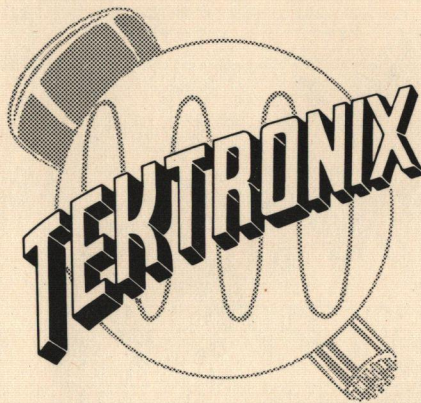


PULSE GENERATOR TYPE 163

SERIAL NUMBER 1361

INSTRUCTION MANUAL

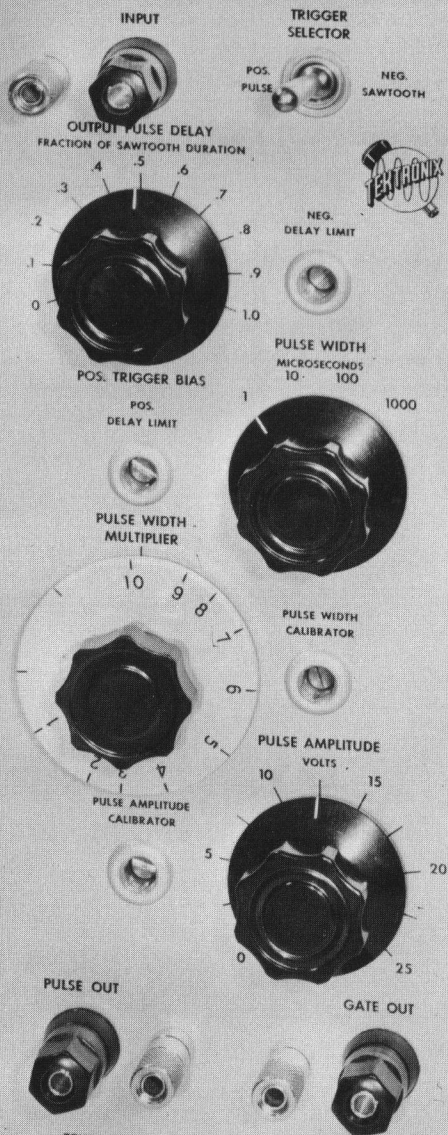


MANUFACTURERS OF CATHODE-RAY AND VIDEO TEST INSTRUMENTS

Sunset Highway and Barnes Road • P. O. Box 831 • Portland 7, Oregon, U. S. A.

Phone: CYpress 2-2611 • Cables: Tektronix

TYPE 163
PULSE GENERATOR
SERIAL



TEKTRONIX, INC., PORTLAND, OREGON, U.S.A.

GENERAL DESCRIPTION

The TEKTRONIX Type 163 Pulse Generator is designed to supply rectangular output pulses of adjustable duration and amplitude when the required trigger voltage is received from an external source.

Two types of triggering waveforms can trigger the Type 163 Pulse Generator, a negative-going sawtooth or a positive pulse. One output pulse is generated for each input pulse or for each cycle of the input sawtooth.

The gate output pulse is taken from the cathode of a cathode follower and the adjustable pulse is taken from a potentiometer comprising the cathode resistor of this cathode follower. The duration of the adjustable pulse and the gate pulse are therefore the same.

The time of occurrence of the output pulse and gate can be adjusted to any point throughout the duration of the triggering sawtooth.

Characteristics

Output Waveform

Positive gate, positive pulse.

Positive Gate Characteristics

Amplitude; fixed, 25 volts, peak to peak.

Duration; 1 μ sec to 10,000 μ sec, continuously adjustable.

Risetime; 0.2 μ sec (without load capacitance).

Decay Time; 0.2 to 0.5 μ sec.

Overshoot; can be adjusted to zero.

Delay; 0 to 100 per cent of sawtooth duration.

Positive Pulse Characteristics

Amplitude; continuously adjustable between 0 and 25 volts, peak to peak. Other characteristics, same as gate.

Output Impedance

Gate, 100 ohms.

Pulse, 500 ohms (varies with pulse-amplitude control setting). Minimum load resistance 3.5 k.

Trigger Requirements

Positive pulse; 2 volts peak to peak, minimum.

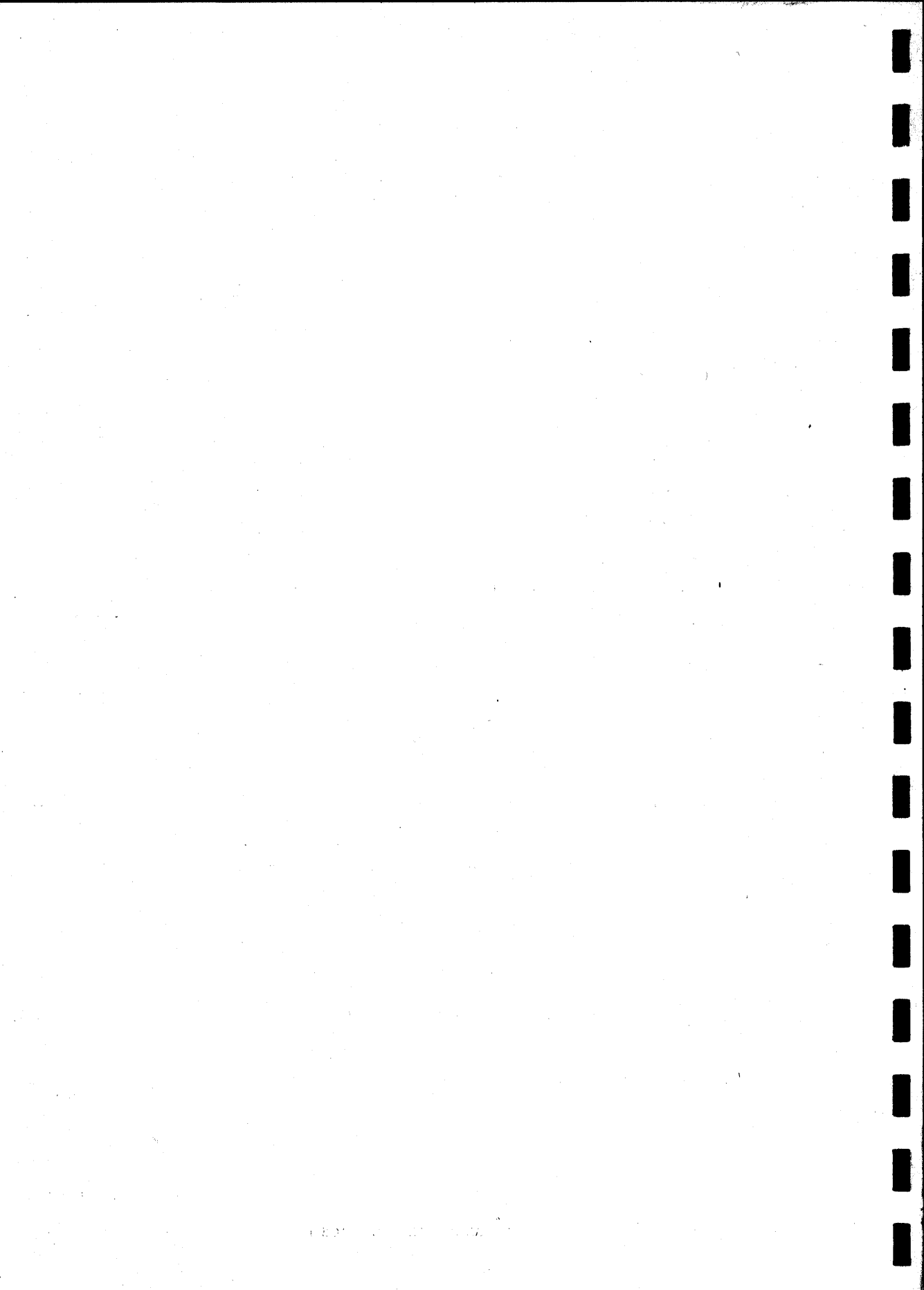
Negative-going sawtooth; Must include dc bias sufficient to keep voltage positive.

Power Requirements

—170 volts at 26 ma.

+225 volts at 35 to 45 ma (minimum to maximum pulse duty cycle).

Five Type 163 units can be operated at once from a Type 160A Power Supply.



OPERATING INSTRUCTIONS

The TEKTRONIX Type 163 Pulse Generator can be operated in any normal indoor location, or in the open if it is protected from moisture.

The instrument should be installed or operated in such a location that adequate ventilation can take place, so that unduly high internal temperatures will not occur.

Placing the Instrument in Operation for the First Time

Power for the Type 163 Pulse Generator can be furnished by the TEKTRONIX Type 160A Power Supply, or by any well-regulated supply capable of furnishing the required voltages and currents.

If the TEKTRONIX Type 160A Power Supply is used, install the interunit octal-plug power cable. No particular precautions are required before power is applied to the unit. Five Type 163 units can be operated at once from a Type 160A Power Supply.

The Type 163 must be triggered from an external source with a trigger waveform of the proper characteristics. The TEKTRONIX Type 162 Waveform Generator will furnish both the required pulse and sawtooth waveforms. The following is a list of convenient settings of controls for observing the operation. Set TRIGGER SELECTOR switch to POS. PULSE position,

POS. TRIGGER BIAS to 0.6, PULSE WIDTH to 1000 microseconds, PULSE WIDTH MULTIPLIER to 1, PULSE AMPLITUDE to 20. Connect a step voltage which has a peak of at least six volts to the INPUT terminal and observe the output at the PULSE OUT terminal using an oscilloscope such as TEKTRONIX Type 532. Set the sweep time of the oscilloscope at approximately 1 millisecond per centimeter, and a pulse will appear approximately 1 centimeter long with the foregoing settings.

Methods of Triggering the Type 163 Pulse Generator

Two triggering waveforms may be used: a positive pulse or a negative-going positive sawtooth. The positive pulse requirements are not strict. Any positive peak value above 2 volts will consistently trigger a pulse. The maximum peak voltage should not exceed about 250 volts.

The negative-going sawtooth must have a dc component such that it does not go below about 20 volts positive at any part of the cycle. The maximum positive excursion of the sawtooth should not exceed about 200 volts. The Type 162 Waveform Generator will furnish a suitable sawtooth triggering waveform. See "Maintenance" for instructions for calibrating the OUTPUT PULSE DELAY dial.

Functions of Front-Panel Controls and Connectors

INPUT Connector to TRIGGER SELECTOR switch for connecting external trigger source.

TRIGGER SELECTOR Two-position toggle switch to accommodate input circuit to POS. PULSE input or NEG. SAWTOOTH input.

OUTPUT PULSE DELAY Variable potentiometer to adjust comparison voltage in voltage-comparator circuit to compare with sawtooth triggering waveform.

POS. TRIGGER BIAS Same variable potentiometer as above, adjusts operating bias of pulse amplifier for most satisfactory triggering.

NEG. DELAY LIMIT Screwdriver-adjustable resistor in series with negative end of OUTPUT PULSE DELAY potentiometer, for adjusting low-voltage triggering level of voltage-comparator circuit to accommodate scale calibrations to various sawtooth amplitudes.

POS. DELAY LIMIT Screwdriver-adjustable resistor in series with positive end of OUTPUT PULSE DELAY potentiometer, for adjusting low-voltage triggering level of voltage-comparator circuit to accommodate scale calibrations to various sawtooth amplitudes.

PULSE WIDTH Four-position switch selects value of coupling capacitor in pulse-generating multivibrator, determines discharge time in conjunction with PULSE WIDTH MULTIPLIER variable resistor, and thereby determines pulse width.

