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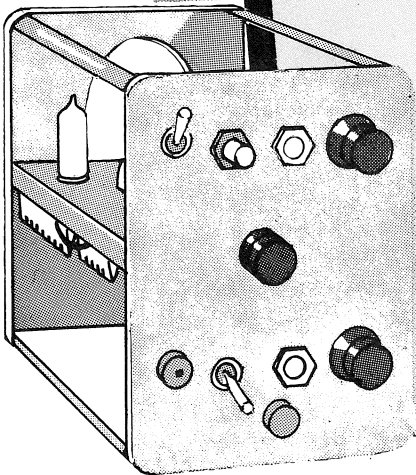
INSTRUCTION MANUAL

OSCILLOSCOPE CALIBRATION AIDS

TYPE TU-1 TYPE TU-2

TEST-LOAD PLUG-IN UNITS

This instruction manual covers the Type TU1 and Type TU2 test plug-ins. These instruments are designed to aid the calibrator in checking power-supply regulation and vertical amplifier gain.



INTRODUCTION

This instruction manual covers the Type TU1 and Type TU2 test plug-ins. These instruments are designed to aid the calibrator in checking power-supply regulation and vertical-amplifier gain. The Type TU2, in addition, checks operation of the dual-trace switching circuitry in the oscilloscope being calibrated.

Since few owners of Tektronix oscilloscopes also have the Type TU1 and TU2, you will find that the instruction manual accompanying your instrument does not mention the use of either plug-in. For this reason this manual includes, under Operating Information, general information dealing with the use of the Type TU1 and TU2 instruments.

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GENERAL DESCRIPTION

The Type TUI Plug-In may be used in any Tektronix convertible oscilloscope designed for plug-ins with either 53/54 and letter designation, or with letter designation. It is not applicable to oscilloscopes designed for use with number-designated plug-ins.

TU-1

The Type TUI incorporates a ZERO REFERENCE switch, a VERTICAL POSITION control, and a LOAD switch. The ZERO REFERENCE switch enables the operator to short the input of the vertical amplifier to check balance. The LOAD switch enables the operator to select either HIGH or LOW load on the oscil-

loscope power supplies. HIGH load represents the maximum load drawn by a plug-in, while the LOW load position represents the minimum load drawn by a plug-in. The VERTICAL POSITION control enables the operator to position the trace vertically on the oscilloscope screen.

TU-2

The Type TU2 enables the operator to check the operation of the dual-trace function by means of the NORMAL-DUAL-TRACE switch. Another switch is provided to attenuate the input signal by a factor of 250 for setting the gain of the unit. The output of the +225-volt supply is available at the front panel as an aid in checking the distributed amplifier in Tektronix oscilloscopes employing this type of vertical amplifier. In addition, the means of changing loads

and a ZERO REFERENCE switch are included in the Type TU2.

Electronic switching of the display is provided by a multivibrator circuit, which duplicates the action of the Type 53C, 53/54C or Type CA circuitry. This permits the operator to check the action of the dual-trace switching circuitry in the oscilloscope being calibrated.



OPERATING INFORMATION

The basic function of the Type TU1 and the Type TU2 are identical. For this reason we will describe the use of the Type TU2 in the instructions which follow. The Type TU2 incorporates all the functions of the Type TU1 plus additional functions not found in the Type TU1.

Preliminary

Install the Type TU2 in the oscilloscope to be calibrated before starting the calibration procedure. Measurements of the various power-supply resistances-to-ground should be made with the Type TU2 installed and the LOAD switch in the LOW position.

Power-Supply Output Voltage

Set the LOAD switch of the Type TU2 to LOW and turn the oscilloscope on. Measure the output voltages of the power supplies. Refer to the instruction manual for the oscilloscope to determine the tolerances allowable on the various supplies.

Power-Supply Ripple

To check power-supply regulation set the LOAD switch of the Type TU2 to HIGH and measure the ripple with the line voltage at 105 volts. With the line voltage at 125 volts set the LOAD switch of the Type TU2 to LOW and measure the ripple. Refer to the instruction manual for your instrument to determine the allowable tolerances for the ripple content.

Other Checks

Other checks and adjustments may be made with the Type TU2 installed. For example: Calibrator adjustment, high-voltage adjustment, geometry adjustment, and some of the adjustments in the vertical amplifier.

