SERIES
67XXB
SWEPT FREQUENCY SYNTHESIZER

OPERATION MANUAL

WILTRON

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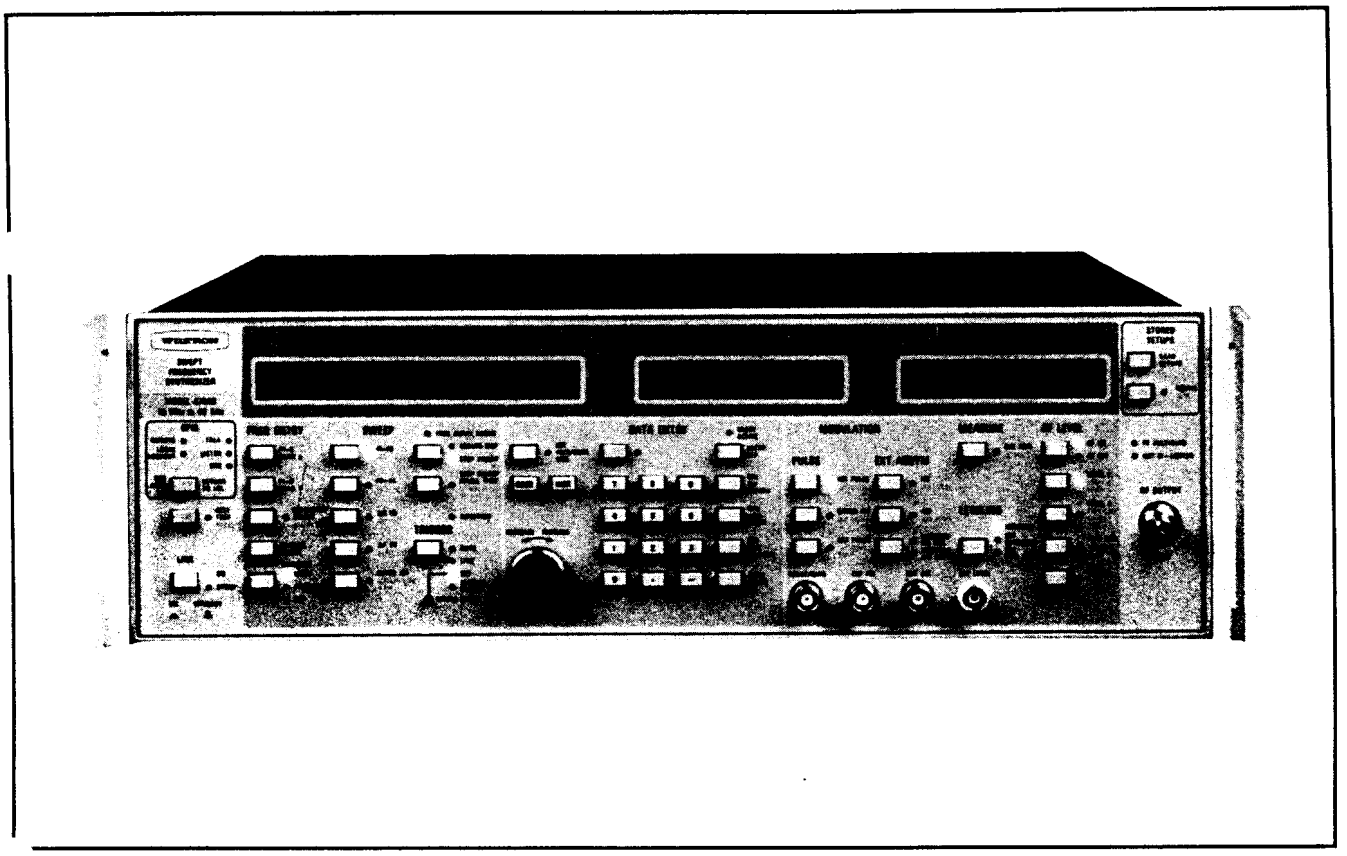


Figure 1-1. Typical Series 67XXB Swept Frequency Synthesizer

SECTION I
GENERAL INFORMATION

1-1 SCOPE OF THE MANUAL

This manual provides general, installation, and operation information for all models in the Series 67XXB Swept Frequency Synthesizer family.

1-2 INTRODUCTION

Section I provides information about the equipment identification number, performance specifications, options, and related manuals.

1-3 IDENTIFICATION NUMBER

All WILTRON instruments are assigned a unique six-digit ID number, such as "405001." Each 67XXB has two ID numbers assigned, one for the basic frame and one for the RF deck. The ID number for the RF deck is affixed to the outside of the rear panel, while that for the basic frame is affixed to chassis floor, below the swing-out RF deck. The RF deck ID number, on the outside, is the primary number. Please use it when ordering parts or corresponding with the Customer Service department.

1-4 RELATED MANUALS

This is one of a two manual set that consists of an Operating Manual (OM) and a Maintenance Manual (MM). The OM provides coverage for all models in the 67XXB series. Conversely, the MMs contains model-dependent information. Because of this model dependency there are eighteen different MMs—one for each frequency model. The MMs provide performance verification, calibration, parts, and service (schematics, block diagrams, circuit description) information for the model being covered. The WILTRON part number for this manual is listed on the title page; the part numbers for the MMs are listed in Table 1-1.

Table 1-1. Maintenance Manual Part Numbers

67XXB Model Numbers	Maintenance Manual Part Numbers
6709B/–40	10370-10204
6717B/–20	10370-10206
6719B	10370-10208
6721B/–20	10370-10210
6722B/–20	10370-10212
6728B/–40	10370-10214
6729B/–20	10370-10216
6730B/–40	10370-10218
6736B	10370-10220
6737B/–20	10370-10222
6740B	10370-10224
6745B	10370-10226
6747B/–20	10370-10228
6753B/–10	10370-10230
6759B/–10	10370-10232
6760B	10370-10240
6763B	10370-10234
6769B	10370-10236
6772B	10370-10238

1-5 DESCRIPTION

The Series 67XXB Swept Frequency Synthesizers are microprocessor-based, GPIB, synthesized signal sources that generate swept and CW frequencies from 10 MHz to 60 GHz. The series, which will expand as additional frequency ranges are added, presently consists of 29 models covering a variety of frequency and power ranges. Table 1-2 shows a listing of all of the present models, their frequency range, and their output power level.

Table 1-2. Series 67XXB Models

67XX Model	Frequency (GHz)	Output Power*
6709B 6709B–40	.01-2	+10 dBm +16 dBm
6717B 6717B–20	01-8.4	+10 dBm +13 dBm
6719B	2-8.4	+13 dBm
6721B 6721B–20	2-12.4	+10 dBm +13 dBm
6722B 6722B–20	.01-12.4	+10 dBm +13 dBm
6728B 6728B–40	8-12.4	+13 dBm +16 dBm
6729B 6729B–20	8-20	+10 dBm +13 dBm
6730B 6730B–40	12.4-20	+13 dBm +16 dBm
6736B 6736B-10	18-26.5	+7 dBm +10 dBm
6737B 6737B–20	2-20	+10 dBm +13 dBm
6740B	26.5-40	+10 dBm
6745B	.01-18	+10 dBm
6747B 6747B–20	.01-20	+10 dBm +13 dBm
6753B	2-26.5	+10 dBm, ≤20 GHz +5 dBm, >20 GHz
6753B–10	2-26.5	+10 dBm
6759B	.01-26.5	+10 dBm, ≤20 GHz +5 dBm, >20 GHz
6759B–10	.01-26.5	+10 dBm
6760B	12.4-40	+10 dBm, ≤20 GHz +5 dBm, >40 GHz
6763B	2-40	+10 dBm, ≤20 GHz +5 dBm, >20 GHz
6769B	.01-40	+10 dBm, ≤20 GHz +5 dBm, >40 GHz
6772B	40-60	0 dBm

* Optional attenuator reduces rated power by 3 dB.

1-6 OPTIONS

The following options are available:

Option 1, Rack Mount. A kit is available containing mounting brackets and chassis track slides.

Option 2A, 110 dB Step Attenuator. When ordered, synthesizer comes supplied with a 110 dB Step Attenuator installed. Rated output power is reduced by 3 dB. This option is available for all models with an upper frequency range of 20 GHz or less.

Option 2B, 110 dB Step Attenuator. When ordered, synthesizer comes supplied with a 110 dB Step Attenuator installed. Rated output power is reduced by 3 dB. This option is available for all models having an upper frequency limit above between 20 and 26.5 GHz.

Option 2C, 110 dB Step Attenuator. When ordered, synthesizer comes supplied with a 110 dB Step Attenuator installed. Rated output power is reduced by 3 dB. This option is available for all models having an upper frequency limit between 26.5 and 40 GHz.

Option 9K, K Connector. Each synthesizer comes supplied with a rear panel K Connector® RF Output instead of the type of connector that would normally be installed on the front panel. The front panel connector is deleted. Rated output power, flatness, and SWR are slightly degraded.

1-7 PERFORMANCE SPECIFICATIONS

Table 1-3, beginning on page 1-5, lists the performance specifications for the 67XXB series synthesizers.

1-8 RECOMMENDED TEST EQUIPMENT

Table 1-4, on page 1-10, provides a lists of recommended test equipment needed to check and service the 67XXB Series Swept Frequency Synthesizers. The entries are coded to show for which types of testing the equipment is used. These codes are described below.

Code	Type of Testing
C	Calibration
P	Performance Verification
T	Troubleshooting

Table 1-3. Performance Specifications, 67XXB Swept Frequency Synthesizer (1 of 5)

FREQUENCY

Frequency information is shown in Table 1-2.

CW MODE

Output: Nine independent, presettable CW frequencies.

Accuracy: Same as internal or external time base.

Internal 10 MHz Time Base Stability:

With Aging: $<5 \times 10^{-10}$/day

With Temperature: $<\pm 5 \times 10^{-9}$/°C over 0°C to 55°C

Resolution:

.01 to 26.5 GHz: 1 kHz

>26.5 to 40 GHz: 2 kHz

>40 to 60 GHz: 3 kHz

10 MHz Reference Output: 2 Vp-p into 50Ω. AC coupled, 50Ω impedance, BNC, rear panel.

External 10 MHz Reference Input: Accepts external 10 MHz ±100 Hz, 0 to +10 dBm time base signal. Automatically disconnects internal time base. BNC, rear panel, 50Ω impedance.

High Resolution Input: Accepts 20-32.1 MHz external synthesizer signal to improve resolution to equal that of external instrument. BNC, rear panel, 50Ω impedance, 0 dBm.

Switching Time (for any step size):
<15 ms typical (25 ms max.) to be within 1 kHz

Lock Output: Provides TTL high signal when frequency is phase locked.

ANALOG SWEEP MODE

F1–F2, F3–F4, ΔF F5, and ΔF F6 Sweep Width: Independently selected, 1 MHz to full range continuous sweep. For >50 MHz sweep width, start/stop and bandswitching frequencies are phase-lock-corrected during every sweep. For ≤50 MHz width, the center frequency is phase-lock-corrected.

Accuracy: The lesser of ±30 MHz or ±(2 MHz + 0.25% of sweep width) for sweep speeds of ≥50 GHz/s.

Resolution: 1 MHz

Sweep Time Range: 30 ms to 99 s

PHASE-LOCKED STEP SWEEP MODE

F1–F2, F3–F4, ΔF F5, and ΔF F6 Sweep Width: Independently selected, 1 kHz to full range. Every frequency in sweep range is phase locked.

Accuracy: Same as internal or external time base.

Resolution (Minimum Step Size):

.01 to 26.5 GHz: 1 kHz

>26.5 to 40 GHz: 2 kHz

>40 to 60 GHz: 3 kHz

Number of Steps: Variable from 1 to 1800

Dwell Time Per Step: Variable from 1 ms to 99s

Switching Time (for any step size):
<15 ms typical (25 ms maximum) to be within 1 kHz.

ALTERNATE SWEEP MODE

Sweeps alternately in analog or step sweep between any two of the sweep ranges: F1–F2, F3–F4, ΔF F5, and ΔF F6.

MANUAL SWEEP MODE

Provides stepped, phase-locked adjustment of frequencies between sweep limits.

PROGRAMMABLE FREQUENCY AGILITY:

Under GPIB control, up to 512 nonsequential frequencies can be stored and then addressed as a phase-locked step sweep.

Switching Time (for any step size): <15 ms typical, 25 ms max. to within 1 kHz.

MARKERS

Up to nine independent, presettable markers.

Video Markers: TTL compatible, high true. BNC, rear panel.

Intensity Markers (Available in Analog Sweep only): Intensified dot on trace. Obtained by momentary dwell in sweep.

Marker Accuracy: Same as sweep frequency accuracy.

Marker Resolution (Step Sweep):

01 to 26.5 GHz: 1 kHz

>26.5 to 40 GHz: 2 kHz

>40 to 60 GHz: 3 kHz

Marker Resolution (Analog Sweep):
Sweep Width/4096 or 1 MHz, whichever is greater

SWEEP TRIGGERING

Auto: Triggers sweep automatically.

Line: Triggers sweep from power line frequency.

External: Accepts TTL high signal of >1 μs width to trigger, abort, or reset analog sweep. BNC, rear panel.

Single: Triggers, aborts, and resets a single sweep. Front panel pushbutton.

SWEEP-RELATED INPUTS/OUTPUTS

Sweep Dwell Input: Accepts TTL low signal to stop sweep. Sweep continues when signal is removed. BNC, rear panel.

Horizontal Sweep Output: Provides 0V at beginning and 10V at end of sweep for all sweep modes, regardless of sweep width. In CW mode, voltage is proportional to frequency between 0V at low end and 10V at high end of range. In CW mode, CW RAMP provides a repetitive, 30 ms, 0V to 10V ramp at rear panel BNC and AUX I/O connectors.

V/GHz Output: 1 V/GHz for models with an upper frequency limit of 20 GHz or less, 0.5 V/GHz for all models with an upper frequency limit above 20 GHz. BNC, rear panel.

Bandswitch Blanking Output: +5V or –5V signal coincident with bandswitching points. Signal present at rear panel BNC and AUX I/O connectors. 100Ω impedance.

Table 1-3. Performance Specifications, 67XXB Swept Frequency Synthesizer (2 of 5)

SWEEP-RELATED INPUTS/OUTPUTS (Continued)

Retrace Blanking Output: +5V or −5V output signal coincident with sweep retrace. Signal present at rear panel BNC and AUX I/O connectors.

Pen Lift Output: Normally open or normally closed internal relay contacts during sweep retrace. BNC, rear panel.

Sequential Sync Output: Provides TTL high signal during retrace and at bandswitching points for interface to scalar network analyzers, −5V during marker, and −10V during selected marker. Signal present at rear panel BNC and AUX I/O connectors.

SPECTRAL PURITY

All specifications apply to the phase-locked CW and Step Sweep Modes.

SPURIOUS SIGNALS

Subharmonics:

.01 to 26.5 GHz: None

>26.5 to 40 GHz: −20 dBc

Harmonics:

.01 to 2 GHz: −40 dBc
(−30 dBc for 6709B-40, 6717B-40, and 6747B-20)

>2 to ≤26.5 GHz: −60 dBc

>26.5 to 60 GHz: −20 dBc

Nonharmonics: −60 dBc, typically −70 dBc

SINGLE-SIDEBAND PHASE NOISE
(dBc, CW Mode, Maximum)

Frequency Range (GHz)	Offset From Carrier (dBc/Hz)				
	30 Hz	100 Hz	1 kHz	10 kHz	100 kHz
0.01 to 8	−67	−72	−76	−80	−98
>8 to 12.4	−64	−69	−73	−77	−100
>12.4 to 20	−60	−65	−69	−73	−100
>20 to 26.5	−58	−63	−67	−71	−97
>26.5 to 40	−54	−59	−63	−67	−95
40 to 60	−50	−55	−59	−63	−90

POWER LINE AND FAN ROTATION SPURIOUS
(dBc, CW Mode, Maximum)

Frequency Range (GHz)	Offset From Carrier (dBc/Hz)		
	<300 Hz	300 Hz to 1 kHz	1 kHz
0.01 to 8	−50	−60	−65
>8 to 12.4	−46	−53	−58
>12 to 20	−41	−48	−53
>20 to 26.5	−40	−47	−52
>26.5 to 40	−35	−42	−47
>40 to 60	−40	−47	−52

RESIDUAL FM
(CW Mode, 50 Hz-15 kHz BW, Typical)

Frequency Range (GHz)	Residual FM (kHz RMS)
0.01 to 2	80
>2 to 8	90
>8 to 12.4	190
>12.4 to 20	240
>20 to 26.5	280
>26.5 to 40	480
>40 to 60	720

RESIDUAL FM
(Analog Sweep, 50 Hz-15 kHz BW)

Frequency Range (GHz)	Residual FM (kHz RMS)
0.01 to 8	5
>8 to 12.4	7
>12.4 to 20	10
>20 to 26.5	15
>26.5 to 40	30
>40 to 60	30

RF OUTPUT

Power level specifications apply at 25° ±10°C.
See Table 1-2 for model power ratings.

LEVELED OUTPUT POWER RANGE

Without Attenuator: 12 dB

With Option 2A, 2B, or 2C: 122 dB

ATTENUATOR INSERTION LOSS

Reduces rated output power by 3 dB max.

OUTPUT POWER RESOLUTION

Entry Resolution: 0.01 dB

Display Resolution: 0.1 dB

Power Level Stability with Temperature:
0.02 dB/°C (Typical)

Power Level Switching Time (to within specified accuracy):

Without Change in Step Attenuator (pulse off): <50 µs

With Change in Step Attenuator (pulse off): <20 ms

ACCURACY AND FLATNESS

See table on next page

Table 1-3. Performance Specifications, 67XXB Swept Frequency Synthesizer (3 of 5)

ACCURACY AND FLATNESS (Continued)

Step Sweep and CW Modes:

Attenuation Below Max Power	Frequency (GHz)			
	0.01 to 20	20 to 26.5	26.5 to 40	40 to 60
Accuracy*				
0 to 12 dB	±0.6 dB	±0.6 dB	±0.8 dB	±1.2 dB***
0 to 30 dB**	±1.4 dB	±2.0 dB	±3.0 dB	N/A
30 to 60 dB**	±2.6 dB	±2.6 dB	±4.6 dB	N/A
60 dB**	±3.1 dB	±4.0 dB	±5.0 dB	N/A
Flatness				
0 to 12 dB	±0.4 dB	±0.4 dB	±0.6 dB	±0.8 dB***
0 to 30 dB**	±0.8 dB	±1.0 dB	±2.0 dB	N/A
30 to 60 dB**	±2.0 dB	±2.0 dB	±3.0 dB	N/A
60 dB**	±2.5 dB	±3.0 dB	±4.0 dB	N/A

* Includes flatness variations. ***External leveling.
** For models with attenuator.

Analog Sweep Modes (typical):

Attenuation Below Max Power	Frequency (GHz)			
	0.01 to 20	20 to 26.5	26.5 to 40	40 to 60
Accuracy*				
0 to 12 dB	±1.0 dB	±1.5 dB	±2.0 dB	±3.0 dB***
0 to 30 dB**	±3.5 dB	±3.6 dB	±4.6 dB	N/A
30 to 60 dB**	±4.0 dB	±4.2 dB	±5.2 dB	N/A
60 dB**	±5.0 dB	±5.2 dB	±6.2 dB	N/A
Flatness				
0 to 12 dB	±1.0 dB	±1.5 dB	±2.0 dB	±3.0 dB***
0 to 30 dB**	±3.0 dB	±3.1 dB	±4.1 dB	N/A
30 to 60 dB**	±3.5 dB	±3.6 dB	±4.6 dB	N/A
60 dB**	±4.0 dB	±4.2 dB	±5.2 dB	N/A

* Includes flatness variations. ***External leveling.
** For models with attenuator.

OTHER POWER LEVEL SPECIFICATIONS

Source Impedance: 50Ω

Source SWR (Internal Leveling):

Without Attenuator:
<1.7 at <2 GHz
<1.6 at <2 to 20 GHz
<2.0 at >20 GHz

With Attenuator: <2.0 typical

Level Offset: Offsets displayed power level to establish a new reference level.

RF On/Off Between Frequency Steps: Shift-plus-trigger key routines select RF On or Off during frequency switching in CW or step sweep mode.

Retrace RF On/Off: Shift-plus-trigger key routines select RF On or Off during retrace.

RF Off: With RF control in Off position, oscillators are turned fully off.

Internal Leveling: Power is leveled at output connector in all modes.

External Leveling:

External Detector: Levels power at remote detector location. Front panel BNC connector, positive or negative 0.5 mV to 500 mV. EXT GAIN CAL adjusts input signal to optimum value.

External Power Meter: Levels output power at remote power sensor location. Front panel BNC connector, ±1V full scale EXT GAIN CAL adjusts input signal to optimum value.

External Leveling Bandwidth (Pulse Off):
>30 kHz typical in Detector mode
>0.7 Hz typical in Power Meter mode

Unleveled Indicator: Lights when output power is unleveled.

POWER SWEEP

Range: Sweeps between any two power levels.

Resolution: 0.01 dB/step

Accuracy: Same as output accuracy.

Number of Steps: Variable from 1 to 1000

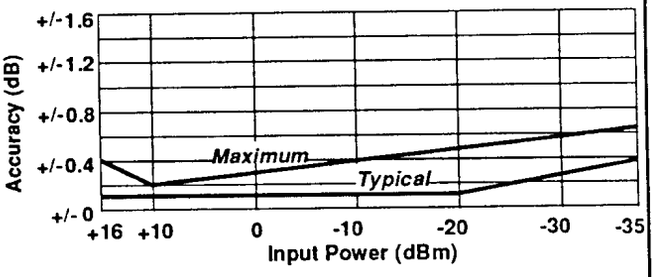
Dwell Time per Step: Variable from 50 ms to 10s

POWER METER

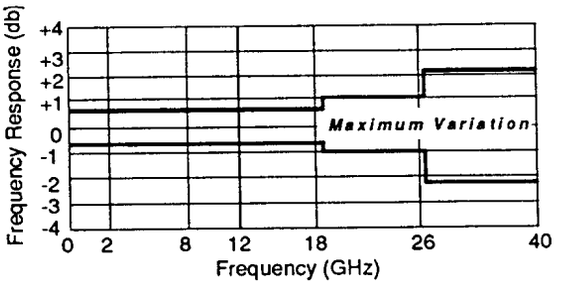
Built-In Power Meter Range: +16 dBm to −35 dBm. Compatible with Wiltron 560–7 or 6400–71 Series Detectors. Rear panel input.

Power Measurement Accuracy:
Power Measurement Accuracy = Meter Accuracy + Detector Frequency Response

Meter Accuracy (25°C):



Detector Frequency Response:



MODULATION

AM, FM, and pulse modulation can be applied simultaneously.

Table 1-3. Performance Specifications, 67XXB Swept Frequency Synthesizer (4 of 5)

PULSE MODULATION
On/Off Ratio: >80 dB
Pulse Rise and Fall Time: <5ns typical, 10 ns max
Pulse Overshoot and Ringing: <10% maximum
Pulse Width Compression: ±5 ns max
Video Feedthru: <±2 mVpk typical, ±5 mVpk max
Accuracy of Peak Pulse Power (Relative to CW level, 100 Hz ≤ PRF ≤ 1 MHz):

Pulse Width	Frequency	
	<2 GHz	≥2 GHz
<100 ns	*	*
100 ns to <200 ns	*	±1.5 dB
200 ns to <500 ns	*	±1.5 dB
500 ns to <1 µs	*	±0.8 dB
1 µs to <2 µs	±0.9 dB	±0.5 dB
2 µs to <5 µs	±0.6 dB	±0.3 dB
≥5 µs	±0.3 dB	±0.3 dB

*RF power is controllable, but not automatically leveled for very narrow pulses.

Internal Pulse Generator
Pulse Width Range: ≤25 ns to ≥99 ms
Pulse Width Control Resolution:
Up to 100 ms width: 25 ns
>100 ms to 1 ms width: 1 µs
>1ms to 10 ms width: 10 µs
>10 ms to 99 ms width: 100 µs
Note: Specified resolution may exceed the 3-digit display resolution.
Pulse Width Accuracy: ±10 ns typical
Pulse Period: 1µs to 100 ms
Pulse Period Resolution:
0.1 µs (1 µs to 99.9 µs)
1 µs (100 µs to 999 µs)
10 µs (1 ms to 9.99 ms)
100 µs (10 ms to 100 ms)
Pulse Period Accuracy: ±10 ns, typical
Gate Width Range: 100 ns to infinity
Pulse Input: Shift-plus-trigger key routines select TTL high or low signal for triggering or gating internal pulse generator. BNC rear panel.
Pulse Sync Output: TTL high signal, 100 ns minimum pulse width, preceding RF pulse by 100 ns. BNC, rear panel.
External Pulse Input:
Pulse Width Range: 10 ns to CW
Pulse Repetition Rate: 10 Hz to 10 MHz
External Trigger: TTL
Delay Time: 50 ns typical
External Triggered Pulse with Delay
Delay Range: 200 ns to 100 ms
Delay Resolution:
100 ns (100 ns to 99.9 µs)
1 µs (100 µs to 999 µs)
10 µs (1 ms to 9.9 ms)
100 µs (10 ms to 100 ms)

AMPLITUDE MODULATION
Specifications are measured at 1 kHz rate, 30% AM depth, with internally leveled RF at 4 dB below maximum rated output, unless otherwise noted.
AM Input: Ac or dc coupling. BNC, front and rear panel, 600Ω impedance.
Sensitivity: 1%/V to 100%/V, selectable.
Sensitivity Accuracy:
±10% of displayed value ±1% AM plus AM flatness.
Depth: 0–90%, ≤26.5 GHz, 0-80%, >26.5 GHz with RF level at 6 dB below maximum rated output.
AM Depth Metering Accuracy: Same as Sensitivity Accuracy.
AM Bandwidth (3 dB, Pulse Off):
≤2 GHz: DC to 50 kHz or 50 Hz to 50 kHz, selectable.
>2 GHz: DC to 100 kHz or 50 Hz to 100 kHz, selectable.
AM Bandwidth with Pulse Modulation (typical):
10 kHz for pulse widths of ≥16 µs
10 kHz times the duty factor for pulse widths of <16 µs
Flatness (relative to 1 kHz rate, pulse off):
±0.3 dB from dc to 10 kHz
Distortion: <5% typical
Incidental Phase Modulation (100 Hz–10 kHz modulation rates): <0.4 radians, typical
Incidental FM: Incidental phase modulation times modulation frequency.

FREQUENCY MODULATION
FM Input: ±1 Vpk provides full range frequency deviation. BNC, front and rear panel, 600Ω impedance.
Sensitivity:
Phase-Locked Mode: 10 kHz/V to 5 MHz/V, selectable to 3 digits.
Unlocked Mode: 10 kHz/V to 25 MHz/V, selectable to 3 digits.
Accuracy: ±5% at 40 kHz modulation rate.
Maximum Deviation:
Phase-Locked Mode:
±20 times the modulation rate.
Unlocked Mode: ±25 MHz
Deviation Meter Accuracy:
±5% of full range plus FM flatness.

