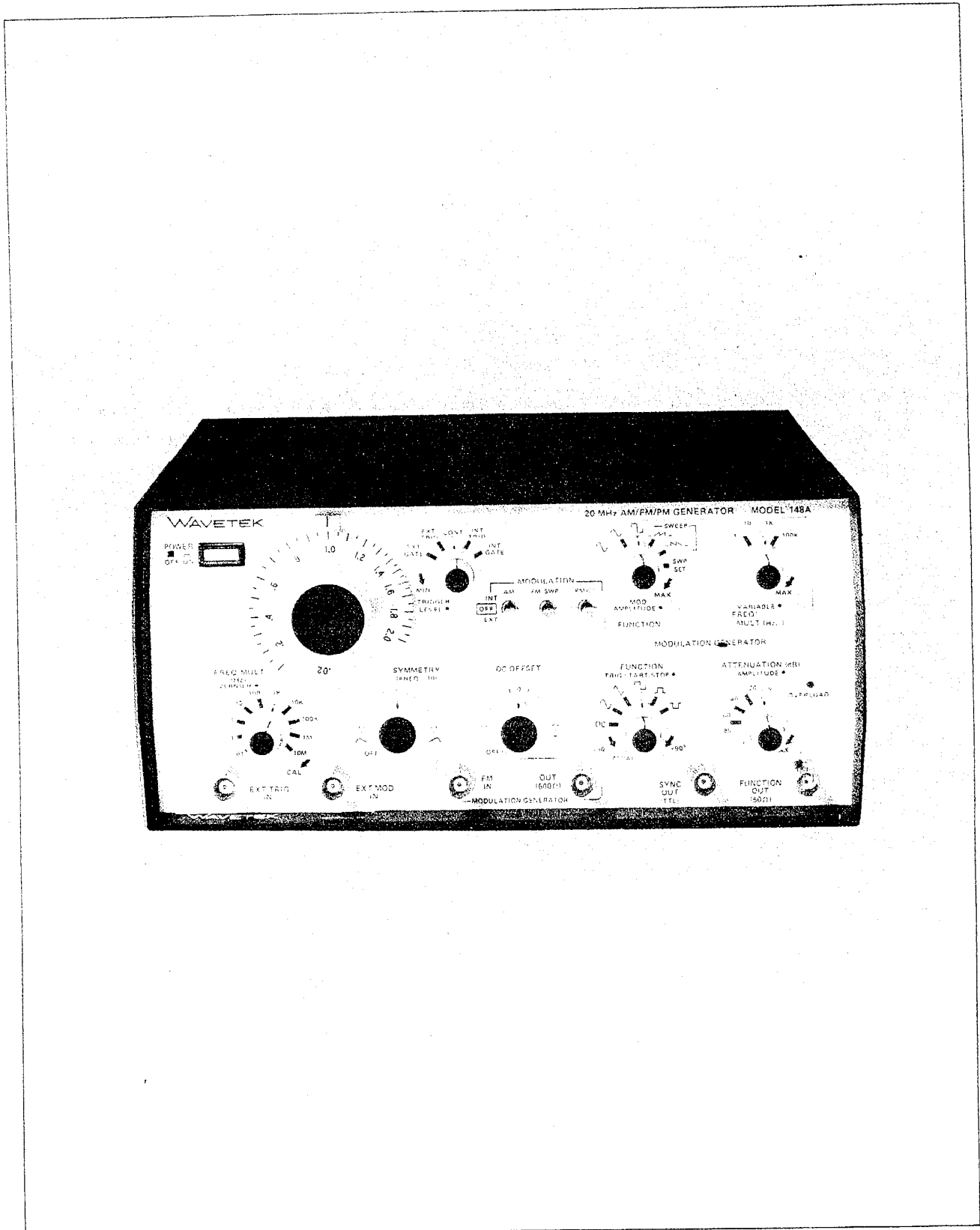


INSTRUCTION MANUAL
MODEL 148A
20 MHz
AM/FM/PM GENERATOR
(with Option 001)

