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1503
TIME DOMAIN REFLECTOMETER

INSTRUCTION MANUAL

Tektronix, Inc.
P.O. Box 500
Beaverton, Oregon 97077

070-1865-01
Product Group 22

Serial Number _____

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THE FOLLOWING SERVICE INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

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OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS

In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

In This Manual



This symbol indicates where applicable cautionary or other information is to be found.

As Marked on Equipment



DANGER — High voltage.



Protective ground (earth) terminal.



ATTENTION — refer to manual.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord. To avoid electrical shock, plug the power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for your product.

Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.

SERVICE SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

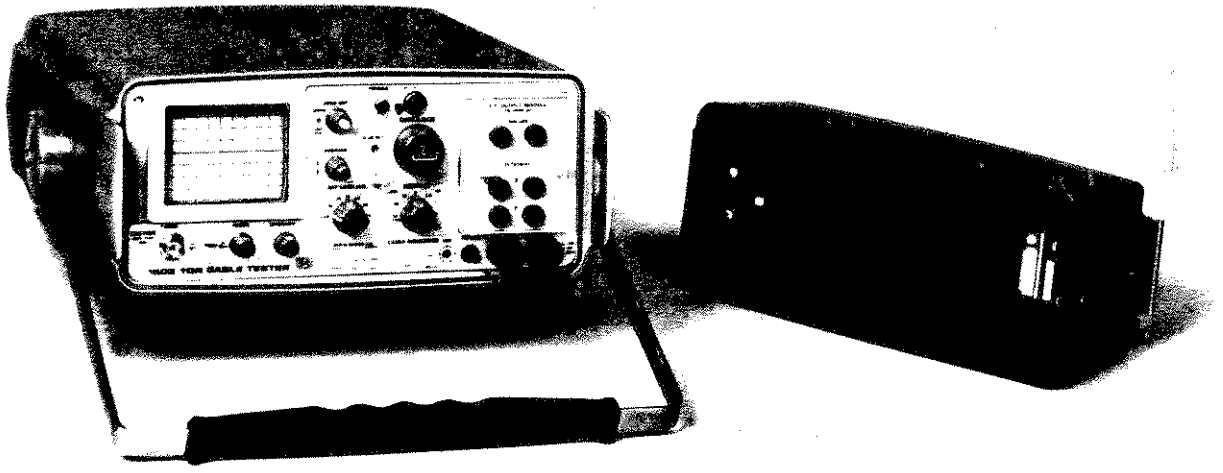
Use Care When Servicing With Power On

Dangerous voltages exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

This product is intended to operate from a power source that will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.



1865-01A

1503 Time Domain Reflectometer.

SPECIFICATION

General Information

The TEKTRONIX 1503 is a portable Time Domain Reflectometer which uses pulse techniques to test cables and provides a visual display of cable faults. The test pulses are transmitted via the CABLE output jack. Reflections are received at the same jack and displayed on the cathode-ray tube (crt).

NOTE

All distances are shown in feet followed by metres in parenthesis. Metric units **are not** *direct conversions from the measurements shown in feet, but represent the calibrated ranges of the metric option 1503. Multiplier settings for the metric options are indicated in the same manner.*

Calibrated distance controls allow an operator to examine up to 50,000 feet (10,000 metres) of cable. Up to 7,500 feet (1,500 metres) of cable can be examined with the multiplier control at X10 (X1) from which 50 to 5000 feet (10 metres to 1000 metres) can be displayed across the 10-division horizontal (X-axis) crt scale with an additional 0 to 2500 feet (0 to 500 metres) of distance covered by the DISTANCE dial. Up to 50,000 feet (10,000 metres) of cable can be examined when the multiplier control is at X100 (X10) of which 500 to 50,000 feet (100 to 10,000 metres) can be examined across the crt face. With the FEET/DIV (METRES/DIV) control set at 50, (100) and X100 (X10) up to 50,000 feet (10,000 metres) of cable can be displayed on the crt screen, but in this position the DISTANCE dial is disabled. The horizontal crt scale is calibrated in distance units from 5 feet (1 metre) per division to 5000 feet (1000 metres) per division in a 1-2.5-5 sequence. Distance calibration accuracy on the crt scale is within ±2% of indication.

There are three externally selectable dielectric constants. Two of these are calibrated for foamed polyethylene (FOAM POLY) and solid polyethylene (SOLID POLY). The third is obtained by "default" conditions; both pushbuttons depressed or both pushbuttons released. When both pushbuttons (FOAM POLY and SOLID POLY) are depressed or released, the effective dielectric constant is variable, being controlled by a screwdriver adjustment labeled "VAR". The fully clockwise position of the "VAR" control sets the dielectric constant for air.

Vertical (Y-axis) deflection of the crt beam is proportional to the amplitude of the reflected signal. The vertical scale is a linear representation of the return pulse and is ordinarily calibrated so that two divisions represent "0 dB" when the reference level is set to "0 dB". The dB reference level is selectable in 7 calibrated steps from 0 dB to 60 dB plus a 0 to 18 dB vernier adjustment.

The transmitted pulse is an impulse signal of approximately 5 V into a 50 Ω, 75 Ω, 93 Ω, or 125 Ω load. Half-sine shaped pulse durations of 10 ns, 100 ns, or 1000 ns are selectable from the front panel. Durations are measured at the half amplitude points.

The 1503 plug-in compartment will accept either the X-Y Output Module or the TEKTRONIX Y-T Chart Recorder. The X-Y Output Module is a standard accessory for the 1503 and provides an interface for an X-Y recorder. The TEKTRONIX Y-T Chart Recorder is an optional accessory. This recorder uses a heated stylus to record on 4 cm wide, heat-sensitive chart paper. The chart recording length represents the entire crt screen and is controlled by the 1503.

The 1503 is a ruggedized portable instrument that can be used in the field as well as in the laboratory. The 1503 meets requirements for a Type III, Class 3, Style A instrument as specified in MIL-T-28800. The 1503 has a ruggedized case that provides protection when the instrument is stored in exposed areas. When the instrument is not being used, the accessories, including the Operators manual, may be packed in the instrument cover and latched tightly on the front of the instrument. Table 1-1 indicates which accessories may be placed in the cover of the 1503.

The characteristics given in Table 1-2 apply over an ambient temperature range from −15°C to +55°C after the instrument has been calibrated at +25°C, ±5°C.

Table 1-1

STANDARD ACCESSORIES FOR THE 1503

Accessory	Tektronix Part Number
2 Replacement Fuses (ac—for front panel)	159-0032-00 (for 115 Vac) or 159-0029-00 (for 230 Vac)
1 Power Cord	161-0066-00
1 Viewing Hood	016-0297-00
1 50 Ω BNC Terminator	011-0123-00
1 X-Y Output Module	016-0606-00
1 Filter, Mesh (crt)	378-0055-00
1 Operators Handbook	070-1864-00
1 Instruction Manual	070-1865-00
1 Cable Assembly	012-0671-00
1 Calculator, TDR Cable Tester	003-0700-01

Table 1-2

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
Impulse		
Width	Selectable: 10 ns, 100 ns, 1000 ns	Measured at half amplitude point.
Accuracy	±20%	
Amplitude		
Terminated	5 V ±20%	
Unterminated	10 V ±20%	
Shape	1/2 sine	
Termination		50 Ω, 75 Ω, 93 Ω ±1%, 125 Ω ±3%.
Jitter	0.2 division maximum	At 5 ft/div (1 m/div)
Graticule Deflection		
Deflection		
Range	+6 to −18 dB	From deflection reference; linear scale on gratiucle. 0 dB=2 div, displayed signal ⩾0.1 div.
Accuracy	±3%	
Deflection Reference	0 to 60 dB	7 steps, 10 dB increments.
Accuracy	±0.1 dB	
Variable	0 to 18 dB	Additive to step increments. Fully clockwise is 18 dB ±2.0 dB.

Table 1-2 (cont)

Characteristics	Performance Requirements	Supplemental Information
Displayed Noise		With proper termination, 10 ns pulse, and pulse completely off-screen.
Aberrations	−30 dB peak-to-peak	Within first three test pulse widths after test pulse.
Random	−80 dB rms	Beyond first three test pulse widths after test pulse.
Low Noise Operation Random	−86 dB rms	Three test pulse widths after initial test pulse.
Test Line Conductor Coupling		AC coupled
Maximum Input		±400 V (dc + peak ac at maximum frequency of 440 Hz).
Distance Control Range	0 to 50,000 feet (0 to 10,000 metres)	
Scales	5 ft/div to 500 ft/div (1 m/div to 100 m/div)	@ X10 (X1) 7 steps, 1-2.5-5 sequence. At 5000 ft/div (1000 m/div) (FIND), the DISTANCE dial is disabled.
Accuracy	±2%	Of display screen from 2nd to tenth graticule line.
Scale Multipliers	X10 and X100 (X1 and X10)	
Accuracy	±2%	From 2nd to tenth graticule line.
Distance Dial Range	0 to 2,500 feet (0 to 500 metres) 0 to 25,000 feet (0 to 5,000 metres)	At X10 setting (At X1 setting) At X100 settings (At X10 settings)
Accuracy	2% of reading, ±2 ft @ X10, (±0.2 metres @ X1) ±20 ft @ X100, (±2 metres @ X10)	
Dielectric Scales Solid Poly	$V_p/V_{air} = 0.66$	Used where velocity of propagation is 65.9% C (C=speed of light.)
Foam Poly	$V_p/V_{air} = 0.81$	Where velocity of propagation is 81% C.

@

Table 1-2 (cont)

Characteristics	Performance Requirements	Supplemental Information
VAR	V_p/V_{air} = 0.31 to 1.0	Activated when both SOLID POLY and FOAM POLY buttons released; or both depressed calibrated for air when VAR control set to Full cw position.
Sweep	40 Hz within −0 Hz, −10 Hz	Noise Filter switch "out".
Sweep (Chart Recorder Mode)	20 sec/sweep nominal	Varies and is dependent on chart recorder.
Chart Tracking	±2% from 2nd to tenth graticule line	
Line Voltage	117 Vac ±20%, 48 to 410 Hz or 234 Vac ±20%, 48 to 410 Hz	
Line Power	5 W average	
Battery Pack Operation	At least 5 hours	C size, 9 cell +20°C to +25°C charge and discharge temperature.
Full Charge Time		16 hours
Typical Charge Capacity		

Charge Temperature	Discharge Temperature		
	−15°C	+20°C to +25°C	+55°C
0°C	40%	60%	50%
+20°C to +25°C	65%	100%	85%
+40°C	40%	65%	55%

External Recorder Interface for X-Y Recorders		
Horizontal	0.1 V/div	Source impedance 10 kΩ
Vertical	0.09 to 0.13 V/div (adjustable)	Source impedance 10 kΩ
Pen Lift		
Mode 1		
Source	V_s = 5 V Nominal with R_s = 10 kΩ	
Sink	≤ 10 mA	V_{out} ≤0.5 V
Mode 2 (inverted Mode 1)		
Source	V_s = 5 V Nominal with R_s = 10 kΩ	
Sink	≤0.5 mA	V_{out} ≤0.6 V

Table 1-2 (cont)

Characteristics	Performance Requirements	Supplemental Information
Y-T Plug-In Chart Recorder Interface		
Vertical	0.2 V/div nominal	Source impedance 200 Ω (switched) The TEKTRONIX Chart Recorder, 016-0506-03 is designed to operate with the 1503. The chart uses a heat sensitive stylus to record on 4 cm chart paper. Chart recording length is controlled by the 1503.
Temperature		
Operating	−15°C to +55°C	At temperatures other than 20°C—25°C, the battery efficiency becomes restricted.
Non-Operating	−62°C to +85°C	With batteries removed. If stored with batteries storage range is −40°C to +55°C.
Humidity	To 100%	
Altitude		
Operating	10,000 feet	
Non-Operating	50,000 feet	
Vibration	3.0 g, 5 to 55 Hz, Test time 45 min	
Shock, Mechanical		
Shock, Pulse	15 g, 1/2 sine shock waveform of 11 ms duration. Total of 18 shocks	
Bench Handling		
Operating	4 drops each face at 4 inches or 45° with opposite edge as pivot	Case on
Non-Operating	4 drops each face at 4 inches or 45° with opposite edge as pivot. Satisfactory operation after drops	Case off
Transit Drop	12 inch drop	
Water Resistance		
Operating	Splash-proof and drip-proof with cover off and instrument operating.	
Non-Operating	Watertight with three feet of water above top of the case for 1 hour	Cover on
Salt Atmosphere		
Structural Parts	Withstand 48 hours exposed to 20% solution without corroding	

Table 1-2 (cont)

Characteristics	Performance Requirements	Supplemental Information
Explosive Atmosphere	Operation does not cause ignition of an ambient-explosive-gaseous mixture with air	
Sand and Dust	Operates after non-operating, cover removed, exposed to dust test of MIL-STD-810, Method 510, Proc. I	
Washability	Capable of being washed	
Electromagnetic Compatibility		
Electromagnetic Interference (EMI)	Meets requirements specified in Table X of MIL-T-28800A	CE01, CS01, CS02, CS06, RE02 (limited to 1 GHz), and RS03, (limited to 1 GHz).
Fungus Inert	Materials used are fungus inert	

Table 1-3

PHYSICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
Weight		
With Panel Cover and Accessories	18.0 pounds (8.2 kg)	
Without Panel Cover and Accessories	16.0 pounds (7.3 kg)	
Height	5.0 inches (12.7 cm)	
Width		
With Handle	12.4 inches (31.5 cm)	
Without Handle	11.8 inches (29.9 cm)	
Depth		
Including Panel Cover	16.5 inches (41.9 cm)	
Handle Extended	18.7 inches (47.4 cm)	

OPERATING INSTRUCTIONS

This section of the manual contains the basic information required for the operation of the 1503 Time Domain Reflectometer. Included is a brief description of the purpose of each front panel control, general operating information, care of the instrument, and basic applications.

FRONT COVER AND HANDLE

The watertight front cover protects the front panel when the instrument is not in use and the cover is latched in place. Special operating instructions are printed on the lid. A canister containing silica gel is mounted on the rear of the instrument to reduce the moisture inside the case.

The cover is released from the unit by pulling forward on the side latches. To secure the cover over the front panel, place the cover into the grooved portion of the front panel and push the latches backward towards the instrument. If the unit is accidentally left on, it will be turned off when the cover is secured over the front panel.

The handle is a friction disc design and will rotate 325°. When the handle is turned so that it is beneath the unit, it will serve as a stand (see Fig. 2-1).

POWERING THE 1503

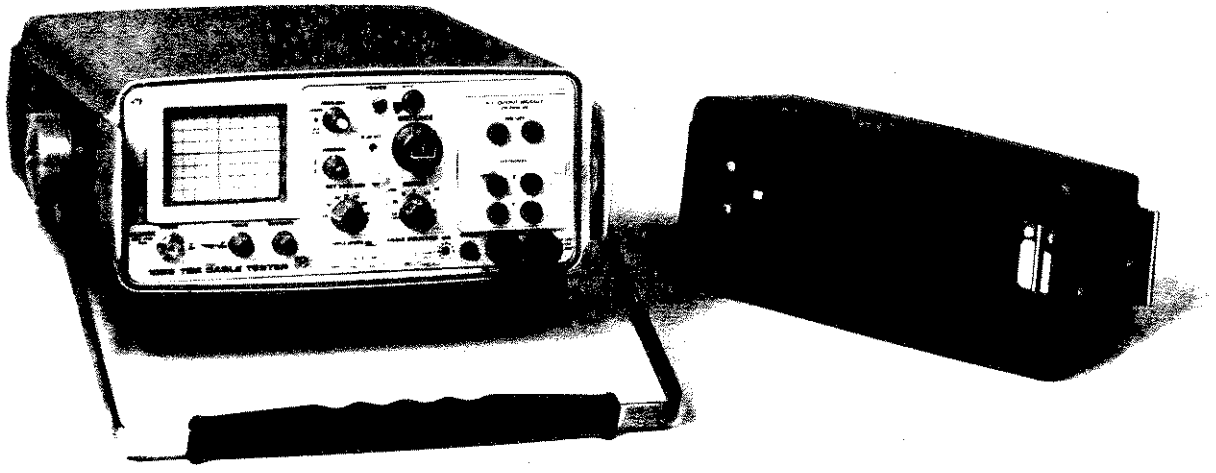
This equipment has a 3-wire power cord with a 3-contact plug for connection to the power source and to protective ground. The plug protective-ground contact connects (through the cord protective-grounding conductor) to the accessible metal parts of the equipment. For electric-shock protection, insert this plug into an outlet that has a securely grounded protective-ground contact.

CAUTION

Do not use this unit with a power inverter that produces a square wave output because power inverters may damage circuitry.

For confirmation that the outlet ground contact is securely grounded, refer to qualified service personnel.

The 1503 operates from the battery supply for a minimum of 5 hours (including 20 chart recordings). If a TEKTRONIX Y-T Chart Recorder is used, the 5 hours operating time will decrease by about 3 minutes for each recording made beyond the 20 specified.



1865-02A

Fig. 2-1. 1503 Time Domain Reflectometer.

Charging the Battery

The battery pack can be charged at any temperature between 0°C and +40°C. It can be operated at any temperature between −15°C and +55°C. For maximum charge capacity, the cells should be charged at −20°C to +25°C.

The battery pack is fully charged in 16 hours when connected to an ac power source and the unit is switched off. The 1503 may be operated while the battery pack is charging, but the charging time will increase. The batteries will not overcharge if the charger is left on longer than 16 hours. Therefore, the 1503 can remain connected to an ac source without damaging the batteries. Approximately once a month or every 15 charge-discharge cycles, the batteries should be charged for approximately 24 hours. Approximately 30 minutes of operating time can be expected from a 1 hour partial charge. For longest battery life, the full 16 hour charge should be completed in preference to a partial charge.

A battery can be damaged by reverse charging. This can occur if an individual cell becomes completely discharged and the current from the other cells flow in a reverse direction through the discharged cell. Such a case can develop due to cell aging, partial charging, or if a cell is replaced. The battery charger uses SCR protection circuits to prevent accidental reverse charging. The SCR protection circuits automatically shut off the instrument whenever battery voltage falls below about 10 V. Do not leave the POWER switch on when the instrument has shut itself down because it will continue to discharge the battery at a slower rate.

A 12 V dc power supply may be substituted for the 1503 battery pack by removing the pack from the unit and connecting the power supply to the terminals inside the battery pack compartment.

CAUTION

When substituting a dc power supply or external battery for the battery pack, be sure the polarity is correct. See Fig. 2-2.

The power pack can be stored at any temperature between −40°C and +55°C with the battery cells either fully or partially charged. The self-discharge rate of the cells increases with increased temperature. A fully charged battery will lose about 50% of its charge in 3 to 4 months if stored at +20°C to +25°C. Therefore, the battery pack should be completely recharged before using if it has been stored without power supplied to its charging circuit for more than a month.

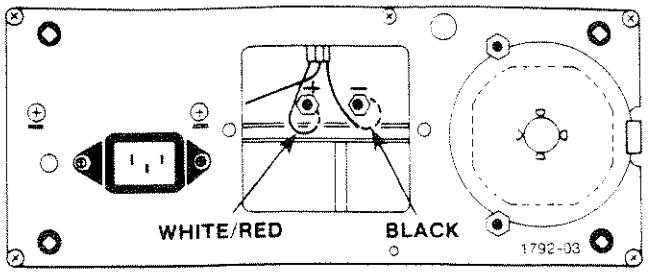


Fig. 2-2. Battery connector polarity.

230 V Operation

The battery charger is factory wired for 115 V ac or 230 V ac if Option 6 is ordered. The standard 115 V ac unit can be changed to 230 V ac operation by rewiring the line transformer. Refer voltage changes to qualified service personnel only.

CAUTION

When the 1503 is wired for 230 V ac, be sure that the two front-panel fuses are changed and the proper plug is installed on the ac cable. Refer to the parts list for the correct parts.

Front Panel Controls (See Fig. 2-3)

1. CABLE	Precision bnc connector used to transmit the impulse signal into the test cable and receive the reflected signal.
2. Impedance selectors	Two push buttons used to select the 1503 output impedance. 50 Ω pushed in, selects 50 Ω impedance. 75 Ω pushed in, selects 75 Ω impedance. Both pushed in, selects 125 Ω impedance. Both out, selects 93 Ω impedance.
3. FOCUS	Controls sharpness of crt display.
4. INTENSITY	Controls brightness of crt display.
5. POSITION/FINE	Vertical position controls for crt display.
6. ZERO REF CHECK	Push button to check horizontal reference location of test impulse signal on crt.

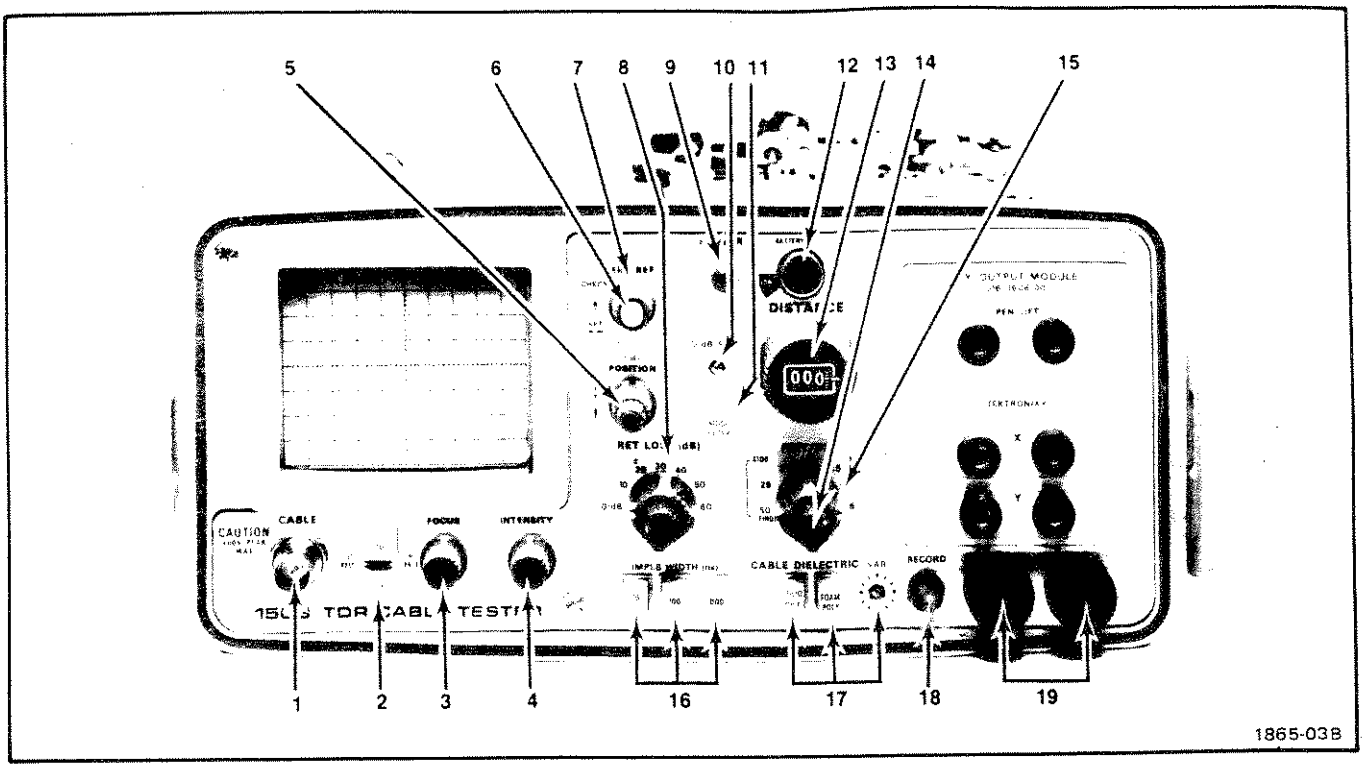


Fig. 2-3. Front-panel controls.

7. ZERO REF SET — Horizontal pulse position control for crt display. Sets test signal edge to a vertical reference line on the crt when the DISTANCE dial is at 000 or ZERO REF CHECK button is pushed.

8. RET LOSS (dB) FINE — Selects dB reference level of the reflected signal. 0-dB to 60-dB in seven calibrated steps. FINE adds 0—18 dB to selected steps.

9. POWER — Pull-on, push-off switch. Does not affect battery charging circuits.

10. 0-dB SET — Screwdriver adjust for 0-dB reference level. Used to set amplitude of test pulse.

11. NOISE FILTER — Reduces displayed noise. Display sweep rate is reduced by a factor of ten.

12. BATTERY — Indicates relative charge of power pack.

13. DISTANCE — Indicates the distance from 1503 to a point on the test cable; 0 to 25000 feet (0 to 500 metres) at X100 (X10). Disabled when the FEET/DIV (METRES/DIV) control is set to 50 (100) and the multiplier is set to X100 (X10).

14. X10 (X1) X100 (X10) — Two-position switch for X10 (X1) or X100 (X10) multiplier. Affects both DISTANCE dial and FEET/DIV (METRES/DIV) control.

15. FEET/DIV (METRES/DIV) — Selects horizontal deflection factor.
X10 (X1) = 5 to 500 feet/div (1 to 100 metres/div).
X100 (X10) = 50 to 5000 feet/div (10 to 1000 metres/div).

16. IMPLS WIDTH — Selects width of test impulse for 10, 100, or 1000 ns.

17. CABLE DIELECTRIC SOLID POLY FOAM POLY VAR	Two push buttons and a screwdriver adjust. Selects proper velocity of propagation. VAR control is activated when both buttons are pressed or released. VAR control is set to air when fully clockwise. VAR control has reference marks every 30° to indicate relative propagation constants.
18. RECORD	Two-position toggle switch. Used to start an X-Y Recorder or TEKTRONIX Y-T Chart recorder. Push up and hold momentarily to pre-heat stylus; then release to start Chart recorder.
19. AC LINE FUSES	Protection fuses for the battery charger circuits.

Plug-in Modules

1. X-Y OUTPUT MODULE	The standard plug-in module for the 1503. Used to interface to an external X-Y chart recorder.
X, Y and PEN LIFT	Three dual sets of front-panel jacks are used to supply horizontal, vertical, and pen lift information to an external X-Y Recorder.
2. Y-T CHART RECORDER	An optional Tektronix Chart Recorder which replaces the X-Y OUTPUT MODULE.
STYLUS POSITION	Screwdriver adjustment to adjust stylus to the same level as the crt display when the RECORD switch is in RECORD position.

OPERATIONAL CHECKOUT

1. Use the step-by-step procedure for an operational check of the 1503. First set the controls as follows:

FOCUS	Midrange
INTENSITY	Fully clockwise
ZERO REF	Fully clockwise
RET LOSS (dB)	0 dB
DISTANCE	000
NOISE FILTER	Out
FEET/DIV	5
(METRES/DIV)	(10)
X10-X100 (X1-X10)	X10 (X1)
CABLE DIELECTRIC	SOLID POLY
IMPLS WIDTH	100
50/75 Ω	50 Ω

2. Adjust the INTENSITY & FOCUS control for a clear bright trace.

3. Adjust the POSITION control to set the trace on the horizontal center line.

4. Attach the 50 Ω terminator to the CABLE connector.

5. Turn the ZERO REF SET button ccw until the test pulse leading edge is located on a vertical reference line. The vertical reference line may be any vertical line you choose on the crt graticule. Adjust the 0-dB SET control for a two division display.

NOTE

Always use the leading edge at the base line of the pulse for setting reference. (See Fig. 2-4.)

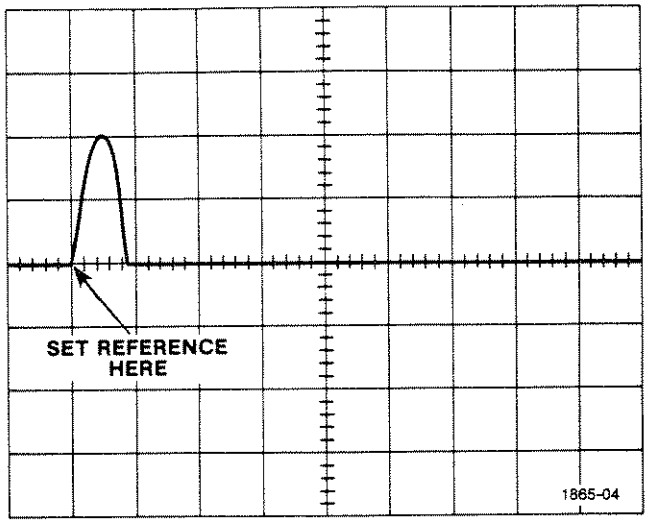


Fig. 2-4. Test pulse at reference line.

6. Adjust the ZERO REF SET button throughout its range to see that the test pulse edge can be set on any vertical graticule line. Set the test pulse edge on the vertical reference line.

7. Set the DISTANCE dial to 010, press the ZERO REF CHECK button and check that the test pulse edge returns

to the vertical reference line of the graticule. Reset the DISTANCE dial to 000.

8. Change the RET LOSS control to 10-dB and adjust the POSITION control so that the horizontal baseline is on the bottom crt graticule line.

9. Press the NOISE FILTER button and check for a reduction in displayed noise as well as a reduction in scan rate. Reset the RET LOSS switch to 0-dB, release the NOISE FILTER button (by depressing a second time).

10. Press IMPLS WIDTH (ns) 1000 and check for a 9 division (within 20%) wide pulse.

11. Press IMPLS WIDTH (ns) 10 and set FEET/DIV (METRES/DIV) to .5 (1) and check for a slightly greater than one division wide pulse.

12. Lift up and hold the RECORD switch. Check that a bright spot appears at left edge of the crt.

13. Release the RECORD switch. The spot will slowly trace the waveform. When the scan is complete the 1503 will automatically return to its normal mode.

Connecting a Test Cable to the 1503

WARNING

Voltages up to 400 V may be expected on long twisted-pair lines. These voltages may be present on the front panel of the 1503. The optional isolation transformer (013-0169-00) is recommended to avoid electrical shock to the user.

CAUTION

Voltages higher than 400 V peak or lower voltages at frequencies higher than 400 Hz may damage the Pulser and/or Sampler circuits of the 1503.

Connect cables, to be tested by the 1503, to the CABLE connector on the front panel. Cables of any impedance may be tested by adjusting the 0-dB SET control and/or using other than 2 crt divisions as the 0-dB reference. However, tests at long ranges may be degraded.

Table 2-1

OPTIONAL ACCESSORIES FOR THE 1503

Accessories	Tektronix Part Number
Adapter Assembly, Isolation Transformer	013-0169-00
Terminator, 75 Ω BNC	011-0102-00
Connector, BNC Female-to-Clip Leads	013-0076-00
Adapter, Camera (Extension)	016-0327-01
Chart Recorder	016-0506-03
Chart paper	006-1658-00 or 01
Connector, BNC Female-to-GR	017-0063-00
Connector, BNC Male-to-GR	017-0064-00
Adapter, 50/125 Ω	017-0090-00
Adapter, 50/75 Ω	017-0091-00
Adapter, 50/93 Ω	017-0092-00
Connector, BNC Female-to-UHF	103-0015-00
Connector, BNC Female-to-Dual Banana Plug	103-0090-00
Connector, BNC Male-to-Male	103-0029-00
Connector, BNC Male-to-UHF Female	103-0032-00
Connector, BNC Male-to-Dual Binding Post	103-0035-00
Connector, BNC Male-to-N Female	103-0058-00
Connector, BNC Female-to-Dual Banana Plug	103-0090-00

Locating a Discontinuity in a Cable

The DISTANCE dial and the FEET/DIV (METRES/DIV) control make it possible to evaulate cables as long as 50,000 feet (10,000 metres), subject to their transmission quality. The entire length can be displayed directly on the crt if desired. If a chart recorder is used, only that portion of the trace seen on the crt will be recorded on the graph.

To check cables using only the crt display, the FEET/DIV (METRES/DIV) control and the X10-X100 (X1-X10) control must be set so that the crt display window is longer than the cable. For example, if the cable is 1500 feet (500 metres) long, set the FEET/DIV (METRES/DIV) control to 25 (10) and the multiplier control to X10 (X10).

This setting of the FEET/DIV (METRES/DIV) control assures that the return signal will appear in the display window. Measure the distance between the test pulse start and the return pulse start.

To more accurately locate the discontinuity, set the FEET/DIV (METRES/DIV) control to a lower setting. (The return pulse does not need to be in the display window.) Adjust ZERO REF SET button so that the test pulse rise is set at a convenient vertical reference graticule line. The ZERO REF SET control may have to be readjusted when changing the FEET/DIV (METRES/DIV) control.

NOTE

Always use the leading edge at the base line of the test/return pulses for setting the reference. (See Fig. 2-4.)

Now turn the DISTANCE dial clockwise until the return pulse is located on the reference graticule line. The reading on the DISTANCE dial times the multiplier gives the length from the CABLE connector to the discontinuity.

NOTE

The dB reference may have to be increased to observe the reflection.

The CABLE DIELECTRIC push buttons allow the 1503 to accurately locate discontinuities in cables with various relative propagation velocity constants (V_p). The SOLID POLY button is calibrated to check solid polyethylene dielectric which has a V_p of 0.66. The FOAM POLY button is calibrated to check foam polyethelyne which has a V_p of 0.81. When both buttons are either in or out, the effective dielectric is variable from 0.31 to 1.00 and is controlled by the screwdriver adjustment control VAR. In the fully clockwise position it is calibrated for air dielectrics (V_p 1.00).

Evaluating a Discontinuity

The RET LOSS control determines the vertical deflection that can be seen on the crt, or recorded on a graph if a chart recorder is used. The control is calibrated to measure the dB loss of the return pulse amplitude relative to the test pulse amplitude. The screwdriver adjustment, 0-dB SET, is used to set the amplitude (number of crt graticule divisions) of the test pulse. The RET LOSS control is then adjusted so that the return pulse amplitude is the same as the 0-dB reference amplitude. The return loss in dB is then read directly from the RET LOSS control settings.

The mathematical definition of RET LOSS is 20 log ρ; where ρ, the reflection coefficient rho, is given by:

$$\rho = \frac{Z_L - Z_o}{Z_L + Z_o}$$

where Z_o is the cable impedance and Z_L is the impedance of the discontinuity, assuming no cable loss.

Fig. 2-5 shows the two parts of a TDR display appropriately labeled to identify the test and return voltage signals. When the return loss = ∞ dB, the cable is terminated by a resistance equal to its characteristic impedance (Z_o), since a perfectly matched cable ($R_L = Z_o$) gives no reflection. When the return loss equals 0 dB with a positive return pulse, the cable has an open termination ($R_L = \infty\ \Omega$). When the return loss equals 0 dB with a negative return pulse, then the cable is terminated with a short ($R_L = 0\ \Omega$).

NOTE

Care must be taken to account for cable loss which is assumed to be zero in the example shown in Fig. 2-5. Actual discontinuities are shown later in this section.

Cables with a characteristic impedance other than 50, 75, 93, or 125 Ω can be evaluated by adjusting the 0-dB SET control to correct the test pulse for two divisions then proceed as normal. Positive or negative re-reflections will be observed, however, due to the impedance mis-match.

The NOISE FILTER button can be used to reduce the noise displayed on the crt. The reduction in noise is accomplished by changing the time constant of the R-C filter and is accompanied by a slowing of the sweep rate.

1503 ACCESSORIES

Plug-ins

The 1503 plug-in compartment will accept either the X-Y OUTPUT MODULE (provided as a standard accessory) or the TEKTRONIX Y-T Chart Recorder (Part Number 016-0506-03) which is supplied with Option 4 instruments.

Using an X-Y Recorder

The X-Y OUTPUT MODULE may be wired for either a positive or negative pen lift signal. Before using the X-Y OUTPUT MODULE, be sure that the pen lift circuit on the etched circuit board is properly connected. Fig. 2-6 shows the proper connection for either a positive or negative pen lift signal.

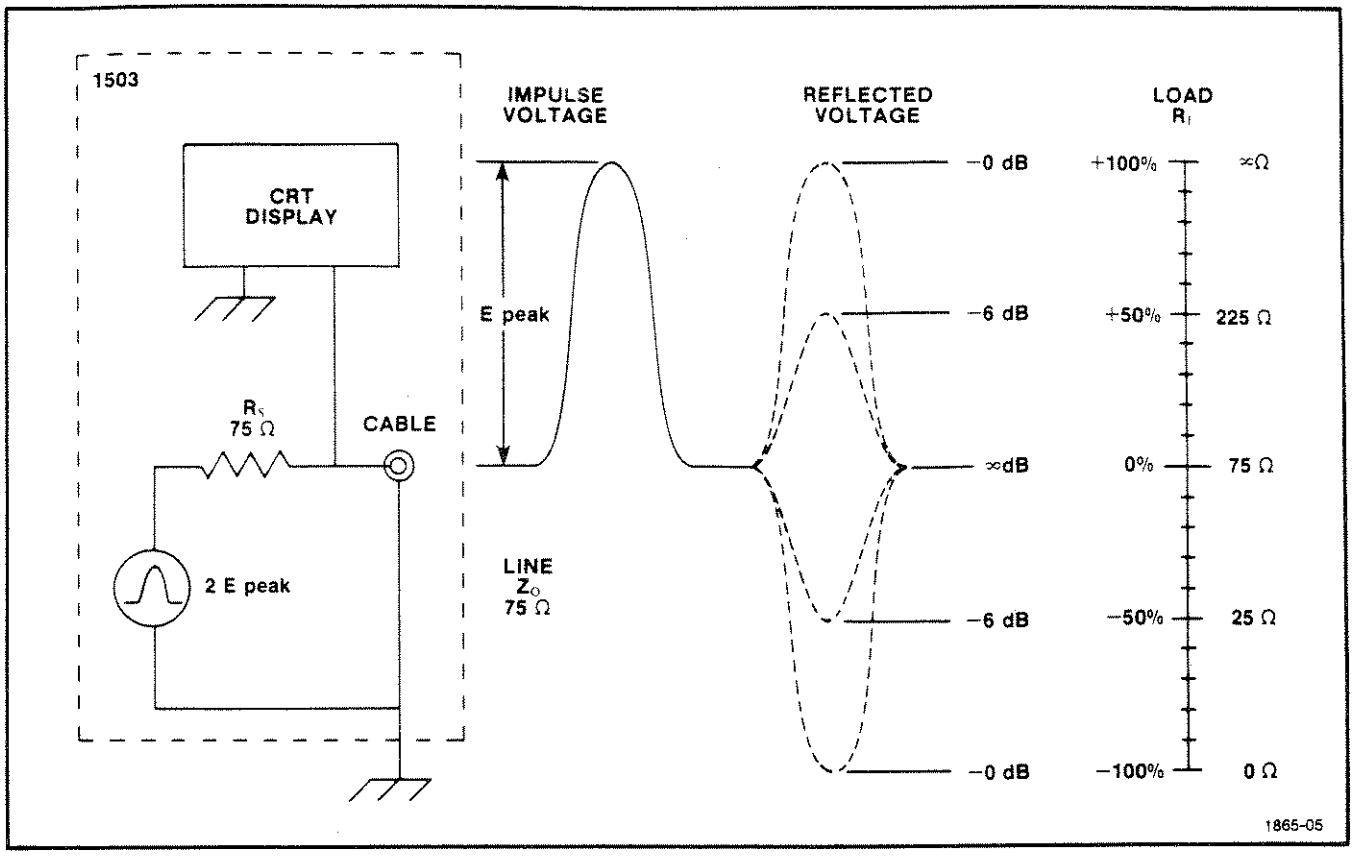


Fig. 2-5. TDR display of R_L vs Z_O.

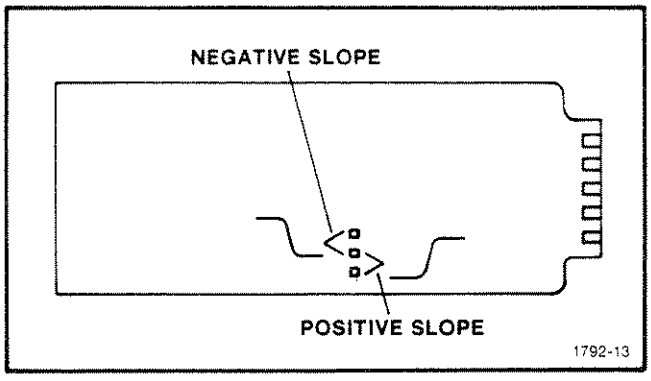


Fig. 2-6. X-Y Output Module strap.

An X-Y recorder can be used with the 1503 by connecting it to the X-Y OUTPUT MODULE when it is plugged into the 1503. Connect the X, Y, and PEN LIFT inputs of the recorder to the corresponding jacks of the X-Y OUTPUT MODULE. See the manual provided with the recorder for further information on its use.

Mesh Filter for the crt

A mesh filter is provided with the 1503 which makes viewing of the crt easier when the unit is being used in the sunlight. This filter is placed over the crt by sliding it onto the slots of the crt bezel.

Viewing Hood

Another accessory provided with the 1503 for light shading is a viewing hood. This unit can be installed over the crt by sliding it down over the crt bezel sides. The mesh filter must be removed before the viewing hood will connect to the crt bezel.

Using a Camera with the 1503

If a Camera Adapter is attached to the crt bezel of the 1503, a C-30B/31B camera can be used to take photographs of the crt display.

Nominal C-30B/31B camera settings are:

f/stop	5.6-11
time	1 s
magnification	1.2 (fixed at 0.5 in C-31B)
focus	as necessary

Battery Care

To charge the batteries, connect the 1503 to a suitable ac power source. The battery pack will be fully charged in 16 hours. Approximately 30 minutes of operating time can be expected from a one hour partial charge. The batteries will not overcharge if left on longer than 16 hours so the 1503 can remain connected to an ac source without damaging the batteries.

Reverse charging a battery can damage it. Reverse charging can occur if an individual cell becomes discharged before the others. Such a case can develop due to cell aging, partial charging, or if a cell is replaced. If a cell becomes completely discharged, it is possible for it to become reverse charged by the current from the stronger cells. The battery charger is designed, using SCR protection circuits, to prevent deep discharge. The SCR protection circuits automatically shut off the instrument whenever battery voltage falls below about 10 V. Do not leave the POWER switch on when the protection circuit has shut down the instrument because there is still a slight drain on the battery.

To obtain longer battery life, the full 16 hour charge should be completed in preference to a partial charge cycle whenever possible. In addition, approxiamtely once a month or every 15 charge-discharge cycles (whichever occurs first), the batteries should be charged for approximately 24 hours.

The battery pack can be charged at any temperature between 0° C and +40° C and discharged (operated) at any temperature between −20° C and +55° C, but for maximum charge capacity, the cells should be charged at +20° C to +25° C. For more information refer to the Specification section of the Instruction Manual.

The power pack can be stored at any temperature between −40° C and +55° C with the battery cells either fully or partially charged. The self-discharge rate of the cells increases with increased temperature. A fully charged battery will lose about 50% of its charge in 3 to 4 months if stored at +20° C to +25° C. Therefore the battery pack should be completely recharged if it has been stored for more than a month.

The 1503 has been made with a ruggedized case that is suitable to provide protection when stored in exposed areas. When the instrument is not being used, the accessories, including the Operators Handbook, should be packed in the instrument cover and the cover latched on the front of the instrument.

Instrument Storage

The 1503 can be stored in temperatures between −62° C and +85° C, but if the temperature is below −40° C or exceeds +55° C, the batteries must be removed and stored in a location where the temperature is between −40° C and +55° C.

MEASUREMENT EXAMPLES

This section shows diagrams and results of checking telephone-type twisted pair lines with the 1503. Errors in impedance matching are the most misleading to the user and must be understood for proper evaluation of the crt display. The notes with each diagram are very condensed. Refer to TEKTRONIX application note on testing telephone long lines for more detail.

WARNING

Voltages up to 400 V may be expected on long twisted pair lines. These voltages may be present on the front panel of the 1503. The optional isolation transformer (013-0169-00) is recommended to avoid electrical shock to the user.

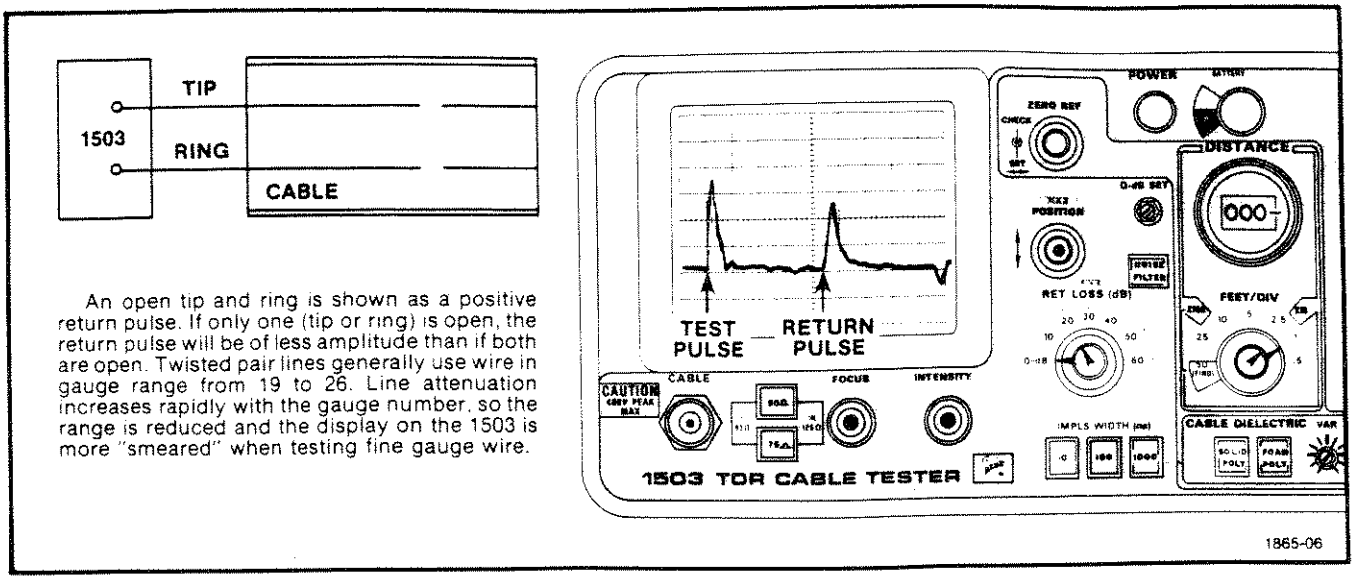


Fig. 2-7. Open Tip and Ring.

