INSTRUCTION MANUAL

Type 133 Plug-In Unit Power Supply

731

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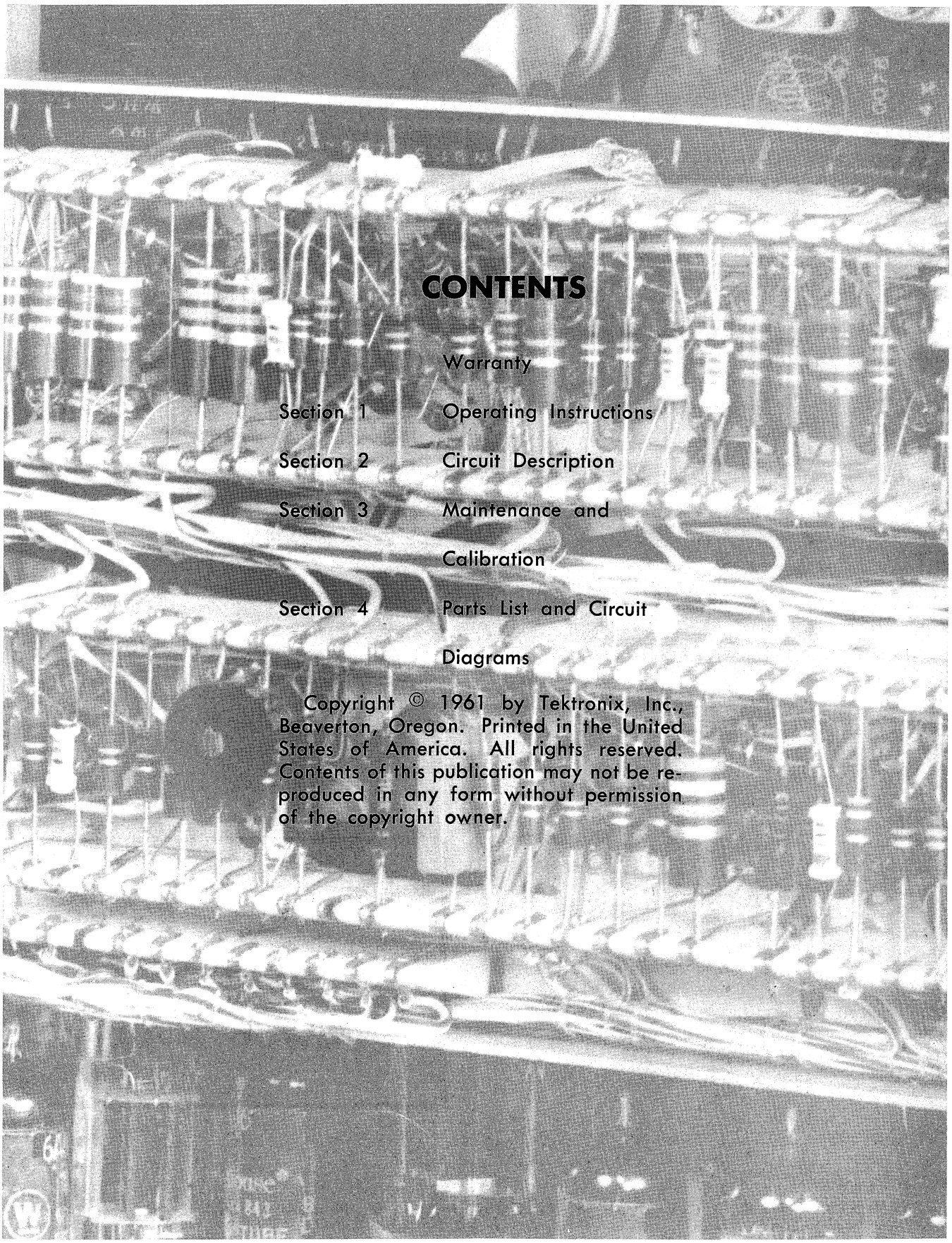

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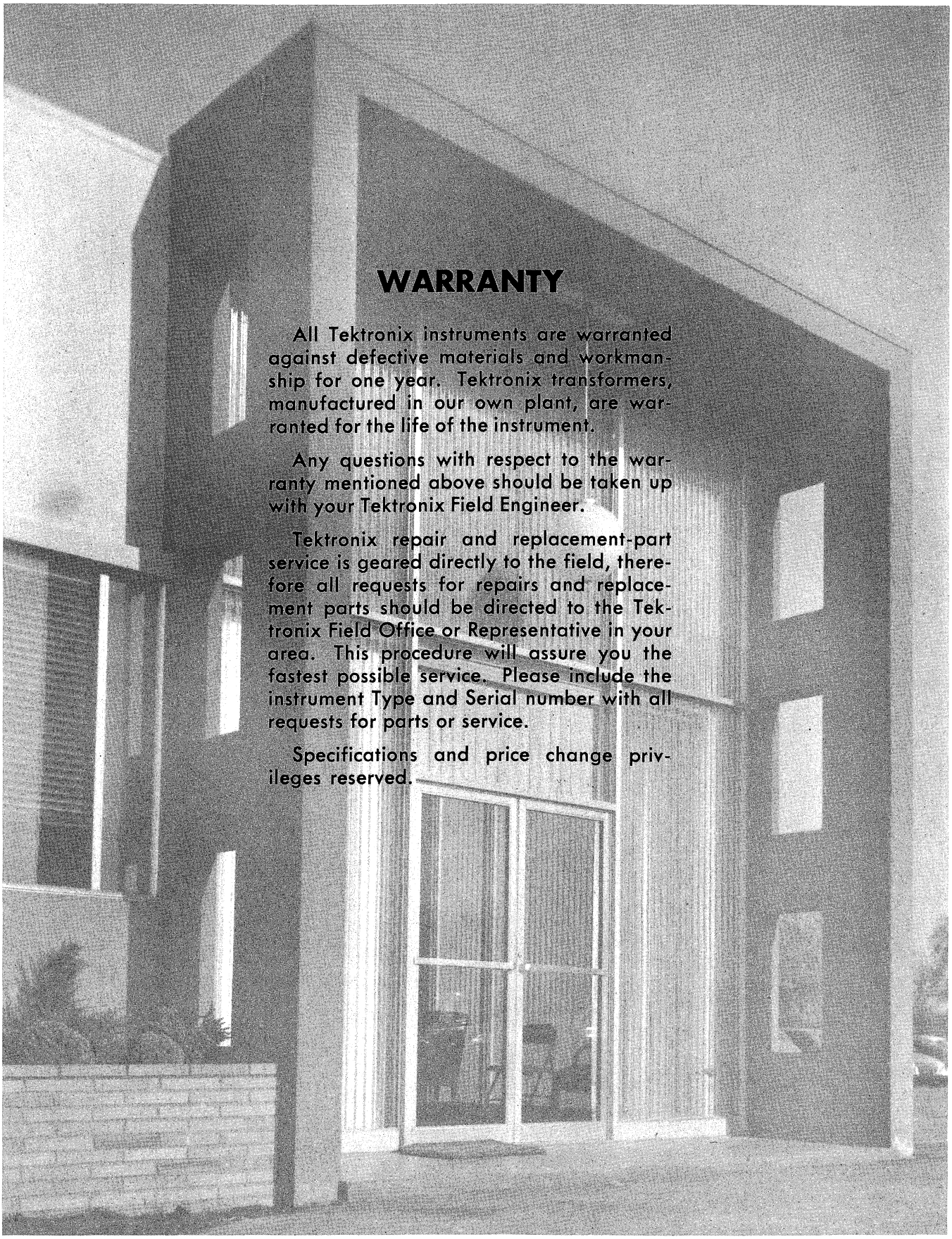


WARRANTY

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.

Fig. 1-1. Type 133 Plug-In Unit Power Supply with a Type L Plug-In Unit inserted.

SECTION 1
OPERATING INSTRUCTIONS

Introduction

The Type 133 Plug-In Unit Power Supply, Fig.1-1, contains the necessary circuitry for powering Tektronix lettered-series plug-in units. Completely self contained, the Type 133 allows independent operation of a plug-in unit for a variety of applications.

The low source impedance (about 2 ohm ±5%) of the Type 133 makes it an ideal driving amplifier for low-impedance input devices such as paper recorders, speakers, etc. It has a maximum power output of about 4.5 watts and will deliver a total current swing up to ±1.5 amperes to a maximum load (short). The instrument will deliver a voltage swing of about ±5 volts across an external load of 100 ohms. Under heavier loading conditions (below about 20 ohms) the voltage swing capability is more limited.

The no-signal dc voltage at the OUTPUT binding post is at ground potential when the Position control of the plug-in unit is centered. This, plus a fixed gain factor, makes it possible to measure the dc level of an input signal in addition to its instantaneous voltage level. The GAIN ADJ. provides the means for setting the fixed gain factor while the DC LEVEL adjustment provides for adjustment of the quiescent dc output voltage level. Both adjustments are on the front panel for easy access.

Table 1-1 shows typical characteristics of the Type 133 used in conjunction with various plug-in units. As shown in the table, the instrument has an upper frequency response (3-db down point) of 100 kc.

TABLE 1-1

TYPE 133 TYPICAL PERFORMANCE

Plug-In Type	Equivalent Noise Referred to Input (peak-to-peak)	(Output Impedance 100 ohms) Maximum Overall Gain	Bandwidth
A	200 μv	10	Dc to 100 kc*
B	200 μv	10 100	Dc to 100 kc* 2 cps* to 100 kc*
CA	200 μv	10	Dc to 100 kc*
D	100 μv	500	Dc to 100 kc*
E	35 μv	10,000	See Type E Plug-In Unit specifications
G	200 μv	10	Dc to 100 kc*
H	200 μv	100	Dc to 100 kc*
K	200 μv	10	Dc to 100 kc*
L	200 μv	10 100	Dc to 100 kc* 3 cps* to 100 kc*
Z	200 μv	10	Dc to 100 kc*

*** 3-db down point**

Line Voltage

A metal tag on the rear of the Type 133 tells you the line voltage for which your instrument is wired. If your instrument is wired for 117-volt operation it will perform satisfactorily at line voltages between 105 and 125 volts, 50-60 cycles. Line voltages beyond the specified limits may cause the power supplies in the instrument to go out of regulation. A 3-ampere fast-blowing fuse is required for 117-volt 60-cycle operation. For 50-cycle operation, a 3.2-ampere slow-blowing fuse is required (see the fuse data on the rear of the instrument).

If desired, you can convert your instrument from 117-volt operation to 110-, 124-, 220-, 234-, or 248-volt operation, or vice versa, by changing the wiring on the fan and line transformer as shown in Fig. 1-2. You should select the nominal line voltage which best applies to your particular area. The regulating range of each nominal line voltage is as follows:

Line Transformer Wired For:	Regulating Range
110 volts	98-118 volts
117 volts	105-125 volts
124 volts	112-132 volts
220 volts	196-236 volts
234 volts	210-250 volts
248 volts	224-264 volts

Fan connections need only be changed when the transformer connections are changed from 110- to 124-volt operation to 220- to 248-volt operation. A 1.5-ampere fast-blowing fuse is required for 220- to 248-volt 60-cycle operation. Use a 1.6-ampere slow-blowing fuse for 50-cycle operation.

