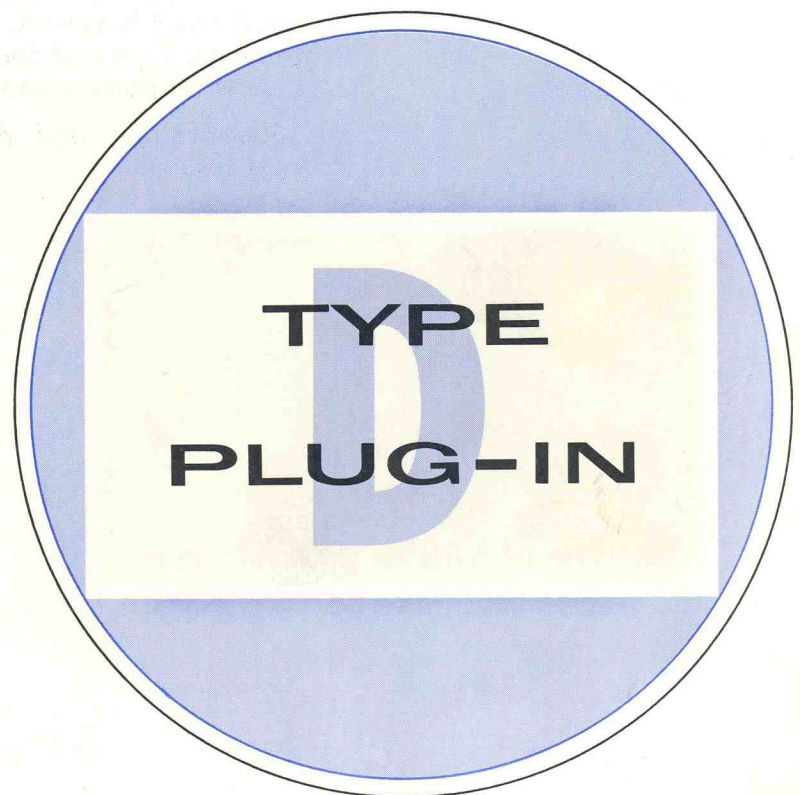


# INSTRUCTION MANUAL



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

070-228

SN 15829





## 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.

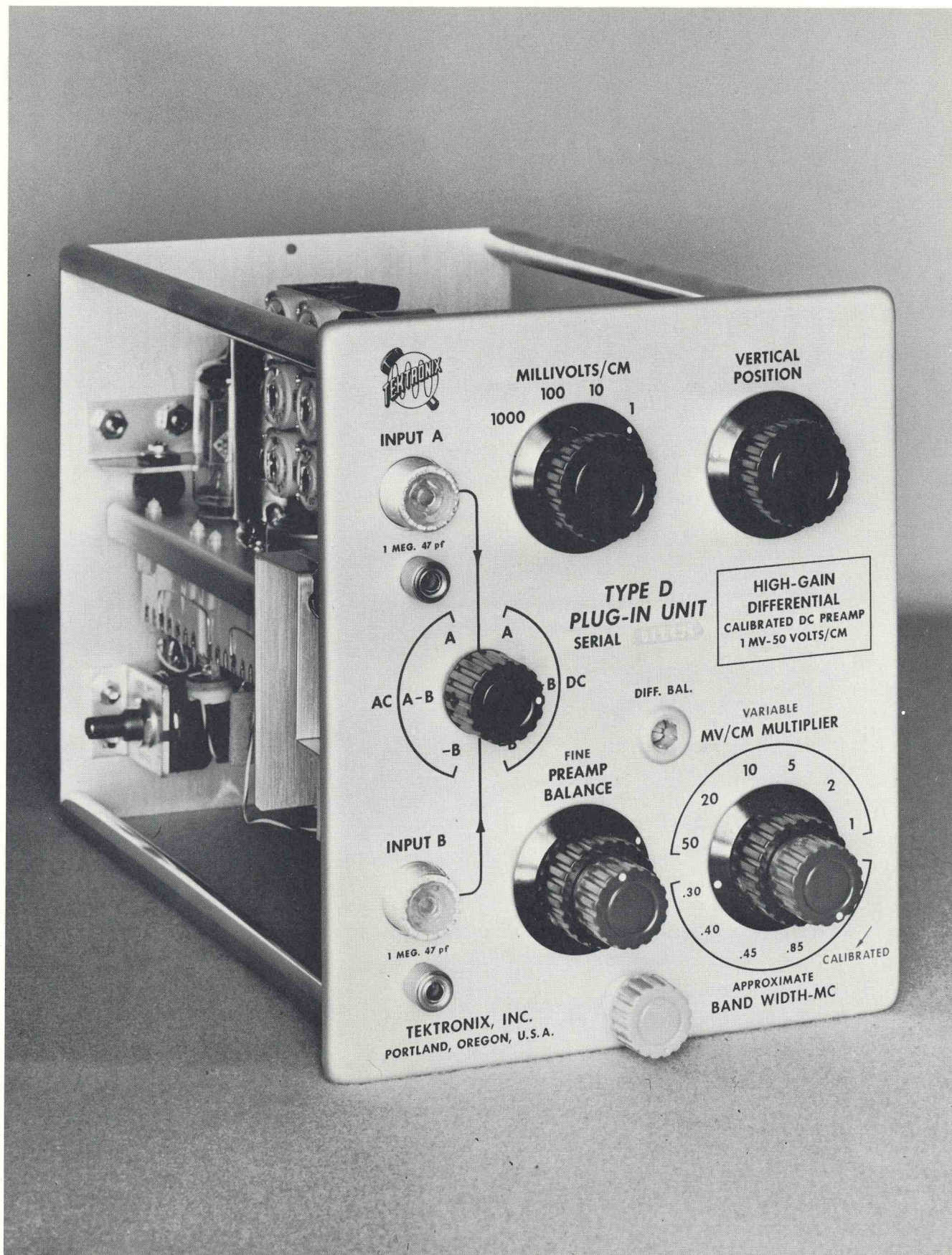




## CONTENTS

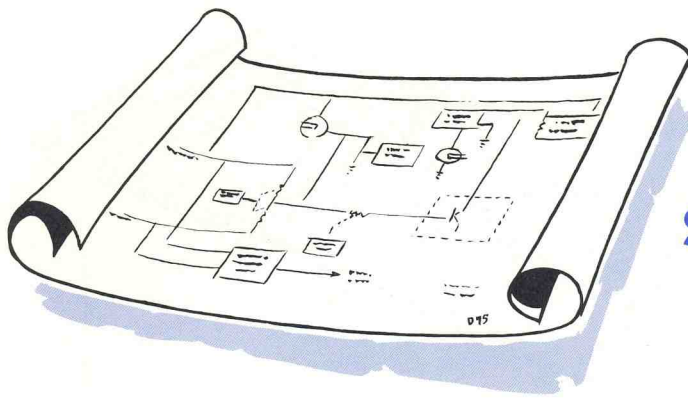
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Type D





# SPECIFICATIONS

## SPECIAL NOTE

At serial number 707 the plug-in type changed to permit use in 540 series as well as 530 series instruments. Type 53D becomes Type 53/54D. At serial number 7245 the front panel designation changed from Type 53/54D to Type D. For purposes of reference in this manual, the instrument will be described as Type D in all cases.

## General

The Type D adapts Type 530- and 540-Series Oscilloscopes (530-Series Oscilloscopes S/N 101-706) for work requiring dc coupling at sensitivities as high as 1 mv/cm, and for differential input with high rejection ratio for in-phase signals. The differential-input connection permits cancellation of unwanted or interfering signals.

## Characteristics

### Sensitivity

Calibrated, 1 mv/cm, continuously variable, 1 mv/cm to 125 v/cm.

### Frequency Response

DC to 350 kc at 1-mv/cm sensitivity, increasing to dc to 2 mc at 50-mv/cm and lower sensitivity.

### Differential Input

The rejection ratio for in-phase signals is greater than 10,000 to 1, DC coupled. At low frequencies, in the AC coupled position, the rejection ratio decreases with frequency. The rejection ratio at 60 cps is about 600 to 1, AC coupled.

### Physical Characteristics

Construction, aluminum alloy chassis; Finish, photo-etched, anodized panel; weight, 4 lbs.

## Functions of Controls and Connectors

**INPUT A** Separate signal inputs to the preamplifier  
**INPUT B** by way of the input selector switch.

### INPUT SELECTOR SWITCH

Six-position switch, providing choice of either input separately, or the two inputs differentially, with either ac or dc coupling.

### MILLIVOLTS/CM DEFLECTION SENSITIVITY MULTIPLIER (S/N 101-706)

Four-position switch to insert attenuators between the signal inputs and the amplifier.

### MV/CM MULTIPLIER DEFLECTION SENSITIVITY (S/N 101-706)

Six-position switch to change gain of amplifier and provide 15 calibrated sensitivities in conjunction with the MILLIVOLTS /CM switch.

