
28	<	1	1	1	0	0
29	=	1	1	1	0	1
30	>	1	1	1	1	0

Switch ON = 1
Switch OFF = 0

Figure 2-3. Available Address Codes and Corresponding ADDRESS Switch Positions



GPIB ADDRESS = 10 (2+8)

DATA DELIMITER = CR

Figure 2-4. Address Selection

2-4.6 Option 3 (GPIB) Installation

Option 3, which consists of the A1 PCB and the A18 GPIB Connector Assembly, may be installed in the field, as follows:

a. Remove the rear panel cover plate and install the A18 Connector Assembly. See Figure 3-20, index number 3, for location.

b. Connect the A18P1 connector to A14P4, on the motherboard. See Figure 7-125 for location.

c. Install the A1 PCB into its marked slot in the 660-D-8000 Mainframe Assembly. See Figure 6-1, index number 1, for location.

2-5 PREPARATION FOR STORAGE AND/OR SHIPMENT

Instructions for preparing the sweep generator for storage, shipment, or both are provided in paragraphs 2-5.1 and 2-5.2.

2-5.1 Preparation for Storage

Preparation for storage involves cleaning the unit, packing the inside of the unit with moisture-absorbing dessicant crystals, and storing the unit in a temperature environment between -40 and +70 degrees centigrade.

2-5.2 Preparation for Shipment

To provide maximum protection against damage in transit, the sweep generator should be repackaged in the original shipping container. If this container is no longer available and the sweep generator is being returned to WILTRON for repair, contact WILTRON Customer Service and a new shipping container will be sent to you free of charge. In the event neither of these two options is possible, the following paragraphs provide instructions for packaging and shipment.

a. Use a Suitable Container. Obtain a corrugated cardboard carton with a 275-pound test strength and inside dimensions of no less than six inches more than the instrument dimensions; this allows for cushioning.

b. Protect the Instrument. Surround the instrument with polyethylene sheeting to protect the finish.

c. Cushion the Instrument. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between the carton and the instrument; allow a minimum of three inches of dunnage on all sides.

d. Seal the Container. Seal the carton by using either shipping tape or an industrial stapler.

e. Address the Container. If the instrument is being returned to WILTRON for service, mark the WILTRON address and your return address on the carton in one or more prominent locations. The WILTRON address is:

WILTRON Company
ATTN: Customer Service
825 E. Middlefield Road
Mountain View, CA 94043

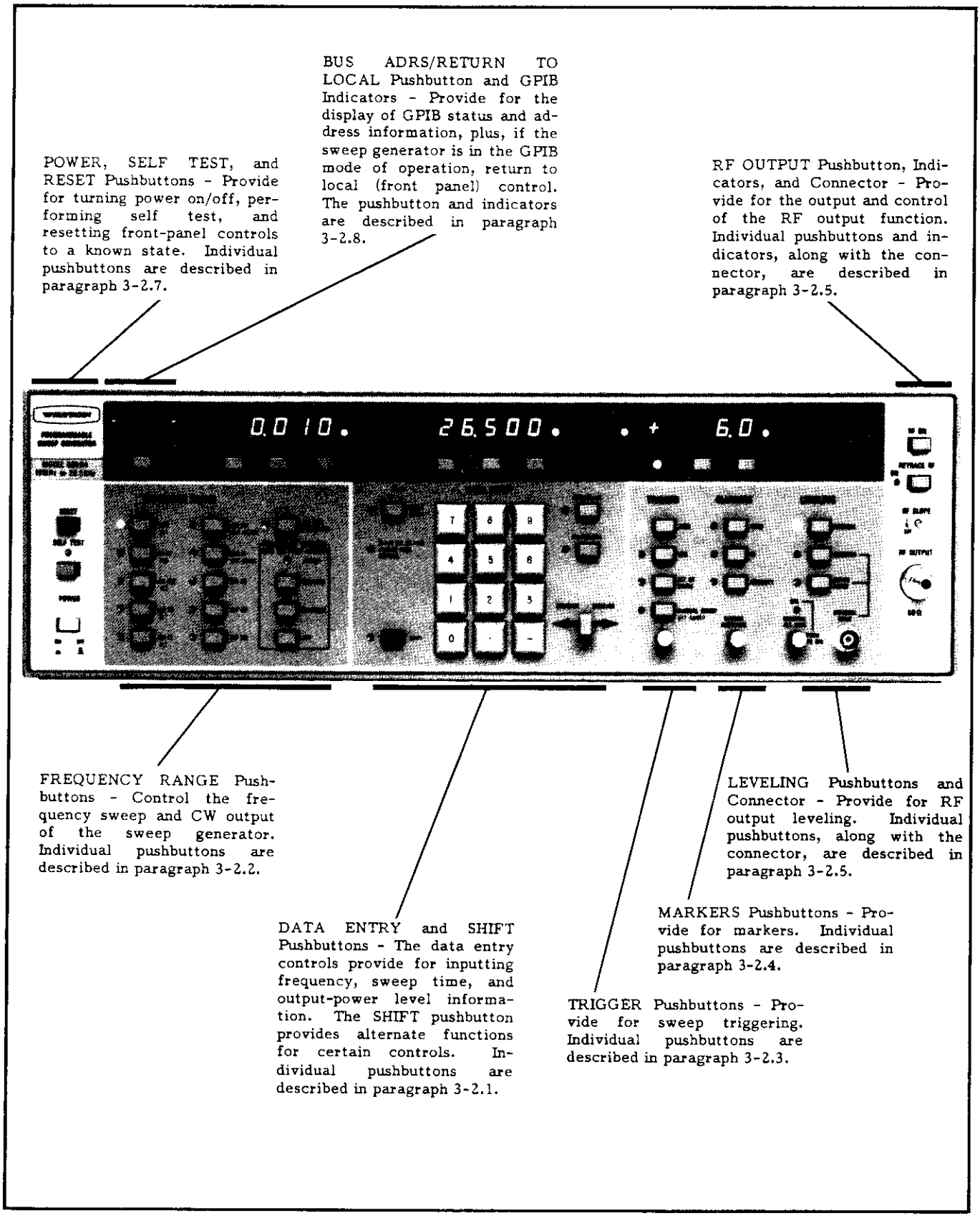


Figure 3-1. Sweep Generator Front Panel Controls

SECTION III

OPERATION

3-1 INTRODUCTION

This section contains information on the front and rear panel controls and connectors, plus a description of the sweep generator self-test feature. Also included are operational checkout procedures and a description of the Option 3 GPIB command codes.

3-2 FRONT PANEL CONTROLS

The front panel controls are grouped by function, as shown in Figure 3-1. Detailed descriptions of individual controls within each group are given in paragraphs 3-2.1 thru 3-2.8.

3-2.1 DATA ENTRY Pushbuttons

There are five discrete frequency parameters (F0, F1, F2, M1, and M2) and one sweep width parameter (ΔF) – plus the sweep time and RF-output power level parameters – used to control the operation of the sweep generator. The DATA ENTRY pushbuttons (Figure 3-2) provide for entering new values for these parameters.

To provide an overview, several examples of how these pushbuttons are used to accomplish data entry are given in Figure 3-3. Individual DATA ENTRY pushbuttons are described in subparagraphs a. through f.

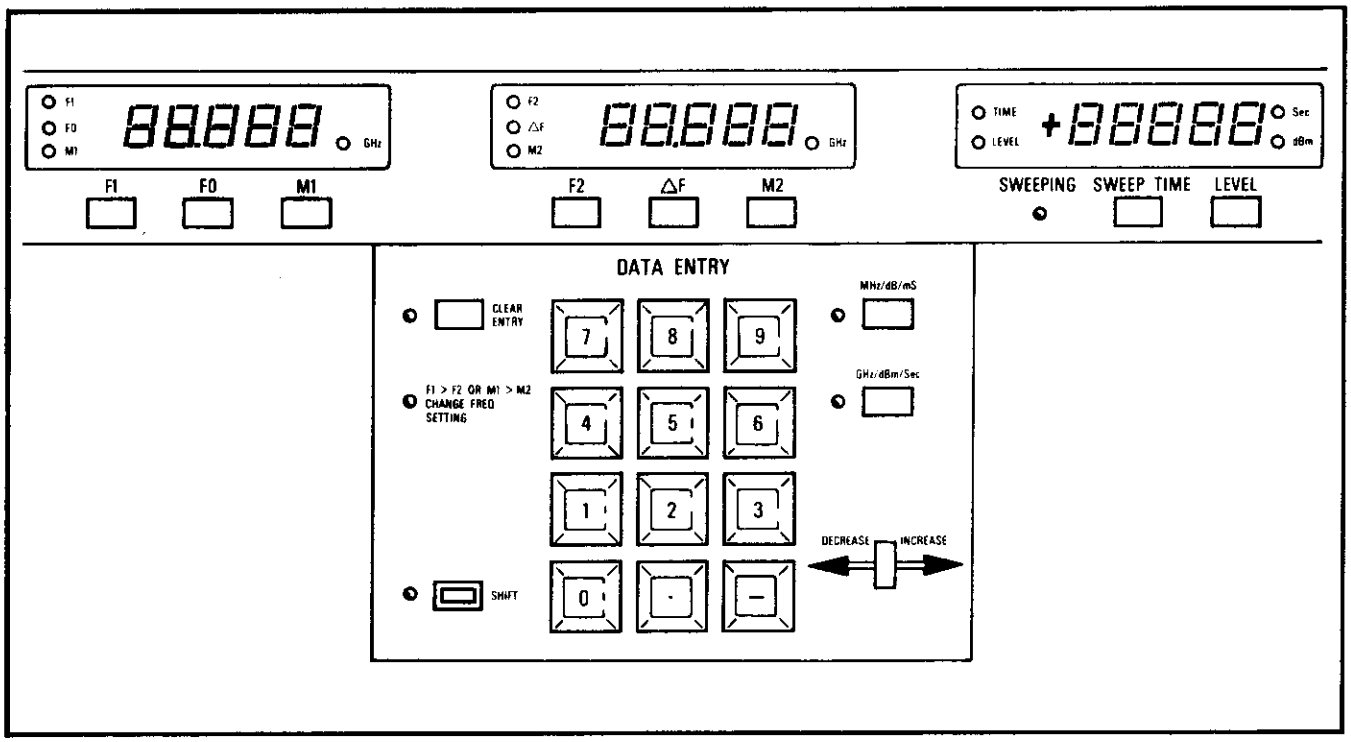


Figure 3-2. DATA ENTRY Pushbuttons

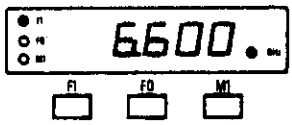
1. To enter a new F1 parameter of 6600 MHz, proceed as follows:

Press [F1] + [6] [6] [0] [0] + [MHz/dB/mS]

or

Press [F1] + [6] [.] [6] + [GHz/dBm/Sec]

The display above the F1 pushbutton will read:



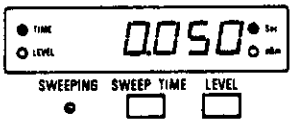
2. To enter a new SWEEP TIME parameter of 50 ms, proceed as follows:

Press [SWEEP TIME] + [5] [0] + [MHz/dB/mS]

or

Press [SWEEP TIME] + [.] [0] [5] [0] + [GHz/dBm/Sec]

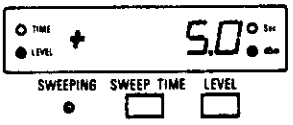
The display above the SWEEP TIME pushbutton will read:



3. To enter a new RF level parameter of 5 dBm, proceed as follows:

Press [LEVEL] + [5] + [GHz/dBm/Sec]

The display above the LEVEL pushbutton will read:

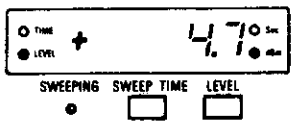


4. To change the RF power level, two methods are available: (1) a new power level may be selected using the example shown in 3, above, or (2) a value in dB may be added to or subtracted from the present power level; the algebraic sum or difference of this arithmetical process will appear on the display in dBm. Examples are shown in a and b, below.

a. To subtract 0.3 dB from the power level selected in 3, above, proceed as follows:

Press [LEVEL] + [-] [.] [3] + [MHz/dB/mS]

The display above the LEVEL pushbutton will read:



b. To add 2 dB to the power level selected in 4a., above, proceed as follows:

Press [LEVEL] + [2] + [MHz/dB/mS]

The display above the LEVEL pushbutton will read:

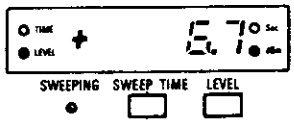


Figure 3-3. How to Enter Parameter Data (Examples)

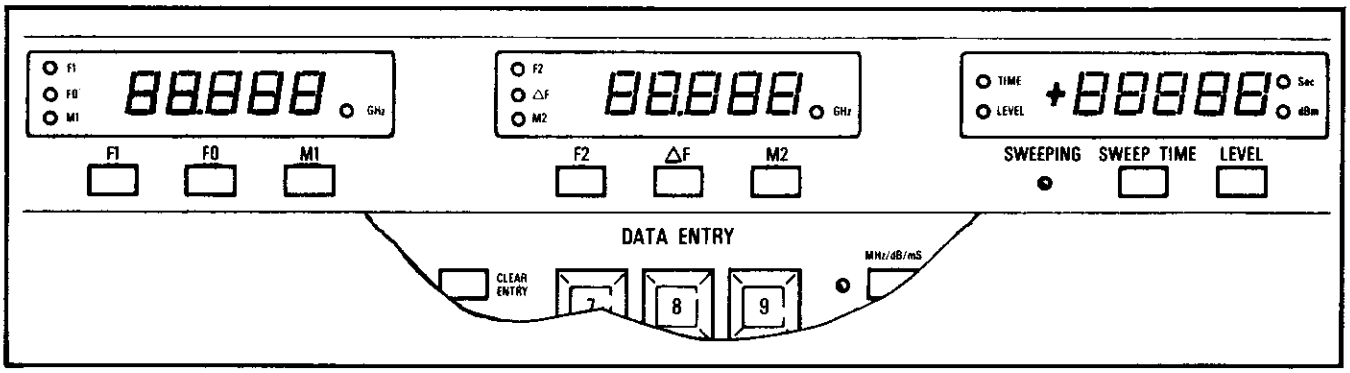


Figure 3-4. F1, F0, M1, F2, ΔF, M2, SWEEP TIME and LEVEL Pushbuttons and SWEEPING Indicator

a. F1, F0, M1, F2, ΔF, M2, SWEEP TIME, and LEVEL Pushbuttons and SWEEPING Indicator (Figure 3-4).

1. The pushbuttons enable the selected parameter's value to be changed via the DATA ENTRY keypad or the INCREASE/DECREASE lever or to be monitored via the appropriate LED readout. The parameter that is selected for either changing or monitoring is hereafter known as the **selected parameter.**

2. The SWEEPING Indicator lights during the forward portion of the frequency sweep. The indicator is out during retrace.

b. DATA ENTRY Keypad (Figure 3-5). The DATA ENTRY keypad is used to change the value of the selected frequency, sweep time, or level parameter. When the selected parameter is frequency (F1, F0, M1, F2, ΔF, or M2), the new value may be entered in either MHz or GHz. When the selected parameter is sweep time, the new value may be entered in either seconds or milliseconds. And, when the selected parameter is power level, the new value may be entered in either dB or dBm.

c. INCREASE/DECREASE Lever (Figure 3-6). When enabled by a parameter pushbutton (F1, SWEEP TIME, LEVEL, etc.), this lever may be used to increase or decrease the parameter's value. The length of lever travel, either right or left, determines the rate at which the parameter's value increases or decreases. To increase or decrease the parameter's value in one-increment steps, "tap" the switch in the direction of desired change. When the lever is "tapped," a frequency parameter will change in 1 MHz increments. An RF level parameter will

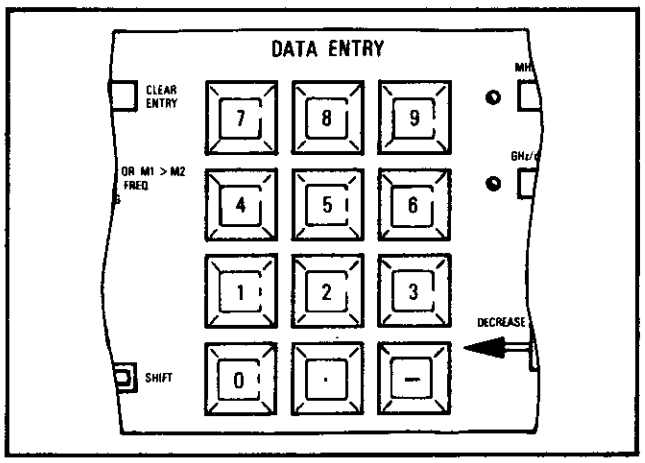


Figure 3-5. DATA ENTRY Keypad

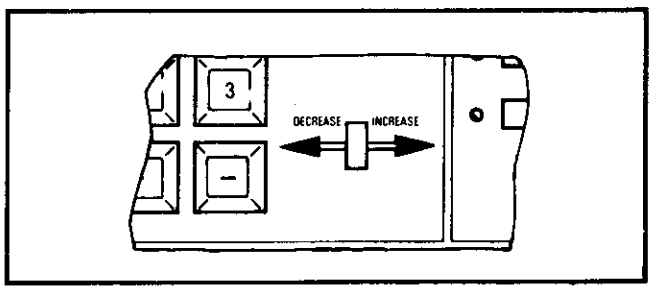


Figure 3-6. INCREASE/DECREASE Lever

change in 0.1 dB increments. And, a sweep time parameter will change in 1 ms increments between .01 and 1.0 seconds, 0.1-second increments between 1 and 10 seconds, and 1-second increments between 10 and 99 seconds.

NOTE

For SWEEP TIME, move the lever toward DECREASE to increase time, and toward INCREASE to decrease time.

d. MHz/dB/mS and GHz/dBm/Sec Pushbuttons (Figure 3-7). These two pushbuttons are data string terminators. That is, they mark the end of a parameter-input entry, and they assign the appropriate units (GHz, dBm, mS, etc.) to the entry. However, whereas

- a frequency parameter may be ended in either MHz or GHz, the value is always displayed in GHz.
- a sweep time parameter may be ended in either seconds (Sec) or milliseconds (mS), the value is always displayed in seconds.
- a power level parameter may be ended in either dB or dBm, the value is always displayed in dBm. The dB terminator pushbutton allows the displayed power level parameter to be either added to or subtracted from in dB's. When the dB terminator is used, the sweep generator performs the calculations that convert the output power to a value in dBm. Example 4 in Figure 3-3 shows the use of the dB terminator pushbutton.

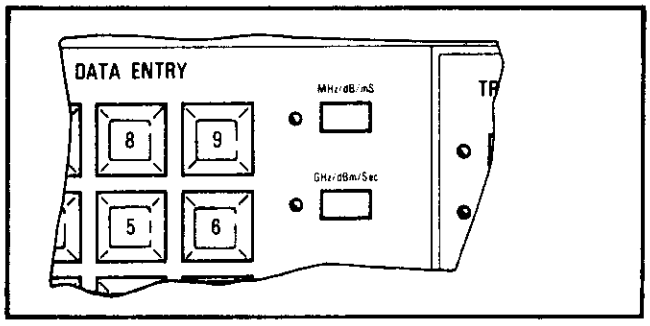


Figure 3-7. MHz/dB/mS and GHz/dBm/Sec (Terminator) Pushbuttons

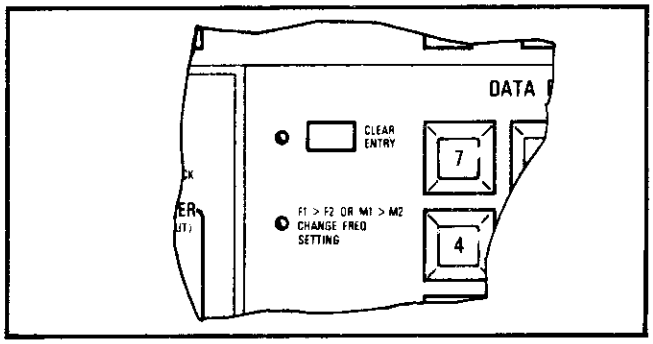


Figure 3-8. CLEAR ENTRY Pushbutton and F1>F2 OR M1>M2 Indicator

e. CLEAR ENTRY Pushbutton and Indicator and F1>F2 OR M1>M2 CHANGE FREQUENCY SETTING Indicator (Figure 3-8).