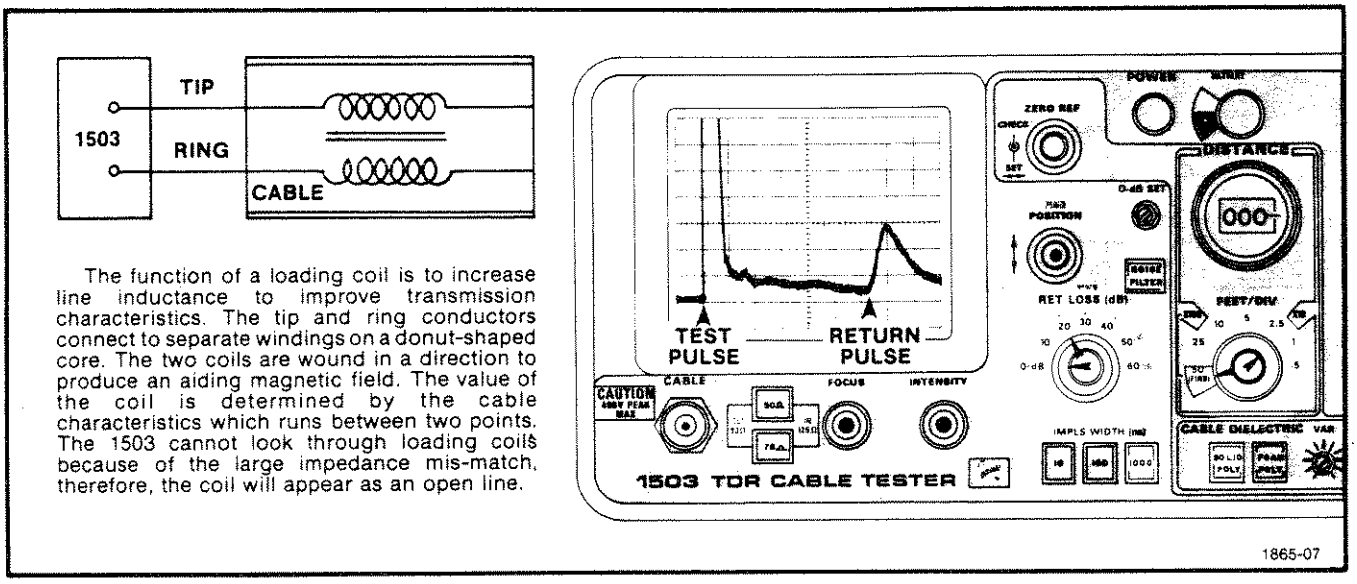
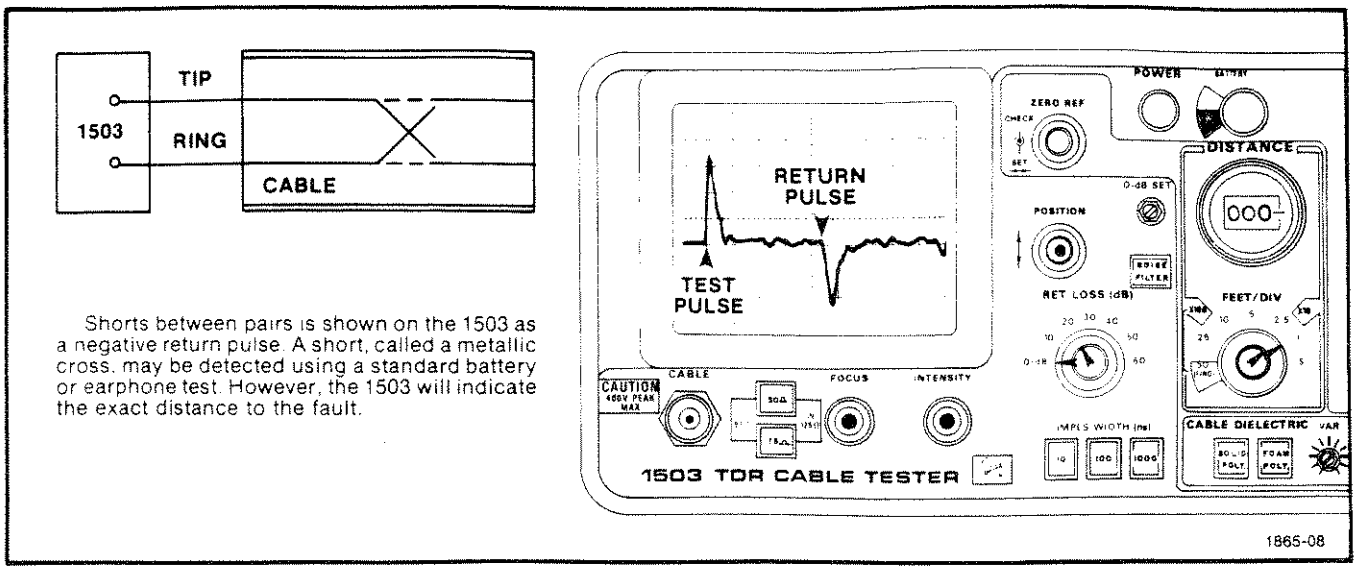
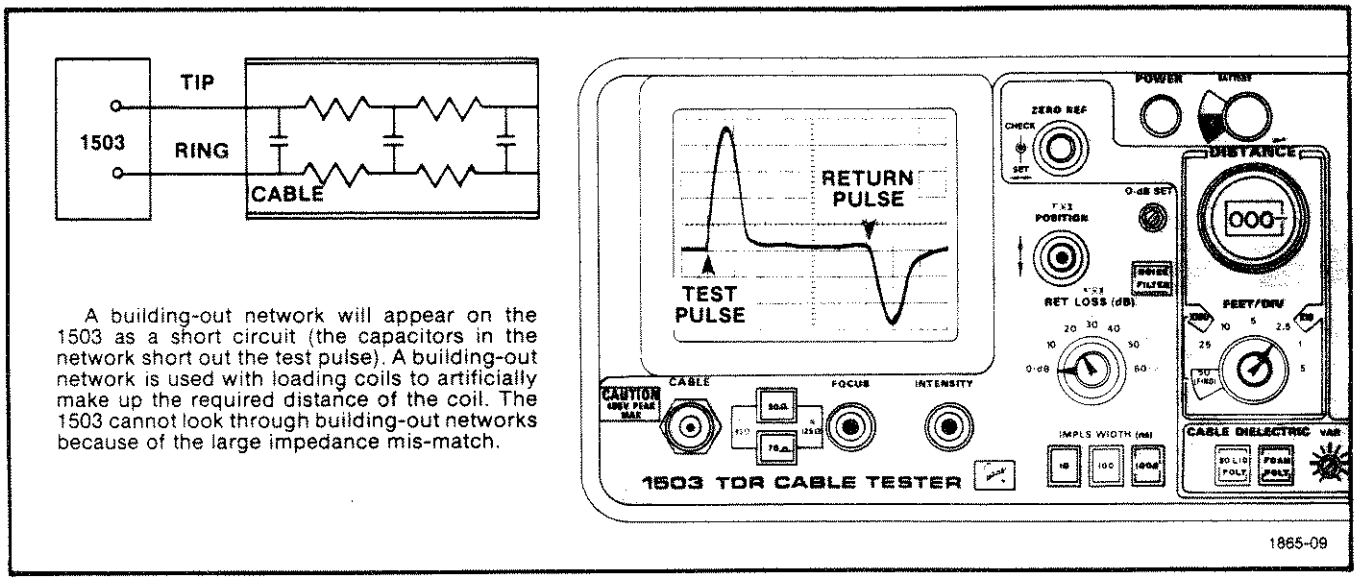


Fig. 2-8. Loading Coil.



Shorts between pairs is shown on the 1503 as a negative return pulse. A short, called a metallic cross, may be detected using a standard battery or earphone test. However, the 1503 will indicate the exact distance to the fault.

Fig. 2-9. Shorted Tip and Ring.



A building-out network will appear on the 1503 as a short circuit (the capacitors in the network short out the test pulse). A building-out network is used with loading coils to artificially make up the required distance of the coil. The 1503 cannot look through building-out networks because of the large impedance mis-match.

Fig. 2-10. Building-out network.

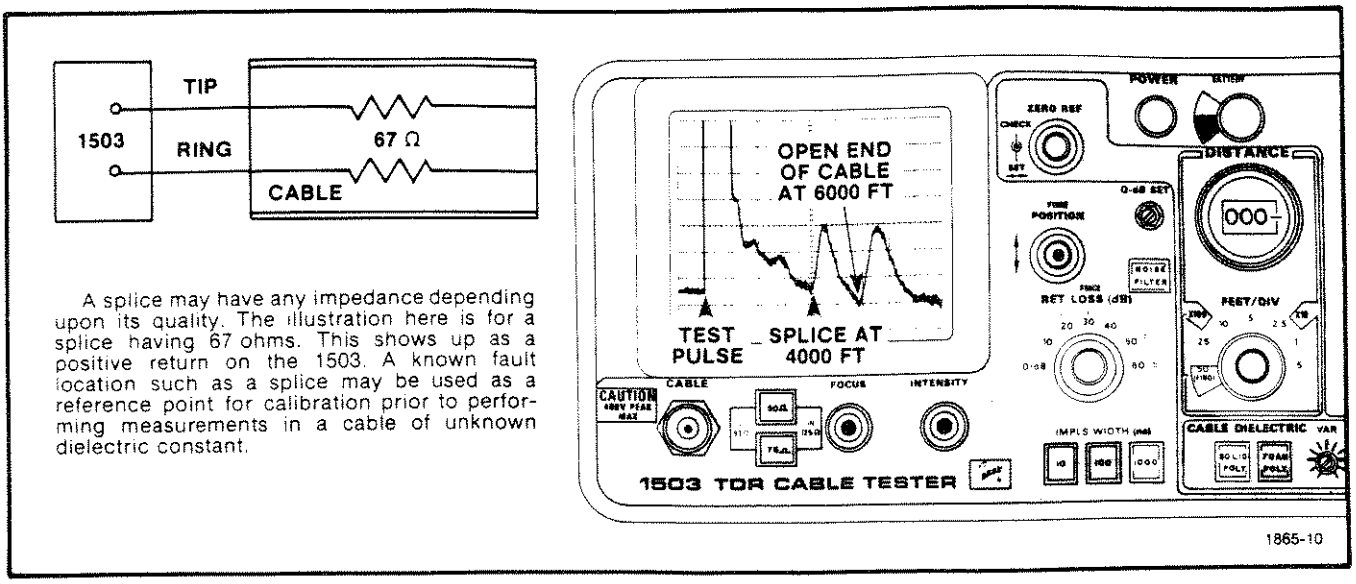
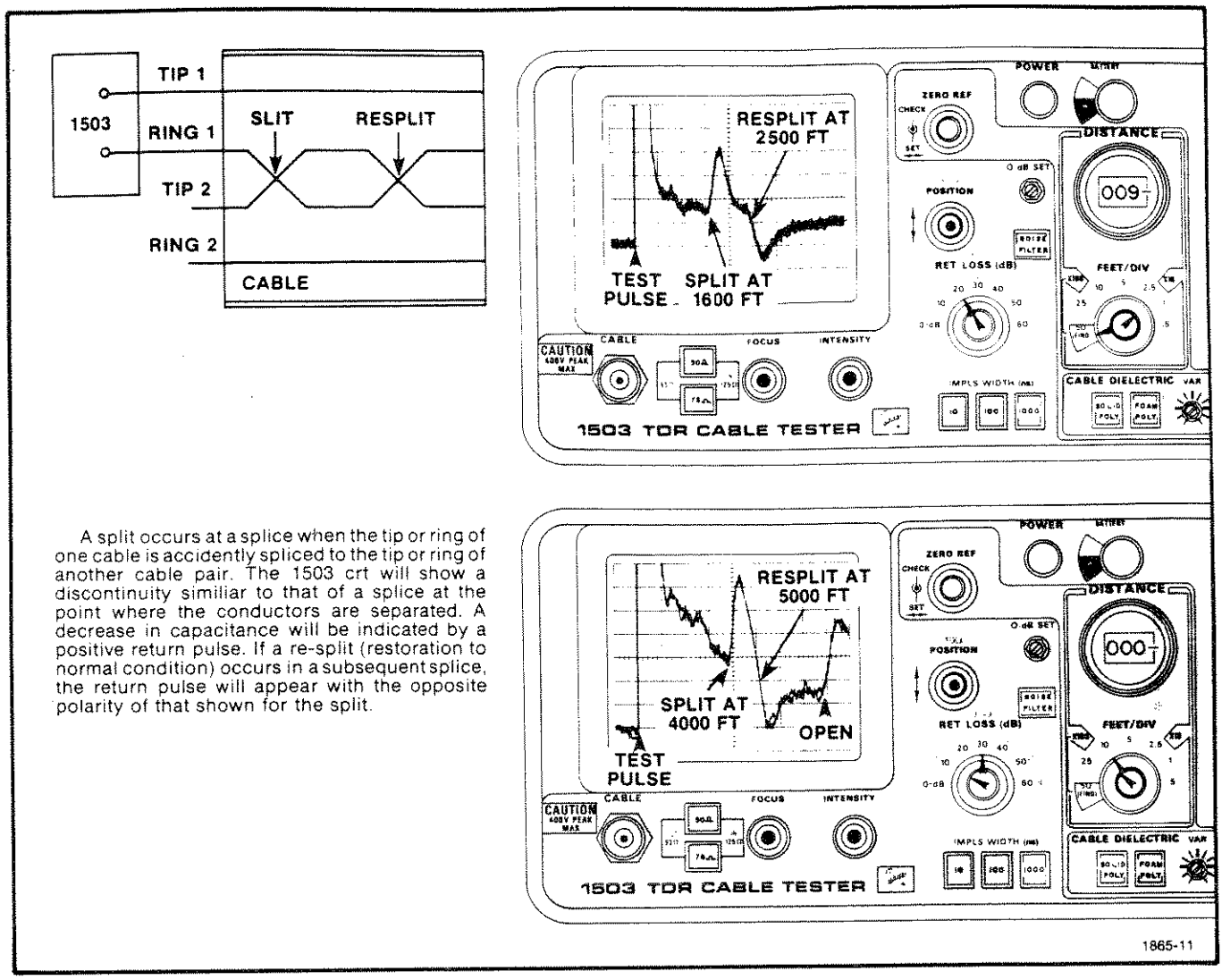


Fig. 2-11. 67-ohm splice at 4000 feet.



A split occurs at a splice when the tip or ring of one cable is accidently spliced to the tip or ring of another cable pair. The 1503 crt will show a discontinuity similiar to that of a splice at the point where the conductors are separated. A decrease in capacitance will be indicated by a positive return pulse. If a re-split (restoration to normal condition) occurs in a subsequent splice, the return pulse will appear with the opposite polarity of that shown for the split.

Fig. 2-12. Split and re-split pair.

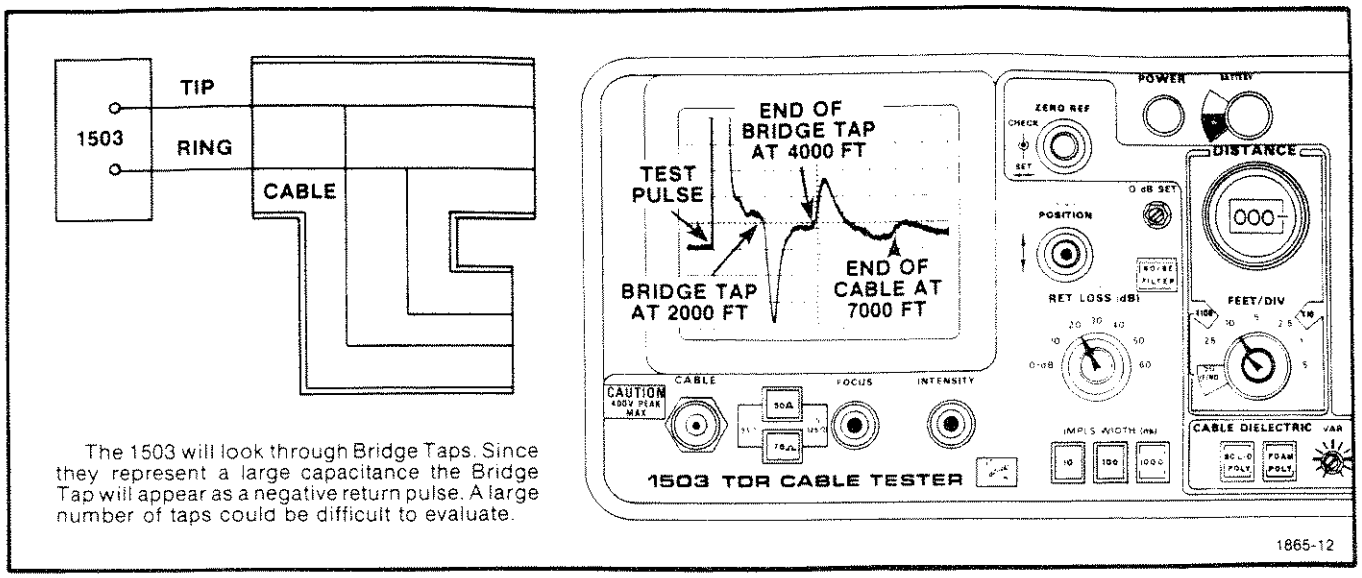


Fig. 2-13. Bridge tap at 4000 feet.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER TO OPERATORS SAFETY SUMMARY AND SERVICE SAFETY SUMMARY PRIOR TO PERFORMING ANY SERVICE.

THEORY OF OPERATION

This section describes the circuits of the 1503 using a combination of block and circuit diagrams on pull-outs at the back of this manual. The components being described can be found in the circuit diagrams. A cross reference table for each schematic is located on the fold-out page with the schematic.

Block Diagrams

There are two block diagrams that show the overall functions of the 1503; Fig. 3-1, a simplified version, and the main block diagram located on a pull-out page.

Circuit Operation

The 1503 uses pulse techniques to check cable conditions. The Pulser circuits transmit the pulses down the cable under test. The Sampler circuits sample the reflections and provide the vertical signal for display on the crt.

Sequential equivalent-time sampling is used to develop a display. Two ramps are generated, a fast ramp and a slow ramp. The fast ramp is compared to the slow ramp or a fixed reference to generate trigger pulses for the Sampler and the Pulser Generator respectively. These comparisons are made by the Pulser and Sampler Comparators.

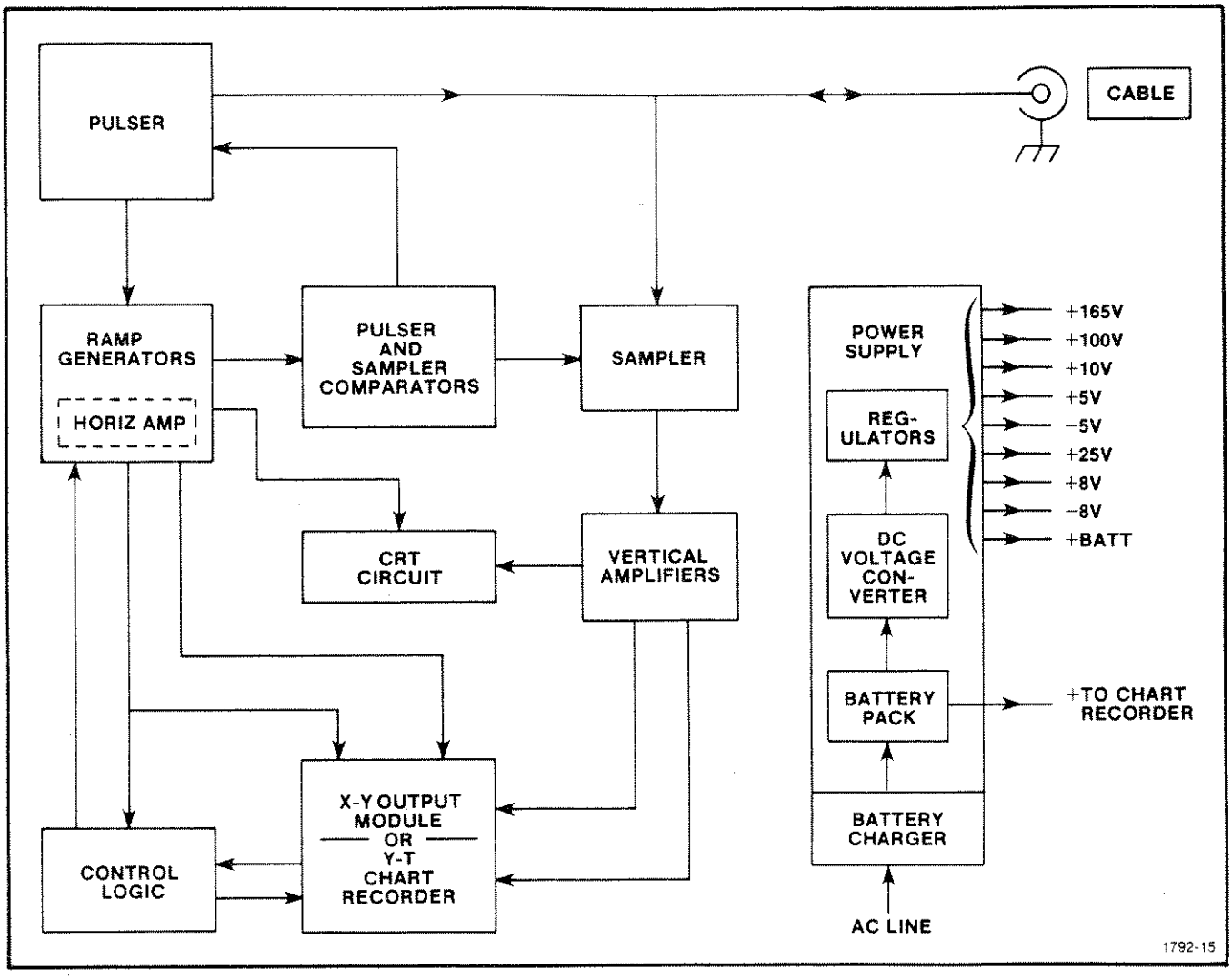


Fig. 3-1. Simplified Block diagram.

A short time after the Pulser Generator transmits the test pulse into the cable under test, depending on the amplitude of the slow and fast ramps, a sampling trigger from the Sampler Comparator causes the Sampler to sample-and-hold the voltage level appearing at the input connector at that time. This voltage sample is amplified and sent to the crt Vertical amplifiers.

The Slow Ramp Generator provides the horizontal sweep for the crt and, combined with the vertical sample, provides a display of the sampled value. Sampling triggers taken later during the next fast ramp time, cause an additional sample to be displayed next to the first one, until a line of dots is formed across the crt, (Fig. 3-2).

The amplified vertical sample and slow ramp signals are also sent to X-Y Interface connectors. These signals, along with a pen lift control signal, provide the information for driving external X-Y recorders.

If the TEKTRONIX Y-T Chart Recorder is used, the amplified vertical signals from the Sampler are applied to the writing stylus drive circuits. The speed of the chart paper is controlled by the holes along the edge of the chart paper passing between a phototransistor and a light emitting diode. These provide digital information to the Control Logic to control the speed of the slow ramp and match the speed of the chart paper. Thus, the trace and grid on the chart recording matches the trace and graticule displayed on the crt.

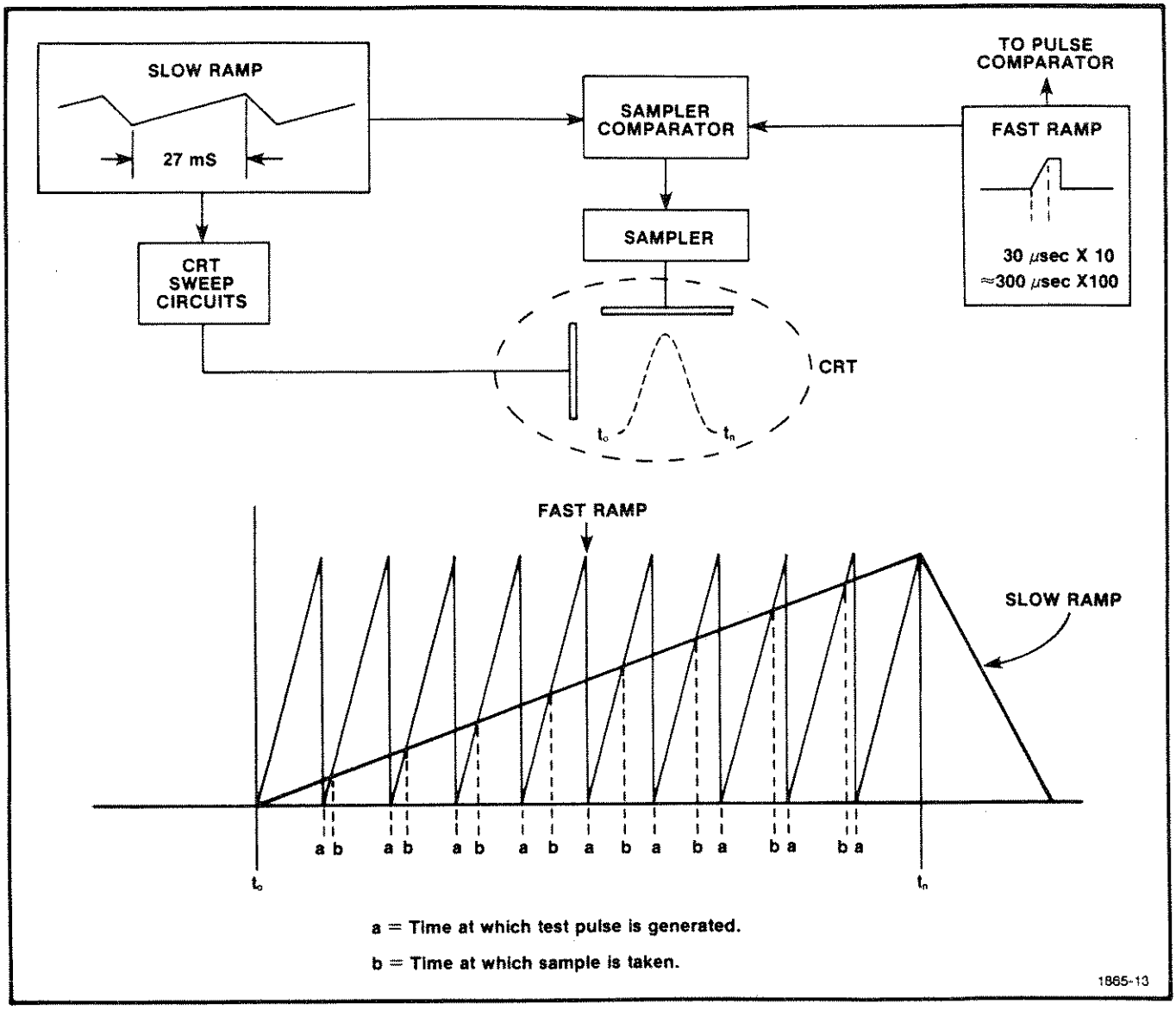


Fig. 3-2. Sampling diagram.

When the slow horizontal scan of the crt has been completed, the vertical input is automatically disconnected and the slow ramp is released to scan at its own speed. The chart paper continues to run until the entire recorded data is outside the chart recorder.

DETAILED CIRCUIT DESCRIPTION

Time Base Generator (Diagram 1)

The Time Base Generator circuits consist of an Inverter/Attenuator, Fast Ramp Generator, and the Timing and Control Logic.

Inverter/Attenuator. The slow ramp signal, is a free running saw tooth generated on the vertical amp/slow ramp board, and entering diagram 1A at P24 in the upper left corner. This signal also goes out to the output amplifier and is the horizontal sweep for the crt. The slow ramp is attenuated by selecting the gain of U1219B with S1215F to provide a calibrated feet per division display on the crt in seven steps: .5, 1, 2.5, 5, 10, 25, and 50 FEET/DIV. This attenuated signal is applied to the inverting input of U1219A through R1216 (FT/DIV CAL). The gain of U1219A as related to the slow ramp is varied by R1216 to provide FT/DIV scale calibration.

The output of U1219A, TP1312, contains a dc level which is obtained from the combined settings of the DISTANCE dial and the ZERO REF SET. The output from the DISTANCE dial also goes to S0151 ZERO REF CHECK. This switch will ground the DISTANCE dial output when pressed and provide a zero reference for checking the setting of the ZERO REF SET potentiometer.

The signal at TP1312 (ORANGE) is a variable amplitude slow ramp whose dc offset is variable by ZERO REF SET and the DISTANCE dial. This signal is applied to the sampler comparator on diagram 1B.

Fast Ramp Generator. The fast ramp generator is basically a constant current integrator consisting of Q1235 and charging capacitors C1238 and C1227. The current for Q1235 is determined by R1137 and R1127. The voltage across these resistors is the 10 volt supply and the base voltage of Q1235 plus the drop across the base-emitter junction of Q1235. The base voltage of Q1235 is the base voltage of Q1142 minus the voltage of the base-emitter junction of Q1142. Thus the two base-emitter voltages of Q1142 and Q1235 cancel each other and compensate for temperature caused changes in base-emitter voltage.

The current through Q1235 will flow when its base is pulled toward ground. When Q1246 is turned off R1135 will pull the base of Q1235 towards +10 V and thus no voltage will exist across R1137 or 1127 and no current will be drawn, conserving battery power between samples.

When Q1247 is turned on, Q1236 will be turned off and Q1235 will be turned on. The current will flow charging C1238 and C1227. The voltage across C1238 will increase linearly with the current. The linear fast ramp is applied to the base of Q1247, which provides a power gain of the fast ramp signal (−2 V to −3.5 V ramp) to drive the comparators, see diagram 1B. It also sends a voltage back to Q1142, through C1243 to compensate for the base current of Q1247.

The resistors R1356, R1357, R1355, and R1353 form voltage dividers whose outputs are selected by S1156 and S1252 (CABLE DIELECTRIC) to set the slope of the fast ramp, keeping ZERO REF SET and DISTANCE calibrated and setting the calibration for FOAM, POLY or Variable cable dielectrics.

Timing and Control Logic

Timing and control of the 1503 Pulser and Sampler circuits begins with the clock signal at U1667C pin 10. The clock runs at a pulse repetition rate of 180 ms, see Fig. 3-3. The clock can be turned off and an external calibration signal inserted at the connector indicated by EXT CAL on the main board.

Fast Ramp Timing. The clock signal is differentiated by C1762 and R1761 and clamped to −5 V by CR1563. The differentiated signal at pin 6 of both U1663 and U1667 will be a positive-going spike occuring at the rising edge of the clock signal. This spike sets the R-S flip-flop so that the output at pin 4 of U1663 goes low. This negative transition is coupled to the delay circuit Q1565 through C1563, turning Q1565 off during the time that C1563 is charging. This holds pin 13 of U1663D high forcing its output at pin 11 to remain low even though pin 12 is low. When C1563 has charged to the point where Q1565 turns back on, the level at pin 13 of U1663D drops to about −4 Volts. The output at pin 11 of U1663D then goes high about 20 ms after the first rising transition of the clock signal.

The output signal from U1663 is coupled to the gate of Q1246, turning it on. It is also coupled through OR gate Q1663C to the base of Q1236, turning it off. This starts the fast ramp by allowing C1238/C1227 to charge.

When the voltage of the rising Fast Ramp at the junction of R1676 and R1663 crosses the reset threshold of U1663A pin 1, the R-S flip-flop will reset, so that its output pin 4 goes high. This high is coupled through U1663D, to the gate of Q1246 and through U1663C to the base of Q1236.

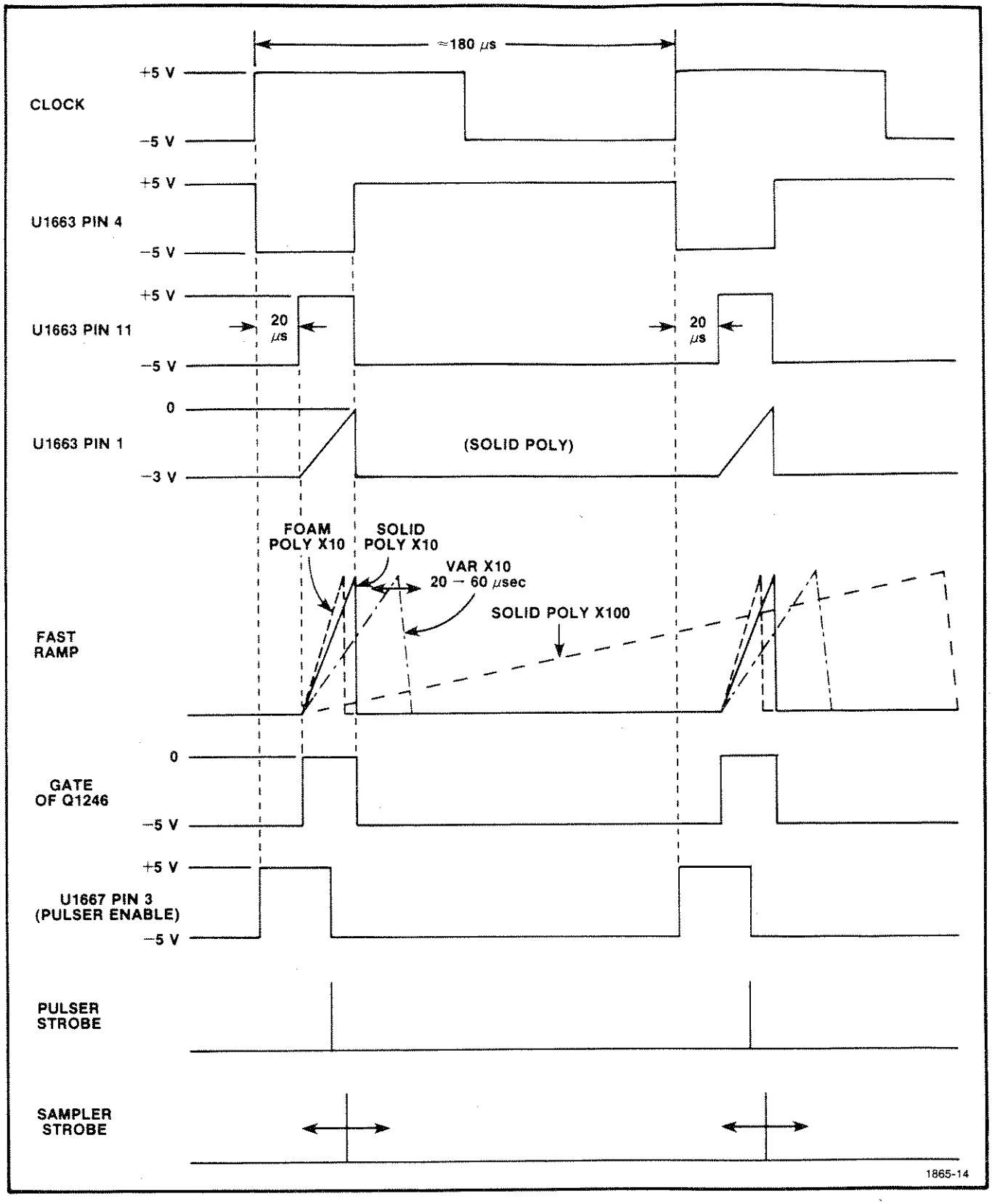


Fig. 3-3. Timing diagram.

Q1246 turns off, stopping the fast ramp rise. Q1236 turns on, discharging C1238/C1227. The fast ramp then returns to the level set by Q1332. The next rising transition of the clock signal begins the cycle over again. Rising transistions of the clock signal have no effect during the time of the fast ramp.

The time that C1238/C1277 take to charge determines the length of the fast ramp, see Fig. 3-3. This time is changed by the multiplier switch S1215R and the CABLE DIELECTRIC pushbuttons S1156 and S1252.

Pulser Enable. R-S flip-flop comprised of U1667A and U1667B is used to enable the power to the pulse generator through Q1657 (Diagram 2). It is also used to reset the Pulser strobe generator, Q1556 and Q1551. Pulser power is enabled 20 ms before the fast ramp starts to ensure that the pulser circuits are stable. The Pulser strobe from CR1654 resets R-S flip-flop U1667A and U1667B. This is necessary to save battery power.

Pulser/Sampler (Diagram 1)

The circuits contained on the Pulser/Sampler portion of the main board consist of a Pulser and a Sampler comparator and the Pulser Generator and Sampling circuits.

Both comparators are identical, except the Pulser Comparator is referenced to a dc level and the Sampler Comparator is referenced to the slow ramp signal. They are both essentially current comparators. In the Pulser Comparator the voltage at the emitter of Q1559 is compared to the voltage at the cathode of CR1755. The current that flows through Q1559 is the difference between those two voltages divided by the value of R1655 and R1755. CR1558 is a 1 milliamp tunnel diode and together with Q1558 forms a fast switch. When the current through Q1559 reaches 1 milliamp CR1558 will fire. The switch will change state and the output at the collector of Q1558 will change from −5 V to +5 V. The transition is about 30 ns. This causes the generation of one test pulse. The switch will remain in this state until the current through tunnel diode (CR1558) has dropped below its valley point. This occurs when the fast ramp is reset.

The Sampler Comparator works the same, except the time at which the comparator fires is delayed due to its being referenced to a slowly increasing voltage (the slow ramp). Thus the sampling point is slewed by the level of the slow ramp (see Fig. 3-2).

Pulse Generator

The Pulse generator consists of a current source Q1435 and various inductors and capacitors selected by IMPULSE WIDTH (S1343). The current source is turned on causing energy to be stored in the selected inductor. The pulser strobe causes Q1435 to turn off which results in an induced pulse whose frequency is determined by the selected inductor/capacitor parallel resonant circuits. The voltage at the collector of Q1435 will swing negative once but will be clamped to zero as it attempts to go positive. The strobe that turns off Q1435 also resets flip-flop U1667A and U1667B and turns off the current source.

Q1556 and Q1551 comprise a pseudo SCR circuit which is triggered by the pulse from the comparator circuit Q1558 and CR1556. When the SCR fires it turns Q1435 off in approximately 2 ns. The trigger from the comparator is also sent to U1667 pin 2, an RS flip-flop, through CR1654 resetting the flip-flop which turns off Q1657, thus keeping the current source Q1435 off.

When Q1435 is turned off the collector voltage will tend to ring due to the energy in the inductor/capacitor circuit and swing negative and positive with respect to ground. Clamping diode CR1434 and Q1436 prevent any positive excursion of the voltage. Due to the clamping action all energy from the inductor/capacitor circuit is dissipated and only one negative-going half-sine pulse is generated.

This pulse is applied through C1447 to the output stage Q1637. The output stage is basically a class B common-emitter amplifier which is biased to about +24 V. The emitter goes to the +25 V supply through a network of resistors. These resistors provide the required gain to output the pulse voltage (0-5 V) into the selected characteristic impedance. The output of the Pulse amplifier Q1637 is sent to the CABLE connector through dc blocking capacitor C1715.

CR1639, R1646, and C1647 form a clamping circuit to prevent high positive transient voltages from damaging Q1637 and the sampling circuits. Voltages above +25 V will forward bias CR1639 causing it to conduct and charge C1647. When the voltage is removed, the excess voltage drains through the +25 V supply; returning the charge on C1647 to its quiesent level of +25 V.

The clock signal from U1667 pin 10 is rectified by CR1647 and CR1648 and regulated by VR1649 to −9 V across C1648. Any fast-transient negative-going voltages on the CABLE will be clamped to about −9 V.

Slow transient positive or negative voltages, less than 400 V and less than 400 Hz, will be blocked by the reactance of C1715 and the selected output resistance.

Sampler

The sampler circuits receive the test pulse and the reflected pulse from the Pulse Generator and the CABLE connector via a coaxial cable. The cable has a ferrite bead isolator. The R1791, R1733, and R1734 provide impedance matching for the cable. Capacitors C1741 and C1742 compensate for a dc component of the pulse train.

First Sampling Gate. During the period in which the gate diodes are forward biased by the strobe pulse capacitors C1697 and C1793 appear in parallel and are charged to a portion of the input signal level at that instant. The amplifier U1795 is too slow to respond. After several hundred nanoseconds the amplifier realizes that its input/output levels are not in the correct proportion and the output begins to move to correct the situation causing charge redistribution between C1793 and C1697. Closer look at the amplifier shows that is a non-inverting amplifier with positive feedback by means of C1697. The gain of the feedback loop is varied from 1 to .62 by R1693 in conjunction with R1692 and the forward gain is 1.62, set by the same resistors for an equivalent loop gain variation of 1 to 1.62. The final state of charge on each of the capacitors C1793 and C1697 is determined by their values and the loop gain. The output voltage thus may be varied by R1693 to produce an output equal to 1.62 times the true input before sampling. This results in an equivalent sampling efficiency of 100%.

First Blow-by Compensation. Blow-by results from energy feeding through the junction capacitance of the sampling diodes even though they are turned off. The first blow-by compensation is accomplished by R1796 and R1793. These resistors feed a portion of the input signal into the inverting input of operational amplifier U1795. This cancels the blow-by voltage at the output of U1795. The amount of compensation depends upon the setting of R1796.

Second Sampling Gate. Q1594 and U1503 comprise the second sampling gate. Second sampling is required to reduce the effect of unbalanced leakage current in the first sampling gate diodes. The output of the sampler comparator Q1578 is used to turn the gate on for about 8 ms, allowing C1593, the second memory capacitor, to charge to the level of the sampled signal. U1503 amplifies the level stored on C1593 and provides the discharge path for C1593 between charge times. Fig. 3-4 illustrates the timing of the second sampling circuits.

Second Blow-by Compensation. Blow-by resulting from gate-drive energy feeding through the gate to source capacitance of the second sampling gate is compensated for by feeding a portion of the drive signal into the inverting input of U1503. This portion is obtained through R1597, C1595, and R1406. The amount of the first sampled signal sent to U1503 is determined by the setting of R1406.

Log Amplifier. Amplifier U1695B in conjunction with R1603 and R2126 is used to amplify the sampled signal logarithmically from 0 to 18 dB providing the FINE dB loss control.

Slow Ramp Generator (Diagram 3)

Integrator. An inverting amplifier circuit with a FET input is used as an integrator. Integrator capacitor C2356 is connected between the collector of Q2345 and the inverting input (gate of Q2246A). A negative current applied to the inverting input through R2353 results in a linear rising voltage at the output (see the waveform shown in Fig. 3-5). This output voltage will continue to rise until it reaches an internal comparison level of 4.1 V. The bi-level comparator output then switches to a higher output level to close the FET switch, Q2257. It also changes its comparison level to −0.1 V. This allows a positive current to be applied to the input of the integrator through R2251. The positive current is ≈13 times larger than the negative current and causes the output voltage of the integrator to decrease linearly. After a short period of time, the integrator output voltage approaches this comparison voltage of −0.1 V and causes the positive current into the integrator to be turned off. At this time the comparator level is switched back to the 4.1 V level and the cycle starts over.

The rise and fall time of the slow ramp can be varied by changing the integrating capacitance values. In the normal 40 Hz scan a value of 0.0013 μF is used. When NOISE FILTER switch S2254 is activated, the scan frequency is reduced by approximately 7 times by paralleling a capacitance value of 0.01 μF to the original 0.0013 μF. For recording (X-Y or chart) purposes, a value of 1 μF is used. (Q2248 acts as a FET switch and is controlled by the Record Logic.)

Bi-Level Comparator. During the positive going sequence of the Slow Ramp Generator, Q2161 is saturated and Q2166 is off. The emitter voltage of Q2161 and Q2166 is 4.1 V. This voltage is controlled by a resistor divider, R2267 and R2158. The collector (output of the comparator) of Q2166 is at a −5 V level because the transistor is not conducting. The anode of CR2159 has to rise to 4.1 V in order to turn off Q2161.

When Q2161 turns off, its collector level will decrease, which causes Q2166 to be turned on and saturated. The emitter voltage output switches to −0.1 V. Q2161 remains off until the anode voltage of CR2159 goes to −0.1 V, which restarts the cycle.

The comparator can be forced into the retrace cycle by a +5 V signal at the anode of CR2262.