### VARIABLE

Potentiometer, concentric with the deflection-sensitivity switch, to provide continuously variable attenuation between the calibrated sensitivities and to decrease the sensitivity to 125 v/cm.

### VERTICAL POSITION

Potentiometer to move the trace vertically.

### DIFF. BAL.

Screwdriver-adjust potentiometer sets dc differential bias on input tubes to provide a fine differential adjustment of the input-stage gain, so maximum rejection will be obtained with differential input.

### PREAMP BALANCE

Seven-position switch to balance the dc voltage on the plates of the input cascode amplifiers.

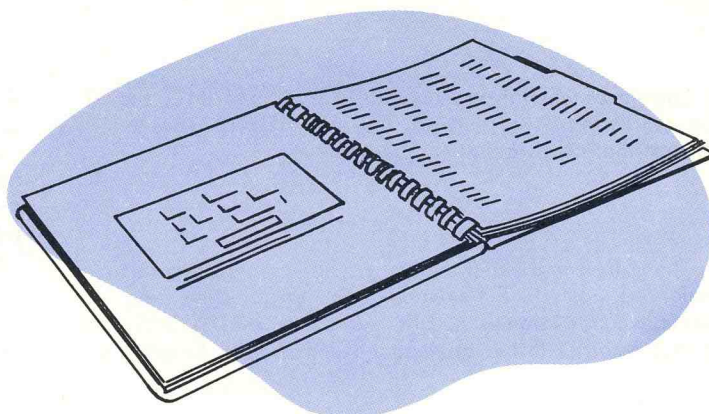
### FINE (S/N 707-up)

Potentiometer to provide a fine adjustment of the dc balance on the input-amplifier plates.



## SECTION 2

# OPERATING INSTRUCTIONS



### General

The Type D High-Gain Differential Calibrated DC preamp is designed to operate as the preamplifier for a Tektronix 530-, 540- or 550-series Oscilloscope (530-Series Oscilloscope S/N 101-706). We assume that it will be operated in this manner in the following instructions.

Be sure to let the preamp warm up for a few minutes after you first apply power to it so it can stabilize. Normally, it will be quite stable after about five minutes.

### Signal Inputs

Either of the two signal inputs can be used independently by turning the input-selector switch to one of the two inputs and connecting the signal to the corresponding input connector.

The DC and AC positions of this switch differ only in that, in the AC positions, a capacitor is inserted in series with the input to remove the dc component of the signal. In the two positions of the switch marked A-B, both inputs are connected to the amplifier, and the signal presented to the main amplifier in the oscilloscope is the difference between the two signals connected to INPUT A and INPUT B.

### Deflection Sensitivity S/N 101-706

The DEFLECTION SENSITIVITY control is a step control which inserts various frequency-compensated attenuators between the input connectors and the amplifier. The DEFLECTION SENSITIVITY MULTIPLIER further decreases the gain by factors of 1, 10, 100, or 1,000 and in conjunction with the DEFLECTION SENSITIVITY switch will give 24 fixed calibrated sensitivities. The variable attenuator control, which is concentric with the DEFLECTION SENSITIVITY control, has a range of about  $2\frac{1}{2}$  to 1, to fill in between the fixed steps, thus making the attenuation continuously variable from 1 mv/cm to 125 v/cm.

### Deflection Sensitivity S/N 707-up

The MILLIVOLTS/CM control is a step control which inserts frequency-compensated attenuators between the input connectors and the amplifier. The MV/CM MULTIPLIER further decreases the gain of the amplifier by factors of 1, 2, 5, 10, 20, and 50. This allows the ranges of the MILLIVOLTS/CM switch to overlap so you can keep the MULTIPLIER

switch in the maximum-band-width positions except when maximum sensitivity is desired. The approximate band width in megacycles is marked along the bottom of the MULTIPLIER switch. The variable attenuator controls which is concentric with the MULTIPLIER switch fills in between the fixed steps of this switch making the attenuation continuously variable from 1 mv/cm to 125 v/cm.

Except when you require sensitivity in excess of 10 millivolts per centimeter, keep the MV/CM MULTIPLIER control in the 10, 20, and 50 positions. In these positions the reduced amplifier gain provides improved stability and increased frequency response. This is especially helpful in reducing the warm-up drift.

#### NOTE:

The VARIABLE attenuator must be turned full right to the CALIBRATED position for the indicator deflection sensitivity to agree with the ruled lines on the graticule.

The ten-times-attenuation probe furnished with the oscilloscope will extend the attenuation to a maximum of 1250 v/cm and reduce the loading on the circuit under test to 10 megohms shunted by about 12  $\mu$ f. The peak voltage to ground applied to the probe should not exceed 600 volts. Larger signals must be externally attenuated. Occasionally, when you are measuring small ac signals in the presence of large dc voltages, you may have to adjust the VERTICAL POSITION control to return the trace to the screen.

### Preamp Balance S/N 707-up

The input cascode amplifier can be balanced by means of the concentric, front-panel PREAMP BALANCE controls. If these controls are properly set, the trace will not shift vertically when the MULTIPLIER switch is rotated.

To make this adjustment set the MILLIVOLTS/CM switch to 100 and the MULTIPLIER switch to 50. Position the trace near center and turn the MULTIPLIER switch to 20. Return the trace to center with the FINE control and, if necessary, with the PREAMP BALANCE switch. Continue turning the MULTIPLIER to the 10 and 5 positions, adjusting the PREAMP BALANCE controls as necessary until there is no trace shift as the MULTIPLIER control is switched between the 5 and 10 positions.

Any shift remaining as the MULTIPLIER control is switched to 1 may be partially compensated for by a slight readjustment of the FINE control until the 2ND STAGE PLATE BAL. control can be adjusted as described in the Maintenance section of this manual.



Sometimes when it appears that PREAMP BALANCE should be readjusted, it is actually the DIFFERENTIAL BALANCE control that needs adjusting. See below.

### Differential Balance S/N 1393-up

The differential input makes possible the application of balanced inputs to the preamp. The best rejection ratio for common-mode signals occurs when the MILLIVOLTS/CM switch is at 1. If the attenuator trimmers and balance re-

sistors are carefully adjusted, the rejection ratio will remain about 10,000 to 1 in the 10, 100 and 1000 positions of the MILLIVOLTS/CM switch. To avoid distortion of the signal, the common-mode signal should not exceed 5 volts, peak-to-peak, at the grid of the first stage. Thus, in the 10 and 100 positions of the MILLIVOLTS/CM switch, it should not exceed 50 volts and 500 volts respectively.

Use of the probes ahead of the preamp reduces the rejection ratio to about 50 to 1 because of the 1 per cent tolerance of the probe resistors.



## SECTION 3

# CIRCUIT DESCRIPTION

### General

The Type D Plug-in unit has a minimum passband DC to 350 kc and a maximum passband DC to 2 mc, depending upon sensitivity. It has four calibrated (Six S/N 101-706) sensitivity steps and six (four S/N 101-706) multiplier positions for each step. The variable attenuator control fills in between these steps making the attenuation continuously variable.

The VERTICAL POSITIONING control is located in the plug-in unit. This is possible because the remainder of the vertical amplifier system is dc coupled so that a dc change at this level becomes a dc change at the crt deflection plates.

### Input Connectors

Either of two input connectors can be switched into the input circuits by means of SW3004. Each of the signal grids of the push-pull input stage is brought out to the front panel by way of the input-selector switch.

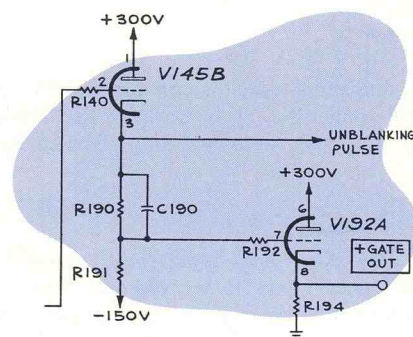
In either the A or the B positions of the switch, one of the grids is grounded and the other one is left free for the signal input. In the A-B position of the switch, both grids are left free for signal inputs. In the DC positions of the switch, the blocking capacitors C3004 and C3204 are shorted out.

### Attenuators

The MILLIVOLTS/CM control (DEFLECTION SENSITIVITY MULTIPLIER control S/N 101-706) inserts various frequency-compensated attenuators between the input connectors and the signal grids of the input stage. The four attenuation ratios are 1, 10, 100, and 1,000.

V3404 and V3454 comprise a cascode push-pull amplifier stage. V3504B is a voltage-setting cathode follower. R3574, the DIFF. BAL. control, adjusts the relative dc levels of the two grounded grids of the cascode amplifier stage. This control is used to equalize the gain of the two halves of the stage for maximum rejection of common-mode signals with differential input.

In serial numbers 101-706 R3553, marked AMPLIFIER BALANCE, adjusts the dc level of the plate of V3404B so that the dc input to the next stage is balanced.



