TEKTRONIX®

1501

SERVICE

INSTRUCTION MANUAL

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TEKTRONIX®

1501

SERVICE

INSTRUCTION MANUAL

Tektronix, Inc. P.O. Box 500 Beaverton, Oregon 97005

Serial Number

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CIRCUIT THEORY

The block diagram on the fold-out page near the back of the manual should be used with this description. That diagram provides a key to a thorough understanding of how the 1501 works. Also, it is useful in isolating difficult troubles. Refer to the left side of the block diagram for a listing of specific transistors and integrated circuits and the schematic where each is found. The parts list which precedes each schematic contains all the electrical components shown on that schematic.

BASIC FUNCTIONS

The basic functions of the circuits in the 1501 TDR are (1) to provide test pulses from a TEST PULSE GENERATOR, (2) to provide HORIZONTAL & TIMING or distance information, (3) to provide VERTICAL or amplitude information, (4) to provide oscillograms via a plug-in strip CHART RECORDER, (5) to provide start, stop and timing CONTROL LOGIC for the chart recorder and (6) to provide regulated voltages from a battery power-pack and POWER SUPPLY. These six functions are identified on the block diagram by corresponding sections having like titles.

The 1501 uses many of the basic principles and basic circuits of sampling oscilloscopes. If you already have an understanding of these principles, you may be able to recognize or deduce most of the purposes of the individual blocks and connections within the TIMING & HORIZONTAL and within the VERTICAL sections merely by careful study of the diagrams.

The TEST PULSE GENERATOR section is similar to most other Time-Domain Reflectometers. However, either a short duration pulse or a long duration, fast rise step signal may be selected as a test signal for the transmission line under test. Either kind of test signal is generated in automatic synchronism with the sampling and display process. The information display may be produced on a separate monitor oscilloscope or on a heat sensitive paper strip chart from the plug-in chart recorder.

Power for the chart recorder comes from regulated voltages supplied by the 1501 mainframe. The supply voltages remain disconnected, however, until the CHART POWER pushbutton is pushed. Thus, the motor will not start until the START pushbutton is pushed. Paper begins to emerge immediately, and the stylus begins to heat. After stylus is hot, the sampling and graph making process begins. A 10-division (25 centimeter) chart record is made, then the sampling process stops. The stylus heating voltage is

turned off at that instant, but the paper continues to move until the last recorded chart division emerges from the slit at the bottom of the recorder. The paper then stops and the record is available. By lifting the chart paper at an angle against the sharp upper lip, each new chart may be separated from the remainder of the roll of paper. The unrecorded part of each strip chart that appears ahead of the graph is for handwritten data. Each strip should be 32.5 centimeters long, and have 13 heavy vertical lines identifying each major horizontal division.

DETAILED FUNCTIONS

HORIZONTAL & TIMING Section

The SAMPLING RATE GENERATOR is a free-running multivibrator with a frequency of about 10 to 12 kHz. Each cycle initiates a negative-going fast ramp in the FAST RAMP GENERATOR and provides an input to the SWEEP GATING MULTI that occasionally causes it to switch and initiate a new sweep in the SWEEP GENERATOR. At the beginning of each sweep, the nearly simultaneous GATING and BLANKING DRIVER signals occur. Monitor oscilloscope retrace blanking is provided by an approximate —5 volt level from the GATING and BLANKING DRIVER and is mixed through a 10 k ohm resistor (R269) with the VERT OUT signal. When a sweep is in progress, the level of the blanking line floats, following the VERT OUT signal.

The FAST RAMP GENERATOR output goes to two comparators: the SLEWING COMPARATOR and the NON-SLEWING COMPARATOR. Successive outputs from the SLEWING COMPARATOR are increasingly delayed with reference to the beginning of each fast ramp, because of the slowly changing reference level at the other input to that comparator. Since it is slaved to the SWEEP GENERATOR through the SWEEP INVERTER, increasingly delayed signals from the STROBE DRIVER are therefore delivered to the sampling circuits during each sweep. That level changes at a rate proportional to the sweep rate. Thus, samples of the voltage near the TEST LINE connector are taken at later and later instants, (relative to the transmission of each test pulse). Successive samples will be delayed by small or large amounts (to correspond with the dielectric constant and propagation factor of the CABLE selected and the distance to be checked), depending on the FEET/DIV (or METERS/DIV) selected. The first of each successive set of samples taken during any sweep may be delayed, using the START POINT control, by a time corresponding to the two-way propagation time of up to at least 500 feet (or 100 meters) of cable. For measurement of long distances a fast ramp having 10 times longer duration is used, and the START POINT control can be set to delay

the start of sample-taking for a time corresponding to 5000 feet (or 1000 meters) of cable.

Notice the three capacitors between the input and output of the SWEEP GENERATOR. C220, controlled by the NOISE FILTER pushbutton, causes the sweep repetition rate to change from about 40 per second to about 4 per second. C225, controlled by FET Q225, shunts C220 and C222 when the CHART POWER pushbutton is pushed. This reduces the sweep rate to approximate the speed of the chart recorder paper (about 2 seconds per division). The sweep will not free-run in this mode. Instead, the GATING MULTI is locked out by the GATING CONTROL circuits until it receives a go signal from the START-STOP CONTROL in the CONTROL LOGIC section. When grounded, the same input line to FET Q225 also signals the GATING CONTROL circuits, preventing the sweep from repeating until the START pushbutton is pushed.

R216 controls the slope of the sweep ramps. It should be set, using the chart recorder, for minimum correction signal across C202. When the chart paper is properly installed and R216 properly set, the sweep ends within one small minor division of the heavy line corresponding to the last major division. When the step mode is selected, there is an abrupt downward swing of the pen when the sweep stops, corresponding to the beginning of retrace, before it cools off.

R192 controls the current delivered to the sliding contact on the START POINT control. It is used to calibrate the 10-turn START POINT control after the slope of the fast ramps has been properly set with R132.

R132 sets the slope of the fast ramps so that FEET/DIV (or METERS/DIV) will be accurate. One of two fast ramp capacitors (C128 or C129) is selected by the FEET/DIV (or METERS/DIV) switch and determines the start point range. The larger of these capacitors must have precisely 10 times the capacitance of the smaller (including stray circuit capacitance) for the best accuracy at all settings of the FEET/DIV (or METERS/DIV) switch.

VERTICAL Section

The STROBE GENERATOR periodically operates the SAMPLING GATE momentarily, to admit, to the SAMPLING PREAMP, voltage existing at the TEST LINE. That sampling time is on the order of 1 nanosecond. Samples are taken approximately every 100 microseconds, and stored as a partial charge in the capacitors C380 and C390. Positive feedback through adjustable capacitor C394 completes each charge in C380 and C390. The voltage from each charge is applied to the sampling preamplifier.

C394 adjusts the sampling gate to have, in effect, 90% sampling efficiency.

The sampling gate diodes are shunted by capacitance that couples undesired charge to the SAMPLING PREAMP input. The BLOWBY INVERTER produces an equal and opposite signal to nullify the undersired charge. R398 sets the gain of the BLOWBY INVERTER.

The SAMPLING PREAMP drives the VERTICAL AMP-LIFIER, which is an operational amplifier, through a part of the gain adjust resistor R442. The resistance connected between the output and the other input of the VERTICAL AMPLIFIER is selected by the %/DIV switch. That switch also controls the gain of the VERTICAL AMPLIFIER. A DC voltage, selectable with the DISPLAY OFFSET control, is applied to the opposite end of R442. The effect of a change in that voltage is to position the display up or down on a monitor oscilloscope or chart recording. The output of the VERTICAL AMPLIFIER normally goes to the PEN DRIVE amplifier via the EXT DRIVE (or EXT SIG) switch. A properly terminated step signal should produce a 1 volt sampled facsimile at the VERT OUT jack when %/DIV is set to 20. When the EXT Drive (or EXT SIG) pushbutton is pushed, any externally supplied signal introduced to the VERT IN jack is routed to the chart recorder and the VERT OUT jack by way of the 1X BUFFER AMPLIFIER. Notice that when the EXT DRIVE (or EXT SIG) pushbutton is pushed, another contact connects the 0 to +5 volt sweep to the SWEEP OUT jack. When that sweep is properly connect to the 1401A or 1401A-1 TEKTRONIX Spectrum Analyzer, and the proper vertical output of the spectrum analyzer is connected to the VERT IN jack on the 1501, a chart recording of a spectrum plot can be made with the 1501.

Notice the two capacitors that may be switched to ground at the input to the VERTICAL AMPLIFIER. One is selected by the NOISE FILTER pushbutton and the other is selected by the CHART POWER pushbutton. These capacitors provide "smoothing" or noise reduction in the display when the sweep rate is slow enough to provide time to average out the random noise.

R442 sets the gain of the VERTICAL AMPLIFIER so that the internally generated step signal produces the correct deflection.

TEST PULSE GENERATOR Section

Either narrow pulses (impulses) or fast rise step-signals may be selected for transmission through the cable under test. The STEP pushbutton selects the step test signal when pushed in, or the impulse test signal when released (out).

The output of the NON-SLEWING COMPARATOR is a pulse edge that causes either the STEP DRIVER or the IMPULSE DRIVER to generate a step or impulse, respectively, for transmission through the transmission line under test, by way of the TEST LINE jack. When the STEP DRIVER is on, the IMPULSE DRIVER is off, and vice versa, depending on the position of the STEP pushbutton. The NON-SLEWING COMPARATOR has a fixed delaying function. It delays the generation of each test pulse, with respect to the beginning of each fast ramp, by a fixed amount of time. The amount of time depends on the slope of the fast ramp and the DC level at the lower input to the NON-SLEWING COMPARATOR. This fixed delay allows strobes, generated during the first part of a sweep, to sample voltage on the line prior to the generation of some test pulses, so that the incident edge of subsequent test pulses may be sampled and displayed later in any sweep.

When the source and line load are matched, the signal delivered to the TEST LINE jack from the STEP GENERATOR has an amplitude of about +1 volt. When the 50 Ω -75 Ω internal slide switch is set to the 75 Ω position, 25 Ω is inserted in series with the output line to make the source impedance 75 Ω and to deliver the same test signal amplitude to a 75 Ω line that is delivered to a 50 Ω line from the basic 50 Ω source impedance.

The INPUT PROTECTOR senses the presense of extraneous voltage on the line that may cause damage to components in the 1501. When more than 5 to 8 volts is on the line, a relay automatically switches a low capacitance blocking capacitor (C346) in series to protect the components. When this happens, a neon light on the front panel flashes periodically. When extraneous voltage on the line must be tolerated, the tests may usually be continued by switching to the IMPULSE mode. Excessive voltage, especially high frequency signal voltage, may produce enough noise in the display to make the tests impractical, however. Once the relay is activated it will hold itself latched while a sweep is in progress, even if voltage on the line goes below 5 volts. At the end of a sweep or chart, however, the relay is unlatched by a signal from the GATING & BLANKING DRIVER. The presense of extraneous voltage on the line that is less than 5 to 8 volts may seriously interfer with the display. In such a case, using the IMPULSE mode may often be a satisfactory solution, providing a blocking capacitor is externally connected in series with the output of the TEST LINE jack.

R148 positions the leading edge of the step signal so it may be visible on the chart or monitor scope at all FEET/DIV (or METERS/DIV) settings in the 5000 foot (or 1000 meter) range. R151 serves a similar purpose for the 500 feet (or 100 meter) range but should be adjusted after R148 has been set, because R148 affects the pulse position in both ranges. Neither adjustment should be made unless the START POINT is first set to 000.

R330 adjusts the position of the leading edge of the impulse to coincide with the leading edge of the step-signal. It should be set using the shortest distance per division.

C366 and R366 are adjusted for the fastest, cleanest step signal.

R347 is adjusted so that the impulse generating avalanche transistor (Q345) does not free-run, but requires very little drive signal to avalanche. It also affects the amplitude of the impulse, so it should be set before IMPULSE amplitude adjustments are made.

C342, R342, and C344 are to minimize aberrations following the impulse. C345 adjusts the amplitude of the impulse delivered to the test line and C378 adjusts the portion of the impulse and reflections that arrive at the sampling gate input.

CONTROL LOGIC Section

The purpose of the control logic section is to provide proper start, stop, and timing information between the CHART RECORDER and HORIZONTAL & TIMING sections of the instrument. When the CHART POWER pushbutton is pushed, an input to the GATING CONTROL circuits is grounded. This prevents the SWEEP GENERATOR from running until the START pushbutton is pushed. The pushbutton also connects a large capacitor (C225) between the input and output of the SWEEP GENERATOR, to assure a long duration sweep closely approximating the paper speed in the chart recorder.

When the START pushbutton is pushed, two outputs from the START-STOP CONTROL circuits immediately turn on the PAPER DRIVE MOTOR and the STYLUS heat by activating the MOTOR VOLTAGE CONTROL circuits and the HEATER VOLTAGE REG circuits. The chart paper then moves, and holes in the left edge (top) of the chart paper periodically admit light from the LED (light emitting diode) to the DETector. The detected light pulses are passed to the PULSE SHAPER circuits, where they are sharpened and passed on to the HOLE COUNTER and ERROR GATE circuits. When the second hole is counted. an output from the START-STOP CONTROL circuit signals the GATING CONTROL circuits and unlocks the SWEEP GATING MULTI. The SWEEP GENERATOR is then started by the SWEEP GATING MULTI as soon as the next pulse arrives from the SAMPLING RATE GENER-ATOR (less than 100 μ s later). By the time the second hole is counted the stylus should be hot and starting to write. If the chart paper has been installed correctly (with the red line visible through a hole in the chart paper set next to a heavy line on the paper), the sweep should commence

precisely as the next heavy line moves across the edge of the hot stylus. After the sweep begins, successive samples are increasingly delayed to correspond with movement of the sweep and movement of the chart paper, and the increasing cable distance that they represent. To ensure precise distance calibration of the chart, the chart speed is monitored by counting holes with a light beam. Each time a hole admits light from the LED to the light DETector a pulse is produced, passed to the PULSE SHAPER and on to the HOLE COUNTER and BINARY TO ANALOG CON-VERTER. The voltage level of the sweep is compared with an analagous current stair-step produced by the BINARY TO ANALOG CONVERTER. Any difference in level is then amplified by the SLOPE ERROR AMPLIFIER and gated into the memory capacitor (C202) by the ERROR GATE. The polarity of any error voltage on the capacitor depends on whether the paper tends to move faster or slower than the sweep. The magnitude of the voltage depends on the inherent difference in rate, but tends to be self-cancelling by automatically altering the sweep speed to match the paper speed. When the speeds match perfectly, the heavy line corresponding to the last of 10 major chart divisions is in contact with the stylus edge at the instant the sweep ends. R216 (in the HORIZONTAL & TIMING section) is usually adjusted for a near-exact sweep slope. Otherwise, the error circuits won't operate correctly.

Fifty holes are counted and 50 equal increments of current are supplied by the BINARY TO ANALOG CONVERTER during each sweep. If the sweep rate matches the paper speed, each increment is matched by current supplied by the sweep voltage through the resistor (R526) shown connected to the null point. When R216 at the input to the SWEEP GENERATOR is adjusted properly, the error signal across C202 is minimized.

When the sweep ends, an input to the START-STOP CONTROL circuits from the GATING & BLANKING DRIVER turns off the HEATER VOLTAGE CONTROL. A nearly simultaneous output from the START-STOP CON-TROL circuits locks out the SWEEP GATING MULTI through the GATING CONTROL circuits. The paper continues to move, however, until a total of 65 holes are counted. At that instant, the motor is turned off by the START-STOP CONTROL circuits, and the motor is electrically braked by the MOTOR VOLTAGE CONTROL circuit. At the same instant, all counters are reset. The process may then be repeated by pushing the START pushbutton. If the CHART POWER pushbutton is released while the paper is moving, the motor will stop. It will then be necessary, by pulling some paper from the recorder, to re-align a major graticule mark on the paper with the red index line.

CHART RECORDER Section

The chart recorder consumes no power when merely plugged into the 1501. When the CHART POWER pushbutton is pushed, the supply voltages are connected to the recorder circuits and the CONTROL LOGIC circuits, and power dissipation increases to at least 0.6 watts, depending on the position of the stylus. When the START pushbutton is pushed, the stylus HEATER VOLTAGE REGULATOR is turned on and heats the writing stylus. The power required to heat the stylus is about 5 watts, depending on the adjustment of R722, the stylus temperature adjustment. With no paper installed in the recorder, heater voltage will not turn off by itself. Even when paper is installed, the CHART POWER pushbutton should be released immediately after making each record, in order to conserve battery charge. Further, the sweep generator is locked out and the instrument may be thought to be defective if a monitor oscilloscope is connected. If the chart recorder stops running while making a chart, it is likely that the chart paper is depleted. The stylus heater voltage will not turn off, and to avoid excessive battery drain, the CHART POWER pushbutton should be released.

The PEN DRIVE AMPLIFIER is activated whenever the CHART POWER pushbutton is pushed. This amplifier normally receives a signal from the 1501 VERTICAL AMPLIFIER, but may also respond to a signal applied to the VERT IN jack if the EXT DRIVE (or EXT SIG) pushbutton is pushed. Such a signal will need to be slaved to the sweeps generated in the 1501, however, to be of practical use. Those sweeps are available at the SWEEP OUT jack when the EXT DRIVE (or EXT SIG) pushbutton is pushed. If a chart recording is to be made and the CHART POWER pushbutton is pushed, no sweep is available until the START pushbutton is also pressed. These sweeps last about 20 seconds and a complete chart takes about 26 seconds to be completed.

The PEN DRIVE AMPLIFIER must have the correct gain to make an accurate chart record. Gain is controlled by R755 and should be set so a 1 volt P-P low frequency signal at the VERT OUT jack produces five chart divisions of deflection. When the gain of the VERTICAL AMPLIFIER in the 1501 is set correctly, a 1 volt step signal is available at that point when the TEST LINE output is terminated to match the source impedance selected with the internal 50 Ω -75 Ω slide switch. The STYLUS POSITION pot should be set so that, with zero volts at the VERT OUT jack, the stylus is precisely positioned to the center of the chart paper. The stylus is approximately centered but does not respond to rotation of the STYLUS POSITION pot unless CHART POWER is applied. If the paper movement is deliberately stopped by releasing the CHART POWER pushbutton the stylus may tend to stick to the paper because it cooled in one position. In that case, rotation of the STYLUS POSITION pot may not move the STYLUS until the paper is advanced.

PERFORMANCE CHECK AND ADJUSTMENT

Introduction

A complete procedure for verifying proper performance of the 1501 and Chart Recorder (016-0506-00) is contained in this section. Instructions are included for making all internal electrical adjustments. Instructions for making mechanical adjustments are included in the Maintenance section of the manual.

We recommend a complete performance check every six months or 1000 hours of operation if no serious performance problems have occurred in that time. If performance troubles are suspected the Preliminary Checks and Troubleshooting Guide may be followed with a minimum amount of equipment and with little investment of time. It will reveal most abnormal performance conditions and will help locate the trouble rapidly.

A complete performance check is recommended any time a serious trouble has been corrected. Some failures do not warrant a complete performance check, since not all circuits are affected by a given circuit repair.

NOTE

Performance Specifications are listed in the Operation Section of the manual. Tolerances and limits mentioned in Section 2 are adequate to verify the tolerances and limits in the section on operation but may sometimes be tighter than absolutely necessary or pertain to conditions that only indirectly apply to the Performance Specifications.

EQUIPMENT REQUIRED

- 1. One monitor oscilloscope, such as the SONY/TEKTRONIX 323. The monitor oscilloscope should have a DC-coupled, external horizontal input, with a sensitivity adjustable to 0.5 V per division on a 10-division full screen scale. It should also have a calibrated DC-coupled vertical input with sensitivities of 1 V, 0.5 V, and 0.2 V per division.
- 2. One DC voltmeter, such as the TEKTRONIX DM 501 (or TEKTRONIX 7000-series oscilloscope and 7A13 plug-in unit). The voltmeter should be accurate to 0.25% or better when reading 5, 7.5, or 75 volts.

- 3. One variable auto-transformer (with voltmeter), such as General Radio W10MT3WA. The auto-transformer should permit line voltage to be varied from 90 V AC to 130 V AC (or 180 V AC to 260 V AC if the 1501 is wired for 225 V AC).
- 4. One Time-Mark Generator such as the TEKTRONIX 2901. The generator should have 10 ns, 50 ns, 0.1 μ s, 0.5 μ s, 1 μ s, and 10 μ s marker output signals of about 0.5 volts P-P into 50 ohms, and 0.1 μ s, 1 μ s, and 10 μ s synchronous trigger signals of about 0.5 volts into 50 ohms.
- 5. One six-foot 1X-10X probe, such as TEKTRONIX P6052, or separate six-foot 1X and 10X probes.
- 6. Three coaxial cables, such as TEKTRONIX 012-0057-01. The cables should be about 42 inches long and have BNC connectors on each end.
- 7. One BNC to GR adapter such as TEKTRONIX 017-0063-00.
- 8. One 50 ohm Termination, such as TEKTRONIX 017-0081-00. The termination impedance should be 50 ohms \pm 0.5% at DC.
- 9. One 50 ohm 2X attenuator, such as TEKTRONIX 017-0080-00. The attenuator should provide 2X \pm 1% attenuation at DC.
- 10. One 50 ohm 5X attenuator, such as TEKTRONIX 017-0079-00. The attenuator should provide 5X \pm 1% attenuation at DC.
- 11. One 50 ohm 5X attenuator, such as TEKTRONIX 011-0060-00. The attenuator should have BNC connectors.
- 12. One 75 ohm Termination, such as TEKTRONIX 011-0102-00. The termination impedance should be 75 ohm \pm .25% at DC.
- 13. One F-to-BNC adapter such as TEKTRONIX 013-0158-00.

Performance Check & Adjustment-1501 Service

- 14. One insulated adjustment tool such as TEKTRONIX 003-0000-00. The tool should have an insulated shaft.
- 15. One insulated adjustment tool such as TEKTRONIX 003-0003-00. This tool should have a short thin, narrow, screwdriver-shaped, metalic tip imbedded in an insulating material. Tool 003-0003-00 should be shortened to about 2 inches.
- 16. One extension cable such as TEKTRONIX 067-0667-00 for troubleshooting the Chart Recorder.

PRELIMINARY CHECKS AND TROUBLESHOOTING GUIDE

All references to the left or right side of the 1501 will mean toward the operator's left or right hand as he views the front panel right side up.

The circuits identified as likely centers of trouble are shown on the block diagram pull-out sheet near the back of the manual. The transistors and integrated circuits associated with each block are identified on the same page.

- 1. Turn off the POWER switch on the 1501 front panel and remove the 1501 from its case by loosening the thumb screw on the rear panel and pulling on the front panel.
- 2. Remove the plug-in Chart Recorder by loosening the thumb screw on the front panel and pulling on the thumb screw. Slide the 50 $\Omega\text{-}75~\Omega$ internal slide switch to the 50 Ω position, toward the front of the 1501. It is accessible through the top of the chart recorder compartment on the circuit card to your left.
- Set the slide switch on the side panel to the FULL CHG position and attach the 1501 power cord between the 1501 and the variable auto transformer. Plug in the auto transformer and turn it on. Set for 120 V AC output to the 1501.
- 4. Release all pushbuttons on the 1501 front panel and set the POWER switch to ON. The settings of the other controls do not matter yet.
- 5. Connect a shielded cable (012-0057-01) between the HORIZ OUT connector on the 1501 and the vertical input connector on the monitor oscilloscope. Turn on the power to the oscilloscope, DC-couple the oscilloscope input, set the VOLTS/DIV to 1, the TIME/DIV to 10 ms and measure the sweep voltage. Its indicated amplitude should be 5 volts

- P-P plus or minus about 0.2 volts. If there is no sweep, look for trouble in the SAMPLING RATE GENERATOR, SWEEP GATING MULTI, GATING CONTROL, or SWEEP GENERATOR circuits. If the sweep voltage is not very close to 5.0 volts, suspect trouble with, or misadjustment of, the power supply voltage.
- 6. Move the cable from the HORIZ OUT jack to the SWEEP VOLTAGE jack. Push the EXT SIG (or EXT DRIVE) pushbutton. The same sweep signal should appear on the oscilloscope. If not, suspect switch contact troubles.
- 7. Set TIME/DIV to 1 second. Push the NOISE FILTER button and check for a slower sweep, and that the sweep amplitude does not change. If not, suspect Q255 or switch contact trouble.
- 8. Release all the pushbuttons then push the STEP pushbutton. Using an F-to-BNC adapter, (013-0158-00), move the shielded cable from the SWEEP VOLTAGE jack to the TEST LINE jack. Change the START POINT control to indicate 100 or more. Set the oscilloscope TIME/DIV to $20~\mu s$ and check the interval of one square-wave cycle. It should be about 80 to $100~\mu s$. (Be sure the variable TIME/DIV control is in the CAL position). If no wave form appears, look for trouble in the FAST RAMP GENERATOR, NON-SLEWING COMPARATOR, or STEP GENERATOR circuits.
- 9. Disconnect the shielded cable from the TEST LINE jack.
- 10. Release all pushbuttons on the 1501 and set %/DIV to 50. Set the oscilloscope INPUT to GND, free-run the trace and position it to center screen.

NOTE

After this step, the vertical position of the oscilloscope display should be controlled only with the 1501 DISPLAY OFFSET knob. Repeat the ground level check anytime you suspect the vertical position control may have been inadvertently moved.

- 11. Connect a shielded cable between the 1501 VERT OUT jack and the vertical input to the monitor oscilloscope. DC-couple the oscilloscope input, then set the VOLTS/DIV to 1 and the TIME/DIV to 5 ms.
- 12. Observe the rectangular wave on the oscilloscope and check that the DISPLAY OFFSET control is able to position the top of the wave more than 1 division above

and below center screen. The negative peaks of the waveform correspond to the 1501 sweep recovery interval and should be about 4 to 7 ms in duration. The upper peaks correspond to the sweep interval and should be about 15 to 30 ms in duration. If no waveform appears, look for trouble in the GATING and BLANKING DRIVER circuits. If you can't move the tops of the waveform, look for trouble in the SLEWING COMPARATOR, STROBE DRIVER, STROBE GENERATOR, SAMPLING GATE, SAMPLING PREAMP, VERTICAL AMPLIFIER or display offset VOLTAGE GENERATOR circuits.

- 13. Push the STEP pushbutton and check that the top of the rectangular wave moves approximately 0.8 volts. If no movement occurs, suspect trouble in the STEP switch contacts or SAMPLING GATE circuits.
- 14. Set the distance per division to 20 feet (or 5 meters) and while observing the test scope display rotate the START POINT control counterclockwise to indicate 000. Check that about a +0.8 volt step appears ahead of the top leading corner of each rectangular wave. If not, R148 may have to be pre-adjusted so that it does. R148 is accessible through a hole in the right side panel.
- 15. Disconnect the shielded cable from the 1501 and release all the pushbuttons.

POWER SUPPLY CHECKS AND ADJUSTMENTS

Follow steps 1 through 3 of the preceding section unless you started with that section.

- 1. Measure the voltage between ground and the orange test point near the middle of the power supply board, using an accurate volt meter or 7A13 plug-in unit (see Figure 2-1). The voltage should be between +5.6 and +5.8 volts. If not, adjust R806 for a reading of 5.7 volts (see Figure 2-1). If using the 7A13 and oscilloscope, it is normal to see about 50 to 100 mV of ripple.
- 2. Measure the voltage between ground and the red test point near the right rear corner of the power supply board using the set-up above. The voltage should be within 225 mV of +7.5 volts. If not, adjust R838 (adjacent to that test point) for a reading of +7.5 volts. (See Figure 2-1).
- 3. Check for +5 volts within ± 150 mV at pin 3 of plug P74 (see Figure 2-1).
- 4. Check for -5 volts within ± 150 mV at pin 2 of plug P74 (see Figure 2-1).
- 5. Check for -75 volts within ± 4.0 V at pin 1 of plug P74 (see Figure 2-1).

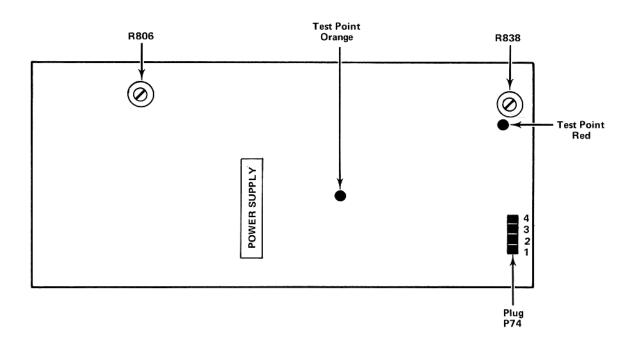


Figure 2-1. Power Supply circuit board showing only test points and adjustment potentiometers. The board is located near the rear of the 1501.

Performance Check & Adjustment-1501 Service

- 6. Repeat the checks in steps 1 through 5 one at a time while varying the line voltage between 90 and 136 volts AC.
- 7. Using a 1X probe connected to the monitor oscilloscope vertical input, AC couple the input and check for about 100 mV P-P ripple or less at the orange test point. Vary the line voltage between 90 and 136 volts AC when checking ripple at each point. Check for 15 mV P-P ripple or less on the +7.5 V test point (red), +5 V test point (pin 3) and -5 V test point (pin 2).
- 8. Check the -75 V test point (pin 1) in the same way for 75 mV P-P ripple or less.
 - 9. Disconnect both ends of the probe.

VERTICAL CHECKS AND ADJUSTMENTS

- 1. Remove the chart recorder from the 1501 and remove the 1501 from its cabinet if you haven't already done so.
- 2. Connect a shielded cable (012-0057-01) between the VERT OUT jack of the 1501 and the vertical input to the monitor oscilloscope. Connect a similar cable between the HORIZ OUT jack on the 1501 and the external horizontal input to the monitor oscilloscope.
- 3. Turn on the POWER switch to the 1501 and oscilloscope and release all pushbuttons on the 1501. Set the %/DIV to 50, the FEET/DIV to 20 (or METERS/DIV to 5) and the START POINT to 000. For ease of adjustment, remove the power cord and operate the 1501 from its internal batteries. Be sure the right side panel slide switch is set for full charge or trickle charge.
- 4. Set the vertical input coupling of the monitor oscilloscope to GND, free-run the sweep, and center the trace with the vertical position control. DC-couple the horizontal input to the monitor oscilloscope and set its controls to display the 0 to +5 volt sweep from the 1501 across precisely ten divisions. For the most linear sweep while using a SONY/TEKTRONIX 323 or 324 oscilloscope, the left side panel slide switch should be set to 10X, and the X10 front panel MAG switch should be pulled. Also, the front panel trigger selector switch should be all the way down, and the TIME/DIV switch should be set to EXT HORIZ. The VARIABLE knob should be used to set the sweep to be precisely ten divisions long. The bright dot at the beginning of the sweep is normal.

- 5. Set the monitor oscilloscope VOLTS/DIV to 0.2 and the vertical input coupling to DC.
- 6. Push the STEP pushbutton on the 1501 and, using only the DISPLAY OFFSET control on the 1501, center the step vertically. It should be 4 divisions in amplitude. If not, preadjust R442 so that it is. R442 is located near the middle of the board that is wired to the %/DIV switch. If no step appears you may have to preadjust R148, accessible through a hole in the right sub-panel.
- 7. Using an F-to-BNC adapter (103-0158-00) if necessary, connect the precision 75 Ω termination (011-0102-00) to the TEST LINE jack. Slide the internal 50 Ω -75 Ω slide switch, accessible on the left through the top of the chart recorder compartment, to the 75 Ω (rear) position. The step signal should now be 2 divisions in amplitude.
- 8. Change the %/DIV to 20, distance to 2 feet (or 0.5 meters) per division and center the step with the DISPLAY OFFSET control. Advance R316 fully clockwise and look for a sudden increase in noise in the trace. See Figure 2-2 for the location of R316. Back off about 10 to 20 degrees counterclockwise from the position where the noise disappears. If no noise appears, set R316 about 10 degrees back from the clockwise end of rotation.
- 9. Set the distance to 500 feet (or 100 meters) per division. Set the START POINT to indicate 020 and adjust R398 for a flat, level trace. Change the %/DIV to 1, recenter the trace with the DISPLAY OFFSET control and fine adjust R398 for a flat, level trace.

