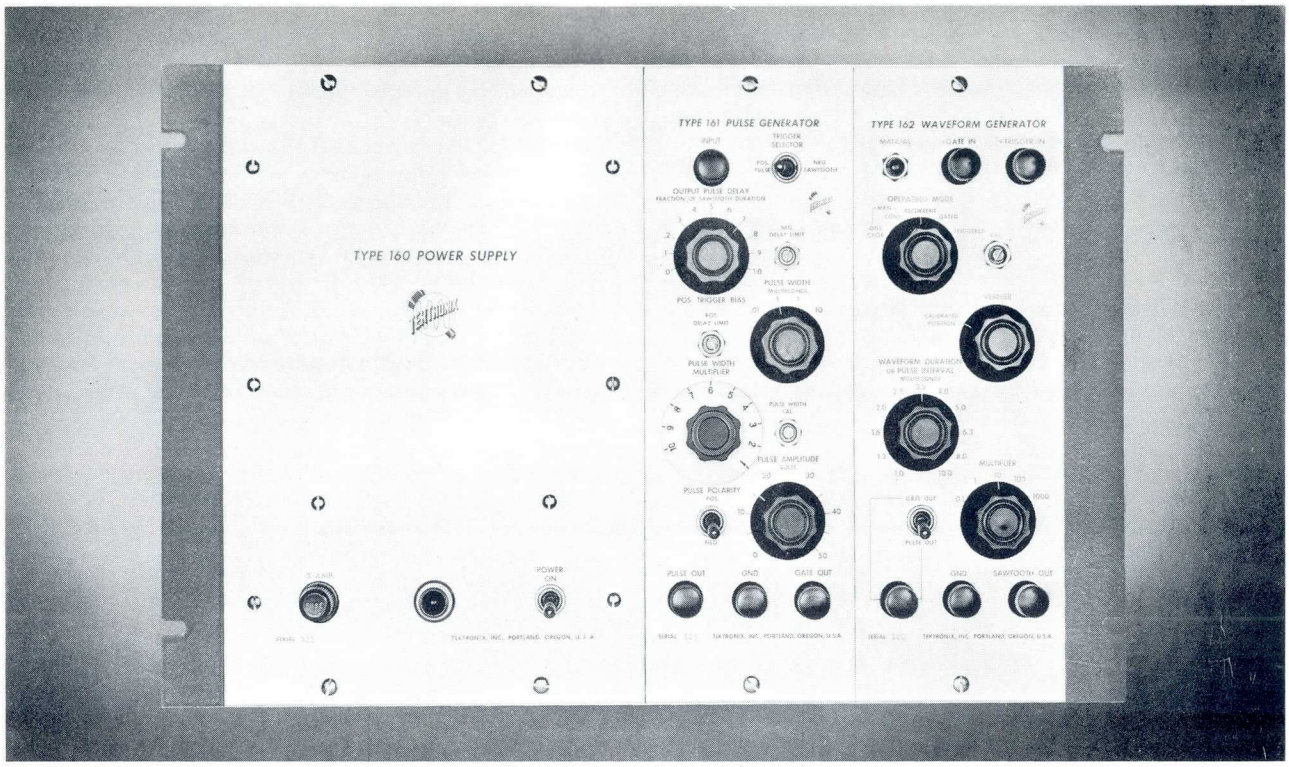
SPECIAL WAVEFORM GENERATORS

TYPE 160 SERIES

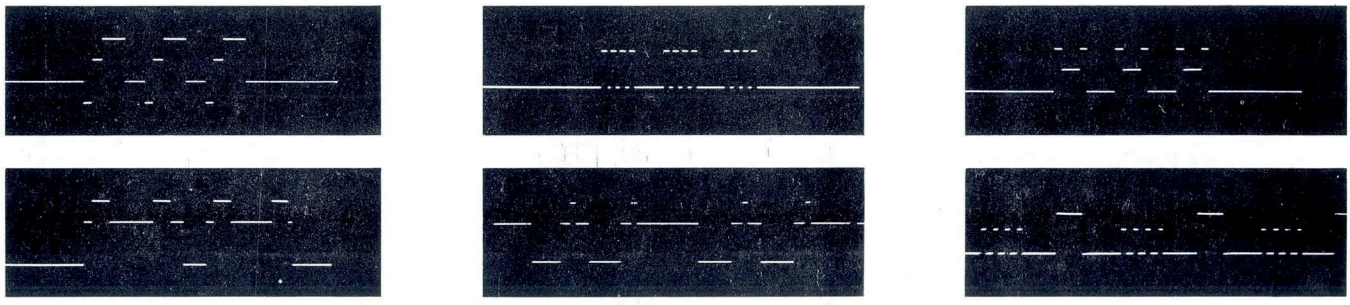


TYPE 160 POWER SUPPLY
TYPE 161 PULSE GENERATOR
TYPE 162 WAVEFORM GENERATOR

The TEKTRONIX **160 Series** of instruments are designed to supply timed pulses of adjustable amplitude and duration. They have been used extensively for nerve stimulation, for example, in neurophysical experiments. In a typical use the response time and the nature of the response to an electrical stimulus generated by a Type 161 or Type 162 is measured on an oscilloscope. By using several instruments together a variety of pulse patterns can be obtained, such as a simulation of a tetanus stimulus.

TYPE 160 POWER SUPPLY

The **Type 160 Power Supply** provides regulated DC voltages and AC filament supply for as many as six Type 161 or Type 162 instruments in any combination.



Some of the waveform combinations possible with Tektronix Type 160 Series Waveform Generators

TEKTRONIX, INC.

SPECIAL WAVEFORM GENERATORS

TYPE 161 PULSE GENERATOR

The **Type 161 Pulse Generator** can be controlled by means of either pulse or sawtooth outputs of the Type 162. The output pulse of the **Type 161** occurs simultaneously with the input pulse from the Type 162, or can be made to occur at any point on the input sawtooth from the Type 162. By selecting the desired portion of the sawtooth for the generation of the pulse, the **Type 161** can provide a delay of any fraction of the sawtooth duration.

