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INSTRUCTION MANUAL

**MODEL 960 SERIES
MICRO SWEEP
1 TO 18.0 GHz
MICROWAVE GENERATORS**

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WAVETEK MICROWAVE, INC.

4650 NORRIS CANYON ROAD, SAN RAMON, CALIFORNIA 94583
(800) 726-4442 TEL: (510) 328-4650 FAX: (510) 328-4700

Code 03

Spectral Purity

	Model			
	962	964	965	967
Residual FM Peak (50 Hz to 15 kHz post-detection bandwidth)	8 kHz	15 kHz	20 kHz	25 kHz
Spurious	- 55 dBc	- 55 dBc	- 55 dBc	- 55 dBc
Harmonics (maximum)	- 12 dBc*	- 20 dBc	- 20 dBc	- 20 dBc

* For output levels less than - 10 dBm, the harmonic specification is - 10 dBc.

Frequency Control

Manual Tuning: A ten turn control knob sets the CW frequency, marker frequencies, and Center Frequency (CF in ΔF Swp). Two single turn control knobs set the Start, Stop, and ΔF frequencies.

External Tune: 0 to + 10V controls the Micro Sweep for the full tuning range; Swp Time control must be in the Ext Tune position for external frequency tuning.

1.2.2 Operating Modes

Start/Stop Sweep: Sweeps from the frequency set by the Start control to the frequency set by the Stop/ ΔF control. Both frequencies are continuously adjustable over full range. Pressing the front panel S/S Swp pushbutton selects the Start/Stop sweep mode. Pushbuttons below the LCD readout select the frequency displayed. Minimum practical sweep width is approximately 1% of band. Downward sweep is permitted but does not provide markers.

ΔF Sweep: Sweeps symmetrically upward, centered on the frequency (CF) set by the main tuning knob. Pressing front panel ΔF Swp pushbutton selects the ΔF sweep mode. Sweep width is set by using the Stop/ ΔF sweep control, and the center frequency is set with the main tuning knob. Pushbuttons below the LCD readout select the frequency displayed. Width is adjustable from 100% to less than 1% of the band. Sweeping beyond the frequency limits of the Micro Sweep is not permitted.

CW Operation: Single frequency RF output is controlled by the main tuning knob. Pressing front panel CW mode pushbutton selects the CW mode. An illuminated LED near the main tuning knob indicates when the knob is functioning as CW, Center Frequency, or marker frequency control.

1.2.3 Sweep Capability

Sweep Modes

The two sweep modes (Start/Stop and ΔF Swp) are described in paragraph 1.2.2.

Sweep Time Continuously adjustable from 0.02 to 20 seconds, nominal, per sweep.

Sweep Out/Ext Tune In

Internal Sweep Sweep output is 0 to + 10V direct-coupled, modified sawtooth waveform regardless of sweep width.

CW Sweep output is linearly proportional to frequency with 0V (lowest frequency) to + 10V (highest frequency), nominal, for full Micro Sweep bandwidth.

Frequency Markers

Three constant width markers, independently adjustable over the full frequency band of the Micro Sweep, are available for all sweep functions (Start/Stop, ΔF , and Remote) plus CW. Markers are only produced when the frequency is swept from low to high frequency.

Intensity Marker: A rectangular pulse provides a marker signal for the Z-axis input to oscilloscope. Pulse polarity is factory set for a negative-going pulse, but may be changed to a positive-going pulse via an internal switch (see paragraph 2.2.3 and figure 3-4). Retrace blanking signal will be of the opposite polarity. A front panel trim adjustment permits intensity adjustment.

Amplitude (RF PIP) Marker: The RF PIP marker is generated by momentarily reducing the RF output. (Factory set position enables this type of marker.) The RF PIP maker can be disabled with an internal switch (see paragraph 2.2.3). A front panel trim adjustment permits PIP depth adjustment.

Operation: Marker 1, Marker 2, and Marker 3 are set in any order by first pressing the pushbutton of the desired marker and displaying its frequency on the LCD readout; this activates the marker to accept other commands. The marker being displayed and operated on is identified by a flashing indicator. Markers which are off will blink with a short duty cycle, and markers which are on will blink with a long duty cycle. The marker is then toggled on or off using the On/Off pushbutton. The marker frequency is changed by pressing the Update pushbutton to "on" and then adjusting the main turning knob.

Resolution: Each marker may be set to a digitized resolution of 0.1% of the Micro Sweeps bandwidth. Display resolution is 10 MHz.

