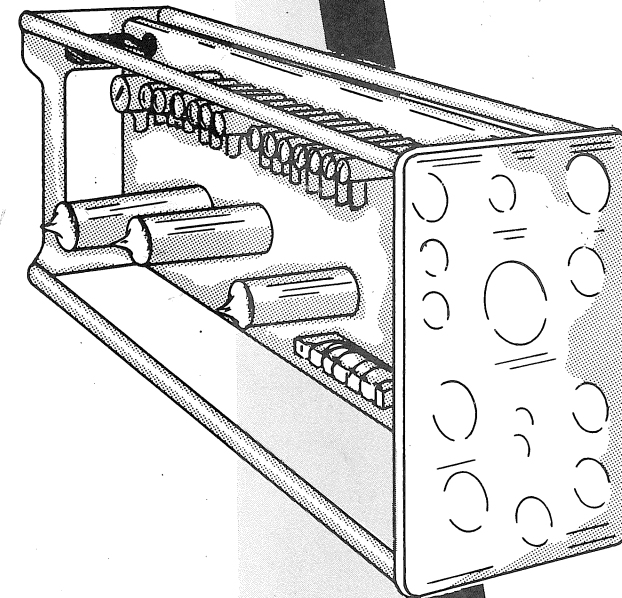


\$500

# INSTRUCTION MANUAL

## OSCILLOSCOPE CALIBRATION AIDS



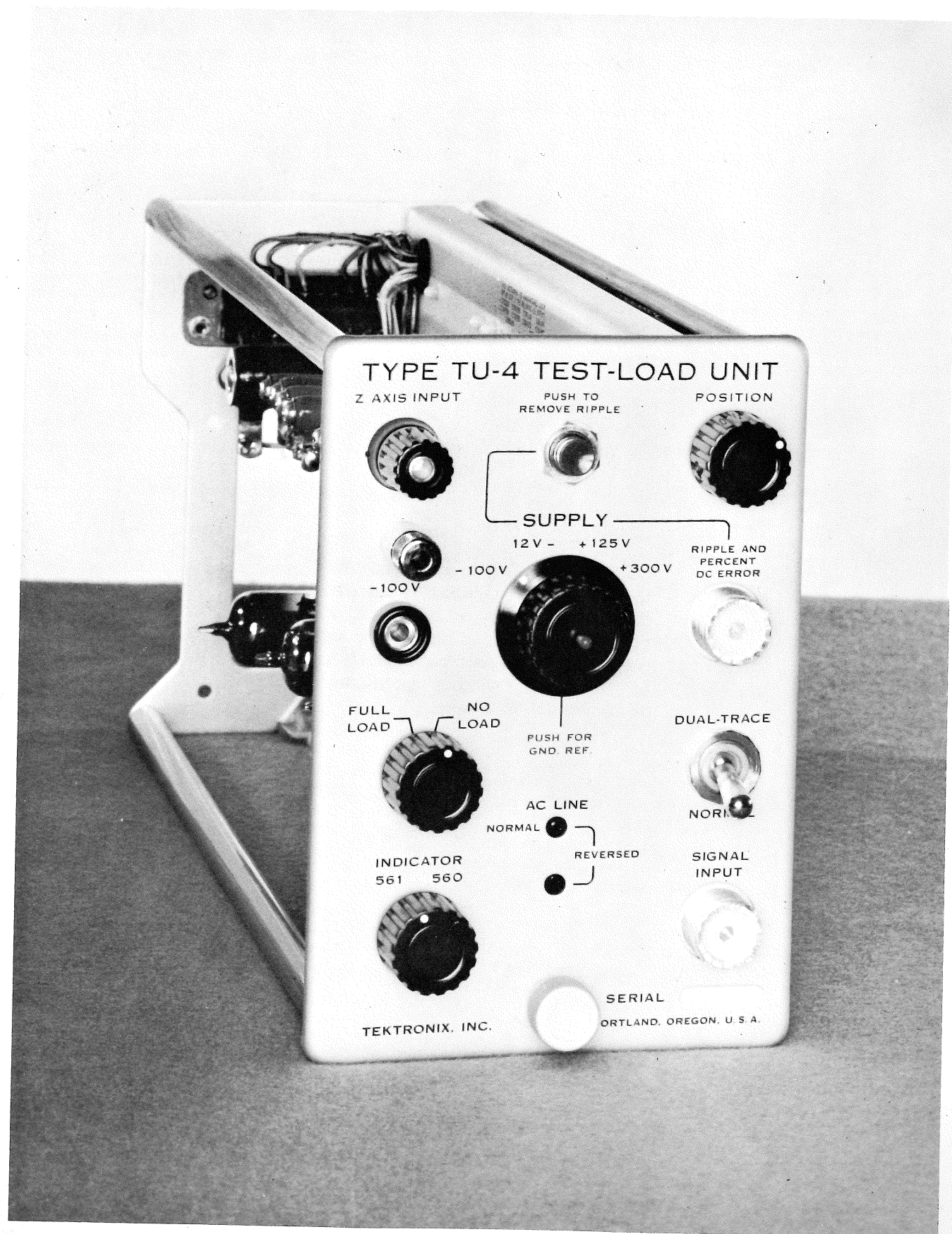
### TYPE TU-4 TEST LOAD PLUG-IN UNIT

This instruction manual covers the Type TU-4 Test plug-in. These instructions are designed to aid the calibrator in checking power-supply regulation and vertical amplifier gain.

Printed on 100% post-consumer waste recycled paper



MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES



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SN 252

## INTRODUCTION

The Type TU-4 Test Load Plug-In Unit is designed as a calibration aid for use with Tektronix Type 560 series Oscilloscopes. Its use is not applicable to oscilloscopes designed for lettered-series plug-in units.

The Type TU-4 allows a quick check of oscilloscope gain, balance, power-supply regulation, and alternate-trace sync output. You can make each check independently with a minimum of additional test equipment.

This manual includes a general description of the Type TU-4, operating information, circuit description, maintenance information, operational checks, a circuit diagram, and a parts list.

## GENERAL DESCRIPTION

The Type TU-4 Test Load Unit is designed as a calibration aid for Tektronix Type 560-Series Oscilloscopes. The INDICATOR control selects loading suitable for either the Type 561 or Type 560 oscilloscope. For other oscilloscopes in the 560-Series the INDICATOR control should be left in the 561 position.

For maximum loading of the Type 560-Series power supplies, two Type TU-4 units should be used with the FULL LOAD-NO LOAD switch in the FULL LOAD position.

No amplification is applied to the input signal by the Type TU-4. The input signal is AC coupled to the deflection plates of the indicator unit.

## OPERATING INSTRUCTIONS

This section may be used in conjunction with the calibration section of the appropriate indicator manual. If desired, any of the following checks may be performed individually and without regard to sequence. It should be noted, however, that if the power supply voltages of the oscilloscope are readjusted, the oscilloscope must be completely recalibrated.

time base to 5 mSEC. Turn the CALIBRATOR control to 20 VOLTS. Connect the CAL. OUT connector to the SIGNAL INPUT connector of the Type TU-4. In addition, connect the CAL. OUT connector to the Z AXIS connector of the Type TU-4.