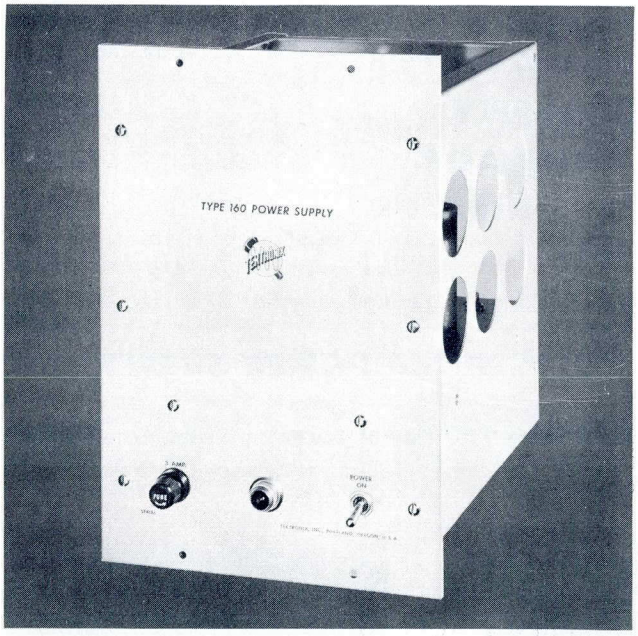
TYPE 162 WAVEFORM GENERATOR

The **Type 162 Waveform Generator** provides gating or enabling pulses and sawtooth waves which can be initiated by means of externally-derived signals such as might be provided by a push button and external battery, or which can be provided by a stable repetition rate generator built into the instrument itself.

USES OF COMBINATIONS OF TYPE 161 AND TYPE 162 GENERATORS

A convenient mounting frame is available which adapts these instruments to relay-rack mounting. One mounting frame will accommodate one **Type 160 Power Supply** and two **Type 161** or **Type 162** generators, or four generators. The **Type 160 Power Supply** will supply the required power for as many as six generator units in any combination. The **Type 161 Pulse Generator** can be used to gate one or more **Type 162 Waveform Generators,** and the **Type 162** can be used to trigger several **Type 161 Pulse Generators.** By using combinations of the generators, a variety of waveforms can be produced. One interunit octal power cable furnished with each generator and two furnished with each **Type 160 Power Supply** provide a convenient means of supplying power to a number of the instruments in combination.

