

**HP 8683A**

**SIGNAL GENERATOR**

**2.3—6.5 GHz**

**(Including Options 001, 002 and 003)**

**SERIAL NUMBERS**

This manual applies directly to instruments with serial numbers prefixed 2402A.

With changes described in Section VII, this manual also applies to instruments with serial numbers prefixed 2333A, 2319A, 2244A, 2208A, 2149A, and 2138A.

For additional important information about serial numbers, see INSTRUMENTS COVERED BY MANUAL in Section I.



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OPERATING AND SERVICE MANUAL PART NO. 08683-90023  
Operating Manual Part No. 08683-90025  
Microfiche Part No. 08683-90024

### SAFETY CONSIDERATIONS

#### GENERAL

This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

This product is a Safety Class I instrument (provided with a protective earth terminal).

#### BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

#### SAFETY EARTH GROUND

An uninterrupted safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set.

#### WARNINGS

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two conductor outlet is not sufficient protection.) In addition, verify that a common ground exists between the unit under test and this instrument prior to energizing either unit.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation. If this instrument is to be energized via an auto-transformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the mains supply).

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

Adjustments described in the manual are performed with power supplied to the instrument

while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.

For continued protection against fire hazard, replace the line fuse(s) only with 250V fuse(s) of the same current rating and type (for example, normal blow, time delay, etc.). Do not use repaired fuses or short circuited fuseholders.

#### SAFETY SYMBOLS



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual (see Table of Contents for page references).



Indicates hazardous voltages.



Indicates earth (ground) terminal.

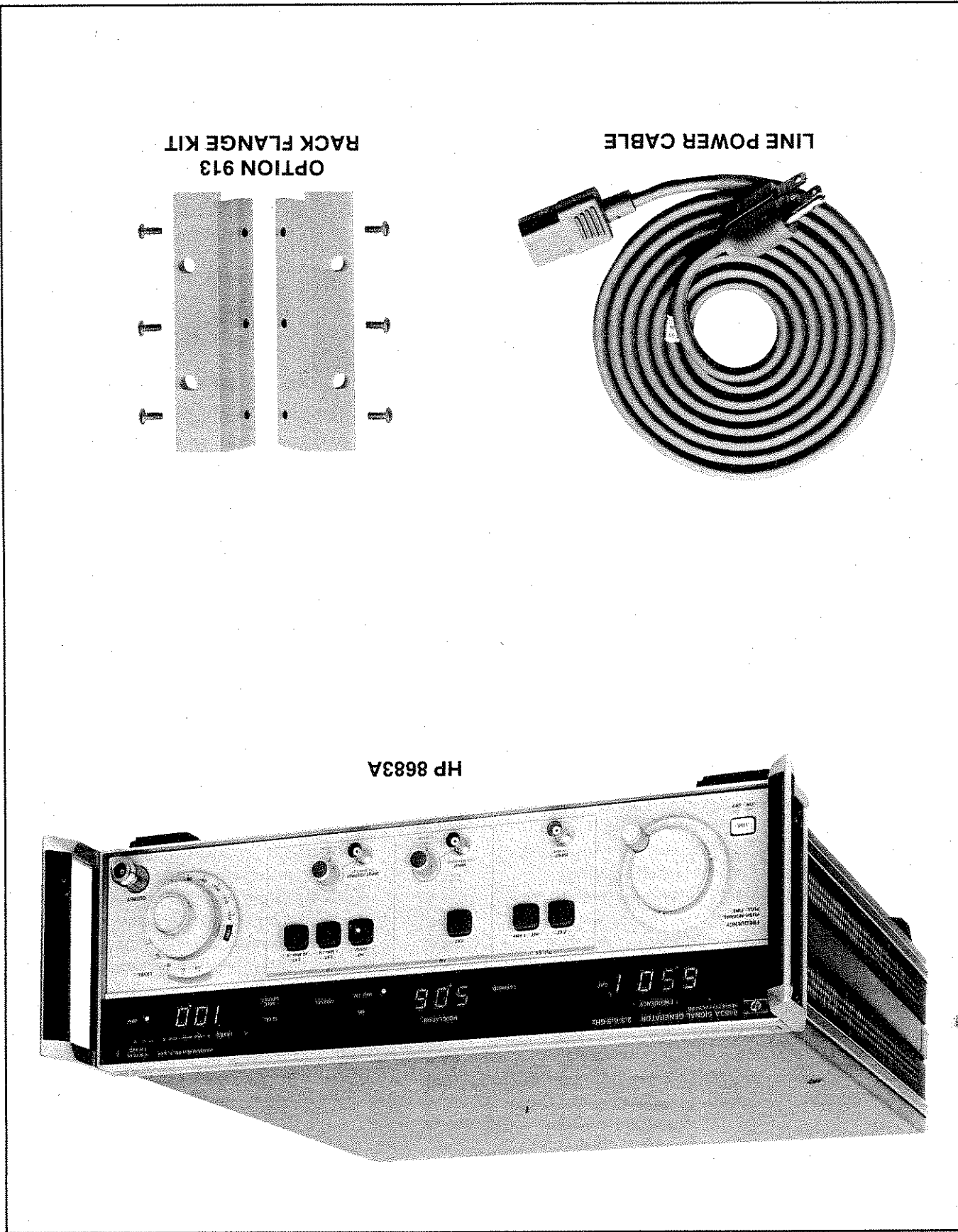
#### WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

#### CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

Figure 1-1. HP 8683A Signal Generator with Accessory Supplied and Option Available





# SECTION I GENERAL INFORMATION

## 1-1. INTRODUCTION

This manual contains information required to install, operate, test, and service the Hewlett-Packard Model 8683A Signal Generator. The Signal Generator is shown in Figure I-1 with all of its externally supplied accessories and the available rack mounting option. This manual also documents Option 001 which increases output power to +10 dBm and Option 003 which adds the capability of operating from 48 to 440 Hz power sources. This section of the manual covers the instrument description, options, accessories, specifications, and other basic information. The remaining sections cover the following information.

- Section II Installation
- Section III Operation
- Section IV Performance Tests
- Section V Adjustments
- Section VI Replaceable Parts
- Section VII Manual Changes
- Section VIII Service

Two copies of the operating information are supplied with the Signal Generator. One copy is in the form of an Operating Manual and simply is a copy of the first three sections of the Operating and Service Manual. It should remain with the instrument for use by the operator. The other copy provided is the Operating and Service Manual which should be retained by the technicians responsible for the periodic servicing of the instrument. Additional copies of either manual may be ordered through your nearest Hewlett-Packard sales office. The part numbers are listed on the title page of this manual.

## 1-2. SPECIFICATIONS

The Operating and Service Manual is also available in microfiche form, and the microfiche part number is also listed on the title page. This number may be used to order the 100 x 150 mm (4 by 6 inch) microfilm transparencies. Each transparency contains up to 98 photo-duplicates of the manual pages and the package includes the latest manual change supplements.

This product is a Safety Class I instrument (i.e., provided with a protective earth terminal). The Signal Generator and all related documentation must be reviewed for familiarization with safety markings and instructions before operation. Refer to the Safety Considerations page found at the beginning of this manual for a summary of the safety information. Safety information pertinent to the task at hand (installation, performance testing, adjustment, or service) will be found throughout the manual.

## 1-3. SAFETY CONSIDERATIONS

This instrument has a two-part serial number in the form of 0000A00000. The number is stamped on the serial number plate attached to the rear panel of the instrument. The first four digits and the letter constitute the serial number prefix, and the last five digits form the suffix. The prefix is the same for all identical instruments, and it changes only when a change is made to the instrument. The suffix, however, is assigned sequentially and is different for each instrument. The contents of this manual apply directly to instruments having the same serial number prefix(es) as listed under Serial Numbers on the title page.

## 1-4. INSTRUMENTS COVERED BY THIS MANUAL

An instrument manufactured after the printing of this manual may have a serial number prefix that is not listed on the title page. This unlisted serial number prefix indicates that the instrument is different from those documented in the manual. The manual for a newer instrument is accompanied by a yellow Manual Changes supplement which contains the change information that explains how to adapt the manual to the newer instrument.

In addition to change information, the supplement may contain information for correcting

control for entering cable length (up to 4.5 metres of RG-214 cable). Using the cable length data and the frequency of the Signal Generator output, the microprocessor computes the cable loss and then, operating through the automatic level control system, increases the output power level to compensate for the calculated losses. When the cable offset is turned on, the power level displayed by the Signal Generator is the level at the OUT-PUT connector of the Signal Generator.

The setting of the rear-panel CABLE OFFSET control appears in the LEVEL display when the CABLE OFFSET key is held down. This makes it easy to verify the setting of the control or to adjust it to a new setting. The display resolution is one-tenth of a metre.

The Signal Generator has an extensive set of built-in diagnostic procedures that will rapidly identify most of the troubles that are likely to occur, and many of the procedures are automatically executed when the instrument is turned on. If a malfunction is detected, an error code number or other special display indicates the nature of the fault. The power-up error codes are described in Section III, Operation, and are also included inside the instrument on the top cover.

A second and more extensive set of diagnostic routines can be accessed by removing the top cover and switching the instrument to the diagnostic mode. This mode allows a technician (using the front-panel switches and indicators) to select individual diagnostic routines that will check power supplies, modulator voltages, detector outputs, flip-flop operation, and many other analog and digital functions. No external test equipment is required for the power-up diagnostics or for most of the testing in the diagnostic mode. The diagnostic routines are fully described in Section VIII, Service, and a summary is included inside the instrument on the top cover.