Setting the Vertical Gain

To set the vertical gain of the main amplifier in the oscilloscope switch the Type TU2 to 250:1 and apply a 100-volt signal from the calibrator. Adjust the gain control in the main ampli-

fier for 4 cm. of vertical deflection. Apply 0.2 volts of calibrator signal and switch to the 1:1 position. Check for 2 cm. of deflection.

Checking the Alternate Trace

To check the operation of the dual-trace switching function disconnect the calibrator signal from the INPUT connector of the Type TU2. Set the NORMAL-DUAL-TRACE switch to the DUAL-TRACE position. Set the ALTERNATE-CHOPPED switch to the ALTERNATE position. A dual trace should appear on the crt. Set the ALTERNATE-CHOPPED switch to the CHOPPED position and the switch at the rear of the oscilloscope (back panel) to the DUAL-TRACE-CHOPPED BLANKING position. Switching transients should be invisible. Return the oscilloscope switch to its normal position after completing this check. When calibrating oscilloscopes fitted with Delaying Sweep circuitry (535, 535A, 545, 545A) check the operation of the dual-trace function on both the A and the B sweep.

Balancing the Vertical Amplifier

A front-panel connector is provided on the Type TU2 which supplies +225 volts when a switch is depressed. A lead connected from the front-panel connector can be used to apply this voltage to the cathodes of the tubes in the vertical amplifier. This effectively cuts them off, and is useful in checking the balance of the stages in the vertical amplifier.

Main Amplifier Balance

The ZERO REFERENCE switch, a push-button control, may be used to short the input terminal to the vertical amplifier. This is useful in checking the balance of the complete amplifier.

CIRCUIT CONSIDERATIONS

The basic circuitry of the Type TU1 and TU2 consists of dummy loads which simulate the loading effect of plug-in preamplifiers. The -150-volt, +100-volt, +225-volt, and +350-volt supplies are connected to the correct loads by the LOAD switch.

Positioning the trace vertically is achieved by varying the dc voltage at pin 3 of the interconnecting plug. The VERTICAL POSITION control, R7, forms part of a voltage divider connected between the 75-volt supply available at pin 15 and ground.

R5, and R6 form a voltage divider connected across the input terminal of the vertical amplifier. The purpose of this divider is to provide

the dc voltage at the input of the vertical amplifier which is present when using a plug-in preamplifier.

V₃₅ is connected as a multivibrator. The multivibrator cannot operate, however, unless the pulses from the oscilloscope sweep circuitry are available. To check dual-trace operation of the oscilloscope the plug-in control is switched to the DUAL-TRACE position. Pulses from the sweep circuitry are coupled to the plug-in through pins 8 and 16 of the interconnecting cable. Pin 8 is grounded, while the pulse at pin 16 is coupled to the multivibrator through the Isolation Diode, V₅₂. The incoming pulses trigger the multivibrator, whose waveform provides the voltage change for the dual-trace operation.



MAINTENANCE INFORMATION

REPLACEMENT PARTS

Standard Parts

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

Tektronix-Manufactured Parts

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

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

Since the production of your instrument, some of the Tektronix-manufactured components may have been superseded with improved components. The part number of these new components will not be listed in your manual. If you order a Tektronix-manufactured component, and if the component has been superseded by a new,

improved component, the new part will be shipped in place of the original. Your local Tektronix Field Engineering Office has knowledge of these changes and may call you if a change in your purchase order is necessary.

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

Parts-Ordering Information

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

Each part in your instrument has a 6-digit Tektronix part number. This number, together with a description of the part, will be found in the Part List. When ordering parts, be sure to include both the description of the part and the part number. For example, a certain resistor should be ordered as follows: R5256, 1.1 k, 1/2 w, Fixed, Comp., 5%, part number 301-112 for a Type TU1 Plug-In Unit, Serial Number 81. When parts are ordered in this manner we are able to fill your orders promptly, and delays that might result from transposed numbers in the part number are avoided.

OPERATIONAL CHECKS

The Type TU1 and the Type TU2 are simple instruments employing standard components.

The components used in both the Type TU1 and the TU2 are standard items. Little component trouble should be experienced. If in doubt as to the value of a component the value may be verified by a bridge of good quality. If tube failure in the Type TU2 is suspected substitution of new tubes provides a rapid check.