TYPE 160 POWER SUPPLY



GENERAL DESCRIPTION

The TEKTRONIX **Type 160 Power Supply** is designed to provide the required voltages and current for as many as six TEKTRONIX **Type 161** or **Type 162 Generators** in any combination. Three regulated DC voltages are supplied. The output terminals consist of three octal sockets, each capable of supplying power for two of these generators.

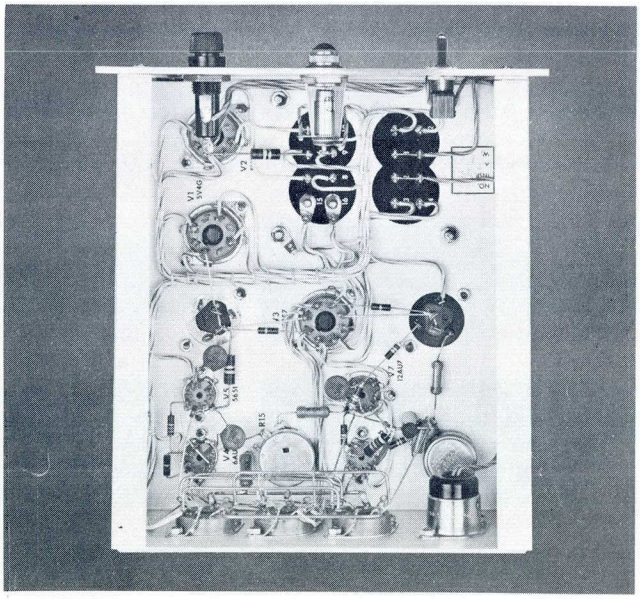
CHARACTERISTICS

Voltages —

+300 volts DC, unregulated, at 170 milliamps.
+225 volts DC, regulated, at 125 milliamps.
+150 volts DC, regulated, at 5 milliamps.
—170 volts DC, regulated, at 125 milliamps.
6.3 volts AC, unregulated, at 10 amps.

Type of Regulation — Electronic, with Type 5651 gas diode reference element.

Output Connections — Three octal female sockets



mounted on rear of chassis. Each socket is capable of supplying power to two generators. Two 17-inch octal interunit power cables are supplied.

Dimensions — 8 1/4" wide, 12 1/4" high, 10" deep.

Weight — 13.5 pounds.

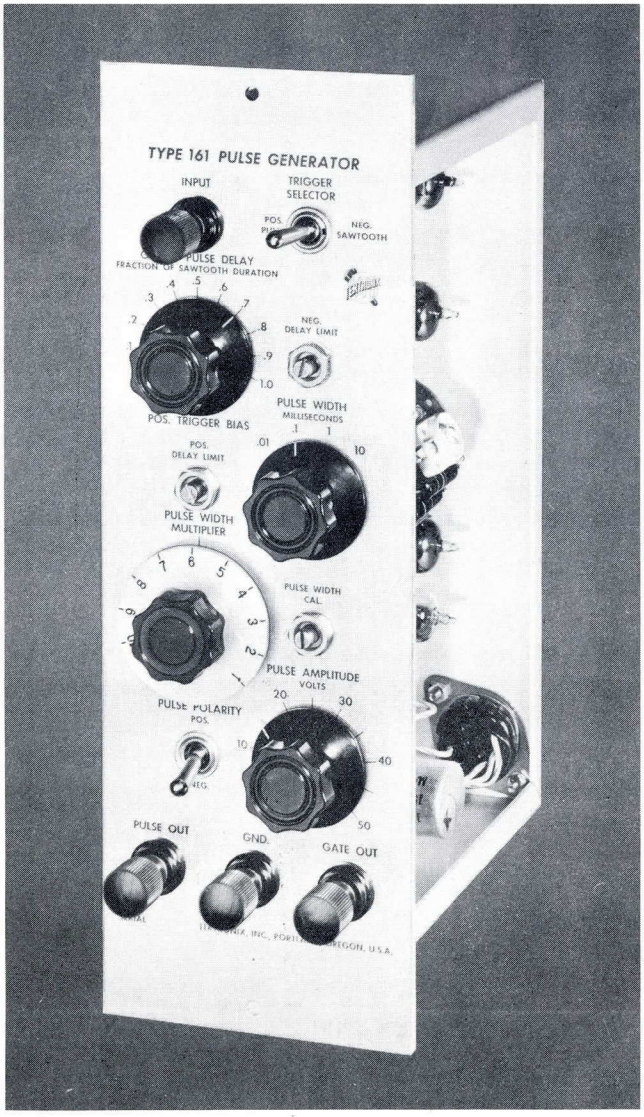
Construction — Aluminum alloy.