Since a fault in the microprocessor might prevent either of the first two diagnostic modes from operating, a third level of diagnostic procedures is furnished. This level is provided by the signature analysis mode. It requires the use of external test equipment, and it provides an efficient method of troubleshooting digital circuitry. The signature analysis procedures are described in Section VIII, Service.

The cable offset feature provides a front-panel key for turning the offset on and off, and a rear-panel

The Signal Generator uses seven-segment digital LED displays to show the output frequency, modulation level, and output level. Smaller LED indicators in each pushbutton key provide an immediate indication of whether or not that particular function is active. Other LED indicators provide warnings when the output is not properly leveled, or when overmodulation is occurring.

The Hewlett-Packard Model 8683A is a cavity tuned, microprocessor enhanced, solid-state signal generator with a microwave output frequency range of 2.3 to 6.5 GHz. Its output is leveled and calibrated over the range of 0 dBm to -120 dBm, and power is available down to approximately -130 dBm. Instruments with Option 001 have an output power range of +10 dBm to -130 dBm. Internal amplitude modulation in the form of a 1 kHz square wave or FM in the form of a 1 kHz sawtooth may be individually selected, and the maximum frequency deviation of the FM may be adjusted from the front panel. An external pulse generator may also be used to pulse modulate the microwave output at rates up to 10 kHz. Whether derived from external or internal sources, AM, FM, and pulse modulation may be applied individually or in various combinations. However, interlocks provided by the microprocessor controlled system prevent the selection of two sources for the same type of modulation. For example, external AM and internal FM can be selected at the same time; external FM and internal FM cannot be selected at the same time. When a conflict occurs, the Signal Generator automatically turns off the previously selected mode and turns on the most recently selected mode.

### 1-5. DESCRIPTION

For information concerning a serial number prefix that is not listed on the title page or in the Manual Changes supplement, contact your nearest Hewlett-Packard office.

are available from Hewlett-Packard. Manual Changes supplement, The supplements are identified with the manual print date and part number, both of which appear on the manual title page. Complimentary copies of the supplements are available from Hewlett-Packard.

### INSTRUMENTS COVERED BY THIS MANUAL (cont'd)

ing upon the country of destination for the original shipment from the factory. Refer to Power Cables in Section II of this manual.

**1-11. ACCESSORIES AVAILABLE**

**1-12. Chassis Slide Mount Kit**

This kit is very useful when the Signal Generator is to be rack mounted. It permits access to internal circuits and components, and access to the rear panel is possible without removing the instrument from the rack. Order HP part number 1494-0018 for the slide mount kit, and part number 1494-0023 for the adapters to be used with non-HP rack enclosures.

**1-13. Chassis Tilt Slide Mount Kit**

This kit is similar to the Chassis Slide Mount Kit but it also allows the instrument to be tilted up or down 90°. Order HP part number 1494-0025 for tilting slides, and part number 1494-0023 for the adapters to be used with non-HP rack enclosures.

**1-14. RECOMMENDED TEST EQUIPMENT**

Table 1-3 lists the test equipment recommended for use in testing, adjusting, and servicing the Signal Generator. If any of the recommended equipments is not available, instruments with equivalent critical specifications may be substituted. Table 1-4 provides a list of recommended service accessories.

**1-6. OPTIONS**

**1-7. Reverse Power Protection (Option 002)**

Option 002 provides 2 kW peak, 10W continuous, and 5 kW pulse of reverse power protection at the RF OUTPUT.

**1-8. Electrical 400 Hz Line Frequency Operation (Option 003)**

Option 003 provides the additional capability of operating from 400 Hz power sources. Option 003 instruments can operate from line frequencies of 48 to 440 Hz, but operation at line frequencies greater than 66 Hz is limited to 100 or 120 Vac.

**1-9. Mechanical Rack Flange Kit (Option 913)**

This kit contains all necessary hardware and installation instructions for mounting the Signal Generator in a rack with standard 19-inch EIA (482.5 millimetres) spacing. The Signal Generator cabinet is 5-1/4 inches (133.4 mm) high. Order HP part number 5061-2071.

**1-10. ACCESSORY SUPPLIED**

The accessory supplied with the Signal Generator is shown in Figure 1-1. The line power cable will be supplied in one of several configurations, depend-

Electrical Characteristics	Performance Limits	Conditions
<p><b>FREQUENCY</b> Range 2.3 GHz to 6.5 GHz</p> <p>Display Resolution 5 MHz</p> <p>Calibration Accuracy ≤4 GHz ±1.25% &gt;4 GHz ±0.75%</p>	<p>See Table 1-2, Supplemental Characteristics</p> <p>Using 4-digit 7-segment display</p>	<p>Up to 18 GHz at maximum specified power</p> <p>Harmonics &lt;-25 dBc</p> <p>Spurious Output &lt;-80 dBc</p> <p>Residual FM &lt;5 kHz peak</p>
<p><b>SPECTRAL PURITY</b></p>	<p>Level Accuracy<sup>1</sup> ±2.5 dB ±3.5 dB 0.1 dB ±1.0 dB</p> <p>Level Flatness</p>	<p>Level Range 0 dBm to -130 dBm +10 dBm to -130 dBm</p> <p>Level Accuracy<sup>1</sup> ±2.5 dB ±3.5 dB 0.1 dB ±1.0 dB</p> <p>Display Resolution</p> <p>Level Flatness</p>
<p><b>RF OUTPUT</b> Level Range</p>	<p>Level Accuracy<sup>1</sup> ±2.5 dB ±3.5 dB 0.1 dB ±1.0 dB</p> <p>Display Resolution</p> <p>Level Flatness</p>	<p>Level Range 0 dBm to -130 dBm +10 dBm to -130 dBm</p> <p>Level Accuracy<sup>1</sup> ±2.5 dB ±3.5 dB 0.1 dB ±1.0 dB</p> <p>Display Resolution</p> <p>Level Flatness</p>
<p><b>GENERAL MODULATION SPECIFICATIONS</b> Types</p>	<p>Internal AM Internal FM External AM External FM External Pulse Simultaneous AM/FM or FM/Pulse</p>	<p>Internal AM Internal FM External AM External FM External Pulse Simultaneous AM/FM or FM/Pulse</p>
<p><sup>1</sup> Accuracy error includes allowances for metering accuracy, detector linearity, temperature, flatness, harmonics, attenuator accuracy, and measurement error. Accuracy specifications apply only to the top 15 dB of the LEVEL vernier range. Option 002 Reverse Power Protection affects level accuracy ±3 dB to -110 dBm and ±4 dB to -120 dBm.</p>		

Table 1-1. Specifications (1 of 4)



Table 1-1. Specifications (2 of 4)

Electrical Characteristics	Performance Limits	Conditions
<p><b>AMPLITUDE MODULATION<sup>2</sup></b></p> <p>AM Depth 0 to 70%</p> <p>AM Distortion (Total Harmonic Distortion) &lt;10% at 40% depth and 1 kHz rate.</p> <p>AM Rates dc to 10 kHz</p> <p>Incidental FM 50 Hz to 10 kHz</p> <p>Incidental FM &lt;10 kHz peak-to-peak</p> <p>Internal AM Fixed 1 kHz (nominal) square wave with a duty cycle of 50 ±5%. On-Off ratio &gt;30 dB at maximum power.</p>	<p>AM Rates dc to 10 kHz</p> <p>Incidental FM 50 Hz to 10 kHz</p> <p>Incidental FM &lt;10 kHz peak-to-peak</p> <p>Internal AM Fixed 1 kHz (nominal) square wave with a duty cycle of 50 ±5%. On-Off ratio &gt;30 dB at maximum power.</p>	<p>At 1 kHz rate</p> <p>dc coupled 40% AM depth (3 dB bw)</p> <p>ac coupled 40% AM depth (3 dB bw)</p> <p>30% AM depth</p>
<p><b>FREQUENCY MODULATION</b></p> <p>Peak Deviation 5 MHz</p> <p>FM Rates dc to 10 MHz</p> <p>Incidental AM 100 Hz to 10 MHz</p> <p>Incidental AM &lt;5%</p> <p>Internal FM Fixed 1 kHz (nominal) sawtooth with variable deviation up to the maximum specified deviation.</p> <p>Distortion A 1 kHz (nominal) sawtooth signal with a nominal amplitude of 1 V peak is available at the FM INPUT/OUTPUT connector. &lt;5%</p>	<p>5 MHz</p> <p>dc to 10 MHz</p> <p>100 Hz to 10 MHz</p> <p>&lt;5%</p> <p>Fixed 1 kHz (nominal) sawtooth with variable deviation up to the maximum specified deviation.</p> <p>A 1 kHz (nominal) sawtooth signal with a nominal amplitude of 1 V peak is available at the FM INPUT/OUTPUT connector. &lt;5%</p>	<p>dc coupled (3 dB bw)</p> <p>ac coupled (3 dB bw)</p> <p>With &lt;100 kHz rate and &lt;1 MHz peak deviation</p> <p>With 100 kHz rate and &lt;1 MHz peak deviation.</p>
<p><b>EXTERNAL PULSE INPUT REQUIREMENTS</b></p> <p>Rate 0 to 10 kHz</p>	<p>0 to 10 kHz</p>	<p>See Table 1-2, Supplemental Characteristics</p>
<p><sup>2</sup> Amplitude modulation specifications are valid for pulse modulation OFF and for the LEVEL vernier range of 5 to 15 dB below the maximum vernier setting with output levels at least 5 dB below the specified maximum output power.</p>		

Electrical Characteristics	Performance Limits	Conditions
<b>EXTERNAL PULSE INPUT REQUIREMENTS</b> (cont'd) Width Input	>10 $\mu$ s TTL compatible	dc coupled
<b>RF PULSE OUTPUT</b> Rise and Fall Time On-Off Ratio	<5 $\mu$ s >30 dB	At maximum leveled power
<b>GENERAL</b> Operating Temperature Range Power Requirements Line Voltage Line Frequency Power Dissipation Conducted and Radiated Interference Operating and Non-operating Environment Safety Net Weight	0°C to 55°C 100, 120, 220 or 240 Vac, +5%, -10% 48 to 66 Hz Option 003 adds 48 to 440 Hz operation <200 VA MIL-STD-461A Temperature, humidity, shock, and vibration Type Tested to MIL-T-28800B Class IV Requirements. Meets requirements of IEC 348 16.8 kg (37 lb)	All specified line voltages may be used Limited to line voltages of 100 or 120 Vac when line frequency is >66 Hz Conducted and radiated interference is within the requirements of CE03, CS01, CS02, CS06, RE02, RS01, and RS03 of MIL-STD-461A. Also within the requirements of VDE 0871 and CISPR Publication 11.

