NOTE

The 10/11M1 was supposed to have been redesignated 067-0522-00, but it never happened. Instead the 10/11M1 was redesigned for the 647A and will work just as well in the 647. The new design is called 067-0544-00 and it replaces the 10/11M1.

John Mulvey
Product Technical Information
January, 1967

MODIFICATION SUMMARY

10/11M1

© 1965, Tektronix, Inc.
All Rights Reserved.

PULSER CAPACITORS CHANGED TO ASSURE MEETING FREQUENCY SPECIFICATIONS

See SQB

M8747

Effective Prod s/n 170

Usable in field instruments s/n 100-169

DESCRIPTION:

Assures meeting pulser frequency specifications by changing capacitors to tighten tolerance specifications. Pulse repetition rate ranges are 1-4 Hz, 250-750 Hz, 40-90 Hz and 400-900 Hz.

Parts Removed:

C113C	2.2μf	3 v	283-019
C113D	0.02μf	150 v	283-004

Parts Added:

C113C	2.2μf	20 v	290-136
C113D, C113F	0.01μf	250 v	283-079

Parts Required for Field Installation:

See 'Parts Added'.

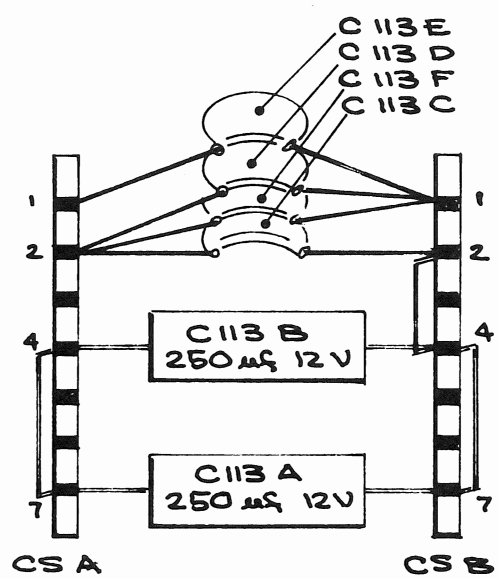
INSTALLATION INSTRUCTIONS:

a) Replace C113C located between CSA-2 and CSB-2, behind the PULSE AMPLITUDE potentiometer, with a 290-136 capacitor.

b) Replace C113D located between CSA-2 and CSB-1 with a 283-079 capacitor.

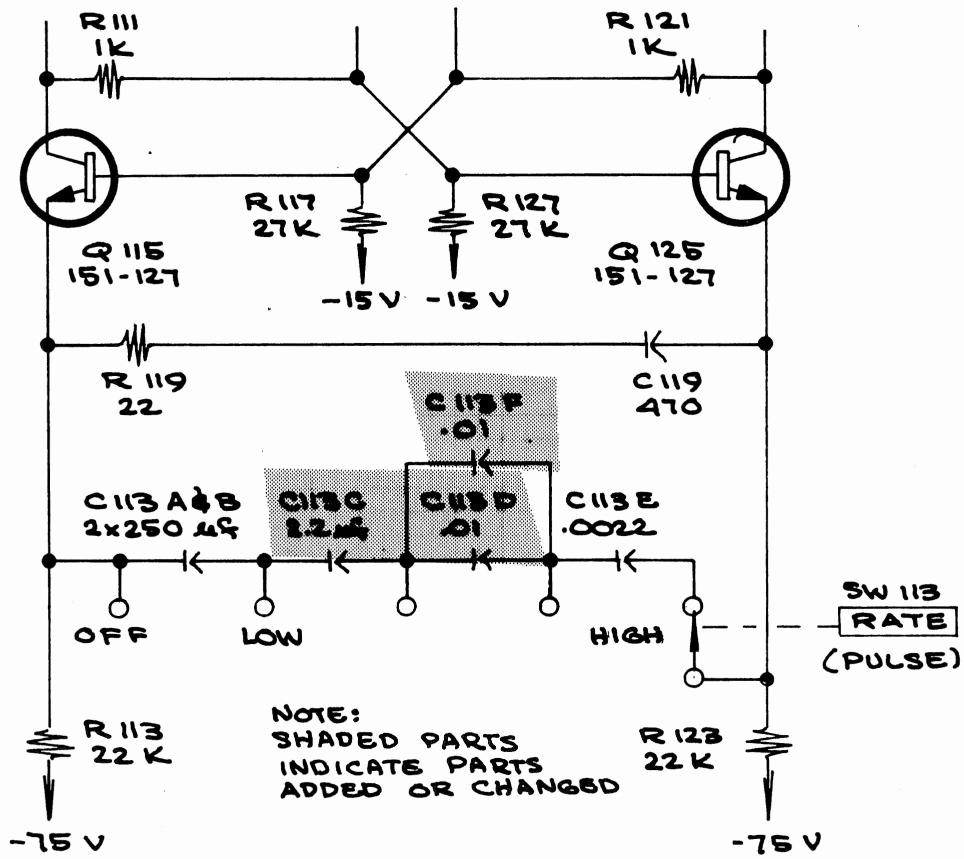
c) Add C113F, a 283-079 capacitor, located in parallel with C113D between CSA-2 and CSB-1.

Refer to drawing below and schematic on following page.



(continued)

M8747 (con'd)



TYPE 10/11 M1 TEST UNIT
PULSER CIRCUIT (PARTIAL)

PULSER DIODES CHANGED TO PROVIDE A COST SAVING — INFORMATION ONLY — M8831

Effective Prod s/n 170

DESCRIPTION:

Provides a cost savings by replacing diodes D170 and D192 in the pulser circuit with less expensive diodes.

Parts Removed:			Parts Added:		
D170, D192	1N3605	152-141	D170, D192	6185	152-185

LEVER KNOB MATERIAL CHANGED TO ELIMINATE DEFORMITY UNDER CERTAIN ENVIRONMENTAL CONDITIONS — See SQB — M9262

Effective Prod s/n 170 — Usable in field instruments SN 100-169

DESCRIPTION:

Changes the type of material used in the manufacture of the lever knob from a charcoal gray cycolac X7 styrene to charcoal gray delrin 500. The delrin 500 lever knobs will not deform when subjected to environmental conditions.

Parts Removed:		Parts Added:	
Knob, lever, cycolac X7 styrene	366-0215-00	Knob, lever, delrin 500	366-0215-01

Parts Required for Field Installation:

See 'Parts Added'.

INSTALLATION INSTRUCTIONS:

Replace the SOURCE switch lever knob with a new 366-0215-01 lever knob.

067-0522-00 REPLACED BY 067-0544-00 — INFORMATION ONLY — M11539

Effective Prod SN none given

FRONT PANEL SYMPTOM: None.

PROBLEM: The need for 067-0522-00 no longer exists because the 067-0544-00 test fixture can be used for both the Type 647 and 647A.

PRODUCTION CHANGE: The 067-0522-00 will cease to manufactured.

BE:fb

TEST UNIT Type 10/11M1

For Standardizing:

Type 647 and RM647 Oscilloscopes to achieve interchangeability with a number of 10 and 11-Series Plug-In Units.

For Setting:

Power supply voltages
Horizontal amplifier gain
Vertical amplifier gain
Vertical amplifier transient response

For Checking:

Power supply ripple and regulation under different load conditions.

The Type 10/11M1 is designed to operate from +15°C to +35°C and will perform to the following specifications throughout this range.

Oscilloscope gain can be adjusted to within ±0.3% accuracy for the horizontal amplifier and within ±0.7% for the vertical amplifier.

An internal fast-rise electronic pulser is adjustable in amplitude, polarity, and repetition rate. Pulse risetime is nominally 3 nsec. Time markers can be inserted through an external input.

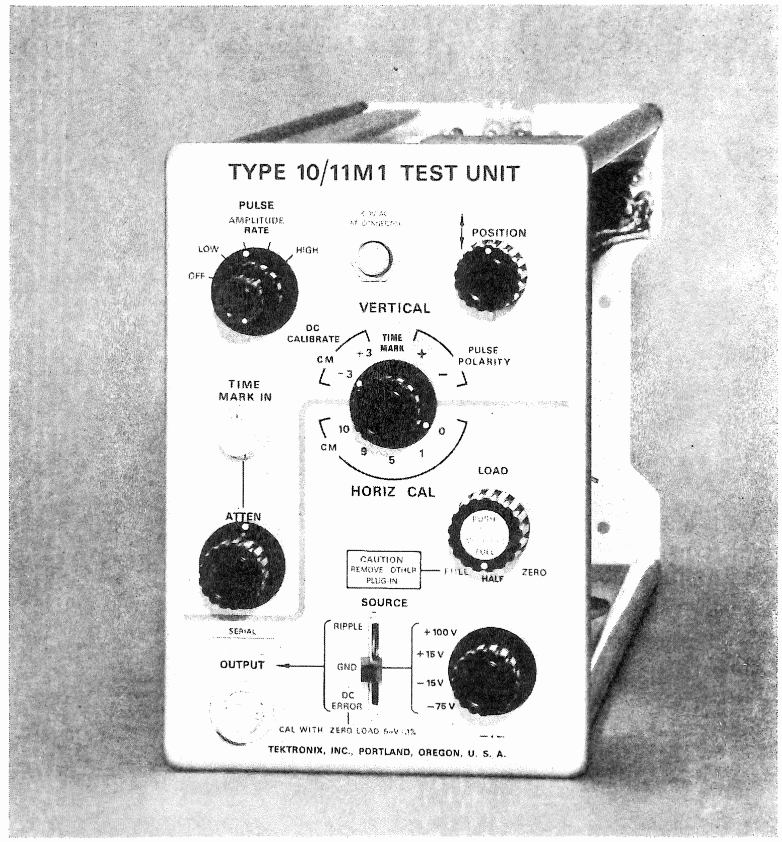
A front-panel output can be used in conjunction with a test oscilloscope to monitor dc error of the regulated power supplies. An output of 5 mv represents an error of 0.1%.

Non-operating environmental capabilities are identical to those of the Type 647.

Net weight is 4¾ lbs., shipping approx. 7 lbs.

TYPE 10/11M1 TEST UNIT

Each instrument includes: 2—instruction manuals (070-441).



TYPE 647 ACCESSORIES

PROBE CHARACTERISTICS WITH TYPE 10A2 AMPLIFIER				
PROBE	P6006	P6007	P6008	P6009
ATTENUATION RATIO	10X	100X	10X	100X
INPUT RESISTANCE	10 megohms	10 megohms	10 megohms	10 megohms
INPUT CAPACITANCE (typical)	6.7 pf	2.1 pf	7.7 pf	2.6 pf
TOTAL RISETIME	<10 nsec	<10 nsec	<8.1 nsec	<7.1 nsec
VOLTAGE RATING	600 volts dc or ac pk-to-pk*	1.5 kv dc or ac RMS, 4.2 kv ac pk-to-pk**	600 volts dc or ac pk-to-pk ***	1.5 kv dc or ac RMS, 4.2 kv ac pk-to-pk**
CABLE LENGTH	3.5'†	3.5'†	3.5'	9'
PART NUMBER	010-127	010-150	010-129	010-170

*Peak-to-peak voltage derating is necessary for CW frequencies higher than 5.7 Mc.
**Peak-to-peak voltage derating is necessary for CW frequencies higher than 200 kc.
***Peak-to-peak voltage derating is necessary for CW frequencies higher than 20 Mc.
†P6006 and P6007 Probes can be ordered in 6, 9, or 12 foot lengths at no additional cost. Longer lengths increase input capacitance and risetime.