1. The CLEAR ENTRY pushbutton clears the keypad of an illegal or incomplete data entry (described below), and allows a new value to be entered.

2. The CLEAR ENTRY indicator flashes when an illegal or incomplete data entry has been attempted. (In addition, an illegal entry causes the LED readout displaying the illegal entry to flash; an incomplete entry causes both data terminator pushbutton indicators (Figure 3-7) to flash.)

3. The F1>F2 OR M1>M2 CHANGE FREQ SETTING indicator, along with the two LED readouts displaying frequency, flashes when a "backward" sweep is attempted. A backward sweep is when the respective value of F2 or M2 is less than that of F1 or M1. To clear a backward sweep, either re-enter the frequency values so that F1 or M1 is less than F2 or M2 or select a different frequency range.

An illegal entry is one in which a frequency, sweep time, or output-power level value beyond the range of the sweep generator is

entered via the keypad. When this occurs, the CLEAR ENTRY pushbutton must be used to clear the keypad before the error can be corrected.

An incomplete entry is one in which a parameter value is entered on the keypad and the entry is not terminated with a terminator pushbutton (Figure 3-7). When this occurs, the error can be corrected by pressing the appropriate terminator pushbutton or by pressing the CLEAR ENTRY pushbutton and re-entering the data.

f. SHIFT Pushbutton (Figure 3-9). Provides additional functions, designated by blue lettering, for the pushbuttons described below. When SHIFT is pressed, the numeric displays and LED indicators will go out, except for the currently active SHIFT functions. Pressing SHIFT again returns the displays and indicators to their unshifted (normal) indications – no parameters are changed.

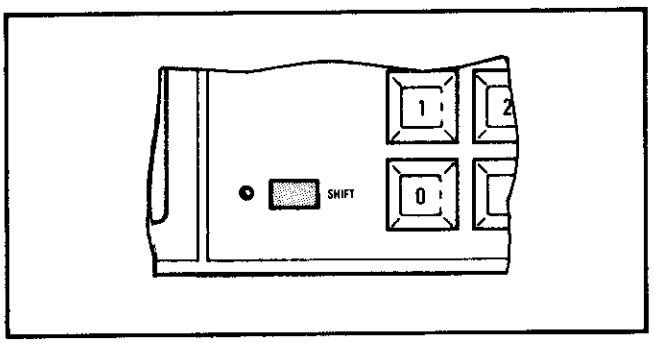


Figure 3-9. SHIFT Pushbutton

1. ALT Pushbuttons (Figure 3-10). Cause the RF output to alternate between any two of the five available sweep ranges (FULL, F1-F2, M1-M2, ΔF F0, ΔF F1). The two sweeps (A and B) are selected, and their start/stop parameters set, in the normal manner (paragraph 3-2.2a). The A (primary) sweep is chosen first, the SHIFT pushbutton is pressed, then the B (alternating) sweep is chosen. After the B sweep is chosen, the numeric displays and LED indicators will return to their unshifted state; the LED indicators associated with the A and B sweep ranges will alternately flash on and off.

When using the alternating sweeps, the following apply:

(a) Frequency markers (VIDEO, RF, and INT) are available and can be set or changed while an alternating sweep is in progress. Marker frequencies can be set on either network analyzer trace. A marker frequency that is changed on one trace will dynamically move to the correct frequency point on the other trace.

(b) When the INCREASE/DECREASE lever is used, it temporarily halts sweep alternations and leaves the A sweep displayed on the network analyzer or oscilloscope. When the lever is released, sweep alternations resume.

(c) If the A or B (or both) sweep is to be a CW frequency, select a ΔF mode and set the ΔF frequency for 0 MHz.

(d) Neither an external nor a manual sweep can be used with an ALT sweep mode. If EXT SWEEP or MANUAL SWEEP has been selected, the microprocessor will ignore any attempt to select an ALT sweep. Conversely, if an ALT sweep has been selected, the microprocessor will ignore attemps to select EXT SWEEP or MANUAL SWEEP.

To exit the alternating sweep mode, press any frequency range pushbutton (including CW).

2. CW FILTER Pushbutton (Figure 3-11). Provides enable/disable, conditional-in/unconditional-out control over the CW filter located in the YIG oscillator tuning circuit. When enabled (LED on), this pushbutton causes the CW filter to be switched-in for CW and narrow (≤50 MHz) sweep modes, and

not inserted otherwise. Conversely, when CW FILTER is disabled (LED off), it causes the CW filter to be unconditionally switched-out of the YIG tuning circuit. CW FILTER is selected by first pressing SHIFT, then this pushbutton. Approximately 1 second after pressing CW FILTER, the front panel will automatically return to its unshifted (normal) state. RESET (default) state: Enabled (On).

NOTE

The CW FILTER pushbutton becomes disabled (LED off) when an alternating (ALT) sweep mode is selected. When the ALT mode is exited, the CW FILTER pushbutton resumes its previously selected state.

3. CW RAMP Pushbutton (Figure 3-11). Provides a 0-10V HORIZ OUTPUT sweep ramp for all CW modes (CW F0, CW F1, CW F2, etc.). This pushbutton should be activated (LED on) when the sweep generator is used with a Model 560 or 560A Scalar Network Analyzer; otherwise, the pushbutton should be off. CW RAMP is selected by first pressing SHIFT, then this pushbutton. Approximately 1 second after pressing CW RAMP, the front panel will automatically return to its unshifted (normal) state. RESET (default) state: Off.

4. EXT SWEEP Pushbutton (Figure 3-14). Provides for sweeping the output frequency using an external sweep ramp, which is supplied via the rear panel EXT SWEEP connector. EXT SWEEP is selected by first pressing SHIFT, then this pushbutton. Approximately 1 second after pressing EXT SWEEP, the front panel will automatically return to its unshifted (normal) state. Pressing any other TRIGGER pushbutton will deactivate EXT SWEEP. RESET (default) state: Off.

3-2.2 FREQUENCY RANGE Pushbuttons

The FREQUENCY RANGE pushbuttons are used to

- select the sweep generator's operational mode – either sweep or CW;
- apply fine-frequency vernier corrections to output frequency in the selected CW mode or to center frequency in the selected ΔF sweep mode;
- apply frequency modulation to or phase-lock control over output frequency in the selected CW output mode.

Individual FREQUENCY RANGE pushbuttons are described below.

a. FULL, F1-F2, M1-M2, ΔF F0, and ΔF F1 Pushbuttons (Figure 3-10). These pushbuttons select the sweep mode as follows:

FULL: Selects a mode in which the frequency sweep is from the sweep generator's lower to its upper frequency limit. When FULL is engaged, its indicator lights, the lower frequency limit appears on the F1-F0-M1 LED readout, and the upper frequency limit appears on the F2-ΔF-M2 LED readout. RESET (default) state: On.

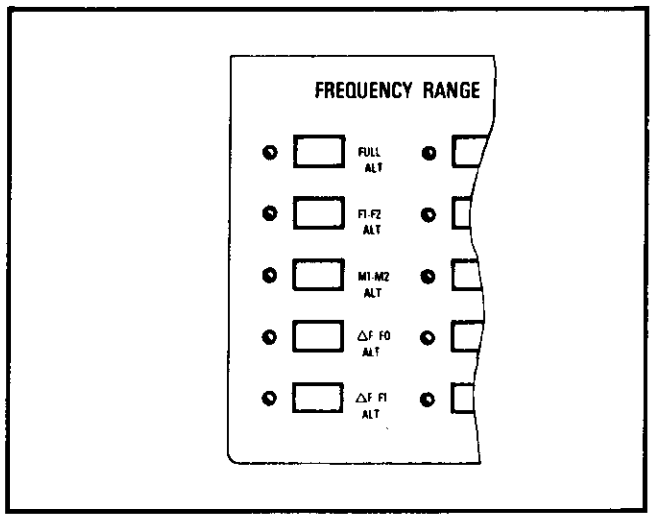


Figure 3-10. FULL, F1-F2, M1-M2, ΔF F0, ΔF F1 Pushbuttons

F1-F2: Selects a mode in which the frequency sweep is from F1 to F2. When F1-F2 is engaged, its indicator lights, the F1 frequency appears on the F1-F0-M1 LED readout, and the F2 frequency appears on the F2-ΔF-M2 LED readout.

M1-M2: Selects a mode in which the frequency sweep is from M1 to M2. When M1-M2 is engaged, its indicator lights, the M1 frequency appears on the F1-F0-M1 LED readout, and the M2 frequency appears on the F2-ΔF-M2 LED readout.

ΔF F0: Selects a mode in which the frequency sweep is symmetrical about the F0 frequency. The width of this sweep, though usually narrow-band, can go from 0 to 100% of the full frequency range. When ΔF F0 is engaged, its indicator lights, the F0 frequency appears on the F1-F0-M1 LED readout, and the ΔF Frequency appears on the F2-ΔF-M2 LED readout.

NOTE

The ΔF F0 and ΔF F1 sweeps can be asymmetrical. Asymmetry will occur when one-half the width of the ΔF sweep will cause the band-edge at either end of the frequency band to be exceeded. The sweep generator cannot sweep beyond its band-edges. (It will sweep only to the band-edge on one side of F0 (or F1) and up to one-half the ΔF sweep on the other side.)

ΔF F1: Selects a mode in which the frequency sweep is symmetrical about the F1 frequency. The width of this sweep and the frequency readouts are as described for ΔF F0, above.

The FULL, F1-F2, M1-M2, etc. controls are interlocked with the CW control group (subparagraph b, below) so that only one control can be engaged at any one time.

b. CW F0, CW F1, CW F2, CW M1, and CW M2 Pushbuttons (Figure 3-11).

These pushbuttons select a CW frequency mode, as follows:

CW F0: Selects a mode in which the CW frequency is at F0. When CW F0 is engaged, its indicator lights, and the F0 frequency appears on the F1-F0-M1 LED readout. The LED readout above F2-ΔF-M2 is blanked out.

CW F1: Selects a mode in which the CW frequency is at F1. When CW F1 is engaged, its indicator lights, and the F1 frequency appears on the F1-F0-M1 LED readout. The LED readout above F2-ΔF-M2 is blanked out.

CW F2: Selects a mode in which the CW frequency is at F2. When CW F2 is engaged, its indicator lights, and the F2 frequency appears on the F2-ΔF-M2 LED readout. The LED readout above F1-F0-M1 is blanked out.

CW M1: Selects a mode in which the CW frequency is at M1. When CW M1 is engaged, its indicator lights, and the M1 frequency appears on the F1-F0-M1 LED readout. The LED readout above F2-ΔF-M2 is blanked out.

CW M2: Selects a mode in which the CW frequency is at M2. When CW M2 is engaged, its indicator lights and the M2 frequency appears on the F2-ΔF-M2 LED readout. The LED readout above F1-F0-M1 is blanked out.

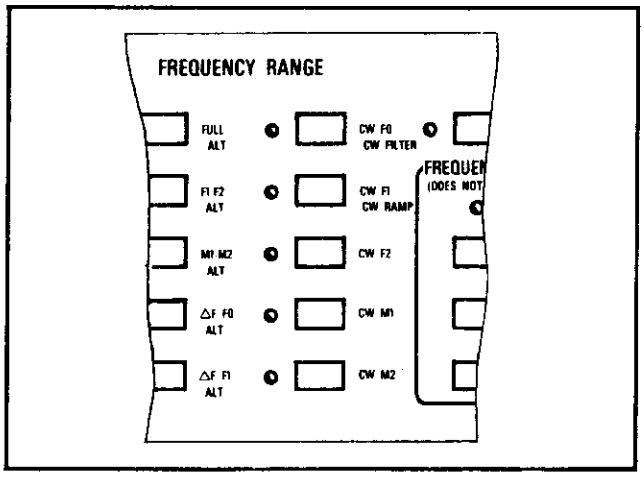


Figure 3-11. CW F0, CW F1, CW F2, CW M1/ and CW M2 Pushbuttons

c. FREQUENCY VERNIER Pushbuttons (Figure 3-12). These pushbuttons may be used to make fine adjustments to (1) output frequency in the selected CW mode or (2) center frequency in the selected ΔF mode. The frequency resolution achievable using these pushbuttons is ±100 kHz for all models except the 6642A, 6653A, and 6659A. For these three models, resolution is ±200 kHz. Individual pushbuttons are described below.

INCREASE: Increases by a maximum of 12.7 MHz (25 MHz for Models 6642A, 6653A and 6659A) the value of selected CW output or ΔF center frequency. The LED readout value of the selected CW or ΔF frequency is not affected by this control.

DECREASE: Decreases by a maximum of 12.7 MHz (25 MHz for Models 6642A, 6653A and 6659A) the value of the selected CW output or ΔF center frequency. The LED readout value of the selected CW or ΔF frequency is not affected by this control.

OFF: Cancels the vernier correction being applied to the selected CW output or ΔF center frequency and turns the ACTIVE indicator OFF in that mode.

NOTE

A different vernier correction value can be entered for each of the five frequency parameters (F0, F1, F2, M1, M2). Once made, the vernier correction is stored in memory with the parameter and remains in effect even when the sweep generator has been turned off. Pressing the OFF pushbutton or changing the frequency value of a parameter cancels the vernier correction.

d. FM AND PHASELOCK Pushbutton (Figure 3-13). This pushbutton allows the sweep generator output frequency to be either frequency-modulated or phase-locked to an external frequency standard. The external FM or phase-lock signal is input via the rear panel EXT FM Ø LOCK INPUT connector.

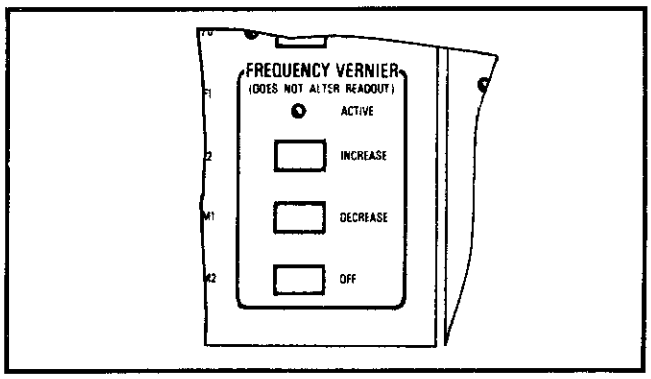


Figure 3-12. FREQUENCY VERNIER Controls

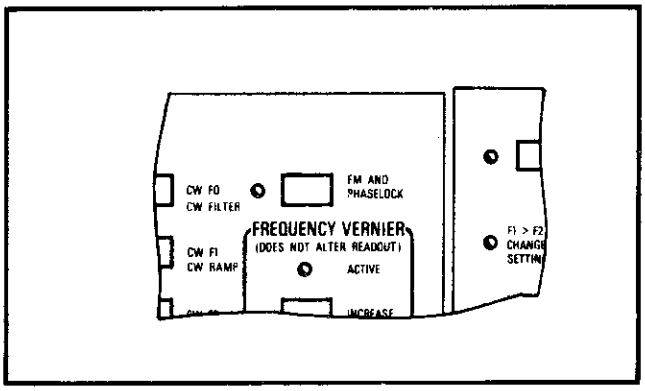


Figure 3-13. FM AND PHASELOCK Pushbutton

3-2.3 TRIGGER Pushbuttons

The TRIGGER pushbuttons (Figure 3-14) select a trigger mode for the frequency sweep. These pushbuttons are interlocked so that only one may be selected at a time. A description of each pushbutton follows:

AUTO: Selects a mode in which the sweep recurs periodically with a minimum delay (hold-off) time between sweeps. RESET (default) state: On.

LINE: Selects a mode in which the sweep recurs at a multiple or submultiple of the line frequency.

EXT OR SINGLE: Selects a mode in which the sweep recurs only when internally or externally triggered. External

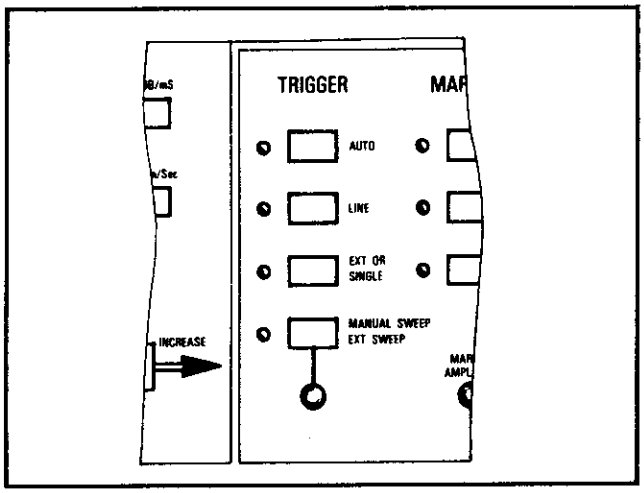


Figure 3-14. TRIGGER Pushbuttons

triggering is via the rear panel EXT TRIGGER INPUT connector; internal triggering is via this pushbutton. When the pushbutton is first pressed, the mode is selected. When the pushbutton is next pressed, the sweep is triggered. And, if the pushbutton is pressed again while the sweep is in progress, the sweep is aborted and reset.

MANUAL SWEEP: Selects a mode in which the frequency band is manually tuned. Manual tuning is provided by the associated control.

3-2.4 MARKERS Pushbuttons

There are three markers (M1, M2, F0) available with the sweep generator. Marker frequency is selected using the DATA ENTRY keypad (paragraph 3-2.1) or the RESET pushbutton (paragraph 3-2.7) – the keypad provides user selection, and the pushbutton provides preset selection. Marker type is selected using the MARKERS pushbuttons (Figure 3-15). The number of markers (1, 2, or 3) that occur when pressing a MARKERS pushbutton depends on which sweep mode has been selected: for FULL, F1-F2, and ΔF F1, all three markers occur; for ΔF F0, markers M1 and M2 occur; and for M1-M2, marker F0 occurs.

To determine which marker frequency (M1, M2, or F0) is being observed on a CRT display, press the M1, M2, and F0 pushbuttons while observing the display. The marker will disappear from the display when the corresponding pushbutton is pressed.

The MARKERS pushbuttons are described below. These pushbuttons are interlocked in such a way that all three may be off, but only one may be on at a time.

VIDEO: Causes a positive-video pulse to occur at the marker frequency(ies). The amplitude of this pulse can be adjusted from 0 to +5 volts using the MARKER AMPLITUDE control. RESET (default) state: On.

RF: Causes a negative RF pip to occur at the marker frequency(ies). The amplitude of this pip can be adjusted between 0 and approximately 10 dB using the MARKER AMPLITUDE control.

INTENSITY: Causes an intensity dot to occur at the marker frequency(ies). The intensity marker is created by causing the sweep to dwell at the marker frequency(ies). No connection is required between the sweep generator and a CRT Z-axis input. The intensity of this marker is not affected by the MARKER AMPLITUDE control.

NOTE

For the intensity marker to be used with the Model 560/560A Scalar Network Analyzer, the network analyzer must be in the REAL TIME display mode.