Blanking

During retrace, a +5V, nominal, direct coupled rectangular pulse provides the Z-axis input to the oscilloscope. Polarity may be changed to negative by changing an internal switch (see paragraph 2.2.4 and figure 3-4). RF blanking is not provided.

Sweep Trigger

Auto-Trigger: Sweep is automatically triggered on a continuous basis.

External Trigger: A single sweep is triggered by a signal at the front panel Trig In BNC. Pressing the Ext Trig pushbutton selects this mode as indicated by an illuminated Ext Trig pushbutton. The sweep is triggered by the falling edge (high or low) of a TTL signal or a switch contact closure to ground. A double press of the pushbutton

will manually trigger a single sweep at slower sweep rates; there will be a brief delay before the sweep begins.

1.2.4 External Modulation

AM

Depth 0 to 25 dB min. (30 dB typical) for a 0 to +10V input.
 Bandwidth 50 kHz typical 3dB bandwidth, dc coupled.
 Input Impedance 10 kΩ nominal.

FM

Deviation ± 5MHz min. deviation for ± 4V input.
 Bandwidth 50 kHz typical, 3dB bandwidth, dc coupled.
 Input Impedance 10kΩ nominal.

1.2.5 Output Characteristics

(See table 1-1.)

Table 1-1. Output Characteristics

	Model			
	962	964	965	967
Output Power				
Unleveled (without internal leveling option 001)	+ 12 dBm	+ 12 dBm	+ 12 dBm	+ 12 dBm
Leveled (via internal leveling option 001)	+ 10 dBm	+ 10 dBm	+ 10 dBm	+ 10 dBm
Unleveled (with internal leveling option 001 installed)	+ 11 dBm	+ 11 dBm	+ 11 dBm	+ 11 dBm
RF Level Control Range				
Unleveled Operation	25 dB minimum, 30 dB typical. 7 dB nominal.			
Leveled Operation				
RF Leveling				
Internal Option	Flat ± 1.0 dB, maximum. Flat ± 0.1 dB maximum, excluding coupler/ detector variations.			
External Leveling (at maximum output using HP 8472A negative polarity detector and 16 dB coupler)				
Input Sensitivity	– 50 dB/mV nominal, gain adjustment provided at front panel. 1kΩ nominal.			
Input Impedance				
Output Impedance	50Ωnominal.			
VSWR (with internal leveling option)	<2.5	<1.5	<1.5	<1.5

1.2.6 General

Connectors

RF Output: Precision Type N.
AC Power: CEE22 Type VI.
All Others: BNC.

Environment

Operating
Temperature: 0 to + 50°C.
Nonoperating
Temperature: – 40 to + 75°C (Rate of temperature
change not to exceed 1° per minute).
Humidity: 0 to 95% noncondensing.
Dimension: 21.6 cm (8½ in.) wide; 9.8 cm (3½
in.) high; 29.9 cm (11¾ in.) deep.
Weight: 5.4 kg (12 lb), nominal.
Power: 90 – 126V or 198 – 252V; 50 – 400
Hz: 40 VA.

1.2.7 Storage

Short Term (<30 days): Same as Environmental limits;
see 1.2.6 General.

Long Term (>30 days): Refer to Preparation for Shipment;
see 1.2.6 General.

1.2.8 Options

001 Internal Leveling

1.3 ITEMS FURNISHED

Each Micro Sweep is shipped with an instruction manual
and a power cable.

1.4 ITEMS REQUIRED BUT NOT FURNISHED

50Ω BNC and 50Ω Type N coaxial cables are required
to interconnect the Micro Sweep to other devices dur-
ing operation. Items referenced in table 1-2 are required
to perform maintenance on the Micro Sweep.

1.5 TEST EQUIPMENT

The tools and test equipment required to perform the
checkout procedure, troubleshooting, and calibration
procedures are contained in table 1-2.