For applications where increased input resistance, reduced loading of the circuit under test, and retention of maximum passband are required, P6008 and P6009 Probes are recommended. In applications where passband is not a prime consideration, P6006 and P6007 Probes can be used. All probes include a variety of tips for easy access to components, even in crowded circuit conditions. Easy adjustment is a feature of all probes. They are compensated by merely turning the probe body with respect to the probe base.

PLUG-IN EXTENSIONS

12" Rigid Extension (Part No. 013-077)
30" Flexible Extension (Part No. 012-080)

REAR-PANEL CONNECTOR

10-Pin Connector for remote single sweep reset and external use of power supply voltages (Part No. 131-300)

BNC to BSM ADAPTER

Converts front-panel outputs on the Type 11B2 to accept BNC cables (Part No. 103-036)

From 1964-65 Catalog
Please refer to Terms and Shipment, General Information page.

INSTRUCTION MANUAL

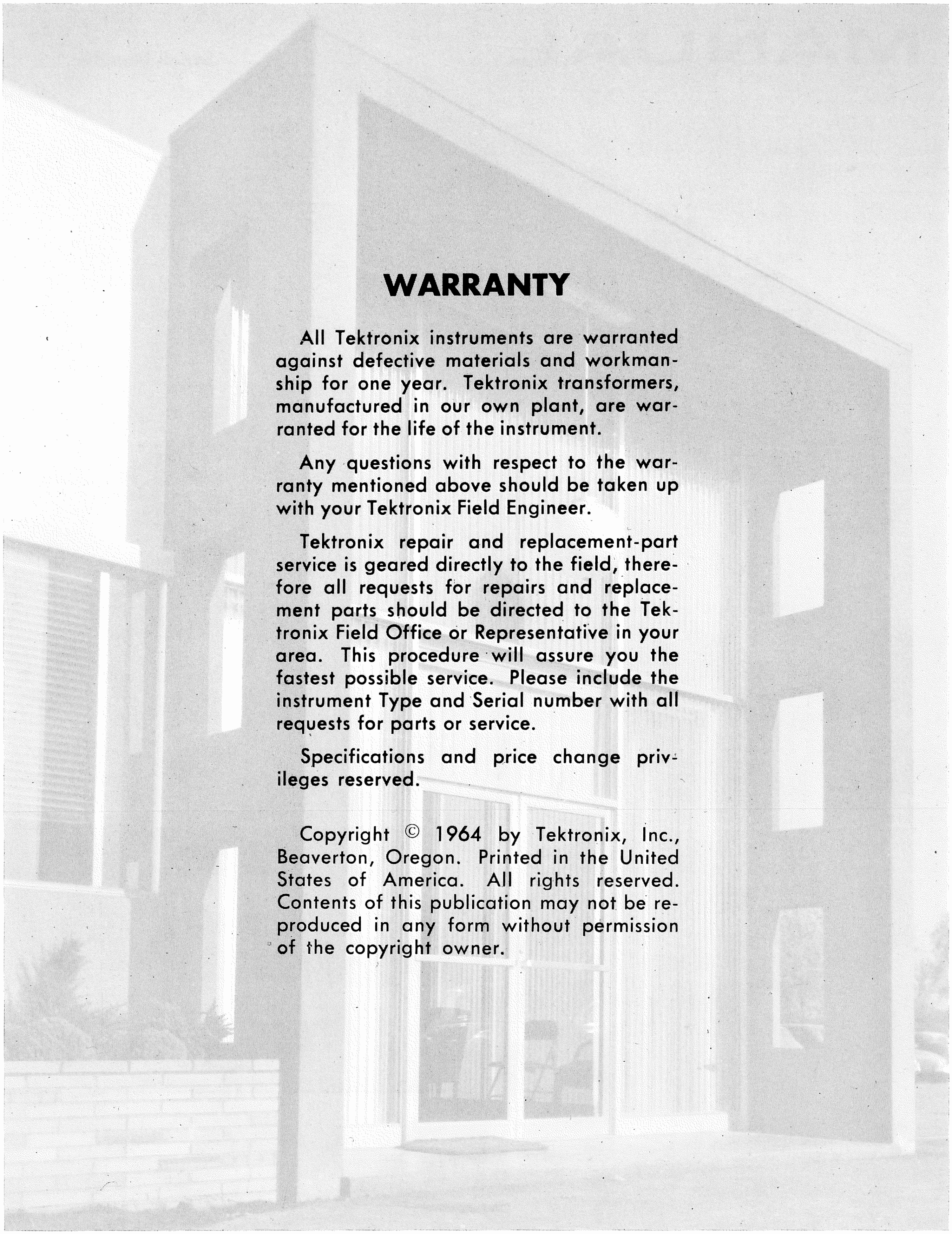
Serial Number ____________

TYPE 10/11M1 TEST UNIT

Tektronix, Inc.

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

070-441 664



WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.

Copyright © 1964 by Tektronix, Inc., Beaverton, Oregon. Printed in the United States of America. All rights reserved. Contents of this publication may not be reproduced in any form without permission of the copyright owner.

CONTENTS

Warranty

Section 1 Characteristics

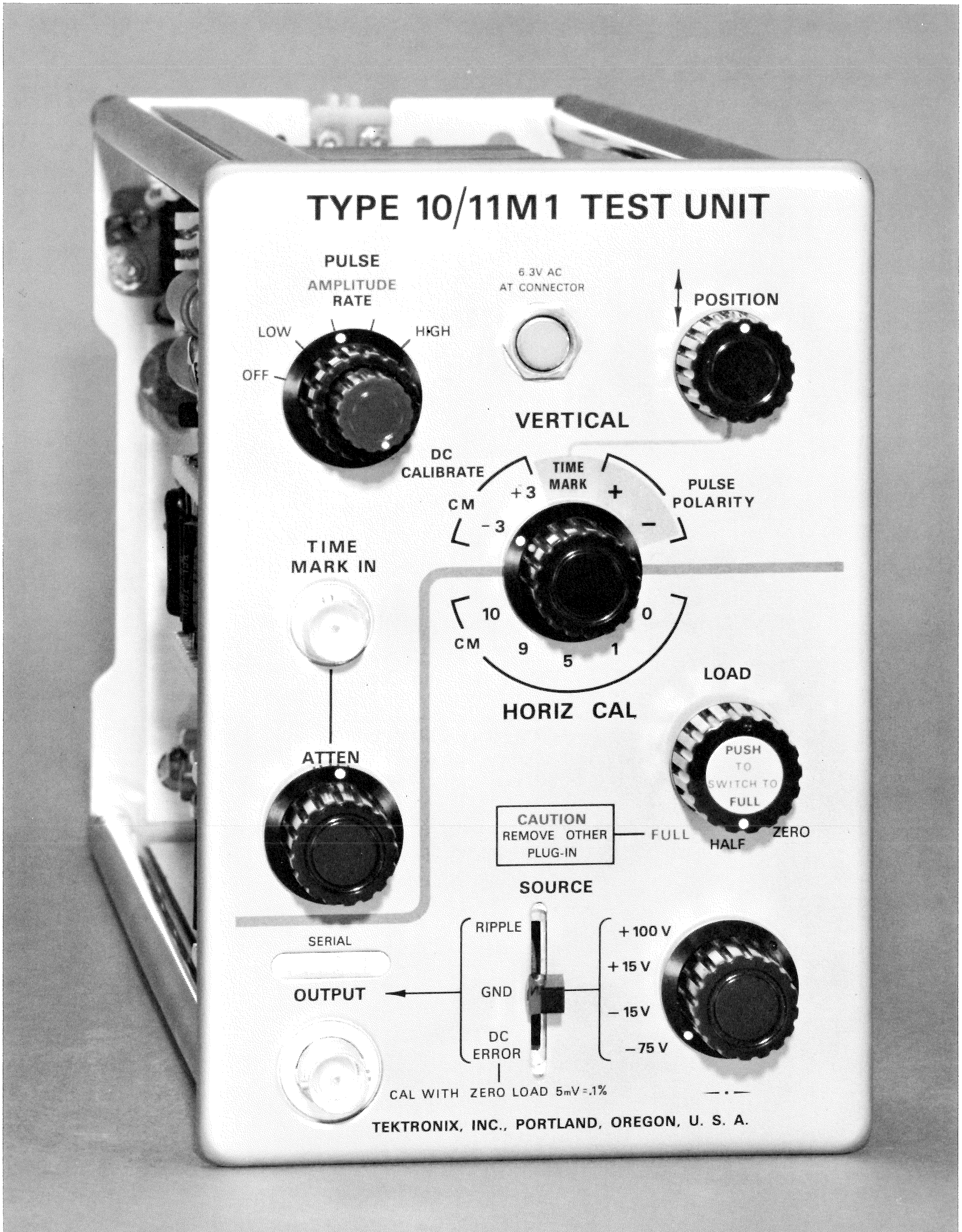
Section 2 Operating Instructions

Section 3 Circuit Description

Section 4 Maintenance and Calibration

Section 5 Parts List and Diagrams

A list of abbreviations and symbols used in this manual will be found on page 5-1. Change information, if any is located at the rear of the manual.



TYPE 10/11M1 TEST UNIT
PULSE
AMPLITUDE
RATE
LOW
HIGH
OFF
6.3V AC
AT CONNECTOR
POSITION
VERTICAL
DC
CALIBRATE
TIME
MARK
+3
+
PULSE
POLARITY
CM
-3
−
TIME
MARK IN
10
0
CM
9
5
1
HORIZ CAL
LOAD
PUSH
TO
SWITCH TO
FULL
ATTEN
CAUTION
REMOVE OTHER
PLUG-IN
FULL
HALF
ZERO
SOURCE
RIPPLE
+100 V
SERIAL
+15 V
OUTPUT
GND
−15 V
DC
ERROR
−75 V
CAL WITH ZERO LOAD 5mV=.1%
TEKTRONIX, INC., PORTLAND, OREGON, U. S. A.

SECTION 1
CHARACTERISTICS

General Description

The Type 10/11M1 Test Unit is a single-unit calibration aid for the Type 647 or Type RM647 Oscilloscope. The unit is designed to calibrate and standardize both the vertical and horizontal circuitry of the Type 647. The Type 10/11M1 aids in setting the oscilloscope: (1) power supply voltages, (2) horizontal amplifier gain, (3) vertical amplifier gain, and (4) vertical amplifier transient response. The 10/11M1 aids in checking: (1) regulation of the power supplies at different load conditions, and (2) power supply ripple. In addition, an external time-mark signal may be applied to the Type 10/11M1 for calibrating or checking the sweep rates of the time-base unit used with the Type 647.

Specifications

VERTICAL DC CALIBRATE Accuracy	±0.7%
HORIZ CAL Accuracy	±0.4%
Pulser Risetime	Less than 3.3 nsec, nominally 3 nsec
Pulser Repetition Rates	1-4 cps, 250-750 cps, 40-90 kc, and 400-900 kc
Pulser Amplitude	Variable, 0-8 cm
Flatness	±0.5% after first 8 nsec
Ringing	Less than 2% peak-to-peak (at frequencies above 300 mc)
TIME MARK INPUT Sensitivity	Less than 150 mv/cm
TIME MARK INPUT Bandwidth	Typically 3-db down below 7 kc and above 50 mc
TIME MARK INPUT Maximum Voltage	100 volts
POSITION Control Range	At least ±3 cm
DC ERROR Sensitivity	5 mv per 0.1% error
DC ERROR Accuracy	±0.25% absolute
Mechanical	Aluminum alloy chassis. Dimensions (overall): $14\frac{1}{2}''$ (L) × $6\frac{1}{4}''$ (H) × $4\frac{1}{4}''$ (W). Weight: Approx. 4 lbs. 10 ozs.
Environmental	Meets all non-operating environmental specifications of the Type 647 Oscilloscope. Calibration accuracy specifications apply within a temperature range of 15° to 35°C.