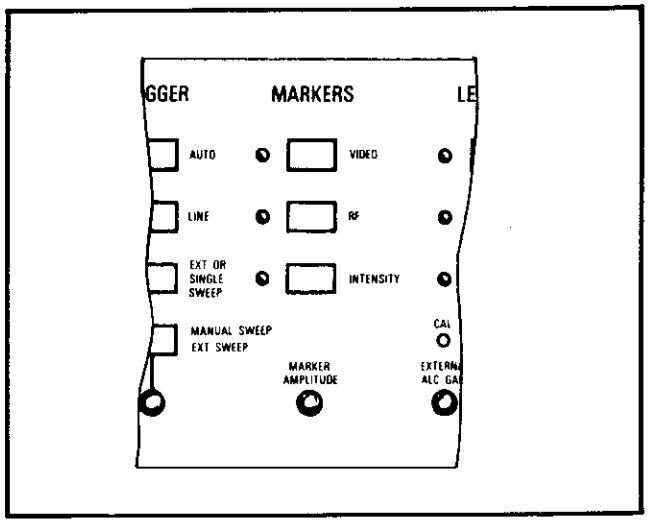


Figure 3-15. MARKERS Pushbuttons

3-2.5 LEVELING Controls

The LEVELING controls (Figure 3-16) select the type of leveling to be employed. These controls are interlocked so that all three pushbuttons may be off, but only one pushbutton may be on at a time. A description of each pushbutton follows.

INTERNAL: Selects an internally mounted directional detector for use in leveling the output power. When this pushbutton is engaged, the output power is sampled at the front-panel connector and fed back for leveling control. Internal leveling is not available for the 26.5-40 GHz band on the 6642A. RESET (default) state: On.

DETECTOR: Allows an external directional coupler and either a positive or a negative detector to be used in leveling the output power. When this pushbutton is engaged, the output power may be sampled at the end of the transmission line and fed back for leveling control.

POWER METER: Allows an external power meter, with either a positive or a negative recorder output voltage, to be used in leveling the output power. When this pushbutton is engaged, the output power may be sampled at the end of the transmission line and fed back for leveling control.

The sweep generator is compatible with power meters having a ±1V FS analog output, such as the HP 431/432, HP 435/436, and PM 1009/1010 models.

EXTERNAL ALC GAIN: Adjusts the gain of the signal applied to the EXTERNAL INPUT connector. The control's calibrate function automatically indicates when the gain is adjusted correctly for optimum ALC operation. To use this function, push in and turn the control until the CAL indicator comes on and stays on continuously. The indicator goes out when the control is released to its normal position.

NOTE

The PUSH TO CAL function is not operative for the 26.5-40 GHz band on the 6642A.

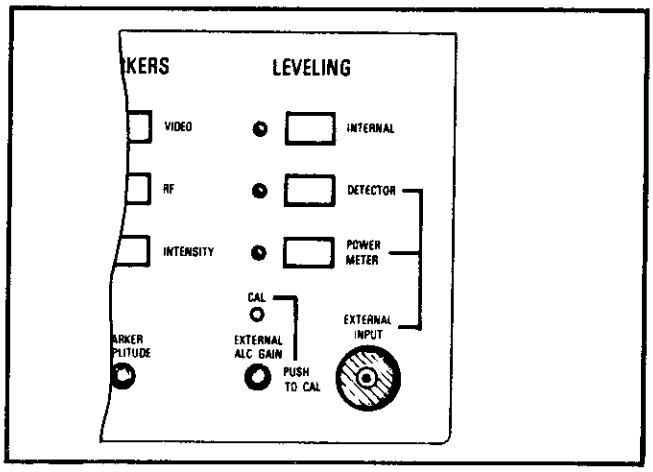


Figure 3-16. LEVELING Controls

3-2.6 RF OUTPUT Controls, Indicators, and Connector

The RF OUTPUT controls, indicators, and connector (Figure 3-17) are described below.

RF ON (Pushbutton): Turns the RF output on and off. RESET (default) state: On.

RETRACE RF (Pushbutton): Turns the RF output on and off during sweep retrace. This control is interlocked with the RF ON control so that it cannot be turned on unless the RF ON control is on, but it can be turned off independently of the RF ON control.

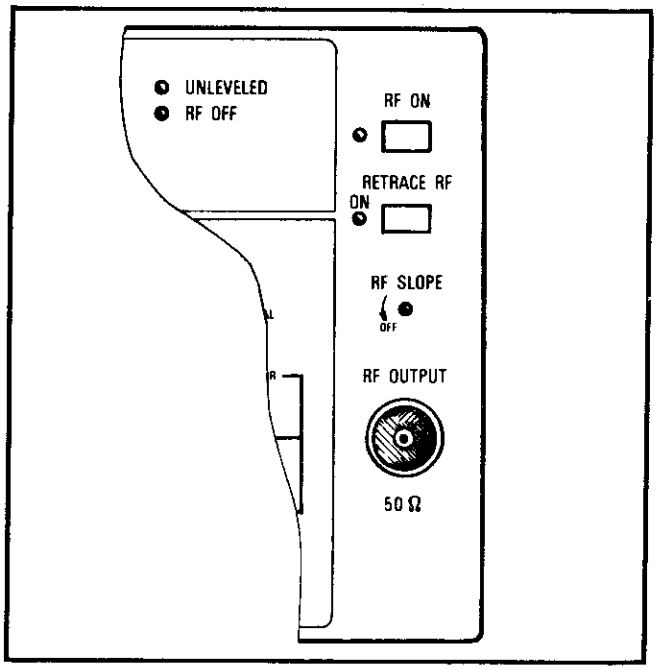


Figure 3-17. RF OUTPUT Controls

RF SLOPE (Control): Clockwise rotation adjusts the slope of the detected, leveled RF output signal. The control is used to compensate for the linear-with-frequency attenuation characteristics of RF transmission lines, when such lines are used with swept-frequency measurements. The OFF position provides optimum flatness at the RF OUTPUT connector.

UNLEVELED (Indicator): Lights when the RF output is unleveled.

RF OFF (Indicator): Flashes when the RF output is off.

RF OUTPUT (Connector): Provides RF output from 50Ω source. To prevent RF losses due to impedance mismatch, the mating connector and cable should have a 50Ω impedance rating.

3-2.7 POWER, SELF TEST, and RESET Controls

These controls (Figure 3-18) are described below.

POWER: Turns ac power on and off. When power is turned on, the A12 Microprocessor PCB software-version number (e.g. 1.7) appears on the F1-F0-M1 LED and a self test is initiated.

SELF TEST: Initiates self testing of sweep-generator circuits. Paragraph 3-4 describes the self-test feature.

RESET: Presets the front panel controls as shown below and numeric parameters as shown in Table 3-1.

Front Panel Controls

FREQUENCY RANGE: FULL (upper and lower frequency limits are displayed).
TRIGGER: AUTO
MARKERS: Off
LEVELING: INTERNAL
RF ON: On

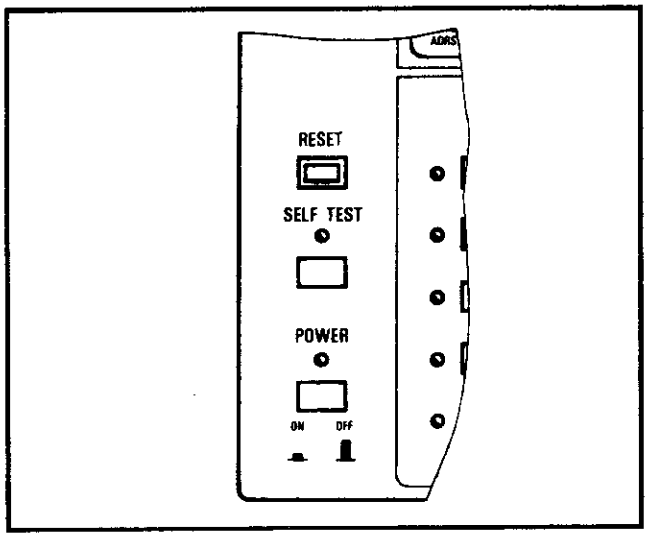


Figure 3-18. POWER, SELF TEST, and RESET Controls

3-2.8 BUS ADRS/RETURN TO LOCAL Control and GPIB Indicators

The BUS ADRS/RETURN TO LOCAL pushbutton and the REMOTE, LOCAL LOCKOUT, TALK, LISTEN, and SRQ GPIB indicators (Figure 3-19) are described below.

BUS ADRS/RETURN TO LOCAL (Pushbutton): In the local (front panel) mode, the pushbutton causes the bus address to be displayed on the SWEEP TIME-LEVEL LED readout. In the remote (GPIB) mode, provided that a local lockout bus message is not programmed, the pushbutton causes the sweep generator to return to the local mode.

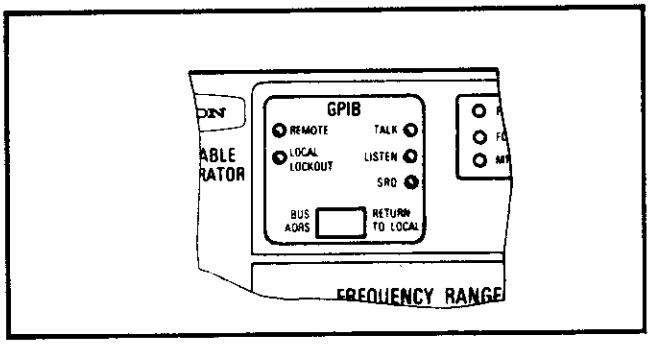


Figure 3-19. BUS ADRS/RETURN TO LOCAL Control and GPIB Indicators

Table 3-1. Reset (Default) Setting for Numeric Parameters

All Models:
SWEEP TIME: 50 ms
LEVEL: Maximum Leveled Power (Table 1-1)
ΔF: 1000 Hz

Model: 6609A

F1: 10 MHz
F2: 2000 MHz
F0: 1000 MHz
M1: 500 MHz
M2: 1500 MHz

Model: 6617A

F1: 10 MHz
F2: 8000 MHz
F0: 4000 MHz
M1: 3000 MHz
M2: 7000 MHz

Model: 6621A

F1: 2000 MHz
F2: 12000 MHz
F0: 9000 MHz
M1: 3000 MHz
M2: 11000 MHz

Model: 6621A-40

F1: 2000 MHz
F2: 12000 MHz
F0: 9000 MHz
M1: 3000 MHz
M2: 11000 MHz

Model: 6629A

F1: 8000 MHz
F2: 18000 MHz
F0: 13000 MHz
M1: 9000 MHz
M2: 17000 MHz

Model: 6629A-40

F1: 8000 MHz
F2: 18000 MHz
F0: 13000 MHz
M1: 9000 MHz
M2: 17000 MHz

Model: 6637A

F1: 2000 MHz
F2: 18000 MHz
F0: 10000 MHz
M1: 3000 MHz
M2: 17000 MHz

Model: 6637A-40

F1: 2000 MHz
F2: 18000 MHz
F0: 10000 MHz
M1: 3000 MHz
M2: 17000 MHz

Model: 6638A

F1: 2000 MHz
F2: 20000 MHz
F0: 11000 MHz
M1: 3000 MHz
M2: 19000 MHz

Model: 6642A

F1: 18000 MHz
F2: 40000 MHz
F0: 25000 MHz
M1: 19000 MHz
M2: 39000 MHz

Model: 6647A

F1: 10 MHz
F2: 18000 MHz
F0: 10000 MHz
M1: 1000 MHz
M2: 17000 MHz

Model: 6648A

F1: 10 MHz
F2: 20000 MHz
F0: 10000 MHz
M1: 3000 MHz
M2: 19000 MHz

Model: 6653A

F1: 2000 MHz
F2: 26000 MHz
F0: 14000 MHz
M1: 3000 MHz
M2: 25000 MHz

Model: 6659A

F1: 10 MHz
F2: 26000 MHz
F0: 14000 MHz
M1: 3000 MHz
M2: 25000 MHz

REMOTE (Indicator): Lights when sweep generator goes under GPIB control. Remains lit until sweep generator is returned to local control.

LOCAL LOCKOUT (Indicator): Lights when sweep generator receives a local lockout message; remains lit until local lockout message is rescinded. When LOCAL LOCKOUT indicator is lit, sweep generator cannot be returned to local control via the front panel.

TALK (Indicator): Lights when sweep generator is addressed to talk; remains lit until unaddressed.

LISTEN (Indicator): Lights when sweep generator is addressed to listen; remains lit until unaddressed.

SRQ (Indicator): Lights when sweep generator sends a Service Request; remains lit until a serial poll is received or the SRQ function is reset (paragraph 3-7.4).

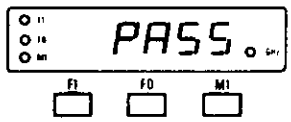
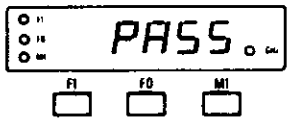
3-3 REAR PANEL CONTROLS AND CONNECTORS

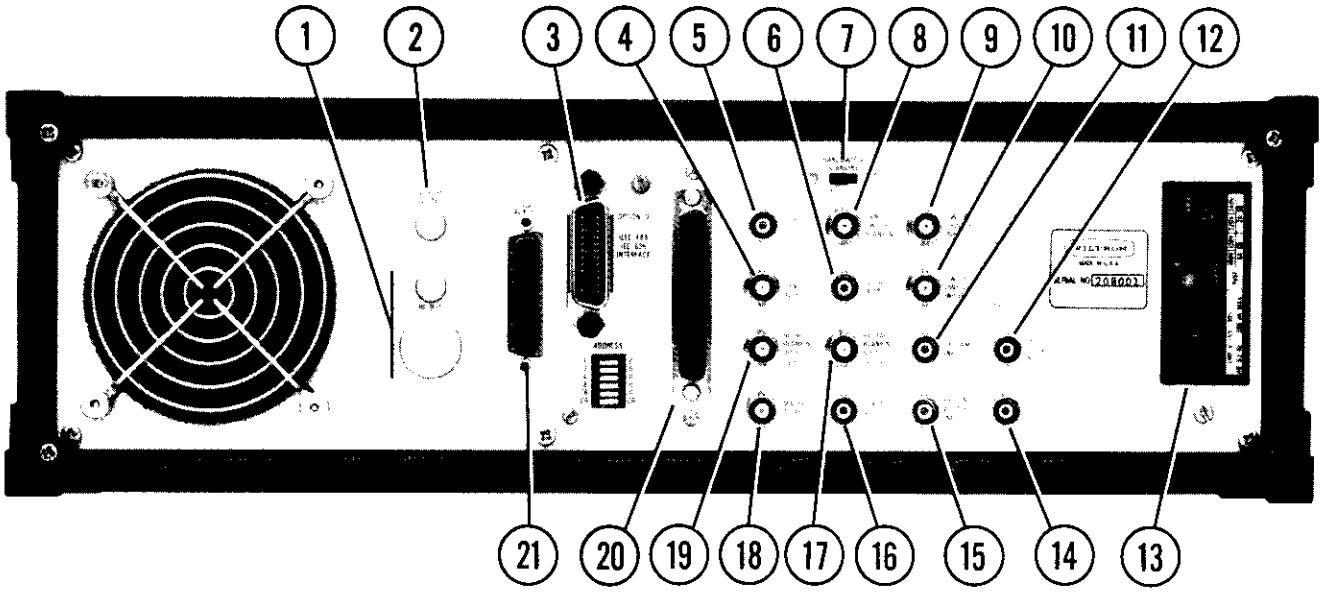
The rear panel controls and connectors are described in Figure 3-20.

3-4 SELF-TEST FEATURES

The sweep generator is equipped with a self-test feature that uses an internal microprocessor to test (1) selected circuits on each of the printed circuit boards and (2) all of the indicators and LED displays on the front panel. There are three ways in which a self-test is initiated. And, if an error is detected, there are up to 25 error codes that may be displayed on the front panel. The three ways in which a self test is initiated are described in Table 3-2; the error codes are described in Table 3-3.

Table 3-2. Three Ways in Which Self-Test is Initiated

How Self Test Is Initiated	Indication If Self Test Passes	Indication If Self Test Fails
1. Pressing POWER pushbutton to ON.		An error code number between 00 and 24 is displayed above the F2-ΔF-M2 group of pushbuttons (Table 3-3).
2. Pressing SELF TEST.	a. All front panel indicators and LED displays are tested. (Indicators and displays light and remain lit 5 seconds.) and b. 	Same as above.
3. Sending sweep generator TST command over the bus (Option 3).	a. Numeric LED readouts are blanked. b. The ASCII character "P" is sent over the bus to the controller.	a. Numeric LED readouts are blanked. b. The ASCII character "F" is sent over the bus to the controller.



(1) **Main RF OUTPUT Connector (Option 9):** Provides 50-ohm RF output. (Not available on 6642A above 26.5 GHz.)

(2) **Auxiliary RF OUTPUT Connector** (Option 10): Provides 50-ohm RF output. Output power is attenuated by ≈25 dB from the power available at the main RF OUTPUT connector.

(3) **IEEE-488 Interface Bus Connector** (Option 3): Provides input output connections to General Purpose Interface Bus (GPIB).

(4) **SEQ SYNC OUTPUT:** Provides a positive pulse during sweep retrace, and when the RF plug-in switches between different YIG oscillators (bandswitches). Signal is used to supply retrace information to the WILTRON Model 560/560A and HP Model 8410 Network Analyzers. Connects to FROM SEQ SYNC WILTRON connector on Model 560 or to Z-AXIS SELECT on Model 560A.

(5) **HORIZ OUTPUT:** Provides 0 to 10 volts during all sweep modes, and during all CW modes when CW RAMP is activated. Connects to HORIZ INPUT (HORIZONTAL INPUT on 560A) connector on Model 560 Scalar Network Analyzer.

(6) **1V/GHz OUTPUT:** Provides voltage signal equal to 1V per GHz for all models except the 6642A, 6653A, and 6659A. For these three models, the signal is 0.5V per GHz. Signal may be used as an approximate frequency reference and also for tuning the HP 8410B Network Analyzer.

(7) **BANDSWITCH BLANKING (+, -):** Switches BANDSWITCH BLANKING signal either plus or minus.

(8) **BANDSWITCH BLANKING:** Provides + or -5V pulse, depending on BANDSWITCH BLANKING switch, during RF oscillator bandswitching. ±5V pulse may be used to blank sweep generator bandswitch points on oscilloscope display.

Figure 3-20. Rear Panel Controls and Connectors

(9) **SWEEP TRIGGER INPUT:** Provides for external sweep triggering when TRIGGER-EXT OR SINGLE pushbutton is engaged. Trigger occurs on closure-to-ground. To provide for proper triggering, the input pulse should be a clock pulse with the following characteristics:

Amplitude: 4 to 25 Vpk	Fall Time: <5μs
Pulse Width: >1μs	Polarity: Low true

(10) **SWEEP DWELL INPUT:** Allows a pulse from the HP 8410 Network Analyzer to cause the sweep generator sweep to dwell during 8410 sweep retrace.

(11) **EXT AM INPUT:** Provides for applying amplitude modulation to the RF output signal. The frequency of the modulating signal can go from dc to 50 kHz. Input impedance is 10 kilohms.

(12) **EXT SQ WAVE INPUT:** Provides for applying square-wave modulation to the RF output signal. The input square wave can have a frequency of up to 50 kHz and an amplitude of ±10 volts. Input impedance is TTL compatible. (Not available on 6642A.)

(13) **Voltage Selector Module:** Allows 100, 115-120, 220, or 230-240 Vac line voltage values to be used with sweep generator. Refer to paragraph 2-3 for setup instructions.