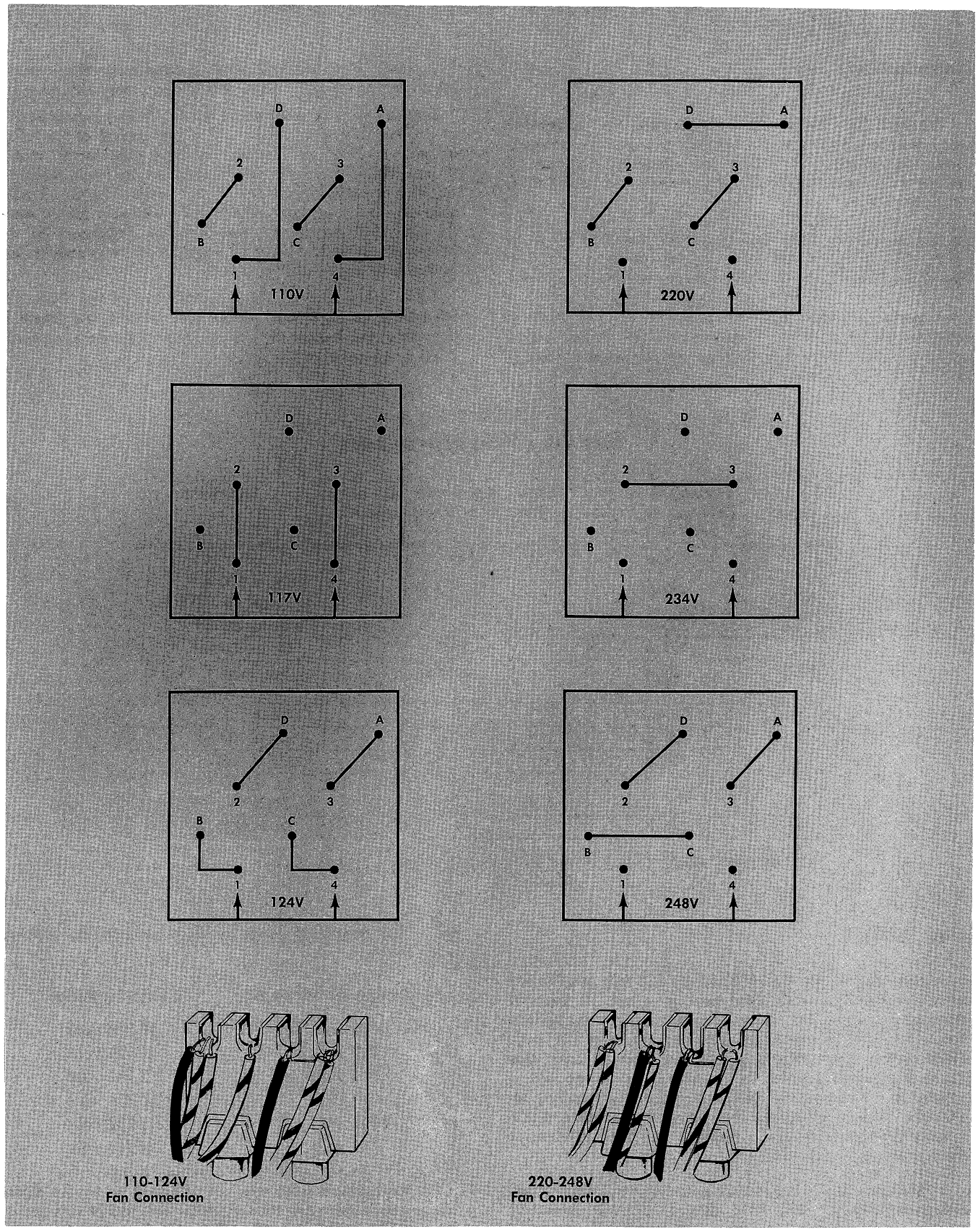


Fig. 1-2. Power transformer and fan connections.

Power consumption of the instrument (with plug-in unit) is 225 watts maximum.

Cooling

The Type 133 is forced-air cooled by a fan at the rear of the instrument. The fan pulls the air into the instrument through the air filter and exhausts the air through the perforations in the bottom and side panels. The panel perforations are located to direct the air flow over the heat-producing components in the instrument. By maintaining a cooler internal temperature, increased stability and component life can be achieved. For this reason, we recommend that you not operate the Type 133 for prolonged periods without the side panels. *Note: When replacing side panels, be sure to place the perforations toward the front of the instrument.*

As you select the physical location for your Type 133 keep in mind cooling requirements. Try to place the instrument where there is sufficient ventilating space for the air to freely circulate in and around the instrument.

A thermal cutout in the instrument protects it from high internal temperatures. The cutout will automatically de-energize the power if the internal temperature goes above 137°F. Once the internal temperature returns to normal the cutout will automatically restore power.

Installation of Plug-In Unit

Each plug-in unit has two guide pins on its interconnecting plug to aid in alignment. When you insert a plug-in unit into the instrument, make sure the plug-in is aligned properly so the guide pins can insure proper mating. With the plug-in unit properly aligned, only a minimum effort is required for its insertion. Once the plug-in unit is seated, tighten the aluminum knob at the bottom center of the unit to hand tightness. To remove a plug-in, turn the aluminum knob counterclockwise until it is free from the Type 133. Then, pull the plug-in straight out by the aluminum knob.

Signal Connections

Wherever possible, keep all signal leads as short as practical. This is most important when you are working with low amplitude signals and minimum noise pickup is essential. Also, be sure to establish a common ground connection between the Type 133, signal source and indicating device.

GAIN ADJ. and DC LEVEL

The first time you use your Type 133, or any time you change plug-in units, the GAIN ADJ. and DC LEVEL should be checked and adjusted as necessary. This should also be done occasionally during normal use of the instrument.

With the DC LEVEL adjustment properly set and the Position control of the plug-in unit centered, the no-signal dc voltage at the OUTPUT binding post will be near ground potential. Gain can be checked by applying an input signal of known amplitude to the plug-in unit and measuring the output amplitude of the Type 133. To determine the proper output amplitude, multiply the appropriate gain figure times the input signal amplitude. The appropriate gain figure can be obtained from Table 1-2.

If you find that either the GAIN ADJ. or DC LEVEL requires adjustment, see "Setting GAIN ADJ. and DC LEVEL" at the rear of this section.

Gain

Gain shown in Table 1-1 applies only when the Volts/Cm switch of the plug-in unit is in its most sensitive position. To determine the overall effective gain for any setting of the Volts/Cm switch for a plug-in unit, refer to Table 1-2.

TABLE 1-2

VOLTS/CM Setting	Gain*	VOLTS/CM Setting	Gain*
50 μv/cm	10,000	.05	10
100 μv/cm	5,000	.1	5
200 μv/cm	2,500	.2	2.5
500 μv/cm	1,000	.5	1
1 mv/cm	500	1	.5
2 mv/cm	250	2	.25
5 mv/cm	100	5	.1
10 mv/cm	50	10	.05
20 mv/cm	25	20	.025

*Voltage gain with single-ended input and the output working into a 100 Ω (or higher) impedance.

Output Voltage Swing

The Type 133 is capable of producing an output voltage swing of about ±5 volts (5 volts peak, on either side of zero) across an external load of 100 ohms. External loading of less than about 20 ohms, however, will limit the voltage swing capability. Be sure that the applied peak signal amplitude, times the gain at a given Volts/Cm setting, does not exceed the voltage swing capability. Otherwise, the amplifier will be overdriven and the output signal will be distorted.

To determine the desired Volts/Cm setting for a given applied signal, divide the peak signal amplitude into 5. Then select the gain figure which is closest to (without exceeding) the foregoing quotient.

Output Polarity

With the NORM.-INV. switch (an internal slide switch on the left side of the instrument) in the NORM. position, the output signal polarity at the MONITOR and OUTPUT binding posts is the same as the applied signal. Placing the NORM.-INV. switch in the INV. position inverts the signal at the MONITOR and OUTPUT binding posts.

Positioning

To preserve the dc level of an applied signal, the plug-in unit Position control should be centered. This also insures that purely ac signals will have a symmetrical voltage swing with respect to zero.

MONITOR Binding Post

The signal at the MONITOR binding post is the same in polarity and amplitude as the signal at the OUTPUT binding post. The MONITOR signal should only be used as a signal source and not as a power source.

Multi-Trace Operation

With a multi-trace plug-in unit inserted into the Type 133, it is possible to display more than one signal simultaneously on the screen of a conventional single-trace oscilloscope. To do this, set the multi-trace plug-in unit for the alternate mode of operation. Connect between the oscilloscope +Gate Out connector and the +GATE IN connector on the rear panel of the Type 133 and set the ALT.-CHOP. switch of the Type 133 to ALT. Connect between the OUTPUT binding post of the Type 133 and the Input connector of the oscilloscope. Then apply the signal to the appropriate Input connectors on the multi-trace plug-in unit. To trigger the oscilloscope, use either external triggering or internal AC FAST (LF REJECT) triggering.

If desired, you can use the Type 133/multi-trace plug-in unit for multi-channel recording. You can use the same connections described previously except that the OUTPUT bind-

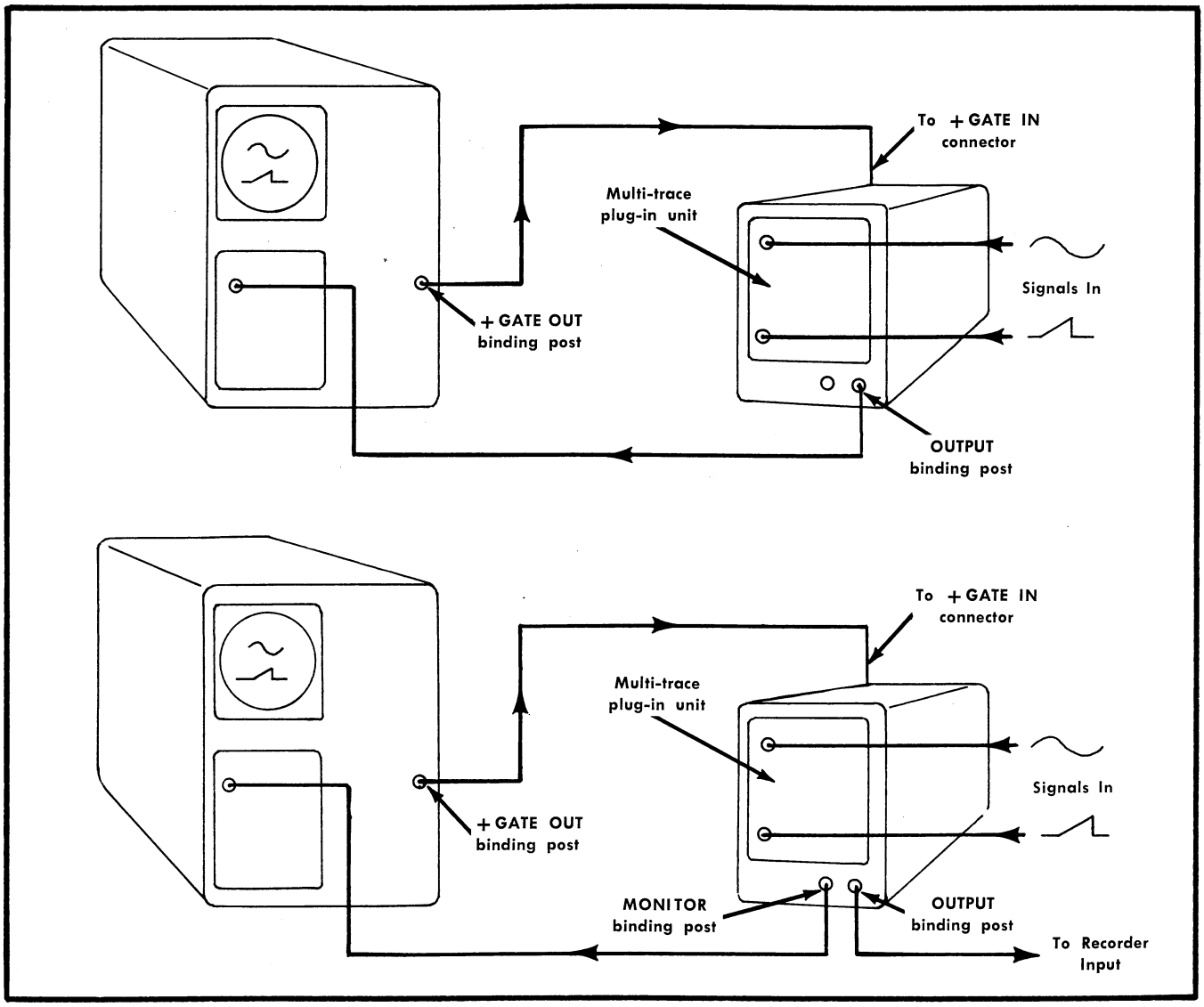


Fig. 1-3. Type 133 connections for multi-channel operation.