Table 1-3. Performance Specifications, 67XXB Swept Frequency Synthesizer (5 of 5)

Modulation Rates (3 dB BW):
Phase–Locked Mode: 100 Hz–250 kHz at ≤300 kHz/V sensitivity.
1–250 kHz (500 kHz, typical) at >300 kHz/V sensitivity.
Unlocked Mode: DC to 250 MHz (500 kHz, typical) rate.
Flatness (Relative to 40 kHz rate):
Phase-Locked Mode:
±1 dB from 200 Hz to 200 kHz (500 kHz, typical) at ≤300 kHz/V sensitivity.
±1 dB from 3 kHz to 200 kHz (500 kHz, typical) at 300 kHz/V sensitivity.
Unlocked Mode: ±1 dB from dc to 200 kHz
Distortion at 1 kHz: <10%
Incidental AM: ±0.2% per MHz deviation

INSTRUMENT STATUS (IEEE-488)

GPIB Indicators:
LED lights indicate the following conditions:
Remote: Operation on GPIB
Talk: Talking on GPIB
Listen: Listening on GPIB
SRQ: Sending a service request
Local Lockout: Disables the RETURN TO LOCAL pushbutton. Instrument can be placed in local mode only via GPIB.
Remote Operation:
All front panel functions (except line power and GPIB address) are programmable via GPIB (IEEE–488). Additional programmable commands include:
Front panel settings, stored setups, error/malfunction messages, operational status and self-test diagnostics.
GPIB Speed: 15K bytes/s
GPIB Address: Selectable from front panel.
IEEE-488 Interface Functions:
Source: SH1
Acceptor Handshake: AH1
Talker: T6
Listener: L4
Service Request: SR1
Remote Local: RL1
Parallel Poll: PP1
Device Clear: DC1
Device Trigger: DT1

GENERAL

Stored Setups: Saves front panel settings and nine additional stored setups for approximately ten years. Setups can be recovered directly by using the RECALL function or sequentially by using the SCAN function. Whenever the instrument is turned on, control settings come on at the same functions and values existing when power was removed.
Memory Sequencing Input: Accepts TTL low signal to sequence through nine stored setups. BNC, rear panel.
Self-Test: Self-test is performed when power is applied or SELF TEST key is pressed. If an error is detected, a diagnostic code appears, identifying the cause and location of the error.
Secure Mode: Front panel readouts are blanked to protect confidential test parameters.
Parameter Entry: Instrument-controlled parameters may be entered in three ways:
Keypad, control knob, or step DECR/INCR keys, the step size of which is variable via the keypad.
Controlled parameters are frequency, power level, sweep speed, dwell time, pulse width, pulse repetition rate, AM % depth, AM sensitivity, and FM sensitivity.
Entry is terminated by pressing appropriate unit key (i.e., GHz, MHz, dBm, ms, %, etc.). Values of each are displayed on LCD readout.
Reset Control: Returns test parameters to preset default values.
Warm Up Time:
From Standby: 30 minutes.
From AC Power Application: 72 hours to achieve $5X10^{-10}$ per day frequency accuracy and stability.
Output Connectors:
Models with Output Frequency ≤20 GHz: Type N female
Models with Output Frequency >20 GHz and ≤40 GHz: K female
Model 6672B: WR19 Waveguide (UG-383/U Flange)
Weight: 25 kg (55 lb) maximum
Dimensions:
133 H x 429 W x 584 D mm
(5-1/4 H x 16-7/8 W x 23 D in.)
Power:
90-130V or 200-240V, 50-400 Hz, 220 VA
(30 VA in Standby)
Standby: With ac line power connected, unit is placed in standby when power switch is released from the Operate position.

ENVIRONMENTAL

Operating Temperature Range: 0°C to 55°C
Relative Humidity: 95%
EMI: Meets the conducted and radiated emission equirements of MIL–STD–461B CE03, RE02 Part 4 Class A3 and VDE 0871/1978, Level B. Tested for conducted and radiated susceptibility per MIL–STD–462, CS02, CS06, and RS03 with no functional failures.

Table 1-4. Recommended Test Equipment

INSTRUMENT	CRITICAL SPECIFICATION	RECOMMENDED MANUFACTURER/MODEL	USE
Spectrum Analyzer with External Mixer	*Frequency:* 0.01 to 100 GHz *Resolution:* 100 Hz	Tektronix, Model 494 With Ext. Mixer PN: 015-3085-00	P, C, T
Frequency Counter	*Frequency:* 0.01 to 60 GHz *Input Impedance:* 50 Ω *Resolution:* 1 Hz *Other:* Ext Time Base Input	EIP Microwave, Inc. Model 578A, Option 91	P, C, T
Power Meter	*Power Range:* –30 to +20 dBm *Other:* GPIB Controllable	Hewlett-Packard Model 436A, with Opt. 022 (HPIB)	P, C, T
Power Sensors	*Frequency Range: 0.01 to 26.5 GHz* *26.5 to 40 GHz*	Hewlett-Packard Model 8485A, Model R8486A	P, C, T
Power Sensor	*Power Range:* 0.1 nW to 10 µW	Hewlett-Packard Model 8484A	C
Digital Multimeter	*Resolution:* 4-1/2 digits (to 20V) *DC Accuracy:* 0.002% + 2 counts *DC Input Impedance:* 10 MΩ *AC Accuracy:* 0.07% + 100 counts (to 20 kHz) *AC Input Impedance:* 1 MΩ	John Fluke, Inc. Model 8840A With Option 8840A-09 (True RMS AC)	P, C, T
Frequency Standard	*Frequency:* 10 MHz *Accuracy:* 1 x 10^{-10}/day	Spectracom Corp. Model 8161	P, C
Function Generator	*Output Voltage:* 300 mV to 10V *Functions:* 200 kHz sine wave, 100 Hz square wave	Hewlett-Packard Model 8116	P, C, T
Oscilloscope	*Bandwidth:* DC to 150 MHz *Sensitivity:* 2 mV *Horiz. Sensitivity:* 50 ns/division	Tektronix, Inc. Model 2445	P, C, T
Modulation Meter	*Frequency Input:* 10 MHz (or the IF of the spectrum analyzer) *FM Max. Deviation:* 500 kHz *FM Accuracy:* ±1% to 100 kHz rate *AM Depth:* 0% to 90% *AM Mod. Rates:* DC to 100 kHz *AM Accuracy:* ± 3% *Filters:* 50 Hz low pass, 15 kHz high pass	Hewlett-Packard Model 8901A	P, C
Scalar Network Analyzer	*Frequency Range:* 0.01 to 40 GHz	WILTRON Model 560A, with 560-7K50 Option 2 RF Detector	P, C
DC Block	150 MHz High-Pass Filter	Narda, Model 4564	P, C
Low Pass Filter	450 MHz Low-Pass Filter	Mini-Circuits, Model LP-450	P

* P = Performance Verification, C = Calibration, T = Troubleshooting

SECTION II
INSTALLATION

CONTENTS

SECTION II
INSTALLATION

2-1 INTRODUCTION

This section provides information on initial inspection, preparation for use, and General Purpose Interface Bus (GPIB) interconnections. It also includes reshipment and storage information.

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 synthesizer 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 the carrier's inspection.

2-3 PREPARATION FOR USE

Preparation for use consists of checking for the correct line voltage. The line voltage selector on the rear panel enables the synthesizer to be used with either 110V or 220V ac. Before leaving the factory, each synthesizer 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, change the LINE SELECT switch (Figure 2-1) to the correct setting and the line fuses to the correct value.

2-4 GPIB SETUP AND INTERCONNECTION

The synthesizer provides automated microwave measurements via the GPIB. The following paragraphs provide information about interface connections, cable requirements, and the addressing of the synthesizer.

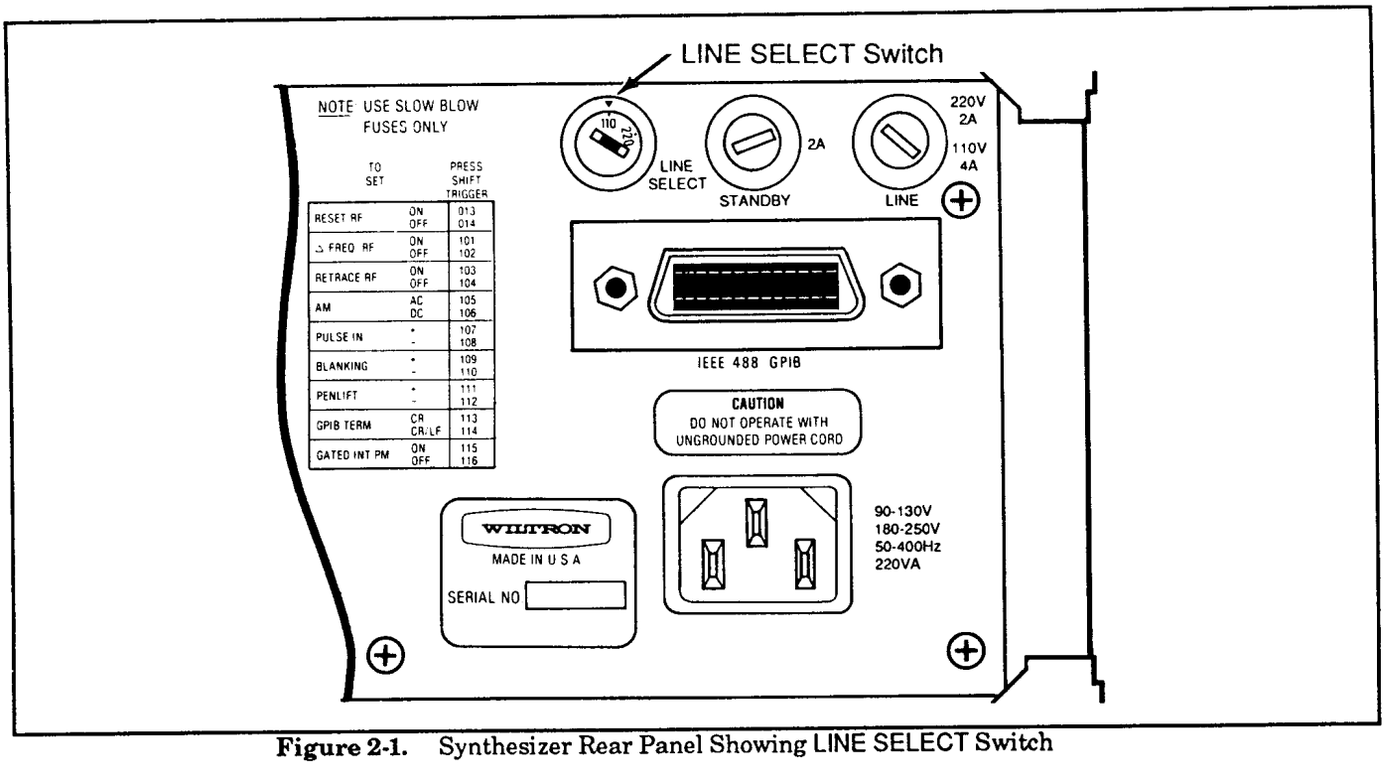


Figure 2-1. Synthesizer Rear Panel Showing LINE SELECT Switch

2-4.1 Interface Connector

Interface between the synthesizer and other devices on the GPIB is via a 24-wire interface cable. This cable uses connector shells having two connector faces. These double-faced connectors allow for the 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 15 instruments at any one time. To achieve design performance on the bus, 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 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 two times the number of bus instruments or 20 meters—whichever is less.

NOTE

For low EMI applications, the GPIB cable should be a fully shielded type, with well-grounded metal-shell connectors

2-4.3 GPIB Interconnection

The only interconnection required for GPIB operation is between the synthesizer and the controller. This interconnection is via a special GPIB cable. The WILTRON Part number for such a cable is 2000-1, -2, or -4 (1, 2, or 4 meters in length).

2-4.4 GPIB Address

The synthesizer leaves the factory preset to address 5. If a different address is desired, it can be set from the front panel, as follows:

1. Press the Shift BUS ADRS key.
2. Observe the present address number on the LEVEL display.
3. Enter a new address number from the keypad, and terminate the entry with the [KHz µSec %/ADRS] key.

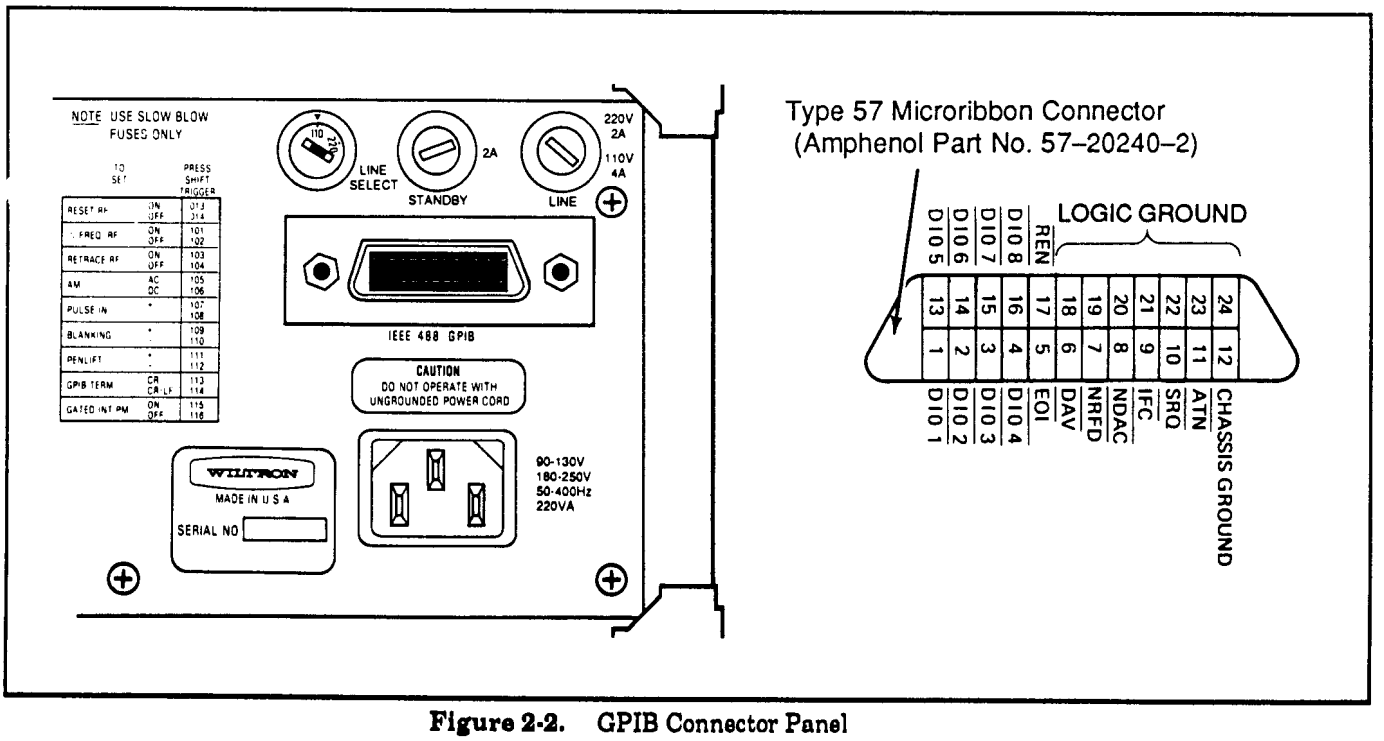


Figure 2-2. GPIB Connector Panel

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

Data is delimited on the GPIB by either the carriage return (CR) ASCII character or both the carriage return and line feed (CR/LF) ASCII characters. Which character is used depends upon the requirements of the system controller. Most modern controllers can use either CR or CR/LF, while many older controllers require one or the other. Consult the controller's manual for its particular requirements.

SHIFT, TRIGGER, 113, sets the delimiter to **CR** and **SHIFT, TRIGGER, 114,** sets the delimiter to **CR/LF**. Default condition is **CR/LF**.

2-5 PREPARATION FOR STORAGE AND/OR SHIPMENT

Paragraphs 2-5.1 and 2-5.2 give instructions for preparing the synthesizer for storage or shipment.

2-5.1 Preparation for Storage

Preparing the synthesizer for storage consists of cleaning the unit, packing the inside with moisture-absorbing dessicant crystals, and storing the unit in a temperature environment that is maintained between -40 and +70 degrees centigrade.

2-5.2 Preparation for Shipment

To provide maximum protection against damage in transit, the synthesizer should be repackaged in the original shipping container. If this container is no longer available and the synthesizer is being returned to WILTRON for repair, advise WILTRON Customer Service; they will send a new shipping container free of charge. In the event neither of these two options is possible, instructions for packaging and shipment are given below.

a. ***Use a Suitable Container.*** Obtain a corrugated cardboard carton with a 275-pound test strength. This carton should have inside dimensions of no less than six inches larger than the instrument dimensions to allow 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. Provide at least 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. For international customers, use the address of your local representative (see Table 2-1). For U.S.A. customers, use the the WILTRON address shown below.

WILTRON Company
ATTN: Customer Service
490 Jarvis Drive
Morgan Hill, CA 95037–0289

Table 2-1. WILTRON Company International Sales Representatives

ARGENTINA
I.A. ELECTRONICA S.R.L.
T.C. de Allende 430
5000 Cordoba
Telephone: (051) 32150
Telex: (390) 51894 ENTOP AR

AUSTRALIA
WILTRON PTY. LTD.
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Fax: (613) 820-9525

CHINA
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Da Hua Radio Instrument Factory
P.O. Box 2452, Beijing
Telephone: (01) 277-681 Ext. 460
FAX: (01) 201 7108

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SELECTRONICA LTDA.
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COSTA RICA
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Telex: (303) 2645 ELEPEX

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S C METRIC A/S
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DK-2850 Naerum
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Opp Taj Residency
Bangalore 560 001
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Fax: c/o 0812-563548

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ATRON ELECTRONICS LTD.
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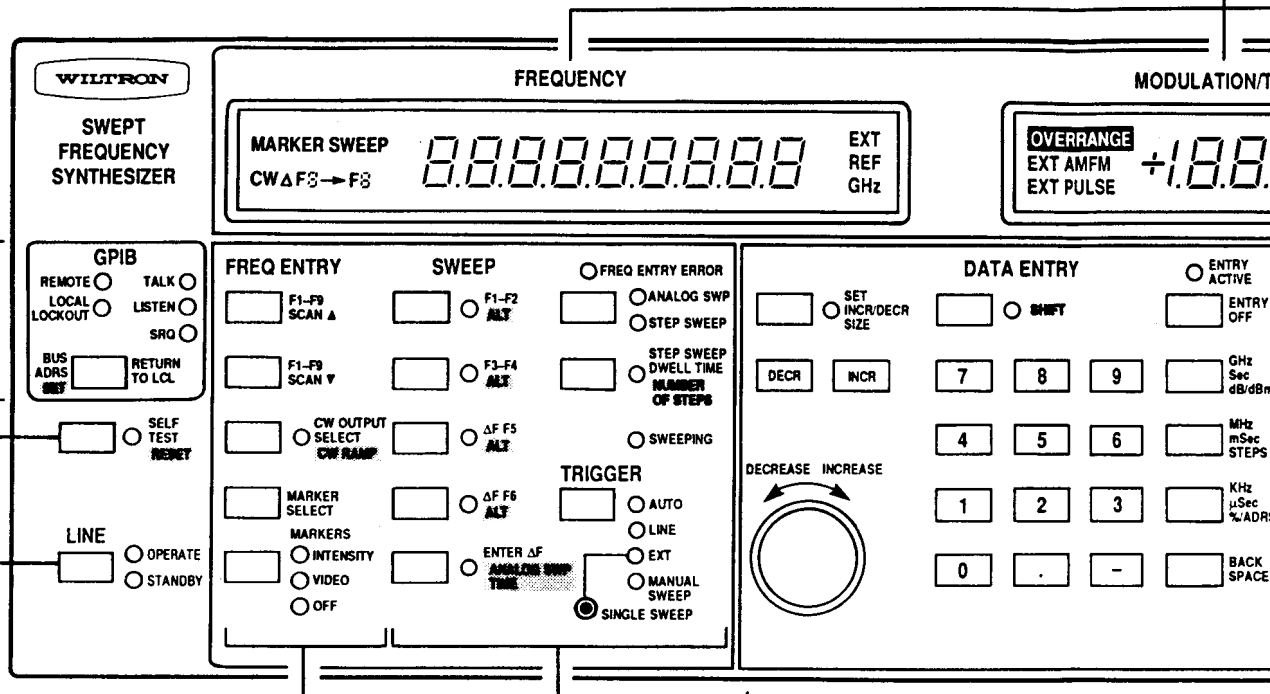
SECTION III
LOCAL (FRONT PANEL) OPERATION

CONTENTS

FREQUENCY, MOD
TIME, and LEVEL
Annunciators indica
parameters and func
LCDs display freque
and RF level values.



GPIB Indicators and Key. Indicators provide bus status and address information, while key provides for returning the synthesizer to front panel control.

SELF TEST/ RESET Keys provide for self testing the 6700B and for resetting the front panel.

LINE Key provides for turning the 6700B from STANDBY to ON.

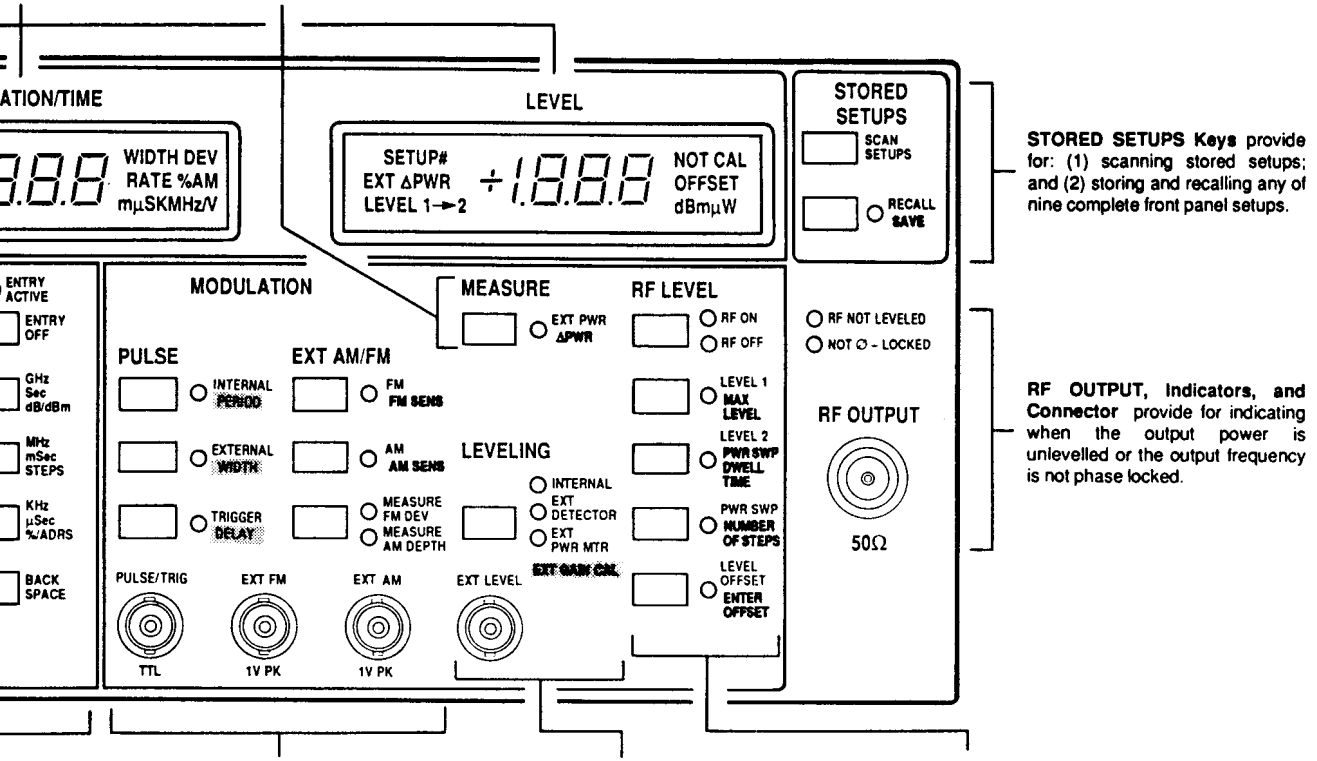
FREQUENCY ENTRY Keys provide for (1) accessing each of the nine preset frequency parameters and opening them for updating, (2) identifying as frequency markers any or all of the nine frequency parameters, (3) outputting discrete CW frequencies, and (4) selecting marker types or turning markers off.

SWEEP Keys provide for (1) selecting one of the four preset frequency sweeps, (2) entering analog sweep time and ΔF frequency values, (3) selecting between analog (continuous) or phase-locked-step sweeps, and (4) selecting a sweep triggering mode. Also, the LED indicator lights to indicate when an abonormal sweep condition has been requested.

DATA ENTRY Keys, Indicators, and Control provide for (1) entering values for each synthesizer parameter and (2) terminating the value entry and assigning the appropriate units (MHz, GHz, dB, etc.). Parameter values can be entered via either the keypad or the INCR/DECR keys or rotary knob.

Y, MODULATION/ LEVEL Displays indicate selected nd functions, while y frequency, time, values.

MEASURE Keys and Indicators provide for (1) measuring RF power with an external detector, and (2) referencing to zero the measured power at a given point.



STORED SETUPS Keys provide for: (1) scanning stored setups; and (2) storing and recalling any of nine complete front panel setups.

RF OUTPUT, Indicators, and Connector provide for indicating when the output power is unlevelled or the output frequency is not phase locked.

MODULATION Keys and Connectors provide for applying external AM or FM or internal/external pulse modulation to the output signal.

LEVELING Keys, Indicators, and Connector provide for (1) leveling the output signal internally, (2) leveling the output signal externally with either a detector or a power meter, and (3) calibrating automatically the gain of the externally leveled input signal so as to provide a stable ALC loop.

RF LEVEL Keys provide for: (1) entering RF power level values, (2) selecting power sweep and offset level functions, (3) entering offset level values, (4) selecting automatically the maximum-level power for the sweep selected, and (5) turning the RF power on or off.

SECTION III
LOCAL (FRONT PANEL) OPERATION

3-1 INTRODUCTION

This section provides information and instructions for operating the 67XXB Series equipment using the front panel controls. It includes a tutorial "Getting Started," in addition to a full description for each of the controls. It also includes rear panel connector and switch descriptions and a pinout diagram for the AUX I/O rear panel connector.

3-2 GETTING STARTED

3-2.1 Front Panel Layout

The 67XXB controls are logically grouped by function around a centrally located data-entry section, as shown in Figure 3-1. The following paragraphs provide an overview of the functional groups. Detailed descriptions of controls within each functional group are given in paragraph 3-3.

3-2.2 General Instrument Control

a. Turning the Instrument On

Press LINE from STDBY to OPERATE

When you connect the 67XXB to the line power, you automatically place the instrument in standby. This provides power to the crystal oscillator heater circuitry. STANDBY operation ensures that the crystal maintains its specified frequency accuracy and stability (5×10^{-10}/day). *Even with the crystal kept warm, however, you must still allow at least a 30-minute warmup time.*

b. Self Testing the 67XXB.

Press SELF TEST RESET

You can press the SELF TEST key anytime to self test the 67XXB. In normal operation, however, the 67XXB automatically self tests each time you switch line power from STANDBY to ON.

c. Resetting the Controls to Their Default Settings.

Press SHIFT + SELF TEST RESET

Refer to Table 3-1 for a listing of the default settings.

3-2.3 Operating the Frequency, Sweep, and Trigger Functions

a. Entering Frequency.

Press F1–F9 SCAN ▲

OR

F1–F9 SCAN ▼

to access one of the nine preset frequency parameters.

The parameter and its value is shown in the FREQUENCY display. You can change the selected parameter's value using the keypad and the appropriate terminator keys. The terminator keys are shown below.

