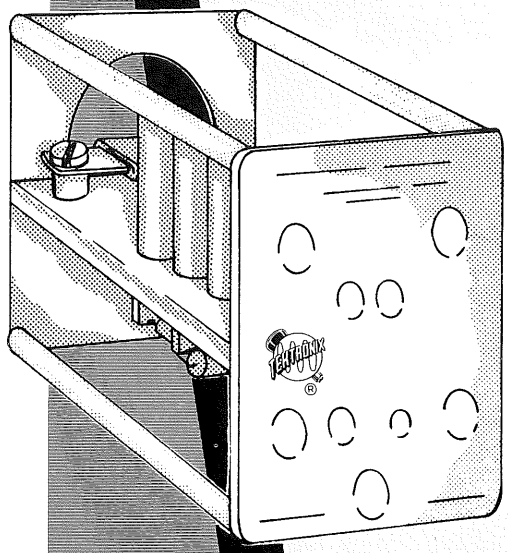
INSTRUCTION MANUAL

OSCILLOSCOPE CALIBRATION AIDS



TYPE TU-3

TEST LOAD PLUG-IN UNIT

This instruction manual covers the Type TU-3 Test plug-in. These instructions are designed to aid the calibrator in checking power-supply regulation and vertical amplifier gain.

MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

INTRODUCTION

The Type TU-3 Test Load Plug-In Unit is designed as a calibration aid for use with Tektronix Type 580 series Oscilloscopes. Its use is not applicable to oscilloscopes designed for lettered-series plug-in units.

The Type TU-3 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-3, operating information, circuit description, maintenance information, operational checks, a circuit diagram, and a parts list.


TYPE TU-3 TEST-LOAD
PLUG-IN UNIT
SERIAL
NORMAL
ALTERNATE SWEEPS
LINE CHECK
VERTICAL POSITION
DIFFERENTIAL REFERENCE CALIBRATION
TEKTRONIX
INPUT
INPUT SELECTOR
CAL. 100V
SIGNA
ZERO REFERENCE
LOAD
HIGH
LOW
TEKTRONIX, INC.
PORTLAND, OREGON, U. S. A.

GENERAL DESCRIPTION

The Type TU-3 incorporates a LOAD switch, a NORMAL ALTERNATE SWEEPS switch, a VERTICAL POSITION control, an INPUT SELECTOR switch, and a ZERO REFERENCE switch. With the LOAD switch set at HIGH, the Type TU-3 subjects the power supply of the oscilloscope to an extreme loading condition. This allows you to check the power-supply regulation while it is operating at an extreme. By setting the LOAD switch to LOW, the opposite loading condition is simulated.

The ZERO REFERENCE switch shorts the push-pull inputs of the oscilloscope vertical amplifier together enabling the operator to check amplifier balance.

Electronic switching of the display is provided by a multivibrator circuit, which is energized when the NORMAL--ALTERNATE SWEEPS switch is in the ALTERNATE SWEEPS position. The switching circuit duplicates the action of a dual-trace plug-in unit when it is operated in the ALTERNATE mode. Its action verifies the presence of dual-trace sync pulses from the oscilloscope under test. If the oscilloscope is working properly, two traces will be displayed on the oscilloscope screen.

The VERTICAL POSITION control provides a means of positioning the oscilloscope display as desired.

Setting the INPUT SELECTOR switch in the SIGNAL position couples a signal from the INPUT connector directly to the grid of the input cathode follower, V43A, with very little attenuation. With the INPUT SELECTOR switch in the CAL. 100V position, the input signal is attenuated by a given amount and used as a calibration signal for setting oscilloscope gain. In this case, the 100-volt calibrator signal from the oscilloscope is applied to the INPUT connector of the Type TU-3

OPERATING INSTRUCTIONS

This section should be used in conjunction with the calibration section of the appropriate Type 580 series instruction manual. If desired, any of the following adjustments or 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 should be completely recalibrated.

Preliminary

Install the Type TU-3 in the oscilloscope to be calibrated before starting the calibration procedure. If you are making various resistance-to-ground measurements in the oscilloscope power supply, set the Type TU-3 LOAD switch to LOW.

If you intend to set the oscilloscope vertical gain, make sure that the CAL. ADJ. (an internal screwdriver adjustment of the Type TU-3) is properly set before proceeding. To calibrate the Type TU-3 CAL. ADJ. potentiometer, proceed as follows:

1. Set the INPUT SELECTOR switch to CAL. 100V and the NORMAL--ALTERNATE SWEEPS switch to NORMAL.

2. Apply a 100-volt calibrator signal to the Type TU-3 INPUT connector. (Use the Calibrator of the oscilloscope in which the Type TU-3 is inserted and not the test oscilloscope described in the next step.)

