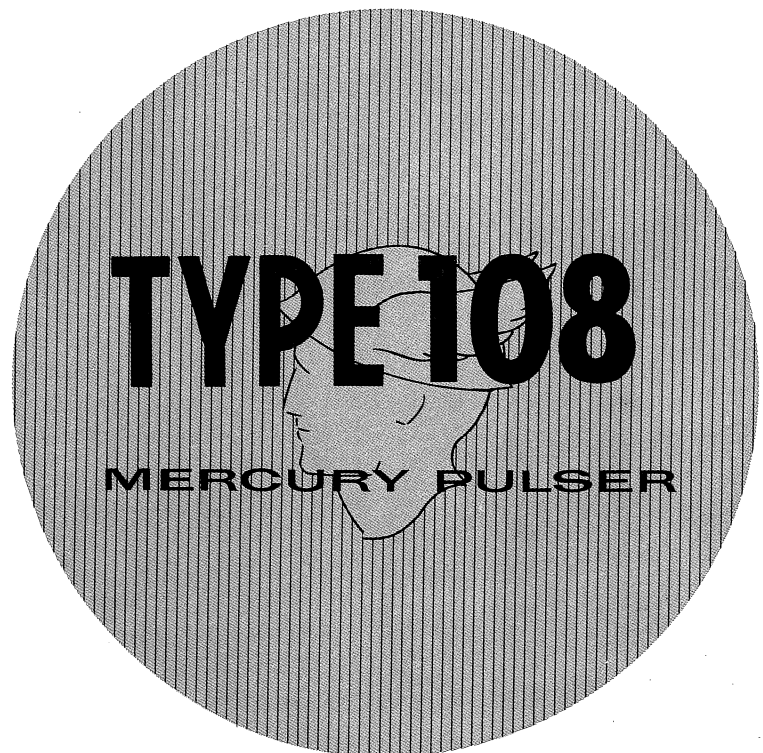


INSTRUCTION MANUAL



S.W. Millikan Way • P.O. Box 500 • Beaverton, Oregon • Phone MI 4-0161 • Cables: Tektronix

070-205

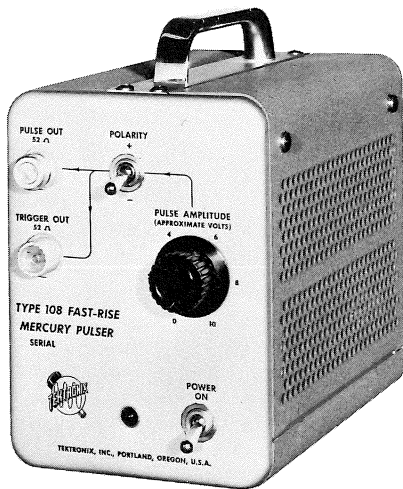
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SECTION 1

DESCRIPTION



The Type 108 generates a fast-rise step-function test signal of known waveform. The Type 108 permits the standardization of the vertical amplifier transient response of a Tektronix convertible oscilloscope.

In addition, the Type 108 provides a fast-rise step-function which may be used for a variety of purposes in electronics work. For example: antenna measurements and the testing of miscellaneous amplifiers is greatly simplified by the use of the Type 108.

OUTPUT WAVEFORM CHARACTERISTICS

RISETIME

The risetime of the Type 108 Fast Rise Mercury Pulser is approximately 1 millimicrosecond into a terminated 52-ohm line.

REPETITION RATE

The repetition rate is 240 step functions per second.

POLARITY

Either positive or negative step functions may be generated.

AMPLITUDE

The amplitude of the step function is continuously adjustable from 0 to 10 volts.

PHYSICAL CHARACTERISTICS

Construction—Aluminum alloy.

Finish—Photoetched panel, blue wrinkle-finished cabinet.

Weight—5 pounds.

Dimensions—9 $\frac{1}{4}$ " long, 5" wide, 7 $\frac{3}{4}$ " high.

Power Requirements—105-125 v, 50-60 cycle, 19 watts.

FRONT PANEL CONTROLS AND CONNECTORS

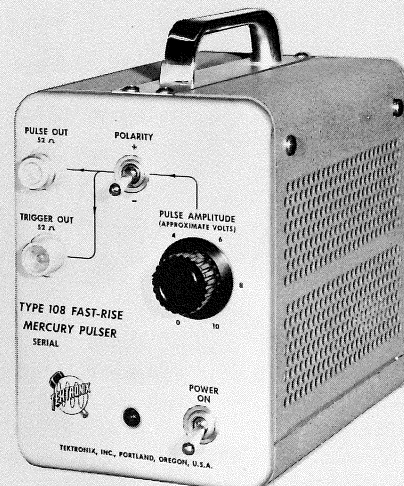
POWER—Turns the instrument on.

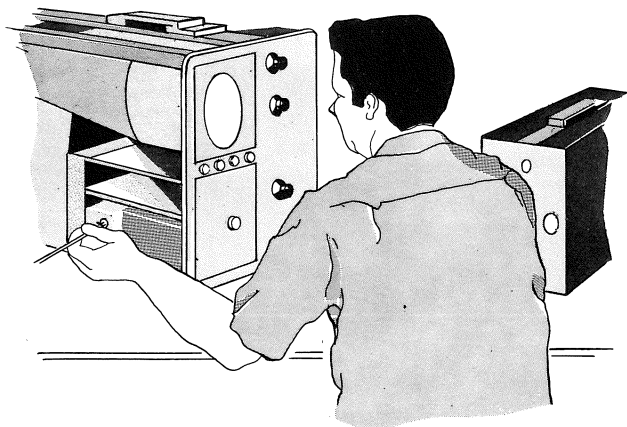
PULSE AMPLITUDE—Enables the operator to vary the amplitude of the output waveform between 0 and 10 volts.