ing post must be connected to the Y-axis input of the recorder. If you wish to observe the output of the Type 133 with an oscilloscope, connect between the MONITOR binding post and the oscilloscope Input. In multi-channel recording, a triggering signal must be applied to the +GATE IN connector on the rear panel of the Type 133. The triggering pulse should be fast rising and have an amplitude of about 30 ±10 volts. The sync triggering pulse must produce a negative excursion each time the recorder completes a scan. This permits the switching circuit in the multi-trace plug-in unit to turn on the succeeding channel.

Setting GAIN ADJ. and DC LEVEL

Before proceeding with either of the following adjustments, install a plug-in unit into the Type 133, turn on the power and allow both instruments to warmup for at least 2 minutes.

NOTE

If your plug-in unit does not have a Volts/Cm switch or a .05 volt per centimeter position, you will need a Gain Set Adaptor (Tek part number 013-005) to set the GAIN ADJ. The Gain Set Adaptor is inserted into the plug-in connector on the Type 133 and the plug-in unit is inserted into the adaptor.

To set the GAIN ADJ., proceed as follows:

1. Apply a 0.1-volt peak-to-peak signal from an oscilloscope Calibrator to the input connector of the Type 133/ plug-in unit. (Or in the case described in the previous note, apply the 0.1-volt signal to the input jack of the Gain Set Adaptor instead of the plug-in unit.)

2. Set the plug-in unit Volts/Cm switch to .05. (Omit this step if your plug-in does not have a .05 position.)

3. With a test oscilloscope, measure the voltage at the OUTPUT binding post. Set the GAIN ADJ. of the Type 133 for a peak-to-peak voltage of 1 volt.

To set the DC LEVEL, proceed as follows:

1. Set the NORM.-INV. switch to NORM. (To gain access to this switch, remove the left side panel from the Type 133.)

2. Set the plug-in unit Position control to midrange.

3. Connect a dc voltmeter between the OUTPUT and MONITOR binding posts.

4. Set the DC LEVEL adjustment for a reading of zero on the voltmeter.

NOTES

SECTION 2
CIRCUIT DESCRIPTION

General

The Type 133 contains a transistorized amplifier, a multi-trace synchronizing and blanking circuit, and a power supply. The amplifier receives the output of the plug-in unit and applies an amplified reproduction of the signal to its OUTPUT connector.

The multi-trace synchronizing and blanking circuit provides either blanking pulses to an oscilloscope for Chopped multi-trace operation, or synchronizing pulses to the multi-trace switching circuit for Alternate multi-trace operation.

The power supply of the Type 133 provides all voltages required by the instrument and any of its plug-in units. The dc supplies of the power supply (with the exception of the 12-volt supply) are regulated against changes in load or line voltage.

Amplifier

The amplifier of the Type 133 is a four-stage transistorized amplifier. The input stage of the amplifier is a variable gain push-pull circuit. Gain of the stage is variable by means of R415 (GAIN ADJ.) which adjusts the emitter degeneration. With R415 set at maximum resistance the stage (and thus, the entire amplifier) has minimum gain. The emitters of Q414 and Q424 are long tailed through R416 and R426 to the +100-volt supply. This serves to elevate the two emitters to about the voltage level of the plug-in output.

R437 (DC LEVEL) permits dc collector voltage adjustment in the first stage. Since the entire amplifier is direct coupled, R437 serves to vary the dc output level at the OUTPUT and MONITOR binding posts.

Due to the push-pull configuration of the input stage, the polarity between the signals at the collectors of Q414 and Q424 is opposite. Either polarity may be selected with the NORM.-INV. switch. With the NORM.-INV. switch in the NORM. position, the signal at the OUTPUT and MONITOR binding posts is in phase with the signal applied to the plug-in unit. In the NORM. position, the output of Q414 is connected to the base of Q444. Since the input impedance of Q444 is relatively low compared to R413, the base of Q444 is essentially in series with the collector of Q414 and R414. Thus, the collector current of Q414 is also the driving current for Q444.

The output of Q444 is developed across its collector-load resistor, R443. Negative feedback through R440 and C440 to the base of Q444 provides for amplifier gain and frequency stability.

Zener diode D463 drops the dc collector voltage of Q444 to near ground level with practically no signal attenuation. The signal is coupled to the bases of Q463 and Q454. Q463 is an emitter follower which provides a high input impedance and low output impedance. The low output impedance provided by Q463 makes it a practical driving stage for the power transistor, Q483.

A portion of the output signal of Q444 is also coupled to the base of Q454. R451 permits adjustment of Q454 base voltage. This, in turn, allows adjustment of quiescent current through Q483 and Q474 so that it may be set at design center (0.2 amp).

Diode D451, in the base circuit of Q454 and Q463, is an ambient temperature compensating device. As the ambient temperature increases, the contact potential of D451 decreases which allows it to pass more current. This, in turn, makes the voltage at the bases of Q454 and Q463 slightly less positive. With the bases of Q454 and Q463 less positive, the collector voltage of Q454 and the emitter voltage of Q463 rise (more positive) causing the current through Q483 and Q474 to decrease and maintain a reasonable value of quiescent current.

With no load connected to the OUTPUT binding post, the collector current of Q474 equals the emitter current of Q483. With the OUTPUT binding post loaded, different conditions exist. If the signal at the OUTPUT swings positive, the collector current of Q474 equals the load current plus the emitter current of Q483. If the signal at the OUTPUT swings negative, the emitter current of Q483 equals the load current plus the collector current of Q474. In other words, on a positive swing, Q474 supplies the load current and on a negative swing, Q483 supplies the load current.

Power Supplies

Plate and filament power for the Type 133 and any of its plug-in units is furnished by a single transformer, T601. The primary windings of T601 are connected in parallel for 117-volt operation, or in series for 234-volt operation.

Three main full-wave power supplies furnish regulated dc voltages of —150, +100, +225, and +350. In addition, a nonregulated full-wave rectifier (shown on the Amplifier Schematic) furnishes outputs of +12 and —12 volts for powering some of the transistors in the instrument.

The —150-volt supply provides a stable reference voltage to the other regulated supplies. The basic reference voltage for the —150-volt supply is provided by V619, a gas diode VR tube. The VR tube maintains a constant voltage drop across itself over a relatively wide current range. The voltage across V619 is applied to one grid of a difference amplifier, V624. The other grid of the difference amplifier is connected to the voltage divider consisting of R632, R634 and R636. Adjustment of R634 (—150 VOLTS) determines the percentage of the total output voltage that appears at the grid of V624A. The voltage at the grid of V624A determines the plate voltage of V624B and thus the grid voltage of V627. V627 is in series with the load and the voltage drop across it determines the voltage across the load. With the —150 VOLTS adjustment properly set, the drop across V627 and the 1.5-k shunting resistor is such that the remaining voltage (voltage across the load) is 150 volts.

Should loading on the supply tend to lower the output voltage, the potential at the grid of V624A will change in proportion and cause an inverse (more positive in this case) change at the plate of V624B. A more positive potential at the plate of V624B (and the grid of V627) causes V627 to decrease in effective resistance. A decrease in the effective resistance of V627 results in less voltage dropped across

it and causes a corrective increase in the voltage across the load. C636 increases the ac response of the circuit and thus improves the regulating ability of the circuit to 120-cycle ripple and line transients.

As mentioned previously, the —150-volt supply serves as a reference for the other regulated supplies. In the +100-volt supply, the divider R658-R659 establishes a voltage of essentially zero at the grid of the amplifier, V654A. (The actual voltage at this grid will be a few volts negative.) Should loading on the supply tend to lower its output voltage, an error voltage will appear at the grid of the amplifier. The error voltage will be amplified and appear at the grids of the series regulator tube, V667. The cathodes of V667 will follow the grid and thus the output voltage will be returned to its nominal value of +100 volts. C658 improves the response of the regulator circuit to sudden changes in output voltage.

In addition to supplying plate voltage, the +100-volt supply furnishes a regulated dc heater voltage to the heaters of some of the tubes in the plug-in units.

The +350- and +225-volt supplies operate similar to the +100-volt supply. The rectifier circuit for the two supplies is elevated about 200 volts. V697A and V687 are series regulator tubes and V654B and V697B are error-voltage amplifiers. In addition, a sample of the unregulated voltage of the 350-volt supply is coupled to the screen of V697B. This decreases 120-cycle ripple content in the +350-volt supply, and improves the regulation of the circuit for line-voltage variations.

Multi-Trace Sync and Blanking Circuit

This circuit is in use whenever the multi-trace feature of an appropriate type plug-in unit is used.

In the Alternate Mode of multi-trace operation, the circuit couples a sync pulse to the switching circuit of the multi-trace plug-in unit. When you are using the Type 133 with an oscilloscope, the oscilloscope +Gate Out is used as the sync pulse source. In this case you must connect between the oscilloscope +Gate Out connector and the +GATE IN connector on the Type 133 rear panel. The gating pulse is applied to the control grid of V924A via C920 and the ALT.-CHOP. switch. The negative-going portion of the gating pulse cuts off V924A momentarily and produces a positive-going pulse at the control grid of V924B. With the ALT.-CHOP. switch in the ALT. position, V924B is connected in series with the triggering circuit in the multi-trace plug-in unit through pin 16 of the Interconnecting Socket. Consequently, the positive-going pulse at the control grid of V924B triggers the switching circuit of the multi-trace plug-in unit at the end of each sweep.