(14) **EXT SWEEP:** Allows an external 0 to 10 volt ramp to be used to sweep the output frequency. To use this input, the EXT SWEEP pushbutton must be activated.

(15) **EXT FM Ø LOCK INPUT:** Provides for applying frequency modulation and phase-lock control (paragraph 3-2.2d) to the RF output signal.

(16) **PENLIFT OUTPUT:** Provides isolated, normally-open relay contacts for lifting recorder pen during sweep retrace. Can be modified internally for normally-closed relay contact operation.

(17) **RETRACE BLANKING OUTPUT (-):** Provides -5V pulse during sweep retrace.

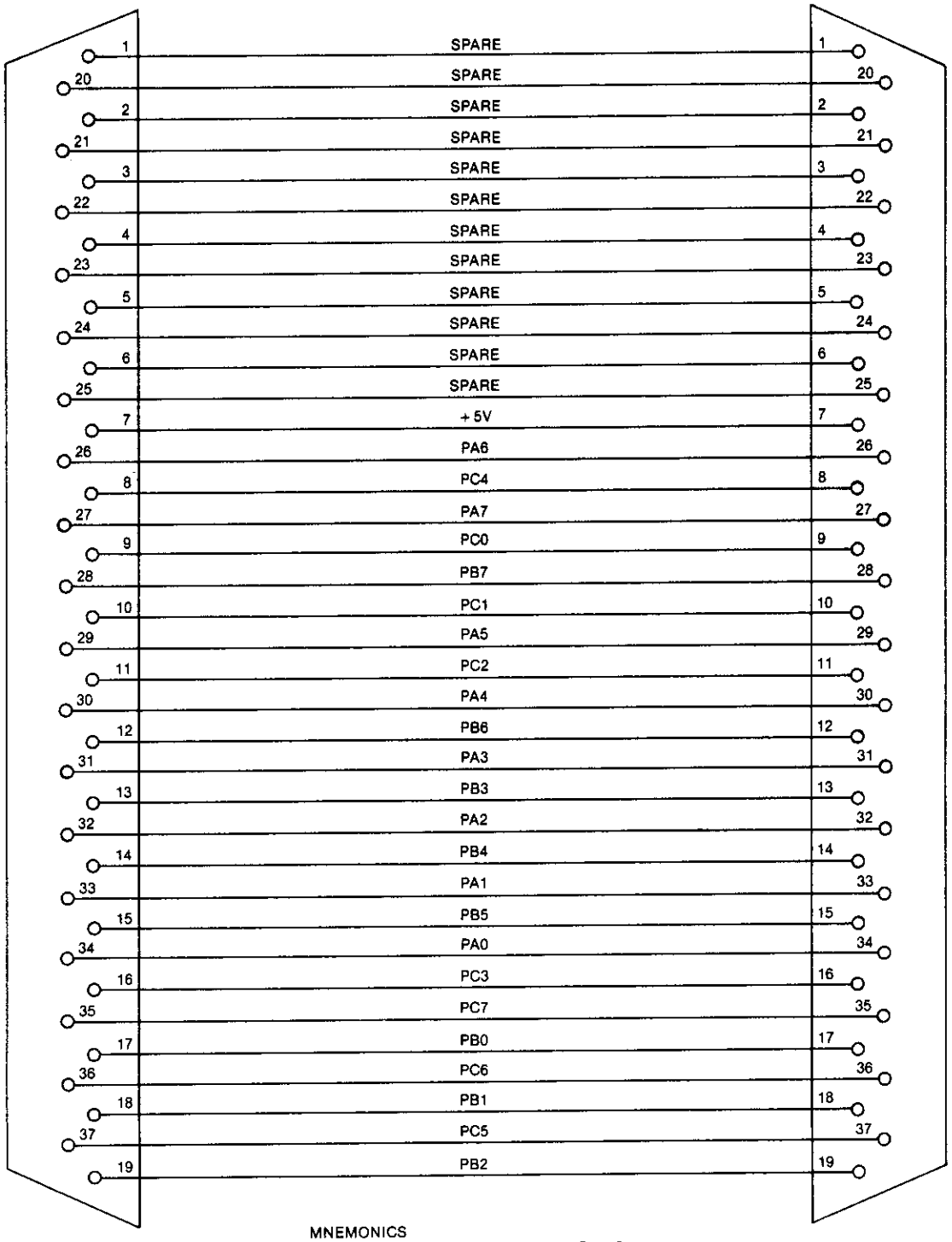
(18) **MARKER OUTPUT:** Provides video marker output when MARKERS-VIDEO pushbutton is engaged. Connects to MARKER INPUT connector on Model 560/560A Scalar Network Analyzer.

(19) **RETRACE BLANKING OUTPUT (+):** Provides +5V pulse during sweep retrace. Connects to FROM BLANKING (+) WILTRON connector on WILTRON Model 560/560A Scalar Network Analyzer.

(20) **DATA I/O** (Option 14): 37-pin connector providing interface between the Model 661 Tracking Sweeper Controller and the GPIB. Connects with DATA I/O port on 661. See Figure 3-21 for a pinout diagram.

(21) **AUX I/O:** 25-pin connector providing interface between the sweep generator and the Model 661 Tracking Sweeper Controller or Model 560A Scalar Network Analyzer. See Figure 3-22 for a pinout diagram.

Figure 3-20. Rear Panel Controls and Connectors (Continued)



MNEMONICS
PA, PB, PC refer to IC A1U1 ports A, B, & C.
Digits refer to bit numbers.

Figure 3-21. Pinout Diagram, DATA I/O Interconnect Cable

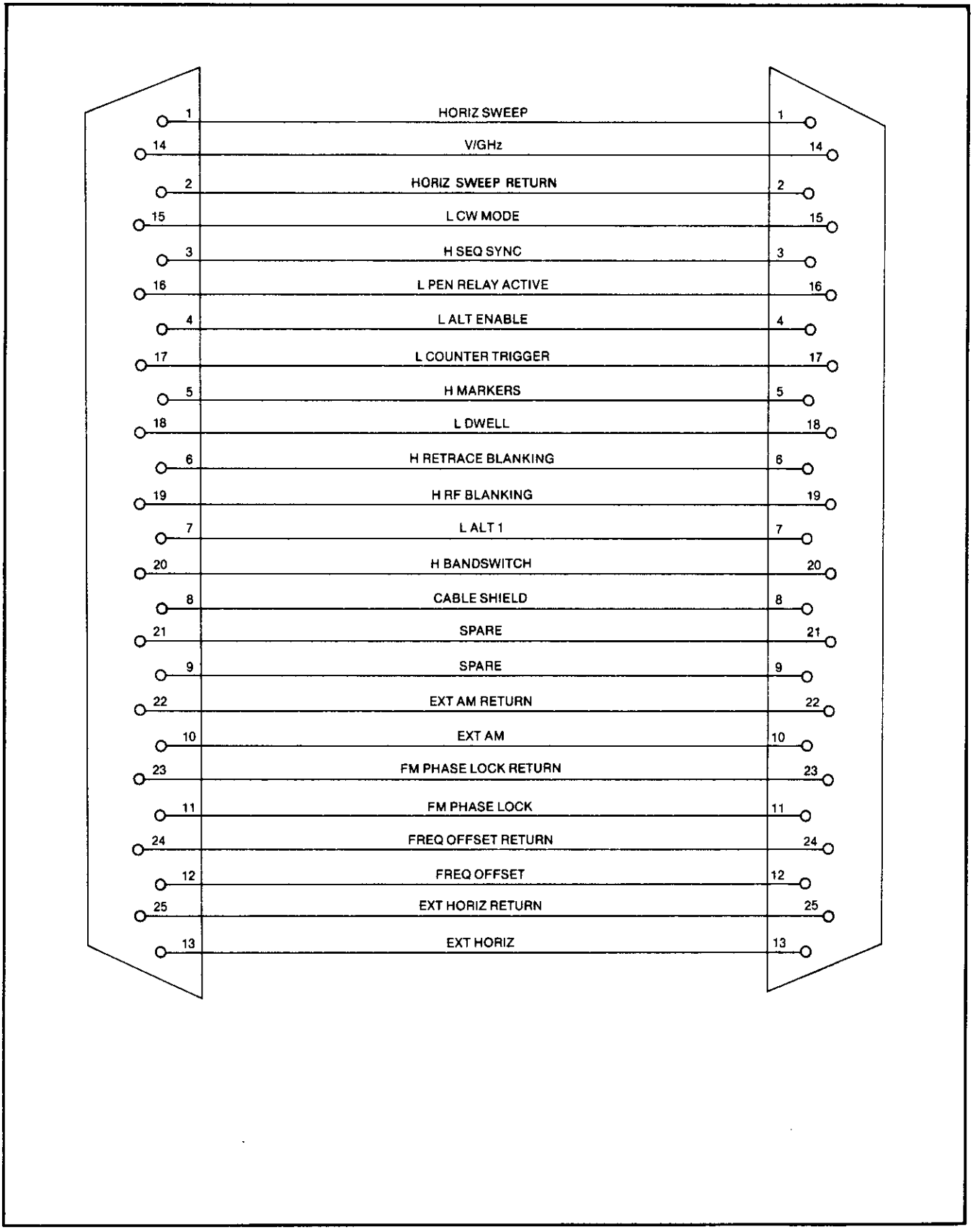
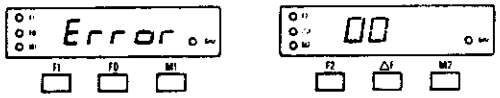
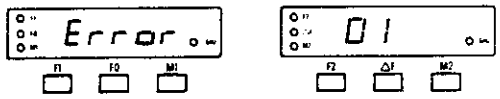
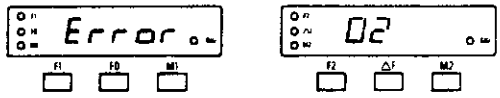
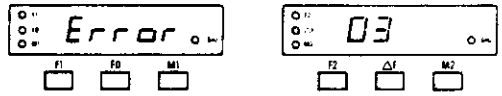
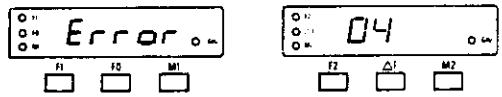
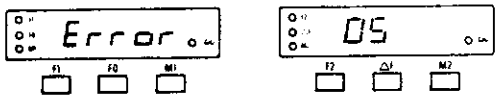
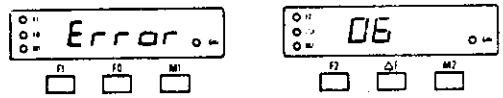
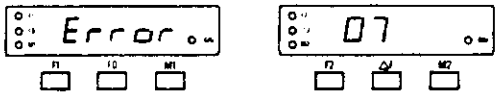
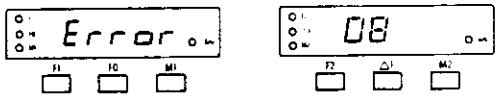
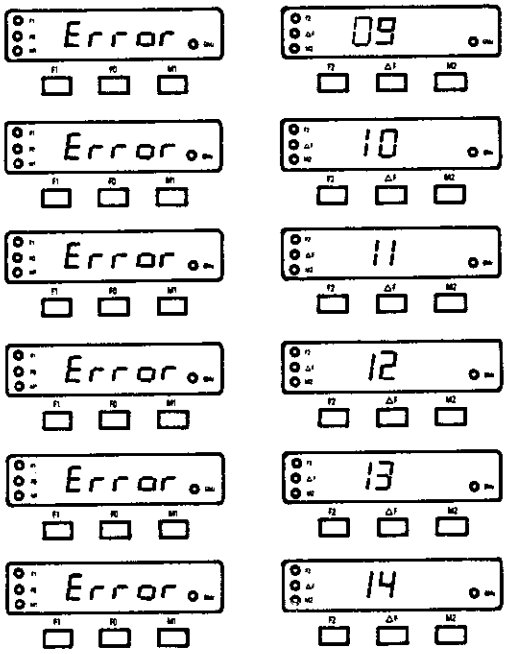
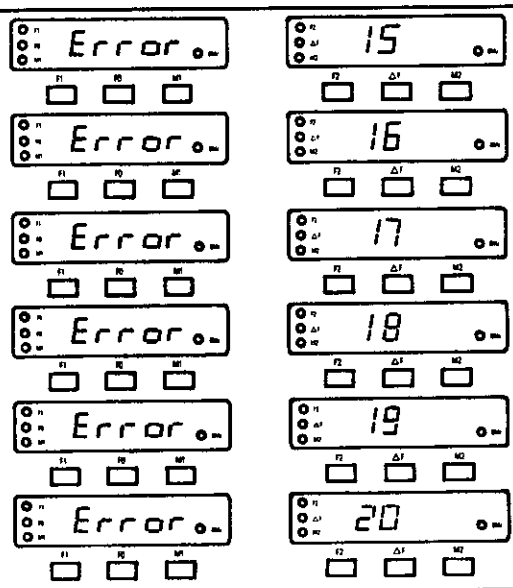
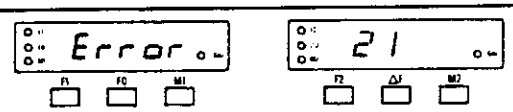
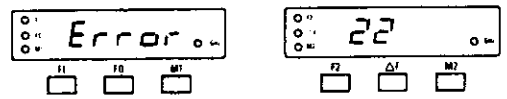
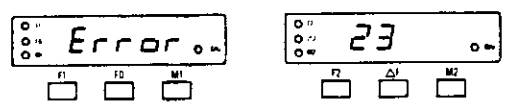


Figure 3-22. Pinout Diagram, AUX I/O Interconnect Cable

Table 3-3. Self-Test Error Codes

GENERAL: The microprocessor's self-test routines reside in software modules; each module is assigned an error-code number. When a self-test is initiated, these software modules are called up in sequential order, beginning with number 00 and ending with number 24. If an error is detected, the error-code number is displayed and the self-test continues. If multiple errors are detected, each error-code number is displayed. To abort self-test once it has begun, press the RESET pushbutton.

SWEEP GENERATOR ERROR DISPLAY	MEANING OF ERROR CODE	RECOMMENDED ACTION
	A voltage supply other than the 5V supply is out of tolerance. If the 5V supply is faulty, the sweep generator will not operate.	See Figure 7-127 for troubleshooting flow-chart.
	Line voltage too low.	See Figure 7-128 for troubleshooting flow-chart.
	Line voltage too high.	See Figure 7-129 for troubleshooting flow-chart.
	ROM U5 fails bit parity check.	Replace A12 U5.
	ROM U6 fails bit parity check.	Replace A12 U6.
	ROM U7 fails bit parity check.	Replace A12 U7.
	ROM U8 fails bit parity check.	Replace A12 U8.
	ROM U9 fails bit parity check.	Replace A12 U9.
	One or more RAMs, U11, U12, U37, U38, fail write verification test.	Replace RAMs.

SWEEP GENERATOR ERROR DISPLAY	MEANING OF ERROR CODE	RECOMMENDED ACTION
	The association of error codes, PCBs, and frequency bands is shown below: Error Code / PCB (Band) 09 A6 (Het.) 10 A6 (Osc. 1) 11 A7 (Osc. 2) 12 A8 (Osc. 3) 13 A9 (Osc. 4)	Troubleshooting flowcharts are given below: Error Code / Flowchart 09 Figure 7-85 10 Figure 7-86 11 Figure 7-87 12 Figure 7-87 13 Figure 7-87 14 Figure 7-88
	The association of error codes and frequency bands is shown below: Error Code / Freq. Band 15 Het. 16 Osc. 1 17 Osc. 2 18 Osc. 3 19 Osc. 4 20 All	See Figure 7-46 for troubleshooting flowcharts.
	Analog circuit error, detected during Ramp Generator (A2) PCB test.	See Figure 7-35 for troubleshooting flowchart.
	Analog circuit error, detected during Marker (A3) PCB test.	See Figure 7-40 for troubleshooting flowchart.
	Analog circuit error, detected during FM Attenuator (A10) PCB test.	See Figure 7-92 for troubleshooting flowchart.

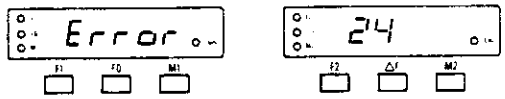
SWEEP GENERATOR ERROR DISPLAY	MEANING OF ERROR CODE	RECOMMENDED ACTION
	Only appears if Option 3 installed. Indicates error detected during GPIB Interface (A1) PCB test.	See Figure 7-28 for troubleshooting flow-chart.

Table 3-4. Recommended Test Equipment for Operational Checkout

EQUIPMENT	REQUIRED CHARACTERISTICS	RECOMMENDED MANUFACTURER	PURPOSE
Scalar Network Analyzer	Ability to display frequency response of sweep generator.	WILTRON Model 560 Scalar Network Analyzer, with 7N50 Detector or 7S50, Option 2 Detector (6642A)	Display sweep generator output during operational checkout.
Microwave Frequency Counter	.01 to 26.5 GHz frequency response with source locking capability.	EIP Model 578	Used with Table 3-6 to check the operation of the FREQUENCY VERNIER controls and phase-locking capability for all models except 6642A.
Microwave Frequency Counter	26.5 to 40 GHz frequency response with source-locking capability.	EIP Model 578/06 with 590 frequency extension kit and Option 91 Remote Sensor	Used with Table 3-6 to check the operation of the 6642A FREQUENCY VERNIER controls and phase-locking capability.
Directional Coupler	Ability to couple signals within a portion of the 10 MHz to 18 GHz frequency range.	NARDA Model 3202B-10	
RF Detector	Ability to detect signals within the 10 MHz to 18 GHz frequency range.	WILTRON Model 75N50	Used with Table 3-7 to check the operation of external leveling feature.
Power Meter	Ability to provide output signal that is (1) proportional to the measured power and (2) 1 volt for full-scale deflection.	Hewlett-Packard Model 435A with 8481 Power Sensor	
Crystal Detector	26.5 to 40 GHz frequency range	HP R422A	
Power Meter		HP 432A, with R486A Thermistor Mount	Used with Table 3-8 to check the operation of the 6642A external leveling feature.
Adapter Cable for 560	Adapt 560 input to waveguide detector.	WILTRON 560-10BX-1	
Connector Adapters (2)	Adapt between SMA-female and BNC-male connectors.	Pomona Elect. 4290	

3-5 OPERATIONAL CHECKOUT PROCEDURES

The operational checkout procedures for the sweep generator are given in paragraphs 3-5.1, 3-5.2, 3-5.3 and 3-5.4. These procedures are organized by function, so that only those functions being used need to be checked.

Table 3-4 (facing page) gives the recommended test equipment for the four operational checkout procedures (Tables 3-5, 3-6, 3-7, 3-8.)

Notice that the test equipment differs for each checkout procedure. If the recommended test equipment is not available, equipment with equivalent characteristics may be substituted.

3-5.1 Operational Checkout, Sweep Generator Confidence Test

This paragraph provides the confidence test procedure for the sweep generator. Figure 3-23 shows the test setup and Table 3-5 gives the test procedure.

Table 3-5. Sweep Generator Confidence Test (All models except 6642A)

1. Connect the equipment as shown in Figure 3-23.

2. Turn on the sweep generator and press RESET. If no error code appears on the appropriate LED readouts (Table 3-3), the sweep generator should be functioning normally.

NOTE

The digits on the LED displays will be random for the first 1/2-second after turn-on.

3. Observe the 560 CRT. A leveled trace should be located near center screen.

4. Press LEVELING INTERNAL. The 560 trace should go unleveled.

5. Press INTERNAL again. A leveled trace returns to the 560 CRT.

6. Press LEVEL and set for 0 dBm (+3 dBm, 6609A; -5 dBm, 6642A). Verify that the 560 trace "jumps" 2 divisions (10 dB), and that the trace remains level.