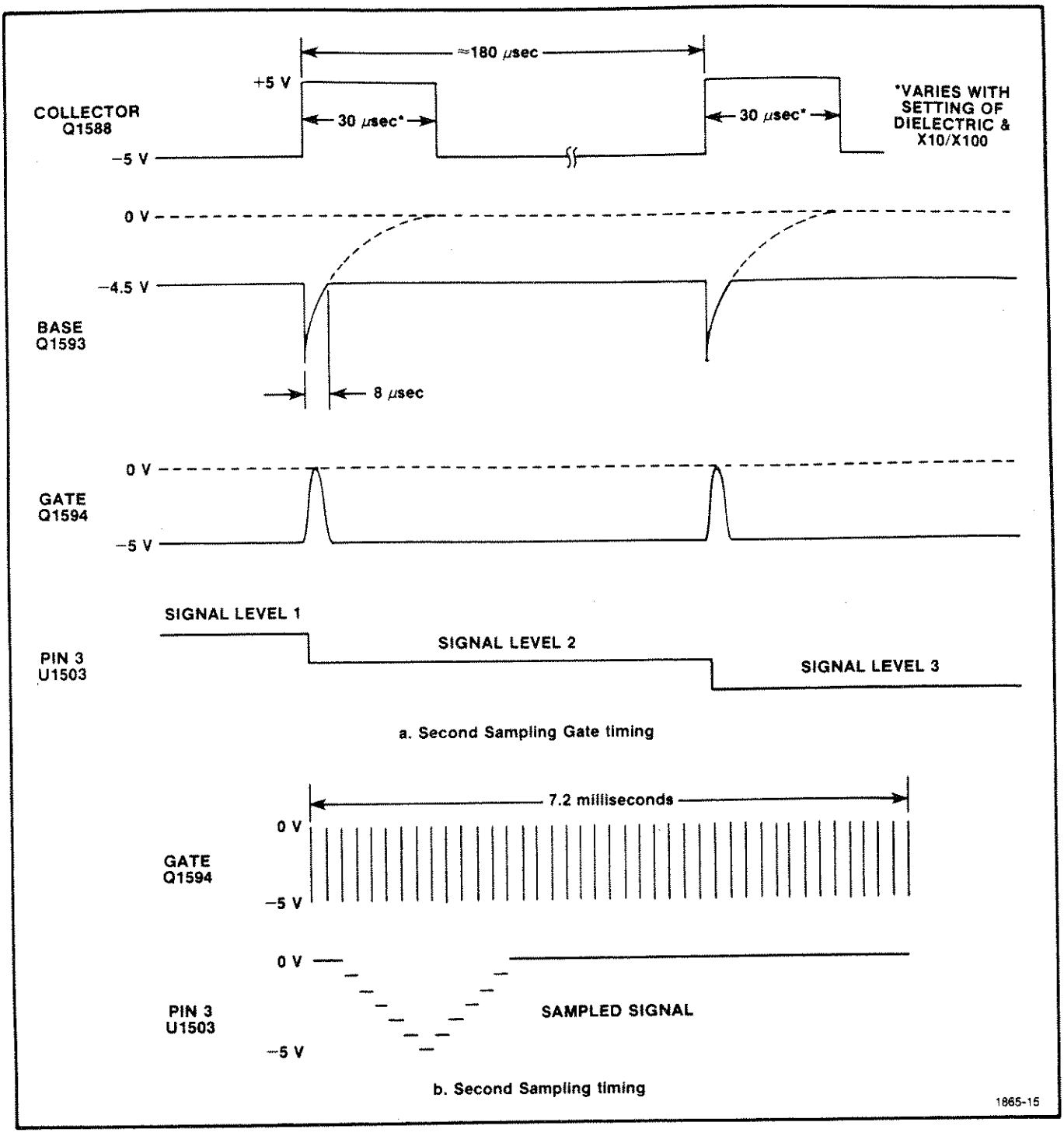


Fig. 3-4. Sampling Circuit timing.

Retrace Signal Amplifier. The retrace signal amplifier uses an input FET (Q2258) to drive amplifier Q2259. The output voltage is +5 V during retrace and −5 V during the scan cycle. The output is used for Chart Recorder Logic and Record Logic.

Current Sources. The positive and negative currents for the retrace sweep are generated by applying +5 V and −5 V to the high value resistors R2251 and R2353 respectively.

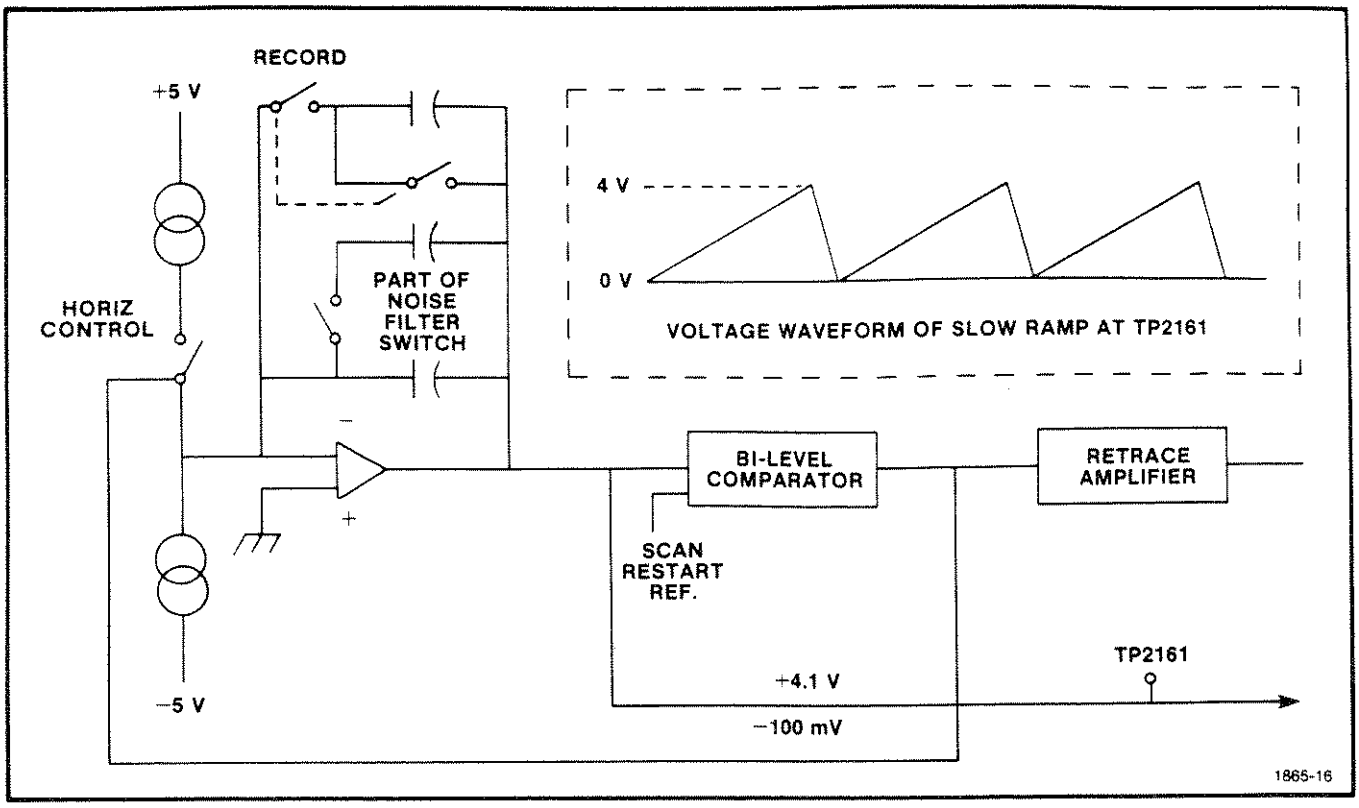


Fig. 3-5. Functional block diagram of the Slow Ramp Generator.

X-Y Recorder Logic

The X-Y Recorder Logic consists of multivibrator U2332B and U2332D; gates U2332A and U2332C (and multiplex switches U3223A and U3223B on diagram 4).

During the normal mode of 1503 operation, the output of the multivibrator (PEN LIFT: TP2157, yellow) is low and Q2248 is not conducting. Pin 10 of U2332C is low and Q2249 is not conducting. By pressing RECORD switch S0481B, the RECORD line goes high, the multivibrator changes level, and TP2157 becomes high (+5 V). This turns on Q2248. The output of U2332A (pin 3) goes low, and the output of U2332C (pin 10) goes high. This turns Q2249 on. Q2249 and Q2248 keep C2356 discharged and the output of the Slow Ramp remains at 0 V. By releasing the RECORD switch, the output of U2332C goes low, which turns Q2249 off, but, Q2248 stays on. This starts the Slow Ramp Generator scanning at a much slower rate due to C2352 being added to the circuit. When the scan cycle ends, the output of retrace amplifier Q2259 goes high, causing multivibrator U2332D and B to be reset. This sets the Recorder Logic back to the normal mode of operation.

The components CR2324, R2324, and C2325 are used to ensure that the Recorder Logic is in the normal mode of operation when the power supply switch is turned on.

Horizontal Output Amplifier (Diagram 4)

The Horizontal Output Amplifier consists of Q3221, Q3118, Q3113, and Q3114. This amplifier amplifies the 0-4 V, slow ramp signal into a differential voltage of approximately 150 V as well as shifting the output level to an average voltage of 85 V. The amplifier gain is approximately 37 and is achieved with a differential transistor amplifier, Q3221 and Q3118. The gain is controlled by the ratio of resistance R3122 or R3121, to the parallel values of resistors R3217 plus R3116, and resistors R3216 plus R3212. R3217 is variable to adjust for crt deflection factor tolerances. The differential amplifier uses Q3113 and Q3114 as a current mirror current source. The thermally stable current is set by R3112, R3114, and R3115. R3213 is used for horizontal positioning.

Vertical Amplifier (Diagram 4)

The Vertical Amplifier circuit contains selectable gain amplifier U2136 with positioning control, variable gain amplifier U2143 to calibrate the instrument for different cable impedances, retrace logic, and a vertical output amplifier.

Selectable Gain Amplifier. This circuit consists of operational amplifier U2136, and a bank of resistors for

gain selection. The required resistors are selected by switch S2126 (RET LOSS). The resistors are selected to provide a logarithmically varying gain.

The operational amplifier is connected as a voltage follower. The non-inverting input receives its signal from the log amplifier through R2138 and the positioning signal from amplifier U2131 through R2137. High-frequency noise is filtered by 0.001 μF capacitor C2137. Additional noise filtering can be obtained by activating the NOISE FILTER switch, S2254, which adds a 0.1 μF capacitor, C2241, to the circuit and reduces the horizontal sweep rate.

Positioning. Vertical trace positioning is accomplished by offsetting the dc level of the input vertical signal. Operational amplifier U2131 provides the dc offset voltage. U2131 is controlled by R0251A (POSITION) and R0251B (FINE).

Variable Gain Amplifier. The Variable Gain Amplifier consists of U2143 with variable gain provided by R0263. The incoming voltage is attenuated approximately 50% by R2233 and R2144. The output voltage is approximately 200 mV per division. The variable gain control has a range of approximately 5 times and is set by the values of R0263 and R2142. The output goes through the Retrace Logic to the Vertical Output Amplifier.

Retrace Logic. The Retrace Logic consists of Gate U3123C, inverter Q3137, controllable oscillator U3123A and U3123D, and analog switches U3223C and U3223D.

The only time the vertical signal is applied to the vertical output amplifier is during the forward scanning cycle. During the retrace cycle, an offset voltage is applied to the vertical output amplifier.

During the slow ramp's forward scan cycle, the retrace signal is negative, as is pin 2 of U3123A. This causes the output of U3123D to be low. Pin 6 of U3223C is also high, while pin 12 of U3223D is low, and the vertical signal passes through the analog gate to the output amplifier.

During the retrace cycle, the output of U3123D is low and pin 6 of U3223C is low while pin 12 of U3223D is high. This allows the output of U3123D to be passed to the vertical output amplifier. This causes the beam to be deflected below the crt viewing area.

Vertical Output Amplifier. The Vertical Output amplifier consists of Q3236, Q3232, Q3139, and Q3235. The mode of operation is identical to that of the Horizontal Output Amplifier. In the Vertical Output Amplifier the amplifier gain is approximately 80. Capacitor C3233 is added to increase high frequency response.

Display Circuits

The display circuit contains the High Voltage Supply, which provides the voltage for the FOCUS control, INTENSITY control, and the cathode of the crt and the crt biasing network. The crt, which provides a display of the conditions of the cable being checked, is also shown in the circuit.

High Voltage. The high voltage circuit consists of: an oscillator, formed by transistors Q4149 and Q4145; transformer T4241; a high voltage multiplier circuit consisting of CR4323, CR4313, CR4311, and CR4211, and a resistor divider string consisting of R4114, R4126, R4222, R4129, R4221, INTENSITY control R0442, and FOCUS control R0432.

The self-starting oscillator is formed by R4148 and R4145 and transformer T4241. The transformer has a separate feedback winding (pins 9, 10, 11) which ac couples the voltage to the bases of the transistors Q4149 and Q4145. R4146 and R4141, along with the 0.001 μF capacitors C4135 or C4134, establish a time-constant sufficient to prevent saturation and establish the oscillator frequency.

Winding 7-8 of the transformer provides a 0.6-V rms signal for the crt filament. This winding is high voltage insulated. Winding 4-6 provides a 500-V square wave that is used to generate the high voltage. The high voltage multiplier circuit converts the 500 V to 2000 V. The resistor divider string is connected between the 2000 V and the 1000 V taps of the multiplier circuit. This provides the voltages for correct biasing of the crt. The FOCUS and INTENSITY controls are part of this divider string. A 150 V zener diode, VR4117, is used to stabilize the cathode to grid potential.

Power Supply

The Power Supply consists of a line selector, transformer T0389, a battery charger network, battery pack BT0369, and the dc to dc voltage converters. The battery charger network contains SCR switch Q6157, SCR triggering circuit Q6143, Q6244, and Q6241, operational amplifier U6138, and current reference resistor R6131.

The dc voltage converters contains an Anti-Deep-Discharge circuit (Q6548, Q6549, and Q6547); a primary regulator (Q6552, Q6557, and VR6459); a duty-cycle controlled oscillator (Q6458, Q6445, C6551, R6545); a fly-back switch (Q6435 and Q6349); and fly-back transformer

T6535. The secondary output windings of T6535 provide the −165 V, +100 V, −25 V, +10 V, −8 V, −8 V, +5 V, and −5 V supplies. The +10 V, +5 V, and −5 V circuits have secondary regulation circuitry. See Fig. 3-6 for a simplified block diagram of the power supply.

Battery Charger. Line transformer T0389 in conjunction with full wave rectifier CR6157 provides battery charge current. The battery charge current is regulated for an average current of 150 mA (independent of battery load).

A reference voltage of approximately 50 mV is created across reference resistor R6132. This voltage is created by R6135 and VR6134. The battery load and charge current are always fed through R6131 and the charger will try to maintain an average current of 150 mA into the battery. This is done by comparing the voltages across two reference resistors (R6132 and R6131) using operational amplifier U6138. Depending upon the battery charge current, the output of the operational amplifier will provide more or less current into the current source input Q6244. With every new cycle, a current (of the same magnitude as the input current) will be released by Q6241 to charge capacitor C6147. This current will be increased or decreased to maintain an average of +50 mV across R6131. The voltage across C6147 builds up every cycle until it reaches the firing threshold level of the programmable unijunction transistor (PUT) Q6143. At this moment, a triggered pulse occurs at the cathode of the PUT, which in turn fires SCR Q6157. When this occurs, a portion of the full-wave rectifier output provides a charge current for the battery during the remainder of the cycle. During this same period, C6147 gets discharged through the anode of the PUT. The point at which the triggering occurs is determined by how fast C6147 becomes charged to the reference voltage of about 4.5 V and the charging speed is determined by the average current to the battery.

Because the charge current and load currents are in the form of pulses, averaging (integration) is performed at the output of operational amplifier U6138 by a 15 μF capacitor C6233. Zener diode VR6235 provides level shifting. Battery pack BT0369 consists of nine nickel-cadmium C cells. CR6234 prevents reverse biasing of C6233.

NOTE

For proper operation, the battery pack must be in place at all times during operation of the instrument.

DC Voltage Converter. The controllable oscillator is an astable multivibrator (Q6458 and Q6445). The collector of Q6445 is high for 8 μs and low during the remainder of the period. The 8 μs period is set by C6551 and R6545 in parallel with R6449 and R6457. The low voltage duration at the output is controlled by the primary regulation voltage of Q6552, R6454, and C6451. Diode CR6452, R6451, and R6453 protect against base-emitter reverse breakdown voltage.

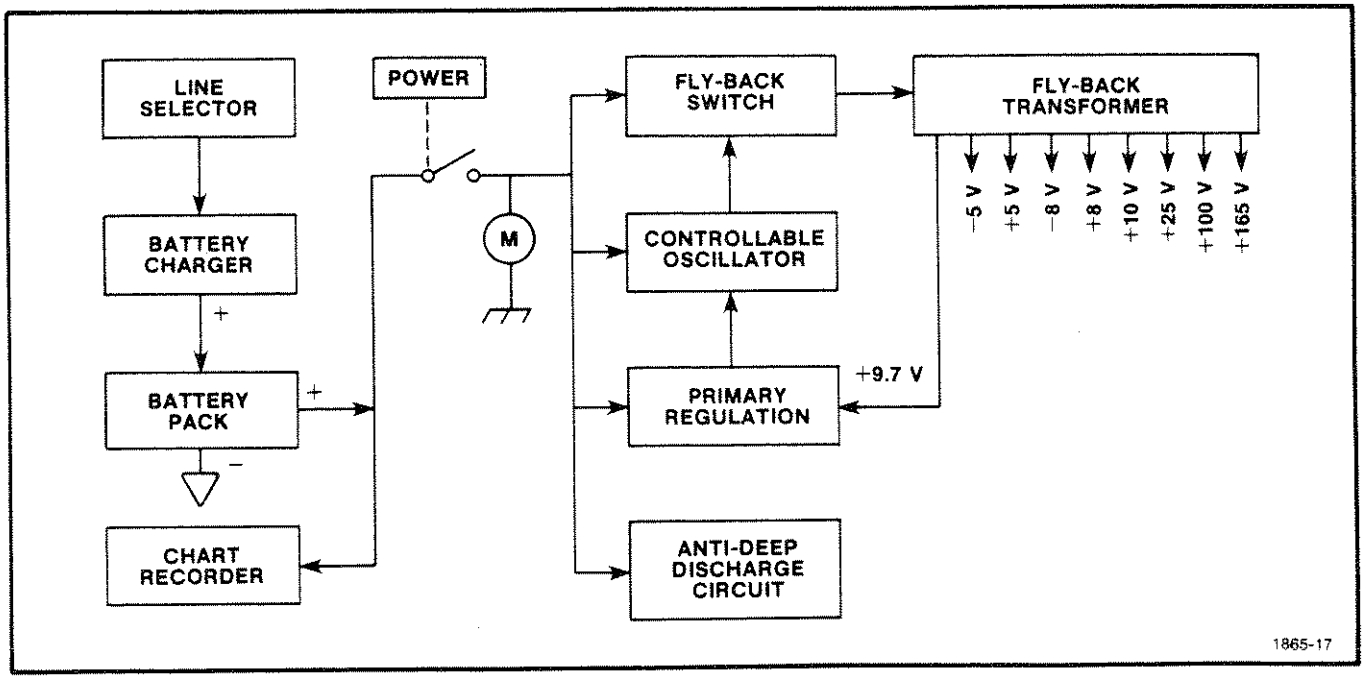


Fig. 3-6. Block diagram of 1503 Power Supply.

The output of the astable multivibrator is connected to the fly-back switching circuitry consisting of Q6349 (a Darlington emitter follower) and Q6435 (a high current switch). Q6435 conducts when the output of the multivibrator is high, so a magnetic field builds up in fly-back transformer T6535 by way of windings 5-6 during the 8 μs period. When Q6435 turns off, the field collapses and the stored energy is transferred to the secondary windings. Diodes CR6347, CR6441 and CR6442 prevent Q6435 from saturating, causing the switch-off time to be faster. To reduce the base drive energy, a voltage source that is lower than the battery pack is used. This is supplied from terminal 3 of T6535 through diode CR6446.

The +25 V (pre-regulated) supply is used to control the primary regulation. (It is also used for the high voltage circuitry and the pulse generator.) A voltage tap is provided by way of R6358 and Q6357 to create 9.7 V as a reference voltage for the primary regulator network. This voltage is compared against the combined voltage of 9.1 V zener diode VR6459 and the base-emitter junction of Q6557. Depending on the voltage level of the 25 V supply, Q6557 conducts more or less. The amplified collector voltage is fed to astable multivibrator Q6458 and Q6445 by way of emitter-follower Q6552. This controls the duty cycle of the astable multivibrator.

Anti-Deep-Discharge Circuit. The Anti-Deep-Discharge circuit prevents the battery pack from going into deep discharge, which could permanently damage the batteries. Q6549 and Q6547 are connected as an SCR network. When fired, both transistors fully conduct, which forces the collector of Q6557 to ground. This reduces the input voltage to the input of the astable multivibrator, and turns it off, disabling the dc voltage converter.

The SCR network is triggered when Q6548 conducts. This happens when the battery voltage drops below 10 V. The +10 V power supply is used as reference voltage by way of CR6546 and R6539. To reset this SCR network, the battery voltage must be removed by turning off the front panel POWER switch. The batteries must be charged or replaced (unless ac power is to be used) before further operation of the instrument. To allow quick discharge of C6443, when the power switch is off, and reset the SCR latch quickly, R0165 is connected between ground and C6443 by switch S0165.

CAUTION

When the Anti-Deep-Discharge circuit is operating, the voltage circuits are turned off, but there is still a small amount of current drawn from the batteries. This will further discharge the batteries (at a slower rate) if the POWER switch is not turned off.

Voltage Regulators. The +165 V, +100 V, +8 V and −8 V supplies are not individually adjustable. R6358 is used to adjust the +25 V supply to the correct output voltage. The +10 V regulator provides a 10 V reference for the +5 V and −5 V regulators.

The 5.1 V zener diode, VR6417, is used in a bridge configuration to provide a reference voltage for the −10 V supply. R6518, R6513, R6413, and R6514 are part of this bridge network. The bridge outputs are fed into operational amplifier U6515, which drives series regulator Q6427. Zener diode VR6419 is used as a start-up circuit. Capacitor C6416 provides additional power supply filtering.

Q6331 is the series regulator for the +5 V power supply. The +5 V is referenced against the output of the divider, R6225 and R6231, which in turn is driven by the +10 V supply. The output of U6236 drives the series regulator in a voltage follower mode.

The −5 V power supply uses Q6227 as a series regulator. U6222 is used as a controlled current source and the minus voltage connection (−V) is connected to the base of the series regulator. Part of the no-load amplifier current is shunted by R6222 and the load current fluctuations are used to control Q6227. R6223 is a current limiter.

Control Logic (Diagram 5)

The Logic board is used only with the TEKTRONIX Y-T Chart Recorder. This board can be removed without affecting the operation of the 1503. However, if this board is removed, the RECORD switch would have to be connected to the Vertical board by connecting the cable from the RECORD switch to P28 on the Vertical board.

The Logic board consists of pulse shaper, U5166A, U5166B, U5166C, and U5166D; binary counter U5147; a horizontal correction network; Chart Recorder Logic for controlling the paper drive motor; stylus heat; a Chart Recorder power switch; and an anti-bounce record circuit.

Pulse Shaper. The Pulse Shaper is made up of U5166A, U5166B, U5166C and U5166D. When the paper is moving, a square wave signal (CHART SPEED SENS) is generated by the holes in the paper passing between a light-emitting diode and a photo-sensitive transistor. The resultant small pulses are shaped to a clean square wave by a high gain amplifier circuit, U5166B and U5166C. The output signal is capacitor-coupled by C5167 to one-shot multivibrator U5166A and U5166D. This one-shot produces an output signal at TP5145 (violet test point) which is a positive going pulse approximately 10 ms wide. This (clock) pulse

is connected to binary counter U5147; and to the end of the paper motion sensor network, R5148.

Counter. The 7-stage binary counter is an integrated circuit U5147. The binary outputs are connected to an R, 2R resistor ladder network, which together with U5117 forms a digital-to-analog converter. Outputs Q1 and Q7 are connected to AND gate U5252B so that it recognizes the count number 65. Q2 clocks multivibrator U5127B at count 2. (The signal from U5127B starts the slow ramp.)

Horizontal Correction Network. The Horizontal Correction network compares the output of the digital-to-analog converter, with the inverted slow ramp signal. U5227 inverts the slow ramp signal.

The digital-to-analog output and inverted slow ramp signal are connected to inverting amplifier U5117, which performs summation and amplification simultaneously. This signal is fed to the Slow Ramp Generator by way of R5118 and will speed up or slow down the Slow Ramp Generator to synchronize it with the paper speed of the Strip Chart Recorder.

Chart Recorder Logic. The logic control signal that is received through pin 2 of P53 is shaped into a narrow impulse (negative going) by U5156B and U5156C. This impulse occurs at the trailing edge of the logic control signal and latches bi-stable multivibrator U5252A and U5252C. Pin 9 of U5252A goes positive, turns on Q5266 which pulls the motor control line to ground, causing the paper drive motor to start rotating. The paper drive motor is turned off at a count of 65 by U5252B. A second signal is capable of turning the motor off. This occurs when the end of the paper is reached and the output from the pulse shaper is stopped. This causes C5249 to discharge and unlatch the multivibrator.

The multivibrator is initially latched when the inverted control signal from pin 4 of U5156B charges C5249. The impulse from pulse shaper U5166A and U5166D keeps C5249 charged. The multivibrator latch (output of pin 10) disables the reset of the counter and turns Q5144 on. This locks out the logic control input line.

Stylus heat control comes from Q5239, which is turned on by flip-flop U5127A. This flip-flop is energized by PEN LIFT signal from the Vertical board. The RETRACE signal

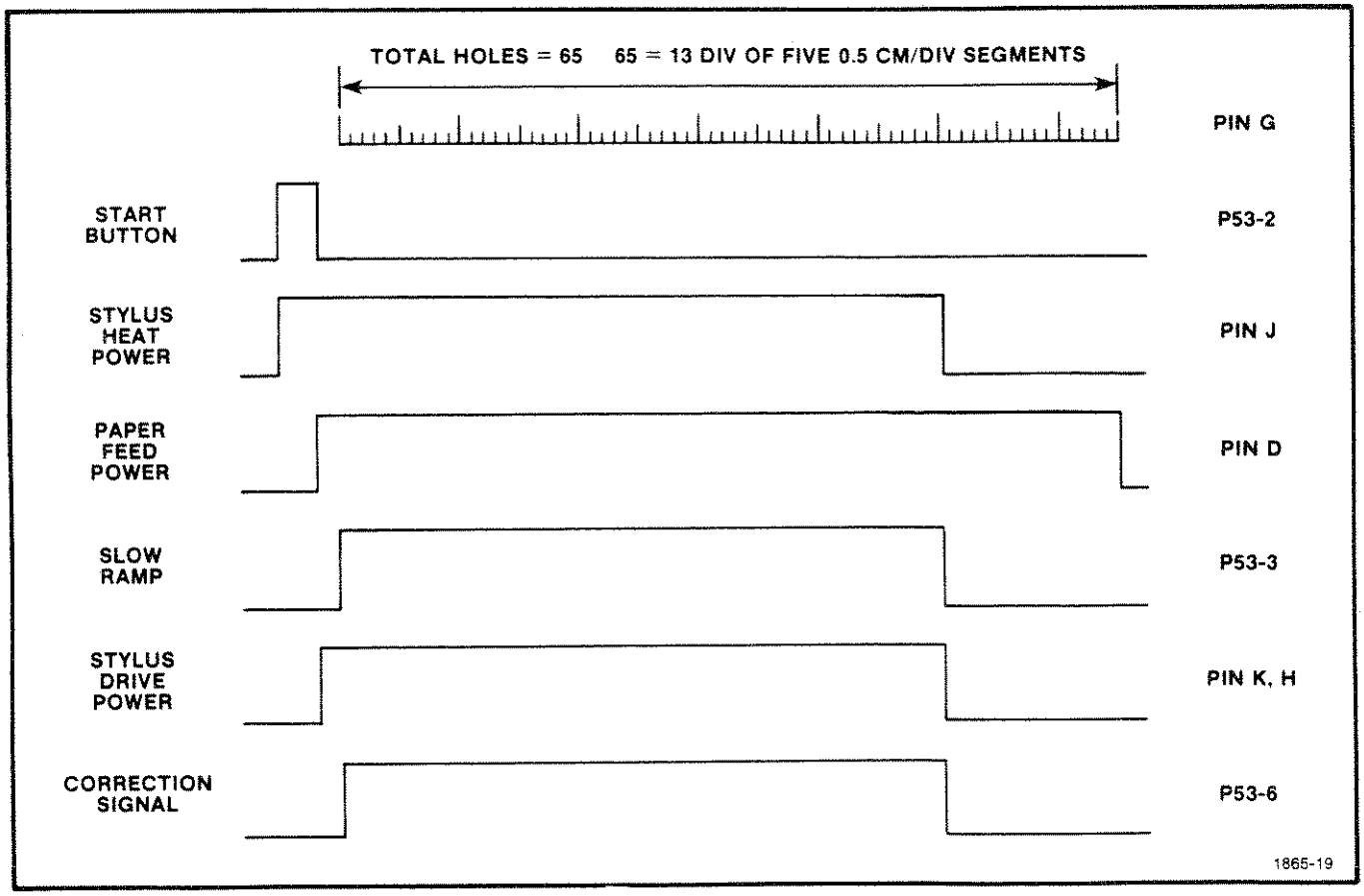


Fig. 3-7. Chart Recorder logic.

turns the stylus heat off. This signal brings the flip-flop back to its original state (where pin 1 is low). The "Q" output also controls the chart pen motor power switch as well as providing the "J" input to flip-flop U5127B.

U5127B controls the start of the Slow Ramp Generator and controls the horizontal correction signal disable network (Q5112) and the power switch to the chart pen drive. The Slow Ramp Generator starts when Q2 of the Counter goes high. The output "Q" of U5127A enables U5127B to be clocked by Q2. When clocked, the pin 15 output of U5127B raises the HORIZ CONTROL line, while the pin 14 output enables the horizontal correction circuit by means of Q5112. The Q output of U5127A enables the heat and pen drive power when high.

Q5237 and Q5229 act as a dc level shift amplifier between flip-flop U5127B and the Slow Ramp Generator, which is on the Vertical board. Q5226 senses when the chart recorder is plugged in.

Chart Recorder Power Switch. The plus or minus 8 V to drive the stylus movement is applied to the Strip Chart Recorder through two electronic switches, Q5273 and Q5277. Q5179 parallels Q5273 to provide more current in the +8 V line. These switches are driven by the same signal that is used to control stylus heat switch Q5239. This signal is passed through Q5173 and Q5279 to the switches.

Anti-Bounce Record. This circuit, consisting of U5156A and Q5156D, removes switching transients from the RECORD switch. The output of this circuit goes to the Vertical board to control the X-Y Record Logic. The Record Logic in turn provides the logic control signal that is received through pin 2 of P53 on the Logic board. If the Logic board is removed from the TDR unit, the harmonica connector from the RECORD switch should be connected to P28 on the Vertical board.

X-Y Output Module

The X-Y Output Module provides an electrical interface between the 1503 and an external X-Y Chart Recorder. Three signals, PEN LIFT, X Output, and Y Output are provided for use by the external Chart Recorder.

The switching mechanisms for the outputs are solid state devices, therefore care should be taken when connecting loads to them. See the specifications listed in the Characteristics section of this manual.

Pen Lift. The Pen Lift signal level changes when the RECORD switch is activated. The normal level is either 0.0 V ±0.5 V or 5 V +0 or −1 V, depending on how the terminal link of the X-Y Output Module board is connected (positive or negative slope, see Fig. 3-9). When the RECORD switch is activated, the level will change from 0 V to 5 V or from 5 V to 0 V. The driving capability of this signal source is given in the Characteristic section of this manual.

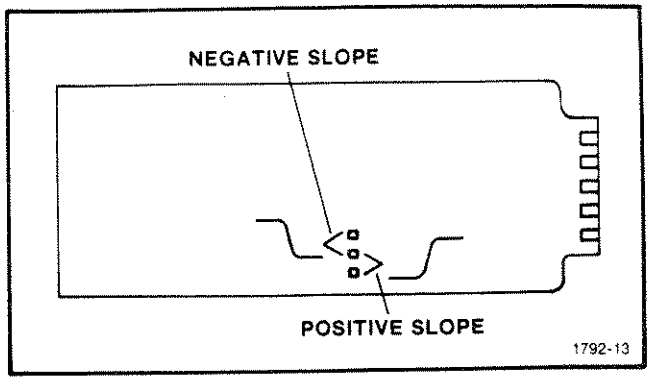


Fig. 3-8. X-Y Output Module strap.

Diode CR7247 is used to clamp the negative voltage swing to −0.6 V. Q7242 provides the capabilities for the operation of units with a positive pen lift or a ground return path.

X Output. The X output is proportional to the horizontal position of the crt beam along the crt face. This signal is a ramp of approximately 20 s duration and raises at a rate of 0.1 V for each division of horizontal travel across the crt. This 0.1 V per division scale factor is set by a voltage divider network comprised of R7138, R7129 and R7122. C7132 is used to reduce noise. Source impedance is less than 13 K (9.4 K minimum).

Y Output. The Y output is proportional to the vertical deflection on the crt. The scale factor (volts output per division of crt deflection) is adjustable, from 0.09 V per division to 0.13 V per division (factory set for 0.1 V/div), by variable resistor R7225. The source impedance of this signal is less than 11 kΩ (8 kΩ minimum) and is determined by R7234, R7224 and R7225. C7232 is used to reduce noise.

CALIBRATION PROCEDURE

PERFORMANCE CHECK PROCEDURE

Calibration Interval

To ensure accuracy, check the calibration of the 1503 every 1000 hours of operation, or every six months if used infrequently. Before complete calibration, thoroughly clean and inspect this instrument.

Tektronix Field Services

Tektronix, Inc. provides complete instrument repair and recalibration at local Field Service Centers and Factory Service Centers. Contact your local Tektronix Field Office or representative for further information.

Using this Procedure

Performance Check. The performance check of this instrument can be made by performing all steps of the performance check. The 1503 can be checked for basic operation by using a cable of known length, impedance, and dielectric, but an accurate check requires removing the case and using the performance check. Whenever the case is removed, it must be resealed using the procedure listed at the end of the Calibration Procedure to maintain watertight integrity.

Partial Calibration. A partial calibration step is often desirable after replacing components. To prevent unnecessary recalibration of other steps, be sure the instrument settings are correct by referring to previous steps.

Complete Calibration. Completion of each step in this procedure ensures that this instrument is correctly adjusted and performing within all given tolerances.

NOTE

When other equipment is substituted, control settings or calibration set up may need to be altered to meet the requirements of the substituted equipment.

Preliminary Procedure

Remove the battery pack from the rear of the 1503 case. Remove the front cover of the 1503.

Loosen the four screws at the rear of the case and set the unit face up. Push down on the handle to break the seal; then place it face down on a flat surface. Take hold of the sides of the case and pull to remove the case from the unit.

Remove the EMI shields from the top and bottom of the unit. Place the battery pack in the rear of the 1503, taking care that the polarity is correct. Connect the ac power cord to the ac outlet, at the rear of the unit, and to a 115 V ac (230 V ac for Option 6) power source.

WARNING

Extreme caution must be used when operating the 1503 with the covers removed. Up to 170 V may be encountered in exposed areas.

Pull the POWER switch to turn the unit on and allow 20 minutes warm-up before proceeding with the calibration.

Table 4-1

LIST OF TEST EQUIPMENT REQUIREMENTS

Description	Performance Requirements	Applications	Example
Power Module		Must be used with all TM 500 plug-ins	TEKTRONIX TM 503 or TM 504
Digital Voltmeter	Range 0-200 V, ±0.1% accuracy	Voltage Measurements	TEKTRONIX DM 505 or DM 502A
Pulse Generator	0.1 ms, 0 to 5 V Output, External Trigger	Timing	TEKTRONIX PG 501
Sinewave Oscillator	200 Hz, 0-10 V into 50 Ω	Vertical Attenuation	TEKTRONIX FG 503
Oscilloscope	5 MHz Bandwidth, 10 mV/Div Vertical Sensitivity	Horizontal	TEKTRONIX SC 501
Step Attenuator	0-50 dB, 0.5% accuracy	Vertical Attenuation	TEKTRONIX 2701 Attenuator
50 Ω Termination (feed through)	50 Ω ±2%	General	Tektronix Part No. 011-0049-01
Adapter bnc female-to-bnc female		General	Tektronix Part No. 103-0028-00
Coaxial Cables (2 required)	50 Ω, 42 inch bnc connectors	General	Tektronix Part No. 012-0057-01
75 Ω Termination	75 Ω ±2%	Vertical Check	Tektronix Part No. 011-0055-00

PERFORMANCE CHECK

1. Vertical Attenuation Check

Control Settings:

RET LOSS	0 dB
NOISE FILTER	Out
0-dB SET	Clockwise
Distance Dial	000
FEET/DIV	0.5
(METRES/DIV)	(1)
CABLE DIELECTRIC	Both Out
VAR	Clockwise

a. Disconnect P21 from the Vert Amp/Slow Ramp board.

b. Connect the sine-wave output from the FG 503 through the 2701 attenuator to P21 on the Vert Amp board. It may be necessary to ground the chassis of the 1503 to the FG 503.

c. Set the FG 503 to a 200 Hz sine wave.

d. Set the 1503 RET LOSS to 0 dB. Set the 0-dB SET fully cw, set the 2701 to 0 dB, and set the FG 503 for a 6 division display.

e. The crt should display a sine wave for each of the following settings of the 1503 RET LOSS switch and the 2701 attenuator switch:

RET LOSS	2701 ATTEN	Display
0 dB	0 dB	6 div ±0.2 div
10 dB	10 dB	6 div ±0.2 div
20 dB	20 dB	6 div ±0.2 div
30 dB	30 dB	6 div ±0.2 div
40 dB	40 dB	6 div ±0.2 div
50 dB	50 dB	6 div ±0.2 div
60 dB	60 dB	6 div ±0.2 div

f. Remove the test leads and replace P21.

2. Display Noise Check

a. Set RET LOSS to 0 dB.

b. Connect the 50 Ω terminator to the CABLE connector and press the 50 Ω impedance button.

c. Set FEET/Div to 5, multiplier to X100, and press the 1000 ns IMPLS WIDTH button.

d. Set 0 dB SET control for a 2 division display.

e. Set the IMPLS WIDTH to 10 ns. Turn the ZERO REF SET control fully clockwise.

f. Set the RET LOSS to 78 dB and adjust the POSITION controls so the base line is located on the crt center line.

g. Check that the peak-to-peak noise is not greater than 3 divisions (−80 dB rms). Ignore occasional spikes.

h. Push the NOISE FILTER button in and check that the peak-to-peak noise is less than 1.5 divisions (−86 dB rms).

3. X10 Timing Check

a. Set the RET LOSS to 20 dB and the multiplier to X10. Set FEET/DIV to 50.

b. Connect the TG 501 Time Mark Generator through a 50 Ω terminator to the CABLE connector on the 1503. Set the TG 501 to 1 μs marks.

c. Connect the + TRIGGER OUT from the TG 501 to the TRIG/DURATION IN on the PG 501 pulse generator. Set the PG 501 PERIOD control to EXT TRIG, the DURATION control to 0.1 ms and the −OUTPUT control to 5 V into 50 Ω (10 V into 1 MΩ).

d. Connect the −OUTPUT from the PG 501 to the EXT CAL terminals on the Main Board (see Fig. 4-6).

e. Set the 1503 ZERO REF SET so that the test pulse is off screen (left) and there is one time-mark per graticule line.

f. Check for 8 time marks in 7.9 divisions.

4. DISTANCE Dial Check

a. Set the FEET/DIV switch to 5 feet.

b. Turn the ZERO REF SET control clockwise, stopping when the last time-mark pulse is seen before the fully clockwise stop on the control is reached. Set the leading edge of the marker on the second graticule line from the left.

c. Set the DISTANCE dial to 050.

d. Check that the leading edge of the second pulse seen as the DISTANCE dial is turned lines up on the second graticule line from the left.

e. Check that when the DISTANCE dial is turned from 050 to 100, 150, 200, and 250 that each marker pulse is located on the reference line within ±2% of the dial reading, ±1 digit.

5. Check Cable Dielectric Settings

a. Set the FEET/DIV switch to 5 feet and the multiplier to X10. Select 1 μs markers from the TG 501.

b. Press the SOLID POLY dielectric button and position a time mark on the second graticule line from the left with the ZERO REF SET control.

c. Check that the two markers are 6.46-6.72 divisions apart.

d. Press the FOAM POLY dielectric button.

e. Check for 7.94-8.26 division between the two pulses.

f. Switch back to AIR dielectric (both buttons out).

6. Check X100 Timing

a. Set the FEET/DIV switch to 5 feet and the multiplier to X100. Set the TG 501 for 1 μs markers.

b. Check for eight markers in 7.84-8.16 divisions.

c. Remove the cables from the 1503. Replace the EXT CAL connector.

ADJUSTMENT PROCEDURE

Introduction

Use this Adjustment Procedure to restore the 1503 to original performance requirements. This adjustment Procedure need not be performed unless the instrument fails to meet the Performance Requirements of the electrical characteristics listed in the Specification section, or if the Performance Check procedure cannot be completed satisfactorily. If the instrument has undergone repairs, the Adjustment Procedure is recommended.

Satisfactory completion of all adjustment steps in this procedure ensures that the instrument will meet the Performance Requirements.

Test Equipment Required

The test equipment (or equivalent) listed in Table 4-1 is required for adjustment of the 1503. Specifications given for the test equipment are the minimum necessary for accurate adjustment. All test equipment is assumed to be correctly calibrated and operating within specifications.

If other test equipment is substituted, calibration setup may need to be altered to meet the requirements of the equipment used.

POWER SUPPLY

Control Settings. Preset the front panel controls as follows:

ZERO REF SET	Fully cw
POSITION	Midrange
RET LOSS (dB)	0
NOISE FILTER	Out
0-dB SET	cw
DISTANCE Dial	000
FEET/DIV	.5
(METRES/DIV)	(1)
MULTIPLIER	X10
FOCUS and INTENSITY	Adjust for clear bright trace
CABLE DIELECTRIC	
SOLID POLY	Out
FOAM POLY	Out
VAR	Fully cw

Place the DM 501 Digital Multimeter in the TM 503 Power Module. Plug in the TM 503 to an ac power source and pull the PWR switch on.

Set the DM 501 RANGE/FUNCTION control to 200 DC VOLTS. Connect the test leads to the HI and LO INPUT terminals.

1. Voltage Measurements

a. Connect the lead from the DM 501 LO terminal to TP6332 (black test point) on the 1503 Power Supply board.

b. Connect the lead from the DM 501 HI terminal to TP6256, Fig. 4-1, (red test point).

c. ADJUST—R6358 (HV ADJ) so the voltmeter reads +25 V ±0.25 V.

d. Move the HI test lead to TP6411 (violet test point).

e. Change the DM 501 RANGE/FUNCTION switch to 20 V dc.

f. ADJUST—R6514 (+10 ADJ) so the voltmeter reads +10 V ±0.1 V.

g. Move the HI test lead to TP6227 (green test point).

h. CHECK—That the voltmeter reads +5 V ±0.25 V.

i. Move the HI test lead to TP6218 (orange test point).

j. CHECK—That the voltmeter reads −5 V ±0.25 V.

k. Change the DM 501 RANGE/FUNCTION switch to 200 V dc.

l. Move the HI test lead to connector P66 Pin 6.

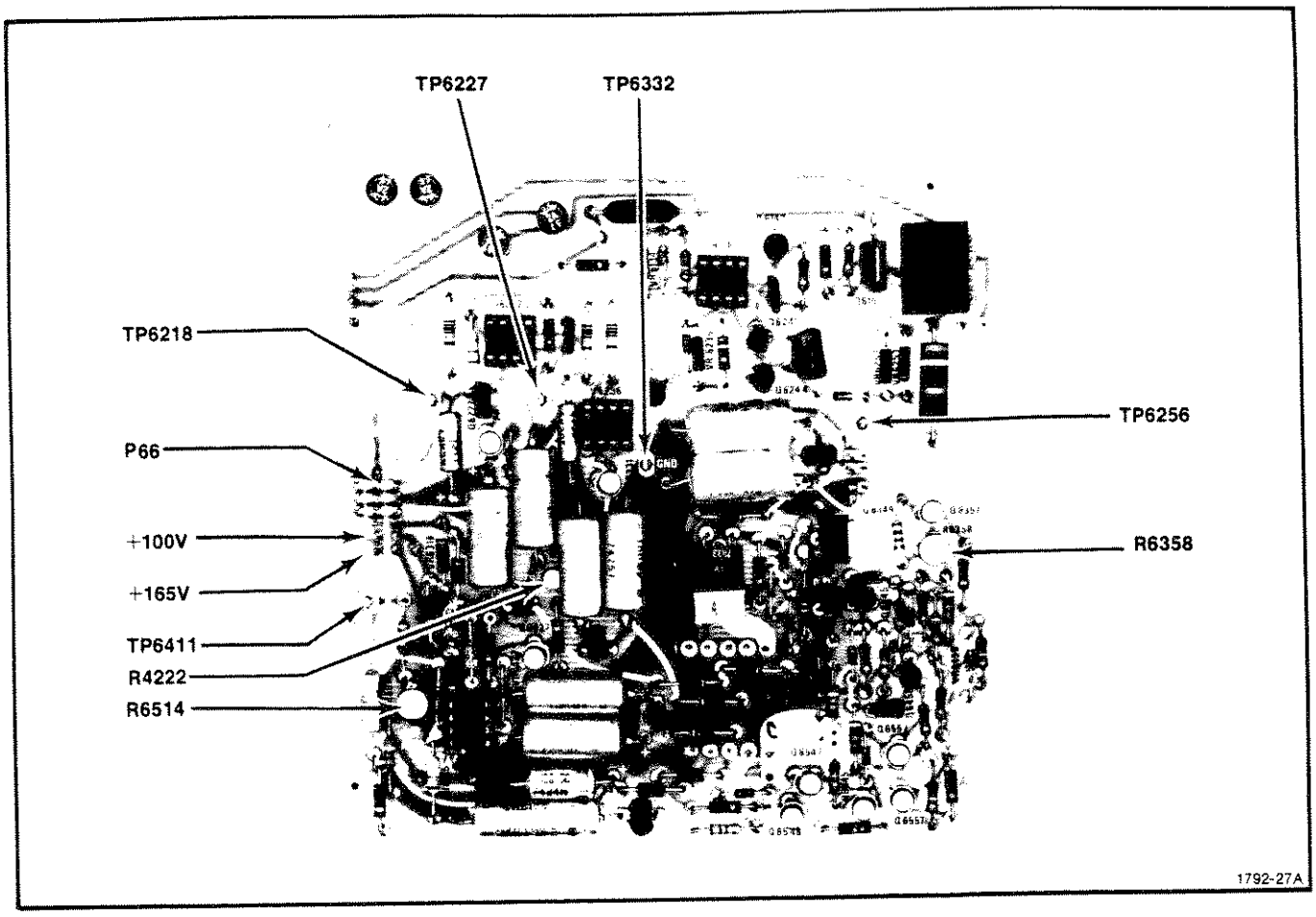


Fig. 4-1. Power Supply test points and adjustment location.

m. CHECK—That the voltmeter reads +100 V ±10 V.

n. Move the HI test lead to P66 Pin 7.

o. CHECK—That the voltmeter reads +165 V ±10 V.

p. Remove the voltmeter test leads.