PULSE WIDTH MULTIPLIER

Continuously-variable resistor in coupling circuit of pulse-forming multivibrator, determines discharge time in conjunction with PULSE WIDTH selected capacitor, thereby determines pulse width.

PULSE WIDTH CALIBRATOR

Screwdriver adjustable voltage-pickoff potentiometer, adjusts negative bias on pulse-generator multivibrator to accommodate PULSE WIDTH calibrations to characteristics of multivibrator tube. May require readjustment when multivibrator tube is replaced.

PULSE AMPLITUDE CALIBRATOR

Screwdriver-adjustable potentiometer which adjusts the bias on the output cathode follower to accommodate PULSE AMPLITUDE calibrations to characteristics of cathode-follower tube.

PULSE AMPLITUDE

Voltage-pickoff variable potentiometer with contact arm connected to PULSE OUT terminal, determines percentage of developed pulse that is made available to output terminal. Calibrated in volts.

PULSE OUT

Binding post connected to arm of PULSE AMPLITUDE potentiometer.

GND

Binding post connected to metal chassis of instrument.

GATE OUT

Binding post to cathode-follower gate amplifier.



CIRCUIT DESCRIPTION

The basic waveform generator of the TEK-TRONIX Type 163 Pulse Generator is a monostable, or "one kick" multivibrator, triggered by sharp pulses from a regenerative trigger amplifier. A voltage-comparator circuit permits triggers to be generated at any point on an input sawtooth voltage to provide adjustable delay. An output cathode follower provides low output impedance.

BLOCK DIAGRAM

The Block Diagram shows the INPUT switch in the position to accept sawtooth triggering pulses.

The sawtooth-comparator circuit compares the input sawtooth with an adjustable comparison voltage, and initiates a voltage step when the two are equal.

The output step voltage from the comparator is formed into a sharp trigger of the desired amplitude regardless of the size or slope of the triggering pulse by means of the regenerative trigger amplifier. The regenerated negative pulse is coupled through the disconnect diode to the plate of the multivibrator.

The negative pulse into the multivibrator causes it to flop from its stable state to its unstable state. The period of time the multivibrator remains in its unstable state determines the width of the output pulse. This period depends on the size of the switched capacitor and the size of variable resistors through which the capacitor discharges.

The charging diode speeds the transition period of the multivibrator back to the stable state at the conclusion of the unstable period.

The cathode follower reduces the output impedance to reduce effects of the external load characteristics on the pulse shape.

When the INPUT selector switch is in the POSITIVE PULSE position, the operation is the same in all circuits except the input tube, which in this switch position becomes a simple amplifier.

INPUT SELECTOR SWITCH

The input selector switch, SW10, connects the grid of V10B to the INPUT terminal in NEG. SAWTOOTH position, and in the POS. PULSE position connects the grid of V10A to the INPUT terminal through a capacitor, while connecting the unused grid of V10B to a positive voltage on voltage divider R10, R11, connected between +225 volts and -170 volts.

SAWTOOTH COMPARATOR

The grid voltage of V10A is determined by the setting of R21, which is part of a voltage divider consisting of R20, R21, and R22. When the required sawtooth voltage at the grid of

V10B is above this voltage, the common cathode voltage closely follows V10B grid as it drops and is more positive than V10A grid, so that V10A is cut off. When the common cathode voltage approaches V10A grid, current suddenly begins to flow in V10A and a negative voltage step appears at V10A plate. Between its two voltage limits, potentiometer R21 can change the bias by more than 100 volts, and can therefore cause the voltage step to occur at any point of the sawtooth within this range.

REGENERATIVE TRIGGER AMPLIFIER

The negative step is transmitted to the grid of V11B through frequency-compensated voltage divider C23, R23, to the grid of V11B. C23 is the compensating capacitor which transmits the higher frequency components of the negative step voltage.

V11 is a bistable regenerative trigger amplifier. In the quiescent state before receipt of the negative step voltage V11B is conducting and V11A is cut off because the common cathode connection is at a higher voltage than the grid of V11A. When the negative step arrives at the grid of V11B the common cathode voltage drops while V11B plate rises, and the grid of V11A, which rises with the plate of V11B, approaches the falling cathode until conduction occurs in V11A. As soon as conduction does occur in V11A a rapid transition takes place, with the current transferring from the B section to the A section, and the attendant rise of B-section plate drives the A-section grid farther positive.

A second stable state is reached when V11B no longer conducts at all and the A-section plate remains down. This new stable state continues as long as the plate of V10A is down low enough to hold off plate current from V11B, regardless of how much farther it falls below this point. The change in plate voltage of V11A is thus determined only by the circuit constants of V11A, and a uniform negative step voltage is obtained regardless of the size or speed of the triggering voltage.

MULTIVIBRATOR

V13 and V14 comprise a monostable multivibrator. In the stable state V14 is conducting with its grid at ground voltage and its cathode slightly above ground. The grid of V13 is held somewhat negative by the setting of potentiometer R42.

The negative pulse from regenerative pulse amplifier V11 coupled through disconnect diode V12A to the plate of the multivibrator forces the plate of V13 and the grid of V14 in the negative directions. As the grid of V14 drops, the common-cathode voltage drops below the grid voltage of V13, thereby causing plate current to flow and further reducing V13 plate. Since the reduction



of current in V14 and increase in current in V13 is regenerative, the transition takes place very rapidly.

In the quiescent state, one end of C54 is at ground potential since there is no current flowing through R50 and R51. The other end of C54 is at +225 volts since there is no current flowing in R40, and there is thus a 225-volt charge on C54.

When the multivibrator is triggered, the plate of V13 drops so that the end of C54 formerly grounded is driven negative carrying the grid of V14 with it past cutoff well below ground, and C54 begins to discharge through R50 and R51. The length of time required for this end of C54 to rise to ground potential depends on the size of R50 and R51, through which the discharge current flows, and on the size of C54. R51 is adjustable by means of a front-panel control labeled PULSE WIDTH MULTIPLIER, and C54 is one of four switched capacitors, C50-C51, C52, C53 and C54, so that the discharge time can be adjusted over a 10,000-to-1 range by selecting capacitors and adjusting the resistor.

As soon as the selected capacitor has discharged until the grid of V14 is again near its cathode, current again flows in V14, the cathode rises because of increased cathode current, the plate of V13 rises carrying V14 grid with it and further increasing current through V14 until the original stable state is resumed with V13 cut off.

In the stable state while V14 is conducting its plate rests in the vicinity of +140 volts because of plate current flowing through R48. During the period while V14 is cut off its plate rises to +225 volts and therefore a square-topped positive pulse of about 85 volts peak-to-peak amplitude is produced.

OUTPUT CATHODE FOLLOWER

The positive pulse is dc coupled to the grid of output cathode-follower V15 through compensated voltage-divider R62, R63 which is returned to an adjustable negative voltage. This divider places the grid of V15 below cutoff during the stable period of multivibrator V14, and raises it into conduction when V14 plate rises during cut-off to +225 volts. The amount of voltage division is designed by selection of R62 and R63 to place the grid of V15 near 25 volts positive when V14 plate is cut off. The voltage to which the negative end of the voltage divider is returned can be adjusted by means of R61, labeled PULSE

AMP CAL so that the peak of the output pulse at the cathode of V15 is 25 volts positive. The output impedance at the gate terminal is approximately 100 ohms and the output impedance at the pulse terminal varies between about 500 ohms and zero, depending on the PULSE AMPLITUDE potentiometer setting. The maximum impedance occurs at about the 13-volt setting.

DISCONNECT DIODE

V12A, the disconnect diode between the regenerative trigger amplifier and the multivibrator is provided to disconnect the multivibrator from the trigger amplifier after the multivibrator has been triggered to its unstable state, so that subsequent trigger signals will not affect the multivibrator until it has again reverted to its stable state. In the stable state when the plate of both V11A and V13 are cut off and rest at +225 volts, a negative pulse at the cathode of the disconnect diode will tend to pull the plate down with it, and thus transmit the pulse to the multivibrator. After the multivibrator is triggered the plate of V13 drops well below the plate of V11A and trigger-size variations of V12A cathode have no effect on V12A plate.

CHARGING DIODE

Charging diode V12B from the grid of multivibrator V14 to ground provides a low-resistance charging path to ground for C53, so that V13 plate can rise more rapidly when the multivibrator returns to its stable state.

POWER CONNECTOR

The octal plug and socket shown on the upper left of the circuit diagram consist of male and female chassis-mounted connectors to fit the interunit cables supplied with the instrument to connect the Type 163 to a Type 160A Power Supply. The female connector permits additional Type 161, Type 162 or Type 163 units to be operated from the same Type 160 Power Supply. R6 in the wiring between power connectors connects unregulated 300 volts to the regulated 225-volt bus to increase the available current for the Type 163.



CIRCUIT DESCRIPTION

The basic waveform generator of the TEK-TRONIX Type 163 Pulse Generator is a monostable, or "one kick" multivibrator, triggered by sharp pulses from a regenerative trigger amplifier. A voltage-comparator circuit permits triggers to be generated at any point on an input sawtooth voltage to provide adjustable delay. An output cathode follower provides low output impedance.

BLOCK DIAGRAM

The Block Diagram shows the INPUT switch in the position to accept sawtooth triggering pulses.

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The negative pulse into the multivibrator causes it to flop from its stable state to its unstable state. The period of time the multivibrator remains in its unstable state determines the width of the output pulse. This period depends on the size of the switched capacitor and the size of variable resistors through which the capacitor discharges.

The charging diode speeds the transition period of the multivibrator back to the stable state at the conclusion of the unstable period.

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V10B is above this voltage, the common cathode voltage closely follows V10B grid as it drops and is more positive than V10A grid, so that V10A is cut off. When the common cathode voltage approaches V10A grid, current suddenly begins to flow in V10A and a negative voltage step appears at V10A plate. Between its two voltage limits, potentiometer R21 can change the bias by more than 100 volts, and can therefore cause the voltage step to occur at any point of the sawtooth within this range.

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The negative step is transmitted to the grid of V11B through frequency-compensated voltage divider C23, R23, to the grid of V11B. C23 is the compensating capacitor which transmits the higher frequency components of the negative step voltage.

V11 is a bistable regenerative trigger amplifier. In the quiescent state before receipt of the negative step voltage V11B is conducting and V11A is cut off because the common cathode connection is at a higher voltage than the grid of V11A. When the negative step arrives at the grid of V11B the common cathode voltage drops while V11B plate rises, and the grid of V11A, which rises with the plate of V11B, approaches the falling cathode until conduction occurs in V11A. As soon as conduction does occur in V11A a rapid transition takes place, with the current transferring from the B section to the A section, and the attendant rise of B-section plate drives the A-section grid farther positive.

A second stable state is reached when V11B no longer conducts at all and the A-section plate remains down. This new stable state continues as long as the plate of V10A is down low enough to hold off plate current from V11B, regardless of how much farther it falls below this point. The change in plate voltage of V11A is thus determined only by the circuit constants of V11A, and a uniform negative step voltage is obtained regardless of the size or speed of the triggering voltage.

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The negative pulse from regenerative pulse amplifier V11 coupled through disconnect diode V12A to the plate of the multivibrator forces the plate of V13 and the grid of V14 in the negative directions. As the grid of V14 drops, the common-cathode voltage drops below the grid voltage of V13, thereby causing plate current to flow and further reducing V13 plate. Since the reduction



of current in V14 and increase in current in V13 is regenerative, the transition takes place very rapidly.

In the quiescent state, one end of C54 is at ground potential since there is no current flowing through R50 and R51. The other end of C54 is at +225 volts since there is no current flowing in R40, and there is thus a 225-volt charge on C54.