NOTE

What appears as a high frequency oscillation may be on the entire trace. Its amplitude should be close to minimum when the trace is flattest. If more than about 1/5 division of oscillation appears when R398 is adjusted for the flattest trace, the sampling gate diodes (CR380 and CR390) may need to be replaced.

10. Change the %/DIV to 50 and set the START POINT to 000. Rotate C394 and notice the amplitude of overshoot and ringing change on the front corner (see Figure 2-3). Set C394 so that the ringing barely disappears (see Figure 2-4).

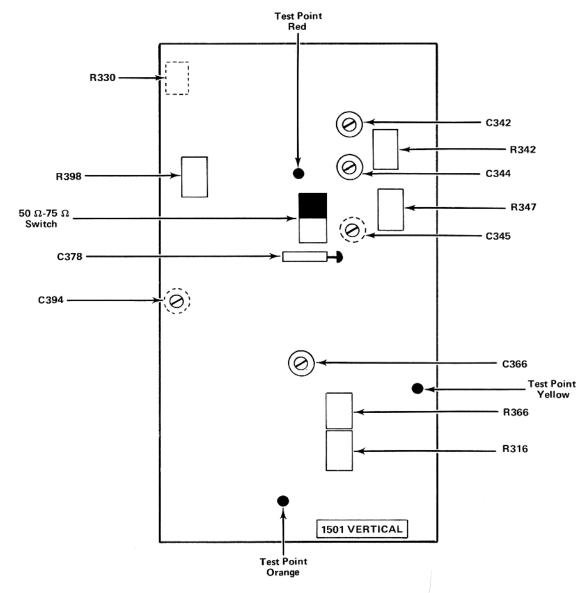


Figure 2-2. Vertical deflection circuit board showing location of test points and adjustable components. Dotted lines indicate locations of components on the left side of the board. The board is mounted in a vertical plane near the DISPLAY OFFSET control.

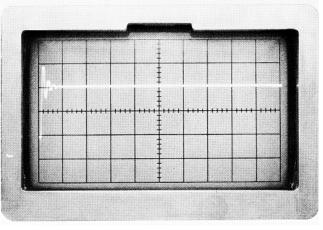


Figure 2-4. Capacitor C394 correctly adjusted.

Figure 2-3. Capacitor C394 improperly adjusted.

- 11. Set the distance per division to 20 feet (or 5 meters) and disconnect the 75 Ω load. Set the internal 50 Ω -75 Ω slide switch to the front (50 Ω) position. Check that the step amplitude measured between the flattest portions is precisely 4 divisions or adjust R442 so that it is. R442 is located near the middle of the board that is wired to the %/DIV switch (see Figure 2-5)..
- 12. Connect a third 50 Ω coaxial jumper cable (012-0057-01) to the TEST LINE jack. Using the necessary adapters, connect a precision 50 Ω terminating resistor (017-0081-00) to the end of the jumper cable. Check that the amplitude reduces by 2 divisions. Change the %/DIV to 20; using the DISPLAY OFFSET control, position the step on screen and check that the displayed amplitude is 5 divisions ±2%.
- 13. Disconnect the 50 Ω terminator and in its place connect the 2X attenuator (017-0080-00). Then attach the terminator to the attenuator. The display should be the same as in the previous step.
- 14. Change the %/DIV to 10; using the DISPLAY OFFSET control, position the end of the top of the waveform 2 1/2 divisions below center screen. Disconnect the terminating resistor from the 2X attenuator and check that the top of the trace moves up 2 1/2 divisions ±3%.
- 15. Change the %/DIV to 5; using the DISPLAY OFFSET control, position the end of the top of the waveform 3 divisions above center screen. Reconnect the 50 Ω terminator and check that the top of the waveform moves down 5 divisions ±3%.
- 16. Disconnect the 2X attenuator and terminator from the jumper cable and substitute the 5X attenuator (017-0079-00). Connect the 50 Ω terminator to the 5X attenuator, and change the %/DIV to 2. Using the DIS-PLAY OFFSET control, position the top of the waveform 2 divisions below center screen. Disconnect the terminator and check that the waveform moves up 2 divisions $\pm 3\%$.
- 17. Change the %/DIV to 1; using the DISPLAY OFFSET control, position the top and the end of the waveform 2 divisions above center screen. Connect the terminator and check that the waveform moves down 4 divisions ±3%.
- 18. Insert the 2X attenuator between the 5X attenuator and the cable. Change the %/DIV to 0.5 and position the end of the waveform precisely two divisions below center screen. Disconnect the 50 Ω terminator and check that the waveform moves up 2 divisions $\pm 3\%$.

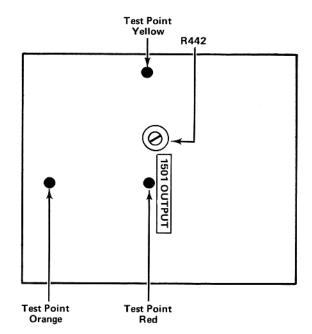


Figure 2-5. Output circuit board showing test points and gain adjustment R442. The board is mounted on a vertical plane directly behind the front panel power switch.

19. Change the %/DIV back to 20%, disconnect the jumper cable from the TEST LINE jack and connect a precision 75 Ω terminating resistor (011-0102-00) to the jack. Slide the 50 Ω -75 Ω internal switch to the rear (75 Ω) position and using the DISPLAY OFFSET control position the waveform and check that the amplitude of the step signal is 5 divisions $\pm 2\%$ between the flattest portions.

TEST PULSE GENERATOR CHECKS AND ADJUSTMENTS

If you have not just completed the preceding section, make the set-up described in steps 1 through 5 of that section. Connect a 75 Ω terminating resistor (011-0102-00) to the TEST LINE jack and set the internal 50 Ω -75 Ω switch to the rear (75 Ω position), then begin here.

1. Set the CABLE dielectric switch to the counterclock-wise position and preset the OTHER pot fully CCW. Set the distance per division to 2 feet (or 0.5 meters) and display the step signal. If the step does not appear then preset R148, through the hole on the right side sub-panel, so it does appear.

NOTE

Use an adjustment tool with little or no metal in the tip when adjusting capacitors in the following steps,

2. See Figure 2-2. Adjust R366 and C366 for the shortest risetime, with about 6% but no more than 8% P-P ringing on the top front corner (see Figure 2-6). Check the ringing at 5% per division.

- 3. Return the %/DIV to 20 and release the STEP pushbutton. Adjust R347 so all evidence of "foot" on the rising edge barely disappears (see Figures 2-7, 2-8, and 2-9).
- 4. While pushing and releasing the STEP pushbutton, check that the beginning of the rising edge of the impulse coincides with the beginning of the rising edge of the step, or adjust R330 so that it does.
- 5. Change the distance per division to 5 feet (or 2 meters) and adjust R342 and C342 to minimize the baseline aberrations following the impulse (see Figure 2-10). The average baseline level following the impulse should not be above or below the level preceding the impulse.
- 6. Change FEET/DIV to 2 (or METERS/DIV to 0.b). Adjust C345 and C378 for 5 divisions of amplitude, with minimum aberrations and a sharp falling edge (see Figure 2-10). Peak-to-peak aberrations should be 8% or less.
- 7. Check that the width of the impulse at 50% amplitude is no more than 1/3 of a major division. If using

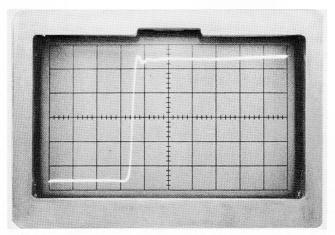


Figure 2-6. Acceptable overshoot and ringing with proper termination.

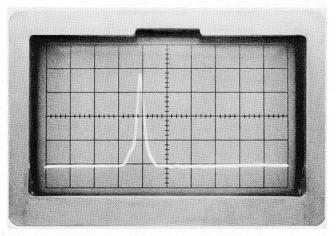


Figure 2-7. "Foot" at beginning of impulse indicating R347 set too far counterclockwise.

a 323 or 324 monitor oscilloscope, the sweep may be expanded ten times with the side panel slide switch and the width checked more accurately at 3.3 major divisions. You may push the NOISE FILTER pushbutton for a more stable display. Position the top of the impulse 2 1/2 divisions above the center line and measure the width at the centerline.

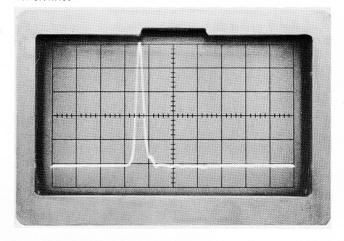


Figure 2-8. R347 adjusted clockwise until "foot" barely but completely disappears.

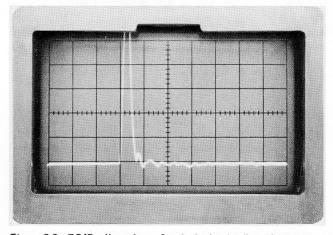


Figure 2-9. R347 adjusted too far clockwise, leading edge moves to the left past the region of the "foot".

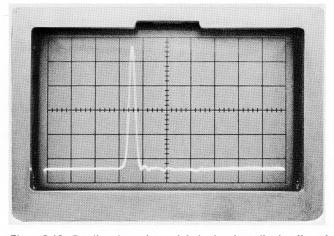


Figure 2-10. Baseline aberrations minimized and amplitude adjusted for 5 divisions.

HORIZONTAL & TIMING CHECKS AND ADJUSTMENTS

If you have not just completed the preceding section, first make the set-up described in steps 1 through 5 of the VERTICAL CHECKS AND ADJUSTMENTS section.

- 1. Apply power to the 2901 Time-Mark Generator. Set the distance per division to 20 feet (or 5 meters), the %/DIV to 50, and push the STEP pushbutton.
- 2. With the START POINT control set to 000 and CABLE set to POLY, check that the step or impulse starts between 1 and 2 divisions from the left edge of the trace. If not, adjust R148 so the step begins two divisions from the left edge. R148 is accessible through a hole in the right side panel.
- 3. Set the FEET/DIV to 2 (or METERS/DIV to 0.5) and check that the step begins between 1 and 4 divisions from the left edge of the trace. If not, adjust R148 as above and check again. If still not within 1 and 4 divisions adjust R151 so that the step begins 2 divisions from the left edge.

NOTE

R151 is located as shown in Figure 2-11. Temporarily turn off power on the 1501 front panel and lift the circuit board 388-2774-00 located under the START POINT control by removing three machine screws near the corners. Being careful not to allow any conductors on the board to contact ground, turn on the power and make the adjustment. Turn off the power, fasten the board in place with the machine screws and re-apply power.

4. Connect the 50 Ω 5X BNC attenuator (011-0060-01) to the MARKER OUT jack on the 2901. Connect a shielded cable (012-0057-01) between the attenuator and the TEST LINE jack on the 1501, using an F-to-BNC adapter. Push the .1 μ s button of the 2901 Time Mark Generator. Connect a 10 megohm 10X passible probe to the TRIGGER OUT jack on the 2901 and apply the tip of the probe to the red test point on the Fast Ramp board (see Figure 2-11). It may be important to use a short ground lead on the probe. Turn off the MARKER AMPLIFIER on the 2901 and push the 1 μ s TRIGGER SELECTOR pushbutton. Set the internal 50 Ω -75 Ω slide switch to the 50 Ω (forward) position.

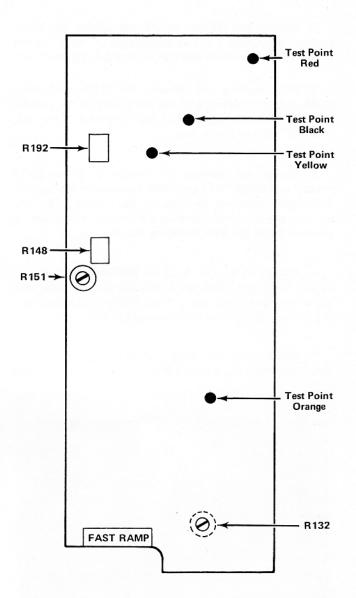


Figure 2-11. Fast Ramp circuit board. Located under and behind the START pushbutton. Mounted in a horizontal plane upside down. R132 is near the START pushbutton. R192 and R148 may be adjusted through holes in the right side panel.

NOTE

For instruments calibrated in METERS/DIV, ignore steps 5 through 15.

5. Set the 1501 FEET/DIV to 50. Set the %/DIV to 50, the START POINT to 000, and the CABLE dielectric to OTHER. Set the OTHER control fully counterclockwise. Check that the trace is still precisely 10 divisions long or adjust the monitor oscilloscope horizontal variable gain so that it is. Center the trace precisely between the left and right hand graticule edges. Move the START POINT control to position the peak of the first clear marker after the step precisely at the beginning of the trace.

NOTE

During the following steps the NOISE FILTER pushbutton may be used to reduce noise in the display. The length and position of the probe ground lead also may affect the noise. Six foot 10X probes work best. Check that there is nearly one marker per division and that the last of the 10 following markers is between about 1/2 minor divisions and 1 1/2 minor division left of the right graticule edge (see Figure 2-12). If not, proceed to the next step and check back later. Counterclockwise rotation of the OTHER control corresponds to air dielectric.

- 6. Change the CABLE switch to the POLY position and set the START POINT control to position the peak of the first marker following the step precisely at the left edge of the trace. Check that the 15th following marker is between 1 and 2 minor divisions to the left of the right edge of the graticule. If not, adjust R132 so that marker is precisely 1 1/2 minor divisions from the right edge of the graticule. R132 is visible from the top and located on a circuit card just below the OTHER potentiometer. When adjusting R132, the START POINT control may have to be moved to keep the first marker precisely at the beginning of the trace (see Figure 2-13).
- 7. Change the CABLE switch to the 0.81 FOAM position and set the START POINT control so that the peak of the first marker following the step is again precisely at the beginning of the trace. Check that the last of the twelve following markers is between 1.1/2 and 3 minor divisions left of the right edge of the graticule (see Figure 2-14).
- 8. Change the CABLE switch back to POLY. Change the FEET/DIV to 20 and position the peak of the first marker to the left edge of the trace with the START POINT control. Check that the peak of the 6th following marker is between 1/2 and 2 1/2 minor divisions from the right edge of the graticule.
- 9. Change the markers to 50 ns (20 MHz sinewave), the FEET/DIV to 5 and the %/DIV to 20. Using the DISPLAY OFFSET control, center the display and set the START POINT control to position the rising edge of the first clean cycle to intercept the centerline at the left edge of the graticule (see Figure 2-15). Check that the corresponding point on the 3rd cycle crosses the centerline somewhere between the right edge of the graticule and 3 minor divisions left of that edge as shown in Figure 2-15.

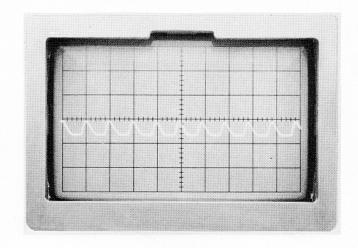


Figure 2-12. 0.1 μ s markers at 50 feet/Div; AIR dielectric.

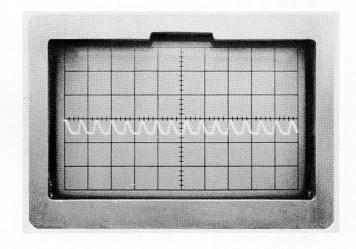


Figure 2-13. 0.1 μ s markers at 50 feet/Div; POLY dielectric.

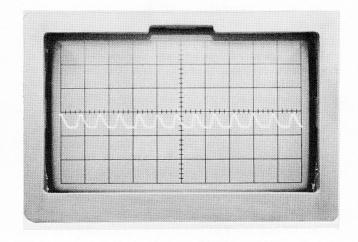


Figure 2-14. 0.1 μs markers at 50 feet/Div; 0.81 FOAM dielectric.

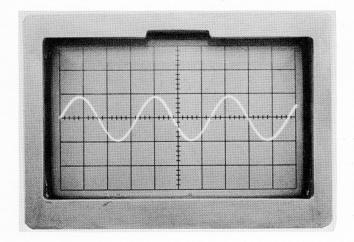
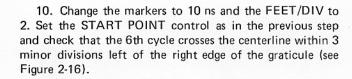
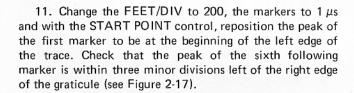


Figure 2-15. 50 ns markers at 5 feet/Div; POLY dielectric.





12. Change the FEET/DIV to 500, reposition the peak of the first marker to coincide with the left edge of the trace and check that the 15th following marker is within 3 minor divisions left of the right edge of the graticule (see Figure 2-18).

13. Set the FEET/DIV to 50 and the CABLE dielectric to POLY. Set the START POINT to 000 and set the marker output to 1 μ s. Move the horizontal position control on the monitor oscilloscope to position the leading edge of the first marker precisely to center screen. Rotate the START POINT control clockwise and position the 10th following marker to center screen. Check that the START POINT control reads between 3176 and 3304. If not, set R192 (right side panel) so that the edge is in precise alignment when the dial is set to 3240 feet. Check that the zero marker hasn't moved more than about 1 minor division when the START POINT is turned back to 000. If it has, repeat the step.

14. Change the FEET/DIV to 5, the markers to 50 ns and the START POINT to 000. Using the oscilloscope horizontal position control, position the middle of the first

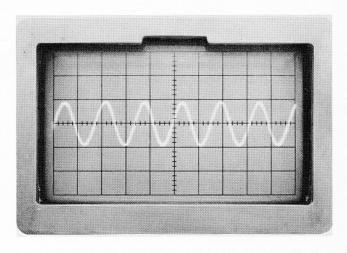


Figure 2-16. 10 ns markers at 2 feet/Div; POLY dielectric.

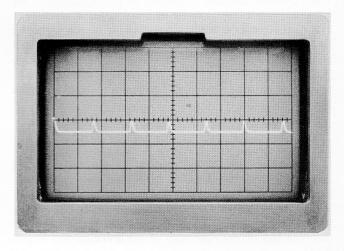


Figure 2-17. 1 μs markers at 200 feet/Div; POLY dielectric.

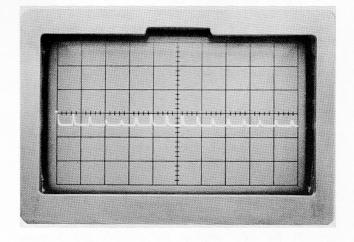


Figure 2-18. 1 μs markers at 500 feet/Div; POLY dielectric.

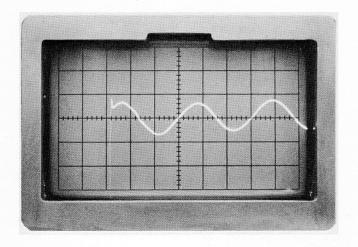


Figure 2-19, 50 ns markers at 5 feet/Div properly positioned for setting of 000 on the START POINT control.

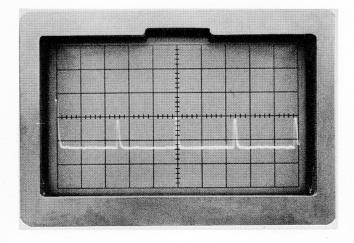


Figure 2-20. 5 μs markers at 200 meters/Div; POLY dielectric.

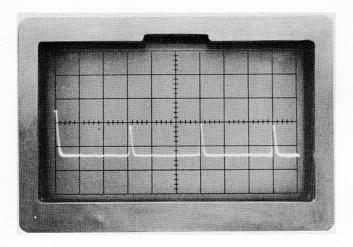


Figure 2-21. 5 µs markers at 200 meters/Div; FOAM .81 dielectric.

clean rising edge of the sine-wave marker to center screen (see Figure 2-19). Turn the START POINT control and count 20 more sine-waves, finally positioning the 20th with only the START POINT control to intercept center screen as above. Check that the dial reads between 318 and 330. If not, R192 should be adjusted as in the preceding step. If it was already adjusted, it may have to be readjusted again to split the residual error equally between the 5000 and the 500 foot range.

15. Disconnect the probe and cable from the 1501 and marker generator.

The following steps pertain to 1501 instruments calibrated in METERS/DIV.

16. Select 5 μ s markers and 10 μ s triggers on the 2901. Set the 1501 METERS/DIV to 200 and the %/DIV to 10. Set the CABLE dielectric to POLY and the START POINT control to 000. Check that the trace is still precisely 10 divisions long or adjust the monitor scope horizontal variable gain so that it is. Center the trace precisely between the left and right hand graticule edges. Move the START POINT control to position the peak (of the first clear marker that follows the step) at the beginning of the trace.

NOTE

During the following steps the NOISE FILTER pushbutton may be used to reduce noise in the display. The length and position of the probe ground lead also may affect noise.

Check that the peak of the fourth following marker appears between the right graticule edge and one minor division left of the graticule edge (see Figure 2-20). If not, adjust R132 so that marker is precisely 1/2 minor division left of the right hand graticule edge. When adjusting R132 the START POINT control may have to be moved to keep the peak of the first marker precisely at the beginning of the trace.

17. Change the CABLE switch to the .81 FOAM position and set the START POINT control so the peak of the first marker following the step is again precisely at the beginning of the trace. Check that the third following marker is within \pm 1/2 minor division of the 9th major division (see Figure 2-21). If not, adjust R132 as in the preceding step and check again.

- 18. Change the CABLE switch back to POLY. On the 2901 Time Mark Generator select 1 μ s Markers. Change the METERS/DIV to 50 and position the peak of the first marker to the left edge of the trace with the START POINT control. Check that the peak of the 5th following marker is between 0 to 1.5 minor divisions to the left of the right edge of the graticule (see Figure 2-22).
- 19. Change the Markers to $0.5 \,\mu s$ and the METERS/DIV to 20. Position the peak of the first marker to the left edge of the trace and check that the peak of the 4th following marker is between 0 to 1.5 minor divisions to the left of the right edge of the graticule (see Figure 2-23).
- 20. Change the Markers to 0.1 μ s and the METERS/DIV to 5. Position the peak of the first marker to the left edge of the trace and check that the peak of the 5th following marker is between 0 to 1.5 minor divisions to the left of the right edge of the graticule (see Figure 2-24).
- 21. Change the Markers to 50 ns and the METERS/DIV to 2. Center the display with the 1501 DISPLAY OFFSET control and position the rising edge of the first clean cycle to intercept the centerline at the left edge of the graticule (see Figure 2-25). Check that the corresponding point on the 4th following cycle crosses the centerline between 0 to 1.5 minor divisions to the left of the right edge of the graticule.
- 22. Change the Markers to 10 ns and the METERS/DIV to 0.5. Position the display as in the previous step and check that the rising edge of the 5th following cycle crosses the centerline between 0 to 1.5 minor divisions to the left of the right edge of the graticule (see Figure 2-26).
- 23. Change the Markers to $0.5 \,\mu s$ and the METERS/DIV to 20. Set the START POINT control to 000. Set the horizontal position control on the monitor scope to position the leading edge of the first marker precisely to center screen (see Figure 2-27). Rotate the START POINT control clockwise and position the 20th following marker to center screen. Check that the START POINT control reads between 969 and 1000 meters. If not, set R192 (right side panel) so the edge is in precise alignment when the dial is set to 989. Check that the zero marker hasn't moved more than about 1 minor division when the START POINT control is turned back to 000. If it has, repeat the step.
- 24. Change the Markers to 50 ns and the METERS/DIV to 2. Set the START POINT control to 000. Center the sine wave with the DISPLAY OFFSET control and, with the monitor scope horizontal position control, set the rising edge of the second or third cycle precisely to center screen (see Figure 2-28). Turn the START POINT control and

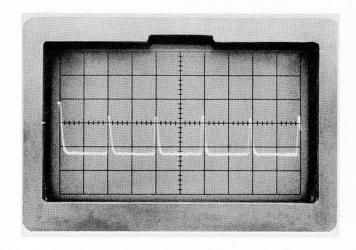


Figure 2-22. 1 μs markers at 50 meters/Div; POLY dielectric.

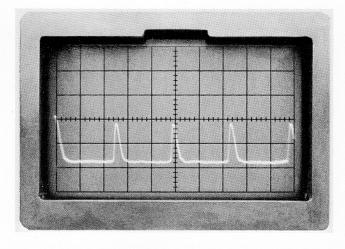


Figure 2-23, 0.5 µs markers at 20 meters/Div: POLY dielectric.

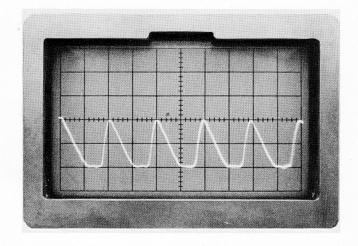


Figure 2-24. 0.1 μs markers at 5 meters/Div; POLY dielectric.

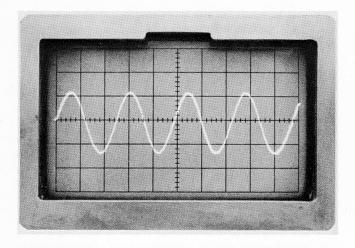


Figure 2-25. 50 ns markers at 2 meters/Div; POLY dielectric.

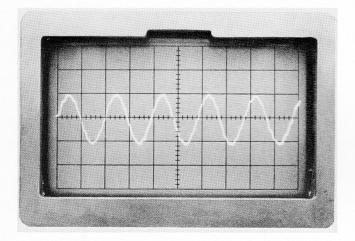


Figure 2-26. 10 ns markers at .5 meters/Div; POLY dielectric.

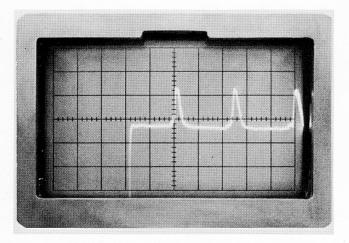


Figure 2-27. 0.5 μs markers at 20 meters/Div properly positioned for setting of 000 on the START POINT control.

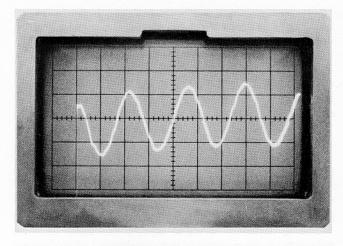


Figure 2-28, 50 ns markers at 2 meters/Div properly positioned for setting of 000 on the START POINT control.

count 20 more cycles, finally positioning the rising edge of the 20th cycle to intercept center screen as before. Check that the dial reads between 969 and 1000 (96.9 to 100 meters). If not, R192 should be adjusted as in the previous step. If it was already adjusted it may have to be readjusted to split the residual error between the 1000 and 100 meter ranges.

25. Disconnect the probe and cable from the 1501 and Marker Generator.

CHART RECORDER CHECKS AND ADJUSTMENTS

There are two internal electrical adjustments in the 016-0506-00 Chart Recorder, and one front panel (STYLUS POSITION) adjustment. The sweep duration adjustment in the 1501 (R216) is unimportant except when using the recorder. Vertical (%/DIV) and horizontal (FEET or METERS) calibration checks described earlier in this procedure should be made before relying on the chart recorder checks. Refer to the Maintenance section of this manual for detailed information on mechanical checks and adjustments of the recorder.

- 1. Remove the 1501 from its cabinet. With the chart recorder unplugged from the 1501 mainframe and the lid of the recorder closed, check that the writing stylus rests within about 2 millimeters of the middle of the graph paper and that it touches the paper. The stylus edge is near the top of the window and visible from a lower part of the window in front of the recorder.
- 2. Slide the 50 Ω -75 Ω internal slide switch, accessible through the top of the chart recorder compartment, to the

 $75~\Omega$ (rear) position. Insert the recorder, properly loaded with paper, into the 1501 mainframe and turn on power. Attach a $75~\Omega$ termination (011-0102-00) to the EXT VERT IN jack and push both the CHART POWER and EXT SIG (or EXT DRIVE) pushbuttons. Check that the stylus is within about 1 millimeter of the center of the chart paper or adjust the STYLUS POSITION screwdriver control to center the stylus.

- 3. Set the %/DIV to 50, the START POINT to 000 and release all the pushbuttons except CHART POWER. With the DISPLAY OFFSET control, check that the stylus may be moved over the eight vertical divisions of the graph paper. Check also that the stylus moves across the paper smoothly. Excessive pressure against the paper may be indicated by an excessively jerky movement of the stylus. Leave the stylus positioned 5 mm (one major vertical division) to the right of center.
- 4. Remove the 75 Ω termination from the EXT VERT IN jack and attach it to the TEST LINE jack using an F-to-BNC adapter (103-0158-00). Set the 1501 for 20 feet (or 5 meters) per division.
- 5. Tear off any chart paper that may be protruding by lifting the paper at a sharp angle against the upper lip of the slot, starting with most pressure against the left edge of the paper. Push the STEP pushbutton then the START pushbutton and make a recording. Tear off the paper and check that the recorder stopped when precisely 32.5 centimeters of paper (65 holes) emerged. Check also that the incident edge of the step signal was recorded and that the step was approximately two major vertical divisions (1 centimeter) in amplitude. If the step does not appear it may be that the stylus doesn't get hot quickly enough. In that case, perform the step 9, then recommence here. A major vertical division is 1/2 centimeter long and a major horizontal division is 2.5 centimeters long.
- 6. Set the distance per division to 500 feet (or 100 meters) and make another recording, but don't tear off the paper. Check that the baseline ahead of the step is still visible and that the step has about the same amplitude as before. Check whether the red line under the chart paper near the top of the window is visible through one of the holes in the edge of the paper that is in line with a major division. If not, gently and slowly pull the paper straight out from the recorder until the red line lies directly behind a major division.
- 7. Set %/DIV to 20 and make another recording. Check that the paper stops with the red line directly behind a major division. Also check whether the step is precisely 5 divisions in amplitude. If not, the chart recorder gain (R755) should be adjusted so the amplitude is precisely 5

divisions. To set R755 the chart recorder must be removed from the 1501 mainframe. If an extension cable (067-0667-00) is available, the 1501 may be operated extended from the 1501 while the proper adjustment is made at the rear of the recorder. Without the extender cable, R755 may be adjusted in a series of trials by repetitively removing, adjusting, inserting, recording, and trying again. Clockwise rotation of R755 increases the step amplitude. R755 is the potentiometer located near the rod that is part of the front panel locking screw.

- 8. Check the recordings to see whether a negative-going step occurs just prior to the end of each trace. If not, adjust R216 fully clockwise and try again (see Figure 2-29). Through a series of trials, adjust R216 so that the ending step occurs within one or two millimeters of the last major division on each chart. This adjustment has a major effect on distance measurement accuracy when using the charts. See Figure 2-30.
- 9. The only remaining adjustment is R722, stylus temperature. This adjustment must be a compromise between the ability to record very steep waveform edges

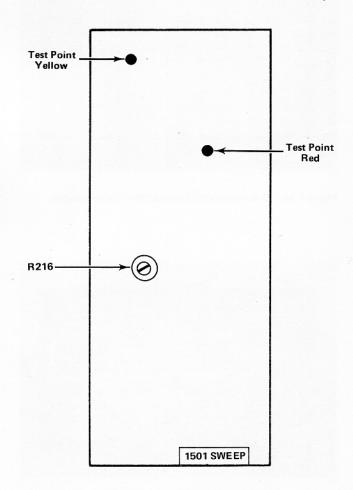


Figure 2-29. Sweep circuit board, Located behind CABLE dielectric

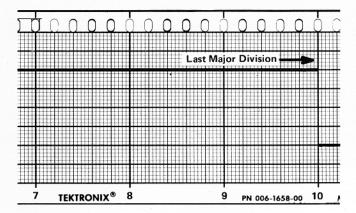


Figure 2-30. Indication of proper adjustment of R216 if paper is properly installed.