The following parts q through t apply to instruments of SN B071995 and below. Proceed to parts u through y for instruments of SN B071996 and up.

q. Set the INTENSITY control fully cw and note display.

r. CHECK—For maximum intensity without trace blooming.

s. ADJUST—R4222 (INTENSITY LIMIT) for maximum intensity without trace blooming. The adjustment is located on the HIGH VOLTAGE board and adjusted through the hole in the POWER SUPPLY board (See Fig. 4-1).

t. Set INTENSITY for normal trace brightness.

The following parts u through y apply to instruments of SN B071996 and up.

u. Connect the voltmeter between TP4243 and TP4251 (see Output Amp-High Voltage Component pull-out page for test point locations).

v. Set the INTENSITY control fully cw.

w. CHECK—For a voltmeter reading of 95 mV ±5 mV.

@

x. ADJUST—R4222 (INTENSITY LIMIT) for a voltmeter reading that is inside the range of 90 mV to 100 mV. The adjustment is located on the HIGH VOLTAGE board and adjusted through the hole in the POWER SUPPLY board (see Fig. 4-1). Check for maximum intensity without trace blooming.

y. Set INTENSITY for normal trace brightness.

DISPLAY

Control Settings. Preset the front panel controls as follows:

RET LOSS 0 dB
NOISE FILTER Out
0-dB SET Clockwise
DISTANCE Dial 000
FEET/DIV .5
(METRES/DIV) (1)
Multiplier X10 (X1)
CABLE DIELECTRIC Both out
VAR Clockwise

2. Trace Focus and Astigmatism

a. Attach the 50 Ω termination to the CABLE connector.

b. With the ZERO REF SET control, set the pulse near mid screen.

c. Set the trace with the POSITION control on the center of the graticule.

d. ADJUST—R3242 (AST is located on the OUTPUT AMPS board) and the front panel FOCUS control until the clearest possible trace, both vertically and horizontally, is obtained.

3. Trace Rotation

a. Turn the ZERO REF SET fully clockwise so that just the horizontal base line is located on the horizontal center line.

b. CHECK—That the trace aligns with the crt horizontal center graticule line.

c. ADJUST—R3143 (ROT is located on the OUTPUT AMPS board) so that the trace aligns with the crt horizontal center graticule line.

4. Trace Geometry

a. Move the trace with the POSITION controls so that it is located three divisions below the horizontal center line.

b. CHECK—That the trace aligns with the graticule line (has no bow).

c. Move the trace with the POSITION controls so that it is located three divisions above the horizontal center line.

d. CHECK—That the trace aligns with the graticule line (has no bow).

e. ADJUST—R3248 (GEO is located on the OUTPUT AMPS board) for the least possible bow in the two positions; three divisions above and three divisions below the horizontal center line.

f. Recheck the trace rotation and focus.

VERTICAL

Control Settings

RET LOSS	0 dB
NOISE FILTER	Out
0 dB SET	Clockwise
DISTANCE Dial	000
FEET/DIV	.5
(METRES/DIV)	(1)
Multiplier	X10 (X1)
CABLE DIELECTRIC	Both out
VAR	Clockwise

5. Vertical Attenuation Check

a. Disconnect P21 from Vert Amp/Slow Ramp board.

b. Connect the sine wave output through the 2701 attenuator from the FG 503 to P21 on the VERT AMP board. It may be necessary to ground the chassis of the 1503 to the FG 503.

c. Set the FG 503 to a 200 Hz sine wave.

d. Set the 1503 RET LOSS to 0 dB, set the 0-B SET fully cw. Set the 2701 to 0 dB, and set the FG 503 VAR ATTEN for a six division display.

e. CHECK—The crt should display a sine wave for each of the following settings of the RET LOSS switch on the 1503 and the STEP ATTENUATOR switch on the 2701 attenuator:

RET LOSS	2701 ATTEN	DISPLAY
0 dB	0 dB	6 div ±0.2 div
10 dB	10 dB	6 div ±0.2 div
20 dB	20 dB	6 div ±0.2 div
30 dB	30 dB	6 div ±0.2 div
40 dB	40 dB	6 div ±0.2 div
50 dB	50 dB	6 div ±0.2 div
60 dB	60 dB	6 div ±0.2 div

f. Remove the test leads from the VERT AMP board and replace P21.

g. To the CABLE input, connect a 42-inch coaxial cable, a female to female adapter, a second 42-inch coaxial cable, to a 75 Ω termination.

h. Press in the 50 Ω and 75 Ω impedance buttons, set RET LOSS to 0 dB and IMPLS WIDTH to 10, and set 0-dB SET for a one division display.

i. Set the fine RET LOSS control to 18 dB and check for an eight division display. If the display is not eight divisions, ±1 division, select the value of R1603 between 1.5K and 1.8M.

j. Set the fine RET LOSS control to 0 dB and remove the termination and cables.

6. Vertical Gain Check

a. Set RET LOSS to 0 dB.

b. Set 0-dB SET control counterclockwise and note amplitude of test pulse.

c. Set 0-dB SET control clockwise.

d. CHECK—Test pulse amplitude should be at least four times greater than that at the counterclockwise position.

7. Sampling Efficiency and Blow-by

a. Connect the 50 Ω terminator to the CABLE connector and press the 50 Ω impedance button.

b. Set RET LOSS to 0 dB, FEET/DIV to five feet, multiplier to X100, and press the 1000 ns IMPLS WIDTH button.

c. Set 0-dB SET control for a two division display.

d. Press the 100 ns IMPLS WIDTH button and ADJUST R1693—SAMPLING EFFICIENCY—so the peak of the pulsing display does not rise above two graticule divisions (see Fig. 4-2).

e. Set the RET LOSS switch to 60 dB.

f. ADJUST—R1796 1st BLOW-BY COMP for a straight base line (no positive or negative pulse) at approximately 2000 feet before the test pulse (see Fig. 4-3a).

g. With the ZERO REF SET control, move the pulse off screen to the right. Set RET LOSS to 78 dB. (Set the fine RET LOSS control to 18 dB.)

h. ADJUST—R1406 2nd BLOW-BY for minimum noise on the base line (see Fig. 4-4a).

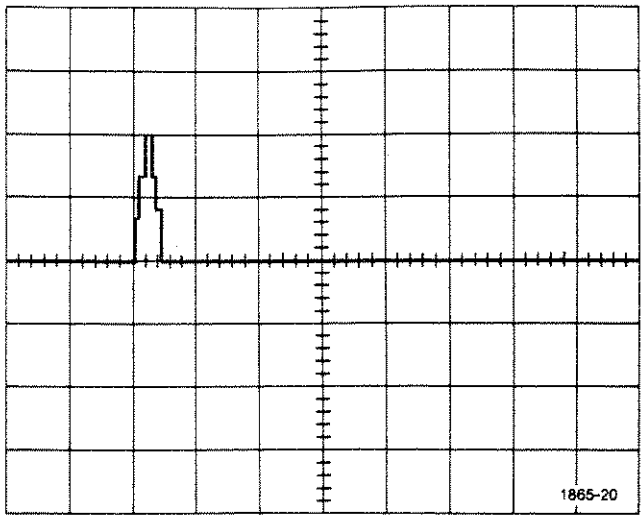


Fig. 4-2. Sampling Efficiency Pulse.

i. Set RET LOSS to 30 dB, IMPLS WIDTH to 1000 ns, and center the leading edge of the pulse on the vertical center line.

j. CHECK—The trailing edge of the pulse should not be greater than two divisions (see Fig. 4-4b).

8. Check Display Noise

a. Set IMPLS WIDTH to 10 ns. Turn the ZERO REF SET control fully counterclockwise.

b. Set the RET LOSS to 78 dB and adjust the POSITION controls so the base line is located on the crt center line.

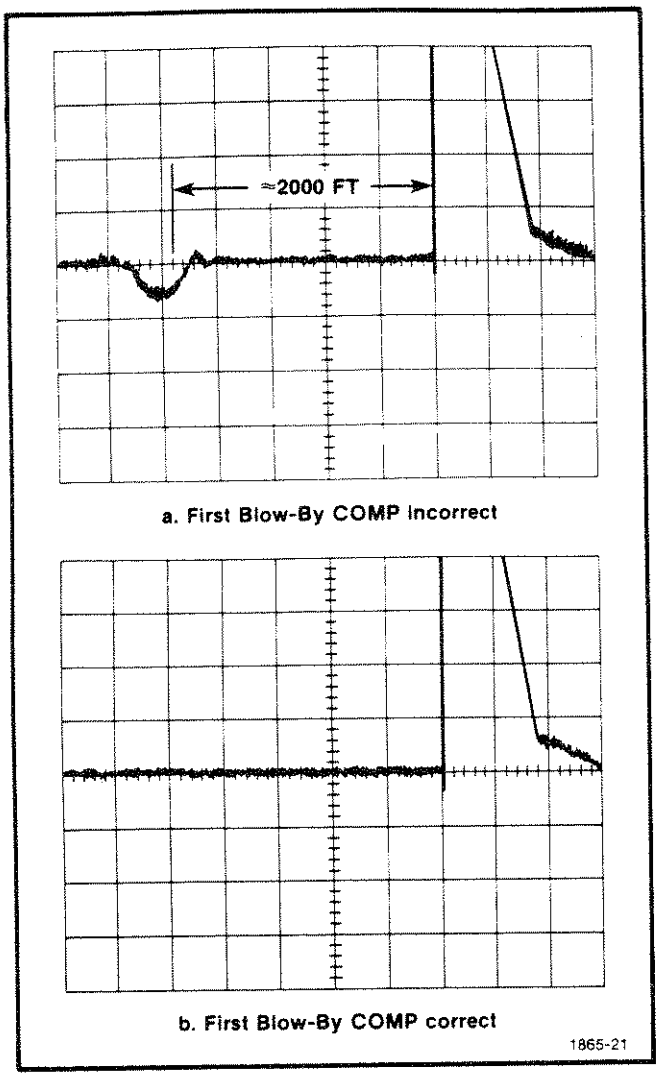


Fig. 4-3. First Blow-by Compensation Adjustments.

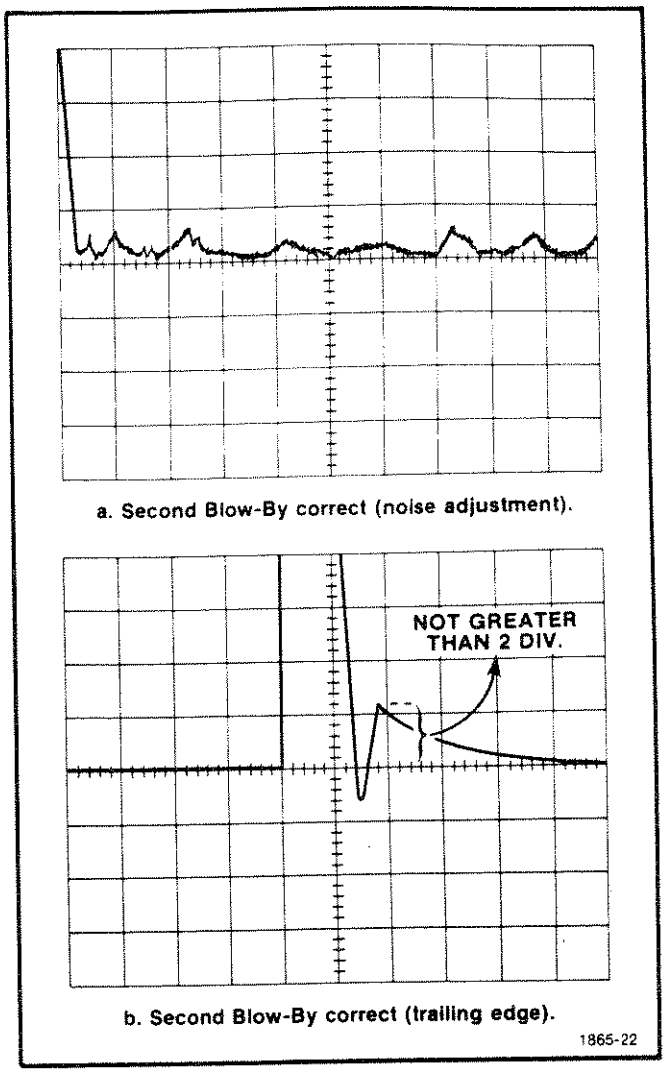


Fig. 4-4. Second Blow-by Compensation Adjustments.

c. CHECK—That the peak-to-peak noise is not greater than three division (−78 dB rms). Ignore occasional spikes.

d. Push the NOISE FILTER button in and check that the peak-to-peak noise is less than 1.5 divisions (−84 dB rms).

HORIZONTAL—STANDARD VERSION (See Step 17 for metric version)

Control Settings

RET LOSS	0 dB
NOISE FILTER	Out
0-dB SET	Clockwise
DISTANCE Dial	000
FEET/DIV	50
Multiplier	X100
CABLE DIELECTRIC	Both out
VAR	Clockwise

IMPS OUT

9. Horizontal Gain and OFFSET

a. Use the POSITION controls to center the trace on the graticule.

b. Set R3217 (HORIZ—located on the OUTPUT AMPS board) to the counterclockwise stop.

c. ADJUST—R3221 (H POS—located on the OUTPUT AMPS board) to center the trace on the graticule.

d. ADJUST—R3217 (HORIZ) so that the retrace at the start of the sweep is just off the graticule area and the trace covers all ten divisions of the graticule.

90) so that a/ record depressed dot is on or to the left of grat.

10. FAST RAMP

a. Connect the test oscilloscope test probe to the front lead of C1238 (see Fig. 4-5).

b. CHECK—For a peak-to-peak amplitude of 6 V, ±0.2 V. Ramp should begin at an approximate −2 V level and ramp should end at an approximate +4 V.

c. ADJUST—R1676 (RAMP PEAK) for a peak-to-peak amplitude of 6 V, ±0.2 V with the ramp beginning at an approximate −2 V level and ramp ending at an approximate +4 V level (see Fig. 4-5).

d. Remove the test probe.

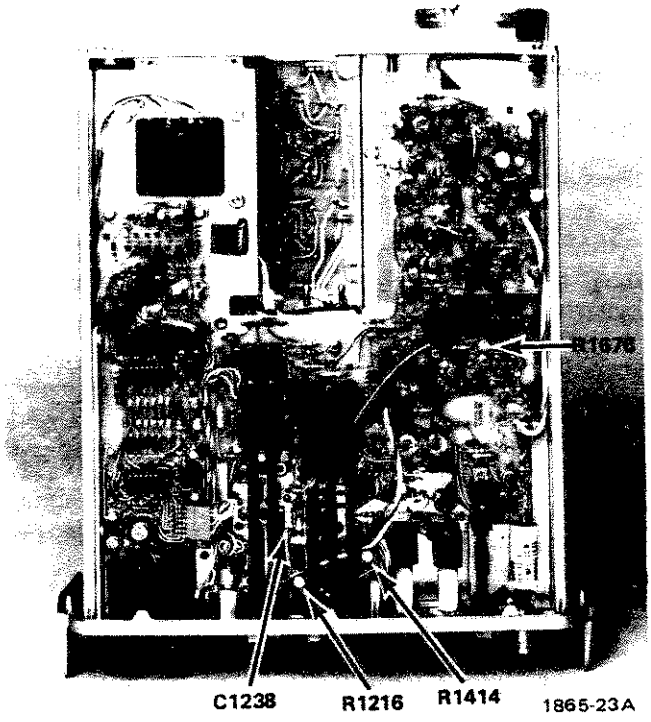


Fig. 4-5. Fast Ramp test point.

11. Timing

a. Set RET LOSS to 20 dB and the multiplier to X10.

b. Connect the TG 501 Time Mark Generator through a 50 Ω terminator to the CABLE connector on the 1503. Set the TG 501 to 1 μs marks.

c. Connect + TRIGGER OUT from TG 501 to TRIG/DURATION IN on PG 501 Pulse Generator. Set PG 501 PERIOD to EXT TRIG, DURATION to 0.1 ms, and − OUTPUT control to 5 V into 50 Ω (10 V into 1 MΩ).

d. Connect the − OUTPUT from the PG 501 to the EXT CAL terminals on the Main Board (see Fig. 4-6).

e. Set the 1503 ZERO REF SET so that the test pulse is off screen. (left) and the time marks are set one per graticule line.

f. CHECK—For 8 time marks in 7.9 divisions.

g. ADJUST—R1216 (FT/DIV CAL) for eight time marks in 7.9 divisions (see Fig. 4-5).

12. DISTANCE Dial

a. Set the FEET/DIV switch to 5 feet.

b. Turn the ZERO REF SET control clockwise, stopping when the last time mark pulse is seen before fully clockwise is reached and set its leading edge on the second graticule line from the left.

c. Set the DISTANCE dial to 050.

d. CHECK—That the leading edge of the second pulse, seen as the DISTANCE dial is turned, lines up on the second graticule line from the left.

e. ADJUST—R1414 DIST CAL to position the leading edge of the pulse on the second graticule line (see Fig. 4-5). Check that the pulse is at the same point on the graticule when the ZERO REF CHECK button is pressed.

f. CHECK—That when turning the DISTANCE dial from 050 to 100, 150, 200, and 250 that each marker pulse is located on the reference line within ±1 digit of the dial.

13. Cable Dielectrics

a. Set the FEET/DIV switch to five feet, multiplier to X10. Select 1 μs markers.

b. Press the SOLID POLY dielectric button and position a time mark on the second graticule line from the left with the ZERO REF SET control.

c. CHECK—That the two markers are 6.39-6.79 divisions apart.

d. Press the FOAM POLY dielectric button.

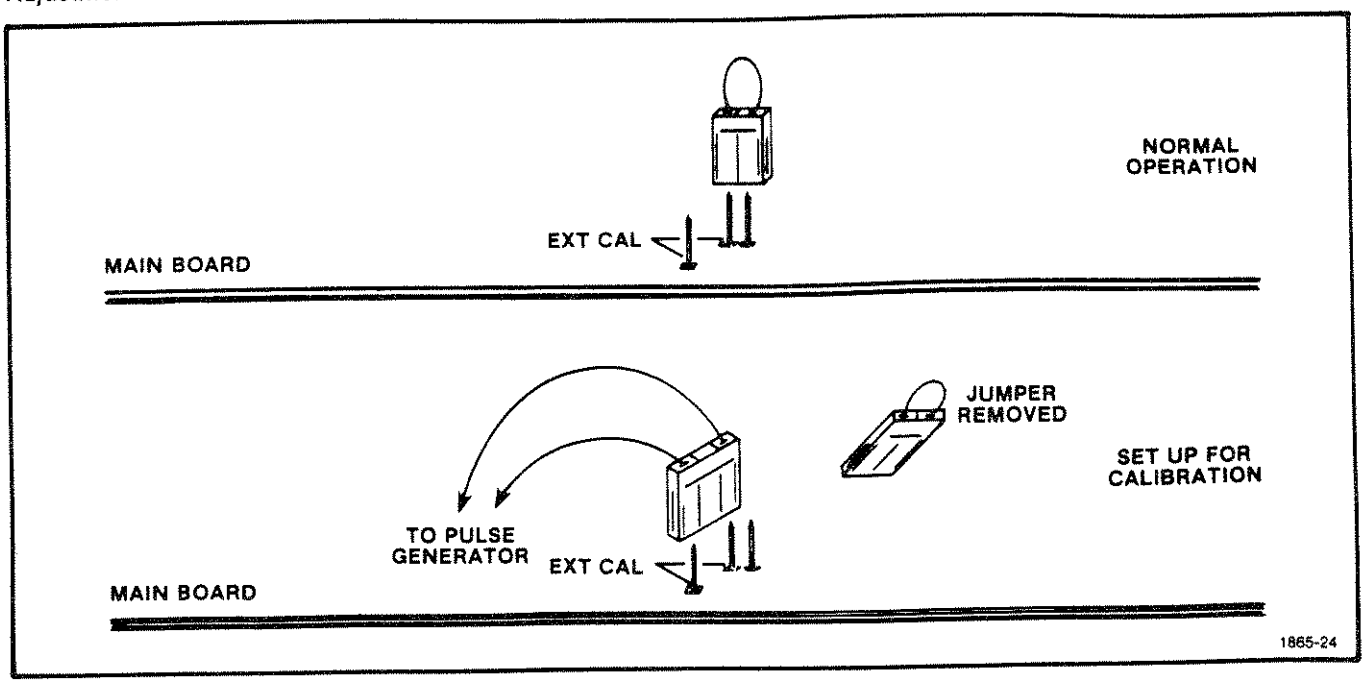


Fig. 4-6. External Calibration connection.

e. CHECK—For 7.9-8.3 divisions between the two pulses.

f. Switch back to AIR (both out).

14. X100 Timing

a. Set the FEET/DIV switch to five feet and the multiplier to X100. Set the TG 501 for 1 μs markers.

b. CHECK—For one marker per division ±2%.

8 in 7.9

c. Remove cables from the 1503. Replace the EXT CAL connector.

15. X100 Position

a. Set IMPLS WIDTH for 100 ns pulse, RET LOSS to 0 dB.

b. With ZERO REF SET position the pulse leading edge on the graticule center line.

c. CHECK—That the pulse start remains at the center line when switching from X100 to X10.

d. ADJUST—R1132 while in the X10 position so that the pulse remains at the center line when switching between X10 and X100.

16. ZERO REF SET

a. Set FEET/DIV to 50, multiplier to X10, and IMPLS WIDTH to 1000.

b. Rotate ZERO REF SET fully counterclockwise and then fully clockwise.

c. CHECK—The leading edge of the pulse should move at least past the second vertical graticule line from the left.

HORIZONTAL—METRIC VERSION (See Step 9 for Standard Version)

Control Settings

RET LOSS	0 dB
NOISE FILTER	Out
0-dB SET	2 div pulse
DISTANCE Dial	000
METRES/DIV	50
Multiplier	X10
CABLE DIELECTRIC	Both out
VAR	Fullyclockwise

17. Horizontal Gain and OFFSET

a. Use the POSITION controls to center the trace on the graticule.

b. Set R3217 (HORIZ—located on the OUTPUT AMPS board) to the counterclockwise stop.

c. ADJUST—R3221 (H POS—located on the OUTPUT AMPS board) to center the trace on the graticule.

d. ADJUST—R3217 (HORIZ) so that the retrace at the start of the sweep is just off the graticule area and the trace covers all ten divisions of the graticule.

18. FAST RAMP

a. Connect the test oscilloscope test probe to the front lead of C1238 (see Fig. 4-7).

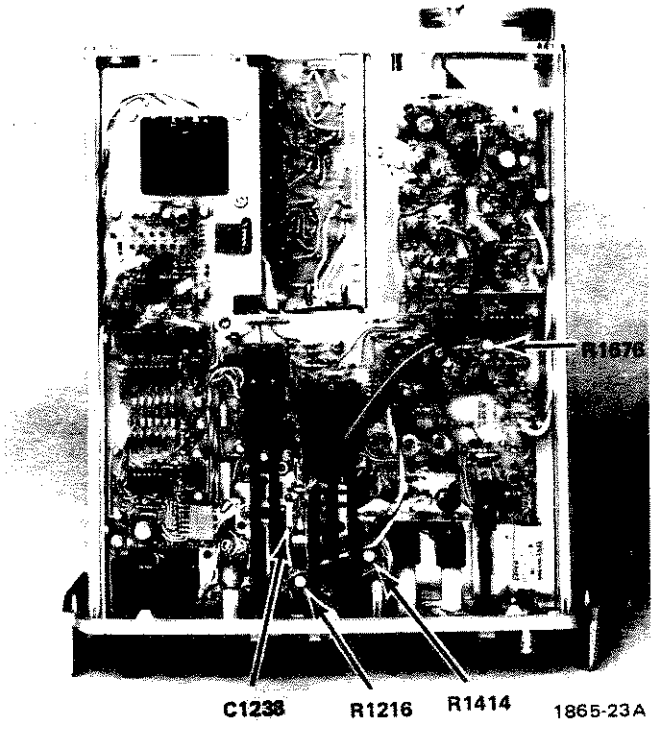


Fig. 4-7. Fast Ramp test point.

b. CHECK—For a peak-to-peak amplitude of 6 V ±0.2 V. Ramp should begin at an approximate −2 V level and ramp should end at an approximate +4 V level.

c. ADJUST—R1676 (RAMP PEAK) for a peak-to-peak amplitude of 6 V ±0.2 V with the ramp beginning at an approximate −2 V level and ramp ending at an approximate +4 V level (see Fig. 4-7).

d. Remove the test probe.

19. Timing

a. Set RET LOSS to 20 dB, and the multiplier to X1.

b. Connect the TG 501 Time Mark Generator through a 50 Ω terminator to the CABLE connector on the 1503. Set the TG 501 to 1 μs marks.

c. Connect + TRIGGER OUT from the TG 501 to TRIG/DURATION IN on the PG 501 Pulse Generator. Set the PG 501 PERIOD to EXT TRIG, DURATION to 0.1 ms, and − OUTPUT control to 5 V into 50 Ω (10 V into 1 MΩ).

d. Connect the − OUTPUT from the PG 501 to the EXT CAL terminals on the 1503 Main Board (see Fig. 4-8).

e. Set the 1503 ZERO REF SET so that the test pulse is off screen (left) and the time marks are set one per graticule line. Use the VARIABLE PULSE DURATION control on the PG 501 to obtain stable time marks.

f. CHECK—Each time mark should align with every third graticule line.

g. ADJUST—R1216 FT/DIV CAL for one mark per every third division.

20. DISTANCE Dial

a. Set the METRES/DIV switch to 10 metres.

b. Turn the ZERO REF SET control clockwise, stopping when the last time mark pulse is seen before fully clockwise is reached and set its leading edge on the second graticule line from the left.

c. Set the DISTANCE dial to 150.

d. CHECK—That the leading edge of the second time mark pulse, as seen as the DISTANCE dial is turned, lines up on the second graticule line from the left.

e. ADJUST—R1414 DIST CAL to position the leading edge of the time mark pulse on the second graticule line. Check that the pulse is at the same point on the graticule when the ZERO REF CHECK button is pressed.

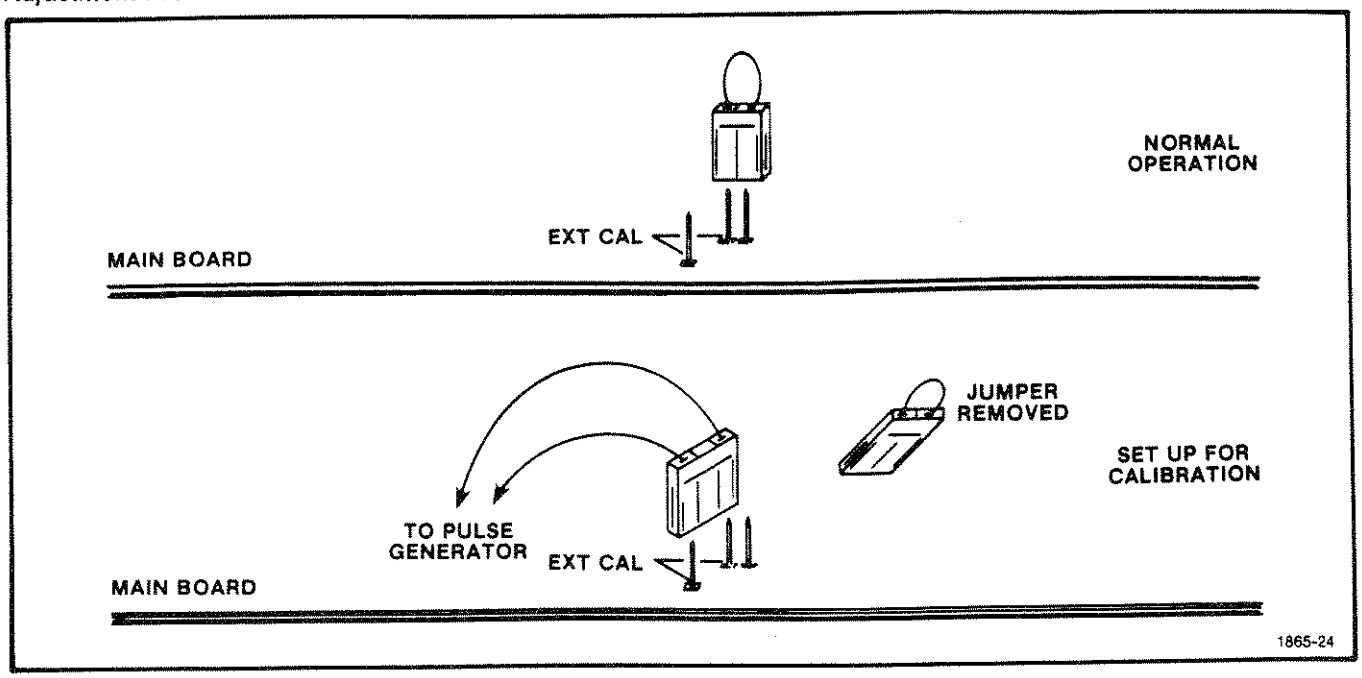


Fig. 4-8. External Calibration connection.

f. CHECK—That when turning the DISTANCE dial from 150 to 300 and 450 that each marker pulse is located on the reference line within ±1 digit of the dial.

21. Cable Dielectrics

a. Set the METRES/DIV switch to 25, the multiplier to X1, and select 1 μs markers.

b. Select SOLID POLY dielectric and position a time marker on the second graticule line from the left using the ZERO REF SET control.

c. CHECK—That the markers are 3.75-4.15 division apart.

d. Select the FOAM POLY dielectric.

e. CHECK—For 4.66-5.06 divisions between pulses.

f. Switch the CABLE DIELECTRIC buttons back to AIR (both out).

22. X10 Timing

a. Set the METRES/DIV switch to five metres, and the multiplier to X10. Set the TG 501 for 1 μs markers.

b. CHECK—For one marker every third division ±2%.

c. Remove cables from the 1503. Replace the EXT CAL connector.

23. X1 Position

a. Set IMPLS WIDTH for 1000 ns pulse and RET LOSS to 0 dB.

b. With ZERO REF SET position the pulse leading edge on the graticule center line.

c. CHECK—That the pulse start remains at the center line when switching from X10 to X1.

d. ADJUST—R1132 while in the X1 position so that the pulse remains at the center line when switching between X1 and X10.

X-Y OUTPUT MODULE

Control Settings

RET LOSS	0 dB
NOISE FILTER	Out
0-dB SET	2 div pulse
DISTANCE Dial	000
FEET/DIV	.5

(METRES/DIV)	(1)
Multiplier	X10 (X1)
CABLE DIELECTRIC	SOLID POLY
IMPLS WIDTH	10

Connect the 50 Ω terminator to the 1503 CABLE connector.

24. Pen Lift Signal

a. Set the Digital Multimeter RANGE/FUNCTION control to 20 on the DC VOLTS scale.

b. Place the terminal connection link of the OUTPUT MODULE board on the negative slope terminals (see Fig. 4-9).

c. Connect the lead from the DVM HI terminal to the X-Y OUTPUT MODULE PEN LIFT red terminal and the lead from the DVM LO terminal to the X-Y OUTPUT MODULE PEN LIFT black terminal.

d. CHECK—That the DVM shows approximately +5 V.

e. Momentarily push the RECORD switch to RECORD, then release the switch. Check that the voltage goes to +0.5 V or less and returns to approximately +5 V at the end of the sweep.

f. Move the terminal connection link to the positive slope terminals on the X-Y OUTPUT MODULE board.

g. CHECK—That the DVM reads approximately 0.5 V.

h. Push the RECORD switch to RECORD and check that the DVM reads +4 V or greater, then returns to approximately 0.5 V at the end of the sweep.

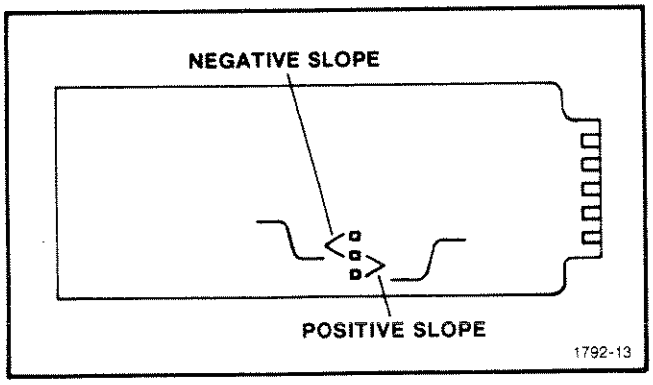


Fig. 4-9. X-Y Output Module strap.

25. Y OUTPUT

a. Move the test leads from the PEN LIFT terminals to the corresponding Y terminals of the X-Y OUTPUT MODULE.

b. Set IMPLS WIDTH to 100 ns and turn ZERO REF SET completely clockwise.

c. Push and hold the RECORD switch to RECORD and adjust the POSITION controls so that the DVM reads 0.0 V.

d. Turn ZERO REF SET slowly counterclockwise and check that the DVM rises to approximately +0.4 V. Release the RECORD switch.

e. ADJUST—R7225 (on X-Y OUTPUT MODULE board) until the DVM peaks at +0.4 V while holding the RECORD switch to RECORD and slowly rotating the ZERO REF SET control.

f. The dot on the left side of the crt should move one division for each 0.1 V read on the DVM.

26. X OUTPUT

a. Move the test leads to the X terminals.

b. Press the RECORD switch.

c. CHECK—That the voltage reads from 0 to 1 V (100 mV/div) as the dot moves across the screen.

REPLACING THE CASE ON THE 1503

To replace the case on the 1503, proceed as follows:

1. Remove any termination and adapters from the CABLE connector.

2. Remove the battery pack and power cord from the back of the 1503.

3. Place the EMI shields on the top and bottom of the 1503.

4. Stand the 1503 on its face. Lubricate the surface of the rubber seals around the edge of the subpanel with a waterproof lubricant.

5. Slide the case over the back of the unit, until it has reached the subpanel.

6. Tighten the four screws on the back of the case until the case is aligned with the groove at the back of the subpanel.

7. Make sure the case is in the groove; then, using a torque screwdriver, tighten the four screws to eight inch-pounds.

NOTE

If the screws are tightened more than eight inch-pounds, the case may crack. If the screws are not tightened equally to the required torque, the water-tight integrity of the case may be compromised.

8. Place the battery pack in its compartment and tighten the two screws (finger tight is sufficient).

9. Place the power cord and the rest of the accessories in the front cover storage compartment and latch it closed.

10. Place the front cover over the front cover panel and close the latches.

MAINTENANCE

NOTE

It is recommended that the 1503 be serviced at a Tektronix Service Center. The instrument should be serviced by a technician skilled in sampling and pulse techniques.

This section of the manual provides information used for preventive maintenance, corrective maintenance, and troubleshooting the 1503. The physical location of all circuit components on the circuit boards are shown on the circuit diagram pullout.

Preventive Maintenance

Preventive maintenance consists of cleaning, visual inspection, lubrication, etc. Preventive maintenance performed on a regular basis will help improve the reliability of the instrument. The severity of the environment to which the 1503 is subjected determines the frequency of needed maintenance. A convenient time to perform preventive maintenance is preceding recalibration of the instrument.

Cleaning

Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket and prevents efficient heat dissipation. It also provides an electrical conduction path.

NOTE

To remove the instrument cabinet, see Preliminary Procedure at the beginning of the Calibration procedure. When the cabinet is removed, the watertight feature may be compromised when the case is reinstalled. See the instructions at the end of the Calibration procedure on replacing the case on the 1503.

Interior. The 1503 is constructed so that the interior of the instrument is protected from dust.

Therefore, the interior of the 1503 should not require cleaning unless the unit has been left with the front cover removed and the plug-in compartment empty. The best way to clean the interior is to blow off the accumulated dust with low-pressure air. Remove any dirt that remains with a soft brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces on 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.

Exterior. The cabinet exterior can be washed with soap and water and rinsed with clear water. Loose dust accumulated on the front panel is best removed with a small brush or a soft cloth dampened with a mild detergent and water solution. Abrasive cleaners should not be used on the front panel.

CRT Implosion Shield. The face of the crt can be cleaned by using ISOPROPYL ALCOHOL applied and wiped very gently dry with KENDALL "NEBRIL" nonwoven wipes.

Lubrication

The reliability of potentiometers, switches and other moving parts can be maintained if they are kept properly lubricated. However, too much lubricant is as detrimental as too little lubricant. A lubrication kit containing the necessary lubricants and instructions is available from Tektronix, Inc.

Visual Inspection

Prior to recalibration, the 1503 should be inspected for such defects as broken connections, damaged circuit boards, improperly seated transistors or pin connectors, frayed cable shields and heat-damaged components.

The corrective procedures for most visible defects are obvious. Particular care should be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument, so it is important that the cause of overheating be corrected to prevent recurrence of the damage.

Semiconductor Checks

Periodic checks of the semiconductors in the 1503 are not recommended. The best check of semiconductor performance is actual operation in the instrument. More details on checking semiconductor operation are given under troubleshooting.

Recalibration

To ensure accurate measurements, check the calibration of the 1503 after each 1000 hours of operation or every six months if used infrequently. In addition, replacement of components may necessitate recalibration of the affected circuits. The calibration procedure can be helpful in localizing troubles in the instrument. Problems may be found or corrected by recalibration.

Servicing the Battery

The battery pack should be inspected every six months or every 500 hours of operation, whichever occurs first. The entire battery pack should be replaced if venting or corrosion has occured.

TROUBLESHOOTING

The following information is provided to facilitate troubleshooting of the 1503. Information contained in other sections of this manual should be used along with the following information to aid in locating defective components. An understanding of the circuit operation is helpful in locating troubles. See the Circuit Description section for information.

Troubleshooting Aids

Diagrams. Circuit diagrams and corresponding circuit boards are located on foldout pages at the rear of the manual. Section 7 contains the Electrical Parts List. From these schematics and parts lists, the component number, location, electrical characteristics and Tektronix, Inc. part number can be cross-referenced. The components that are located on the front panel are shown on the circuit diagrams with their front-panel titles enclosed in a block. Additional aids for troubleshooting can be found in the Calibration section of this manual.

COMPONENT REMOVAL AND REPLACEMENT

Fuses

All ac line fuses are located on the front panel. All dc protection links and spares are located on the Power Supply board inside the instrument. Remove the 1503 from its case. Remove the aluminum shield from the top of the unit. The fuses are upright plug-in types located near the center of the instrument (see Fig. 5-1).

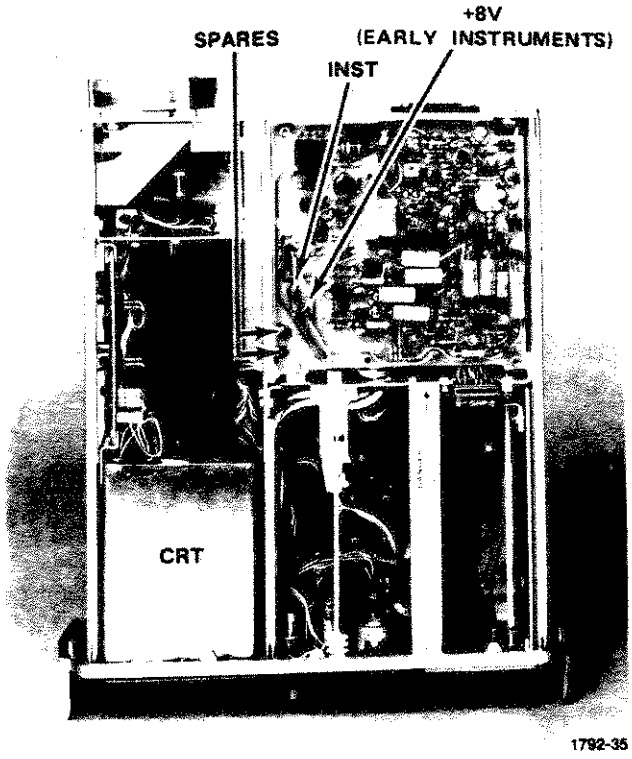


Fig. 5-1. DC protection link location.

Transistor and Integrated Circuits

See Fig. 5-2 for the lead configurations of the transistors and integrated circuits used in the 1503.

Circuit Board Replacement

Most of the components mounted on the circuit boards can be replaced without removing the boards from the instrument. An exception is the HV circuit board which is located underneath the Power Supply board. If a circuit board is damaged beyond repair, the entire assmebly (including all soldered-on-components) can be replaced. The number is given in the Electrical Parts List for the completely wired board. Note the position of all plugs and connectors to make replacement easy.

Use the following procedure to remove a circuit board. Follow the inverse procedure to replace boards.

Power Supply Boards

1. Remove the four screws.

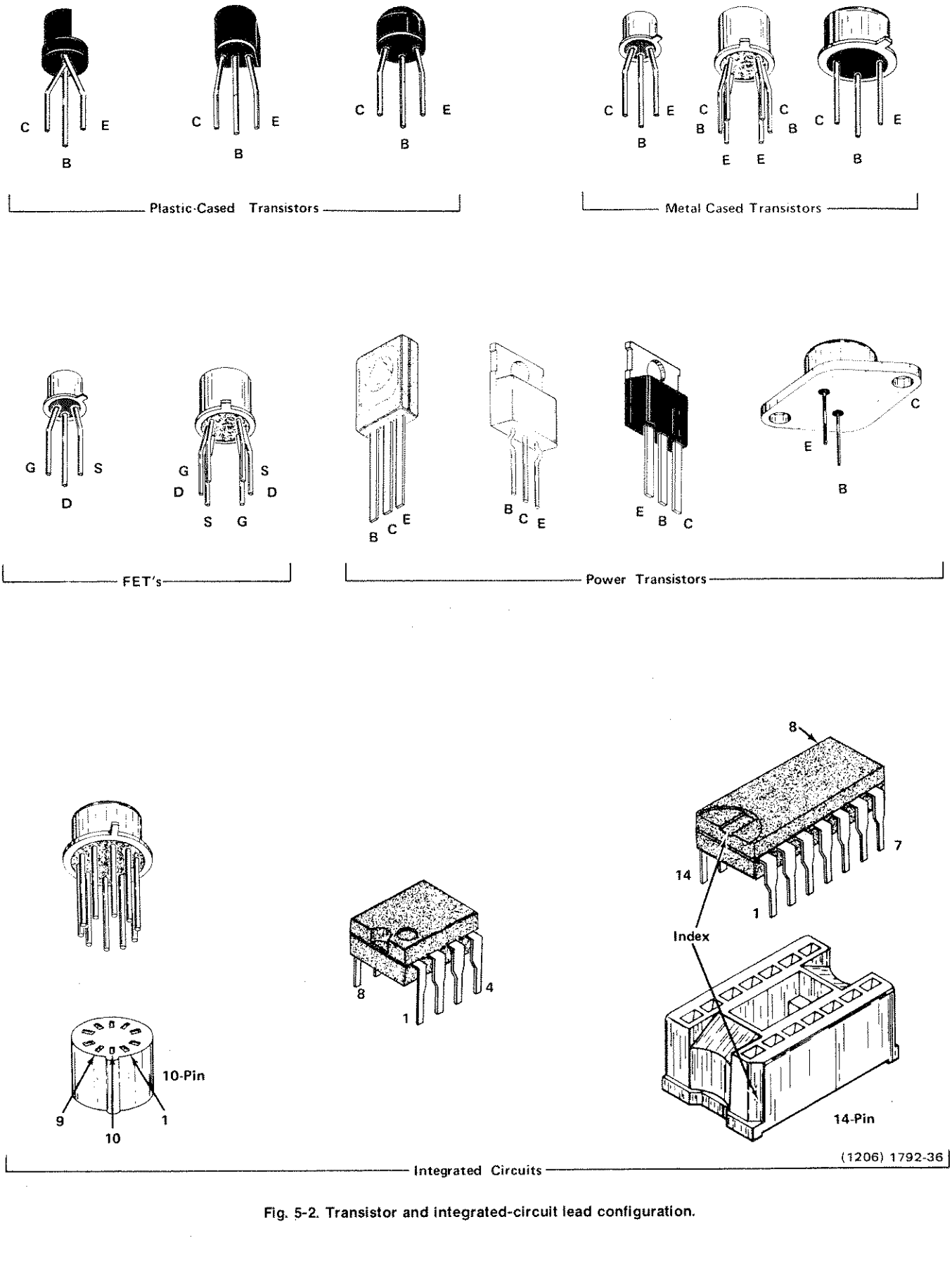


Fig. 5-2. Transistor and integrated-circuit lead configuration.