Accessories

Information on accessories for use with this instrument is included at the rear of the mechanical parts list.

NOTES

SECTION 2

OPERATING INSTRUCTIONS

FUNCTION OF FRONT-PANEL CONTROLS AND CONNECTORS

PULSE AMPLITUDE — Control for adjusting pulse height when the VERTICAL switch is set to one of the PULSE POLARITY positions.

PULSE RATE — A five-position switch concentric with the PULSE AMPLITUDE control. Sets the repetition rate of the pulse when the VERTICAL switch is set to one of the PULSE POLARITY positions. The pulser is turned off when the switch is set to OFF.

6.3V AC AT CONNECTOR — Lamp that lights to indicate the presence of 6.3 V AC voltage at interconnecting plug.

POSITION — Vertically positions the display when the plug-in unit is in the vertical opening of the oscilloscope and the VERTICAL switch is set to either TIME MARK or the PULSE POLARITY positions. The POSITION control has no effect when the VERTICAL switch is set DC CALIBRATE or when the Type 10/11M1 is in the horizontal plug-in compartment.

VERTICAL/HORIZ CAL — The positions labeled around the upper half of this switch apply and are in effect when the Type 10/11M1 is in the vertical plug-in compartment. Function of each position is as follows:

DC CALIBRATE positions (—3 CM and +3 CM) provide an accurate amount of deflection above and below the centerline for setting the gain of the vertical amplifier of the Type 647. When the vertical gain of the Type 647 is being set with a Type 10/11M1, an 11-series time base must be inserted in the horizontal plug-in compartment of the oscilloscope.

TIME MARK position allows an external time-mark signal to be connected to the TIME MARK IN connector and be displayed on the oscilloscope.

PULSE POLARITY positions (+ and —) reverse the polarity of the signal from the pulser.

The positions labeled around the lower half of this switch apply and are in effect when the Type 10/11M1 is in the horizontal plug-in compartment. The HORIZ CAL positions of the switch provide the indicated amount of horizontal deflection for setting the centering and gain of the horizontal amplifier. When the horizontal centering and gain of the Type 647 are being set with a Type 10/11M1, the oscilloscope vertical plug-in compartment may be left empty.

TIME MARK IN — Connector for applying an external time-mark signal when the VERTICAL/HORIZ CAL switch is set to TIME MARK.

ATTEN — Variable attenuator for the signal applied to the TIME MARK IN connector.

LOAD — Three-position switch that selects the amount of loading on the power supply of the oscilloscope.

SOURCE — Two switches that determine the signal information appearing at the OUTPUT connector. The voltage SOURCE switch selects the desired power supply voltage of the oscilloscope. The other SOURCE switch determines what check may be made on a given supply voltage. In the RIPPLE position, the selected supply voltage is ac coupled to the OUTPUT connector. This blocks the dc component of the supply and allows only the ac or ripple voltage to appear at the OUTPUT connector. The GND position gives a convenient ground-reference without disconnecting and grounding the monitoring oscilloscope. The DC ERROR position compares the selected power supply voltage to an accurate reference voltage and couples the difference to the OUTPUT connector. A zero volt reading at the OUTPUT connector indicates that the power supply voltage is correct. A voltage reading at the OUTPUT connector indicates the power supply is incorrect (0.1% per 5 mv).

OUTPUT — Output connector for monitoring the information selected by the SOURCE switches.

OPERATION

Specific operating information on the use of the Type 10/11M1 for calibrating and standardizing the Type 647 Oscilloscope is given in the oscilloscope instruction manual. The information presented in this manual is a general discussion on the various capabilities of the Type 10/11M1 Test Unit.

The Type 10/11M1 is most useful where more than one Type 647 is to be calibrated and standardized. In such a case, the gain, transient response, and power supplies of the oscilloscopes will be matched to a very high degree. This insures that the plug-in units used with the Type 647 can be freely interchanged from one oscilloscope to another without having to recalibrate the plug-in units.

Oscilloscope Transient Response

The pulser contained in the Type 10/11M1 Test Unit provides a fast-rise pulse for setting or checking the transient response of the oscilloscope. The risetime of this pulse is typically 3 nsec. To observe the output signal of the pulser on the oscilloscope, insert the Type 10/11M1 into the left-hand plug-in compartment and a time-base plug-in unit into the right-hand opening. Then, set the VERTICAL control of the Type 10/11M1 to either + or —. When operating in the + position, use the positive-going edge of the displayed waveform to adjust oscilloscope transient response. When the VERTICAL control is set to —, use the negative-going edge of the waveform for transient response adjustments. The PULSE AMPLITUDE and RATE controls determine the amplitude and repetition rate of the Pulser. Set the controls of the time-base plug-in unit for a stable internally triggered display at the desired sweep rate. Once the time base is properly triggered, triggering will be unaffected by positioning or amplitude changes with the Type 10/11M1.

Oscilloscope Vertical Deflection

The DC CALIBRATE positions of the VERTICAL switch provide an accurate dc signal that shifts the position of a free-running trace three divisions above or below the graticule centerline when the gain and centering of the Type 647 vertical amplifier are properly set. To insure correct average horizontal deflection voltage and vertical deflection sensitivity when this check or adjustment is made, the Type 10/11M1 must be in the oscilloscope vertical plug-in compartment, and an 11-series time base must be in the horizontal plug-in compartment.

Displaying Time-Mark Signals

With the VERTICAL switch set to TIME MARK, an external time-mark signal may be applied to the TIME MARK IN connector for checking or calibrating the sweep rates of a time-base unit used with the Type 647. The ATTEN control varies the displayed amplitude of the signal applied to the TIME MARK IN connector and the POSITION control positions the display vertically on the screen. Whenever it is desired to display a signal applied to the TIME MARK IN connector, the Type 10/11M1 must be in the vertical plug-in compartment of the oscilloscope.

Horizontal Deflection Calibration

The 0, 1, 5, 9, and 10 positions of the HORIZ CAL switch provide accurate dc levels that shift the position of a displayed dot the indicated number of centimeters to the right on the screen. The 0 position corresponds to the first vertical graticule line on the left-hand side of the screen. In the oscilloscope, the HORIZ GAIN and HORIZ CENT adjustments must be set to make the position of the displayed dot correspond to the settings of the HORIZ CAL switch. For this check or adjustment, the Type 10/11M1 must be in the horizontal plug-in compartment of the oscilloscope.

Power Supply Checks and Adjustments

The two SOURCE switches allow ripple and dc error measurements to be made on each of the four regulated power supplies in the oscilloscope. These measurements and adjustments will be made while monitoring the signal voltage at the OUTPUT connector. Each of the measurements and adjustments is explained briefly in the following paragraphs.

Ripple Check. With the SOURCE switches set up for ripple measurement, the selected supply voltage is ac coupled to the OUTPUT connector of the Type 10/11M1. The ripple measurement at the OUTPUT connector should be measured with a highly sensitive peak-to-peak voltmeter or oscilloscope. Ripple checks can be made on each power supply in the oscilloscope at different load conditions as selected by the LOAD switch.

CAUTION

The Type 10/11M1 must be the only plug-in unit installed in the oscilloscope when the LOAD switch is set to FULL. Otherwise, the oscilloscope power supplies will be overloaded.

Voltage Check. The DC ERROR position provides a means of measuring the voltage of each oscilloscope power supply. The voltage amplitude at the OUTPUT connector is proportional to the per cent of voltage error of the power supply. Each 5-millivolt multiple at the OUTPUT connector represents 0.1% error in the supply voltage. For example, a voltage reading of +10 millivolts at the OUTPUT connector would indicate that the supply being checked is actually 0.2% higher than nominal.

When checking or adjusting the supplies in the oscilloscope, start with the —75-volt supply since this supply serves as a reference voltage for the other supplies in the oscilloscope. If the —75-volt supply is incorrect, the other supplies will also be incorrect.

Multi-Trace Sync Pulse Check. A placarded test point in the Type 10/11M1 allows a check of the multi-trace sync pulse from a time-base plug-in unit. This sync pulse should appear at the end of each sweep of the time-base plug-in unit. For this check, the Type 10/11M1 Test Unit must be in the left-hand opening and the time-base plug-in unit must be in the right-hand opening of the oscilloscope. Also, the left-hand side panel of the oscilloscope must be removed to gain access to the multi-trace sync test point in the Type 10/11M1.

SECTION 3
CIRCUIT DESCRIPTION

General Description

The Type 10/11M1 contains a vertical input amplifier stage, a variable repetition rate fast-rise square-wave pulser, dummy load resistors, and accurate dc voltage circuits for calibrating gain and power supply voltages of the oscilloscope. The unit (and schematics) has two sections; Vertical and Horizontal. The Vertical circuitry appears on the schematic titled "Pulser Circuit" and the Horizontal circuitry appears on the schematic titled "Power Supply and Horizontal Calibration". In the following discussion, refer to the appropriate schematic to locate the components mentioned.

Pulser Circuit Schematic

The following discussion deals with all the circuitry that appears on the "Pulser Circuit" schematic.

Input Amplifier. The input amplifier, (or time-mark amplifier) is a conventional single-stage transistor amplifier with a grounded emitter and loaded collector. The amplifier (Q194) is feedback stabilized through R194. Voltage gain of the stage is about 1.33×. The input signal (or time mark) is applied to the TIME MARK IN connector (J190) and is ac coupled to potentiometer R191 (ATTEN). The center arm of the potentiometer is coupled to the base of Q194. The diode D192 is connected to the base of Q194 to limit the negative voltage at this point.

The output signal from the collector of Q194 passes through C188 to the vertical amplifier of the oscilloscope when the VERTICAL/HORIZ CAL switch is set to TIME MARK. The signal from the collector of Q194 also passes through C198 to the time-base plug-in unit as an internal trigger signal.

Pulser Circuit. The Pulser circuit consists of a variable-frequency astable multivibrator Q115/Q125, current-switching transistors Q134/Q144, and disconnect diodes D132, D133, D142, and D143. When the PULSE RATE switch is set to any position except OFF, the multivibrator free runs at a rate determined by the capacitance selected by the PULSE RATE switch. Q164 and Q174 are common-base stages which pass the differential current signal developed by the pulser and shift it to the proper dc level.

As the multivibrator flips back and forth, Q115 and Q125 are alternately turned on and off. The signal developed across R114 (from the collector of Q115) is coupled to the time-base plug-in unit for use as an internal trigger signal. The signal from the collector of Q125 turns Q144 on and off. Since Q144 is in series with Q134, both transistors turn on and off simultaneously. (Q134 has essentially a fixed voltage on its base due to D124.) The differential current supplied through R130 and R140 is either shunted through transistors Q134 and Q144 or is conducted through the diodes D132, D133, D142, and D143. When the transistors Q134 and Q144 are "on" the diodes are "off". When the transistors are "off" the diodes are "on". Amplitude control R135 varies the amplitude of this switched differential current. The emitters of the grounded base transistors Q164 and Q174 present a low impedance and offer a summing point for the switched differential current, through R133 and R143; the positioning current, through R148 and R158; and the fixed bias current, through R161 and R171. The speed and quality of the "switching on" of the transistors Q134 and Q144 is better than "switching off" and the former step transition should be used for transient response adjustments. This transition can be recognized as the transition from the level variable with the amplitude control to the level variable only with position control.