POLARITY—Allows the operator to select either a positive- or negative-going step function.

PULSE OUT—Connector supplying the output step-function waveform.

TRIGGER OUT—Connector supplying a source of trigger pulses for use where external triggering is desired.





SECTION 2

OPERATING INFORMATION

The Type 108 is used principally for setting the vertical-amplifier compensations and adjusting the delay lines of 540- and 550-Series Oscilloscopes. These adjustments are described in detail in the Calibration section of the 530-, 540-, and 550-Series Instruction Manuals. Consequently, we will discuss only the operation of the Type 108 itself in this manual. In addition to its use in the 540- and 550-Series oscilloscopes, the Type 108 is suitable for use with those 530-Series Oscilloscopes incorporating a delay line in the vertical deflection system.

PRELIMINARY ADJUSTMENTS

Note that a TRIGGER OUT connector is provided on the front panel of the Type 108. For use with some oscilloscopes you may find it advantageous to use an external source of triggering signal. In the instructions which follow it is assumed that INTERNAL triggering will be used.

Coil Current Adjustment

For best results, the coil current adjustment should be made each time the Type 108 is put into service. The need for readjustment is indicated by erratic mercury switch operation.

To make the adjustment:

1. Place the POWER switch of the Type 108 in the ON position.
2. Turn the oscilloscope STABILITY control full right.
3. Set the TRIGGERING MODE switch to the AC FAST position.
4. Set the TRIGGER SLOPE switch to +INT.
5. Turn the AMPLITUDE control full right.
6. Position the trace, as necessary, with the VERTICAL POSITION control.
7. Using a sweep rate of 2 milliseconds per centimeter, adjust the STABILITY and TRIGGERING LEVEL controls for a stable display. The waveform jitter is normal.
8. Set the COIL CURRENT ADJUST control to the position that gives the least jitter and a pulse about every 2 centi-

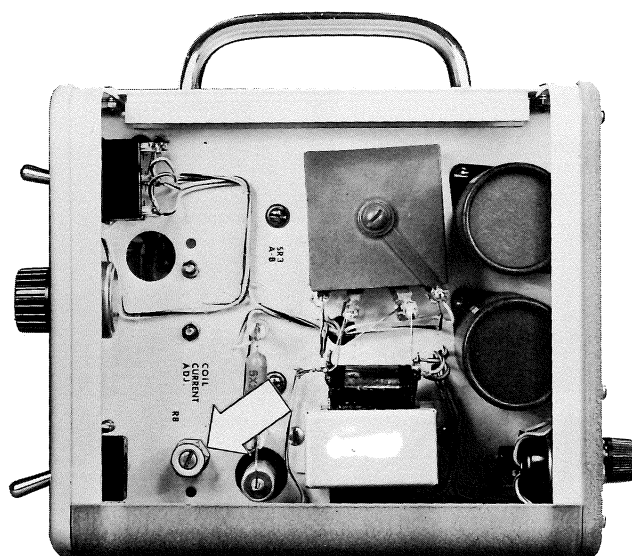


Fig. 2-1. Adjusting the mercury-switch coil current.

meters (every 4 milliseconds). Figure 2-2 shows the normal display. The dimensions a and b shown in Figure 2-2 may not be equal, depending upon the characteristics of the switch and the COIL CURRENT ADJUST setting. Usually the best setting of the COIL CURRENT ADJUST control is indicated by the loudest sound and a steady hum.

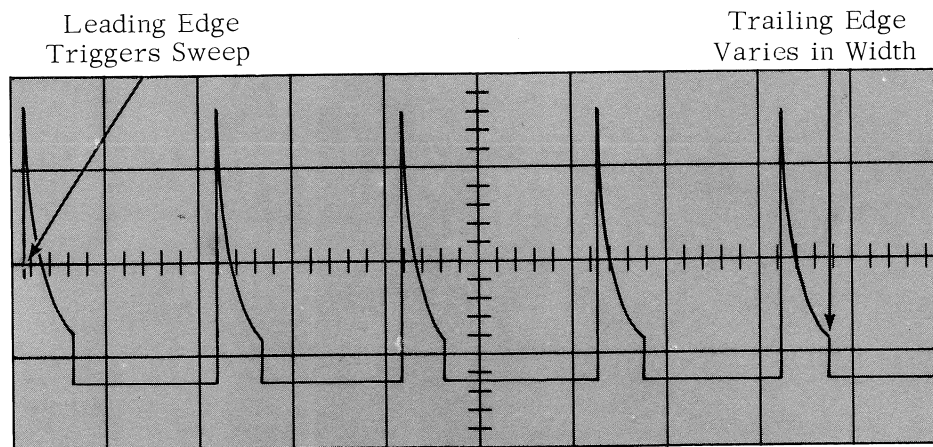


Fig. 2-2. Line drawing of a typical Type 108 waveform at a sweep rate of 2 milliseconds per centimeter. The normal pulse jitter is not reproduced here.

OPERATION

The Positive Step Function

Useful oscilloscope displays are obtained at sweep speeds of 10 microseconds per centimeter and faster, using internally derived triggering signals. Internal triggering results

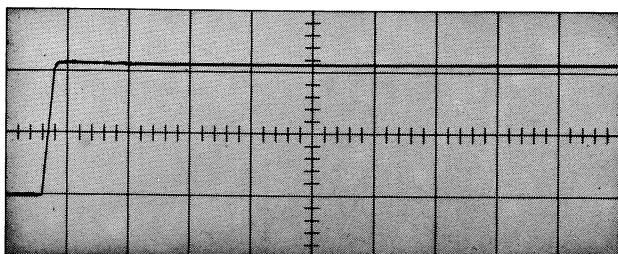


Fig. 2-3. The positive step function displayed on a 540-Series oscilloscope.

in a stable display even through the mercury switch has jitter (the usual case). To display a positive step function:

1. Turn the AMPLITUDE control to zero.
2. Set the TRIGGERING MODE switch to the AC FAST position.
3. Set the TRIGGER SLOPE switch to +INT.
4. Set the TIME/CM and MULTIPLIER switches to give the desired sweep rate (for example, 1 microsecond per centimeter).
5. Turn the TRIGGERING LEVEL and STABILITY controls full right, getting a free-running sweep.
6. Adjust the INTENSITY control for normal brilliance.