2. Remove the pin connectors to P1, P2, and P3 near the rear edge of the board.

3. Carefully lift the rear of the board until the pin connectors underneath come into view.

4. Remove the pin connectors from the bottom of the board and lift it out of the chassis.

HV Board

1. Remove the Power Supply board following the previous procedure.

DANGER

2 kV may be present on the HV Board from charged capacitors.

2. Discharge the possible 2 kV potential by placing a short between point A, Fig. 5-3 and ground. This point is accessible by removing the Battery Pack and turning the 1503 upside down.

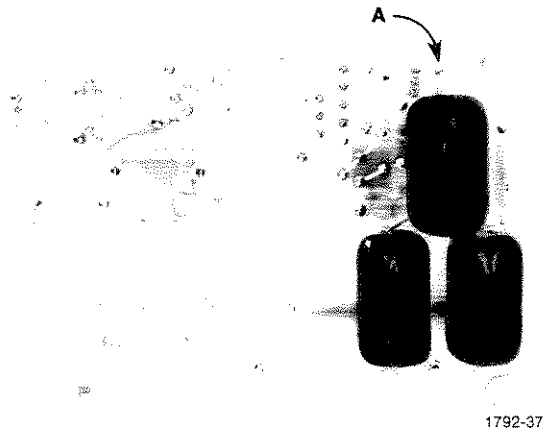


Fig. 5-3. Rear view of the HV board.

3. Remove the pin connectors.

4. Remove the four screws holding the board in the chassis.

5. Lift the HV board out of the chassis.

Power Cord Conductor Identification

Conductor	Color	Alternate Color
Ungrounded (Line)	Brown	Black
Grounded (Neutral)	Blue	White
Grounding (Earthing)	Green-Yellow	Green-Yellow

Power Transformer

1. Remove the Power Supply and the HV boards from the chassis using the previous procedures.

2. Unsolder the two leads on the bottom of the Power Transformer.

3. Remove the four bolts holding the transformer in place. The ground wire and lug on the bottom will come off when the bolt and nut are removed.

4. Lift the Power Transformer out of the chassis.

Output Amplifier Board

1. Remove the four pin connectors from the top of the Output Amps board.

2. Remove the four screws holding the board in the chassis.

3. Lift the board out of the hole in the side of the chassis.

Logic Board

1. Remove the three pin connectors from the Logic board.

2. Remove the four screws holding it in the chassis.

3. CAREFULLY lift on the rear of the Logic board to pull the board off the ten feed-thru pins which are mounted on the chassis. Lift the board off the chassis when clear of the pins.

4. Use care when replacing the board to prevent bending the pins or the pin connectors on the board.

Vertical Amp/Slow Ramp Board

Removal of the main board and the Vertical Amp/Slow Ramp board requires removal of some front panel controls. This will destroy the water-tight seals, and special techniques are required to replace the components and preserve the seals. The removal of these boards should be done at a Factory Service Center.

Cathode-Ray Tube Replacement

To replace the crt, proceed as follows:

WARNING

Use care when handling a crt. Protective clothing and safety glasses should be worn. Avoid striking it on any object which might cause it to crack or implode. When storing a crt, place it in a protective carton or set it face down in a protected location on a smooth surface with a soft mat under the faceplate to protect it from scratches.

1. Remove the Battery Pack from the 1503.

2. Remove the pin connectors from the top of the Output Amps board.

3. Remove the four screws holding the crt socket bracket to the frame.

4. Remove the screw bracing the rear of the crt socket.

5. Slide the entire assembly (crt, socket, bracket, and crt shield) to the rear about 1/4 inch. Lift straight up on the entire assembly, clearing the tabs on the front panel casting.

6. Set the assembly on top of the 1503 with the socket wiring still attached.

7. Remove the rubber gasket from around the crt face.

8. Unplug the socket from the crt.

9. Carefully remove the crt from the shield, guiding the two-wire pin connector through the hole in the shield as the crt comes out the front.

10. The Trace Rotation Yoke (L0234) can now be removed and installed on the new crt. Position of the Yoke is not critical. Make sure it is tight against the nect of the crt and fastened with tape.

11. Install the crt reversing the above procedure. Use care when tightening the screw bracing the crt from the rear of the chassis.

230/115 Volt Line Selector. The line selector is composed of the input transformer's terminals and can be wired for either 115 V or 230 V. It is factory wired for 115 V. If 230 V operation is required, remove the wire straps from lugs 1-2 and 3-4 of T0389 then connect a strap from lug 2 to lug 3. See Fig. 5-4.

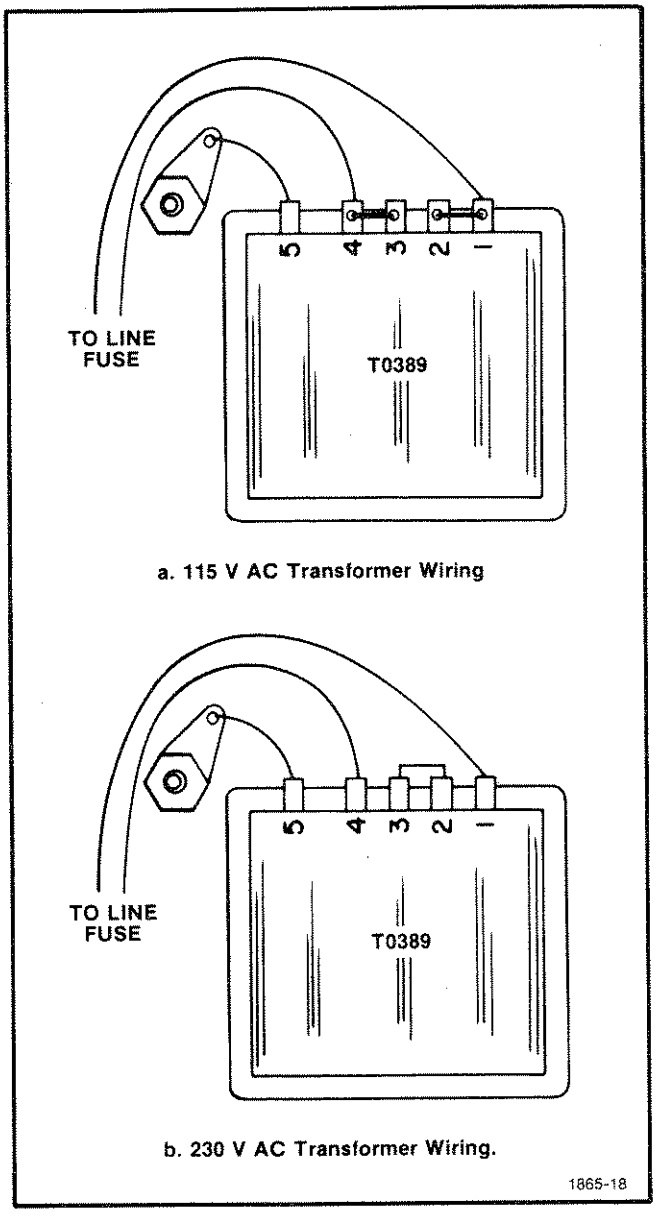


Fig. 5-4. Power transformer wiring.

CAUTION

If the instrument is wired for 230 V operation, be sure that the two front panel fuses are changed to the proper slow-blow fuses described in the parts list.

Water-tight Seals

The 1503 may be operated in any weather (rain, snow, dust, etc.). To prevent moisture and dust from getting inside the instrument, special seals are used around the pushbuttons, crt, power switches, and rotary controls. Removal of any of the components on the front panel will require special resealing procedures to retain their water-tight integrity. We recommend that the instrument be returned to a Tektronix Factory Service Center to have this resealing done, if water-tight resealing is required. Sealing instructions are included in this section, however.

The gaskets installed in the slots around the front panel casting where the case and front cover fit, should be replaced at regular intervals (six to eight months depending on locality and use).

In order to maintain the water-tight integrity of the 1503, it is important to visually inspect the water-tight seals periodically. Seals around the X-Y Output Module, the battery pack and the front cover seal on the front panel should be checked regularly to see that they have not become damaged. The clam shell seal on the back of the front-panel casting and the seals around the front-panel controls and connectors should be inspected when the cabinet has been removed for maintenance, calibration purposes, or if a leak is suspected.

CAUTION

Anytime the cabinet has been removed from the 1503 or when any front panel controls or connectors have been removed from the front panel, the water-tight integrity of the 1503 will be jeopardized.

RESEALING PROCEDURES

MATERIALS REQUIRED

Tektronix Part No.	Description	Notes
006-2302-00	Dow Corning No. 3144 Adhesive Sealant	This Room Temperature Vulcanizing agent (RTV) is used to form watertight gaskets. (After application, allow 24 hours curing time.)
252-0199-00	Dow Corning No. 3140 Coating	This RTV agent is used where the application requires a sealant more fluid than the No. 3144 sealant. (Allow 24 hour curing time.)
006-0315-00	Dow Corning No. 4 Silicone Dielectric Compound	This compound is used in the Battery Pack assembly.
006-2475-00	Dow Corning No. 1204 Primer	Used as a primer for No. 3144 sealant applications.
006-2207-00	General Electric No. G-661 Silicone grease	Used as a waterproof lubricant.
006-0500-00	Acetone	Cleaning Agent.
006-0034-00	Isopropyl Alcohol	Cleaning Agent.

ASSEMBLY PROCEDURES

NOTE

In the following assembly steps, the part being discussed is identified by its location in the Replaceable Mechanical Parts list (MPL) of the Instruction Manual.

1. Preparation of the Subpanel for further assembly (see Fig. 5-5)

a. SUBPANEL, FRONT

MPL Item 3-26.

b. Procedure

1. Clean entire Subpanel with isopropyl alcohol.

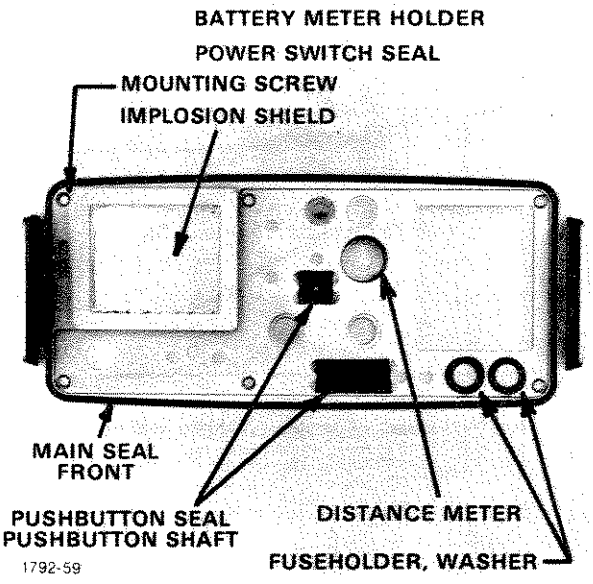


Fig. 5-5 Subpanel, identification of parts for steps 1 through 7.

2. Install the Holder for the Battery Level Indicator in the Subpanel

a. HOLDER

MPL Item 2-57.

b. Procedure

1. Insert the holder into the Subpanel.

2. This item does not require the application of a sealing compound.

3. Install the seal for the Power Switch in the Subpanel

a. SEAL, SWITCH

MPL Item 2-55.

b. Procedure

1. Clean mating surface of seal with acetone.

2. Coat mating surface of seal with No. 3144 sealant.

3. Install seal in Subpanel.

4. Install washers for the Fuseholders in the Subpanel

a. WASHER, FLAT (2 ea.)

MPL Item 2-51.

b. Procedure

1. Clean the washers with acetone.

2. Coat the mating surfaces of the washers with No. 3144 sealant.

3. Insert the washers in the Subpanel.

5. Install the Pushbutton seals in the Subpanel

a. SEAL, PUSHBUTTON

MPL Item 2-53, MPL Item 2-54, and MPL Item 2-52.

b. Procedure

1. Clean mating surfaces of seals with acetone.

2. Coat mating surfaces with No. 3144 Sealant.

3. Install seals in subpanel.

6. Installation of rubber seals in two grooves located on the outer (see Figs. 5-5 and 5-6) edges of the front and rear sides of the Subpanel

a. SEAL, RUBBER (2 ea.)

MPL Item 2-58.

b. Procedure

1. Clean the rubber seals with acetone.

2. Apply a film of No. 3140 sealant to the inner surface of each groove. See Fig. 5-6. Do not apply the sealant to the other surfaces of the grooves. No. 3140 is more fluid than No. 3144 and can be applied with a hypodermic type applicator.

3. Place a seal in each groove. Trim each seal to a length such that its ends butt together. Apply a film of No. 3140 sealant to the butt joint.

4. Before installing the instrument in a cabinet, lubricate the outer edges of the seals as shown in Fig. 5-6.

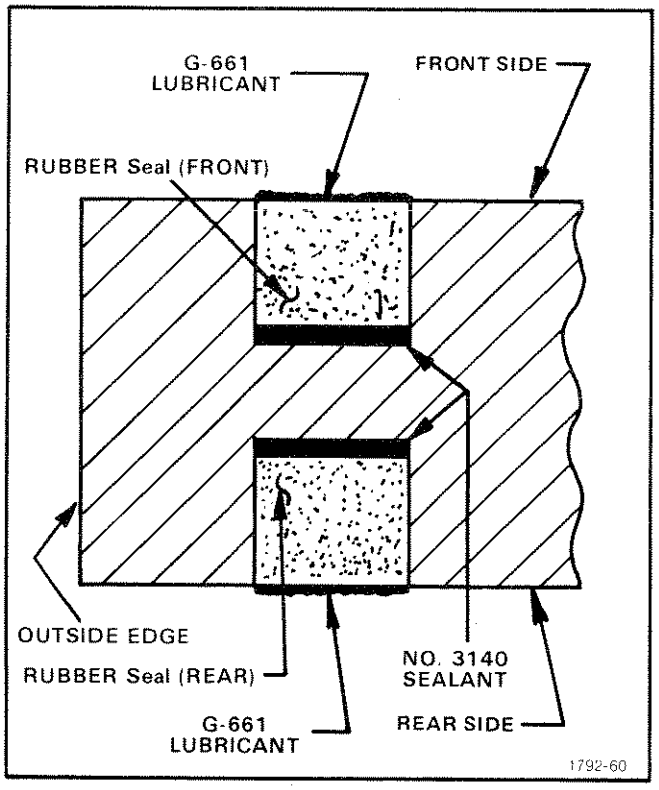


Fig. 5-6. Rubber Seals, edge sealing for subpanel.

7. Install the implosion shield and its retainer on the Subpanel (see Figs. 5-5 and 5-7)

a. SHIELD, IMPLOSION

MPL Item 2-91.

b. RETAINER

MPL Item 2-90.

c. Procedure

1. Clean the retainer and the implosion shield mounting area of the Subpanel with acetone.

2. Remove the protective paper from the implosion shield.

3. Position the shield on the Subpanel and form a continuous bead of No. 3144 sealant, approximately .090 inch in diamter, around the shield/Subpanel interface.

4. Position the retainer over the bead of sealant and press into place.

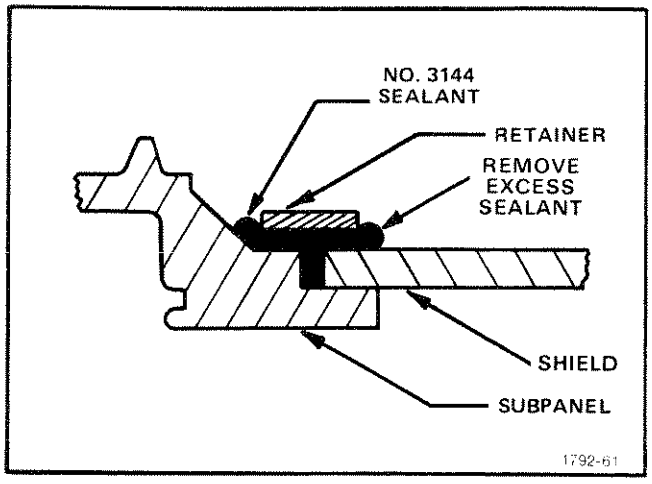


Fig. 5-7. Detail of implosion shield sealing.

NOTE

1. Pressing the retainer should cause some of the sealant to appear outside the retainer area, see Fig. 5-7. Failure of the sealant to appear at any point around the retainer is an indication of inadequate sealing.

2. When performing this step, assure that the shield makes flush contact with the subpanel, see Fig. 5-7.

5. After a curing time of approximately 4 hours, use a small wooden dowel, such as a Q-tip handle, and remove the excess sealant that is visible between the shield and retainer.

8. Preparation of Front Panel for assembly (see Fig. 5-8)

a. FRONT PANEL

MPL Item 2-49 and (Option 5) MPL Item 2-49.

b. Procedure

1. Clean mating surface of front panel with acetone.

2. Coat mating surface of panel with No. 1204 primer. Allow 2 hour curing time.

2. Apply No. 3144 sealant to mating surface of seal.

3. Position seal on rear side of Front Panel.

4. Allow 2 hour curing time. Inspect seal bond, and remove any excess sealant. Allow an additional 22 hour curing time.

NOTE

Be sure seal is bonded securely to edge of panel as well as rear surface of panel.

9. Bonding of Plug-in Compartment seal to Front Panel (see Fig. 5-9)

a. SEAL, PLUG-IN

MPL Item 2-50.

b. Procedure

1. Clean mating surfaces of seal with acetone.

10. Bonding of washer to BNC type connector that is located on the Main Circuit Board Assembly (see Fig. 5-10)

a. CONNECTOR, RECEPTACLE

MPL Item 2-170.

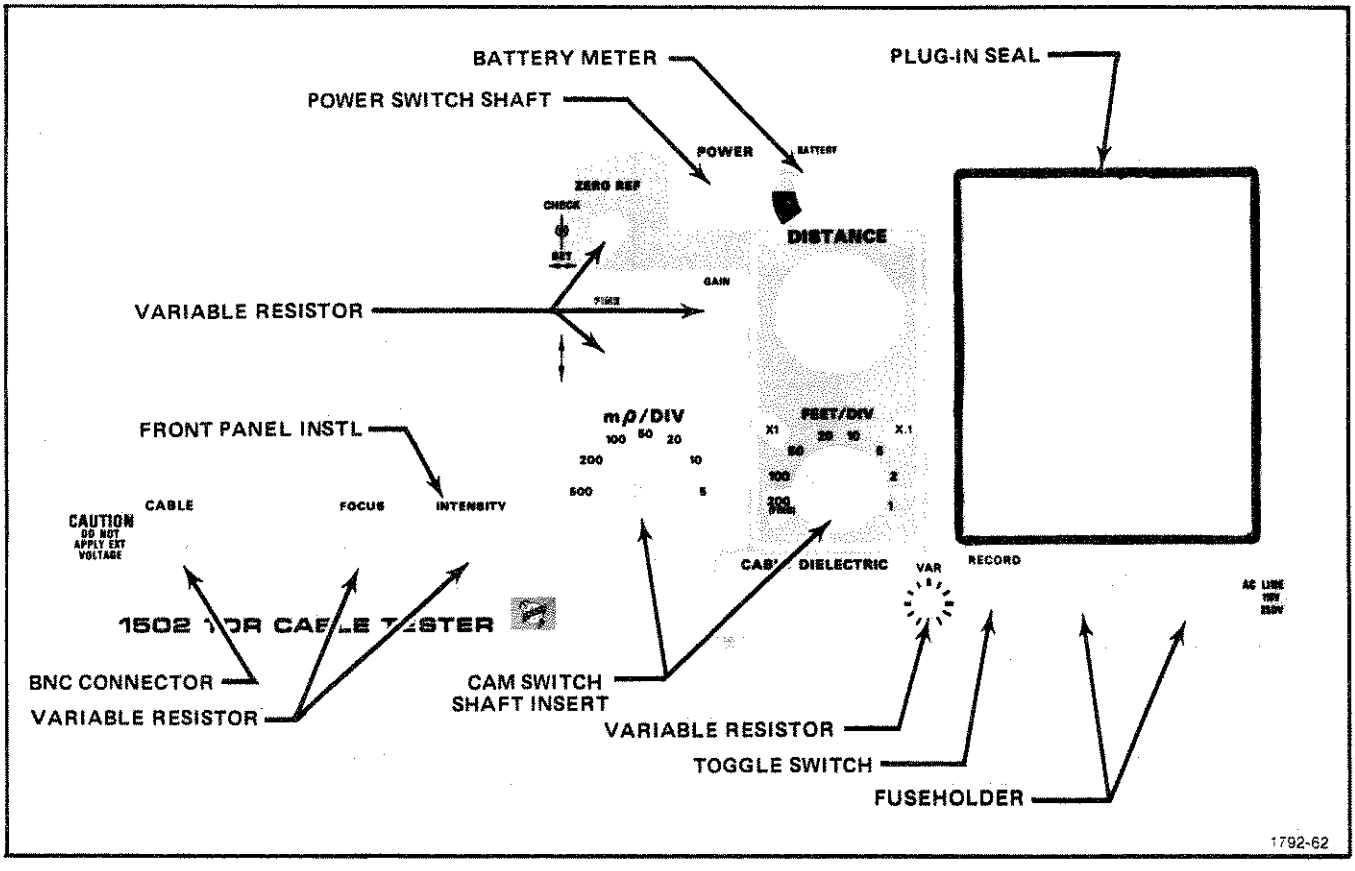


Fig. 5-8. Front Panel, identification of parts for assembly steps 8 through 26.

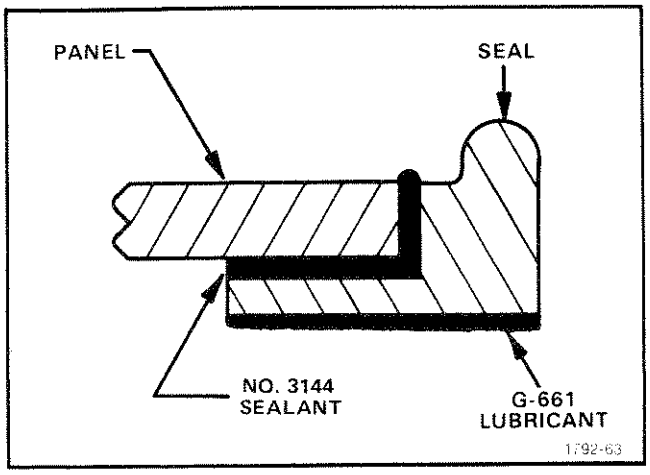


Fig. 5-9. Detail of Plug-In Compartment seal.

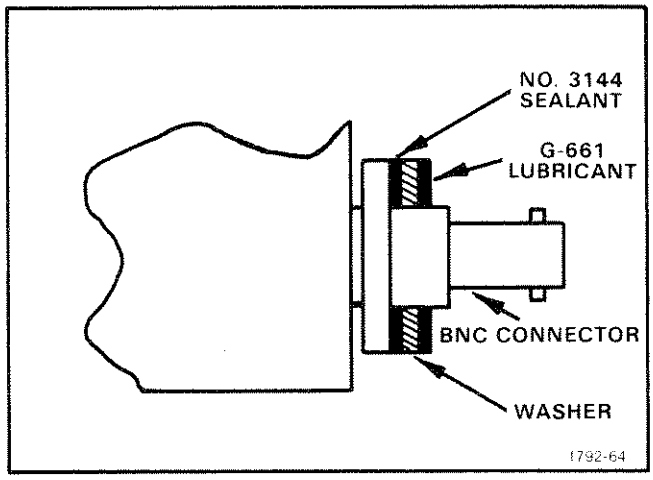


Fig. 5-10. Detail of BNC Connector and Washer.

b. WASHER, FLAT SPONGE

MPL Item 2-94.

c. Procedure

1. Clean mating surfaces of BNC Connector and Washer with acetone. Allow to dry.

2. Apply No. 1204 Primer to mating surface of BNC connector. Allow 2 hour curing time.

3. Coat mating surface of washer with No. 3144 sealant.

4. Assemble washer on BNC connector.

11. Install pushbuttons and their shaft assemblies (see Fig. 5-11)

a. PUSHBUTTONS

MPL Item 2-7, MPL Item 2-8, MPL Item 2-9, MPL Item 2-10, MPL Item 2-11, MPL Item 2-12, MPL Item 2-13, and MPL Item 2-14.

b. EXTENSION SHAFT

MPL Item 2-97 (8 ea.).

c. Procedure

1. Clean the mating surfaces of each shaft with isopropyl alcohol.

2. Insert the shafts into the pushbutton seals. See Fig. 5-11.

3. Apply bead of No. 3144 sealant to each shaft/seal interface.

4. Install pushbuttons in their respective locations.

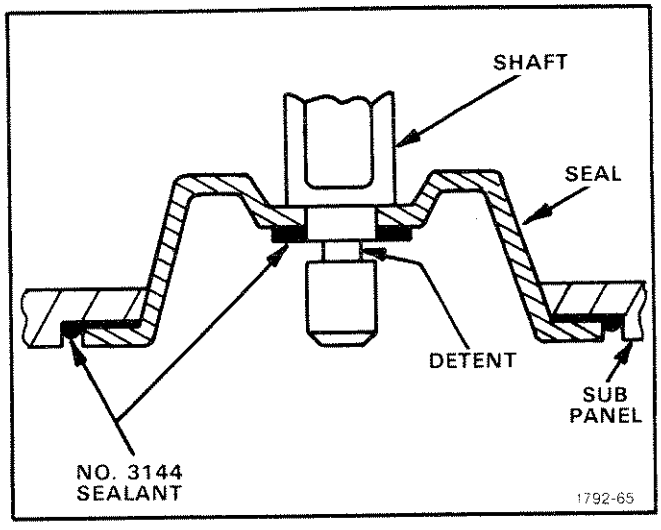


Fig. 5-11. Detail of Pushbuttons and their Shafts.

12. Attach Subpanel to the three Frame Sections (see Fig. 5-12)

a. FRAME SECTIONS

Left, MPL Item 3-115; Center, MPL Item 3-116; Right, MPL Item 3-117.

b. SCREWS

1. MPL Item 3-27 (1 ea.), MPL item 3-28 (5 ea.).

c. Procedure

1. Fill the countersunk screw holes on the Subpanel with No. 3144 sealant. See Fig. 5-12.

2. Attach the Subpanel to the three Frame sections. The decorative screw is installed in the upper-left corner of the subpanel.

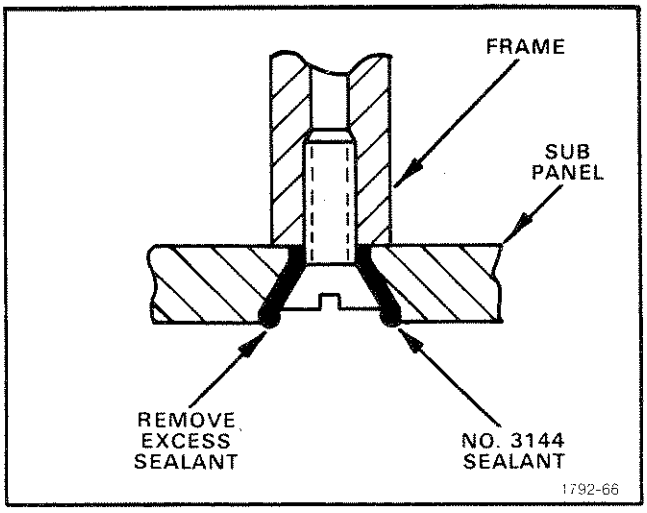


Fig. 5-12. Detail of Subpanel screwhole sealing.

13. Install Front Panel on Subpanel

a. Procedure

1. Apply G-661 lubricant to the rear surface of the Plug-in Seal, and to the two Fuse Holder Seals.

2. Place Front Panel on the Subpanel.

14. Install Fuseholders in Front Panel (see Fig. 5-13)

a. FUSEHOLDERS

MPL Item 2-26.

b. Procedure

1. Install the two Fuseholders as shown in Fig. 5-13.

2. Tighten the retaining nut on the fuseholder until the Front Panel is pulled flush with the Subpanel.

CAUTION

Do not overtighten.

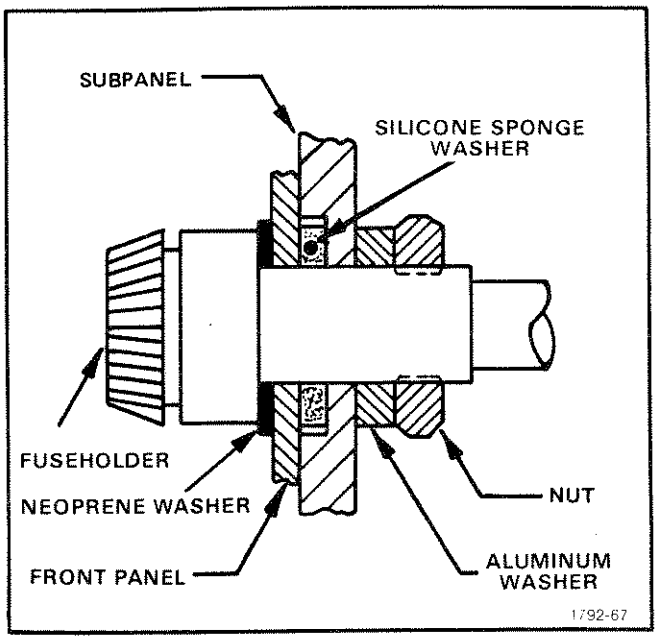


Fig. 5-13. Detail of Fuseholder installation.

15. Install Fuseholder Caps (see Fig. 5-14)

a. WASHERS

MPL Item 2-27.

b. Procedure

1. Clean washers and Fuseholder Caps with isopropyl alcohol.

2. Apply No. 3144 sealant to one surface of a washer and place the washer in one of the Fuseholder Caps. Repeat for the other washer and cap.

3. Insert the caps in the Fuseholders and press to ensure the washers are fully seated.

4. Remove the caps, inspect, and remove any excess sealant.

5. Apply a film of G-661 lubricant to exposed surface of washer.

6. Insert fuse (see Electrical Parts list for correct value) into cap and install cap with fuse in the Fuseholder.

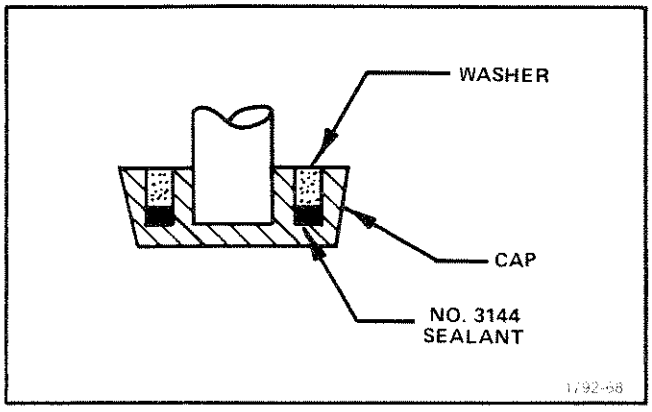


Fig. 5-14. Detail of Fuseholder Caps.

16. Install Battery Meter (see Fig. 5-15 and 5-16)

a. METER

MPL Item 2-56.

b. Procedure

1. Apply a thin bead of No. 3144 sealant to the junction of the bezel and meter canister (see Fig. 5-15).

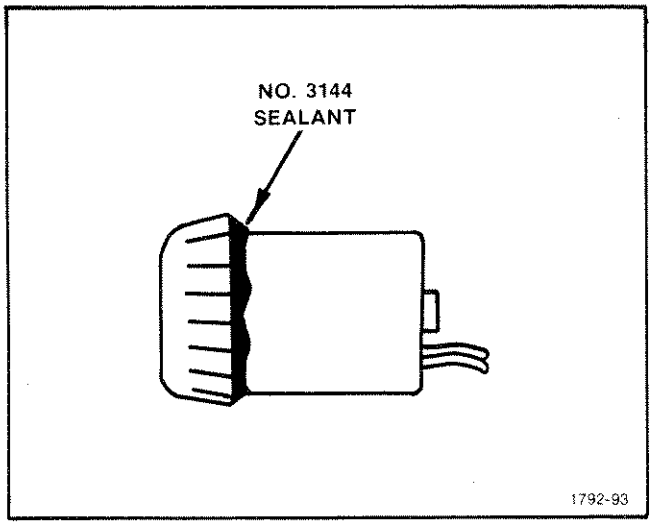


Fig. 5-15. Application of sealant to Battery Meter.

2. Install Meter in Front Panel with markings aligned as shown in Fig. 5-16.

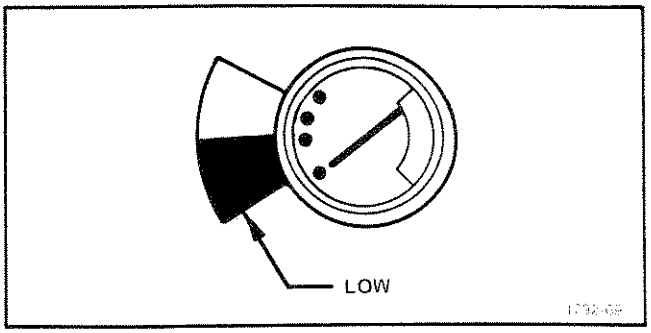


Fig. 5-16. Alignment of Battery Meter.

17. Install the FOCUS and INTENSITY controls (see Fig. 5-17)

a. RESISTOR, VARIABLE (2 ea.)

MPL Item 2-40 and Item 2-43.

These two variable resistors are used for FOCUS and INTENSITY control and are listed in the Electrical Parts list.

b. Procedure

1. Unscrew the bushing part of the resistor assembly and pack the barrel/shaft interface with G-661 lubricant.

2. Screw the bushing into the resistor assembly.

3. Form a bead of No. 3144 sealant around the fillet area of the bushing.

4. Use the washers and nuts supplied and install these two controls in the Front Panel.

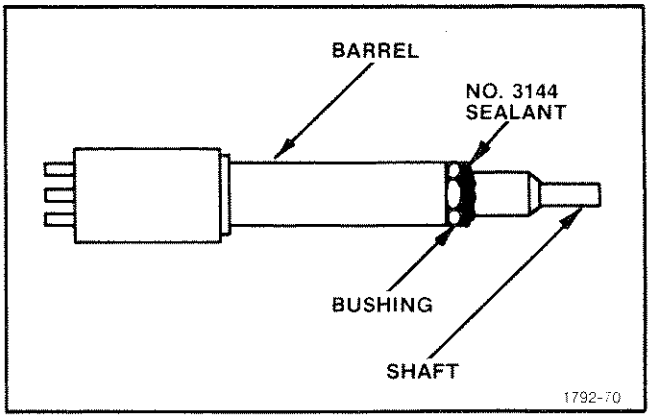


Fig. 5-17. Application of sealant to FOCUS and INTENSITY controls.

18. Install FINE POSITION control (see Fig. 5-18 and 5-19)

a. RESISTOR, VARIABLE

MPL Item 2-32.

The part number for this variable resistor is listed in the Electrical Parts list.

b. Procedure

1. Form a bead of No. 3144 sealant around the bushing threads as shown in Fig. 5-18.

2. Install nut on bushing as shown in Fig. 5-19.

3. Form a bead of No. 3144 sealant at the interface of the nut and bushing as shown in Fig. 5-19.

4. Use washer and nut supplied and install the control in the Front Panel.

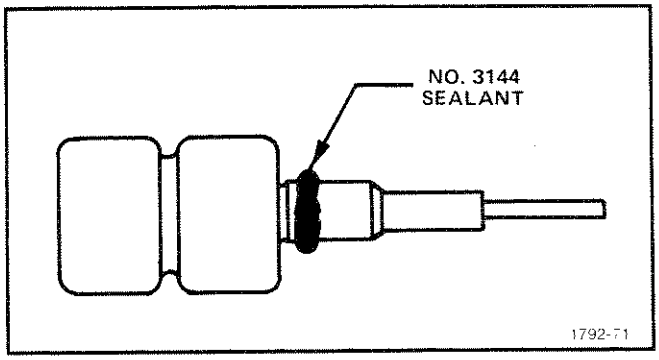


Fig. 5-18. Application of sealant to FINE control bushing.

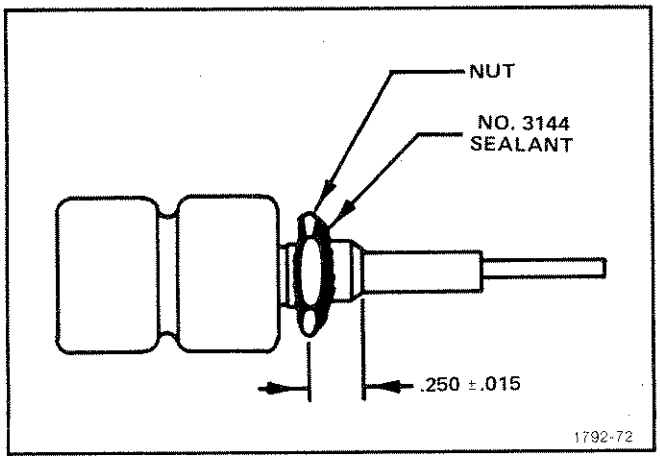


Fig. 5-19. Application of sealant to FINE control nut.

19. Install the DISTANCE METER in the Front Panel (see Fig. 5-20)

a. RESISTOR, VARIABLE

MPL Item 2-46.

This variable resistor is listed in the Electrical Parts list as the Distance Meter.

b. Procedure

1. Insert the resistor assembly in the Front Panel.

2. Form a bead of No. 3144 sealant at the interface of the resistor assembly and the Front Panel. The bead should include the threads and anti-rotation lug.

3. Use the flat-washer, lock-washer, and nut to secure the resistor assembly to the Front Panel.

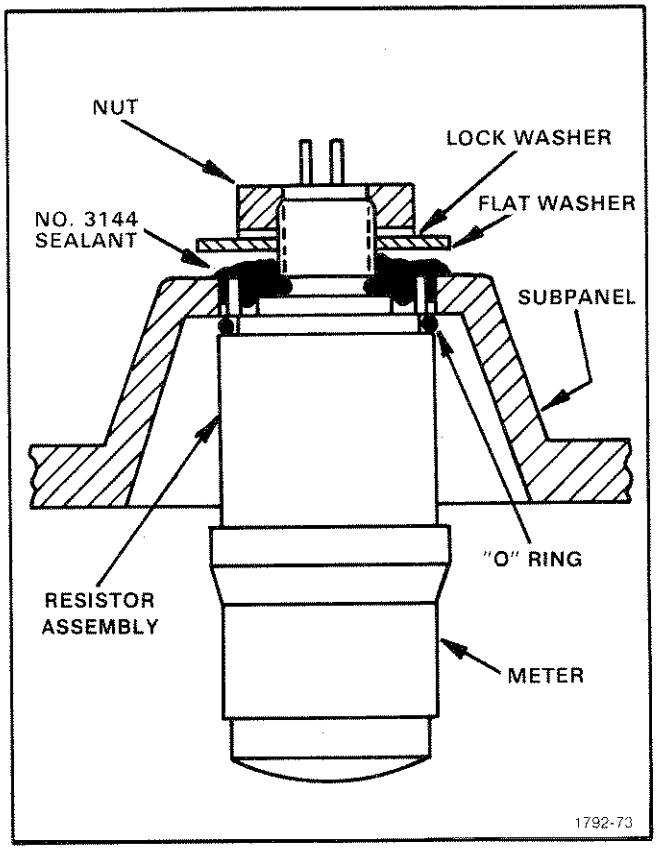


Fig. 5-20. Installation of Distance Meter.

20. Install the ZERO REFERENCE control in the Front Panel (see Figs. 5-21 and 5-22)

a. RESISTOR, VARIABLE

MPL Item 2-49.

This variable resistor is listed in the Electrical Parts list.

b. Procedure

1. Form a bead of No. 3144 sealant around the threads of the bushing as shown in Fig. 5-21.

2. Flatten or remove the anti-rotation lug on the resistor housing.

3. Install nut as shown in Fig. 5-22.

4. Form a bead of No. 3144 sealant around the nut/bushing interface.

5. Use attaching hardware and install resistor in Front Panel.

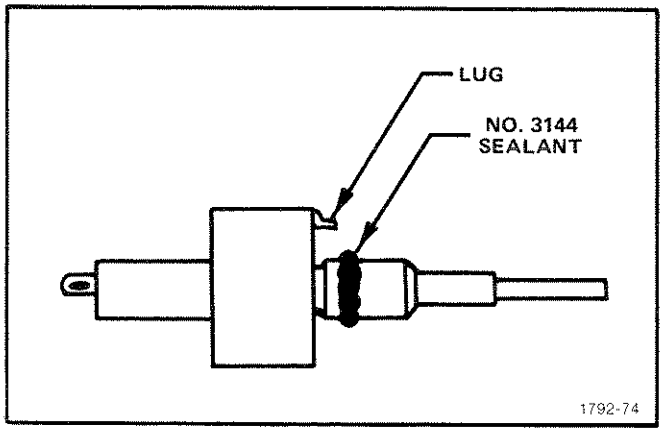


Fig. 5-21. Application of sealant to ZERO REFERENCE control bushing.

21. Install the Record control (see Figs. 5-23, 5-24, 5-25)

a. SWITCH, TOGGLE

MPL Item 2-23.

b. CAP, TOGGLE SWITCH, SEAL

MPL Item 2-24.

c. Procedure

1. Form a bead of No. 3144 sealant around the bushing/switch body interface as shown in Fig. 5-23.

2. Install nut that was supplied with the switch, as shown in Fig. 5-24.

3. Form a bead of No. 3144 sealant around the bushing/nut interface as shown in Fig. 5-24.

4. Use attaching hardware and install the toggle switch in the Front Panel.

5. Install the cap-seal on the toggle switch (see Fig. 5-25).

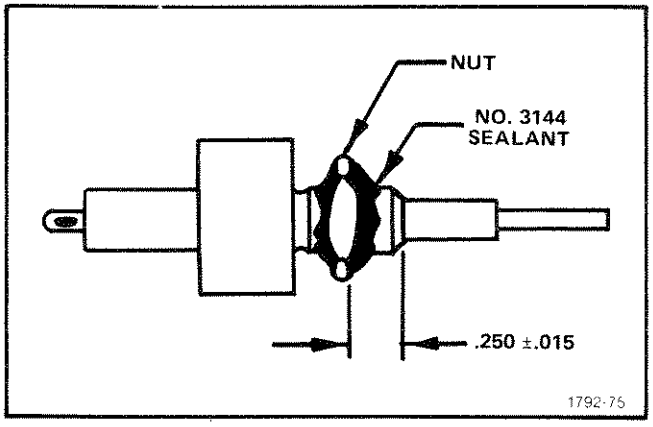


Fig. 5-22. Application of sealant to ZERO REFERENCE control nut.

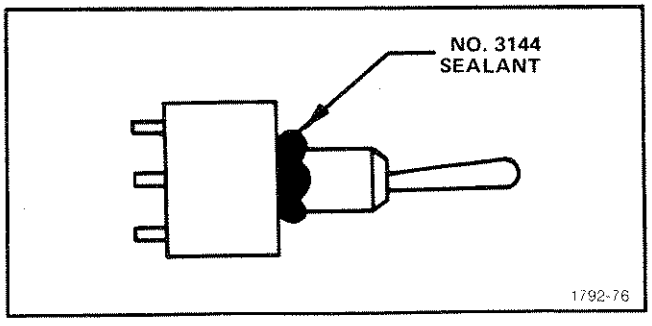


Fig. 5-23. Application of sealant to RECORD toggle-switch bushing.

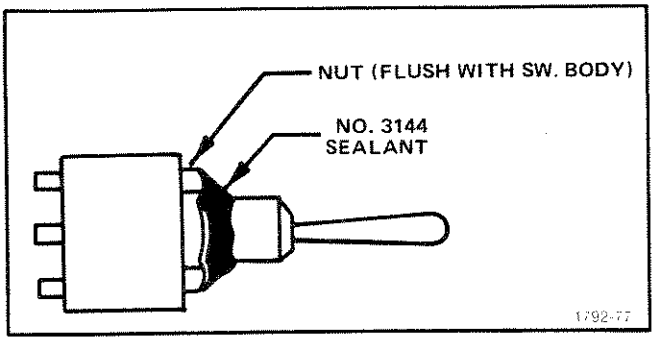


Fig. 5-24. Application of sealant to RECORD toggle-switch nut.

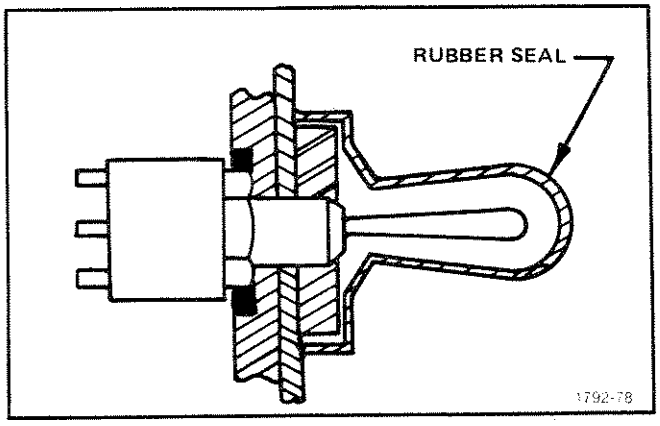


Fig. 5-25. Installation of rubber Cap-Seal on RECORD toggle-switch.

22. Install the VAR control and the 0-dB SET control (see Figs. 5-26 and 5-27)

a. RESISTOR, VARIABLE

MPL Item 2-19 (VAR control), MPL Item 2-35 (0-dB SET control).

b. Procedure

1. Partially unscrew Hex spacer nut and form a bead of No. 3144 sealant around the bushing threads as shown in Fig. 5-26.