RC networks R164/C164 and R174/C174 provide thermal balance on both sides of the push-pull circuit. This prevents distorting voltages due to thermal shift with dissipation changes in the transistors.

Power Supply and Horizontal Calibration

Load Circuitry. Dummy load resistors are used in the Type 10/11M1 to check the oscilloscope power supply under different loading conditions. The LOAD switch, SW290, selects one of three loading conditions: ZERO, HALF, and FULL. In the ZERO position of the load switch, the only power drawn from the oscilloscope is that required for the Pulser circuit and the companion plug-in unit (if any). With the LOAD switch in the HALF position the approximate loading on the power supplies is as follows: —75-volt supply, 7 watts; —15-volt supply, 3.75 watts; +15-volt supply, 11 watts; +100-volt supply, 8 watts; +300-volt supply, 4.5 watts. With the LOAD switch in the FULL position, loading is as follows: —75-volt supply, 14.3 watts; —15-volt supply, 5.6 watts; +15-volt supply, 21.4 watts; +100-volt supply, 15.9 watts; +300-volt supply, 9 watts.

CAUTION

The Type 10/11M1 must be the only plug-in unit in the oscilloscope when the LOAD switch is in the FULL position; otherwise the power supplies of the oscilloscope will be overloaded.

Horiz Cal Circuitry. The Horiz Cal circuitry is a precision dc current source for calibrating the gain of the horizontal amplifier in the oscilloscope. Sensitivity of the horizontal amplifier in the oscilloscope is 347 μa per division of deflection. Each 54 k resistor (R265 and R267) in the circuit can be thought of as supplying the proper amount of current for deflecting the oscilloscope beam exactly 4 divisions (centimeters). Each 216 k resistor (R264 and R269) deflects the beam 1 division (centimeter). The HORIZ CAL switch arranges the precision resistors in various ways to obtain 0, 1, 5, 9, and 10 divisions of deflection on the crt.

Dc Error Circuitry. The Dc Error circuitry checks the voltage of each power supply in the oscilloscope. The voltage at the OUTPUT connector of the Type 10/11M1 is proportional to a percentage of error in a given supply when the function switch is set to DC ERROR (i.e., each 5 millivolts at the OUTPUT connector equals 0.1% error in the supply voltage that is being checked).

Operation of the Dc Error circuitry is as follows: the circuit contains two Zener-regulated voltage dividers with nominal output voltages of +9 volts and −9 volts. The +9-volt divider is regulated by Zener diode D206 and the −9-volt divider is regulated with D214. These two voltages are used as the reference voltages when checking the various supply voltages of the oscilloscope. The +SUPPLY REF and −SUPPLY REF adjustments vary the dividers slightly so that they are in the range of adjustment of all of the CALIB adjustments (R220, R230, R240, and R250). This is necessary because of the voltage tolerance of the Zener diodes (D206 and D214). The voltage of each regulated supply in the oscilloscope is coupled through a resistance divider in the Error circuit. Each of these voltage dividers is designed to reduce the voltage of each supply to either + or −9 volts, depending on the polarity of the supply. The negative supply voltages are compared to the +9-volt reference and the positive supply voltages are compared to the −9-volt reference. The algebraic sum of the comparison of each supply voltage is coupled to the OUTPUT connector of the Type 10/11M1. The algebraic sum of the comparison will be exactly zero volts when there is no error in the supply voltage (i.e., (+9 v) + (−9 v) = 0 v). Fig. 3-1 shows a simplified drawing of the Error circuit with the +100-volt supply connected for comparison.

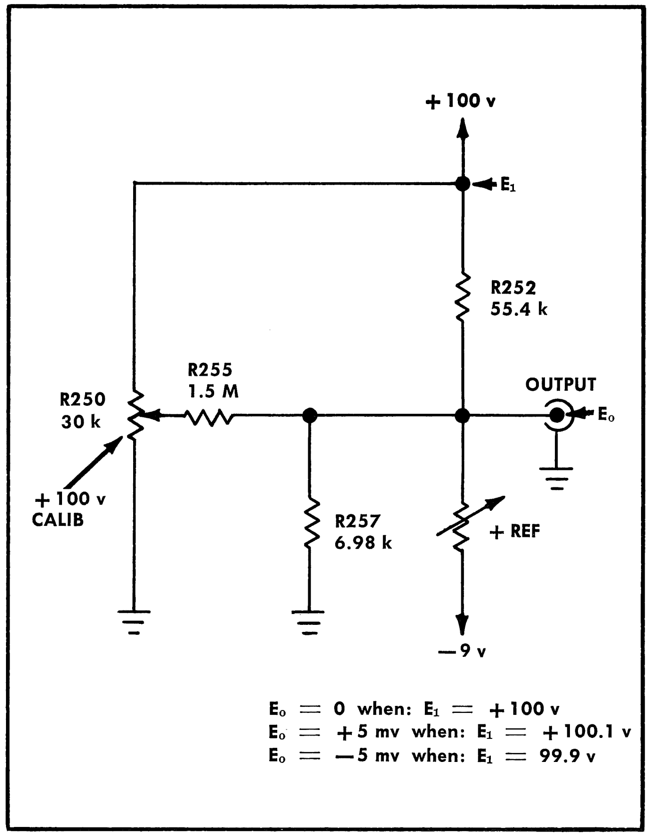


Fig. 3-1. Simplified schematic of the Error circuit with the +100-volt supply connector for comparison.

SECTION 4
MAINTENANCE AND CALIBRATION

MAINTENANCE

Visual Inspection

The instrument should be visually inspected occasionally for such defects as poor connections, broken or damaged ceramic terminal strips, improperly seated transistors, and heat-damaged parts. The remedy for most of these defects is obvious. But a heat-damaged component is usually the symptom of some defect that is not obvious. The cause of overheating should be determined and corrected before the part is replaced, otherwise the damage may be repeated.

Transistor Checks

Periodic preventive maintenance checks on the transistors in the Type 10/11M1 are not recommended. Satisfactory operation of the instrument in all respects is adequate assurance that the transistors are performing properly

Recalibration

To insure that the Type 10/11M1 maintains its accuracy, check the calibration after each 500 hours of operation or every six months if used intermittently. Complete calibration instructions appear later in this section.

The calibration procedure can also be helpful in isolating troubles in the instrument. Also, minor troubles in the instrument that may not be apparent during normal operation may be revealed and corrected during calibration.

Ordering Parts

Many of the components in the Type 10/11M1 are standard electronic parts that may be purchased locally. However, all parts in the instrument can be obtained from Tektronix through your local Tektronix Field Engineer or Field Office. Before ordering, consult the parts list of this manual to determine the value, tolerance, and rating required.

Some of the parts used in the Type 10/11M1 are not standard parts and can only be purchased from Tektronix through your local Tektronix Field Engineer or Field Office.

Soldering to Ceramic Strips

Special silver-bearing solder is used to establish a bond to ceramic terminal strips in Tektronix instruments. This bond can be broken by repeated soldering (especially if ordinary tin-lead solder is used) or by excessive heating. The silver-bearing solder used should contain about 3% silver. Silver-bearing solder is usually available locally or may be purchased from Tektronix in one-pound rolls; order by part number 251-514.

When soldering to ceramic terminal strips:

1. Use a wedge-shaped soldering iron tip about 1/8 inch wide. This will allow you to apply heat directly to the solder in the notch and thereby reduce the overall heating effect.

2. Maintain a clean, properly tinned tip.

3. Use a hot iron for a short time. A 50- to 75-watt iron is usually adequate.

4. Avoid putting pressure on the strip with the soldering iron or other tools. Excessive pressure can crack or chip the strip.

Replacing Ceramic Terminal Strips

Fig. 4-1 shows an assembled ceramic terminal strip. Replacement strips with studs attached are supplied under a single part number and the spacers under another number. The original spacers may be reused if they are not damaged. Usually, the old strip can be pried or pulled out of the chassis with a pair of pliers. In some cases, you may choose to use a hammer and punch to drive the studs out of the chassis.

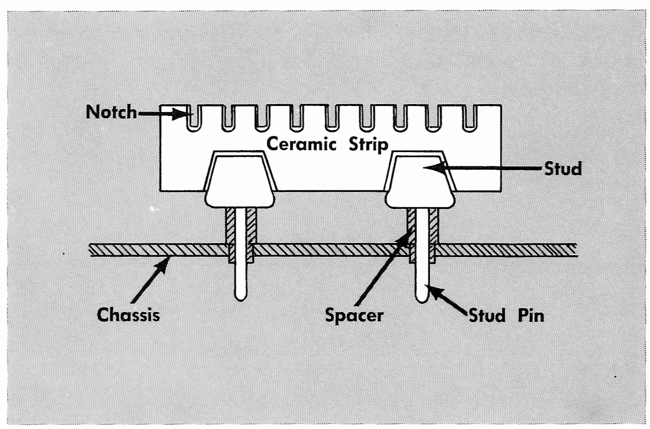


Fig. 4-1. Ceramic strip assembly.

Once the damaged strip has been removed, place the new or used (but undamaged) spacers in the chassis holes. Then carefully force the studs of the new strip into the spacers until they are completely seated. If necessary, use a soft-faced mallet and lightly tap the strip directly over the stud to seat the studs in the spaces.

Replacing Wafer Switches

Individual wafers are normally not replaced in the wafer switches. Complete switch assemblies, either wired or unwired, may be ordered from Tektronix. See the Parts List, Section 5 of this manual.

When soldering leads to a switch, do not let solder flow around and beyond the terminal rivet since this can destroy the spring tension of the contact.

Troubleshooting Aids

The Type 10/11M1 contains certain features intended to speed and simplify troubleshooting and maintenance. Most of the wire in the instrument is color coded to aid in circuit tracing. All regulated power supply leads are coded as follows:

1. The basic wire color indicates voltage polarity; tan for negative and white for positive.

2. The stripe colors indicate supply voltage according to the standard EIA color code. Stripes are read in the order of decreasing width.

For example, the —75-volt supply leads are tan wire (negative) bearing stripes of violet (seven), green (five), and black (no zero).

The instrument contains a number of stable metal-film resistors identified by their gray background color and color-coding. If a resistor has three significant figures and a multiplier, it will be EIA color coded. If it has four significant figures and multiplier, the value will be printed on the body of the resistor. For example, a 333 k resistor will be color coded but a 333.5 k resistor will have its value printed on the resistor body. The color coding sequence is shown in Table 4-1 and Fig. 4-2.

Switch wafers shown on the schematics are coded to indicate the physical positions of the wafers on a rotary switch. The number portion of the code refers to the wafer position as counted from the front- or driven-end of the switch shaft. Letters F and R identify the front or rear of a given wafer.

Several diode types are used in the Type 10/11M1. Fig 4-3 shows how to identify the polarity of the various diodes.

TABLE 4-1

Color Code Sequence

Color	1st Sig. Fig.	2nd Sig. Fig.	3rd Sig. Fig.	Multiplier	(±) % Tolerance
Black	0	0	0	1	—
Brown	1	1	1	10	1
Red	2	2	2	100	2
Orange	3	3	3	1,000	—
Yellow	4	4	4	10,000	—
Green	5	5	5	100,000	0.50
Blue	6	6	6	1,000,000	0.25
Violet	7	7	7	10,000,000	0.10
Gray	8	8	8	100,000,000	0.05
White	9	9	9	1,000,000,000	—
Gold	—	—	—	0.1	5
Silver	—	—	—	0.01	—
No Color	—	—	—	—	10

CALIBRATION

Introduction

This portion of the manual contains a complete calibration procedure for the Type 10/11M1 Test Unit. The instrument will not require frequent calibration but will need occasional adjustments as components age or are replaced.