7. Turn the AMPLITUDE control to the right of zero until the waveform generated by the Type 108 provides an unstable display having a suitable amount of vertical deflection (for example, 3 centimeters).

8. Turn the STABILITY control left until the trace disappears, then two or three degrees further left; or turn it to the PRE-SET position.

9. Turn the INTENSITY control about 30 degrees further to the right.

11. Reduce the room illumination, if necessary, and carefully adjust the FOCUS, INTENSITY, ASTIGMATISM and SCALE ILLUMINATION controls to give the sharpest trace consistent with usable brightness.

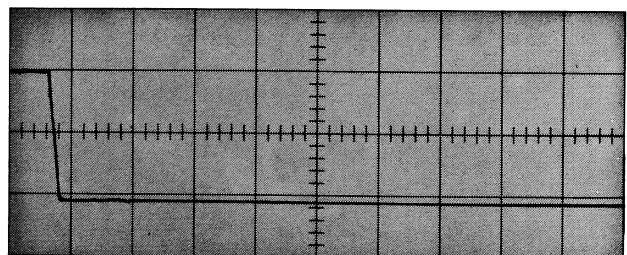


Fig. 2-4. The negative step function displayed on a 540-Series oscilloscope.

The Negative Step Function

Tektronix oscilloscopes are usually adjusted for optimum response to a positive step function. Should you wish to

check the response of your oscilloscope to a negative step function, use the following procedure:

1. Turn the AMPLITUDE control to zero.
2. Set the TRIGGERING MODE switch to the AC FAST position.
3. Set the TRIGGER SLOPE switch to —INT.
4. Set the TIME/CM and MULTIPLIER switches to give the desired sweep rate (for example, 1 microsecond per centimeter).
5. Turn the TRIGGERING LEVEL control full left.
6. Turn the STABILITY control full right, getting a free-running sweep.
7. Adjust the INTENSITY control for normal brilliance.
8. Turn the AMPLITUDE control to the left of zero until the waveform generated by the Type 108 provides an unstable

display having a suitable amount of vertical deflection (for example, 3 centimeters).

9. Turn the STABILITY control left until the trace disappears, then two or three degrees further left; or turn it to the PRE-SET position.

10. Turn the INTENSITY control about 30 degrees further to the right.

11. Turn the TRIGGERING LEVEL control right for a stable display of the negative step function. Over a considerable range, the setting of the TRIGGERING LEVEL control is non-critical.

12. Reduce the room illumination, if necessary, and carefully adjust the FOCUS, INTENSITY, ASTIGMATISM and SCALE ILLUMINATION controls to give the sharpest trace consistent with usable brightness.

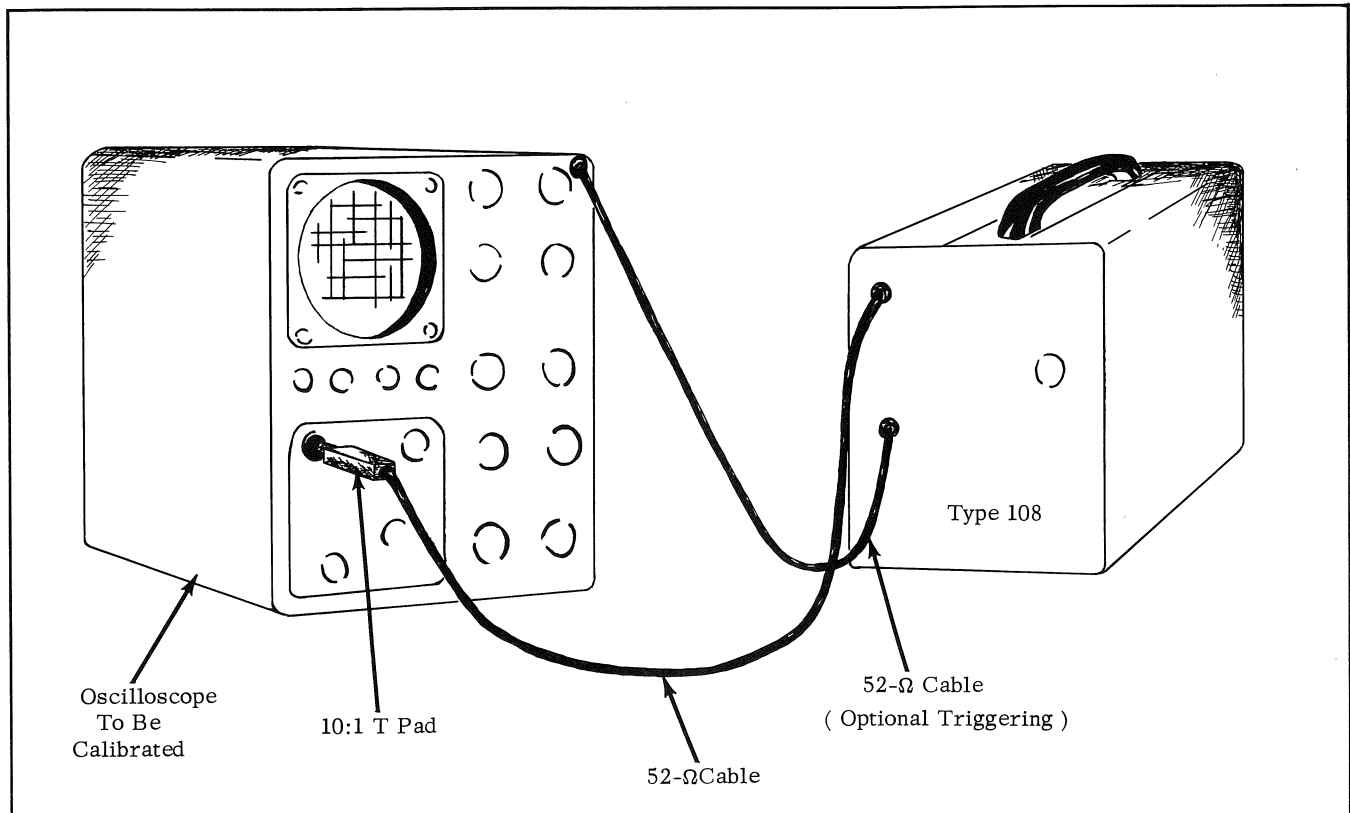
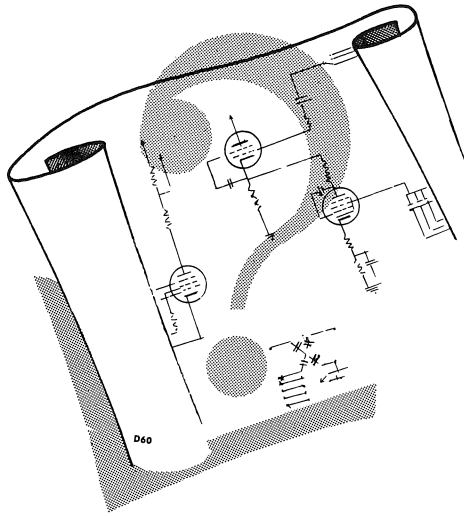