3. With a test oscilloscope--whose ground is not common to the Type TU-3 and Type 580 series oscilloscope--measure the voltage across the DIFFERENTIAL REFERENCE CALIBRATION binding posts. (Connect the chassis of the test oscilloscope to one of the binding posts and the input of the test oscilloscope to the opposite binding post.)

4. The peak-to-peak voltage across the DIFFERENTIAL REFERENCE CALIBRATION binding posts should be .2 volts--if not, adjust the Type TU-3 CAL. ADJ. for an amplitude of .2 volts, peak-to-peak.

5. Remove all connections from the Type TU-3.

Power-Supply Output Voltages

To check the oscilloscope power-supply voltages, set the LOAD switch of the Type TU-3 to LOW and turn on the oscilloscope. Measure the output voltages of the power supply. Refer to the oscilloscope manual to determine the allowable tolerance on each supply.

Power-Supply Ripple

To check the oscilloscope power-supply ripple, set the LOAD switch of the Type TU-3 to HIGH and measure the ripple on the various supplies with the line voltage at 105 volts (210 volts if your instrument is wired for 234-volt operation). Next, set the line voltage at 125 volts (or 250 volts), the LOAD switch to LOW and again measure the ripple on the various supplies. Refer to the oscilloscope instruction manual for ripple specifications.

Setting the Oscilloscope Vertical Gain

First, be sure that the CAL. ADJ. is properly set as described at the beginning of this section. With the Type TU-3 properly calibrated, set its INPUT SELECTOR switch to CAL. 100V and apply a 100-volt Calibrator signal to the INPUT connector. Set the NORMAL--ALTERNATE SWEEPS switch to NORMAL. Adjust the oscilloscope Vertical Gain adjustment for exactly 2.2 centimeters of vertical deflection.

Checking Oscilloscope Alternate-Trace Operation

To check the oscilloscope alternate-trace operation, set the NORMAL-ALTERNATE SWEEPS switch to ALTERNATE SWEEPS and the INPUT SELECTOR switch to SIGNAL. Set the triggering controls of the oscilloscope for a free-running sweep and the Time/Cm switch to 1 μsecond per centimeter. A dual trace should appear on the oscilloscope screen. (Note: You may have to adjust the Type TU-3 VERTICAL POSITION control to get both traces into the viewing area of the graticule.)

Oscilloscope Vertical Amplifier Balance

The degree of vertical amplifier imbalance can be observed by depressing the ZERO REFERENCE switch and comparing the trace position with the crt electrical center. You can determine the crt electrical center by shorting the vertical deflection plates together and noting the position of a free-running trace.

Other Checks

The Type TU-3 can be used as a limited-bandpass plug-in unit and is therefore useful for various other checks and adjustments that may be mentioned in the oscilloscope calibration procedure. When using the Type TU-3 as a plug-in unit preamplifier, its sensitivity is about .2 volts per centimeter with the INPUT SELECTOR switch set to SIGNAL and about 45.5 volts per division with the INPUT SELECTOR switch set to CAL. 100V.

The LINE CHECK lamp (on the front panel) is connected across one of the primary windings of the oscilloscope line transformer. It is lighted whenever line power is applied to the instrument.

CIRCUIT DESCRIPTION

The basic circuitry of the Type TU-3 consists of dummy loading resistors, two cathode followers, and a bistable multivibrator. The dummy loading resistors are connected to each regulated supply of the oscilloscope when the LOAD switch is set to HIGH. They subject the power supply of the oscilloscope to a maximum loading condition. With the LOAD switch in the LOW position, the dummy loading resistors are disconnected from the circuit and there is only minimum current drain from the oscilloscope power supplies.

The two cathode followers, V43A and V43B, decouple the input signal from the oscilloscope vertical amplifier and elevate the voltage at the vertical amplifier input to the proper level (about +50 volts). The VERTICAL POSITION control, R36, varies the bias and hence, the cathode voltage of V43A. The voltage difference between the cathodes of V43A and V43B determines the position of the trace on the screen of the oscilloscope. The grid of V43B is fixed by voltage divider R40, R41, and C41. The ZERO REFERENCE switch shorts together the cathodes of V43 to insure that the voltage difference between the cathodes is zero. With the voltage difference between the two cathodes

at zero, the position of the trace on the screen of the oscilloscope is determined by the degree of vertical-amplifier imbalance. By comparing the foregoing trace position with the crt electrical center, the amount of vertical-amplifier imbalance can be observed. The DIFFERENTIAL REFERENCE CALIBRATION binding posts provide an external means of checking the voltage output of the cathode followers.