2. Re-tighten the Hex spacer nut.

3. Pack the Shaft/Threaded Bushing interface with G-661 lubricant as shown in Fig. 5-27.

4. Form a bead of No. 3144 sealant on the end of the Hex space nut as shown in Fig. 5-27.

5. Install the resistor in the Front Panel.

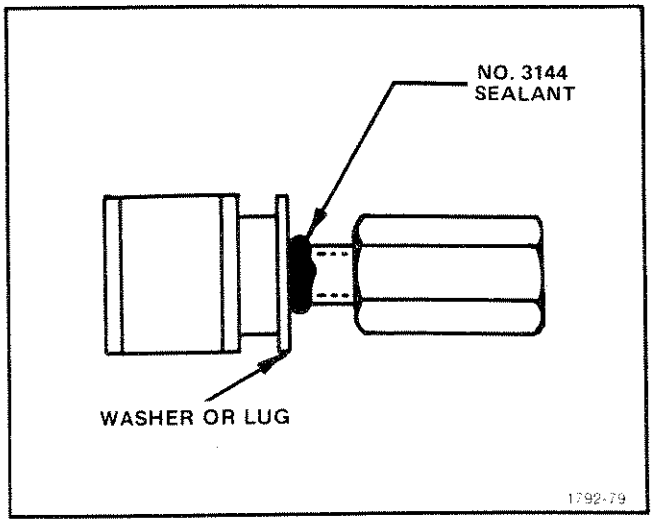


Fig. 5-26. Application of sealant to the 0-dB SET control bushing.

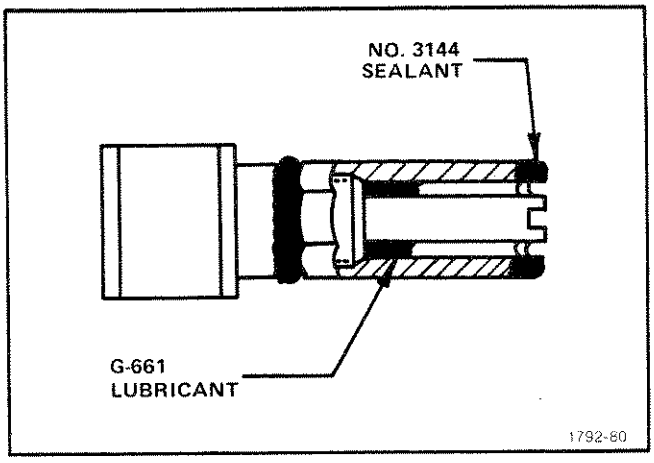


Fig. 5-27. Detail showing lubrication and sealing for the variable resistor.

23. Partial installation procedure for Main Circuit Board Assembly

a. MAIN CIRCUIT BOARD ASSY.

Not shown in MPL as separate item.

b. Procedure

1. Lubricate washer on BNC connector with G-661 lubricant.

2. Insert Main Circuit Board Assembly into instrument chassis engaging pushbutton shafts with their respective switches. (Take care not to damage pushbutton seals.)

3. Do not install Main Circuit Board holding screws at this point.

24. Install cam switch inserts (see Fig. 5-28)

a. INSERT, SHAFT SEAL (2 ea.)

MPL Item 2-100.

b. PACKING (O-ring, 2 ea.)

MPL Item 2-101.

c. Procedure

1. Apply G-661 lubricant to O-ring and install as shown in Fig. 5-28.

2. Form a bead of No. 3144 sealant around the fillet area of the insert.

3. Install the two inserts in the Front Panel. Tighten until snug, then back off 2° to 3°. Remove any excess sealant.

25. Finish installation procedure for Main Circuit Board Assembly

a. Procedure

1. Install washer and nut on BNC connector. Tighten nut to a torque reading of 20 ±3 inch-pounds.

2. Install Main Circuit Board holding screws.

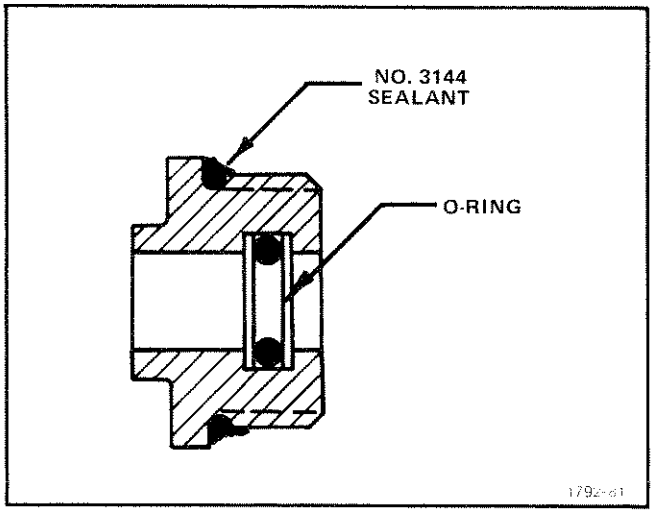


Fig. 5-28. Lubrication of the O-rings and sealing for the cam-switches.

26. Install Power Switch Shaft into Front Panel (see Fig. 5-29)

a. EXTENSION-SHAFT

MPL Item 2-17.

b. BUSHING

MPL Item 2-18.

c. Procedure

1. Insert the bushing into the Power Switch Seal that was previously installed in the Front Panel.

2. Apply G-661 lubricant to the detent area of the Power Switch Shaft.

3. Install as shown in Fig. 5-29.

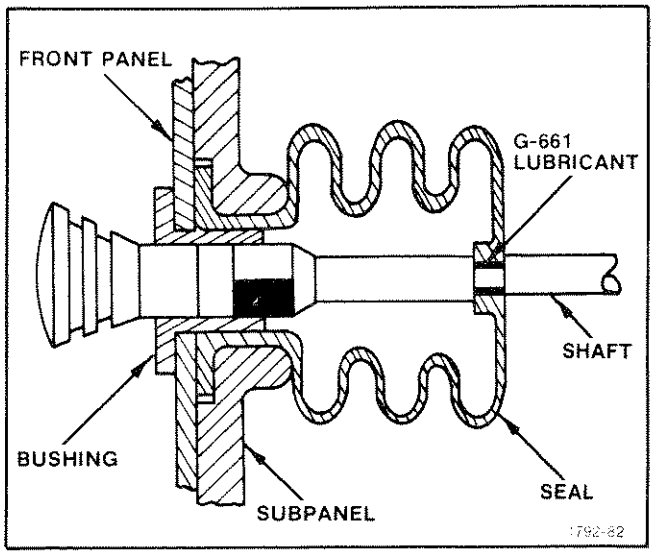


Fig. 5-29. Installation of the POWER switch.

27. Installation of the POSITION knob and the FINE POSITION knob (see Figs. 5-30 and 5-31)

a. KNOB, POSITION

MPL Item 2-4.

b. KNOB, FINE POSITION

MPL Item 2-2.

c. Procedure

1. Apply G-661 lubricant to the POSITION knob as shown in Fig. 5-30.

2. Assemble the POSITION knob and the FINE POSITION knob on the control shafts as shown in Fig. 5-31.

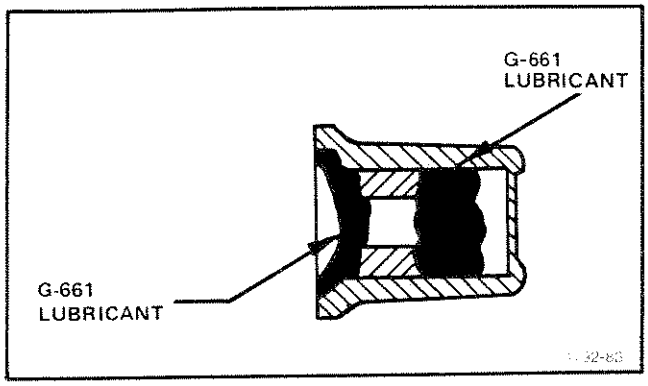


Fig. 5-30. Lubrication of POSITION control knob.

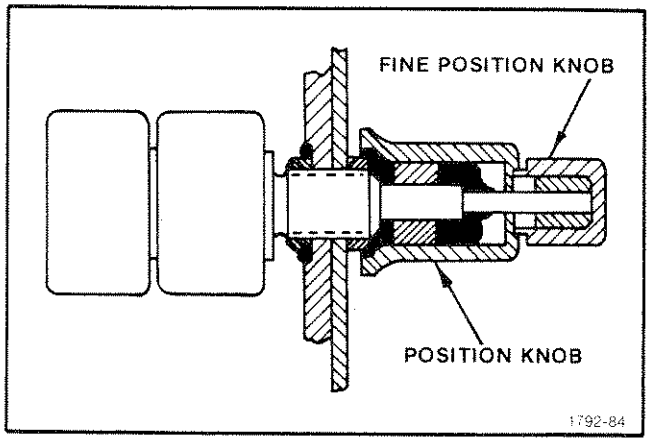


Fig. 5-31. Installation of knob on shaft.

28. Installation of the ZERO REFERENCE knob and the zero reference CHECK pushbutton (see Figs. 5-32 and 5-33)

a. KNOB, ZERO REFERENCE

MPL Item 2-4 (same as FINE POSITION knob).

b. PUSHBUTTON

MPL Item 2-3.

c. Procedure

1. Apply G-661 lubricant to the ZERO REFERENCE knob as shown in Fig. 5-32.

2. Assemble the knob and pushbutton on the control shafts as hown in Fig. 5-33.

2. Actuate the pushbutton several times. Remove any excess lubricant.

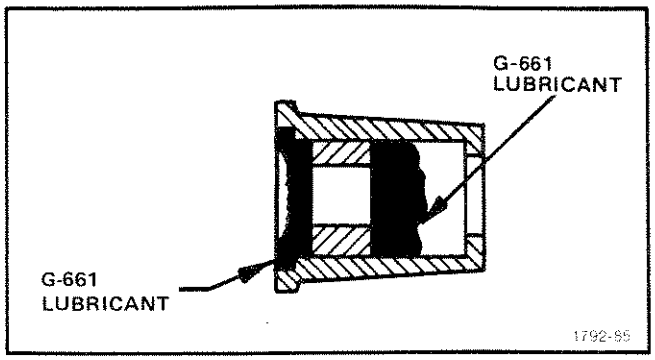


Fig. 5-32. Lubrication of ZERO REFERENCE knob.

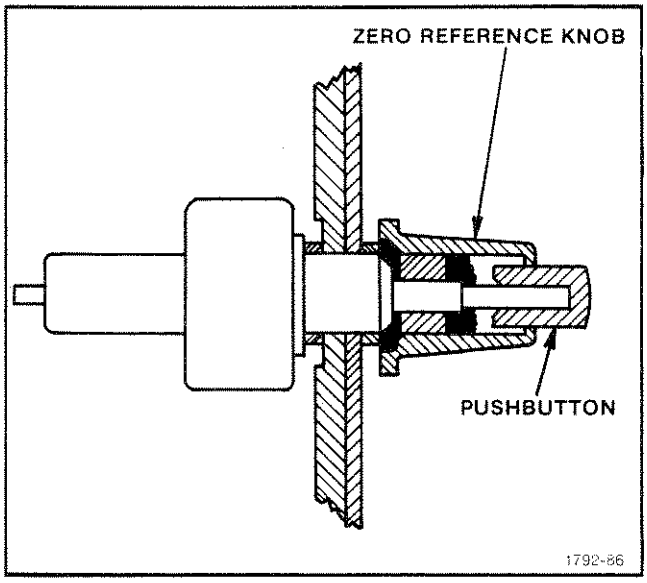


Fig. 5-33. Installation of knob on ZERO REFERENCE control.

29. Install the FOCUS and INTENSITY knobs (see Fig. 5-34)

a. KNOB, 2 ea.

MPL Item 2-1.

b. Procedure

1. Apply G-661 lubricant to both knobs as shown in Fig. 5-34.

2. Install the knobs on the shafts of the FOCUS and INTENSITY controls.

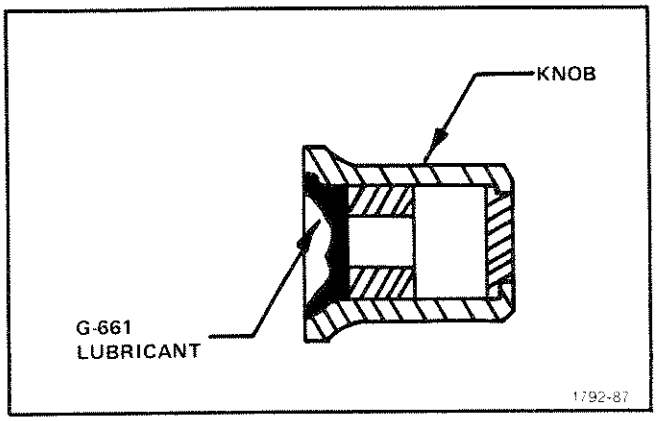


Fig. 5-34. Lubrication of FOCUS and INTENSITY control knobs.

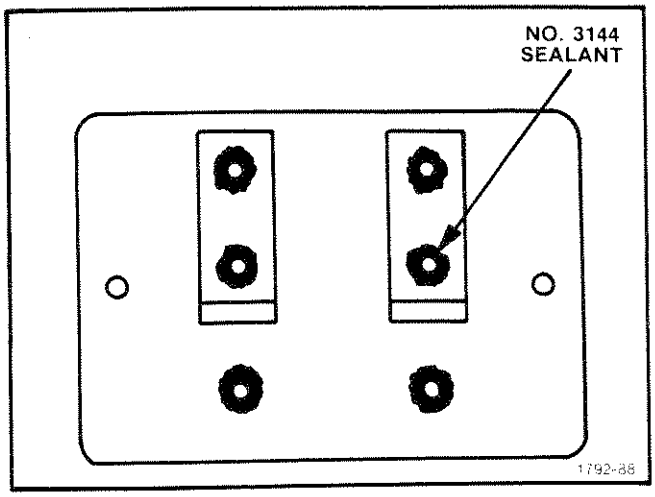


Fig. 5-35. Sealing of Battery Pack screwholes.

30. Watertight sealing procedures for the Battery Pack (see Figs. 5-35 and 5-36)

a. BATTERY PACK

MPL Item 2-30.

b. PANEL

Not shown in MPL.

c. HEAT SINKS

Not shown in MPL.

d. GASKET

Not shown in MPL.

e. Procedure

1. Clean Panel with isopropyl alcohol.

2. Form a bead of No. 3144 sealant in and around each of the six screw holes in the Panel. See Fig. 5-35.

3. Apply a film of Dow Corning No. 4. Compound to the mating surfaces of the heat sinks and the Panel and join as shown in Fig. 5-36.

4. Clean the gasket with acetone.

5. Apply a film of No. 3144 sealant to the gasket and attach it to the Panel as shown in Fig. 5-36.

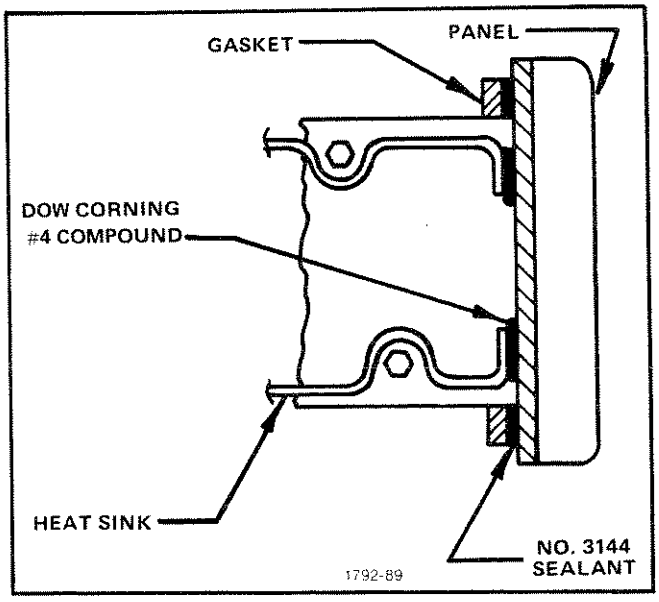


Fig. 5-36. Application of dielectric type compound.

31. Watertight sealing procedures for the Front Panel jacks of the X-Y Output Module, 016-0606-00, (see Fig. 5-37)

a. FRONT PANEL

MPL Item 3-13.

b. SUB PANEL

MPL Item 3-14.

c. JACK, TIP: BLACK

MPL Item 3-5.

d. JACK, TIP: RED

MPL Item 3-6.

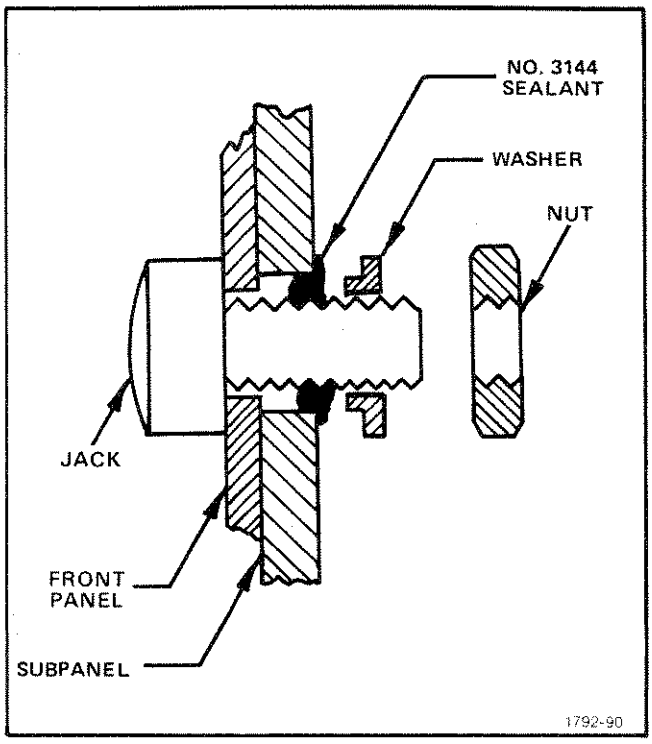


Fig. 5-37. Detail of front-panel jacks.

e. Procedure

1. Clean the mating surface of the Subpanel with isopropyl alcohol.

2. Align the Front Panel over the Subpanel and insert one of the jacks in its respective position.

3. Form a bead of No. 3144 Sealant around the Jack/Subpanel interface as shown in Fig. 5-37.

4. Use the supplied washer and nut to secure the jack in position.

5. Repeat Steps 3 and 4 for the remaining five jacks.

32. Preparation of the Thumbscrews that are used for securing the X-Y Output Module (see Fig. 5-38)

a. PACKING (O-ring)

MPL Item 3-10.

b. PIN, (shaft)

MPL Item 3-8.

c. KNOB

MPL Item 3-7.

d. Procedure

1. Insert one of the Pins (shaft) through the Front Panel and Subpanel.

2. Apply G-661 lubricant to the O-ring.

3. Position the O-ring on the shaft as shown in Fig. 5-38.

4. Place the knob on the shaft and tighten the setscrew.

5. Repeat procedure for the second thrumbscrew.

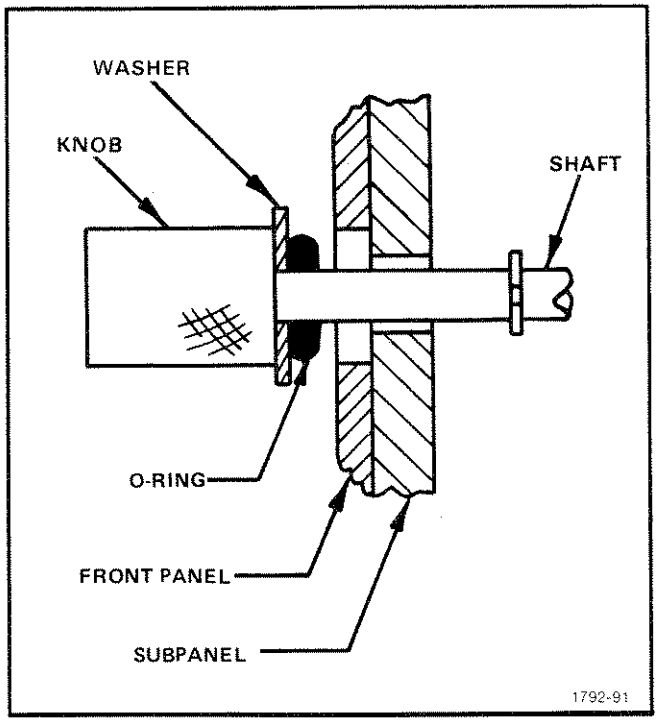


Fig. 5-38. Detail of X-Y Module thumbscrews.

33. Attach Latch Assemblies (2 ea.) to the Front Cover (see Fig. 5-39)

a. COVER, FRONT

MPL Item 1-29.

b. LATCH ASSY.

MPL Item 1-0.

c. Procedure

1. Clean mating surfaces of Front Cover and Latch Assembly with isopropyl alcohol.

2. Apply No. 3144 sealant to the two screw-holes in each Latch Assembly as shown in Fig. 5-39.

3. Attach the two Latch Assemblies to the Front Cover.

REMINDER: Don't forget to lubricate surface of rubber seals around edge of subpanel with G-661 lubricant before installing instrument in cabinet and attaching front cover.

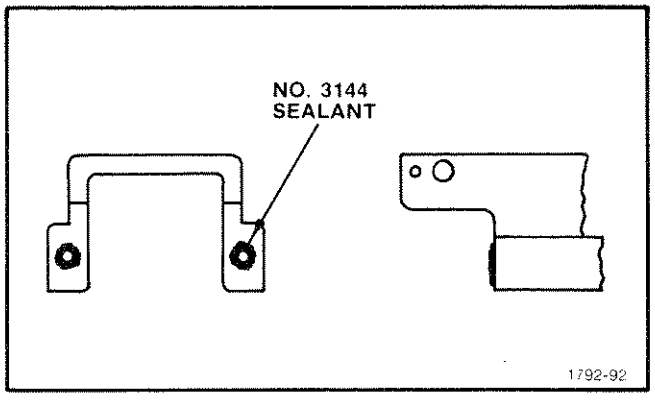


Fig. 5-39. Sealing of latch-assembly screwholes.

Distance Indicator Knob Replacement

If it is necessary to attach a knob shell/lens assembly to the DISTANCE indicator, form a bead of No. 3144 adhesive sealant (Tektronix Part No. 006-1171-00) at the interface of the DISTANCE indicator and the knob shell.

REPACKAGING FOR SHIPMENT

If the Tektronix instrument is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing: owner (with address) and the name of an individual at your firm that can be contacted, complete instrument serial number and a description of the service required.

Save and re-use package in which your instrument was shipped. If the original packaging is unfit for use or not available, repackage the instrument as follows:

1. Obtain a carton of corrugated cardboard having inside dimensions of no less than six inches more than the instrument dimensions; this will allow for cushioning. Refer to the following table for carton test strength requirements.

2. Surround the instrument with polyethylene sheeting to protect the finish of the instrument.

3. Cushion the instrument on all sides by tightly packing dunnage or urethane foam between carton and instrument, allowing three inches on all sides.

4. Seal carton with shipping tape or industrial stapler.

SHIPPING CARTON TEST STRENGTH

Gross Weight (lb)	Carton Test Strength (lb)
0-10	200
10-30	275
30-120	375
120-140	500
140-160	600

OPTIONS

Option 1 provdes discrete cable dielectric (relative propagation velocity) selections from 0.2 to 1.0 in .01 increments.

Option 4 provides a chart recorder for self-contained hard copy capability.

Option 5 provides metric calibration and metric front-panel notation.

Option 76 provides a crt with P7 phosphor, which is excellent for long-persistence display requirements.

POWER CORD OPTIONS

Option A1: 220 V/16 A, Universal Europe, 161-0132-00.

Option A2: 240 V/13 A, United Kingdom, 161-0133-00.

Option A3: 240 V/10 A, Australian, 161-0135-00.

Option A4: 240 V/15 A, North American, 161-0134-00.

Option A5: 250 V/6 A, Swiss, 161-0154-00.

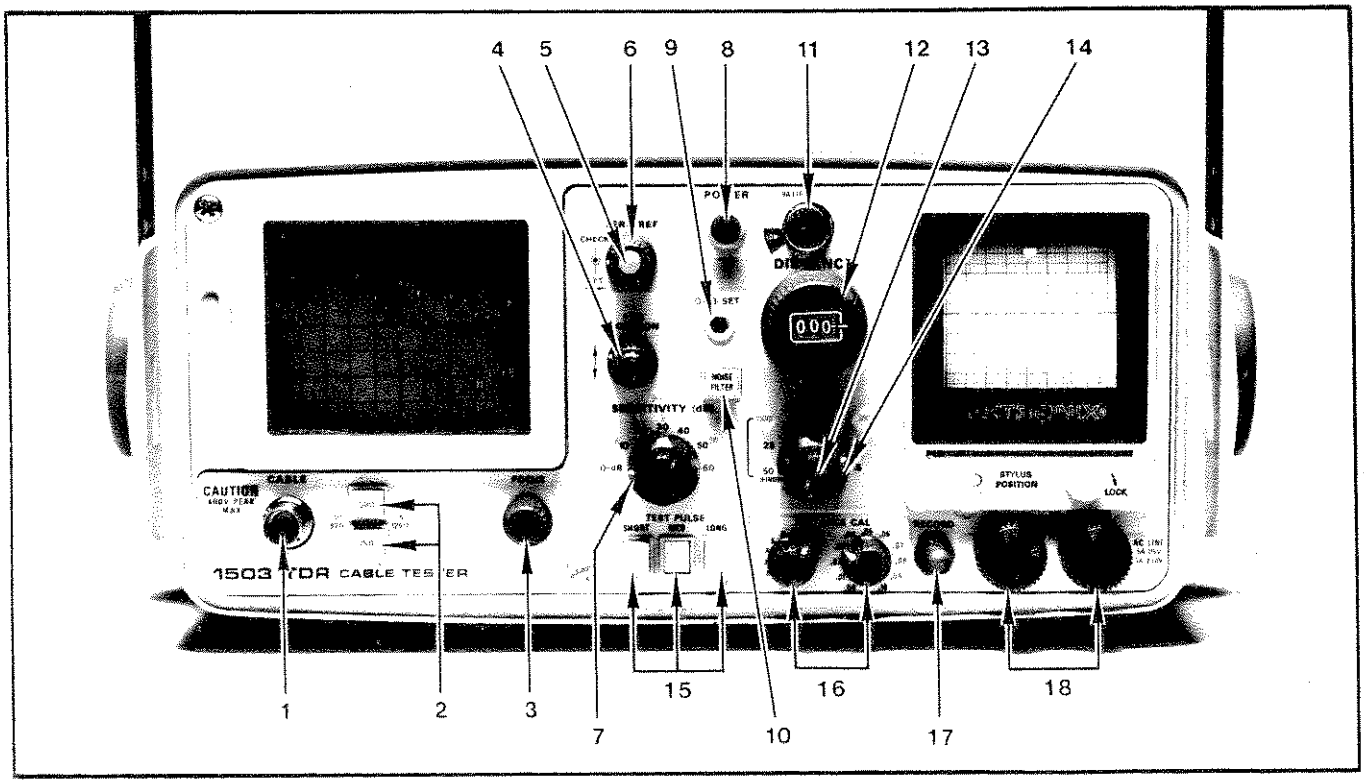


Fig. Option 1-1. Front-panel controls.

OPTION 1

1503 OPTION 1 differs from the 1503 standard model as follows:

1. The two front-panel CABLE DIELECTRIC pushbuttons have been replaced by two rotary DISTANCE CAL switches; the VAR adjustment has been deleted. To make these changes a PC Board (PC 9) has been added. See Fig. Option 1-2.

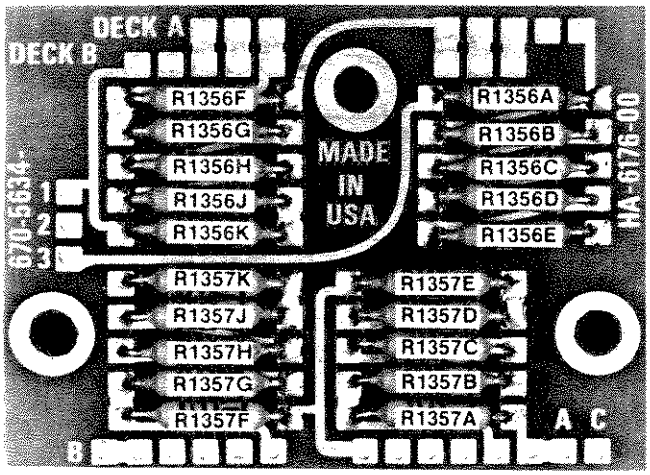


Fig. Option 1-2

2. The INTENSITY function has been removed and factory set; the FOCUS control has been relocated. A change in the High Voltage Board has been made accordingly. See Fig. Option 1-3.

3. RET LOSS (dB) has been renamed SENSITIVITY (dB).

4. IMPLS WIDTH has been redefined as TEST-PULSE, and the pushbuttons have been marked SHORT, MED, and LONG, instead of 10, 100, 1000.

Front-Panel Controls

1. CABLE — Precision bnc connector used to transmit the impulse signal into the test cable and receive the reflected signal.

2. Impedance selectors — Two push buttons used to select the 1503 output impedance. 50 Ω pushed in, selects 50 Ω impedance. 75 Ω pushed in, selects 75 Ω impedance. Both pushed in, selects 125 Ω impedance. Both out, select 93 Ω impedance.

3. FOCUS — Controls sharpness of crt display.

4. POSITION/FINE — Vertical position controls for crt display.

5. ZERO REF CHECK — Push button to check horizontal reference location of test impulse signal on crt.

6. ZERO REF SET — Horizontal pulse position control for crt display. Sets test signal edge to a vertical reference line on the crt when the DISTANCE dial is at 000 or ZERO REF CHECK button is pushed.

7. SENSITIVITY (dB) — Selects dB reference level of the reflected signal. 0—60 dB in seven calibrated steps. FINE adds 0—18 dB.

8. POWER — Push-pull, off-on switch. Does not affect battery charging circuits.

9. 0 dB SET — Screwdriver adjust for 0 dB reference level. Used to get amplitude of test pulse.

10. NOISE FILTER — Reduces displayed noise. Display sweep rate is reduced by a factor of ten.

11. BATTERY — Indicates relative charge of power pack.

12. DISTANCE — Indicates the distance from 1503 to a point on the test cable; 0 to 25000 feet (0 to 500 metres) at X100 (X10). Disabled when the FEET/DIV (METRES/DIV) control is set to 50 (100) and the multiplier is set to X100 (X10).

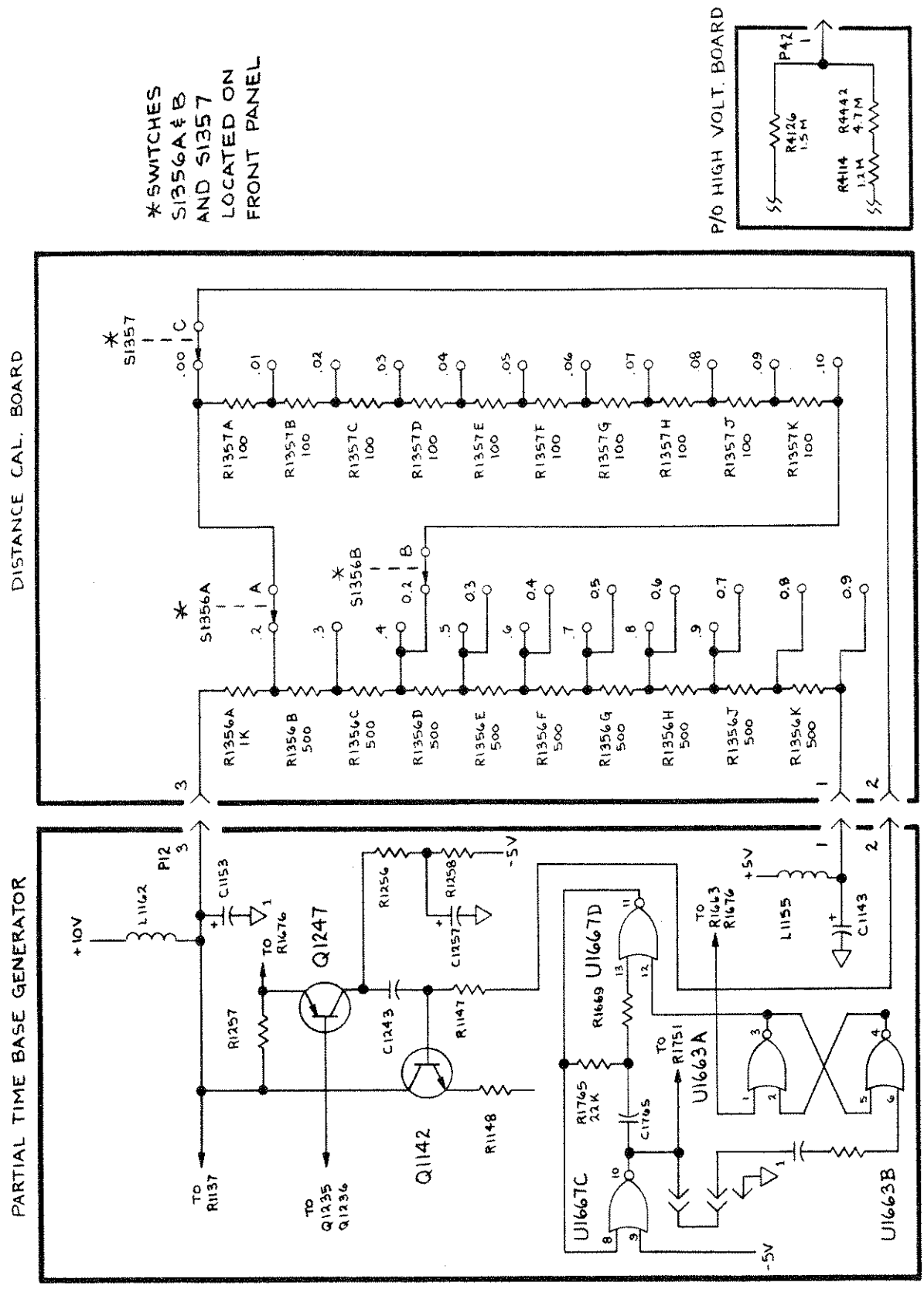


Fig. Option 1-3

13. X10 (X1) X100 (X10) — Two-position switch for X10 (X1) or X100 (X10) mutliplier. Affects both DISTANCE dial and FEET/DIV (METRES/DIV) control.

14. FEET/DIV (METRES/DIV) — Selects horizontal deflection factor.
X10 (X1) = 5 to 500 feet/div (1 to 100 metres/div).
X100 (X10) = 50 to 5000 feet/div (10 to 1000 metres/div).

15. TEST PULSE — Selects duration of test impulse; SHORT (10 ns), MED (100 ns), or LONG (1000 ns).

16. DISTANCE CAL — Two rotary switches, providing direct calibration in terms of propagation velocity, expressed as a fraction of C (speed of light). The right switch provides settings from 00 to .01 in increments of .01 C. The left switch provides settings from .2 to .9 in increments of .1 C. The cable Vp factor is found by adding the two switch settings.

17. RECORD — Two-position toggle switch. Used to start an X-Y Recorder or TEKTRONIX Y-T Chart recorder. Push up and hold momentarily to pre-heat stylus then release to start Chart recorder.

18. AC LINE FUSES — Protection fuses for the battery charger circuits.

CALIBRATION

Calibrate OPTION 1 according to the Calibration Procedure in the 1503 Instruction Manual, with the following exceptions:

Under control settings in all sections of the manual Calibration Procedure (Power Supply, Display, Vertical and Horizontal-Standard Version), change:

(from)	
CABLE DIELECTRIC VAR	Both Out Clockwise
(to)	
DISTANCE CAL	Both Clockwise (.9 and .1 = 1.0)

Replace parts q through y of the Power Supply portion of the manual Calibration Procedure with the following parts q through s.

q. Connect the voltmeter between TP4243 and TP4251 (see Output Amp-High Voltage Component pull-out page for test point locations).

r. CHECK—For a voltmeter reading of 60 mV ±5 mV.

s. ADJUST—R4222 (INTENSITY LIMIT) for a voltmeter reading that is inside the range of 55 mV to 65 mV. The adjustment is located on the HIGH VOLTAGE board and adjusted through the hole in the POWER SUPPLY board (see Fig. 4-1). Check for optimum trace brightness without blooming.

12. DISTANCE CAL

a. Set the FEET/DIV switch to five feet, multiplier to X10. Select 1 μs markers.

b. With the ZERO REF SET, position the display so that the leading edge of one time marker is on the first graticule line and the corresponding point of the next time marker is on the last graticule line (10 div).

c. Use the following table to check the DISTANCE CAL switches:

Switch Setting		Div Between
Left	**Right**	**Markers, +0.4% to −3.6%**
.9	.1	10
.9	.09	9.9
.9	.08	9.8
.9	.07	9.7
.9	.06	9.6
.9	.05	9.5
.9	.04	9.4
.9	.03	9.3
.9	.02	9.2
.9	.01	9.1
.9	.00	9.0
.8	.1	9.0
.7	.1	8.0
.6	.1	7.0
.5	.1	6.0
.4	.1	5.0
.3	.1	4.0
.2	.1	3.0

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
0000M	SONY/TEKTRONIX CORPORATION	P O BOX 14, HANEDA AIRPORT	TOKYO 149, JAPAN
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
03508	GENERAL ELECTRIC COMPANY, SEMI-CONDUCTOR PRODUCTS DEPARTMENT	ELECTRONICS PARK	SYRACUSE, NY 13201
03888	KDI PYROFILM CORPORATION	60 S JEFFERSON ROAD	WHIPPANY, NJ 07981
04222	AVX CERAMICS, DIVISION OF AVX CORP	P O BOX 867, 19TH AVE. SOUTH	MYRTLE BEACH, SC 29577
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
09353	C AND K COMPONENTS, INC.	103 MORSE STREET	WATERTOWN, MA 02172
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
12969	UNITRODE CORPORATION	580 PLEASANT STREET	WATERTOWN, MA 02172
14099	SEMTECH CORP.	652 MITCHELL RD.	NEWBURY PARK, CA 91320
14552	MICRO SEMICONDUCTOR CORP.	2830 E FAIRVIEW ST.	SANTA ANA, CA 92704
14752	ELECTRO CUBE INC.	1710 S. DEL MAR AVE.	SAN GABRIEL, CA 91776
14936	GENERAL INSTRUMENT CORP., SEMICONDUCTOR PRODUCTS GROUP	P.O. BOX 600,600 W. JOHN ST.	HICKSVILLE, NY 11802
15238	ITT SEMICONDUCTORS, A DIVISION OF INTER NATIONAL TELEPHONE AND TELEGRAPH CORP.	P.O. BOX 168, 500 BROADWAY	LAWRENCE, MA 01841
17856	SILICONIX, INC.	2201 LAURELWOOD DRIVE	SANTA CLARA, CA 95054
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
19396	ILLINOIS TOOL WORKS, INC. PAKTRON DIV.	900 FOLLIN LANE, SE	VIENNA, VA 22180
24138	INTERNATIONAL ELECTRONIC CORP.	316 S SERVICE RD,HUNTINGTON STA	MELVILLE, L.I., NY 11746
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
28480	HEWLETT-PACKARD CO., CORPORATE HQ.	1501 PAGE MILL RD.	PALO ALTO, CA 94304
32997	BOURNS, INC., TRIMPOT PRODUCTS DIV.	1200 COLUMBIA AVE.	RIVERSIDE, CA 92507
34430	MONSANTO COMMERCIAL PRODUCT, CO. FABRICATOR PRODUCTS DIV.	BOX 3790, 611 EAST CERRITOS AVE.	ANAHEIM, CA 92803
50434	HEWLETT-PACKARD COMPANY	640 PAGE MILL ROAD	PALO ALTO, CA 94304
51642	CENTRE ENGINEERING INC.	2820 E COLLEGE AVENUE	STATE COLLEGE, PA 16801
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
59660	TUSONIX INC.	2155 N FORBES BLVD	TUCSON, AZ 85705
59821	CENTRALAB INC SUB NORTH AMERICAN PHILIPS CORP	7158 MERCHANT AVE	EL PASO, TX 79915
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W. UNIVERSITY ST.	ST. LOUIS, MO 63107
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
78488	STACKPOLE CARBON CO.		ST. MARYS, PA 15857
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
81073	GRAYHILL, INC.	561 HILLGROVE AVE., PO BOX 373	LA GRANGE, IL 60525
84411	TRW ELECTRONIC COMPONENTS, TRW CAPACITORS	112 W. FIRST ST.	OGALLALA, NE 69153
90201	MALLORY CAPACITOR CO., DIV. OF P. R. MALLORY AND CO., INC.	3029 E. WASHINGTON STREET P. O. BOX 372	INDIANAPOLIS, IN 46206
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601
96733	SAN FERNANDO ELECTRIC MFG CO	1501 FIRST ST SAN FERNANDO CA 91341	