Table 1-1. Specifications (3 of 4)

Table 1-1. Specifications (4 of 4)

Electrical Characteristics	Performance Limits		Conditions
<p><b>GENERAL (cont'd)</b>                      Dimensions:                      Full envelope                      Height x Width x Depth</p>	<p>145 H x 457 W x 495.5 mmD                      (5.75 H x 18 W x 19.5 inches D)</p>	<p>Note: For ordering cabinet accessories, the module sizes are 5 1/4 H, 1 MW, and 17 D.</p>	

Table 1-2. Supplemental Characteristics (1 of 2)

<p>Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted performance parameters.</p> <p><b>FREQUENCY</b></p> <p>Frequency Stability: As a function of time, frequency stability is &lt;30 kHz/minute 20 minutes after turn-on and &lt;100 kHz/hour 60 minutes after turn-on (at a constant ambient temperature). Typically, frequency drift with respect to mode changes (CW to FM or FM to CW) is &lt;20 kHz. Stability as a function of temperature is &lt;15 MHz change over the range of 0°C to 55°C, and stability as a function of line voltage is &lt;20 ppm for transient line changes from +5% to -10%.</p> <p>Tuning is accomplished via a rotary tuning control requiring approximately 20 turns to cover the full band in the normal tuning mode and approximately 200 turns to cover the full band in the fine-tuning mode. The tuning range extends approximately 200 MHz above and 50 MHz below the specified frequency range.</p> <p><b>SPECTRAL PURITY</b></p> <p>SSB Broadband Noise Floor: At maximum specified output level, the noise floor is &lt;-150 dBc.</p> <p>Residual AM (averaged rms): &lt;0.1% in a 300 Hz to 15 kHz post-detection bandwidth.</p> <p>SSB Phase Noise (averaged rms): &lt;-72 dBc in a 1 Hz bandwidth offset 10 kHz from the carrier.</p> <p><b>RF OUTPUT</b></p> <p>Reverse power must not exceed 1 watt average nor 100 watts peak. Pulse energy (pulse power x pulse width) must not exceed 1 mW-s.</p> <p>Reverse Power with Option 002 must not exceed 2kW peak, 10W continuous, or 5 kW-<math>\mu</math>s pulse.</p> <p>Typically, the output impedance is 50 ohms and the SWR is &lt;2.0.</p> <p>Auxiliary Output: The signal at the rear-panel Type-N connector is typically &gt;-15 dBm into 50 ohms; it is derived from the oscillator output before reaching the amplitude modulation or pulse modulation circuits. Therefore, the auxiliary output signal may be a CW signal or may include frequency modulation, but it cannot be amplitude modulated or pulse modulated. The source impedance is approximately 50 ohms.</p> <p><b>RF Power Level Display:</b> The output level may be displayed in dBm or dB REL (relative to a user selected reference level). A CABLE OFFSET feature permits automatic correction of the power level so that the indicated level represents the level at the end of a known length of RG-214 cable.</p> <p><b>AMPLITUDE MODULATION</b></p> <p>External AM Sensitivity: Variable, and nominally is 100% AM per volt peak into 600 ohms with AM vernier at full cw position.</p> <p>AM Display Accuracy: <math>\pm 5\%</math> of full scale for depths up to 50% at a 1 kHz rate. The OVERMOD indicator may turn on in the top 5 dB of the specified LEVEL vernier range.</p> <p>Maximum Allowable Input Level: <math>\pm 5</math> V peak.</p> <p><b>FREQUENCY MODULATION</b></p> <p>External FM Sensitivity: On both the 1 MHz/V and 10 MHz/V ranges, peak deviation (with FM vernier fully cw) is approximately 100% of selected range per volt peak. Nominal input impedance is 50<math>\Omega</math>. FM sensitivity is lower at the low end of the frequency range; in the 1 MHz/V range, it typically is about 600 kHz/V.</p> <p>Phase Lock Input: Rear-panel BNC connector with a typical sensitivity of -5 MHz/V. The input impedance is nominally 1 k<math>\Omega</math>. The phase lock input sensitivity is lower at the low end of the frequency range.</p> <p>FM Display Accuracy (10 MHz/V range): <math>\pm 10\%</math> of full scale for deviations up to 5 MHz at a 100 kHz rate.</p> <p>Maximum Allowable Input Level: 5V peak.</p>	<p>Supplemental characteristics are intended to provide information useful in applying the instrument by giving typical, but non-warranted performance parameters.</p> <p><b>FREQUENCY</b></p> <p>Frequency Stability: As a function of time, frequency stability is &lt;30 kHz/minute 20 minutes after turn-on and &lt;100 kHz/hour 60 minutes after turn-on (at a constant ambient temperature). Typically, frequency drift with respect to mode changes (CW to FM or FM to CW) is &lt;20 kHz. Stability as a function of temperature is &lt;15 MHz change over the range of 0°C to 55°C, and stability as a function of line voltage is &lt;20 ppm for transient line changes from +5% to -10%.</p> <p>Tuning is accomplished via a rotary tuning control requiring approximately 20 turns to cover the full band in the normal tuning mode and approximately 200 turns to cover the full band in the fine-tuning mode. The tuning range extends approximately 200 MHz above and 50 MHz below the specified frequency range.</p> <p><b>SPECTRAL PURITY</b></p> <p>SSB Broadband Noise Floor: At maximum specified output level, the noise floor is &lt;-150 dBc.</p> <p>Residual AM (averaged rms): &lt;0.1% in a 300 Hz to 15 kHz post-detection bandwidth.</p> <p>SSB Phase Noise (averaged rms): &lt;-72 dBc in a 1 Hz bandwidth offset 10 kHz from the carrier.</p> <p><b>RF OUTPUT</b></p> <p>Reverse power must not exceed 1 watt average nor 100 watts peak. Pulse energy (pulse power x pulse width) must not exceed 1 mW-s.</p> <p>Reverse Power with Option 002 must not exceed 2kW peak, 10W continuous, or 5 kW-<math>\mu</math>s pulse.</p> <p>Typically, the output impedance is 50 ohms and the SWR is &lt;2.0.</p> <p>Auxiliary Output: The signal at the rear-panel Type-N connector is typically &gt;-15 dBm into 50 ohms; it is</p>
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Table 1-2. Supplemental Characteristics (2 of 2)

<p>ing range, and the other output provides a RELATIVE VERNIER LEVEL signal representing the 0 to 25 dB range of the LEVEL vernier.</p> <p><b>SERVICE MODES</b></p> <p>An internally selected diagnostic service mode provides a series of microprocessor controlled test routines that will rapidly measure and display power supply voltages and various analog voltages. These routines will also verify normal operation of most of the digital circuitry involved. Many of these same tests are automatically performed when power is applied to the instrument, and diagnostic codes are displayed to indicate the nature of any malfunction detected.</p> <p>A second service mode permits the use of a signature analyzer when troubleshooting the microprocessor and its associated circuitry.</p> <p>An edge connector providing RS-232 type signals is available for connecting the microprocessor to an HP 2600 series terminal. With this arrangement, a single diagnostic routine simultaneously displays the voltages measured at 28 different points in the instrument. Any voltage that is out of tolerance is identified by underlining or by reverse video on the terminal display. Another routine displays the actual voltage transitions measured at the outputs of 32 flip-flops so an inoperative flip-flop can easily be identified.</p>	<p><b>PULSE MODULATION</b></p> <p>The EXT mode permits the pulse rate to be determined by an external source. The external signal must be a positive-going signal of &gt;1.0V, and it must have a width of &gt;20 ns. Nominal input impedance is 50Ω.</p> <p>The input is TTL compatible.</p> <p><b>SIMULTANEOUS MODULATION</b></p> <p>During simultaneous Pulse Modulation and Amplitude Modulation, the 3 dB AM bandwidth for 40% AM depth can be approximated by <math>BW = 100 \text{ times pulse duty cycle (in Hz)}</math>.</p> <p><b>OVERMODULATION INDICATOR</b></p> <p>The OVERMOD indicator lights and the MODULATION display shows 99.9 when external AM inputs cause more than 99.8% AM, when FM causes more than approximately 6 MHz deviation, or when any dc superimposed on the external FM signal results in positive or negative peak input amplitudes in excess of 1.2V. The AM and FM vernier controls may be pulled out to provide ac coupling and remove unwanted dc offsets from the INPUT signal.</p> <p><b>RECORDER OUTPUTS</b></p> <p>Two rear-panel BNC connectors provide analog output voltages suitable for driving X-Y recorders or strip chart recorders. One output provides a 0 to 10V FREQUENCY signal representing the specified tuning range, and the other output provides a RELATIVE VERNIER LEVEL signal representing the 0 to 25 dB range of the LEVEL vernier.</p>
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Instrument	Critical Specification	Recommended Model	Use
50 MHz Reference Attenuator	Attenuation: 30 dB Accuracy: 30 dB ±0.05 dB at 50 MHz	11708A (Supplied with HP 8484A Power Sensor)	P, A, T
50 Ohm Feed-Thru Termination	Accuracy: ±1%	HP 10100C	P, T
70 MHz Modulator/Demodulator	Distortion: <1% Must be capable of demodulating 10 MHz FM rates at 50 MHz deviation on a 70 MHz carrier.	HP 3717A	P
Amplifier	Gain: 20 dB at 20 kHz	HP 465A	P
Audio Analyzer	Internal Distortion: <1% at 10 kHz Provides 100 kHz source and 100 kHz distortion measurement. Must be capable of measuring 11 mV rms.	HP 8903A	P, A, T
Digital Voltmeter	Range: 0 to 30 Vdc Resolution: 0.01 Volt	HP 3455A	P, A, T
Diode Detector	Video Bandwidth: >5 MHz Frequency Range: 2.3 GHz to 6.5 GHz	HP 8470B Opt 012	P, A, T
Frequency Counter	Range: 2.3 GHz to 6.5 GHz	HP 5342A	P, A, T
Frequency Counter	Dual Channel, Differential Measurements	HP 5345A	P
Gain-Phase Meter	Frequency Range: 1 Hz to 13 MHz	HP 3575A Opt. 001	A
Logic Probe	Suitable for TTL and CMOS testing	HP 545A	T
Mixer <sup>2</sup>	Frequency Range: 2.3 GHz to 6.5 GHz	RHG DMI-18	P, A, T
Modulation Analyzer	Frequency: 12.5 MHz Filters: 300 Hz high-pass and 15 kHz low-pass Residual AM <0.1%. Must be capable of FM measurement in presence of AM, must be capable of average and peak responding modulation measurements, and must provide demodulated AM and FM outputs.	HP 8901A	P, A, T
Oscilloscope	>200 MHz bandwidth	HP 1725A	P, A, T
Power Meter	Range: +10 dBm to -60 dBm Resolution: 0.1 dB Must be compatible with HP 8481A and HP 8484A Power Sensors.	HP 436A	P, T