WAVETEK
SAN DIEGO

9045 BALBOA AVENUE, SAN DIEGO, CALIFORNIA



Model 148A 20MHz AM/FM/PM Generator

SECTION 1

GENERAL DESCRIPTION

1.1 THE MODEL 148A

Wavetek Model 148A, 20 MHz AM/FM/PM Generator is a precision source of sine, triangle, square, ramp and pulse waveforms plus dc voltage. The waveforms may be controlled in symmetry as well as amplitude and dc offset. A built-in modulation generator can modulate frequency, phase and amplitude or modulation may be by an external source.

The generator may be run in continuous mode or triggered for a single pulse or gated for a burst of pulses. Triggering and gating may be by the Model 148 built-in modulation generator or by an external source. The triggered and gated waveform start/stop point is selectable from -90° through $+90^\circ$. Start/stop control plus dc offset control gives haverswave capability.

The main output of waveforms may be attenuated and offset. A TTL sync pulse is available at main generator frequencies, and the modulation generator waveforms are available at fixed amplitudes.






Frequency of both the main generator and the modulation generator can be manually controlled at the front panel or electrically controlled by external voltages.

An external sync input (Option 001) located on the rear panel allows the instrument to be synchronized to an external signal source.

1.2 SPECIFICATIONS

1.2.1 Main Generator

1.2.1.1 Waveforms

Selectable sine , triangle , square , positive square , negative square  and dc. A TTL sync pulse is provided on a separate output connector. All can be produced with variable symmetry, amplitude and dc offset.

1.2.1.2 Operational Modes

Continuous: Generator oscillates continuously at the selected frequency.

External Trigger: Generator is quiescent until triggered by an external signal, then generates one cycle at the selected frequency.

External Gate: Same as external trigger, except generator oscillates at the selected frequency for the duration of the positive state of the external signal plus the time to complete the last cycle.




Internal Trigger: Same as external trigger, except that the modulation generator is internally connected to the trigger input of the main generator.






Internal Gate: Same as external gate, except that the modulation generator is internally connected to the trigger input of the main generator.

1.2.1.3 Modulation Modes

Internal Modulation

Setting a front panel modulation switch in the IN1 position routes the selected modulation function from the modulation amplitude control to the selected modulating circuits of the main generator.

Amplitude Modulation (AM): , ,  modulation functions are used in this internal modulation mode. With modulation amplitude ccw, carrier amplitude output is not amplitude modulated and approximately half of normal (AM OFF) amplitude. Clockwise rotation of modulation amplitude results in increasing amplitude modulation of the carrier to at least 100% AM.

Frequency Modulation (FM) and Sweep:  and  modulation functions are used to linearly sweep the main generator frequency. The frequency dial sets the lower sweep limit and the modulation amplitude control determines the upper frequency limit (not to exceed $2.0 \times$ multiplier). A sweep set mode allows precision setting of upper frequency limit. For frequency deviation, the dial determines the center frequency and modulator ,  or  varies the main generator frequency above and below center by an amount determined by the modulator amplitude.

Phase Modulation (PM): As in External Modulation. Amplitude of modulator \sim , \wedge , \sqcap functions varies phase up to $\pm 50^\circ$.

External Modulation

A BNC feeds an external signal to the modulating circuits when selected by a front panel modulation toggle switch in the EXT position.

Amplitude Modulation (AM): External modulating signals with zero dc component produce suppressed carrier modulation; i.e., a carrier (at main generator function output) amplitude of zero. The function output modulated signal has an amplitude sensitivity of 3 volts peak (1.5 Vp into 50 Ω) per volt peak in. A carrier signal level at the function output can be produced at a sensitivity of 3 Vp (1.5 Vp into 50 Ω) per 1 Vp dc component in. Modulating the dc component modulates the carrier level. Percent modulation (AM) will be the ratio of the peak ac to peak dc of the modulating signal. Input impedance is $> 2.5 \text{ k}\Omega$.