When the multivibrator is triggered, the plate of V13 drops so that the end of C54 formerly grounded is driven negative carrying the grid of V14 with it past cutoff well below ground, and C54 begins to discharge through R50 and R51. The length of time required for this end of C54 to rise to ground potential depends on the size of R50 and R51, through which the discharge current flows, and on the size of C54. R51 is adjustable by means of a front-panel control labeled PULSE WIDTH MULTIPLIER, and C54 is one of four switched capacitors, C50-C51, C52, C53 and C54, so that the discharge time can be adjusted over a 10,000-to-1 range by selecting capacitors and adjusting the resistor.

As soon as the selected capacitor has discharged until the grid of V14 is again near its cathode, current again flows in V14, the cathode rises because of increased cathode current, the plate of V13 rises carrying V14 grid with it and further increasing current through V14 until the original stable state is resumed with V13 cut off.

In the stable state while V14 is conducting its plate rests in the vicinity of +140 volts because of plate current flowing through R48. During the period while V14 is cut off its plate rises to +225 volts and therefore a square-topped positive pulse of about 85 volts peak-to-peak amplitude is produced.

OUTPUT CATHODE FOLLOWER

The positive pulse is dc coupled to the grid of output cathode-follower V15 through compensated voltage-divider R62, R63 which is returned to an adjustable negative voltage. This divider places the grid of V15 below cutoff during the stable period of multivibrator V14, and raises it into conduction when V14 plate rises during cut-off to +225 volts. The amount of voltage division is designed by selection of R62 and R63 to place the grid of V15 near 25 volts positive when V14 plate is cut off. The voltage to which the negative end of the voltage divider is returned can be adjusted by means of R61, labeled PULSE

AMP CAL so that the peak of the output pulse at the cathode of V15 is 25 volts positive. The output impedance at the gate terminal is approximately 100 ohms and the output impedance at the pulse terminal varies between about 500 ohms and zero, depending on the PULSE AMPLITUDE potentiometer setting. The maximum impedance occurs at about the 13-volt setting.

DISCONNECT DIODE

V12A, the disconnect diode between the regenerative trigger amplifier and the multivibrator is provided to disconnect the multivibrator from the trigger amplifier after the multivibrator has been triggered to its unstable state, so that subsequent trigger signals will not affect the multivibrator until it has again reverted to its stable state. In the stable state when the plate of both V11A and V13 are cut off and rest at +225 volts, a negative pulse at the cathode of the disconnect diode will tend to pull the plate down with it, and thus transmit the pulse to the multivibrator. After the multivibrator is triggered the plate of V13 drops well below the plate of V11A and trigger-size variations of V12A cathode have no effect on V12A plate.

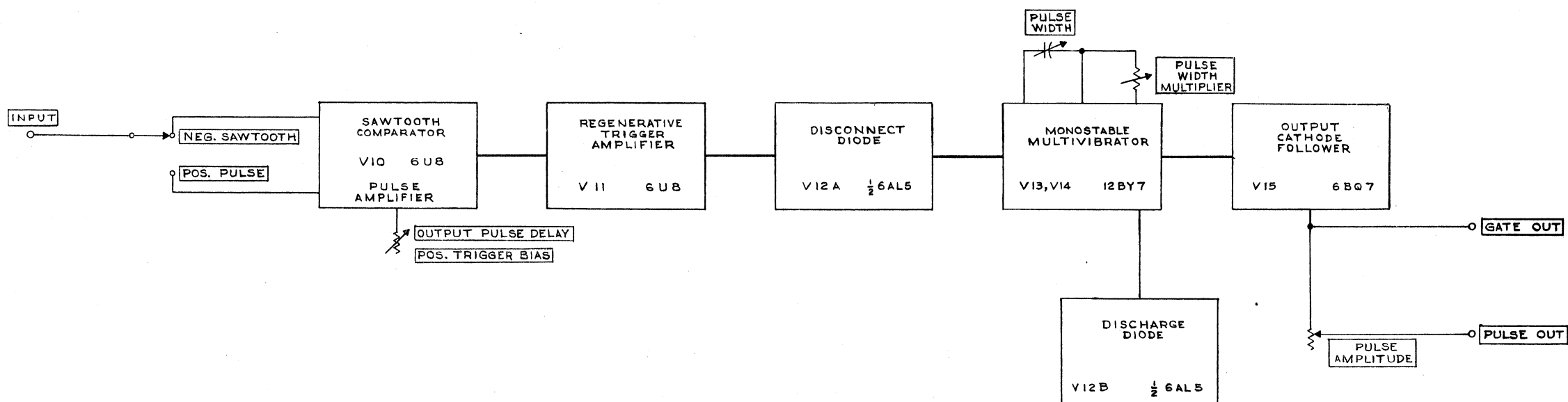
CHARGING DIODE

Charging diode V12B from the grid of multivibrator V14 to ground provides a low-resistance charging path to ground for C53, so that V13 plate can rise more rapidly when the multivibrator returns to its stable state.

POWER CONNECTOR

The octal plug and socket shown on the upper left of the circuit diagram consist of male and female chassis-mounted connectors to fit the interunit cables supplied with the instrument to connect the Type 163 to a Type 160A Power Supply. The female connector permits additional Type 161, Type 162 or Type 163 units to be operated from the same Type 160 Power Supply. R6 in the wiring between power connectors connects unregulated 300 volts to the regulated 225-volt bus to increase the available current for the Type 163.





TEKTRONIX TYPE 163 PULSE GENERATOR

BLOCK DIAGRAM

ABBREVIATIONS

Cer.	ceramic	m	milli or 10 ⁻³
Comp.	composition	Ω	ohm
EMC	electrolytic, metal cased	Poly.	polystyrene
EMT	electrolytic, metal tubular	Prec.	precision
f	farad	PT	paper tubular
h	henry	Tub.	tubular
k	kilohm or 10 ³ ohms	v	working volts dc
meg	megohm or 10 ⁶ ohms	Var.	variable
μ	micro or 10 ⁻⁶	w	watt
μμ	micromicro or 10 ⁻¹²	WW	wire wound
GMV		guaranteed minimum value	

PULSE GENERATOR

Capacitors

C5	2 x15 μf	EMC	Fixed	350 v	—20% to +50%	290034
C11	.001 μμf	Cer.	Fixed	500 v	GMV	283000
C15	.01 μf	PT	Fixed	600 v	20%	285511
C23	12 μμf	Cer.	Fixed	500 v	10%	281506
C33	39 μμf	Cer.	Fixed	500 v	10%	281516
C42	.01 μf	PT	Fixed	400 v	20%	285510
C50	7-45 μμf	Cer.	Var	500 v		281012
C51	56 μμf	Cer.	Fixed	500 v	10%	281521
C52	.001 μf	Mica	Fixed	500 v	Timing Capacitors	} 295030
C53	.01 μf	PT	Fixed	400 v	Selected	
C54	.1 μf	PT	Fixed	400 v	See Text	
C63	1.5-7 μμf	Cer.	Var.	500 v		281006

Resistors

R5	10 Ω	½ w	Fixed	Comp.	10%	302100
R6	8 k	5 w	Fixed	WW	5%	308007
R10	180 k	½ w	Fixed	Comp.	10%	302184
R11	100 k	½ w	Fixed	Comp.	10%	302104
R13	47 Ω	½ w	Fixed	Comp.	10%	302470
R14	22 k	½ w	Fixed	Comp.	10%	302223
R15	470 k	½ w	Fixed	Comp.	10%	302474
R16	100 k	2 w	Fixed	Comp.	10%	306104
R20	100 k	2 w	Var.	Comp.	20%	POS. DELAY LIMIT 311026
R21	100 k	2 w	Var.	Comp.	20%	OUTPUT PULSE DELAY, 311026
						POS. TRIGGER BIAS.
R22	50 k	2 w	Var.	Comp.	20%	NEG. DELAY LIMIT 311023
R23	220 k	½ w	Fixed	Prec.	1%	309052
R24	500 k	½ w	Fixed	Prec.	1%	309003
R30	2.2 k	½ w	Fixed	Comp.	10%	302222
R31	8.2 k	2 w	Fixed	Comp.	10%	306822
R32	3.3 k	½ w	Fixed	Comp.	10%	302332
R33	220 k	½ w	Fixed	Prec.	1%	309052
R34	433 k	½ w	Fixed	Prec.	1%	309001
R40	2.7 k	2 w	Fixed	Comp.	10%	306272
R41	47 Ω	½ w	Fixed	Comp.	10%	302470
R42	100 k	2 w	Var.	Comp.	20%	PULSE WIDTH 311026
						CALIBRATOR
R43	470 k	½ w	Fixed	Comp.	10%	302474
R45	18 k	2 w	Fixed	Comp.	10%	306183
R46	39 k	1 w	Fixed	Comp.	10%	304393
R47	18 k	2 w	Fixed	Comp.	10%	306183

Resistors (Continued)

R48	8.2 k/2	4 w	Fixed	Comp.	10%	306822
R49	47 Ω	$\frac{1}{2}$ w	Fixed	Comp.	10%	302470
R50	Selected to match R51					312013
R51	100 k, Selected for linearity }					
R60	150 k	1 w	Fixed	Comp.	10%	304154
R61	20 k	2 w	Var.	Comp.	20% PULSE AMPLIFIER CALIBRATOR	311018
R62	700 k	$\frac{1}{2}$ w	Fixed	Prec.	1%	309008
R63	780 k	$\frac{1}{2}$ w	Fixed	Prec.	1%	309011
R64	47 Ω	$\frac{1}{2}$ w	Fixed	Comp.	10%	302470
R65	47 Ω	$\frac{1}{2}$ w	Fixed	Comp.	10%	302470
R66	2 k	2 w	Var.	Comp.	20% PULSE AMPLITUDE	311008

Switches

SW10	Double Pole	Double Throw	Toggle	TRIGGER SELECTOR	260014
SW20	2-wafer	4-position	Rotary	PULSE WIDTH	260030

Vacuum Tubes

V10	6U8	Sawtooth Comparator	154033
V11	6U8	Regenerative Trigger Amplifier	154033
V12A	$\frac{1}{2}$ 6AL5	Disconnect Diode	154016
V12B	$\frac{1}{2}$ 6AL5	Discharge Diode	
V13	12BY7	Multivibrator	154047
V14	12BY7	Multivibrator	154047
V15	6BQ7A	Cathode Follower Output Amplifier	154028



C

SCHEMATIC DIAGRAM

ABBREVIATIONS USED IN OUR PARTS LISTS

Cer.	ceramic	m	milli
Comp.	composition	Ω	ohm
EMC	electrolytic, metal cased	Poly.	polystyrene
EMT	electrolytic, metal tubular	Prec.	precision
f	farad	PT	paper tubular
h	henry	Tub.	tubular
k	thousands of ohms	v	working volts dc
meg	megohms	Var.	variable
μ	micro	w	watt
$\mu\mu$	micromicro	WW	wire wound
	GMV		guaranteed minimum value

ABBREVIATIONS USED IN OUR CIRCUIT DIAGRAMS

Resistance values are in ohms. The symbol k stands for thousands. A resistor marked 2.7 k has a resistance of 2,700 ohms. The symbol M stands for million. For example, a resistor marked 5.6 M has a resistance of 5.6 megohms.

Unless otherwise specified on the circuit diagram, capacitance values marked with the number 1 and numbers greater than 1 are in $\mu\mu\text{f}$. For example, a capacitor marked 3.3 would have a capacitance of 3.3 micromicrofarads. Capacitance values marked with a number less than 1 are in μf . For example, a capacitor marked .47 would have a capacitance of .47 microfarads.