<sup>1</sup> P = Performance Tests; A = Adjustments; T = Troubleshooting  
<sup>2</sup> RHG Electronics Laboratory, Inc., 161 East Industry Court, Deer Park, N.Y. 11729, Tel. (616) 242-1100, TWX 510-227-6083.

Table 1-3. Recommended Test Equipment (1 of 2)

Table 1-3. Recommended Test Equipment (2 of 2)

Instrument	Critical Specification	Recommended Model	Use <sup>1</sup>
Power Sensor	Range: +10 dBm to -30 dBm Frequency: 2.3 GHz to 6.5 GHz Must be compatible with HP 436A Power Meter.	HP 8481A	P, T
Power Sensor	Range: -30 dBm to -60 dBm Frequency: 2.3 GHz to 6.5 GHz Must be compatible with HP 436A Power Meter.	HP 8484A	P, T
Pulse Generator	Rise and Fall Time: < 10 ns Pulse Width: ≤100 ns PRF: 0 to 1 MHz Pulse Amplitude: 3V to 5V peak	HP 8013B	P, A, T
Signal Generator	Frequency Range: 2.3 GHz to 6.5 GHz Output Power: +10 dBm	HP 8683B	P
Signature Analyzer	Minimum Pulse Width of 10 ns Data Probe Input Impedance: 50 kΩ Start, Stop, and Clock Input Impedance: 50Ω	HP 5004A	T
Spectrum Analyzer (Low Frequency)	20 kHz to 100 kHz measurement of -110 dBm signals.	HP 3580A	P, A, T
Spectrum Analyzer	Frequency Range: 2.3 GHz to 18.0 GHz Sensitivity: +10 dBm to -86 dBm Resolution: 100 kHz Zero scan capability at 0.2 ms/division Log and linear vertical scaling Video and free-run triggering	HP 8565A	P
Test Oscillator	Frequency Range: 50 Hz to 10 MHz Output: 1 volt into 50 ohms 1 volt into 600 ohms	HP 651B	P, A, T

<sup>1</sup> P = Performance Tests; A = Adjustments; T = Troubleshooting

Accessory*	Specification	Suggested Model
Torque Wrench (SMA Connectors)	15±0.3 inch-pounds	Utica Tool Co.** "A" Series Preset Wrench, Model #CHA-5, 15±0.3 inch-pounds (requires 5/16-inch open-end wrench)
Open-End Wrench (SMA Connectors)	5/16-inch	Utica Tool Co. Open End Standard, Model #OP102, 5/16-inch
Torque Wrench (SMC Connectors)	4±0.3 inch-pounds	Utica Tool Co.** "A" Series Preset Wrench, Model #CHA-5, 4±0.3 inch-pounds (requires 1/4-inch open-end wrench)
Open-End Wrench (SMC Connectors)	1/4-inch	Utica Tool Co. Open End Standard, Model #OP82, 1/4-inch
Pliers (External Retaining Rings)		Model #P-102X90 Industrial Retaining Ring Co., 57 Cordier Street, Irvington, N.J. 07111
Extender Boards (Two Required)	36 contacts (2 x 18)	HP 08684-60018
Foam Pad	Conductive polyurethane foam, 12 x 12 x 0.25 inches	HP 4204-0094

\* Refer to Section VIII, Service, for applications.  
\*\*Utica Tool Company, Inc., Orangeburg, SC 29115 or the nearest Utica Tool Company distributor.

Table 1-4. Service Accessories



## SECTION II INSTALLATION

### 2-1. INTRODUCTION

This section provides the information needed to install the Signal Generator. Included is information pertinent to the initial inspection, power requirements, line voltage and fuse selection, operating environment, instrument mounting, storage, and shipment.

### 2-2. INITIAL INSPECTION

*To avoid hazardous electrical shock, do not perform electrical tests when there are signs of shipping damage to any portion of the outer enclosure (covers and panels).*

#### WARNING

Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked mechanically and electrically. The procedures for checking electrical performance are given in Section IV, Performance Tests. If the contents are incomplete, if there is a mechanical defect, or if the instrument does not pass the performance tests, notify the nearest Hewlett-Packard office. If the shipping container is damaged or the cushioning material shows signs of stress, notify the carrier and the Hewlett-Packard office. Keep the shipping material for the carrier's inspection.

#### WARNING

*To avoid the possibility of hazardous electrical shock, do not operate this instrument at line voltages greater than 126.5 Vac with line frequencies greater than 66 Hz. Leakage currents at these settings may exceed 3.5 mA.*

Signal Generators require a power source of 115 (90 to 126) Vac or 230 (198 to 252) Vac, 48 to 66 Hz, single phase. Signal Generators with Option 003

have the additional capability of operating with line frequencies of 48 to 440 Hz. However, operation at line frequencies >66 Hz is limited to a nominal line voltage of 100 or 120 Vac. The power consumption of both versions is <200 VA.

#### WARNINGS

*This is a Safety Class I product (i.e., provided with a protective earth terminal). An uninterruptible safety earth ground must be provided from the Mains power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and secured against any unintended operation.*

*If the instrument is to be energized via an external autotransformer (for voltage reduction), make sure the common terminal is connected to neutral (that is, the grounded side of the mains supply).*

### 2-5. Line Voltage and Fuse Selection

#### CAUTION

*Before plugging this instrument into the Mains (line) voltage, be sure that the correct operating voltage and fuse have been selected.*

A rear-panel line-power module permits operation from 90 to 126 Vac sources or from 198 to 252 Vac sources. The number visible in the window on the module indicates the nominal line voltage (100, 120, 220 or 240 Vac) to which the instrument must be connected. Verify that the line voltage selection card and the fuse are matched to the power source to be used. Refer to Figure 2-1, Line Voltage and Fuse Selection. Table 2-1 lists the ratings and HP part numbers for the replaceable fuses.

#### WARNING

*For protection against fire hazards, the line fuse should be a 250V normal-blow fuse with the correct current rating.*

Rack mounting information is provided with the rack mounting kits. If a kit was not ordered as an option with the Signal Generator, it may be purchased through the nearest Hewlett-Packard office. Refer to Mechanical Options in Section I for the part number.

The Signal Generator weighs 16.8 kg (37 lbs); therefore, care must be exercised when lifting to avoid personal injury. Use equipment slides when rack mounting.

**WARNING**

**2-10. Rack Mounting**

The instrument cabinet has plastic feet and fold-away tilt stands for convenience in bench operation. The plastic feet are designed to ensure proper stacking with other instruments in similar housings, and the tilt stands raise the front of the Signal Generator for easier viewing of the front panel.

**2-9. Bench Operation**

Temperature ..... 0 to +55°C  
 Humidity ..... <95% relative  
 Altitude ..... <4570 metres (15 000 feet)

The following limitations:

The operating environment should be within the

**2-8. Operating Environment**

**Coaxial Connectors.** The front-panel RF OUTPUT connector and the rear-panel AUXILIARY OUTPUT connectors require 50-ohm Type N male mating connectors. All other input and output signal connectors require 50-ohm BNC male mating connectors. Both types must be compatible with the specifications of US MIL-C-39012.

**2-7. Mating Connectors**

This instrument is equipped with a three-wire power cable. When connected to an appropriate power receptacle, this cable grounds the instrument cabinet. The type of power cable plugged with each instrument is determined by the country of destination. Refer to Figure 2-2 for the part numbers of the power cables and plugs available.

extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection.