In serial numbers 707-up the PREAMP BALANCE switch, SW 3484, provides a coarse adjustment of the dc level on the plate of V3454B and the concentric FINE adjustment varies the dc level of V3404B so the input to the next stage can be balanced.

### Output Stage

V3604 and V3704 comprise a push-pull gain stage. V3504A is a voltage-setting cathode follower which supplies the screen voltage for this stage. The MULTIPLIER switch, SW3604, (DEFLECTION SENSITIVITY switch, SW3014 S/N 101-706) selects fixed resistors for the plate loads of the cascode and output amplifiers to adjust the gain in fixed steps. R3664, GAIN ADJ., and R3724, VARIABLE, also adjust the gain of this stage by varying the cathode coupling between the two tubes.

### Output-Stage Controls

The relative screen potentials of the two tubes are adjusted by R3704, marked VAR. ATTEN. BAL. This adjustment is necessary to set the two cathodes at the same potential so that a vertical shift of the trace will not occur when either the GAIN ADJ. or the VARIABLE controls are varied.

R3814, marked 2ND STAGE PLATE BAL, balances the output of this stage so the input to the cathode follower stage will be balanced. V3904 is a cathode-follower stage to drive the main amplifier, R3914, marked VERTICAL POSITION, adjusts the relative dc potentials of the two cathodes which positions the trace vertically. R3964, marked VERT. POS RANGE, adjusts the relative bias on the grids of V3094 to make it possible to center the trace vertically with the VERTICAL POSITION control set at mid-range.

### Heaters

The heaters of all the tubes in this unit are supplied with dc from the main unit. Terminal 15 of the connecting plug furnishes part of the current to operate the heater string and the additional current required to operate V3404 and V3454, is supplied by the 100-volt bus, through R4014.



## MAINTENANCE

### Replacement of Components

Tektronix will supply replacement components at current net prices. However, since most of the components are standard electronic and radio parts we suggest you get them from your local dealer if you can. Be sure to consult your instruction manual first to see what tolerances are required.

We specially select some of the components, whose values must fall within prescribed limits, by sorting through our regular stocks. The components so selected will have standard RETMA color-code marks showing the values and tolerances of the stock they were selected from, but they will not in general be replaceable from dealer stocks.

Such selected parts, as well as the parts we manufacture at Tektronix, are identified in the parts list either by notes or by our own stock numbers. Order these parts from the Tektronix factory in Portland, Oregon.

### Tube Replacement Notice

In serial numbers 3462 and up the 12AU7 tubes used as V3404 and V3454 in this plug-in unit are of Telefunken manufacture, and are especially selected and aged at the factory. Tests indicate that these tubes give the best overall performance with regard to drift and microphonics in this particular application.

### Parts-Ordering Information

You will find a serial number on the frontispiece of this manual. This is the serial number on the instrument the manual was prepared for. Be sure the manual number matches the number of the instrument when you order parts.

A Tektronix instruction manual usually contains hand-made changes to diagrams and parts list, and sometimes text. These changes are in general only appropriate to the instrument the manual was prepared for, the instrument whose serial number appears on the manual frontispiece. The hand-made changes show changes to the instrument that have been made after printing of the manual.

We make some of the instrument changes during the factory test procedure. Our technicians hand-tailor the circuits, if it seems appropriate, to provide the widest possible latitude of operation. Other changes are made to include the latest circuit improvements as they are developed in our engineering department, or when improved components become available. In any event, the changes are to your benefit. We have tried to give you the best instrument we can.

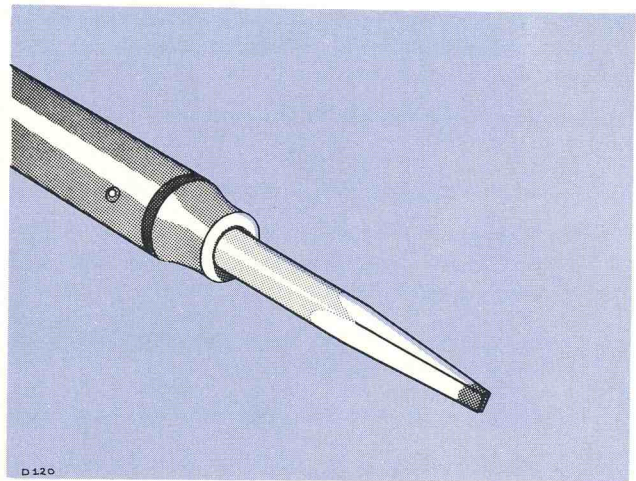


Fig. 4-1 Preparation of soldering iron tip

### SOLDERING AND CERAMIC STRIPS

Many of the components in your Tektronix instrument are mounted on ceramic terminal strips. The notches in these strips are lined with a silver alloy. Repeated use of excessive heat, or use of ordinary tin-lead solder will break down the silver-to-ceramic bond. Occasional use of tin-lead solder will not break the bond if excessive heat is not applied.

If you are responsible for the maintenance of a large number of Tektronix instruments, or if you contemplate frequent parts changes, we recommend that you keep on hand a stock of solder containing about 3% silver. This type of solder is used frequently in printed circuitry and should be readily available from radio-supply houses. If you prefer, you can order the solder directly from Tektronix in one-pound rolls. Order by Tektronix part number 251-514.

Because of the shape of the terminals on the ceramic strips it is advisable to use a wedge-shaped tip on your soldering iron when you are installing or removing parts from the strips. Fig. 4-1 will show you the correct shape for the tip of the soldering iron. Be sure and file smooth all surfaces of the iron which will be tinned. This prevents solder from building up on rough spots where it will quickly oxidize.

When removing or replacing components mounted on the ceramic strips you will find that satisfactory results are obtained if you proceed in the manner outlined below.

1. Use a soldering iron of about 75-watt rating.



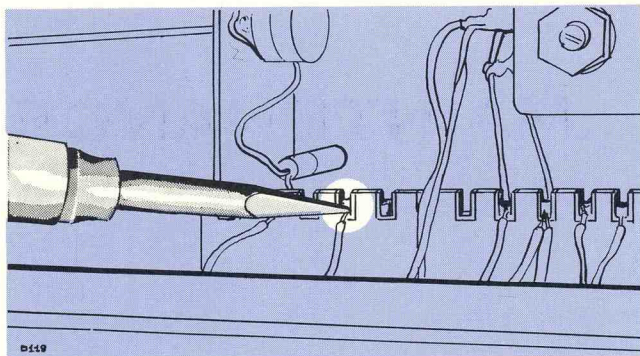


Fig. 4-2 Applying soldering iron tip to ceramic strip

2. Prepare the tip of the iron as shown in Fig. 4-1.
3. Tin only the first 1/16 to 1/8 of the tip. For soldering to ceramic terminal strips tin the iron with solder containing about 3% silver.
4. Apply one corner of the tip to the notch where you wish to solder (see Fig. 4-2).
5. Apply only enough heat to make the solder flow freely.
6. Do not attempt to fill the notch on the strip with solder; instead, apply only enough solder to cover the wires adequately, and to form a slight fillet on the wire as shown in Fig. 4-3.

In soldering to metal terminals (for example, pins on a tube socket) a slightly different technique should be employed. Prepare the iron as outlined above, but tin with ordinary tin-lead solder. Apply the iron to the part to be soldered as shown in Fig. 4-4. Use only enough heat to allow the solder to flow freely along the wire so that a slight fillet will be formed.

### General Soldering Considerations

When replacing wires in terminal slots clip the ends neatly as close to the solder point as possible. In clipping

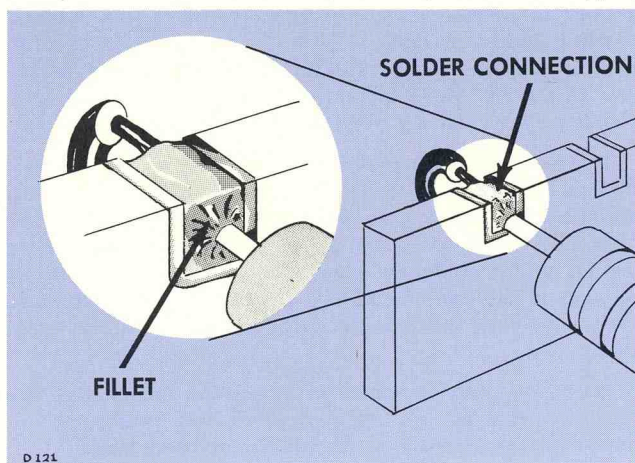


Fig. 4-3. Fillet on wire

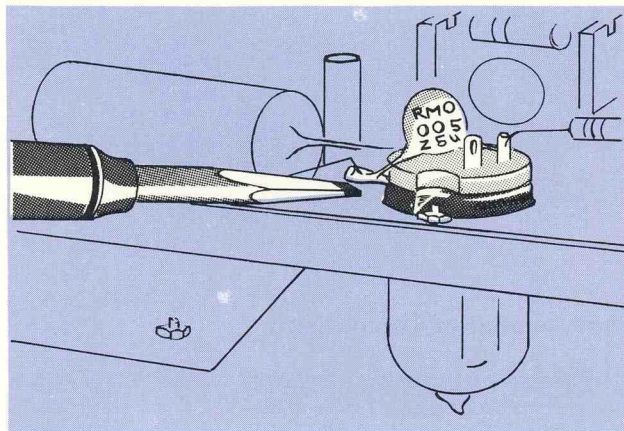


Fig. 4-4. Soldering to metal terminals

the ends of wires take care the end removed does not fly across the room as it is clipped.