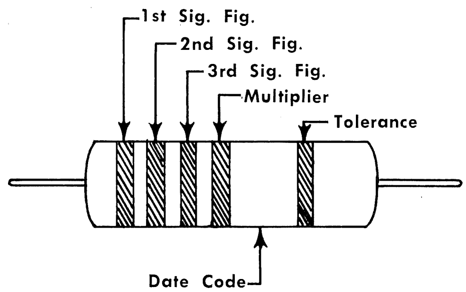


Fig. 4-2. Standard EIA color code for metal-film resistors.

Calibration is a valuable part of preventive maintenance since many types of minor troubles may be discovered and corrected before they become serious enough to disable the instrument. Also, certain troubles can be easily isolated to a particular section of the instrument by attempting calibration.

Equipment Required

1. Calibrated Tektronix Type 647 or Type RM647 Oscilloscope (plug-in extension required with Type RM647).

2. Calibrated Tektronix Type 11B-series time-base plug-in unit.

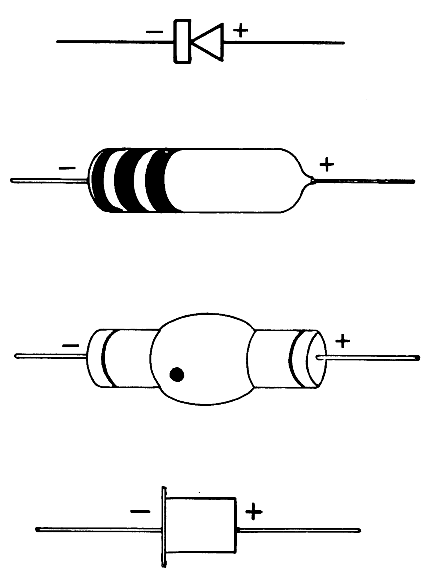


Fig. 4-3. Typical diode polarities.

3. Dc differential voltmeter such as a John Fluke Model 803 or equivalent. Accuracy of at least ±0.05% at readings of 15 volts, 75 volts, and 100 volts.

4. Test oscilloscope such as a Tektronix Type 530- or 540-series with a Type D Plug-In Unit. The oscilloscope must be dc coupled and have a deflection factor of 1 mv/cm.

5. A source of line voltage within the regulating range of the Type 647 Oscilloscope.

Preliminary Procedure

1. Insert the Type 10/11M1 into the left-hand plug-in compartment of the Type 647 Oscilloscope. (The right-hand compartment should be empty.)

2. Apply line power to the Type 647 and turn on its POWER ON switch.

3. Allow at least 5 minutes for the Type 647 to warm up and stabilize.

4. Set the front-panel controls of the Type 10/11M1 and Type 647 as follows:

Type 10/11M1

PULSE RATE	OFF
POSITION	Centered
VERTICAL HORIZ CAL	TIME MARK
LOAD	ZERO
Other controls	Any position

Type 647

1 KC CALIBRATOR	OFF
INTENSITY	ccw
ON OFF	POWER ON
Other controls	Any position

Check and Adjustment Procedure

Dc Error Calibration. This procedure describes how to set the +SUPPLY REF, —SUPPLY REF, —75 V CALIB, —15 V CALIB, +15 V CALIB and +100 V CALIB adjustments. This is accomplished by first setting the power supplies of the Type 647 with the accurate differential voltmeter. Then, the Type 10/11M1 adjustments are set to match the power supplies of the Type 647. The complete procedure is as follows:

1. Connect the precision differential voltmeter (item 3 under "Equipment Required") to the —75-volt supply in the Type 647 Oscilloscope.

NOTE

The —75-volt supply leads in the oscilloscope are color coded: tan wire with a violet stripe, a green stripe, and a black stripe.

2. Adjust the —75-volt power supply adjustments in the oscilloscope for a null of exactly 75 volts on the differential voltmeter.

3. Repeat steps 1 and 2 for the —15-, +15-, and +100-volt supplies of the Type 647 Oscilloscope. The supply leads are color coded as follows:

—15-volt supply	tan wire with a brown stripe, green stripe, and a black stripe.
+15-volt supply	white wire with a brown stripe, green stripe, and black stripe.
+100-volt supply	white wire with two brown stripes and a black stripe.

4. Connect the test oscilloscope (item 4 of "Equipment Required") to the OUTPUT connector of the Type 10/11M1.

5. Free run the test oscilloscope and set the SOURCE function switch of the Type 10/11M1 to GND.

6. Establish a ground reference on the test oscilloscope by positioning the free-running trace to the horizontal centerline.

7. Set the SOURCE function of the Type 10/11M1 to DC ERROR.

8. Switch the SOURCE voltage switch of the Type 10/11M1 alternately between the —75 V and —15 V positions and set the deflection factor of the test oscilloscope so that the trace is on the screen in both positions of the SOURCE voltage switch. Do not move the POSITION control of the test oscilloscope as this will destroy the ground reference.

9. Adjust the —SUPPLY REF potentiometer in the Type 10/11M1 for approximately equal and opposite deflection above and below the ground reference point on the oscilloscope.

10. Repeat steps 8 and 9 using the +100 V and +15 V positions of the SOURCE voltage switch and adjust the +SUPPLY REF potentiometer in the Type 10/11M1 for approximately equal and opposite deflection above and below the ground reference point on the oscilloscope.

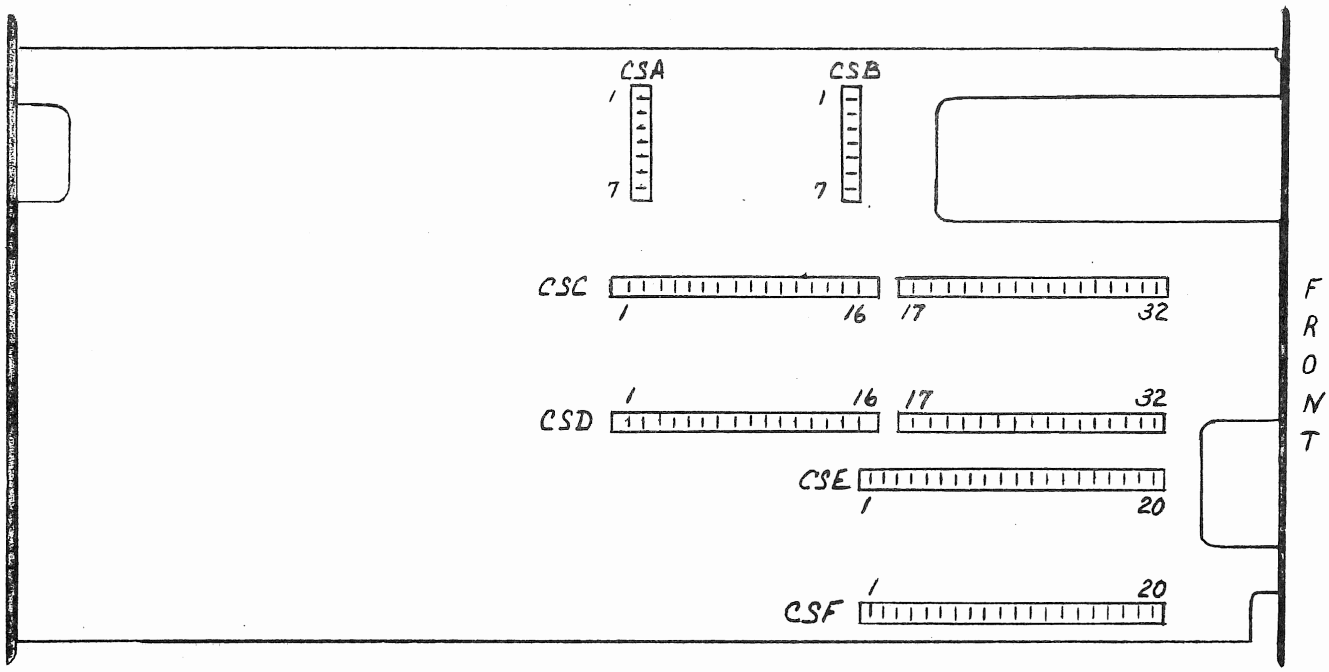
11. While switching between the GND and DC ERROR positions of the SOURCE function switch, adjust each of the CALIB adjustments of the Type 10/11M1 to within ±5 millivolts as measured on the test oscilloscope. See the following:

SOURCE Voltage Switch Setting	Adjust
—75 V	R220, —75 V CALIB
—15 V	R230, —15 V CALIB
+15 V	R240, +15 V CALIB
+100 V	R250, +100 V CALIB

12. Disconnect the test oscilloscope from the OUTPUT connector.

NOTES

STRIP LAYOUT –
067-0522-00 (10/11M1)



CHASSIS – 610·127

MOD #	M9319	
DATE	4-8-66	
KIT #	ALL	

8/26/64

SECTION 5
PARTS LIST and DIAGRAMS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

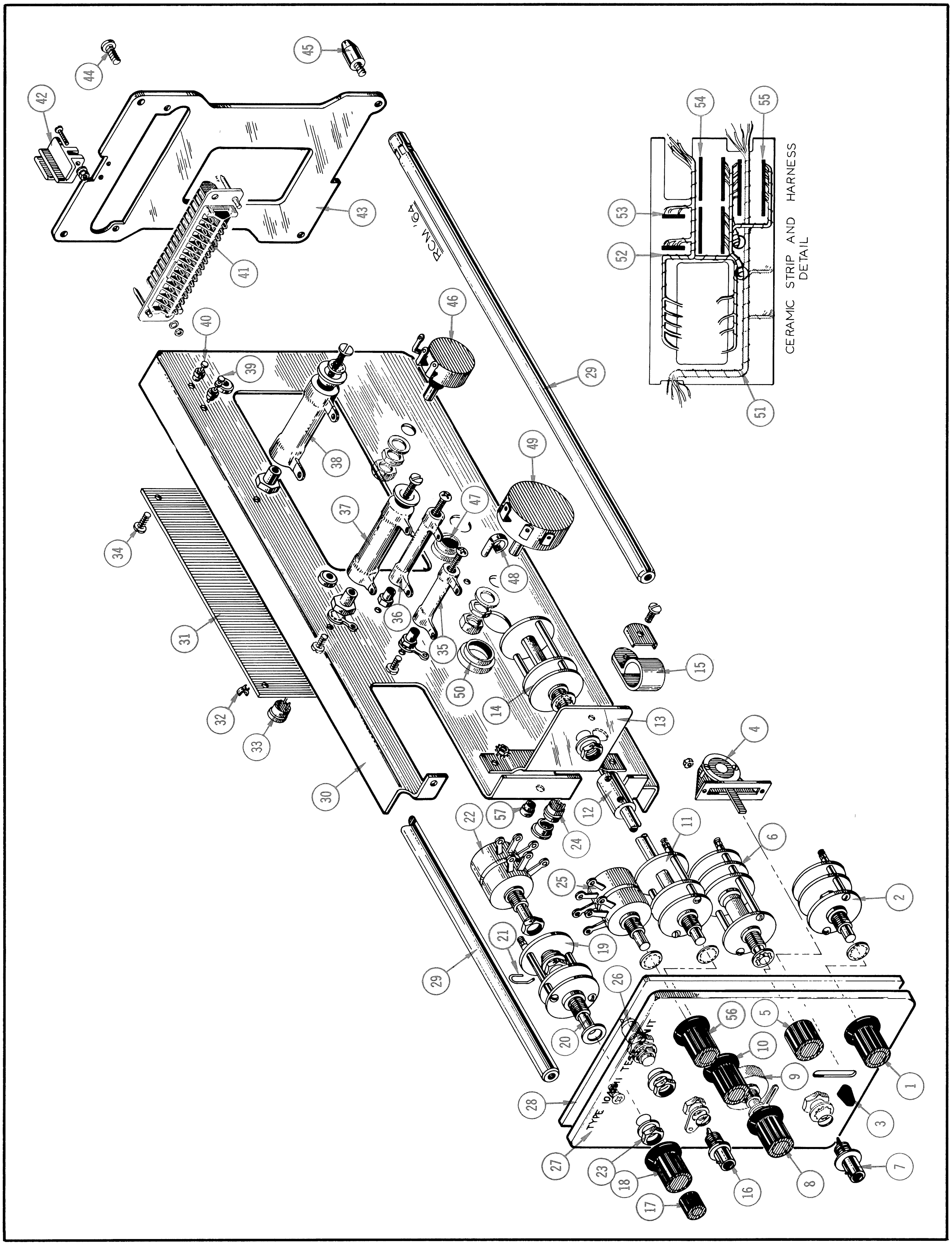
ABBREVIATIONS AND SYMBOLS

a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle
mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