Before connecting this instrument, the protective earth terminal of the instrument must be connected to the protective conductor of the (Mains) power cord. The Mains plug shall be inserted only in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an

**WARNING**

**2-6. Power Cable**

Line Voltage	Rating	Part Number
220/240V	1.5A, 250V	2110-0043
100/120V	3A, 250V	2110-0003

Table 2-1. Fuse Ratings and Part Numbers

Figure 2-1. Line Voltage and Fuse Selection

**WARNING**

Do not operate this instrument with frequencies greater than 66 Hz. Line frequencies greater than 66 Hz with line voltages greater than 126.5 Vac will cause a potential shock hazard that could result in personal injury (leakage current at these settings may exceed 3.5 mA). In addition, damage to the instrument may result.

1. Open cover door, pull the FUSE PULL lever and rotate to left. Remove the fuse.
2. Remove the Line Voltage Selection Card. Position the card so the line voltage appears at top-left corner. Push the card firmly into the slot.
3. Rotate the FUSE PULL lever to its normal position. Insert a fuse of the correct value in the holder. Close the cover door.

SELECTION OF OPERATING VOLTAGE

Operating voltage is shown in module window.

**2-11. STORAGE AND SHIPMENT**

**2-12. Environment**

The instrument should be stored in a clean, dry environment. The following environmental limitations apply to both storage and shipment.

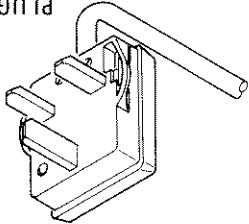
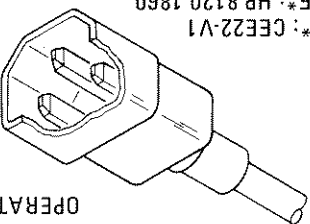
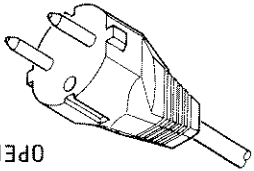
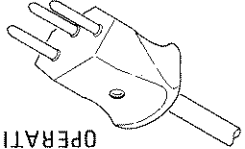
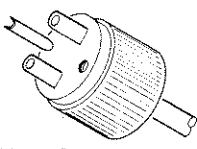
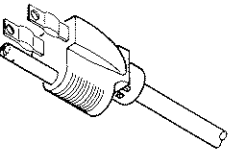
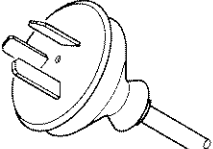
- Temperature ..... -62°C to +85°C
- Humidity ..... <95% Relative
- Altitude ..... >15 300 metres (50 000 feet)

**2-13. Packaging**

**Original Packaging.** Containers and material identical to those used in factory packaging are available through Hewlett-Packard offices. If the instrument is being returned to Hewlett-Packard for servicing, please complete one of the blue repair tags located at the end of this manual and attach it to the instrument. Be sure to include the type of service required, return address, model number, and full serial number. Mark the container FRA-GILE to assure careful handling. In any correspondence concerning a Hewlett-Packard instrument, refer to the instrument by model number and include the full serial number.

- Other Packaging.** The following general instructions should be followed for repackaging with commercially available packaging materials.
- a. Complete one of the blue service tags located at the end of this manual and attach it to the instrument. Be sure to indicate the type of service required, return address, model number, and full serial number. Then wrap the instrument in heavy paper or plastic.
  - b. Use a strong shipping container. A double-wall carton made of 2.4 MPa (350 psi) test material is adequate.
  - c. Use enough shock absorbing material (75 to 100 mm or 3 to 4 inch layer) around bottom, top, and all sides to provide a firm cushion and to prevent movement within the container.
  - d. Seal the shipping container securely.
  - e. Mark the shipping container FRAGILE to assure careful handling.

Figure 2-2. Power Cable and Plug Part Numbers

*The number shown for the cable is an HP part number for a complete cable including the plug.			
 <p>OPERATION 220/240V</p> <p>PLUG*: BS 1363A CABLE*: HP 8120-1351</p>	 <p>OPERATION 220/240V</p> <p>PLUG*: CEE22-V1 CABLE*: HP 8120-1860</p>	 <p>OPERATION 220/240V</p> <p>PLUG*: CEE7-VII CABLE*: HP 8120-1689</p>	 <p>OPERATION 220/240V</p> <p>PLUG*: SEV 1011.1959-24507 TYPE 12 CABLE*: HP 8120-2104</p>
 <p>OPERATION 220/240V</p> <p>PLUG*: NEMA 6-15P CABLE*: HP 8120-0698</p>	 <p>OPERATION 100/120V</p> <p>PLUG*: NEMA 5-15P CABLE*: 8120-1378</p>	 <p>OPERATION 220/240V</p> <p>PLUG*: NZSS 198/AS C12 CABLE*: HP 8120-1369</p>	



## SECTION III OPERATION

### 3-1. INTRODUCTION

This section provides operating instructions for the Hewlett-Packard 8683A Signal Generator. It summarizes the major operating characteristics, describes controls and indicators, and provides operator's checks and an abbreviated performance test. It also explains how to set the output frequency, output level, modulation type, and modulation level. The function of each input and output connector is described in detail.

### 3-2. Operating Characteristics

Table 3-1 briefly summarizes the major operating characteristics of the Signal Generator. This table is not intended to be an in-depth listing of all characteristics. For more detailed information, refer to Table I-1, Specifications, and Table I-2, Supplemental Characteristics. Figure 3-1 provides a simplified description of the front-panel features, and Figure 3-2 provides a more detailed description of the display and control features. Figure 3-3 describes the rear-panel features.

Table 3-1. Operating Characteristics

AM (cont'd)	FREQUENCY
Rates (3 dB bandwidth): dc to 10 KHz	Range: 2.3 GHz to 6.5 GHz
Indicated Accuracy: $\pm 5\%$ of full scale for depths up to 50% at a 1 KHz rate	Display Resolution: $\leq 5$ MHz
Internal AM: Fixed 1 KHz square wave	Calibration Accuracy: $\leq 4$ GHz $\pm 1.25\%$
	$> 4$ GHz $\pm 0.75\%$
FM	AMPLITUDE
Peak Deviation: 5 MHz	Range: 0 dBm to -130 dBm
Indicated Accuracy: (10 MHz/V range) $\pm 10\%$ of full scale for deviations up to 5 MHz at a 100 KHz rate	Display Resolution: 0.1 dB
Internal FM: 1 KHz sawtooth with variable deviation rate	Level Accuracy: $\pm 2.5$ dB (from maximum power down to -110 dBm)
External Pulse Input Requirements	$\pm 3.5$ dB (From $< -110$ dBm down to -120 dBm)
Rate: 0 to 10 KHz	Level Flatness: $\pm 1.0$ dB for power levels $> -10$ dBm
Width: $> 10$ $\mu$ s	
Input Levels: TTL compatible	
Combined Modulation	MODULATION
AM, FM, and pulse modulation may be combined.	Depth: 0 to 70% at a 1 KHz rate



### FREQUENCY Display

The FREQUENCY display provides a 4-digit indication of carrier frequency over the range of 2.3 GHz to 6.5 GHz with a resolution of  $\leq 5$  MHz. It also displays test results when in the diagnostic mode.

### MODULATION Display

The MODULATION display provides a 3-digit indication of AM depth or FM deviation. The AM indication may range from 0 to 99.9% with an accuracy of approximately  $\pm 5\%$  of full scale, and the FM indication may range up to 9.99 MHz peak deviation with an accuracy of approximately 10% of full scale. LED annunciators in the % AM and MHz FM keys indicate whether AM or FM data is being displayed. A separate OVERMOD annunciator illuminates when AM exceeds 99.8%, when FM deviation exceeds approximately 6 MHz peak, or when any dc superimposed on the external FM signal results in positive or negative peak input voltage greater than 1.2V. When AM and FM are used at the same time, the MODULATION display will remain in the last mode selected by the % AM or MHz FM keys. If the type of modulation being displayed is turned off, the MODULATION display is automatically switched to the remaining mode. If both AM and FM are turned off, the MODULATION display is blanked.

### LEVEL Display

The LEVEL display provides a 3½-digit indication of the microwave output amplitude over the range of +10 dBm to -130 dBm with a resolution of 0.1 dB. The level displayed may be in dBm or dB relative, and the mode is indicated by a LED annunciator in the dBm key or the dB REL key. Selection of one mode automatically cancels the other mode.

The CABLE OFFSET key is an alternate action switch that turns the cable loss correction factor on or off. When its LED annunciator is not illuminated, the LEVEL display shows the power level at the OUTPUT connector of the Signal Generator. When the cable offset is turned on (CABLE OFFSET annunciator lighted) the displayed level remains the same; however, the actual output power level is increased (up to the maximum available level) to compensate for cable losses in up to four and one-half metres (14.7 feet) of RG-214 cable. The microprocessor uses the setting of the rear-panel CABLE OFFSET control and the indicated output frequency to calculate the offset correction. When the CABLE OFFSET key is held down, the LEVEL display shows the setting of the rear-panel CABLE OFFSET control.

### LINE Switch

The LINE switch applies primary power to the Signal Generator.

### FREQUENCY Control

The FREQUENCY control provides continuous tuning over the range of 2.3 GHz to 6.5 GHz. When pushed in for the normal tuning mode, it requires approximately 20 turns to cover the entire tuning range. When pulled out for the fine-tuning mode, it requires approximately 200 turns to cover the entire range.