(requiring high temperature) and producing reasonably narrow lines over most of the trace. Also, because heating the stylus requires many times more power than all the other functions in the 1501 combined, battery life is shortened and the number of recordings between recharge cycles reduced when the temperature is very high. The usual recommended setting is so that the baseline barely starts to appear as the first major division (zero reference) goes under the stylus. At 500 feet (or 100 meters) per division the incident pulse is very steep and very close to the first major division, so it normally doesn't entirely record. You may conserve battery power greatly, if the points of interest don't extend back to the first major division, by adjusting stylus heat for as light a line as you prefer. R722 is located at the back of the recorder, near the side panel.

POWER PACK CHECKS and ADJUSTMENTS

Excessive charge current may shorten the life of the internal battery. Too little charge current will require excessive time to completely recharge the battery. The battery should charge with a regulated average of 180 mA when AC power is applied if the power pack slide switch is set to the FULL CHG position. The amount of current may be checked by measuring the voltage-drop across the 0.3 ohm precision resistor R615.

The resistor terminals are not accessible, however, until the power pack is removed.

To remove the power pack:

- 1. Remove the AC power cord.
- 2. Set the power pack switch to EXT DC.
- 3. Release the securing clamp and pull the power pack away from its mounting area.
- 4. Disconnect the three power leads (green, black, and white) which connect the power pack to the 1501.

Resistor R615 is located near the center of the power pack circuit board and is the largest resistor on the board. Set the slide switch to the FULL CHG position and apply AC power through the power cord. Check that the average DC voltage-drop across R615 is 54 mV $\pm\,5$ mV. If not, adjust potentiometer R644, also located on the circuit board, for 54 mV.

MAINTENANCE

GENERAL MAINTENANCE

Introduction

The following section includes, maintenance information, circuit diagrams, electrical parts lists, a mechanical parts list and mechanical parts illustrations for the 1501.

Index and Description of Maintenance Aids

Chart Recorder Maintenance. Instructions for replacing and adjusting the chart recorder stylus and for replacing the rubber rollers are given in this section. Instructions for calibrating the chart recorder are given in the Performance Check and Adjustment section of this manual.

Circuit Board Layouts (Back of Foldout Diagrams). A layout of the circuit board related to a particular circuit diagram can be found on the back of the preceding diagram. Circuit numbers are used to indicate the component locations.

Circuit Description (Section 1). A description of the circuit blocks in the 1501 is provided in Section 1, Circuit Theory, of this manual. This section is helpful for understanding the operation of the instrument and for locating malfunctions that cannot be located using the diagrams of the performance check and adjustment procedure.

Cleaning. Instructions for cleaning the interior and exterior of the 1501 are given in this section.

Component Removal and Replacement. Instructions for removing and replacing various components in the 1501 such as: fuses, cam switches, battery cells, and circuit boards are given in this section.

Diagrams (See tabbed foldout pages). A complete set of circuit diagrams is given on foldout pages at the end of this section. Each component in the instrument is shown along with its circuit number and electrical value. Waveforms that can be expected at various points in the circuitry are also included with the diagrams. A block diagram of the major circuits in the instrument can be found at the beginning of the diagram foldouts. Information on the symbols and the logic used in the diagrams is given in this section. The abbreviations and reference designators used in circuit numbers are shown at the beginning of each electrical parts list.

Electrical Parts List (See Related Circuit Diagram). An electrical parts list precedes each circuit diagram. Each parts list contains all the components found on the related diagram, in alpha-numeric order. Instructions for ordering replacement parts are provided at the beginning of each electrical parts list.

Performance Check and Adjustment (Section 2). The performance check and adjustment section of this manual provides a combined adjustment and performance check procedure. This section also includes a troubleshooting procedure.

Transistor and Integrated Circuit Lead Configuration. Fig. 3-2 in this section shows the lead configurations of the transistors and integrated circuits used in the 1501.

Troubleshooting Procedure (Section 2). A troubleshooting procedure, which is helpful for locating the source of a malfunction, is located at the beginning of Section 2.

Mechanical Parts List and Illustrations (See Foldouts Following the Circuit Diagrams.)

Cleaning

The 1501 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown.

Exterior. Loose dust accumulated on the outside of the 1501 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a mild detergent and water solution. Abrasive cleaners should not be used.

Interior. Dust in the interior of the instrument should be removed occasionally to prevent electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow out the accumulated dust with dry, low-velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces or for cleaning circuit boards.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone or similar solvents.

Diagram Symbols

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).

Values less than one are in microfarads (μ F).

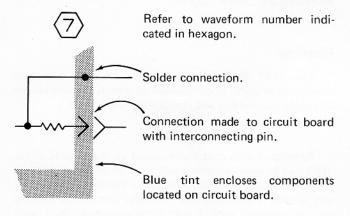
Resistors = Ohms (Ω) .

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

The following special symbols are used on the diagrams.

External control or connector.

Refer to diagram number indicated in diamond.



Logic

The schematics and block diagrams in this manual which involve digital logic are drawn in terms of positive logic. In positive logic, the true state is the more positive of the two logic levels and the false state is the more negative. The small circles on some of the input or output terminals of the logic symbols indicate a logic negation. Any terminal having a logic negation symbol on it will be at a false level (or low) when the related device is in its activated state. For further information on the logic used in this manual see MIL-STD 806B.

COMPONENT REMOVAL AND REPLACEMENT

Fuses

Replacement of the AC line fuse is covered in the Power Pack section of this manual. To replace the DC fuse (F10) and the chart recorder fuse (F23), remove the instrument from its case. See Fig. 3-1 for location of fuses and spares.

Transistors and Integrated Circuits

See Fig. 3-2 for the lead configurations of the transistors and integrated circuits used in the 1501.

Power Pack

The power pack can be removed from the 1501 by disconnecting three square-pin connectors at the circuit board, and releasing the clamp at the front of the power pack. Switch the power selector switch (at the rear of the power pack) to the EXT DC position before removal. This reduces the number of exposed points to which the internal battery is connected.

WARNING

The battery used in the power pack is capable of delivering a large amount of energy. Rings, watch bands, or other metallic items, which may short-circuit the battery, can rapidly become hot enough to cause severe burns.

Circuit Boards. Components on the battery charger circuit board can be replaced without removing the board. To reach the under-side of the board, remove the three nuts which hold the board in place. Turn the power pack over to permit the washers to fall free of the board. After the nuts and washers have been removed, the outer end of the board can be lifted up, pivoting it on the wiring cable. Be careful that the screw near the transformer does not bind on the corner of the board. If the board must be completely removed, the wire color code should be recorded before any wires are unsoldered.

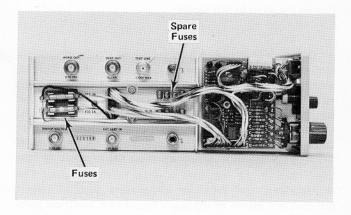


Fig. 3-1. Location of AC line fuses.

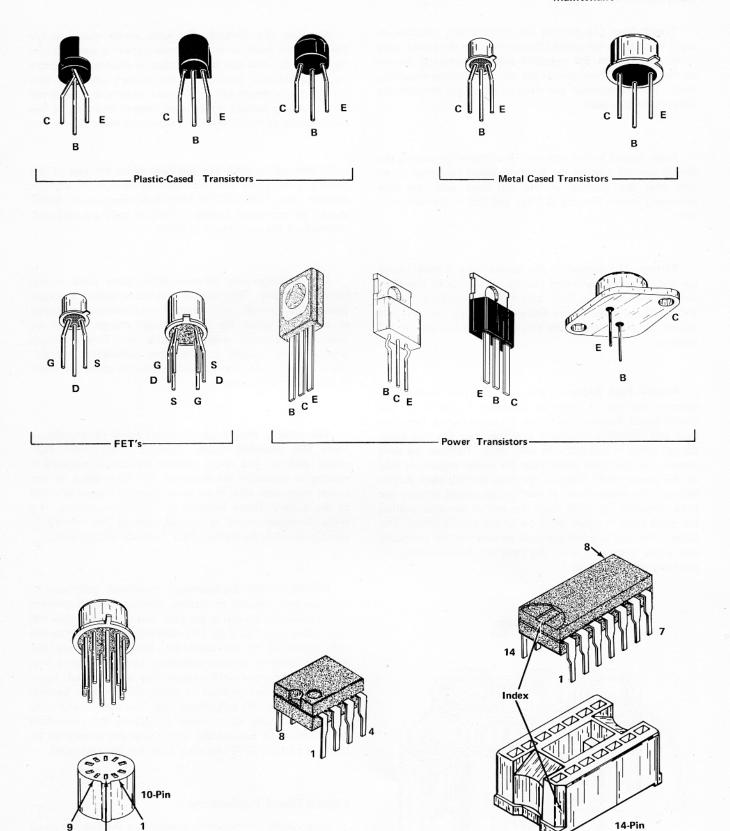


Fig. 3-2. Transistor and Integrated Circuit Lead Configuration.

Integrated Circuits

Transformer. To remove the transformer, unsolder its eight leads from the circuit board. Remove the power pack cover plate, from the opposite side by removing the six screws from it. Then remove the two transformer mounting bolts. The transformer can then be lifted out through the holes in the side plate.

Fuse. Access to the fuse can be obtained by pulling the plastic cap off toward the bottom. When replacing it, be sure that the grooves in the cap align with the fuse mounting board. See Fig. 3-2 for 115-230 V fuse information.

Battery. The battery in the power pack is made up of six 1.25 V nickel-cadmium (NiCd) cells strapped together, series-aiding (see Fig. 3-3). Information regarding care of these cells is given in the Operators Manual section, and should be read before any servicing is performed on the battery.

Battery Pack Removal. Unsolder the two leads which connect the battery pack to terminals 1 and M on the circuit board. Free one lead from the cable clamp. Tape one lead end (creating minimum bulk) so that the two leads cannot come in contact with each other. Remove the nine screws and the cover plate from the power connector side of the power pack. Remove the three battery pack screws through the access holes in the circuit board, freeing the pack. Separate the pack from the rest of the unit, pulling the pack leads through the hole in the circuit board. The battery holding bracket can now be removed by removing one screw from each end. The pack can be re-installed by reversing the procedure.

SIDE TOWARD CIRCUIT BOARD

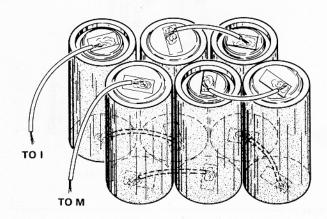


Fig. 3-3. Connection of battery cells in power pack.

Servicing the Battery. The cells which make up the battery have been selected to meet specific performance requirements, and can be expected to maintain relatively equal capabilities throughout the battery operating life. Introducing a strong cell into a weak battery or a weak cell into a strong battery may cause reverse charging of the weaker cells, as explained in the Operators Manual.

If one cell is defective and fails while the rest of the battery is still quite new, that cell may be replaced without concern. The TEKTRONIX Field Representative or Office should be consulted before individual cells are replaced, especially if the warranty is in effect.

Gas evolution and recombination takes place during battery charging. This creates a pressure within the cells which they normally withstand. If a cell becomes defective or a circuit causes the recommended charge rate to be exceeded, excessive pressure builds up. This excessive pressure may rupture a relief vent, exhausting the gas, which may shorten the life of the cell and cause corrosion in the surrounding area.

The battery should be inspected every six months or every 500 operating hours, whichever occurs first. Individual cells or the entire battery should be replaced if venting or corrosion has occurred. The cover plate, on the power connector side, must be removed to expose one side of the battery. Check between the cells for corrosion. If a more thorough check is desired, remove the battery in accordance with the Battery Pack Removal instructions.

Individual Cell Replacement. Individual cells can be removed and replaced by cutting the straps which connect the two ends of the cell to the pack and soldering a new cell in its place (see Fig. 3-3). The replacement cell must be the type specified in the parts list. Other types may not function properly, despite operating claims. Operating time and/or temperature performance may be degraded. However, if a substitution must be made, the cell must be able to withstand a 180 mA charge rate. The cells should only be used as long as it takes to obtain the prescribed replacement. To balance the cells charge the battery for 24 hours at a FULL CHG rate after a cell has been replaced.

Circuit Board Replacement

Most of the components mounted on the circuit boards can be replaced without removing the boards from the instrument. If a circuit board is damaged beyond repair, the entire assembly (including all soldered-on-components) can be replaced. The number is given in the Electrical Parts List for the completely wired board.

Use the following procedure to remove a circuit board.

- 1. (a) To lift the board for maintenance or access to areas beneath the board, disconnect the pin connectors which might impair lifting.
- 1. (b) To completely remove the board disconnect all the pin connectors.
 - 2. Remove all screws holding the board to the chassis.
- 3. Lift the circuit board partially or all the way out of the instrument. Do not force or bend the board.
- 4. To replace the board, reverse the order of removal. The correct orientation of the "harmonica" pin connectors are printed on the circuit board and on the diagrams. Replace the pin connectors carefully so they mate correctly with the pins. If forced into place incorrectly the pin connectors may be damaged.

Cam Switch Assembly Repair

The cam switch assembly consists of a delrin cam and a set of contacts mounted on an adjacent circuit board. The lobes on the cam activate the contacts; and the cam is rotated with a front panel control labelled FEET/DIV (or METERS/DIV). A switch repair kit, which includes tools, instructions, and replacement contacts, is available from Tektronix, Inc. (TEKTRONIX Part No. 006-1416-00).

CAUTION

Repair of cam switches should be undertaken only by experienced maintenance personnel. For assistance in the repair of cam switches contact your local TEKTRONIX Field Office or representative.

Use the following procedure to disassemble and repair the cam switch assembly:

- 1. Remove the sweep board (top) and the logic board (bottom) to gain access to the cam switch assembly. Use the procedure as outlined in the circuit board section of this manual.
 - 2. Remove the front panel switch lever knob.
- 3. Remove the two screws from the top of the metal cover and remove the cover.

- 4. Separate the cam from the circuit board by removing the four connecting screws from the circuit board.
- 5. Disconnect the cam from its support blocks by removing the retaining ring from the shaft on the front of the switch and sliding the cam out of the support block.



Be careful not to lose the small detent roller.

6. Replace defective switch contacts by unsoldering the damaged contacts and cleaning the solder from the holes in the circuit board. Next, position the new contacts in the holes so that they are properly aligned with respect to the other contacts and the mating area on the circuit board. (An alignment tool is provided with the cam switch repair kit.) Solder the new contacts into place. Ensure that the spring ends of the contacts have adequate clearance from the circuit board.



The switch alignment and spring tension of the contacts must be carefully maintained for proper operation of the cam switch.

- 7. Do a continuity check on the newly installed contacts.
- 8. Reassemble the cam switch assembly by reversing the previous process.
 - 9. Reinstall the sweep and logic circuit boards.

Chart Recorder Repair

Except for the stylus and the rubber rollers, the chart recorder is virtually maintenance free. Instructions for replacing the stylus and the rubber rollers are given in the following procedures. If replacement of other mechanical parts should be necessary, refer to the exploded views which are located in the mechanical parts list section.

Changing the Stylus

1. Disconnect P94 from the circuit board (see Fig. 3-4A).

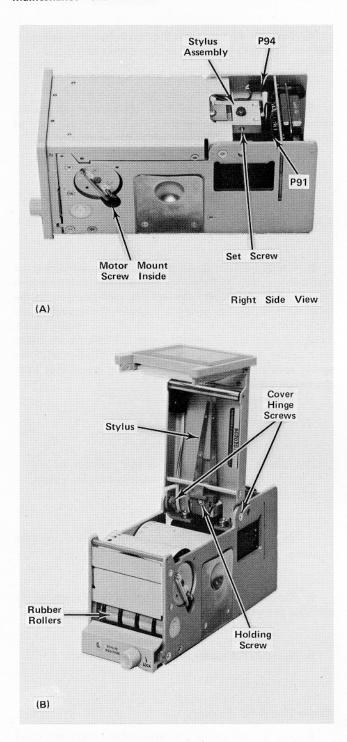


Fig. 3-4A and B. Location of chart recorder components.

- Remove the two screws from the rear of the cover and carefully remove the cover (see Fig. 3-4B).
 - 3. Disconnect P91 from the circuit board.

- 4. Using a .05 inch allen wrench, loosen the set screw and lift the assembly off the motor shaft.
 - 5. Remove the holding screw from the stylus assembly.
 - 6. Separate the stylus and the holder.
- 7. Install a new stylus (TEKTRONIX Part No. 119-0365-00).
- 8. Loop the stylus wires around the motor shaft as shown in Fig. 3-5. Connect P91.



The recorder will not operate accurately unless step 8 is performed exactly as described.

- 9. Reinstall the stylus assembly so that approximately 1/16 inch of the motor shaft protrudes through the assembly.
 - 10. Center the writing element on the writing roller.
- 11. Tighten the set screw; the stylus should now move freely with a light pressure on the writing roller. Adjust as necessary by bending the stylus near the holder.
- 12. Move the stylus assembly into a vertical position. (Some RTV may be applied to wire where they come out of the stylus holder for additional strain relief.)
- 13. Reinstall the cover; the stylus should be located between the two metal rollers.
- 14. With the cover closed and the paper roll removed, check if the stylus holder clears the lift bar. Readjust the height of the stylus holder and stylus pressure as necessary.

Replacing the Rubber Rollers

- 1. Remove the Chart Recorder from the instrument (1501).
- 2. Remove the right side (see Fig. 3-4A). The cover must be removed first.)
 - 3. Loosen the motor mount screws.

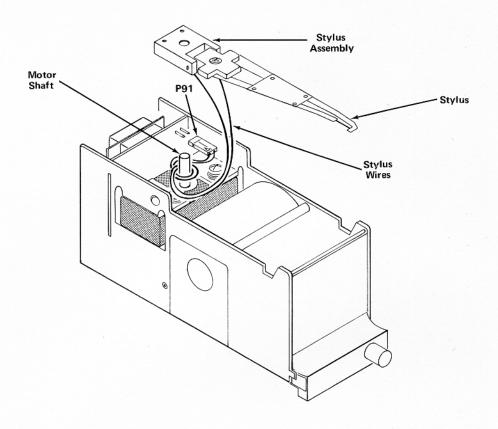


Fig. 3-5. Correct alignment of stylus assembly connecting wire.

- 4. Remove the metal roller.
- 5. Remove the old rubber rings and install four new rings.
- 6. Set the metal roller back into the left bearing. Be sure drive belt is positioned properly.
 - 7. Replace the right side.

8. Move the motor slightly to take up slack in the belt and tighten the motor mount screws.



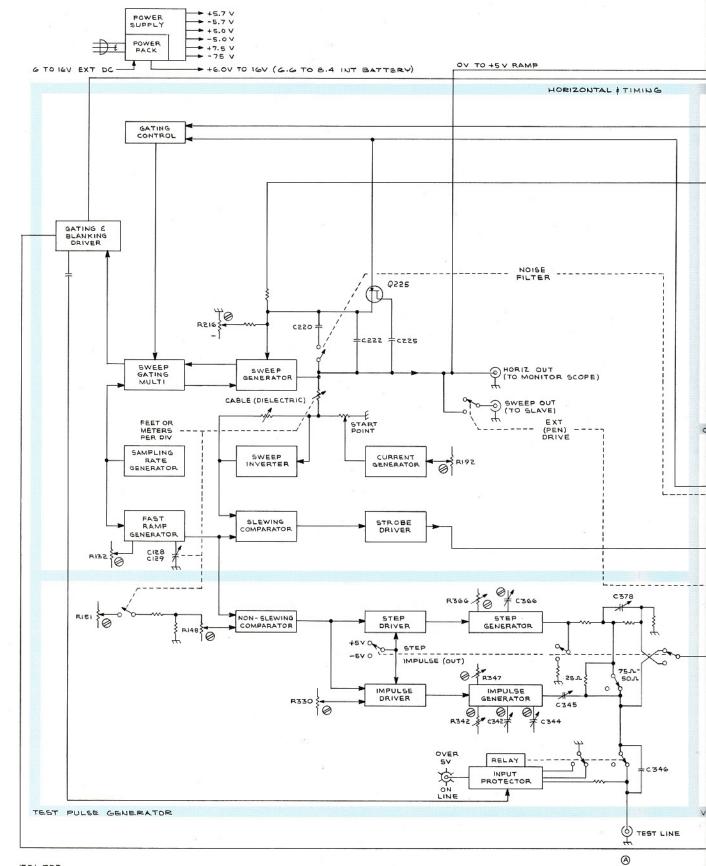
Do NOT overtighten the drive belt.

9. Position the motor L-C network to be clear of the paper roll and drive roller.

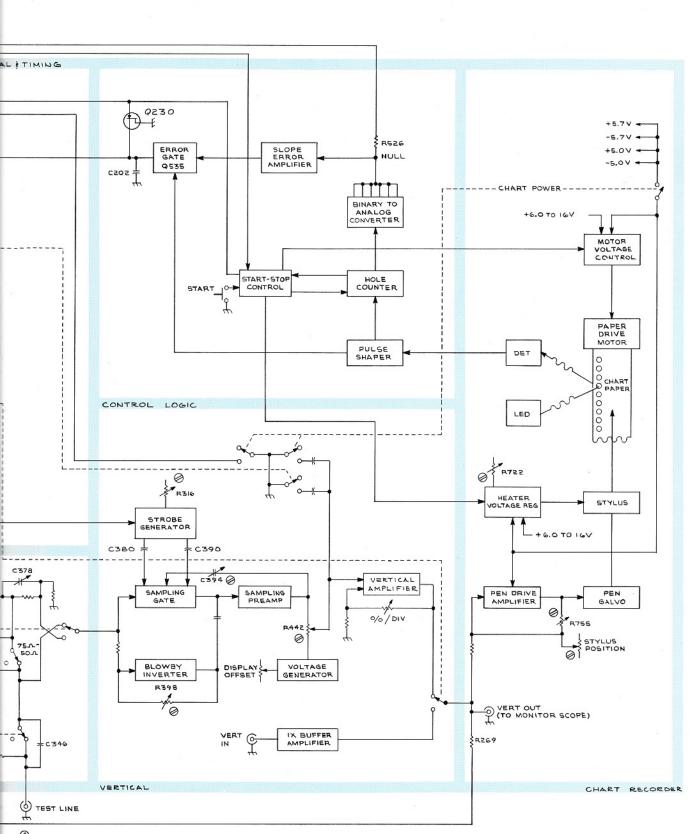
TRANSISTORS AND IC'S BY BLOCK

BLOCK	SCHEMATIC	TRANSISTORS & I.C.'s
Power Supply	8	Q810, Q812, Q815, Q820, Q825, Q826, Q834,Q835,Q855, U855, Q864, Q865
Power Pack	6	Q617, Q620, Q621, Q634, Q636
Gating Control	2	Q245, Q242
Gating & Blanking Driver	2	Q260, Q268, Q265
Sweep Gating Multi	2	Q238, Q240, Q250
Sweep Generator	2	Q205 A, B, Q206 A, B, Q208, Q222
Sampling Rate Generator	. 1	U100 A, B, C, D, E
Sweep Inverter	1 and 4	U175
Current Generator	1	Q190, Q188
Fast Ramp Generator	1	Q116, Q120, Q124, Q126, Q125, Q135, Q136
Slewing Comparator	1	Q158, Q160, Q162, Q165, Q166, Q168, Q170, Q172, Q195
Non-Slewing Comparator	1	Q138, Q140, Q142, Q145, Q146, Q148, Q155
Strobe Driver	3	Q302, Q310
Step Driver	3	Q355, Q358, Q360
Impulse Driver	3	Q325, Q335, Q338
Step Generator	3	Q365, Q368
Impulse Generator	3	Q345
Strobe Generator	3	Q312
Sampling Gate	3	CR380, CR390
Blowby Inv	3	Q399
Sampling Pre-amp	3	Q385 A, B, U386
Input Protector	4	P410, Q412, Q413, Q420, Q425, Q423, Q421, Q424
Voltage Generator	4	U436
Vertical Amplifier	4	U446
1X Buffer Amp	4	U468
Pen Drive Amp	7	U750
Pen Galvo (motor)	7	B55
Heater Voltage Regulator	7	Q725, Q728, Q734, Q736, Q737, Q738
LED	7	CR40
DET	7	Q40
Paper Drive Motor	7	B20
Motor Voltage Regulator	7	Q705, Q706, Q710, Q715, Q720
Pulse Shaper	5	Q503, Q506, U512, B, D, Q515, Q516
Hole Counter	5	U516, U518
START-STOP Control	5	U520 A, B, U512 C, A, U570 A, B, Q565, Q570, Q566, Q575
Binary to Analog Converter	5	Q545, Q550, Q555, Q540, Q536, Q522, Q525, Q538, Q542, Q548, Q552, Q558
Slope-error Amplifier	5	U525
Error Gate	5	Q535

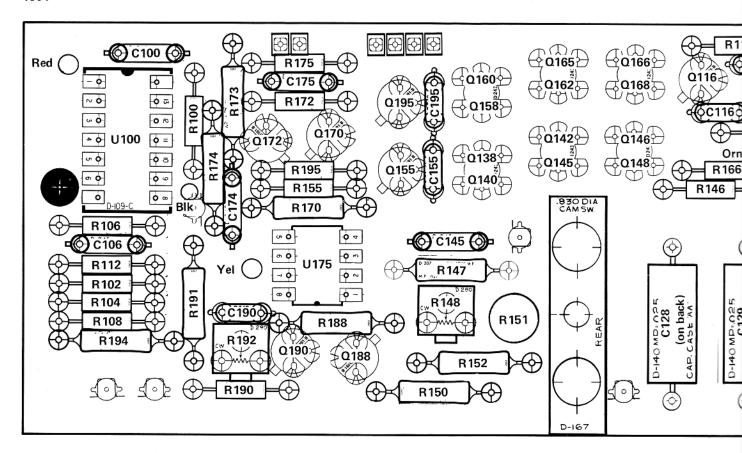
This list serves two functions: (1) It tells on which schematic each block in the block diagram can be found; (2) it identifies the transistors and integrated circuits that make up each block. This list can be used with the Preliminary Checks and Troubleshooting Guide in section 2 to help locate the source of a malfunction.



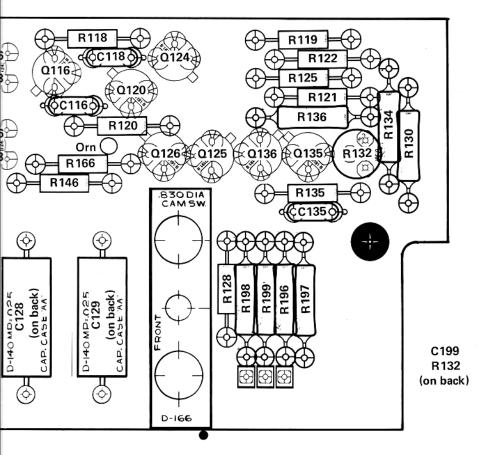
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BLOCK DIAGRAM 672 EKP



Fast Ramp circuit board

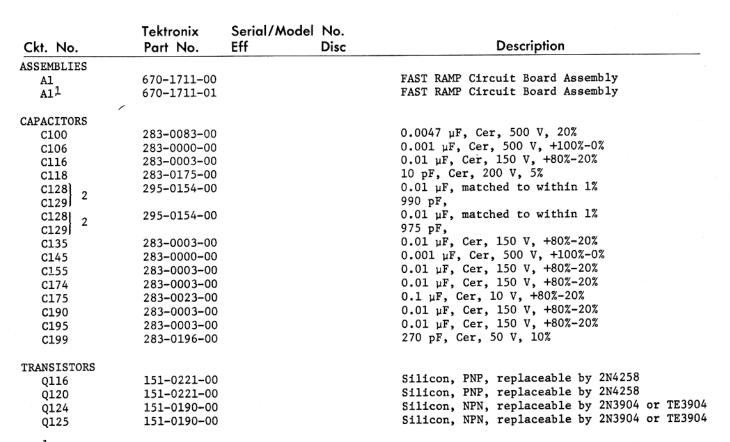


Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL H	Filter Heat dissipating device	PTM	paper or plastic, tubular molded
ΑT	Attenuator, fixed or variable		(heat sink, etc.)	R	Resistor, fixed or variable
В	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
С	Capacitor, fixed or variable	K	Relay	T	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or
CRT	cathode-ray tube	M	Meter		non-repairable
DL	Delay line	Q	Transistor or silicon-	٧	Electron tube
DS	Indicating device (lamp)		controlled rectifier	Var	Variable
Elect.	Electrolytic	Р	Connector, movable portion	VR	Voltage regulator (zener diode,
EMC	electrolytic, metal cased	PMC	Paper, metal cased		etc.)
EMT	electrolytic, metal tubular	PT	paper, tubular	WW	wire-wound
F	Fuse			Υ	Crystal

FAST RAMP (1)



Metric.

Individual timing capacitors in this assembly must be ordered by the 9 digit part number, letter suffix and tolerance printed on the timing capacitor to be replaced. Example:

285-XXXX-XX F-

The letter suffix and the tolerance should be the same of the timing capacitors in the assembly.

FAST RAMP () (cont)

	Tektronix	Serial/Model	No	
Ckt. No.	Part No.	Eff	Disc	Description
CKI. 110.	1411 140.	L 11	D130	Description
TRANSISTORS (cont)				
Q126	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q135	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q136	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q138	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q140	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q142	151-0192-00			Silicon, NPN, selected from MPS6521
Q145	151-0192-00			Silicon, NPN, selected from MPS6521
Q146	151-0192-00			Silicon, NPN, selected from MPS6521
Q148	151-0192-00			Silicon, NPN, selected from MPS6521
Q155	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q158	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q160	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q162	151-0192-00			Silicon, NPN, selected from MPS6521
Q165	151-0192-00			Silicon, NPN, selected from MPS6521
-	151-0192-00			Silicon, NPN, selected from MPS6521
Q166	151-0192-00			Silicon, NPN, selected from MPS6521
Q168				Silicon, NPN, selected from MPS6521
Q170	151-0192-00			Silicon, PNP, replaceable by MPS6523
Q172	151-0216-00			
Q188	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q190	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q195	151-0188-00			Silicon, PNP, replaceable by 2N3906
RESISTORS				
R1,	311-1361-00			5 kΩ, Var
R1 R1	311-1461-00			5 kΩ, Var
R100	316-0222-00			2.2 kΩ, 1/4 W, 10%
R102	316-0103-00			10 kΩ, 1/4 W, 10%
R104	316-0332-00			3.3 kΩ, 1/4 W, 10%
R106	315-0562-00			5.6 kΩ, 1/4 W, 5%
R108	315-0123-00			12 k Ω , 1/4 W, 5%
R112	316-0102-00			1 kΩ, 1/4 W, 10%
R118	316-0472-00			4.7 kΩ, 1/4 W, 10%
R119	316-0103-00			10 kΩ, 1/4 W, 10%
R120	316-0563-00			56 kΩ, 1/4 W, 10%
R121	316-0392-00			$3.9 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R122	316-0473-00			47 kΩ, 1/4 W, 10%
R125	316-0183-00			18 kΩ, 1/4 W, 5%
R128	316-0101-00			100 Ω, 1/4 W, 10%
R130	321-0277-00			7.5 $k\Omega$, 1/8 W, 1%
R130	311-0609-00			2 kΩ, Var
R134	321-0258-00			4.75 kΩ, 1/8 W, 1%
R135	316-0183-00			18 kΩ, 1/4 W, 10%
	321-0251-00			4.02 kΩ, 1/8 W, 1%
R136 R136 ¹	321-0251-00			5.23 kΩ, 1/8 W, 1%

¹ Metric.