Occasionally you will wish to hold a bare wire in place as it is being soldered. A handy device for this purpose is a short length of wooden dowel, with one end shaped as shown in Fig. 4-5. In soldering to terminal pins mounted in plastic rods it is necessary to use some form of "heat sink" to avoid melting the plastic. A pair of long-nosed pliers (see Fig. 4-6) makes a convenient tool for this purpose.

### Ceramic Strips

Two distinct types of ceramic strips have been used in Tektronix instruments. The earlier type mounted on the chassis by means of #2-56 bolts and nuts. The later type is mounted with snap-in, plastic fittings. Both styles are shown in Fig. 4-7.

To replace ceramic strips which bolt to the chassis, screw a #2-56 nut onto each mounting bolt, positioning the bolt so that the distance between the bottom of the bolt and the bottom of the ceramic strip equals the height at which

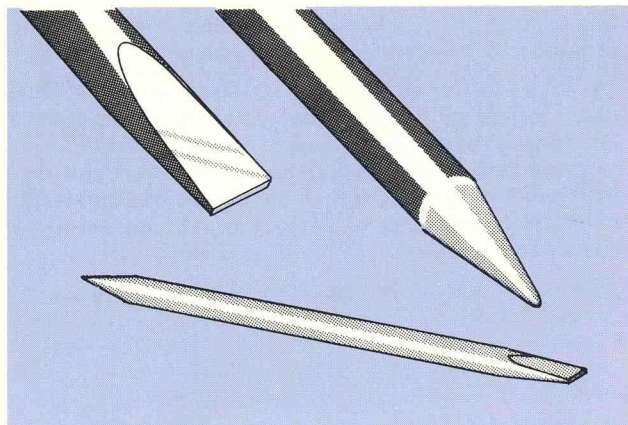


Fig. 4-5. Wooden dowel used as soldering aid.



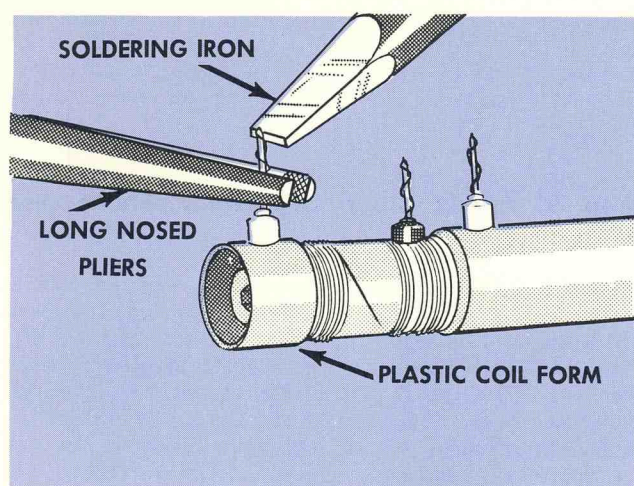


Fig. 4-6. Long-nosed pliers used as a heat sink.

you wish to mount the strip above the chassis. Secure the nuts to the bolts with a drop of red glyptal. Insert the bolts through the holes in the chassis where the original strip was mounted, placing a #2 starwasher between each nut and the chassis. Place a second set of #2 flatwashers on the protruding ends of the bolts, and fasten them firmly with another set of #2-56 nuts. Place a drop of red glyptal over each of the second set of nuts after fastening.

### Mounting Later Ceramic Strips

To replace ceramic strips which mount with snap-in plastic fittings, first remove the original fittings from the chassis. Assemble the mounting post on the ceramic strip. Insert the nylon collar into the mounting holes in the chassis. Carefully force the mounting posts into the nylon collars. Snip off the portion of the mounting post which protrudes below the nylon collar on the reverse side of the chassis. Note: considerable force may be necessary to push the mounting rods into the nylon collars. Be sure that you apply this force to that area of the ceramic strip directly above the mounting rods.

### Equipment needed for calibration of Type D

1. Type 530-540-Series Oscilloscope
2. Tektronix Type 105 Square-Wave Generator or equivalent, providing square-waves at 1 kc and 100 kc with a frequency accuracy of  $\pm 3\%$  and rise time of at least .02  $\mu\text{sec}$ .
3. Input Capacitance Standardizer (CS47)
4. 52  $\Omega$  termination resistor (B52R)
5. 52  $\Omega$  cable
6. Plug-In Extension (EP53).

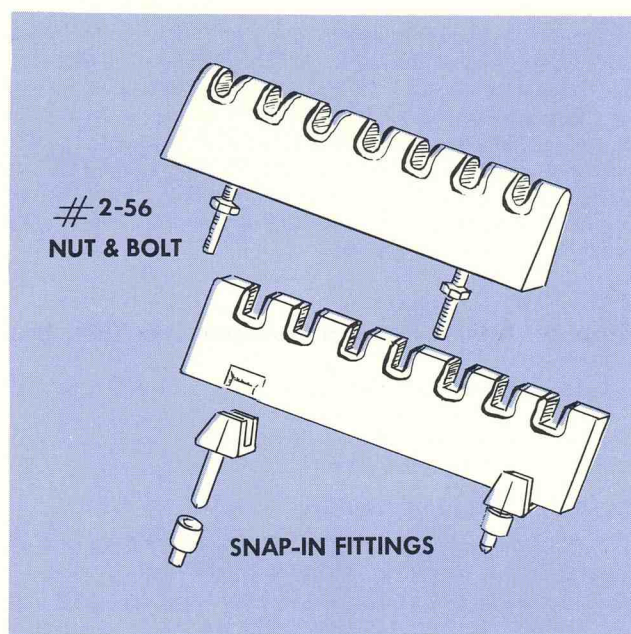


Fig. 4-7. Ceramic strips and fittings.

### Step 1. Oscilloscope Controls

The test oscilloscope should have control settings as follows, unless otherwise stated:

HORIZONTAL DISPLAY	INTERNAL SWEEP or TIME BASE A
TRIGGERING MODE	AUTOMATIC
TRIGGER SLOPE	-INT
STABILITY	PRESET
TIME/CM	1 MSEC

### Step 2. Determine Vertical System Electrical Center

Determine the "Vertical-System Electrical Center" of the oscilloscope by placing a jumper between pins 1 and 3 of the interconnecting socket and observing the vertical level of the crt trace. This level will be referred to later in the calibration procedure.

### Step 3. Adjust Vertical Position Range

Connect a jumper across R3854 (7.3k resistor on the DEFLECTION SENSITIVITY or MV/CM MULTIPLIER switch) and adjust the VERT. POS. RANGE control to center the trace on the graticule "Vertical System Electrical Center."



### Step 4. Adjust 2nd Stage Plate Balance and Variable Attenuator Balance

Connect a jumper between the grids, pins 1, of V3604 and V3704. Adjust the VAR. ATTN BAL. control (labeled C.F. ADJ. S/N 101-650), so that the trace remains stationary on the screen as the VARIABLE control is varied throughout its range. Now adjust the 2ND STAGE PLATE BAL. so that the trace remains stationary as the MV/CM MULTIPLIER or DEFLECTION SENSITIVITY switch is varied between 1 and 2. These controls may interact slightly, so that one or two readjustments are necessary.

### Step 5. Adjust Preamp Balance and Diff. Bal.

Set Type D controls as follows:

MV/CM MULTIPLIER (DEFLECTION SENSITIVITY)	1
INPUT SELECTOR SWITCH	A-B DC

From the Square-Wave Calibrator apply 10 volts to both INPUT A and INPUT B. Adjust the DIFF. BAL. control for minimum deflection while keeping the trace centered with the PREAMP BALANCE or AMPLIFIER BALANCE controls. If these controls are far out of adjustment, it may be helpful to start with the MV/CM MULTIPLIER at 10 or 20.

### Step 6. Set Millivolts/CM Switch Adjustments (S/N 1393 and up only)

Leave Type D controls set as in the previous step. From the SQUARE WAVE CALIBRATOR on the oscilloscope, apply signal in both INPUT A and INPUT B.

Adjust balance controls for minimum deflection:

MILLIVOLTS/CM SWITCH	CALIBRATOR	ADJUST FOR FLAT TOP
10	20 volts	R3044
100	50 volts	R3074
1000	100 volts	R3154

### Step 7. Adjust Gain

Set up Type D controls as follows:

MILLIVOLTS/CM	1
MV/CM MULTIPLIER	50
INPUT SELECTOR SWITCH	A DC

From the SQUARE WAVE CALIBRATOR, apply .2 volts to INPUT A and adjust R3664 for 4 centimeters of deflection.