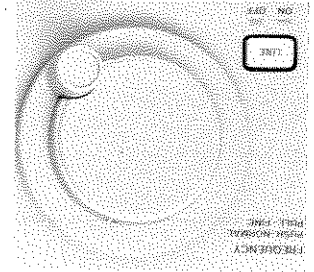
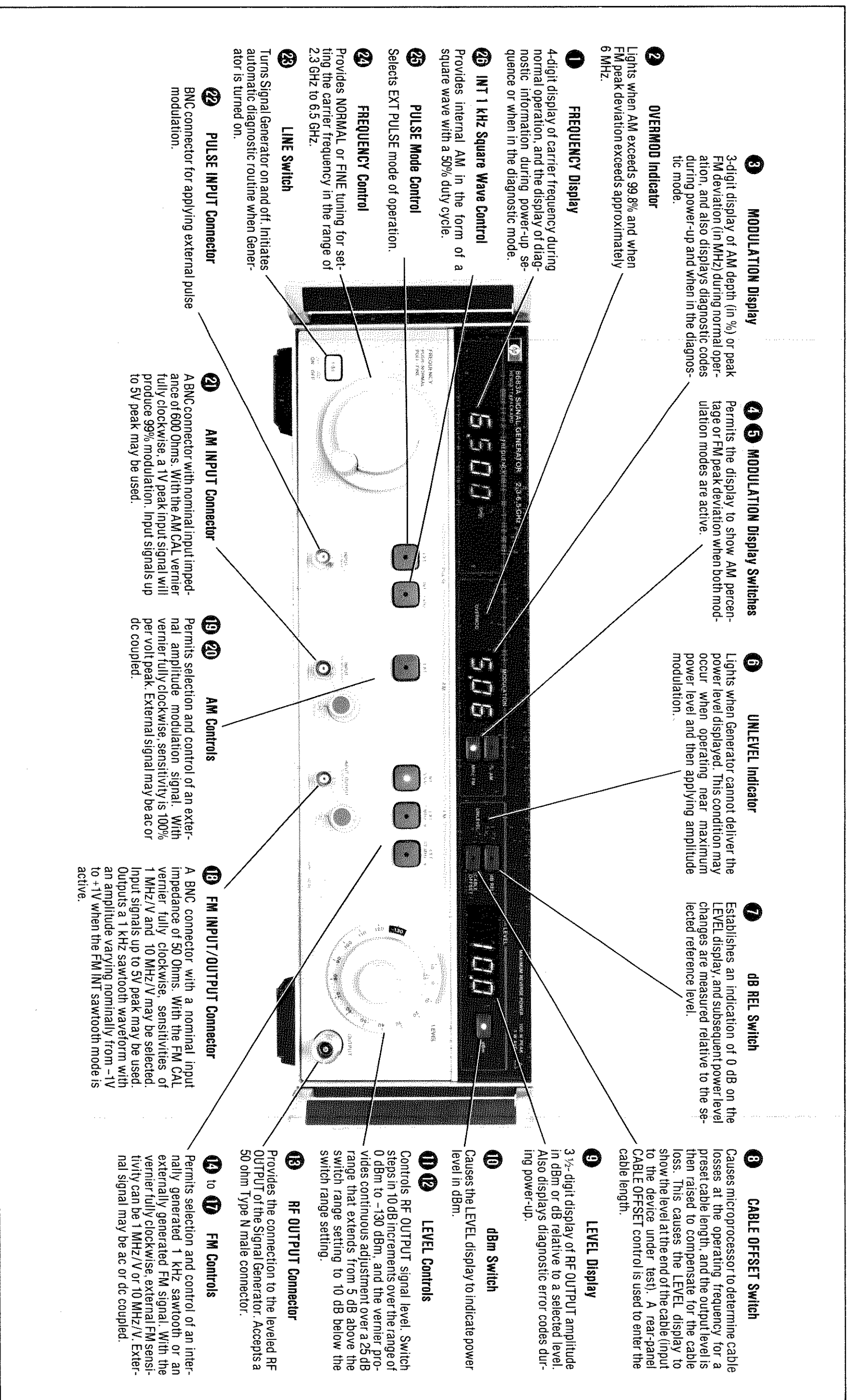


Figure 3-2. Display and Control Features (1 of 3)

## SIMPLIFIED FRONT PANEL FEATURES



**3 MODULATION Display**

3-digit display of AM depth (in %) or peak FM deviation (in MHz) during normal operation, and also displays diagnostic codes during power-up and when in the diagnostic mode.

**4 5 MODULATION Display Switches**

Permits the display to show AM percentage or FM peak deviation when both modulation modes are active.

**6 UNLEVEL Indicator**

Lights when Generator cannot deliver the power level displayed. This condition may occur when operating near maximum power level and then applying amplitude modulation.

**7 dB REL Switch**

Establishes an indication of 0 dB on the LEVEL display, and subsequent power level changes are measured relative to the selected reference level.

**8 CABLE OFFSET Switch**

Causes microprocessor to determine cable losses at the operating frequency for a preset cable length, and the output level is then raised to compensate for the cable loss. This causes the LEVEL display to show the level at the end of the cable (input to the device under test). A rear-panel CABLE OFFSET control is used to enter the cable length.

**9 LEVEL Display**

3½-digit display of RF OUTPUT amplitude in dBm or dB relative to a selected level. Also displays diagnostic error codes during power-up.

**10 dBm Switch**

Causes the LEVEL display to indicate power level in dBm.

**11 12 LEVEL Controls**

Controls RF OUTPUT signal level. Switch steps in 10 dB increments over the range of 0 dBm to -130 dBm, and the vernier provides continuous adjustment over a 25 dB range that extends from 5 dB above the switch range setting to 10 dB below the switch range setting.

**13 RF OUTPUT Connector**

Provides the connection to the leveled RF OUTPUT of the Signal Generator. Accepts a 50 ohm Type N male connector.

**14 to 17 FM Controls**

Permits selection and control of an internally generated 1 kHz sawtooth or an externally generated FM signal. With the vernier fully clockwise, external FM sensitivity can be 1 MHz/V or 10 MHz/V. External signal may be ac or dc coupled.

**1 FREQUENCY Display**

4-digit display of carrier frequency during normal operation, and the display of diagnostic information during power-up sequence or when in the diagnostic mode.

**20 INT 1 KHz Square Wave Control**

Provides internal AM in the form of a square wave with a 50% duty cycle.

**25 PULSE Mode Control**

Selects EXT PULSE mode of operation.

**24 FREQUENCY Control**

Provides NORMAL or FINE tuning for setting the carrier frequency in the range of 2.3 GHz to 6.5 GHz.

**23 LINE Switch**

Turns Signal Generator on and off. Initiates automatic diagnostic routine when Generator is turned on.

**22 PULSE INPUT Connector**

BNC connector for applying external pulse modulation.

**21 AM INPUT Connector**

A BNC connector with nominal input impedance of 600 Ohms. With the AM CAL vernier fully clockwise, a 1V peak input signal will produce 99% modulation. Input signals up to 5V peak may be used.

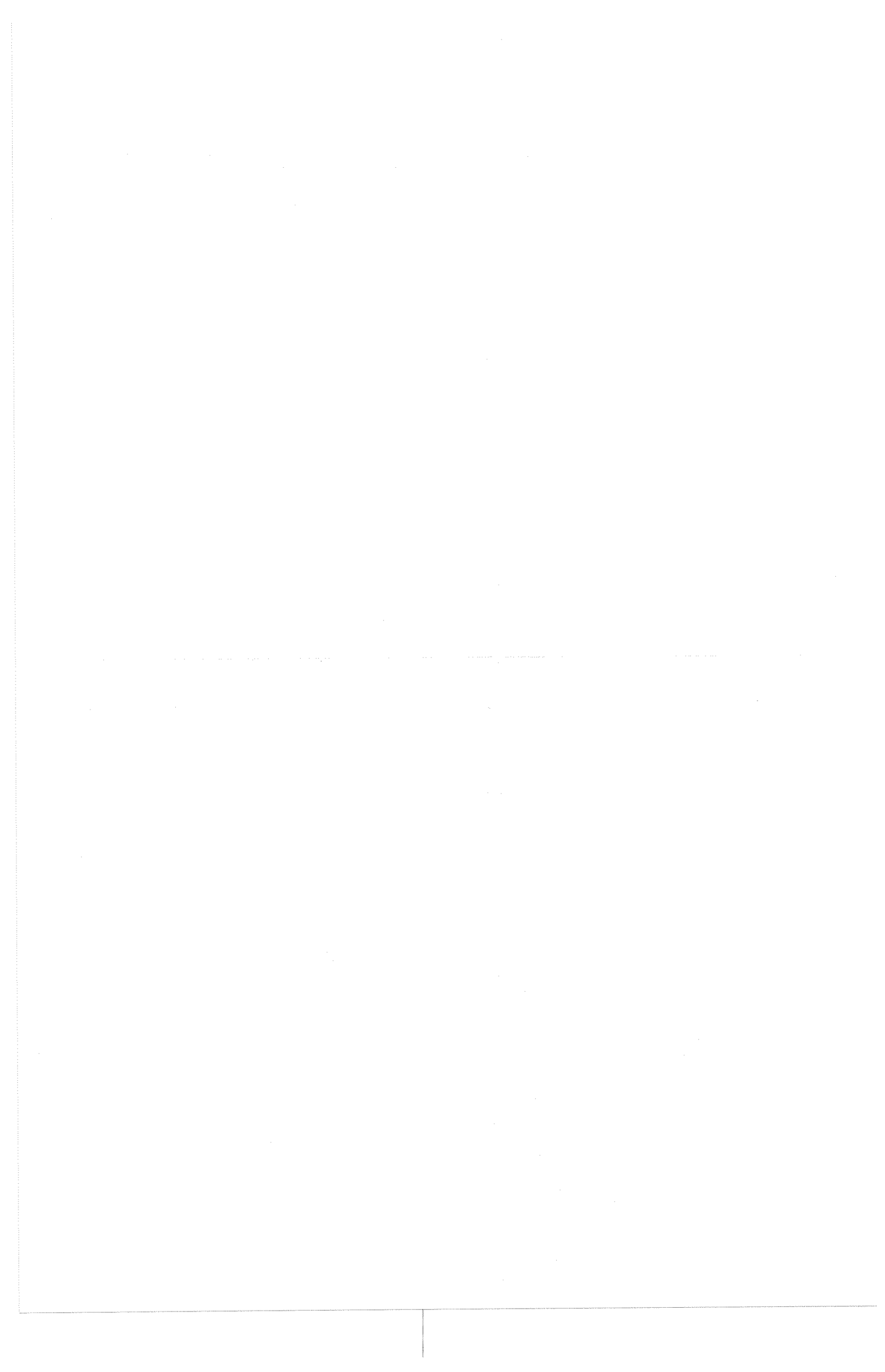
**19 20 AM Controls**

Permits selection and control of an external amplitude modulation signal. With vernier fully clockwise, sensitivity is 100% per volt peak. External signal may be ac or dc coupled.