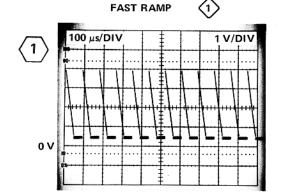
FAST RAMP 🗘 (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
DECISIONS (+)			
RESISTORS (cont)	321-0289-00		10 kΩ, 1/8 W, 1%
R147	311-1278-00		250 Ω, Var
R148 R150	321-0212-00		1.58 k Ω , 1/8 W, 1%
R151	311-0613-00	во10100 во10138	100 kΩ, Var
R151	311-1287-00		100 kΩ, Var
R151	311-0613-00		100 kΩ, Var
R151 R152	316-0103-00		10 kΩ, 1/4 W, 10%
R152	315-0104-00		100 kΩ, 1/4 W, 5%
R155	316-0393-00		39 kΩ, 1/4 W, 10%
R166	315-0682-00		6.8 kΩ, 1/4 W, 5%
R170	321-0236-00		2.8 kΩ, 1/8 W, 1%
R172	316-0472-00		4.7 k Ω , 1/4 W, 10%
R173	321-0335-00		30.1 kΩ, 1/8 W, 1%
R174	321-0318-00		20 kΩ, 1/8 W, 1%
R175	316-0102-00		1 kΩ, 1/4 W, 10%
R188,	321-0222-00		2 kΩ, 1/8 W, 1%
R188 ¹	321-0251-00		4.02 kΩ, 1/8 W, 1%
R190	316-0682-00		$6.8 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R191	321-0342-00		35.7 k Ω , 1/8 W, 1%
R192	311-1283-00		10 k Ω , Var
R194	321-0361-00		56.2 kΩ, 1/8 W, 1%
R195	316-0393-00		39 kΩ, 1/4 W, 10%
R196	321-0260-00		4.99 kΩ, 1/8 W, 1%
R197,	321-0298-00		12.4 kΩ, 1/8 W, 1%
R197 ¹	321-0318-00		20 kΩ, 1/8 W, 1%
R198	321-0356-00		49.9 kΩ, 1/8 W, 1%
R199 ₁	321-0394-00		124 kΩ, 1/8 W, 1%
R199 ¹	321-0414-00		20 kΩ, 1/8 W, 1%
SWITCH			7.7.
S 5	105-0298-00		Actuator assembly, RANGE FEET/DIV
INTEGRATED CIRCUIT			T. 2016
U100	156-0068-00		Five NPN transistor array, selected from CA3046
U17 5	156-0067-00)	Operational amplifier, replaceable by UA741C

 $¹_{\text{Metric.}}$

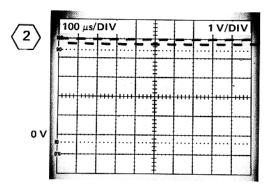
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TEST CONDITIONS



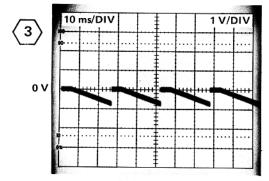
Test Point - RED

1501 - Control Settings Not Important



Test Point - BLACK

1501 — Control Settings Not Important



Test Point - YELLOW

1501

FEET/DIV

500

CABLE

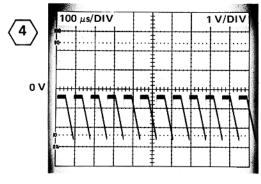
SOLID POLY

NOISE FILTER

Released

Other Controls

Settings Not Important



Test Point - ORANGE

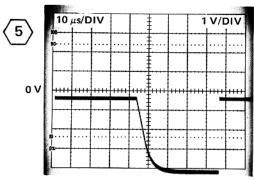
1501

FEET/DIV

500

Other Controls

Settings Not Important



Test Point - ORANGE

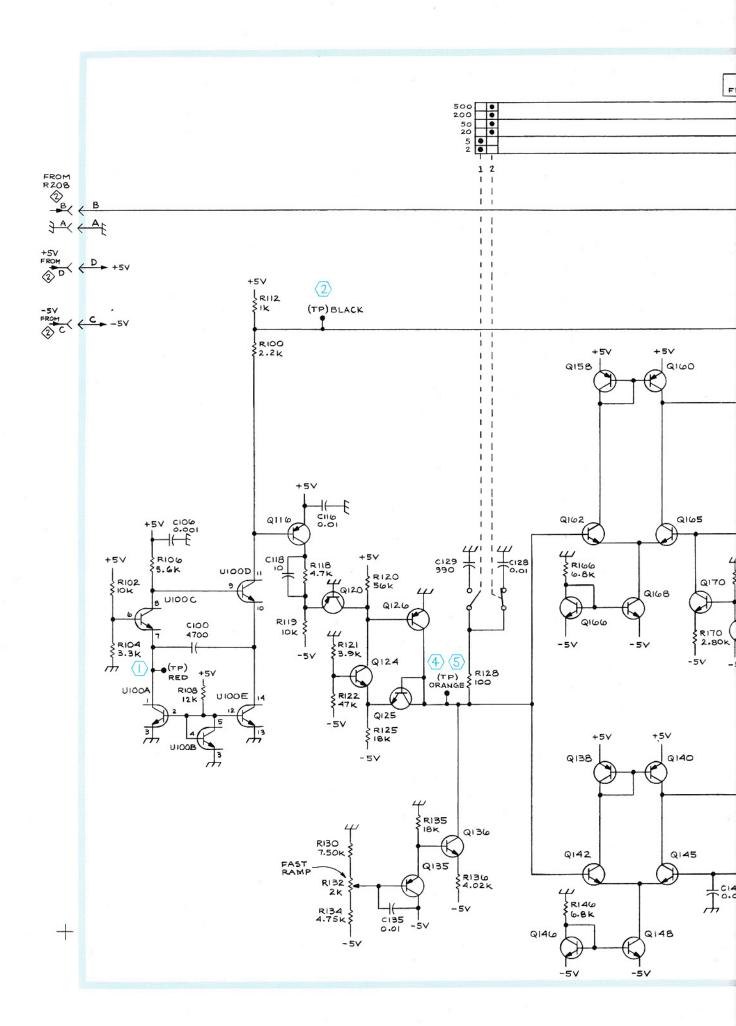
1501

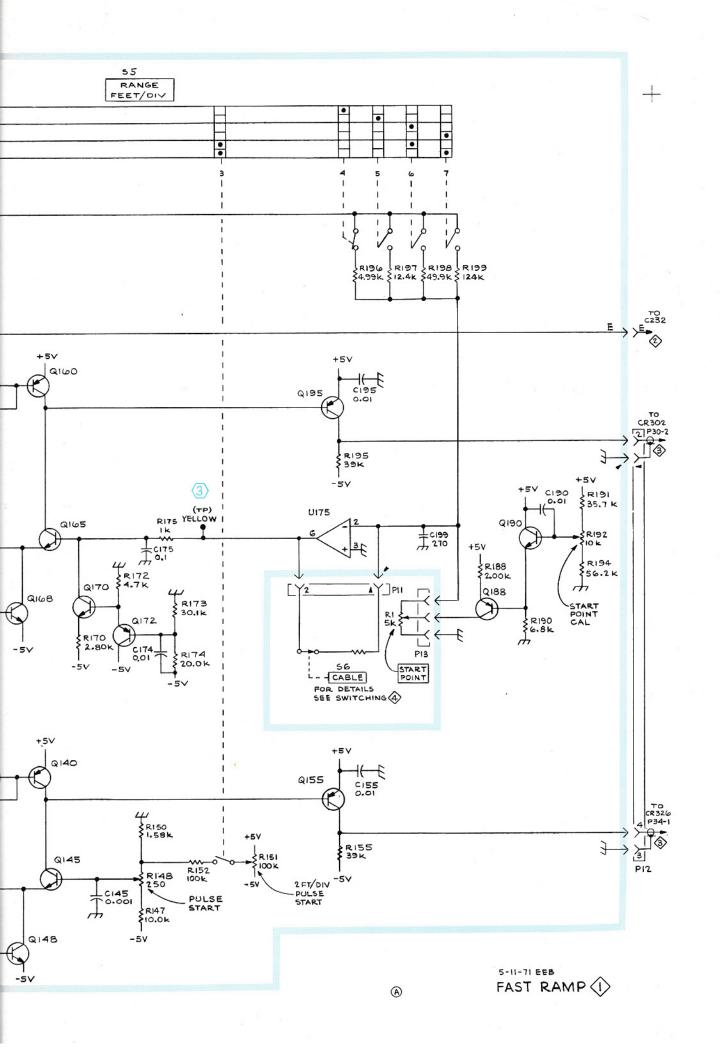
FEET/DIV

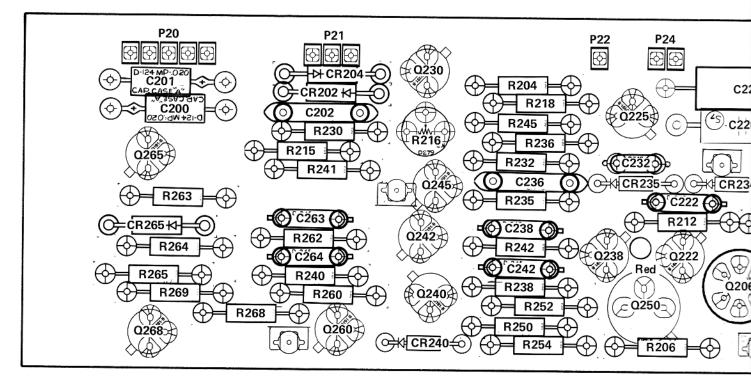
5

Other Controls

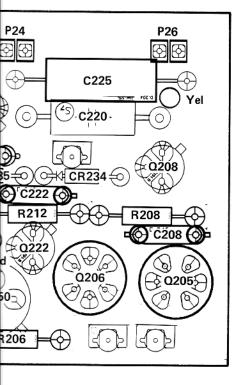
Settings Not Important







Sweep circuit board



Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

Α	Assembly, separable or	FL	Filter	PTM	paper or plastic, tubular
	repairable	Н	Heat dissipating device		molded
ΑT	Attenuator, fixed or variable		(heat sink, etc.)	R	Resistor, fixed or variable
В	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
С	Capacitor, fixed or variable	K	Relay	Т	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or
CRT	cathode-ray tube	M	Meter		non-repairable
DL	Delay line	Q	Transistor or silicon-	٧	Electron tube
DS	Indicating device (lamp)		controlled rectifier	Var	Variable
Elect.	Electrolytic	P	Connector, movable portion	VR-	Voltage regulator (zener diode,
EMC	electrolytic, metal cased	PMC	Paper, metal cased		etc.)
EMT	electrolytic, metal tubular	PT	paper, tubular	ww	wire-wound
F	Fuse			Υ	Crystal



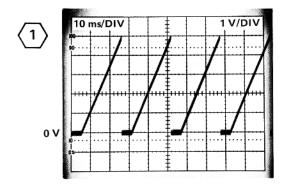
Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
ASSEMBLY	,		
A2	670-1707-00		SWEEP Circuit Board Assembly
CAPACITORS			
C200	290-0177-00		1 μF, Elect., 50 V, 20%
C201	290-0177-00		1 μF, Elect., 50 V, 20%
C202	283-0194-00		4.7 μF, Cer, 50 V, 20%
C208	283-0060-00		100 pF, Cer, 200 V, 5%
C220	285-0569-00		0.01 µF, PTM, 200 V, 20%
C222	283-0156-00	B010100 B020159	1000 pF, Cer, 200 V, +100%-0%
C222	283-0067-00	B020160	0.001 μF, Cer, 200 V, 10%
C225	285-0809-00	5020100	1 μF, Plastic, 50 V, 10%
C232	283-0076-00		27 pF, Cer, 500 V, 10%
C236	283-0026-00		0.2 µF, Cer, 25 V, +80%-20%
C238	283-0003-00		0.01 μF, Cer, 150 V, +80%-20%
C242	283-0115-00		47 pF, Cer, 200 V, 5%
C263	283-0111-00		0.1 μF, Cer, 50 V
C264	283-0003-00		0.01 µF, Cer, 150 V, +80%-20%
DIODES			
CR202	152-0246-00		Silicon, replaceable by CD12676 or FD3375
CR204	152-0246-00		Silicon, replaceable by CD12676 or FD3375
CR234	152-0141-02		Silicon, replaceable by 1N4152
CR235	152-0141-02		Silicon, replaceable by 1N4152
CR240	152-0141-02		Silicon, replaceable by 1N4152
CR265	152-0246-00		Silicon, replaceable by CD12676 or FD3375
TRANSISTORS			
	151 0261 00		Silicon, PNP, replaceable by NS7406, dual
Q205A,B	151-0261-00		Silicon, FET, selected from S/2N3684 or replaceable
Q206A,B	151 -1 044 - 00		by 2N3955, dual
0208	151-0188-00		Silicon, PNP, replaceable by 2N3906
Q222	151-1022-00		Silicon, FET, selected from 2N4392
Q225 Q225	151-1022-00		Silicon, FET, selected from 2N4392
Q223 Q230	151-1022-00		Silicon, FET, selected from 2N4392
Q238	151-1022-00		Silicon, NPN, replaceable by 2N3904 or TE3904

SWEEP ② (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description
TRANSISTORS	(cont)			
Q240	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q240 Q242	151-1022-00			Silicon, FET, selected from 2N4392
Q242 Q245	151-0188-00			Silicon, PNP, replaceable by 2N3906
0250	151-0100-00			Germanium, PNP, replaceable by 2N1303
0260	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q265	151-0341-00			Silicon, NPN, replaceable by 2N3565
Q268	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
RESISTORS				
R204	316-0106-00			10 MΩ, 1/4 W, 10%
R206	316-0123-00			12 kΩ, 1/4 W, 10%
R208	316-0471-00			470 Ω, 1/4 W, 10%
R212	316-0472-00			47 kΩ, 1/4 W, 10%
R215	316-0104-00			100 kΩ, 1/4 W, 10%
R216	311-0613-00			100 kΩ, Var
R2 1 8	316-0156-00			15 MΩ, 1/4 W, 10%
R230	316-0103-00			10 kΩ, 1/4 W, 10%
R232	316-0103-00			$10 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R235	316-0333 -0 0			33 kΩ, 1/4 W, 10%
R236	316-0333-00			33 kΩ, 1/4 W, 10%
R238	316-0103-00			10 kΩ, 1/4 W, 10%
R240	316-0103-00			10 k Ω , 1/4 W, 10%
R241	316-0224-00			220 kΩ, 1/4 W, 10%
R242	316-0223-00			22 kΩ, 1/4 W, 10%
R245	316-0472-00			4.7 kΩ, 1/4 W, 10%
R250	316-0103-00			$10 \text{ k}\Omega$, $1/4 \text{ W}$, 5%
R252	316-0152-00			1.5 $k\Omega$, 1/4 W, 10%
R254	316-0473-00			47 kΩ, 1/4 W, 10%
R260	316-0223-00			22 kΩ, 1/4 W, 10%
R262	316-0103-00			$10 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R263	316-0104-00			$100 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R264	316-0473-00			47 kΩ, 1/4 W, 10%
R265	316-0105-00			$1 \text{ M}\Omega$, $1/4 \text{ W}$, 10%
R268	316-0104-00			$100 \text{ k}\Omega$, $1/4 \text{ W}$, 5%
R269	316-0103-00			10 kΩ, 1/4 W, 10%

SWEEP





TEST CONDITIONS

Test Point - YELLOW

1501

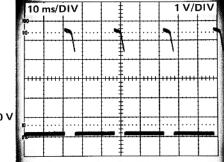
All Pushbuttons

Released

Other Controls

Settings Not Important





Test Point - RED

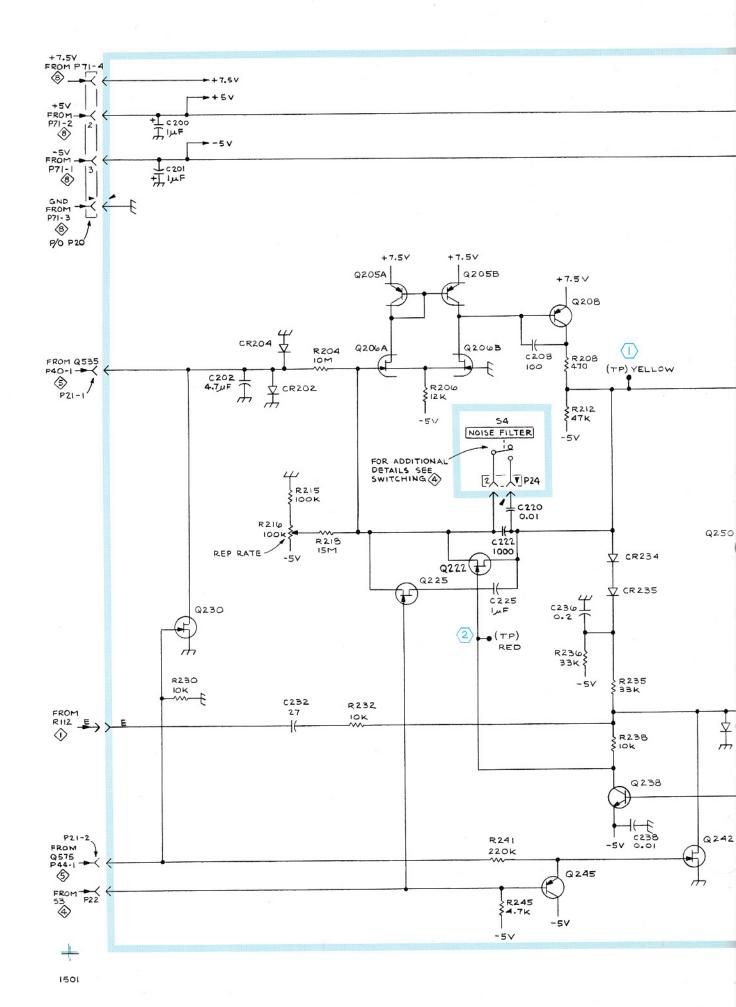
1501

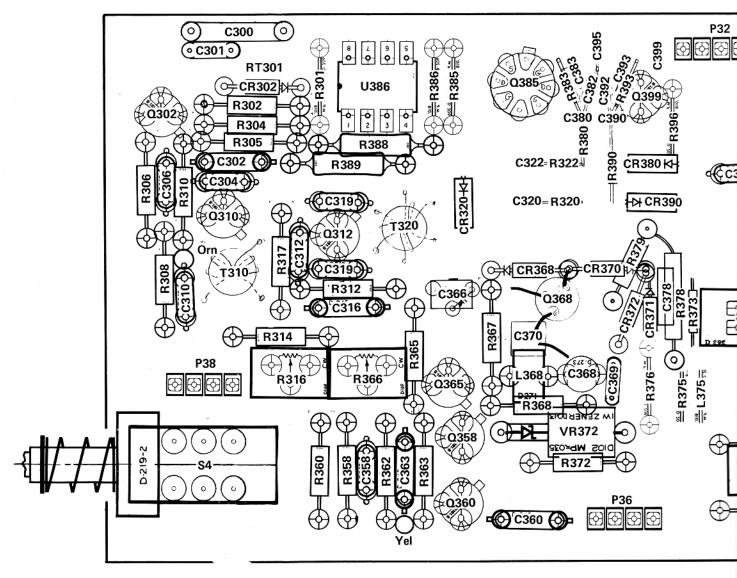
All Pushbuttons

Released

Other Controls

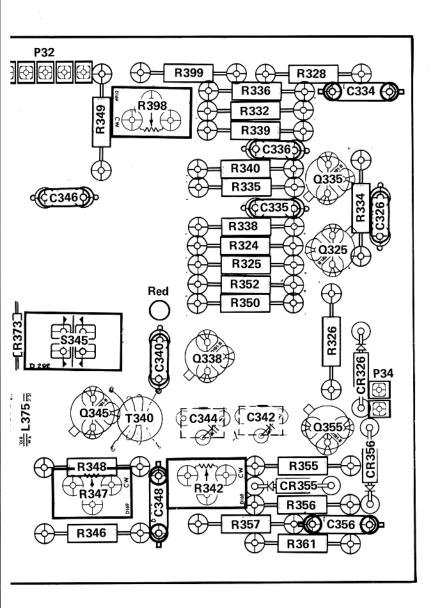
Settings Not Important





R330, R345, R374, R377 C345, C394, CR345, J346 K345, S1 (on back of board)

Vertical circuit board



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ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL H	Filter Heat dissipating device	PTM	paper or plastic, tubular molded
AT	Attenuator, fixed or variable		(heat sink, etc.)	R	Resistor, fixed or variable
В	Motor	HR	Heater	RT	Thermistor
ВТ	Battery	J	Connector, stationary portion	S	Switch
c	Capacitor, fixed or variable	K	Relay	Т	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or
CRT	cathode-ray tube	м	Meter		non-repairable
DL	Delay line	Q	Transistor or silicon-	٧	Electron tube
DS	Indicating device (lamp)		controlled rectifier	Var	Variable
Elect.	Electrolytic	Р	Connector, movable portion	VR	Voltage regulator (zener diode,
EMC	electrolytic, metal cased	PMC	Paper, metal cased		etc.)
EMT	electrolytic, metal tubular	PT	paper, tubular	ww	wire-wound
F	Fuse		in the same of the	Υ	Crystal

VERTICAL ③

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	Description
ASSEMBLIES			
A3	670-1710-00	B010100 B020159	VERTICAL Circuit Board Assembly
A3	670-1710-01	B020160 B029999	VERTICAL Circuit Board Assembly
A3	670-1710-02	в030000	VERTICAL Circuit Board Assembly
CAPACITORS			
C300	283-0010-00	1	0.05 μF, Cer, 50 V
C301	283-0010-00	1	0.05 μF, Cer, 50 V
C302	283-0060-00		100 pF, Cer, 200 V, 5%
C304	283-0196-00		270 pF, Cer, 50 V, 10%
C306	283-0201-00	1 .	27 pF, Cer, 200 V, 10%
C310	283-0196-00		270 pF, Cer, 50 V, 10%
C312	283-0140-00		4.7 pF, Cer, 50 V, 5%
C316	283-0003-00	1	0.01 μF, Cer, 150 V, +80%-20%
C318	283-0140-00	1	4.7 pF, Cer, 50 V, 5%
C319	283-0140-00)	4.7 pF, Cer, 50 V, 5%
C320	283-0069-00)	15 pF, Cer, 50 V, 20%
C322	283-0069-00	1	15 pF, Cer, 50 V, 20%
C326	283-0108-00)	220 pF, Cer, 200 V, 10%
C334	283-0060-00)	100 pF, Cer, 200 V, 5%
C335	283-0196-00)	270 pF, Cer, 50 V, 10%
C336	283-0201-00)	27 pF, Cer, 200 V, 10%
C340	283-0196-00)	270 pF, Cer, 50 V, 10%
C342	281-0158-00)	7-45 pF, Var, Cer, 50 V
C344	281-0151-00)	1-3 pF, Var, Cer, 100 V
C345	281-0140-00)	5-25 pF, Var, Cer, 100 V
C346	283-0156-00	во10100 во29999	1000 pF, Cer, 200 V, +100%-0%
C346	283-0079-00	возоооо	0.01 μF, Cer, 250 V, 20%
C347	283-0003-00)	0.01 μF, Cer, 150 V, +80%-20%
C356	283-0060-00		100 pF, Cer, 200 V, 5%
C358	283-0201-00)	27 pF, Cer, 200 V, 10%
C360	283-0000-00)	0.001 μF, Cer, 500 V, +100%-0%
C363	283-0060-00)	100 pF, Cer, 20 V, 5%

VERTICAL ③ (cont)

Ckt. No.	Tektronix Part No.	Serial/Mode Eff	l No. Disc	Description
CAPACITORS (c	ont)			
C366	281-0139-00			2.5-9 pF, Var, Cer, 100 V
C368	290-0530-00			68 μF, Elect., 6 V, 20%
C369	283-0177-00			1 μF, Cer, 25 V, +80%-20%
C370	283-0072-00			0.01 μF, Cer, 20%
C378	281-0095-00			0.2-1.5 pF, Var, Teflon
C380	283-0140-00			4.7 μF, Cer, 50 V, 5%
C382	283-0196-00			270 pF, Cer, 50 V, 10%
C383	283-0196-00			270 pF, Cer, 50 V, 10%
C390	283-0140-00			4.7 pF, Cer, 50 V, 5%
C392	283-0196-00			
C393	283-0196-00			270 pF, Cer, 50 V, 10%
C394				270 pF, Cer, 50 V, 10%
	281-0140-00			5-25 pF, Var, Cer, 100 V
C395	283-0201-00			27 pF, Cer, 200 V, 10%
C399	283-0157-00			7 pF, Cer, 500 V, 5%
DIODES				
CR302	152-0322-00			Silicon, replaceable by AllO8
CR320	152-0322-00			Silicon, replaceable by AllO8
CR326	152-0322-00			Silicon, replaceable by All08
CR345	152-0458-01			Silicon, Schottky barrier
CR355	152-0322-00			Silicon, replaceable by AllO8
CR356	152-0322-00			Silicon, replaceable by Al108
CR368	152-0458-01			Silicon, Schottky barrier
CR370	152-0458-01			Silicon, Schottky barrier
CR371	152-0333-00			Silicon, replaceable by FDH6012
CR372	152-0333-00			Silicon, replaceable by FDH6012
CR380	152-0457-00			Silicon, replaceable by MD0288
CR390	152-0457-00			Silicon, replaceable by MD0288
VR372	152-0309-00			Zener, replaceable by 1N3828A, 1 W, 6.2 V, 5%
CONNECTORS				
J15	131-1145-00			Receptacle, electrical, female
J346	131-1003-00			Receptacie, electrical, remaie Receptacie, coaxial cable
RELAYS				
K345	148-0078-00			Relay, latch, DPDT, 200 mW
TNDUCTORS				
INDUCTORS	100 0500 00			000 . 11
L368 L375	108-0598-00 108-0420-00			200 µH 60 nH
TRANSISTORS				
Q302	151-0269-00)59999	Silicon, NPN, replaceable by SE3005
Q302	151-0441-01	B060000		Silicon, NPN, selected from 2N2857
Q310	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q312	153-0556-00			Silicon, NPN, selected from 2N2501
Q325	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q335	151-0269-00	во10100 во	59999	Silicon, NPN, replaceable by SE3005
Q335	151-0441-01	в060000		Silicon, NPN, selected from 2N2857

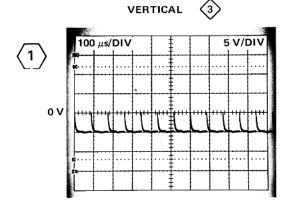
VERTICAL ③ (cont)

Ckt. No.	Tektronix Part No.	Serial/Mod Eff	el No. Disc	Description
TRANSISTORS (cont)			
Q338	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q345	153-0556-00			Silicon, NPN, selected from 2N2501
Q355	151-0341-00			Silicon, NPN, replaceable by 2N3565
Q358	151-0269-00	B010100	в059999	Silicon, NPN, replaceable by SE3005
Q358	151-0441-01	B060000	2033333	Silicon, NPN, selected from 2N2857
Q360	151-0271-00	2000000		Silicon, PNP, replaceable by SAB4113
Q365	151-0269-00	B010100	в059999	Silicon, NPN, replaceable by SE3005
Q365	151-0441-01	B060000	2037777	Silicon, NPN, selected from 2N2857
Q368	151-0271-00	2000000		Silicon, PNP, replaceable by SAB4113
Q385A,B	151-1044-00			Silicon, FET, selected from D/2N3684 or replaceable by 2N3955
Q399	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
RESISTORS				
R302	316-0473-00			47 kΩ, 1/4 W, 10%
R304	316-0103-00			10 kΩ, 1/4 W, 10%
R305	316-0472-00			4.7 kΩ, 1/4 W, 10%
R306	316-0222-00			2.2 kΩ, 1/4 W, 10%
R308	316-0103-00			10 kΩ, 1/4 W, 10%
R310	316-0103-00			10 kΩ, 1/4 W, 10%
R312	316-0103-00			10 kΩ, 1/4 W, 10%
R314	316-0474-00			470 kΩ, 1/4 W, 10%
R316	311-1243-00			500 kΩ, Var
R317	316-0103-00			10 kΩ, 1/4 W, 10%
R320	317-0151-00			150 Ω, 1/8 W, 5%
R322	317-0151-00			150 Ω, 1/8 W, 5%
R324	316-0333-00			33 kΩ, 1/4 W, 10%
R325	316-0223-00			22 kΩ, 1/4 W, 10%
R326	316-0471-00			470 Ω, 1/4 W, 10%
R328	316-0223-00			22 kΩ, 1/4 W, 10%
R330	311-1240-00			25 kΩ, Var
R332	316-0223-00			22 kΩ, 1/4 W, 10%
R334	316-0473-00			47 kΩ, 1/4 W, 10%
R335	316-0103-00			10 k Ω , 1/4 W, 10%
R336	316-0222-00			2.2 kΩ, 1/4 W, 10%
R338	316-0103-00			10 kΩ, 1/4 W, 10%
R339	316-0472-00			4.7 k Ω , 1/4 W, 10%
R340	316-0103-00			10 kΩ, 1/4 W, 10%
R342	311-1237-00			$1 \text{ k}\Omega$, Var
R345	316-0105-00			$1 \text{ M}\Omega$, $1/4 \text{ W}$, 10%
R346	316-0474-00			470 kΩ, 1/4 W, 10%
R347	311-1243-00			500 kΩ, Var
R348 R349	316-0222-00 315-0433-00			2.2 kΩ, 1/4 W, 10% 43 kΩ, 1/4 W, 5%
R350	316-0333-00			33 kΩ, 1/4 W, 10%
R352 R355	316-0223-00			22 kΩ, 1/4 W, 10%
	316-0331-00			330 Ω, 1/4 W, 10%
R356	316-0472-00 316-0101-00			4.7 k Ω , 1/4 W, 10% 100 Ω , 1/4 W, 10%
R357	210-0101-00			100 %, 1/4 W, 10%

VERTICAL (3) (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description
RESISTORS		,		
R358	316-0103-00			10 kΩ, 1/4 W, 10%
R360	316-0103-00			10 kΩ, 1/4 W, 10%
R361	315-0912-00			9.1 kΩ, 1/4 W, 5%
R362	316-0103-00			10 kΩ, 1/4 W, 10%
R363	316-0331-00			330 Ω, 1/4 W, 10%
R365	316-0471-00			470 Ω, 1/4 W, 10%
R366	311-1237-00			1 k Ω , Var
R367	316-0472-00			4.7 kΩ, 1/4 W, 10%
R368	316-0150-00			15 Ω , 1/4 W, 10%
R372	316-0102-00			1 kΩ, 1/4 W, 10%
R373	316-0120-00			12 Ω, 1/4 W, 10%
R374	321-0096-00			97.6 Ω, 1/8 W, 1%
R375	316-0101-00			100 Ω, 1/4 W, 10%
R376	321-0101-00			110 Ω, 1/8 W, 1%
R377	321-0039-00			24.9 Ω, 1/8 W, 1%
R378	321-0164-00			499 Ω, 1/8 W, 1%
R379	321-0072-00			54.9 Ω, 1/8 W, 1%
R380	317-0221-00			220 Ω, 1/8 W, 5%
R383	317-0107-00			100 MΩ, 1/8 W, 5%
R385	316-0223-00			22 kΩ, 1/4 W, 10%
R386	316-0223-00			22 kΩ, 1/4 W, 10%
R388	321-0314-00			18.2 kΩ, 1/8 W, 1%
R389	321-0314-00			18.2 kΩ, 1/8 W, 1%
R390	317-0221-00			220 Ω, 1/8 W, 5%
R393	317-0107-00			100 MΩ, 1/8 W, 5%
R396 R398	317-0103-00 311-1239-00			10 kΩ, 1/8 W, 5%
R399				2.5 k Ω , Var
KJ99	316-0103-00			10 kΩ, 1/4 W, 10%
SWITCHES				
S1	260-1332-00			Push, CABLE TEST SIG
S345	260-0960-01			Slide, $50 \Omega/75 \Omega$
TRANSFORME				
T310	120-0544-00			Toroid, 2 windings
T320	120-0620-00			Toroid, 3 windings
Т340	120-0544-00			Toroid, 2 windings
INTEGRATED	CIRCUIT			
U386	156-0067-00			Operational amplifier, replaceable by UA741C