Mechanical Inspection

1. Tighten screws and nuts wherever possible.
2. Visually check all lead dress, all solder joints, and the terminals of the rotary switches.
3. Check the dress of the large resistors mounted on the upper side of the chassis. The resistors should be standing erect on their terminals rather than bent to one side or the other where there is a danger of two resistors touching.

Electrical Checks

1. Check the 1/16 amp fuse (accessible from the

front panel).

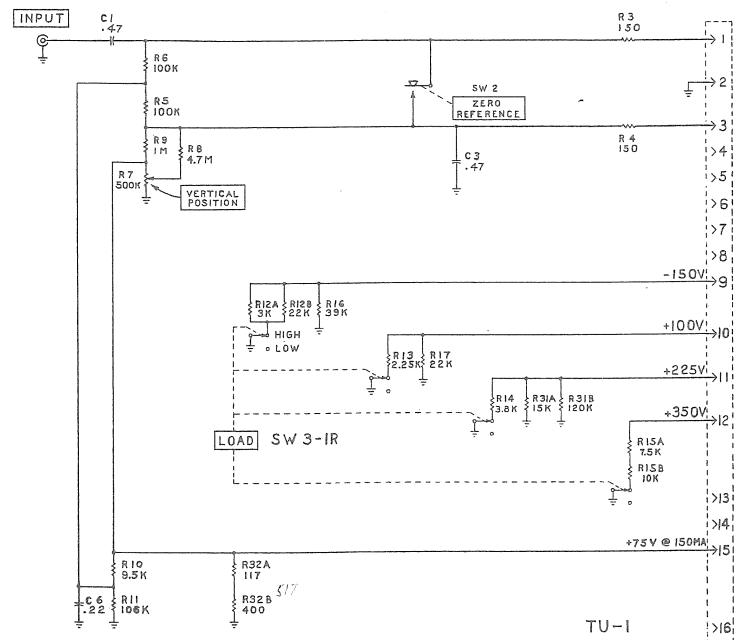
2. With no input signal measure the voltage change across pins 1 and 3 of the interconnecting plug. There should be approximately 1/2-volt change as the VERTICAL POSITION control is rotated from one extreme position to the other.
3. The waveform of the multivibrator may be checked with another oscilloscope. Connect the probe from the second oscilloscope to the junction of R29 and R30. With the Type TU2 operating in the ALTERNATE mode the waveform should resemble that shown at A. With the Type TU2 operating in the CHOPPED mode the waveform should resemble that shown as B.



Fig. 2. (A) Waveform present at the cathode of the plug-in multivibrator when the Type TU2 is operating in the Alternate mode. (B) Waveform present at the cathode of the plug-in multivibrator when the plug-in is operating in the Chopped mode.