GHz
Sec
dB/dBm

MHz
mSec
STEPS

KHz
µSec
%/ADRS

Table 3-1. RESET (Default) Parameters

67XXB MODEL NUMBER	MIN/MAX POWER LEVEL PARAMETERS (dBm)					FREQUENCY PARAMETERS (GHz)								
	LEVEL 1 (Max.) LEVEL 2 (Min.)	Standard Model (No Atten.)	Option 2A Attenuator (Hign End Freq ≤20 GHz)	Option 2B Atten (Hign End Freq >20 and ≤26.5 GHz)	Option 2C Atten (Hign End Freq >26.5 and ≤40 GHz)	F1	F2	F3	F4	F5	F6	F7	F8	F9
6709B	LEVEL 1 LEVEL 2	+10 −2	+7 −115	N/A	N/A	.01	2	.25	.5	.75	1	1.25	1.5	1.75
6709B-40	LEVEL 1 LEVEL 2	+16 +4	+13 −109	N/A	N/A	.01	2	.25	.5	.75	1	1.25	1.5	1.75
6717B	LEVEL 1 LEVEL 2	+10 −2	+7 −115	N/A	N/A	.01	8.4	1	2	3	4	5	6	7
6717B-20	LEVEL 1 LEVEL 2	+13 +1	+10 −112	N/A	N/A	.01	8.4	1	2	3	4	5	6	7
6719B	LEVEL 1 LEVEL 2	+13 +1	+10 −112	N/A	N/A	2	8.4	3	3.5	4	5	6	7	8
6721B	LEVEL 1 LEVEL 2	+10 −2	+7 −115	N/A	N/A	2	12.4	3	5	7	8	9	10	11
6721B-20	LEVEL 1 LEVEL 2	+13 +1	+10 −112	N/A	N/A	2	12.4	3	5	7	8	9	10	11
6722B	LEVEL 1 LEVEL 2	+10 −2	+7 −115	N/A	N/A	.01	12.4	2	3	5	6	8	10	11
6722B-20	LEVEL 1 LEVEL 2	+13 +1	+10 −112	N/A	N/A	.01	12.4	2	3	5	6	8	10	11
6728B	LEVEL 1 LEVEL 2	+13 +1	+10 −112	N/A	N/A	8	12.4	8.5	9	9.5	10	10.5	11	11.5
6728B-40	LEVEL 1 LEVEL 2	+16 +4	+13 −109	N/A	N/A	8	12.4	8.5	9	9.5	10	10.5	11	11.5
6729B	LEVEL 1 LEVEL 2	+10 −2	N/A	N/A	N/A	8	20	10	11	13	14	16	18	19
6729B-20	LEVEL 1 LEVEL 2	+13 +1	N/A	N/A	N/A	8	20	10	11	13	14	16	18	19
6730B	LEVEL 1 LEVEL 2	+13 +1	N/A	N/A	N/A	12.4	20	13	14	15	16	17	18	19
6730B-40	LEVEL 1 LEVEL 2	+16 +4	N/A	N/A	N/A	12.4	20	13	14	15	16	17	18	19
6736B	LEVEL 1 LEVEL 2	+7 −5	N/A	N/A	N/A	18	26.5	19	20	21	22	23	24	25
6737B	LEVEL 1 LEVEL 2	+10 −2	N/A	N/A	N/A	2	20	4	7	10	11	13	15	18
6737B-20	LEVEL 1 LEVEL 2	+13 +1	N/A	N/A	N/A	2	20	4	7	10	11	13	15	18
6740B	LEVEL 1 LEVEL 2	+10 −2	N/A	N/A	+7 −115	26.5	40	28	30	32	33	34	36	38
6745B	LEVEL 1 LEVEL 2	+10 −2	N/A	N/A	N/A	.01	18	2	5	8	10	12	14	16
6747B	LEVEL 1 LEVEL 2	+10 −2	N/A	N/A	N/A	.01	20	1	4	8	10	12	15	18
6747B-20	LEVEL 1 LEVEL 2	+13 +1	N/A	N/A	N/A	.01	20	1	4	8	10	12	15	18
6753B	LEVEL 1 LEVEL 2	+5 −7	N/A	+2 −120	N/A	2	26.5	5	8	11	14	17	20	23
6753B-10	LEVEL 1 LEVEL 2	+10 −2	N/A	+7 −115	N/A	2	26.5	5	8	11	14	17	20	23
6759B	LEVEL 1 LEVEL 2	+5 −7	N/A	+2 −120	N/A	.01	26.5	1	5	10	15	18	20	23
6759B-10	LEVEL 1 LEVEL 2	+10 −2	N/A	+7 −115	N/A	.01	26.5	1	5	10	15	18	20	23
6760B	LEVEL 1 LEVEL 2	+5 −7	N/A	N/A	+3 −120	12.4	40	16	20	24	28	31	35	38
6763B	LEVEL 1 LEVEL 2	+5 −7	N/A	N/A	+3 −120	2	40	7	11	16	21	26	32	38
6769B	LEVEL 1 LEVEL 2	0 −12	N/A	N/A	N/A	.01	40	6	10	15	20	26	32	38
6772B	LEVEL 1 LEVEL 2	0 −12	N/A	N/A	N/A	40	60	42	44	46	48	50	53	56

Notes: *1. Default maximum (LEVEL 1) and minimum (LEVEL 2) specified leveled power range limits at F1 frequency.*

Other Non-Frequency or Power Level Parameters

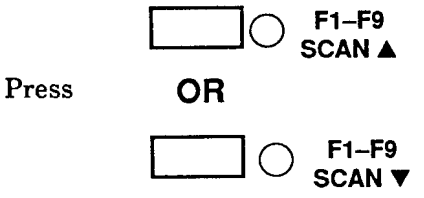
ΔF	1 GHz
Sweep Time	50 ms
AM Sensitivity	30%/V
FM Sensitivity	300 kHz/V
Step Sweep Number of Steps Dwell Time	 100 1 ms
Internal Generator Pulse Width Pulse Period	 500 µs 1 ms

Level Offset	0.0 dB
Power Sweep Dwell Time With Attenuator Without Attenuator	 100 ms 100 ms
Number of Steps	100

Step Sizes

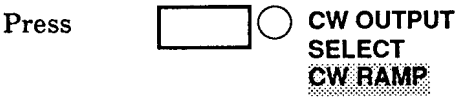
Frequency	0.1 GHz
Power Level	0.1 dB
Sweep Time	10 ms
Internal Generator Pulse Width Pulse Period	 100 µs 1 ms
Level Offset	0.1 dB
AM Sensitivity	1%/V
FM Sensitivity	10 kHz/V

b. Selecting a CW Frequency

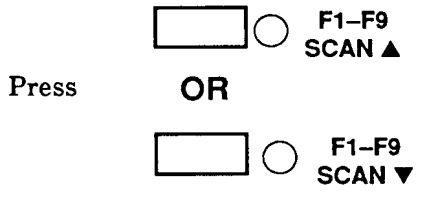


to select a frequency parameter.

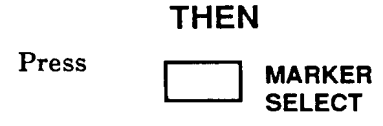
THEN



to activate that parameter as the CW output frequency. Any one of the nine parameters can be so selected. In the CW mode, one of the nine frequencies is always active.



THEN

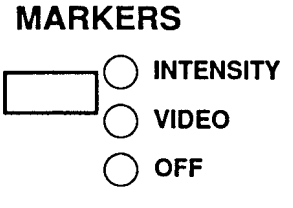


c. Using Frequency Markers

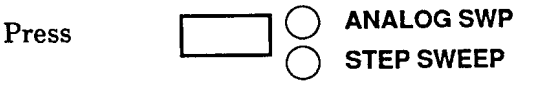
To select a frequency parameter.

1. You can select up to nine marker frequencies and turn each one on and off individually. This means that the only markers you need to have visible are the one(s) that you are currently using. Marker frequency accuracy is the same as sweep accuracy.

2. The MARKERS key (below) determines the marker type, in addition it toggles all selected markers on or off.



d. Selecting a Sweep

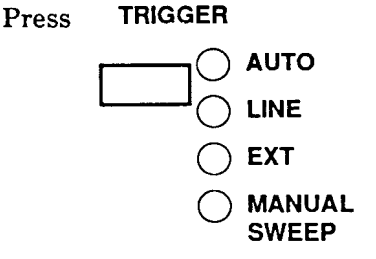


to light either the Analog or Step Sweep indicator. Analog sweep should be used when a continuous, quick sweep is desired. Each Analog Sweep is phase-lock corrected, which makes it more accurate than with a standard sweep generator. In a Step Sweep the output is a succession of phase-locked CW frequencies.

Either type of sweep (analog or step) can be selected in four ranges; F1–F2, F3–F4, ΔF F5, or ΔF F6. By having four sweep ranges available, you can preset each, then quickly switch between them as measurement needs dictate.

You can also switch between any two of your preset ranges on alternate sweeps. One application is to let you see the total band on one sweep then zoom in on a smaller area for the next sweep.

e. Triggering the Sweep



AUTO: The sweep recurs periodically with a minimum delay (hold-off) time between sweeps.

LINE: The sweep recurs at a multiple or submultiple of the 50 to 400 Hz line frequency.

EXT: Sweep recurs when triggered externally. The sweep is triggered by either pressing the associated SINGLE SWEEP button or applying a TTL pulse to the rear panel SWEEP TRIGGER INPUT connector.

MANUAL SWEEP: Provides for manually sweeping the frequency range using the DECREASE INCREASE knob. Manual sweeps are a succession of phase-locked CW frequencies.

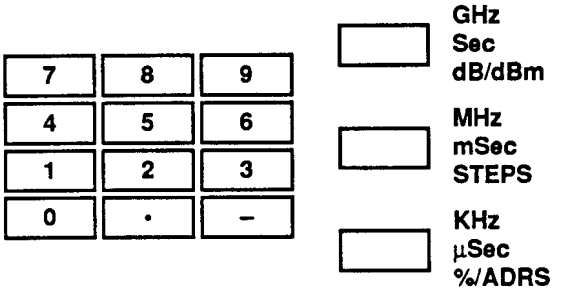
3-2.4 Entering Data

a. Using the Keypad

1. To enter frequency data:

Press [ ] ○ F1–F9 SCAN ▲ OR [ ] ○ F1–F9 SCAN ▼

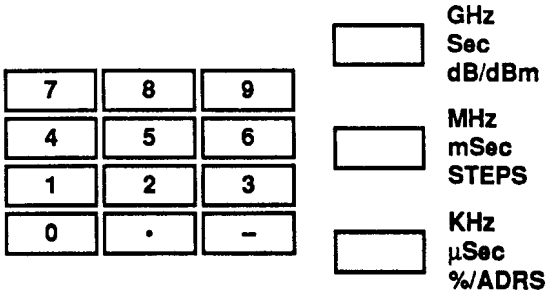
to select a frequency parameter. Then enter the desired value from the keypad and press the required terminator key.



2. To enter power level data:

Press [ ] ○ LEVEL 1 MAX LEVEL OR [ ] ○ LEVEL 2 PWR SWP DWELL TIME

to select a level parameter. Then enter the desired value from the keypad and press the required terminator key.



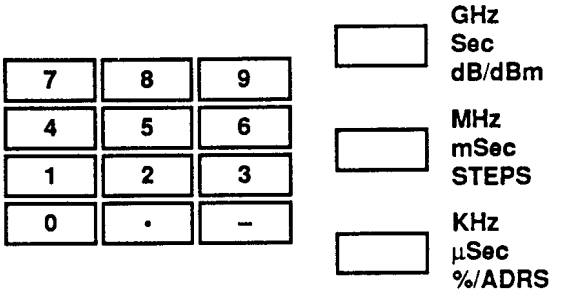
3. To enter time data:

[ ] ○ SHIFT

Press THEN

[ ] ○ ENTER ΔF ANALAOG SWP TIME

to select the sweep time parameter. Then enter the desired value from the keypad and press the required terminator key.

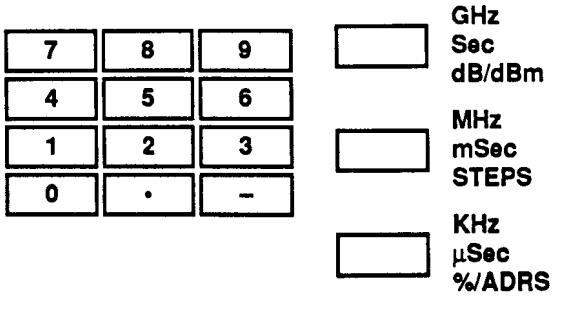


b. Using the DECR INCR Keys.

1. To select a frequency

Press [ ] ○ F1–F9 SCAN ▲ OR [ ] ○ F1–F9 SCAN ▼ THEN [ ] ○ SET INCR/DECR SIZE

Set the incremental size using the keypad and terminator keys:



Increment the frequency using the

DECR INCR keys.

2. To select a power level

Press [ ] LEVEL 1 MAX LEVEL
OR
[ ] LEVEL 2 PWR SWP DWELL TIME
THEN
[ ] SET INCR/DECR SIZE

Set the incremental size using the keypad and terminator keys. Increment the power level using the DECR INCR keys.

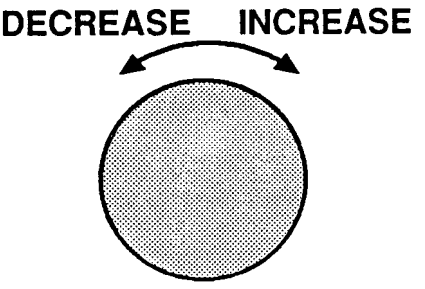
3. To select a sweep time

Press [ ] ENTER ΔF ANALOG SWP TIME
THEN
[ ] SET INCR/DECR SIZE

Set the incremental size using the keypad and terminator keys. Increment the sweep time using the DECR INCR keys.

c. Using the DECREASE INCREASE *Knob*

There are two methods available for increasing or decreasing a parameter's value using the DECREASE INCREASE knob. The first is to select the desired frequency, level, or time parameter—as shown above—then use the



knob to change the parameter value. Using this method, you increment or decrement the parameter by the minimum unit size: 1 kHz for frequency, 0.1 ms for time, 1 unit for step, and 0.1 dBm for RF level. Turning the knob rapidly changes the parameter in larger steps.

The second method uses this key to select the incremental size.

[ ] SET INCR/DECR SIZE

Refer to Figure 3-2 for an example.

Example: Increase the F1 frequency first by 10 kHz then by 963 kHz.

1. Select the F1 parameter.
2. Press the SET INCR/DECR SIZE key and enter 10 kHz using the keypad and terminator keys.
3. Press the INCR key . The frequency wil increase by 10 kHz.
4. Rotate the DECREASE INCREASE knob clockwise. The frequency will again increase by 10 kHz.
5. Press the SET INCR/DECR SIZE key then enter 963 kHz using the keypad and terminator keys.
6. Press the INCR key . The frequency wil increase by 963 kHz.
7. Rotate the DECREASE INCREASE knob. The frequency will now increase in 100 kHz increments. Note that the DECR INCR keys change a parameter by the *exact* amount programmed; whereas, the DECREASE INCREASE knob changes a parameter by *one count* of the most-significant digit programmed.

Figure 3-2. Increasing a Parameter Using the DECREASE INCREASE Knob

3-2.5 Setting Level and Modulation

a. Controlling Pulse Modulation

1. With the 67XXB, there is no need for an external pulse modulator. Modulation capability is built into the RF deck. This feature reduces the system complexity and provides better level accuracy than would an external modulator. An internal pulse generator allows you to supply the internal modulator with your choice of pulse period and width.

   (a) To select internal modulation at a period and width of your choosing,

   Press [ ] ○ INTERNAL PERIOD

   to activate the internal pulse modulator.

   (b) Select the desired modulation parameter by pressing

   [ ] ○ SHIFT
   THEN
   [ ] ○ INTERNAL PERIOD

   Enter the desired internal period value using the keypad and terminator keys.

   AND

   [ ] ○ SHIFT
   THEN
   [ ] ○ EXTERNAL WIDTH

   Enter the desired internal width value using the keypad and terminator keys.

   (c) To select delay

   Press [ ] SHIFT
   THEN
   [ ] ○ EXT TRIG DELAY

2. You can also externally pulse modulate the RF output. To do this,

   (a) Connect an external pulse or function generator to

   Front Panel PULSE/TRIG OR Rear Panel PULSE/GATE/TRIG

   (b) Press [ ] ○ EXTERNAL WIDTH

   (c) To modulate output so that a TTL-high logic pulse (+ PULSE IN) turns RF on

   Press [ ] ○ SHIFT
   THEN
   TRIGGER
   [ ]

   THEN 107 on keypad

7	8	9
4	5	6
1	2	3
0	.	–

   (d) To modulate output so that a TTL-low logic pulse (– PULSE IN) turns RF on

   Press [ ] ○ SHIFT
   THEN
   TRIGGER
   [ ]

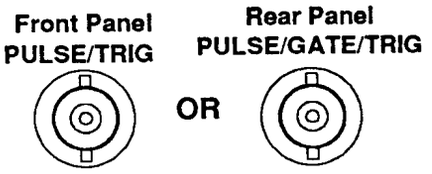
   THEN 108 on keypad

7	8	9
4	5	6
1	2	3
0	.	–

b. Gating the Pulse Modulation

For sophisticated applications, the internal pulse generator can be gated by an external signal to produce bursts of pulse-modulated-RF. To use this mode:

1. Connect an external pulse generator to either



2. To modulate output so that a TTL-high logic pulse (+ PULSE IN) turns RF off

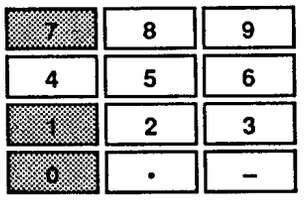
Press ☐ ○ SHIFT

THEN

TRIGGER

☐

THEN 107 on keypad



3. To modulate output so that a TTL-low logic pulse (– PULSE IN) turns RF on

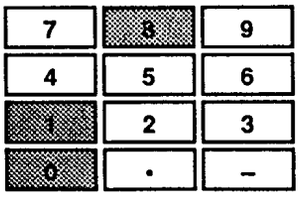
Press ☐ ○ SHIFT

THEN

TRIGGER

☐

THEN 108 on keypad



4. Select internal modulation

Press ☐ ○ INTERNAL PERIOD

to activate the internal pulse modulator.

5. Select the desired modulation parameter by pressing

☐ ○ SHIFT

THEN

☐ ○ INTERNAL PERIOD

Enter the desired internal period value using the keypad and terminator keys.

AND

☐ ○ SHIFT

THEN

☐ ○ EXTERNAL WIDTH

Enter the desired internal width value using the keypad and terminator keys.

6. Select internal gating,

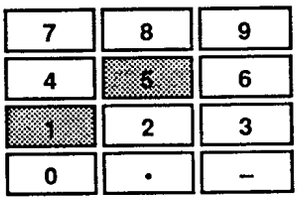
Press ☐ ○ SHIFT

THEN

TRIGGER

☐

THEN 115 on keypad



7. Set the gating width and rate on the external generator.

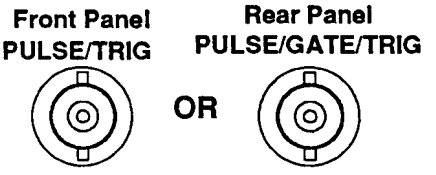
NOTE

The external gating source can be synchronized with the internal pulse generator by using the 10 MHz REF output as a frequency reference for the external generator.

8. To exit the Gated Internal Pulse mode of operation, press SHIFT, TRIGGER, 116.

c. Providing External Triggered Pulse Modulation

1. Connect the external trigger signal to



2. To trigger the internal pulse generator

Press [ ] TRIGGER DELAY

3. The pulse width is determined by the pulse width setting for internal pulse operation; its PRF (period) is determined by the external triggering signal.

4. To delay the output pulse from the external triggering signal

Press [ ] ○ SHIFT

THEN

[ ] ○ TRIGGER DELAY

5. You can adjust the delay from a minimum of 200 nsec to 100 ms, using keypad and terminator keys.

NOTE

The external triggering signal period must be less than the combined delay time plus pulse width.

6. To trigger the internal pulse generator with the leading edge of a positive-going pulse (+PULSE IN)

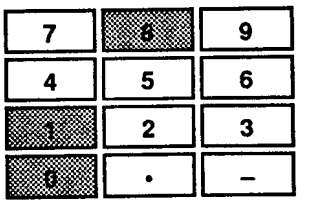
Press [ ] SHIFT

THEN

TRIGGER

[ ]

THEN 108 on keypad



7. To trigger the internal pulse generator with the leading edge of a negative-going pulse (– PULSE IN)

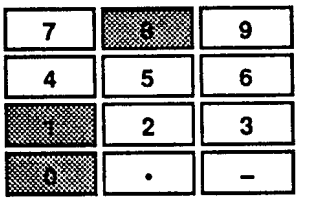
Press [ ] ○ SHIFT

THEN

TRIGGER

[ ]

THEN 108 on keypad

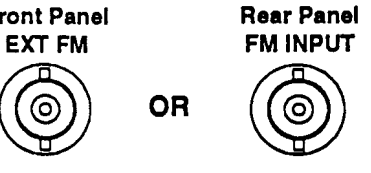


d. Providing External Amplitude or Frequency Modulation (AM or FM)

The 67XXB provides FM and AM capability. You can FM in either the phase-locked state or in a wideband unlocked mode. All three modulation methods—AM, FM, and Pulse—can be active simultaneously.

1. *Providing Frequency Modulation*

(a) Connect an external signal generator to



(b) Set the generator for an output of 2 volts peak-to-peak.

(c) Press [ ] ○ FM / FM SENS

to activate the external FM input.

(d) Select the sensitivity for FM deviation as follows:

(1) Press [ ] ○ SHIFT

THEN

[ ] ○ FM / FM SENS

(2) On the keypad, enter an FM deviation-per-volt sensitivity value of between 10 kHz and 5 MHz for phase-locked operation, or between 10 kHz and 25 MHz for unlocked operation.

NOTE

UNLOCKED operation requires disabling the YIG lock loop. To do so,

Press [ ] ○ SHIFT

THEN

TRIGGER

[ ]

THEN 080 on keypad

7	8	9
4	5	6
1	2	3
0	.	–

(3) The 67XXB then allows FM deviation sensitivities greater than 5 MHz. Be aware, however, that frequency accuracy and stability are seriously degraded in the UNLOCKED mode.

(4) To restore the 67XXB to a locked operation, (1) reduce FM sensitivity or turn off FM, then (2) repeat the above SHIFT-TRIGGER key sequence and enter **081** on the keypad.

(e) On the external signal generator, enter a modulating frequency as follows:

(1) For the phase-locked mode: Enter values between 50 Hz and 250 kHz, for sensitivity values of 300 kHz/V or less; or between 1 kHz and 250 kHz, for sensitivity values of greater than 300 kHz/V.

NOTE

In phaselock mode, peak deviation should not exceed 20X the modulating rate. Consequently, modulating generator should be set to produce frequency that is greater than the following:

$$\frac{\textit{FM Sensitivity} \times \textit{Peak Input Volts}}{20}$$

An FM OVERRANGE indication in the MOD display means either that the deviation is too great for the modulating rate or that the 1V input range has been exceeded.

(2) For the unlocked mode: On the external signal generator, enter values between dc and 250 kHz.

2. *Providing Amplitude Modulation*

(a) Connect a signal generator to

Front Panel EXT AM OR Rear Panel AM INPUT

(b) Set the generator for an output of 2 volts peak-to-peak.

(c) Press [ ] ○ AM / AM SENS

to activate the external AM input.

(d) Select the sensitivity as follows:

(1) Press [ ] ○ SHIFT

THEN

[ ] ○ AM / AM SENS

(2) On keypad, enter the desired –AM percent-per-volt sensitivity value (a number between 1 and 99.9), and

Press [ ] KHz / mSec / %ADRS

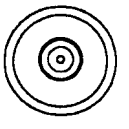
NOTE

An AM OVERRANGE indication in the MOD display means that the 1V input range has been exceeded.

3. *Leveling the Frequency Sweep*

The 67XXB offers three leveling modes: internal, external detector, and external power meter. The modes are described below.

(a) The *internal mode* uses a built-in directional coupler and detector to level the sweep at the RF OUTPUT connector. This is the default mode; it is also the mode in which you will likely make most of your measurements.



(b) The external detector mode, allows you to level the output power at the point of measurement. At this point, the synthesizer output is sensed using a directional coupler and detector and fed back to the front panel EXT LEVEL connector.

(c) The *external power meter* mode, also provides for leveling the sweep at the point of measurement. Only now, the synthesizer output is sensed using he RECORDER jack on a power meter. As with the detector mode, you feed this signal back to the front panel EXT LEVEL connector.

NOTE

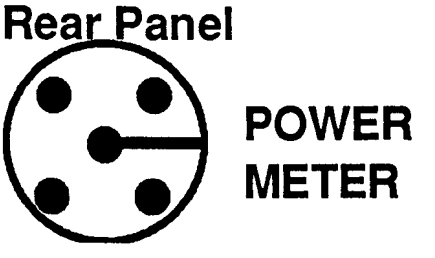
When using external leveling, you must adjust the leveling loop gain for compatibility with the external power detector (Figure 3-3).

1. Connect the external leveling coupler and detector (or power meter) together.
2. Terminate the coupler throughport for best calibration.
3. Connect the detector output to the EXT INPUT connector.
4. Press the LEVEL 1 key and set for the desired output level.
5. Press the LEVELING key to light the EXT DETECTOR or EXT PWR MTR indicator, as appropriate
6. Press SHIFT then EXT GAIN CAL to automatically calibrate the external loop gain.
7. Remove the coupler termination and connect the desired load.

Figure 3-3. External Gain Calibrate Procedure

4. *Measuring the Output Signal*

To further increase its utility, the 67XXB has the capability of measuring three of its output-signal parameters—power, FM deviation, and AM depth. The sensing head for power measurements is provided by a Series 560 detector that connects to the POWER METER jack on the rear panel.



(a) *Power Measurement Function.* This function allows you to measure the microwave power from a test device and display its value on the LEVEL display. A typical use is characterizing the loss of the cable used to connect the 67XXB to a test device. After determining the loss of the cable, you can then adjust the level offset function described in paragraph 3-2.6c to compensate. By so doing, you ensure that the LEVEL display agrees with the actual power at the end of the cable. Through the use of extender cables power measurements can be made up to 200 feet from the instrument.

(b) *AM Measurement Function.* Setting AM SENS to a percentage value, such as 30%, only provides that percentage value if the input AM is exactly 1 volt. For example, if you had called for 30% AM but your input signal was only 0.5 volt peak, then the MODULATION/TIME display will read 15% "%AM" instead of 30%. To measure AM Sensitivity, proceed as follows:

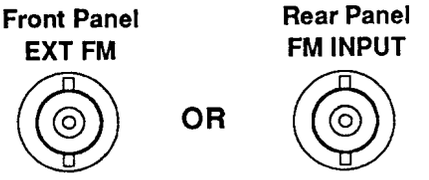
(1) Supply a modulating signal to

(2) Press ▭ ○ AM / AM SENS

(3) Press (twice) ▭ ○ MEASURE FM DEV / ● MEASURE AM DEV

(c) *FM Measurement Function.* As described for AM, above, the FM deviation values using the FM SENS settings are only valid when the input FM is exactly 1V peak. Example: If you had called for an FM deviation of 250 kHz but your input signal was only 0.5V peak, the MODULATION/TIME display will read 125 kHz/V "FM DEV" instead of 250 kHz/V. To measure FM deviation, proceed as follows:

(1) Supply a modulating signal to



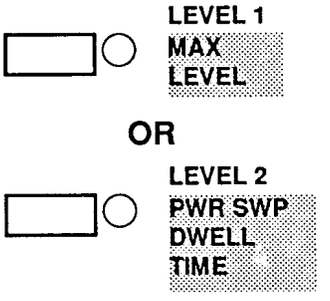
(2) Press ▭ ○ FM / FM SENS

(3) Press ▭ ● MEASURE FM DEV / ○ MEASURE AM DEV

3-2.6 Using the RF LEVEL Function

The 67XXB provides three ways for setting the output power level—static, swept, or offset. These three modes are described below.

a. Static (Non-Swept) Power Mode. In this mode you use



to set a static, non-varying output power level. Setting a different value for each of these keys lets you quickly switch from one level to another—a distinct advantage when measuring devices that must be characterized at different levels. You can also use these two keys to set the end points for the power sweep described in subparagraph b, below.

To select a static power level, proceed as follows:

1. Press [ ] ○ LEVEL 1 MAX LEVEL

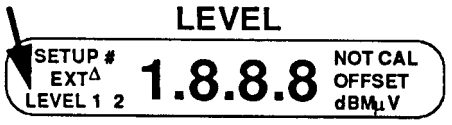
OR

[ ] ○ LEVEL 2 PWR SWP DWELL TIME

2. Enter the digits of the desired level on the keypad, then press

[ ] GHz Sec dBm

3. Observe that the requested level appears on the LEVEL display and that the appropriate LEVEL 1 or 2 annunciator appears.



b. Power Sweep Mode

In this mode, the output power is swept between two power levels. This is very useful for measuring level sensitive devices such as amplifiers. In such a measurement, you would sweep from a low to a higher level and observe amplifier gain.