TEST CONDITIONS



Test Point - RED

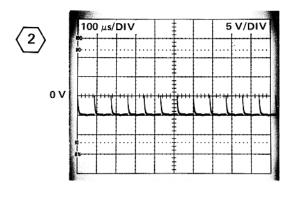
1501

All Pushbuttons

Released

Other Controls

Settings Not Important



Test Point - ORANGE

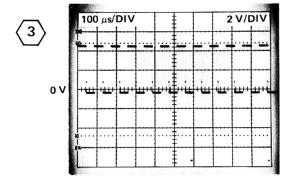
1501

All Pushbuttons

Released

Other Controls

Settings Not Important



Test Point - YELLOW

1501

CHART POWER

Released

EXT SIG

Released

NOISE FILTER

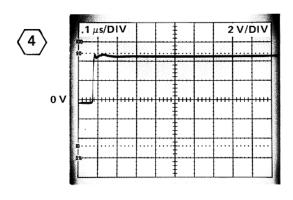
Released

STEP

Pressed

Other Controls

Settings Not Important



Test Point - YELLOW

1501

CHART POWER

Released

EXT SIG

Released

NOISE FILTER

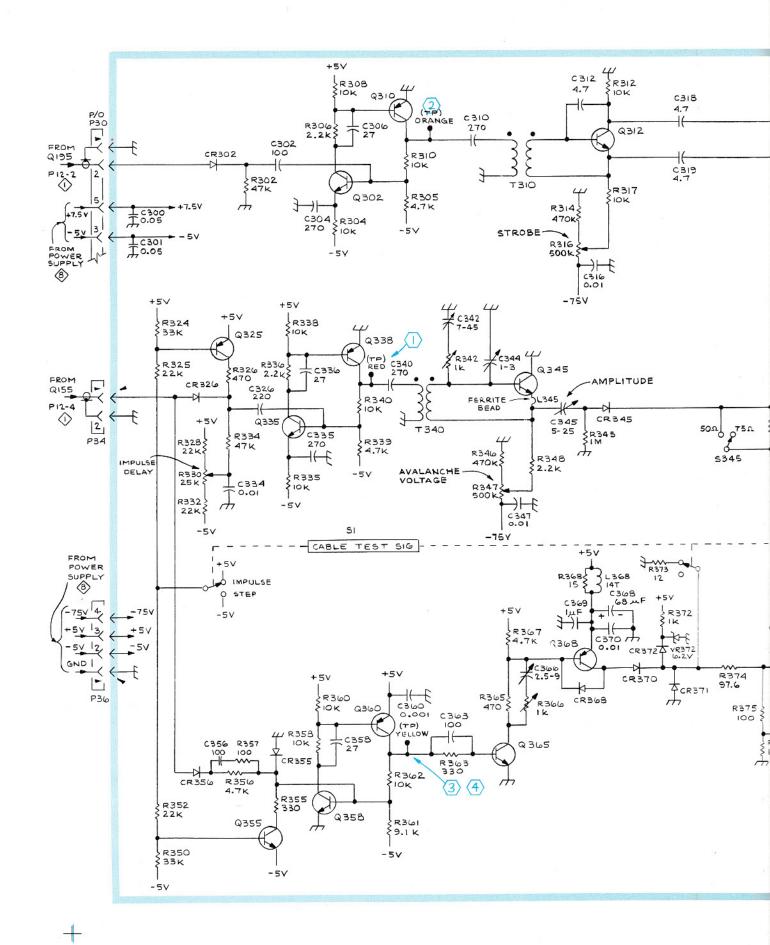
Released

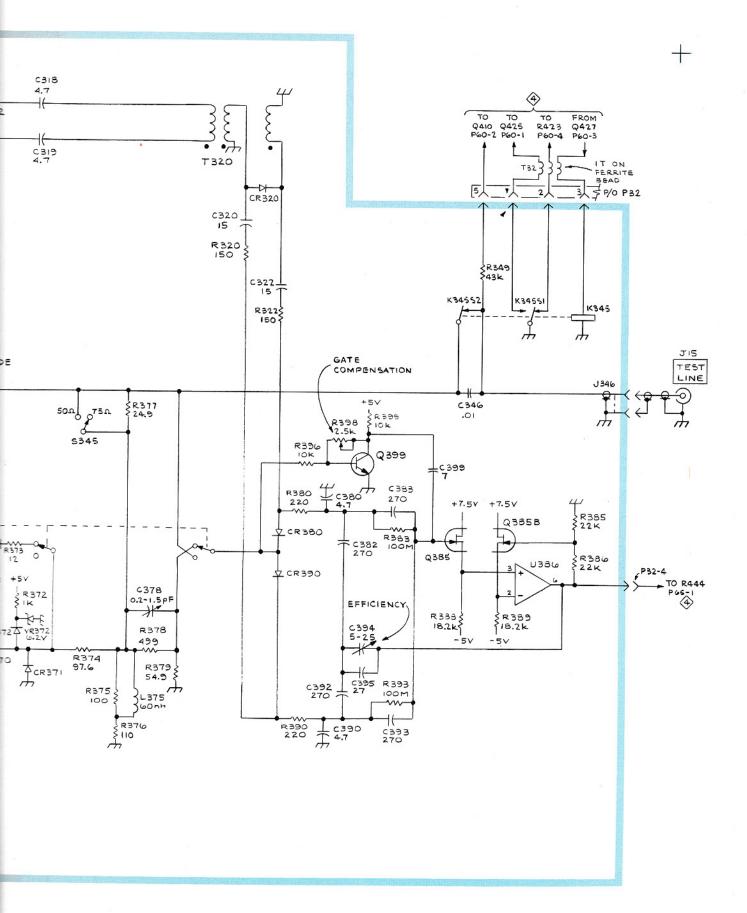
STEP

Pressed

Other Controls

Settings Not Important

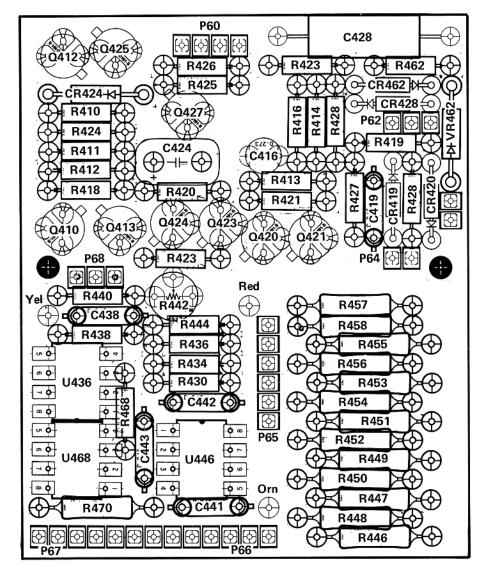




1273 EEB

(B)





Output circuit board

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL H	Filter Heat dissipating device	PTM	paper or plastic, tubular molded
ΑT	Attenuator, fixed or variable		(heat sink, etc.)	R	Resistor, fixed or variable
В	Motor	HR	Heater	RT	Thermistor
ВТ	Battery	J	Connector, stationary portion	S	Switch
C	Capacitor, fixed or variable	K	Relay	Т	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or
CRT	cathode-ray tube	М	Meter		non-repairable
DL	Delay line	Q	Transistor or silicon-	٧	Electron tube
DS	Indicating device (lamp)		controlled rectifier	Var	Variable
Elect.	Electrolytic	Ρ .	Connector, movable portion	VR	Voltage regulator (zener diode,
EMC	electrolytic, metal cased	PMC	Paper, metal cased		etc.)
EMT	electrolytic, metal tubular	PT	paper, tubular	ww	wire-wound
F	Fuse			Υ	Crystal

SIGNAL OUTPUT & SWITCHING �

ASSEMBLY A4 670-1712-00 OUTPUT Circuit Board Assembly CAPACITORS C416 290-0522-00 1 μF, Elect., 50 V, 20% C419 283-0204-00 0.01 μF, Cer, 50 V, 20% C424 290-0519-00 100 μF, Elect., 20 V, 20% C428 285-0815-00 1 μF, PTM, 100 V, 5% C438 283-0023-00 0.1 μF, Cer, 10 V, +80%-20% C441 283-0111-00 0.1 μF, Cer, 50 V C442 283-0010-00 0.05 μF, Cer, 50 V C443 283-0010-00 0.05 μF, Cer, 50 V C443 283-0010-00 0.05 μF, Cer, 50 V C444 152-0075-00 Germanium, replaceable by 1N4152 CR420 152-0141-02 Silicon, replaceable by D238 or ED48 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR462 152-0141-02 Silicon, replaceable by 1N4152 CR462 152-0141-02 Silicon, replaceable by 1N4152 STHICON, replaceable by 1N4152 STHICO	Ckt. No.	Tektronix Part No.	Serial/Model No Eff Disc	
CAPACITORS C416 290-0522-00 1 μF, Elect., 50 V, 20% C419 283-0204-00 100 μF, Cer, 50 V, 20% C424 290-0519-00 100 μF, Cer, 50 V, 20% C428 285-0815-00 1 μF, PTM, 100 V, 5% C438 283-0023-00 0.1 μF, Cer, 50 V C441 283-0111-00 0.1 μF, Cer, 50 V C442 283-0010-00 0.05 μF, Cer, 50 V C443 283-0010-00 0.05 μF, Cer, 50 V C443 283-0001-00 0.05 μF, Cer, 50 V C443 283-0010-00 0.005 μF, Cer, 50 V C442 283-0010-00 0.005 μF, Cer, 50 V C443 283-0010-00 0.005 μF, Cer, 50 V C442 283-0010-00 0.005 μF, Cer, 50 V C443 283-0001-00 0.005 μF, Cer, 500 V DIODES CR419 152-0141-02 Silicon, replaceable by 1N4152 CR424 152-0075-00 Germanium, replaceable by GD238 or ED48 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR426 152-0141-02 Silicon, replaceable by 1N4152 VR462 152-0280-00 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical	ASSEMBLY			
C416 290-0522-00		670-1712-00		OUTPUT Circuit Board Assembly
C416 290-0522-00	CAPACITORS			
C424 290-0519-00 100 μF, Elect., 20 V, 20% C428 285-0815-00 1 μF, PTM, 100 V, 5% C438 283-0023-00 0.1 μF, Cer, 10 V, +80%-20% O.1 μF, Cer, 50 V O.1 μF, Cer, 50 V O.05 μF, Cer, 50 V O.005 μF, Cer, 500 V O	C416	290-0522-00		1 μF, Elect., 50 V, 20%
C428 285-0815-00 1 μF, PTM, 100 V, 5% C438 283-0023-00 0.1 μF, Cer, 10 V, +80%-20% C441 283-0111-00 0.1 μF, Cer, 50 V C442 283-0010-00 0.05 μF, Cer, 50 V C443 283-0001-00 0.005 μF, Cer, 50 V DIODES CR419 152-0141-02 Silicon, replaceable by 1N4152 CR420 152-0141-02 Silicon, replaceable by Silicon, replaceable by CR424 152-0075-00 Germanium, replaceable by Silicon, replaceable by Silicon	C419	283-0204-00		0.01 μF, Cer, 50 V, 20%
C438 283-0023-00		290-0519-00		100 μF, Elect., 20 V, 20%
C441 283-0111-00 0.1 μF, Cer, 50 V 0.05 μF, Cer, 50 V 0.05 μF, Cer, 50 V 0.05 μF, Cer, 50 V 0.005 μF, Cer, 50 V 0.005 μF, Cer, 50 V 0.005 μF, Cer, 500 V 0.	C428	285-0815-00		1 μF, PTM, 100 V, 5%
C442 283-0010-00 0.05 μF, Cer, 50 V 0.005 μF, Cer, 50 V 0.005 μF, Cer, 500 V DIODES CR419 152-0141-02 Silicon, replaceable by 1N4152 Silicon, replaceable by 1N4152 Silicon, replaceable by 1N4152 CR424 152-0075-00 Germanium, replaceable by SD238 or ED48 Silicon, replaceable by 1N4152 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR462 152-0141-02 Silicon, replaceable by 1N4152 VR462 152-0280-00 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical	C438	283-0023-00		0.1 μF, Cer, 10 V, +80%-20%
DIODES CR419 152-0141-02 Silicon, replaceable by 1N4152 CR420 152-0075-00 Germanium, replaceable by GD238 or ED48 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR462 152-0141-02 Silicon, replaceable by 1N4152 CR462 152-0141-02 Silicon, replaceable by 1N4152 VR462 152-0280-00 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical METER	C441	283-0111-00		0.1 μF, Cer, 50 V
DIODES CR419	C442	283-0010-00		0.05 μF, Cer, 50 V
CR419 152-0141-02 Silicon, replaceable by 1N4152 CR420 152-0141-02 Silicon, replaceable by 1N4152 CR424 152-0075-00 Germanium, replaceable by GD238 or ED48 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR462 152-0141-02 Silicon, replaceable by 1N4152 VR462 152-0280-00 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical METER	C443	283-0001-00		0.005 μF, Cer, 500 V
CR419 152-0141-02 Silicon, replaceable by 1N4152 CR420 152-0141-02 Silicon, replaceable by 1N4152 CR424 152-0075-00 Germanium, replaceable by GD238 or ED48 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR462 152-0141-02 Silicon, replaceable by 1N4152 VR462 152-0280-00 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical METER	DIODES			
CR424 152-0075-00 Germanium, replaceable by GD238 or ED48 CR428 152-0141-02 Silicon, replaceable by 1N4152 CR462 152-0141-02 Silicon, replaceable by 1N4152 VR462 152-0280-00 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical J13 131-0106-01 Receptacle, electrical Receptacle, electrical Receptacle, electrical	CR419	152-0141-02		Silicon, replaceable by 1N4152
CR428 152-0141-02 Silicon, replaceable by 1N4152 Silicon, replaceable by 1N4152 Silicon, replaceable by 1N4152 VR462 152-0280-00 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptable, electrical Receptable silicon, replaceable by 1N753A, 0.4 W, 6.2 V, 5% Receptable by 1N753A, 0.4 W, 6.2 V, 5% Receptable by 1N4152 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% Receptable by 1N4152 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS Receptable by 1N753A, 0.4 W, 6.2 V, 5% Receptable by 1N4152 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% Receptable by 1N753A, 0.4 W, 6.2 V, 5% Receptable by 1N4152 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS Receptable by 1N753A, 0.4 W, 6.2 V, 5% Receptable by 1N4152 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5%	CR420	152-0141-02		
CR462 152-0141-02 Silicon, replaceable by 1N4152 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical Receptacle, electrical J11 131-0106-01 Receptacle, electrical Receptacle, electrical J12 131-0106-01 Receptacle, electrical Receptacle, electrical Receptacle, electrical Receptacle, electrical Receptacle, electrical Receptacle, electrical	CR424	152-0075-00		Germanium, replaceable by GD238 or ED48
VR462 152-0280-00 Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5% BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical J13 131-0106-01 Receptacle, electrical METER	CR428	152-0141-02		Silicon, replaceable by 1N4152
BULBS DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 J11 J11 J11 J12 J131-0106-01 Receptacle, electrical Receptacle, electrical Receptacle, electrical Receptacle, electrical Receptacle, electrical Receptacle, electrical	CR462	152-0141-02		
DS15 150-0035-00 Neon, AID-T, 0.3 mA CONNECTORS J10 131-0106-01 Receptacle, electrical J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical J13 131-0106-01 Receptacle, electrical	VR462	152-0280-00		Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5%
CONNECTORS J10	BULBS			
J10 131-0106-01 Receptacle, electrical J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical J13 131-0106-01 Receptacle, electrical METER	DS15	150-0035-00		Neon, AID-T, 0.3 mA
J11 131-0106-01 Receptacle, electrical J12 131-0106-01 Receptacle, electrical J13 131-0106-01 Receptacle, electrical METER	CONNECTORS			
J12 131-0106-01 Receptacle, electrical Receptacle, electrical Receptacle, electrical		131-0106-01		Receptacle, electrical
J13 131-0106-01 Receptacle, electrical METER	J11	131-0106-01		Receptacle, electrical
METER	J12	131-0106-01		Receptacle, electrical
0.000 1.1450	J13	131-0106-01		Receptacle, electrical
M10 149-0031-00 Meter, 0-200 μA, ±15%	METER			
	M10	149-0031-00		Meter, 0-200 μA, ±15%

SIGNAL OUTPUT & SWITCHING 🚸 (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description	
TRANSISTORS					
Q410	151-0341-00			Silicon, NPN, replaceable by 2N3565	
Q412	151-0341-00			Silicon, NPN, replaceable by 2N3565	
Q412	151-0342-00			Silicon, PNP, replaceable by 2N4249	
0420	151-0341-00			Silicon, NPN, replaceable by 2N3565	
Q421	151-0341-00			Silicon, NPN, replaceable by 2N3565	
Q423	151-0254-00			Silicon, NPN, replaceable by 2N5308	
Q424	151-0302-00			Silicon, NPN, replaceable by 2N2222A	
Q425	151-0254-00			Silicon, NPN, replaceable by 2N5308	
Q427	151-0301-00			Silicon, PNP, replaceable by 2N2907	
RESISTORS	•			•	
R2	317-0203-00			20 kΩ, 1/8 W, 5%	
R3	315-0470-00			47 Ω, 1/4 W, 10%	
R4	321-0183-02			787 Ω, 1/8 W, 1/2%	
R5	321-0173-01			619 Ω, 1/8 W, 1/2%	
R6	311-1064-00			500 Ω, Var	
R7	321-0164-03			499 Ω, 1/8 W, 1/2%	
R8	311-1325-00			50 kΩ, Var	
R9	315-0103-00			10 kΩ, 1/4 W, 5%	
R10	315-0103-00			10 kΩ, 1/4 W, 5%	
R410	315-0512-00			5.1 kΩ, 1/4 W, 5%	
R411	316-0103-00			10 kΩ, 1/4 W, 10%	
R412	315-0512-00			5.1 kΩ, 1/4 W, 5%	
R413	316-0104-00			10 kΩ, 1/4 W, 10%	
R414	316-0105-00			1 MΩ, 1/4 W, 10%	
R416	316-0102-00			$1 \text{ k}\Omega$, $1/4 \text{ W}$, 10%	
R418	316-0104-00			100 kΩ, 1/4 W, 10%	
R419	316-0105-00			$1 \text{ M}\Omega$, $1/4 \text{ W}$, 10%	
R420	316-0102-00			$1 \text{ k}\Omega$, $1/4 \text{ W}$, 10%	
R421	316-0474-00			470 kΩ, 1/4 W, 10%	
R422	316-0473-00			47 kΩ, 1/4 W, 10%	
R423	316-0105-00			1 MΩ, 1/4 W, 10%	
R424	315-0201-00			200 Ω, 1/4 W, 5%	
R425	316-0103-00			10 kΩ, 1/4 W, 10%	
R426	316-0102-00			1 kΩ, 1/4 W, 10%	
R427	316-0105-00			$1 M\Omega, 1/4 W, 10\%$	
R428	316-0472-00			4.7 $k\Omega$, 1/4 W, 10%	
R429	316-0225-00			2.2 MΩ, 1/4 W, 10%	
R430	316-0472-00			4.7 kΩ, 1/4 W, 10%	
R434	316-0472-00)		4.7 kΩ, 1/4 W, 10%	
R436	316-0104-00			100 kΩ, 1/4 W, 10%	
R438	316-0473-00			47 kΩ, 1/4 W, 10%	
R440	316-0103-00)		10 kΩ, 1/4 W, 10%	
R442	311-0633-00			$5 \text{ k}\Omega$, Var	
R444	315-0393-00			39 kΩ, 1/4 W, 5%	
R446	321-0289-00)		10 kΩ, 1/8 W, 1%	
R447	321-0327-00			24.9 kΩ, 1/8 W, 1%	
R448	321-0310-00			16.5 kΩ, 1/8 W, 1%	
R449	321-0356-00			49.9 kΩ, 1/8 W, 1%	
R450	321-0298-00			12.4 kΩ, 1/8 W, 1%	
	321-0385-00				
R451	321-0363-00	,		100 kΩ, 1/8 W, 1% 11 kΩ, 1/8 W, 1%	

SIGNAL OUTPUT & SWITCHING �(cont)

	ription
RESISTORS (cont)	
R453 321-0423-00 249 kΩ, 1/8 W, 1%	
$R454$ 321-0290-00 10.2 k Ω , 1/8 W, 1%	
R455 321-0452-00 499 kΩ, 1/8 W, 1%	
R456 321-0289-00 10 k Ω , 1/8 W, 1%	
R457 321-0481-00 1 MΩ, 1/8 W, 1%	
R458 321-0289-00 10 kΩ, 1/8 W, 1%	
$R462$ 315-0432-00 4.3 k Ω , 1/4 W, 5%	
R468 316-0105-00 1 MΩ, 1/4 W, 10%	
R470 321-0289-00 10 k Ω , 1/4 W, 1%	
SWITCHES	
S3A Wired 262-0960-00 B010100 B039999 Push, CHART POWER	
S3B EXT SIG	
S3A) Wired 262-0960-01 B040000 Push, CHART POWER	
S3B EXT SIG	
S3A 260-1331-00 Push, CHART POWER	
S3B EXT SIG	
S4 260-1333-00 Push, NOISE FILTER	
S6 260-1330-00 Rotary, CABLE	
S7 260-1329-00 Rotary, REFLECTION %/DI	V
INTEGRATED CIRCUITS	
U436 156-0067-00 Operational amplifier,	replaceable by UA741C
U446 156-0067-00 Operational amplifier,	replaceable by UA741C
U468 156-0067-00 Operational amplifier,	replaceable by UA741C

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-					

SIGNAL OUTPUT & SWITCHING

10 ms/DIV

0 V



TEST CONDITIONS

Test Point - RED

1501

CHART POWER

Released

EXT SIG

Released

NOISE FILTER

Released

FEET/DIV

20

START POINT

000

%/DIV

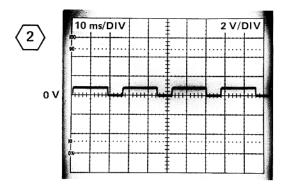
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STEP

Pressed

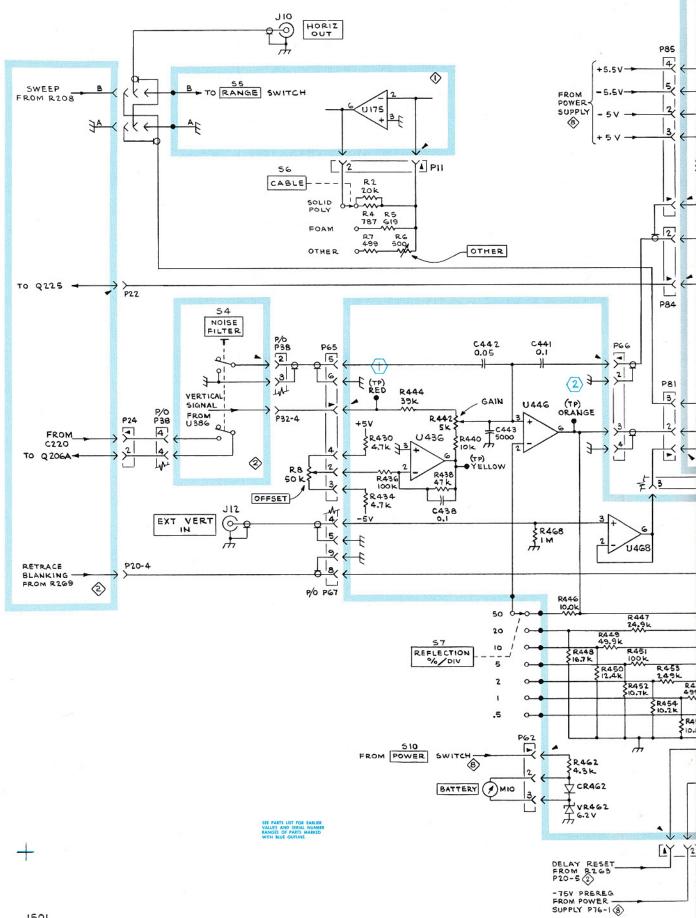
Other Controls

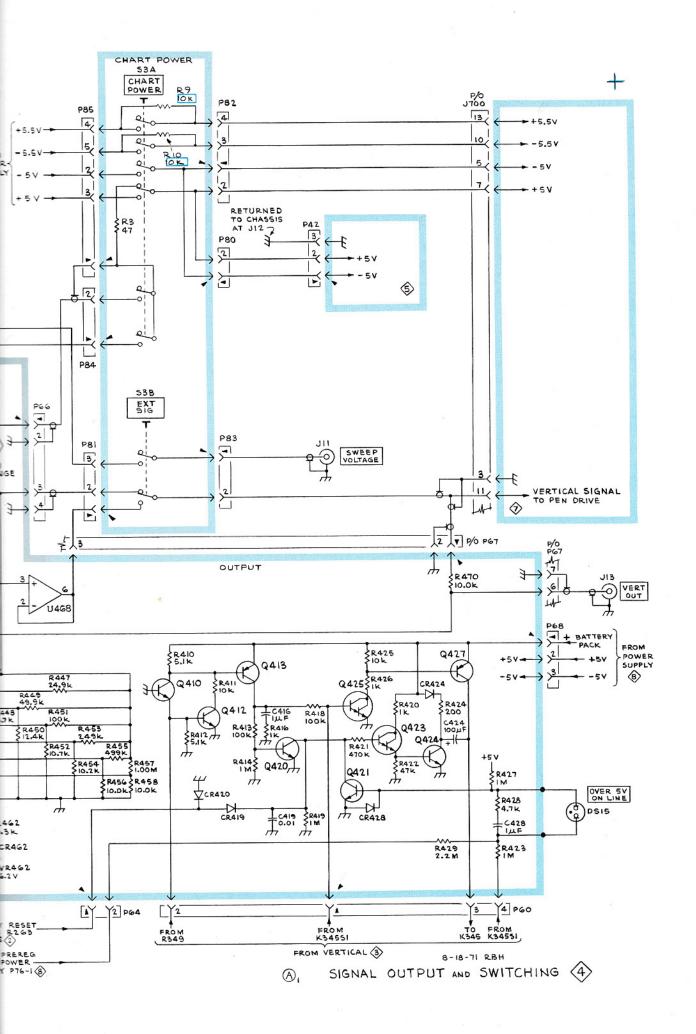
Settings Not Important

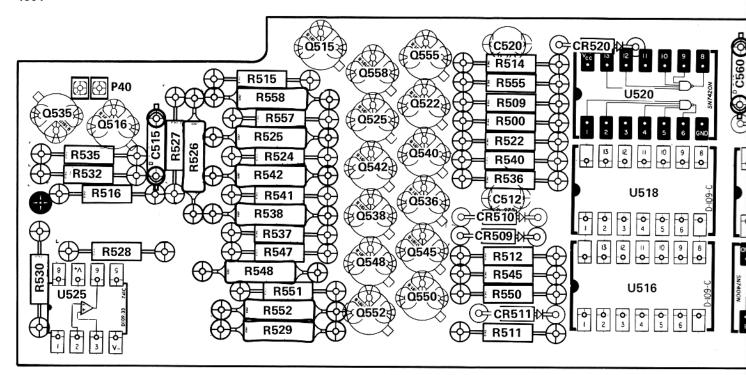


Test Point - ORANGE

1501 - Same as for RED test point except the DC OFFSET control should be centered.

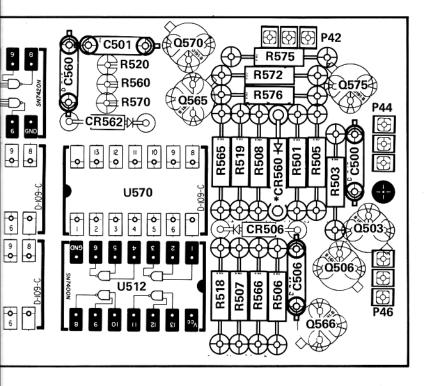






*See Part List for serial number ranges.