In the Chopped Mode of multi-trace operation, the circuit provides a blanking pulse to the crt circuit of the oscilloscope. A connection must be made from the CHOPPED BLANKING OUT connector on the rear panel of the Type 133 to the Crt Cathode binding post on the rear of the oscilloscope. With the ALT.-CHOP. switch in the CHOP. position, a pulse from the multi-trace plug-in is applied to the control grid of V924A through pin 16 of the Interconnecting Socket and the ALT.-CHOP. switch. The pulse is coupled through V924 and the CHOPPED BLANKING OUT connector to the crt cathode circuit in the oscilloscope. This cuts off the crt beam momentarily each time the switching circuit of the plug-in changes states. This, in turn, blanks the switching transients that would normally be observed as the plug-in switched from one channel to the other.

NOTE

The limited bandpass of the Type 133 prohibits satisfactory operation of multi-trace plug-in units in the Chopped Mode. For most multi-trace applications the Alternate Mode of operation will be adequate. If it is necessary to operate in the Chopped Mode, it will also be necessary to lower the repetition rate of the Switching Multivibrator in the plug-in unit to less than 100 kc. Contact your local Tektronix Field Engineer for information concerning this modification.

SECTION 3
MAINTENANCE AND CALIBRATION

Introduction

This section of the manual contains general maintenance information, troubleshooting instructions, and calibration procedures. This information is intended to help you obtain optimum service from your Type 133.

MAINTENANCE

Preventive Maintenance

Periodically you should visually inspect the inside of the instrument for possible trouble sources. Excessive dust accumulation, parts clearances, and metallic foreign material can lead to electrical failure. The instrument should be wiped free of dirt accumulation with a soft lint-free cloth each time a side panel or bottom plate is removed.

The air filter at the rear of the instrument minimizes dirt accumulation in the instrument. However, if the filter gets excessively dirty, instrument cooling will be hampered. To clean the filter, remove it from the instrument and run hot water through it from the inside out. Or, if the filter is exceptionally dirty, you may wash it in hot soapy water. Be sure that you rinse the filter thoroughly after washing. A new filter is coated with an adhesive which greatly increases its filtering ability. When a filter is cleaned, the adhesive material is removed and must be replaced. Filter adhesives can usually be purchased from air conditioning suppliers.

Removal and Replacement of Parts

Procedures for replacement of most parts in the Type 133 are obvious. Detailed instructions for their removal are therefore not required. Other parts, however, can best be removed if a definite procedure is followed. Instructions for the removal of some of these parts are contained in the following paragraphs. Parts-ordering information is included in the parts list at the rear of this manual.

Removal of Side Panel

To remove the side panels from the Type 133, loosen the two screw-head fasteners at the top of each side panel and pull the upper portion of the panel outward. When replacing the panels, hook them over the bottom rails before pushing the upper portion into place. Also, when replacing the side panels, place the perforations toward the front of the instrument.

WARNING

Remove the power cord from the instrument before you remove or replace any of the internal components.

Removal of Ceramic Strips

To remove a ceramic terminal strip, unsolder all components and connections, then pry the strip, with yokes attached, out of the chassis. An alternative method is to use diagonal cutters to cut off one side of each yoke to free the strip, using care not to damage the spacer. After removing the strip, the remainder of each yoke can be easily extracted from the chassis with a pair of pliers. The yokes need not be salvaged since new ones are furnished with the new strips. However the spacers may be reused. If you find it necessary to order spacers, however, specify the mounting height of sleeve required: $^3/_{32}$", $^3/_{16}$", or $^3/_8$". When ordering strips, specify the height and the number of notches required.

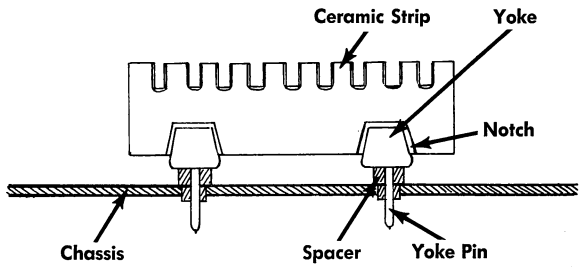


Fig. 3-1. Ceramic strip installation.

To install a new strip, place the spacers in the chassis holes, insert the yoke pins through the spacers, and press down on the top of the strip to seat the yokes. Use a plastic or hard-rubber mallet, if necessary, to seat the yokes firmly. If desired, the extending portion of the yoke pins may be cut off to within about an eighth of an inch of the lower end of the spacers.

Be sure to observe the soldering precautions described in the next paragraph when resoldering connections to the strip.

Soldering Precautions

In the production of Tektronix instruments, we use a special silver-bearing solder to establish a bond to the ceramic terminal strips. This bond can be broken by the repeated use of ordinary tin-lead solder, or by the application of too much heat. For this reason, we recommend the use of a wedge-shaped soldering-iron tip and solder containing about 3% silver. This solder is locally available in most areas, or it may be purchased directly from Tektronix in one-pound rolls (order by part number 251-514). Occasional use of ordinary solder will not break the bond if too much heat is not applied.

Test Points

Certain major test points are shown on the circuit diagrams. Reference to these points is made in the troubleshooting and calibration sections. The physical location of each test point is identified in the photographs on the circuit diagrams pages.

Voltages are shown at each test point on the circuit diagrams. The conditions under which the voltages were obtained are also indicated on the diagrams.

Test points are numbered consecutively starting with the diagram for the amplifier. Numbers increase from left to right across the page and continue from left to right across the diagrams for the Multi-Trace Sync and Blanking circuit and the Power Supply. The numerical arrangement of the test points should make it easy to find any particular test point.

TROUBLESHOOTING

If trouble occurs in the instrument, first eliminate the plug-in unit as the possible cause. You can do this by using a plug-in known to be in good working order. Then check the calibration of the Type 133; in particular, check the power-supply voltages. An improper control adjustment will often be observed as an apparent trouble.

When it has been determined that trouble definitely exists in the Type 133, perform a complete visual inspection of the instrument. Troubles such as loose wires, heat-damaged components, and improperly seated tubes may be found most easily by visual inspection. If you encounter a burnt component, find and eliminate the cause of overheating before the component is replaced.

WARNING

Remove power from the instrument before you attempt to remove tubes, transistors, or other circuit components. Also, be sure all tubes and transistors are in place when the power is turned on.

Faulty tubes are a prevalent cause of circuit failure. Therefore, if a visual check is unsuccessful, check the tubes in the suspected circuit. Check the tubes by substitution rather than with a "tube tester"; "tube testers" often will not indicate the suitability of a tube to perform a given function in a circuit. Be sure to return all good tubes to their original sockets . . . otherwise you may have to unnecessarily recalibrate the instrument because of different tube characteristics.

Troubleshooting the Power Supply

If there is no power present anywhere in the instrument (power-supply outputs, tube filaments, etc.), check the primary circuit of T601. Check especially the fuse, thermal cutout switch, POWER ON switch, and power source. If all of these are satisfactory, check the primary of T601 for continuity. If the pilot light or any of the tube filaments are lighted, you may assume that the primary circuit of T601 is operating correctly.

If one or more of the supplies fails to regulate, check the line voltage. It should be between 105 and 125 volts rms for an instrument wired for 117-volt operation, or between 210 and 250 volts rms for an instrument wired for 234-volt operation. If not, change the wiring on the line transformer as shown in Fig. 1-2 or bring the power source within the nominal limits.

If the line voltage is within the specified limits, and one of the power-supply voltages is not correct, check that particular regulator circuit. If none of the supply voltages are correct, the trouble is probably in the —150-volt supply, since this serves as a reference for the other regulated supplies.

To check a regulator circuit, first replace the tubes as described previously. If this does not eliminate the trouble, check the voltage at all test points shown on the Power Supply schematic. Note: All voltages were measured with a 20,000 Ω/v voltmeter.

If there is excessive ripple on any of the supplies, check the filter capacitor or capacitors (C612, C642, C667, or C672).

Troubleshooting the Amplifier

A faulty component in the Type 133 Amplifier circuit will generally result in partial or complete loss of gain at either the MONITOR or OUTPUT binding posts. If this is the case, check the signal at the MONITOR binding post as you switch the NORM.-INV. between positions. If the signal at the MONITOR binding post is normal in both positions, you can assume that the input stage of the Type 133 Amplifier (Q414 and Q424) is functioning properly. If not, the Q414-Q424 stage is defective. To troubleshoot the first stage, perform voltage and resistance checks throughout the stage. The appropriate resistances can be approximated from the schematic diagram. The voltages at various points throughout the circuit are indicated on the schematic diagram.

If the Q414-Q424 stage is working properly, connect a voltmeter between ground and test point 4. As you monitor this voltage, vary the plug-in unit Position control throughout its range. The voltage at the test point should vary approximately through the range indicated on the schematic. If not, the trouble is Q444 or its associated circuitry.

If the Q444 stage is working properly, connect the voltmeter to test point 5 and vary the plug-in unit Position control throughout its range. The voltage should vary as shown. If it does not, D463, D451, C451, or R450 may be the cause of the trouble.

If the base-to-ground voltage of Q463 is proper, connect the voltmeter to test point 6 and vary the Position control. If the voltage does not vary as indicated, D451, C451, R451, or R450 may be defective.

If the base-to-ground voltage of Q454 is as indicated, connect the voltmeter to test point 7 and again vary the Position control. An improper voltage range at this point would indicate that Q463 or R464 is probably defective.

If the emitter-to-ground voltage of Q463 is as indicated, connect the voltmeter to test point 8 and vary the Position control. The voltage should measure about +12 volts and should not vary more than a few millivolts. If not, the trouble is either R474, Q474, R484, Q483, or F483.

If the voltage at test point 8 is as described, connect the voltmeter to test point 9 and again vary the Position control. If the voltage range is not as indicated, the trouble is probably in F483, Q483, R484, Q474 or R474.

If all the foregoing voltages vary as described and the instrument is still faulty, the trouble is the circuit between the OUTPUT binding post and the junction of R486, R484, and the collector of Q474.

CALIBRATION

The Type 133 Plug-In Unit Power Supply is a stable instrument and should not require calibration more often than every six months, or after each 500 hours of operation, whichever is sooner.

This procedure is arranged in proper sequence for a complete calibration of the instrument. If desired, you may perform any of the adjustments individually or out of sequence with the exception of the —150 VOLTS adjustment. You should not vary the —150 VOLTS adjustment unless it is actually out of adjustment; then you must completely calibrate the instrument.

Various operational checks are described throughout the calibration procedure. These checks assure that the instrument is satisfactorily performing various functions which may not be apparent during normal use. If desired, you may neglect these portions of the procedure as they do not affect the instrument calibration.

The location of the internal adjustments and test points referred to in this section will be found in the photographs on the Amplifier and Power Supply schematics.

Equipment Required

The following equipment is required for a complete calibration of the Type 133.

1. Test oscilloscope with a vertical risetime of 35 microseconds or less, an amplitude calibrator signal (at least 3% accuracy), and a vertical sensitivity of 0.1 volt per division. (Tektronix Type 530- or 540-Series Oscilloscope recommended with a Type A, B, CA, D, G, H, K, or L Plug-In Unit.)

2. Dc voltmeter, sensitivity at least 5000 ohms per volt and accurate to at least 1%.

3. A Tektronix plug-in unit for insertion into the Type 133. (Preferably, the plug-in unit that you normally use with the instrument.)

The following additional equipment is required if you desire to make various operational checks that are described in the calibration procedure.

1. Powerstat- or Variac-type autotransformer with a current rating of at least 5 amperes (for 117-volt operation) or 2.5 amperes (for 234-volt operation).