Adjust the Time-Base plug-in triggering controls for a stable display.

If the Z-axis modulation is operating correctly you will note that the leading corner of the square wave is less intense than the remainder of the waveform. You may confirm this by removing the connection to the Z AXIS connector of the Type TU-4 and noting the brightening of the forward corner which occurs as you do so.

### Equipment Required

The following instruments are required when using the Type TU-4 Test Load Unit as a calibration aid for a 560 Series Indicator.

1 Type 67 Time-Base Plug-in Unit

1 Test Oscilloscope with at least 10 millivolt/cm dc coupled vertical sensitivity, such as a Tektronix Type 531 with Type H Plug-In Unit.

### -100 V Check

A connector is provided on the front-panel of the Type TU-4 for checking the -100 volt indicator supply. The supply is connected to this connector no matter which position the SUPPLY switch is in.

### Preliminary

Install the Type TU-4 in the left-hand compartment of the indicator. If you are making resistance-to-ground measurements in the indicator power supply, set the FULL LOAD-NO LOAD switch of the Type TU-4 to NO LOAD. Set the INDICATOR switch to the appropriate indicator type.

### Supply Checking

In checking both the voltage accuracy of the indicator regulated supplies and the amount of ripple voltage on each of them, the Test Oscilloscope must be connected to the RIPPLE AND PERCENT DC ERROR connector. For voltage checking it is important that the test scope plug-in unit input tube does not have excessive grid current. (See the Type H Plug-In Unit manual Calibration Procedure Step 5.)

### Z-Axis Modulation

Z- Axis Modulation of the indicator may be checked with the Type TU-4 as follows:

1. Install a suitable time-base unit, such as the Type 67 in the right-hand plug-in compartment of the indicator. Turn the indicator POWER switch to ON. Set the TIME/DIV. control of the

During calibration the Type TU-4 is adjusted so that, if the supplies in the indicator are at their exact output voltage, only the ripple voltage will appear at the RIPPLE AND PERCENT

DC ERROR connector. The test oscilloscope may be connected to this connector for measuring ripple and dc error.