1. *To power sweep*:

(a) Press [ ] ○ LEVEL 1 MAX LEVEL

(b) Enter the low level value on the keypad, and terminate using

[ ] GHz Sec dB/dBm

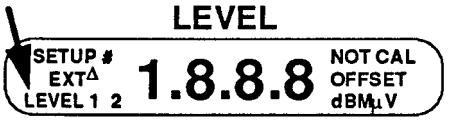
(c) Press [ ] ○ LEVEL 2 PWR SWP DWELL TIME

(d) Enter the high level value on the keypad, and terminate using

[ ] GHz Sec dB/dBm

(e) Press [ ] PWR SWP NUMBER OF STEPS

(f) Observe that the level readout on the LEVEL display sweeps from the low to the high value, and that the LEVEL 1 2 annunciator appears.



2. To change the length of time that the power remains at any one level, proceed as follows:

(a) Press [ ] ○ SHIFT

THEN

[ ] ○ LEVEL 2 PWR SWP DWELL TIME

(b) Enter the digits of the desired new value on the keypad, and terminate using

[ ] ○ GHz Sec dB/dBm

OR

[ ] ○ MHz mSec STEPS

(c) Observe that the MODULATION/TIME display shows the dwell time until shortly after the function has been terminated

3. To change the number of levels at which the power sweep dwells, proceed as follows:

(a) Press

THEN

(b) Enter the digits of the desired new value on the keypad, and terminate with

(c) The number of power steps is indicated in the LEVEL display until shortly after the function is terminated.

c. Level Offset Mode

This mode allows you to compensate for a device on the output that alters the output power level (a cable or an amplifier, for instance). The displayed level can be offset by a constant so that it accurately reflects the power level at the point of interest. As an example, let us assume that you want to compensate for a 10 dB amplifier located between the 67XXB output and the test device. Proceed as follows:

1. Press

2. Observe the that the LEVEL display indicates the power available at the RF OUTPUT connector.

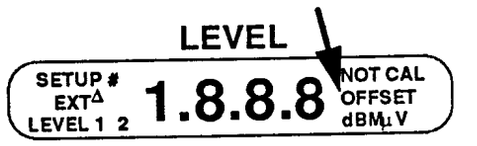
3. Press

THEN

4. Enter 10 dB from the keypad.

5. Press

6. Observe the that the displayed LEVEL value decreased by 10 dBm and that the OFFSET annunciator appears.



d. Max Level

When all the leveled power possible is needed,

Press

THEN

In a CW mode, this gives you the maximum leveled power at the present frequency setting. In a swept mode, within a few sweeps MAX LEVEL gives you the maximum level that can be sustained across the entire sweep.

3-2.7 Using Stored Setups

The 67XXB offers the capability for storing up to nine complete front panel setups.

1. To store a setup,

Press

THEN

and enter the desired setup number on the keypad The number appears on the LEVEL display.

LEVEL
7

2. To recall a stored setup,

Press [ ] ○ RECALL / SAVE

and enter the desired setup number on the keypad. The number appears on the LEVEL display.

3. To determine what setups are stored in which memory location, use

[ ] SCAN / SETUPS

Press this key several time and observe that the front panel settings change as the stored setups are sequentially recalled.

NOTE

Setup #0 automatically saves the current front panel if you have made any control changes. After a SCAN or RECALL, you can recover your ordinal front panel by pressing RECALL 0 or by scanning to Setup #0. The SAVE function also writes the old contents of the memory you are updating into Setup #0. Consequently, if you accidentally write over an important stored setup, you can still recover it as Setup #0. You cannot SAVE directly to Setup #0.

3-2.8 Monitoring the Output

The lock and level status of the microwave output is automatically monitored and displayed using LED's.

○ RF NOT LEVELED

alerts you that RF is unleveled.

○ NOT Ø-LOCKED

alerts you that the RF output signal is not phase-locked.

NOTE

The NOT Ø – LOCKED indicator is lit when in ANALOG SWEEP or UNLOCKED FM modes.

3-2.9 Controlling and Monitoring GPIB Status

All front panel functions (except line power and GPIB address) are programmable from the IEEE-488 Bus (GPIB). Additionally, the GPIB address can be read and set from the front panel.

1. To determine what address the synthesizer is set for

Press BUS ADDR / SET [ ] ○ RETURN TO LCL

If the 67XXB is not under bus control, the address number appears on the LEVEL display. When the instrument is being controlled from the bus, this key returns it to local control—provided the LOCAL LOCKOUT bus message has not been implemented.

2. To set the 67XXB for a different address:

(a) Press [ ] ○ SHIFT

THEN

BUS ADDR / SET [ ] ○ RETURN TO LCL

(b) Enter the new address number from the keypad, then press

[ ] KHz / µSec / %ADRS

3-3 FRONT PANEL DESCRIPTION

Detailed descriptions for the individual front panel keys and connectors are provided in the following paragraphs.

3-3.1 SELF TEST or RESET and LINE Keys (Figure 3-5)

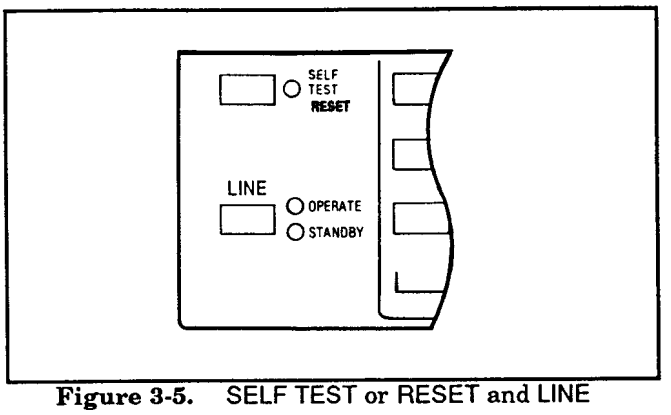


Figure 3-5. SELF TEST or RESET and LINE Keys

a. **SELF TEST *or* RESET *<Shifted> Key***

SELF TEST: Provides an instrument self test. If the self test is unsuccessful, an error code will appear on the FREQUENCY display.

RESET: Presets the front panel to the factory-selected settings. It also clears the GPIB interface.

NOTE

Pressing this key clears the front panel setup presently in place. If that setup is needed for future testing, save it as a stored setup before pressing RESET.

b. **LINE *Key***

When in the OPERATE position, this key supplies a dc control voltage to the power supply circuits—thus activating the instrument. In standby, the instrument is deactivated, except for the 10 MHz crystal standard and oven.

CAUTION

Power is always applied to this circuit when the instrument is connected to an ac source.

Two LEDs indicate whether the 67XXB is in the POWER OPERATE or STANDBY mode.

3-3.2 FREQ ENTRY Keys (Figure 3-6)

a. **F1-9 SCAN *Up/Down Keys***

These keys provide two functions: They sequence through each of the nine preset frequency parameters (F1-F9), and they access and open for updating the parameter that is annunciated on the RF frequency display. Pressing and releasing these keys sequence the parameters discretely, starting with the on that had been displayed when the mode was last exited. The sequencing order for the F1–F9 SCAN▲ key is up from F1 to F9 and that for F1-F9 SCAN▼ key is down from F9 to F1. Pressing and holding either key sequences the parameters continuously. Parameter updating is accomplished using the DATA ENTRY keys (paragraph 3-3.4).

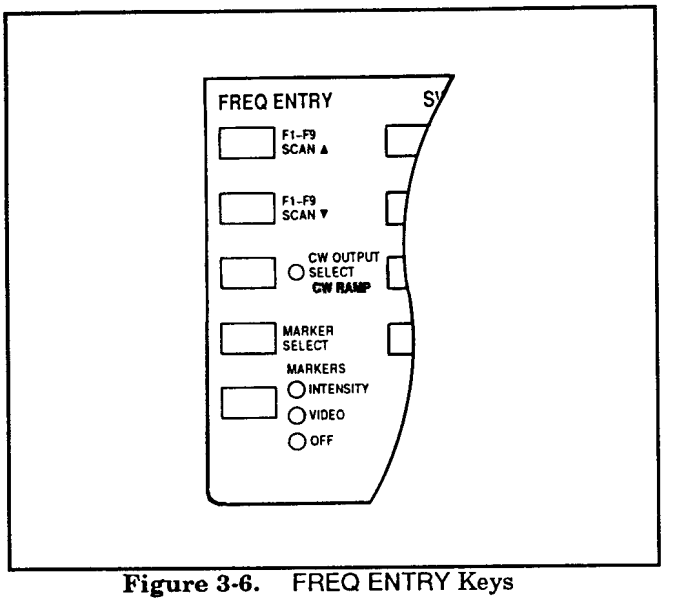


Figure 3-6. FREQ ENTRY Keys

Sequencing through the nine preset frequencies as described above, does not cause the output frequency to change. These keys allow a frequency parameter to be accessed and to have its value changed without disturbing the frequency then being output—except when the frequency being changed has been selected as an output.

b. **CW OUTPUT SELECT *or* CW RAMP *<Shifted> Key***

CW OUTPUT selects the frequency displayed in the frequency display to be output at the RF OUTPUT port. It lights the associated LED to indicate that the CW function is active.

This key is interlocked with sweep keys F1-F2, F3-F4, ΔF F5, and ΔF F6 so that only one of these functions can be active.

CW RAMP causes a horizontal ramp to be applied to the rear panel HORIZONTAL OUTPUT BNC connector for driving an analyzer display.

c. **MARKER SELECT *Key***
This key selects as a potential frequency marker the frequency parameter then being annunciated on the FREQUENCY display. The *potential* marker becomes an *actual* marker when the MARKERS key is pressed to light either the VIDEO or INTENSITY indicators. Any of the nine stored frequencies can be labeled as markers by using the F1-F9 SCAN and MARKER SELECT keys.

This key in conjunction with the MARKERS key described below allows the frequency markers to be enabled individually or altogether.

d. **MARKERS VIDEO, INTENSITY, *or* OFF *Key***
The INTENSITY position enables as an intensity marker each of the frequency parameters that has been identified as a potential marker (see above)—*provided that the marker is within the sweep frequency range.*

The VIDEO position enables as a video marker each of the frequency parameters identified as a potential marker (see above)—provided that the marker is within the sweep frequency range. The video marker is a +5V pulse at the rear panel.

The OFF position turns off all selected markers. This key, in conjunction with the MARKERS key, allows the video markers to be enabled individually or altogether.

3-3.3 SWEEP and TRIGGER Keys and Indicators (Figure 3-7)

a. **F1–F2 *or* ALT *<Shifted> Key***
F1–F2 selects the F1-to-F2 sweep mode. When activated, the associated LED lights and the two frequency values, along with the SWEEP and F1–F2 annunciators, appear on the FREQUENCY display. Parameters F1 and F2 can be accessed using the F1–F9 SCAN up or down keys; their values can be changed using the DATA ENTRY keys. Nine markers are available, providing that their frequency is within the sweep range.

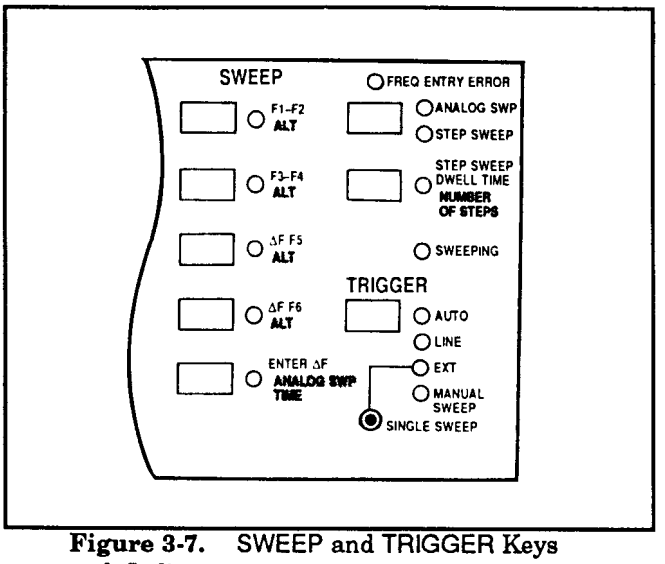


Figure 3-7. SWEEP and TRIGGER Keys and Indicators

ALT selects any one of the four stored sweeps to alternate with the primary sweep previously selected. The two end-point frequencies of the primary sweep, along with the sweep's annunciators, are displayed on the FREQUENCY display. The end-point frequencies of the primary sweep may be viewed using the F1–F9 SCAN up or down key without leaving the ALT sweep mode. The two frequencies may then be changed using the DATA ENTRY keys.

The associated LED lights to indicate which sweep is in progress.

b. **F3–F4 *or* ALT *<Shifted> Key***
F3–F4 functions the same as F1–F2 above. All nine markers are available in this sweep mode also, provided they fall within the sweep range. Markers F3 and F4 appear at their respective ends of the sweep.

ALT functions the same as ALT above.

c. **ΔF F5 *or* ALT *<Shifted> Key.***
ΔF F5 selects the ΔF F5 sweep mode. In this mode, the frequency sweeps symmetrically about the F5 frequency. The width of this sweep is determined by the ΔF frequency parameter. Up to four digits of both the F5 and ΔF frequencies appear on the FREQUENCY display—the F5 frequency appears on the left and the ΔF frequency on the right.

All nine markers are available. The F5 marker, if chosen, appears at the center of the sweep.

The associated LED and the FREQUENCY display SWEEP and F5 annunciators light when the function is activated.

ALT functions the same as ALT above.

d. **ΔF F6 *or* ALT *<Shifted> Key***
ΔF F6 functions the same as ΔF F5 above. All nine markers are available in this sweep mode also. The F6 marker, if chosen, appears in the middle of the sweep.

ALT functions the same as ALT above.

e. **ENTER ΔF *or* ANALOG SWP TIME *<Shifted> Key*** ENTER ΔF accesses the ΔF parameter and opens it for updating using the DATA ENTRY keys. Up to four digits of both the F5 and ΔF frequencies appear on the FREQUENCY display—the F5 frequency appears on the left and the ΔF frequency on he right.

The associated LED lights when this parameter is open for entry.

ANALOG SWP TIME accesses the sweep time parameter and opens it for updating using the DATA ENTRY keys. The sweep time is selectable from 30 ms to 99 s. The three most-significant digits of the sweep time appear on the MODULATION/TIME display.

The associated LED lights when this parameter is open for entry.

f. **FREQ ENTRY ERROR *Indicator***
This indicator flashes to indicate that the selected sweep-start frequency is greater than or equal to the selected sweep-stop frequency. It will also flash if ΔF exceeds the instrument's frequency range. To clear this condition, enter the correct frequency values or select a different sweep mode.

g. **ANALOG SWP *or* STEP SWEEP *Key***
This key selects either the ANALOG SWEEP or STEP SWEEP mode. Two LEDs indicate the current operating mode. In the ANALOG SWEEP mode, the output frequency is swept continuously between its F1–F2, F3–F4, ΔF F5, or ΔF F6 frequency limits. The sweep is phase-lock corrected at both the low and high ends of the band and at each bandswitch point.
In any sweep mode, when the sweep width is ≤50 MHz only the midpoint frequency is phase-lock corrected.

In the STEP SWEEP mode, the frequency changes in discrete, synthesized steps between the F1–F2, F3–F4, ΔF F5, or ΔF F6 frequency limits. The number of steps between endpoints and the dwell-time-per-step can be specified as outlined in paragraph 3-3.3h below.

h. **STEP SWEEP DWELL TIME *or* NUMBER OF STEPS *<Shifted> Key***
STEP SWEEP DWELL TIME accesses the dwell-time parameter of the synthesized step sweep and opens it for updating using the DATA ENTRY keys. This parameter defines the length of time that the synthesized step sweep dwells at each frequency point. Dwell time is selectable from 1 ms to 99 s. The tree most-significant digits appear on the MODULATION/TIME display.

The associated LED lights when this parameter is open for entry.

NUMBER OF STEPS accesses the number-of-steps parameter of the synthesized step-sweep and opens it for updating using the DATA ENTRY keys. This parameter defines the number of discrete steps taken by the step-sweep when traveling between its low- and high-end frequencies. The parameter is selectable from 1 to 1800 steps. The step setting appears on the LEVEL display.

The associated LED and the # symbol on the LEVEL display light when this parameter is open for updating.

i. **SWEEPING *Indicator***
The sweeping LED lights during the forward portion of each sweep. It also lights when the CW RAMP function is selected.

j. **TRIGGER *Key***
This key sequences between the AUTO, LINE, and EXT sweep triggering modes and the MANUAL SWEEP mode. The associated LEDs

indicate which one of the triggering/sweep modes has been selected.

In the AUTO mode, the sweep continually sweeps from its low- to its high-end frequency with optimal retrace time.

In the LINE mode, the sweep is triggered to start by the power-line-voltage waveform.

In the EXT mode, the sweep can be triggered to start in either of two ways: by applying an external TTL-compatible clock pulse to the rear panel SWEEP TRIGGER INPUT or by momentarily pressing the associated SINGLE SWEEP button. The sweep starts either when the button is pressed or with the positive leading edge of the clock pulse. If a sweep is in progress when either of these events occurs, it will abort and reset.

In the MANUAL SWEEP mode, the output frequency can be manually tuned from its low- to its high-end frequency using the DECREASE INCREASE knob. The output frequency changes in phase-locked steps and appears on the FREQUENCY display

3-3.4 DATA ENTRY Keys, Indicators, and Control (Figure 3-8)

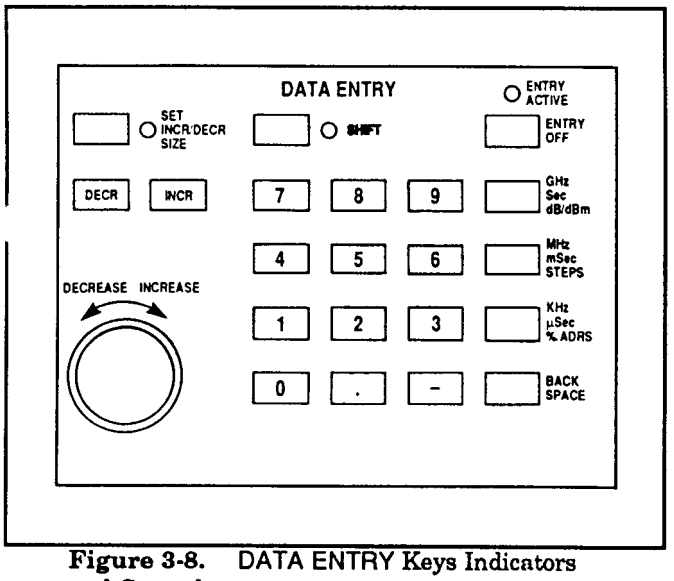


Figure 3-8. DATA ENTRY Keys Indicators and Control

a. **SET INCR/DECR SIZE *Key***
This key accesses the increase/decrease-size parameter and opens it for updating using keypad. For example, the output frequency size is selectable in steps of from 1 kHz up to the value of the synthesizer's top-end frequency. The size, in GHz, appears on the FREQUENCY display. After entering the size value and terminating it in its proper units (kHz, dBm, ms, etc.), (1) the size parameter closes, (2) the parameter that was opened immediately prior to pressing this key reopens, and (3) the FREQUENCY display again displays that parameter's value.

A different increment-size-value can be entered for frequency, time, RF level, and number of of steps.

b. **INCREASE *Key***
This key increments a frequency, time, RF level, or step parameter by the value that has been set using the SET INCR/DECR SIZE key. Pressing and releasing the key increments the size in discrete steps. Holding the key depressed greater than 0.5 seconds increments the size at a 3 Hz rate. The increment key only affects open parameters.

c. **DECREASE *Key***
This key decrements a frequency, time, RF level, or step parameter in the same manner described for the INCREASE key above.

d. **DECREASE INCREASE *Knob***
This control decreases or increases a parameter's size by a preset resolution, when turned slowly. Turning the knob rapidly changes the parameter's value in larger steps. The SET INCR/DECR SIZE key can be used to change the knob's minimum resolution. See Figure 3-2, on page 3-7, for an example.

e. ***Keypad***
The numeric keypad provides for entering frequency, time, RF level, percentage, FM sensitivity, and number-of-steps values.

f. **ENTRY ACTIVE *Indicator***
This LED lights to indicate that a parameter has been accessed and is open for updating.

g. **ENTRY OFF *Key***
This key closes the parameter previously accessed. It can be used to ensure that all

parameters are closed (to prevent accidental parameter changes).

h. **GHz Sec dB/dBm *Key***
This key terminates a keypad data entry and assigns the appropriate units. An F1–F9 or ΔF frequency entry may be terminated in MHz; however, it is always displayed in GHz.

i. **MHz mSec STEPS *Key***
This key terminates a keypad data entry and assigns the appropriate units. An F1–F9 or ΔF frequency entry may be terminated in MHz; however, it is always displayed in GHz.

j. **kHz μSec %/ADRS *Key***
This key terminates a data entry via the keypad and assigns the appropriate units. A frequency entry may be terminated in kHz; however, it is always displayed in GHz.

k. **BACKSPACE *Key***
This key deletes the last number or decimal point entered from the keypad.

3-3.5 MODULATION and AM/FM Keys and MODULATION Connectors (Figure 3-9)

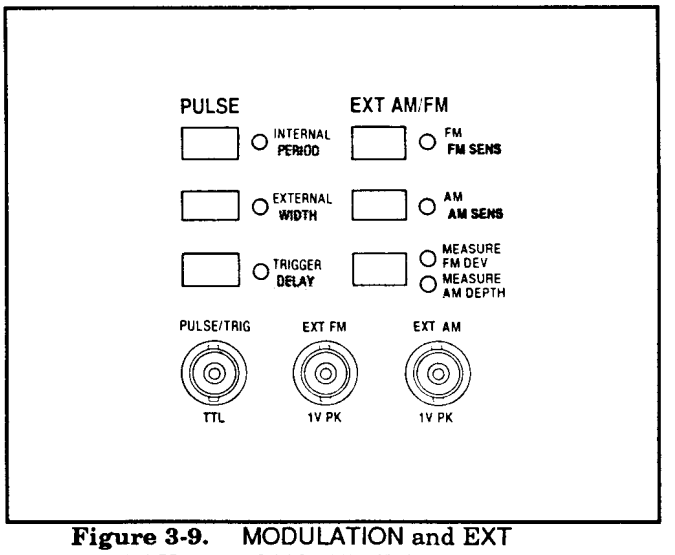


Figure 3-9. MODULATION and EXT AM/FM Keys and MODULATION Connectors

a. **INTERNAL *or* PERIOD *(Shifted) Key***
INTERNAL activates the built-in pulse generator, which then controls the internal pulse modulator. In this mode, the RF output is modulated by a pulse train for which the pulse width and rate is selectable using shift-plus-trigger routines (paragraph 3-2.5a) (SHIFT, TRIGGER, 115 turns gating on, and SHIFT, TRIGGER, 116 turns gating off.

The associated LED lights when this mode is selected.

PERIOD accesses the pulse-period parameter and opens it for updating using the DATA ENTRY keys. Values of 1 μsec to 100 msec may be entered.

The associated LED lights when this mode is selected.

b. **EXTERNAL *or* WIDTH *(Shifted) Key***
EXTERNAL accesses the external modulation mode; whereby, the internal pulse modulator is driven by a TTL signal from an external function generator connected to the PULSE/TRIG connector.

The associated LED lights when this parameter is open for updating.

WIDTH accesses the pulse-width parameter, and opens it for updating using the DATA ENTRY keys. Values of 0.025 μs to 99 ms may be entered.

The associated LED lights when this parameter is open for entry.

c. **TRIGGER *or* DELAY *<Shifted> Key***
TRIGGER allows triggering the internal pulse generator with an external signal. The pulse width is determined by the internal width setting and the PRF or period is determined by the external triggering signal. Typical minimum delay is 200 seconds. This delay may be increased to 100 ms by setting the DELAY.

The associated LED lights when this parameter is open for updating.

DELAY sets the period of time from when an external trigger is received until the pulse is initiated. The delay may be adjusted from 200 nsec to 100 msec.

NOTE

The external trigger pulse width must be less than the programmed pulse width plus programmed delay.

The associated LED lights when this function is active.

d. **MODULATION *Connectors***
PULSE/TRIG lets you use an external TTL level to trigger the internal pulse generator. The polarity (TTL high-active or TTL low-active) of the gating signal is selectable via either the GPIB or front panel shift-plus-trigger routines (paragraph 3-2.5a) (SHIFT, TRIGGER, 107 for + PULSE IN or SHIFT, TRIGGER, 108 for – PULSE IN).

EXT FM provides for applying an FM signal to the RF output. The deviation is proportional to input voltage, with sensitivity selectable from either the front panel or the GPIB. Input impedance is 600 ohms.

EXT AM provides for applying a linear AM signal to the RF output. Sensitivity is front panel or GPIB controllable. It is variable between 1%/V and 99.9%/V. The usable input range is ±1V. Input impedance is 600 ohms.

e. **FM *or* FM SENS *(Shifted) Key***
FM selects the external FM mode; whereby, the output signal can be frequency modulated via either the front panel EXT FM or the rear panel FM INPUT connector. You use front panel shift-plus-trigger routines (paragraph 3-2.5d) to switch between locked and unlocked FM. SHIFT, TRIGGER, 080 allows for unlocked FM and SHIFT, TRIGGER, 081 allows for locked FM. Default is locked FM.

FM SENS accesses the FM modulation-sensitivity parameter and opens it for updating using the DATA ENTRY keys. Sensitivity range is (1) 10 kHz/V to 5MHz/V in locked FM mode and (2) up to 25 MHz/V in unlocked FM mode. The INCR or DECR key can be used to sequence up or down through these values. Maximum usable input range is ±1V.

The associated LED lights when the function is activated.

f. **AM *or* AM SENS *(Shifted) Key***
AM selects the external AM mode; whereby, the output signal can be amplitude modulated via either the front panel EXT AM or the rear panel AM INPUT connector. SHIFT, TRIGGER, 105 AC couples the input signal, and SHIFT, TRIGGER 106 DC couples the input signal. Default is DC coupled AM.

The associated LED lights when the function is activated.

AM SENS accesses the AM modulation-sensitivity parameter and opens it for updating using the DATA ENTRY keys. Discrete values of 1%/V to 100%/V may be entered using the DATA ENTRY keys.

The associated LED lights when this parameter is open for updating.

g. **MEASURE FM DEV *and* MEASURE AM DEPTH *(Toggle)* Key**
MEASURE FM DEV enables the FM deviation measurement function, displays the measured deviation in the Modulation/Time display, and lights the MEASURE FM DEV LED. The function measures the voltages of the external modulation signal and calculates the peak frequency deviation.

MEASURE AM DEPTH enables the AM depth measurement function, displays the measured depth in the MODULATION/TIME display, and lights the MEASURE AM DEPTH LED. The function measures the voltage of the external modulation signal and calculates the percentage modulation value.

3-3.6 MEASURE Key and Indicator (Figure 3-10)

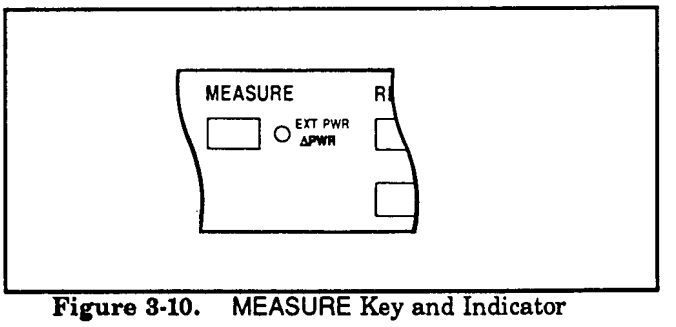


Figure 3-10. MEASURE Key and Indicator

EXT POWER selects the external power measuring function; whereby, RF power is measure and displayed on the LEVEL display. The power is measured with a 560-7 Series RF Detector connected to the rear panel POWER METER connector.