2. Ac voltmeter capable of monitoring the output voltage of the autotransformer.

3. High sensitivity oscilloscope with a vertical sensitivity of at least 10 millivolts per division. (Tektronix Type 530- or 540-Series Oscilloscope recommended with a Type B, D, L, or H Plug-In Unit and a 1X probe.)

Calibration Procedure

Preliminary. Connect the line cord to the Type 133 and turn on the power. (If you have a variable autotransformer as described in "Equipment Required", connect its output directly to the Type 133 and set the output to the voltage for which your instrument is wired.) Insert a plug-in unit into the Type 133 and allow both instruments to warmup for at least two minutes before proceeding.

NOTE

Do not make the following adjustment unless it is actually out of tolerance (150 ±3 volts) or unless you intend to perform a complete calibration.

—150 VOLTS Adjustment. Connect the dc voltmeter between ground and test point 23 and adjust the —150 VOLTS adjustment for exactly 150 volts.

Power Supply Operational Checks. Connect the dc voltmeter between ground and the +100-, +225-, and the +350-volt supplies (test points 22, 21, and 20, respectively). The voltage at each point should be within 3% of its nominal value. If not, you may have to readjust the —150 VOLTS slightly to get all voltages within tolerance.

Connect the high-sensitivity test oscilloscope alternately to test points 20, 21, 22, and 23 and vary the output of the autotransformer from 105 to 125 volts (210 to 250 volts if your instrument is wired for 234-volt operation) at each point. The ripple voltage (peak-to-peak) at any of the foregoing test points should not exceed 15 millivolts. (Note: To measure the ripple voltage, ac-couple the input of the oscilloscope so that the relatively high dc level does not affect the measurements.) After making the ripple measurements, return the line voltage to 117 volts (or the design-center voltage).

DC LEVEL Adjustment. Set the DC LEVEL adjustment as described in the Operating Instructions section.

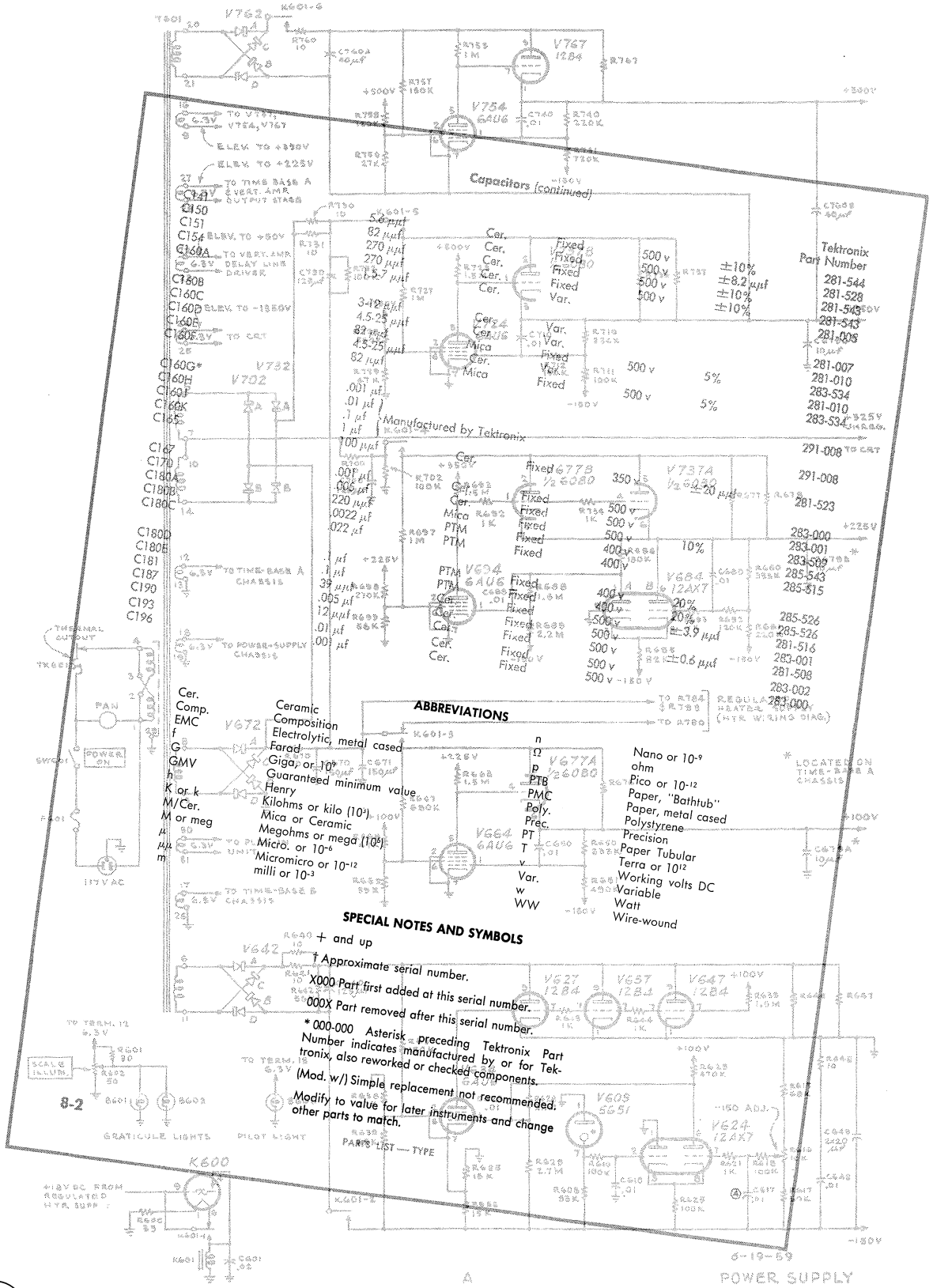
OUTPUT STAGE QUIESCENT CURRENT. Connect the dc voltmeter between test point 9 and the OUTPUT binding post. Set the OUTPUT STAGE QUIESCENT CURRENT adjustment for exactly 0.25 volt.

GAIN ADJ. Set the GAIN ADJ. as described in the Operating Instructions section.

Alternate-Trace Sync Circuit Check. Insert a Tektronix Type CA Plug-In Unit into the Type 133 and set the Type CA Mode switch to Alternate. Set the ALT.-CHOP. switch on the rear panel of the Type 133 to ALT. Connect between the oscilloscope +Gate Out connector and +GATE IN connector on the rear of the Type 133. Connect between the OUTPUT connector of the Type 133 and the input of the test oscilloscope. Set the triggering controls of the test oscilloscope for a free-running 0.1-millisecond-per-division sweep. Check the test oscilloscope display for two traces. (Note: You may have to vary the Position controls of the Type CA Unit slightly to get both traces into the viewing area of the graticule.)

NOTES

PARTS LIST *and* DIAGRAMS



MANUFACTURERS OF CATHODE-RAY OSCILLOSCOPES

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

Values are fixed unless marked Variable.

Bulbs

Ckt. No.	Tektronix Part Number	Description	S/N Range
B601	150-018	Incandescent GE #12 Pilot Light	

Capacitors

Tolerance ±20% unless otherwise indicated.

Tolerance of all electrolytic capacitors are as follows: (with exceptions)

3V —50V = —10% - +250%

51V —350V = —10% - +100%

351V —450V = —10% - +50%

C414	281-509	15 μμf	Cer.	500 v	10%	
C440	281-501	4.7 μμf	Cer.	500 v	±1 μμf	
C451	283-026	.2 μf	Discap	25 v		
C454	283-010	.05 μf	Discap	50 v		
C463	283-026	.2 μf	Discap	25 v		
C472	283-041	.0033 μf	Discap	500 v	5%	
C490	290-074	2000 μf	EMC	20 v		
C492	290-090	2000 μf	EMC	20 v		
C601	285-553	1 μf	PMC	600 v		X440-up
C612A,B	290-133	2 x 125 μf	EMC	350 v		
C621	283-008	.1 μf	Discap	500 v		
C636	283-008	.1 μf	Discap	500 v		
C658	283-008	.1 μf	Discap	500 v		
C642	290-082	2 x 200 μf	EMC	250 v		
C667A,B,C	290-073	40 x 20 x 20 μf	EMC	475 v		
C672	290-157	80 μf 400 v x 125 μf	EMC	250 v		
C688	283-008	.1 μf	Discap	500 v		
C698	283-008	.01 μf	Discap	500 v		
C918	283-002	.01 μf	Discap	500 v		
C920	281-505	12 μμf	Cer.	500 v	10%	
C921	283-002	.01 μf	Discap	500 v		
C924	283-002	.01 μf	Discap	500 v		
C927	283-008	.1 μf	Discap	500 v		
C929	281-543	270 μμf	Cer.	500 v	10%	
C930	283-000	.001 μf	Discap	500 v		

Diodes

D451	152-008	T12G
D463	152-004	1N707/1N763
D490A,B	152-035	1N1563
D492A,B	152-035	1N1563
D612A,B,C,D	152-047	1N2862 (or equal)
D642A,B,C,D	152-047	1N2862 (or equal)

Diodes *(continued)*

Ckt. No.	Tektronix Part Number	Description	S/N Range
D672A,B	152-047	1N2862 (or equal)	
D674A,B	152-047	1N2862 (or equal)	

Fuses

F483	159-015	3 amp 3 AG Fast-Blo	
F601	159-015	3 amp 3 AG Fast-Blo	

Inductors

L486	276-507	Ferrite Bead Suppressor	

Resistors

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

R413	301-752	7.5 k	½ w			5%
R414	301-203	20 k	½ w			5%
R415	311-008	2 k		Var.		GAIN ADJ.
R416	301-303	30 k	½ w			5%
R423	301-752	7.5 k	½ w			5%
R424	301-203	20 k	½ w			5%
R425	302-561	560 Ω	½ w			
R426	301-303	30 k	½ w			5%
R432	301-104	100 k	½ w			5%
R433	301-104	100 k	½ w			5%
R436	302-822	8.2 k	½ w			
R437	311-018	20 k	2 w	Var.		DC LEVEL
R440	301-752	7.5 k	½ w			5%
R443	306-153	15 k	2 w			
R450	304-183	18 k	1 w			
R451	311-158	200 Ω		Var.		Output Stage Quiescent Current
R453	306-562	5.6 k	2 w			
R454	302-220	22 Ω	½ w			
R464	use 308-234	5 k	8 w		WW	5%
R472	302-330	33 Ω	½ w			
R474	308-204	1 Ω	10 w		WW	
R484	308-204	1 Ω	10 w		WW	
R486	308-205	2 Ω	25 w		WW	
R490	302-561	560 Ω	½ w			
R492	302-561	560 Ω	½ w			
R496	308-206	7.5 k	5 w		WW	
R604	302-102	1 k	½ w			
R605	302-102	1 k	½ w			
R607	302-102	1 k	½ w			
R608	302-102	1 k	½ w			
R610	304-100	10 Ω	1 w			