EXPLODED VIEW



Ⓐ

EXPLODED VIEW

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	366-0173-00			1	KNOB, small charcoal — SOURCE VOLTAGE
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x $^3/_{16}$ inch HSS
2	260-0630-00			1	SWITCH, unwired — SOURCE VOLTAGE
	- - - - - -			-	Mounting Hardware: (not included)
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ x $^1/_2$ inch
	210-0840-00			1	WASHER, .390 ID x $^9/_{16}$ inch OD
	210-0413-00			1	NUT, hex, $^3/_8$-32 x $^1/_2$ inch
3	366-0215-00	100	169	1	KNOB, lever — SOURCE FUNCTION
	366-0215-01	170		1	KNOB, lever — SOURCE FUNCTION
4	260-0490-00			1	SWITCH, lever — SOURCE FUNCTION
	- - - - - -			-	Mounting Hardware: (not included)
	210-0586-00			2	NUT, keps, 4-40 x $^1/_4$ inch
5	366-0280-00			1	KNOB, small charcoal — LOAD
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x $^3/_{16}$ inch HSS
6	260-0626-00			1	SWITCH, unwired — LOAD
	- - - - - -			-	Mounting Hardware: (not included)
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ x $^1/_2$ inch
	210-0840-00			1	WASHER, .390 ID x $^9/_{16}$ inch OD
	210-0413-00			1	NUT, hex, $^3/_8$-32 x $^1/_2$ inch
7	131-0274-00			1	CONNECTOR, chassis mounted, BNC, with hardware
8	366-0173-00			1	KNOB, small charcoal — ATTEN
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x $^3/_{16}$ inch HSS
9	- - - - - -			1	POT
	- - - - - -			-	Mounting Hardware: (not included)
	210-0207-00			1	LUG, solder, $^3/_8$ inch
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ x $^1/_2$ inch
	210-0840-00			1	WASHER, .390 ID x $^9/_{16}$ inch OD
	210-0413-00			1	NUT, hex, $^3/_8$-32 x $^1/_2$ inch
10	366-0172-00			1	KNOB, small charcoal — VERTICAL/HORIZ CAL
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x $^3/_{16}$ inch HSS
11	262-0672-00			1	SWITCH, wired — HORIZ CAL
	- - - - - -			-	Includes:
	260-0629-00			1	SWITCH, unwired — HORIZ CAL
	- - - - - -			-	Mounting Hardware: (not included)
	210-0012-00			1	LOCKWASHER, internal, $^3/_8$ x $^1/_2$ inch
	210-0840-00			1	WASHER, .390 ID x $^9/_{16}$ inch OD
	210-0413-00			1	NUT, hex, $^3/_8$-32 x $^1/_2$ inch
12	376-0007-00			1	COUPLING
	- - - - - -			-	Includes:
	213-0005-00			2	SCREW, set, 8-32 x $^1/_8$ inch HSS
13	407-0068-00			1	BRACKET, switch
	- - - - - -			-	Mounting Hardware: (not included)
	211-0510-00			2	SCREW, 6-32 x $^3/_8$ inch BHS
	210-0457-00			2	NUT, 6-32 x $^5/_{16}$ inch

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	Q T Y.	DESCRIPTION
14	262-0671-00			1	SWITCH, wired — VERTICAL
	- - - - - -			-	Includes:
	260-0628-00			1	SWITCH, unwired — VERTICAL
	- - - - - -			-	Mounting Hardware: (not included)
	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ x $^{1}/_{2}$ inch
	210-0840-00			1	WASHER, .390 ID x $^{9}/_{16}$ inch OD
	210-0413-00			1	NUT, hex, $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
15	343-0007-00			1	CLAMP, cable, $^{5}/_{8}$ inch
	- - - - - -			-	Mounting Hardware: (not included)
	210-0863-00			1	WASHER, "D" type, #10
	211-0507-00			1	SCREW, 6-32 x $^{5}/_{16}$ inch BHS
16	131-0106-00			1	CONNECTOR, chassis mounted, BNC
	- - - - - -			-	Mounting Hardware: (not included)
	210-0255-00			1	LUG, solder, $^{3}/_{8}$ inch
	210-0413-00			1	NUT, hex, $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
17	366-0189-00			1	KNOB, small red — AMPLITUDE
	- - - - - -			-	Includes:
	213-0020-00			1	SCREW, set, 6-32 x $^{1}/_{8}$ inch HSS
18	366-0175-00			1	KNOB, small charcoal — PULSE RATE
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x $^{3}/_{16}$ inch HSS
19	262-0670-00			1	SWITCH, wired — PULSE RATE
	- - - - - -			-	Includes:
	260-0627-00			1	SWITCH, unwired — PULSE RATE
20	384-0323-00			1	ROD, extension
21	376-0014-00			1	COUPLING, pot
22	- - - - - -			1	POT
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			2	NUT, hex, $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ x $^{1}/_{2}$ inch
23	- - - - - -			-	Mounting Hardware For Switch Assembly: (not included)
	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ x $^{1}/_{2}$ inch
	210-0840-00			1	WASHER, .390 ID x $^{9}/_{16}$ inch OD
	210-0413-00			1	NUT, hex, $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
24	136-0181-00			1	SOCKET, 3 pin transistor
	- - - - - -			-	Mounting Hardware: (not included)
	354-0234-00			1	RING, locking, transistor socket
25	- - - - - -			1	POT
	- - - - - -			-	Mounting Hardware: (not included)
	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ x $^{1}/_{2}$ inch
	210-0840-00			1	WASHER, .390 ID x $^{9}/_{16}$ inch OD
	210-0413-00			1	NUT, hex, $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
26	136-0164-00			1	SOCKET, lamp
	- - - - - -			-	Mounting Hardware: (not included)
	210-0413-00			1	NUT, hex, $^{3}/_{8}$-32 x $^{1}/_{2}$ inch
	210-0012-00			1	LOCKWASHER, internal, $^{3}/_{8}$ x $^{1}/_{2}$ inch
	210-0978-00			1	WASHER, $^{3}/_{8}$ ID x $^{1}/_{2}$ inch OD
	210-0590-00			1	NUT, hex, $^{3}/_{8}$-32 x $^{7}/_{16}$ inch
27	333-0862-00			1	PANEL, front
28	387-0981-00			1	PLATE, front sub-panel
29	384-0615-00			4	ROD, spacer

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
30	441-0584-00			1	CHASSIS, aluminum
	- - - - - -			-	Mounting Hardware: (not included)
	211-0507-00			3	SCREW, 6-32 x 5/16 inch BHS
	211-0538-00			3	SCREW, 6-32 x 5/16 inch FHS phillips
31	670-0067-00			1	ASSEMBLY, printed circuit board
	- - - - - -			-	Includes:
32	344-0064-00			8	CLIP, diode
33	136-0183-00			4	SOCKET, 3 pin transistor
	- - - - - -			-	Mounting Hardware For Circuit Board Assy: (not included)
34	211-0008-00	100	169	4	SCREW, 4-40 x 1/4 inch BHS
	211-0116-00	170		4	SCREW, sens, 4-40 x 5/16 inch PHB
35	- - - - - -			1	RESISTOR, 8 watt
	- - - - - -			-	Mounting Hardware: (not included)
	211-0545-00			1	SCREW, 6-32 x 1 1/4 inches THS phillips
	210-0478-00			1	NUT, hex, resistor mounting
	210-0206-00			1	LUG, solder, SE10 long
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
36	- - - - - -			3	RESISTOR, 10 watt
	- - - - - -			-	Mounting Hardware For Each: (not included)
	211-0553-00			1	SCREW, 6-32 x 1 1/2 inches RHS phillips
	210-0601-00			1	EYELET
	210-0478-00			1	NUT, hex, resistor mounting
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
37	- - - - - -			1	RESISTOR, 20 watt
	- - - - - -			-	Mounting Hardware: (not included)
	212-0037-00			1	SCREW, 8-32 x 1 3/4 inches Fil HS
	210-0808-00			1	WASHER, centering
	210-0462-00			1	NUT, hex, resistor mounting
	210-0206-00			1	LUG, solder, SE10 long
	212-0004-00			1	SCREW, 8-32 x 5/16 inch BHS
38	- - - - - -			6	RESISTOR, 25 watt
	- - - - - -			-	Mounting Hardware For Each: (not included)
	212-0037-00			1	SCREW, 8-32 x 1 3/4 inches Fil HS
	210-0008-00			1	LOCKWASHER, internal, #8
	210-0809-00			1	WASHER, centering
	210-0462-00			1	NUT, hex, resistor mounting
	212-0004-00			1	SCREW, 8-32 x 5/16 BHS
39	131-0359-00			1	CONNECTOR, terminal feed-thru
	- - - - - -			-	Mounting Hardware: (not included)
	358-0176-00			1	BUSHING, teflon
40	131-0227-00			1	CONNECTOR, terminal standoff
	- - - - - -			-	Mounting Hardware: (not included)
	358-0176-00			1	BUSHING, teflon
41	131-0096-00			1	CONNECTOR, chassis mounted, 32 contact, male
	- - - - - -			-	Mounting Hardware: (not included)
	211-0008-00			2	SCREW, 4-40 x 1/4 inch BHS
	210-0201-00			2	LUG, solder, SE4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
42	351-0063-00			2	GUIDE, shoe, plug-in latch
	- - - - - -			-	Mounting Hardware For Each: (not included)
	211-0012-00			2	SCREW, 4-40 x 3/8 inch BHS
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch

EXPLODED VIEW *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
43	387-0777-00			1	PLATE, rear
	- - - - - -			-	Mounting Hardware: (not included)
44	212-0044-00			2	SCREW, 8-32 x 1/2 inch RHS phillips
45	214-0370-00			2	PIN, locating
46	- - - - - -			5	POT
	- - - - - -			-	Mounting Hardware For Each: (not included)
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	220-0427-00			1	NUT, jam, 3/8-32 x 1/2 x 7/32 inch thick
47	348-0063-00			1	GROMMET, delrin, 1/2 inch
48	343-0089-00			1	CLAMP, cable, size "D"
49	- - - - - -			1	POT
	- - - - - -			-	Mounting Hardware: (not included)
	210-0013-00			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
	220-0427-00			1	NUT, jam, 3/8-32 x 1/2 x 7/32 inch thick
50	348-0064-00			1	GROMMET, delrin, 5/8 inch
51	179-0936-00			1	CABLE HARNESS, coaxial
52	179-0935-00			1	CABLE HARNESS, chassis
53	124-0149-00			2	STRIP, ceramic, 7/16 inch x 7 notches
	- - - - - -			-	Each Includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0009-00			2	SPACER, nylon, .313 inch
54	124-0146-00			4	STRIP, ceramic, 7/16 inch x 16 notches
	- - - - - -			-	Each Includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0009-00			2	SPACER, nylon, .313 inch
55	124-0145-00			2	STRIP, ceramic, 7/16 inch x 20 notches
	- - - - - -			-	Each Includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	Mounting Hardware For Each: (not included)
	361-0009-00			2	SPACER, nylon, .313 inch
56	366-0148-00			1	KNOB, small charcoal — POSITION
	- - - - - -			-	Includes:
	213-0004-00			1	SCREW, set, 6-32 x 3/16 inch HSS
57	348-0055-00			2	GROMMET, delrin, 1/4 inch
					STANDARD ACCESSORIES
	070-0441-00			2	MANUAL, instruction (not shown)

ELECTRICAL PARTS

Values are fixed unless marked Variable.