Inductance values marked in mh are in millihenrys. Inductance values marked in μh are in microhenrys.

Your instrument **WARRANTY** appears on the reverse side of this sheet.

SERIAL NO. 1361

IMPORTANT

Include the INSTRUMENT TYPE and the above SERIAL NUMBER in any correspondence regarding this instrument. The above serial number must match the instrument serial number if parts are to be ordered from the manual. Your help in this will enable us to answer your questions or fill your order with the least delay possible.



WARRANTY

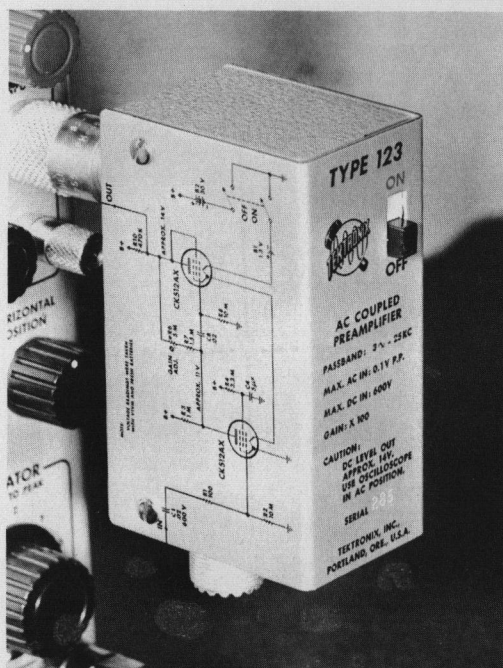
All Tektronix instruments are fully guaranteed against defective materials and workmanship for one year. Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them pre-paid (via air if requested) as soon as possible, usually within 24 hours.

Tektronix transformers, manufactured in our own plant, carry an indefinite warranty.

All price revision and design modification privileges reserved.

ACCESSORIES

Operational Accessories TYPE 123 PREAMPLIFIER



Compact
3 5/8" high, 1 1/2" wide, 2-3/16" deep.

Weights only 10 ounces.

Voltage Gain
Accurately set at 100 times.

Passband
Within 2% from 15 cycles to 6 kc.
Within 3 db from 3 cycles to 25 kc.

Maximum Input Signal
0.1 v peak-to-peak.

Hum-Free Low-Level Amplification
Powered by miniature batteries.

GENERAL DESCRIPTION

The Tektronix Type 123 Preamplifier is a compact, light-weight, battery-operated amplifier for use in applications where a gain of 100 without additional hum signal is desired. Passband is 3 cycles to 25 kc. Etched

wiring, miniature tubes and small batteries are combined in a unit about the size of 2 king-size cigarette packages. Where reduced high-frequency response is permissible, ground-loop hum pickup can be virtually eliminated by mounting the Type 123 close to the circuit under observation. Coaxial connectors permit the Type 123 to be connected directly to an oscilloscope or other instrument, and at reduced high-frequency response, in a connecting cable, or even for use as a probe. Shock-mounted chassis reduces the effects of microphonics, shift, and drift.

Applications of the Type 123 are confined to the audio range; for example, observing hum levels, transducer pre-amplifier, and other low-level applications where a gain of 100 is desired.

CHARACTERISTICS

Voltage Gain—Gain is 100, adjustable with screw-driver calibration control.

Passband—Within 3 db from 3 cycles to 25 kc. Within 2% from 15 cycles to 6 kc.

Battery Powered—A small mercury cell supplies the filament voltage and a miniature 30 v battery is the source of plate voltage. Life of the mercury cell is approximately 100 hours. Low plate current, 75 microamps, assures plate-supply battery life of more than 100 hours.

Noise Level—The maximum noise level with the input grounded is less than 7.5 microvolts, rms.

Output Signal Level—DC level of output is approximately +15 v.

Maximum Input Signal—Maximum input signal for linear amplification is 0.1 v, peak-to-peak.

Input Impedance—10 megohms.

Effective Output Impedance—31 kilohms.

Vacuum Tube Complement—Two Type 512AX sub-miniature filament-type pentodes.

MECHANICAL SPECIFICATIONS

Construction—Aluminum-alloy cover and etched-wiring chassis.

Finish—Photo-etched anodized front panel.

Dimensions—3 5/8" high, 4 1/8" including coaxial connector; 1 1/2" wide; 2-3/16" deep, 3 3/4" including coaxial connector.

Weight—10 ounces.

Power Requirements—One 1.345 v mercury cell and one 30 v miniature battery, included with the instrument.

Price \$50

Includes: 1—Mercury cell
1—B battery

ACCESSORIES

Operational Accessories TYPE 124 TELEVISION ADAPTOR

Line Selection

Sync separator and delayed trigger circuitry permit triggering the oscilloscope at any selected line of a field.

Field Shift

Push button provides instant shift to corresponding line or lines in opposite field.

Gated Time Markers

Intensity markers of 1 μ sec, 0.1 μ sec, 0.05 μ sec and 0.005 H (200 per television line).

APPLICATIONS

The Type 124 adapts any triggered wide-band oscilloscope to the observation of the television composite video signal. Greatly increases the usefulness of the oscilloscope in television development and maintenance work.

GENERAL DESCRIPTION

The delayed-trigger output of the Type 124 is continuously variable from zero to 25 milliseconds after receipt of a vertical sync pulse. By adjusting the delay, an oscilloscope can be triggered at the start of any desired line in a field. Panel push button provides instant shift to opposite field. Triggering occurs at half the television vertical rate. Duration of the output pulse is less than 1 μ sec, and amplitude is 2 v positive. Triggering may be accomplished by the composite video signal of either polarity, 0.5 v minimum to 20 v maximum, peak to peak, or a 60-cycle sine wave.

The time-marker generator requires a positive gate of 20 v minimum to 50 v maximum, peak to peak. Markers are supplied for the duration of the gate. Time-marker intervals are 1 μ sec, 0.1 μ sec, 0.05 μ sec, and 0.005 H (200 per television line). Amplitude is continuously variable from zero to 30 v. Phase control permits positioning the markers on the trace.

To make use of the time-marker output of the Type 124, the oscilloscope should have a positive gate output and a CRT cathode terminal.

VACUUM TUBE COMPLEMENT

Trigger inverter and output CF	6BQ7A
Sync separator and dc restorer	12BZ7
Phantastron	6BH6
Trigger coupling diode	6AL5
Bistable multivibrator	6U8



Cathode-coupled amplifier	12BZ7
Bistable multivibrator	12BZ7
Time-marker oscillator	6AK5
Gating CF and pulse shaping amplifier	6BQ7A
Time-marker output amplifier	6BQ7A
Rectifier	6AX5
Rectifier	6X4
Regulator amplifiers	2 6AU6
Regulator series tubes	2 12B4
Voltage reference	OA2

MECHANICAL SPECIFICATIONS

Ventilation—forced-air cooling.

Mounting frame—provides secure mounting to the top of Tektronix 5" Oscilloscopes.

Connecting cables—the four connecting cables supplied with the Type 124 are designed for use with Tektronix Oscilloscope Types 511, 511A, 513, 514, and 514A. Cable extensions will be necessary in many cases when the Type 124 is used with other triggered wide-band oscilloscopes.

Size—6 $\frac{3}{4}$ " high, 12 $\frac{3}{4}$ " wide, 12 $\frac{1}{2}$ " deep.

Weight—21 lbs.

Construction—aluminum alloy.

Finish—photo-etched anodized panel, wrinkle-finished cabinet.

Power requirements—105-125 v or 210-250 v, 50 60 cycles, 120 watts.

Price \$29!

Includes: 1—FM124 Mounting frame (014003)
4—Connecting cables
1—Instruction manual

ACCESSORIES

Operational Accessories TYPE 126 POWER SUPPLY

Output Voltages

- + 300 v dc, unregulated.
- + 225 v dc, regulated, 45 ma maximum.
- + 150 v dc, regulated, 5 ma maximum.
- 170 v dc, regulated, 30 ma maximum.
- 6.3 v ac, unregulated, 4 amps maximum.

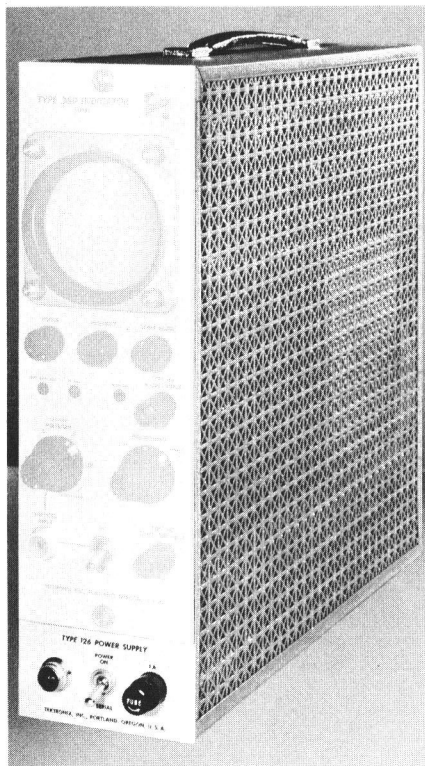
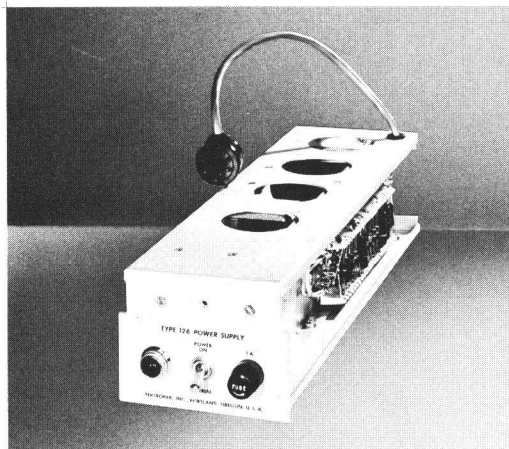
Small — Adds only 2½" in height to Type 360 Indicator.

Electronic Voltage Regulation

GENERAL DESCRIPTION

The Tektronix Type 126 Power Supply supplies the required voltages and currents necessary to power one Type 360 Indicator or any one of the Type 160-Series Waveform Generators. The Type 126 mounts beneath the unit to be powered, and includes a cabinet to house both the Type 126 and the powered unit.

A Type 126 Power Supply combined with a Type 360 Indicator makes a practical, compact slave unit for any Tektronix oscilloscope. (The oscilloscope has the necessary sweep sawtooth and unblanking pulse for the Type 360 Indicator available at front-panel connectors.)



VACUUM TUBE COMPLEMENT

Rectifiers	2	6BW4
Regulator amplifier		6AU6
Regulator amplifier and voltage regulator CF		6AN8
Series regulators	2	12B4
Voltage reference		5651

MECHANICAL SPECIFICATIONS

Construction — Aluminum alloy.
 Finish — Photo-etched anodized panel, blue wrinkle cabinet.
 Dimensions — 4⅛" wide, 15½" deep, cabinet height 14¾".
 Weight — 10½ pounds.
 Power Requirements — 105-125 or 210-250 v, 50-60 cycles, 50 watts.