Fig. 2-5. Type 108 correctly connected to the oscilloscope to be calibrated.

SECTION 3

CIRCUIT INFORMATION



The Type 108 fills the need for a test-signal generator, of known waveform, that can be used to standardize the vertical-amplifier transient response of a Tektronix convertible oscilloscope. As a result of component aging, particularly tubes, the transient response of an electronic amplifier changes over a period of time. In contrast, the Type 108 has very stable waveform characteristics. The waveform of the Type 108 is determined by stable circuit constants. Ordinary measuring equipment will verify circuit values should the output waveform be in doubt.

OUTPUT WAVEFORM

The output of a vertical amplifier involves two separate and distinct waveform slopes. In Fig. 3-1(a), that portion of the waveform between points d and e corresponds to the risetime of the Type K. The gradual slope from e to f corresponds to a long time-constant undershoot of the Type K. For clarity, the amount of the undershoot is exaggerated.

Fig. 3-1(b) shows the main-unit vertical-amplifier response of a properly adjusted oscilloscope. A slight overshoot of the main-unit oscilloscope amplifier compensates for the undershoot of the Type K. Once again, the overshoot of the main-unit vertical amplifier is exaggerated for clarity. The actual overshoot is approximately 2 per cent.

You do not actually observe the curves of Fig. 3-1(a) and Fig. 3-1(b), when you use the Type 108. The waveform displayed on the oscilloscope screen is shown in Fig. 3-1(c). You automatically overcompensate the main-unit vertical amplifier by the proper amount when you adjust for the optimum overall response shown.

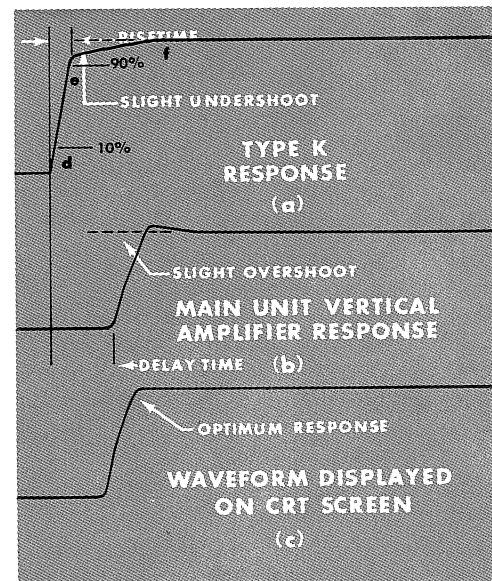


Fig. 3-1. Waveform differences in a Type K/540-Series oscilloscope combination displaying the Type 108 output waveform.

MERCURY SWITCH

The fast rise and stable display of the Type 108 is made possible by the bounce-free low-impedance mercury switch

incorporated into the design. Fig. 3-2 illustrates the important switch details. For simplicity, an extra pair of contacts

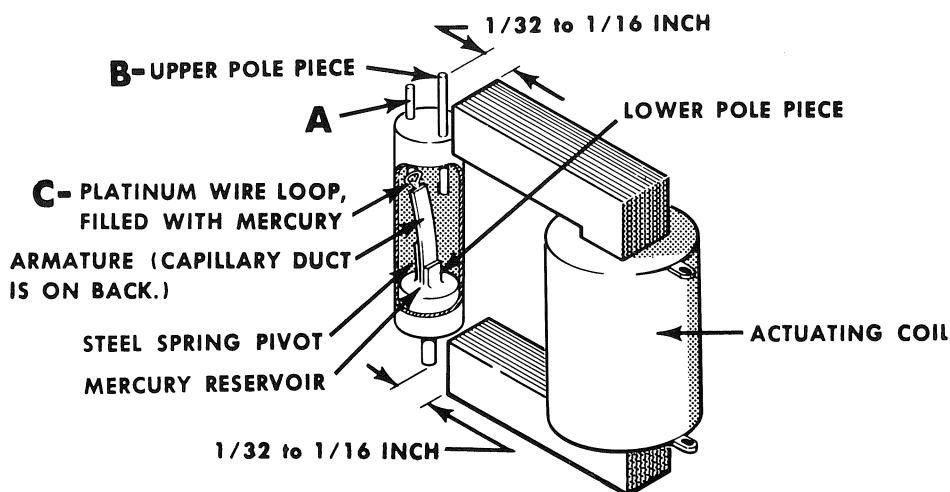


Fig. 3-2. The Type 108 mercury switch. The drawing is not to scale.

not used in the electrical circuit are omitted. As a safety precaution, the high-pressure hydrogen-filled glass envelope is encapsulated in an additional plastic case.