### Step 8. Adjust Output Compensations

Leaving Type D controls as in the previous step, reset the oscilloscope TIME/CM control to 10  $\mu$ sec. From the Type 105, apply a 100 kc signal to INPUT A and set the 105 OUTPUT AMPLITUDE control for 3.5 cm of deflection. Adjust C3824 and C3874 for optimum flat top and square corner on the display.

### Step 9. Adjust Input Capacitors (Shunt and Neutralization)

Leaving Type D controls as previously, reset the oscilloscope TIME/CM control to 1 MILLISEC. Terminate the Type 105 cable with an Input Capacitance Standardizer (CS 47). From the Type 105, apply a 1 kc signal to INPUT A and set the Type 105 OUTPUT AMPLITUDE control for 3.5 cm of deflection. Adjust C3424 for flat top. Set the Type D INPUT SELECTOR switch to A-B DC and adjust C3444 for flat top (neutralization). Repeat the same procedure on Type D INPUT B, using C3434 for input capacitor adjustment and C3414 for neutralization adjustment.

### Step 10. Adjust MILLIVOLTS/CM Switch Compensations

Leaving Type D controls and scope controls as in the previous step, apply a 1 kc signal to INPUT B from the Type 105. Adjust 105 OUTPUT AMPLITUDE for 3.5 cm of deflection.

MILLIVOLTS/CM SWITCH	ADJUST FOR FLAT TOP	ADJUST FOR MIN. OVERSHOOT
10	C3214	C3224
100	C3244	C3254
1000	C3274	C3284

Switch 1 kc signal to INPUT A and adjust as follows:

MILLIVOLTS/CM SWITCH	ADJUST FOR FLAT TOP	ADJUST FOR MIN. OVERSHOOT
10	C3014	C3024
100	C3044	C3054
1000	C3074	C3084

### Step 11. Adjust HF Differential Balance Capacitor (S/N 1393 and up only)

Set Type D controls as follows:

MILLIVOLTS/CM	1
MV/CM MULTIPLIER	1
INPUT SELECTOR SWITCH	A-B DC

From the SQUARE WAVE CALIBRATOR on the oscilloscope, apply 10 volts of signal to both INPUT A and INPUT B. Adjust C3394 for minimum spike on waveform.



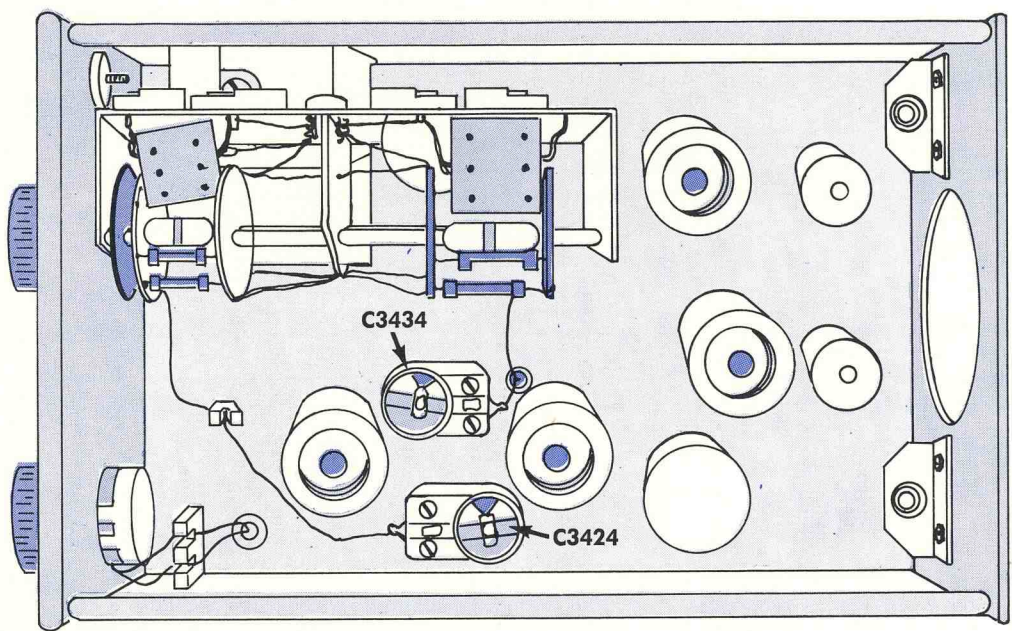


Fig. 4-8. Type D Unit, Top View.

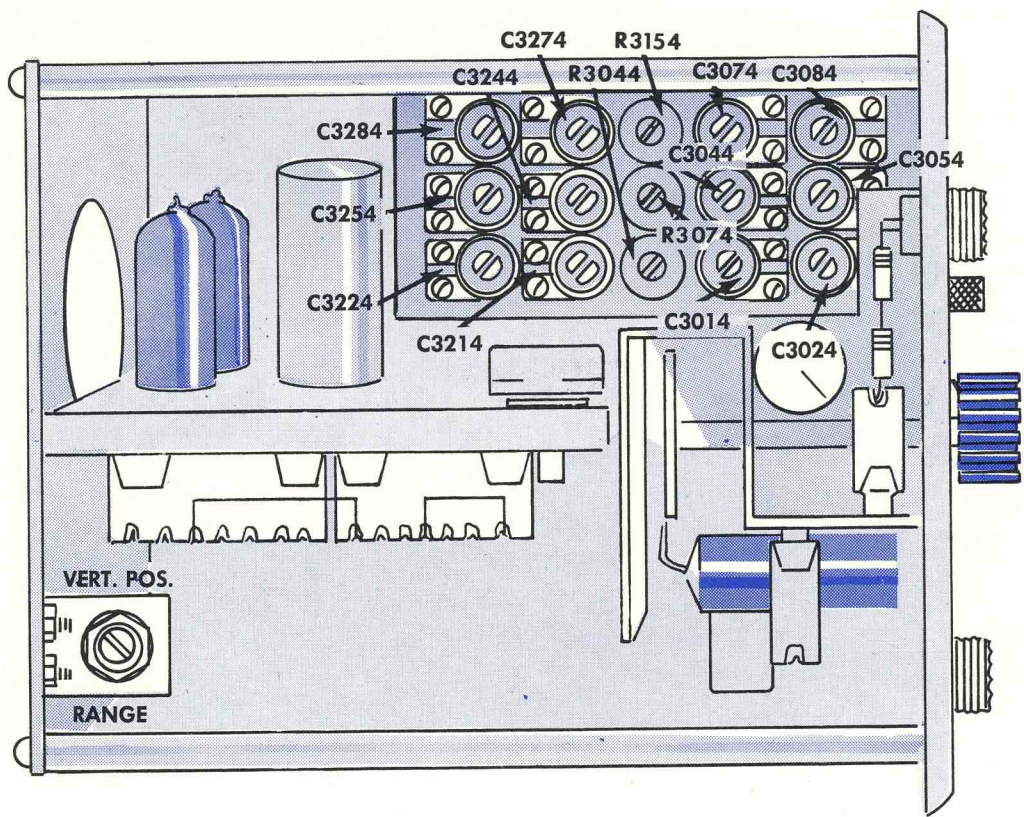


Fig. 4-9. Type D Unit, Left Side View.