Frequency Modulation (FM) and Sweep: Sensitivity is 20% of frequency range/volt peak. Linear behavior results only when all instantaneous frequencies called for fall within the frequency range ($2 \times$ multiplier to $0.002 \times$ multiplier). The instantaneous frequency called for is the multiplier and dial setting altered by the instantaneous voltage at the modulation input. Input impedance is 5 k Ω .

Phase Modulation (PM): Sensitivity is 10° phase shift/volt peak. Linear behavior results only when all instantaneous transition frequencies called for fall within the frequency range ($2 \times$ multiplier to $0.002 \times$ multiplier). The instantaneous frequencies called for will depend heavily on the modulation frequency and waveform. Inoperative at frequency multiplier settings below 100. Input frequencies roll off at 6 dB/octave above one half of full range frequency and above 150 kHz. Input impedance is 10 k Ω .

1.2.1.4 Frequency Range

0.0002 Hz to 20 MHz in 10 overlapping ranges with approximately 1% vernier control.

1.2.1.5 Function Output (50 Ω)

\sim , \wedge and \sqcap selectable and variable to 30V p-p (15V p-p into 50 Ω). \square and τ up to 15 Vp (7.5 Vp into 50 Ω). All waveforms and dc can supply 150 mA

peak current and may be attenuated to 60 dB in 20 dB steps. An additional 20 dB vernier also controls the waveform amplitudes.

1.2.1.6 Adjustable Waveform Start/Stop Point

Approximately -90° to $+90^\circ$ to 2 MHz (operative on sine and triangle waveforms only).

1.2.1.7 DC Output and DC Offset

Selectable through function output (50 Ω). Controlled by front panel controls to a minimum of $\pm 14.4 \text{ Vdc}$ ($\pm 7.2 \text{ Vdc}$ into 50 Ω) with signal peak plus offset limited to $\pm 15 \text{ Vdc}$ ($\pm 7.5 \text{ Vdc}$ into 50 Ω). DC offset and wave form attenuated proportionately by the 60 dB output attenuator.

1.2.1.8 External Modulation Input

AM: Sensitivity of 3 Vp out/Vp (1.5V into 50 Ω). Input impedance is $> 2.5 \text{ k}\Omega$.

FM: Sensitivity of 20% of frequency range/Vp. Input impedance is 5 k Ω .

PM: Sensitivity of 10° phase shift/Vp. Input impedance is 10 k Ω .

1.2.1.9 Symmetry

Symmetry of all waveform outputs is continuously adjustable from 1:19 to 19:1. Varying symmetry provides variable duty-cycle pulses, sawtooth ramps and non-symmetrical sine waves.

NOTE

When SYMMETRY control is used, indicated frequency is divided by approximately 10.

1.2.1.10 Sync Output (TTL)

TTL level pulse which will drive 10 TTL loads. Frequency and time symmetry are the same as for function output.

1.2.1.11 Trigger and Gate

Input Range: 1V p-p to $\pm 10\text{V}$.

Input Impedance: 10 k Ω , 33 pF.

Pulse Width: 25 ns minimum.

Repetition Rate: 10 MHz maximum.

Adjustable triggered signal start/stop point: approximately -90° to $+90^\circ$ to 2 MHz.

1.2.1.12 Frequency Precision

Dial Accuracy

$\pm(1\%$ of setting + 1% of full range) on $\times 100$ thru $\times 1M$ ranges.
 $\pm(2\%$ of setting + 2% of full range) on $\times .01$ thru $\times 10$ and $\times 10M$ ranges.

Time Symmetry

$\pm 0.5\%$ on $\times 100$ thru $\times 100k$ ranges and from 0.2 to 2.0 on dial.
 $\pm 5\%$ on all other ranges and from 0.02 to 2.0 on dial.

1.2.1.13 Amplitude Precision

Amplitude Change With Frequency

Sine variation less than:
 ± 0.1 dB thru $\times 100k$ ranges;
 ± 0.5 dB on $\times 1M$ range;
 ± 3 dB on $\times 10M$ range.