Ckt. No.	Tektronix Part Number		Description			S/N Range
R619	304-103	10 Ω	1 w			
R620	302-104	100 k	½ w			
R621	302-102	1 k	½ w			
R623	302-105	1 meg	½ w			
R624	302-102	1 k	½ w			
R627	308-055	1.5 k	10 w		WW	5%
R628	301-273	27 k	½ w			5%
R630	302-102	1 k	½ w			
R631	302-564	560 k	½ w			
R632	309-279	180 k	½ w		Prec.	1%
R634	311-023	50 k		Var.		—150 v Volts
R636	309-049	150 k	½ w		Prec.	1%
R640	308-166	16 Ω	5 w		WW	5%
R641	307-007	2.7 Ω	1 w			
R650	302-563	56 k	½ w			
R651	302-563	56 k	½ w			
R653	302-105	1 meg	½ w			
R654	302-102	1 k	½ w			
R655	302-102	1 k	½ w			
R658	309-140	500 k	½ w		Prec.	1%
R659	309-009	720 k	½ w		Prec.	1%
R663	304-470	47 Ω	1 w			
R664	302-102	1 k	½ w			
R665	304-470	47 Ω	1 w			
R667	308-037	1 k	25 w		WW	5%
R668	308-045	167 Ω	5 w		WW	5%
R670	304-100	10 Ω	1 w			
R671	304-100	10 Ω	1 w			
R672	302-104	100 k	½ w			
R673	306-104	100 k	2 w			
R683	302-105	1 meg	½ w			
R684	302-102	1 k	½ w			
R685	302-102	1 k	½ w			
R686	302-102	1 k	½ w			
R688	309-149	1.2 meg	½ w		Prec.	1%
R689	309-141	750 k	½ w		Prec.	1%
R690	302-564	560 k	½ w			
R691	302-563	56 k	½ w			
R693	302-105	1 meg	½ w			
R694	302-102	1 k	½ w			
R695	302-102	1 k	½ w			
R698	309-012	970 k	½ w		Prec.	1%
R699	309-143	950 k	½ w		Prec.	1%
R916	301-305	3 meg	½ w			5%
R917	302-472	4.7 k	½ w			
R918	309-148	1 meg	½ w		Prec.	1%
R919	309-140	500 k	½ w		Prec.	1%
R920	302-102	1 k	½ w			
R923	309-290	21.5 k	½ w		Prec.	1%
R924	309-100	10 k	½ w		Prec.	1%

Resistors *(continued)*

Ckt. No.	Tektronix Part Number		Description	S/N Range
R925	302-102	1 k	½ w	
R926	302-103	10 k	½ w	
R927	302-102	1 k	½ w	
R929	302-472	4.7 k	½ w	

Switches

SW440	260-212	Slide	DPDT
SW601	260-134	Toggle	POWER ON
SW924	260-212	Slide	Rear Panel Switch
TK601	260-120	Thermo	137°F ±5°

Transformers

T601	*120-227	LV Power

Transistors

Q414	151-055	2N398
Q424	151-055	2N398
Q444	Use 151-084	2N1225
Q454	151-056	TI483
Q463	151-056	TI483
Q474	151-057	2N1905
Q483	151-057	2N1905

Electron Tubes

V619	154-291	OG3
V624	154-095	6AW8
V627	154-307	7233
V654	154-095	6AW8
V667	154-056	6080
V687	154-202	EL86/6CW5
V697	154-260	6GE8/7734
V924	154-187	6DJ8/ECC88

Type 133
Mechanical Parts List

			Tektronix Part Number
ADAPTER, 3 WIRE TO 2 WIRE			103-013
ANGLE, BRACE RAIL BOTTOM RIGHT 16 1/16	SN 101-322X		122-095
ANGLE, BRACE RAIL BOTTOM LEFT 16 1/16	SN 101-322X		122-096
ANGLE, BRACE RAIL BOTTOM LEFT & RIGHT	SN 323-up		122-106
ANGLE, BRACE RAIL TOP LEFT			122-097
ANGLE, BRACE RAIL TOP RIGHT			122-098
BAR, 3/16 x 1/2 x 1 W/2 6-32 HOLES			381-084
BAR, EXTR. CHAN. TOP SUPPORT W/HANDLE			Use 381-230
BRACKET, PHOS. BRONZE GROUND CLIP			406-245
BRACKET, POT			406-717
BRACKET, TIE POINT	SN 101-154X		406-719
BUSHING, 3/8-32 x 9/16 x .412			358-010
BUSHING, NYLON (FOR 5 WAY BINDING POST)			358-036
CABLE, HARNESS, POWER			179-537
CABLE, HARNESS, 110V			179-539
CABLE, HARNESS V. A.			179-548
CAP, FUSE			Use 200-582
CHASSIS, POWER			441-386
CHASSIS, AMP			441-387
CLAMP, CABLE 5/16 PLASTIC			343-004
CONNECTOR, CHASSIS MOUNT 16 CONT FEMALE			131-018
CONNECTOR, CHASSIS MOUNT COAX 1 CONT FEMALE		SN 101-449	131-081
CONNECTOR, CHASSIS MOUNT BNC	SN 450-up		131-126
CONNECTOR, CHASSIS MOUNT 3 WIRE MALE			131-150
CUP, SHOCKMOUNT RETAINER			201-011
EYELET, TAPERED BARREL			210-601
FAN, BLADE 4 1/2"	SN 101-439		369-011
FAN, BLADE 4 1/2"	SN 440-up		369-016
FILTER, AIR 5 7/8 x 5 7/8 x 3/4	SN 101-499		Use 050-148
FILTER, AIR	SN 500-up		378-025
GROMMET, POLYPROPOLENE (SNAP-IN)			348-031
GROMMET, RUBBER 5/16			348-003
GROMMET, RUBBER 3/8			348-004
GROMMET, RUBBER 1/2			348-005
GROMMET, RUBBER 5/8			348-012
HOLDER, FUSE			352-010
HOLDER, FUSE SINGLE (3 AG FUSE)			352-031
HOUSING, AIR FILTER 6 1/8 x 6 1/8 x 7/8			380-015
LOCKWASHER, INT. #4			210-004

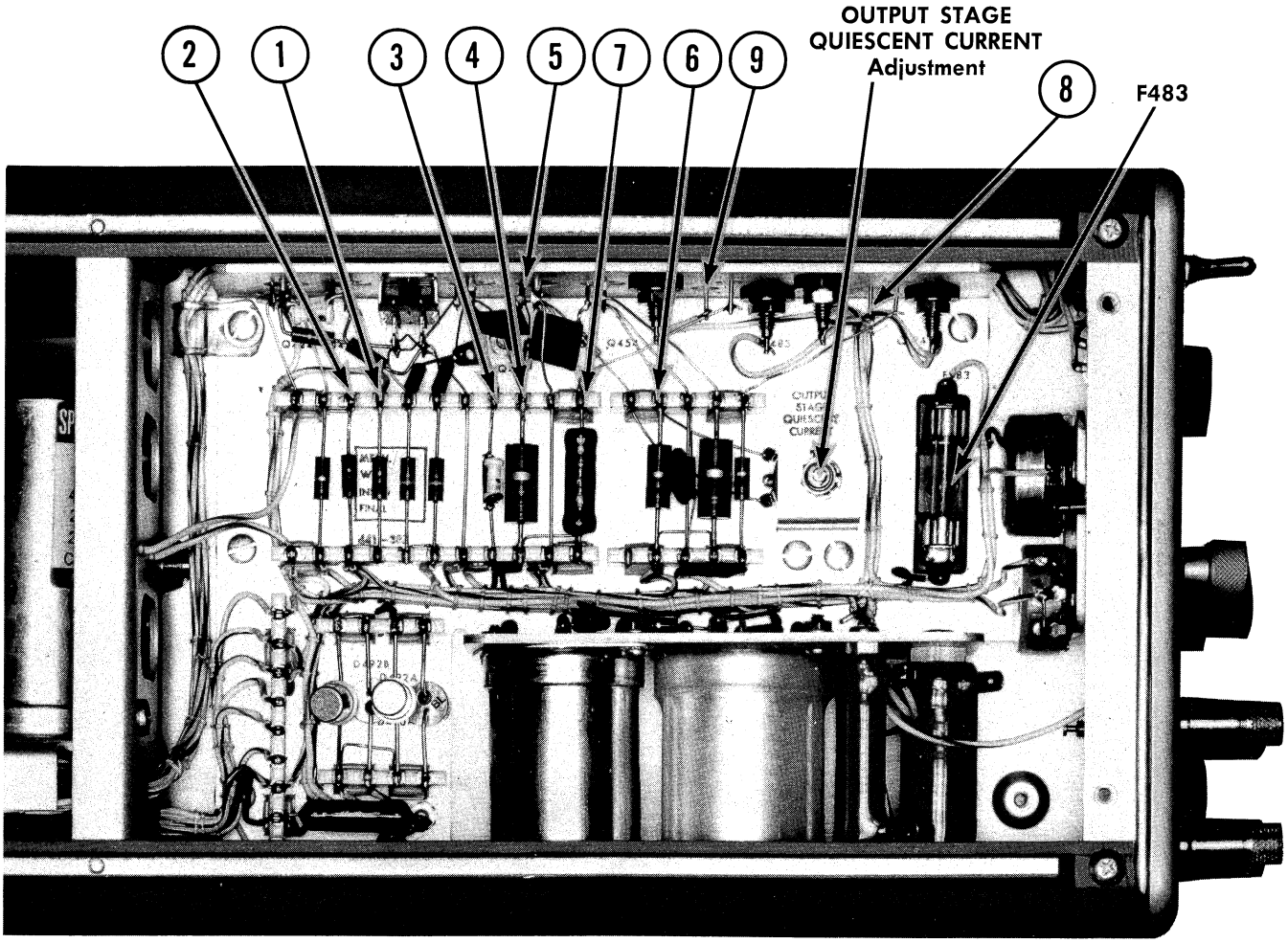
Mechanical Parts List *(Cont'd)*

	Tektronix Part Number
LOCKWASHER, INT. #6	210-006
LOCKWASHER, EXT. #8	210-007
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
LOCKWASHER, INT. 1/4	210-046
LUG, SOLDER SE6 W/2 WIRE HOLES	210-202
LUG, SOLDER SE10 LONG	210-206
LUG, SOLDER POT PLAIN 3/8	210-207
LUG, GROUND .025 x 15/16 MIL'D STEEL	210-241
MOTOR, FAN SN 101-439	147-014
MOTOR, FAN SN 440-up	147-025
MOUNT, FAN MOTOR 4 1/2" SN 101-439	426-052
MOUNT, FAN MOTOR 4 1/2" SN 440-up	426-053
NUT, CAP HEX 8-32 x 15/16	210-402
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, SPEED #6	210-437
NUT, HEX 3/8-32 x 1/2	210-413
NUT, HEX 10-32 x 3/8 x 1/8	210-445
NUT, HEX 1/4-28 x 3/8 x 3/32	210-455
NUT, KEPS 6-32 x 5/16	210-457
NUT, KEPS 8-32 x 11/32	210-458
NUT, HEX 8-32 x 1/2 x 23/64	210-462
NUT, SWITCH 12 SIDED	210-473
NUT, HEX 6-32 x 5/16 5-10W RES. MTNG.	210-478
NUT, HEX 3/8-32 x 1/2 x 11/16	210-494
NUT, HEX 10-32 x 3/8 x 1/8	210-564
NUT, KEPS STEEL 10-32 x 3/8	220-410
PANEL, FRONT	333-666
PLATE, INSULATOR .020 x 1.15 x 1.7	Use 387-345
PLATE, BOTTOM SN 101-322	387-436
PLATE, BOTTOM SN 322-up	387-697
PLATE, CAB. SIDE RIGHT	387-437
PLATE, CAB. SIDE LEFT	387-438
PLATE, PLUG-IN	387-439
PLATE, SUBPANEL FRONT	387-442
PLATE, BULKHEAD	387-443
PLATE, SUBPANEL REAR SN 101-154	387-441
PLATE, SUBPANEL REAR SN 155-up	387-592
PLATE, REAR OVERLAY SN 101-154	387-442
PLATE, REAR OVERLAY SN 155-up	387-593
POST, BINDING 5 WAY STEM & CAP ASS'Y FLUTED CAP	129-036