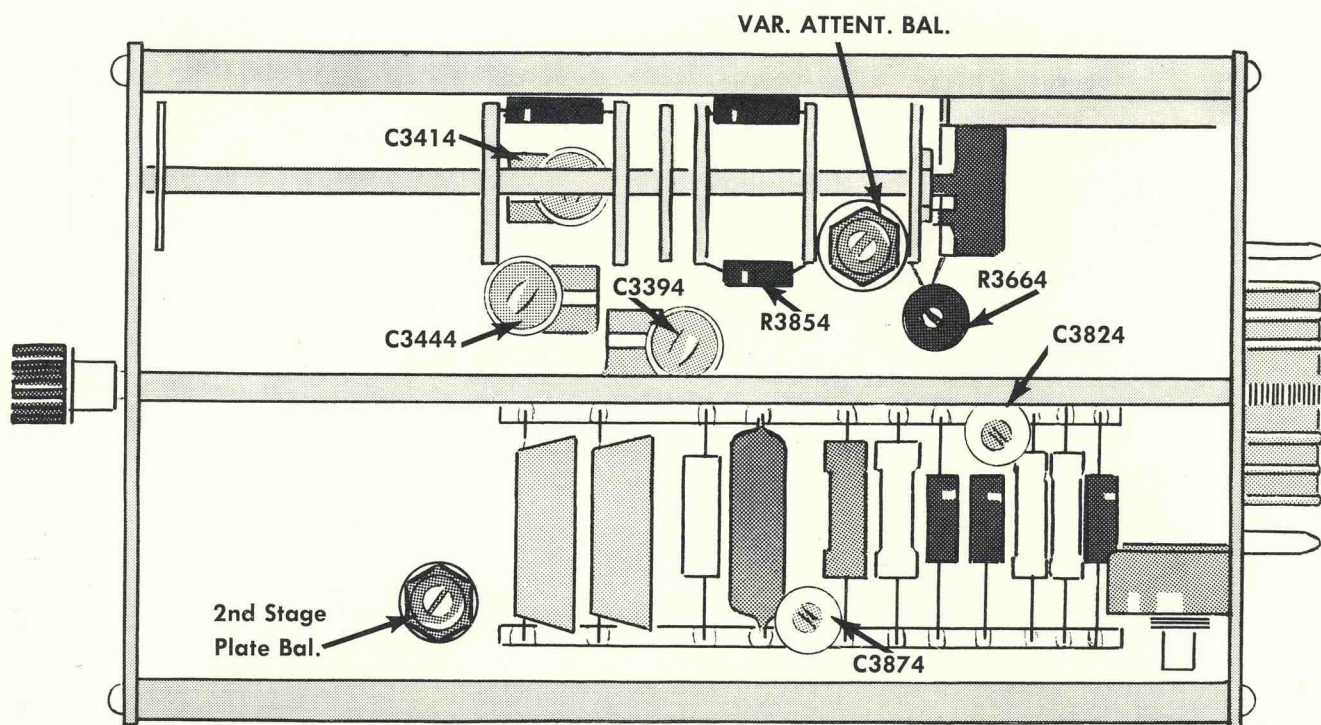


Fig. 4-10. Type D Unit, Bottom View.



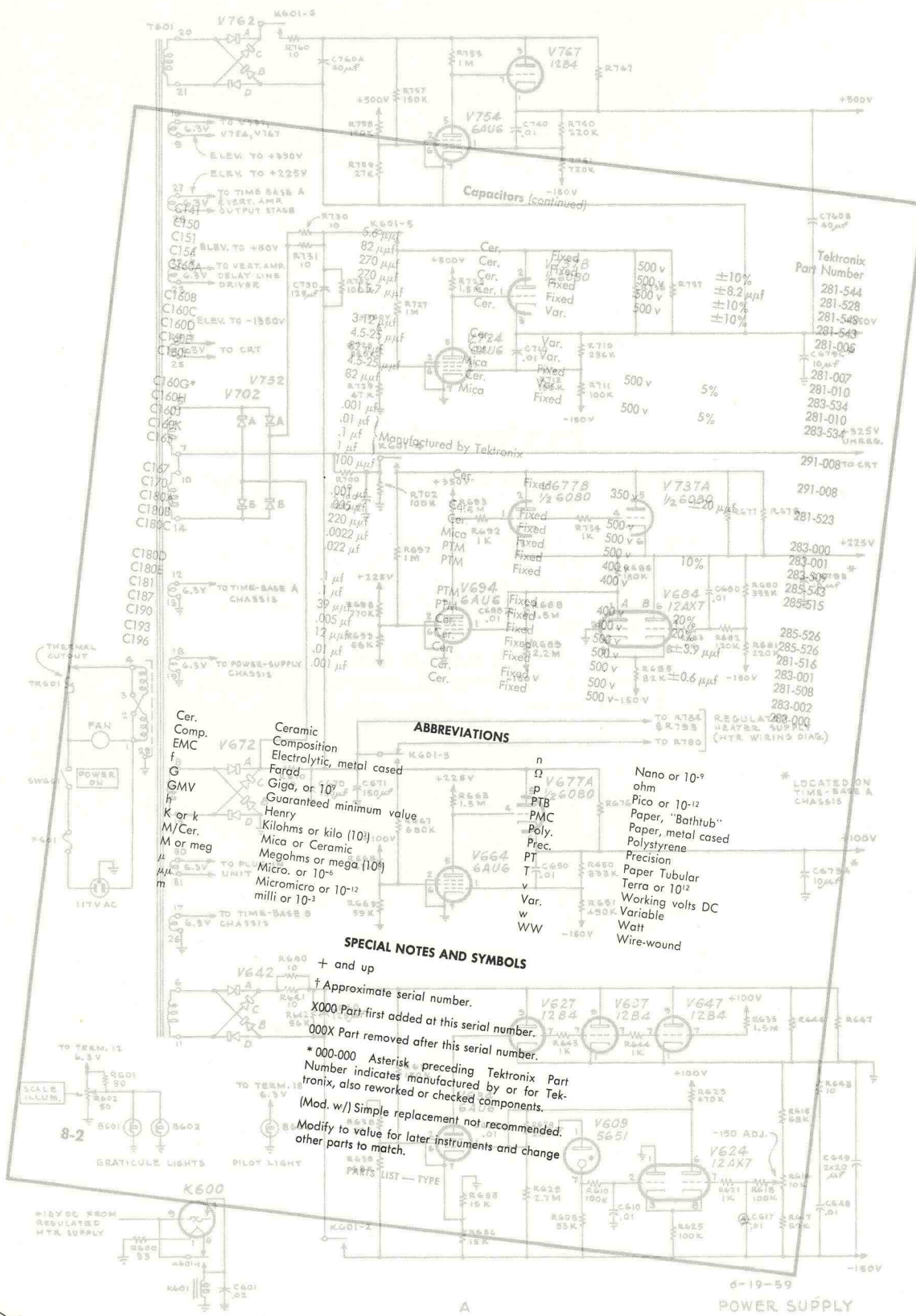








## DIAGRAMS





## **HOW TO ORDER PARTS**

Replacement parts are available through your local Tektronix Field Office.

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

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



# PARTS LIST

\* 000-000 Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, also reworked or checked components.

Values fixed unless marked Variable.

Tolerance  $\pm 20\%$  unless otherwise indicated.

## Capacitors

						Tektronix Part Number
C3004		.1 $\mu\text{f}$	PTM		600 v	Use *295-066
C3004 and C3204 matched within $\pm 1\%$ of each other, furnished as a unit.						
C3014	101-1392	8-50 $\mu\text{mf}$	Cer.	Var.	500 v	281-022
	1393-up	7-45 $\mu\text{mf}$	Cer.	Var.	500 v	281-012
C3024		1.5-7 $\mu\text{mf}$	Cer.	Var.	500 v	281-005
C3034	101-6594X	27 $\mu\text{mf}$	Cer.		500 v	281-512
C3044	101-1392	8-50 $\mu\text{mf}$	Cer.	Var.	500 v	281-022
	1393-up	7-45 $\mu\text{mf}$	Cer.	Var.	500 v	281-012
C3054		1.5-7 $\mu\text{mf}$	Cer.	Var.	500 v	281-005
C3064		330 $\mu\text{mf}$	Mica		500 v	10% 283-518
C3074	101-1392	8-50 $\mu\text{mf}$	Cer.	Var.	500 v	281-022
	1393-up	7-45 $\mu\text{mf}$	Cer.	Var.	500 v	281-012
C3084		1.5-7 $\mu\text{mf}$	Cer.	Var.	500 v	281-005
C3094	101-1392	.0068 $\mu\text{f}$	Mica		500 v	10% 283-532
	1393-up	.002 $\mu\text{f}$	Mica		500 v	5% 283-529
C3204		.1 $\mu\text{f}$	PTM		600 v	Use *295-066
C3204 and C3004 matched within $\pm 1\%$ of each other, furnished as a unit.						
C3214	101-1392	8-50 $\mu\text{mf}$	Cer.	Var.	500 v	281-022
	1393-up	7-45 $\mu\text{mf}$	Cer.	Var.	500 v	281-012
C3224		1.5-7 $\mu\text{mf}$	Cer.	Var.	500 v	281-005
C3234	101-6594X	27 $\mu\text{mf}$	Cer.		500 v	10% 281-512
C3244	101-1392	8-50 $\mu\text{mf}$	Cer.	Var.	500 v	281-022
	1393-up	7-45 $\mu\text{mf}$	Cer.	Var.	500 v	281-012
C3254		1.5-7 $\mu\text{mf}$	Cer.	Var.	500 v	281-005
C3264		330 $\mu\text{mf}$	Mica		500 v	10% 283-518
C3274	101-1392	8-50 $\mu\text{mf}$	Cer.	Var.	500 v	281-022
	1393-up	7-45 $\mu\text{mf}$	Cer.	Var.	500 v	281-012
C3284		1.5-7 $\mu\text{mf}$	Cer.	Var.	500 v	281-005
C3294	101-1392	.0068 $\mu\text{f}$	Mica		500 v	10% 283-532
	1393-up	.002 $\mu\text{f}$	Mica		500 v	5% 283-529
C3384	X1846-up	2.2 $\mu\text{mf}$	Cer.		500 v	$\pm 1/2 \mu\text{mf}$ 281-500
C3394	X1846-up	1.5-7 $\mu\text{mf}$	Cer.	Var.	500 v	281-005
C3404		.001 $\mu\text{f}$	Cer.		500 v	GMV 283-000
C3414		1.5-7 $\mu\text{mf}$	Cer.	Var.	500 v	281-005
C3424	101-3461	5-20 $\mu\text{mf}$	Cer.	Var.	500 v	Use 281-010
	3462-up	4.5-25 $\mu\text{mf}$	Cer.	Var.	500 v	281-010
C3434	101-3461	5-20 $\mu\text{mf}$	Cer.	Var.	500 v	Use 281-010
	3462-up	4.5-25 $\mu\text{mf}$	Cer.	Var.	500 v	281-010



