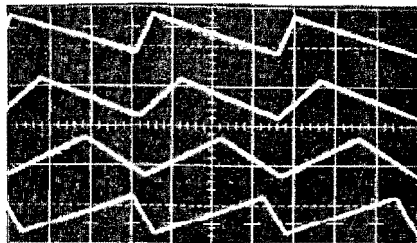




MODELS 142 & 144

FUNCTION GENERATORS

# 10 MHz VCG Generators



- Frequency From 0.0005 Hz to 10 MHz
- Step Attenuator to 60 dB
- Full 30 Volt Peak-To-Peak Output
- Variable Symmetry on All Waveforms

### Frequency From 0.0005 Hz to 10 MHz

The extended frequency range of Models 142 and 144 from 0.0005 Hz to 10 MHz gives you the high and the low (half hour cycles) frequency waveforms you need for the majority of your test requirements. The full frequency range is for sine, square, triangle, positive pulse and negative pulse waveforms.

The 142 is a basic function generator. The 144 has internal sweep capability and trigger/gate operation added.

### Variable Symmetry on All Waveforms

Pulses with on/off ratios as great as 19:1 can be generated in either

polarity. Ramp or sawtooth rise/fall ratios of 19:1 to 1:19 may also be generated.

### VCG — Voltage Controlled Generator

Frequency can be controlled by an external voltage to analog program or frequency modulate the output with an external ac or dc control. Zero to 5 volts will vary the frequency over a 1000:1 ratio.

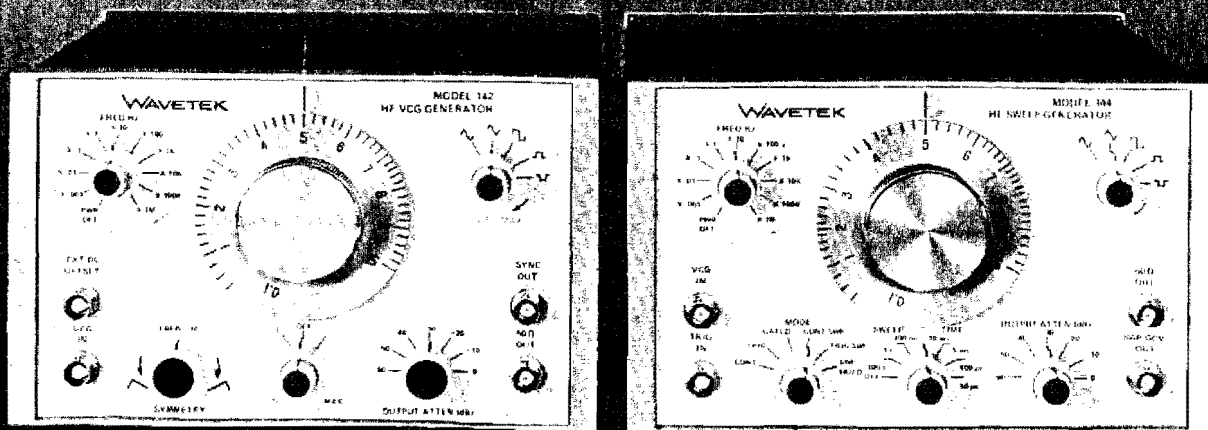
### Two Independent Generators

The Model 144 gives you two independent generators, the main function generator and an auxiliary ramp generator. The auxiliary generator can sweep, trigger and gate the main generator with controllable

sweep time and trigger and gate repetition rates.








### Sweep or Generator Control Voltage (GCV) Output

When the Model 144 is being used in one of the three internal sweep modes, the SWP/GCV output is a voltage proportional to frequency, ideally suited as a horizontal or X-axis drive for oscilloscopes or recorders. When the Model 144 is in the other modes, the output is a fixed 5 volt sawtooth, which can be used to trigger or tone burst the main generator.



**VERSATILITY**

**Waveforms**

Sine , square , triangle , positive pulse  and negative pulse . Symmetry of all outputs continuously adjustable from 1:19 to 19:1. Varying triangle symmetry provides a sawtooth  or  output.