Although it is not readily apparent, the stationary electrodes marked A and B form the single-throw switch shown in our circuit diagram. A description of the switching action follows:

1. When the actuating coil is not energized, the armature is held by spring force against contact A.
2. Mercury is fed from the reservoir into the hairpin loop C at the end of the armature by capillary action. When the switch is in operation, the capillary transfer of the mercury from the reservoir to the hairpin loop is aided by centrifugal forces.
3. Magnetic materials are used in fabricating the switch contacts and the armature. These switch parts are located in and form a part of the magnetic circuit. When the actuating coil is energized, magnetic forces move the armature from contact A to contact B.
4. The armature and the switch contacts are wetted by the mercury, allowing the mercury to adhere to their surfaces. When the hairpin loop moves from contact A to contact B, a column of mercury momentarily bridges the gap between these electrodes. After a short time the mercury column falls and returns to the reservoir. The time that the mercury column maintains contact between the terminals A and B varies considerably from switch to switch and from one switch operation to the next for a particular switch. Usually the connection lasts for a period of more than 50 microseconds. This far exceeds the requirements for the Type 108 in its normal application.
5. As the actuating coil is deenergized, the armature returns to its normal rest position, repeating the switching action. This gives two switch closures for each complete cycle of the vibrating armature. The armature normally vibrates at 120 cycles per second, corresponding to 240 switch closures per second.

ACTUATING-COIL CIRCUIT

One of the design objectives for the Type 108 was to increase the pulse repetition rate to the highest practical value. Higher repetition rates correspond to increased apparent trace brightness. The maximum usable repetition rate is determined by the mercury switch capabilities. Reliable switching is observed for armature-vibration frequencies up to about 120 cycles per second.

A full-wave bridge selenium rectifier, SR3A, is used to rectify the 60-cycle supply voltage. The resultant voltage waveform has a large 120-cycle component as well as a dc component. Most of the 120-cycle voltage component is applied directly to the actuating coil, L17, as a result of the bypassing action of C7. The COIL CURRENT ADJ. control serves primarily to adjust the dc current flowing in the actuating coil. When properly adjusted, this control sets the average position of the mercury-switch armature to a reliable operating point.

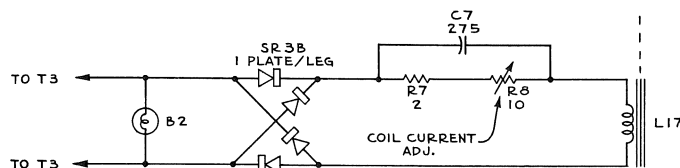
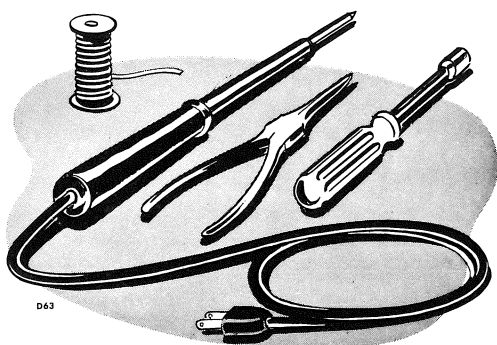


Fig. 3-3. The actuating-coil circuit diagram.



SECTION 4

MAINTENANCE

REPLACEMENT PARTS

NOTE

Always include the instrument TYPE and SERIAL NUMBER in any correspondence concerning the instrument.

Standard Parts

Replacement components can be obtained from Tektronix at current net prices. However, since most of the components are standard electronic and radio parts, they can generally be obtained locally in less time than required to obtain them from the factory. Before ordering or purchasing parts, be sure to consult the parts list to determine the tolerances required.

Tektronix-Manufactured Parts

Tektronix manufactures almost all of the mechanical parts, and some of the electronic components, used in your instrument. When ordering mechanical parts, be sure to describe the part completely to prevent delays in filling your order.

The Tektronix-manufactured electronic components are so noted in the parts list. These components, as well as the mechanical parts, must be obtained from the factory or from the local Tektronix Field Engineering Office.

Since the production of your instrument, some of the Tektronix-manufactured components may have been superceded with improved components. The part number of these new components will not be listed in your manual. If you order a Tektronix-manufactured component, and if the component has been superceded by a new, improved component, the new part will be shipped in place of the original. Your local Tektronix Field Engineering Office has knowledge of these changes and may call you if a change in your purchase order is necessary.

Replacement-information notes sometimes accompany the improved component to aid in its installation.

Parts Ordering Information

You will find a serial number on the frontispiece of this manual. This is the serial number of the instrument for which the manual was prepared. Be sure that the number on the manual matches the serial number of the instrument when ordering parts from the Parts List.

Each part in your instrument has a 6-digit Tektronix part number. This number, together with a description of the part, will be found in the Parts List. When ordering parts, be sure to include both the description of the part and the part number. For example, a certain resistor should be ordered as follows: R5256, 1.1 K, $\frac{1}{2}$ w Fixed, Comp., 5%, part number 301-112 for a Type 108, Serial Number 81. When parts are ordered in this manner we are able to fill your orders promptly, and delays that might result from transposed numbers in the part number are avoided.

OPERATIONAL CHECKS

Mechanical Inspection

1. Tighten screws and nuts wherever possible.
2. Visually check lead dress, all solder joints and the clearance between the lugs and the plates of the selenium rectifier stack.