Table 1-2. Test Equipment

Category	Recommended Equipment	Alternate Equipment	Test Equipment Parameters
Oscilloscope	Tektronix 2465	Tektronix 453 Tektronix 475	Sensitivity: 5mV/div. Rise/Fall time: <0.05 μ S. Sweep rate: 50 mS/div to 5 μ s/div. Trigger: Int and Line
Spectrum Analyzer	Tektronix 492	HP 8559 HP 141T	Range: 1 to 18 GHz. Freq/Division: 10 kHz/div. Bandwidth: 3kHz.
RF Counter, Phase Locking	EIP 575		Range: 5Hz to 10 kHz and 1 to 18 GHz.
RF Power	HP 436A with HP 8484A Power Sensor	Wavetek Pacific Measurements Model 7500	Response: 1 to 18 GHz. Range: + 20 to - 40 dBm. Readout: dBm and dBref.
Digital Voltmeter	Fluke 8600A	Fluke 8050A	Range: 19 mV to 19V full scale. Resolution: 4 1/2 digits. Accuracy: 1/2 LSB.
Test Generator	Wavetek 182A		
DC Voltage Source	Fluke 332B	Datel Model DCV-8500	0.0 to + 15V.
Oscilloscope Probe	Tektronix P6028	Tektronix P6101	Direct Probe (X1)
Directional Coupler	Krytar 1820	Narda 3292-1	Range: 1 to 18 GHz Coupling: - 16 dB.
Crystal Detector	HP 8470B Option 012		Polarity: Negative. Range: 1 to 18 GHz. Sensitivity: >400 μ V/ μ W.
RF Attenuators	HP 8491B HP 8491B Option 010 HP 8491B Option 040		3dB with Type N connectors, 1 to 18 GHz. 10 dB with Type N connectors, 1 to 18 GHz.
Terminations	Tektronix 5015-1003-00		50 Ω , BNC connectors.
Coaxial Adapters	Pomona Model 3285	Tektronix 103-0030-00	BNC Tee.
Coaxial Cables			50 Ω BNC (M) to BNC (M). 50 Ω Type N (M) to Type N (M).

SECTION 1

GENERAL DESCRIPTION

1.1 INTRODUCTION

The 960 Micro Sweep series consist of four compact, lightweight microwave sweep generators that collectively cover the 1 to 18 GHz frequency range. These generators feature three operating modes (Start/Stop Sweep, ΔF Sweep, and CW) with three independently settable frequency markers. Frequency is displayed to 10 MHz resolution on a LCD display.

Frequency can be swept using either of two sweep modes (Start/Stop Sweep and ΔF Sweep). In Start/Stop Sweep, both the start and stop frequencies can be independently set; the Micro Sweep may be swept up or down in frequency. In ΔF Sweep, the center frequency and total frequency deviation each can be controlled; ΔF Sweep sweeps symmetrically upward only. For both sweep modes, the maximum sweep width is 100% of a Micro Sweep's frequency band, while the minimum sweep width is approximately 1%. Both sweep can be auto-triggered (continuous sweep) or triggered which allows the sweep to be started by an external signal. Furthermore, the frequency can be remotely controlled (External Tune) or frequency modulated (FM).

Three independently settable frequency markers can be used in the two sweep modes, CW, and external frequency tuning. These markers may be RF PIP, Z-Axis, or both. Internal switches select the type of marker. Plus, the polarity of the Z-Axis (Intensity markers) output can be set, using internal switches, for either positive or negative intensity control of an oscilloscope trace. In addition, marker intensity or PIP depth also can be set.

Output power is continuously variable. Maximum power is greater than +12 dBm, unleveled, or +10 dBm internally leveled. RF level control range is greater than 25 dB, unleveled, and a nominal 7dB when leveled. An optional internal leveler (Option 001) maintains the output level within ± 1.0 dBm or better across the Micro Sweep's frequency band. The RF output also may be leveled using an external coupler and diode detector. The output can be amplitude modulated (AM) using an external signal.

1.2 SPECIFICATIONS

1.2.1 Frequency Characteristics

Frequency Range

The frequency ranges of the Model 960 Series Micro Sweeps are as follows:

Model 962	1.0 — 4.0 GHz
Model 964	3.7 — 8.4 GHz
Model 965	7.0 — 12.4 GHz
Model 967	12.0 — 18.0 GHz

Frequency Accuracy

When operated at $25^{\circ}\text{C} \pm 10\%$ and maximum RF output, the absolute frequency accuracy of the Model 960 Series Micro Sweep is better than $\pm 1\%$ (0.5% typical) for CW, $\pm 1\%$ (typical) for Markers and Center Frequency, and $\pm 2\%$ (typical) for Start, Stop, and ΔF .

Display Resolution

The front panel display resolution is 10 MHz.

Frequency Stability

The frequency stability (typical) of the Model 960 Series is measured after 1 hour warm-up in a constant environment. Other conditions apply as indicated.

With Temperature	0.007% per $^{\circ}\text{C}$ (0 to +50 $^{\circ}\text{C}$).
With Line Voltage	0.001% with 10% line voltage change.
With Time: Short Term	0.004% over 5 minutes (after 1 hr. warm up and 15 minutes following any frequency change).
With Time: Long Term	0.01% over 1 hr. (after 1 hr. warm up and 15 min. following any frequency change).
With Load (midband 3:1 VSWR)	0.1%.