Finish — Buffed photo-etched metal panel, etched metal chassis.

VACUUM TUBE COMPLEMENT

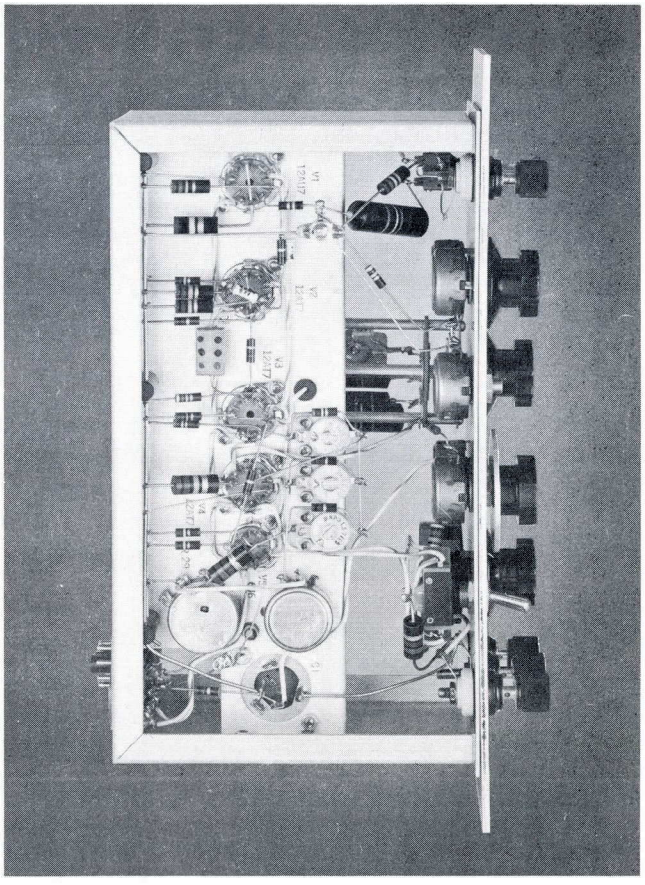
+300 v rectifier		5V4
—170 v rectifier		5V4
+225 v series regulator	1/2	6AS7
—170 v series regulator	1/2	6AS7
—170 v error voltage amplifier		6AU6
Gas diode voltage reference		5651
—225 v error voltage amplifier		6AU6
+150 v error voltage amplifier	1/2	12AU7
+150 v series regulator	1/2	12AU7

TYPE 161 PULSE GENERATOR



GENERAL DESCRIPTION

The TEKTRONIX **Type 161 Pulse Generator** is designed to supply calibrated rectangular output pulses of adjustable duration and amplitude and of either polarity when the required trigger voltage is received from an external source. Two types of trigger waveforms can be used to trigger the **Type 161,** a negative-going sawtooth or a



SPECIAL WAVEFORM GENERATORS

positive pulse. One output pulse is generated for each input pulse or each cycle of the sawtooth.

When a negative sawtooth waveform is used to trigger the generator a rectangular pulse of either polarity and a 50-volt positive gating pulse are generated. The time of occurrence of the pulse and of the gate can be adjusted to any point throughout the duration of the sawtooth. The duration of the generated pulse and the output gate are the same.

When a positive pulse is used to trigger the generator, the same output waveforms are available, but there is no delay available in the generation of the pulse.

CHARACTERISTICS

Output Waveform — Positive gate. Positive pulse. Negative pulse.

Positive Gate Characteristics — Amplitude, 50 volts positive from ground potential, not adjustable. Duration, 10 μsec to 0.1 sec.

Positive Pulse Characteristics — Amplitude, 0 to 50 volts, continuously variable. Duration, 10 μsec to 0.1 sec continuously variable. Risetime, 0.5 μsec. Overshoot, less than 5%. Delay, 0 to 100% of duration of input sawtooth.

Negative Pulse Characteristics — Identical with positive pulse, except polarity.

Output Impedance — Positive pulse, 1800 ohms maximum. Negative pulse, 5000 ohms maximum. Positive gate, 1000 ohms maximum.

Method of Triggering — Positive pulse, or negative-going positive sawtooth.