3. Check the mechanical clearances between the switch contacts and the pole pieces of the actuating coil. These clearances should be between $\frac{1}{32}$ and $\frac{1}{16}$ inch. If there is inadequate clearance, loosen the switch mounting screws (see Fig. 4-1 and position the switch assembly for the proper clearance.

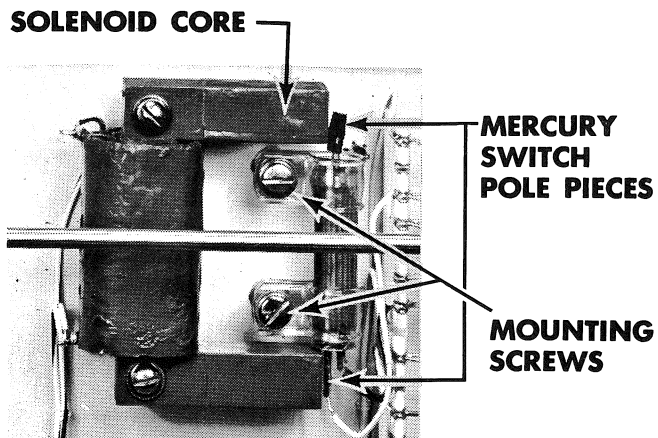


Fig. 4-1. The mercury-switch pole pieces should be positioned within $1/32$ to $1/16$ inch of the solenoid core. Loosening the mounting screws permits adjustment.

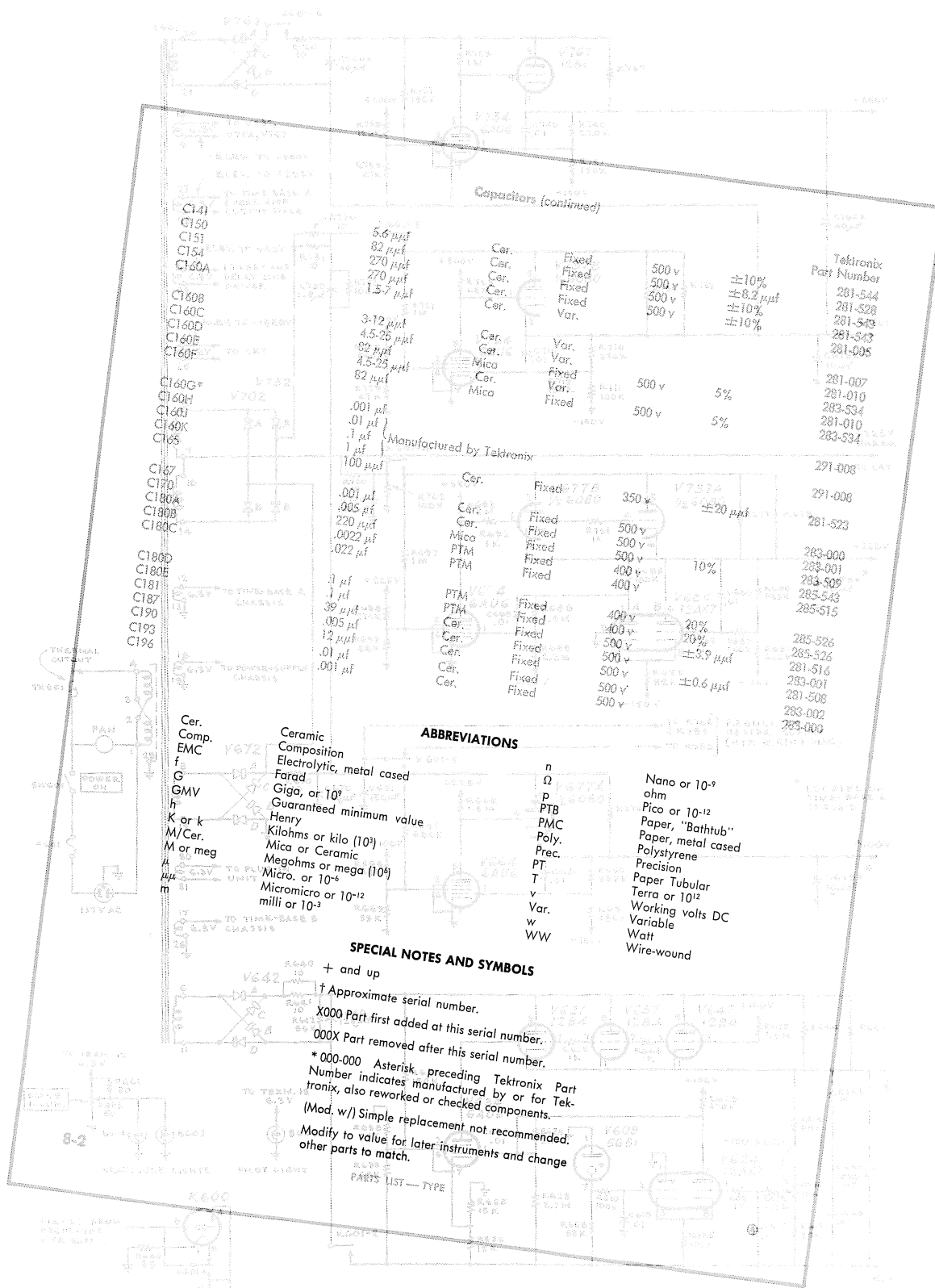
Components Checks

The risetime-shaping circuits are best checked by measuring the individual component values. Check C14, R15, R16, R20, R23 and R26. The individual capacitors which form C14 should be removed from the instrument before they are measured. Many of the resistive components can be measured satisfactorily while soldered in place.