# Capacitors (continued)

Tektronix  
Part Number

C3444		1.5-7 $\mu\mu\text{f}$	Cer.	Var.	500 v		281-005
C3454		.001 $\mu\text{f}$	Cer.		500 v	GMV	283-000
C3514		.01 $\mu\text{f}$	Cer.		500 v	GMV	283-002
C3614		.01 $\mu\text{f}$	Cer.		500 v	GMV	283-002
C3824		8-50 $\mu\mu\text{f}$	Cer.	Var.	500 v		281-022
C3874		8-50 $\mu\mu\text{f}$	Cer.	Var.	500 v		281-022
C4004		.01 $\mu\text{f}$	Cer.		500 v	GMV	283-002

# Inductors

L3014	X1393-up	1.8 $\mu\text{h}$					108-105
L3214	X1393-up	1.8 $\mu\text{h}$					108-105

# Resistors

R3014	X1393-up	220 $\Omega$	$\frac{1}{2}$ w		Comp.	5%	301-221
R3024		900 k	$\frac{1}{2}$ w		Prec.	1%	309-111
R3034	101-1392	111 k	$\frac{1}{2}$ w		Prec.	1%	309-046
	1393-up	106 k	$\frac{1}{2}$ w		Prec.	1%	309-161
R3044	X1393-up	10 k	$\frac{1}{10}$ w	Var.	Comp.	20%	311-017
R3054		990 k	$\frac{1}{2}$ w		Prec.	1%	309-013
R3064	101-1392	10.1 k	$\frac{1}{2}$ w		Prec.	1%	309-034
	1393-up	9.85 k	$\frac{1}{2}$ w		Prec.	1%	309-160
R3074	X1393-up	500 $\Omega$	$\frac{1}{10}$ w	Var.	Comp.	20%	311-056
R3084		1 meg	$\frac{1}{2}$ w		Prec.	1%	309-014
R3094	101-1392	1 k	$\frac{1}{2}$ w		Prec.	1%	309-115
	1393-up	1.19 k	$\frac{1}{2}$ w		Prec.	1%	309-158
R3104	X1393-up	5 k	$\frac{1}{2}$ w		Prec.	1%	309-159
R3154	X1393-up	2.5 k	$\frac{1}{10}$ w	Var.	Comp.	20%	311-010
R3214	X1393-up	220 $\Omega$	$\frac{1}{2}$ w		Comp.	5%	301-221
R3224		900 k	$\frac{1}{2}$ w		Prec.	1%	309-111
R3234	101-1392	111 k	$\frac{1}{2}$ w		Prec.	1%	309-046
	1393-up	106 k	$\frac{1}{2}$ w		Prec.	1%	309-161
R3254		990 k	$\frac{1}{2}$ w		Prec.	1%	309-013
R3264	101-1392	10.1 k	$\frac{1}{2}$ w		Prec.	1%	309-034
	1393-up	9.85 k	$\frac{1}{2}$ w		Prec.	1%	309-160
R3274	X1393-up	5 k	$\frac{1}{2}$ w		Prec.	1%	309-159
R3284		1 meg	$\frac{1}{2}$ w		Prec.	1%	309-014
R3294	101-1392	1 k	$\frac{1}{2}$ w		Prec.	1%	309-115
	1393-up	1.19 k	$\frac{1}{2}$ w		Prec.	1%	309-158
R3404	101-746	20 k	8 w		WW	Use	*310-514
	747-835	20 k	4 w	Mica Plate		Use	*310-514
	836-up	20.5 k	4 w	Mica Plate		1%	*310-514
R3414		47 $\Omega$	$\frac{1}{2}$ w		Comp.	10%	302-470
R3424		1 meg	$\frac{1}{2}$ w		Prec.	1%	309-014
R3434		1 meg	$\frac{1}{2}$ w		Prec.	1%	309-014
R3444		47 $\Omega$	$\frac{1}{2}$ w		Comp.	10%	302-470

## Resistors (continued)

Tektronix  
Part Number

R3454	101-746 747-835 836-up	20 k 20 k 20.5 k	8 w 4 w 4 w		WW	5% Use	*310-514 *310-514 *310-514
R3464		120 k	1/2 w	Mica Plate	Prec.	1%	309-091
R3474	X651-up	560 k	1 w	Mica Plate	Comp.	10%	304-564
R3484A-F	X651-up	8.2 k	1/2 w		Comp.	10%	302-822
R3504		10 k	5 w		WW	5%	308-008
R3514		10 k	5 w		WW	5%	308-008
R3524		1.2 meg	1 w		Comp.	10%	304-125
R3554		500 k	2 w	Var.	Comp.	20%	311-034
R3564		10 k	5 w		WW	5%	308-008
R3574		1 k	2 w	Var.	Comp.	20%	311-006
R3584		10 k	5 w		WW	5%	308-008
R3604		31.1 k	1/2 w		Prec.	1%	309-037
R3614		183 k	1/2 w		Prec.	1%	309-050
R3624		18 k	1/2 w		Prec.	1%	309-036
R3634		38 k	1/2 w		Prec.	1%	309-124
R3644		12.7 k	1/2 w		Prec.	1%	309-122
R3654		4.23 k	1/2 w		Prec.	1%	309-118
R3664		2.5 k	1/10 w	Var.	Comp.	20%	311-010
R3674	101-1727 1728-up	39 k 39 k	1 w 1 w		Comp. Comp.	Use	*312-582 *312-582
R3674 and R3734 matched within 2% of each other, furnished as a unit.							
R3684		82 k	1/2 w		Prec.	1%	309-043
R3694	X3393-up	6.8 k	1/2 w		Comp.	10%	302-682
R3704		5 k	2 w	Var.	Comp.	20%	311-011
R3714		82 k	1/2 w		Prec.	1%	309-043
R3724		5 k	2 w	Var.	Comp.	20%	311-011
R3734	101-1727 1728-up	39 k 39 k	1 w 1 w		Comp. Comp.	Use 10%	*312-582 *312-582
R3744		18 k	1/2 w		Prec.	1%	309-036
R3764		Selected*	1/2 w		Comp.		
* Range is 220 to 470 k.							
R3804		820 k	1 w		Comp.	10%	304-824
R3814		1 meg	2 w	Var.	Comp.	20%	311-039
R3824	101-430 431-up	50 k 50 k	1/2 w 1 w		Prec. Prec.	Use 1%	310-086 310-086
R3834	101-430 431-up	143 k 143 k	1/2 w 1 w		Prec. Prec.	Use 1%	310-088 310-088
R3844		29.2 k	1/2 w		Prec.	1%	309-123
R3854		7.3 k	1/2 w		Prec.	1%	309-120
R3864	101-430 431-up	143 k 143 k	1/2 w 1 w		Prec. Prec.	Use 1%	310-088 310-088
R3874	101-430 431-up	50 k 50 k	1/2 w 1 w		Prec. Prec.	Use	310-086 310-086
R3904	101-4063 4064-up	10 k 8.2 k	1 w 1 w		Comp. Comp.	10% 10%	304-103 304-822
R3914	101-4063 4064-up	10 k 5 k	2 w 2 w	Var. Var.	Comp. Comp.	20% 20%	311-016 311-011
R3924	101-4063 4064-up	10 k 8.2 k	1 w 1 w		Comp. Comp.	10% 10%	304-103 304-822



# Resistors (continued)

							Tektronix Part Number
R3954	101-4063X	12 k	1 w		Comp.	10%	304-123
R3964	101-4063	10 k	2 w	Var.	Comp.	20%	311-016
	4064-up	5 k	2 w	Var.	Comp.	20%	311-011
R3974	101-4063X	12 k	1 w		Comp.	10%	304-123
R4004		84 $\Omega$	5 w		WW	5%	308-056
R4014	101-3461X	3.3 k	2 w		Comp.	10%	306-332

# Switches

				Unwired	Wired
SW3004	101-212	2 wafer, 6 pos., rotary	INPUT SEL.	*260-074	
(SW1)	213-up	2 wafer, 6 pos., rotary	INPUT SEL.	*260-088	
SW3014	101-706	4 wafer, 4 pos., rotary	DEFL. SENS. MULT.	*260-075	*262-071
(SW2)	707-1392	4 wafer, 4 pos., rotary	MV/CM	*260-075	*262-071
	1393-up	4 wafer, 4 pos., rotary	MV/CM	*260-142	*262-108
SW3604	101-706	4 wafer, 6 pos., rotary	DEFL. SENS.	*260-077	*262-072
(SW3)	707-up	4 wafer, 6 pos., rotary	MV/CM MULTIPLIER	*260-077	*262-072
SW3484	X651-up	1 wafer, 7 pos., rotary	PREAMP BALANCE	*260-090	*262-081

# Vacuum Tubes

V3404 †	101-1826	5814	Use	*157-049
	1827-3460	5814	Use	*157-049
	3461-up	12AU7		*157-049
V3454 †	101-1826	5814	Use	*157-049
	1827-3460	5814	Use	*157-049
	3461-up	12AU7		*157-049

† V3404 and V3454 are a matched pair.