Transistors Q15 and Q25 combine to make up a bistable multivibrator. Transistor Q23, is a sync amplifier which receives and amplifies a sync pulse from the oscilloscope at the end of each sweep. Each time the bistable multivibrator receives a sync pulse it switches to the opposite state. With the NORMAL--ALTERNATE SWEEPS switch in the ALTERNATE SWEEPS position, the output of the multivibrator is coupled through the INPUT SELECTOR switch and C34 to the grid of the input cathode follower. With the multivibrator switching to opposite states at the end of each sweep, it establishes two alternating voltage levels at the grid of the input cathode follower. The two alternate voltage levels are synchronized with the oscilloscope sweep circuit. At faster sweep rates, two apparently simultaneous traces are observed on the screen of the oscilloscope. (Note: The input to the cathode follower, V43A, is ac coupled and has a lower frequency response limit of about 1 cps. Consequently, a marked slanting of the two traces will be observed at slower sweep rates.)

The voltage divider, R30-R31-R32, is adjustable with R32. It is set so that its attenuation plus the slight attenuation of V43A and the negative feedback from the oscilloscope vertical amplifier equals a total attenuation of 500X. This insures that when a 100-volt calibrating signal is applied to the INPUT connector an effective signal amplitude of .2 volts, peak-to-peak, will be applied to the vertical amplifier of the oscilloscope. The INPUT SELECTOR switch must be in the CAL. 100V position for the signal to be attenuated as described.

The LINE CHECK bulb, B78, is connected across one of the primary windings of the oscilloscope power transformer. This indicates that there is power applied and that the line fuse and thermal cutout of the oscilloscope are closed.

MAINTENANCE

Parts Replacement

Replacement parts for the Type TU-3 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 or purchasing 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 and some of the electronic components. When ordering mechanical parts, be sure to describe the part fully to prevent order-filling delays.

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

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.

OPERATIONAL CHECKS

The Type TU-3 is a simple electronic instrument and employs conventional components. It should provide many hours of troublefree operation.

If trouble is encountered in your Type TU-3, first perform a visual inspection of the entire instrument looking especially for; burnt components, poor connections, loose tubes, etc. If a visual inspection of the Type TU-3 does not reveal the cause of trouble, check V43. Tube substitution is the quickest and most reliable method to check a given tube.

Mechanical Inspection

1. Tighten screws and nuts wherever possible.

2. Visually check all lead dress, all solder joints, and the terminals of the switches.

3. Check the physical proximity of all uninsulated components. Adjacent components should have ample clearance to prevent arcover and shorting.

Electrical Checks

1. With no input signal, measure the voltage change across the DIFFERENTIAL REFERENCE CALIBRATION binding posts as the VERTICAL POSITION control is rotated through its range. The total voltage change should be about 1/2 volt varying around zero. While still monitoring the voltage, depress the ZERO REFERENCE switch--the voltage should read zero regardless of the setting of the VERTICAL POSITION control.

2. The waveform of the multivibrator may be checked with another oscilloscope at either of the DIFFERENTIAL REFERENCE CALIBRATION binding posts. When checking the alternate sweep waveform, set the NORMAL--ALTERNATE SWEEPS switch to ALTERNATE SWEEPS and the INPUT SELECTOR switch to SIGNAL. Set the Stability control of the Type 580 oscilloscope for a free-running trace at a sweep rate of about 50 microseconds per centimeter. On the test oscilloscope, set its input coupling switch for ac coupling. Fig. 1 shows the typical waveform observed with a test oscilloscope at the right-hand DIFFERENTIAL REFERENCE CALIBRATION binding post with the Type TU-3 operating in the ALTERNATE SWEEPS mode.

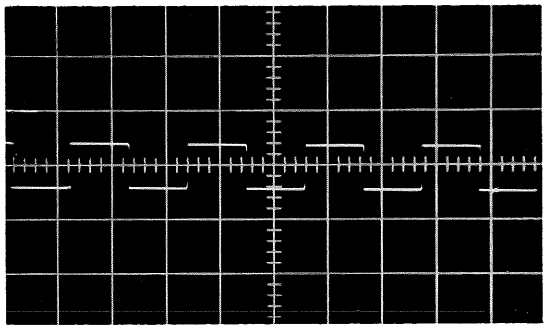


Fig. 1 Waveform present at the right-hand DIFFERENTIAL REFERENCE CALIBRATION binding post with the Type TU-3 operating in the ALTERNATE SWEEPS mode.