END OF CONFIDENCE TEST

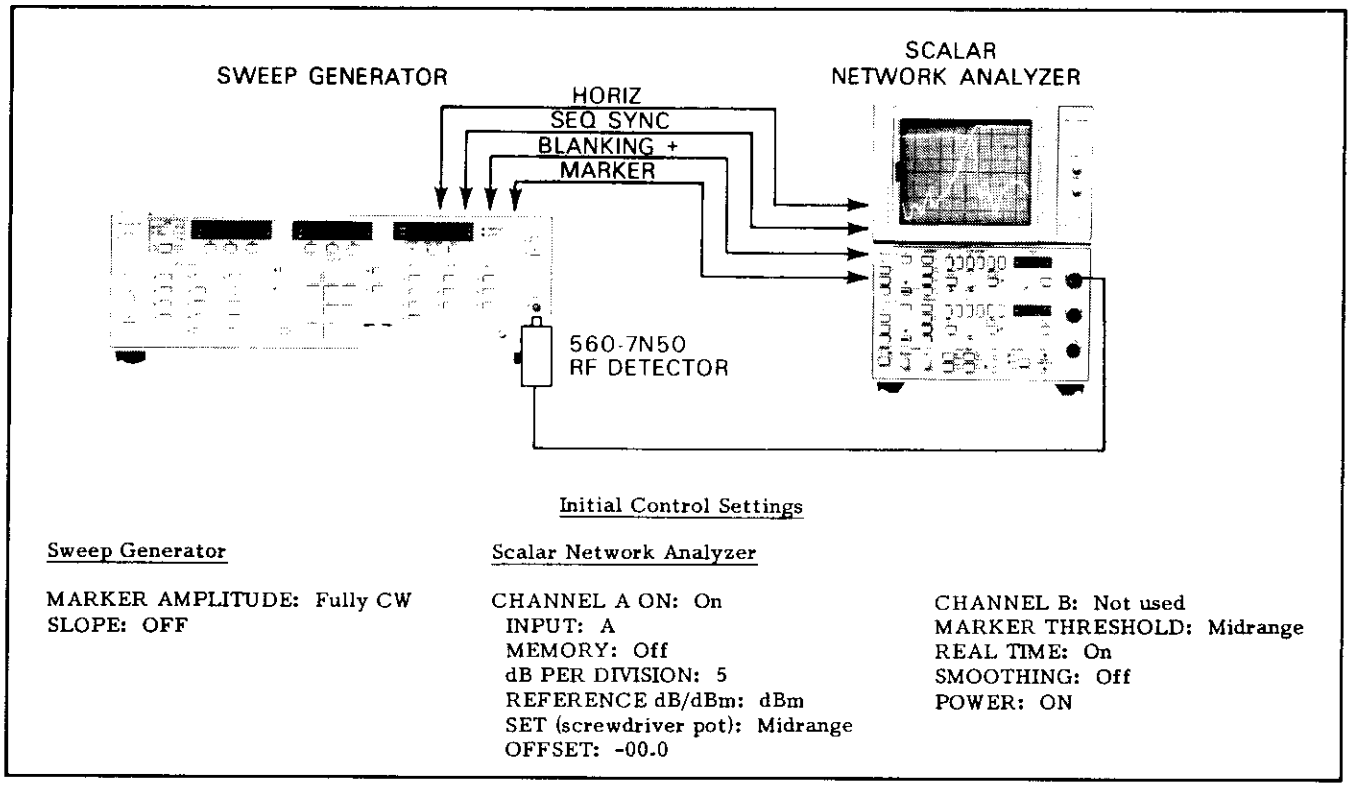


Figure 3-23. Equipment Setup for Confidence Test (except 6642A)

3-5.2 Operational Checkout Procedure, FREQUENCY VERNIER Pushbuttons and Phase-Lock Operation

The FREQUENCY VERNIER pushbuttons provide for making small changes to the output frequency in the CW F0 thru CW M2, ΔF F0, and ΔF F1 operational modes. These frequency changes do not affect the readout that appears on the respective frequency's front panel LED display.

The phase-lock operation automatically "locks" the sweep generator's output frequency to the crystal-controlled time-base of the frequency counter. When the EIP 578 Source Locking Counter is used, the phase-lock function allows the sweep generator's frequency to be accurately resolved to 100 kHz for all models except the 6642A, 6653A and 6659A. For these 3 models, resolution is ±200 kHz.

The test setup for operationally checking the FREQUENCY VERNIER controls and phase-lock operation for all models except 6642A is shown in Figure 3-24; the test setup for the 6642A is shown in Figure 3-25; the checkout procedure is given in Table 3-6.

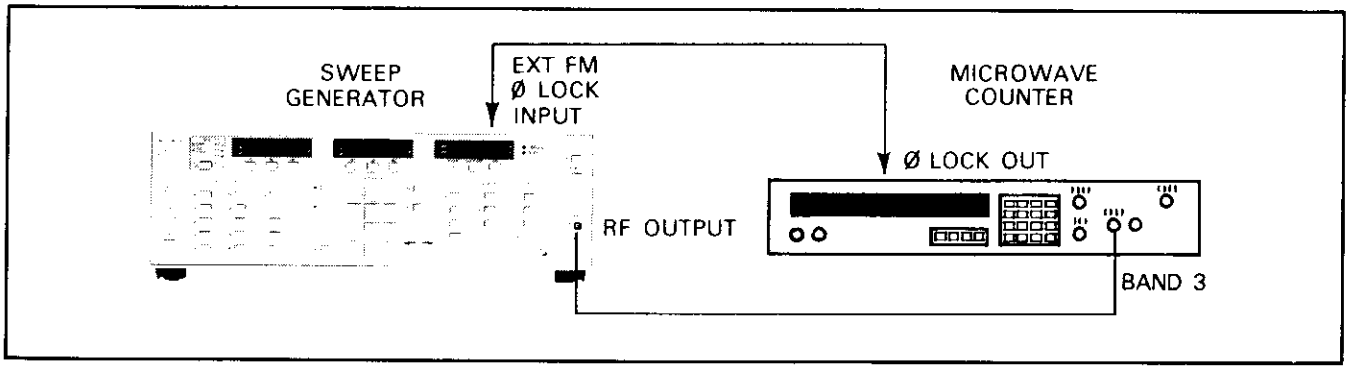


Figure 3-24. Test Setup for Operational Checkout of FREQUENCY VERNIER Controls (All models except 6642A)

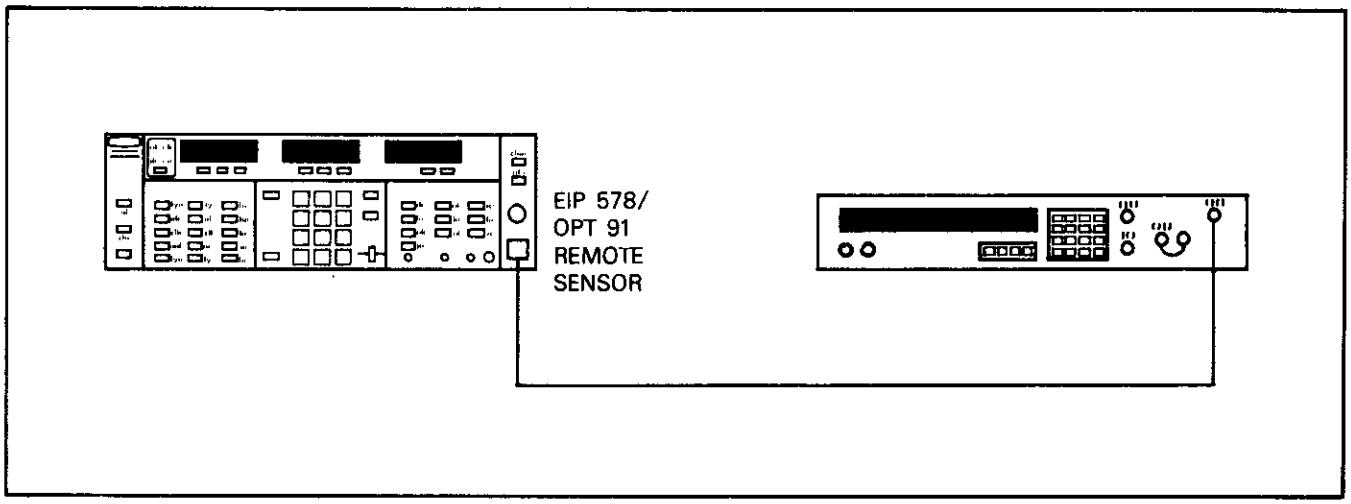


Figure 3-25. Test Equipment Setup for Operational Checkout of FREQUENCY VERNIER Controls on Model 6642A, 26.5-40 GHz Band

Table 3-6. Operational Checkout Procedure, FREQUENCY VERNIER Controls and Phase-Lock Operation (all models)

1. Connect test equipment as shown in Figure 3-24 or 3-25.
2. Turn on power to sweep generator (sweeper) and frequency counter (counter).
3. On sweeper, press LEVEL and set for 0 dBm.
4. Connect 50Ω cable between RF OUTPUT on sweeper and the appropriate BAND input on counter.

Frequency Vernier Controls Operation

5. On sweeper, press CW F0 and set for low-end frequency +50 MHz.
6. Observe counter:
   a. If frequency is below the sweeper-output frequency, press & hold FREQUENCY VERNIER INCREASE until counter frequency equals sweeper frequency.
   b. If frequency is above the sweeper-output frequency, press & hold FREQUENCY VERNIER DECREASE until counter frequency equals sweeper frequency.
7. On sweeper, press CW F2 and set for midband frequency.
8. Repeat step 6 above.
9. On sweeper, press CW M2 and set for high-end frequency -50 MHz.
10. Repeat step 6 above.

Table 3-6. Operational Checkout Procedure, FREQUENCY VERNIER Controls and Phase-Lock Operation (all models) (Continued)

11. Verify that the FREQUENCY VERNIER ACTIVE indicator is lit for each of the parameters receiving a frequency correction, as follows:
    a. Press CW F0 and verify that ACTIVE indicator is lit.
    b. Press CW F1 and verify that ACTIVE indicator is not lit.
    c. Press CW F2 and verify that ACTIVE indicator is lit.
    d. Press CW M1 and verify that ACTIVE indicator is not lit.
    e. Press CW M2 and verify that ACTIVE indicator is lit.
    f. Press ΔF F0 and verify that ACTIVE indicator is lit.
    g. Press ΔF F1 and verify that ACTIVE indicator is not lit.
12. Verify that frequency-vernier correction is canceled when the parameter to which a vernier correction was applied is changed, as follows:
    a. Press CW F0 and set for midband frequency.
    b. Verify that the FREQUENCY VERNIER ACTIVE indicator went out.

Phase-Lock Operation

13. Connect a BNC-to-BNC test cable between Ø LOCK OUT on counter and EXT FM Ø LOCK INPUT on sweeper.
14. On counter, enter a lock frequency within the sweeper's range (use keypad and enter this frequency on the auxiliary (small) display).
15. On sweeper,
    a. Press CW F1 and set for the "lock" frequency.
    b. Press FM AND PHASELOCK.
16. On counter, press LOCK.
17. Observe counter; it should indicate the lock frequency ± 1 count.

3-5.3 Operational Checkout Procedure, External Leveling Function (All Models Except 6642A)

External leveling of the RF source is provided by the front panel EXTERNAL INPUT connector and the LEVELING-DETECTOR or -POWER METER pushbutton. A test setup for external leveling is shown in Figure 3-26; the operational checkout procedure is given in Table 3-7.

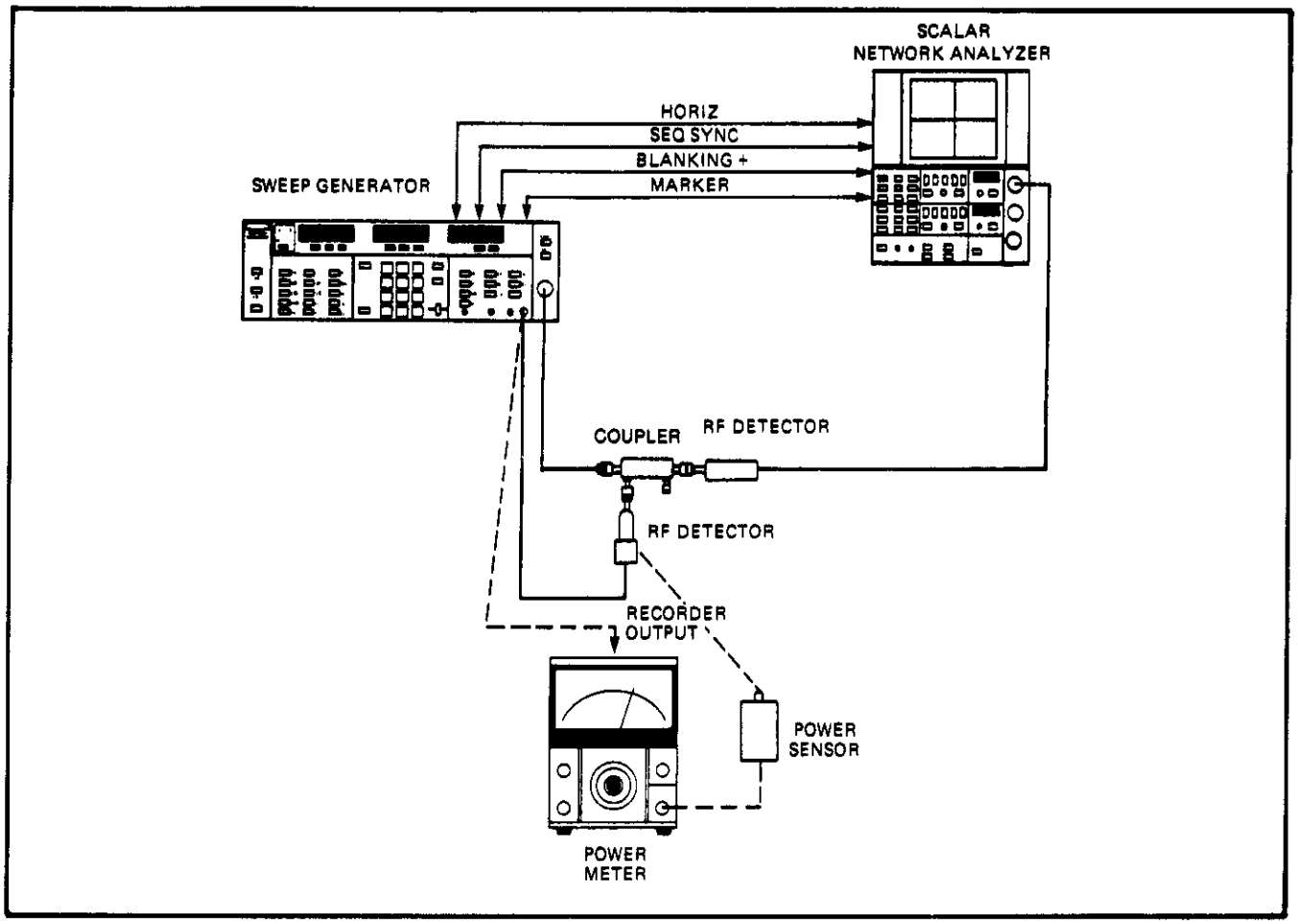


Figure 3-26. Test Setup for External Leveling (except 6642A)

Table 3-7. Operational Checkout Procedure, LEVELING-DETECTOR and -POWER METER Controls (except 6642A)

1. Connect test equipment for detector leveling, as shown by the solid lines in Figure 3-26.
2. Turn on power on sweep generator (sweeper) and scalar network analyzer (network analyzer).
3. On sweeper,
   a. Press FREQUENCY RANGE – F1-F2.
   b. Set F1 and F2 parameters for a sweep range compatible with the directional coupler being used. For example:
      - Push F1 and set for 1 GHz.
      - Push F2 and set for 12.4 GHz.

      The above two settings are compatible with the NARDA 3202B-10.
   c. Press LEVEL and set for 0 dBm.

Table 3-7. Operational Checkout Procedure, LEVELING-DETECTOR and -POWER METER Controls (Continued)

d. Press SWEEP TIME and set for 50 ms.

e. Press TRIGGER – AUTO.

f. Press LEVELING – INTERNAL.

4. On network analyzer,

a. Position front panel controls as follows:

CHANNEL A ON: On
INPUT: A
MEMORY: Off
REFERENCE dB/dBm: dBm
OFFSET: 00.0
dB PER DIVISION: 1

b. Press Channel A REF POS LOCATE and adjust SET control to position trace on center graticule line.

c. Release REF POS LOCATE and observe that a leveled trace slightly below the 0 dBm reference line appears on the CRT.

5. On sweeper,

a. Press LEVELING – DETECTOR.

b. Push in on EXTERNAL ALC GAIN control and turn until CAL indicator comes on and stays on.

c. Release EXTERNAL ALC GAIN.

6. Observe that a leveled trace is present on CRT.

7. Observe that the UNLEVELED indicator on the sweeper is not lit.

8. On sweeper, press LEVELING – DETECTOR to off. Observe that the CRT trace becomes unleveled and the sweeper UNLEVELED indicator lights.

9. Disconnect the RF detector from between the sweeper and the directional coupler; in its place, connect the power meter as shown by the dashed lines in Figure 3-24.

10. On sweeper,

a. Press CW F1.

b. Press LEVELING – POWER METER.

c. Push in on EXTERNAL ALC GAIN control and turn until CAL indicator comes on and stays on.

Table 3-7. Operational Checkout Procedure, LEVELING-DETECTOR and -POWER METER Controls (except 6642A) (Continued)

d. Release EXTERNAL ALC GAIN.

NOTE

The response to a changing power level is slow using a power meter; consequently, external leveling should be accomplished using either CW or a slow (99 s) sweep speed.

3-5.4 Operational Checkout Procedure, External Leveling Function (6642A)

External leveling of the RF source is provided by the front panel EXTERNAL INPUT connector and the LEVELING -DETECTOR or -POWER METER pushbutton. In this model, which uses two RF output connectors, external leveling (1) must be used with the 26.5-40 GHz band – which does not contain an internal leveling capability – and (2) can only be used with one band at a time. That is, both the 18-26.5 and 26.5-40 GHz bands cannot be externally leveled at the same time. A test equipment setup for externally leveling the 26.5-40 GHz band is shown in Figure 3-27; the procedure for leveling the 26.5-40 GHz band is given in Table 3-8.