**Operational Modes**

Continuous: Generator oscillates continuously at frequency set by voltage and manual control.

*NOTE: The following modes apply only to the Model 144.*

Triggered: Generator quiescent until triggered by an external signal, then generates one cycle at selected frequency.

Gated: As triggered mode, except generator oscillates for the duration of the external signal.

Continuous Sweep: Recurring low-to-high frequency oscillation. Range and rate selectable.






Triggered Sweep: Low-to-high frequency oscillation with each trigger input; then return to low frequency after sweep.

Sweep-and-Hold: Sweep-to-high frequency oscillation.

**Frequency Range**

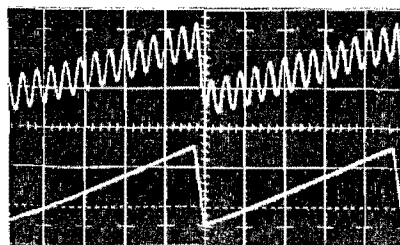
0.0005 Hz to 10 MHz in 10 overlapping decade ranges with dial and frequency vernier.

**Main Output**

, ,  selectable and variable to 30V p-p (15V p-p into 50Ω).  and  selectable and variable to ±15V peak (7.5V peak into 50Ω). Precision output attenuator calibrated in 10 dB steps to 60 dB with 20 dB vernier for overall attenuation of 80 dB. Output impedance 50Ω.

**DC Offset**

Waveform offset selectable through 50Ω output. Controlled manually and (142 only) electronically by applying an external voltage. Adjustable between ±10 Vdc (±5 Vdc into 50Ω) with peak output limited to ±15 Vdc (±7.5 Vdc into 50Ω). Voltage controlled offset sensitivity approximately ~0.4 V/V with output connected to 50Ω load. DC offset and output waveform attenuated proportionately by the 60 dB output attenuator.



External DC Offset

**Sync Output**

Amplitude greater than 4V p-p (2V p-p into 50Ω). Rise and fall times less than 50 ns. Square waveform for symmetrical outputs; rectangular waveform for pulse and ramp outputs. Sync pulse polarity opposite that of output square wave.

**VCG — Voltage Controlled Generator**

Up to 1000:1 frequency change with external 0 to ±5V signal. Upper frequency is limited to maximum of selected range.

Slew Rate: 2% of range per μs.

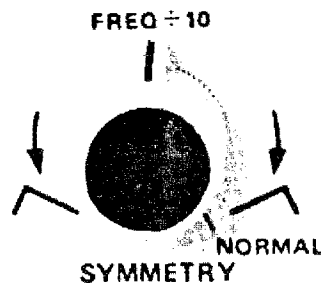
Linearity:

±0.2% for 10 Hz to 100 kHz.

±0.5% for 0.001 Hz to 1 MHz.

Input Impedance: 5 kΩ.

**Symmetry Control**



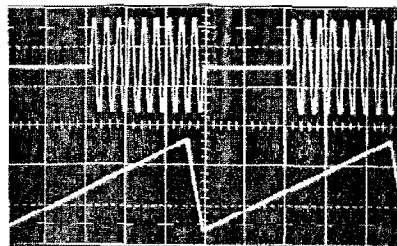
Symmetry of all waveform outputs is continuously adjustable from 1:19 to 19:1. Varying symmetry provides variable duty cycle pulses, sawtooth ramps and nonsymmetrical sine waves.

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

**Trigger and Gate (144 only)**

Input: 1V peak-to-peak min.

Impedance: 10 kΩ.



Tone Burst Using Sweep Signal as Trigger

**FREQUENCY PRECISION**

**Dial Accuracy**

±(1% of setting + 1% of full scale) for 0.01 Hz to 1 MHz.

±(2% of setting + 2% of full scale) for 1 to 10 MHz.

**Time Symmetry**

±0.5% for 10 Hz to 100 kHz.

±1.0% for 0.01 Hz to 500 kHz.

**AMPLITUDE PRECISION**

**Amplitude Change With Frequency**

Sine variation less than:

±0.1 dB to 100 kHz.

±0.2 dB to 1 MHz.