PARTS LIST

Values are fixed unless marked Variable.

Circuit No.	Tektronix Part No.	Description			
		BULBS			
B78	150-002	NE-2			
		CAPACITORS			
Tolerance +or-20% unless otherwise indicated.					
Tolerance of all electrolytic capacitors are as follows: (with exceptions)					
3 V - 50 V = -10% +250%					
51 V - 350 V = -10% +100%					
351 V - 450 V = -10% +50%					
C15	281-525	47 μμf	Cer.	500 v	
C25	281-525	470 μμf	Cer.	500 v	
C31	283-000	.001 μμf	Discap	500 v	GMV
C34	285-562	.47 μf	PTM	400 v	
C41	290-000	6.25 μf	EMT	300 v	
C70	283-006	.02 μf	Discap	600 v	
		DIODES			
D12	152-008	T12G			
D22	152-008	T12G			
		RESISTORS			
Resistors are fixed, composition, +or-10% unless otherwise indicated.					
R13	302-681	680 Ω	1/2 w		
R15	302-472	4.7 k	1/2 w		
R16	301-473	47 k	1/2 w		5%
R18	302-333	33 k	1/2 w		
R22	302-390	39 Ω	1/2 w		
R23	302-681	680 Ω	1/2 w		
R25	302-472	4.7 k	1/2 w		
R26	301-473	47 k	1/2 w		5%
R28	301-102	1 k	1/2 w		5%
R30	310-056	333 k	1 w	Prec.	1%
R31	309-115	1 k	1/2 w	Prec.	1%
R32	311-084	1 k	.2 w	Var.	Cal. Adj.
R36	311-026	100 k		Var.	VERTICAL POSITION
R37	302-685	6.8 meg	1/2 w		
R38	302-104	100 k	1/2 w		

R40	310-052	10 k	1 w	Prec.	1%
R41	310-052	10 k	1 w	Prec.	1%
R42	302-101	100 Ω	1/2 w		
R44	304-123	12 k	1 w		
R46	302-101	100 Ω	1/2 w		
R48	304-123	12 k	1 w		
R70	309-226	93.1 Ω	1/2 w	Prec.	1%
R71	309-226	93.1 Ω	1/2 w	Prec.	1%
R74	306-470	47 Ω	2 w		
R78	302-334	330 k	1/2 w		
R80	308-010	40 k	5 w	WW	5%
R81	306-274	270 k	2 w		
R83	306-124	120 k	2 w		
R84	306-184	180 k	2 w		
R86	308-044	3.8 k	25 w	WW	5%
R87	304-184	180 k	1 w		
R90	306-560	56 Ω	2 w		
R91	308-020	3 k	10 w	WW	5%
R92	305-123	12 k	2 w		5%
R93	305-183	18 k	2 w		5%
R96	308-041	2.4 k	25 w	WW	5%
R97	306-223	22 k	2 w		
R98	306-154	150 k	2 w		