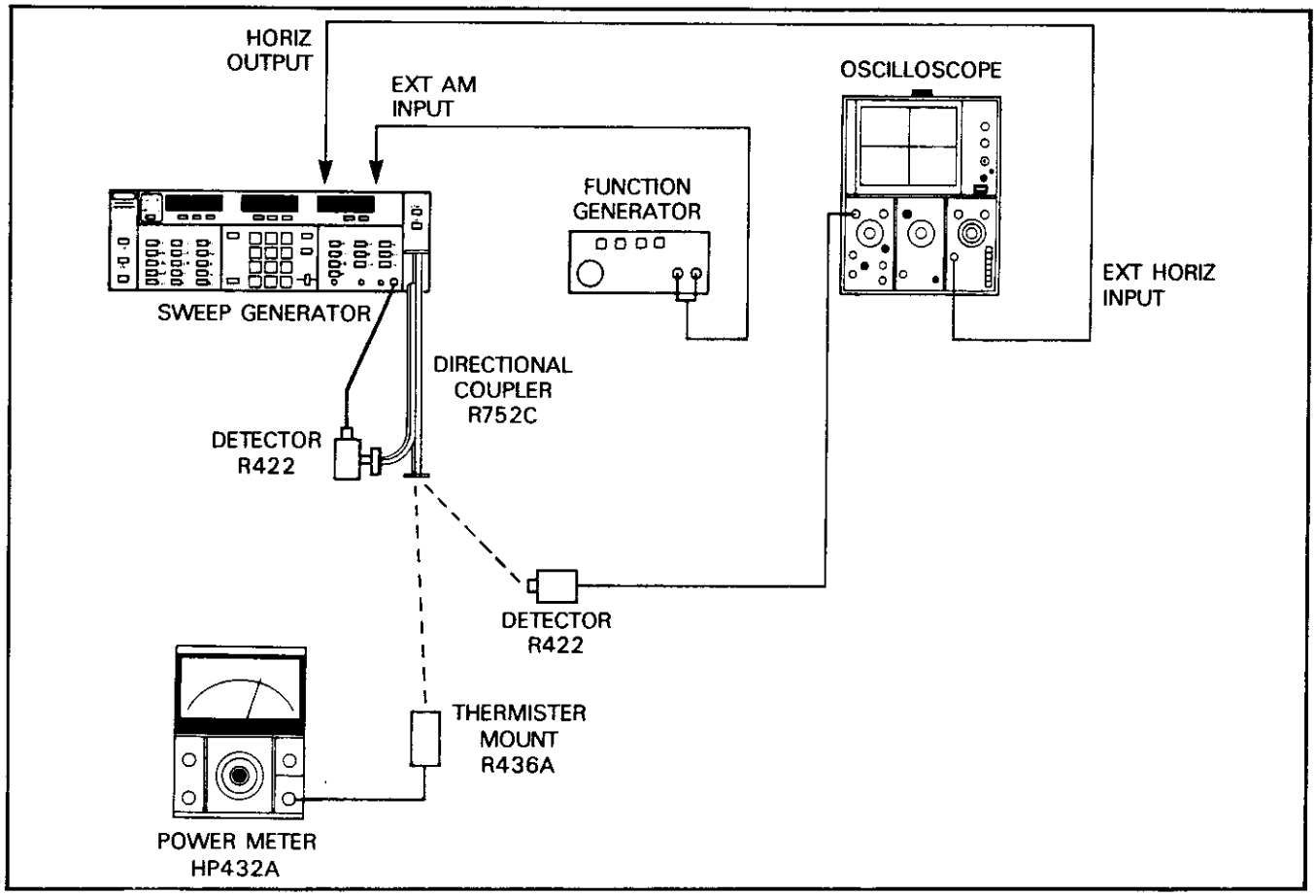


Figure 3-27. External Leveling Test Setup (6642A)

Table 3-8. Operational Checkout Procedure, LEVELING-DETECTOR and -POWER METER Controls (6642A)

1. Connect test equipment for detector leveling, as shown in Figure 3-27. Turn the equipment on.

2. Adjust function generator for a 10 kHz, 0-300 mV square-wave output.

3. On sweeper,

   a. Adjust RF SLOPE fully counterclockwise to OFF.

   b. Press RESET.

   c. Press CW F1.

   d. Press LEVELING – DETECTOR.

4. On oscilloscope, adjust vertical and horizontal controls to obtain a square wave.

5. On sweeper, adjust EXTERNAL ALC GAIN for best square-wave response.

6. Remove the oscilloscope from the directional coupler, and connect the power meter's thermistor mount in its place.

7. On sweeper,

   a. Adjust EXTERNAL ALC GAIN for a 0 dBm reading on power meter.

   b. Press CW F2.

   c. Readjust EXTERNAL ALC GAIN (if necessary) for 0 dBm power meter reading.

   d. Press CW F1.

   e. Repeat steps a. thru d. as necessary to obtain 0 dBm at both 27 and 40 GHz.

   f. Press LEVEL and set for -10 dBm.

9. Observe that power meter indicates -10 dBm. If not, refer to paragraph 5-11.2 for adjustment instructions.

10. Disconnect the power meter, and connect the waveguide to the device-under-test.

11. The sweeper is now ready for making 0 to -10 dBm leveled power measurements.

3-6 DESCRIPTION OF THE IEEE-488 (IEC-625) INTERFACE BUS

The IEEE-488 bus (General Purpose Interface Bus – GPIB) is an instrumentation interface for integrating instruments, calculators, and computers into systems. The bus uses 16 signal lines to effect transfer of data and commands to as many as 15 instruments. The instruments on the bus are connected in parallel, as shown in Figure 3-28. Eight of the signal lines (DIO 1 thru DIO 8) are used for the transfer of data and other messages in a byte-serial, bit-parallel form. The remaining eight lines are used for communications timing (handshake), control, and status information. Data is transmitted on the eight GPIB data lines as a series of eight-bit characters, referred to as bytes. Normally, a seven-bit ASCII (American Standard Code for

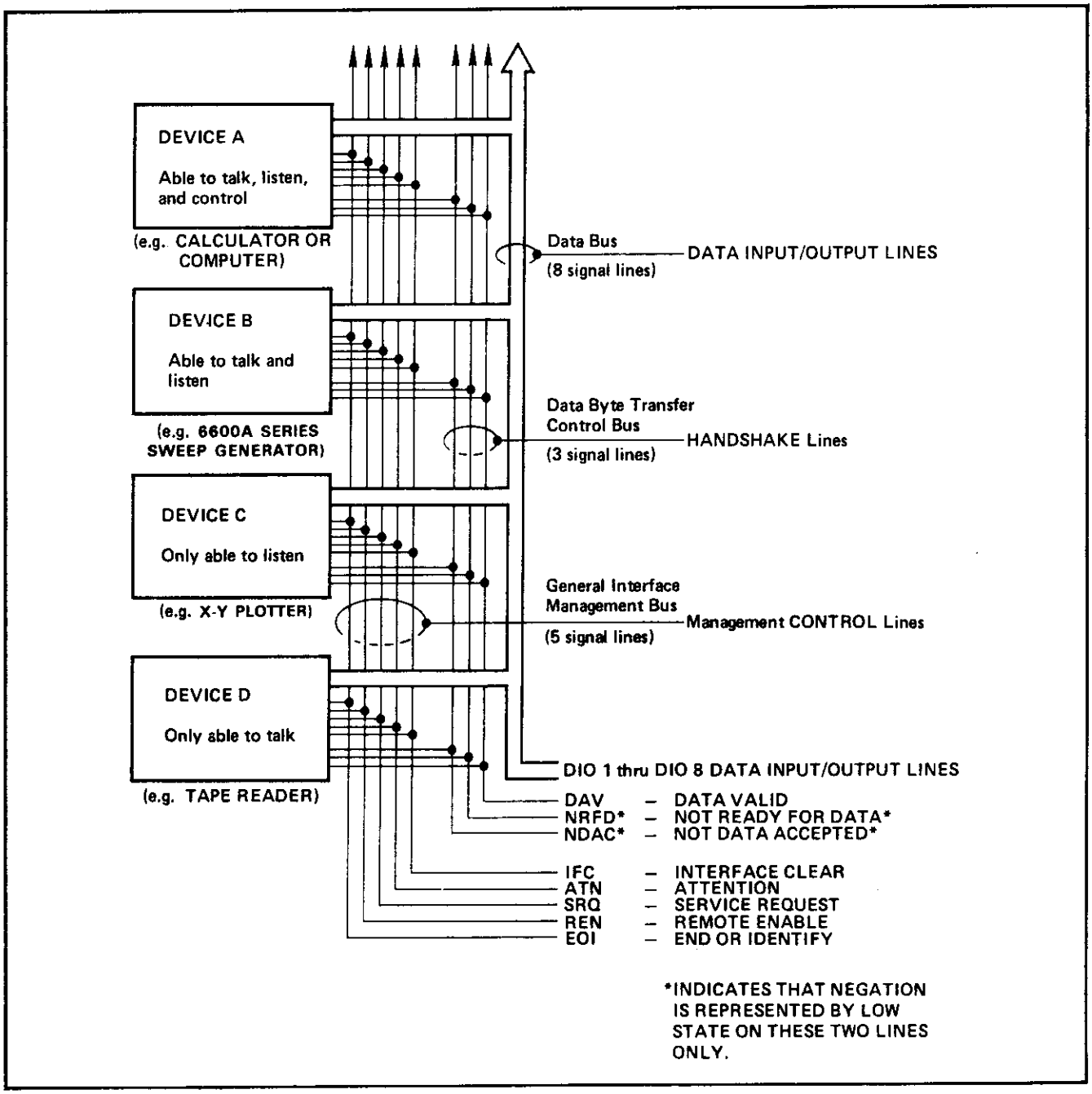


Figure 3-28. Interface Connections and Bus Structure

Information Interchange) code is used. The eighth (parity) bit is not used. Data is transferred by means of an interlocked handshake technique. This technique permits asynchronous communications over a wide range of data rates. The following paragraphs provide an overview of the data, management, and handshake buses, and describe how these buses interface with the sweep generator.

3-6.1 Data Bus Description

The data bus contains eight bi-directional, active-low signal lines – DIO 1 thru DIO 8. One byte of information (eight bits) is transferred over the bus at a time. DIO 1 represents the least-significant bit (LSB) in the byte; DIO 8 represents the most-significant bit (MSB) in the byte. Each byte represents a peripheral address (either primary or secondary), a control word, or a data byte. Data bytes are usually formatted in ASCII code, without parity. The data bus provides the conduit for transmitting control information and data between the controller and the instrument (sweep generator).

3-6.2 Management Bus Description

The management bus is a group of five signal lines that are used to control the operation of the bus system. Functional information regarding the individual management-bus control lines is provided below.

a. ATN (attention). When this line is TRUE, the sweep generator will respond to appropriate interface messages (e.g. device clear and serial poll) and to its own listen/talk address.

b. EOI (end or identify). This line is set TRUE during the last byte of a multi-byte message. This line is also used in conjunction with ATN to indicate a parallel-poll.

c. IFC (interface clear). When this line is TRUE, the sweep generator interface functions are placed in a known state, i.e., unaddressed to talk, unaddressed to listen, and service request idle.

d. REN (remote enable). When this line is TRUE, the sweep generator is enabled for entrance into the remote state (i.e., certain front panel functions disabled) upon receipt of its listen address. The remote state is exited when either (1) the REN line is FALSE (high), (2) the go-to-local (GTL) message is received, or (3) the sweep generator programming command RL (return to local) is received.

e. SRQ (service request). This line is pulled LOW (true) by the sweep generator to indicate that certain conditions (paragraph 3-7.4) exist.

3-6.3 Data Byte Transfer Control (Handshake) Bus Description

Information is transferred on the data lines under control of a technique called the three-wire handshake. The three handshake bus signal lines are described below; Figure 3-29 shows a typical interlocking handshake operation.

a. DAV (data valid). This line is set TRUE (arrow 1) when the talker has (1) sensed that NRFD is FALSE, (2) placed a byte of data on the bus, and (3) waited an appropriate length of time for the data to settle.

b. NRFD (not ready for data). This line is set TRUE (arrow 2) by a listener to indicate that valid data has not yet been accepted. The time between the events shown by arrows 1 and 2 is variable, and depends upon the speed with which a listener can accept the information.

c. NDAC (not data accepted). This line is set FALSE by a listener when the listener has accepted the current data byte for internal processing. When the data byte has been accepted, the listener releases its hold on NDAC and allows the line to go FALSE. However, because the GPIB is constructed in a wired-OR configuration, this line will not go FALSE until all listeners participating in the interchange have also released the line. As shown by the arrow labeled 3, when the NDAC line

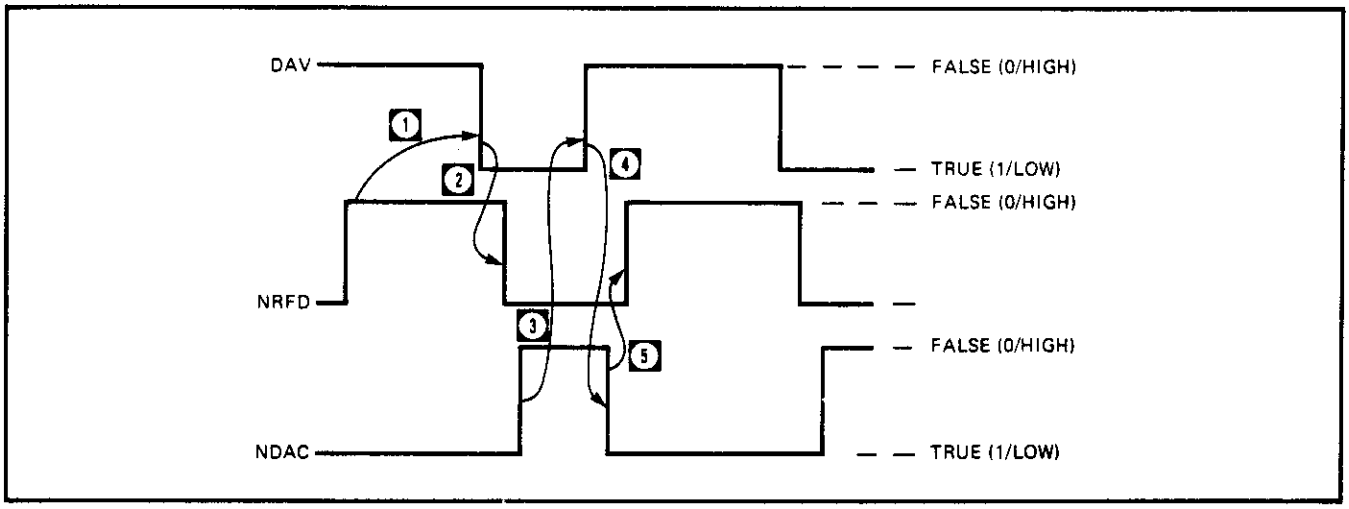


Figure 3-29. Typical Handshake Operation

goes FALSE the DAV line follows suit a short time later. The FALSE state of the DAV line indicates to the bus that valid data has been removed; consequently, with valid data no longer on the line, the NDAC line is pulled LOW again in preparation for the next data interchange. This action is shown by the arrow labeled 4.

The next action that occurs is shown by arrow 5. This arrow shows NRFD going FALSE after NDAC returns to its TRUE state. The FALSE state of NRFD indiciates to the bus that all listeners are ready for the next information interchange. The time period between these last two events (NDAC going TRUE and NRFD going FALSE) is variable and is dependent upon the length of time that it takes a listener to process the data byte. Therefore, the result of the wired-OR construction of the handshake bus is that a talker is forced to wait for the slowest instrument to accept the current data before it can place a new byte of information on the bus.

3-7 GPIB OPERATION (Option 3)

The sweep generator, when equipped with Option 3, has the capability for complete front-panel-control operation over the GPIB. When used on the GPIB, the sweep generator functions as both a listener and a talker; Figure 3-30 provides a listing showing the GPIB subset functions and gives the sweep generator's capability for each function.

To provide bus control, a system of device-dependent commands (hereafter known as bus commands) and IEEE-488 Bus Messages (hereafter known as bus messages) is used. The bus commands (approximately 100 in number) are divided into the following six classes:

1. Front Panel Control Related Commands.
2. Digital Sweep Commands.
3. Group Execute Trigger Mode Commands.
4. Service Request Mode Commands.
5. Output Commands.
6. Miscellaneous Commands.

These six classes of commands are described in paragraphs 3-7.1 thru 3-7.6, respectively. The bus messages recognized by the sweep generator are discussed in paragraph 3-7.7. In addition to bus commands and bus messages, the two types of errors that can occur with bus programming are discussed in paragraph 3-7.8. The sweep generator's default-from-reset-or-turn-on states are described in paragraph 3-7.9. A description of information supplied to provide quick reference data for GPIB programmers is given in paragraph 3-7.10. And an alphabetical index to bus command mnemonics is provided in paragraph 3-7.11.

GPIB SUBSET	FUNCTION	DESCRIPTION
AH1	Acceptor Handshake	Complete Capability
SH1	Source Handshake	Complete Capability
T6	Talker	1. Basic Talker 2. Serial Poll 3. Unaddressed if MLA 4. No Talk Only (TON)
TEØ	Talker With Address Extension	No Capability
L4	Listener	1. Basic Listener 2. Unaddressed if MTA 3. No Listen Only (LON)
LEØ	Listener With Address Extension	No Capability
SR1	Service Request	Complete Capability
RL1	Remote/Local	Complete Capability
PP1	Parallel Poll	Complete Capability
DC1	Device Clear	Complete Capability
DT1	Device Trigger	Complete Capability
CØ	Controller	No Capability

Figure 3-30. 6600A Series Sweep Generator IEEE-488 Interface Bus Subset Capability

3-7.1 GPIB Commands: Front Panel Controls

The GPIB commands used to activate front-panel-control functions are listed in Table 3-9. Programming examples that demonstrate the use of these commands are shown in Figure 3-31.

Table 3-9. 6600A Series Sweep Generator Front-Panel-Control-Related Commands

FRONT PANEL CONTROL	BUS COMMAND	NOTES
A. DATA ENTRY		
1. Parameter Entry Controls		Select the sweep generator parameter and enter the parameter's value. The decimal digits (Xs) in these commands are the parameter's value in either GHz or MHz, seconds or milliseconds, dBm or dB (see below). This value is written in the same manner that it is entered from the keyboard, i.e., either an integer or decimal number (e.g. 2 or 2.21) followed by a suitable terminator (paragraph 3-2.1). The number is not limited to two or four digits; it can be any number of digits, so long as it does not exceed the limits of the instrument.
F0	FØXXXXGH (or MH)	
F1	F1XXXXGH (or MH)	
F2	F2XXXXGH (or MH)	
M1	M1XXXXGH (or MH)	
M2	M2XXXXGH (or MH)	
ΔF	DLFXXXXGH (or MH)	
SWEEP TIME	SWTXXSEC (or MS)	
RF LEVEL	LVLXXDM (or DB)	
2. Data Terminators		Select parameter terminator (paragraph 3-2.1).
GHz	GH	
MHz	MH	
Seconds	SEC	
Milliseconds	MS	
dB	DB	
dBm	DM	
3. SHIFT	SH	Enables shifted functions (paragraph 3-2.1f) to be selected using their unshifted command codes. Example: To select an F1-F2/M1-M2 alternating sweep, program "SH FF MM".
4. CLEAR ENTRY	CLR	Clears invalid (or illegal) parameter entries (paragraph 3-2.1e).
B. FREQUENCY RANGE		
1. Sweep Range Controls		Select sweep range (paragraph 3-2.2a).
FULL	FUL	
F1-F2	FF	
M1-M2	MM	
ΔF F0	DFØ	
ΔF F1	DF1	

Table 3-9. 6600A Series Sweep Generator Front-Panel-Control-Related Commands (Continued)

FRONT PANEL CONTROL	BUS COMMAND	NOTES
2. CW Frequency Select Controls		Select sweep range (paragraph 3-2.2b).
CW F0	CFØ	
CW F1	CF1	
CW F2	CF2	
CW M1	CM1	
CW M2	CM2	
3. Frequency Vernier Controls		Provide a vernier correction for the selected frequency parameter. Correction is specified in hundreds of kilohertz (paragraph 3-2.2c).
INCREASE	FVSXXXE	
DECREASE	FVS-XXXE	
OFF	FVØ	Cancels the vernier correction (paragraph 3-2.2c).
C. TRIGGER Controls		Select trigger mode (paragraph 3-2.3).
AUTO	AUT	Selects AUTO sweep.
LINE	LIN	Selects LINE sweep.
EXT OR	EXT	Selects external sweep.
SINGLE	TRS	Triggers single sweep.
MANUAL SWEEP	MAN	Selects manual frequency tuning. NOTE When MAN command is used, sweep tuning is accomplished using front panel controls.
D. MARKERS Controls		Turn on the selected marker (paragraph 3-2.4).
VIDEO	VM1	
RF	RM1	
INTENSITY	IM1	
All Markers Off	MKØ	Turns all markers off.