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CIRCUIT BOARD ASSEMBLIES		
A1	670-3866-00	B010100	B082958	CKT BOARD ASSY:MAIN	80009	670-3866-00
A1	670-3866-01	B082959		CKT BOARD ASSY:MAIN	80009	670-3866-01
A1	670-4388-00	B010100	B082958	CKT BOARD ASSY:MAIN	80009	670-4388-00
A1	----- -----			(OPTION 5 ONLY)		
A1	670-4388-01	B082959		CKT BOARD ASSY:MAIN	80009	670-4388-01
A1	----- -----			(OPTION 5 ONLY)		
A2	670-3895-00	B010100	B029999	CKT BOARD ASSY:VERT AMPL/SLOW RAMP	80009	670-3895-00
A2	670-3895-01	B030000	B082958	CKT BOARD ASSY:VERT AMPL/SLOW RAMP	80009	670-3895-01
A2	670-3895-02	B082959	B094630	CKT BOARD ASSY:VERT AMPL/SLOW RAMP	80009	670-3895-02
A2	670-3895-03	B094631		CKT BOARD ASSY:VERTICAL AMPL/SLOW RAMP	80009	670-3895-03
A3	670-3130-00	B010100	B069999	CKT BOARD ASSY:OUTPUT AMPLIFIER	80009	670-3130-00
A3	670-3130-02	B070000	B082958	CKT BOARD ASSY:OUTPUT AMPLIFIER	80009	670-3130-02
A3	670-3130-03	B082959		CKT BOARD ASSY:OUTPUT AMPLIFIER	80009	670-3130-03
A4	670-3010-00	B010100	B069999	CKT BOARD ASSY:SWEEP GEN	80009	670-3010-00
A4	670-3010-01	B070000	B082958	CKT BOARD ASSY:SWEEP GEN	80009	670-3010-01
A4	670-3010-02	B082959		CKT BOARD ASSY:SWEEP GEN	80009	670-3010-02
A5	670-3513-00	B010100	B019999	CKT BOARD ASSY:CHART RECORDER LOGIC	80009	670-3513-00
A5	670-3513-01	B020000	B082958	CKT BOARD ASSY:CHART RECORDER LOGIC	80009	670-3513-01
A5	670-3513-02	B082959		CKT BOARD ASSY:CHART RECORDER LOGIC	80009	670-3513-02
A6	670-3520-00	B010100	B020245	CKT BOARD ASSY:POWER	80009	670-3520-00
A6	670-3520-01	B020246	B082958	CKT BOARD ASSY:POWER	80009	670-3520-01
A6	670-3520-02	B082959		CKT BOARD ASSY:POWER	80009	670-3520-02
A7	670-3865-00	B010100	B082958	CKT BOARD ASSY:X-Y PLUG IN	80009	670-3865-00
A7	----- -----			(016-0606-00 ONLY)		
A7	670-3865-01	B082959		CKT BOARD ASSY:X-Y PLUG IN	80009	670-3865-01
A7	----- -----			(016-0606-00 ONLY)		
A8	670-5634-00			CKT BOARD ASSY:CABLE VP FACTOR	80009	670-5634-00
A8	----- -----			(OPTION 1 ONLY)		
A1	----- -----			CKT BOARD ASSY:MAIN		
C1143	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
C1153	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C1227	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	19396	DU490B103J
C1227	----- -----			(OPTION 5 ONLY)		
C1238	285-0650-00			CAP.,FXD,PLSTC:0.027UF,5%,100V	56289	192P27352
C1238	285-0719-00			CAP.,FXD,PLSTC:0.015UF,5%,100V	84411	663UW-15351
C1238	----- -----			(OPTION 5 ONLY)		
C1243	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	56289	1C10Z5U223M050B
C1249	281-0623-00	B040710		CAP.,FXD,CER DI:650PF,5%,500V	04222	7001-1362
C1257	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1321	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131M058Z5U0474M
C1324	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1331	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1422	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1434	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1447	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131M058Z5U0474M
C1456	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C1459	283-0104-00			CAP.,FXD,CER DI:2000PF,5%,500V	59660	811-565B202J
C1503	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	59660	831-518-Z5D0181J
C1505	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1508	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1525	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
C1531	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
C1534	283-0625-00			CAP.,FXD,MICA D:220PF,1%,500V	00853	D105F221F0
C1536	290-0559-00			CAP.,FXD,ELCTLT:22UF,20%,35V	90201	TDC226M035WLG
C1538	283-0694-00			CAP.,FXD,MICA D:2240PF,0.5%,300V	00853	D195F2241E0
C1548	283-0193-00			CAP.,FXD,CER DI:510PF,2%,100V	51642	200-100-NP0-511G
C1554	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1556	283-0115-00			CAP.,FXD,CER DI:47PF,5%,200V	59660	805-519-C0G0470J
C1558	283-0047-00			CAP.,FXD,CER DI:270PF,5%,500V	59821	2DDH73L271J
C1563	283-0060-00			CAP.,FXD,CER DI:100PF,5%,200V	59660	855-535U2J101J
C1565	283-0154-00			CAP.,FXD,CER DI:22PF,5%,50V	72982	8111B061C0G220J
C1574	283-0047-00			CAP.,FXD,CER DI:270PF,5%,500V	59821	2DDH73L271J
C1577	283-0047-00			CAP.,FXD,CER DI:270PF,5%,500V	59821	2DDH73L271J
C1578	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C1585	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1586	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1593	285-0598-00			CAP.,FXD,PLSTC:0.01UF,5%,100V	19396	DU490B103J
C1595	283-0023-00			CAP.,FXD,CER DI:0.1UF,+80-20%,12V	71590	2DDU66B104Z
C1596	283-0115-00			CAP.,FXD,CER DI:47PF,5%,200V	59660	805-519-C0G0470J
C1601	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C1605	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1607	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1647	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C1648	290-0559-00			CAP.,FXD,ELCTLT:22UF,20%,35V	90201	TDC226M035WLG
C1654	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1673	283-0115-00			CAP.,FXD,CER DI:47PF,5%,200V	59660	805-519-C0G0470J
C1677	283-0115-00			CAP.,FXD,CER DI:47PF,5%,200V	59660	805-519-C0G0470J
C1686	283-0032-00			CAP.,FXD,CER DI:470PF,5%,500V	59660	0831085Z5E00471J
C1687	283-0107-00			CAP.,FXD,CER DI:51PF,5%,200V	96733	R3017
C1697	283-0175-00			CAP.,FXD,CER DI:10PF,5%,200V	96733	TDR43BY100DP
C1698	283-0103-00			CAP.,FXD,CER DI:180PF,5%,500V	59660	831-518-Z5D0181J
C1701	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1706	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C1715	285-0537-00			CAP.,FXD,PPR DI:0.5UF,20%,400V	14752	650BIB1E504
C1741	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131M058Z5U0474M
C1742	283-0209-00			CAP.,FXD,CER DI:1UF,20%,50V	51642	UC35050Z5U105MPS
C1743	290-0517-00			CAP.,FXD,ELCTLT:6.8UF,20%,35V	56289	196D685X0035KA1
C1762	283-0193-00			CAP.,FXD,CER DI:510PF,2%,100V	51642	200-100-NP0-511G
C1765	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	59660	805534Y5DO152J
C1775	283-0159-00			CAP.,FXD,CER DI:18PF,5%,50V	51642	T150-050NP0180J
C1783	283-0107-00			CAP.,FXD,CER DI:51PF,5%,200V	96733	R3017
C1793	283-0076-00			CAP.,FXD,CER DI:27PF,10%,500V	59660	831-500S2L27OK
CR1358	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1432	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1433	150-1000-00			LT EMITTING DIO:RED,650NM,40MA MAX	34430	MV-50
CR1463	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1556	152-0457-00			SEMICOND DEVICE:SILICON,25V	28480	5082-2068
CR1557	152-0322-00	B083169		SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR1558	152-0169-00			SEMICOND DEVICE:TUNNEL,1MA,10PF	03508	STD962
CR1561	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1563	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1564	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1572	152-0322-00	B083169		SEMICOND DEVICE:SILICON,15V,HOT CARRIER	50434	5082-2672
CR1581	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1582	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1639	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR1647	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
CR1648	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1654	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1659	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1673	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1688	152-0457-00			SEMICOND DEVICE:SILICON,25V	28480	5082-2068
CR1689	152-0457-00			SEMICOND DEVICE:SILICON,25V	28480	5082-2068
CR1696	152-0457-00			SEMICOND DEVICE:SILICON,25V	28480	5082-2068
CR1735	152-0107-00			SEMICOND DEVICE:SILICON,400V,400MA	12969	G727
CR1752	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1755	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR1792	152-0457-00			SEMICOND DEVICE:SILICON,25V	28480	5082-2068
L1155	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L1162	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L1433	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L1441	108-0215-00			COIL,RF:1.1UH	80009	108-0215-00
L1449	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L1541	108-0833-00			COIL,RF:10.2UH	80009	108-0833-00
L1546	108-0832-00			COIL,RF:FIXED,88UH POT CORE	80009	108-0832-00
L1555	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L1753	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L1774	276-0647-00			CORE,EM:TOROID,FERRITE	78488	57-0126
Q1142	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1235	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q1236	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1246	151-1078-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	17856	J2133
Q1247	151-0216-00			TRANSISTOR:SILICON,PNP	04713	SPS8803
Q1332	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q1435	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1436	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q1551	151-0441-00			TRANSISTOR:SILICON,NPN	04713	SRF501
Q1556	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q1558	151-0131-00	B010100	B083168	TRANSISTOR:GERMANIUM,PNP	04713	2N964
Q1558	151-0188-00	B083169		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1559	151-0441-00			TRANSISTOR:SILICON,NPN	04713	SRF501
Q1565	151-0333-00			TRANSISTOR:SILICON,NPN,SEL FROM MPS918	04713	SPS1752
Q1571	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q1573	151-0441-00			TRANSISTOR:SILICON,NPN	04713	SRF501
Q1575	151-0441-00	B010100	B049999	TRANSISTOR:SILICON,NPN	04713	SRF501
Q1575	151-0302-00	B050000		TRANSISTOR:SILICON,NPN	07263	S038487
Q1578	151-0131-00	B010100	B083168	TRANSISTOR:GERMANIUM,PNP	04713	2N964
Q1578	151-0188-00	B083169		TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q1588	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1593	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1594	151-1078-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	17856	J2133
Q1637	151-0450-00			TRANSISTOR:SILICON,PNP,SEL FROM 2N5583	80009	151-0450-00
Q1657	151-1078-00			TRANSISTOR:SILICON,JFE,N-CHANNEL	17856	J2133
Q1658	151-0441-00	B010100	B049999	TRANSISTOR:SILICON,NPN	04713	SRF501
Q1658	151-0302-00	B050000		TRANSISTOR:SILICON,NPN	07263	S038487
Q1678	151-0221-00			TRANSISTOR:SILICON,PNP	04713	SPS246
Q1772	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q1775	151-0441-00			TRANSISTOR:SILICON,NPN	04713	SRF501
R1115	321-0976-04			RES.,FXD,FILM:602 OHM,0.1%,0.125W	91637	HFF188D60202B
R1117	321-0973-04			RES.,FXD,FILM:60.2K OHM,0.1%,0.125W	91637	MFF1816D60201B
R1118	321-0604-00			RES.,FXD,FILM:30K OHM,0.25%,0.125W	91637	MFF1816D30001C
R1127	321-0170-00			RES.,FXD,FILM:576 OHM,1%,0.125W	91637	MFF1816G576R0F

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R1132	311-1337-00			RES..VAR,NONWIR:25K OHM,10%,0.50W	73138	89-129-1
R1137	321-0262-03			RES..FXD,FILM:5.23K OHM,0.25%,0.125W	91637	MFF1816G52300F
R1135	315-0473-00			RES..FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1147	315-0103-00			RES..FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1148	315-0223-00			RES..FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1158	321-0155-00			RES..FXD,FILM:402 OHM,1%,0.125W	91637	MFF1816G402R0F
R1158	----- -----			(NOT USED IN OPTION 1)		
R1216	311-1268-00			RES..VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R1218	315-0223-00			RES..FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1227	321-0603-00			RES.,FXD,FILM:15K OHM,0.25%,0.125W	91637	MFF1816D15001C
R1228	321-0268-03			RES.,FXD,FILM:6.04K OHM,0.25%,0.125W	91637	MFF1816D60400C
R1228	321-0277-03			RES..FXD,FILM:7.5K OHM,0.25%,0.125W	24546	NC55C7501C
R1228	----- -----			(OPTION 5 ONLY)		
R1229	321-0239-03			RES..FXD,FILM:3.01K OHM,0.25%,0.125W	91637	MFF1816D30100C
R1249	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
R1256	315-0471-00			RES..FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1257	315-0103-00			RES..FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1258	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1313	315-0333-00			RES..FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1314	315-0223-00			RES..FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1317	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R1317	----- -----			(OPTION 5 ONLY)		
R1317	315-0563-00			RES..FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R1319	315-0473-00			RES..FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1328	315-0101-00			RES..FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1336	315-0101-00			RES..FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1337	321-0227-00			RES.,FXD,FILM:2.26K OHM,1%,0.125W	91637	MFF1816G22600F
R1338	321-0235-00			RES..FXD,FILM:2.74K OHM,1%,0.125W	91637	MFF1816G27400F
R1353	321-0243-00			RES..FXD,FILM:3.32K OHM,1%,0.125W	91637	MFF1816G33200F
R1353	----- -----			(NOT USED IN OPTION 1)		
R1354	315-0223-00			RES..FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1355	321-0221-00			RES.,FXD,FILM:1.96K OHM,1%,0.125W	91637	MFF1816G19600F
R1355	----- -----			(NOT USED IN OPTION 1)		
R1356	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R1356	----- -----			(NOT USED IN OPTION 1)		
R1357	321-0272-00			RES..FXD,FILM:6.65K OHM,1%,0.125W	91637	MFF1816G66500F
R1357	----- -----			(NOT USED IN OPTION 1)		
R1406	311-1275-00			RES.,VAR,NONWIR:1M OHM,10%,0.50W	32997	3329P-L58-105
R1414	311-1270-00			RES.,VAR,NONWIR:12K OHM,10%,0.5W	32997	3329P-L58-253
R1421	315-0362-00			RES..FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R1424	315-0821-00			RES..FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R1431	315-0512-00			RES..FXD,CMPSN:5.1K OHM,5%,0.25W	01121	CB5125
R1436	315-0200-00			RES.,FXD,CMPSN:20 OHM,5%,0.25W	01121	CB2005
R1457	315-0471-00			RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R1462	315-0222-00			RES..FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R1477	315-0103-00			RES..FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1486	315-0103-00			RES..FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1496	315-0101-00			RES..FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1502	315-0105-00			RES..FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R1506	315-0103-00			RES..FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1507	315-0101-00			RES..FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1508	315-0332-00			RES..FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1509	315-0101-00			RES..FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1532	315-0152-00			RES..FXD,CMPSN:1.5K OHM,5%,0.25W	01121	CB1525
R1533	315-0102-00			RES..FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

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R1544	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1543	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1545	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1547	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R1552	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1557	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1562	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1563	315-0304-00			RES.,FXD,CMPSN:300K OHM,5%,0.25W	01121	CB3045
R1576	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1577	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1582	315-0331-00	B010100	B010128	RES.,FXD,CMPSN:330 OHM,5%,0.25W	01121	CB3315
R1582	315-0221-00	B010129		RES.,FXD,CMPSN:220 OHM,5%,0.25W	01121	CB2215
R1584	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1587	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1588	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1589	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1592	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R1597	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1599	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R1602	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1603	315-0822-00	B010100	094199	RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R1603	315-0562-00	B094200		RES.,FXD,CMPSN:5.6K OHM,5%,0.25W	01121	CB5625
R1603	----- -----			(TEST SELECTABLE NOMINAL VALUE)		
R1604	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1606	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1608	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1633	321-0085-00			RES.,FXD,FILM:75 OHM,1%,0.125W	91637	MFF1816G75R00F
R1634	321-0094-00			RES.,FXD,FILM:93.1 OHM,1%,0.125W	91637	MFF1816G93R10F
R1635	321-0107-00			RES.,FXD,FILM:127 OHM,1%,0.125W	91637	MFF1816G127R0F
R1641	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R1643	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1646	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1651	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
R1661	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1663	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1655	321-0169-00			RES.,FXD,FILM:562 OHM,1%,0.125W	91637	MFF1816G562R0F
R1664	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R1672	315-0392-00			RES.,FXD,CMPSN:3.9K OHM,5%,0.25W	01121	CB3925
R1673	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1674	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1669	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
R1676	311-1273-00			RES.,VAR,NONWIR:200K OHM,10%,0.5W	32997	3329P-L58-204
R1677	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1683	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1687	317-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R1688	317-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R1692	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
R1693	311-1267-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
R1694	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R1701	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R1724	321-0089-00			RES.,FXD,FILM:82.5 OHM,1%,0.125W	91637	MFF1816G82R50F
R1725	321-0149-00			RES.,FXD,FILM:348 OHM,1%,0.125W	91637	MFF1816G348R0F
R1731	321-0122-00			RES.,FXD,FILM:182 OHM,1%,0.125W	91637	MFF1816G182R0F
R1733	322-0097-00			RES.,FXD,FILM:100 OHM,1%,0.25W	75042	CEBT0-1000F
R1734	321-0076-00			RES.,FXD,FILM:60.4 OHM,1%,0.125W	91637	MFF1816G60R40F

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R1743	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1751	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R1752	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1754	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R1755	315-0271-00			RES.,FXD,CMPSN:270 OHM,5%,0.25W	01121	CB2715
R1761	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1762	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R1765	315-0513-00	B010100	B040709	RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R1765	315-0223-00	B040710		RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1773	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R1774	315-0511-00			RES.,FXD,CMPSN:510 OHM,5%,0.25W	01121	CB5115
R1781	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1782	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R1783	315-0566-00			RES.,FXD,CMPSN:56M OHM,5%,0.25W	01121	CB5665
R1784	317-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R1785	317-0270-00			RES.,FXD,CMPSN:27 OHM,5%,0.125W	01121	BB2705
R1791	321-0068-00			RES.,FXD,FILM:49.9 OHM,1%,0.125W	91637	MFF1816G49R90F
R1793	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R1796	311-1267-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	32997	3329P-L58-502
S1156	263-0011-08			SWITCH,PB ASSY:1 PUSH,10MM,2 CONTACTS	80009	263-0011-08
S1156	----- -----			(NOT USED IN OPTION 1)		
S1252	263-0011-07			SWITCH,PB ASSY:1 PUSH,10MM,1 CONTACT	80009	263-0011-07
S1252	----- -----			(NOT USED IN OPTION 1)		
S1624	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5MM,W/2 CONTACTS	80009	263-0010-00
S1625	263-0011-00			SWITCH,PB ASSY:1 PUSH,10 MM,W/4 CONTACTS	80009	263-0011-00
T1686	120-0544-00			XFMR,TOROID:	80009	120-0544-00
U1219	156-0158-00	B010100	B072079	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U1219	156-0158-04	B072080		MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	01295	N99320JG
U1503	156-0686-00			MICROCIRCUIT,LI:OPNL AMPL,HIGH IMPEDANCE	02735	CA3130S
U1663	156-0349-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U1667	156-0349-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	27014	CD4001CJ
U1695	156-0158-00	B010100	B072079	MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	18324	MC1458N
U1695	156-0158-04	B072080		MICROCIRCUIT,LI:DUAL OPERATIONAL AMPLIFIER	01295	N99320JG
U1795	156-0335-00	B010100	B082958	MICROCIRCUIT,LI:OP AMPL,FET INPUT	27014	LH0042CH
U1795	156-1149-01	B082959		MICROCIRCUIT,LI:OPER AMPL,JFET,BURN-IN	27014	GLEA134/A+
VR1649	152-0438-00			SEMICOND DEVICE:ZENER,3W,9.1V,5%	12969	UZ1364

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A2	----- -----			CKT BOARD ASSY:VERTICAL AMPL/SLOW RAMP		
C2137	283-0000-00			CAP.,FXD,CER DI:0.001UF, + 100-0%,500V	59660	831610Y5U0102P
C2138	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C2146	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C2147	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C2158	283-0340-00			CAP.,FXD,CER DI:45PF,5%,1000V	59660	0808505C0G0450J
C2229	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C2232	290-0530-00			CAP.,FXD,ELCTLT:68UF,20%,6V	90201	TDC686M006NLF
C2241	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C2325	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C2345	290-0512-00	B030000		CAP.,FXD,ELCTLT:22UF,20%,15V	56289	196D226X0015KA1
C2349	283-0115-00			CAP.,FXD,CER DI:47PF,5%,200V	59660	805-519-C0G0470J
C2351	283-0204-00	B010100	094630	CAP.,FXD,CER DI:0.01UF,20%,50V	96733	R2676
C2351	285-1256-00	B094631		CAP.,FXD,MTLZD:0.01UF,10%,100V		
C2352	285-1056-00			CAP.,FXD,PLSTC:1UF,2%,50V	14752	650B1A105G
C2356	283-0624-00			CAP.,FXD,MICA D:1300PF,2%,500V	00853	D195F132G0
CR2159	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2216	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2217	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2262	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2324	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2341	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2344	152-0141-02	B030000		SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR2358	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
Q2161	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q2162	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q2246	151-1054-00			TRANSISTOR:SILICON,JFE,N-CHANNEL,DUAL	17856	DN1114
Q2248	151-1022-00			TRANSISTOR:FET,N-CHAN,SI,F1782,T0-18	17856	FN1234
Q2249	151-1022-00			TRANSISTOR:FET,N-CHAN,SI,F1782,T0-18	17856	FN1234
Q2257	151-1022-00			TRANSISTOR:FET,N-CHAN,SI,F1782,T0-18	17856	FN1234
Q2258	151-1022-00			TRANSISTOR:FET,N-CHAN,SI,F1782,T0-18	17856	FN1234
Q2259	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q2341	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q2342	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
Q2345	151-0410-00			TRANSISTOR:SILICON,PNP	80009	151-0410-00
R2137	315-0623-00			RES.,FXD,CMPSN:62K OHM,5%,0.25W	01121	CB6235
R2138	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R2139	315-0153-00			RES.,FXD,CMPSN:15K OHM,5%,0.25W	01121	CB1535
R2142	315-0123-00			RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R2144	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R2146	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2149	316-0186-00			RES.,FXD,CMPSN:18M OHM,10%,0.25W	01121	CB1861
R2157	315-0473-00	B010100	B010128	RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R2157	315-0333-00	B010129		RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R2158	321-0422-00			RES.,FXD,FILM:243K OHM,1%,0.125W	91637	MFF1816G24302F
R2166	315-0185-00			RES.,FXD,CMPSN:1.8M OHM,5%,0.25W	01121	CB1855
R2220	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2221	321-0766-06			RES.,FXD,FILM:4.053K OHM,0.25%,0.125W	91637	MFF1816C40530C
R2222	321-0770-03			RES.,FXD,FILM:4.204K OHM,0.25%,0.125W	91637	MFF1816D42040C
R2223	321-0931-03			RES.,FXD,FILM:1.11K OHM,0.25%,0.125W	91637	MFF1816D11100C
R2224	321-0193-03			RES.,FXD,FILM:1K OHM,0.25%,0.125W	91637	MFF1816D10000C
R2225	315-0330-00			RES.,FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R2226	321-0749-06			RES.,FXD,FILM:450 OHM,0.25%,0.125W	91637	MFF1816C450R0C
R2227	321-0912-03			RES.,FXD,FILM:408 OHM,0.25%,0.125W	24546	NC55C4080C
R2228	321-0781-06			RES.,FXD,FILM:400K OHM,0.25%,0.125W	91637	MFF1816C40002C

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R2229	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R2233	315-0393-00			RES.,FXD,CMPSN:39K OHM,5%,0.25W	01121	CB3935
R2235	315-0330-00			RES..FXD,CMPSN:33 OHM,5%,0.25W	01121	CB3305
R2236	315-0104-00			RES..FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2237	315-0104-00			RES..FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2242	315-0333-00			RES..FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R2247	315-0105-00			RES..FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2251	315-0155-00			RES..FXD,CMPSN:1.5M OHM,5%,0.25W	01121	CB1555
R2258	315-0223-00			RES..FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2266	315-0105-00			RES..FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2267	321-0318-00			RES..FXD,FILM:20K OHM,1%,0.125W	91637	MFF1816G20001F
R2311	315-0682-00	B010100	B029999	RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R2311	315-0682-00	B030000		RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
R2321	321-1399-06			RES..FXD,FILM:142K OHM,0.25%,0.125W	91637	MFF1816C14202C
R2322	321-0996-03			RES..FXD,FILM:99K OHM,0.25%,0.125W	24546	NC55C9902C
R2323	321-0679-00			RES..FXD,FILM:34K OHM,0.5%,0.125W	91637	MFF1816D34001D
R2324	315-0224-00			RES..FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R2325	321-0622-00			RES..FXD,FILM:37.96K OHM,0.25%,0.125W	91637	MFF1816D37961C
R2326	321-1283-03			RES..FXD,FILM:8.76K OHM,0.25%,0.125W	91637	MFF1816D87600C
R2337	315-0104-00			RES..FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R2345	315-0103-00	B030000		RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R2346	315-0105-00			RES..FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2347	315-0105-00			RES..FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2348	315-0105-00			RES..FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R2353	325-0199-00			RES..FXD,FILM:24M OHM,2%,0.25W	03888	PVC60-G24004G
R2354	315-0272-00			RES..FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R2355	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R2361	321-0321-00			RES..FXD,FILM:21.5K OHM,1%,0.125W	91637	MFF1816G21501F
R2363	321-0321-00			RES..FXD,FILM:21.5K OHM,1%,0.125W	91637	MFF1816G21501F
S2254	260-1445-02			SWITCH,PUSH:DPDT,W/8 POLE SPRING	80009	260-1445-02
U2131	156-0067-00	B010100	B072079	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U2131	156-0067-12	B072080		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
U2136	156-0067-00	B010100	B072079	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U2136	156-0067-12	B072080		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
U2143	156-0067-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U2332	156-0350-00	B010100	B082958	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0350-00
U2332	156-0350-02	B082959		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,SEL	80009	156-0350-02
VR2212	152-0149-00	B010100	B029999	SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3
VR2212	152-0149-00	B030000		SEMICOND DEVICE:ZENER,0.4W,10V,5%	04713	SZG35009K3
VR2212	----- -----			(SELECTED)		

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A3	----- -----			CKT BOARD ASSY:OUTPUT AMPLIFIER		
C3132	283-0067-00			CAP.,FXD,CER DI:0.001UF,10%,200V	59660	835-515-Z5D0102K
C3219	283-0116-00			CAP.,FXD,CER DI:820PF,5%,500V	59660	801547B821J
C3226	283-0116-00			CAP.,FXD,CER DI:820PF,5%,500V	59660	801547B821J
C3233	283-0114-00			CAP.,FXD,CER DI:0.0015UF,5%,200V	59660	805534Y5DO152J
C3241	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
C3246	290-0534-00			CAP.,FXD,ELCTLT:1UF,20%,35V	56289	196D105X0035HA1
Q3113	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q3114	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q3118	151-0279-00			TRANSISTOR:SILICON,NPN	01295	SGC2622
Q3137	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q3139	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q3221	151-0279-00			TRANSISTOR:SILICON,NPN	01295	SGC2622
Q3232	151-0279-00			TRANSISTOR:SILICON,NPN	01295	SGC2622
Q3235	151-0341-00			TRANSISTOR:SILICON,NPN	07263	S040065
Q3236	151-0279-00			TRANSISTOR:SILICON,NPN	01295	SGC2622
R3112	321-0280-00	B010100	B069999	RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
R3112	321-0251-00	B070000		RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R3114	321-0251-00	B010100	B069999	RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R3114	321-0222-00	B070000		RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R3115	321-0251-00	B010100	B069999	RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R3115	321-0222-00	B070000		RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R3116	321-0306-00	B010100	B069999	RES.,FXD,FILM:15K OHM,1%,0.125W	91637	MFF1816G15001F
R3116	321-0277-00	B070000		RES.,FXD,FILM:7.5K OHM,1%,0.125W	91637	MFF1816G75000F
R3121	315-0474-00	B010100	B069999	RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R3121	321-0420-00	B070000		RES.,FXD,FILM:232K OHM,1%,0.125W	91637	MFF1816G23202F
R3122	315-0474-00	B010100	B069999	RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R3122	321-0420-00	B070000		RES.,FXD,FILM:232K OHM,1%,0.125W	91637	MFF1816G23202F
R3124	315-0203-00			RES.,FXD,CMPSN:20K OHM,5%,0.25W	01121	CB2035
R3126	315-0123-00	B010100	B069999	RES.,FXD,CMPSN:12K OHM,5%,0.25W	01121	CB1235
R3126	321-0267-00	B070000		RES.,FXD,FILM:5.9K OHM,1%,0.125W	91637	MFF1816G59000F
R3131	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R3133	315-0754-00	B010100	B069999	RES.,FXD,CMPSN:750K OHM,5%,0.25W	01121	CB7545
R3133	321-0440-00	B070000		RES.,FXD,FILM:374K OHM,1%,0.125W	91637	MFF1816G37402F
R3134	315-0754-00	B010100	B069999	RES.,FXD,CMPSN:750K OHM,5%,0.25W	01121	CB7545
R3134	321-0440-00	B070000		RES.,FXD,FILM:374K OHM,1%,0.125W	91637	MFF1816G37402F
R3135	321-0308-00	B010100	B069999	RES.,FXD,FILM:15.8K OHM,1%,0.125W	91637	MFF1816G15801F
R3135	321-0279-00	B070000		RES.,FXD,FILM:7.87K OHM,1%,0.125W	91637	MFF1816G78700F
R3136	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3138	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3139	321-0251-00	B010100	B069999	RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R3139	321-0222-00	B070000		RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R3142	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3143	311-1556-00			RES.,VAR,NONWIR:50K OHM,20%,0.50W	73138	91-78-0
R3146	321-0251-00	B010100	B069999	RES.,FXD,FILM:4.02K OHM,1%,0.125W	91637	MFF1816G40200F
R3146	321-0222-00	B070000		RES.,FXD,FILM:2K OHM,1%,0.125W	91637	MFF1816G20000F
R3148	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R3149	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R3212	321-0325-00	B010100	B069999	RES.,FXD,FILM:23.7K OHM,1%,0.125W	91637	MFF1816G23701F
R3212	321-0297-00	B070000		RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R3213	311-1556-00	B010100	B069999	RES.,VAR,NONWIR:50K OHM,20%,0.50W	73138	91-78-0
R3213	311-1557-00	B070000		RES.,VAR,NONWIR:25K OHM,20%,0.50W	73138	91-79-0
R3216	321-0325-00	B010100	B069999	RES.,FXD,FILM:23.7K OHM,1%,0.125W	91637	MFF1816G23701F
R3216	321-0297-00	B070000		RES.,FXD,FILM:12.1K OHM,1%,0.125W	91637	MFF1816G12101F
R3217	311-1557-00	B010100	B069999	RES.,VAR,NONWIR:25K OHM,20%,0.50W	73138	91-79-0

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R3217	311-1559-00	B070000		RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91-81-0
R3219	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3225	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R3226	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R3229	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R3233	315-0363-00	B010100	B069999	RES.,FXD,CMPSN:36K OHM,5%,0.25W	01121	CB3635
R3233	321-0313-00	B070000		RES.,FXD,FILM:17.8K OHM,1%,0.125W	91637	MFF1816G17801F
R3234	315-0183-00	B010100	B069999	RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R3234	321-0284-00	B070000		RES.,FXD,FILM:8.87K OHM,1%,0.125W	91637	MFF1816G88700F
R3237	311-1554-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	91-76-0
R3238	315-0183-00	B010100	B069999	RES.,FXD,CMPSN:18K OHM,5%,0.25W	01121	CB1835
R3238	321-0284-00	B070000		RES.,FXD,FILM:8.87K OHM,1%,0.125W	91637	MFF1816G88700F
R3242	311-1554-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	91-76-0
R3248	311-1554-00			RES.,VAR,NONWIR:200K OHM,20%,0.50W	73138	91-76-0
R3249	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
U3123	156-0350-00	B010100	B082958	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0350-00
U3123	156-0350-02	B082959		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,SEL	80009	156-0350-02
U3223	156-0289-00			MICROCIRCUIT,DI:QUAD BILATERAL SWITCH	07263	74LS95(PC OR DC)

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A4	----- -----			CKT BOARD ASSY:HIGH VOLTAGE POWER		
C4118	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	59660	871-533E103P
C4119	285-1093-00			CAP.,FXD,PLSTC:0.027UF,0.1%,200V	19396	51-17243
C4128	283-0068-00			CAP.,FXD,CER DI:0.01UF,+100-0%,500V	59660	871-533E103P
C4134	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4135	283-0000-00			CAP.,FXD,CER DI:0.001UF,+100-0%,500V	59660	831610Y5U0102P
C4312	285-1093-00			CAP.,FXD,PLSTC:0.027UF,0.1%,200V	19396	51-17243
C4321	285-1093-00			CAP.,FXD,PLSTC:0.027UF,0.1%,200V	19396	51-17243
C4328	285-0644-00			CAP.,FXD,PLSTC:0.033UF,20%,600V	56289	430P333X06
CR4151	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4156	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR4211	152-0429-00			SEMICOND DEVICE:SILICON,5000V,10MA	14099	SA3282
CR4311	152-0429-00			SEMICOND DEVICE:SILICON,5000V,10MA	14099	SA3282
CR4313	152-0429-00			SEMICOND DEVICE:SILICON,5000V,10MA	14099	SA3282
CR4323	152-0429-00			SEMICOND DEVICE:SILICON,5000V,10MA	14099	SA3282
Q4145	151-0273-00	B010100	B020245	TRANSISTOR:SILICON,NPN	80009	151-0273-00
Q4145	151-0347-00	B020246	B069999	TRANSISTOR:SILICON,NPN	56289	2N5551
Q4145	151-0136-03	B070000		TRANSISTOR:SILICON,NPN,SEL	80009	151-0136-03
Q4149	151-0273-00	B010100	B020245	TRANSISTOR:SILICON,NPN	80009	151-0273-00
Q4149	151-0347-00	B020246	B069999	TRANSISTOR:SILICON,NPN	56289	2N5551
Q4149	151-0136-03	B070000		TRANSISTOR:SILICON,NPN,SEL	80009	151-0136-03
R4114	315-0106-00	B010100	B020231	RES.,FXD,CMPSN:10M OHM,5%,0.25W	01121	CB1065
R4114	315-0125-00	B020232	B069999	RES.,FXD,CMPSN:1.2M OHM,5%,0.25W	01121	CB1255
R4114	315-0625-00	B070000		RES.,FXD,CMPSN:6.2M OHM,5%,0.25W	01121	CB6255
R4122	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4123	315-0470-00			RES.,FXD,CMPSN:47 OHM,5%,0.25W	01121	CB4705
R4126	315-0225-00	B010100	B020231	RES.,FXD,CMPSN:2.2M OHM,5%,0.25W	01121	CB2255
R4126	315-0155-00	B020232	B069999	RES.,FXD,CMPSN:1.5M OHM,5%,0.25W	01121	CB1555
R4126	315-0474-00	B070000		RES.,FXD,CMPSN:470K OHM,5%,0.25W	01121	CB4745
R4129	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R4141	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4145	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R4146	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R4148	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R4221	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R4222	311-1257-00			RES.,VAR,NONWIR:5M OHM,20%,0.50W	32997	3386F-T04-505
R4245	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R4442	315-0475-00			RES.,FXD,CMPSN:4.7M OHM,5%,0.25W	01121	CB4755
R4442	----- -----			(OPTION 1 ONLY)		
T4241	120-0975-00	B010100	B069999	XFMR,PWR,SDN/SU:HIGH VOLTAGE POT CORE	80009	120-0975-00
T4241	120-0975-01	B070000		TRANSFORMER,RF:HIGH VOLTAGE POT CORE	80009	120-0975-01
VR4117	152-0247-00			SEMICOND DEVICE:ZENER,0.4W,150V,5%	04713	SZG275K1RL

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A5	----- -----			CKT BOARD ASSY:CHART RECORDER LOGIC		
C5116	283-0198-00			CAP.,FXD,CER DI:0.22UF,20%,50V	56289	1C10Z5U223M050B
C5117	283-0054-00			CAP.,FXD,CER DI:150PF,5%,200V	59660	855-535U2J0 151J
C5131	290-0524-00	B010100	B019999	CAP.,FXD,ELCTLT:4.7UF,20%,10V	90201	TDC475M010EL
C5159	283-0203-00			CAP.,FXD,CER DI:0.47UF,20%,50V	72982	8131M058Z5U0474M
C5167	283-0004-00			CAP.,FXD,CER DI:0.02UF,+80-20%,150V	59821	SDDH69J203Z
C5219	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C5249	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C5253	283-0154-00			CAP.,FXD,CER DI:22PF,5%,50V	72982	8111B061C0G220J
C5263	283-0110-00			CAP.,FXD,CER DI:0.005UF,+80-20%,150V	59660	855-547-E-502Z
C5266	283-0010-00			CAP.,FXD,CER DI:0.05UF,+100-20%,50V	56289	1C10Z5U503Z050B
C5276	283-0346-00			CAP.,FXD,CER DI:0.47UF,+80-20%,100V	72982	8131-M100F474Z
CR5162	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR5243	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR5244	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR5245	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR5254	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
Q5112	151-1078-00	B010100	B019999	TRANSISTOR:SILICON,JFE,N-CHANNEL	17856	J2133
Q5112	151-1022-00	B020000		TRANSISTOR:FET,N-CHAN,SI,F1782,T0-18	17856	FN1234
Q5114	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q5144	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q5173	151-0126-00			TRANSISTOR:SILICON,NPN	04713	ST1046
Q5179	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q5226	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q5229	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q5237	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q5239	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q5266	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q5273	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q5277	151-0260-00			TRANSISTOR:SILICON,NPN	80009	151-0260-00
Q5279	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
R5112	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5116	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5118	316-0186-00			RES.,FXD,CMPSN:18M OHM,10%,0.25W	01121	CB1861
R5119	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5121	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5122	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5126	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5128	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5130	321-0644-00			RES.,FXD,FILM:100K OHM,0.25%,0.125W	91637	MFF1816C10002C
R5131	315-0335-00			RES.,FXD,CMPSN:3.3M OHM,5%,0.25W	01121	CB3355
R5132	321-0756-03			RES.,FXD,FILM:50K OHM,0.25%,0.125W	91637	MFF1816D50001C
R5134	321-0644-00			RES.,FXD,FILM:100K OHM,0.25%,0.125W	91637	MFF1816C10002C
R5135	321-0756-03			RES.,FXD,FILM:50K OHM,0.25%,0.125W	91637	MFF1816D50001C
R5136	321-0756-03			RES.,FXD,FILM:50K OHM,0.25%,0.125W	91637	MFF1816D50001C
R5137	321-0756-03			RES.,FXD,FILM:50K OHM,0.25%,0.125W	91637	MFF1816D50001C
R5138	321-0644-00			RES.,FXD,FILM:100K OHM,0.25%,0.125W	91637	MFF1816C10002C
R5139	321-0644-00			RES.,FXD,FILM:100K OHM,0.25%,0.125W	91637	MFF1816C10002C
R5141	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5148	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5155	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5158	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5161	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5163	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5166	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045

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R5167	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5168	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5171	315-0333-00			RES.,FXD,CMPSN:33K OHM,5%,0.25W	01121	CB3335
R5177	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5178	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R5211	321-0318-02			RES.,FXD,FILM:20K OHM,0.5%,0.125W	91637	CMF55116D20001D
R5216	321-0306-01			RES.,FXD,FILM:15K OHM,0.5%,0.125W	91637	MFF1816G15001D
R5221	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5222	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5223	321-0345-00			RES.,FXD,FILM:38.3K OHM,1%,0.125W	91637	MFF1816G38301F
R5225	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5229	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5231	321-0756-03			RES.,FXD,FILM:50K OHM,0.25%,0.125W	91637	MFF1816D50001C
R5232	321-0644-00			RES.,FXD,FILM:100K OHM,0.25%,0.125W	91637	MFF1816C10002C
R5233	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5234	321-0644-00			RES.,FXD,FILM:100K OHM,0.25%,0.125W	91637	MFF1816C10002C
R5235	321-0644-00			RES.,FXD,FILM:100K OHM,0.25%,0.125W	91637	MFF1816C10002C
R5236	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5237	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5246	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5247	315-0566-00			RES.,FXD,CMPSN:56M OHM,5%,0.25W	01121	CB5665
R5248	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5255	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5259	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5263	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
R5266	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R5267	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5268	315-0472-00			RES.,FXD,CMPSN:4.7K OHM,5%,0.25W	01121	CB4725
R5269	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R5275	315-0561-00			RES.,FXD,CMPSN:560 OHM,5%,0.25W	01121	CB5615
U5117	156-0686-00			MICROCIRCUIT,LI:OPNL AMPL,HIGH IMPEDANCE	02735	CA3130S
U5127	156-0525-03	B010100	B082958	MICROCIRCUIT,DI:DUAL J-K MASTER SLAVE FF	80009	156-0525-03
U5127	156-0525-03	B082959		MICROCIRCUIT,DI:DUAL J-K MASTER SLAVE FF	80009	156-0525-03
U5147	156-0523-01			MICROCIRCUIT,DI:7-STAGE BINARYCOUNTER,SCRN	04713	MC14024BCLD
U5156	156-0350-00	B010100	B082958	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0350-00
U5156	156-0350-02	B082959		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,SEL	80009	156-0350-02
U5166	156-0350-00	B010100	B082958	MICROCIRCUIT,DI:QUAD 2-INPUT NAND GATE	80009	156-0350-00
U5166	156-0350-02	B082959		MICROCIRCUIT,DI:QUAD 2 INPUT NAND GATE,SEL	80009	156-0350-02
U5227	156-0067-00	B010100	B072079	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U5227	156-0067-12	B072080		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
U5252	156-0524-02			MICROCIRCUIT,DI:TRIPLE 3-INPUT NAND GATES	80009	156-0524-02

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A6	----- -----			CKT BOARD ASSY:POWER		
C6147	283-0177-00			CAP.,FXD,CER DI:1UF, +80-20%,25V	56289	2C20Z5U105Z025B
C6219	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
C6224	283-0177-00			CAP.,FXD,CER DI:1UF, +80-20%,25V	56289	2C20Z5U105Z025B
C6226	283-0177-00			CAP.,FXD,CER DI:1UF, +80-20%,25V	56289	2C20Z5U105Z025B
C6228	290-0114-00			CAP.,FXD,ELCTLT:47UF,20%,6V	56289	150D476X0006B2
C6233	290-0527-00			CAP.,FXD,ELCTLT:15UF,20%,20V	90201	TDC156M020FL
C6243	290-0559-00			CAP.,FXD,ELCTLT:22UF,20%,35V	90201	TDC226M035WLG
C6246	290-0137-00			CAP.,FXD,ELCTLT:100UF, +75-15%,30V	56289	109D107C7030T2
C6323	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C6326	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C6329	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C6336	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C6341	290-0137-00			CAP.,FXD,ELCTLT:100UF, +75-15%,30V	56289	109D107C7030T2
C6342	283-0142-00	B020232		CAP.,FXD,CER DI:0.0027UF,5%,200V	59660	875571YEE0272J
C6415	290-0701-00			CAP.,FXD,ELCTLT:470UF,40%,16VDC	90201	TTX471U0161E1A3P
C6416	290-0134-00			CAP.,FXD,ELCTLT:22UF,20%,15V	56289	150D226X0015B2
C6426	290-0701-00			CAP.,FXD,ELCTLT:470UF,40%,16VDC	90201	TTX471U0161E1A3P
C6429	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C6443	290-0701-00			CAP.,FXD,ELCTLT:470UF,40%,16VDC	90201	TTX471U0161E1A3P
C6444	283-0107-00			CAP.,FXD,CER DI:51PF,5%,200V	96733	R3017
C6447	283-0111-00			CAP.,FXD,CER DI:0.1UF,20%,50V	56289	273C11
C6451	283-0047-00			CAP.,FXD,CER DI:270PF,5%,500V	59821	2DDH73L271J
C6455	283-0115-00	B020246		CAP.,FXD,CER DI:47PF,5%,200V	59660	805-519-C0G0470J
C6515	283-0000-00			CAP.,FXD,CER DI:0.001UF, +100-0%,500V	59660	831610Y5U0102P
C6525	290-0425-00			CAP.,FXD,ELCTLT:100UF,20%,20V	90201	THF107M020P1G
C6527	290-0164-00			CAP.,FXD,ELCTLT:1UF, +50-10%,150V	56289	500D105F150BA7
C6529	290-0658-00			CAP.,FXD,ELCTLT:4UF, +50-10%,200V	56289	600D405F200KD4
C6551	283-0077-00			CAP.,FXD,CER DI:330PF,5%,500V	59660	831-500B331J
CR6139	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR6157	152-0488-00			SEMICOND DEVICE:SILICON,200V,1500MA	04713	SDA317
CR6234	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6247	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6346	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR6347	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6414	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR6438	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR6439	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR6441	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6442	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6446	152-0400-00	B010100	B020245	SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR6448	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6452	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6534	152-0400-00			SEMICOND DEVICE:SILICON,400V,1A	80009	152-0400-00
CR6536	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
CR6537	152-0586-00			SEMICOND DEVICE:SILICON,600V,500MA	14936	RGP10J-011
CR6546	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
CR6551	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
F6112	159-0128-00			FUSE,CARTRIDGE:2A,125V,5 SEC	75915	273002
F6113	159-0128-00			FUSE,CARTRIDGE:2A,125V,5 SEC	75915	273002
F6122	159-0128-00			FUSE,CARTRIDGE:2A,125V,5 SEC	75915	273002
F6123	159-0128-00			FUSE,CARTRIDGE:2A,125V,5 SEC	75915	273002
L6344	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L6423	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L6428	108-0598-00			COIL,RF:200UH	80009	108-0598-00

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L6532	108-0598-00			COIL,RF:200UH	80009	108-0598-00
L6538	108-0598-00			COIL,RF:200UH	80009	108-0598-00
Q6143	151-0508-00			TRANSISTOR:UJT,SI,2N6027,TO-98	03508	X13T520
Q6155	151-0506-00			SCR:SILICON	03508	C106B2X283
Q6227	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q6241	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q6244	151-0188-00			TRANSISTOR:SILICON,PNP	04713	SPS6868K
Q6331	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q6349	151-0390-00			TRANSISTOR:SILICON,NPN	04713	SPS3414
Q6357	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q6427	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q6435	151-0352-00			TRANSISTOR:SILICON,NPN	03508	X44C282
Q6445	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
Q6458	151-0424-00			TRANSISTOR:SILICON,NPN	04713	SPS8246
Q6547	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q6548	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q6549	151-0301-00			TRANSISTOR:SILICON,PNP	27014	2N2907A
Q6552	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
Q6557	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
R6131	308-0463-00			RES.,FXD,WW:0.3 OHM,1%,3W	91637	RS2B-KR3000F
R6132	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6133	315-0362-00			RES.,FXD,CMPSN:3.6K OHM,5%,0.25W	01121	CB3625
R6134	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R6135	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R6147	315-0272-00			RES.,FXD,CMPSN:2.7K OHM,5%,0.25W	01121	CB2725
R6148	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R6149	315-0361-00			RES.,FXD,CMPSN:360 OHM,5%,0.25W	01121	CB3615
R6214	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R6215	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R6222	315-0821-00	B010100	B029999	RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R6222	315-0181-00	B030000		RES.,FXD,CMPSN:180 OHM,5%,0.25W	01121	CB1815
R6223	315-0202-00	B010100	B029999	RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
R6223	315-0821-00	B030000	B030499	RES.,FXD,CMPSN:820 OHM,5%,0.25W	01121	CB8215
R6223	315-0431-00	B030500		RES.,FXD,CMPSN:430 OHM,5%,0.25W	01121	CB4315
R6225	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R6231	321-0289-00			RES.,FXD,FILM:10K OHM,1%,0.125W	91637	MFF1816G10001F
R6235	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
R6254	304-0391-00			RES.,FXD,CMPSN:390 OHM,10%,1W	01121	GB3911
R6346	315-0101-00	B010100	B020245	RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R6346	315-0471-00	B020246		RES.,FXD,CMPSN:470 OHM,5%,0.25W	01121	CB4715
R6356	315-0753-00	B010100	B020245	RES.,FXD,CMPSN:75K OHM,5%,0.25W	01121	CB7535
R6356	315-0563-00	B020246		RES.,FXD,CMPSN:56K OHM,5%,0.25W	01121	CB5635
R6358	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R6413	321-0352-00	B010100	B020231	RES.,FXD,FILM:45.3K OHM,1%,0.125W	91637	MFF1816G45301F
R6413	321-0332-00	B020232		RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R6424	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R6426	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R6444	307-0103-00			RES.,FXD,CMPSN:2.7 OHM,5%,0.25W	01121	CB27G5
R6445	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R6447	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0. 25W	01121	CB1015
R6449	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R6451	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R6453	315-0513-00			RES.,FXD,CMPSN:51K OHM,5%,0.25W	01121	CB5135
R6454	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R6455	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
R6456	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
R6457	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R6459	315-0204-00			RES.,FXD,CMPSN:200K OHM,5%,0.25W	01121	CB2045
R6513	321-0346-00	B010100	B020231	RES.,FXD,FILM:39.2K OHM,1%,0.125W	91637	MFF1816G39201F
R6513	321-0332-00	B020232		RES.,FXD,FILM:28K OHM,1%,0.125W	91637	MFF1816G28001F
R6514	311-1268-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	32997	3329P-L58-103
R6517	316-0156-00			RES.,FXD,CMPSN:15M OHM,10%,0.25W	01121	CB1561
R6518	321-0260-00			RES.,FXD,FILM:4.99K OHM,1%,0.125W	91637	MFF1816G49900F
R6538	315-0433-00			RES.,FXD,CMPSN:43K OHM,5%,0.25W	01121	CB4335
R6539	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R6544	315-0243-00			RES.,FXD,CMPSN:24K OHM,5%,0.25W	01121	CB2435
R6545	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R6548	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R6549	315-0154-00			RES.,FXD,CMPSN:150K OHM,5%,0.25W	01121	CB1545
R6553	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R6554	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R6557	315-0224-00			RES.,FXD,CMPSN:220K OHM,5%,0.25W	01121	CB2245
R6558	315-0103-00	B010100	B020245	RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R6558	315-0102-00	B020246		RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
T6535	120-0976-00			XFMR,FLYBACK:POT CORE	80009	120-0976-00
U6138	156-0067-00	B010100	B072079	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U6138	156-0067-12	B072080		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
U6222	156-0067-00	B010100	B072079	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U6222	156-0067-12	B072080		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
U6236	156-0067-00	B010100	B072079	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U6236	156-0067-12	B072080		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
U6515	156-0067-00	B010100	B072079	MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	MICROA741CP
U6515	156-0067-12	B072080		MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	01295	UA741CJG
VR6134	152-0243-00			SEMICOND DEVICE:ZENER,0.4W,15V,5%	14552	TD3810983
VR6235	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
VR6252	152-0278-00			SEMICOND DEVICE:ZENER,0.4W,3V,5%	04713	SZG35009K20
VR6253	152-0127-00			SEMICOND DEVICE:ZENER,0.4W,7.5V,5%	04713	SZG35009K2
VR6318	152-0265-00			SEMICOND DEVICE:ZENER,0.4W,24V,5%	04713	SZG35009K8
VR6417	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR6419	152-0175-00			SEMICOND DEVICE:ZENER,0.4W,5.6V,5%	04713	SZG35008
VR6427	152-0195-00			SEMICOND DEVICE:ZENER,0.4W,5.1V,5%	04713	SZ11755
VR6459	152-0306-00			SEMICOND DEVICE:ZENER,0.4W,9.1V,5%	15238	Z5409