**18 FM INPUT/OUTPUT Connector**

A BNC connector with a nominal input impedance of 50 Ohms. With the FM CAL vernier fully clockwise, sensitivities of 1 MHz/V and 10 MHz/V may be selected. Input signals up to 5V peak may be used. Outputs a 1 kHz sawtooth waveform with an amplitude varying nominally from -1V to +1V when the FM INT sawtooth mode is active.

Figure 3-1. Simplified Front Panel Features





### PULSE MODE

#### EXT PULSE Control

When the EXT pulse mode is selected the rate, delay and width will be determined by the pulse generator connected to the INPVT connector.

#### Int 1 kHz Square Wave Control

Selection of the INT 1 kHz mode provides internally generated amplitude modulation in the form of a square wave with a 50% duty cycle and an on/off ratio of >30 dB. The 1 kHz internal square wave cannot be used in conjunction with the external pulse modulation mode.

#### PULSE INPUT Connector

The PULSE INPVT connector is used in the EXT PULSE mode to connect an external modulating pulse to the Signal Generator. When the EXT mode is selected, the LED annunciator lights to indicate that the EXT PULSE mode is active and an external signal is required for pulse modulation. The input is TTL compatible and the maximum input level is  $\pm 5V$  peak.

#### AM Controls

AM controls are provided for the selection and control of an external modulating signal. With the AM vernier control set fully clockwise, the AM sensitivity is nominally 100% per volt peak at the AM INPVT connector. The vernier permits reduction of the amplitude modulation down to <1%. The AM EXT annunciator will light when the external AM mode is selected. When the vernier control knob is pushed in, the external modulating signal is dc coupled; when the knob is pulled out, the signal is ac coupled. The input impedance is 600 ohms. Amplitude modulation may be combined with pulse modulation and/or frequency modulation.

#### FM Controls

FM controls are provided for the selection of an internal 1 kHz sawtooth, and selection of external FM with a deviation sensitivity of 1 MHz/V or 10 MHz/V. An annunciator in each key lights to indicate which mode has been selected. Since the three modes are mutually exclusive, the selection of one mode will automatically cancel any previously selected mode. Actuation of an FM control vernier control knob is pushed in, the external modulation signal is dc coupled; when the knob is pulled out, the signal is ac coupled. The vernier permits deviation control from the maximum specified deviation down to less than 1 MHz. The input impedance is 50 $\Omega$ . Frequency modulation may be combined with pulse modulation and/or amplitude modulation.

When operating in the FM INT sawtooth mode, the 1 kHz sawtooth that generates the frequency modulation is also available at the FM INPVT/OUTPVT connector. It has a rate of 1 kHz, and varies approximately from -1V to +1V. The FM vernier control has no effect on this signal. When using this sawtooth output, the external load impedance should be greater than 1 k $\Omega$ .

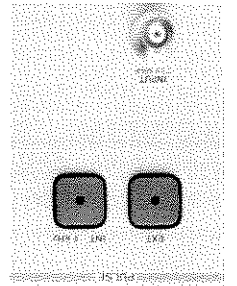
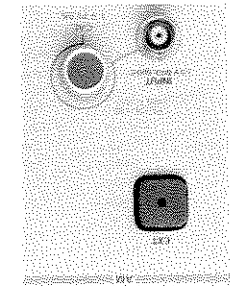
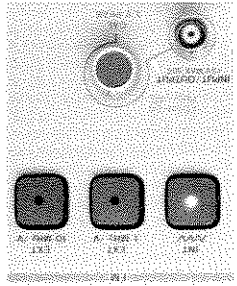


Figure 3-2. Display and Control Features (2 of 3)

Figure 3-2. Display and Control Features (3 of 3)

The front-panel RF OUTPUT connector is the primary microwave output connector, and it provides some degree of reverse power protection (refer to Table 1-2, Supplemental Characteristics). The RF OUTPUT connector accepts 50N Type N male connectors.

### OUTPUT Connector



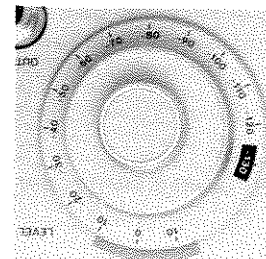
The UNLEVEL indicator lights when the Signal Generator cannot deliver power equal to the level displayed. This condition may occur when operating near the maximum power level and then applying amplitude modulation or applying a cable offset correction.

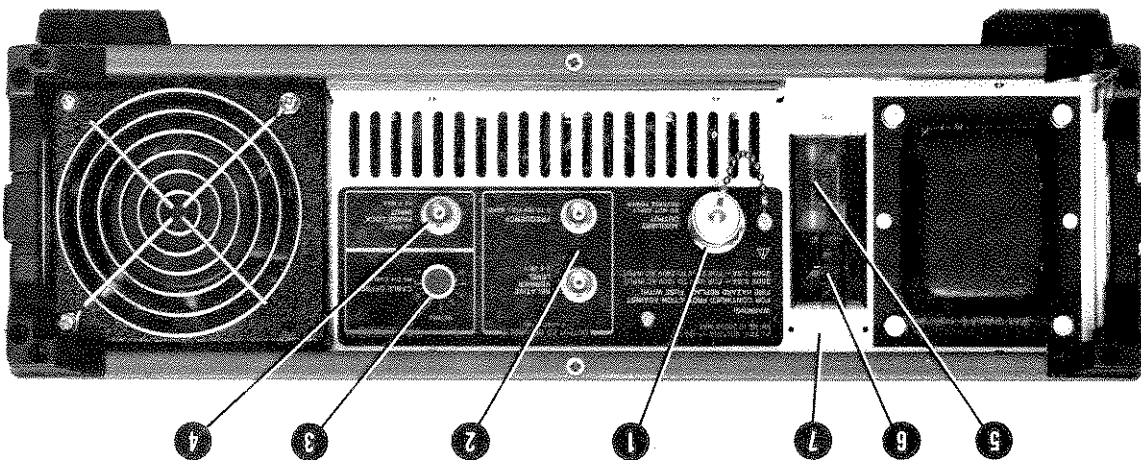
### UNLEVEL Indicator



The RF output level of the Signal Generator is controlled by a step attenuator and a vernier control. The output level can be varied over the range of 0 dBm to -130 dBm (+10 dBm in increments with Option 001) with a resolution of 0.1 dB. The attenuator steps in increments of 10 dB while the vernier provides a 25 dB control range that extends from 5 dB above the selected range to 10 dB below the selected range. The gray area above the LEVEL switch indicates the vernier range available for any given switch setting.

### LEVEL Control





**1** AUXILIARY OUTPUT Connector

The AUXILIARY OUTPUT connector provides an unlevelled sample of the oscillator output signal that is derived from the oscillator output prior to the amplitude modulation and pulse modulation circuits, so AM and pulse modulation are not available on the signal. It will contain any FM component in the oscillator output. The rear-panel AUXILIARY OUTPUT connector accepts a male Type-N connector. The protective cap must be installed when the AUXILIARY OUTPUT is not in use; without the cap, RF leakage might produce erroneous results when testing at low signal levels.

**CAUTION**

*Never apply reverse power to the AUXILIARY OUTPUT connector. There is no reverse power protection at this point, and reverse power may destroy the microwave amplifier and the oscillator.*

**2** OUTPUT TO RECORDER Connectors

The recorder outputs include the RELATIVE VERNIER LEVEL output and the FREQUENCY output. The RELATIVE VERNIER LEVEL output provides an analog signal of 0V to 10V scaled at 2.5 dB/V to represent the 0 dB to 25 dB attenuation range of the front-panel LEVEL VERNIER control. The FREQUENCY output provides an analog signal of 0V to 10V that represents the specified frequency range. The loads connected to the recorder outputs should have an impedance greater than 1 MΩ.

**3** CABLE OFFSET Control

The CABLE OFFSET control provides a cable loss correction for up to 4.5 metres (14.7 feet) of RG-214 coaxial cable. When the CABLE OFFSET mode is

**4** PHASE LOCK INPUT Connector

selected by the front-panel control, the microprocessor applies a correction to the levelled output power and the display shows the power level at the end of the cable (input to device under test). The correction factor is based upon the predicted cable losses at the selected output frequency.

The PHASE LOCK INPUT connector provides a control feature that may basically be considered an inverted FM control input. It has a sensitivity of  $\pm 2$  volts. When phase locking the Signal Generator output to an external signal, there are two input bandwidths available. Selecting either external FM mode provides a wide input bandwidth. Turning off all FM provides a narrow input bandwidth.