The associated LED lights when this function is selected.

ΔPWR selects the power-difference measurement function. You must activate the MEASURE EXT PWR function before using the ΔPWR function. Measured power at the time ΔPWR is activated becomes a reference level and the display is set to 0 dB. Subsequent changes in measured power with respect to the reference level are then displayed in dB.

3-3.7 LEVELING or EXT GAIN CAL Key, Indicators, and Connector (Figure 3–11)

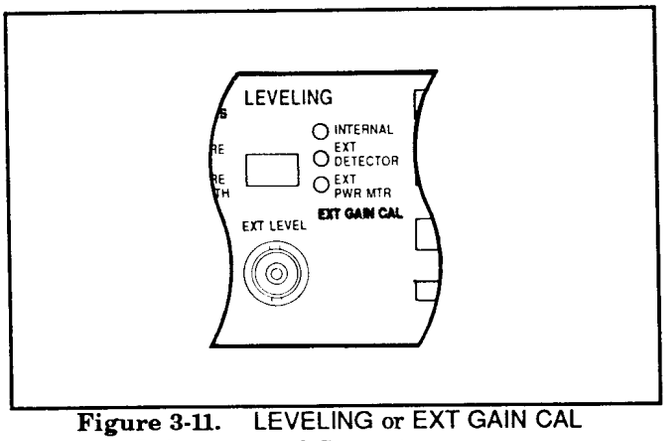


Figure 3-11. LEVELING or EXT GAIN CAL Key, Indicators, and Connector

The INTERNAL position selects the internal leveling mode; whereby, leveling is accomplished using the internal directional coupler and detector.

The EXT DETECTOR position selects a mode whereby an external detector can be used to level the output signal. The signal from this detector, which is applied to the EXT LEVEL connector, can be either positive or negative.

The EXT PWR MTR position selects a mode whereby the recorder voltage from a compatible power meter can be used to level the output signal. This voltage which is applied to the EXT LEVEL connector, can be either positive or negative. The 67XXB is compatible with power meters having a ±1V full scale analog output, such as the HP 431/432, HP 435/436, and PM 1009/1010 models.

EXT GAIN CAL adjusts the EXT LEVEL input gain to make the ALC loop stable when leveling with an external detector or power meter.

3-3.8 RF LEVEL Keys and Indicators (Figure 3-12)

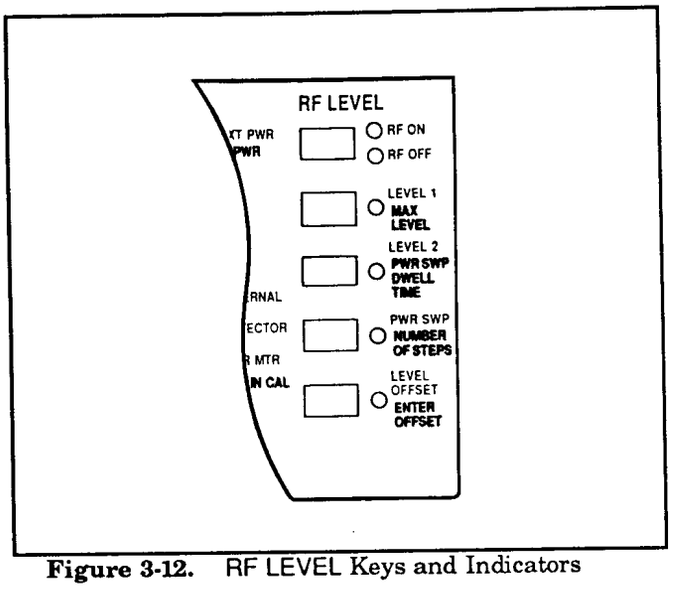


Figure 3-12. RF LEVEL Keys and Indicators

a. **RF ON *or* RF OFF *Key***

This key turns the RF output power on or off.

b. **LEVEL 1 *or* MAX LEVEL**

LEVEL 1 accesses the level 1 parameter and opens it for updating using the DATA ENTRY keys. The three most-significant digits of the power-level value appear on the LEVEL display.

The associated LED lights when this parameter is open for entry.

MAX LEVEL selects the maximum leveled power function. This function sets the RF power to the maximum-leveled value that can be maintained either at the current CW frequency or across the current frequency-sweep range.

The associated LED lights momentarily when this function is selected.

c. **LEVEL 2 *or* PWR SWP DWELL TIME *<Shifted> Key***

LEVEL 2 accesses the level 2 parameter and opens it for updating using the DATA ENTRY keys. The three most-significant digits of the power level value appear on the LEVEL display.

The associated LED lights when this parameter is open for entry.

PWR SWP DWELL TIME accesses this parameter, and opens it for updating using the DATA ENTRY keys. This parameter provides for dwelling (stopping) the power sweep at each power level for a specified length of time. Dwell times of from 50 ms to 10 s may be entered; their value appears on the MODULATION/TIME display.

The associated LED lights when this parameter is open for entry.

d. **PWR SWP *or* NUMBER OF STEPS <Shifted> Key**

PWR SWP selects the power sweep mode, whereby the leveled output power sweeps between levels 1 and 2. The power level can sweep from a high level to a low level or vice versa. That is, the LEVEL 1 value can be greater or lesser than the LEVEL 2 value.

The associated LED lights when this mode is selected.

NUMBER OF STEPS accesses the level sweep step parameter and opens it for updating using the DATA ENTRY keys. This parameter defines the number of steps that the sweep takes when transitioning between LEVEL 1 and LEVEL 2. The step setting is displayed on the LEVEL display and can be set for any number between 1 and 1000.

The associated LED lights when this parameter is open for entry.

NOTE

The synthesizer can interleave power and frequency sweeps. If you select both frequency and power sweeps, for each step of the power sweep, a frequency sweep occurs.

e. **LEVEL OFFSET *or* ENTER OFFSET *<Shifted> Key***

LEVEL OFFSET selects the level offset function. In this mode, the LEVEL display can be offset from the actual RF output level by a selectable value to compensate either for the loss of an external transmission line or for the gain of a test device.

The associated LED lights when this function is selected.

ENTER OFFSET accesses the power-offset parameter and opens it for updating using the DATA ENTRY keys. Parameter values can range between ± 99.9 dB.

NOTE

The largest number that can be displayed is plus or minus 199.9 dBm.

The associated LED lights when this parameter is open for entry.

3-3.9 RF Indicators and RF OUTPUT Connector (Figure 3-13)

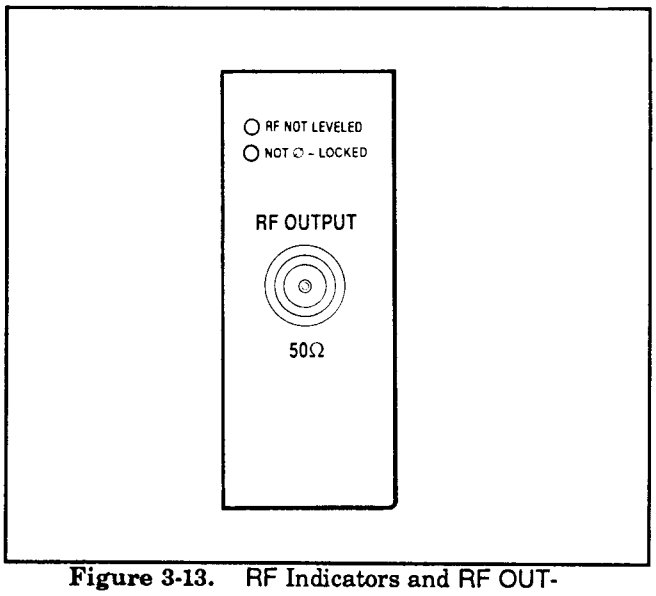


Figure 3-13. RF Indicators and RF OUTPUT Connector

a. **RF NOT LEVELED**

The LED lights when the RF output goes unleveled. The LEVEL display is not accurate if this indicator is lit.

b. **NOT Ø – LOCKED**

The LED lights when the output frequency is not phase locked. The frequency accuracy and stability of the RF output is greatly reduced if this LED is lit.

c. **RF OUTPUT**
The connector provides RF output from a 50 ohm source.

NOTE

To prevent power losses due to an impedance mismatch, the mating connector and cable should also be rated at 50 ohms.

3-3.10 STORED SETUPS Keys (Figure 3-14)

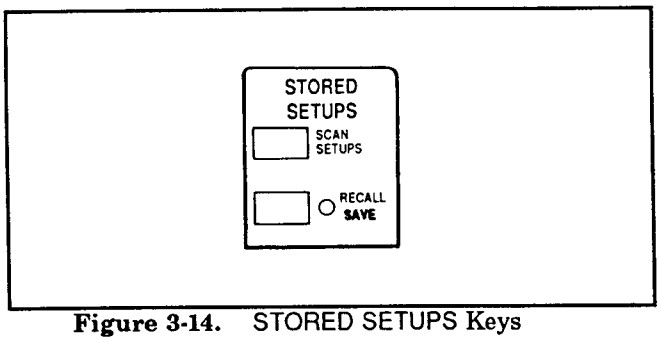


Figure 3-14. STORED SETUPS Keys

a. **SCAN SETUPS *Key***
This key sequences upward through the nine stored setups, the numbers (#) of which appear on the LEVEL display. The upward sequence starts with the setup number *following* the one that appeared when the mode was last exited. An external, normally open switch connected to the rear panel MEMORY SEQ INPUT also can be used to scan the setups.

b. **RECALL *or* SAVE *<Shifted> Key***
RECALL recalls a stored setup, the number of which is entered on the keypad. When you recall a new setup, the new setup replaces the previously active front panel settings. The old settings are automatically saved as Setup #0, except when the old settings are an unmodified recalled setup. The number of the recalled setup is shown on the LEVEL display. The associated LED lights when this function has been selected.

SAVE saves the current front panel settings into one of the nine available memory locations, the number of which is entered on the keypad. The setup number appears on the LEVEL display. You cannot SAVE directly to Setup #0.

3-3.11 FREQUENCY, MODULATION/ TIME, and LEVEL Displays (Figure 3-15)

a. **LEVEL *Display***
This readout displays RF output and measured power in dBm. It also displays a stored-setup number and the number-of-steps parameter. Annunciators indicate when the RF output is uncalibrated. (The NOT CAL annunciator lights when external leveling has been selected, but the EXT GAIN CAL key has not been pressed.) Annunciators also indicate which mode has been selected: LEVEL 1 or 2, OFFSET, MEASURE, and POWER SWEEP 1 → 2.

b. **MODULATION/TIME *Display***
This readout displays the following:

- Sweep and dwell times
- Pulse width and rate
- FM deviation and modulation sensitivity
- AM depth and modulation sensitivity

Sweep and dwell times appear in MHz, kHz, and Hz; FM deviation appears in MHz and kHz; and AM depth appears in %. Annunciators indicate when overrange conditions exist, and they announce what modulation mode has been selected: that is, INT PULSE, EXT PULSE, EXT FM, EXT AM.

c. **FREQUENCY *Display***
This readout displays in GHz the nine preset RF parameters (F1–F9) and up to 4 digits of the

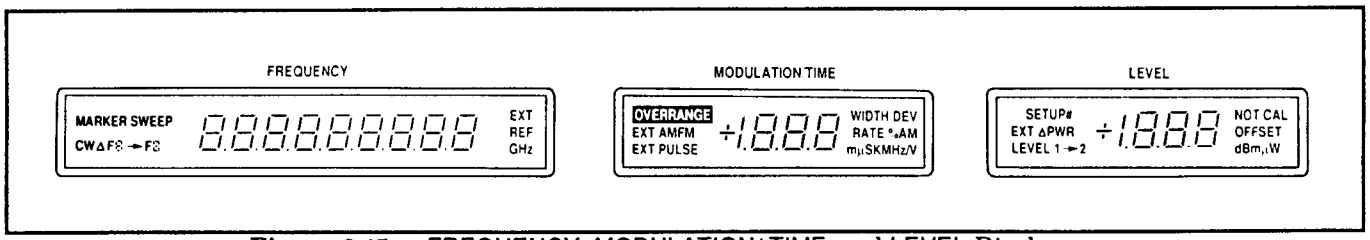


Figure 3-15. FREQUENCY, MODULATION/ TIME, and LEVEL Displays

sweep-range end-frequencies and ΔF frequency. Annunciators indicate which parameter's frequency is being displayed and whether it has been selected as a marker.

3-3.12 GPIB Indicators and BUS ADRS/ RETURN TO LCL Key (Figure 3-16)

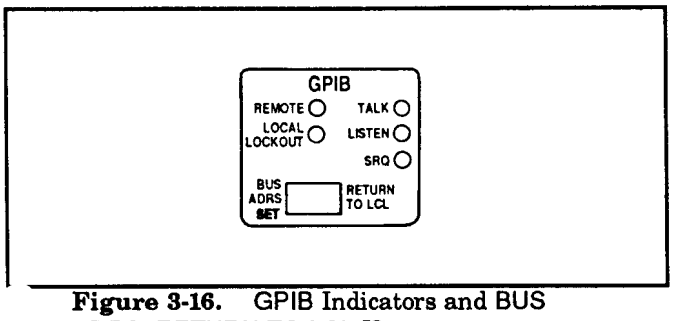


Figure 3-16. GPIB Indicators and BUS ADRS/ RETURN TO LCL Key

a. **REMOTE *Indicator***
This LED lights when the synthesizer goes under GPIB control; it remains lit until the 67XXB is returned to local control.

b. **LOCAL LOCKOUT *Indicator***
This LED lights when a local lockout message is received; it remains lit until the message is rescinded. When lit, the synthesizer cannot be returned to local control via the front panel.

c. **TALK *Indicator***
This LED lights when the synthesizer is addressed to talk and remains lit until unaddressed.

d. **LISTEN *Indicator***
This LED lights when the synthesizer is addressed to listen and remains lit until unaddressed.

e. **SRQ *Indicator***
This LED lights when the synthesizer requests service from the controller (sends out an SRQ); it remains lit until a serial poll is received or the SRQ function is reset.

f. **BUS ADRS SET *and* RETURN TO LCL *Key***
This key displays the 67XXB bus address, when the synthesizer is in the local mode. When in the remote (GPIB) mode, this key returns the synthesizer to the local mode—provided a local lockout bus message has not been programmed.

3-4 SELF-TEST FEATURE

The synthesizer has a self-test feature that tests most of the PCBs and other internal assemblies. Self test is entered in any of three ways: by turning the synthesizer on, pressing the front panel SELF TEST key, or sending the appropriate bus command.

If the synthesizer fails self test, an error code is displayed on the front panel or, if in the GPIB mode, on the bus controller. Descriptions of these error codes, along with a troubleshooting flowchart, are given in the appropriate 67XXB Maintenance Manual (refer to Section I, paragraph 1-4).

3-5 REAR PANEL DESCRIPTION

A pinout diagram for the rear panel AUX I/O connector is provided in Figure 3-17. The rear panel connectors and switch are described in Figure 3-18.

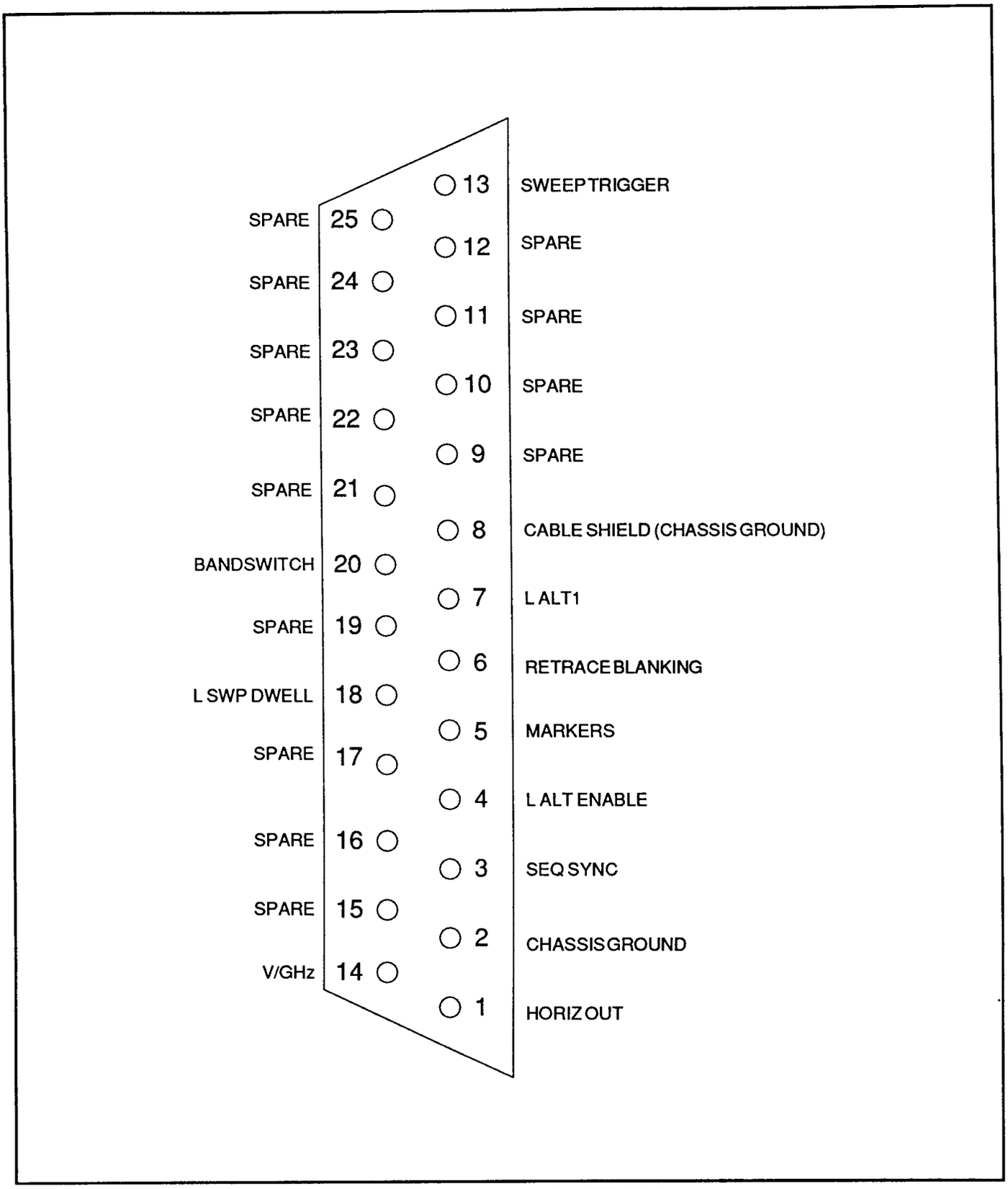
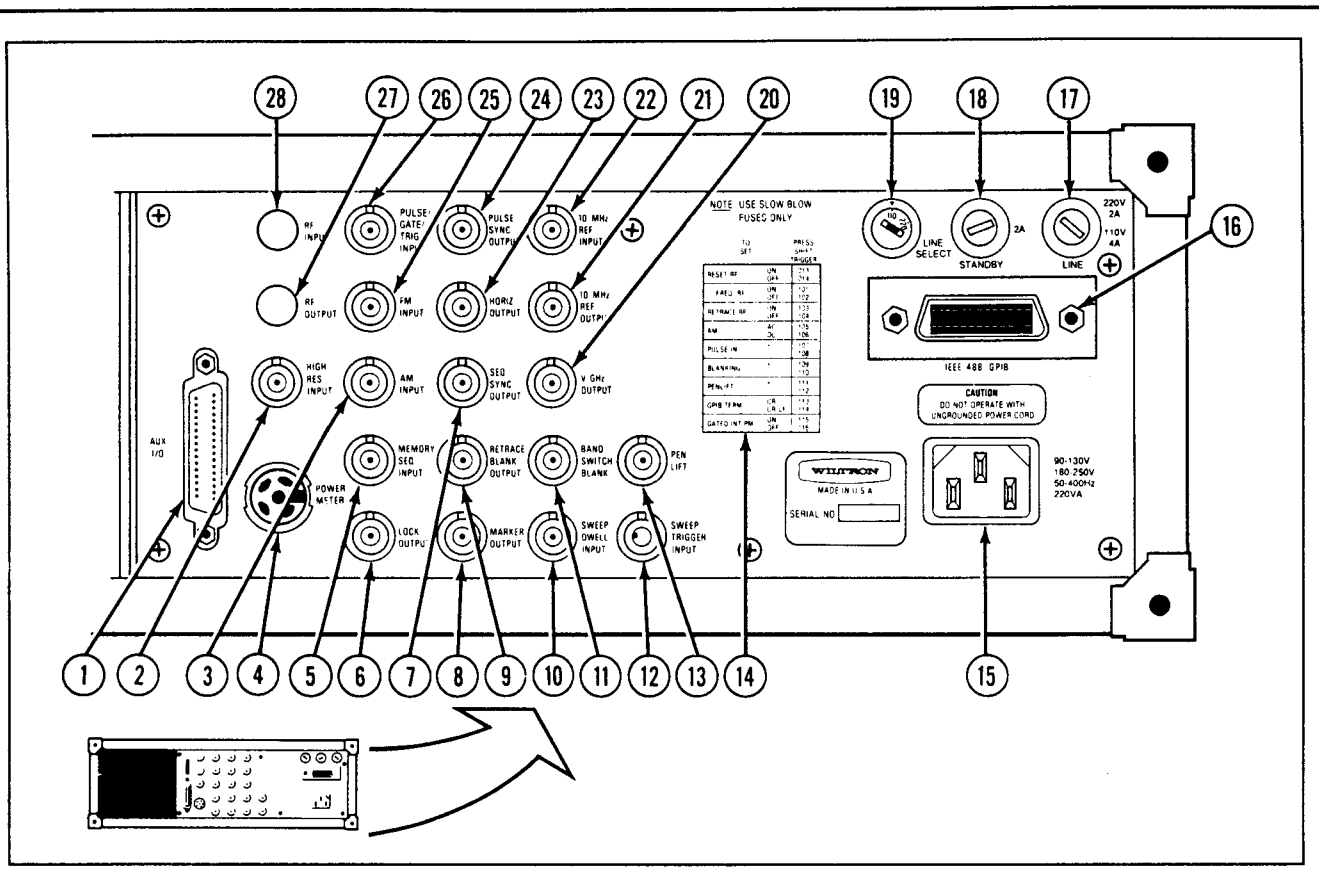


Figure 3-17. Pinout Diagram for AUX I/O Connector



1 **AUX I/O:** Provides a single-cable interface with the Model 560A Scalar Network Analyzer and future WILTRON instruments. A pinout diagram is shown in Figure 3-17.

2 **HIGH RES INPUT:** Accepts an external 20–32.1 MHz source to substitute for the internal fine-frequency loop, thus allowing frequency resolution into the millihertz region. 50Ω, 0 dBm input.

3 **AM INPUT:** Accepts an external modulating signal to produce linear AM on the RF output. Sensitivity is front panel or GPIB controllable. Usable input range is ±1 volt peak. 600Ω impedance.

4 **POWER METER:** Provides an input for the 560-7 Series RF Detector used to measure microwave power.

5 **MEMORY SEQ INPUT:** Accepts an external, momentary contact switch to sequence through the nine, stored, front panel setups.

6 **LOCK OUTPUT:** Provides a TTL-high signal when phase locked.

7 **SEQ SYNC OUTPUT:** Provides a TTL high pulse during sweep retrace and bandswitch. Also, when video markers have been selected, this output contains –5V marker pulses during the positive portions of the signal (forward sweep). The last-selected (enhanced) marker appears as a –10V level.

8 **MARKER OUTPUT:** Provides a TTL-high output at each frequency marker in a sweep, if VIDEO MARKERS have been selected.

9 **RETRACE BLANK OUTPUT:** Provides a –5V or +5V output during sweep retrace. Polarity depends on the BLANKING: +, – setting (item 14).

10 **SWEEP DWELL INPUT:** A TTL-low signal on this input causes the sweep to dwell.

11 **BANDSWITCH BLANK:** Provides a –5V or +5V output during oscillator bandswitching. Polarity depends on the BLANKING: +, – setting (item 14).

12 **SWEEP TRIGGER INPUT:** Provides for externally triggering the sweep, when in the external trigger mode (front panel TRIGGER EXT indicator lit). To trigger a sweep, this input must receive a TTL-low SIGNAL for at least 1 µsec.

13 **PEN LIFT:** Provides relay contacts for lifting or dropping a chart recorder's pen during sweep retrace. The PENLIFT: +, – setting makes these contacts normally open or normally closed (item 14).

Figure 3-18. Rear Panel, 67XXB Series Swept Frequency Synthesizers (1 of 2)

(14) **Shift-Plus-Trigger Routines.** Press the SHIFT then TRIGGER keys and enter the indicate numerals on the keypad to implement the listed functions.

RESET RF: ON. Provides normal RESET key operation as detailed in paragraph 3-3.1a. This is default setting.
RESET RF: OFF. Suppresses the output-power level when RESET key is pressed. The level-value is not reset. Pressing LEVEL 1 or LEVEL 2 following a RESET returns output power to the value last set before the RESET key was pressed.

ΔFRQ RF: ON. Selects RF level to be on during frequency switching in the CW or step sweep modes.
ΔFRQ RF: OFF: Selects RF level to be off during frequency switching in the CW or step sweep modes only. The RF is blanked before starting a frequency change and enabled when the RF is within approximately 1 kHz of the final frequency.

RETRACE RF: ON. Selects the RF to be on during retrace.
RETRACE RF—OFF: Selects the RF to be off during retrace. Has no effect in manual or external sweep mode when the RF is always on.

AM: AC. Selects ac coupling for the EXT AM INPUT The response is attenuated 3 dB at 50 Hz.
AM: DC. Selects dc coupling for the EXT AM INPUT.

PULSE: +. Causes RF to turn on when a TTL-high signal is applied to the PULSE/GATE/TRIG input and PULSE, INTERNAL key is engaged. Pulse width is determined by PULSE, WIDTH key setting.
PULSE: –. Causes RF to turn on when a TTL-low signal is applied to the PULSE/GATE/TRIG input and PULSE, INTERNAL key is engaged. Pulse width is determined by PULSE, WIDTH key setting.

BLANKING: +. Selects positive polarity for the 5 volt RETRACE BLANKING and BANDSWITCH BLANKING outputs at the AUX I/O connector (pins 6 and 20 respectively).
BLANKING: –. Selects negative polarity for the 5 volt RETRACE BLANKING and BANDSWITCH BLANKING outputs at the AUX I/O connector (pins 6 and 20 respectively).

PEN LIFT: +. Selects normally-open contacts on the internal Penlift relay. Used in conjunction with the PENLIFT OUTPUT connector.
PEN LIFT: –. Selects normally-closed contacts on the internal Penlift relay. Used in conjunction with the PENLIFT OUTPUT connector.

GPIB TERM (data terminator): CR. Selects carriage return (CR) ASCII character for GPIB data delimiter.
GPIB TERM (data terminator): CR/LF. Selects both carriage return and line feed ASCII characters (CR/LF) for GPIB data delimiters.

GATED INT PM: ON. Turns on the internally gated mode of operation. (paragraph 3-3.5.)
GATED INT PM: OFF. Turns off the internally gated mode of operation (paragraph 3-3.5.)

(15) **Input AC Receptacle:** Provides for connecting line power to the 67XXB.

(16) **IEEE-488 Interface Bus Connector.** Provides input/output connections to the General Purpose Interface Bus (GPIB). For the pinout diagram, see Section II, Figure 2-2.

(17) **Main Line Fuse:** Provides over-voltage/current protection for synthesizer circuits during operation and standby.

(18) **Standby Line Fuse:** Provides overcurrent protection for synthesizer circuits during standby operation.

(19) **LINE SELECT Switch:** Provides selection for 110 or 220 Vac line voltages.