Logic circuit board



Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL H	Filter Heat dissipating device	PTM	paper or plastic, tubular molded
ΑT	Attenuator, fixed or variable		(heat sink, etc.)	R	Resistor, fixed or variable
В	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
С	Capacitor, fixed or variable	K	Relay	T	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	Ü	Assembly, inseparable or
CRT	cathode-ray tube	M	Meter		non-repairable
DL	Delay line	·Q	Transistor or silicon-	٧	Electron tube
DS	Indicating device (lamp)		controlled rectifier	Var	Variable
Elect.	Electrolytic	P	Connector, movable portion	VR	Voltage regulator (zener diode,
EMC	electrolytic, metal cased	PMC	Paper, metal cased		etc.)
EMT	electrolytic, metal tubular	PT	paper, tubular	WW	wire-wound
F	Fuse			Υ	Crystal

LOGIC 🕏

	Tektronix Serial/Model No.						
Ckt. No.	Part No.	Eff	Disc	Description			
ASSEMBLIES							
A5	670-1708-00	B010100	B049999	LOGIC Circuit Board Assembly			
A5	670-1708-01	B050000		LOGIC Circuit Board Assembly			
CAPACITORS							
C500	290-0534-00			1 μF, Elect., 35 V, 20%			
C501	290-0534-00			1 μF, Elect., 35 V, 20%			
C506	283-0111-00			0.1 µF, Cer, 50 V			
C512	290-0525-00			4.7 µF, Elect., 50 V, 20%			
C515	283-0111-00			0.1 µF, Cer, 50 V			
C520	290-0525-00			4.7 µF, Elect., 50 V, 20%			
C543	283-0204-00	XB050000		0.01 µF, Cer, 50 V, 20%			
C560	283-0111-00			0.1 μF, Cer, 50 V			
DIODES							
CR506	152-0141-02			Silicon, replaceable by 1N4152			
CR509	152-0141-02			Silicon, replaceable by 1N4152			
CR510	152-0141-02			Silicon, replaceable by 1N4152			
CR511	152-0141-02			Silicon, replaceable by 1N4152			
CR520	152-0141-02			Silicon, replaceable by 1N4152			
CR528	152-0246-00	B010100	B010159X	Silicon, replaceable by CD12676 or FD3375			
CR530	152-0246-00	B010100	B010159X	Silicon, replaceable by CD12676 or FD3375			
GR543	152-0075-00	XB050000		Germanium, replaceable by GD238 or ED48			
CR560	152-0075-00	B010100	B049999X	Germanium, replaceable by GD238 or ED48			
CR562	152-0141-02			Silicon, replaceable by 1N4152			
TRANSISTORS							
Q503	151-0341-00			Silicon, NPN, replaceable by 2N3565			
Q506	151-0341-00			Silicon, NPN, replaceable by 2N3565			
Q515	151-0341-00			Silicon, NPN, replaceable by 2N3565			
Q516	151-0341-00			Silicon, NPN, replaceable by 2N3565			
Q522	151-0342-00			Silicon, PNP, replaceable by 2N4249			
Q525	151-0302-00			Silicon, NPN, replaceable by 2N2222A			
Q535	151-1022-00			Silicon, FET, selected from 2N4392			
Q536	151-0342-00			Silicon, PNP, replaceable by 2N4249			
Q538	151-0302-00			Silicon, NPN, replaceable by 2N2222A			

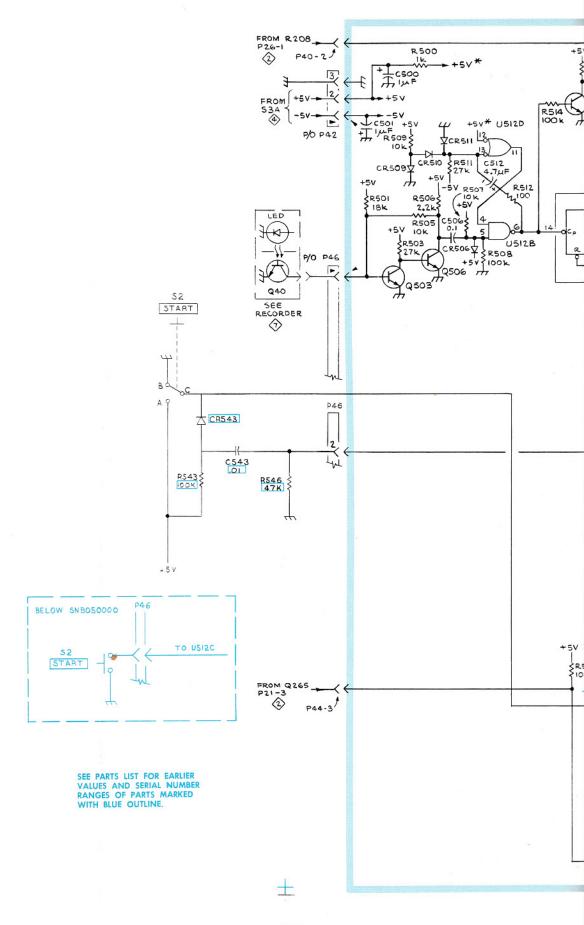
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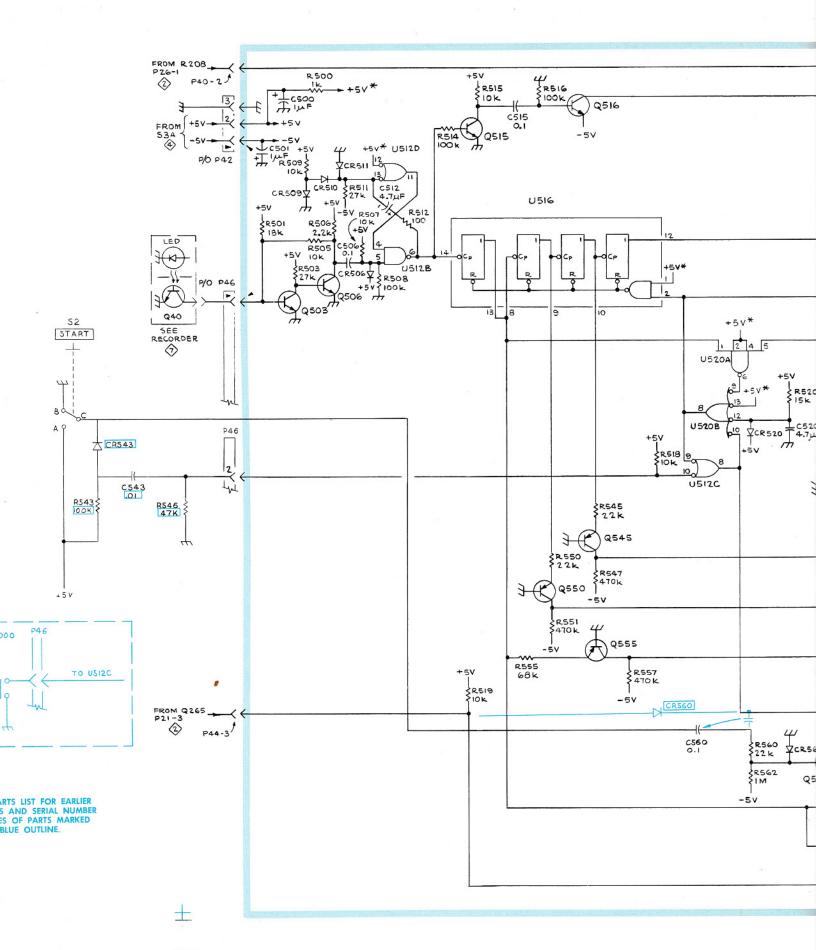
Ckt. No.	Tektronix Part No.	Serial/Mode Eff	l No. Disc	Description
TRANSISTORS (cont)			
Q540	151-0342-00			Silicon, PNP, replaceable by 2N4249
Q542	151-0342-00			Silicon, NPN, replaceable by 2N4249
Q545	151-0302-00			
				Silicon, PNP, replaceable by 2N4249
Q548	151-0302-00			Silicon, NPN, replaceable by 2N2222A
Q550	151-0342-00			Silicon, PNP, replaceable by 2N4249
Q552	151-0302-00			Silicon, NPN, replaceable by 2N2222A
Q555	151-0342-00			Silicon, PNP, replaceable by 2N4249
Q558	151-0302-00			Silicon, NPN, replaceable by 2N2222A
Q565	151-0341-00			Silicon, NPN, replaceable by 2N3565
Q566	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q570	151-0342-00			Silicon, PNP, replaceable by 2N4249
Q575	151-0341-00			Silicon, NPN, replaceable by 2N3565
RESISTORS				
R500	316-0102-00			1 kΩ, 1/4 W, 10%
R501	315-0183-00			18 kΩ, 1/4 W, 5%
R503	316-0273-00			27 kΩ, 1/4 W, 10%
R505	316-0103-00			10 kΩ, 1/4 W, 10%
R506	316-0222-00			2.2 kΩ, 1/4 W, 10%
R507	316-0103-00			10 kΩ, 1/4 W, 10%
R508	316-0104-00			100 k Ω , 1/4 W, 10%
R509	316-0104-00			10 kΩ, 1/4 W, 10%
R511	316-0273-00			$27 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
. p512	316-0101-00			100 0 1/4 11 10%
R512				100 Ω, 1/4 W, 10%
R514	316-0104-00			$100 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R515	316-0103-00			10 kΩ, 1/4 W, 10%
R516	316-0104-00			100 kΩ, 1/4 W, 10%
R518	316-0103-00			10 kΩ, 1/4 W, 10%
R519	316-0103-00			10 kΩ, 1/4 W, 10%
R520	316-0153-00			15 k Ω , 1/4 W, 10%
R522	316-0223-00			22 kΩ, 1/4 W, 10%
R524	316-0474-00			470 kΩ, 1/4 W, 10%
R525	321-0319-02	B010100 F	3010159	20.5 kΩ, 1/8 W, 1/2%
R525	321-0327-03	B010160		24.9 kΩ, 1/8 W, 1/4%
R526	321-0302-00	B010100 H	3010159	13.7 kΩ, 1/8 W, 1%
R526	321-0651-00	B010160		15.8 kΩ, 1/8 W, 1/4%
R527	316-0564-00	B010100 H	3010159	560 kΩ, 1/4 W, 10%
R527	315-0155-00	B010160		1.5 MΩ, 1/4 W, 5%
R528	315-0203-00			20 kΩ, 1/4 W, 5%
R529	321-0465-01	B010100 H	3010159	681 kΩ, 1/8 W, 1/2%
R529	321-0891-00	B010160		800 kΩ, 1/8 W, 1%
R530	315-0202-00			2 kΩ, 1/4 W, 5%
R532	316-0104-00			100 kΩ, 1/4 W, 10%
R535	316-0104-00			$1 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R536	316-0223-00			$1 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R537	316-0474-00	PO10100 T	010150	470 kΩ, 1/4 W, 10%
R538 R538	321-0726-01 321-0756-03	B010100 F B010160	3010159	42.27 kΩ, 1/8 W, 1/2% 50 kΩ, 1/8 W, 1/4%

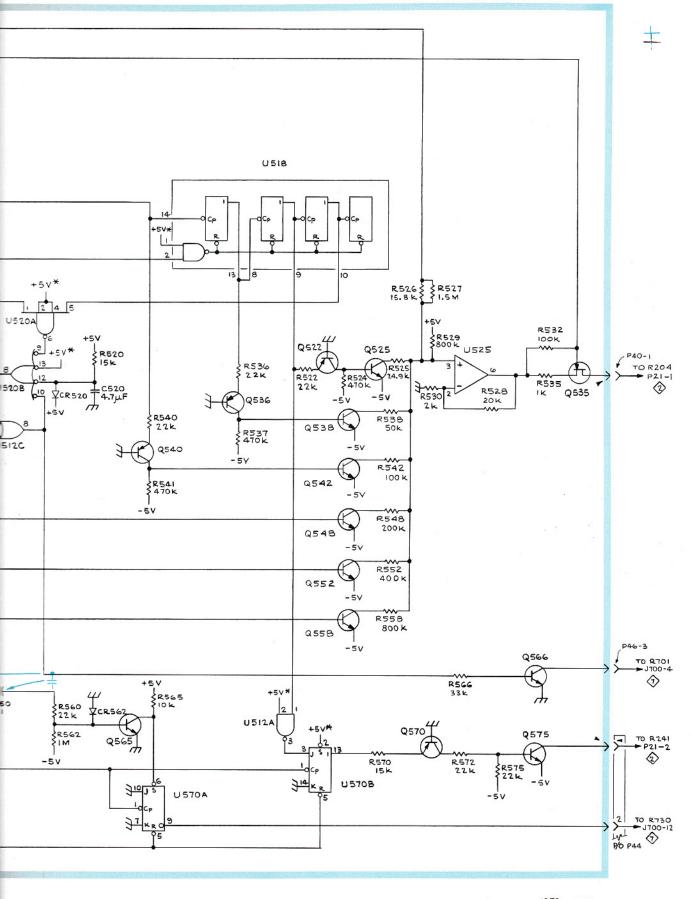
LOGIC 🤄 (cont)

Ckt. No.	Tektronix Part No.	Serial/Mo Eff	del No. Disc	Description
		LII	Disc	Doddipilon .
RESISTORS (22 10 1/4 11 10%
R540	316-0223-00			22 kΩ, 1/4 W, 10%
R541	316-0474-00	7010100	D010150	470 kΩ, 1/4 W, 10%
R542	321-0727-01	B010100	B010159	84.54 kΩ, 1/8 W, 1/2%
R542	321-0645-00	B010160		100 kΩ, 1/8 W, 1/2%
R543	316-0104-00	XB050000		100 kΩ, 1/4 W, 10%
R545	316-0223-00	**********		22 kΩ, 1/4 W, 10%
R546	316-0473-00	XB050000		47 kΩ, 1/4 W, 10%
R547	316-0474-00			470 kΩ, 1/4 W, 10%
R548	321-0694-00	B010100	B010159	169 kΩ, 1/8 W, 1/2%
R548	321-0414-00	B010160		200 kΩ, 1/8 W, 1%
R550	316-0223-00			$22 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R551	316-0474-00			470 kΩ, 1/4 W, 10%
R552	321-0436-01	B010100	B010159	340 kΩ, 1/8 W, 1/2%
R552	321-0781-06	B010160		400 kΩ, 1/8 W, 1/4%
R555	316-0683-00			68 kΩ, 1/4 W, 10%
R557	316-0474-00			470 kΩ, 1/4 W, 10%
R558	321-0465-01	B010100	B010159	681 kΩ, 1/8 W, 1/2%
R558	321-0891-00	B010160		800 kΩ, 1/8 W, 1%
R560	316-0223-00			22 kΩ, 1/4 W, 10%
R562	315-0105-00			1 MΩ, 1/4 W, 10%
R565	316-0103-00			10 kΩ, 1/4 W, 10%
R566	316-0333-00			33 kΩ, 1/4 W, 10%
R570	316-0153-00			15 kΩ, 1/4 W, 10%
R572	316-0223-00			22 kΩ, 1/4 W, 10%
R575	316-0223-00			22 kΩ, 1/4 W, 10%
SWITCHES				
S2	260-0247-00	B010100	B049999	Pushbutton, START
S2	260-0324-00	в050000		Pushbutton, START
INTEGRATED	CIRCUITS			
U512	156-0113-00			Quad 2-input positive nand gate, low power, replaceable by SN74L00N
U516	156-0101-00			Single 3 MHz 1-&-3-bit binary ripple counter, replaceable by SN74L93N
U518	156-0101-00			Single 3 MHz 1-&-3-bit binary ripple counter, replaceable by SN74L93N
U520	156-0160-00			Dual 2-input positive nand gate, low power, replaceable by SN74L20N
U525	156-0067-00			Operational amplifier, replaceable by UA741C
U570	156-0161-00			Dual 3 MHz J-K master-slave flip-flop, low power, replaceable by SN74L78N

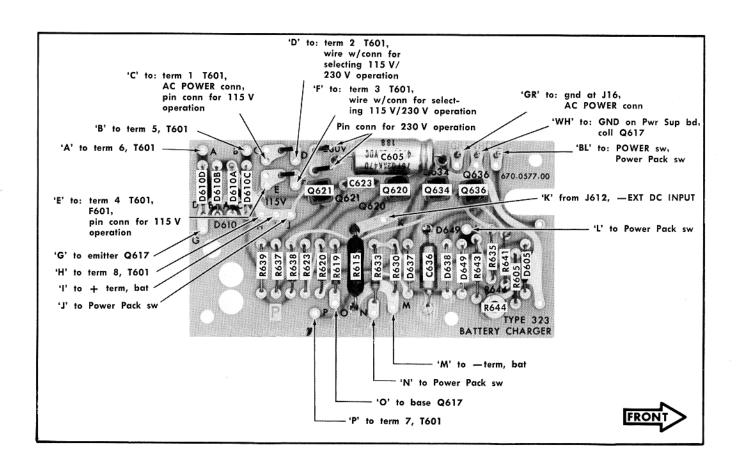
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B LOGIC (5)



Power Pack circuit board

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

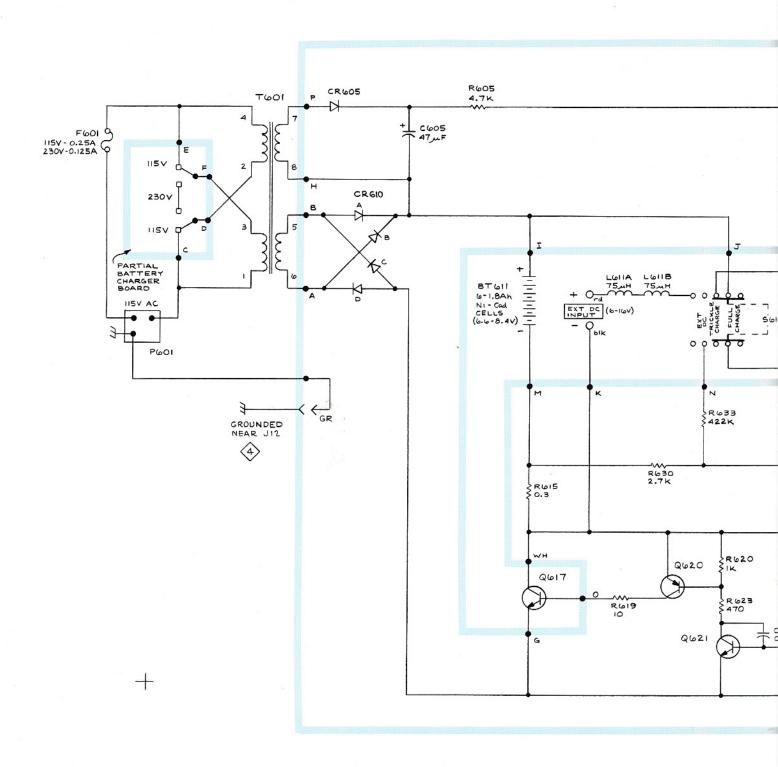
Α	Assembly, separable or	FL	Filter	PTM	paper or plastic, tubular
	repairable	Н	Heat dissipating device		molded
ΑT	Attenuator, fixed or variable		(heat sink, etc.)	R	Resistor, fixed or variable
В	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
C	Capacitor, fixed or variable	K	Relay	Т	Transformer
Čer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or
CRT	cathode-ray tube	М	Meter		non-repairable
DL	Delay line	Q	Transistor or silicon-	٧	Electron tube
DS	Indicating device (lamp)		controlled rectifier	Var	Variable
Elect.	Electrolytic	Ρ.	Connector, movable portion	VR	Voltage regulator (zener diode,
EMC	electrolytic, metal cased	PMC	Paper, metal cased		etc.)
EMT	electrolytic, metal tubular	PT	paper, tubular	ww	wire-wound
F	Fuse		, ., .,	Υ	Crystal

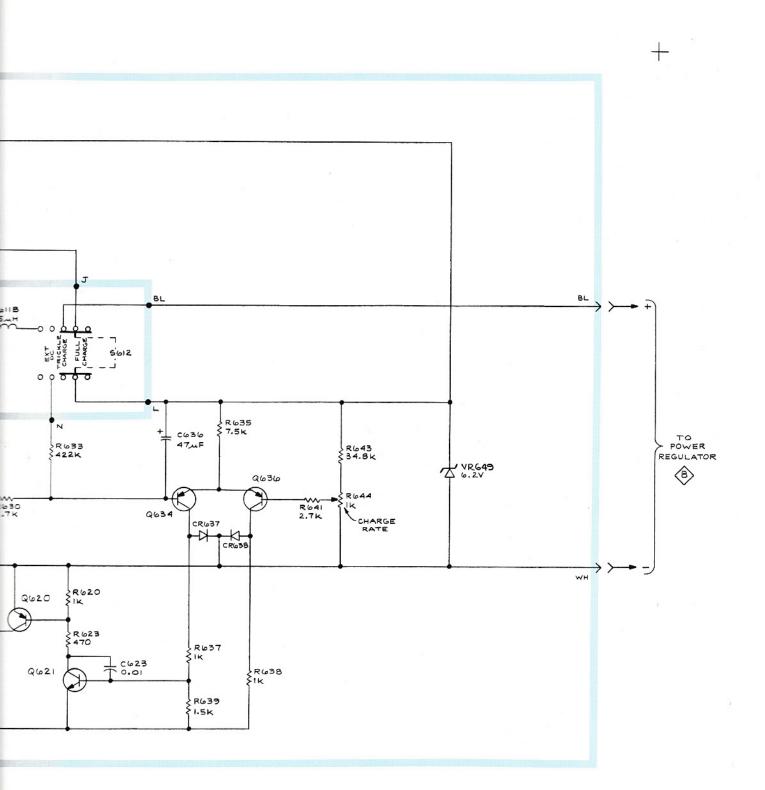
POWER PACK (6)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description
ACCEMBLY				
ASSEMBLY	014 0110 00			POWER PACK
A6	016-0119-02			POWER PACK
BATTERY				
BT611	146-0012-01			Battery set
BIOII	210 0022 01			
CAPACITORS				•
C605	290-0287-00			47 μ F, Elect., 25 V, 20%
C623	283-0003-00			0.01 μF, Cer, 1 50 V, +80%-20%
C636	290-01 1 4-01			47 μF, Elect., 6 V
DIODES				
CR605	152-0107-00			Silicon, replaceable by TI60 or 1N647
	D(4)152-0107-00			Silicon, replaceable by TI60 or 1N647
CR637	152-0008-00			Germanium, replaceable by T12G
CR638	152-0008-00			Germanium, replaceable by T12G
VR649	152-0166-00			Zener, selected from 1N753A, 0.4 W, 6.2 V, 5%
FUSES				
F601	159-0074-00			Cartridge, 0.1 A, 250 V, slo-blo, 230 V operation
	159-0074-00			Cartridge, 0.2 A, 250 V, slo-blo, 115 V operation
F 601	139-0080-00			Cartifuge, 0.2 A, 250 V, Sio-bio, 115 V operation
CONNECTORS				
J611	136-0139-00			Socket, banana jack assembly
J612	136-0140-00			Socket, banana jack assembly
P601	131-0552-00			Receptacle, electrical
INDUCTOR				
L611A.B	108-0488-00			150 µH
ت و تمدیان	100 0400-00			

POWER PACK (cont)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description	
TRANSISTORS					
0617	151-0229-00			Silicon, NPN, replaceable by 2SD28	
0620	151-0219-00			Silicon, PNP, replaceable by 2N4250	
0621	151-0224-00			Silicon, NPN, replaceable by 2N3692	
0634	151-0219-00			Silicon, PNP, replaceable by 2N4250	
Q636	151-0219-00			Silicon, PNP, replaceable by 2N4250	
RESISTORS	•				
R605	315-0472-01			4.7 k Ω , 1/4 W, 5%	
R615	308-0463-00			0.3 Ω, 3 W, WW, 1%	
R619	315-0100-01			10 Ω, 1/4 W, 5%	
R620	315-0102-01			$1 \text{ k}\Omega$, $1/4 \text{ W}$, 5%	
R623	315-0471-02			470 Ω, 1/4 W, 5%	
R630	315-0272-02	•		$2.7 \text{ k}\Omega$, $1/4 \text{ W}$, 5%	
R633	321-0445-00			422 kΩ, 1/8 W, 1%	
R635	315-0752-00			7.5 kΩ, 1/4 W, 5%	
R637	315-0102-01			1 kΩ, 1/4 W, 5%	
R638	315-0102-01			1 kΩ, 1/4 W, 5%	
R639	315-0152-01			1.5 k Ω , 1/4 W, 5%	
R641	315-0272-02			2.7 $k\Omega$, 1/4 W, 5%	
R643	321-0341-30			34.8 kΩ, 1/8 W, 1%	
R644	311-0635-00			1 k Ω , Var	
SWITCH					
\$ 612	260-0902-00			Slide	
TRANSFORMER					- 80
T601	120-0503-00			Power	





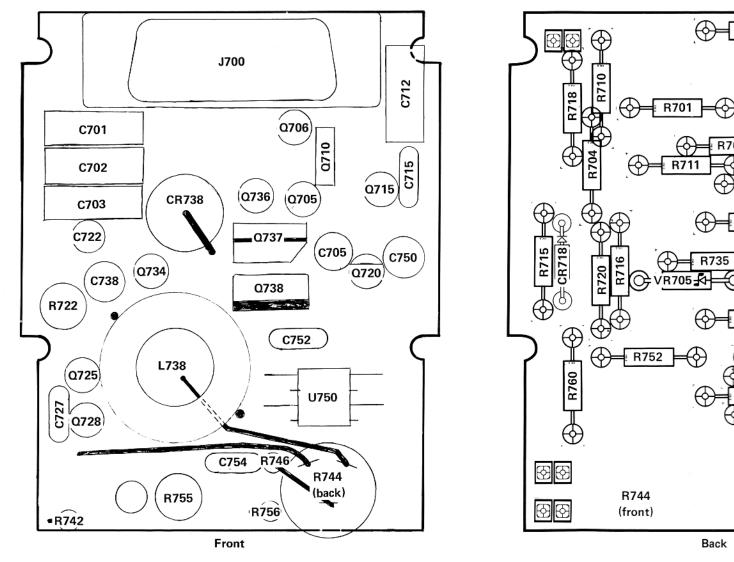
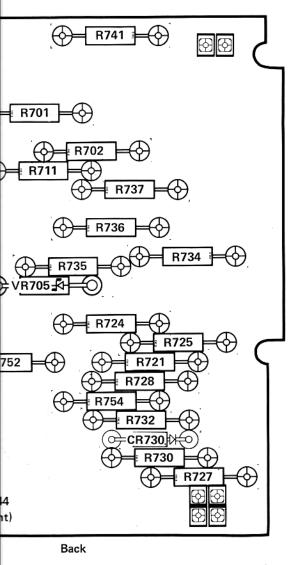


Chart Power circuit board



A

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ABBREVIATIONS AND REFERENCE DESIGNATORS

Α	Assembly, separable or	FL	Filter	PTM	paper or plastic, tubular
	repairable	Н	Heat dissipating device		molded
ΑT	Attenuator, fixed or variable		(heat sink, etc.)	R	Resistor, fixed or variable
В	Motor	HR	Heater	RT	Thermistor
BT	Battery	j	Connector, stationary portion	S	Switch
С	Capacitor, fixed or variable	K	Relay	Т	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or
CRT	cathode-ray tube	М	Meter		non-repairable
DL	Delay line	Q	Transistor or silicon-	٧	Electron tube
DS	Indicating device (lamp)		controlled rectifier	Var	Variable
Elect.	Electrolytic	P	Connector, movable portion	VR	Voltage regulator (zener diode,
EMC	electrolytic, metal cased	PMC	Paper, metal cased		etc.)
EMT	electrolytic, metal tubular	PT	paper, tubular	ww	wire-wound
F	Fuse			Υ	Crystal

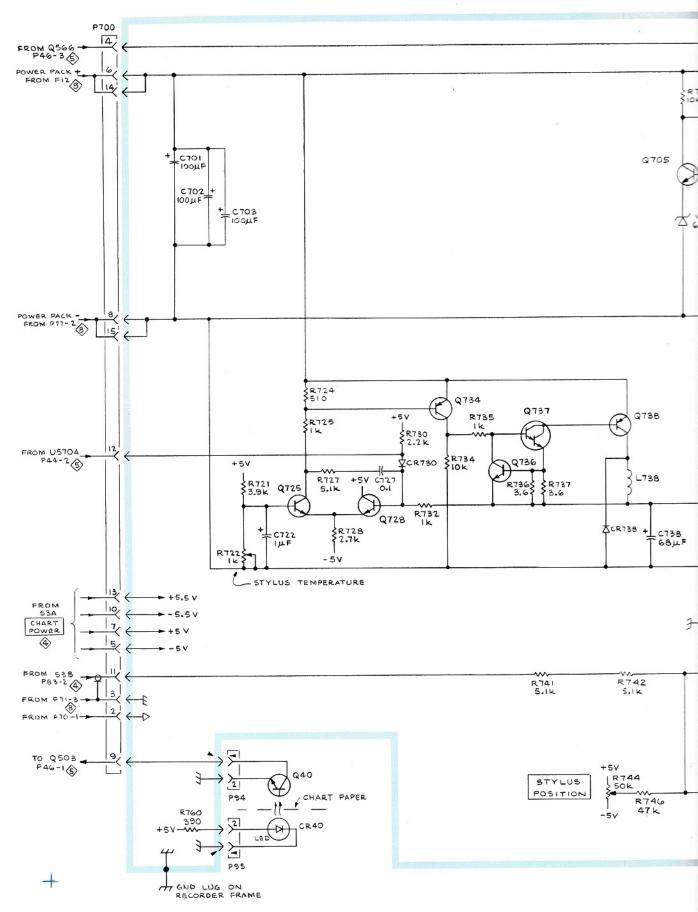
CHART RECORDER 🕏

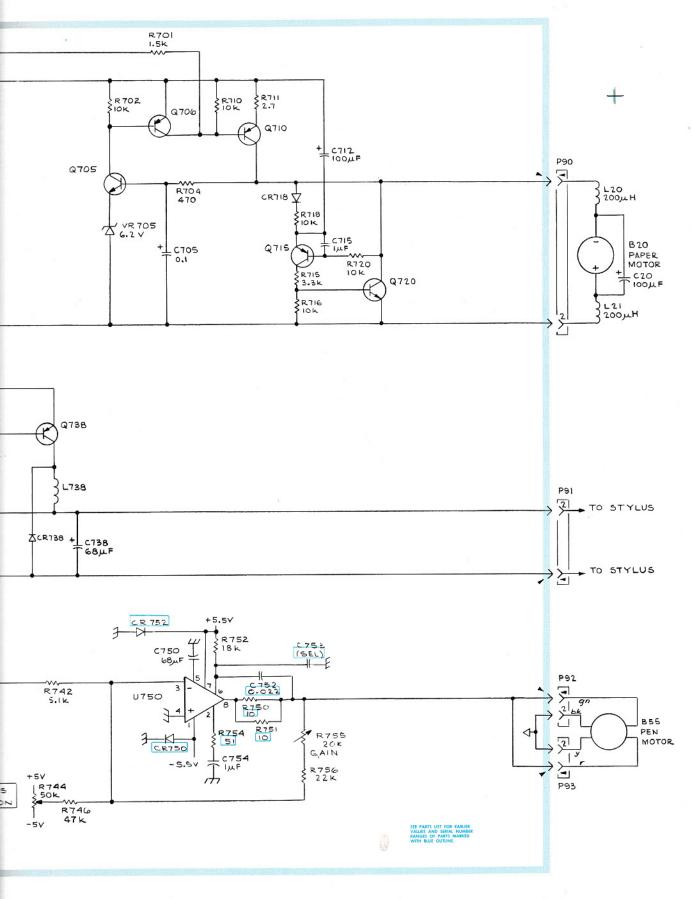
	Tektronix	Serial/Mod	lel No.	
Ckt. No.	Part No.	Eff	Disc	Description
ASSEMBLY				
A7	670-1742-0	0 во10100	во39999	CHART CONTROL Circuit Board Assembly
A7	670-1742-0	1 во40000		CHART CONTROL Circuit Board Assembly
MOTORS				
B20	147-0036-0	0		Motor, DC, 7.5 V, 420 mV
B55	147-0037-C	1		Motor, DC, 2 coils, 14 Ω each, 1.5 W
CAPACITORS				
C20	290-0531-0	0		100 μF, Elect., 10 V, 20%
C701	290-0519-0	0		100 μF, Elect., 20 V, 20%
C702	290-0519-0	0		100 μF, Elect., 20 V, 20%
C703	290-0519-0	0		100 μF, Elect., 20 V, 20%
C605	283-0111-0	0		0.1 μF, Cer, 50 V
C712	290-0519-0	0		100 μF, Elect., 20 V, 20%
C715	283-0177-0	0		1 μF, Cer, 25 V, +80%-20%
C722	290-0522-0	0		1 μF, Elect., 50 V, 20%
C727	283-0111-0	0		0.1 μF, Cer, 50 V
C738	290-0530-0	0		68 μF, Elect., 6 V, 20%
C750	290-0530-0	0		68 μF, Elect., 6 V, 20%
C752	283-0111-0	0 B010100	B039999	0.1 μF, Cer, 50 V
C752	283-0191-0	0 во40000		0.022 μF, Cer, 50 V, 20%
C753	Selected	XB040000		
C754	283-0177-0	0		1 μF, Cer, 25 V, +80%-20%
DIODES				
CR40	150-1004-0	1		Diode holder assembly
CR718	152-0141-0	2		Silicon, replaceable by 1N4152
CR730	152-0141-0	2		Silicon, replaceable by 1N4152
CR738	152-0502-0	0		Silicon, replaceable by MBD5300
CR750	152-0333-0	0 XB040000		Silicon, FDH6012
CR752	152-0333-0	0 XB040000		Silicon, FDH6012
VR705	152-0280-0	0		Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5%
CONNECTORS				•
J700	131-1164-0	0		Receptacle, electrical, 15 pin
P700	131-1165-0	0		Receptacle, electrical, 15 pin

CHART RECORDER ③ (cont)

Ckt. No.	Tektronix Part No.	Serial/Mode Eff	l No. Disc	Description
INDUCTORS				
L20	108-0598-00			200 μH
L21	108-0598-00			200 μH
				75 μH
L738	108-0708-00			/ μπ
TRANSISTORS				
Q40	151-0313-01			Silicon, NPN, replaceable by FPT106
Q705	151-0341-00			Silicon, NPN, replaceable by 2N3565
q 706	151-0342-00			Silicon, PNP, replaceable by 2N4249
Q710	151-0335-00			Silicon, PNP, replaceable by MJE370
Q715	151-0342-00			Silicon, PNP, replaceable by 2N4249
Q720	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q725	151-0341-00			Silicon, NPN, replaceable by 2N3565
Q728	151-0341-00			Silicon, NPN, replaceable by 2N3565
Q734	151-0342-00			Silicon, PNP, replaceable by 2N4249
Q736	151-0341-00			Silicon, NPN, replaceable by 2N3565
Q737	151-0331-00			Silicon, NPN, replaceable by D40C8 or selected
Q131	151 0551 00			from D40C5
Q738	151-0366-00			Silicon, PNP, replaceable by X45C277
DECICEODO				
RESISTORS	216 2152 20			1 5 1-0 1/4 11 109
R701	316-0152-00			$1.5 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R702	316-0103-00			10 kΩ, 1/4 W, 10%
R704	316-0471-00			470 Ω, 1/4 W, 10%
R710	316-0103-00			10 kΩ, 1/4 W, 10%
R711	307-0103-00			2.7 Ω, 1/4 W, 5%
R715	316-0332-00			3.3 k Ω , 1/4 W, 10%
R7 1 6	316-0103-00			10 k Ω , 1/4 W, 10%
R718	316-0103-00			$10 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R720	316-0103-00			10 kΩ, 1/4 W, 10%
R721	316-0392-00			3.9 kΩ, 1/4 W, 10%
R722	311-1263-00			1 kΩ, Var
R724	315-0511-00			510 Ω, 1/4 W, 5%
R725	316-0102-00			1 kΩ, 1/4 W, 10%
R727	315-0512-00			5.1 kΩ, 1/4 W, 5%
R728	316-0272-00			2.7 kΩ, 1/4 W, 10%
R730	316-0222-00			2.2 kΩ, 1/4 W, 10%
R732	316-0102-00			$1 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R734	316-0103-00			10 kΩ, 1/4 W, 5%
R735	316-0102-00			$1 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R736	307-0111-00			3.6Ω , $1/4 W$, 5%
R737	307-0111-00			3.6 Ω, 1/4 W, 5%
R741	315-0512-00			5.1 kΩ, 1/4 W, 5%
R742	315-0512-00			5.1 kΩ, 1/4 W, 5%
R744	311-0580-00			50 kΩ, Var
R746	316-0473-00			47 kΩ, 1/4 W, 10%
R750	315-0100-00			10 Ω, 1/4 W, 5%
R751	315-0100-00			10 Ω, 1/4 W, 5%
R752	316-0183-00			$18 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R754	307-0103-00	Domonto.	во30000	2.7 Ω, 1/4 W, 5%
R754	315-0510-00			51 Ω, 1/4 W, 5%
R755	311-0644-00			20 k Ω , Var
R756	316-0223-00	1		22 kΩ, 1/4 W, 10%
R760	316-0391-00			390 Ω, 1/4 W, 10%
INTEGRATED CI	RCUIT			
บ750	156-0157-00			Single audio amplifier, replaceable by MFC8010

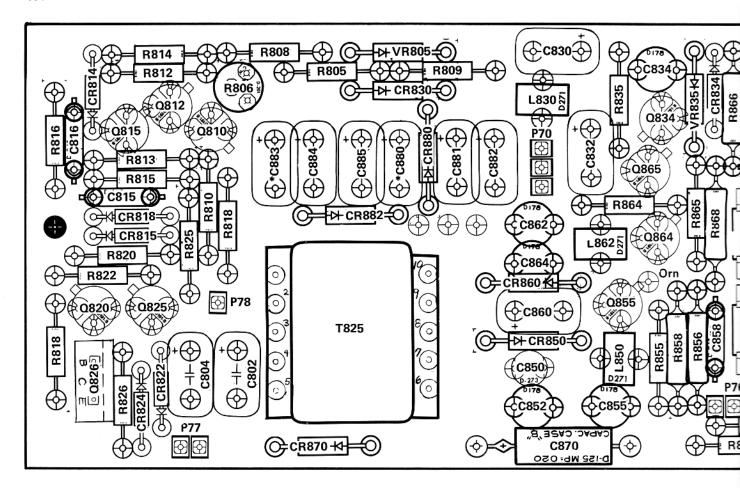
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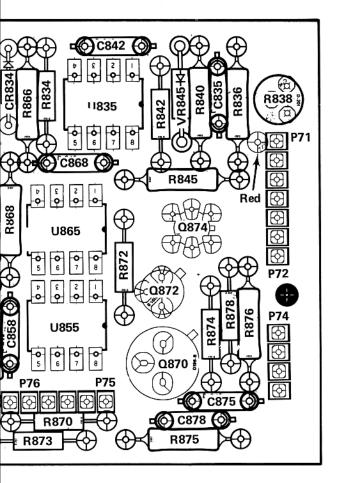






*See Parts List for serial number ranges.