±2.0 dB to 10 MHz.

**Amplitude Symmetry**

All waveforms (except pulse) symmetrical within ±1% to 1 MHz.

**Step Attenuator Accuracy**

±0.25 dB per 10 dB step.

**WAVEFORM CHARACTERISTICS**

**Sine Distortion (Continuous Mode)**

Less than:

0.5% for 10 Hz to 100 kHz.

1.0% for 100 kHz to 1 MHz.

All harmonics at least 30 dB down for 1 to 10 MHz.

**Triangle Linearity**

Greater than 99% for 0.0005 Hz to 100 kHz.

**Square Wave Rise and Fall Time**

Less than 20 ns terminated into 50Ω load (limited to 500 V/μs).

**Total Aberrations**

Less than 5%.

**GENERAL**

**Stability**

Amplitude, frequency and dc offset.

Short Term: ±0.05% for 10 minutes.

Long Term: ±0.25% for 24 hours.

**Environmental**

Specifications apply at 25°C ±5°C.

Instrument will operate from 0°C to +50°C.

**Dimensions**

21.6 cm (8½ in.) wide; 13.3 cm (5¼ in.) high; 29.2 cm (11½ in.) deep.

**Weight**

4.1 kg (9 lb) net; 5.9 kg (13 lb) shipping.

**Power**

105 to 125V or 200 to 250V; 50 to 400 Hz; less than 40 watts.

*NOTE: Specifications apply for frequencies obtained when dial is between 1 and 10 with SYMMETRY control to NORM. Symmetry and vernier affect frequency calibration.*

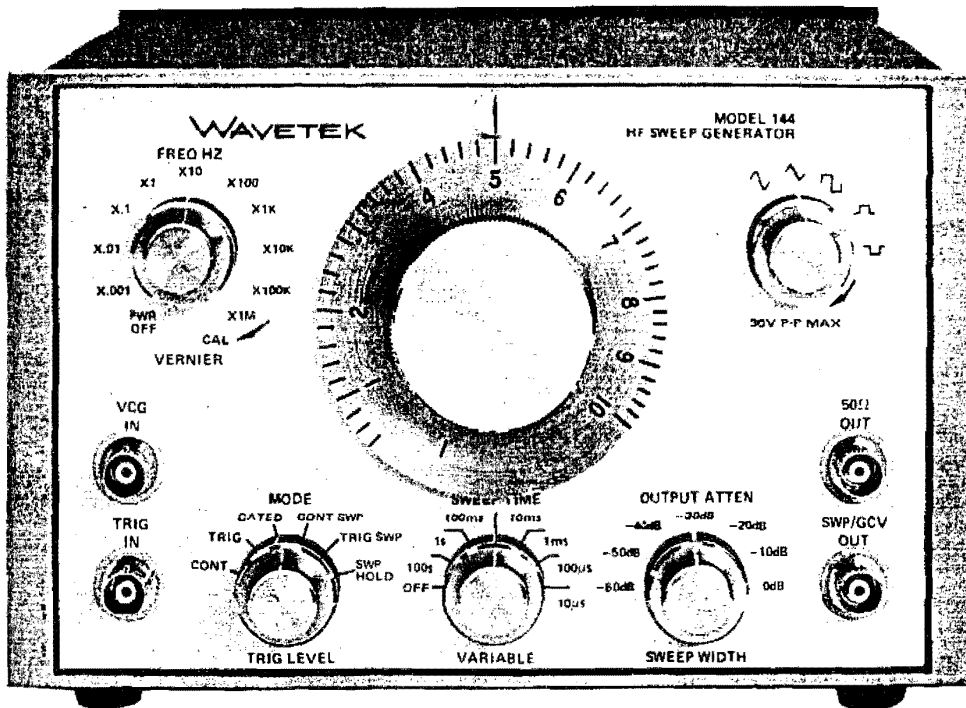


Figure i – Model 144 HF Sweep Generator

#### SCOPE OF THIS MANUAL

This manual provides descriptive material and instructions for the installation, operation, maintenance, and repair of this instrument. Wavetek's product improvement program ensures that the latest electronic developments are incorporated in all Wavetek instruments by the addition of circuit and component changes as rapidly as development and testing permit. Due to the time required to document and print instruction manuals, it is not always possible to incorporate the more recent changes in the released manual. In this case, data will be found on engineering change sheets at the rear of the manual. If no change sheets are included, the manual is correct as printed.