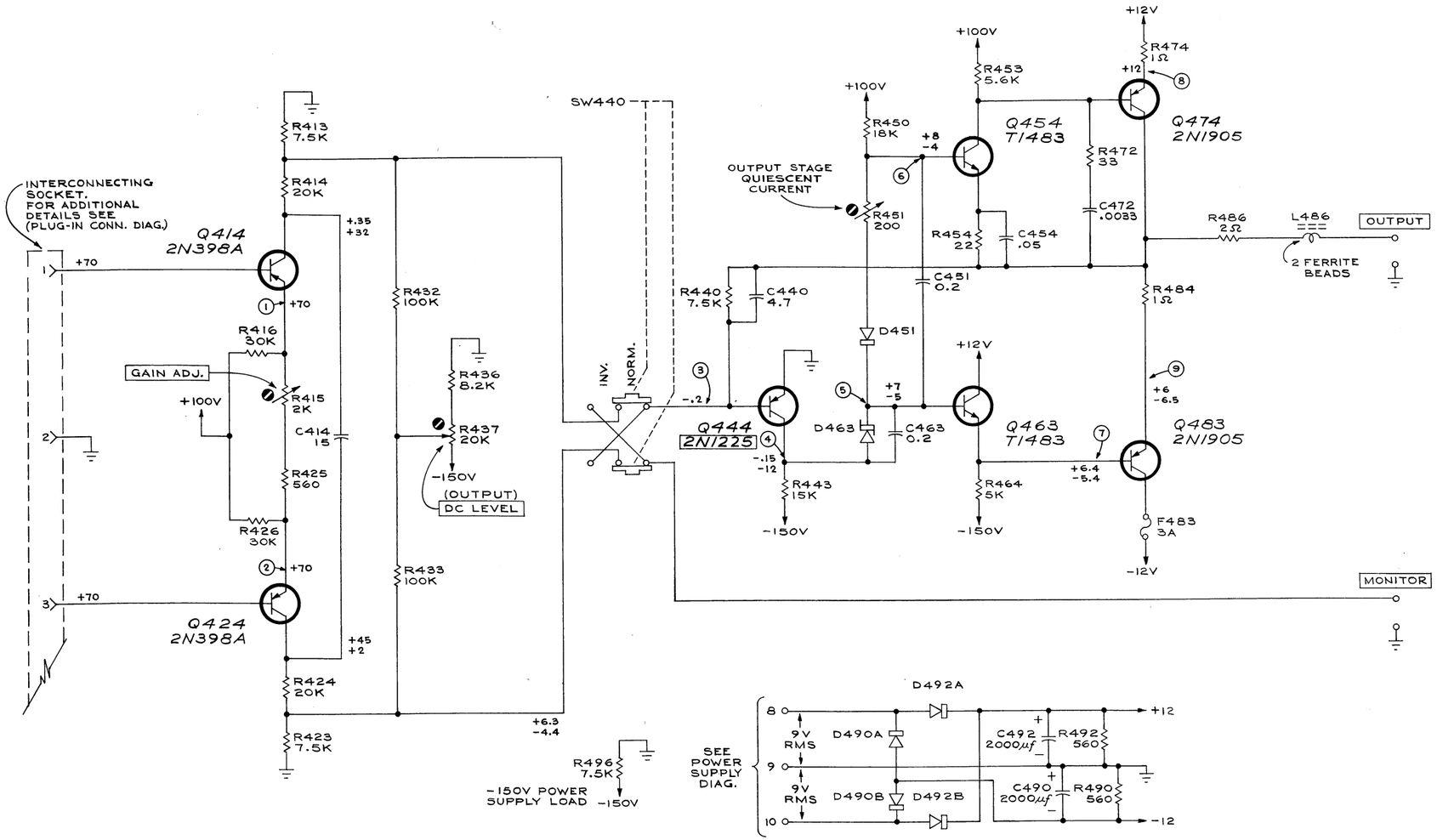
		Tektronix Part Number
POST, TERMINAL, TRANSISTOR MTNG	101-489X	129-049
POST, BINDING (355-507 & 200-182)		129-051
RING, LOCKING SWITCH		354-055
SCREEN, ALUM MESH	SN X500-up	387-765
RING, FAN		354-121
SCREW 4-40 x 1/4 BHS		211-008
SCREW 4-40 x 5/8 RHS		211-016
SCREW 6-32 x 1/4 BHS		211-504
SCREW 6-32 x 5/16 BHS		211-507
SCREW 6-32 x 3/8 BHS		211-510
SCREW 6-32 x 3/4 BHS		211-514
SCREW 6-32 x 5/16 PAN HS W/LOCKWASHER		211-534
SCREW 6-32 x 3/8 TRUSS HS, PHILLIPS		211-537
SCREW 6-32 x 5/16 TRUSS HS, PHILLIPS		211-542
SCREW 6-32 x 5/16 RHS		211-543
SCREW 6-32 x 3/4 TRUSS HS, PHILLIPS		211-544
SCREW 6-32 x 1 1/2 RHS, PHILLIPS		211-553
SCREW 6-32 x 3/8 FHS, 100°, CSK, PHILLIPS		211-559
SCREW 8-32 x 5/16 BHS		212-004
SCREW 8-32 x 3/8 BHS		212-023
SCREW 8-32 x 1 1/4 RHS		212-031
SCREW 8-32 x 1 3/4 FIL HS		212-037
SCREW 8-32 x 3/8 FHS, 100°, PHILLIPS		212-040
SCREW 8-32 x 1 1/2 Phillips		212-061
SCREW 10-32 x 5/16 BHB		212-518
SCREW 10-32 x 4, HEX HEAD		212-545
SCREW THREAD CUTTING 6-32 x 3/8 TRUSS HS, PHILLIPS		213-041
SCREW THREAD CUTTING 5-32 x 3/16 PAN H STEEL, PHILLIPS		213-044
SCREW THREAD CUTTING 6-32 x 5/16 PHS, PHILLIPS		213-054
SCREW THREAD FORMING #4 x 1/4 PHS, PHILLIPS		213-088
SCREW THS, #6 x 32		213-104
SCREW 2-32 x 5/16 RHS, PHILLIPS		213-113
SHOCKMOUNT, BLACK RUBBER 1/2 x 1/2 W/8-32 STUD		Use 348-008
SOCKET, STM7G		136-008
SOCKET, STM8 MOLDED		136-013
SOCKET, STM9G		136-015
SOCKET, LIGHT ASSEMBLY		136-047
SOCKET, 4 PIN TRANSISTOR		136-095
SPACER, NYLON MOLDED 3/16 FOR CERAMIC STRIPS		361-008
SPACER, NYLON MOLDED 5/16 FOR CERAMIC STRIPS		361-009
STRIP, CERAMIC 3/4 x 4 NOTCHES, CLIP MOUNTED		124-088
STRIP, CERAMIC 3/4 x 9 NOTCHES, CLIP MOUNTED		124-090

Mechanical Parts List *(continued)*

	Tektronix Part Number
STRIP, CERAMIC 3/4 x 11 NOTCHES, CLIP MOUNTED	124-091
STRIP, CERAMIC 7/16 x 5 NOTCHES, CLIP MOUNTED	124-093
STRIP, CERAMIC 7/16 x 9 NOTCHES, CLIP MOUNTED	124-095
STRIP, CERAMIC 7/16 x 11 NOTCHES, CLIP MOUNTED	124-106
STRIP, CERAMIC 4 NOTCHES, 2 CLIP MOUNTED	124-120
TAG, VOLTAGE RATING	334-649
TUBE, SPACER	166-031
TUBE, SPACER	166-155
TUBING, PLASTIC INSUL. #20 BLACK	162-504
WASHER, STEEL 6L x 3/8 x .032	210-803
WASHER, STEEL 8S x 3/8 x .032	210-804
WASHER, CENTERING 25W RES.	210-809
WASHER, STEEL .390 x 9/16 x .020	210-840
WASHER, RUBBER (FOR FUSE HOLDER)	210-873
WASHER, BAKELITE .129 x 1/2 WITH 3/8 SHOULDER	210-900
WASHER, STEEL .470 x 21/32 x .030	210-902



Amplifier test points.



IMPORTANT:

ALL CIRCUIT VOLTAGES WERE OBTAINED WITH A 20,000Ω/V. VOM. ALL READINGS ARE IN VOLTS.

VOLTAGE & WAVEFORM AMPLITUDE MEASUREMENTS ARE NOT ABSOLUTE. THEY MAY VARY BETWEEN INSTRUMENTS AS WELL AS WITHIN THE INSTRUMENT ITSELF DUE TO NORMAL MANUFACTURING TOLERANCES, TRANSISTOR, AND VACUUM TUBE CHARACTERISTICS.

VOLTAGE READINGS TAKEN UNDER THE FOLLOWING CONDITIONS:

LINE VOLTAGE.....117 VAC
PLUG-IN UNIT..... TYPE CA
PLUG-IN POSITION CONTROL
FOR UPPER READINGS..... CW
FOR LOWER READINGS..... CCW
PLUG-IN INV.-NORM. SWITCH..... NORM.
133 INV.-NORM. SWITCH..... NORM.