Trigger Sensitivity — Positive pulse, 2-volt peak minimum. Sawtooth, rate of change of input waveform, 15 volts/sec. Maximum repetition rate, 50 kc.

Construction — Aluminum alloy.

Finish — Buffed photo-etched metal panel, etched metal chassis.

Dimensions — 4 1/8" wide, 12 1/4" high, 7 1/2" deep.

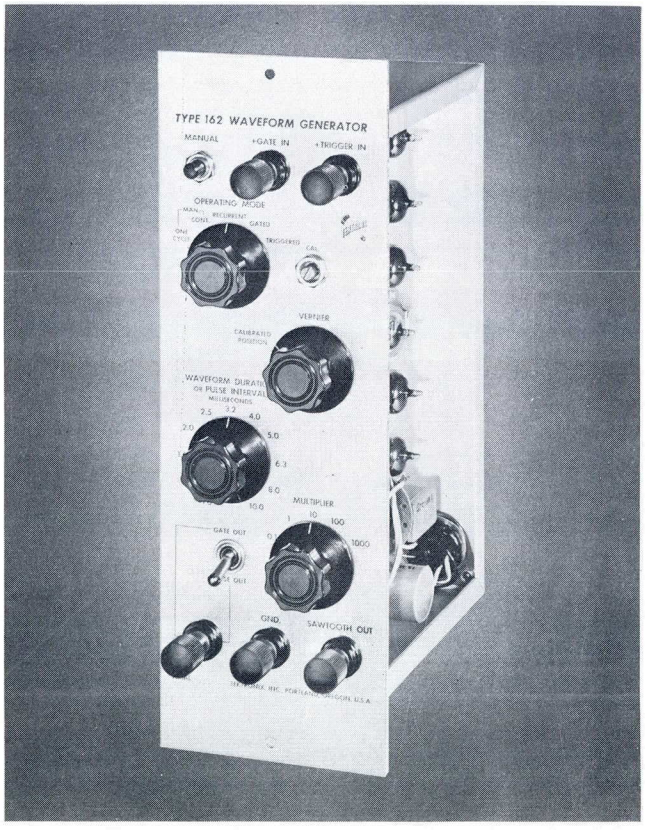
Weight — 5 pounds.

Power Requirements — 225 volts DC positive at 22 ma. 170 volts DC negative at 17 ma. 6.3 volts AC at 1.1 amps.

VACUUM TUBE COMPLEMENT

Comparator	12AU7
Schmitt trigger	12AT7
Coupling diode and first half of one-kick multivibrator	12AT7
Second half multivibrator and positive pulse cathode follower	12AT7
Negative pulse amplifier	6J6

TYPE 162 WAVEFORM GENERATOR



GENERAL DESCRIPTION

The TEKTRONIX **Type 162 Waveform Generator** provides three types of waveforms of adjustable duration and repetition rate; pulse, gate, and sawtooth. Generation of the waveform can be initiated either by means of an externally derived electrical impulse, or by means of front-panel controls and switches. Pulse and gate waveforms have a minimum risetime of approximately one microsecond and an amplitude of 50 volts. The shortest pulse duration is approximately 10 microseconds. The sawtooth waveform is a positive voltage decreasing uniformly from positive 150 volts to positive 20 volts.

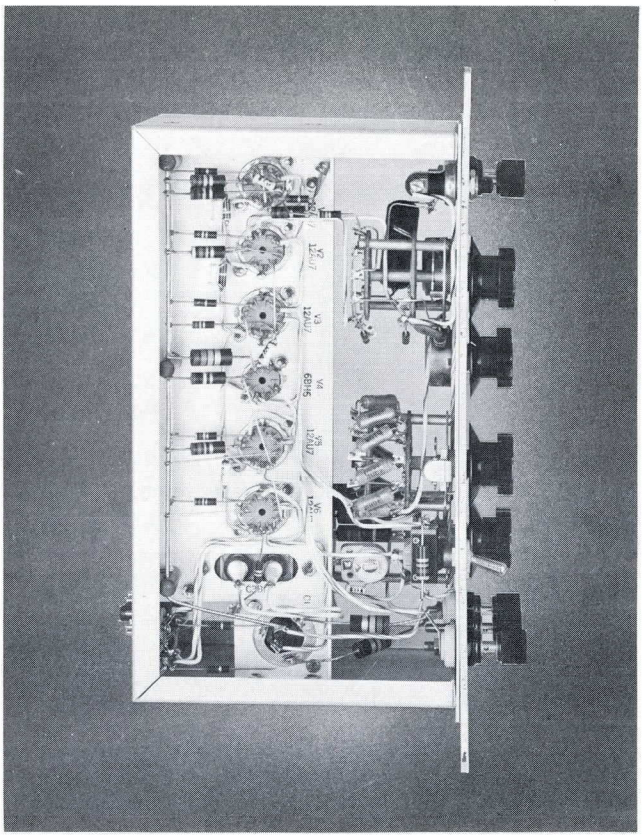
The **Type 162** is useful for initiating chains of events electrically, and for controlling the duration of their occurrence and their repetition rate. When generating waveforms recurrently the instrument provides an unusually stable repetition rate. The **Type 162** is specifically designed to operate in conjunction with TEKTRONIX **Type 161 Pulse Generators.**