Ckt. No.	Tektronix Part No.	Description				S/N Range

Bulb

B289	150-043	Bulb Ass'y, Incandescent	6.3 V AC AT CONNECTOR			

Capacitors

Tolerance ±20% unless otherwise indicated.
Tolerance of all electrolytic capacitors as follows (with exceptions):

3 V — 50 V = —10%, +250%
51 V — 350 V = —10%, +100%
351 V — 450 V = —10%, +50%

Ckt. No.	Tektronix Part No.	Description				S/N Range
C111	281-518	47 pf	Cer	500 v		
C113A	290-217	250 μf	EMT	12 v		
C113B	290-217	250 μf	EMT	12 v		
C113C	Use 290-136	2.2 μf	EMT	20 v		
C113D	283-004	0.02 μf	Cer	150 v		100-169
	283-079	0.01 μf	Cer	250 v		170-up
C113E	283-028	0.0022 μf	Cer	50 v		
C113F	283-079	0.01 μf	Cer	250 v		X170-up
C119	281-525	470 pf	Cer	500 v		
C121	281-518	47 pf	Cer	500 v		
C130	283-057	0.1 μf	Cer	200 v		
C136	281-544	5.6 pf	Cer	500 v	10%	
C150	283-081	0.1 μf	Cer	25 v	—20% +80%	
C161	283-081	0.1 μf	Cer	25 v	—20% +80%	
C164	283-003	0.01 μf	Cer	150 v		
C171	283-081	0.1 μf	Cer	25 v	—20% +80%	
C174	283-003	0.01 μf	Cer	150 v		
C176	290-106	10 μf	EMT	15 v	—10% +75%	
C180	285-633	0.22 μf	PTM	100 v	10%	
C188	285-555	0.1 μf	PTM	100 v		
C190	283-008	0.1 μf	Cer	500 v		
C192	281-616	6.2 pf	Cer	200 v		
	281-616	6.8 pf	Cer	200 v		
C198	285-598	0.01 μf	PTM	100 v	5%	
C199	281-523	100 pf	Selected			
C259	285-528	0.1 μf	PTM	600 v		

Diodes

D124	*152-075	Germanium	Tek Spec			
D132 D142	*152-193	Tek GaAs (1 pair)				
D133 D143	*152-193	Tek GaAs (1 pair)				

Diodes *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description				S/N Range
D170	Use *152-185	Silicon	Replaceable by 1N3605			
D192	Use *152-185	Silicon	Replaceable by 1N3605			
D201	†152-124	Zener	1N938A	9 v (0.001%/°C)		
D202	†152-124	Zener	1N938A	9 v (0.001%/°C)		
D206	†152-174	Zener	1N938A	9 v (0.001%/°C)	Selected	
D214	†152-174	Zener	1N938A	9 v (0.001%/°C)	Selected	

Connectors

J190	131-106	Chassis Mt., 1 Contact, Female, BNC
J259	131-274	Chassis Mt., Insulated, BNC

Inductor

L194	*108-088	3.2 μh

Transistors

Q115	*151-127	Selected from 2N2369
Q125	*151-127	Selected from 2N2369
Q134	151-097	2N955
Q144	151-107	2N967
Q164	*151-127	Selected from 2N2369
Q174	*151-127	Selected from 2N2369
Q194	*151-127	Selected from 2N2369

Resistors

Resistors are fixed, composition, ±10% unless otherwise indicated.

R111	315-102	1 k	¼ w			5%
R113	301-223	22 k	½ w			5%
R114	315-101	100 Ω	¼ w			5%
R115	315-131	130 Ω	¼ w			5%
R117	315-273	27 k	¼ w			5%
R119	316-220	22 Ω	¼ w			
R121	315-102	1 k	¼ w			5%
R123	301-223	22 k	½ w			5%
R124	302-102	1 k	½ w			
R125	315-181	180 Ω	¼ w			5%
R127	315-273	27 k	¼ w			5%
R130	322-189	909 Ω	¼ w		Prec	1%
R133	321-068	49.9 Ω	⅛ w		Prec	1%
R135	311-007	2 x 1 k	2 w	Var		AMPLITUDE (Pulse)
R136	321-101	110 Ω	⅛ w		Prec	1%
R140	322-189	909 Ω	¼ w		Prec	1%
R143	321-068	49.9 Ω	⅛ w		Prec	1%
R148	322-222	2 k	¼ w		Prec	1%
R150	311-007	2 x 1 k	2 w	Var		POSITION
R152	315-362	3.6 k	¼ w			5%

†Temperature Compensated.

Resistors *(Cont'd)*

Ckt. No.	Tektronix Part No.	Description					S/N Range
R153	315-242	2.4 k	1/4 w			5%	
R155	315-122	1.2 k	1/4 w			5%	
R158	322-222	2 k	1/4 w		Prec	1%	
R161	323-607	600 Ω	1/2 w		Prec	1%	
R162	315-362	3.6 k	1/4 w			5%	
R163	315-242	2.4 k	1/4 w			5%	
R164	321-115	154 Ω	1/8 w		Prec	1%	
R165	315-122	1.2 k	1/4 w			5%	
R167	322-094	93.1 Ω	1/4 w		Prec	1%	
R170	302-102	1 k	1/2 w				
R171	323-607	600 Ω	1/2 w		Prec	1%	
R174	321-115	154 Ω	1/8 w		Prec	1%	
R176	322-085	75 Ω	1/4 w		Prec	1%	
R177	322-094	93.1 Ω	1/4 w		Prec	1%	
R182	323-685	52.7 k	1/2 w		Prec	1/4%	
R183	323-682	195.7 Ω	1/2 w		Prec	1/4%	
R185	323-683	1.86 k	1/2 w		Prec	1/4%	
R186	323-684	1.928 k	1/2 w		Prec	1/4%	
R190	302-105	1 meg	1/2 w				
R191	311-005	500 Ω	2 w	Var		ATTEN	
R192	316-561	560 Ω	1/4 w				
R194	316-102	1 k	1/4 w				
R195	315-202	2 k	1/4 w			5%	
R197	302-331	330 Ω	1/2 w				
R199	315-101	100 Ω	1/4 w			5%	
R201	308-092	4.5 k	5 w		WW	5%	
R202	308-322	970 Ω	1/2 w		WW	1%	
R204	308-185	7 k	1/2 w		WW	1%	
R206	308-226	10 k	1/2 w		WW	1%	
R208	311-488	10 k	4 w	Var		—SUPPLY REF	
R214	308-185	7 k	1/2 w		WW	1%	
R215	308-185	7 k	1/2 w		WW	1%	
R216	308-226	10 k	1/2 w		WW	1%	
R218	311-488	10 k	4 w	Var		+SUPPLY REF	
R220	311-490	30 k	2 w	Var		—75 V CALIB	
R222	323-276	7.32 k	1/2 w		Prec	1%	
R225	323-498	1.5 meg	1/2 w		Prec	1%	
R227	308-327	41.6 k	1/2 w		WW	1%	
R230	311-489	15 k	2 w	Var		—15 V CALIB	
R232	323-328	25.5 k	1/2 w		Prec	1%	
R235	322-610	500 k	1/4 w		Prec	1%	
R237	308-325	8.32 k	1/2 w		WW	1%	
R240	311-489	15 k	2 w	Var		+15 V CALIB	
R242	308-325	8.32 k	1/2 w		WW	1%	
R245	322-610	500 k	1/2 w		Prec	1%	