(20) **V/GHz OUTPUT:** Provides a signal that is equal to either 0.5V/GHz for output frequencies of >20 GHz or 1V/GHz for output frequencies of ≤20 GHz.

(21) **10 MHz REF OUTPUT:** Provides a TTL compatible 10 MHz signal from the internal frequency standard. 50Ω impedance.

(22) **10 MHz REF INPUT:** Accepts an external 10 MHz ±100 Hz, 0 to +10 dBm frequency standard. Automatically disconnects the internal standard and sets front panel EXT REF indicator in FREQUENCY display. 50Ω impedance.

(23) **HORIZ OUTPUT:** Provides a 0V to 10V ramp during all sweep modes, and a voltage proportional to frequency for all CW modes. 50Ω impedance.

(24) **PULSE SYNC OUTPUT:** Provides a TTL-high 100 ns minimum-width sync pulse for the pulsed RF output. This pulse leads the output pulse by approximately 100 ns.

(25) **FM INPUT:** Accepts an external modulating signal to produce FM on the RF output. Sensitivity is front panel or GPIB selectable. Usable input is ±1V peak. 600Ω impedance.

(26) **PULSE/GATE/TRIG : +.** Accepts an external TTL level signal to pulse modulate the RF output or to gate the internal pulse generator. Polarity depends on the PULSE IN: +, – setting (item 14).

(27) **RF OUTPUT:** Optional output connector in place of the front panel RF OUTPUT port. 50Ω impedance.

(28) **RF INPUT:** For future use.

Figure 3-18. Rear Panel, 67XXB Series Swept Frequency Synthesizers (2 of 2)

SECTION IV
GPIB OPERATION

CONTENTS

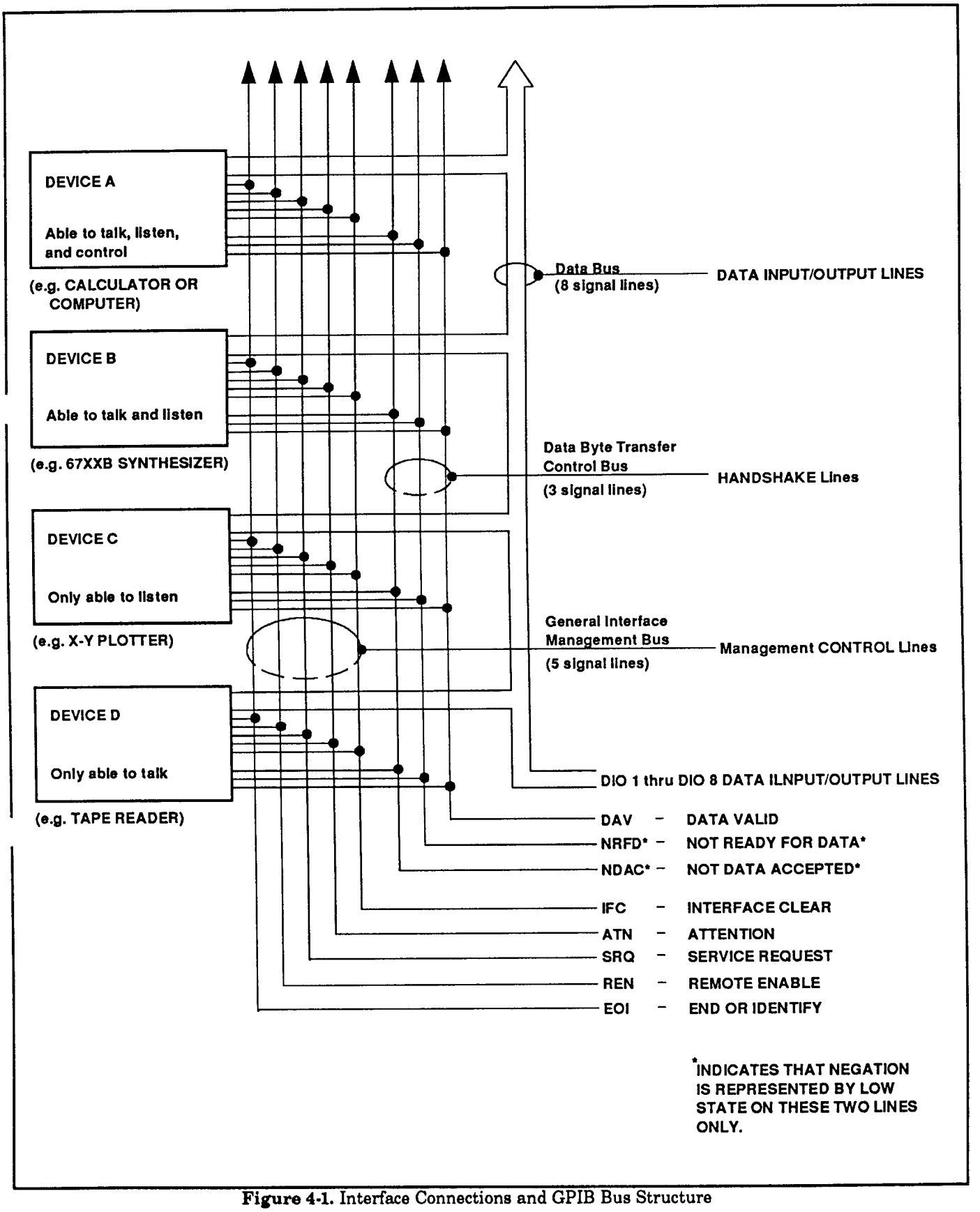


Figure 4-1. Interface Connections and GPIB Bus Structure

SECTION IV
GPIB OPERATION

4-1 INTRODUCTION

This section provides a description of the GPIB and the synthesizer command codes. It also provides several examples of bus programming

4-2 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 4-1 (facing page). 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 are 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 Information Interchange) code is use. The eighth (parity) bit is not used. Data transferral is 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, and handshake buses, and describe how these buses interface with the synthesizer.

4-2.1 Data Bus Description

The data bus is the conduit for transmitting information and data between the controller and the synthesizer. It 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 this byte and DIO 8 represents the most-significant bit (MSB). 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.

4-2.2 Management Bus Description

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

a. ATN (Attention)

When this line is TRUE, the synthesizer responds to appropriate interface messages—such as, device clear and serial poll—and to its own listen/talk address.

b. EOI (End or Identify)

When this line is TRUE, the last byte of a multibyte message has been placed on the line. Also used in conjunction with ATN to indicate a parallel poll.

c. IFC (Interface Clear)

When this line is TRUE, the synthesizer interface functions are placed in a known state—such as, unaddressed to talk, unaddressed to listen, and service request idle.

d. REN (Remote Enable)

When this line is TRUE the synthesizer is enabled—upon receipt of its listen address—for entry into the remote state. The mode is exited either when the REN line goes FALSE (high) or when the synthesizer receives a Go-To-Local (GTL) message or a Return-To-Local (RL) command.

e. SRQ (Service Request)

This line is pulled LOW (true) by the synthesizer to indicate that certain preprogrammed conditions exist (paragraph 4-4.11).

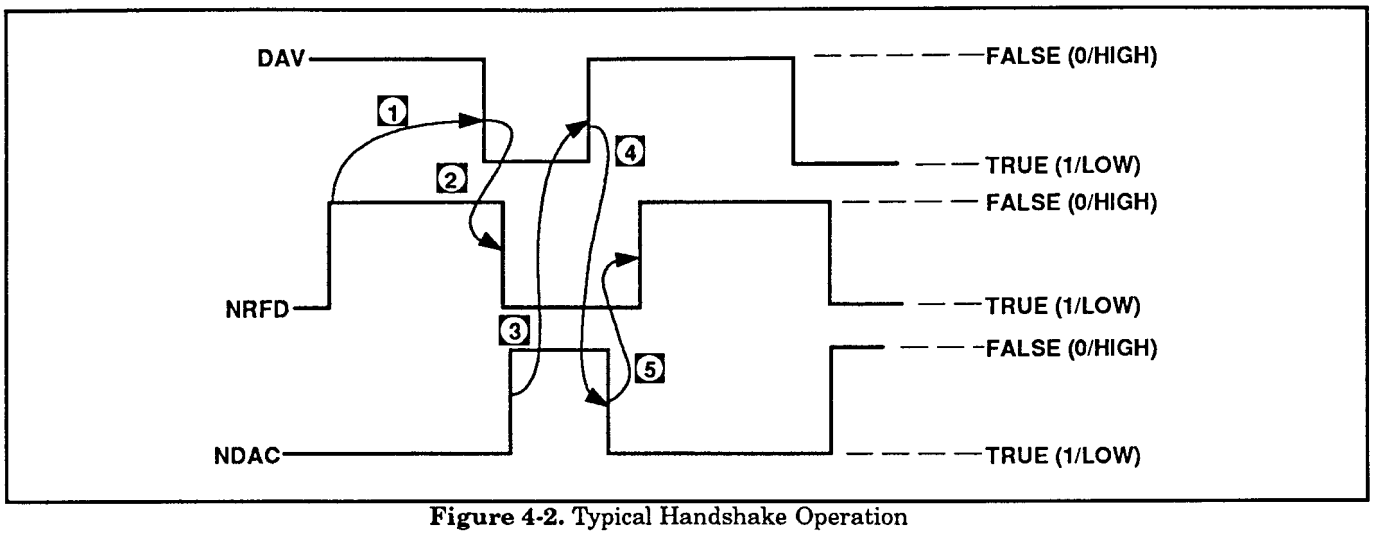


Figure 4-2. Typical Handshake Operation

.3 Data Byte Transfer Control (Handshake) Bus Description

Information is transferred on the data lines by a technique called the three-wire handshake. The three handshakebus signal lines (Figure 4-2) are described below.

a. DAV (Data Valid)

This line goes 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 goes TRUE (arrow 2) when a listener indicates that valid data has not yet been accepted. The time between the events shown by arrows 1 and 2 is iable and depends upon the speed with which a listener can accept the information.

c. NDAC (Not Data Accepted)

This line goes FALSE to indicate that a 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, since the GPIB is constructed in a wired-OR configuration, NDAC will not go FALSE until all listeners participating in the interchange have also released the line. As shown by arrow 3, when NDAC goes FALSE, DAV follows suit a short time later. The FALSE state of DAV indicates that valid data has been removed; consequently, NDAC goes LOW in preparation for the next data interchange (arrow 4).

Arrow 5 shows the next action in time: NRFD going FALSE after NDAC has returned TRUE. The FALSE state of NRFD indicates that all listeners are ready for the next information interchange. The time between these last two events is variable and depends on how long it takes a listener to process the data byte. In summation, the wired-OR construction forces a talker to wait for the slowest instrument to accept the current data byte before placing a new data byte on the bus.

4-3 GPIB OPERATION

All front panel keys, except for power on/standby, are bus controllable. When used on the GPIB, the synthesizer functions as both a listener and a talker. Table 4-1 provides a listing of the GPIB subset functions and gives the capability for each.

4-4 COMMAND CODES, DESCRIPTION

The command codes recognized by the synthesizer are classified and described in Table 4-2.

4-4.1 Command Codes: Inputting Restrictions and Notes

The following paragraphs (1) describe restrictions that apply to the inputting of commands into the synthesizer and (2) provide a helpful note for improving the readability of synthesizer programs.

Table 4-1. 67XXB IEEE-488 Bus Subsets

GPIB Subset	Function	Description
AH1	Acceptor Handshake	Complete Capability
SH1	Source Handshake	Complete Capability
T6	Talker	No Talk Only (TON)
TE0	Talker With Address Extension	No Capability
L4	Listener	No Listen Only (LON)
LE0	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

a. Restrictions

The synthesizer does not accept parameter or data entries in an exponential or scientific notation format. The accepted data formats are as follows:

1. A decimal or integer format for entering parameters and data.
2. A binary-byte format for entering both the status byte mask commands (paragraph 4-4.11) and the RCF and RCM stored-setup commands (paragraph 4-4.10).

b. Notes

The synthesizer recognizes 65 characters:

1. The 52 upper- and lower-case alphabetic characters. (Both cases of a character are interpreted as the same character.)
2. The minus sign (–).
3. The comma (,).
4. The decimal point (.).
5. The numerals 0 through 9.

All characters other than those 65 are ignored and can be interspersed between meaningful characters without ill effect. This feature can improve readability. For example, the two command codes shown below are interchangable.

"F12.754GHF27.7992GHSF1SWPMK0L12DM"

"F1=2.754 GH, F2=7.792 GH, SF1, SWP, MK0, L1=2DM"

NOTE

The insertion of additional characters increases the time it takes to send the string of data to the synthesizer. In the example above, the first command string sends 33 characters, whereby the second sends 47 characters.

Table 4-2. Command Code Classes

Command Class	Command Codes*	Paragraph	Table	Page
Parameter Entry Commands	F1, F2, F3 (M1), F4 (M2), F5 (F0), F6-F9, DLF, SDT, SNS, SWT, LOS, PDT, PNS, AMS, FMS, PDY, PER, PW, SYZ, UP, DN, CLO, PR	4-4.2	4-3	4-7, 4-8
Data Entry Commands	0 thru 9, -, ., DB, DM, GH, MH, KH, SEC, MS, US, GV, MV, KV, PCV, SPS, CLR	4-4.2	4-4	4-8
CW Frequency Commands	ACW, CF1, CF2, CF3 (CM1), CF4 (CM2), CF5 (CF0), CF6, CF7, CF8, CF9, SQF, SQU, SQD	4-4.3	4-5	4-10
Analog and Digital Sweep Commands	AD1, AFU, AF1 (AFF), AF3 (AMM), AD5, AD6, AUT, DF1, DU0, DU1, DF5 (DF0), DF6, (FUL), EXT, LIN, MAN, RSS, SF1 (FF), SF3 (MM), SP0, SP1, SSP, SWP, TRS, TSS	4-4.4	4-6	4-11
Frequency Marker Commands	IM1, VM1, ME0, ME1, MK0	4-4.5	4-7	4-13
Modulation Commands	AM0, AM1, FM0, FML, FMU, IP, XP, GP, P0, SQP, DPT	4-4.6	4-8	4-14, 4-15
Power Leveling Commands	L1(LVL), L2, RF0, RF1, LO0, LO1, IL1, DL1, PL1, LVO, LSP, MLP, EGC, EGI, EGO, LC0, LC1, OUV	4-4.7	4-9	4-15
Measure Function Commands	AMI, FMD, MOM, PD0, PD1, PM0, PM1	4-4.8	4-10	4-17
Output Commands	OI, OFL, OFH, OF1, OF2, OF3 (OM1), OF4 (OM2), OF5 (OF0), OF6-OF9, OL1 (OLV), OL2, OLO, OPM, OST, OPW, OSD, OPD, OSS, OPS, OAS, OFS, OMM, OSB, OES, ODF, OFP, OSE, OPP, ODP	4-4.9	4-11	4-17
Stored Setup Commands	SAF, RCF, SAM, RCM, SSN1-SSN9, RSN1-RSN9, SM	4-4.10	4-12	4-19
Service Request and Status Byte Commands	FB1, FB0, ES1, ES0, UL1, UL0, LE1, LE0, PE1, PE0, SE1, SE0, SQ1,SQ0, SB1, SB0, MB0, MB1, MB2, CSB, EL0, EL1	4-4.11	4-13	4-20, 4-21
Shift-Plus-Trigger Override Commands	AMA, AMD, BPN, BPP, EP0, EP1, PPC, PP0, RC0, RC1, RT0, RT1	4-4.12	4-14	4-23
Group Execute Trigger (GET) Commands	GTC, GTD, GTU, GTS, GTT, GTF, GTL, GTO, Y	4-4.13	4-15	4-23
Fast-Frequency-Switching Commands	ZL000-ZL512, ZEL, ZS000-ZS512, CAL	4-4.14	4-16	4-24
Self Test Commands	TST	4-4.15	4-17	4-24
Miscellaneous Commands	DS1, DS0, RL, RST, CS0, CS1, HR0, HR1	4-4.16	4-18	4-25

4-4.2 Command Codes: Parameter and Data Entry Commands

Table 4-3 lists the 22 commands that enable parameter entry. The table also gives the range of values permitted for each parameter, and it shows the data-terminator characters (terminators) for each. An appropriate terminator must be used to terminate a numeric-parameter entry, and it must immediately follow the numeric value. If it does not, a parameter entry error will result.

All of the commands given in Table 4-3 open a parameter for data entry. Once opened, a parameter remains open until one of the following occurs:

- Another parameter is opened.
- A function other than video markers, intensity markers, or leveling is commanded.
- The CLO (Close Parameter) command is received.

When a parameter is open for entry, its value can be changed as follows:

- By sending a numeric value followed by the appropriate terminator.
- By incrementing or decrementing its value using an associated step size. These parameter entry commands do not change the operating mode of the synthesizer—*unless the parameter being changed is also the one being output.* Any parameter, therefore, may be used to preset values without altering the output.

Example: Assume that the synthesizer is executing an F3–F4 sweep from 3 GHz to 10 GHz. Changing the value of F1 to 3 GHz with the string "F1 3 GH" does not change the operating mode of the synthesizer. However, changing the value of F4 with the string "F4 16.01 GH" changes the end point of the F3–F4 sweep to 16.01 GHz.

Table 4-4 lists the Data Entry codes and Figure 4-3 gives a detailed description of the SYZ command.

Table 4-3. Parameter Entry Codes

Command Code	Parameter	Values	Terminator	Step Size
F1 F2 F3 F4 F5 F6 F7 F8 F9 DLF	Frequency 1 Frequency 2 Frequency 3 Frequency 4 Frequency 5 Frequency 6 Frequency 7 Frequency 8 Frequency 9 ΔF Sweep Width	Dependent on the frequency range of the instrument	GH MH KH	Yes
SDT	Dwell Time, Phase-Locked Step Sweep	1 ms to 99s	MS SEC	No
SNS	Number of Steps, Phase-Locked Step Sweep	1 to 1800	SPS	Yes
SWT	Analog Sweep Time	30 ms to 99	MS SEC	No
LOS	Level Offset	+99.9 dB to –99.9 dB	DB	No
PDT	Dwell Time, Power Sweep	50 ms to 99s	SEC	Yes
PNS	Number of Steps, Power Sweep	1 to 1000	SPS	Yes
AMS	AM Sensitivity	1 %/V to 99 %/V	PCV	Yes

Table 4-3. Parameter Entry Codes (Continued)

Command Code	Parameter	Values	Terminator	Step Size
FMS	FM Sensitivity	Unlocked: 10 kHz/V—25 MHz/V Locked: 10 kHz/V—5 MHz/V	KV MV GV	Yes
PER	Pulse Period, Internal Programmable Pulse Generator (PPG)	1 µs to 100 ms	KH MH	Yes
PR	Pulse Rate, Internal Programmable Pulse Generator (PPG) ***Note**: This parameter is converted to pulse period 1/(pulse rate)*			
PW	Pulse Width, Internal PPG	25 ns to 99 ms	US MS SEC	Yes
UP	Increments a frequency, time, or level parameter	N/A	N/A	Yes
DN	Decrements a frequency, time, or level parameter	N/A	N/A	Yes
PDY	Opens pulse delay for update	1 µs to 100 ms	US MS SEC	Yes
SYZ	Opens the step-size parameter for updating (Figure 4-3)	N/A	N/A	N/A
CLO	Closes the parameter that had been previously opened	N/A	N/A	N/A

Table 4-4. Data Entry Commands

Command Type	Command Code	Description
Data Entry or Modification	0, 1, 2, 3, 4, 5, 6, 7, 8, 9 – . CLR	Numerals for Parameter Value Entries Minus Sign Decimal Point Clear data entry
Data Terminators	DB DM GH MH KH SEC MS GV MV KV PCV SPS	Decibels (dB) dBm GHz MHz KHz Seconds Milliseconds (ms) GHz per volt (GHz/V) MHz per volt (MHz/V) kHz per volt (kHz/V) Percent per volt (%/V Steps

Six step sizes are used, with some sizes shared between parameters that have common units. Most of the parameters listed in Table 4-3 have associated step sizes. As shown, the ten frequency parameters have a common step size, as do the three level parameters (the commands to set Level 1 and Level 2 are described in paragraph 4-4.7). All other applicable parameters have individual step sizes.

To set the step size for a parameter, first send the code to open the parameter, and then send the "SYZ" command. Now the step size can be set by sending a numeric string with the proper terminator. When the terminator is received, the step size is accepted and the original parameter is again open for entry.

Example: To set the F1 frequency to 4 GHz, the step size to 10 MHz, and to increment the F1 frequency 3 times by the value of the step size, the following command codes would be sent:

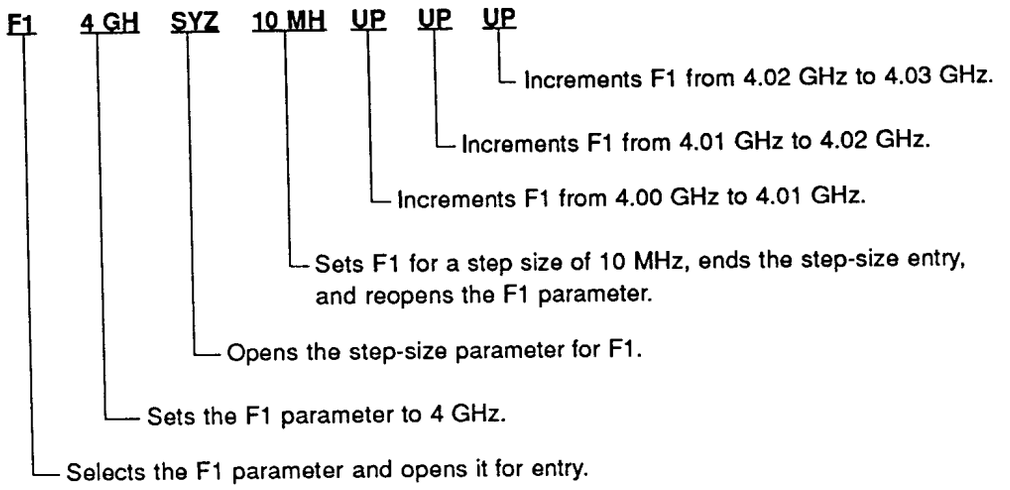


Figure 4-3. Using the SYZ (Size) Command

4-4.3 Command Codes: CW Frequency Commands

Table 4-5 lists the CW-Frequency Mode commands. These commands call up each of the nine preset (or previously set) CW frequencies.

As described for the front panel F1–9 SCAN keys, these commands both output their associated frequency and open that frequency's parameter for data entry.

The tenth command shown in Table 4-5, SQF, accesses the preset frequencies in sequential order—that is, F1 to F9.

Synthesizer response to an SQF command depends on what state it is in at the time the command is received. For example, if it is in a CW mode with the current output frequency open for entry, the SQF command (1) causes the output to change to the next next sequential frequency and (2) opens that frequency's parameter for a data entry. However, if the synthesizer is in any other state (except CW), the SQF command causes it to switch to the last CW frequency that was output and opens that parameter for data entry.

Figure 4-4 shows an example of a CW frequency command.

Table 4-5. CW Frequency Commands

Command Code	Function	Opens For Entry
CF1 CF2 CF3 CF4 CF5 CF6 CF7 CF8 CF9	1. These commands place the synthesizer in the CW mode at the preset (or a previously set) frequency. 2. Programming any of these commands will deselect any previously programmed CW command. That is, only one CW command can be active.	F1 F2 F3 F4 F5 F6 F7 F8 F9
SQF	Sequences to the next CW frequency	The CW output parameter then selected
SQU	Scan CW frequency up	Next frequency parameter
SQD	Scan CW frequency down	Next frequency parameter
ACW	Activates the currently scanned frequency as CW.	Next frequency parameter

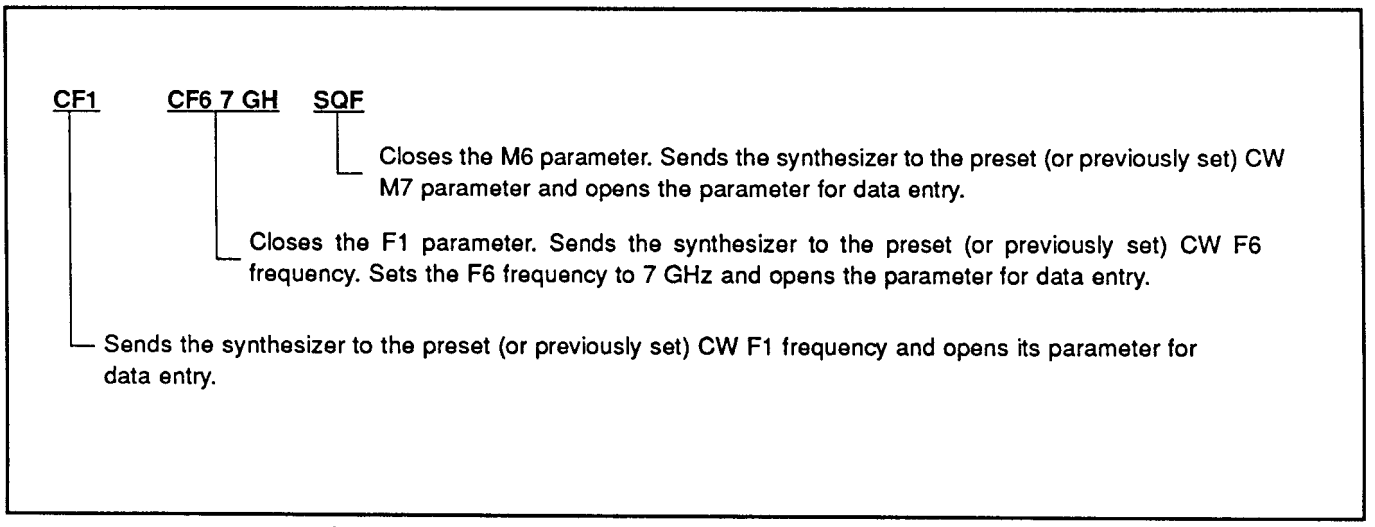


Figure 4-4. Example of a CW Frequency Command

4-4.4 Command Codes: Analog and Digital Sweep Commands

Table 4-6 lists the Analog and Digital Sweep Commands. These commands are divided into five subclasses and are described below.

a. Sweep Range

Six sweep ranges are available. The SF1, SF3, DF5, and DF6 sweeps function as described for their respective front panel counterparts in Section III. The FUL and DF1 sweeps do not have front panel counterparts; they are available only over the bus.

The FUL command causes a full-band sweep from the synthesizer's low frequency limit to its high frequency limit.

The DF1 command causes a symmetrical sweep about the F1 frequency, as described for the ΔF F5 sweep in paragraph 3-2.3c.

Examples:

1. Programming "F1 2 GH F2 8 GH SF1" sets F1 to 2 GHz, F2 to 8 GHz, and implements an F1–F2 sweep.
2. Programming "DLF 6 GH F5 7 GH DF5" sets ΔF to 6 GHz, F5 to 7 GHz and implements a ΔF F5 sweep.

Programming Note: If the commanded sweep range is invalid, a parameter error message (paragraph 4-6) will be generated, and the output of the synthesizer will not be altered.

The following are two examples of an invalid sweep range: Programming an F1–F2 sweep when the F1 frequency is greater than the F2 frequency or programming a ΔF F5 sweep when the F5 frequency plus or minus half the ΔF value exceeds the range of the synthesizer.

b. Alternate Sweep

Six alternating sweep commands are available, one for each of the six sweep ranges. As described for the front panel ALT keys, if the instrument is sweeping when an alternate sweep command is received, the synthesizer output will alternate between the commanded sweep and the sweep then being executed.

Example: Assume that the synthesizer had been previously programmed and was then executing an F1-F2 sweep. Programming "AF3" would then activate the F3–F4 sweep and cause it to alternate with the F1–F2 sweep.

Programming Note: An alternate sweep command will only be recognized when the synthesizer has been programmed to sweep. It will be ignored at all other times.

c. Sweep-Trigger Mode

Four sweep trigger modes are available over the bus—as from the front panel: Auto, Line, Ext/Single, and Manual. They function as described for their front panel counterparts.

d. Single-Sweep Trigger/Reset

Two single sweep commands are available; one starts the sweep and another resets it. When the External/Single sweep-trigger mode has been selected, the TRS command triggers a single sweep.