Table 3-9. 6600A Series Sweep Generator Front-Panel-Control-Related Commands (Continued)

FRONT PANEL CONTROL	BUS COMMAND	NOTES
E. LEVELING Controls		Select the leveling source (paragraph 3-2.5).
INTERNAL	IL1	
DETECTOR	DL1	
POWER METER	PL1	
No Leveling	LVØ	Turns leveling off.
F. RF Output Controls		
RF OFF	RFØ	Turns RF off.
RF ON	RF1	Turns RF on.
RETRACE RF Off	RTØ	Turns RF off during retrace.
RETRACE RF On	RT1	Turns RF on during retrace (paragraph 3-2.6).
G. POWER	None	AC power cannot be turned off and on over the interface bus.
H. SELF TEST	TST	Initiates a self-test (paragraph 3-4).
I. RESET	RST	Resets all parameters and controls to a predetermined (initialized) state (paragraph 3-2.7). NOTE The RST command causes the sweep generator's GPIB interface to become unaddressed. Therefore, RST should be used alone.
J. FM OR PHASELOCK		Allows external frequency modulation or phase-lock control to be applied to the sweep generator (paragraph 3-2.2d).
Off	FMØ	
On	FM1	

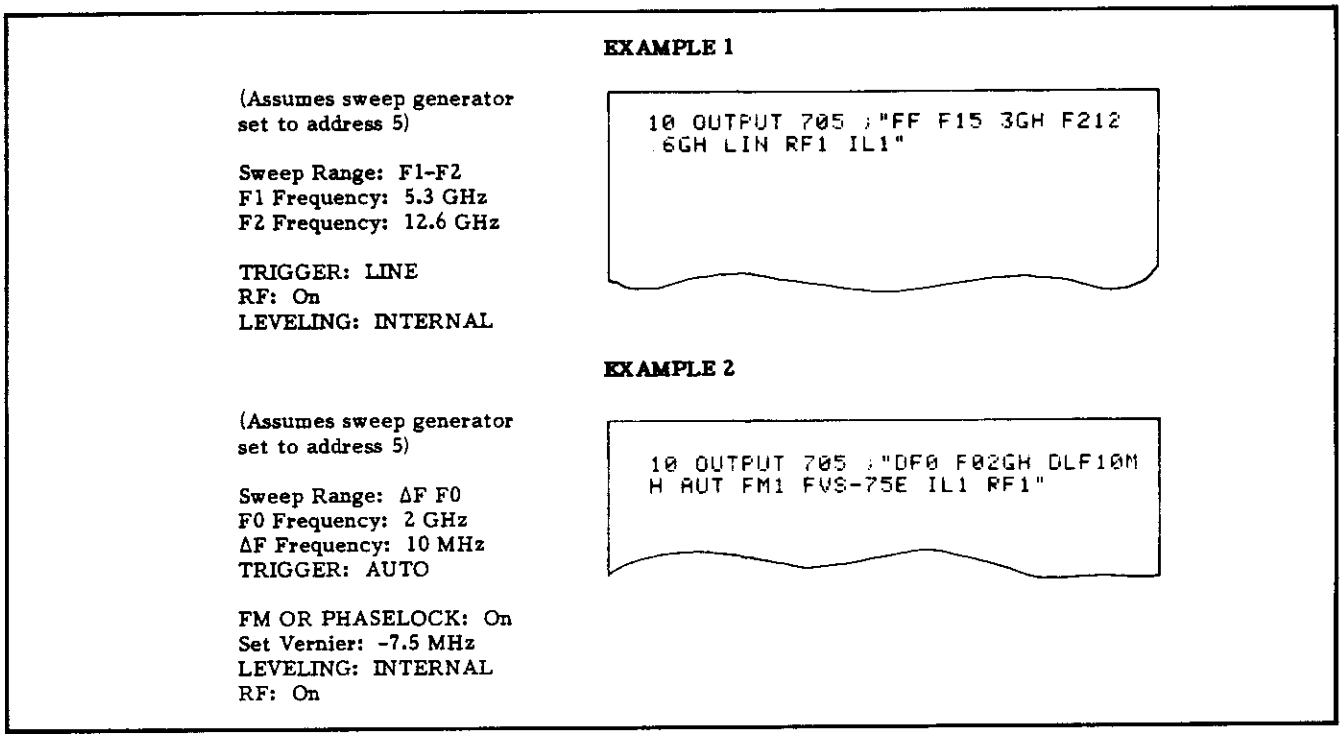


Figure 3-31. GPIB Front Panel Programming Examples

3-7.2 GPIB Commands: Step Sweep

To provide a high-resolution sweep over a narrow band of frequencies, the sweep generator is equipped with a digitally stepped sweep (step sweep). This sweep, which contains 4096 discrete points, can be incrementally stepped so that any number (or all) of the discrete points can be used. The width of the step sweep and the frequency start and stop points (or center frequency for a ΔF sweep) are selected using front-panel-control command statements. (Example: FF F1XXXXGH F2XXXXGH, DFØ FØXXXXGH, DLFXXXXMH, or MM M1XXXXMH M2XXXXMH.) Because the step sweep is a frequency sweep, the following apply:

a. The front panel LED displays remain unchanged as the sweep progresses from start to stop.

b. The frequencies corresponding to the step sweep's intermediate steps must be calculated. The formula for calculating step sweep frequencies is given in Appendix 2.

The step sweep commands are given in Table 3-10.

Table 3-10. 6600A Series Sweep Generator Digital Sweep Commands

NAME	COMMAND	FUNCTION
Step Sweep	STP	Selects the Step Sweep mode of operation.
Step Select	STSXXXXE	Selects the increment point at which the Step Sweep starts. This sweep start can be any point from 0 to 4095. Zero is the usual starting point, in which case STSØE (or STSE) is the command to use.

Table 3-10. 6600A Series Sweep Generator Digital Sweep Commands (Continued)

NAME	COMMAND	FUNCTION
Increment Size	SIZXXXXE	Selects the number of steps by which the Step Sweep is to be incremented when an "N" command (see below) is received. Also, selects the number of steps in which an "UP" or "DN" command (Table 3-14) will increment the selected parameter (paragraph 3-2.1a). The Xs in this command represent digits. A maximum of 4 and a minimum of 0 digits may be used. The number that is formed by the digits must be an integer. If a fractional number is used, any digits that appear to the right of the decimal point are ignored. (Example: SIZ146E and SIZ146.5E are equivalent commands.)
Go to Next Step	N	Increments the Step Sweep by the number of steps programmed with the Increment Size Command. The following is an example of the syntax required to implement a step sweep that starts at 0 volts, has an increment size of 819 steps, and takes data at 5 discrete frequency points: 1Ø OUTPUT 7Ø5;* "STP STSE SIZ819E" 2Ø FOR I = Ø TO 4 3Ø • 4Ø • Input Statements, etc. 5Ø • 6Ø OUTPUT 7Ø5; "N" 7Ø NEXT I *Assumes sweep generator address is 5.

3-7.3 GPIB Commands: Group Execute Trigger Modes

To speed up bus operations, the Group Execute Trigger (GET) bus message can be used to increment or decrement frequency, sweep time, or output-power level. The GET bus message can also be used to increment or decrement the step sweep. The bus commands that configure the sweep generator for this increase/decrease response to a GET bus message are listed in Table 3-11.

Table 3-11. 6600A Series Sweep Generator Group Execute Trigger (GET) Mode Commands

NAME	COMMAND	FUNCTION
Trigger Single Sweep	GTS	Configures the sweep generator to execute a single sweep each time a GET bus message is received. This is the default mode, i.e., the mode assumed when no GET Mode command is programmed.
Increment-Selected Parameter	GTU	Configures the sweep generator to execute an "UP" command (Table 3-14) each time a GET bus message is received.
Decrement-Selected Parameter	GTD	Configures the sweep generator to execute a "DN" command (Table 3-14) each time a GET bus message is received.
Go to Next Step	GTN	Configures the sweep generator to execute an "N" command (Table 3-10) each time a GET bus message is received.

3-7.4 GPIB Commands: Service Request Modes

To notify the controller that certain conditions exist (such as end-of-sweep, marker encountered, unleveled, and error entry), the sweep generator uses the GPIB Service Request function. To use this function, the sweep generator employs a system of Service Request mode commands; these commands are described in Table 3-12.

Table 3-12. 6600A Series Sweep Generator Service Request (SRQ) Commands

NAME	COMMAND	FUNCTION
Enable SRQ Capability	SQ1	Enables the following SRQ mode commands to request service from the controller.
Disable SRQ Capability	SQØ	Disables the SRQ function. This is the default mode, i.e., the mode assumed when neither SQ1 nor SQØ is programmed.
Dwell-at-Marker Mode: On	DW1	Activates the dwell-at-marker mode. In this mode, when an intensity marker is encountered, the frequency sweep will dwell at the marker until a Continue Sweep (CNT) command is received. When DW1 and SQ1 are

Table 3-12. 6600A Series Sweep Generator Service Request (SRQ) Commands (Continued)

NAME	COMMAND	FUNCTION
Dwell-at-Marker Mode (continued):		both programmed, the SRQ line is pulled LOW (true), and Status Byte (Figure 3-32) bits 0 and 6 are set HIGH (decimal 65). When DW1 and SQØ are both programmed, only the Status Byte is generated; the SRQ line is not activated.
Off	DWØ	Deactivates the dwell-at-marker mode. This is the default mode, i.e., the mode assumed when neither DW1 nor DWØ is programmed.
End-of-Sweep Mode:		
On	ES1	Activates the end-of-sweep mode. When ES1 and SQ1 are both programmed, the ending of the frequency sweep causes the SRQ line to be pulled LOW (true) and Status Byte bits 1 and 6 to be set HIGH (decimal 66). When ES1 and SQØ are both programmed, only the Status Byte is generated; the SRQ line is not activated.
Off	ESØ	Deactivates end-of-sweep mode. This is the default mode, i.e., the mode assumed when neither ES1 nor ESØ is programmed.
Unleveled Condition Mode:		
On	UL1	Activates the unleveled-condition mode. When UL1 and SQ1 are both programmed, an unleveled output-power condition causes the SRQ line to be pulled LOW (true) and Status Byte bits 2 and 6 to be set HIGH (decimal 68). When UL1 and SQØ are both programmed, only the Status Byte is generated; the SRQ line is not activated.
Off	ULØ	Deactivates the unleveled condition mode. This is the default mode; i.e., the mode assumed when neither ULØ nor UL1 is programmed.
Parameter-Entry Error Mode:		
On	PE1	Activates the parameter-entry error mode. When PE1 and SQ1 are both programmed, a parameter-entry error (paragraph 3-7.8) causes the SRQ line to be pulled LOW (true) and Status Byte bits 4 and 6 to be set HIGH (decimal 80). When PE1 and SQØ are both programmed, only the Status Byte is generated; the SRQ line is not activated.

Table 3-12. 6600A Series Sweep Generator Service Request (SRQ) Commands (Continued)

NAME	COMMAND	FUNCTION
Parameter-Entry Error Mode (continued):		
Off	PEØ	Deactivates the parameter-entry error mode. This is the default mode; i.e., the mode assumed when neither PEØ nor PE1 is programmed.
Syntax Error Mode:		
On	SE1	Activates the syntax error mode. When SE1 and SQ1 are both programmed, a syntax error (paragraph 3-7.8) causes the SRQ line to be pulled LOW (true) and Status Byte bits 5 and 6 to be set HIGH (decimal 96). When SE1 and SQØ are both programmed, only the Status Byte is generated; the SRQ line is not activated.
Off	SEØ	Deactivates the syntax error mode. This is the default mode, i.e., the mode assumed when neither SEØ nor SE1 is programmed.

STATUS BYTE BITS

7	6	5	4	3	2	1	0

Bits 3 and 7 are not used by the sweep generator.

Bit 6 is the request service bit. This bit is set HIGH when certain conditions, as shown below, exist.

Bits 0, 1, 2, 4, and 5 are combined with the service request bit to provide a code number that tells the controller which condition exists. The condition codes are given below.

Bit 6 & Ø set HIGH: An intensity marker was encountered.

Bit 6 & 1 set HIGH: The frequency sweep has ended.

Bit 6 & 2 set HIGH: An unleveled RF output condition has been detected.

Bit 6 & 4 set HIGH: An invalid parameter was entered.

Bit 6 & 5 set HIGH: A syntax error has been detected.

NOTE

The Status Byte is explained under "Serial Poll Operation" in Table 3-15.

Figure 3-32. Sweep Generator Status-Byte Coding

3-7.5 GPIB Commands: Output

To provide equipment identification and parameter information upon request, the sweep generator is equipped with output commands. The use of these commands causes the sweep generator to output the requested information when next addressed to talk. These output commands are given in Table 3-13.

Table 3-13. 6600A Series Sweep Generator Output Commands

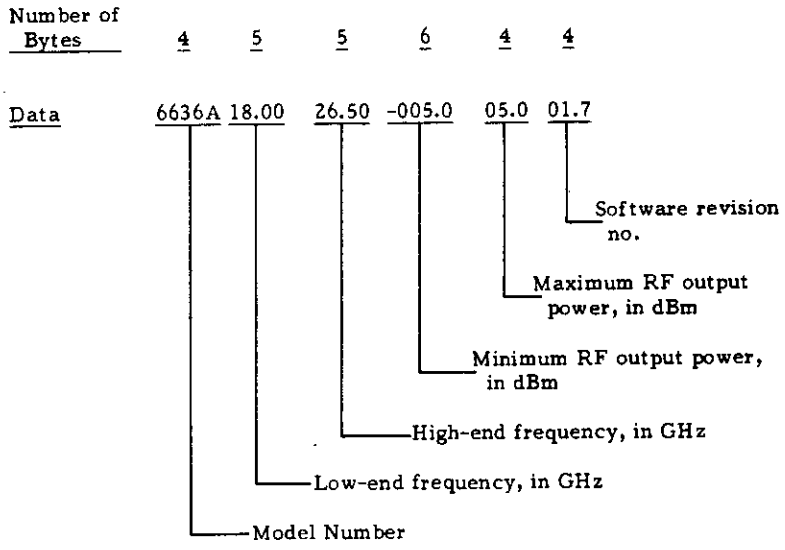
NAME	COMMAND	FUNCTION
Output Identify	OI	**Causes the sweep generator to identify itself by sending certain parameter information over the bus. This parameter information consists of model number, low-end frequency, high-end frequency, minimum output-power level, maximum output-power level, and software revision number. This command can be used to send parameter information to the controller automatically, thus relieving the operator from having to input the information manually. The format in which the OI data is returned is shown below.** 
Output ΔF Parameter	ODF	Returns the value of the ΔF frequency parameter to the controller, value is given in MHz.
Output FØ Parameter	OFØ	Returns the value of the FØ frequency parameter to the controller. Value is given in MHz.
Output F1 Parameter	OF1	Returns the F1 frequency value, as described above.
Output F2 Parameter	OF2	Returns the F2 frequency value, as described above.

Table 3-13. 6600A Series Sweep Generator Output Commands (Continued)

NAME	COMMAND	FUNCTION
Output F_{low}	OFL	Returns the low-end frequency value, as described above.
Output F_{high}	OFH	Returns the high-end frequency value, as described above.
Output M1 Parameter	OM1	Returns the M1 frequency value, as described above.
Output M2 Parameter	OM2	Returns the M2 frequency value, as described above.
Output Power Level	OLV	Returns the output-power level value to the controller. Value is given in ±0.1 dB increments.
Output Status Byte	OSB	Returns the Status Byte (Figure 3-32) to the controller.
Output Sweep Time	OST	Returns the sweep time value to the controller. Value is given in milliseconds.

3-7.6 GPIB Commands: Miscellaneous

There are 9 GPIB commands unrelated to either front-panel, digital-sweep, GET-mode, SRQ-mode or output operation. These miscellaneous commands are described in Table 3-14.

Table 3-14. 6600A Series Sweep Generator Miscellaneous Commands

NAME	COMMAND	FUNCTION
Continue Sweep	CNT	Causes the sweep to continue after having dwelled at an intensity marker. CNT is used in conjunction with the SRQ Dwell-at-Marker Mode.
Front Panel Displays:		
Off	DSØ	Turns off the front panel numeric displays so that unauthorized personnel cannot read the frequency range currently in use.
On	DS1	Turns the front panel numeric displays on. This is the default, or unprogrammed, condition (paragraph 3-7.9).

Table 3-14. 6600A Series Sweep Generator Miscellaneous Commands (Continued)

NAME	COMMAND	FUNCTION
Decrement the Selected Parameter	DN	Decrements the selected frequency, sweep time, or RF level parameter by the number of steps programmed with the Increment Size command (SIZ). For DN to be effective, the selected parameter must still be active. That is, the selected parameter's command statement (F1XXXXGH, SWTXXMS, LVLXXDM, etc.) must be the last command to appear before DN is commanded. A non-parameter command, such as AUT, IL1, or VM1, cannot be sandwiched between the parameter mnemonic and the DN command. If necessary, ensure that the selected parameter is still active by prefacing DN (or a string of DNs) with the selected parameter's mnemonic. For example, send F1 DN (or DN DN DN etc.) rather than just DN (or DN DN DN etc.).
Increment the Selected Parameter	UP	Increments the selected frequency, sweep time, or RF level parameter by the number of steps programmed with the Increment Size command (SIZ). As described for the DN command, above, the selected parameter must still be active for UP to be effective.
CW Filter:		
Out	FLØ	Causes the CW filter to be out of the RF output signal line.
In	FL1	Inserts a CW filter in the RF output signal line. This command overrides the CW filter control inherent in front-panel programming (i.e., CW filter inserted for sweep widths 50 MHz and below and not inserted for sweep widths above 50 MHz).
Return to Local	RL	Causes the sweep generator to return to local (front panel) control, provided that a local lockout message (Table 3-15) is not in effect.
Recall the Front Panel Control Settings	RCL	Causes the sweep generator to be reconfigured with the front-panel-control settings that were previously saved using the SAV command (below). Figure 3-33 provides a programming example.
Horizontal Output During CW		
OFF ON	CS0 CS1	Operation is the same as that described for the CW RAMP function in paragraph 3-2.1f.3.

Table 3-14. 6600A Series Sweep Generator Miscellaneous Commands (Continued)

NAME	COMMAND	FUNCTION
Reset Sweep	RSS	Resets the frequency sweep to the sweep-start frequency, as programmed by a Parameter Entry command (e.g. FFF1XXXXGH). RSS can be used to abort the sweep currently in progress prior to sending a trigger command.
Save the Front Panel Control Settings	SAV	Causes the sweep generator to return an ASCII encoded representation of the entire instrument setup. This instrument setup information is contained in a data string approximately 310 bytes long. The SAV command can be used to store the front-panel-control settings for a measurement test setup. This test setup information can be stored on a program tape for future use. Figure 3-33 provides a programming example.

Example 1 - Print SAV information (GPIB address assumed to be 5).

```
10 DIM A$[350]
20 OUTPUT 705 ;"SAV"
30 ENTER 705 ; A$
40 PRINT A$

2@@@@@@@E J@@@@@EH@@JJ@1D@@DBBLH@@@@
£@B@E@@DDDDDDDDDDDBA@K@L@LDDDB@@
L@L@LDD@D@LID@LIDDBBH@L@LDD@D@LI
D@LDD@D@LID@LDIDDDDIA@LDD@D@LBI@
LDD@D@LID@LID@@BH@L@L@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@ADKD@@@@GN@@@@
@@J@@CACH@@@@@@J@@@@@J@@@@BH@@@@C
B@@@@@J@@DHJHANBHBKDCDFJGNDCEFAG
O@@CBCCGCGDGDGD@@@@LHB@IKKH@CEH@H
@H@H@@@@EJEJ@@ECBA@AME
```

Line 10 - dimension A$ to accommodate 350 bytes of data.