Price **\$100**

Includes: 1—Instruction manual

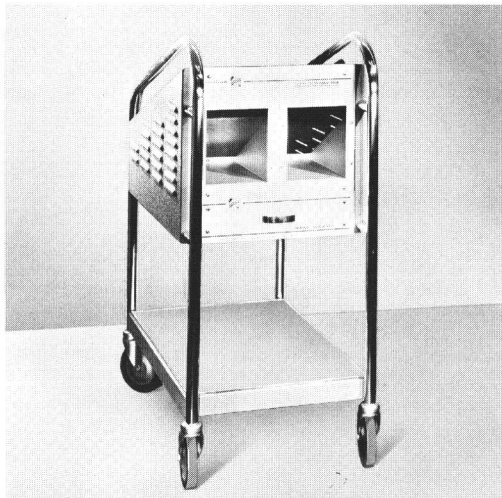
ACCESSORIES

Operational Accessories

SCOPE-MOBILE



The Tektronix Type 500 Scope-Mobile is a sturdy, mobile support for Tektronix 5" Oscilloscopes. Convenient observation of the crt face is achieved by a 20-degree backward tilt of the top surface. Auxiliary equipment can be mounted in the enclosed vented space behind the blank front panel. A drawer, felt-lined and operating on roller bearings, provides handy storage for probes, cables, manuals, etc. An open shelf, topped with tough linoleum, is located at the bottom. Power input and three convenience outlets are mounted at the rear. Total weight is 42 pounds. Dimensions are 18½" wide, 39" high and 30" deep.....\$97.50



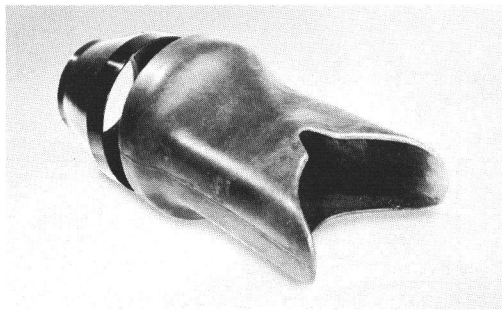
The Tektronix Type 500/53 Scope-Mobile is the Type 500 with a Type 53 Scope-Mobile front-panel installed. This front-panel has two supporting cradles to accommodate the Type 53 and 53/54 Plug-In Preamplifiers used in the Type 530 and Type 540-Series Oscilloscopes. In all other characteristics the Type 500/53 is identical to the Type 500.....108.00

Type 53 Scope-Mobile Panel — converts the Type 500 into a Type 500/53 Scope-Mobile by replacing the standard blank panel.....10.50

VIEWING HOODS



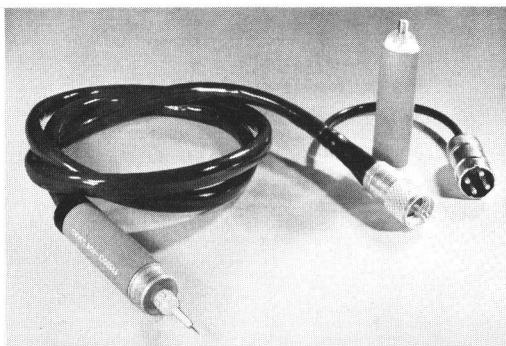
H510 Viewing Hood, for Tektronix 5" Oscilloscopes. Includes molded rubber eye-piece and aluminum light shield 4.50



H310 Viewing Hood, for Tektronix 3" Oscilloscopes. Includes molded rubber eye-piece and spun-aluminum light shield 4.50

ACCESSORIES

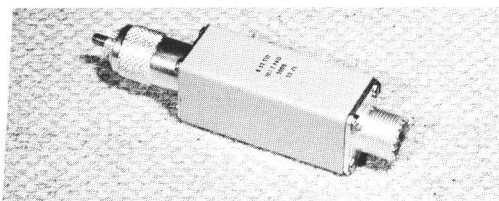
Operational Accessories



P500CF Cathode-Follower Probe—For use with Types 524D and 524AD Oscilloscopes. Presents low capacitance with minimum attenuation. Input impedance is 40 megohms paralleled by 4 μF , gain 0.8 to 0.85. Input to probe is ac-coupled, limiting its low-frequency response to 5 cycles. Amplitude distortion is less than 3% on unidirectional signals up to 5 volts. 10x attenuator head is included with probe, and should be used on signals exceeding a few volts to minimize amplitude distortion. With the attenuator head attached, the probe input impedance is approximately 10 megohms paralleled by 2 μF . Probe output level is 11 v positive, making it necessary to use the ac-coupled position of the oscilloscope AC-DC switch. Probe cable is 42" long. 64.00

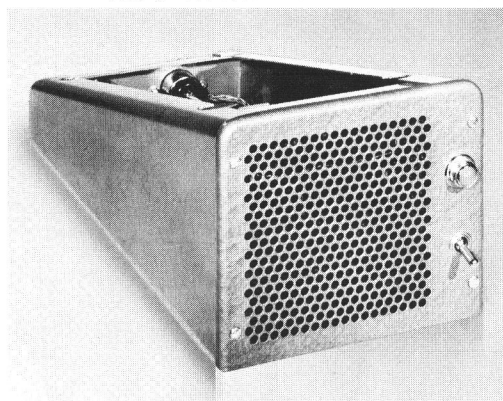
A modification kit is available to equip the Type 524D Oscilloscope with a front-panel probe-power connector. Modification Kit K524-1021A. 5.00

TERMINATIONS, PADS, ATTENUATORS



B52-R	52-ohm terminating resistor, 1.5 w. . .	8.50
B52-L5	52-ohm 'L' pad, 5 to 1 voltage ratio, 1.5 w	8.50
B52-L10	52-ohm 'L' pad, 10 to 1 voltage ratio, 1.5 w	8.50
B52-75L	Minimum-loss pad, 52 ohms to 75 ohms	11.50
B52-170L	Minimum-loss pad, 52 ohms to 170 ohms	11.50

B52-T10	52-ohm 'T' pad, 10 to 1 voltage ratio, 1.5 w	11.50
B75-R	75-ohm terminating resistor, 1.5 w. . .	8.50
011 023	75-ohm terminating resistor for Type 525, 0.5 w	4.00
B75-L5	75-ohm 'L' pad, 5 to 1 voltage ratio, 1.5 w	8.50
B75-L10	75-ohm 'L' pad, 10 to 1 voltage ratio, 1.5 w	8.50
B75-T10	75-ohm 'T' pad, 10 to 1 voltage ratio, 1.5 w	11.50
B93-R	93-ohm terminating resistor, 1.5 w. . .	8.50
B93-L5	93-ohm 'L' pad, 5 to 1 voltage ratio, 1.5 w	8.50
B93-L10	93-ohm 'L' pad, 10 to 1 voltage ratio, 1.5 w	8.50
B93-52L	Minimum-loss pad, 93 ohms to 52 ohms, 1.5 w.	11.50
B93-T10	93-ohm 'T' pad, 10 to 1 voltage ratio, 1.5 w	11.50
B170-R	170-ohm terminating resistor, 1.5 w. . .	8.50
B170-A	170-ohm π -attenuator, using 2% precision resistors, 1 to 64 db in 1 db steps, 0.25 w	45.00



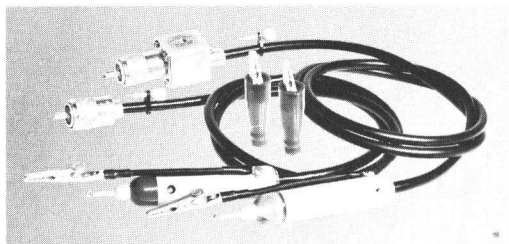
FB 310 Fan Base—for Type 310 Oscilloscope. Provides filtered, forced-air ventilation to assure safe operating temperature when the Type 310 Oscilloscope is being used continuously over long periods, or in hot or limited-ventilation areas. The fan base tilts the oscilloscope to a convenient viewing angle. For use on 105-125 v, 60 cycle only. 25.00

FB 310-S1 Fan Base—for use on 210-250 v, 50 to 60 cycles only. 25.00

ACCESSORIES

Operational Accessories

PROBES



P400-Series Low-Capacitance Probes—This series of low-capacitance probes preserves the transient response of Tektronix fast-rise instruments. The P400-Series probes are free of overshoot and ringing and have relatively uniform high-frequency response. With exception of the P450-L, these probes can be used on other instruments having input capacitances from 20 to 50 μf . General physical characteristics of the P400-Series probe are identical to the P510A probe. Color-coding of the plastic nose indicates attenuation ratio. Probes have 42" cable with coaxial connector and are rated at 600 v peak-to-peak. Two interchangeable Tektips—a straight tip and a hooked tip—each adding less than 0.5 μf to the input capacitance, and an alligator clip assembly are supplied with the probes.

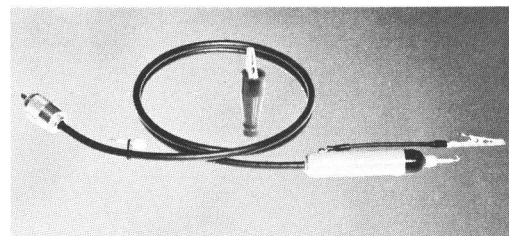
P405, P410, P420	10.50
P450, P450-L, P4100	12.50
Replacement Tektips, each	.25

P400-SERIES PROBE SPECIFICATION

Probe	Attenuation Ratio	Resistance (Megohms)	INPUT IMPEDANCE		DB Loss at 30 MC
			Capacitance Minimum*	Capacitance Maximum†	
P405	5:1	5	12 μf	19 μf	1-2
P410	10:1	10	8 μf	11 μf	1
P420	20:1	10	5.5 μf	7 μf	1
P450	50:1	10	3.5 μf	3.5 μf	1
P450-L	50:1	10	2.5 μf		1
P4100	100:1	10	2.5 μf	2.5 μf	1

*When connected to instruments with 20- μf input capacitance.

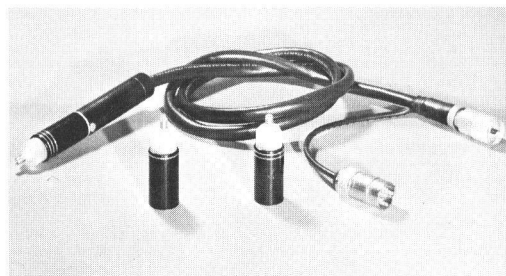
†When connected to instruments with input capacitances up to 50 μf .



P510A Attenuator Probe provides an attenuation of ten times when used with Tektronix oscilloscopes and amplifiers. The P510A is small and streamlined, and pre-

sents an input impedance of 10 megohms paralleled by 14 μf . The probe is completely insulated — made of high-impact-strength fiberglass-reinforced alkyd — and has an internal brass shield. Two interchangeable Tektips—a straight tip and a hooked tip, and an alligator clip assembly are furnished. Probe has a 42" cable with coaxial connector, and is rated at 600 v peak-to-peak.

P510A	8.50
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P170CF Cathode Follower Probe was developed for use with the Type 517 Oscilloscope. The cathode-follower tube is a 5718 triode whose cathode load is the 170-ohm termination of the preamplifier grid line in the Type 517. Plate and heater voltages for this tube are provided at a four-terminal socket on the panel of the oscilloscope. The signal is attenuated by 2 times when using the P170CF. The input impedance of the probe will depend on the attenuator head being used, also since transit time in the cathode-follower tube is involved, it will decrease appreciably at the higher frequencies. When the probe is used without an attenuator head, the input looks like 12 megohms shunted by 5 μf . The probe cable is 42" long. Probe complete with 3 attenuator heads

REPLACEMENT ATTENUATOR HEADS

PAX-I Attenuator Head for P170CF, attenuation can be varied between 4 times and 40 times. 11.00

PAX-II Attenuator Head for P170CF, attenuation can be varied between 20 times and 200 times. 11.00

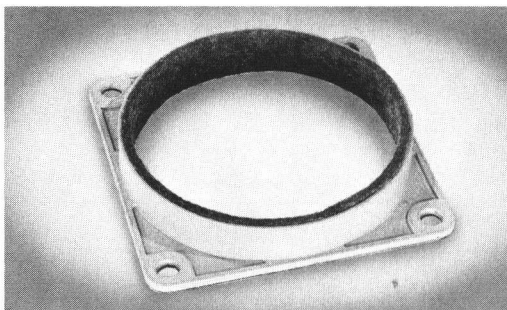
PAX-III Attenuator Head for P170CF, attenuation can be varied between 200 times and 2000 times. 11.00

P170CF can be used with the Type 513 Oscilloscope, but low-frequency response will suffer somewhat, depending on the attenuator head being used. It is necessary to terminate the 170-ohm cable at the oscilloscope input. B170R terminating resistor is designed for this. (See terminations.) A rectifier kit, KP170CF, is recommended for installation in Type 513 to rectify the 6.3 volt heater supply.