CHARACTERISTICS

Output Waveform — Positive pulse. Positive gate. Negative-going sawtooth.

Pulse Characteristics — Amplitude, 50 volts positive from ground. Duration, 10 μsec to 0.2 sec. Risetime, 1 μsec, approximately, minimum. Repetition rate, 0.1 cps to 10 kc for recurrent operation.

SPECIAL WAVEFORM GENERATORS



Gate Characteristics — Amplitude, 50 volts positive from ground. Duration, 100 μsec to 10 sec. Repetition rate, 0.1 cps to 10 kc for recurrent operation.

Sawtooth Characteristics — Amplitude decreases uniformly with time from positive 150 volts to positive 20 volts. Duration, 100 μsec to 10 sec. Repetition rate, 0.1 cps to 10 kc for recurrent operation.

Output Impedance — Approximately 1000 ohms for all outputs.

Triggering Means — Externally derived electrical pulse or gate. Front-panel pushbutton or switch.

Triggering Input Impedance — High impedance, consisting of control grid with 1-megohm grid return resistor.

Trigger Sensitivity — Positive pulse, 3 volts peak or greater with risetime 5 milliseconds or less. Sine-wave, 2 volts rms, frequency between 5 cps and 50 kc. At frequencies below 5 cps, the product of rms voltage times frequency must exceed 10.

Gate Sensitivity — Three volts.

Construction — Aluminum alloy.

Finish — Buffed photo-etched metal panel, etched metal chassis.

Dimensions — 4 1/8" wide, 12 1/4" high, 7 1/2" deep.

Weight — 5 pounds.

Power Requirements — 225 volts DC positive at 28 ma. 150 volts DC positive at 1 ma. 170 volts DC negative at 1.5 ma. 6.3 volts AC at 1.7 amps.

VACUUM TUBE COMPLEMENT

Schmitt trigger circuit		12AU7
Trigger amplifier (operating mode selection)	½	12AU7
Multivibrator	½	12AU7
Multivibrator	½	12AU7
Pulse and gate shaping amplifier	½	12AU7
Phantastron		6BH6
Pulse and gate amplifier	½	12AU7
Phantastron plate coupling cathode follower, sawtooth out	½	12AU7
Pulse and gate output cathode follower	½	12AU7
Phantastron plate catching diode	½	12AU7

Type 160 Power Supply — $110

Type 161 Pulse Generator — $95

Type 162 Waveform Generator — $95

MOUNTING FRAME adapts Type 160 Series to rack mounting. Holds four waveform generators — or two waveform generators and one power supply.

Type FA 160 Mounting Frame — $5

TYPE 163 PULSE GENERATOR

N E W I N S T R U M E N T

Fast-Rise Pulse Generator

Output Waveforms
Variable-amplitude positive pulse.
Fixed-amplitude positive gate.