Ripple present at the RIPPLE AND PERCENT DC ERROR connector may be removed by holding down the PRESS TO REMOVE RIPPLE button. This allows measurement of the percentage of DC error in the supply output.

The display may be referenced to ground by pressing the PUSH FOR GND. REF.

The individual supply voltage dividers within the TU-4 are designed to indicate 10 millivolts of dc signal per one percent error of the indicator supply. This is true only when the indicator -100 volt regulated supply has been adjusted for zero percent dc error. Thus the test oscilloscope and Type H Plug-In Unit must be set with a dc coupled vertical sensitivity of 10 millivolts/cm to indicate 1% error per centimeter of vertical deflection.

Percent error of the regulated supplies of 560 Series Indicators is +or-2% for the -100, +125 and +300 volt supplies and +or-2.5% for the -12.16 volt supply.

The most accurate measurement can be made by alternately pushing and releasing the PUSH

FOR GND. REF. button on the front of the TU-4 while watching the test scope crt screen.

### AC LINE

You will find a pair of indicator lights on the front panel of the Type TU-4 marked AC LINE: These are used for checking the polarity of the plug-in connections to the primary of the indicator power transformer. When these connections are properly made only the upper indicator lamp, marked NORMAL, will light. If the connections have been reversed - for example: while changing the power transformer wiring from 117 to 234 volts - both indicator lamps will light as soon as the POWER switch is turned to ON.

### Dual-Trace Check

Operation of the dual-trace synchronizing circuits in the time-base plug-in may be checked in the DUAL-TRACE position of the DUAL-TRACE NORMAL switch. With no input signal connected to the SIGNAL INPUT connector of the Type TU-4, and with a free-running time-base of approximately 5 milliseconds per division, turn the DUAL-TRACE NORMAL switch to the DUAL-TRACE position. Two horizontal lines, separated by approximately two centimeters should be displayed.

## CIRCUIT DESCRIPTION

The circuitry of the Type TU-4 may be separated into three major division: the Dual-Trace Switching Circuit, the Power Supply Monitoring Circuit, and the Power Supply Loading Circuit.

### Dual-Trace Switching

The Sweep-Gating Multivibrator in the Time-Base Plug-In generates pulses which are used to trigger the Dual-Trace Switching Circuit in the Type TU-4. Triodes V15A and V15B operate as a bistable multivibrator. V32C is a sync amplifier that receives and amplifies the sync pulses from the time-base plug-in unit at the end of each sweep. The plate of V32C drives the two cathodes of V32A negative, thus switching the multivibrator to its other stable state during the time the crt is blanked off. With the DUAL-TRACE NORMAL switch in the DUAL-TRACE position, the signal from pin 1

of V15A is ac coupled to one of the crt vertical deflection plates. With the multivibrator switching to opposite states at the end of each sweep, two alternating voltage levels are presented to the crt vertical deflection system. At fast sweep rates two apparently simultaneous traces are observed on the crt screen.

The power supply Monitoring circuit resistance dividers have been factory adjusted. When the -100 volt supply of the 560 indicator is adjusted for zero percent error, and if each of the other regulated supplies are exactly correct, there will be no voltage to ground present at the RIPPLE AND PERCENT DC ERROR connector. The one percent 1-megohm resistors, R46, R56, R66 and R76 form a two-to-one voltage divider with the test scope 1-megohm input resistance. Thus the voltage error that will appear at the internal divider side of each of the 1-megohm resistors is

20 millivolts per 1% error. The test scope will indicate 10 millivolts per 1% supply error.

The power supply loading circuitry of the TU-4 is operated by the FULL LOAD NO LOAD switch. The purpose is to operate the indicator regulated power supplies at extremes of load conditions and determine that they

regulated properly. With the test scope connected to the RIPPLE AND DC ERROR connector, the ripple voltage of each supply can be measured. The INDICATOR 561 560 switch inserts the proper loading resistors for the proper indicator so that each supply is fully loaded when the FULL LOAD NO LOAD switch is in the FULL LOAD position.

## MAINTENANCE

### Parts Replacement

Replacement parts for the TU-4 can be obtained from Tektronix at current net prices. Most of the components, however, are standard electronic parts and can generally be purchased locally in less time than is required to obtain them from the factory. Before ordering parts, be sure to consult the parts list in this manual to determine the required tolerances and other information regarding the part.