Power Supply circuit board



Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable	FL H	Filter Heat dissipating device	PTM	paper or plastic, tubular molded
ΑT	Attenuator, fixed or variable		(heat sink, etc.)	R	Resistor, fixed or variable
В	Motor	HR	Heater	RT	Thermistor
BT	Battery	J	Connector, stationary portion	S	Switch
С	Capacitor, fixed or variable	K	Relay	Т	Transformer
Cer	Ceramic	L	Inductor, fixed or variable	TP	Test point
CR	Diode, signal or rectifier	LR	Inductor/resistor combination	U	Assembly, inseparable or
CRT	cathode-ray tube	М	Meter		non-repairable
DL	Delay line	Q	Transistor or silicon-	٧	Electron tube
DS	Indicating device (lamp)		controlled rectifier	Var	Variable
Elect.	Electrolytic	Р	Connector, movable portion	VR	Voltage regulator (zener diode,
EMC	electrolytic, metal cased	PMC	Paper, metal cased		etc.)
EMT	electrolytic, metal tubular	PT	paper, tubular	ww	wire-wound
F	Fuse			Υ	Crystal

POWER SUPPLY (8)

Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description
ASSEMBLY				
A8	670-1709-00			POWER SUPPLY Circuit Board Assembly
CAPACITORS				
C802	290-0519-00			100 μF, Elect., 20 V, 20%
C804	290-0519-00			100 µF, Elect., 20 V, 20%
C815	283-0000-00			0.001 µF, Cer, 500 V, 100%-0%
C816	283-0000-00			0.001 µF, Cer, 500 V, 100%-0%
C830	290-0531-00			100 μF, Elect., 10 V, 20%
C832	290-0531-00			100 uF, Elect., 10 V, 20%
C834	290-0529-00			47 μF, Elect., 20 V, 20%
C835	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C842	283-0081-00			0.1 µF, Cer, 25 V, +80%-20%
C850	290-0512-00			22 μF, Elect., 15 V, 20%
C852	290-0529-00			47 μF, Elect., 20 V, 20%
C855	290-0529-00			47 μF, Elect., 20 V, 20%
C858	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C860	290-0531-00			100 uF, Elect., 10 V, 20%
C862	290-0529-00			47 μF, Elect., 20 V, 20%
C864	290-0529-00			47 μF, Elect., 20 V, 20%
C868	283-0032-00			470 pF, Cer, 500 V, 5%
C870	290-0480-00			0.5 µF, Elect., 200 V
C875	283-0111-00			0.1 μF, Cer, 50 V
C878	283-0111-00			0.1 µF, Cer, 50 V
C880	290-0519-00	B010100 B	059999X	100 μF, Elect., 20 V, 20%
C881	290-0519-00	B010100 B	059999	100 µF, Elect., 20 V, 20%
C881	290-0671-00	B060000		150 uF, Elect., 15 V, 20%
C882	290-0519-00	B010100 B	059999	100 µF, Elect., 20 V, 20%
C882	290-0671-00	B060000		150 µF, Elect., 15 V, 20%
C883	290-0519-00	B010100 B	059999X	100 μF, Elect., 20 V, 20%
C884	290-0519-00	B010100 B	059999	100 μF, Elect., 20 V, 20%
C884	290-0671-00	B060000		150 μF, Elect., 15 V, 20%
C885	290-0519-00	B010100 B	059999	100 μF, Elect., 15 V, 20%
C885	290-0671-00	B060000		150 μF, Elect., 15 V, 20%

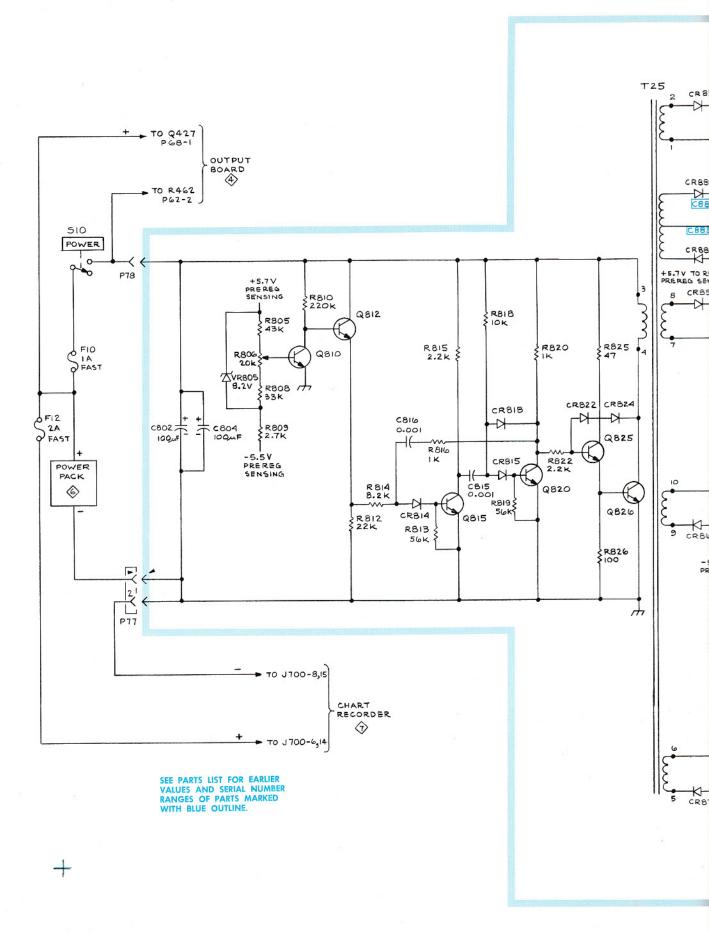
POWER SUPPLY $\stackrel{\hat{\$}}{\circ}$ (cont)

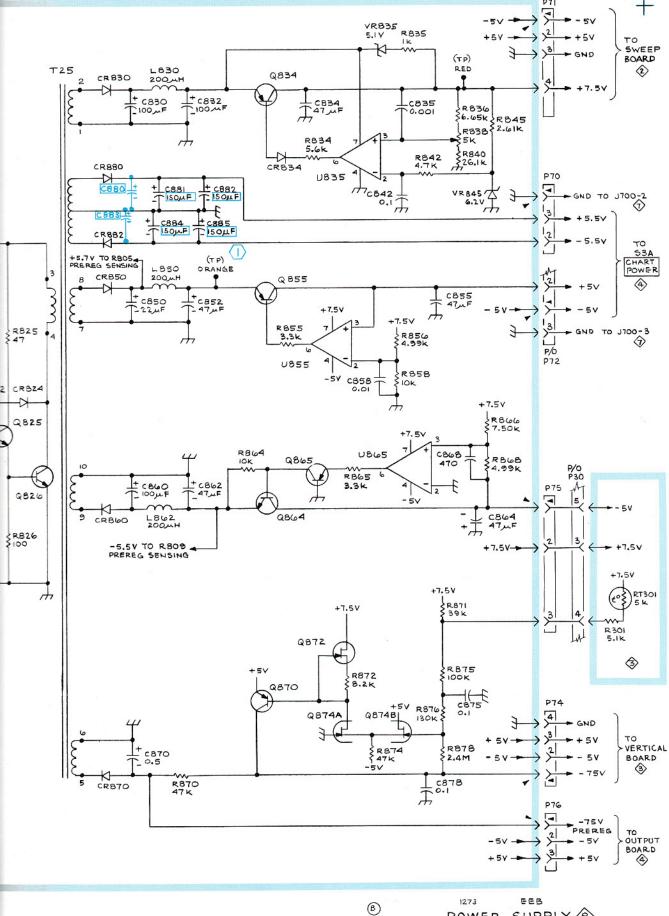
Ckt. No.	Tektronix Part No.	Serial/Model Eff	No. Disc	Description
DIODES				
CR814	152-0141-02			Silicon, replaceable by 1N4152
CR815	152-0141-02			Silicon, replaceable by 1N4152
CR818	152-0141-02			Silicon, replaceable by 1N4152
CR822	152-0141-02			Silicon, replaceable by 1N4152
CR824	152-0141-02			Silicon, replaceable by 1N4152
CR830	152-0400-00			Silicon, replaceable by 1N4936
CR834	152-0141-02			Silicon, replaceable by 1N4152
CR850	152-0180-00			Silicon, selected from UTR1112
CR860	152-0180-00			Silicon, selected from UTR1112
CR870	152-0107-00			Silicon, replaceable by TI60 or 1N647
CR880	152-0180-00			Silicon, selected from UTR1112
CR882	152-0180-00			Silicon, selected from UTR1112
VR805	152-0217-00			Zener, selected from 1N756A, 0.4 W, 8.2 V, 5%
VR835	152-0279-00			Zener, replaceable by 1N751A, 0.4 W, 5.1 V, 5%
VR845	152-0280-00			Zener, replaceable by 1N753A, 0.4 W, 6.2 V, 5%
FUSES				
F10	159-0064-00			Cartridge, 1 A, 250 V, fast-blo
F12	159-0107-00			Cartridge, 2 A, 250 V, fast-blo
INDUCTORS				
L830	108-059 8- 00			200 μΗ
L850	108-0598-00			200 μH
L862	108-0598-00			200 μH
TRANSISTORS				
Q810	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q812	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q815	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q820	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q825	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q826	151-0352-00			Silicon, NPN, selected from D44C6 Silicon, PNP, replaceable by 2N5447 or 2N3702
Q834	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q855	151-0164-00			Silicon, NPN, replaceable by 2N3447 of 2N3702
Q864	151-0207-00 151-0188-00			Silicon, PNP, replaceable by 2N3906
Q865	151-0188-00			Silicon, PNP, selected from 2N4888
Q870 Q872	151-1004-00			Silicon, FET, selected from 2N4302 or replaceable
Q872				by U1489
Q874A,B	151-1054-00			Silicon, FET, replaceable by FD1644, dual
RESISTORS				
R301	315-0512-00			5.1 kΩ, 1/4 W, 5%
RT301	307-0124-00			$5 \text{ k}\Omega$, Thermal
R805	315-0433-00			43 kΩ, 1/4 W, 5%
R806	311-1269-00			20 kΩ, Var
R808	315-0333-00			33 kΩ, 1/4 W, 5%
R809	316-0272-00			2.7 kΩ, 1/4 W, 10%
R810	316-0224-00			220 kΩ, 1/4 W, 10%
R812	316-0223-00			22 kΩ, 1/4 W, 10%
R813	316-0563-00			56 k Ω , 1/4 W, 10%
R814	316-0822-00			8.2 k Ω , 1/4 W, 10%
R815	316-0222-00			2.2 kΩ, 1/4 W, 10%
R816	316-0102-00			1 kΩ, 1/4 W, 10%
R818	316-0103-00			10 kΩ, 1/4 W, 10%

POWER SUPPLY (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff Disc	
RESISTORS	(cont)		
R819	316-0563-00		56 kΩ, 1/4 W, 10%
R820	316-0102-00		1 kΩ, 1/4 W, 10%
R822	316-0222-00		$2.2 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R825	316-0470-00		47 Ω, 1/4 W, 10%
R826	316-0101-00		100 Ω, 1/4 W, 10%
R834	316-0562-00		5.6 kΩ, 1/4 W, 10%
R835	316-0102-00		1 kΩ, 1/4 W, 10%
R836	321-0272-00		6.65 kΩ, 1/8 W, 1%
R 838	311-0633-00		5 kΩ, Var
R840	321-0329-00		26.1 kΩ, 1/8 W, 1%
R842	316-0472-00		4.7 kΩ, 1/4 W, 10%
R845	321-0233-00		2.61 kΩ, 1/8 W, 1%
R855	316-0332-00		3.3 kΩ, 1/4 W, 10%
R856	321-0260-00		4.99 kΩ, 1/8 W, 1%
R858	321-0289-00		10 kΩ, 1/8 W, 1%
R864	316-0103-00		10 k Ω , 1/4 W, 10%
R865	316-0332-00		$3.3 \text{ k}\Omega$, $1/4 \text{ W}$, 10%
R866	321-0277-00		7.5 k Ω , 1/8 W, 1%
R868	321-0260-00		4.99 kΩ, 1/8 W, 1%
R870	316-0473-00		47 kΩ, 1/4 W, 10%
R871	315-0393-00		39 kΩ, 1/4 W, 5%
R872	316-0822-00		8.2 kΩ, 1/4 W, 10%
R874	316-0473-00		47 kΩ, 1/4 W, 10%
R875	322-0385-00		100 kΩ, 1/4 W, 1%
R876	322-0396-00		130 kΩ, 1/4 W, 1%
R878	315-0245-00		2.4 MΩ, 1/4 W, 5%
SWITCH			C1/1 POWD
S10	260-0903-00		Slide, POWER
TRANSFORME			P
T25	120-0745-00		Power, pot core
INTEGRATED			0
U835	156-0067-00		Operational amplifier, replaceable by UA741C
U855	156-0067 00		Operational amplifier, replaceable by UA741C
U865	156-00 67 -00		Operational amplifier, replaceable by UA741C

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POWER SUPPLY (8)

MECHANICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS

внв	binding head brass	h	height or high	ОНВ	oval head brass
BHS	binding head steel	hex.	hexagonal	OHS	oval head steel
CRT	cathode-ray tube	ННВ	hex head brass	PHB	pan head brass
csk	countersunk	HHS	hex head steel	PHS	pan head steel
DE	double end	HSB	hex socket brass	RHS	round head steel
FHB	flat head brass	HSS	hex socket steel	SE	single end
FHS	flat head steel	ID	inside diameter	THB	truss head brass
Fil HB	fillister head brass	lg	length or long	THS	truss head steel
Fil HS	fillister head steel	ŎD	outside diameter	w	wide or width

FIGURE 1 MAIN FRAME

Fig. & Index No.	Tektronix Part No.	Serial/M Eff	lodel No. Disc	Q † y	Description 1 2 3 4 5
1-1	366-1190-00			1	KNOB, grayREFLECTION %/DIV
				-	knob includes:
	213-0153-00			2	SETSCREW, 5-40 x 0.125 inch, HSS
-2	366-0494-00			2	KNOB, grayDISPLAY OFFSET & CABLE
				-,	each knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
- 3	366 - 02 15- 02			1	KNOB, lever switch
-4	366-1257-63			1	PUSHBUTTONSTEP
- 5	366-1257-64				PUSHBUTTONNOISE FILTER
- 6	366-1257-65			1	PUSHBUTTONCHART POWER
- 7	366-1257-66			1	PUSHBUTTONEXT SIG
-8	426-0681-00				FRAME, pushbutton
- 9				1	RESISTOR, variable (See R8 electrical list)
				-	mounting hardware: (not included w/resistor)
-10	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-11	210-0940-00			1	WASHER, flat 0.25 ID x 0.375 inch OD
-12 -13 -14 -15	358-0342-00 210-0046-00 220-0510-00			1 1	RESISTOR, variable (See R6 electrical list) mounting hardware: (not included w/resistor) BUSHING WASHER, lock, internal 0.261 ID x 0.40 OD NUT, hex., 0.25-32 x 0.312 inch
-16	260-0247-00 260-0324-00	B010100 B050000	в049999	1	SWITCH, push (S2) SWITCH, push (S2)
17	210 0502 00				mounting hardware: (not included w/switch)
-17					NUT, hex., 0.25-32 x 0.312 inch
	210-0940-00				WASHER, flat, 0.25 ID x 0.375 inch OD
-19	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-20	260-1329-00			1	SWITCH, rotary reel (S7)
				_	
-21	210-0590-00				NUT, hex., 0.375 x 0.437 inch
-22	210-0978-00				WASHER, flat, 0.375 ID x 0.50 inch OD

Fig. &			Q	
Index	Tektronix	Serial/Model No.	t	D Soften
No.	Part No.	Eff Disc		Description 1 2 3 4 5
1-23	260-1330-00			SWITCH, rotary cable (S6)
-24	220-0480-02			mounting hardware: (not included w/switch)
-24 -25	210-0590-00			NUT, dodecagon, black NUT, hex., 0.375 x 0.437 inch
-23	210-0570-00		1	NOT, HEX., 0.373 X 0.437 THEIR
-26				CIRCUIT BOARD ASSEMBLYLOGIC (See A5 electrical list)
-20			_	circuit board assembly includes:
- 27	131-0608-00		11	TERMINAL, pin, 0.365 inch long
-28	136-0252-04		133	
			-	mounting hardware: (not included w/circuit board assembly)
- 29	211-0116-00		3	SCREW, sems, 4-40 \times 0.312 inch, PHB
-30			1	RESISTOR, variable (See R1 electrical list)
-31	333-1496-00			PANEL, front
-32	333-1496-01 200-0609-00			PANEL, front (Used on Option 2 & 3 only) BASE, lampholder
-32 -33	352-0084-00			LAMPHOLDER
- 33	149-0031-02			METER, battery level ASSEMBLY
			, ,	meter includes:
- 34	149-0031-00		1	METER, battery level
	131-0708-00		2	CONNECTOR, terminal
			- 1	mounting hardware: (not included w/meter)
- 35	352-0243-00		1	HOLDER, indicator
•				
-36	214-0992-00			INDICATOR, switch position
- 37	260-0903-00		1	SWITCH, slide (S10)
-38	210-0586-00		2	mounting hardware: (not included w/switch) NUT, keps, 4-40 x 0.25 inch
-39	211-0005-00			SCREW, 4-40 x 0.125 inch, PHS
- 40	386-2072-00			PLATE, mounting
			_	,
-41			1	CIRCUIT BOARD ASSEMBLYOUTPUT (See A4 electrical list)
			-	circuit board assembly includes:
-42	131-0608-00		31	TERMINAL, pin, 0.365 inch long
- 43	214-0579-00		3	TEST POINT
-44	136-0252-04		45	SOCKET, pin connector
- 45	211-0116-00		2	mounting hardware: (not included w/circuit board assembly) SCREW, sems, 4-40 x 0.312 inch, PHB
- 45	211-0116-00		. 2	SCREW, Sellis, 4-40 x 0.312 Illell, FRB
-46	384-1061-01		1	SHAFT, extension
-47			1	CIRCUIT BOARD ASSEMBLYVERTICAL (See A3 electrical list)
• • •			_	circuit board includes:
- 48	136-0252-01		8	SOCKET, pin connector
	136-0252-04		60	SOCKET, pin connector
- 49	131-0608-00		20	TERMINAL, pin, 0.365 long
- 50	214-0579-00		3	TEST POINT

Fig. &				Q	
Index		Serial/	Model No.	t	.
No.	Part No.	Eff	Disc		Description
140.	Full No.	LII	Disc	у	1 2 3 4 5
1-51	344-0061-00	PO10100	DO10107W	/.	CLTD 1:-1-
	129-0250-00	B010100	B010127X	4	CLIP, diode
-53	129-0106-00			1	POST, 0.925 inch long
- 54	131-1003-00			2	POST, 0.125 inch long
- 55	260-0960-01			1	RECEPTICAL, coaxial (J346)
- 56	260-1333-00			1	SWITCH, slide (S345)
- 57	361-0384-00			1	SWITCH, push (S4)
-58	260-1332-00			4	SPACER, 0.133 inch long
-30				1	, r
- 59	211-0007-00			3	mounting hardware: (not included w/circuit board assembly) SCREW, 4-40 x 0.188 inch, PHS
- 60	441-1036-00			1	CHASSIS, vertical & side board
				-	
-61	211-0502-00			3	SCREW, 6-32 x 0.188 inch, 100° csk, FHS
-62	211-0504-00			2	SCREW, 6-32 x 0.25 inch, PHS
					,
-63	200-0103-00			2	CAD hinding neat
-64	355-0507-00				CAP, binding post
-04					STEM, binding post
- 65	210-0455-00			- 1	mounting hardware: (not included w/stem)
-66	210-04455-00			1	NUT, hex., 0.25-28 x 0.375 inch
	210-0040-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
- 67	355-0507-00			1	STEM, binding post
				-	
-68	210-0455-00			1	NUT, hex., 0.25-28 x 0.375 inch
- 69	210-0223-00				TERMINAL, lug, 0.25 inch diameter, SE
- 70	131-1145-00			1	CONNECTOR, w/hardware (J15)
				-	mounting hardware: (not included w/connector)
- 71	210-0255-00			1	
- 72	131-0106-01			2	CONNECTOR, BNC, w/hardware (J11 & J13)
- 73	131-0106-01			2	CONNECTOR, BNC, w/hardware (J11 & J13) CONNECTOR, BNC, w/hardware (J10 & J12)
. 5					mounting hardware for each: (not included w/connector)
- 74	210-0255-00			1	TERMINAL, lug, 0.391 inch diameter, SE
				1	rug, 0.591 then diameter, 5E
- 75	334-1857-00			1	DIATE identification
- 76	334-1858-00			1	PLATE, identification, upper
-77 -77	352-0266-00			1	PLATE, identification, lower
, ,				2	FUSEHOLDER
- 78	210-0405-00		•	-	mounting hardware for each: (not included w/fuseholder)
-79	210-0403-00			1	NUT, hex., 2-56 x 0.188 inch
-80	211-0112-00			1	WASHER, lock, .092 ID x 0.175 inch OD
-00	211-0114 - 00			1	SCREW, 2-56 x 0.375 inch, 100° csk, FHS

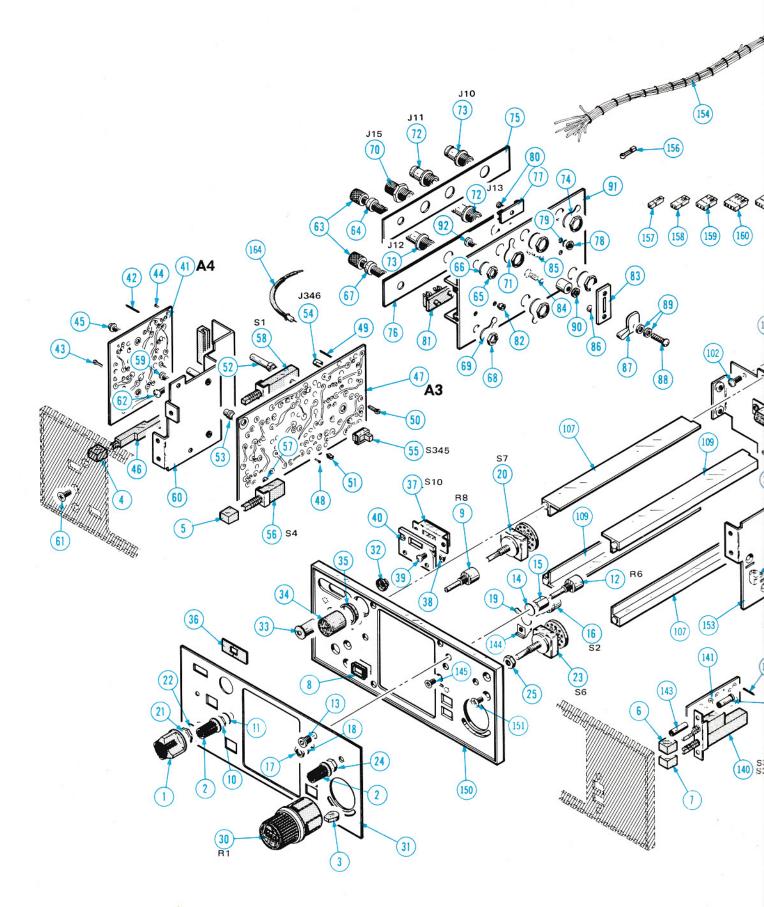
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Fig. &	T. Laurent	Cartal/Mandal Ni	Q	
No.	Tektronix Part No.	Serial/Model No. Eff Disc	t	Description
	Tull 140.	LII DISC	У	1 2 3 4 5
1-81	352-0135-00			FUSEHOLDER, spare
-82	361-0007-00		-	mounting hardware: (not included w/fuseholder)
-02	301-0007-00	•	2	SPACER, plastic
-83	386-2219-00		1	PLATE, indexing battery pack
				mounting hardware: (not included w/plate)
-84	213-0012-00			SCREW, thread cutting, 4-40 x 0.375 inch 100° csk, FHS
-85	213-0034-00			SCREW, thread cutting, 4-40 x 0.312 inch, PHS
-86	361-0501-00		2	SPACER, 0.219 inch long
-87	105-0062-02		1	CATCH, friction
				mounting hardware: (not included w/catch)
-88	211-0192-00			SCREW, shouldered, 4-40 x 0.34 inch
- 89	210-0907-00		2	WASHER, retaining, 0.25 inch OD
- 90	210-0948-00		1	WASHER, plastic, 0.166 ID \times 0.216 inch OD
- 91	407-0988-00		1	BRACKET
			-	mounting hardware: (not included w/bracket)
- 92	211-0504-00		4	SCREW, 6-32 x 0.25 inch, PHS
- 93	386-2116-00			SUPPORT, power supply
				mounting hardware: (not included w/support)
- 94	211-0502-00		2	SCREW, 6-32 x 0.188 inch, 100° csk, FHS
- 95			1	CIRCUIT BOARD ASSEMBLYPOWER SUPPLY (See A8 electrical list
	·		_	circuit board assembly includes:
- 96	131-0608-00		24	
- 97	136-0252-04		63	SOCKET, pin connector
			-	mounting hardware: (not included w/circuit board assembly)
- 98	220-0438-00			NUT, hex., 4-40 x 0.25 inch long
- 99	220-0449-00		4	NUT, sleeve, $4-40 \times 0.50$ inch long
-100	342-0109-00		1	INSULATOR
-101	441-1034-00			CHASSIS, power supply
			-	mounting hardware: (not included w/chassis)
- 102	211-0504-00		2	SCREW, $6-32 \times 0.25$ inch, PHS
-103	131-1165-00		1	CONNECTOR, receptical (P700)
			_	mounting hardware: (not included w/connector)
-104	211-0034-00		2	SCREW, 2-56 x 0.50 inch, PHS
-105	166-0024-00		2	SPACER, tube, 0.125 inch long
				•

		1.	IGORD I	HAIN FRAME (COME)
Fig. &			Q	
-	Tektronix	Serial/Model No		B
				Description
No.	Part No.	Eff Disc	y_	1 2 3 4 5
1-106	252-0564-00		ft	CHANNEL, plastic, 0.5 foot
-107	351-0315-00		2	GUIDE, plug-in, bottom right & top left
			-	mounting hardware for each: (not included w/guide)
-108	211-0504-00			SCREW, 6-32 x 0.25 inch, PHS
				,,,
-100	351-0317-00		2	CUIDE pluggin bottom loft & top might
-109	331-0317-00			GUIDE, plug-in, bottom left & top right
110	011 050/ 00			mounting hardware for each: (not included w/guide)
-110	211-0504-00		1	SCREW, 6-32 x 0.25 inch, PHS
-111			1	CIRCUIT BOARD ASSEMBLYSWEEP (See A2 electrical list)
			-	circuit board includes:
-112	136-0263-03		5	SOCKET, pin connector
-113	136-0252-04		50	SOCKET, pin connector
-114	131-0608-00		13	TERMINAL, pin, 0.365 inch long
-115	214-0579-00		2	TEST POINT
			_	mounting hardware: (not included w/circuit board assembly)
-116	211-0116-00		4	SCREW, sems, 4-40 x 0.312 inch, PHB
-117	220-0449-00		2	
-11/	220-0449-00		, 2	Noi, Sieeve, 4-40 x 0.30 inch long
-118	214-1657-00		1	LEVER, cam switch
-110	214-1037-00	•		
110	211 0102 00		-	lever includes:
-119	211-0183-00		1	SCREW, 4-40 x 0.50 inch, SHS
-120			1	CIRCUIT BOARD ASSEMBLYFAST RAMP (See A1 electrical list)
			-	circuit board assembly includes:
-121	131-0592-00		5	TERMINAL, pin, 0.885 inch long
	131-0608-00		9	TERMINAL, pin, 0.365 inch long
	136-0252-04		97	SOCKET, pin connector
-123	214-0579-00		4	TEST POINT
-124	351-0155-00		2	TERMINAL, lead guide
- 125	131-0604-00		7	CONTACT, electrical, cam switch
	105-0298-00		1	CAM SWITCH ASSEMBLY
			_	cam switch assembly includes:
-126			1	COVER, cam switch
			_	mounting hardware: (not included w/cover)
-127	211-0022-00		2	SCREW, 2-56 x 0.188 inch, PHS
-128	210-0001-00		2	WASHER, lock, internal, 0.92 ID x 0.18 inch OD
- 129	210-0405-00		2	NUT, hex., 2-56 x 0.187 inch
120	254001000		1	DING waterings
-1 30	354-0219-00		1	RING, retainer
-131	401-0057-01		1	BEARING, cam switch, front
-132	214-1139-01 ¹		-	SPRING, flat, gold
	214-1139-02		-	SPRING, flat, green
	214-1139-03 ¹		-	SPRING, flat, red
- 133	214-1127-00		1	ROLLER, detent
-1 34	105-0295-00		1	DRUM, cam switch
-135	401-0056-00		1	BEARING, cam switch, rear
-136	210-0406-00		4	NUT, hex., 4-40 x 0.187 inch
			_	mounting hardware: (not included w/cam switch assembly)
-137	211-0116-00		4	SCREW, sems, 4-40 x 0.312 inch, PHB
-137			-	mounting hardware: (not included w/circuit board assembly)
-138	211-0116-00		4	SCREW, sems, 4-40 x 0.312 inch, PHB
-130	211-0110-00		4	DOREM, SEIIS, 4-40 A V.JIZ IIICII, FIID

 $^{^{1}\}mathrm{Replace}$ only with part bearing the same color code as the original part in your instrument.