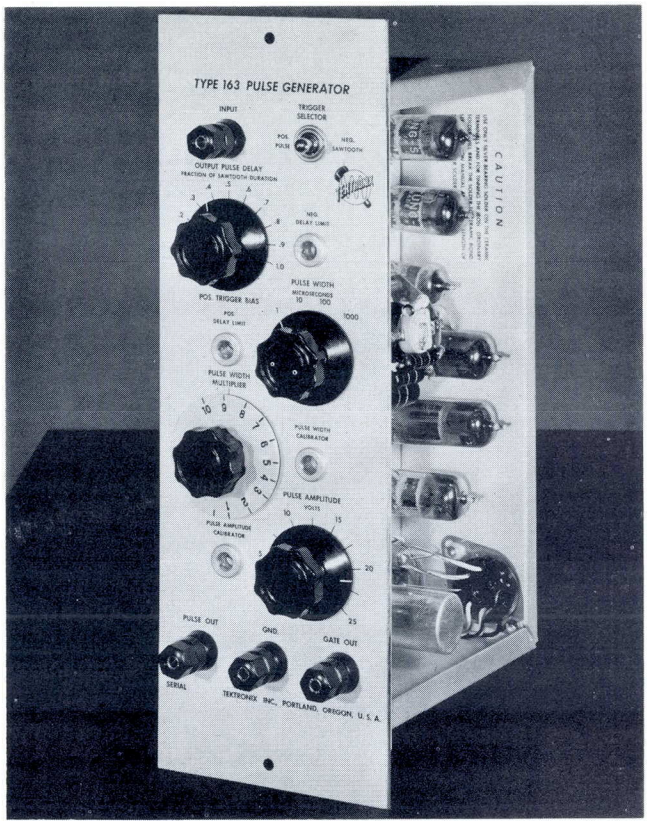
Output Characteristics
Risetime—less than 0.2 μsec (without load capacitance).
Decay Time—0.2 μsec (without load capacitance).
Overshoot—can be adjusted to zero.
Duration—calibrated, continuously variable, 1 μsec to 10,000 μsec.
Delay—calibrated, continuously variable, 0 to 100% of triggering sawtooth duration.

Amplitude
Pulse—calibrated, continuously variable, 0 to 25 v, peak to peak.
Gate—fixed, 25 v, peak to peak.

Cathode-Follower Output
Pulse—from arm of variable cathode resistor.
Gate—from top of same resistor.

Trigger Requirements
Positive pulse, 2 v peak to peak minimum.
Negative-going sawtooth; must include dc bias sufficient to keep voltage positive.

Power Requirements
−170 v at 26 ma.
+225 v at 35 to 45 ma (minimum to maximum pulse duty cycle).
6.3 v ac at 3.6 amp.



GENERAL DESCRIPTION

The Tektronix Type 163 Pulse Generator is designed to supply rectangular pulses of less than 0.2 μsec risetime when the required trigger voltage is received from an external source. A Tektronix Type 162 Waveform Generator is an excellent source for either the negative-going sawtooth or positive pulse necessary to trigger the Type 163.

When triggered by a sawtooth voltage the time of occurrence of the output pulse and gate can be adjusted to any point throughout the duration of the sawtooth. Output delay is indicated as a fraction of the triggering sawtooth duration by a calibrated control. Pulse and gate width in microseconds and pulse amplitude in volts may be read directly from calibrated controls.

The Type 163 can be operated up to 50% duty cycle at the minimum time setting on any range. Correspondingly higher duty cycles are obtained at higher multiplier control settings. The maximum repetition rate is 500 kc when a pulse of 1-μsec duration is generated.

Voltages necessary to operate the Type 163 may be obtained from a Tektronix Type 160 Power Supply. As many as three Type 163 units can be powered by a single Type 160 unit.

VACUUM TUBE COMPLEMENT

Comparator and pulse amplifier		6U8
Regenerative trigger amplifier		6U8
Disconnect diode and charge diode		6AL5
Monostable multivibrator	2	12BY7
Output Cathode follower		6BQ7

OTHER CHARACTERISTICS

Mounting—adapted to rack mounting by the Tektronix Type FA160 Mounting Frame.
Construction—aluminum alloy.
Finish—photo-etched anodized panel, etched chassis.
Dimensions—4⅛″ wide, 12¼″ high, 7½″ deep.
Weight—5 pounds.

Price—$95 f.o.b. Portland (Beaverton), Oregon.
Includes the following: 1—Type 163 Pulse Generator
1—10″ Connecting Cable
1—Set mounting screws and cup washers
1—Instruction Manual

Currently Available Extras

Tropicalization	$12.00

Recommended Additional Accessories

Type FA160 Mounting Frame	$ 5.00
Type FA160 Blank Panel, mounting screws and washers	6.50
Extra Instruction Manual	1.50

Tektronix, Inc.