Knob Position

Free-run the oscilloscope sweep and adjust the PULSE AMPLITUDE control of the Type 108 for zero deflection. When this has been done the PULSE AMPLITUDE control should indicate 0. If it does not, loosen the set screw holding the knob to the shaft and set the dot on the knob to 0. Retighten the set screw after setting the knob.

PARTS LIST *and* DIAGRAMS



MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

HOW TO ORDER PARTS

Replacement parts are available through your local Tektronix Field Office.

Improvements in Tektronix instruments are incorporated as soon as available. Therefore, when ordering a replacement part it is important to supply the part number including any suffix, instrument type, serial number, plus a modification number where applicable.

If the part you have ordered has been improved or replaced, your local Field Office will contact you if there is a change in part number.

PARTS LIST

Bulbs

Tektronix
Part Number

B2	6.3 V	Incandescent	Type 12	150-018
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Capacitors

C3		2000 μ f	EMC	Fixed	30 v		290-087
C4		2000 μ f	EMC	Fixed	30 v		290-087
C7		275 μ f	EMT	Fixed	6 v		290-020
C14	101-108X	.5 μ f	MPT	Fixed	600 v		285-545
C14A		.1 μ f	Cer.	Fixed	100 v		Use 283-012
C14B		.1 μ f	Cer.	Fixed	100 v		Use 283-012
C14C		.1 μ f	Cer.	Fixed	100 v		Use 283-012
C14D		.1 μ f	Cer.	Fixed	100 v		Use 283-012
C14E		.1 μ f	Cer.	Fixed	100 v		Use 283-012
C20	101-108	12 μ μ f	Cer.	Fixed	500 v	$\pm 1.2 \mu$ μ f	281-506
C20	109-187X	27 μ μ f	Cer.	Fixed	500 v	$\pm 2.7 \mu$ μ f	281-512
C21	101-108X	4.7 μ μ f	Cer.	Fixed	500 v	$\pm 1 \mu$ μ f	281-501

Fuses

F2	.5 Amp	3 AG	Fast blo	159-025
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Inductors

L17	Solenoid, Iron Core	108-127
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Resistors

R3		47 Ω	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-470
R7		2 Ω	5 w	Fixed	WW	5%	308-119
R8		10 Ω		Var.	WW		311-001
R12		500 Ω		Var.	Comp.		311-005
R14	101-108	180 Ω	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-181
R14	109 & up	1 k	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-102
R15	X188 & up	91 Ω	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-910
R16	X188 & up	120 Ω	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-121
R20	101-108	51 Ω	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-510
R20	109 & up	15 Ω	$\frac{1}{2}$ w	Fixed	Comp.	5%	301-150
R23		220 Ω	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-221
R26		68 Ω	$\frac{1}{2}$ w	Fixed	Comp.	10%	302-680

Selenium Rectifiers

SR3	8/500 MA Plates	106-055
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Switches