The RSS command resets the sweep to the start frequency, whenever the command is received while a single sweep is in progress.

e. Analog/Digital Sweep Select

Two commands are available; one selects an analog sweep and the other a digital sweep. The selected sweep mode applies to all sweep ranges.
Programming Note: Commanding either SWP or SSP does not, in itself, provide a swept output. It only determines whether the swept output will be analog or digital. If, on the other hand, the synthesizer is then outputting a sweep when one of these commands is received, that sweep will assume the commanded mode.

f. Special Step Sweep (Steps Not Equally Spaced)

This special step sweep provides non-equally spaced steps for a digitally stepped sweep. It can be used in any of the four available sweep modes (F1-F2, F3-F4, ΔF F5, ΔF F6). The start frequency in this sweep must be equal to the first frequency programmed with the ZL000-ZL512 command (Table 4-16). The intermediate steps can be programmed to be any frequency within the range of the programmed sweep.

Figure 4-5 shows an example of sweep frequency programming.

Table 4-6. Analog and Digital Sweep Commands

Command Code	Function	Opens For Entry
	Sweep Range	
SF1	Selects the F1–F2 Sweep Mode	None
SF3	Selects the F3–F4 Sweep Mode	None
FUL	Selects the Full Band Sweep Mode	None
DF1	Selects the ΔF F1 Sweep Mode	None
DF5	Selects the ΔF F5 Sweep Mode	None
DF6	Selects the ΔF F6 Sweep Mode	None

Table 4-6. Analog and Digital Sweep Commands

Command Code	Function	Opens For Entry
	Alternate Sweep	
	Selects Alternate Sweep	
AF1	F1–F2	None
AFU	Full	None
AF3	F3–F4	None
AD5	ΔF F5	None
AD6	ΔF F6	None
AD1	ΔF F1	None
	Sweep Trigger	
AUT	Selects Auto Trigger	None
LIN	Selects Line Trigger	None
EXT	Selects External/Single Trigger	None
	Single-Sweep Trigger/Reset	
MAN	Selects Manual Sweep	None
TRS	Trigger a Single Sweep	None
RSS	Resets a Single Sweep	None
	Analog/Digital-Sweep Select	
SWP	Selects Analog Sweep	None
SSP	Selects Phase-Locked Step Sweep	None
DU1	Selects computer-controlled step sweep (Refer to Figure 4-4A for a programming example)	None
DU0	Deselects computer-controlled step sweep	None
TSS	Steps to next point in DU1 mode.	
	Special Step Sweep (Steps Not Equally Spaced)	
SP0	Deselects non-equally spaced step sweep	None
SP1	Selects non-equally spaced step sweep (Note: SP1 can be use with DU1 mode)	None
	Example: Assume a frequency sweep of 3 GHz to 10 GHz, and steps at 3, 6, 8, 9, and 10 GHz	

	Sample Coding in BASIC
	`10 OUTPUT 705; "ZL000 3GH 6GH 8GH 9GH 10GH ZEL"`
	`20 OUTPUT 705; "F1 3GH F2 10GH SNS 4SPS"`
	`30 OUTPUT 705; "SP1 SSP SF1"`	

	Explanation of Code Line 10 sets up the step frequencies Line 20 sets start and stop frequencies and number of steps (frequency points –1) Line 30 sets synthesizer to SP1, Step Sweep, and F1-F2 modes	

```
 10 !     "DUAL"
 20 CLEAR
 30 DISP "ENTER # OF STEPS"
 40 INPUT S
 50 DISP "ENTER WAIT TIME [mS]"
 60 INPUT W
 70 WAIT 100
 80 DISP "ENTER 'LO' START FREQ
    [GHz]"
 90 INPUT F1
100 DISP "ENTER 'LO' STOP FREQ [
    GHz]"
110 INPUT F2
120 DISP "ENTER OFFSET [GHz]"
130 INPUT F3
140 !
150 ! Initialize both 6700's
160 !
170 OUTPUT 705 ;"CF1F1";F1;"GHF2
    ";F2;"GHSNS";S;"SPSSSPEXTCLO
    "
180 OUTPUT 705 ;"CF1F1";F1+F3;"G
    HF2";F2+F3;"GHSNS";S;"SPSSSP
    EXTCLO"
190 WAIT 1000
200 !
210 ! Set both to dual mode and
    enable GET to end DWELL
220 !
230 SEND 7 ; CMD "%&" DATA "GTLO
    U1FF" EOL
240 WAIT 100
250 ! Trigger the sweep and wait
     for retrace to finish.
260 SEND 7 ; CMD "%&" DATA "TRS"
     EOL
270 WAIT 100
280 ! Listen address both 6700's
290 SEND 7 ; CMD "%&"
300 FOR C=1 TO S+1
310 WAIT W
320 ! Trigger both to next point
330 TRIGGER 7
340 NEXT C
350 GOTO 260
```

Figure 4-4A. Programming Example, DU1

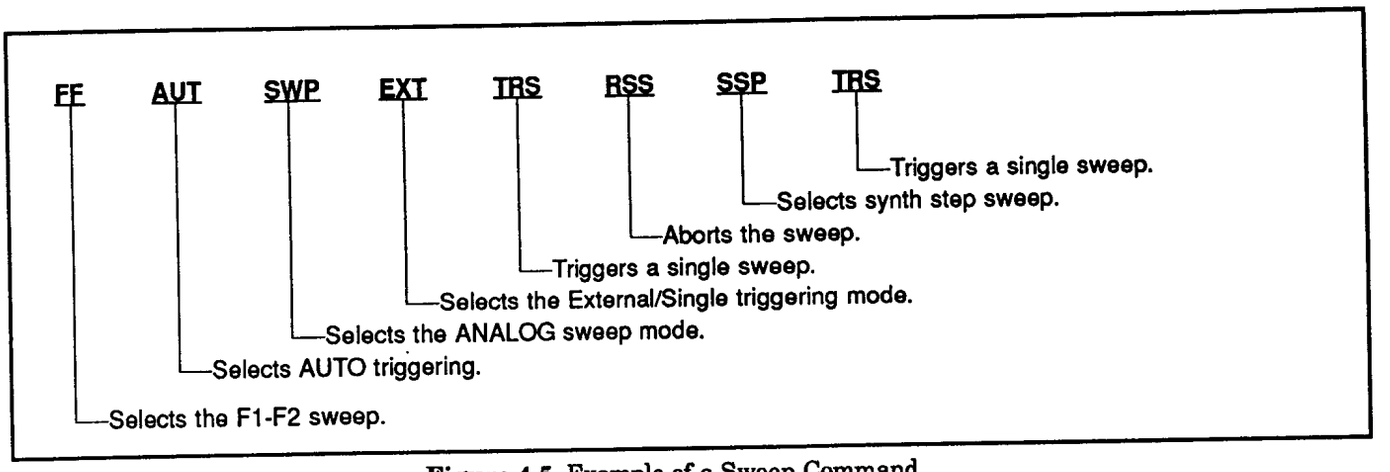


Figure 4-5. Example of a Sweep Command

4-4.5 Command Codes: Frequency Marker Commands

Table 4-7 lists the Frequency Marker Commands. As described for the front panel marker keys, these commands provide for (1) selecting a CW frequency as a potential marker, (2) selecting a potential marker as an active marker, and (3) individually turning markers on and off.

The ME1 command will enable a marker at the current frequency that is open for update. Conversely, the ME0 command will disable that same marker. If a frequency parameter is not open, no action will be taken. The VM1 and IM1 commands will turn on their respective intensity and video markers, and the MK0 commands will turn all markers off.

Programming Note: Only one marker mode can be active. Consequently, if the intensity mode is active and the video mode is programmed, the displayed markers will change to video markers. Either mode can be turned off with the MK0 command.

Figure 4-6 shows an example of frequency marker programming.

4-4.6 Command Codes: Modulation Commands

Table 4-8 lists the Modulation Commands. These commands provide for modulating the output signal with AM, FM, or pulse modulation.

4-4.7 Command Codes: Output Power Leveling Commands

Table 4-9 lists the Output Power Leveling Commands. These commands provide (1) for turning the power leveling off or (2) for leveling the output power using any of the following:

- The internal leveling detector.
- An external detector connected to the front panel EXT LEVEL jack.
- An external power meter connected to the front panel EXT LEVEL jack.

Figure 4-7 shows an example of output-power-level programming.

Table 4-7. Frequency Marker Commands

Command Code	Function	Opens for Entry
ME1	Enables marker at the active frequency, F1-F9	None
ME0	Disables marker at the active frequency	None
MKO	Turns off markers	None
IM1	Turns on Intensity Markers	None
VM1	Turns on Video Markers	None
MK0	Turns off Markers. Enabled markers remain enabled, but are not active.	None

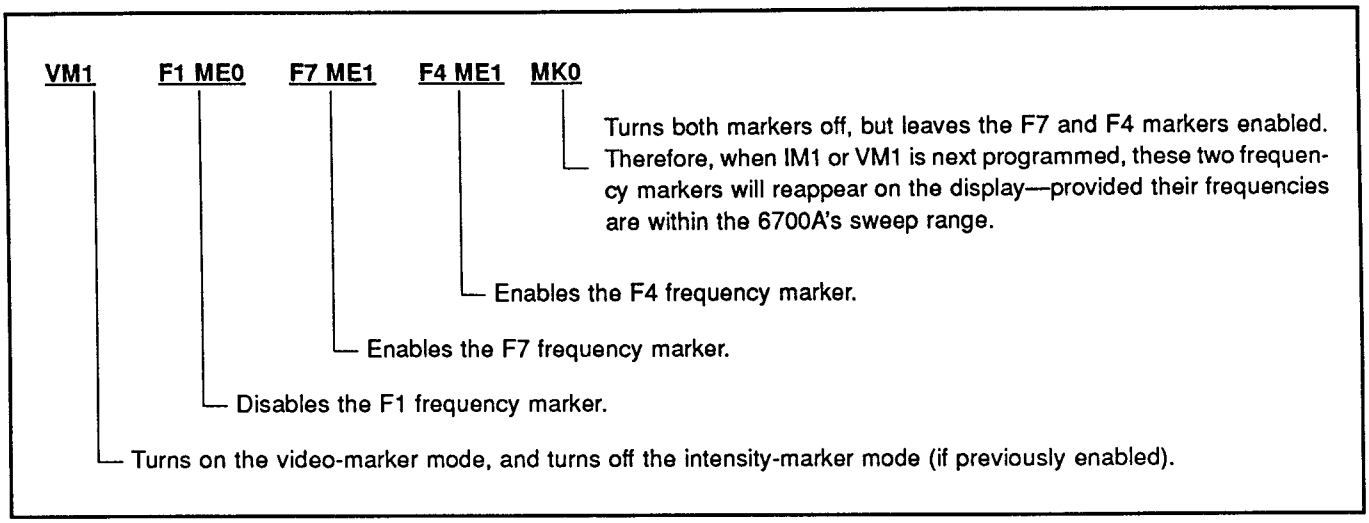


Figure 4-6. Example of Frequency Marker Programming

Table 4-8. Modulation Commands (1 of 2)

Command Code	Function
AM1	Enables the external AM function. This command does not disable the FM function, had the latter function been previously programmed.
AM0	Disables the external AM function. This is the default mode.
FM0	Disables the external FM function and re-establishes phase lock, had the FMU command (see below) been previously programmed. This is the default mode.
FML	Enables the output signal to be modulated by an external FM input applied to either the front panel EXT FM jack or the rear panel FM INPUT jack. In this mode, the synthesizer output is phase locked. This is the default mode.
FMU	Enables the output signal to be modulated by an external FM input applied to either the front panel EXT FM jack or the rear panel FM INPUT jack. In this mode, the synthesizer output is *not* phase locked. This mode can be used for frequency deviations of up to ±25 MHz. In the locked-FM mode, deviations are limited to 20 times the rate (20 x rate).
IP	1. Turns on the internal programmable pulse generator (PPG) and enables the internal pulse modulator to modulate the RF output. 2. Disables the external pulse modulation or externally gated pulse modulation, had either of those modes been previously programmed.
XP	1. Enables an external pulse modulation signal to modulate the RF output. 2. Turns off the internal PPG and disables the internal pulse modulator, had the IP command been previously programmed. 3. Turns off the internal PPG and disables the externally gated mode, had the GP command been previously programmed.
GP	Turns on the internal PPG, and enables an external pulse modulation signal to gate the PPG.
P0	Disables all pulse modulation.

Table 4-8. Modulation Commands (2 of 2)

Command Code	Function
SQP	1. Turns on the internal PPG, sets the PPG to produce a 1 kHz square wave, and enables the internal pulse modulator to modulate the RF output. 2. Also disables the external pulse modulation or the externally gated pulse modulation, had either of those modes been previously programmed. *Programming Note:* The SQP command produces the same results as the command string "IP PR 1 KH PW .5 MS CLO" and has been included to make setting up a 1 kHz square wave more convenient.
DPT	Turns on internal PPG with delayed trigger.

Table 4-9. Power Leveling Commands (1 of 2))

Command Code	Function	Opens For Entry
L1	1. Selects the Level 1 power value as the RF output power level. 2. Deselects the Level 2 parameter, had it been previously programmed.	LEVEL 1
L2	1. Selects the Level 2 power value as the RF output power level. 2. Deselects the Level 1 parameter, had it been previously programmed.	LEVEL 2
RF1 RF0	Turns on the RF output. Turns off the RF output.	None
LO1	Turns on the Level Offset function. When on, the value of the Level Offset parameter is added to the level measured by the internal leveling loop; the resultant value is displayed.	None
LO0	Turns off the Level Offset function.	None
IL1	1. Selects the Internal leveling function,whereby the internal detector is used to level the output power. 2. Turns off (deselects) the DL1 and PL1functions, had either been previously programmed.	None
DL1	1. Selects the External Detector leveling function, whereby the positive or neg ative output from an external detector can be used to level the output power. 2. Turns off (deselects) the IL1 or PL1functions, had either been previously programmed.	None
PL1	1. Selects the External Power Meter function,whereby the positive or negative output from an external power meter can be used to level the output power. 2. Turns off (deselects) the IL1 or DL1functions, had either been previously programmed.	None
EGC	Selects the External Gain CALIBRATE for use with the DL1 and PL1 codes	None

Table 4-9. Power Leveling Commands (2 of 2)

Command Code	Function	Opens For Entry
LV0	Turns off the power leveling functions. The maximum power available from the synthesizer is output. **CAUTION** For some models, this power level can exceed 100 mW (+20 dBm).	None
LSP	Selects the Power Sweep mode. The power level will sweep as determined by the preset (or previously set) dwell-time and number-of-steps parameters. See the example in Figure 4-7.	None
MLP	Sets the applicable Level 1 or Level 2 value to the maximum leveled available power for the frequency sweep or CW frequency then being output. **CAUTION** For some models, this power level can exceed 100 mW (+20 dBm)	None
EGI	Provides for entering a value to program the external-level gain DAC.	None
EGO	Outputs the value of the external level DAC.	None
LC0	Turns off the level-vs-frequency correction.	None
LC1	Turns on the level-vs-frequency correction.	None
OUV	Outputs the voltage from the ALC linearizer	None

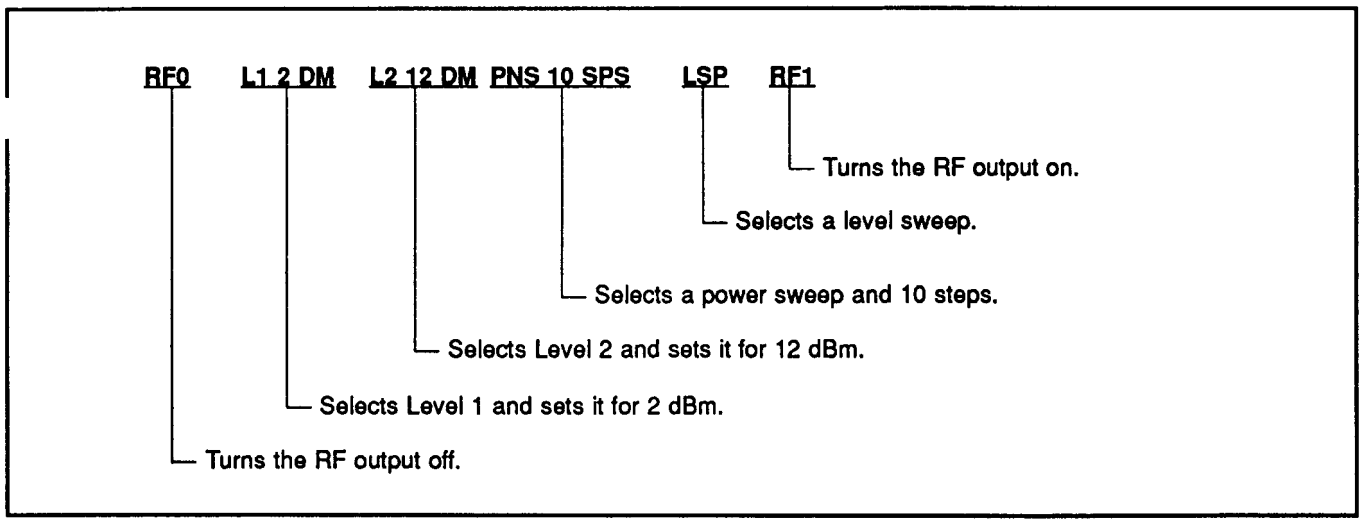


Figure 4-7. Example of Power Level Programming

4-4.8 Command Codes: Measure Function Commands

Table 4-10 lists the Measure Function Commands. These commands provide for measuring any of the following:

- The actual modulation depth of the output signal, as caused by an external AM signal connected to either the front panel EXT AM jack or the rear panel AM INPUT jack.
- The actual frequency deviation of the output signal, as caused by an external FM signal connected to either the front panel EXT FM jack or the rear panel FM INPUT jack.
- The actual RF power of an external source, via a 560-7 Series Detector connected to the rear panel POWER METER jack.

Table 4-10. Measure Function Commands

Command Code	Function
AMI	Selects the AM Measurement mode, whereby the synthesizer measures the depth of the external AM input. The measurement results will be sent to the controller upon receipt of an OMM command (Table 4-11).
FMD	Selects the FM Measurement mode, whereby the synthesizer measures the deviation of the external FM input. The measurement results will be sent to the controller upon receipt of an OMM command. When either AMI or FMD is received, measurements are continuously taken until the mode is exited by receipt of the MOM command.
MOM	Turns off the modulation measurement modes.
PM1	Selects the Power Meter Measurement mode, whereby RF power can be measured at an external source by a 560-7 Series Detector connected to the rear panel POWER METER connector. The measurement results will be sent to the controller upon receipt of an OPM command. Power measurements can be taken simultaneously with modulation measurements.
PM0	Turns off the Power Meter Measurement mode.
PD1	Selects the ΔPWR Power Meter mode. Turn on the power meter with the PM1 command.
PD0	Turns off ΔPWR Power Meter mode.

4-4.8 Command Codes: Output Commands

Table 4-11 lists the Output Commands. These commands provide for outputting data from the synthesizer to the controller. Figure 4-8 shows an example of output-command programming.

Table 4-11. Output Commands (1 of 2)

Command Code	Function
OI	Causes the sweep generator to identify itself by sending certain parameter information over the bus. This parameter information consists of the model number, low-end frequency, high-end frequency, minimum output-power level, maximum output-power level, software revision number, and serial 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 string is 34 characters long.
OFL	Returns the low-end frequency value to the controller. The units are in MHz.
OFH	Returns the high-end frequency value to the controller. The units are in MHz.
OF1	Returns the F1 frequency value to the controller. The units are in MHz.
OF2	Returns the F2 frequency value to the controller. The units are in MHz.
OF3	Returns the F3 frequency value to the controller. The units are in MHz.
OF4	Returns the F4 frequency value to the controller. The units are in MHz.
OF5	Returns the F5 frequency value to the controller. The units are in MHz.
OF6	Returns the F6 frequency value to the controller. The units are in MHz.
OF7	Returns the F7 frequency value to the controller. The units are in MHz.
OF8	Returns the F8 frequency value to the controller. The units are in MHz.
OF9	Returns the F9 frequency value to the controller. The units are in MHz.
OL1	Returns the LEVEL 1 power value to the controller. The units are in dBm.

Table 4-11. Output Commands (2 of 2)

Command Code	Function
OL2	Returns the LEVEL 2 power value to the controller. The units are in dBm.
OLO	Returns the Level Offset power value to the controller. The units are in dB.
OPM	Returns the internal power meter measurement value to the controller. The units are in dBm.
OST	Returns the sweep time value to the controller. The units are in ms.
OPW	Returns the internal PPG pulse width value to the controller. The units are in dBm.
OSD	Returns the dwell time of the digital sweep to the controller.The units are in seconds.
OPD	Returns the dwell time of the power sweep to the controller. The units are in seconds.
OSS	Returns the number-of-steps parameter of the digital sweep to the controller. The units are in steps.
OAS	Returns the AM sensitivity value to the controller. The units are in percent per volt (%/V).
OFS	Returns the FM sensitivity value to the controller. The units are in MHz per volt (MHz/V).
OPS	Returns the Returns the Power Sweep Number-of Steps to the controller.
OPP	Returns the pulse period of the internal PPG to the controller. The units are in ms.
OMM	1. Returns the AM measurement value to the controller, when the AMI command either has been or is also programmed. The units are in percent (%). 2. Returns the FM measurement value to the controller, when the FMD command either has been or is also programmed. The units are in MHz.
OSB	Returns the bit status of the Primary Status Byte (Figure 4-9) to the controller.
OES	Returns the bit status of all three status bytes to the controller.
OFP	Returns the frequency of the fine loop oscillator in MHz.
OSE	Returns the parameter that had a syntax error to the controller.
ODF	Returns the value for delta-F (ΔF) to the controller.
ODP	Outputs the pulse delay time in μs

```
760 OUTPUT 705;"OF1"
770 ENTER 705;A
780 PRINT "F1 is set at ";A;" MHz"


1050 OUTPUT 705;"OSS"
1060 ENTER 705;A
1070 PRINT "Digital Sweep has ";A;" Steps"
```

Figure 4-8. Example of Output Command Programming

4-4.9 Command Codes: Stored Setup Commands

Table 4-12 lists the Stored Setup Commands. These commands provide for saving a front panel setup and recalling it for use. The commands SSN1 thru SSN9, RSN1 thru RSN9, and SM duplicate the functions of the SAVE, RECALL, and SCAN SETUPS front panel keys respectively.

If more than nine setups are needed, or if it is desirable to store the setups in the controller instead of the synthesizer memory, the synthesizer can be commanded to output and accept stored setups over the bus.

The SAF and RCF commands save and recall the current front panel setup by outputting or receiving a 300-byte (approximately) data string that describes the instrument state.

The SAM and RCM commands perform the same two functions as described for the SAF and RCF commands, except that all of the stored setups are included in the data string along with the then current front panel setup. For these commands, the data string is approximately 3000 bytes long.

Table 4-12. Stored Setup Commands

Command Code	Function
SAF	Outputs the then-current front panel setup.
RCF	Readies the synthesizer to receive a new front panel setup. The SAF and RCF commands save and recall the current front panel setup by outputting or receiving a 300-byte (approximately) data string that describes the instrument state. The SAM and RCM commands perform identical functions, except that all of the stored setups are also included in the data string. For these commands, the data string is approximately 3000 bytes long.
SAM	Outputs both the then-current front panel setup and all stored setups.
RCM	Readies the synthesizer to receive a new front panel setup and new stored setups.
SSN1-SSN9	Saves the then-current front panel setup in memory location 1thru 9, based on the numeral sent with the command.
RSN1-RSN9	Recalls to the front panel the synthesizer setup stored in memory location 1 thru 9, based on the numeral sent to the front panel with the command.
SM	Recalls the next stored setup in sequence

	NOTE
	SAF and SAM output binary data. The string is terminated with "EOI" on the last byte sent (no CR or LF is sent).
	
	Example
	`10 DIM A$ [300]`
	`20 OUTPUT 705; "SAF"`
	`30 ENTER 705 USING "#%, #%K"; A$ (Requires EOI to be the terminator of the read.)`
	`40 OUTPUT 705; "RCF"; A$ (A$ must follow the SAF.)`

4-4.10 Command Codes: Service Request (SRQ) and Status Byte Commands

Table 4-13 lists the Service Request and Status Byte Commands. These commands enable the synthesizer to request service from the controller when certain, predefined conditions exist.

The synthesizer contains three status bytes: the primary and two extended bytes. These status bytes are shown and their bits identified in Figure 4-9.

The synthesizer responds to a serial poll by sending the primary status byte. Any bit in this byte can cause an SRQ to be generated, provided the bit has been so enabled. (See the FB1, ES1, LE1, PE1, SE1, and SB1 commands). However, regardless of whether a bit has been enabled to cause an SRQ, the bit will still be set (and read by the controller) when the condition on which it reports has been detected.

Bits in the primary status byte can be enabled to cause an SRQ by either of two methods. The first uses the 16 commands described in Table 4-13 to individually enable or disable each bit. The second method uses a single 8-bit byte (SM0) to mask (Figure 4-10) any or all of the status-byte bits to cause an SRQ.

Example: Sending the command "MB0" (CHR$(80)) enables status byte bits 4 and 6 to generate an SRQ.

Table 4-13. Service Request (SRQ) Commands (1 of 2)

Command Code	Function
ES1	Enables an SRQ to be generated when Status Byte bit 1 is set (end of a single sweep, Figure 4-9)
ES0	Inhibits an SRQ from being generated at the end of a single sweep. This is the default mode
FB1	Enables an SRQ to be generated when Status Byte bit 0 (Extended Status Byte 1) is set.
FB0	Inhibits an SRQ from being generated when the Extended Status Byte 1 bit is set. This is the default mode.
LE1	Enables an SRQ to be generated when Status Byte bit 3 (Lock Error) is set.
LE0	Inhibits an SRQ from being generated when the Lock Error bit is set. This is the default mode.
MB0	Sets the enable mask byte (Figure 4-10), thereby allowing any or all of the bits in the Primary Status Byte to generate an SRQ using one 8-bit byte. This command can be equivalent to sending ES1, FB1, LE1, PE1, SE1, SB1, and UL1.
MB1	Sets the enable mask byte for Extended Status Byte 1.
MB2	Sets the enable mask byte for Extended Status Byte 2.
PE1	Enables an SRQ to be generated when Status Byte bit 4 (Parameter Range Error) is set.
PE0	Inhibits an SRQ from being generated when the Parameter Range Error bit is set. This is the default mode.
SE1	Enables an SRQ to be generated when Status Byte bit 5 (Syntax Error) is set.
SE0	Inhibits an SRQ from being generated when the Syntax Error bit is set. This is the default mode.
SB1	Enables an SRQ to be generated when Status Byte bit 7 (Extended Status Byte 2) is set.
SB0	Inhibits an SRQ from being generated when the Extended Status Byte 2 bit is set. This is the default mode.
SQ0	Turns off the SRQ mode. This is the default mode.
SQ1	Turns on the SRQ mode. That is, this command allows an enabled bit (as described above) to pull the SRQ line low and request service from the conroller.
UL1	Enables an SRQ to be generated when Status Byte bit 2 (RF Unlevelled) is set.

Table 4-13. Service Request (SRQ) Commands (2 of 2)

Command Code	Function

ULO	Inhibits an SRQ from being generated when the RF Unlevelled bit is set. This is the default mode.
	
	NOTE
	All status bytes are latched except those indicated with the "*" in Figure 4-9. Once set, an OES or OSB command must be received before condition will be reset. SRQ (Bit 6) is cleared by serial poll only.
	
	Example
	`OUTPUT 705; "OES"`
	`ENTER 705 USING "#, B"; A, B, C`
	`MAIN = A`
	`1 EXT = B`
	`2 EXT = C`

CSB	Clears all GPIB status bytes.
EL0	Disables updating of the ESB2 lock bit. This is the default mode.
EL1	Enables updating of the ESB2 lock bit.