133 AMP.

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

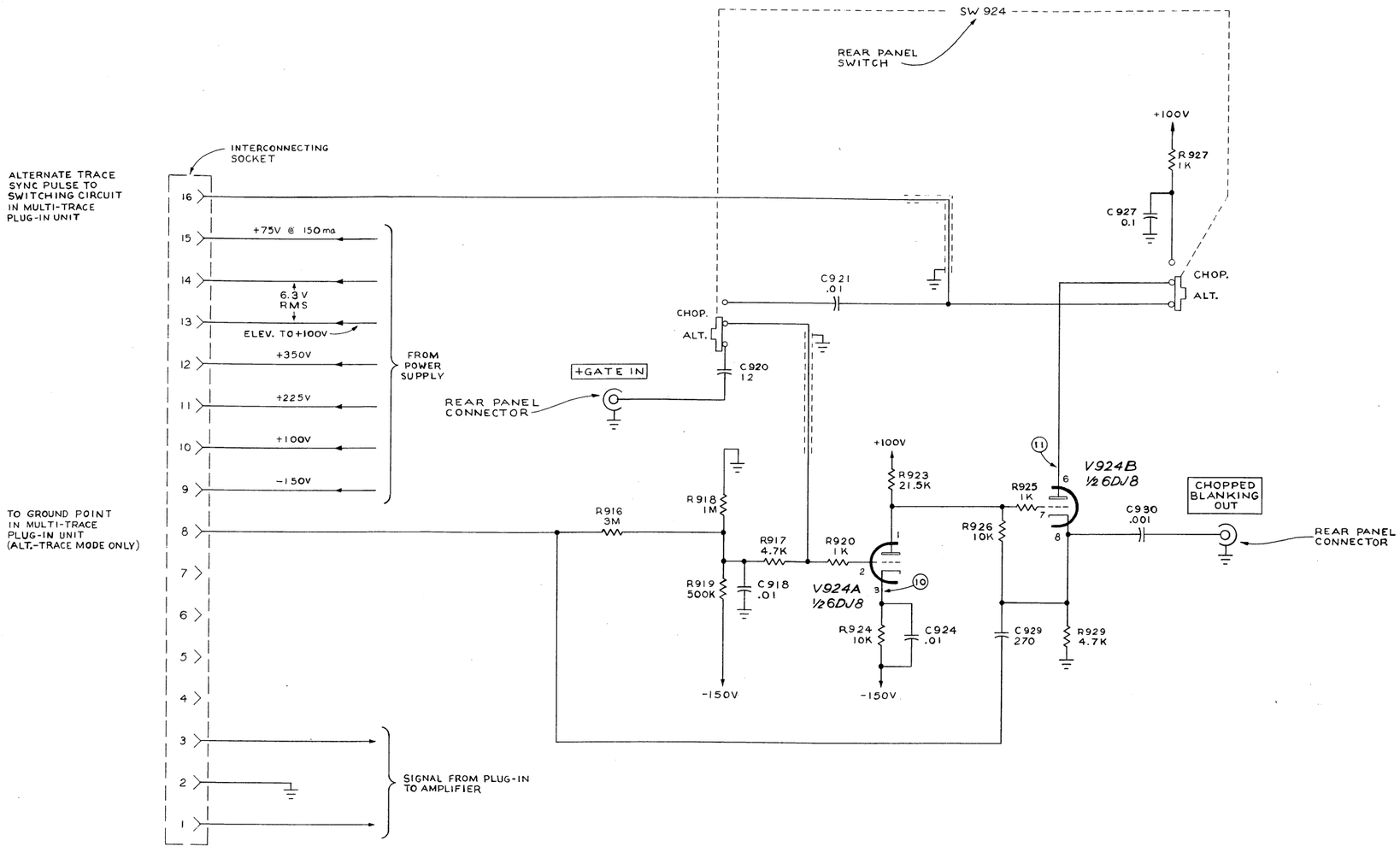
TYPE 133

A4

MRH
2-7-62

AMPLIFIER

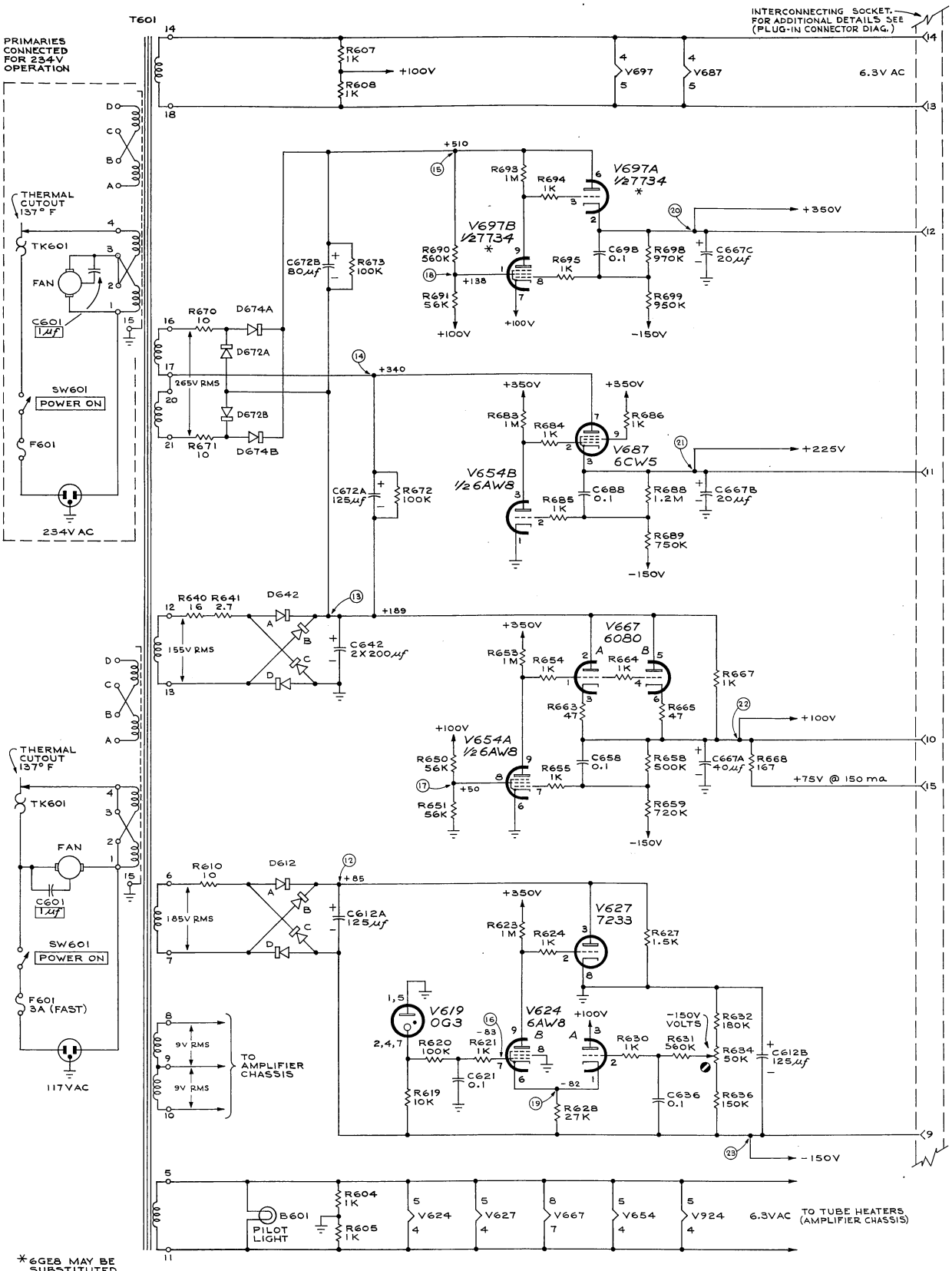
CIRCUIT NUMBERS 401 THRU 499



JN
10-18-61

PLUG-IN CONNECTOR & MULTI-TRACE SYNC

CIRCUIT NUMBERS 916 THRU 929



*6GE8 MAY BE SUBSTITUTED FOR 7734

VOLTAGE READINGS TAKEN UNDER THE FOLLOWING CONDITIONS:
LINE VOLTAGE ..... 117 VAC
PLUG-IN UNIT ..... TYPE CA
INPUT SIGNAL ..... NONE
ALSO SEE NOTE ON AMPLIFIER DIAG.

133 PWR. SPLY.

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE

C

MRH 864

POWER SUPPLY

CIRCUIT NUMBERS 601 THRU 699

TYPE 133

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.

PARTS LIST CORRECTION

REMOVE:

C918	283-0002-00	0.01 µF	500 V	
R917	302-0472-00	4.7 kΩ	1/2 W	10%

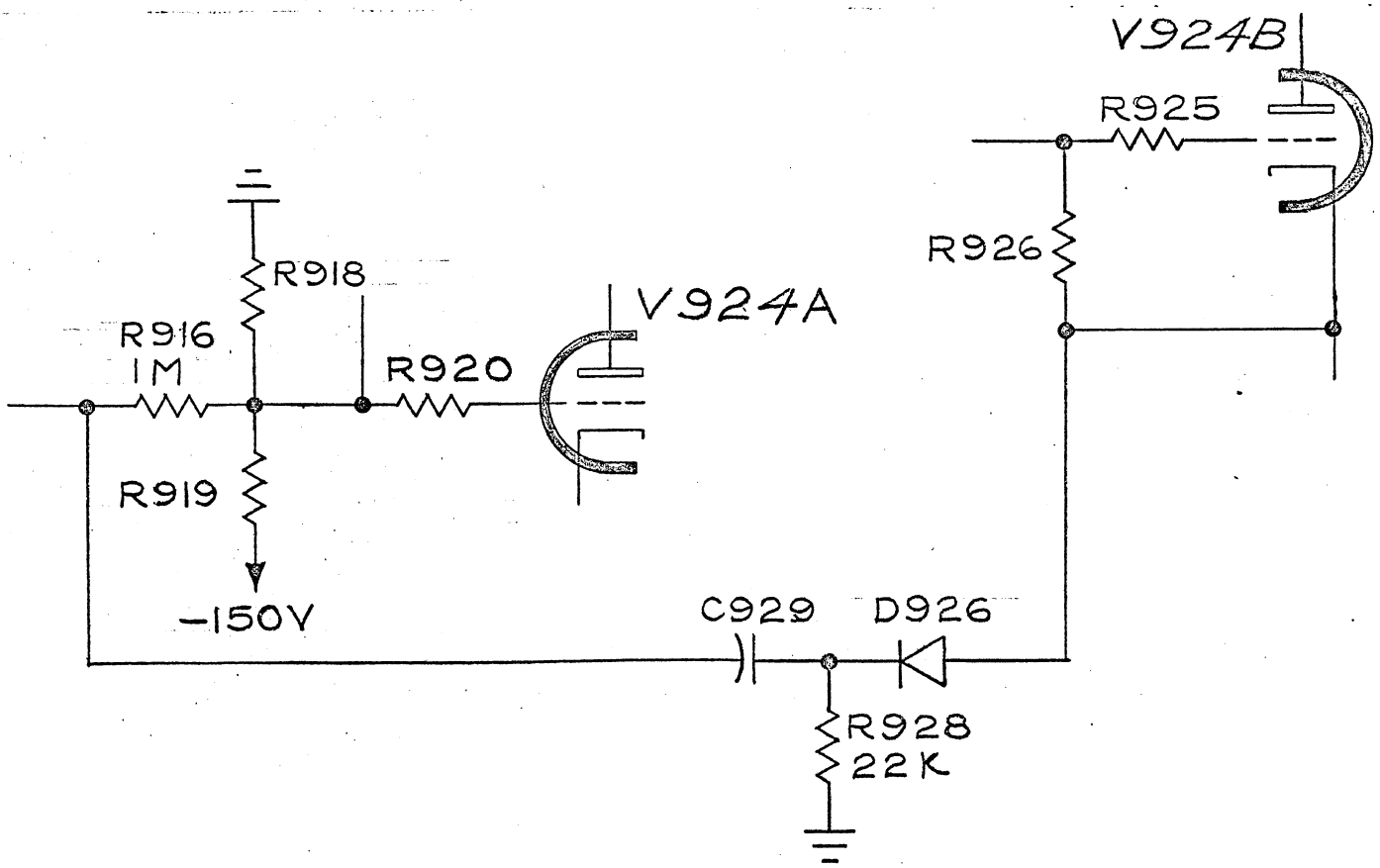
ADD:

D926	152-0185-00		Diode, 6185	
R928	302-0223-00	22 kΩ	1/2 W	10%

CHANGE TO:

C920	281-0542-00	18 pF	500 V	10%
R916	301-0105-00	1 MΩ	1/2 W	5%

SCHEMATIC CORRECTION



PART MULTI - TRACE SYNC

TYPE 133 -- TENT. S/N 610

PARTS LIST CORRECTION

CHANGE TO:

Q474	151-137	2N2148
Q483	151-137	2N2148