Line 20 - address sweep generator to listen and send SAV command.

Line 30 - address sweep generator to talk and input SAV command data into A$.

Line 40 - print information contained in A$.

Encoded ASCII data bytes representing the binary data contained in the front panel control RAM memories.

Example 2 - Record SAV information into a tape file.

```
10 DIM A$[350]
20 OUTPUT 705 ;"SAV"
30 ENTER 705 ; A$
40 CREATE "filename",3
50 ASSIGN# 1 TO "filename"
60 PRINT# 1 ; A$
70 ASSIGN# 1 TO *
```

Line 10 - } see Example 1 above.
Line 20 - }
Line 30 - }

Line 40 - create a tape file and make it 3 records long.

Line 50 - assign the tape file to buffer #1.

Line 60 - print the data contained in file #1.

Line 70 - close file #1.

Example 3 - Recall SAV information from tape file.

```
10 DIM A$[350]
20 ASSIGN# 1 TO "filename"
30 READ# 1 ; A$
40 ASSIGN# 1 TO *
50 OUTPUT 705 ;"RCL",A$
```

Line 10 - see Examples 1 and 2 above.

Line 20 - see Line 50, Example 2 above.

Line 30 - load data from file #1 into A$.

Line 40 - close file #1.

Line 50 - address sweep generator to listen; send both RCL command and data contained in A$.

Figure 3-33. Programming Examples Using SAV and RCL Commands

3-7.7 Bus Messages

The 6600 Series Sweep Generators recognize most of the IEEE-488 bus messages. A listing of the recognized bus messages, including specific information describing how the messages are used, is given in Table 3-15. Sample program statements showing how the WILTRON 85/HP9845A, HP 9825A, and Tektronix 4051/4052 bus controllers implement the recognized bus messages are shown in Table 3-16.

Table 3-15. Bus Messages Recognized by the 6600A Series Sweep Generators

BUS MESSAGE	HOW MESSAGE IS USED BY SWEEP GENERATOR
Device Clear	1. Aborts all current sweep generator GPIB activities. 2. Resets the STS, SIZ, SQ1, DW1, UL1, ES1, EF, and EI commands to their default condition (paragraph 3-7.9).
Go to Local	Returns the sweep generator to local control.
Group Execute Trigger	1. Triggers a new sweep if the EXT (Table 3-9) and the GTS (Table 3-11) commands are both programmed. 2. Increments the selected parameter (paragraph 3-2.1a) by the number of steps programmed using the SIZ command (Table 3-10) if the GTU command (Table 3-11) is programmed. 3. Decrements the selected parameter by the number of steps programmed using the SIZ command if the GTD command (Table 3-11) is programmed. 4. Increments the digital sweep by the number of steps programmed using the SIZ command if the GTN command (Table 3-11) is programmed.
Interface Clear	Stops the sweep generator GPIB interface from listening or talking. The front panel controls are not cleared.
Local Lockout	Prevents the RETURN TO LOCAL pushbutton or the RL command (Table 3-14) from returning the sweep generator to local control.
Remote Enable	Places the sweep generator under remote control if the REM line is TRUE and the sweep generator is addressed to listen. If placed in remote and not supplied with program data, sweep generator operation is determined by the position in which the front panel controls were set immediately prior to going remote.
Service Request (SRQ) Messages:	The sweep generator is equipped with SRQ capability. It will respond to both serial- and parallel-poll messages. Serial- and parallel-poll operations are described below.

Table 3-15. Bus Messages Recognized by the 6600A Series Sweep Generators (Continued)

BUS MESSAGE	HOW MESSAGE IS USED BY SWEEP GENERATOR
Serial-Poll Enable (SPE) Serial-Poll Disable (SPD)	Serial Poll Operation The SPE message causes the sweep generator to respond with a decimally-coded status byte (Figure 3-32). This status byte is coded to give the controller two pieces of information: 1. Whether it was the device requesting service. 2. If it was the service-requesting device, the type of service that it needs. The SPD message, which is sent by the controller in response to receiving a status byte, terminates serial-poll operation.
Parallel-Poll Configure (PPC) Parallel-Poll Enable (PPE) Parallel-Poll Unconfigure (PPU) Parallel-Poll Disable (PPD)	Parallel-Poll Operation When queried by a parallel-poll message command (PPOLL or pol; see Table 3-16), the sweep generator (if configured for parallel-poll operation; see below) responds by setting its assigned data bus line to the logical state (1, 0) that indicates its correct SRQ status. To configure a bus device that is (1) built for parallel-poll operation and (2) designed to be remotely configured on the bus, the controller sends a two-byte parallel-poll configure and enable (PPC and PPE) message. The PPC byte configures the device to respond to a parallel-poll message such as PPOLL or pol. The PPE byte assigns the logical sense (1, 0) that the parallel-poll response will take. When the sweep generator receives the PPC/PPE message, it configures itself to properly respond to the parallel-poll message. The PPU (or PPD) message is sent by the controller when a parallel-poll response is no longer desired. This message causes the sweep generator to become unconfigured for parallel-poll response.

Table 3-16. Sample Bus Message Statements

BUS MESSAGE	SAMPLE STATEMENT SHOWING HOW MESSAGE IS IMPLEMENTED		
	MODELS 85/9845A	HP 9825	TEKTRONIX 4051
Go to Local (GTL)	LOCAL 7[1] LOCAL 705[2]	lcl 7[1] lcl 705[2]	WBYTE Ω 9½, 63, 37, 4:
Group Execute Trigger (GET)	TRIGGER 7 TRIGGER 705	trg 7 trg 705	WBYTE Ω 9½, 63, 37, 8:
Interface Clear (IFC)	ABORTIO 7 ABORTIO 705	cli 7 cli 705	
Local Lockout (LLO)	LOCAL LOCKOUT 7	llo 7	WBYTE Ω 17:[1]
Remote Enable	REMOTE 7 REMOTE 705	rem 7 rem 705	PRINT Ω 5[2]
Serial Poll (Query Message)	SPOLL (7) SPOLL (705)	rds (7)→A: if bit (7, A); gto (Line No.)	POLL A, B; 5[2]
Parallel Poll (Query Message)	PPOLL (7)	pol(7)→A: if bit (0, A) = 1; gsb "Serv 0": if bit (1, A) = 1; gsb "Serv 1"	
Parallel Poll Configure (PPC) (The statements assign the sweep generator data line DIO5 for parallel-poll response with Sense (S) = 0.)	MODEL 85 ONLY: SEND 7; LISTEN 5 CMD 3 SCG 5 UNL HP 9845 ONLY: PPOLL CONFIGURE 705; 5	polc 705, 5[2]	

[1] Sends message to all bus instruments.
[2] Sends message to instrument at address 5 (sweep generator).

Table 3-16. Sample Bus Message Statements (Continued)

BUS MESSAGE	SAMPLE STATEMENT SHOWING HOW MESSAGE IS IMPLEMENTED		
	MODELS 85/9845A	HP 9825	TEKTRONIX 4051
Parallel Poll Unconfigure (PPU)	MODEL 85 ONLY: SEND 7; LISTEN 5 CMD 21 HP 9845 ONLY: PPOLL UNCONFIGURE 705	polu 7 polu 705	
Device Clear (DC and SDC)	MODEL 85 ONLY: CLEAR 7 CLEAR 705 HP 9845 ONLY: RESET 7 RESET 705	clr 7 clr 705	INIT[1] WBYTE Ω 95, 63, 37, 4:[2]

[1] Sends message to all bus instruments.
[2] Sends message to instrument at address 5 (sweep generator).

3-7.8 Program Errors

There are two types of errors that occur in bus programming: invalid-parameter errors and syntax errors. These two error types are described below.

a. Invalid-Parameter Error. Invalid-parameter errors are those that will cause either the front panel CLEAR ENTRY, F1>F2 OR M1>M2 CHANGE FREQ SETTING, or GHz/dBm/Sec and MHz/dB/mS indicators to flash. These errors include:

1. Programming a frequency sweep where F1 is greater than F2 or M1 is greater than M2 (backward sweep, paragraph 3-2.1e).
2. Attempting to enter a frequency, sweep-time, or RF level parameter that exceeds the limits of the sweep generator.
3. Failing to properly end a parameter entry with a suitable terminator, such as MH, DB, MS, etc.

Invalid-parameter errors cause the front-panel indicators to flash.

b. Syntax Errors. Syntax errors are errors that occur in the formulation of a program statement, such as writing "EXTTFS" instead of "EXTTRS". To prevent misinterpretation of command statements, the sweep generator ignores

all portions of the command statement following the syntax error. All commands are ignored until the sweep generator receives the Unlisten command (ASCII ?) over the bus or until the sweep generator is addressed to talk. An example showing how the sweep generator evaluates a syntax error is given in Figure 3-34.

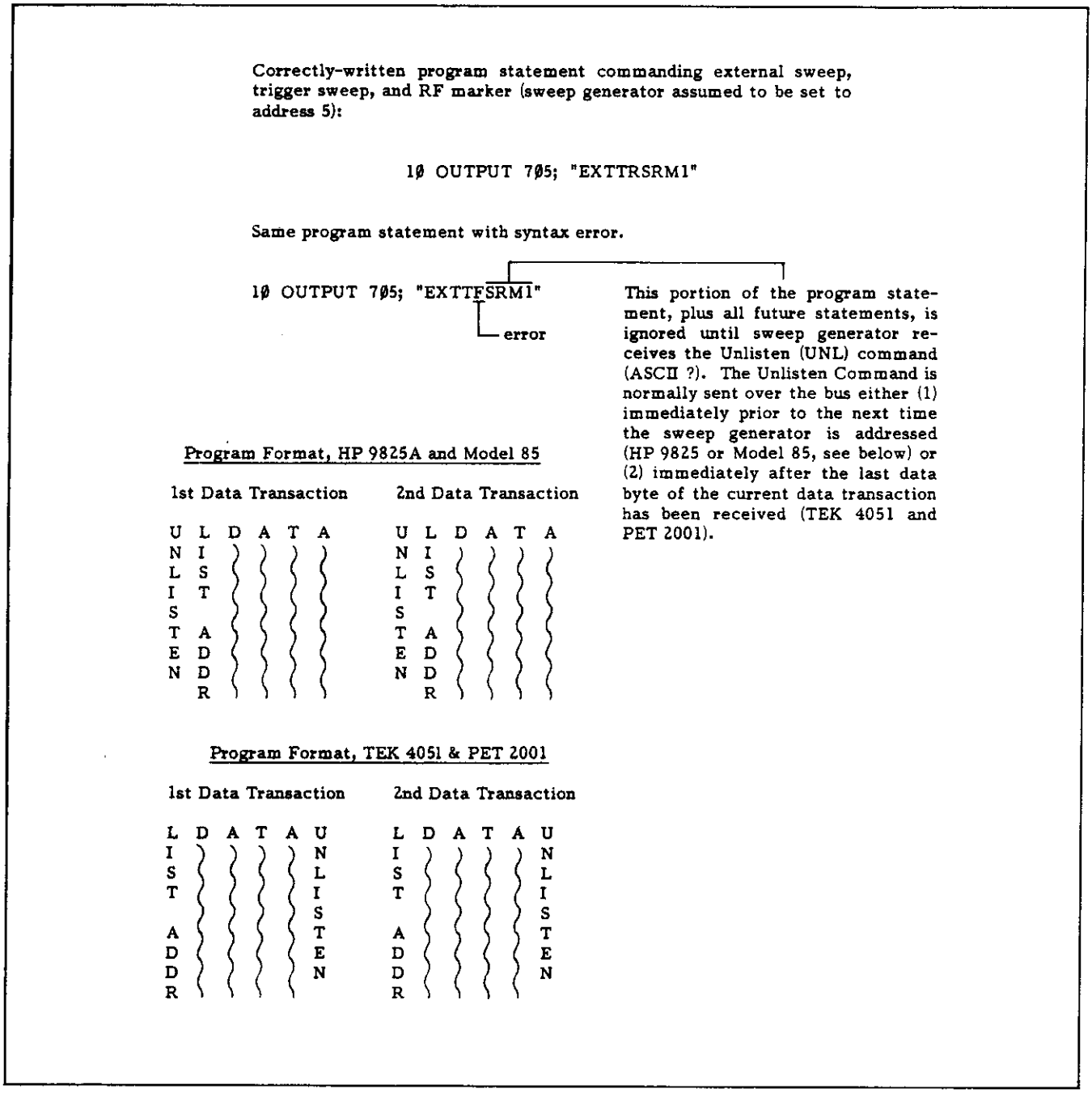


Figure 3-34. Program Statement with Syntax Error (Example)

3-7.9 Reset Programming and Default Conditions

Reset programming provides the means for quickly returning the sweep generator to its default (preprogrammed) operational state. In the manual (local) mode, the default state can be entered into only by pressing the RESET pushbutton. In the GPIB (remote) mode, however, there are several ways in which to enter the default state. These reset-programming methods, along with related data, are given in Table 3-17. The default settings for the numeric frequency, sweep time, and output power level parameters are the same as those given for the RESET pushbutton (Table 3-1). A recommended command sequence for reset programming is given in Figure 3-35. The use of this recommended command sequence assures that all parameters and commands assume their preprogrammed state each time reset is desired.

Line #	Purpose
10	Sends Device Clear Bus Message. This message clears the sweep generator GPIB interface.
20	Sends Reset Bus Command. This command resets the sweep generator front panel controls to a predetermined (initialized) state.
30	Sends new front panel settings: full sweep, internal leveling, and output-power level of 0 dBm.

```
10 CLEAR 705
20 OUTPUT 705 ;"RST"
30 OUTPUT 705 ;"FUL IL1 LVL0DM"
```

Figure 3-35. Reset Programming Statements

Table 3-17. Resetting the Sweep Generator GPIB Interface Circuits

METHODS OF RESETTING GPIB INTERFACE CIRCUITS	FUNCTIONS AFFECTED	DEFAULT CONDITION
1. Pressing RETURN TO LOCAL pushbutton.	Digital Sweep	STS = Ø SIZ = Ø
	Service Request Modes	SQØ DWØ ULØ ESØ
	Group Execute Trigger Mode	GTS
	Bus Messages	Local

Table 3-17. Resetting the Sweep Generator GPIB Interface Circuits (Continued)

METHODS OF RESETTING GPIB INTERFACE CIRCUITS	FUNCTIONS AFFECTED	DEFAULT CONDITION
2. Pressing RESET pushbutton.	Same as above.	Same as above, plus local and local lockout messages are also reset.
3. Sending RST command over the bus.	Same as above.	Same as 2, above.
4. Executing the interface message Device Clear.	Same as above.	Same as 1, above, except local bus message is not reset.
5. Turning the POWER switch on and off.	Same as above	Same as 2, above.

3-7.10 Quick Reference Data

An alphabetical index of sweep generator GPIB command codes, along with a tabulation of default data, is provided in Appendix 1. This appendix may be copied and used as a handy source for the quick reference of certain GPIB programming data.

3-7.11 Index of Sweep Generator GPIB Command Codes

An alphabetical index of the sweep generator GPIB command codes is given in Table 3-18. This table lists the command mnemonic, the name of the command, and the table number where the command is described.

Table 3-18. Index of Sweep Generator GPIB Command Mnemonics

MNEMONIC	NAME	TABLE NO.
AUT	Auto Trigger	3-9
CFØ	CW Select FØ	3-9
CF1	CW Select F1	3-9
CF2	CW Select F2	3-9
CLR	Clear Keypad	3-9
CM1	CW Select M1	3-9
CM2	CW Select M2	3-9
CNT	Continue Sweep	3-14
CS0	Horizontal Output Off During CW Operation	3-14
CS1	Horizontal Output On During CW Operation	3-14
DB	dB Data Terminator	3-9
DFØ	Sweep Range ΔF F0	3-9
DF1	Sweep Range ΔF F1	3-9
DL1	Detector Leveling	3-9
DLF	Enter ΔF Frequency	3-9
DM	dBm Data Terminator	3-9
DN	Decrement Selected Parameter	3-14
DSØ	Front Panel Displays Off	3-14
DS1	Front Panel Displays On	3-14
DWØ	Dwell at Marker Mode Off	3-12
DW1	Dwell at Marker Mode On	3-12
ESØ	End of Sweep Mode Off	3-12

Table 3-18. Index of Sweep Generator GPIB Command Mnemonics (Continued)

MNE-MONIC	NAME	TABLE NO.
ES1	End of Sweep Mode On	3-12
EXT	External Trigger	3-9
FØ	Enter Parameter FØ	3-9
F1	Enter Parameter F1	3-9
F2	Enter Parameter F2	3-9
FF	Sweep Range F1-F2	3-9
FLØ	CW Filter Off	3-14
FL1	CW Filter On	3-14
FMØ	Frequency Modulation Off	3-9
FM1	Frequency Modulation On	3-9
FUL	Sweep Range Full	3-9
FVØ	Frequency Vernier Off	3-9
FVS	Set Frequency Vernier	3-9
GH	GHz Data Terminator	3-9
GTD	GET* Mode Execute "DN" Command	3-11
GTN	GET Mode Execute "N" Command	3-11
GTS	GET Mode Trigger Sweep	3-11
GTU	GET Mode Execute "UP" Command	3-11
IL1	Internal Leveling	3-9
IM1	Intensity Marker	3-9
LIN	Line Trigger	3-9
LVØ	Leveling Off	3-9
LVL	Enter Level Parameter	3-9
M1	Enter M1 Parameter	3-9
M2	Enter M2 Parameter	3-9
MAN	Manual Sweep	3-9
MH	MHz Data Terminator	3-9
MKØ	Markers Off	3-9
MM	Sweep Range M1-M2	3-9
MS	Millisecond Data Terminator	3-9
N	Go to Next Increment (Digital Sweep)	3-10
ODF	Output ΔF Frequency	3-13
OI	Identify Instrument	3-13
OFØ	Output FØ Frequency	3-13
OF1	Output F1 Frequency	3-13
OF2	Output F2 Frequency	3-13
OFL	Output Low-End Frequency	3-13
OFH	Output High-End Frequency	3-13
OLV	Output RF Level	3-13
OM1	Output M1 Frequency	3-13
OM2	Output M2 Frequency	3-13
OSB	Output Status Byte	3-13
OST	Output Sweep Time	3-13
PEØ	Parameter Entry Error Mode Off	3-12
PE1	Parameter Entry Error Mode On	3-12
PL1	Power Meter Leveling	3-9
RCL	Recall Front Panel Setup	3-14
RFØ	RF Off	3-9
RF1	RF On	3-9
RL	Return to Local	3-14
RM1	RF Marker On	3-9
RSS	Reset Sweep	3-14
RST	Reset Front Panel	3-9
RTØ	RF During Retrace Off	3-9
RT1	RF During Retrace On	3-9
SAV	Save Front Panel Setup	3-14
SEØ	Syntax Error Mode Off	3-12
SE1	Syntax Error Mode On	3-12
SEC	Seconds Data Terminator	3-9
SH	Shift	3-9
SIZ	Increment Size	3-10
SQØ	SRQ Mode Off	3-12
SQ1	SRQ Mode On	3-12
STP	Step Sweep	3-10
STS	Step Select	3-10
SWT	Enter Sweep Time Parameter	3-9
TRS	Trigger Sweep	3-9
TST	Self-Test	3-9
ULØ	Unleveled Condition Mode Off	3-12
UL1	Unleveled Condition Mode On	3-12
UP	Increment Selected Parameter	3-14
VM1	Video Marker On	3-9

*Group Execute Trigger