SW2		Power On		260-134
SW12		Polarity		260-014
SW17		Mercury		260-194

Transformers

T3	101-226	Power	117 v	USE	120-133
T3	227 & up	Power	117 V/234 v		120-133

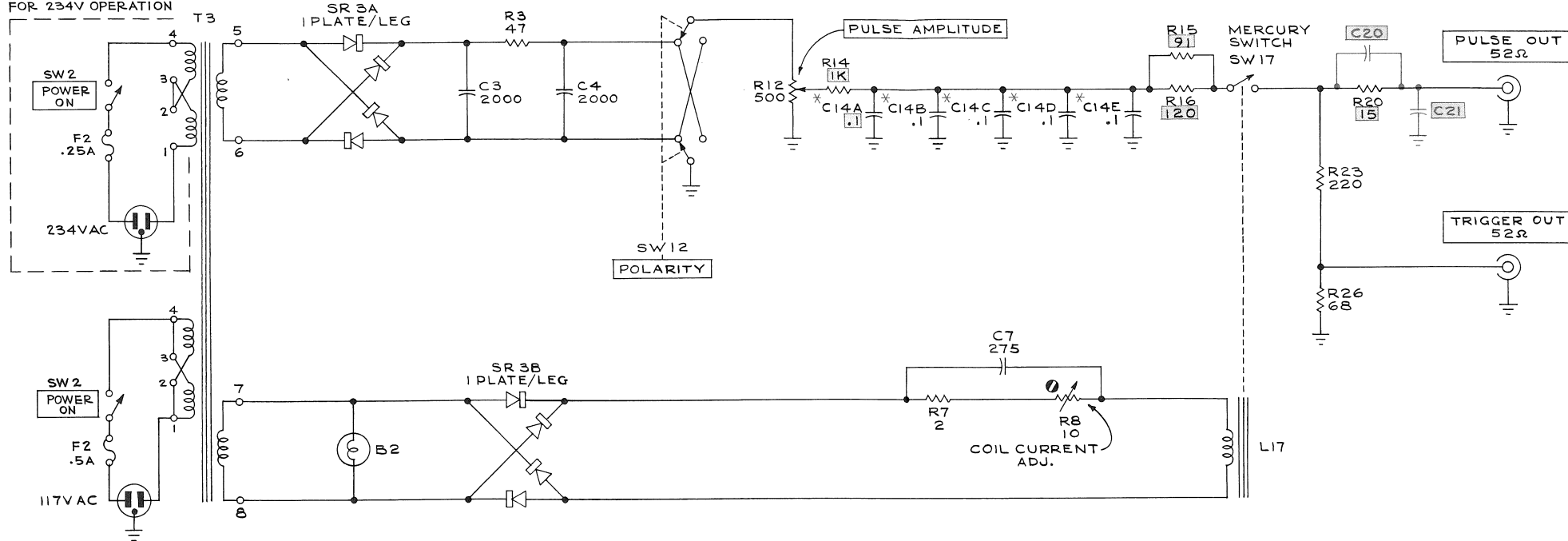
Type 108 Mechanical Parts List

	Tektronix Part Number
ADAPTOR, POWER CORD SN 188-up	103-013
BAR $\frac{3}{16} \times \frac{1}{2} \times 1$ w/2 holes SN 188-up	381-084
BAR, EXTRUDED CHANNEL TOP SUPPORT (Blue vinyl finish)	381-160
CABLE, HARNESS, MERCURY PULSER	179-237
CABLE, HARNESS, 110 VOLT	179-238
CAP, FUSE	200-015
CHASSIS	441-195
CLAMP, CABLE, $\frac{7}{16}$ plastic	343-005
CONNECTOR, CHASSIS MT., 2 contact, male SN 101-187	131-010
CONNECTOR, CHASSIS MT., 83-IRTY	131-038
CONNECTOR, CHASSIS MT., 1 contact, female	131-101
CONNECTOR, CHASSIS MT., 3 wire, male SN 188-up	131-102
CORD, POWER	161-010
GROMMET, RUBBER $\frac{1}{4}$	348-002
GROMMET, RUBBER $\frac{5}{16}$	348-003
GROMMET, RUBBER $\frac{5}{8}$	348-012
HANDLE	367-007
HOLDER, FUSE	352-010
JEWEL, PILOT LIGHT, RED	378-517
KNOB, BLACK	366-042
LOCKWASHER, STEEL INT. #4	210-004
LOCKWASHER, STEEL INT. #6	210-006
LOCKWASHER, STEEL INT. #8	210-008
LOCKWASHER, STEEL EXT. #10	210-009
LOCKWASHER, STEEL INT., $\frac{3}{8} \times \frac{1}{16}$	210-013
LUG, SOLDER SE4	210-201
LUG, SOLDER POT, PLAIN, $\frac{3}{8}$	210-207
NUT, HEX 4-40 $\times \frac{3}{16}$	210-406
NUT, HEX 6-32 $\times \frac{1}{4}$	210-407
NUT, HEX 8-32 $\times \frac{5}{16}$	210-409
NUT, HEX 10-32 $\times \frac{5}{16}$	210-410
NUT, HEX $\frac{3}{8}$ -32 $\times \frac{1}{2}$	210-413
NUT, HEX $\frac{3}{8}$ -32 $\times \frac{1}{2} \times \frac{5}{8}$	210-444
NUT, KEPS 6-32 $\times \frac{5}{16}$	210-457
NUT, 12-SIDED, $\frac{15}{32}$ -32 $\times \frac{5}{64}$	210-473
PANEL, FRONT	333-440
PLATE, CAB. BOTTOM (Blue Wrinkle Finish) SN 101-319	386-674
PLATE, CAB. SIDE (Blue Wrinkle Finish) SN 101-675	386-675
PLATE, SUB PANEL, REAR	386-791

Mechanical Parts List (continued)

	Tektronix Part Number
PLATE, SUB PANEL, FRONT	386-792
PLATE, OVERLAY (Blue Wrinkle Finish) SN 101-319	386-793
PLATE, CAB. SIDE (Blue Vinyl Finish) SN 320-up	387-029
PLATE, CAB. BOTTOM (Blue Vinyl Finish) SN 320-up	387-030
PLATE, OVERLAY (Blue Vinyl Finish) SN 320-up	387-031
RING, SHIELD	354-005
SCREW 4-40 x $\frac{5}{16}$ FHS, Phillips	211-038
SCREW 6-32 x $\frac{5}{16}$ BHS	211-507
SCREW 6-32 x 1 BHS	211-517
SCREW 6-32 x $1\frac{1}{4}$ BHS	211-529
SCREW 6-32 x $\frac{3}{8}$ Truss HS, Phillips	211-537
SCREW 6-32 x $\frac{5}{16}$ FHS, 100, CSK, Phillips	211-538
SCREW 6-32 x $\frac{5}{16}$ Truss HS, Phillips	211-542
SCREW 6-32 x $\frac{5}{16}$ RHS	211-543
SCREW 8-32 x $\frac{5}{16}$ BHS	212-004
SCREW 8-32 x $1\frac{1}{4}$ RHS	212-031
SOCKET, JEWEL LIGHT, RED	136-047
SPACER, INSUL. $\frac{3}{8}$ x $\frac{3}{8}$	361-001
SPACER, NYLON $\frac{1}{16}$ (For Ceramic Strip)	361-007
SPACER, NYLON $\frac{5}{16}$ (For Ceramic Strip)	361-009
SPACER, TEFLON, ROD, HOLE THRU	361-010
SPACER, MTR. BASE SN 188-up	361-012
STRIP, CERAMIC $\frac{3}{4}$ x 1 notch, clip mounted	124-100
TAG, VOLTAGE RATING	334-649
TAG, SERIAL NO. INSERT	334-679
TUBE, SPACER, $.196$ x $\frac{5}{16}$ x $\frac{7}{16}$	166-006
TUBE, SPACER, $.180$ x $\frac{1}{4}$ x $\frac{1}{2}$	166-035
WASHER, STEEL $6L$ x $\frac{3}{8}$ x $.032$	210-803
WASHER, STEEL $8S$ x $\frac{3}{8}$ x $.032$	210-804
WASHER, STEEL $10S$ x $\frac{7}{16}$ x $.036$	210-805
WASHER, RUBBER	210-873
WASHER, STEEL $.470$ x $2\frac{1}{32}$ x $.030$	210-902

PRIMARY CONNECTIONS
FOR 234V OPERATION



* C14A WAS C14, C14B WAS C15,
C14C WAS C16, C14D WAS C17,
C14E WAS C18.

SEE PARTS LIST FOR EARLIER
VALUES AND S/N CHANGES
OF PARTS MARKED

MRH
4-7-61

AA₁

TYPE 108 MERCURY PULSER

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

NOTE

We do not recommend the use of the Type 108 with systems having risetimes faster than 3.5 nanoseconds.