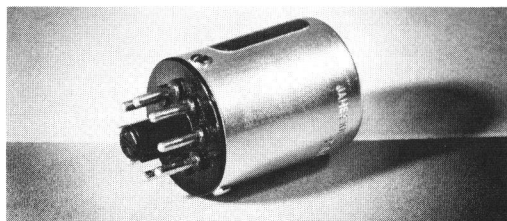
KP170CF DC Filament Kit for Type 513	4.50
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ACCESSORIES

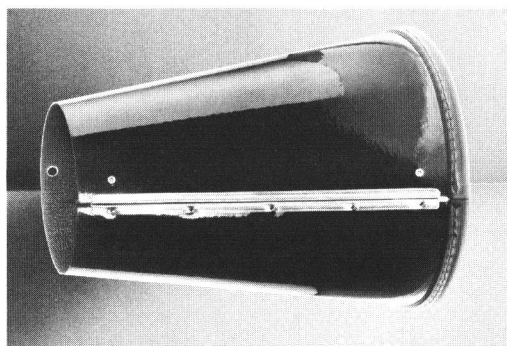
Operational Accessories



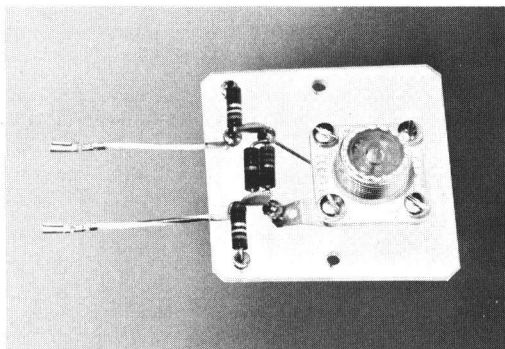
BE510 Bezel, for mounting camera on Tektronix 5" oscilloscopes. Dimensions— $5\frac{7}{8}$ " square; ring $\frac{7}{8}$ " deep, diameter $5\frac{5}{8}$ " outside, $5\frac{1}{8}$ " inside. Die-cast construction, wrinkle finish, felt lined. 4.50



CO181A Crystal-Oven Combination—A 1-mc crystal mounted in a temperature-stabilized oven. Directly interchangeable with standard crystal. Plugs into crystal socket of the Type 181—no wiring changes necessary. Provides a frequency stability of 2 ppm over a 24-hour period 27.00



HC 310 Collapsible Viewing Hood, for Tektronix 3" Oscilloscopes. It is made of black acrylic plastic with handy fastening arrangement. Will fit into side pocket of Type 310 carrying case. Tek no. 016-010 3.50



DP 52 Deflection Plate Connector, for Type 530 and 540-Series Oscilloscopes. A convenient means of making a connection directly to the cathode-ray tube vertical-deflection plates. Function of the vertical positioning control is still retained. The connector is designed for use with a 52-ohm cable.

For instruments with serial numbers below 5001, Tek no. 013-006 5.00

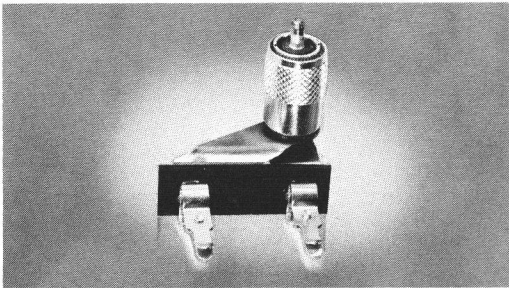
For instruments with serial numbers 5001 and above, Tek no. 013-007 5.00



CC 310 Canvas Carrying Case, for Tektronix Type 310 Oscilloscope. The case has a zipper fastener along the top and one end. The other end is padded for extra protection for knobs and cathode-ray tube. A side pocket holds probes, power cords, etc. Color is forest green with olive-drab carrying straps. Tek no. 253-541 12.00

ACCESSORIES

Operational Accessories



F30 Production Test Fixture, for use with the Type 130 L,C Meter. Speeds sorting and testing of capacitors and inductors 3.00

COAXIAL CABLES

- P52 Coaxial cable, 52 ohms nominal impedance, 42" long 4.00

- P75 Coaxial cable, 75 ohms nominal impedance, 42" long 4.00
- P93 Coaxial cable, 93 ohms nominal impedance, 42" long 4.00
- P93A Coaxial output cable, 93 ohms, terminated with variable attenuator, 42" long . . 13.50
- P93B Coaxial output cable, 93 ohms, terminated with 1/2-watt 93-ohm resistor, 42" long 5.00
- P170 Coaxial cable, 170 ohms nominal impedance, 42" long 9.50

MISCELLANEOUS

- A100 Adapter, clip lead 2.00
- A510 Adapter, binding post 2.00
- FA160 Frame, mounting, for Type 122 and Type 160-Series units 5.00

ACCESSORIES

Test Accessories

Type 107 Square-Wave Generator

Risetime

Less than 3 millimicroseconds into a terminated 52-ohm cable.

Frequency Range

Approximately 400 kc to 1 mc, uncalibrated.

Output Voltage

0.1 to 0.5 v, approximately, when cable is terminated in 52 ohms.

GENERAL DESCRIPTION

The Tektronix Type 107 Square-Wave Generator is basically intended as a Test Accessory for the Type 540-Series Oscilloscopes. For examination of high-frequency response, a square wave having a risetime faster than that of the amplifier being tested is necessary. The Type 540-Series Oscilloscopes with the Type 53/54K Plug-In Preamplifier have a combination risetime of 12 millimicroseconds. The Type 107, with its risetime of 3 millimicroseconds, provides a suitable square wave for checking and adjusting the high-frequency response of the Type 540-Series Oscilloscopes and Type 53/54 Wide-Band Preamplifiers.

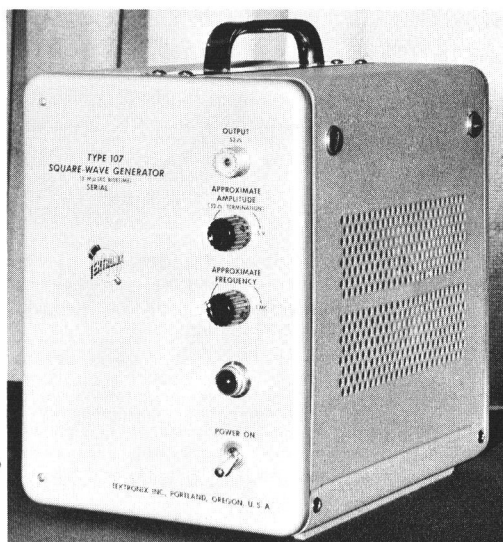
CHARACTERISTICS

Risetime—Less than 3 millimicroseconds when the output 52-ohm cable is terminated.

Frequency Range—A front-panel control varies the frequency over an uncalibrated range of approximately 400 kc to 1 mc.

Output Voltage—When the output cable is terminated the output voltage range is approximately 0.1 v to 0.5 v. If the cable is not terminated, the voltage range is 0.2 v to 1 v.

Output Trigger—An output trigger signal is available at a coaxial connector at the rear of the instrument.



Waveform—Special design consideration has been placed on the shape of the positive portion of the waveform. Therefore, only this portion should be used in transient response testing.

VACUUM TUBE COMPLEMENT

Multivibrator	6BQ7A
Amplifier	12BY7
Shaper amplifier	12BY7
Driver amplifier	12BY7
Output amplifier	6AU6
Rectifiers	2 6BW4
Output voltage regulator	OA2

MECHANICAL SPECIFICATIONS

Ventilation—Forced-air ventilation assures safe operating temperature.

Construction—Aluminum-alloy chassis and cabinet.

Finish—Photo-etched panel, wrinkle-finished cabinet.

Dimensions—11" long, 6¾" wide, 10½" high.

Weight—13 pounds.

Power Requirements—105-125 v or 210-250 v, 50-60 cycles, 100 watts.

Price \$165

Includes: 1—P52, 52-ohm 42" coaxial cable
1—B52-R, 52-ohm terminating resistor
1—B52-T10, 52-ohm 'T' pad
1—Instruction manual

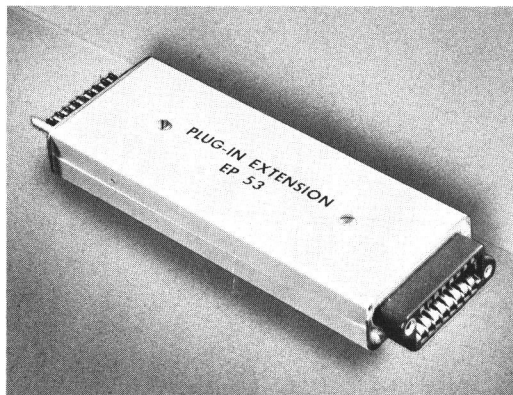
Price f.o.b. Portland, Oregon.

ACCESSORIES

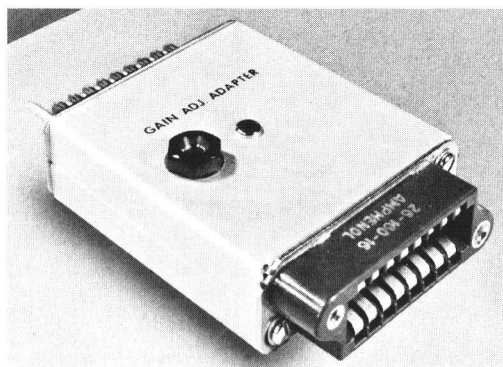
Test Accessories



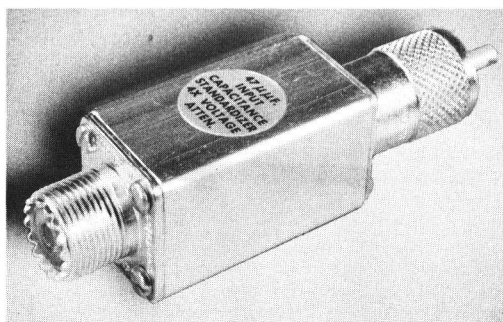
015-001 (S30) Delta Standards, for calibration of the Type 130 L.C. Meter. The unit provides accurately adjusted steps of capacitance and inductance, selected by a rotary selector switch. Values of the capacitance steps correspond to the full-scale adjustments required on the five scales of the Type 130. Two resistors of identical manufacture and similar capacitance, values of 1 megohm and 0.1 megohm, are provided for the resistance compensation adjustment. A 300- μ H standard permits proper adjustments of the inductance ranges 22.00



013-002 (EP53) Plug-in Extension — Allows the plug-in preamplifier unit for the Type 530 and Type 540-Series Oscilloscopes to be operated partially out of its housing. 5.00



013-005 (EP53A) Gain Set Adapter—Permits an external calibrating signal to bypass the plug-in preamplifier, for calibrating the sensitivity of the main amplifier of Type 530 and 540-Series Oscilloscopes. 5.00