# SECTION 1

## INTRODUCTION

### 1.1 PURPOSE OF THE EQUIPMENT

The Model 144 HF Sweep Generator is a precision 0.0005 Hz to 10 MHz source of sine, triangle, square, positive pulse, and negative pulse waveforms. Each with variable amplitude, dc offset, and symmetry. Frequency range selection is provided in 10 decades, with a vernier control permitting adjustment of approximately 1% of the selected range. Maximum output amplitude is 30 V p-p into an open circuit (15 V p-p into 50 ohms) with a 60 dB calibrated step attenuator and a 20 dB vernier attenuator (80 dB overall) allowing signal levels as low as 1.5 mV p-p. Both the output waveform and the dc offset are attenuated by the 60 dB calibrated step attenuator.

Six operational modes (continuous, triggered, gated, continuous sweep, triggered sweep, and sweep and hold), plus tone burst capability, are provided by the Model 144. The main output can be internally swept over a 1000:1 ratio at sweep speeds from 10  $\mu$ s to 100 seconds—or it can be frequency modulated, dc programmed, or externally swept over the 1000:1 ratio by applying an external control signal to the front panel VCG IN connector. A single cycle of output, or one full sweep of the output, can be obtained if an external trigger is applied to the front panel TRIG IN connector.

In addition to the 50 $\Omega$  main output and a separate rear panel SYNC output, the Model 144 also has a front panel SWP/GCV output. When the main output is not internally swept, the sawtooth output of the internal sweep generator appears at the SWP/GCV OUT connector. When the main output is internally swept, a GCV output proportional to the instantaneous frequency of the main generator will appear at the SWP/GCV OUT connector. This GCV output (Generator-Controlled-Voltage) can be used to drive X-Y recorders or the vertical and horizontal deflection circuits of oscilloscopes, video monitors, etc.

Varying the triangle symmetry produces a sawtooth or "ramp" signal with a rise or fall time as steep as 50 nanoseconds at a recurring rate of 1 MHz. Pulse outputs as narrow as 50 nanoseconds, with repetition rates as high as 1 MHz (on-off ratios as great as 19:1), can be generated in either polarity. Even the sine wave symmetry may be varied over this 1:19 to 19:1 range if desired. When the

output symmetry is not 1:1, the indicated output frequency must be divided by approximately 10.

With this instrument it is possible to simultaneously program or sweep the output frequency, select the output symmetry desired, and manually vary the dc offset. This capability, coupled with the variety of waveforms available and precision output amplitude control, makes the Model 144 an extremely versatile instrument.








### 1.2 GENERAL PHYSICAL DESCRIPTION

Weighing approximately 9 pounds (13 pounds when shipped) the Model 144 is 8- $\frac{1}{2}$  inches wide, 5- $\frac{3}{4}$  inches high, and 11- $\frac{1}{2}$  inches deep. Housed in a compact, ruggedized, portable case, the Model 144 is normally shipped with a 10-foot, 3-wire, detachable line cord and one copy of this instruction manual.

### 1.3 SPECIFICATIONS

#### 1.3.1 Versatility

#### WAVEFORMS

Selectable sine , square , triangle , positive pulse , and negative pulse . Symmetry of all outputs continuously adjustable from 1:19 to 19:1. Varying triangle symmetry produces sawtooth  or  output. Separate SWP/GCV OUTPUT and separate SYNC OUTPUT with variable symmetry as described below.

#### OPERATING FREQUENCY RANGE

0.0005 Hz to 10 MHz in the following ranges:

X.001	0.0005 Hz to .01 Hz
X.01	0.005 Hz to 0.1 Hz
X.1	0.05 Hz to 1 Hz
X1	0.1 Hz to 10 Hz
X10	0.1 Hz to 100 Hz
X100	1 Hz to 1 kHz
X1K	10 Hz to 10 kHz
X10K	100 Hz to 100 kHz
X100K	1 kHz to 1 MHz
X1M	10 kHz to 10 MHz

Note: When symmetry control is used, indicated frequency is divided by approximately 10.