SWITCHES

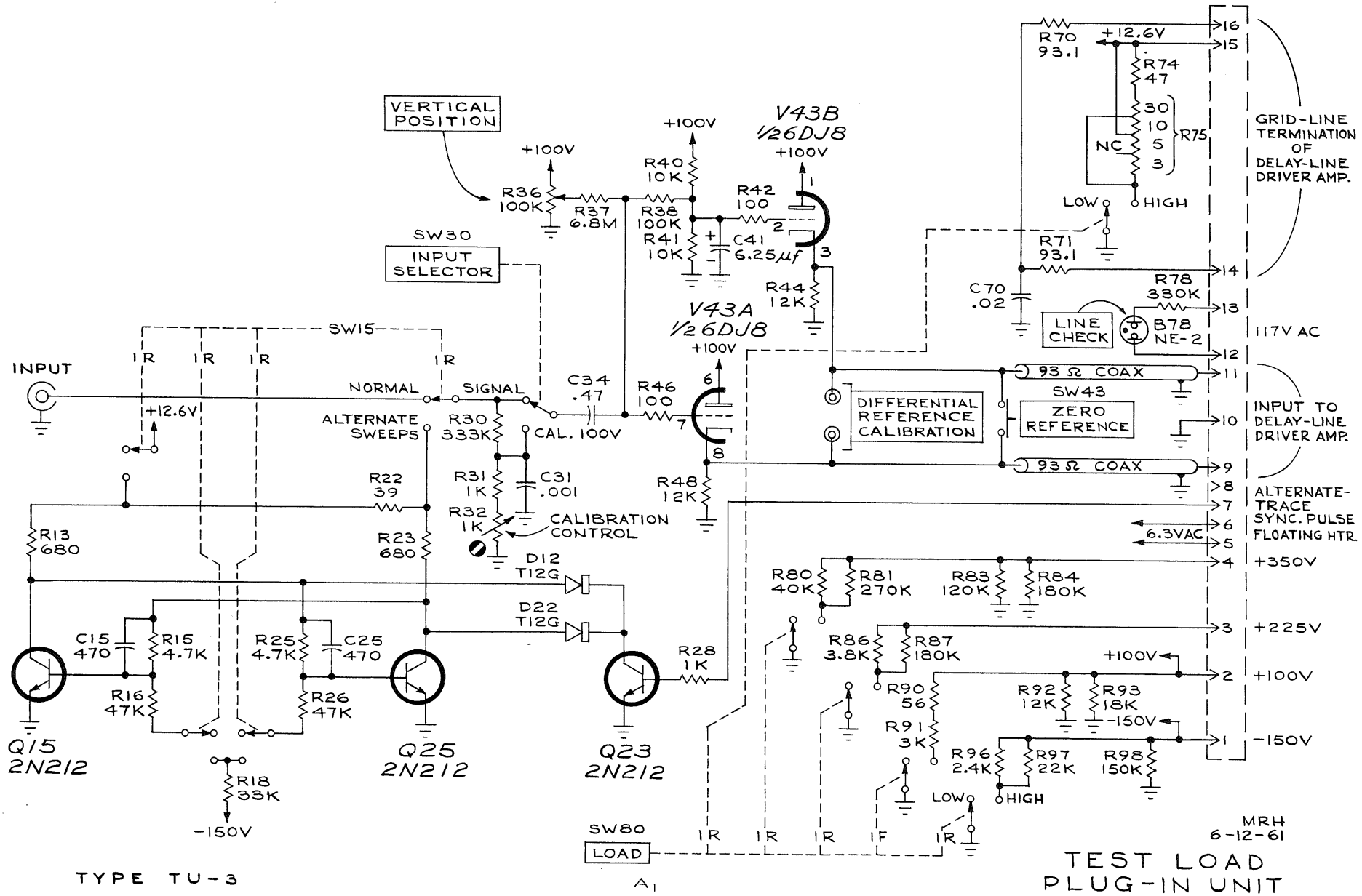
	Unwired		
SW15	*260-283	Normal-Alternate Sweeps	Rotary Single Wafer
SW30	260-209	Input Selector	SPDT Toggle
SW43	260-017	Zero Reference	SPDT Push-Button
SW80	*260-284	Load Switch	Rotary Single Wafer

TRANSISTORS

Q15	151-005	2N212
Q23	151-005	2N212
Q25	151-005	2N212

ELECTRON TUBES

V43	154-187	6DJ8


VERTICAL POSITION
+100V
R36 100K
R37 6.8M
R40 10K
R38 100K
R41 10K
R42 100
C41 6.25μf
V43B 1/2 6DJ8
+100V
SW30
INPUT SELECTOR
R44 12K
V43A 1/2 6DJ8
+100V
SW15
1R 1R 1R 1R
INPUT
NORMAL
SIGNAL
C34 .47
R46 100
+12.6V
ALTERNATE SWEEPS
R30 333K
CAL. 100V
R31 1K
C31 .001
R32 1K
CALIBRATION CONTROL
R48 12K
DIFFERENTIAL REFERENCE CALIBRATION
SW43
ZERO REFERENCE
93Ω COAX
93Ω COAX
R22 39
R23 680
R13 680
D12 T12G
D22 T12G
R28 1K
C15 470
R15 4.7K
R16 47K
R25 4.7K
C25 470
R26 47K
R18 33K
-150V
Q15 2N212
Q25 2N212
Q23 2N212
R70 93.1
+12.6V
R74 47
R75 30 10 5 3 NC
LOW HIGH
R71 93.1
C70 .02
R78 330K
LINE CHECK
B78 NE-2
117V AC
GRID-LINE TERMINATION OF DELAY-LINE DRIVER AMP.
INPUT TO DELAY-LINE DRIVER AMP.
ALTERNATE-TRACE SYNC. PULSE FLOATING HTR.
6.3VAC
+350V
+225V
+100V
-150V
R80 40K
R81 270K
R83 120K
R84 180K
R86 3.8K
R87 180K
R90 56
R91 3K
R92 12K
R93 18K
R96 2.4K
R97 22K
R98 150K
LOW HIGH
SW80
LOAD
1R 1R 1R 1F 1R
A1
MRH 6-12-61
TYPE TU-3
TEST LOAD PLUG-IN UNIT

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AN OREGON CORPORATION

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