011-021 (CS 47) Input Capacitance Standardizer—For use with Type 53 and Type 53/54 Plug-In Preamplifiers having an input capacitance of 47 μ F. With this accessory the input capacitance of each preamplifier can be standardized to 47 μ F, eliminating the necessity for probe readjustment when used with different plug-in preamplifiers 11.50

011-022 (CS 20) Input Capacitance Standardizer—Similar to 011-021 (CS 47), for use with the Type 53/54C and Type 53/54K Plug-In Preamplifiers having 20 μ F input capacitance 11.50

ACCESSORIES

Replacement Parts

GRATICULES

386-395	Unruled, for Type 310.....	1.00
386-312	Unruled, for Type 315.....	1.00
331-027	Quarter-inch divisions, 8 divisions vertically, 10 horizontally, for Type 310 and 360	1.50
331-005	Quarter-inch divisions, 8 divisions vertically, 10 horizontally, for Type 315....	1.50
386-326	Unruled, fits Types 511A, 512, 513, 514, 514A, 524D, 524AD.....	1.00
331-023	Centimeter ruling, 4 centimeters vertically, 10 horizontally, for Types 511A with 5CP CRT.....	1.50
331-024	Centimeter ruling, 4 vertically, 10 horizontally, for Type 514 with 5CP CRT, 513 with T51PA CRT.....	1.50
331-006	Centimeter ruling, 6 centimeters vertically, 10 horizontally, for Type 512 with 5CP CRT, Types 514A, 524D, 524AD and Type 511A with 5ABP CRT	1.50
331-010	Centimeter ruling, 8 centimeters vertically, 10 horizontally, for Type 512 with 5ABP CRT.....	1.50
331-007	Centimeter ruling, 4 centimeters vertically, 8 horizontally, for Type 513 with 5XP CRT	1.50
331-008	Centimeter ruling, 4 centimeters vertically, 8 horizontally, for Type 517....	9.50
331-009	TV RMA style ruling for percentage measurements, for Types 524D and 524AD	1.50
331-035	Ruling in percentages, —40 to +100, for Type 525.....	1.50
331-026	Centimeter ruling, 8 centimeter vertically, 10 horizontally, for Type 532....	1.50
331-016	Centimeter ruling, 6 centimeters vertically, 10 horizontally, for Types 531 and 535.....	1.50
331-025	Centimeter ruling, 4 centimeters vertically, 10 horizontally, for Types 541 and 545.....	1.50
331-028	Division ruling, 10 divisions vertically, 10 horizontally, for Type 570.....	1.50

CATHODE-RAY-TUBE LIGHT FILTERS

378-511	3" Amber (for Type 310 and 360).....	.50
378-509	3" Green (for Type 310 and 360).....	.50
378-510	3" Blue (for Type 310 and 360).....	.50
378-506	3" Amber (for Type 315D).....	.50

378-505	3" Green (for Type 315D).....	.50
378-507	3" Blue (for Type 315D).....	.50
378-501	(F510-3) 5" Amber.....	.90
378-503	(F510-5) 5" Green.....	.90
378-504	(F510-6) 5" Blue.....	.90

AC POWER CORDS

161-004	(COP 16-8) No. 16 wire, 8' long....	2.40
161-003	(COP 18-1) No. 18 wire, 1' long....	.85
161-001	(COP 18-8) No. 18 wire, 8' long....	1.50
161-007	(COP 18-8) Right angle.....	1.50

PATCH CORDS

Two series of patch cords are available. The Series-PC patch cords have a male and female banana-type connector on each end for the purpose of "stacking" the connectors. The Series-W530 patch cords have single banana plugs on each end. Both series are available in red or black and in 18 inch and 6 inch lengths.

012-013	Type W-530B, black, 18"	1.00
012-023	Type PC-6B, black, 6"	1.25
012-024	Type PC-6R, red, 6"	1.25
012-028	Type W-531B, black, 6"	1.00
012-029	Type W-531R, red, 6"	1.00
012-031	Type PC-18R, red, 18"	1.25

SPECIAL CORDS AND LEADS

012-007	(W112R) Red output lead for Type 112	1.00
012-008	(W112B) Black output lead for Type 112	1.00
012-009	(W122) Battery power lead for Type 122	7.50
012-014	(W130B) Black output lead for Type 130	1.00
012-015	(W130R) Red output lead for Type 130	1.00
012-016	(W160-20) 20" inter-unit power cable for Type 160-Series.....	2.00
012-017	(W160-10) 10" inter-unit power cable for Type 160-Series.....	2.00
012-012	(W517) Inter-unit power cable for Type 517.....	9.50

MISCELLANEOUS

011-018	Attenuator unit, for Type 190A.....	19.00
010-003	P93C Probe, for Type 130.....	2.00
014-003	FM 124 Mounting frame, for Type 124..	5.00

ACCESSORIES

Replacement Parts

INSTRUCTION MANUALS				
104A	1.50	514 or 514D	2.75	
105	1.75	514A or 514AD	3.00	
112	1.50	515	4.00	
121	1.50	517 or 517A	4.50	
122	1.50	524D or 524AD	5.00	
124	1.75	525	4.50	
126	1.50	531	4.50	
130	1.50	532	4.50	
160 or 160A	1.50	535	5.00	
161	1.50	536	5.00	
162	1.50	541	4.50	
163	1.50	545	5.00	
180	2.00	53A or 53/54A	1.50	
181	1.75	53B or 53/54B	1.50	
190A	1.50	53C or 53/54C	1.50	
310	3.50	53/54D	1.50	
315D	4.00	53/54E	1.50	
316	4.00	53G or 53/54G	1.50	
360	1.75	53/54K	1.50	
511A or 511AD	2.75	53/54L	1.50	
512	2.75	53/54T	1.50	
513 or 513D	2.75	570	4.50	
		575	5.00	

APPROXIMATE SHIPPING WEIGHTS

INSTRUMENT TYPE	NET WEIGHT IN POUNDS	DOMESTIC PACKED IN POUNDS	EXPORT PACKED		VOLUME IN CU. FT.
			WEIGHT IN POUNDS	KILOGRAMS	
104A	22	32	53	24	5
105	35 1/2	49	65	30	5
112	32	49	75	51	7
121	18 1/2	24	45	20	4
122	5 1/2	9	16	7	1
130	9	17	38	17	4
160 Series	33	56	74	34	7
160A	21	28	50	22	4
161	3 1/2	7	14	6	1
162	3 1/2	7	14	6	1
163	3 1/2	7	14	6	1
FA-160	1 1/4	3			
180	37	49	66	30	5
181	17 1/2	24	49	22	7
190A	24	35	55	25	5
310	23 1/2	30	49	22	4
316	35	47	65	30	4
360	9	17	32	15	4
515	40	66	88	40	7
517A					
Indicator Unit ...	76	101	127	58	9
Power Supply ...	72	83	105	48	5
Scopemobile	42	62	67	30	7
524AD	61	84	117	53	8
Viewing Hood ...	1 1/4	4	11	5	1
525	54	86	101	46	9
531	61 1/2	80	105	48	8
532	52	73	94	43	8
535	65	85	110	50	8
536	57	83	103	47	8
541	61 1/2	80	103	47	8
545	65	85	111	50	8
53/54A	3 1/2	10	12	5	1
53/54B	3 1/2	10	12	5	1
53/54C	5 1/2	12	14	6	1
53/54D	4	11	14	6	1
53/54E	4 1/2	12	14	6	1
53/54G	4 1/2	12	14	6	1
53/54K	3 1/2	10	12	5	1
53/54L	4 1/2	12	14	6	1
53/54T	5	12	14	6	1
570	75	96	116	53	8
575	70	96	116	53	8
124	21	32	58	26	5
500	42	53	62	28	7

GENERAL INFORMATION

Terms and Shipment

For domestic orders, placed in accordance with the normal Tektronix marketing practices, our terms are 1% ten days, net thirty days. However, for departures from normal practice, for example, when shipment must be made "f.o.b. destination" in order to meet special conditions of a customer's purchasing requirement the terms are precisely net thirty days, the 1% discount being reserved to offset the reversed damage claim responsibility. Shipping delay may be prevented by establishing credit at the time of placing your order. When desirable, COD shipments can be arranged. Normally all prices and original quotations are f.o.b. Portland, Oregon.

Unless otherwise specified, shipment would usually be made via Railway Express or Motor Freight. We feel it preferable that purchase orders show shipment to be "Best Way" whenever feasible. In case air shipment is desired, please specify whether Air Express or Air Freight. Lacking specification, Air Freight would be chosen.

Export Orders

To provide our overseas customers with instruments at prices based on eminently fair exchange rates, assistance in ordering, and most important, service after receipt of their instruments, Tektronix has established authorized distributors in many overseas countries. To take advantage of these services, available **ONLY** through your **AUTHORIZED TEKTRONIX DISTRIBUTOR**, and to eliminate the necessity of paying a premium for our instruments, please direct all inquiries and orders to the **TEKTRONIX DISTRIBUTOR** in your country. Customers in a country not presently served by an authorized Tektronix distributor are asked to send all inquiries and orders directly to Tektronix, Inc., Portland, Oregon.

Delivery

Acceptance of purchase orders is indicated by our acknowledgement, and estimated shipment time is given from date of acknowledged acceptance. Every effort is made to meet the estimated shipment date, but there is the possibility that circumstances beyond our control might make it impossible to meet the quoted schedules.

Field Maintenance

Tektronix Field Maintenance is provided on a non-profit basis, as a service to our customers. Work is expedited whether or not the instrument is in warranty.

Requests for repairs or replacement parts should include type number and serial number and should be directed to our representative or branch office in your area. In an emergency, please wire or phone Field Engineering, Tektronix, Inc., Portland, Oregon, in addition to notifying the local representative. This procedure will assure you the fastest possible service.

If an instrument must be returned to the factory for repairs, notify Field Engineering directly or through the local representative, **indicating type number and serial number**, and you will be notified at once as to procedure to be followed. **PLEASE DO NOT RETURN AN INSTRUMENT BEFORE RECEIVING DIRECTIONS.** Instruments and parts returned from countries other than the United States **must be accompanied by an invoice** to clear through customs.

It is standard practice for Tektronix to incorporate improvements as they are developed in our laboratories. Owners of existing instruments are notified of modifications, and modification kits are made available, when practicable, to those who wish to modernize their own instruments.

For customers who have large quantities of Tektronix instruments and wish to equip their maintenance departments with factory-tested components, integrated kits of parts are available. Kits are designed to cover expected needs of a group of ten instruments of the same type.

Warranty

All Tektronix instruments are fully guaranteed against defective materials and workmanship for one year. Should replacement parts be required, whether at no charge under warranty or at established net prices, notify us promptly, including sufficient details to identify the required parts. We will ship them prepaid (via air to meet emergencies, if requested) as soon as possible, usually within 24 hours.

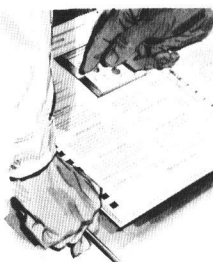
Tektronix transformers, manufactured in our own plant, carry an indefinite warranty.

Overseas Warranty Replacements

The same general warranty policies above apply; however, surface shipment will be made prepaid C.I.F. port of unloading. Customers requesting air shipment for emergency replacements will be invoiced for one-half of the shipment charges and Tektronix will assume the remainder of these charges C.I.F. airport of destination.

TEKTRONIX FIELD SERVICES

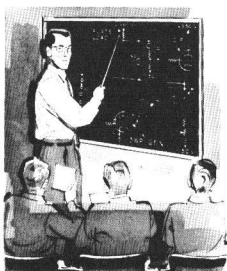
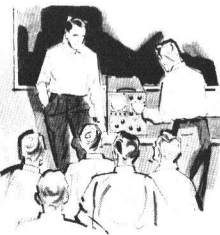
Tektronix Customers are urged to take advantage of the many field services available to them through Tektronix Field-Engineering Offices, Engineering Representatives, and Overseas Engineering Organizations. Some of these services are described below.