### Tektronix-Manufactured Parts

Tektronix manufactures almost all of the mechanical parts in the instrument. When ordering mechanical parts, be sure to describe the part fully to prevent order-filling delays.

### Parts Ordering Information

Place all part orders directly with your local Tektronix Field Office or Representative.

You will find a serial number in the front panel of your instrument. A matching serial number should appear on the frontispiece of this manual indicating that the manual is completely applicable to your instrument. Be sure the number in the manual matches the number of the instrument before using the manual to order parts from the parts list.

Each part in your instrument has a six digit Tektronix part number. This part number together with a description of the part, will be found in the parts list. When ordering parts be sure to include both the part number and part description.

## OPERATIONAL CHECKS

The Type TU-4 is a simple electronic instrument and employs conventional components. It should provide many hours of trouble-free operation.

If trouble is encountered in the Type TU-4, first perform a visual inspection of the entire instrument looking especially for; burnt components, poor connections, loose tubes, etc. If a visual inspection does not reveal the cause of trouble, change tubes. Tube substitution is

the quickest and most reliable method of checking a given tube.

As an aid to finding troubles, Table 1 has been prepared, giving resistance values to ground of most of the terminals of the 24 pin interconnecting plug at the rear of the TU-4. Terminals not shown are not connected to anything and should read infinite resistance to ground.

TABLE I

CONNECTOR PIN NUMBER	TO	LOAD SWITCH	INDICATOR SWITCH	RESISTANCE IN OHMS
1	Ground	---	---	1
2	Ground	---	---	0
3	Ground	---	---	Infinite

Table 1 (Con't)

5	Ground	No	---	Infinite
5	Ground	Full	---	14 K
5	Pin #16	No	---	Infinite
5	Pin #16	Full	561	15
5	Pin #16	Full	561	33
6	Ground	No	---	Infinite
6	Ground	Full	561	4.6 K
6	Ground	Full	560	14 K
6	Pin #10	Full	---	0
7	Ground	---	---	Infinite
8	Ground	---	---	Infinite
9	Ground	---	---	0
10	Ground	No	---	45 K
10	Ground	Full	561	4.6 K
10	Ground	Full	560	14 K
11	Ground	---	---	Infinite
13, 14, 15	Ground	No	---	120 K
13, 14, 15	Ground	Full	561	2 K
13, 14, 15	Ground	Full	560	4.8 K
13, 14, 15	Pin #20	Full	---	0
16	Ground	---	---	15 K
16	Pin #5	Full	561	15
16	Pin #5	Full	560	33
16	Pin #5	No	---	Infinite
17	Ground	---	---	1 Meg
20	Ground	No	---	Infinite
20	Ground	Full	561	2 K
20	Ground	Full	560	4.8 K
21	Ground	---	---	1 Meg
22	Ground	No	---	Infinite
22	Ground	Full	---	0
23	Ground	No	561	35 K
23	Ground	No	560	3.5 K
23	Ground	Full	561	1.7 K
23	Ground	Full	560	1.9 K
24	Ground	---	---	Infinite
24	To Z Axis Input on Front Panel			0

### CALIBRATION PROCEDURE

#### Equipment Required

In addition to the equipment required when using the Type TU-4 as a calibration aid for a 560 Series Oscilloscope, you will need one high quality differential voltmeter with an accuracy of at least  $\pm 0.05\%$ . It will be used to permit accurate adjustment of four regulated supply ZERO SET potentiometers within the Type TU-4. The adjustments can be easily made by removing the left side panel of the 560 indicator in which the cali-

bration is made, and plugging the TU-4 into the left compartment of the oscilloscope.

#### 1. Check -100 volt front panel jack.

Connect the differential voltmeter between the front panel -100 V jack and ground, and adjust the 560 indicator -100 volt power supply for exactly -100 volts.

#### 2. Connect the test oscilloscope to the RIPPLE AND PERCENT DC ERROR connector. Place

the SUPPLY switch to -100 V. Now watching the crt screen, adjust the TU-4 -100 V ZERO SET R41 potentiometer for zero trace shift while alternately pushing and releasing the PUSH FOR GND. REF. button. This correctly established the internal -100 V reference.

3. With the differential voltmeter, measure and record the voltage of each of the remaining regulated supplies. See Figure 1. Place the FULL LOAD NO LOAD switch in FULL LOAD when measuring the -12.21 volt supply and at NO LOAD when measuring all other supplies. Then calculate the percentage error from the voltage required. Now observing each of the supplies in turn on the test oscilloscope, adjust the appropriate ZERO SET potentiometer for the crt deviation in percent equal to the calculated percent error. Thus the TU-4 power supply monitoring circuit references can be established at the correct value. A more accurate setting may be obtained by pressing the PUSH TO REMOVE RIPPLE button.