Primary Status Byte

Status Bit 2 *Bit 7*	SRQ *Bit 6*	Syntax Error *Bit 5*	Parameter Range Error *Bit 4*	Unlock Error *Bit 3*	RF Unleveled *Bit 2*	End of Sweep *Bit 1*	Status Bit 1 *Bit 0*

Extended Status Byte 1

Not Used *Bit 7*	Not Used *Bit 6*	Not Used *Bit 5*	External* Fine Loop In Use *Bit 4*	Not Used *Bit 3*	Not Used *Bit 2*	Modulation Range Error *Bit 1*	Self Test Failed *Bit 0*

Extended Status Byte 2

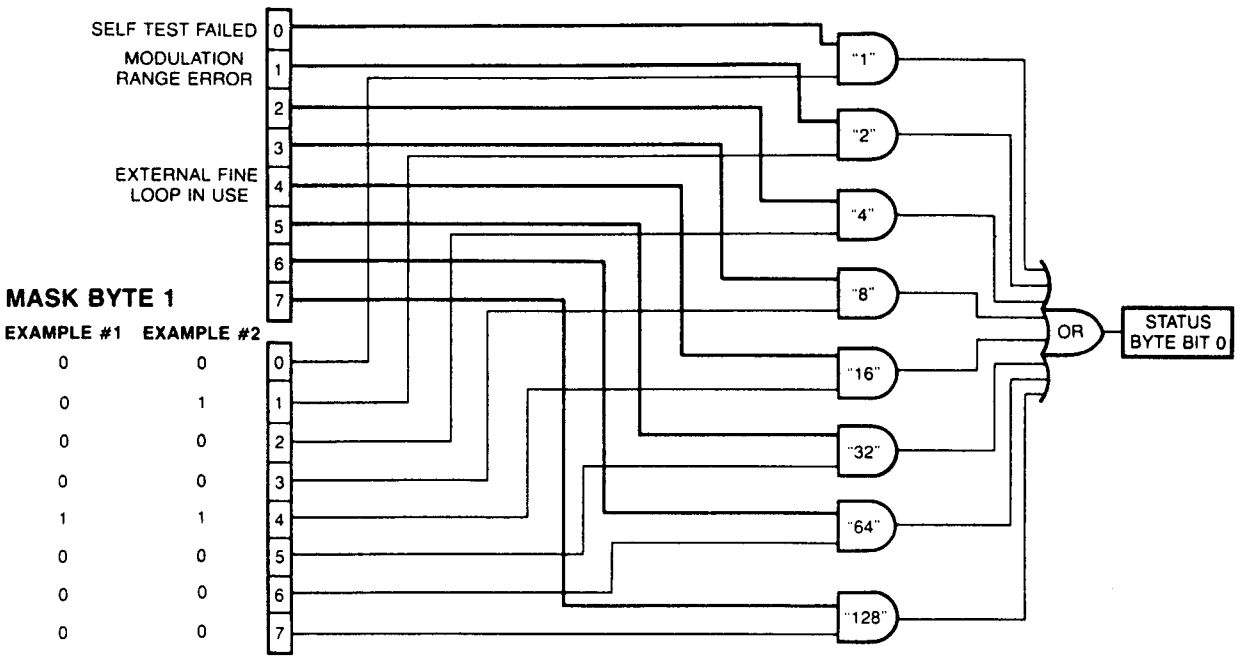
Not Used ** *Bit 7*	Cal Finished *Bit 6*	Analog Sweep Lock Error *Bit 5*	RF* Unlocked Bit 4	Not Used Bit 3	Crystal Oven Bit 2	Modulation Measurement Complete Bit 1	Power Measurement Complete *Bit 0*

*Non-latched bit:
EL1 enables RF Unlocked bit in Extended Status Byte 2;
EL0 disables RF Unlocked bit in Extended Status Byte 2; (this is default)
**For factory use only.

Figure 4-9. Status Bytes

The 67XXB contains a software mask (below) that allows the three status bytes to be manipulated over the bus. Such manipulation is accomplished by sending the command codes SM0, SM1, SM2, or all three at once, followed by an argument that assigns an on/off condition for each bit in the byte. Two examples are shown below:

EXTENDED STATUS BYTE 1



MASK BYTE 1

EXAMPLE #1	EXAMPLE #2
0	0
0	1
0	0
0	0
1	1
0	0
0	0
0	0

EXAMPLE 1
"SM1" (CHR $(16))

Sets bit 4 in Mask Byte 1 to 1 and all other bits to 0, thus enabling bit 4 in Extended Status Byte 1 to be read from the bit 0 position in the Primary Status Byte.

EXAMPLE 2
"SM1" (CHR $(18))

Sets bits 1 and 4 in Mask Byte 1 to 1 and all other bits to 0, thus enabling bits 1 and 4 in Extended Status Byte 1 to be read from the bit 0 position in the Primary Status Byte.

Figure 4-10. Status Byte Mask

.12 Command Codes: Shift-Plus-Trigger Routines Override Commands

Table 4-14 lists the Shift-Plus-Trigger Routines Override Commands. These commands permit the functions decaled in the rear panel box and described in Figure 3-18 to be controlled over the bus.

When a decaled function is set from the bus, the function will remain in that condition until it is changed or until the synthesizer is returned to local control.

4-4.13 Command Codes: Group Execute Trigger Mode Commands

Table 4-15 lists the Group Execute Trigger (GET) Commands. These commands allow the GET bus message (Table 4-19) to be used to trigger certain synthesizer functions and thus speed up bus operations.

In its default state, the synthesizer responds to a GET message by triggering a single sweep.

Table 4-14. Shift-Plus-Trigger Routines Override Commands

Command Code	Function
AMA	External AM Input, AC Coupled
AMD	External AM Input, DC Coupled
BPN	Blanking Pulse, –5 Volts
BPP	Blanking Pulse, +5 Volts
EP0 EP1	External Pulse Input, TTL High is RF Off External Pulse Input, TTL High is RF On
PPC PP0	Pen Lift Relay, Contacts Normally Closed Pen Lift Relay, Contacts Normally Open
RC0 RC1	RF Off During Frequency Switching RF On During Frequency Switching
RT0 RT1	RF Off During Retrace RF On During Retrace

Table 4-15. Group Execute Trigger Commands

Command Code	Function
GTC	Configures the synthesizer to execute an SQF command (Table 4-5) each time a GET message is received.
GTD	Configures the synthesizer to execute a DN command (Table 4-4) each time a GET message is received.
GTU	Configures the synthesizer to execute a UP command (Table 4-4) each time a GET message is received.
GTS	Configures the synthesizer to execute a TRS (Table 4-6) command each time a GET bus message is received. This is the default mode.
GTT	Configures the synthesizer to execute a TST command (Table 4-17) each time a GET message is received.
GTF	Configures the synthesizer to execute a fast frequency-switching function (Table 4-16) each time a GET message is received.
GTL GTO	Configures the synthesizer to execute a TSS command on GET. Disables the GET functions.
Y	Sending "Y" is the same as sending GET.

4-4.13 Command Codes: Fast Frequency Commands

Table 4-16 lists the Fast Frequency-Switching Commands. These commands provide for reducing the time (approximately) that it takes to switch between two CW frequencies (from 15 ms to 12 ms).

In the fast frequency-switching mode, up to 512 frequencies can be loaded into a stack. A stack pointer can then be set and the synthesizer commanded to switch from the pointed-to frequency to the bottom of the stack.

4-4.14 Command Codes: Self Test Commands

Table 4-17 lists the Self Test Commands. These commands provide for executing a complete or partial synthesizer self test.

4-4.15 Command Codes: Miscellaneous Commands

Table 4-18 is a list of miscellaneous commands that do not fit into any of the other classifications. These commands provide the following operations:

- Blanking and restoring the front panel LCDs
- Returning the synthesizer to local control
- Resetting the synthesizer
- High Resolution
- CW Ram

Table 4-16. Fast-Frequency-Switching Commands

Command Code	Function
ZL000–ZL512	Loads a CW frequency-value into the a stack, the position of which is indicated by the 000 thru 512 numerals.
ZS000–ZS512	Sets the pointer for the next frequency in the stack.

ZEL	Ends frequency loading.
	
	Example:
	
	`OUTPUT 705; "ZL000"  . . . Set pointer for load`
	`OUTPUT 705; "10 GH, 11 GH, 12 GH, 13 GH"`
	`OUTPUT 705; "ZEL"`
	`NEW`
	`OUTPUT 705; "ZS000"  . . . Set pointer to start`
	`TRIGGER 705;  . . . . . Sets 10 GHz`
	`TRIGGER 705;  . . . . . Sets 11 GHz`
	`TRIGGER 705;  . . . . . Sets 12 GHz`
	`TRIGGER 705;  . . . . . Sets 13 GHz`
	`GO TO NEW`

CAL	Causes 67XXA to initiate a SELF CAL routine. If FAST FREQ is active, it will recalculate the values for each point. This should be done if a lock error occurs.

Table 4-17. Self Test Commands

Command Code	Function
TST	Executes a complete synthesizer self test. Bit 0 in Extended Status Byte 1 is set if self test fails

Table 4-18. Miscellaneous Commands

Command code	Function
DS0 DS1	Turns off the front panel LCDs, preventing unauthorized persons from determining operating frequency. Turns the front panel LCDs back on. The LCDs can also be restored by resetting the synthesizer.
RL	Returns the synthesizer to local (front panel) control.
RST	Resets the synthesizer to its default settings (Table 3-1). ***NOTE*** Sending this command clears the synthesizer setup then in place. If this setup is needed for future testing, save it as a stored setup (paragraph 4-4.10) before sending RST.
HR1 HR0	Turns on the high-resolution mode. Turns off the high-resolution mode.
CS0 CS1	Turns off the CW ramp. Turns on the CW ramp.

4-5 BUS MESSAGES, SYNTHESIZER RESPONSE TO

Table 4-19 lists the bus messages recognized by the synthesizer. Table 4-20 lists programming statements showing how the WILTRON 85 and the HP Series 200 bus controllers implement the recognized bus messages.

Table 4-19. Bus Messages Recognized by the 67XXB Series Synthesizers (1 of 2)

Bus Messages	How Message Is Used By the Synthesizer
Device Clear	Resets the synthesizer to its default state. Sending this message is equivalent to sending the RST command.
Go to Local	Returns the synthesizer to local (front panel) control.
Group Execute Trigger	1. Triggers a new sweep, if the EXT and the GTS commands (Tables 4-6 and 4-15, respectively) are both programmed. 2. Increments the selected parameter by the amount programmed using the SYZ command, provided that the GTU command (Table 4-15) has also been programmed. 3. Decrements the selected parameter by the amount programmed using the SYZ command, provided that the GTD command (Table 4-15) has also been programmed. 4. Sequences to the next CW frequency, provided that the GTC command (Table 4-15) has also been programmed. 5. Provides a fast frequency change (12 ms), provided that the GTF command (Table 4-15) has also been programmed. 6. Executes a self test, provided that the GTT (Table 4-15) command has also been programmed.
Interface Clear	Stops the synthesizer GPIB interface from listening or talking. The front panel controls are not cleared.
Local Lockout	Prevents the front panel RETURN TO LOCAL key or the RL bus command (Table 4-18) from returning the synthesizer to local (front panel) control.

Table 4-19. Bus Messages Recognized by the 67XXB Series Synthesizers (2 of 2)

Bus Messages	How Message Is Used By the Synthesizer
Remote Enable	Places the synthesizer under remote (GPIB) control if the REN line is TRUE and the synthesizer has been addressed to listen. ***NOTE*** If the synthesizer is placed in remote and not supplied with program data, its operation is determined by the positions in which the front panel controls were set immediately prior to going remote.
Service Request Messages	The synthesizer has been equipped with an SRQ capability. It will respond to both serial- and parallel-poll messages. Responses to these messages are described below.
Serial-Poll Enable (SPE) Serial-Poll Disable (SPD)	The SPE message causes the controller to respond Enable (SPE) decimally-coded status byte (Figure 4-9).
	Parallel Poll Operation
Parallel-Poll Configure (PPC)	When queried by a parallel-poll message (PPOLL, Table 4-20), the synthesizer (if configured for parallel-poll operation) responds by setting its assigned data bus line to the logical state (1, 0) that indicates its correct SRQ status.
Parallel-Poll Enable (PPE)	To configure a bus device that is (1) built for parallel-poll operation and (2) designed to be remotely configured via the bus, the controller sends a two-byte parallel-poll configure and enable (PPC and PPE) message.
Parallel-Poll Unconfigure (PPU)	The PPC byte configures the device to respond to a message, such as PPOLL. The PPE byte assigns the logical sense (1, 0) that the parallel-poll response will take. When the synthesizer receives the PPC/PPE message, it configures itself to properly respond to the message.
Parallel-Poll Disable (PPD)	The PPU (or PPD) message is sent by the controller when a parallel-poll response is no longer needed. This message causes the synthesizer to become unconfigured for a parallel-poll response.

Table 4-20. Methods of Generating Bus Commands

Function	Method Of Execution	
	Wiltron 85	HP Series 200
Go to Local (GTL)	LOCAL 7 LOCAL 705	LOCAL 7 LOCAL 705
Group Execute Trigger (GET)	TRIGGER 7 TRIGGER 705	TRIGGER 7 TRIGGER 705
Interface Clear (IFC)	ABORTIO 7	ABORT 7
Device Clear (DC) (SDC)	CLEAR 7 CLEAR 705	CLEAR 7 CLEAR 705
Local Lockout (LLO)	LOCAL LOCKOUT 7	LOCAL LOCKOUT 7
Remote Enable (REN)	REMOTE 7 REMOTE 705	REMOTE 7 REMOTE 705
Serial Poll	A=SPOLL (705)	A=SPOLL (705)
Parallel Poll Configure (PPC)	SEND 7; UNL LISTEN 5 CMD 3 SCG 5	PPOLL CONFIGURE 705;4
Parallel Poll	A=PPOLL (7)	A=PPOLL (7)

4-6 PROGRAM ERRORS

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

a. Invalid-Parameter Error

Invalid parameter errors are those that cause the front panel CLEAR, SWEEP WIDTH or SWEEP RANGE ERROR, GHz/S/dB/dBm/%, MHz/mS/STEPS, or kHz/μS indicators to flash. These errors include:

1. Programming a frequency sweep where F1 is greater than F2 or F3 is greater than F4.
2. Attempting to enter a frequency, sweep-time, or RF level parameter that exceeds the limits of the synthesizer.
3. Failing to properly end a parameter entry with a suitable terminator (i.e.: MH, DB, MS, etc.).

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

b. Syntax Errors.

Syntax errors are those that occur in the formulation of a program statement, such as writing "EXTTFS" instead of "EXTTRS."

To prevent misinterpretation of command statements, the synthesizer ignores all portions of the command statement following the syntax error.

All commands are ignored until the synthesizer receives the Unlisten command (ASCII 63; "?" character) over the bus or until the synthesizer is addressed to talk.

4-7 RESET PROGRAMMING AND DEFAULT CONDITIONS

Table 4-21 describes the five methods that can be used to reset the synthesizer. They provide a means for quickly returning the synthesizer to its default (preprogrammed) operational state.

The default settings for the numeric frequency, sweep time, and output-power level parameters are the same as those given for the INSTR RESET key (Tables 3-3 and 3-9).

Figure 4-11 provides a recommended sequence for programming a reset command. Using this command sequence ensures that all parameters and commands assume their preprogrammed state each time reset is desired.

4-8 PROGRAMMING EXAMPLES

Tables 4-22 thru 4-24 provide three examples of GPIB programming using the synthesizer command codes. These programs have been written to run on the HP200 Series computers.

Figure 4-12 provides a test equipment setup for running these programs.

Table 4-21. Resetting the 67XXB GPIB Interface Circuits

Methods of Resetting GPIB Interface Circuits	Functions Affected	Default Conditions
1. Pressing the front panel RETURN TO LOCAL key.	Bus Messages	Local
2. Pressing the front panel RESET key.	Service Request Modes	ES0, FB0, LE0, PE0, SB0, SE0, SQ0, UL0, SB0 GTS Local and Local Lockout
3. Sending the RST command over the bus.	Same as 2 above	Same as 2 above except that the local bus message is not reset.
4. Executing the interface message Device Clear.	Same as 2 above	Same as 2 above except that the local bus message is not reset.
5.Turning the POWER switch on and off.	Same as 2 above	Places the GPIB into the power-on state. Device state does not change

Line	Purpose
10	Sends Device Clear Bus Message. This message clears the sweep generator GPIB interface.
20	Sends new front panel settings: Full Sweep, Internal Levelling, and Output-Power Level of 10.

```
10 CLEAR 705
20 OUTPUT 705 ;"FUL IL1 L1 0DM"
```

Figure 4-11. Reset Programming Statements

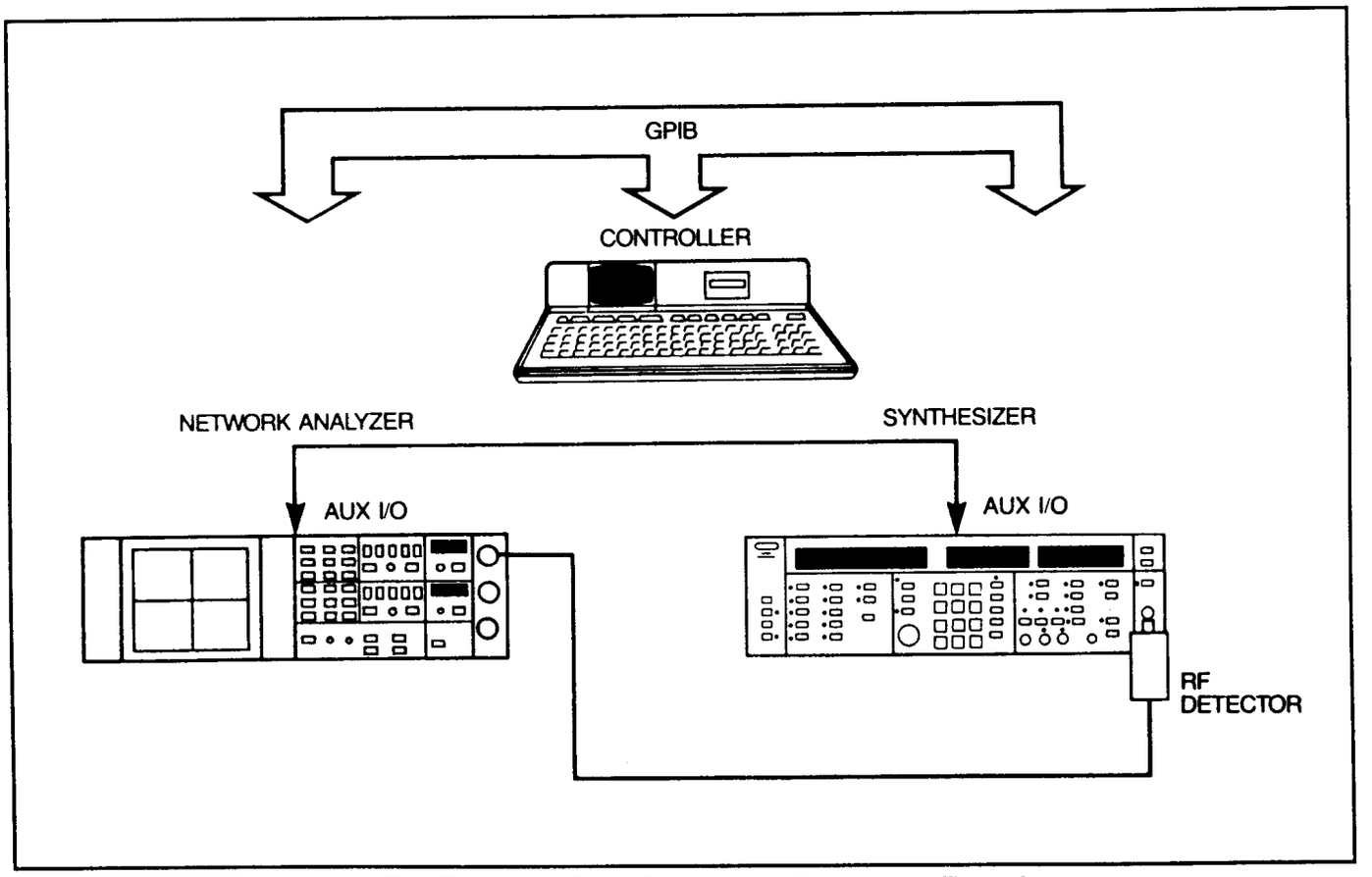


Figure 4-12. Test Equipment Setup for Runing GPIB Program Examples

Table 4-22. Using the Output Identify Command

The following subroutine uses the output identify (OI) command to identify the synthesizer's model number, minimum and maximum frequencies, and minimum and guaranteed power levels. This subroutine is used in the programs in Tables 4-23 thru 4-24 to read the limits of the synthesizer. This subroutine can also be used to identify a WILTRON Series 6600 Programmable Sweep Generator.

```
 10 !  "GET OI"
 20 ! Gets the output id sting
 30 ! from a 6700A SYNTH
100 OUTPUT 705 ;"OI"
110 DIM A$[35]
120 ENTER 705 ; A$
130 M$=A$[1,4] ! Model Number
140 F1$=A$[5,9] ! Flow
150 F2$=A$[10,14] ! Fhigh
160 L2$=A$[15,20] ! Min Power
170 L1$=A$[21,24] ! Guar Power
180 S$=A$[25,28] ! Soft Ver
190 S1$=A$[29,34] ! Seral Num
200 PRINT "Model Number :";M$
210 PRINT "Serial Number :";S1$
220 PRINT "Low Freq :";F1$
230 PRINT "High Freq :";F2$
240 PRINT "Guar Power :";L1$
250 PRINT "Min Power :";L2$
260 PRINT "Software Ver :";S$
270 END
```

Program Explanation

Line 100: Sends the "OI" command.
Line 110: Dimensions the variable.
Line 120: Gets the "OI" string.
Line 130: Sets M$ to the model number.
Line 140: Sets F1$ to the synthesizer low-end frequency.
Line 150: Sets F2$ to the synthesizer high-end frequency.
Line 160: Sets L2$ to the minimum power point.
Line 170: Sets L1$ to the maximum specified power point.
Line 180: Sets S$ to the software version number.
Line 180: Sets S1$ to the serial number.
Lines 200-260: Prints the data obtained.

Table 4-23. Controlling CW Frequency/Parameter Entries

The following program:

(1) receives entries from the keyboard to set initial frequency and step-size parameters, and

(2) activates the soft keys on the controller so that they can step the frequency up or down.

```
30    Address=705
40    CALL Iddev(Address,Model,Fmin,Fmax,Pmin,Pmax)
60    DISP "ENTER POWER SWEEP STARTING LEVEL (dBm) ";
70    INPUT Powerstart
80    IF Powerstart>Pmax OR Powerstart<Pmin THEN
90      DISP "POWER OUT OF RANGE - ";
100     GOTO 60
110   END IF
120   DISP "ENTER POWER SWEEP ENDING LEVEL (dBm)";
130   INPUT Powerstop
140   IF Powerstop>Pmax OR Powerstop<Pmin THEN
150     DISP "POWER OUT OF RANGE - ";
160     GOTO 120
170   END IF
180   DISP "ENTER NUMBER OF STEPS";
190   INPUT Noofsteps
200   IF Noofsteps<1 OR Noofsteps>1000 THEN
210     DISP "NUMBER OF STEPS OUT OF RANGE - ";
220     GOTO 180
230   END IF
240   DISP "ENTER DWELL TIME AT EACH STEP (mS)";
250   INPUT Dwell
260   IF Dwell<100 OR Dwell>10000 THEN
270     DISP "DWELL TIME OUT OF RANGE - ";
280     GOTO 240
290   END IF
300   OUTPUT Address;"L1";Powerstart;"DM L2";Powerstop;"DM PNS";Noofsteps;"SPS"
310   OUTPUT Address;"PDT";Dwell;"MS LSP"
340   END
1010  SUB Iddev(Address,Model,Fmin,Fmax,Pmin,Pmax)
1020  DIM Ident$[28]
1030  OUTPUT Address;"OI"
1040  ENTER Address;Ident$
1050  Model=VAL(Ident$[1,4])
1060  Fmin=VAL(Ident$[5,9])
1070  Fmax=VAL(Ident$[10,14])
1080  Pmin=VAL(Ident$[15,20])
1090  Pmax=VAL(Ident$[21,24])
1100  SUBEND
```

Program Explanation

Line 30: Sets the address of the synthesizer.
Line 40: Calls the device identification subroutine described in line 1010 (Table 4-22).
Line 50: Turns off the key definitions.
Lines 60-110: Prompts the user for the starting frequency, checks the frequency's validity, and tells the user if the frequency is valid.
Line 180: Sets the synthesizer to the starting frequency and step size.
Lines 190-240: Set up keys and key labels.
Line 250: Waits for a key to be pressed.
Line 300: Reports that the STEP UP key was pressed; sends the UP command.
Line 310: Waits for the next key.
Line 320: Reports that the STEP DOWN key was pressed; sends the DN command.
Line 330: Waits for the next key.
Line 340: Ends the main program.
Lines 1010-1090: Identify the synthesizer address, model, frequency range, and power range.

Table 4-24. Controlling Power Level and Power Sweep

The following program accepts user inputs for (1) power sweep starting and ending levels, (2) numbers of steps in the sweep, and (3) sweep dwell times. After accepting such inputs, the program then commands the synthesizer to obtain a display of the power sweep.

The synthesizer should be connected to a scalar network analyzer as shown in Figure 4-12.

```
20    ! PARAMETER ENTRY, SYZ, UP, AND DN COMMANDS
30    Address=705
40    CALL Iddev(Address,Model,Fmin,Fmax,Pmin,Pmax)
50    OFF KEY
60    DISP "ENTER FREQUENCY IN GHz";
70    INPUT Freq
80    IF Freq>Fmax OR Freq<Fmin THEN
90      DISP "FREQUENCY OUT OF RANGE - ";
100     GOTO 60
110   END IF
120   DISP "ENTER STEP SIZE IN GHz";
130   INPUT Stepsize
140   IF Stepsize>Fmax-Fmin OR Stepsize<.000001 THEN
150     DISP "ILLEGAL STEP SIZE - ";
160     GOTO 120
170   END IF
180   OUTPUT Address;"CF1";Freq;"GH SYZ";Stepsize;"GH"
190   ON KEY 0 LABEL "STEP" GOTO 300
200   ON KEY 5 LABEL " UP " GOTO 300
210   ON KEY 1 LABEL "STEP" GOTO 320
220   ON KEY 6 LABEL "DOWN" GOTO 320
230   ON KEY 2 LABEL "NEW " GOTO 50
240   ON KEY 7 LABEL "FREQ" GOTO 50
250   GOTO 250
300   OUTPUT Address;"UP"
310   GOTO 250
320   OUTPUT Address;"DN"
330   GOTO 250
340   END
1010  SUB Iddev(Address,Model,Fmin,Fmax,Pmin,Pmax)
1020  DIM Ident$[28]
1030  OUTPUT Address;"OI"
1040  ENTER Address;Ident$
1050  Model=VAL(Ident$[1,4])
1060  Fmin=VAL(Ident$[5,9])
1070  Fmax=VAL(Ident$[10,14])
1080  Pmin=VAL(Ident$[15,20])
1090  Pmax=VAL(Ident$[21,24])
1100  SUBEND
```

Program Explanation

Line 30: Sets the synthesizer to address 5.
Line 40: Calls the subroutine to identify the device described in line 1010 (Table 4-22).
Lines 60-110: Accept the starting power level entry and checks its validity.
Lines 120-170: Accept the ending power level entry and checks its validity.
Lines 180-230: Accept the power sweep number-of-steps entry and checks its validity.
Lines 240-290: Accept the power sweep dwell time entry and checks it validity.
Lines 300-310: Set the synthesizer to perform the above defined power sweep.
Line 340: Ends the main program.
Lines 1010-1090: Identify the synthesizer model.