Ordering—There are many types of oscilloscopes, each designed for a specific application area. Your Field Engineer can help you select the one best suited to your present and future needs, and he will be happy to arrange a demonstration of the instrument....in your application if you so desire.

If you are a Purchasing Agent or Buyer, your Field Engineer or his secretary can help you with information on prices, terms, shipping estimates, and best method of transportation on instruments, accessories, and replacement parts.

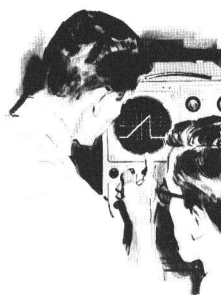
Operation—Your Tektronix Oscilloscope can be most useful to you when you are familiar with all control functions. Your Field Engineer will be glad to demonstrate the use of your instrument in various applications to help you become more familiar with its operation. If your instrument is to be used by several engineers, your Field Engineer will be happy to conduct informal classes on its operation in your laboratory.



Maintenance—Tektronix willingly assumes much of the responsibility for continued efficient operation of the instruments it manufactures. If you should experience a stubborn maintenance problem, your Field Engineer will gladly help you isolate the cause. Often a telephone discussion with him will help you get your instrument back into operation with minimum delay. If yours is a

large laboratory, your Field Engineer can be of service to your maintenance engineers by conducting informal classes on test and calibration procedures, trouble-shooting techniques, and general maintenance.

If you are responsible for the maintenance of a large quantity of Tektronix Instruments, ask your Field Engineer about the free factory training course in maintenance and calibration.

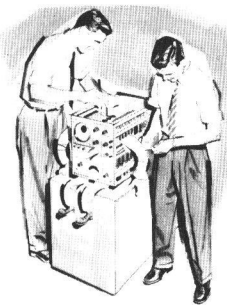


Applications—Perhaps the answers you need in a specific application can be obtained faster and easier through use of your Tektronix Oscilloscope. Your Field Engineer can help you find out, and if use of your oscilloscope is indicated, help you with procedures. He may also be able to suggest many time-saving uses for your oscilloscope in routine checks and measurements.

Instrument Reconditioning

—An older Tektronix Oscilloscope, properly reconditioned, can give you many additional years of service. Your Field Engineer will gladly explain the advantages and limitations of factory reconditioning, and make the necessary arrangements if you decide in favor of it.

Many major repair and recalibration jobs can be performed at a nearby Field Repair Station. Ask your Field Engineer about this at-cost service to Tektronix customers.



Communications—Your Field Engineer is a valuable communication link between you and the factory. He knows the exact person to contact in each circumstance, and he can reach that person fast and easily. Let him help speed your communications with the factory on any problem related to your Tektronix Instruments.

Tektronix, Inc.

AN OREGON CORPORATION

Main Office and Factory—Sunset Highway and Barnes Road

Mailing Address—P. O. Box 831, Portland 7, Oregon

Phone—CYpress 2-2611 • TWX—PD311 • Cable—TEKTRONIX

Tektronix Field Engineering Offices

ALBUQUERQUE	Tektronix, Inc., 127C Jefferson St., N. E., Albuquerque, New Mexico	Phone: 6-1279
BALTIMORE*	Tektronix, Inc., 8118 Harford Rd., Baltimore 14, Maryland	TWX—BOULEVARD MARYLAND 535
	Washington Area Phone	ENterprise 1-6023
BOSTON*	18 Austin St., Newtonville 60, Massachusetts	LAsell 7-2212
BRONXVILLE*	49 Pondfield Road, Bronxville 8, New York	TWX—BRONXVILLE NY 1207
CHICAGO*	Tektronix, Inc., 7514 W. North Ave., Elmwood Park 35, Illinois	DEerfield 7-3771
CLEVELAND	Tektronix, Inc., 3353 Edgecliff Terrace, Cleveland 11, Ohio	GLadstone 6-7930
	Detroit Area: ENterprise 7121	Pittsburg Area: ZENith 0212
DALLAS*	Tektronix, Inc., 6211 Denton Drive, P. O. Box 35104, Dallas 35, Texas	TWX—DL 264
		Fleetwood 2-4087
DAYTON	Tektronix, Inc., 3898 Linden Ave., Room 212, Dayton 3, Ohio	Lincoln 1774
HOUSTON	Tektronix, Inc., 2605 Westgrove Lane, Houston 6, Texas	MOhawk 7-8301, 7-8302
KANSAS CITY	Tektronix, Inc., 5920 Nall, Mission, Kansas	RAndolph 2-6522
		ST. Louis Area: ENterprise 6510
LOS ANGELES*	Tektronix, Inc., 12434 Santa Monica Blvd., West Los Angeles 25, California	BRadshaw 2-1563
	TWX—WEST LOS ANGELES CAL 6698	GRanite 3-1105
MINNEAPOLIS	Tektronix, Inc., 3100 W. Lake Street, Minneapolis 16, Minnesota	WAlnut 7-9559
NEW YORK*	Tektronix, Inc., 840 Willis Avenue, Albertson, L. I., New York	TWX—G CY NY 1416
PHILADELPHIA	Tektronix, Inc., 7709 Ogontz Ave., Philadelphia 50, Pennsylvania	TWX—PH 930
PHOENIX	Tektronix, Inc., 2415 E. McDowell Road, Phoenix, Arizona	WAverry 4-5678
SAN FRANCISCO*	Tektronix, Inc., 1436 El Camino Real, Menlo Park, California	BRidge 5-9762
SYRACUSE*	Tektronix, Inc., 313 Nottingham Road, Syracuse 10, New York	TWX—SS 423
		Phone: 72-3339
TORONTO*	Tektronix, Inc., 3 Finch Ave., East, Willowdale, Ontario, Canada	Toronto, Baldwin 5-1138
UNION*	Tektronix, Inc., 412 Chestnut Street, Union, New Jersey	TWX—UNVL 82
		MURdock 8-2222

* REPAIR CENTERS

Tektronix Engineering Representatives

ATLANTA	Bivins & Caldwell, 3133 Maple Drive, N. E., Atlanta 5, Georgia	TWX—AT 987
DENVER	Hytronic Measurements, Inc., 1295 South Bannock Street, Denver 23, Colorado	CEdar 3-7522
FORT MYERS	Arthur Lynch & Associates, 35 W. Northshore Ave., Fort Myers, Florida	PEarl 3-3701
HIGH POINT	Bivins & Caldwell, P. O. Box 5262, High Point, North Carolina	TWX—HIGH POINT NINT NC 454
PORTLAND	Hawthorne Electronics, 700 S. E. Hawthorne Blvd., Portland 14, Oregon	Phone: 3672
SEATTLE	Hawthorne Electronics, 107 Administration Bldg., Boeing Field, Seattle, Washington	BElmont 4-9375
		MOhawk 3962

Tektronix Overseas Distributors

ADELAIDE	Electronic Industries Imports Pty. Ltd., 90 Grote St., Adelaide, S.A., Australia	LA 4468/9
BERLIN	Rohde & Schwarz Vertriebs, GmbH, Berlin W30, Augsburgerstrasse 33, West Germany	91 27 62
BOMBAY	Electronic Enterprises, 46, Karani Building, Opp. Cama Bldg., New Charni Road, Bombay 4, India	75376
BRISBANE	Electronic Industries Imports Pty. Ltd., 52 Bowen St., Brisbane, Qld., Australia	8 7161
BRUXELLES	Regulation-Mesure, S.P.R.L. 22, rue Saint-Hubert, Bruxelles, Belgium	70. 79. 89
HANNOVER	Rohde & Schwarz Vertriebs, GmbH, Hannover, Schillerstrasse 23, West Germany	1 33 80
HELSINKI	Into O/Y, 11 Meritullinkatu, Helsinki, Finland	62 14 25, 35 125
ISRAEL	Landseas Products Corp., 48 West 48th Street, New York 36, New York	COLUMbus 5-8323
	Landseas Eastern Co., P.O. Box 2554, Tel Aviv, Israel	
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KARLSRUHE	Rohde & Schwarz Vertriebs, GmbH, Karlsruhe, Kriegstrasse 39, West Germany	25202
KOBENHAVN	Tage Olsen A/S, Centrumsgaarden, Room 133, 6D, Vesterbrogade, Kobenhavn V, Denmark	Palae 1369, Palae 1343
KOLN	Rohde & Schwarz Vertriebs, GmbH, Koln, Habsburger-Ring 2-12, West Germany	215341
LONDON	Livingston Laboratories Ltd., Retcar Street, London N.19, England	Archway 6251
MELBOURNE	Electronic Industries Imports Pty. Ltd., 139-143 Bouverie St., Carlton, N. 3, Melbourne, Australia	FJ 4161
MUNCHEN	Rohde & Schwarz Vertriebs, GmbH, Munchen 9, Auerfeldstrasse 22, West Germany	4 46 38
	Rohde & Schwarz Vertriebs, Munchen 9, Brienerstrasse 23, West Germany	59 52 65
OSLO	Eugen Nilsson, Mollergaten 8, Oslo, Norway	33 14 28, 33 27 62
PARIS	Maurice I. Parisier & Co., 1860 Broadway, New York 23, New York	Circle 5-5701
	Relations Techniques Intercontinentales, 145, Avenue Malakoff, Paris 16, France	Passy 08-36, Kleber 54-82
PERTH	Electronic Industries Imports Pty. Ltd., 68 Railway Pde., West Perth, W.A., Perth, Australia	BA 9686
RIO DE JANEIRO	Empresa Comercial Importadora Limitada, Rua Araujo Porto Alegre, 70-8°, Rio De Janeiro, Brazil	42-9460
ROMA	CESA-Elettronica, 20 via Tevere, Roma, Italy	846.592, 865.722
'S-GRAVENHAGE	C. N. Road, Weteringakade 37, 's-Gravenhage, Netherlands	771920
STOCKHOLM	Erik Ferner AB, Bjornsonsgatan 197, Bromma, Stockholm, Sweden	37 42 77, 37 77 00
SYDNEY	Electronic Industries Imports Pty. Ltd., 713 Parramatta Rd., Leichhardt, NSW, Sydney, Australia	LM 3311
TOKYO	Midoriya Electric Co., Ltd., 3-4 Chome, Ginzaishi, Chuo-Ku, Tokyo, Japan	(56) 1786 7415 7416 7439 5396 8282
ZURICH	Omni Ray AG, Dufourstrasse 56, Zurich 8, Switzerland	(051) 34-44-30

Other OVERSEAS areas please write or cable directly to the Export Department, Portland, Oregon, U.S.A.

5/57

Printed in U. S. A.

CALIBRATION RECORD

Tektronix Type 163 — Serial No. 1361

1. Adjust PULSE AMPLITUDE CALIBRATOR ✓.
2. Adjust pulse shape (C63) ✓.
3. Check trigger sensitivity (2 v or less) ✓.
4. Check GATE OUT ✓.
5. Adjust NEG. DELAY LIMIT and POS. DELAY LIMIT ✓.
6. Adjust PULSE WIDTH CALIBRATOR (10 microsecond range) ✓.
7. Adjust C50 (1 microsecond range) ✓.
8. Check pulse width of 100 and 1000 microsecond ranges ✓.
9. Calibrate PULSE WIDTH MULTIPLIER dial ✓.
10. Check risetime (less than 0.2 microsecond) ✓.

Calibration Engineer P. SalomonDate 4-17-58Quality Control Engineer Bill YerkesDate 4-29-58