#### 4. Check Alternate Sweep Operation.

Install a Type 67 Time-Base Plug-In Unit in the right hand compartment of the 560 indicator unit. Set the TIME/DIV to 5 millise

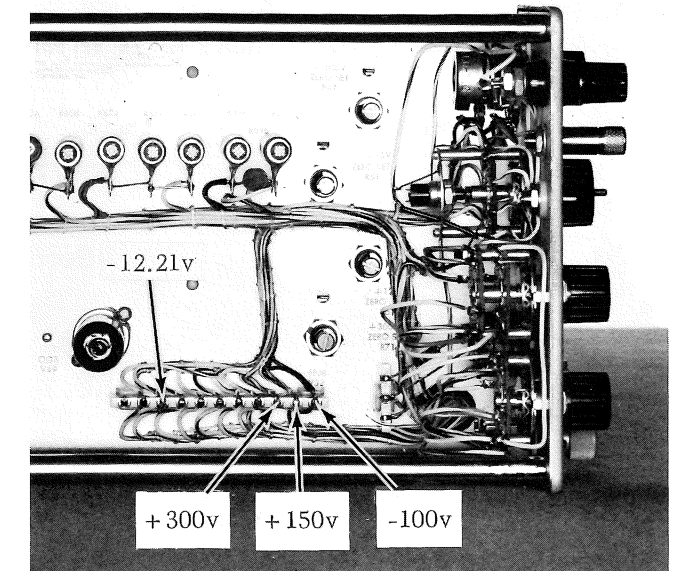


Fig. 1. Internal test points for 560 Indicator regulated power supplies.

and the TRIGGERING LEVEL to FREE RUN. Switch the TU-4 to DUAL TRACE. Two apparent sweeps should appear about two centimeters apart.

**PARTS LIST**

**BULBS**

Values are fixed unless marked Variable.

Ckt. No.	S/N Range	Description	Tektronix Part No.
B91		Neon, Type NE-2	150-002
B92		Neon, Type NE-2	150-002

**CAPACITORS**

Tolerance +or-20% unless otherwise indicated.

Ckt. No.	Value	Type	Voltage	Tektronix Part No.
C6	.1 $\mu$ f	Discap	500 v	283-008
C7	.47 $\mu$ f	PTM	400 v	285-562
C13	47 $\mu$ $\mu$ f	Cer.	500 v	281-518
C23	47 $\mu$ $\mu$ f	Cer.	500 v	281-518
C32	100 $\mu$ $\mu$ f	Cer.	350 v	281-523
C70	.1 $\mu$ f	PTM	600 v	285-587
C72	.1 $\mu$ f	Discap	10 v	283-023
C94	.01 $\mu$ f	Discap	500 v	283-002

**RESISTORS**

Resistors are fixed, composition, +or-10% unless otherwise indicated.

Ckt. No.	Value	Power	Tolerance	Special	Tektronix Part No.
R10	11 k	1/2w	5%		301-113
R13	330 k	1/2w	5%		301-334
R15	390 k	1/2w	5%		301-394
R17	5.6 k	1/2w	5%		301-562
R20	11 k	1/2w	5%		301-113
R23	330 k	1/2w	5%		301-334
R25	390 k	1/2w	5%		301-394
R32	36 k	1/2w	5%		301-363
R33	360 k	1/2w	5%		301-364
R40	27 k	2 w	5%		305-273
R41	20 k	2 w		Var. -150V Zero Set	311-018
R42	154 k	1/2w		Prec. 1%	309-234
R43	193 k	1/2w		Prec. 1%	309-243
R45	4.21 k	1/2w		Prec. 1%	309-105
R46	1 meg	1/2w		Prec. 1%	309-148
R51	10 k	2 w		Var. -12.16V Zero Set	311-016
R52	78 k	1/2w		Prec. 1%	309-168
R53	11.76 k	1/2w		Prec. 1/4%	309-200
R55	2.4 k	1/2w		Prec. 1/4%	309-188
R56	1 meg	1/2w		Prec. 1%	309-148

R61	10 k	2 w		Var. +125V Zero Set	311-016
R62	120 k	1/2w		Prec. 1%	309-091
R63	100 k	1/2w		Prec. 1%	309-260
R65	2.05 k	1/2w		Prec. 1%	309-104
R66	1 meg	1/2w		Prec. 1%	309-148