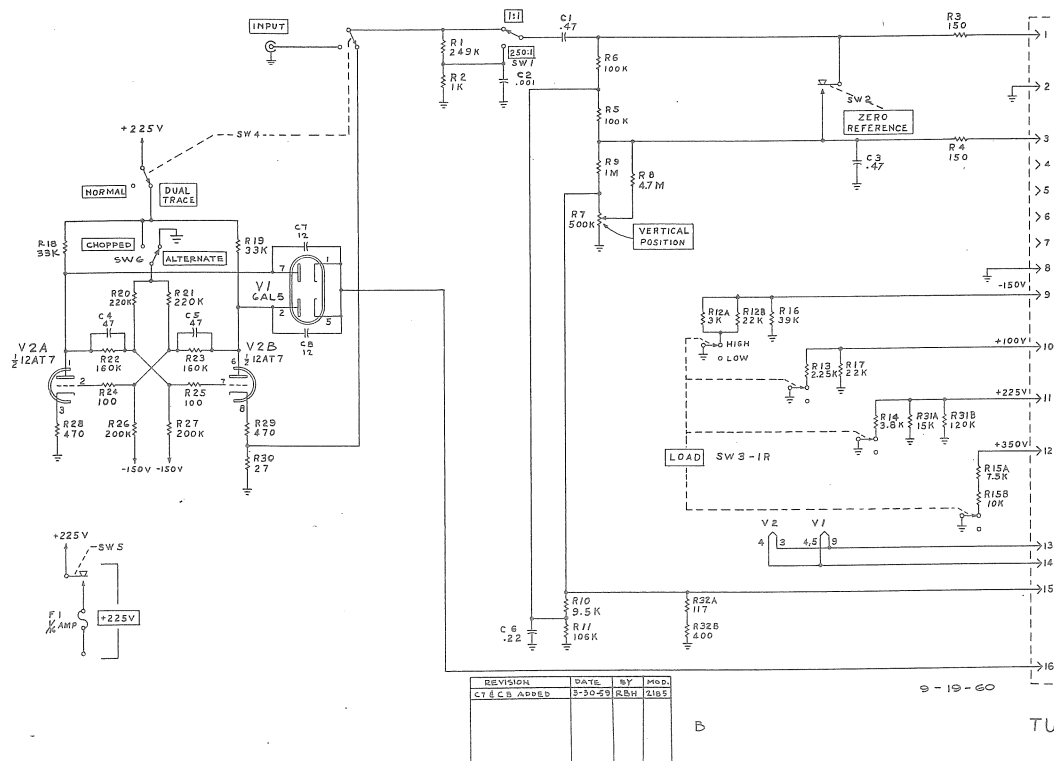


CIRCUIT DIAGRAMS



TU-1

A₁ TU-1 811 6-5-58



TU-2

TU-2 TEST LOAD UNIT

ABBREVIATIONS

Cer.	Ceramic	m	milli or 10
Comp.	Composition	Ω	ohm
EMC	Electrolytic, metal-cased	PBT	Paper, "Bathtub"
f	Farad	PMC	Paper, metal-cased
GMV	Guaranteed minimum value	Poly	Polystyrene
h	Henry	Prec.	Precision
k	Kilohm or 10 ohms	PT	Paper tubular
M/Cer	Mica or Ceramic	v	Working volts DC
meg	Megohm or 10 ohms	Var.	Variable
μ	Micro. or 10	w	Watt
μμ	Micromicro or 10	WW	Wire-wound

* Asterisk preceding Tektronix Part Number indicates that it was manufactured by or for Tektronix; also reworked or checked components.

PARTS LIST

CAPACITORS

Ckt. No.	Description	Part No.
C1	.47 μf PTM Fixed 400 v	285-562
C2	.001 μf Cer. Fixed 500 v	283-000
C3	.47 μf PTM Fixed 400 v	285-562
C4	47 μμf Cer. Fixed 500 v +or- 9.4 μμf	281-518
C5	47 μμf Cer. Fixed 500 v +or- 9.4 μμf	281-518
C6	.22 μf MT Fixed 400 v	285-533
C7	X246 12 μμf Cer. Fixed 500 v +or- 1.2 μμf	281-506
C8	X246 12 μμf Cer. Fixed 500 v +or- 1.2 μμf	281-506

FUSES

F1	1/16 Amp	3 AG	Fast-Blo	159-024
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RESISTORS

R1	250 k	1/2 w	Fixed	Prec.) Selected to total) 249 K, + or - 1/2%	*312-588
R2	1 k	1/2 w	Fixed	Prec.		
R3	150 Ω	1/2 w	Fixed	Comp.	10%	302-151
R4	150 Ω	1/2 w	Fixed	Comp.	10%	302-151
R5	100 k	1/2 w	Fixed	Comp.	10%	302-104
R6	100 k	1/2 w	Fixed	Comp.	10%	302-104
R7	500 k	2 w		Comp.	20%	311-034
R8	4.7 Meg	1/2 w	Fixed	Comp.	10%	302-475
R9	1 Meg	1/2 w	Fixed	Comp.	10%	302-105
R10	9.5 k	1/2 w	Fixed	Prec.	1%	309-121
R11	106 k	1/2 w	Fixed	Prec.	1%	309-161
R12A	3 k	10 w	Fixed	WW	5%	308-020
R12B	22 k	2 w	Fixed	Comp.	10%	306-223
R13	2.25 k	10 w	Fixed	WW	5%	308-059
R14	3.8 k	25 w	Fixed	WW	5%	308-044
R15A	7.5 k	10 w	Fixed	WW	5%	308-022
R15B	10 k	10 w	Fixed	WW	5%	308-023
R16	39 k	1 w	Fixed	Comp.	10%	304-393
R17	22 k	1 w	Fixed	Comp.	10%	304-223
R18	33 k	2 w	Fixed	Comp.	10%	306-333
R19	33 k	2 w	Fixed	Comp.	10%	306-333
R20	220 k	1/2 w	Fixed	Comp.	10%	302-224
R21	220 k	1/2 w	Fixed	Comp.	10%	302-224
R22	160 k	1/2 w	Fixed	Comp.	5%	301-164
R23	160 k	1/2 w	Fixed	Comp.	5%	301-164
R24	100 Ω	1/2 w	Fixed	Comp.	10%	302-101
R25	100 Ω	1/2 w	Fixed	Comp.	10%	302-101