## MAIN OUTPUT

Sine, Square, triangle, positive pulse, and negative pulse; selectable. Maximum output 30 V p-p into open circuit; (15 V p-p pulse) calibrated 15 V p-p into 50Ω. Precision output attenuator calibrated in 10 dB steps to -60 dB with 20 dB vernier for overall attenuation of -80 dB. Output impedance is 50Ω. Short circuit current is 150 mA.

## SYNC OUTPUT

Amplitude greater than 4 V p-p into open circuit; 2 V p-p into 50Ω. Rise and fall times less than 50 ns. Square waveform for symmetrical outputs, rectangular waveform for pulse and ramp outputs. Sync pulse polarity opposite that of output square wave.

### DC Offset

Controlled manually by rear panel control. Adjustable range ±10 Vdc open circuit (±5 Vdc into 50Ω) with peak signal and offset amplitude limited to ±15 Vdc into open circuit (±7.5 Vdc into 50Ω). DC offset and output waveform attenuated proportionately by 60 dB output attenuator.

## SWP/GCV OUTPUT

SWP OUTPUT (0 to +5 V fixed) when in Continuous, Triggered, or Gated modes. GCV OUTPUT (0 to +5 V maximum) proportional to frequency control settings when in Continuous Sweep, Triggered Sweep, or Sweep and Hold modes.

### 1.3.2 Operational Modes

#### Continuous

Operating as a standard VCG (voltage-controlled generator) frequency of 50Ω OUTPUT is determined by front panel control settings in conjunction with VCG INPUT signal. Output of internal sweep generator appears at SWP/GCV OUT connector.

#### Triggered

Only one complete cycle of output appears at 50Ω OUT connector for each pulse applied to TRIG IN connector.

#### Gated

Same as Triggered mode except that output oscillations continue for duration of gating signal applied to TRIG IN connector.

#### Continuous Sweep

Main generator is swept by internal sweep generator so that frequency of 50Ω OUTPUT is swept from a low frequency established by front panel frequency controls to a high frequency determined by SWEEP WIDTH control setting.

Sweep rate is determined by SWEEP TIME and VARIABLE controls. GCV OUTPUT (generator-controlled voltage) appears at SWP/GCV connector.

#### Triggered Sweep

Same as Continuous Sweep mode except that output is swept only once for each pulse applied to TRIG IN connector. During time between sweeps, main generator oscillates at low frequency determined by frequency control settings.

#### Sweep and Hold

A gated sweep in which the frequency output is held at maximum at the end of each sweep for the duration of the gate signal at the TRIG IN connector. Between gate signals, the output is the low frequency determined by the frequency control settings.

**Tone Burst** — Accomplished in Gated mode by connecting ramp output of SWP/GCV OUTPUT to TRIG INPUT. Tone burst rate, frequency, and duration can be independently controlled in this configuration.

#### Trigger Input

1 V peak into 10 kΩ, dc coupled.

#### Sweep Time

10 μs to 100 seconds.

#### Sweep Width

Up to 1000:1 with single turn control.

### 1.3.3 Horizontal Precision

#### Frequency Dial Accuracy

0.01 Hz to 1 MHz ±(1% of setting +1% of full scale) for symmetrical waveforms.

1 MHz to 10 MHz ±(2% of setting +2% of full scale) for symmetrical waveforms.

#### Vernier

Permits frequency adjustment of approximately 1% of range.

#### Time Symmetry

10 Hz to 100 kHz . . . . . ±0.5%

0.01 Hz to 500 kHz . . . . . ±1.0%

### 1.3.4 Voltage-Controlled Generator

#### VCG CONTROL RANGE

Up to 1000:1 frequency change with external voltage input. Upper frequency is limited to maximum of selected range. Required external signal for full voltage control is 5 volts with input impedance of 5 kΩ.