R71	20 k	2 w		Var. +300 V Zero Set	311-018
R72	287 k	1/2w		Prec. 1%	309-328
R73	100 k	1/2w		Prec. 1%	309-260
R75	2.05 k	1/2w		Prec. 1%	309-104
R76	1 meg	1/2w		Prec. 1%	309-148

R80A	8 k	5 w		WW 5%	308-007
R80B	6 k	10 w		WW 5%	308-124
R81A	2 k	10 w		WW 5%	308-017
R81B	1 k	10 w		WW 5%	308-089
R81C	1 k	10 w		WW 5%	308-089

R81D	1 k	10 w		WW 5%	308-089
R81E	167 $\Omega$	5 w		WW 5%	308-045
R83A	16 $\Omega$	5 w		WW 5%	308-166
R83B	2 $\Omega$	5 w		WW 5%	308-119
R84	15 $\Omega$	25 w		WW 5%	308-133

R86A,B	5.6 k	2 w		WW 5%	305-562
R87A,B	40 $\Omega$	10 w		WW 5%	308-012
R87C	2 k	10 w		WW 5%	308-017
R88	4 k	5 w		WW 5%	308-051
R89A	1 k	10 w		WW 5%	308-089

R89B	750 $\Omega$	5 w		WW 5%	308-067
R90	2.25 k	10 w		WW 5%	308-059
R91	100 k	1/2w			302-104
R92	100 k	1/2w			302-104
R94	1 meg	1/2w		5%	301-105

R95	120 k	1/2w		5%	301-124
R96	2x250 k		Var.	POSITION	311-114
R97	120 k	1/2w		5%	301-124
R98	1 meg	1/2w		5%	301-105

**SWITCHES**

Part No.	Type	Function	Unwired	Wired
SW15	Toggle		260-014	
SW70**	Rotary	VOLTAGE SEL.	*260-391	*262-411
SW71**	Pushbutton		260-247	
SW72	Pushbutton		260-016	
SW80	Rotary	LOAD SEL.	*260-390	
SW81	Rotary	VOLTAGE SEL.	*260-393	*262-411

**ELECTRON TUBES**

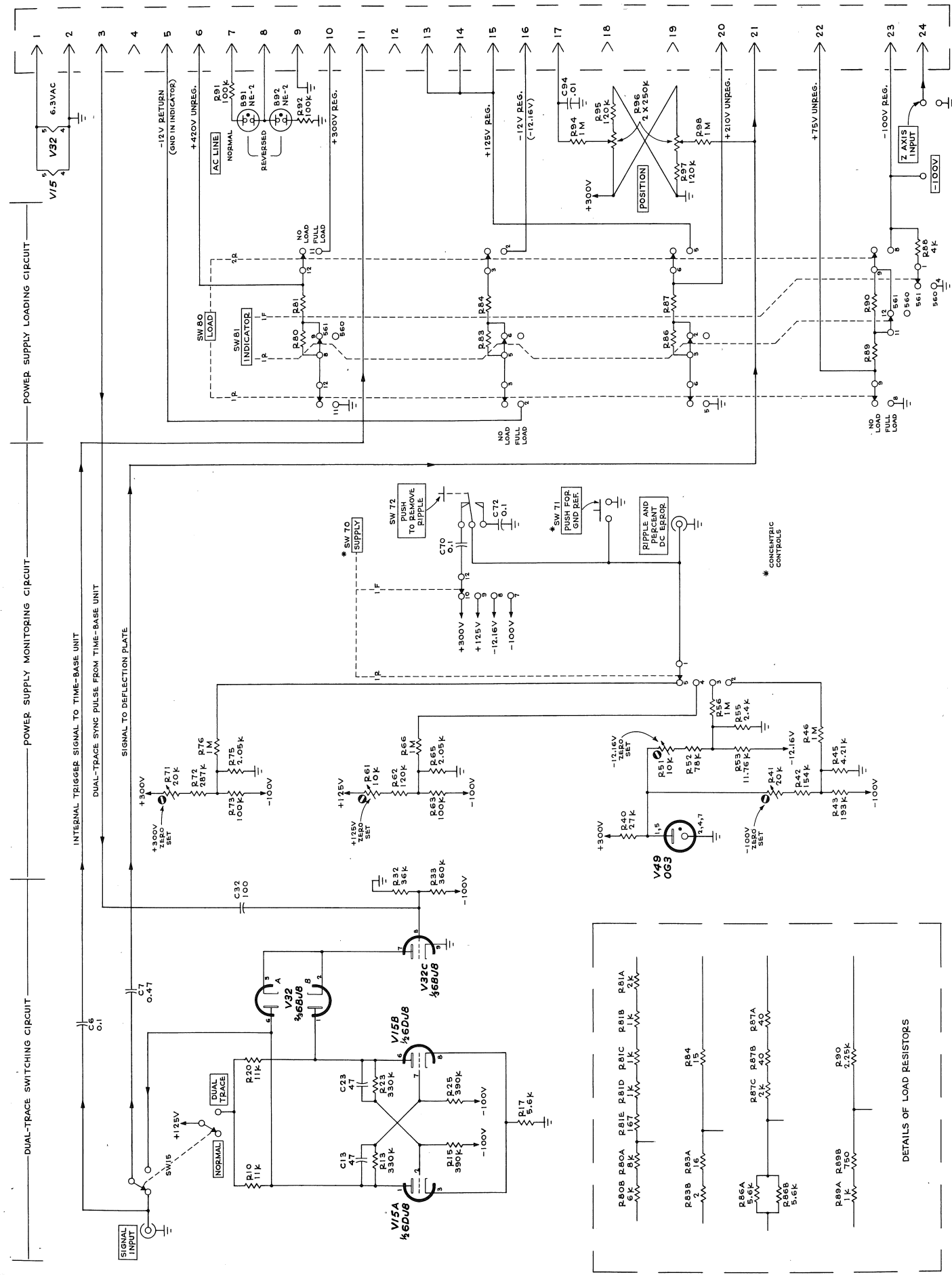
V15	6DJ8	154-187
V32	6DJ8	154-305
V49	OG3	154-291