R26	200 k	1/2 w	Fixed	Comp.	5%	301-204
R27	200 k	1/2 w	Fixed	Comp.	5%	301-204
R28	470 Ω	1/2 w	Fixed	Comp.	10%	302-471
R29	470 Ω	1/2 w	Fixed	Comp.	10%	302-471
R30	27 Ω	1/2 w	Fixed	Comp.	10%	302-270
R31A	15 k	10 w	Fixed	WW	5%	308-024
R31B	120 k	1 w	Fixed	Comp.	10%	304-124
R32A	117 Ω	5 w	Fixed	WW) Selected to total) 510 Ω + or - 1%	*312-589
R32B	400 Ω	20 w	Fixed	WW		

SWITCHES

SW1	250:1 - 1:1	Toggle	*260-014
SW2	Zero Reference	Push-button	*260-017
SW3	Load	Rotary	*260-107
SW4	Normal Dual Trace	Toggle	*260-014
SW5	370-up	SPST Push-button	*260-247
SW6	370-up	Rotary, Single Wafer	*260-341

VACUUM TUBES

V35 2	12AT7	154-039
V52 1	6AL5	154-016



TU-1 TEST LOAD UNIT

ABBREVIATIONS

Cer.	Ceramic	m	milli or 10
Comp.	Composition	Ω	ohm
EMC	Electrolytic, metal-cased	PBT	Paper, "Bathtub"
f	Farad	PMC	Paper, metal-cased
GMV	Guaranteed minimum value	Poly	Polystyrene
h	Henry	Prec.	Precision
k	Kilohm or 10 ohms	PT	Paper tubular
M/Cer	Mica or Ceramic	v	Working volts DC
meg	Megohm or 10 ohms	Var.	Variable
μ	Micro. or 10	w	Watt
$\mu\mu$	Micromicro or 10	WW	Wire-wound

* Asterisk preceding Tektronix Part Number indicates that it was manufactured by or for Tektronix; also reworked or checked components.

PARTS LIST

CAPACITORS

Ckt. No.	Description				Part No.
C1	.47 μ f	PTM	Fixed	400 v	285-562
C3	.47 μ f	PTM	Fixed	400 v	285-562
C6	.22 μ f	MT	Fixed	400 v	285-533

RESISTORS

R3	150 Ω	1/2 w	Fixed	Comp.	10%	302-151
R4	150 Ω	1/2 w	Fixed	Comp.	10%	302-151
R5	100 k	1/2 w	Fixed	Comp.	10%	302-104
R6	100 k	1/2 w	Fixed	Comp.	10%	302-104
R7	500 k	2 w	Var.	Comp.	20%	311-034
R8	4.7 meg	1/2 w	Fixed	Comp.	10%	302-475
R9	1 meg	1/2 w	Fixed	Comp.	10%	302-105
R10	9.5 k	1/2 w	Fixed	Prec.	1%	309-121

R11	106 k	1/2 w	Fixed	Prec.	1%	309-161
R12A	3 k	10 w	Fixed	WW	5%	308-020
R12B	22 k	2 w	Fixed	Comp.	10%	306-223
R13	2.25 k	10 w	Fixed	WW	5%	308-059
R14	3.8 k	25 w	Fixed	WW	5%	308-044
R15A	7.5 k	10 w	Fixed	WW	5%	308-022
R15B	10 k	10 w	Fixed	WW	5%	308-023
R16	39 k	1 w	Fixed	Comp.	10%	304-393
R17	22 k	1 w	Fixed	Comp.	10%	304-223
R31A	15 k	10 w	Fixed	WW	5%	308-024
R31B	120 k	1 w	Fixed	Comp.	10%	304-124
R31A	117 Ω	5 w	Fixed	WW)	Selected to total	*312-589
R32B	400 Ω	20 w	Fixed	WW)	510 Ω , + or - 1%	

SWITCHES

SW2	ZERO REFERENCE	Pushbutton	*260-017
SW3	LOAD	Rotary	*260-107



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