Resistors *(Cont'd)*

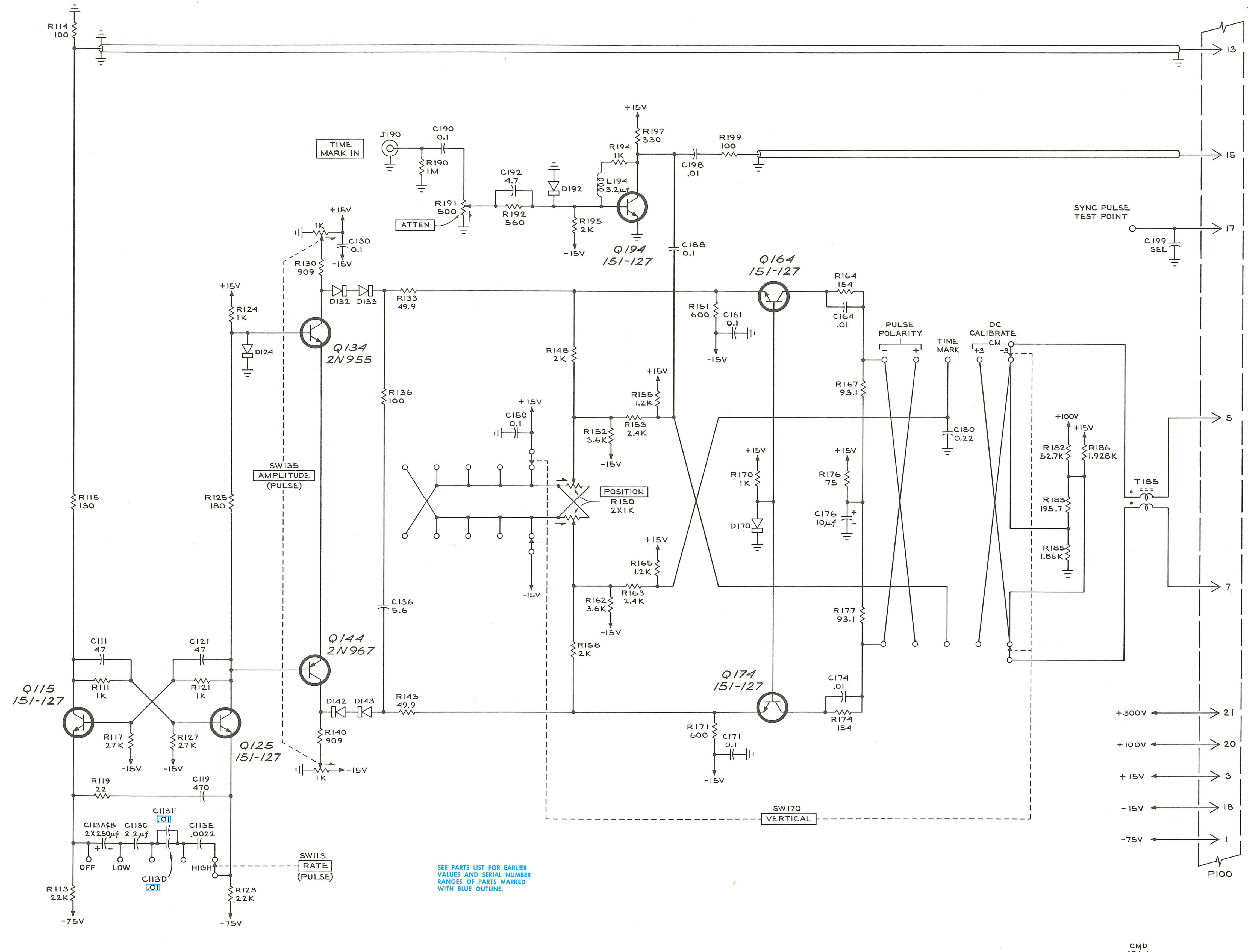
Ckt. No.	Tektronix Part No.	Description					S/N Range
R247	323-328	25.5 k	½ w		Prec	1%	
R250	311-490	30 k	2 w	Var		+100 V CALIB	
R252	308-328	55.4 k	½ w		WW	1%	
R255	323-498	1.5 meg	½ w		Prec	1%	
R257	323-274	6.98 k	½ w		Prec	1%	
R259	*308-090	0.25 Ω	1 w		WW		
R260	323-291	10.5 k	½ w		Prec	1%	
R262	323-382	93.1 k	½ w		Prec	1%	
R264	308-309	216 k	¼ w		WW	¼%	
R265	308-308	54 k	¼ w		WW	1/10%	
R267	308-308	54 k	¼ w		WW	1/10%	
R269	308-309	216 k	¼ w		WW	¼%	
R270	323-291	10.5 k	½ w		Prec	1%	
R272	323-382	93.1 k	½ w		Prec	1%	
R291A	308-155	800 Ω	25 w		WW	5%	
R291B	308-029	400 Ω	20 w		WW	5%	
R291C	305-223	22 k	2 w			5%	
R293A	308-160	60 Ω	8 w		WW	5%	
R293B	308-012	40 Ω	10 w		WW	5%	
R295A	308-233	25 Ω	25 w		WW	5%	
R295B	308-174	117 Ω	8 w		WW	5%	
R295C	308-188	3 Ω	25 w		WW	5%	
R295D	308-184	7.5 Ω	25 w		WW	5%	
R295E	308-165	0.5 Ω	5 w		WW	5%	
R297A	308-102	1.25 k	25 w		WW	5%	
R297B	308-053	8 k	5 w		WW	5%	
R297C	308-147	750 Ω	25 w		WW	5%	
R299A	308-025	20 k	10 w		WW	5%	
R299B	308-023	10 k	10 w		WW	5%	

Switches

	Unwired	Wired		
SW113	260-627	*262-670	Rotary	RATE (PULSE)
SW170	260-628	*262-671	Rotary	VERTICAL
SW250	260-630		Rotary	SOURCE (SUPPLY)
SW259	260-490		Lever	SOURCE (MODE)
SW270	260-629	*262-672	Rotary	HORIZ CAL
SW290	260-626		Rotary	LOAD

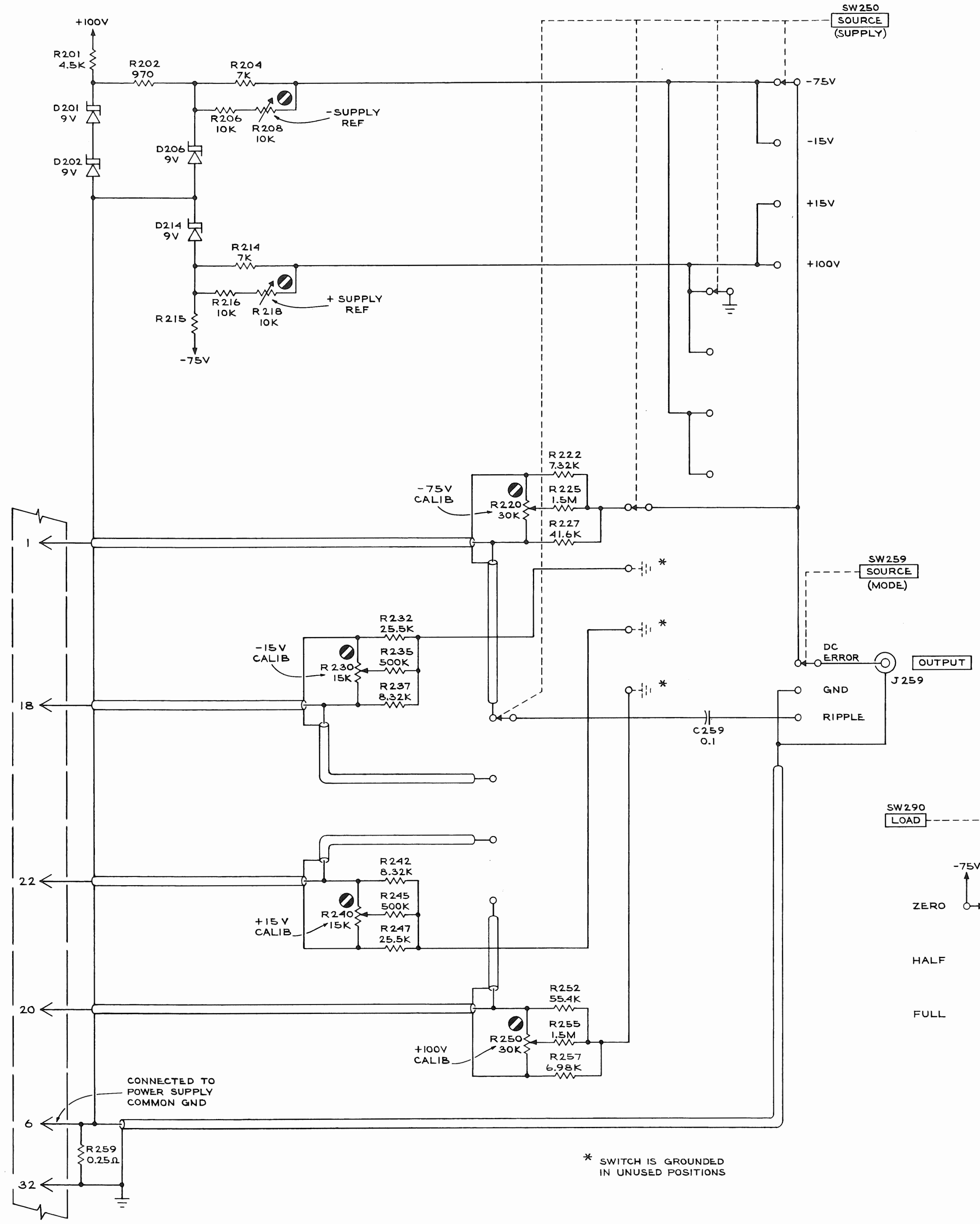
Transformer

T185	276-541	Core, Ferrite

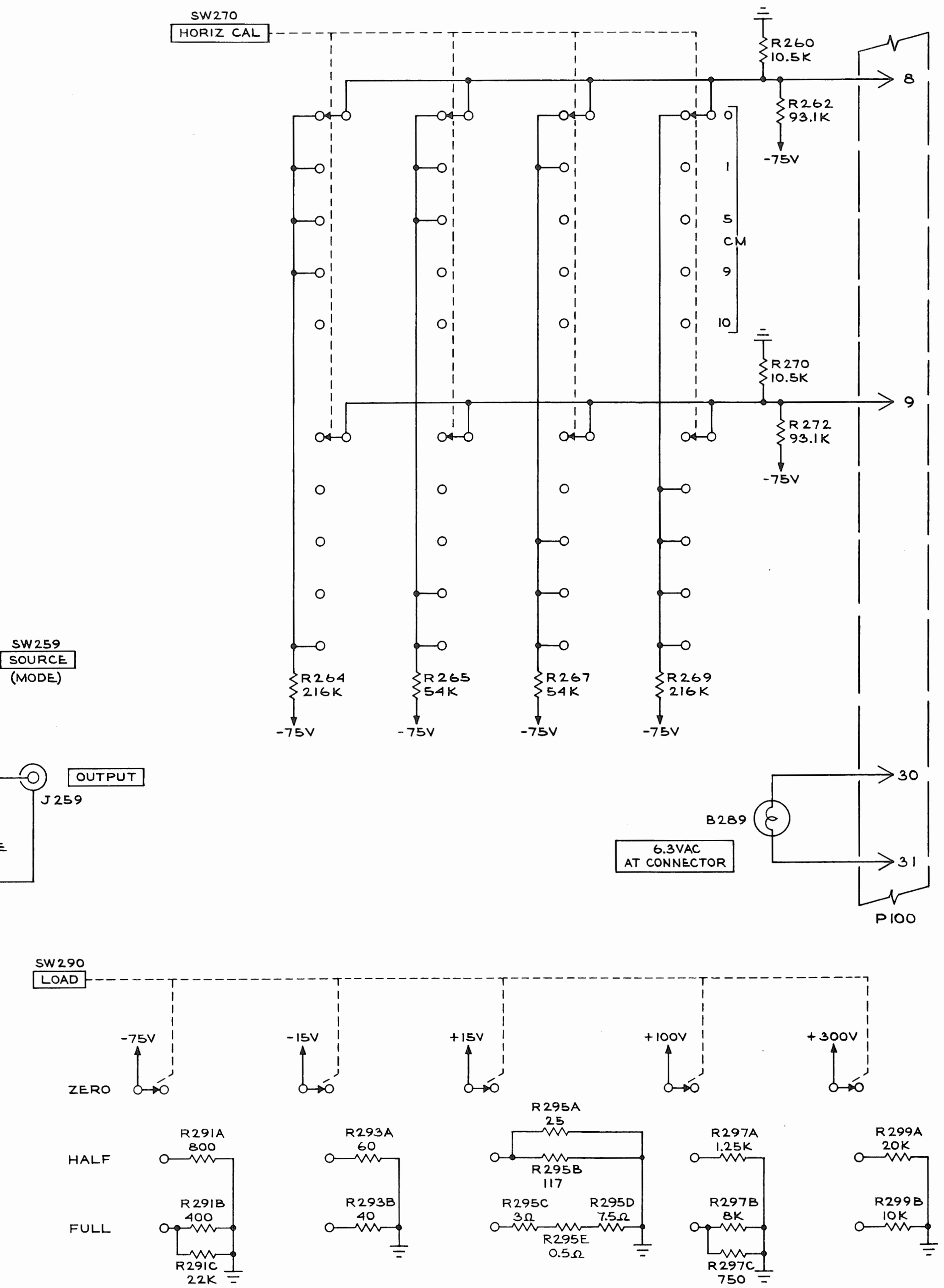


TYPE 10/11 M1 TEST UNIT

PULSER CIRCUIT



TYPE 10/11 M1 TEST UNIT



CMD 365

HORIZONTAL & POWER SUPPLY CALIBRATION

A2