\*\*SW70 and SW71 have concentric controls.

**MECHANICAL PARTS LIST**

BUSHING, FOR 5-WAY BINDING POST	358-036
BUSHING, 500 OD x .187 LONG x .250 ID	358-042
CABLE, HARNESS, #1	179-524
CABLE, HARNESS, #2	179-525
CABLE, HARNESS, 110V	179-526
CABLE, HARNESS, SWITCH	179-527
CHASSIS	441-363
CLAMP, CABLE 3/4 PLASTIC	343-008
CONNECTOR, CHASSIS MOUNT 1 CONT. FEMALE	131-081
CONNECTOR, CHASSIS MOUNT 24 CONT. MALE	131-149
EYELET, TAPERED BARREL	210-601
FASTENER, PAWL RIGHT W/STOP	214-052
GROMMET, RUBBER 1/2	348-005
GUIDE, PLUG-IN 5/8 x 13/16 w/3/16 TRACK	351-037
HOLDER, NEON DOUBLE	352-006
KNOB, LARGE BLACK, 1.4 INSERT HOLE 1/8 CONC. HOLE	366-037
KNOB, SMALL BLACK, 1/4 HOLE PART WAY	366-044
KNOB, PLUG-IN SECURING	366-109
LOCKWASHER, INT. #4	210-004
LOCKWASHER, INT. #6	210-006
LOCKWASHER, INT. #8	210-008
LOCKWASHER, INT. #10	210-010
LOCKWASHER, INT. 1/4	210-011
LOCKWASHER, POT INT. 3/8 x 1/2	210-012
LUG, SOLDER, SE4	210-201
LUG, SOLDER, SE6 W/2 WIRE HOLES	210-202
LUG, SOLDER, SE8	210-205
LUG, SOLDER, SE10 LONG	210-206
LUG, SOLDER, 1/4 HOLE LOCK ROUND PERIMETER	210-223
NUT, HEX, 4-40 x 3/16	210-406
NUT, HEX, 6-32 x 1/4	210-407
NUT, HEX, 8-32 x 5/16	210-409
NUT, HEX, 3/8-32 x 1/2	210-413
NUT, HEX, 15/32-32 x 9/16	210-414
NUT, HEX, 10-32 x 3/8 x 1/8 THICK	210-445
NUT, HEX, 1/4-28 x 3/8 x 3/32 THICK	210-455