Fig. & Index	Tektronix	Serial/Model No.	Q †	Description
No.	Part No.	Eff Disc	у	Description
1-	262-0960-00		1	SWITCH ASSEMBLY
			-	switch assembly includes:
- 139	131-0592-00		7	TERMINAL, pin, 0.885 inch long
	131-0787-00		11	TERMINAL, pin, 0.64 inch long
-140	260-1331-00		1	SWITCH, push (S3A & S3B
-141	388-2742-00		1	CIRCUIT BOARD
			-	mounting hardware: (not included w/switch assembly)
- 142	210-0599-00		2	NUT, sleeve, $4-40 \times 0.391$ inch long
-143	361-0502-00		2	SPACER, sleeve, 0.469 inch long
-144	220-0547-01		3	NUT, block
				mounting hardware for each: (not included w/nut)
- 145	211-0105-00		1	SCREW, $4-40 \times 0.188$ inch, 100° csk, FHS
-146	220-0547-01		2	NUT, block
			-	mounting hardware for each: (not included w/nut)
-147	211-0007-00		1	SCREW, 4-40 \times 0.188 inch, PHS
-148	220-0547-03		2	NUT, block
			-	mounting hardware for each: (not included w/nut)
-1 49	211-0105-00		1	SCREW, $4-40 \times 0.188$ inch, 100° csk, FHS
- 150	426-0824-01		1	FRAME, panel front
			-	mounting hardware: (not included w/frame)
-151	211-0502-00		2	SCREW, 6-32 x 0.188 inch, 100° csk, FHS
-152	348-0145-00			GROMMET, U-shaped
	002-0147-00			SHEET, plastic 1 x 6 inches long (not shown)
	441-1035-00		1	CHASSIS
-154	179-1784-00		1	WIRING HARNESS
155	121 0707 00		-	wiring harness includes:
-133	131-0707-00 131-0708-00		98 18	CONNECTOR, terminal CONNECTOR, terminal
_156	131-0740-01		2	CONNECTOR, terminal
-170	131-0755-01		2	CONNECTOR, terminal
-157	352-0171-00		1	HOLDER, terminal connector, 1 wire (black)
-158	352-0169-00		9	HOLDER, terminal connector, 2 wire (black)
-159	352-0161-00		9	HOLDER, terminal connector, 3 wire (black)
-160	352-0162-00		7	HOLDER, terminal connector, 4 wire (black)
-161	352-0163-00		4	HOLDER, terminal connector, 5 wire (black)
-162	352-0164-00		1	HOLDER, terminal connector, 6 wire (black)
-163	352-0167-00		1	HOLDER, terminal connector, 9 wire (black)
-164	175-1410-00		1	CABLE ASSEMBLY, coaxial w/connector (J15 to J346)

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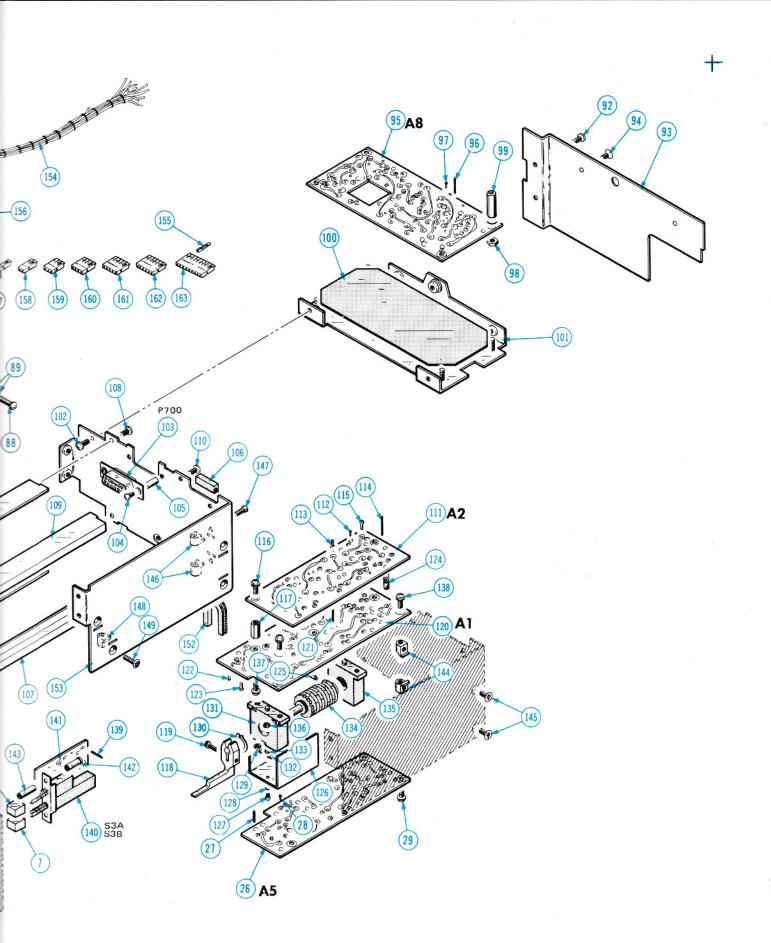


FIGURE 2 CHART RECORDER

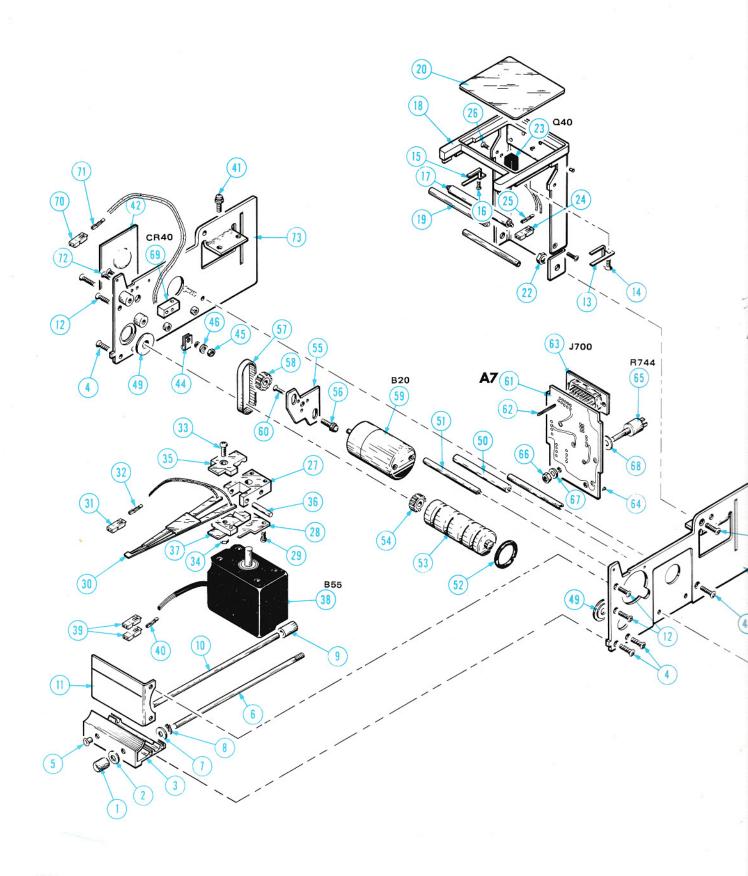
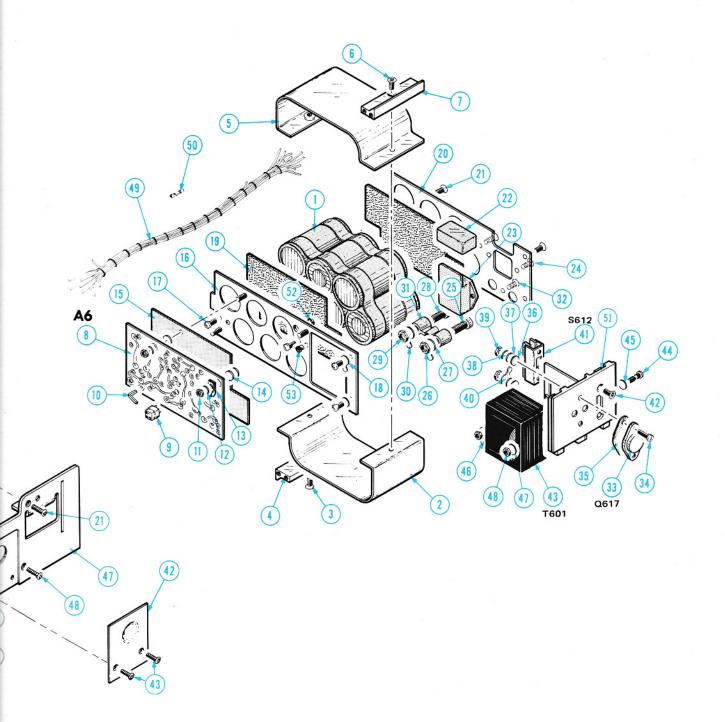
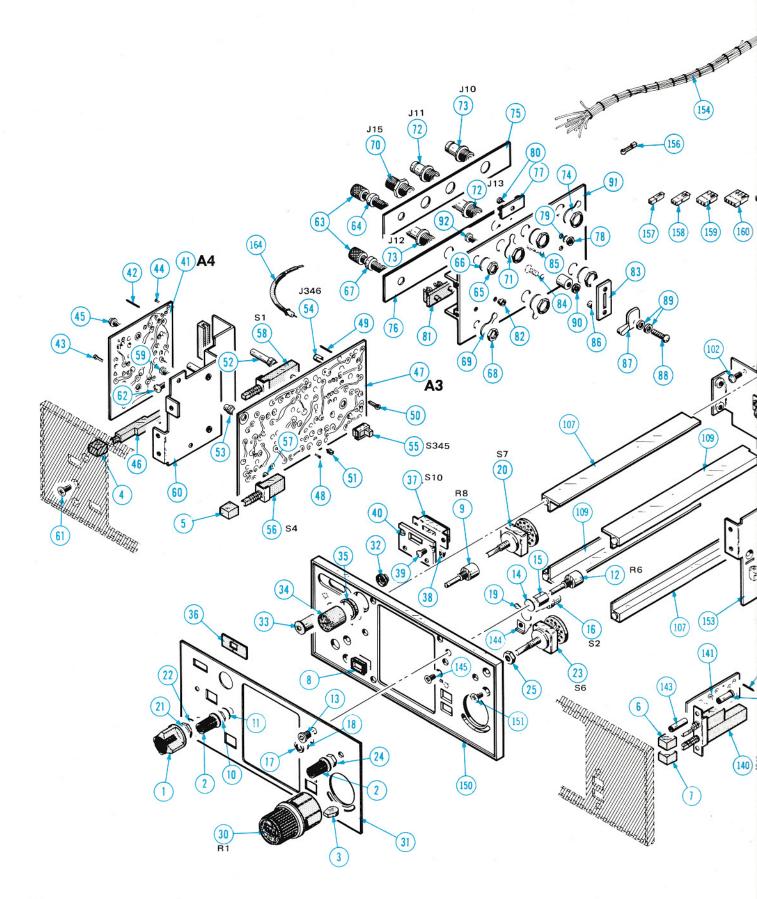
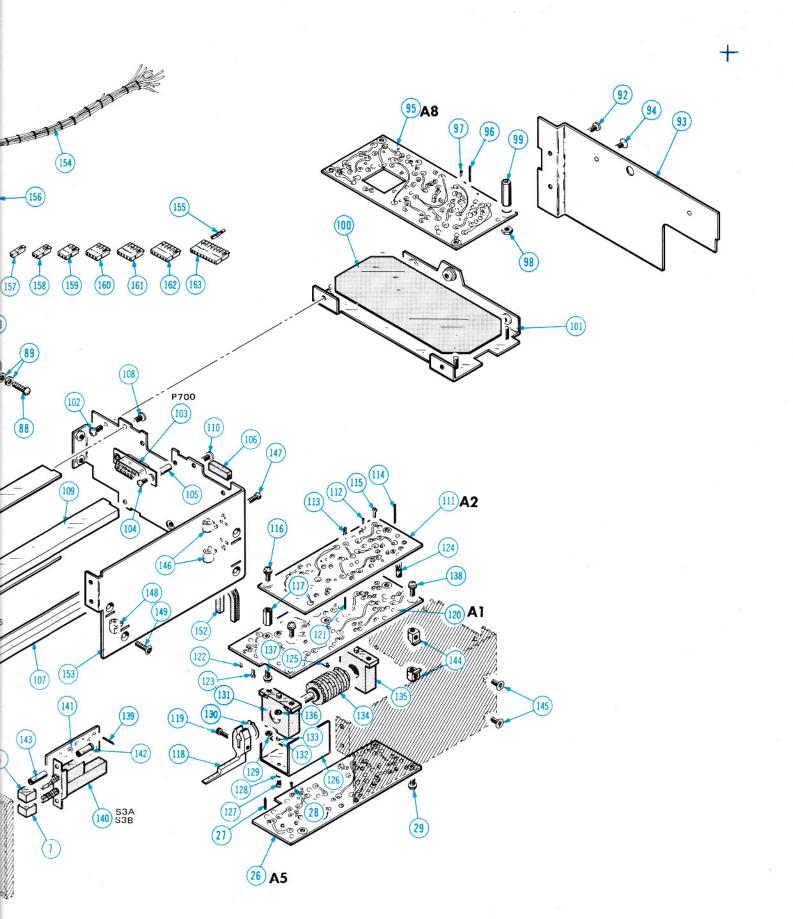


FIGURE 3 POWER PACK



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FIGURE 2 CHART RECORDER

F: ^		FI		2 CHART RECORDER
Fig. &			Q	
Index	Tektronix	Serial/Model No.	t	Description
No.	Part No.	Eff Disc	У	1 2 3 4 5
2-1	366-1368-00		1	KNOB, plug-in, securing
			_	knob includes:
	213-0076-00		1	SETSCREW, 2-56 x 0.125 inch, HSS
- 2	210-1011-00			WASHER, plastic, 0.117 ID x 0.375 inch OD
-3	426-0852-00			FRAME SECTION, front
			-	
-4	211-0101-00			SCREW, 4-40 x 0.250 inch, 100° csk, FHS
- 5	358-0378-00		1	BUSHING
- 6	384-0824-00			ROD, securing
- 7	210-0803-00		1	WASHER, flat, 0.150 ID x 0.375 inch OD
-8	354-0175-00		1	RING, retainer
- 9	376-0029-00		1	COUPLER
			-	coupler includes:
	213-0075-00		2	SETSCREW, $4-40 \times 0.9375$ inch, HSS
-10	384-1157-00			SHAFT, extension
-11	386-2118-00			PLATE, backing
				mounting hardware: (not included w/plate)
-12	211-0030-00		3	SCREW, 2-56 x 0.250 inch, 82° csk, FHS
-13	214-1678-00		1	SPRING, roller tension, right
13			_	
- 14	213-0254-00			SCREW, thread cutting, 2-56 x 0.250 inch, 100° csk, FHS
-15	214-1679-00		1	SPRING, roller tension, left
				mounting hardware: (not included w/spring)
- 16	213-0254-00			SCREW, thread cutting, 2-56 x 0.250 inch, 100° csk, FHS
-17	214-1674-00		1	ROLLER, chart paper driven
-18	200-1302-01		1	
			-	bezel assembly includes:
-1 9	214-1663-00		1	ROLLER, chart paper
-20	331-0298-00		1	WINDOW, observation
			-	mounting hardware: (not included w/bezel assy)
-21	211-0101-00		2	SCREW, 4-40 x 0.250 inch, 100° csk, FHS
-22	220-0629-00		2	NUT, sleeve
			_	
-23			1	
0.4	252 0160 00		-	transistor holder assembly includes:
			1	HOLDER, terminal connector, 2 wire
-25	131-0707-00		2	CONNECTOR, terminal
-26	213-0254-00		2	mounting hardware: (not included w/transistor holder assy) SCREW, 2-56 x 0.250 inch, 100° csk, FHS
	00		-	John, I so h oraso know, 100 con, 110

FIGURE 2 CHART RECORDER (cont)

Fig. &			Q		
Index Tektronix		Serial/Model No.	t	Description	
No.	Part No.	Eff Disc	У	1 2 3 4 5	_
2-27	214-1681-00		1	HINGE, half, stationary	
			-	hinge includes:	
	213-0205-00		1	SETSCREW, 4-40 x 0.188 inch, HSS	
-28	214-1680-00		1	SPRING, pen hinge	
			<u>-</u>	mounting hardware: (not included w/spring)	
- 29	211-0116-00		2	SCREW, sems, 4-40 x 0.312 inch, PHB	
-30	119-0365-01		1	STYLUS	
-50			_	stylus includes:	
-31	352-0169-00		1	HOLDER, terminal connector, 2 wire	
-32	131-0708-00		2		
J.			_	mounting hardware: (not included w/stylus)	
-33	211-0008-00			SCREW, $4-40 \times 0.187$ inch	
-34	210-0406-00			NUT, hex., 4-40 x 0.187 inch	
-35	214-1682-00			HINGE, half, upper	
-36	214-1749-00			PIN, hinge	
-37	214-1682-01		1	HINGE, half, lower	
- 38	147-0037-01		1	MOTOR D.C. (B55)	
-30			_	motor includes:	
-39	352-0169-00		2	HOLDER, terminal connector	
-40	131-0707-00		4	CONNECTOR, terminal	
-10			_	mounting hardware: (not included w/motor)	
-41	211-0601-00		4	SCREW, sems, 6-32 x 0.312 inch, PHB	
- 42	352-0296-00		2	HOLDER, paper	
74			_	mounting hardware for each: (not included w/holder)	
- 43	211-0112-00		2		
- 44	343-0119-00		1	CLAMP, cable, 0.094 inch diameter	
-44	343-0119-00		-		
- 45	210-0405-00			NUT, hex., 2-56 x 0.187 inch	
	210-0403-00			WASHER, lock, split, 0.092 ID x 0.175 inch OD	
- 46	210-0850-00			WASHER, flat, .093 ID x 0.281 inch OD	
_ 1.7	626_0027_00		1	FRAME SECTION, right slide	
- 47	426-0837-00			mounting hardware: (not included w/frame)	
-48	211-0030-00		1	SCREW, 2-56 x 0.250 inch, 82° csk, FHS	
-40	211-0030-00		T	DOMEN, E DO A 0,200 Inches OF COR, Inc	

FIGURE 2 CHART RECORDER (cont)

Fig. &			Q	
• .	Tektronix	Serial/Model No.	t	Description
No.	Part No.	Eff Disc	v	1 2 3 4 5
	1411 140.			2 0 4 0
2-49	401-0147-00		2	BEARING, drive roller
-50	214-1662-00		1	ROLLER, chart paper (stationary)
- 51	214-1664-00			ROLLER, chart paper (stylus)
-52	354-0429-00		4	RING, rubber
-53	214-1675-01			ROLLER, chart paper (drive core)
-54	401-0186-02		1	SPROCKET, wheel
			-	sprocket includes:
	213-0140-00		1	SETSCREW, 2-56 x 0.094 inch, HSS
- 55	386-2084-00		1	PLATE, motor mounting
			-	
- 56	211-0116-00		2	SCREW, sems, 4-40 x 0.312 inch, PHB
- 57	214-1709-00			BELT, positive drive
- 58	401-0186-01			SPROCKET, wheel
				sprocket includes:
	213-0076-00		1	SETSCREW, 2-56 x 0.125 inch, HSS
- 59	147-0036-00	•	1	MOTOR, paper drive (B20)
			-	mounting hardware: (not included w/motor)
- 60	211-0202-00		3	SCREW, 1.7×5 MM, 90° csk, FHS
- 61			1	CIRCUIT BOARD ASSEMBLY (See A7 electrical list)
-01	·		_	circuit board includes:
-62	131-0608-00		12	TERMINAL, pin, 0.365 inch long
-63	131-1164-00		1	CONNECTOR, receptical electrical (J700)
-64	136-0252-04		15	SOCKET, pin, connector
- 65			1	RESISTOR, variable (See R744 electrical list)
			_	mounting hardware: (not included w/resistor)
-66	210-0583-00		1	NUT, hex., 0.25-32 x 0.312 inch
- 67	210-0940-00		1	WASHER, flat, 0.25 ID \times 0.375 inch OD
-68	210-0992-00		1	WASHER, plastic, 0.265 ID x 0.437 inch OD
-69			1	DIODE HOLDER ASSEMBLY (See CR40 electrical list)
			-	diode holder assembly includes:
-70			1	
-71	. 131-0707-00		2	
			_	mounting hardware: (not included w/diode holder assy)
-72	213-0254-00		2	SCREW, thread cutting, 2-56 x 0.250 inch, 100° csk, FHS
-73	426-0838-00		1	FRAME SECTION, left
-74	129-0326-00		1	POST, metalic, 2.10 inches long, 0.125 inch OD
			-	mounting hardware: (not included w/post)
-75	211-0030-00		2	
-76	129-0327-00		1	POST, metalic, 2.024 inches long, 0.188 inch OD .

FIGURE 3 POWER PACK

			r IGUN	E 3 FOWER PACK
Fig. &			Q	
Index	Tektronix	Serial/Model No.	ŧ	
				Description
No.	Part No.	Eff Disc	у_	1 2 3 4 5
3-	016-0119-02		1	POWER PACK, w/batteries
5-			_	power pack includes:
-1	146-0012-01		1	BATTERY SET
-1				
			-	battery set includes:
	146-0011-01		6	BATTERY, NiCd, 1.25 V, solder lug type
	016-0119-01		-	POWER PACK, w/o batteries
			-	power pack includes:
- 2	343-0148-00		1	CLAMP, battery retaining
			-	mounting hardware: (not included w/clamp)
- 3	211-0025-00		1	SCREW, 4-40 x 0.375 inch, 100° csk, FHS
-4	105-0063-00		1	STRIKE, post
				, ,
- 5	343-0148-03		1	CLAMP, battery retaining
-5	343-0140-03		_	mounting hardware: (not included w/clamp)
,	011 0005 00			SCREW, 4-40 x 0.25 inch, 100° csk, FHS
- 6	211-0025-00		1	
- 7	105-0063-00		1	STRIKE, post
-8			1	CIRCUIT BOARD ASSEMBLYBATTERY CHARGER (See A6
-0			_	electrical parts list)
				circuit board assembly includes:
			-,	•
- 9	136-0220-00		4	SOCKET, transistor, 3 pin, square
	214-0506-00		3	CONNECTOR, square pin
-10	214-0507-00		4	CONNECTOR, square pin, angled
			-	mounting hardware: (not included w/circuit board assy)
-11	210-0406-00		6	NUT, hex., 4-40 x 0.188 inch
-12	210-0004-00		3	WASHER, lock, internal, 0.12 ID x 0.26 inch OD
- 13	343-0119-00		1	CLAMP, cable, 0.094 inch diameter
-14	210-0994-00		2	WASHER, flat, 0.125 ID \times 0.25 inch OD
-15	214-1059-00		1	INSULATOR
-16	386-1328-00		1	PLATE, battery box, inside
			_	mounting hardware: (not included w/plate)
-17	211-0008-00		5	SCREW, 4-40 x 0.25 inch, PHS
-18	210-0201-00		1	TERMINAL, lug, 0.12 inch diameter, SE
10	210 0201 00		_	22.2.2
- 19	214-1013-01		2	INSULATOR, plate, foam
- 20	386-1327-00		1	PLATE, battery box, outside
-20	360-1327-00		_	mounting hardware: (not included w/plate)
0.1			6	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-21	211-0101-00		0	SOREW, 4-40 x 0.25 Inch, 100° CSK, FIIS
0.0	200 0012 00		1	COVER fund
-22	200-0813-00		1	COVER, fuse
- 23	131-0552-00		1	CONNECTOR, w/fuseholder
			-	mounting hardware: (not included w/connector)
-24	211-0101-00		2	SCREW, $4-40 \times 0.25$ inch, 100° csk, FHS
- 25	136-0140-00		1	SOCKET, banana jack, charcoal
			_	mounting hardware: (not included w/socket)
-26	210-0465-00		1	NUT, hex., 0.25-32 x 0.375 inch
-27	210-0403-00		1	
-21	210-0223-00		T	Idealimb, 105, 0.25 to a 0.450 then ob

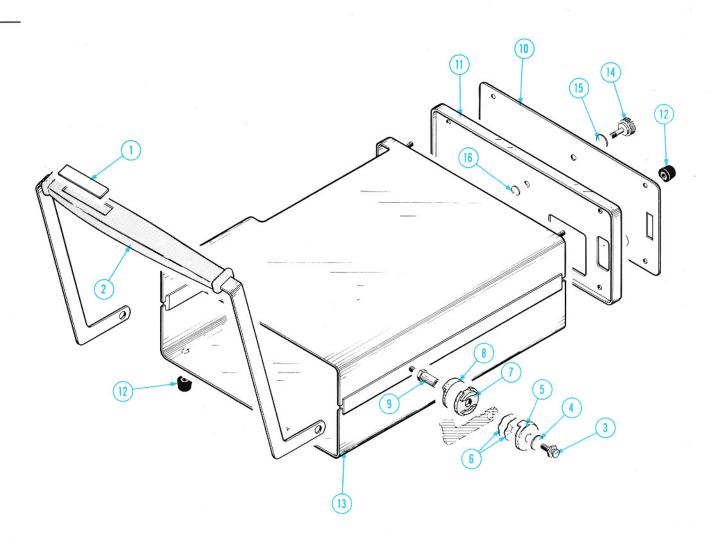
FIGURE 3 POWER PACK (cont)

Fig. &			Q	
Index	Tektronix	Serial/Model No.	t	Description
No.	Part No.	Eff Disc	y 1	2 3 4 5
-28	136-0139-00		1	SOCKET, banana jack, red
			-	mounting hardware: (not included w/socket)
-29	210-0465-00		1	NUT, hex., 0.25-32 x 0.375 inch
-30	210-0223-00		1	TERMINAL, lug, 0.25 ID x 0.438 inch OD
-31	352-0132-00		1	HOLDER, tip jack
			-	mounting hardware: (not included w/holder)
-32	213-0107-00		1	SCREW, thread forming, 4-40 \times 0.25 inch, 100° csk, FHS
- 33			1	TRANSISTOR (See Q617 electrical parts list)
			-	mounting hardware: (not included w/transistor)
- 34	211-0510-00		2	SCREW, 6-32 x 0.375 inch, PHS
- 35	214-1025-00		1	INSULATOR, mica
- 36	210-0811-00		2	WASHER, fiber, shouldered
- 37	210-0802-00		1	WASHER, flat, 0.15 ID x 0.312 inch OD
-38	210-0006-00		2	WASHER, lock, internal, 0.146 ID x 0.283 inch OD
-39	210-0407-00		2	NUT, hex., $6-32 \times 0.25$ inch
- 40	210-0202-00		1	TERMINAL, lug, SE
-41	260-0902-00		1	SWITCH, slideEXT DC, TRICKLE CHG, Full CHG (S612)
			-	mounting hardware: (not included w/switch)
-4 2	211-0119-00		2	SCREW, 4-40 x 0.25 inch, 100° csk, FHS
-43			1	TRANSFORMER (See T601 electrical parts list)
			-	mounting hardware: (not inclued w/transformer)
-44	211-0153-00		2	SCREW, 4-40 x 1.281 inches, RHS
- 45	210-0906-00		2	WASHER, fiber, 0.125 ID x 0.203 inch OD
- 46	210-0201-00		1	TERMINAL, lug, 0.12 inch diameter, SE
-47	210-0004-00		1	WASHER, lock, 0.12 ID x 0.26 inch OD
- 48	210-0406-00		2	NUT, hex., 4-40 x 0.188 inch
- 49	179-1207-00		1	WIRING HARNESS
- 50	131-0371-00		3	CONNECTOR, terminal
- 51	214-0993-00		1	HEATSINK, transistor
- 52	348-0055-00		1	GROMMET, plastic, 0.25 inch diameter
- 53	348-0031-00		1	GROMMET, plastic, 0.156 inch diameter

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Fig. & Index	Tektronix	Serial/Model No.	Q t	
No.	Part No.	Eff Disc	У	1 2 3 4 5 Description
4-	437-0132-00		1	CABINET ASSEMBLY
			-	cabinet assembly includes:
-1	334-1544-01		1	PLATE, identification
-2	367-0127-00		1	HANDLE, carrying
			2	mounting hardware: (not included w/handle)
-3	213-0179-02		2	SCREW, cap, 6-32 X 0.394 inch, HHS
-4	132-0084-00		2	SPACER, plastic, 0.45 inch diameter
-5	200-0819-00		2	COVER, handle brake assembly
-6	210-1053-00		4	WASHER, spring tension
-7	386-1331-00		2	PLATE, brake, friction, 0.782 inch OD
-8	386-1339-00		2	PLATE, brake, friction, 0.781 inch OD
-9	129-0148-02		2	POST, hex., 6-32 X 0.444 inch
-10	386-2080-00		1	PANEL, rear
-11	426-0824-02		1	FRAME-PANEL, rear
-12	348-0187-00		8	FOOT, cabinet
-13	390-0241-00		1	CABINET SUBASSEMBLY
-14	213-0170-00		1	THUMBSCREW, 8-32 X 0.82 inch
-15	210-1011-00		1	WASHER, plastic, 0.13 ID X 0.375 inch OD
-16	354-0324-00		1	RING, retaining, 0.102 ID X 0.27 inch OD



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FIGURE 6 REPACKAGING

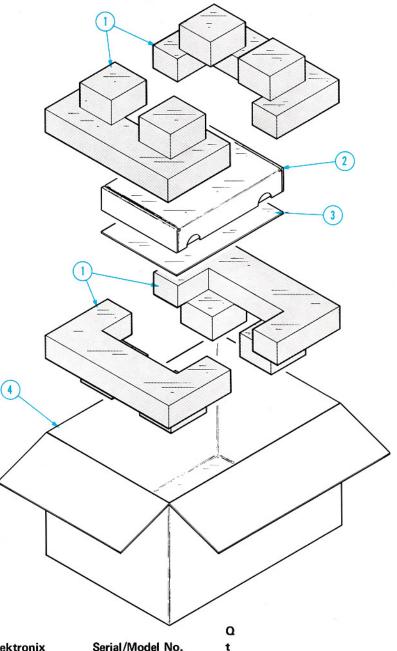


Fig. & Index	Tektronix	Serial/Model No.		Q t			
No.	Part No.	Eff	Disc	У	1 2	3 4 5	Description
6-	065-0180-00			1	CART	TON ASSEMB	LY
					car	rton assembly	includes:
-1	004-0259-00			2	FF	RAME	
-2	004-0816-00			1	CA	ARTON, acces	sory
-3	004-1123-00			1	PA	D SET, 1 pied	ce
-4	004-0815-00			1	CA	ARTON	

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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.

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.



PRODUCT GENERAL CHANGE REFERENCE S23,351

DATE 6-10-76 REV.

CHANGE:

DESCRIPTION

This applies to all instruments with detachable cord.

WARNING

To avoid electrical shock or equipment damage, be sure to replace the cord set only with another of the same polarity.

Power Cord Conductor Identification

ConductorColorAlternate ColorUngrounded (Line)BrownBlackGrounded (Neutral)BlueWhiteGrounding (Earthing)Green-YellowGreen-Yellow



PRODUCT 1501 SERVICE 070-1206-00

CHANGE REFERENCE <u>C2/176</u> **DATE** <u>1-9-76</u>

CHANGE:

DESCRIPTION

TEXT CORRECTION

Page 2-14

Column one; step 3.

Change the fourth line of step 3 to read:

be moved over the six vertical divisions of the graph



1501 Service PRODUCT __

EFF SN B070000-up

CHANGE REFERENCE M23,061

4-1-75 DATE

CHANGE:

DESCRIPTION

070-1206-00

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

Α5

670-1708-02

LOGIC Circuit Board Assembly

R501

316-0683-00

68 k Ω , 1/4 W, 10%

R505

316-0393-00

39 k Ω , 1/4 W, 10%

Α7

670-1742-02

CHART CONTROL Circuit Board Assembly

MECHANICAL PARTS LIST CHANGE

ADD:

175-0702-00 1 WIRE STRAP, Teflon Insulated 7/8"