V3504		12AU7		154-041
V3604 †	101-3392	5879	Selected	*157-018
	3393-up	5879		*157-051
V3704 †	101-3392	5879	Selected	*157-018
	3393-up	5879		*157-051

† V3604 and V3704 are a matched pair.

V3904		12AU7		154-041
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## Type D Mechanical Parts List

	Tektronix Part Number
BINDING POST CAP	200-103
BINDING POST ADAPTOR STEM	355-507
BRACKET, SWEEP CHASSIS	406-125
BRACKET, VERT. POS. POT MOUNTING	406-127
BRACKET, ATTEN. MTG. SN 393-up	406-185
BRACKET, SWITCH SUPPORT SN 4564-up	406-214
BUSHING, $\frac{3}{8}$ -32 x $\frac{9}{16}$ x .412	358-010
CABLE HARNESS	179-059
CERAMIC POST $\frac{1}{2}$ " SN 101-8609	129-009
CERAMIC POST 1" SN 101-8609	129-017
CERAMIC STRIP $\frac{3}{4}$ x 2 notches, clip mounted	124-086
CERAMIC STRIP $\frac{3}{4}$ x 4 notches, clip mounted	124-088
CERAMIC STRIP $\frac{3}{4}$ x 7 notches, clip mounted	124-089
CERAMIC STRIP $\frac{3}{4}$ x 1 notches, clip mounted SN 8610-up	124-100
CLAMP, CABLE $\frac{1}{2}$ " SN 10,790-up	343-006
CLAMP, CABLE $\frac{5}{8}$ "	343-007
CHASSIS	441-072
CONNECTOR, CHASSIS MT. 1-contact, female	131-012
CONNECTOR, 16-contact, male	131-017
COUPLING, POT	376-014
EYELET, BRASS	210-601
FASTENER, SNAP, Double pronged Delrin	214-153
FRAME PLATE $5\frac{1}{32}$ x $6\frac{1}{32}$	387-532
GROMMET, RUBBER $\frac{1}{4}$ "	348-002
GROMMET, RUBBER $\frac{5}{16}$ "	348-003
KNOB, SMALL RED	366-038
KNOB, LARGE BLACK $\frac{1}{4}$ " hole thru	366-040
KNOB, LARGE BLACK w/2 dots 180° apart	366-041
KNOB, LARGE BLACK $\frac{1}{4}$ " hole part way	366-042
KNOB, SMALL BLACK	366-044
KNOB, PLUG-IN SECURING	366-125
LOCKWASHER #2 EXT	210-002
LOCKWASHER #4 INT	210-004
LOCKWASHER #6 INT	210-006
LOCKWASHER #8 INT	210-008
LOCKWASHER $\frac{1}{4}$ INT	210-011
LOCKWASHER Pot INT	210-012
LOCKWASHER $\frac{3}{8}$ x $1\frac{1}{16}$ INT	210-013
LUG, SOLDER SE4	210-201



# Mechanical Parts List (continued)

	Tektronix Part Number
LUG, SOLDER Pot	210-207
NUT, HEX 2-56 x $\frac{3}{16}$	210-405
NUT, HEX 4-40 x $\frac{3}{16}$	310-406
NUT, HEX 6-32 x $\frac{1}{4}$	210-407
NUT, HEX 8-32 x $\frac{5}{16}$	210-409
NUT, HEX $\frac{3}{8}$ -32 x $\frac{1}{2}$	210-413
NUT, HEX 1-72 x $\frac{5}{32}$	210-438
NUT, HEX $\frac{1}{4}$ -28 x $\frac{3}{8}$ x $\frac{3}{32}$	210-455
NUT, KEP 6-32 x $\frac{5}{16}$	210-457
NUT, HEX 6-32 x $\frac{5}{16}$	210-478
NUT, HEX $\frac{3}{8}$ -32 x $\frac{1}{2}$ x $\frac{11}{16}$	210-494
PANEL, FRONT SN 101-212	333-110
PANEL, FRONT SN 213-651	333-127
PANEL, FRONT SN 652-3498	333-148
PANEL, FRONT SN 3499-7244	333-285
PANEL, FRONT SN 7245-up	333-512
RING, RETAINING	354-025
ROD, EXTENSION $\frac{1}{8}$ x $7\frac{3}{16}$	384-075
ROD, EXTENSION $\frac{1}{8}$ x $1\frac{13}{16}$	384-082
ROD, FRAME $\frac{3}{8}$ x $8\frac{7}{8}$ tapped 8-32	384-508
ROD, SECURING $\frac{3}{16}$ x $10\frac{1}{2}$ , 10-24 thread one end	384-510
ROD, ALUM. $\frac{3}{8}$ x $2\frac{3}{32}$ , tapped 6-32 SN 4564-up	385-093
SCREW, 4-40 x $\frac{1}{4}$ BHS	211-008
SCREW, 4-40 x $\frac{5}{16}$ BHS	211-011
SCREW, 4-40 x $\frac{3}{8}$ BHS	211-012
SCREW, 4-40 x $\frac{1}{2}$ RHS	211-015
SCREW, 4-40 x $\frac{7}{8}$ RHS	211-018
SCREW, 4-40 x $\frac{5}{16}$ Pan HS w/lockwasher	211-033
SCREW, 4-40 x $\frac{5}{16}$ FHS Phillips slot	211-038
SCREW, 6-32 x $\frac{5}{16}$ BHS	211-507
SCREW, 6-32 x $\frac{1}{2}$ BHS	211-511
SCREW, 6-32 x $\frac{3}{8}$ BHS	211-510
SCREW, 6-32 x $\frac{3}{4}$ THS	211-544
SCREW, 8-32 x $2\frac{1}{2}$ RHS	212-015
SCREW, 8-32 x $2\frac{1}{2}$ RHS	212-022
SCREW, 8-32 x $\frac{1}{2}$ FHS Phillips slot	212-043
SCREW, 8-32 x $\frac{1}{2}$ RHS Phillips slot	212-044
SCREW, 4-40 x $\frac{5}{16}$ RHS Thread cutting, Phillips slot	213-034
SCREW, 4-40 x $\frac{1}{4}$ PHS Thread cutting, Phillips slot	213-035
SHIELD, SOCKET $2\frac{9}{32}$ ID	337-005

# Mechanical Parts List (continued)

	Tektronix Part Number
SHIELD, TUBE 1 1/32 ID w/spring	337-008
SHIELD, INPUT, S-SHAPE	337-072
SHIELD, INPUT	337-131
SHOCKMOUNT, RUBBER	348-007
SOCKET, STM9G	136-015
SPACER, ALUM. .118 ID x 5/32 OD x 1 1/16	166-106
SPACER, NYLON 5/32" for Ceramic strip	361-007
SPACER, NYLON 3/8" for Ceramic strip	361-009
SUBPANEL	386-352
TUBING #20 BLACK PLASTIC	162-504
WASHER, 5S x 9/32 x .025	210-801
WASHER, 6S x 5/16 x .028	210-802
WASHER, 6L x 3/8 x .032	210-803
WASHER, 8S x 3/8 x .32	210-804
WASHER, FIBER #10 SHOULDERED	210-812
WASHER, STEEL .390 ID x 9/16 OD x .020	210-840
WASHER, STEEL #2 .093 ID x 9/32 OD x .020	210-850
WASHER, STEEL #4L .119 ID x 3/8 OD x .025	210-851
WASHER, FIBER, RED	210-906
WIRE #22 SOLID, WHITE	175-522
WIRE #26 STRANDED, WHITE	175-529





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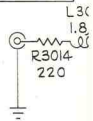
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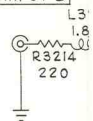


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INPUT A



INPUT B







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## **MANUAL CHANGE INFORMATION**

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

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





TYPE D  
M5104 Tent SN 16440

R3024	change to	900k	1/2w	Prec	1%	309-394
R3034	change to	106k	1/2w	Prec	1%	309-395
R3224	change to	900k	1/2w	Prec	1%	309-394
R3234	change to	106k	1/2w	Prec	1%	309-395
R3476	add	6.8k	1/2w	Comp	5%	301-682
R3484G	add	18k	1w	Comp	5%	303-183
SW3014	change to	MV/CM			wired	*262-474
SW3484	change to	PREAMP BALANCE			wired	*262-473

PART CKT DIAG