NUT, HEX, 8-32 x 1/2 x 9/32 THICK RES. MTG.	210-462
NUT, SWITCH 12 SIDED	210-473
NUT, HEX, 6-32 x 5/16 5-10W RES. MTG.	210-478
NUT, CAPTIVE STEEL W/IRIDITE FINISH	210-510
PANEL, FRONT	333-646
PLATE, REAR	387-581
PLATE, FRONT	387-589
POST, BINDING, 5-WAY STEM AND CAP ASS'Y (FLUTED)	129-036
POST, BINDING, ASS'Y OF 355-507 and 200-182	129-051
RING, LOCKING SWITCH	354-055
ROD, EXT. RED NYLON	384-230
ROD, POST SUPPORT 3/8 x 3/8 x 1 5/32 TAPPED 6-32 BOTH ENDS	384-566
SCREW, 4-40 x 1/4 BHS	211-008
SCREW, 4-40 x 3/8 BHS	211-012
SCREW, 4-40 x 1 FHS	211-031
SCREW, 6-32 x 1/4 BHS	211-504
SCREW, 6-32 x 5/16 BHS	211-507
SCREW, 6-32 x 5/16 FHS, 100°, CSK PHILLIPS	211-538
SCREW, 6-32 x 3/4 TRUSS HS PHILLIPS	211-544
SCREW, 6-32 x 1 1/2 RHS PHILLIPS	211-553
SCREW, 8-32 x 2 1/4 RHS	212-014
SCREW, 8-32 x 1 3/4 FHS	212-037
SCREW, 8-32 x 1/2 FHS, 100°, PHILLIPS	212-043
SCREW, 8-32 x 1/2 RHS, PHILLIPS	212-044
SCREW, THREAD CUTTING 5-32 x 3/16 PHS PHILLIPS	213-044
SOCKET, STM7	136-007
SOCKET, STM9	136-014
SOCKET, BANANA JACK BLACK	136-052
SPACER, NYLON MOLDED	361-009
STRIP, CERAMIC 7/16 x 3 NOTCHES CLIP MTD.	124-092
STRIP, CERAMIC 7/16 x 11 NOTCHES CLIP MTD.	124-106
TAG, LABEL "NOTICE OF TUBE REPLACEMENT . . ."	334-769
WASHER, STEEL 6L x 3/8	210-803
WASHER, STEEL 8S x 3/8	210-804
WASHER, BRASS CENTERING RES. 25W	210-809
WASHER, STEEL .390 x 9/16 x .020	210-840
WASHER, STEEL FLAT	210-902



TYPE TU-4 TEST LOAD PLUG-IN UNIT  
10-04-61



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- MINNEAPOLIS** Tektronix, Inc., 3307 Vera Cruz Ave. North, Minneapolis 22, Minnesota...TWX—MP 983 533-2727
- MONTREAL** Tektronix, Inc., 3285 Cavendish Blvd., Suite 160, Montreal 28, Quebec, Canada HUNter 9-9707
- NEW YORK CITY AREA**
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 Tektronix, Inc., 840 Willis Avenue, Albertson, L. I., New York...TWX—G CY NY 1416 Pioneer 7-4830
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- ORLANDO\*** Tektronix, Inc., 205 East Colonial Drive, Orlando, Florida...TWX—OR 7008 GARden 5-3483
- PHILADELPHIA\*** Tektronix, Inc., 7709 Ogontz Ave., Philadelphia 50, Pennsylvania...TWX—PH 930 WAverly 4-5678
- PHOENIX\*** Tektronix, Inc., 7000 E. Camelback Road, Scottsdale, Arizona...TWX—SCSDL 52 WHitney 6-4273
- PORTLAND** Tektronix, Inc., P. O. Box 500, Beaverton, Oregon... MITchell 6-1926
- POUGHKEEPSIE\*** Tektronix, Inc., 8 Raymond Avenue, Poughkeepsie, New York...TWX—POUGH 5063 GROver 1-3620
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- SAN FRANCISCO BAY AREA**
- Lafayette Tektronix, Inc., 3530 Golden Gate Way, Lafayette, California...TWX: LAF CAL 1639 YELlowstone 5-6101  
 From Oakland, Berkeley, Richmond, Albany and San Leandro...CLifford 4-5353
- \*Palo Alto Tektronix, Inc., 3944 Fabian Way, Palo Alto, California...TWX—PAL AL 112 DAVenport 6-8500
- SEATTLE** Tektronix, Inc., 236 S.W. 153rd St., Seattle 66, Washington...TWX—SE 47 CHerry 3-2494
- SYRACUSE\*** Tektronix, Inc., East Molloy Road and Pickard Drive, P. O. Box 155, Syracuse 11, New York  
 TWX—SS 423 GLENview 4-2426
- TORONTO\*** Tektronix, Inc., 4A Finch Ave., West, Willowdale, Ontario, Canada Toronto, BALdwin 5-1138
- WASHINGTON D. C.\*** Tektronix, Inc., 9619 Columbia Pike, Annandale, Virginia...TWX—F CH VA 760 Clearbrook 6-7411
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