Step Attenuator Accuracy

± 0.3 dB per 20 dB step at 2 kHz.

1.2.1.14 Waveform Characteristics

Sine Distortion

$< 0.5\%$ on $\times 100$ Hz to $\times 10$ kHz.
 $< 1.0\%$ on $\times .01$ to $\times 10$ Hz and $\times 100$ kHz ranges.
All harmonics 30 dB below fundamental on $\times 1$ MHz range.
All harmonics 26 dB below fundamental on $\times 10$ MHz range.

Square Wave Rise/Fall Times

At FUNCTION OUT < 25 ns for 15V p-p into a 50Ω load.

Triangle Distortion

Odd harmonics within 15% of correct value to 2 MHz.

1.2.1.15 External Sync Input (Option 001)






The external sync input requires a minimum signal level of 1 Vp-p and a maximum signal level of 20 Vp-p. Its input impedance is approximately $2\text{ k}\Omega$ with 10 pF. The frequency of the external sync signal must be within 1% of the 148A's frequency setting.

1.2.2 Modulation Generator






1.2.2.1 Waveforms

Selectable sine , triangle , square , up ramp  and down ramp .

1.2.2.2 Frequency Range

, ,  0.1 Hz to 100 kHz in three 100:1 ranges.
,  Sweep: 0.2 Hz to 200 kHz (2 \times setting).

1.2.2.3 Output (600 Ω)

,  and  are fixed level 10V p-p balanced about ground.  and  are fixed level 5 Vp from 0 to +5V.

1.2.2.4 Frequency Modulation (FM IN)

Voltage control of modulator frequency with sensitivity of 20% of range per volt. Input impedance is $5\text{ k}\Omega$.

1.2.2.5 Waveform Characteristics

Sine Distortion

$< 5\%$.

Time Symmetry

$< 1\%$ from 1 Hz to 10 kHz.
 $< 5\%$ from 0.1 Hz to 100 kHz.

1.2.3 General

1.2.3.1 Stability (for amplitude, dc offset and frequency)

Short Term: $\pm 0.05\%$ for 10 minutes.
Long Term: $\pm 0.25\%$ for 24 hours.

1.2.3.2 Environmental

Temperature Range: $25^\circ\text{C} \pm 5^\circ\text{C}$ ambient for spec operation. 0°C to 50°C ambient for operation. -55°C to 75°C for storage.

Altitude sea level to 10,000 for operation. Sea level to 40,000 ft for storage.

Relative Humidity: $< 95\%$ at 25°C and sea level (non condensing).

1.2.3.3 Dimensions

28.6 cm (11 $\frac{1}{4}$ in.) wide; 13.3 cm (5 $\frac{1}{4}$ in.) high; 27.3 cm (10 $\frac{3}{4}$ in.) deep.

1.2.3.4 Weight

5 kg (11 lb) net; 6.6 kg (14 $\frac{1}{2}$ lb) shipping.

1.2.3.5 Power

90 to 105V, 108 to 126V, 198 to 231V and 216 to 252V selectable; 48 to 400 Hz; less than 40 watts.

NOTE

Unless otherwise noted, all specifications apply from 0.1 to 2.0 on frequency dial when FUNCTION OUT is at maximum and 50Ω terminated, with SYMMETRY control at OFF. Symmetry and vernier affect frequency calibration. Maximum possible asymmetry is a function of frequency setting.

1.3 ITEMS FURNISHED

Model 148A Instruction Manual is furnished with the Model 148A.

1.4 ITEMS REQUIRED

Coaxial cables with BNC connectors are required, but not furnished, for the distribution of signals.

1.5 TEST EQUIPMENT AND TOOLS

Recommended test equipment for electrical acceptance checkout is described in paragraph 2.3

Recommended test equipment for troubleshooting and calibration is described in paragraph 5.2.

Only standard tools are required for maintenance and calibration.