**5** Fuse

3A, 250V, Normal-Blow for 100/120V ac operation, or 1.5A, 250V Normal-Blow for 220/240V operation. Ordering information is presented in Section II Installation.

**6** Line Power Module

Permits operation from 100, 120, 220, or 240 Vac. The number visible in the window indicates the nominal line voltage to which the instrument must be connected (see Figure 2-1). The center conductor is the safety earth ground.

**7** Serial Number Plate

The first four digits and a letter constitute the prefix which defines the instrument configuration. The last five digits form a sequential suffix that is unique for each instrument. The plate also identifies any options supplied with the instrument.

Figure 3-3. Rear Panel Features

Power-up Error Code Numbers	Test	Modulation Display Test Numbers	Frequency Display
E50	+5 Volt Power Supply	00	5.25V
E54	+6.2 Volt ALC Reference	01	6.20V
E55	+6.5 Volt microcircuit power supply	02	6.50V
E51	+15 Volt power supply	03	15.00V
E52	-15 Volt power supply	04	-15.00V
E53	-30 Volt power supply	05	-30.00V
E57	Oscillator Power Supply-High Band	06	-30.00 to 11.00V
E56	Oscillator Power Supply-Low Band	07	-30.00 to 11.00V
E59	Detector Differential on A6	10	0.00V
E58	Detector Amplifier on A6	11	0.00V
E61	PIN Modulator Voltage A5TP4	12	-9.00 to -0.5V
E60	Multiplying DAC, ALC A7U5 Pin 8	13	-0.1 to 5.00V
E62	#1 Freq. potentiometer, lower 1/3	16	5.12V
E63	#2 Freq. potentiometer, middle 1/3	17	5.12V
E64	#3 Freq. potentiometer, upper 1/3	18	5.12V
E10	1. "--" means DAC is ok on bits 3-11 bits 0-2 not checked. 2. # means this DAC bit is in error. If this error code is displayed all other error codes may be inaccurate. ROM checksum error Front Panel checks Software can't find this software table	36	1. --
E01-E04			2. #
E05-E08			Table No.
E09			

Table 3-2. Power-up Error Codes

3-3. OPERATOR'S CHECKS

NOTE

If the instrument does not operate properly and is being returned to Hewlett-Packard for service, please complete one of the blue repair tags located at the end of this manual and attach it to the instrument.

Upon receipt of the instrument, or to check the Signal Generator for an indication of normal operation, perform the following the operational procedure. These procedures are designed to familiarize the operator with the Signal Generator and to provide an understanding of the operating capabilities.

1. Press LINE switch and verify that FREQUENCY, MODULATION, and LEVEL displays are filled with minus signs, go blank, and then are filled with eights. Refer to Table 3-2 if any error codes appear on the displays.

2. Rotate FREQUENCY control and verify that the FREQUENCY display responds to the changes in frequency.

3. Rotate the LEVEL step switch through steps and verify that the LEVEL display moves in 10 dB steps.

4. Rotate the LEVEL vernier and verify that the LEVEL display responds to the changes.

**OPERATOR'S CHECKS (cont'd)**

5. Press FM INT key and verify that its annunciator lights, the MODULATION display lights, and the MHz FM annunciator lights.

6. Rotate the FM vernier and verify that the MODULATION display responds to the changes in FM deviation. Rotate the FM vernier to the full clockwise position and verify that the OVERMOD annunciator lights.

7. Press AM EXT key and verify that its annunciator lights and that the MODULATION display changes from MHz FM to % AM.

8. Press AM EXT key and verify that its annunciator goes off.

9. Press FM INT key and verify that its annunciator goes off.

10. Press dB REL key; verify that its annunciator is lit and that the LEVEL display shows 0.0.

11. Press dBm key; verify that its annunciator is lit and that the dB REL key annunciator goes off.

12. Press and hold the CABLE OFFSET key; verify that its annunciator lights and that the LEVEL display shows a number in the range of 0.0 to 4.5 (this number is determined by the setting of the rear-panel CABLE OFFSET control).

13. Release CABLE OFFSET key and verify that the LEVEL display returns to the settings established by the LEVEL switch and LEVEL vernier.

**3-4. OPERATING INSTRUCTIONS**

Paragraphs 3-5 through 3-8 explain how to set the Signal Generator for the CW mode, AM mode, FM mode, and pulse mode. Two or three types of modulation may be combined when desired. The front panel controls used to set the various modes of operation are shown in Figure 3-1.

**NOTE**

The presence of a power-up error code when the instrument is turned on may not be critical. For instance, an error code indicating a faulty FM peak detector would not be critical if the Generator is to be used in the CW, AM, or pulse

**3-5. CW MODE OPERATION**

a. Press LINE switch (23) and verify that power-up diagnostics are completed without a critical error code display.

b. Using the FREQUENCY control (24), set desired frequency on the FREQUENCY display (1).

**NOTE**

If a higher frequency resolution is required, a frequency counter may be connected to the rear-panel AUXILIARY OUTPUT connector.

c. Using the LEVEL switch (11) and LEVEL vernier (12), set desired power level on the LEVEL display (9).

d. If the CABLE OFFSET feature is to be used, press and hold the CABLE OFFSET key (8) to display the CABLE OFFSET setting on the LEVEL display (9). If necessary, use rear-panel CABLE OFFSET control to establish correct setting.

**3-6. AM MODE OPERATION**

a. Press LINE switch (23) and verify that power-up diagnostics are completed without a critical error code display.

b. Using the FREQUENCY control (24), set desired frequency in the FREQUENCY display (1).

**NOTE**

If a higher frequency resolution is required, a frequency counter may be connected to the rear-panel AUXILIARY OUTPUT connector.

c. Using the LEVEL switch (11) and LEVEL vernier (12), set desired power level in the LEVEL display (9).

d. The EXT AM (external amplitude modulation) and CABLE OFFSET functions are mutually exclusive. The activation of either will deactivate the other.

†Indicates manual change. See Section VII.

c. Using the LEVEL switch (11) and LEVEL vernier (12), set desired power level on the LEVEL display (9).

*If a higher frequency resolution is required, a frequency counter may be connected to the rear-panel AUXILIARY OUTPUT connector.*

**NOTE**

b. Using the FREQUENCY control (24), set desired frequency on the FREQUENCY display (1).  
a. Press LINE switch (23) and verify that power-up diagnostics are completed without a critical error code display.

**3-7. FM MODE OPERATION**

*External AM may be combined with FM and/or pulse modulation. The INT1 kHz square wave may be combined with FM.*

*At RF output levels near the maximum specified power, the application of high levels of amplitude modulation may cause the UNLEVEL indicator (6) to light. This occurs when the RF amplifier cannot deliver the power required for the indicated level of modulation. Lowering the RF output level or the modulation level will cause the UNLEVEL indicator to go out.*

**NOTES**

f. For external AM operation, press AM EXT key (19) and verify that its annunciator lights. Then connect external modulation source to AM INPUT connector (21), and adjust external source level and/or AM vernier (20) to display desired modulation level (% AM) on the MODULATION display (3). The OVERMOD indicator (2) lights when an AM level above 99.8% is selected.

*In the next step, the maximum allowable input level is 5V peak.*

**CAUTION**

e. For internal AM operation, press PULSE 1 kHz key (26) and verify that its annunciator lights. This will provide a 1 kHz square wave with a nominal 50% duty cycle.

**AM MODE OPERATION (cont'd)**

c. Using the LEVEL switch (11) and LEVEL vernier (12), set desired power level on the LEVEL display (9).

*If a higher frequency resolution is required, a frequency counter may be connected to the rear-panel AUXILIARY OUTPUT connector.*

**NOTE**

b. Using the FREQUENCY control (24), set desired frequency on the FREQUENCY display (1).  
a. Press LINE switch (23) and verify that power-up diagnostics are completed without a critical error code display.

**3-8. PULSE MODE OPERATION**

*FM may be combined with AM and/or pulse modulation.*

**NOTE**

g. For external FM operation, press FM EXT 1 MHz/V key (15) or FM EXT 10 MHz/V key (16) and verify that its annunciator lights. Then connect external FM source to the FM INPUT/OUTPUT connector (18), and adjust external source level and/or FM vernier (17) to display the desired modulation level (MHz FM) on the MODULATION display (3). The OVERMOD indicator (2) lights when a peak deviation of 6.1 MHz or higher is selected.

*In the next step, the maximum allowable input level is 5V peak.*

**CAUTION**

f. Set FM deviation by using FM vernier (17) to obtain the desired modulation level (MHz FM) on the MODULATION display (3).

e. For internal FM operation, press FM INT key (14) and verify that its annunciator lights. This will provide a 1 kHz sawtooth output.

d. If the CABLE OFFSET feature is to be used, press and hold the CABLE OFFSET key (8) to display the CABLE OFFSET setting on the LEVEL display (9). If necessary, use rear-panel CABLE OFFSET control to establish correct setting.

**PULSE MODE OPERATION (cont'd)**

- d. If the CABLE OFFSET feature is to be used, press and hold the CABLE OFFSET key (8) to display the CABLE OFFSET setting on the LE-VEL display (9). If necessary, use rear-panel CABLE OFFSET control to establish correct setting.

**External Pulse Mode Operation**

- e. Press EXT PULSE key (25) and verify that its annunciator lights.

**CAUTION**

*In the next step, the maximum allowable input level is 5V peak.*

**NOTE**

- f. Set external pulse source for a compatible output level, and connect the source to the PULSE INPUT (22) connector.
  - g. Set pulse rate and pulse width as required on the external pulse source.
- The external pulse mode may be combined with AM and/or FM. It cannot be combined with the INT 1 kHz square wave.*