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A7	----- -----			CKT BOARD ASSY:X-Y PLUG-IN		
A7	----- -----			(016-0606-00 ONLY)		
C7132	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	51642	400050Z5U105Z
C7232	283-0059-00			CAP.,FXD,CER DI:1UF,+80-20%,50V	51642	400050Z5U105Z
CR7247	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
Q7242	151-0302-00			TRANSISTOR:SILICON,NPN	07263	S038487
R7122	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
R7129	321-0288-00			RES.,FXD,FILM:9.76K OHM,1%,0.125W	91637	MFF1816G97600F
R7138	321-0335-00			RES.,FXD,FILM:30.1K OHM,1%,0.125W	91637	CMF55116G30101F
R7146	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
R7224	315-0223-00			RES.,FXD,CMPSN:22K OHM,5%,0.25W	01121	CB2235
R7225	311-1559-00			RES.,VAR,NONWIR:10K OHM,20%,0.50W	73138	91-81-0
R7234	315-0113-00			RES.,FXD,CMPSN:11K OHM,5%,0.25W	01121	CB1135
R7244	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R7245	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A8	----- -----			CKT BOARD ASSY,CABLE VP FACTOR		
A8	----- -----			(OPTION 1 ONLY)		
R1356	321-0193-03			RES.,FXD,FILM:1K OHM,0.25%,0.125W	91637	MFF1816D10000C
R1356	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R1356	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R1356	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R1356	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R1356	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R1356	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R1356	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R1356	321-0612-03			RES.,FXD,FILM:500 OHM,0.25%,0.125W	91637	MFF1816D500R0C
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
R1357	321-0097-07			RES.,FXD,FILM:100 OHM,0.1%,0.125W	24546	NE55E1000B
S1356	260-1918-00			SWITCH,ROTARY:DISTANCE CAL,8 POSITION	81073	51SP2201208N
S1357	260-1919-00			SWITCH,ROTARY:DISTANCE CAL,11 POS	81073	51SP3001111N

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
BT0369	016-0595-00			BATTERY SET:	80009	016-0595-00
C0380	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-521-S-Y5S-10
C0390	283-0279-00			CAP.,FXD,CER DI:0.001UF,20%,3000V	59660	878-521-S-Y5S-10
CR0282	150-1040-01			LAMP,LED:W/LEADS & DIODE HOLDER	80009	150-1040-01
F0401	159-0029-00	B010100	B049999	FUSE,CARTRIDGE:3AG,0.3A,250V,SLOW-BLOW	71400	MDL3/10
F0401	159-0032-00	B050000		FUSE,CARTRIDGE:3AG,0.5A,250V,SLOW-BLOW	71400	MDL 1/2
F0401	159-0054-00	B010100	B049999	FUSE,CARTRIDGE:3AG,0.15A,250V,SLOW-BLOW	71400	MDL 15/100
F0401	----- -----			(OPTION 6 ONLY)		
F0401	159-0029-01	B050000		FUSE,CARTRIDGE:BUSSMAN ONLY	71400	MDL3/10
F0401	----- -----			(OPTION 6 ONLY)		
F0491	159-0029-00	B010100	B049999	FUSE,CARTRIDGE:3AG,0.3A,250V,SLOW-BLOW	71400	MDL3/10
F0491	159-0032-00	B050000		FUSE,CARTRIDGE:3AG,0.5A,250V,SLOW-BLOW	71400	MDL 1/2
F0491	159-0054-00	B010100	B049999	FUSE,CARTRIDGE:3AG,0.15A,250V,SLOW-BLOW	71400	MDL 15/100
F0491	----- -----			(OPTION 6 ONLY)		
F0491	159-0029-01	B050000		FUSE,CARTRIDGE:BUSSMAN ONLY	71400	MDL3/10
F0491	----- -----			(OPTION 6 ONLY)		
L0234	108-0671-00			COIL,TUBE DEFL:TRACE ROTATOR	80009	108-0671-00
M0171	149-0031-00	B010100	B029999	METER,BTRY LVL:0-350UA,15%,0.50 DIA,SCALE	24138	P-202
M0171	149-0044-02	B030000		METER,BAT LEVEL:1MA,345 OHMS,0.5 DIA	0000M	MURATA MC-12M
R0151	311-1806-00	B010100	B079999	RES.,VAR,NONWIR:500 OHM,20%,1W	12697	381S-CM40942
R0151	----- -----			(FURNISHED AS A UNIT WITH S0151)		
R0151	311-2010-01	B080000		RES.,VAR,WW:PNL,500 OHM,5%,1W,W/SW	80009	311-2010-01
R0151	----- -----			(FURNISHED AS A UNIT WITH S0151)		
R0165	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
R0251	311-0678-00			RES.,VAR,NONWIR:2 X 50K OHM,10%,0.50W	71590	BA211-008
R0252	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R0262	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
R0263	311-0160-00			RES.,VAR,NONWIR:50K OHM,10%,0.50W	12697	381-CM30918
R0271	311-1707-00	B010100	B039999	RES.,VAR,WW:5K OHM,5%,1.5W	32997	3610S-420-502
R0271	----- -----			(OPTION 5 ONLY)		
R0271	311-1707-02	B040000		RES.,VAR,WW:PNL,5K OHM,5%,1.5W,W/KNOB	80009	311-1707-02
R0271	----- -----			(OPTION 5 ONLY)		
R0271	311-1800-00	B010100	B039999	RES.,VAR,WW:PNL,5K OHM,5%,1.5W	32997	3610S-514-502
R0271	311-1800-02	B040000		RES.,VAR,WW:PNL,5K OHM,5%,1.5W,W/KNOB	80009	311-1800-02
R0352	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
R0432	311-0690-01	B010100	B020329	RES.,VAR,NONWIR:5M OHM,0.50W	0000M	OBD
R0432	311-1905-00	B020330		RES.,VAR,NONWIR:PNL,5M OHM,20%,0.50W	12697	CM412712
R0442	311-0690-01	B010100	B020329	RES.,VAR,NONWIR:5M OHM,0.50W	0000M	OBD
R0442	----- -----			(NOT USED IN OPTION 1)		
R0442	311-1906-00	B020330		RES.,VAR,NONWIR:PNL,5M OHM,20%,0.25W	12697	CM41713
R0442	----- -----			(NOT USED IN OPTION 1)		
R0472	311-0091-00			RES.,VAR,NONWIR:1K OHM,10%,0.50W	01121	W-3083E
R0472	----- -----			(NOT USED IN OPTION 1)		
R2126	311-1005-00			RES.,VAR,NONWIR:15K OHM,10%,0.50W	12697	382-CM40952
S0151	311-1806-00	B010100	B079999	RES.,VAR,NONWIR:500 OHM,20%,1W	12697	381S-CM40942
S0151	----- -----			(FURNISHED AS A UNIT WITH R0151)		
S0151	311-2010-01	B080000		RES.,VAR,WW:PNL,500 OHM,5%,1W,W/SW	80009	311-2010-01
S0151	----- -----			(FURNISHED AS A UNIT WITH R0151)		
S0165	260-0834-00			SWITCH,TOGGLE:DPDT,5A,125VAC,0.25-40 THD	09353	U21-SHZQE
S0481	260-1727-00			SWITCH,TOGGLE:DPDT,0.4VA AND 20V MAX	09353	7215 SYZ(B)E
S1215	263-1118-00			SW CAM ACTR AS:FEET/DIV	80009	263-1118-00
S1343	263-0013-00			SWITCH,PB ASSY:3 LATCHING,100MM,W/DETENT	80009	263-0013-00
S1356	260-1918-00			SWITCH,ROTARY:DISTANCE CAL,8 POSITION	81073	51SP2201208N
S1356	----- -----			(OPTION 1 ONLY)		

Ckt No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
S1357	260-1919-00			SWITCH,ROTARY:DISTANCE CAL,11 POS	81073	51SP3001111N
S1357	----- -----			(OPTION 1 ONLY)		
S1624	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5MM,W/2 CONTACTS	80009	263-0010-00
S1625	263-0011-00			SWITCH,PB ASSY:1 PUSH,10 MM,W/4 CONTACTS	80009	263-0011-00
S2126	263-1125-00			SW CAM ACTR AS:FEET/DIV	80009	263-1125-00
T0389	120-0978-00			XFMR,PWR,STPDN:	80009	120-0978-00
V0235	154-0667-02			ELECTRON TUBE:CRT,P-31	80009	154-0667-02
V0235	154-0667-03	B020321		ELECTRON TUBE:CRT,P-7	80009	154-0667-03
V0235	----- -----			(OPTION 76 ONLY)		

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols

Graphic symbols and class designation letters are based on ANSI Standard Y32.2-1975.

Logic symbology is based on ANSI Y32.14-1973 in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The overline on a signal name indicates that the signal performs its intended function when it is in the low state.

Abbreviations are based on ANSI Y1.1-1972.

Other ANSI standards that are used in the preparation of diagrams by Tektronix, Inc. are:

Y14.15, 1966	Drafting Practices.
Y14.2, 1973	Line Conventions and Lettering.
Y10.5, 1968	Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.

American National Standard Institute
1430 Broadway
New York, New York 10018

Component Values

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

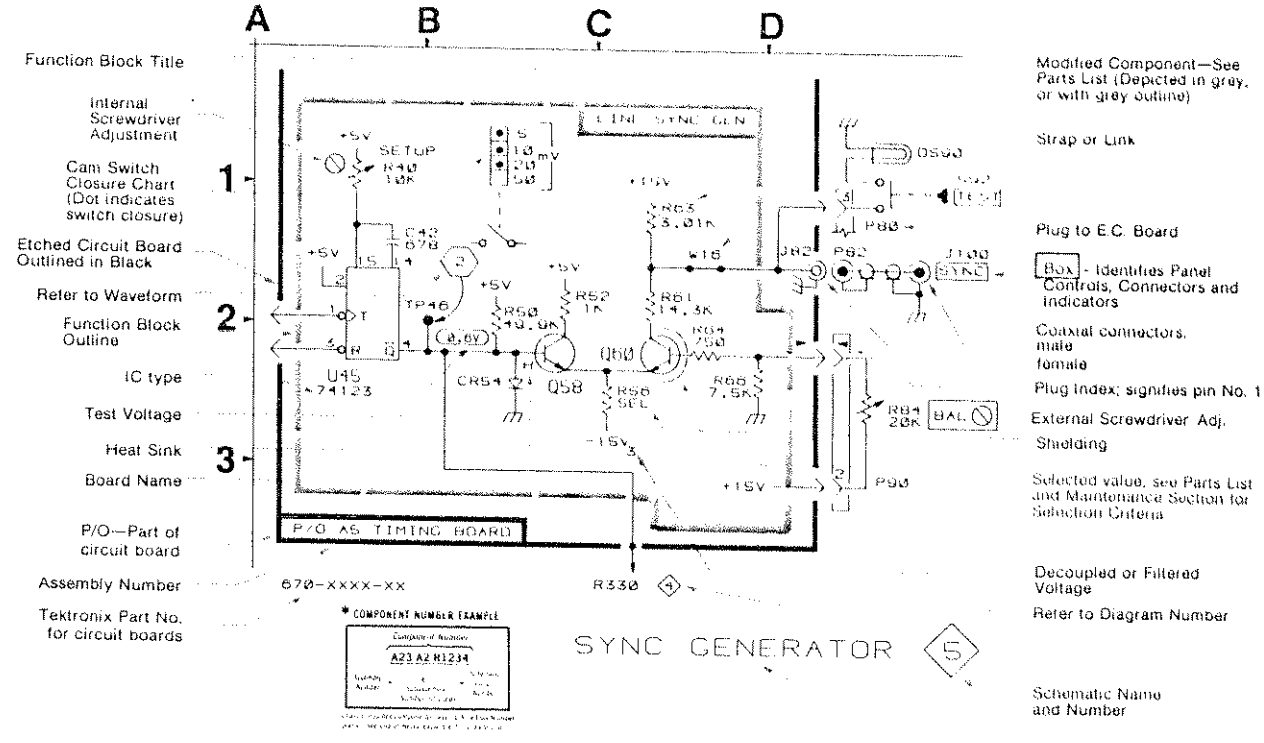
Capacitors = Values one or greater are in picofarads (pF). Values less than one are in microfarads (μF).
Resistors = Ohms (Ω).

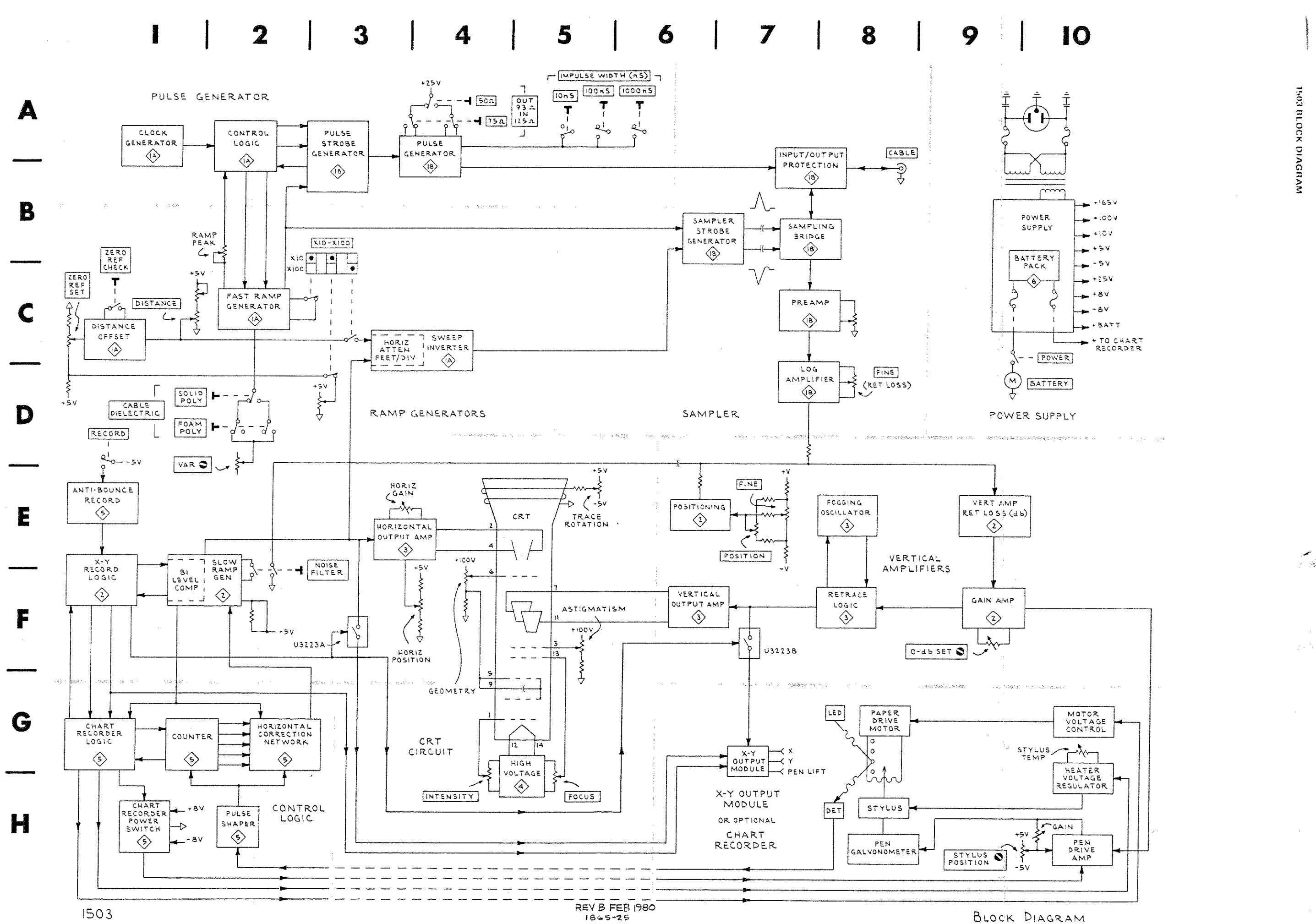
The information and special symbols below may appear in this manual.

Assembly Numbers and Grid Coordinates

Each assembly in the instrument is assigned an assembly number (e.g., A20). The assembly number appears on the circuit board outline on the diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram and corresponding component locator illustration. The Replaceable Electrical Parts list is arranged by assemblies in numerical sequence; the components are listed by component number *(see following illustration for constructing a component number).

The schematic diagram and circuit board component location illustration have grids. A lookup table with the grid coordinates is provided for ease of locating the component. Only the components illustrated on the facing diagram are listed in the lookup table. When more than one schematic diagram is used to illustrate the circuitry on a circuit board, the circuit board illustration may only appear opposite the first diagram on which it was illustrated; the lookup table will list the diagram number of other diagrams that the circuitry of the circuit board appears on.





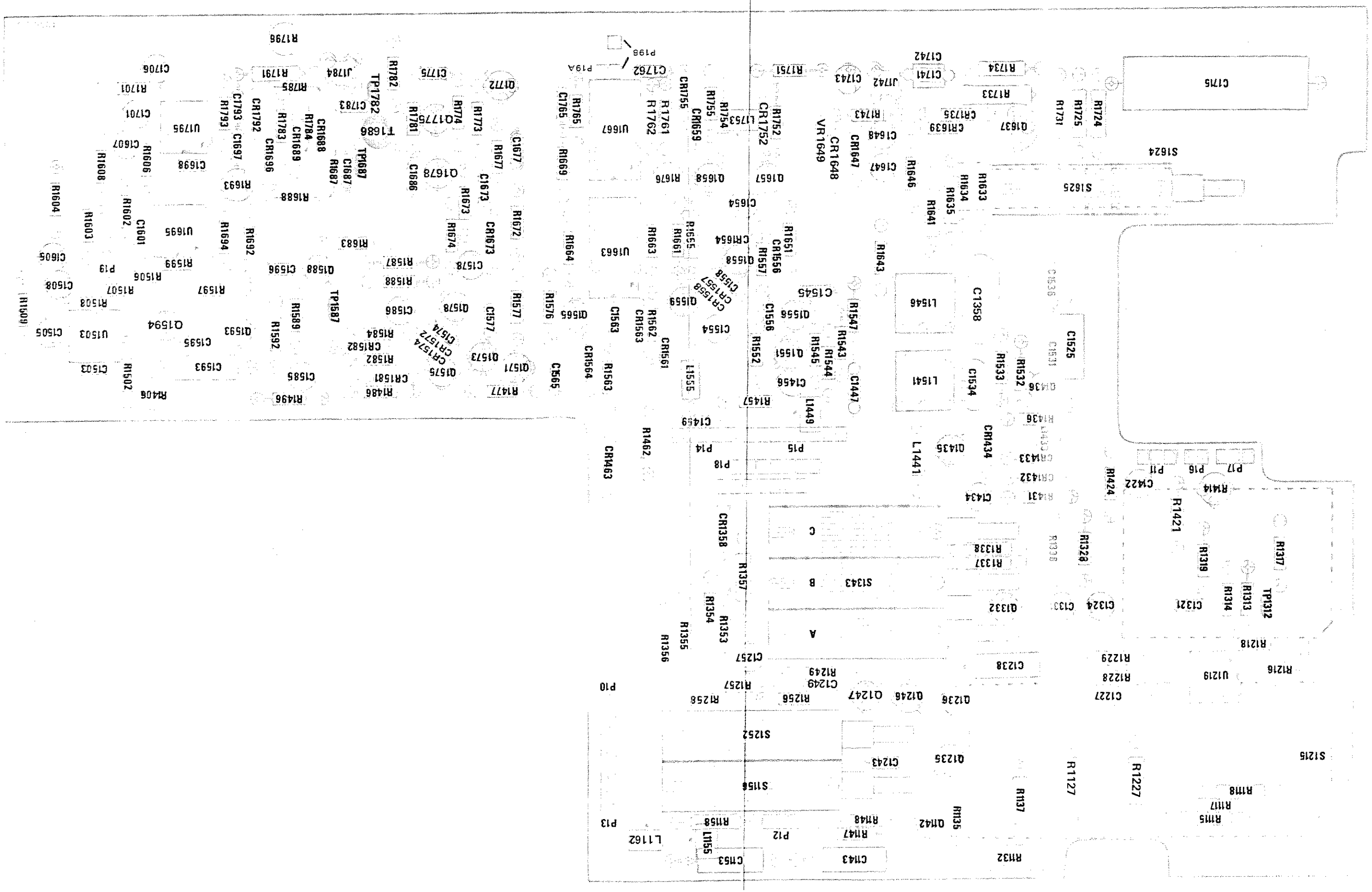
1503

REV B FEB 1980
1845-25

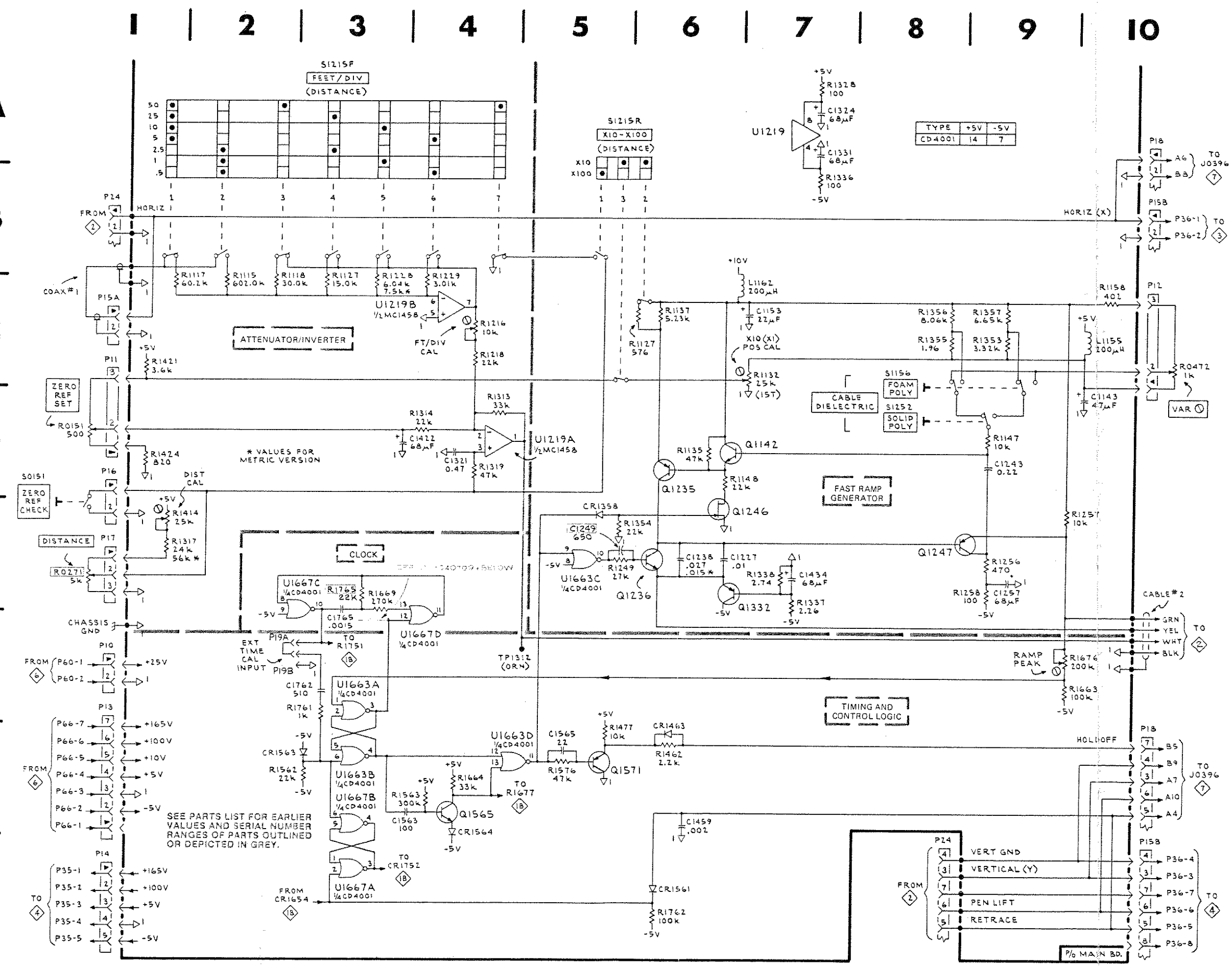
BLOCK DIAGRAM

Main Board

REV C JAN 1981



CKT NO	GRID LOC
C1143	D10
C1153	C7
C1227	E7
C1238	E6
C1243	D9
C1249	E5
C1257	E9
C1321	D4
C1324	A7
C1331	B7
C1422	D4
C1434	E7
C1459	G6
C1563	G4
C1565	G5
C1762	F3
C1765	E3
CR1358	E5
CR1463	G6
CR1561	H6
CR1563	G3
CR1564	G4
L1155	C10
L1162	B7
Q1142	D7
Q1235	D6
Q1236	E6
Q1246	E7
Q1247	E9
Q1332	E7
Q1565	G4
Q1571	G5
R0151	D1
R0271	E1
R0472	C10
R1115	B2
R1117	B2
R1118	B3
R1127	C6
R1132	C7
R1135	D7
R1137	C6
R1147	D9
R1148	D7
R1158	C10
R1216	C6
R1218	C4
R1227	B3
R1228	B3
R1229	B4
R1249	E6
R1256	E9
R1257	E10
R1258	E9
R1313	D4
R1314	D4
R1317	E2
R1319	D4
R1328	A7
R1336	B7
R1337	E7
R1338	E7
R1353	C9
R1354	E6
R1355	C8
R1356	C8
R1357	C9
R1414	E2
R1421	C1
R1424	D1
R1462	G6
R1477	G5
R1562	G3
R1563	G4
R1576	G5
R1663	F10
R1664	G4
R1669	E3
R1676	F10
R1761	F3
R1762	H6
R1765	E3
S0151	D1
S1156	C9
S1252	D9
S1215F	A3
S1215R	A6
TP1312	F5
U1219A	D5
U1219B	C4
U1663A	F3
U1663B	G3
U1663C	E5
U1663D	G5
U1667A	H3
U1667B	G3
U1667C	E3
U1667D	E4

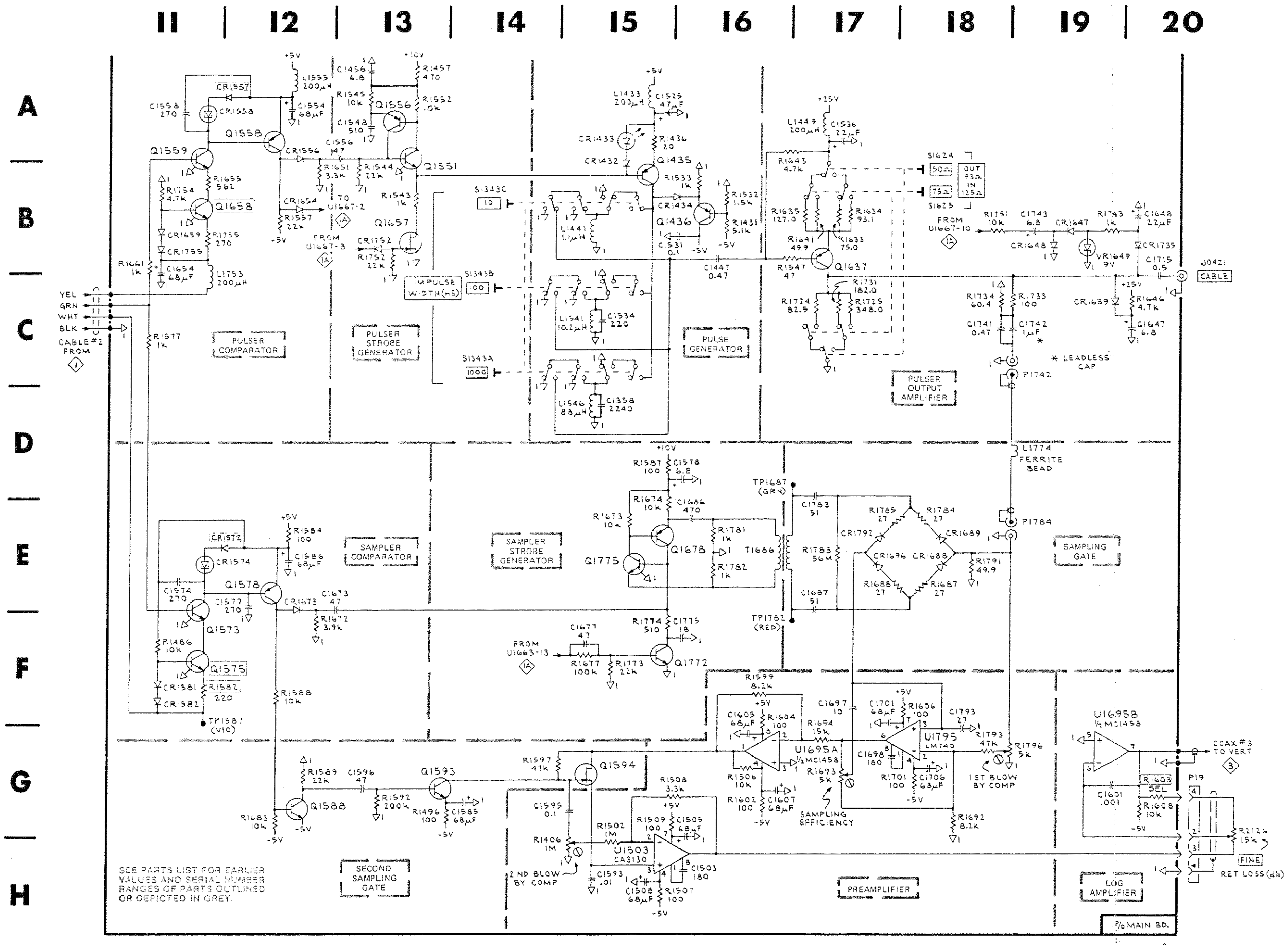


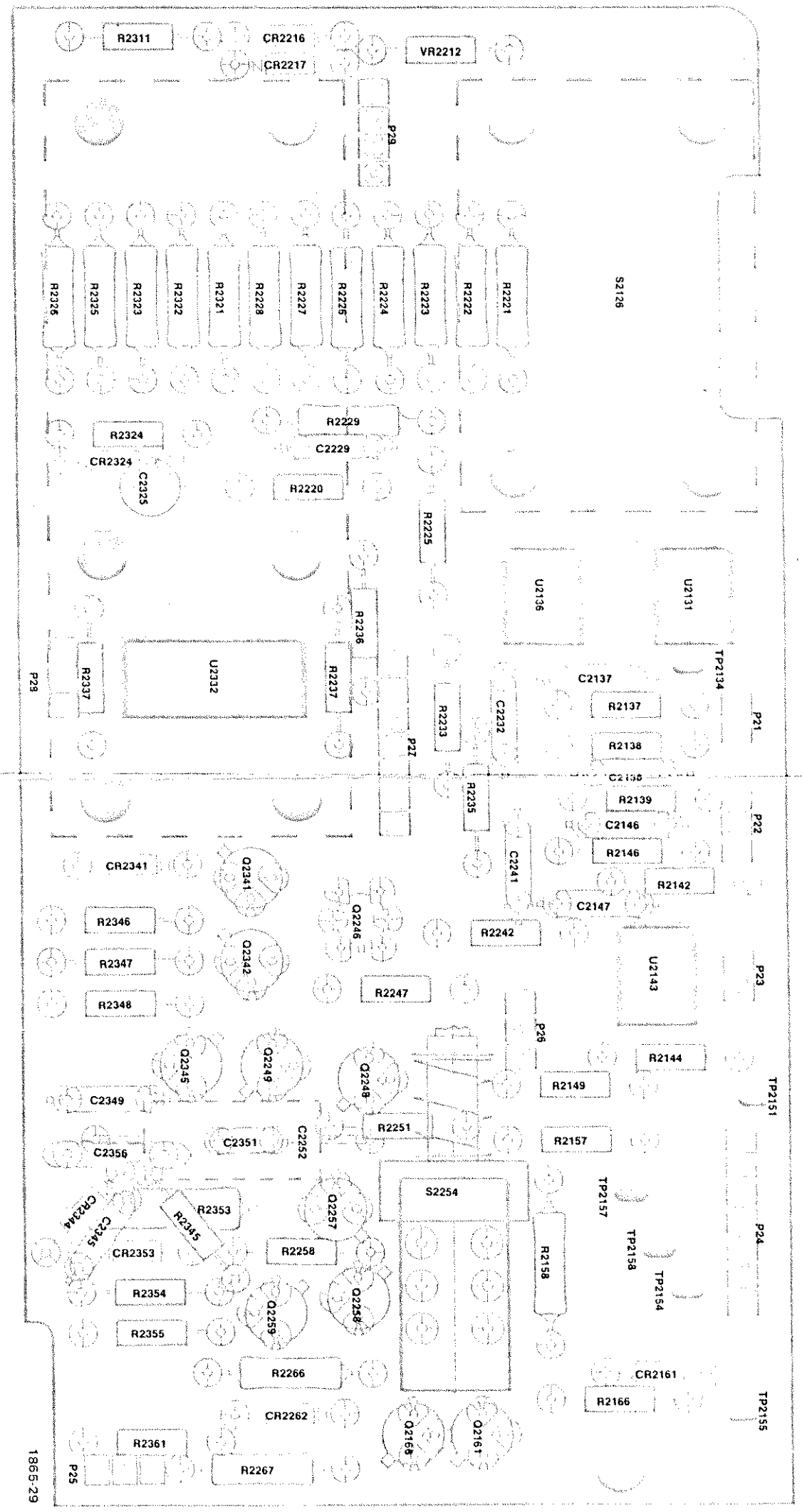
1503

1865-27
REV JUN 1983

TIME BASE GENERATOR ⑦ NLL

CKT NO	GRID LOC
C1358	D15
C1447	B16
C1456	A13
C1503	H16
C1505	G16
C1508	H15
C1525	A15
C1531	B15
C1534	C15
C1536	A17
C1548	A13
C1554	A12
C1556	A13
C1558	A11
C1574	E11
C1577	E12
C1578	D16
C1585	G14
C1586	E12
C1593	A15
C1595	G15
C1596	G13
C1601	G19
C1605	G16
C1607	G16
C1647	C20
C1648	B20
C1654	B11
C1673	E13
C1677	F15
C1686	E16
C1687	E17
C1697	F17
C1698	G17
C1701	F17
C1706	G18
C1715	B20
C1741	C18
C1742	C19
C1743	B19
C1775	F16
C1783	E17
C1793	G18
CR1432	B15
CR1433	A15
CR1434	B15
CR1556	A12
CR1557	A12
CR1558	A11
CR1572	E12
CR1574	E11
CR1581	F11
CR1582	F11
CR1639	C19
CR1647	B19
CR1648	B19
CR1654	B12
CR1659	B11
CR1673	E12
CR1688	E17
CR1689	E18
CR1696	E17
CR1735	B20
CR1752	B13
CR1755	B11
CR1792	E17
L1433	A15
L1441	B15
L1449	A17
L1541	C15
L1546	D15
L1555	A12
L1753	C11
L1774	D18
Q1435	B15
Q1436	B16
Q1551	B13
Q1556	A13
Q1558	A12
Q1559	A11
Q1573	F11
Q1575	F11
Q1578	E12
Q1588	G12
Q1593	G13
Q1594	G15
Q1637	B17
Q1657	B13
Q1658	B11
Q1678	E15
Q1772	F15
Q1775	E15
R1406	H15
R1431	B16
R1436	A15
R1457	A13
R1486	F11
R1496	G13
R1502	H15
R1506	G16
R1507	H15
R1508	G15
R1509	G15
R1532	B16
R1533	B16
R1543	B13
R1544	B13
R1545	A13
R1547	B17
R1552	A13
R1557	B12
R1577	C11
R1582	F11
R1584	E12
R1587	D15
R1588	F12
R1589	G12
R1592	G13
R1597	G14
R1599	F16
R1602	G16
R1603	G20
R1604	F16
R1606	F18
R1608	G20
R1633	B17
R1634	B17
R1635	B17
R1641	B17
R1643	A17
R1646	C20
R1651	B12
R1655	B11
R1661	B11
R1672	F12
R1673	E15
R1674	E15
R1677	F15
R1683	G12
R1687	E18
R1688	E17
R1692	G18
R1693	G17
R1694	G17
R1701	G18
R1724	C17
R1725	C17
R1731	C17
R1733	C19
R1734	C18
R1743	B19
R1751	B18
R1752	B13
R1754	B11
R1755	B11
R1773	F15
R1774	F15
R1781	E16
R1782	E16
R1783	E17
R1784	E18
R1785	E17
R1791	E18
R1793	G18
R1796	G18
R2126	H20
S1624	B/C17
S1625	B/C17
S1343A	C14/15
S1343B	C14/15
S1343C	B14/15
T1686	E16
TP1587	F11
TP1687	D17
TP1782	F17
U1503	H15
U1695A	G17
U1695B	G19
U1795	G18
VR1649	B19

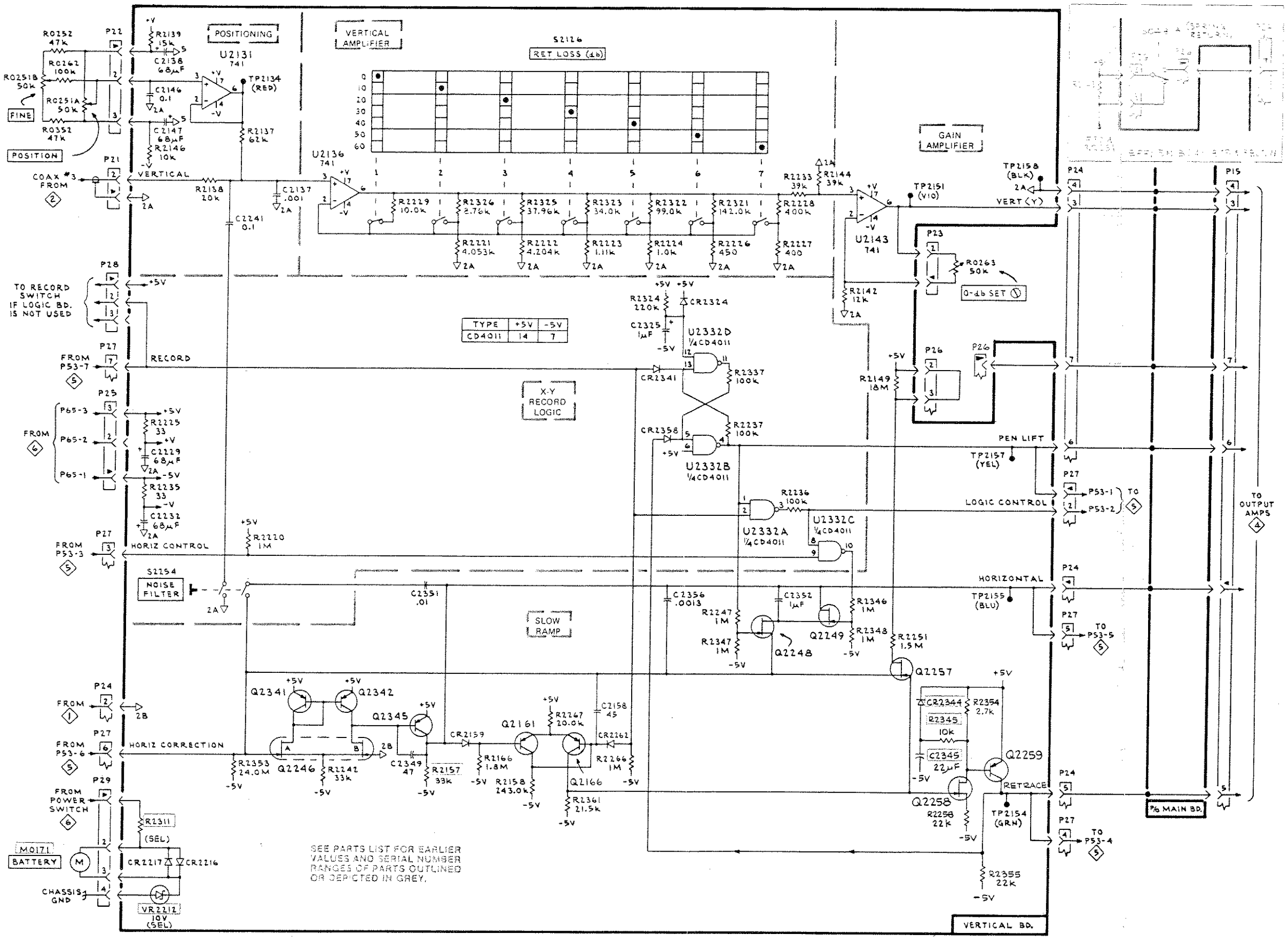

11
12
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14
15
16
17
18
19
20
A
B
C
D
E
F
G
H
Q1559
Q1558
Q1556
Q1551
Q1658
Q1657
Q1435
Q1436
Q1637
Q1573
Q1578
Q1575
Q1588
Q1593
Q1594
Q1772
Q1775
Q1678
CR1557
CR1558
CR1556
CR1654
CR1752
CR1433
CR1432
CR1434
CR1659
CR1755
CR1572
CR1574
CR1581
CR1582
CR1673
CR1792
CR1696
CR1688
CR1687
CR1689
L1555 200µH
L1433 200µH
L1449 200µH
L1753 200µH
L1541 10.2µH
L1546 88µH
L1774 FERRITE BEAD
T1686
P1742
P1784
P19
J0421
CABLE
YEL
GRN
WHT
BLK
CABLE #2 FROM
PULSER COMPARATOR
PULSER STROBE GENERATOR
PULSE GENERATOR
PULSER OUTPUT AMPLIFIER
SAMPLER COMPARATOR
SAMPLER STROBE GENERATOR
SECOND SAMPLING GATE
PREAMPLIFIER
SAMPLING GATE
LOG AMPLIFIER
IMPULSE WIDTH(ns)
S1343C
S1343B
S1343A
10
100
1000
S1624
S1625
50Ω
75Ω
OUT 93Ω IN 125Ω
FROM U1667-10
FROM U1667-3
FROM U1663-13
TO U1667-2
U1695A ½MC1458
U1695B ½MC1458
U1795 LM740
U1503 CA3130
TP1587 (V10)
TP1687 (GRN)
TP1782 (RED)
SAMPLING EFFICIENCY
1ST BLOW BY COMP
2ND BLOW BY COMP
COAX #3 TO VERT
R1603 SEL
FINE
RET LOSS (dB)
* LEADLESS CAP
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
P/O MAIN BD.



Vertical Amplifier/Slow Ramp Board

REV A FEB 1980

CKT NO	GRID LOC	CKT NO	GRID LOC
C2137	B3		
C2138	A2	R2354	G9
C2146	A2	R2355	H9
C2147	B2	R2361	G5
C2158	G5		
C2229	E2	S0481A	A10
C2232	E2	S2126	A5
C2241	C2	S2254	F2
C2325	C6		
C2349	G4	U2131	A2
C2351	F4	U2136	B3
C2352	F7	U2143	B8
C2356	F6	U2332	D6,E7
CR2159	G4	VR2212	H2
CR2216	H2		
CR2217	H2		
CR2262	G6		
CR2324	C6		
CR2341	D6		
CR2358	D6		
M0171	H1		
Q2161	G5		
Q2166	G5		
Q2246A	G6		
Q2246B	G6		
Q2248	F7		
Q2249	F7		
Q2257	F8		
Q2258	G8		
Q2259	G9		
Q2341	G3		
Q2342	B3		
Q2345	G4		
R0251A	A1		
R0251B	A1		
R0252	A1		
R0262	A1		
R0263	C9		
R0352	B1		
R2137	B2		
R2138	B2		
R2139	A2		
R2142	C8		
R2144	B7		
R2146	B2		
R2149	D8		
R2157	G4		
R2158	G5		
R2220	E3		
R2221	C4		
R2222	C3		
R2223	C5		
R2224	C6		
R2225	D2		
R2226	C7		
R2227	C7		
R2228	B7		
R2229	B4		
R2233	B7		
R2235	E2		
R2236	E7		
R2237	D7		
R2242	G3		
R2247	F7		
R2251	F8		
R2258	H9		
R2266	B6		
R2267	G5		
R2311	H2		
R2321	B7		
R2322	B6		
R2323	B5		
R2324	C6		
R2325	B5		
R2326	B4		
R2337	D7		
R2346	F8		
R2347	F7		
R2348	F8		
R2353	G2		



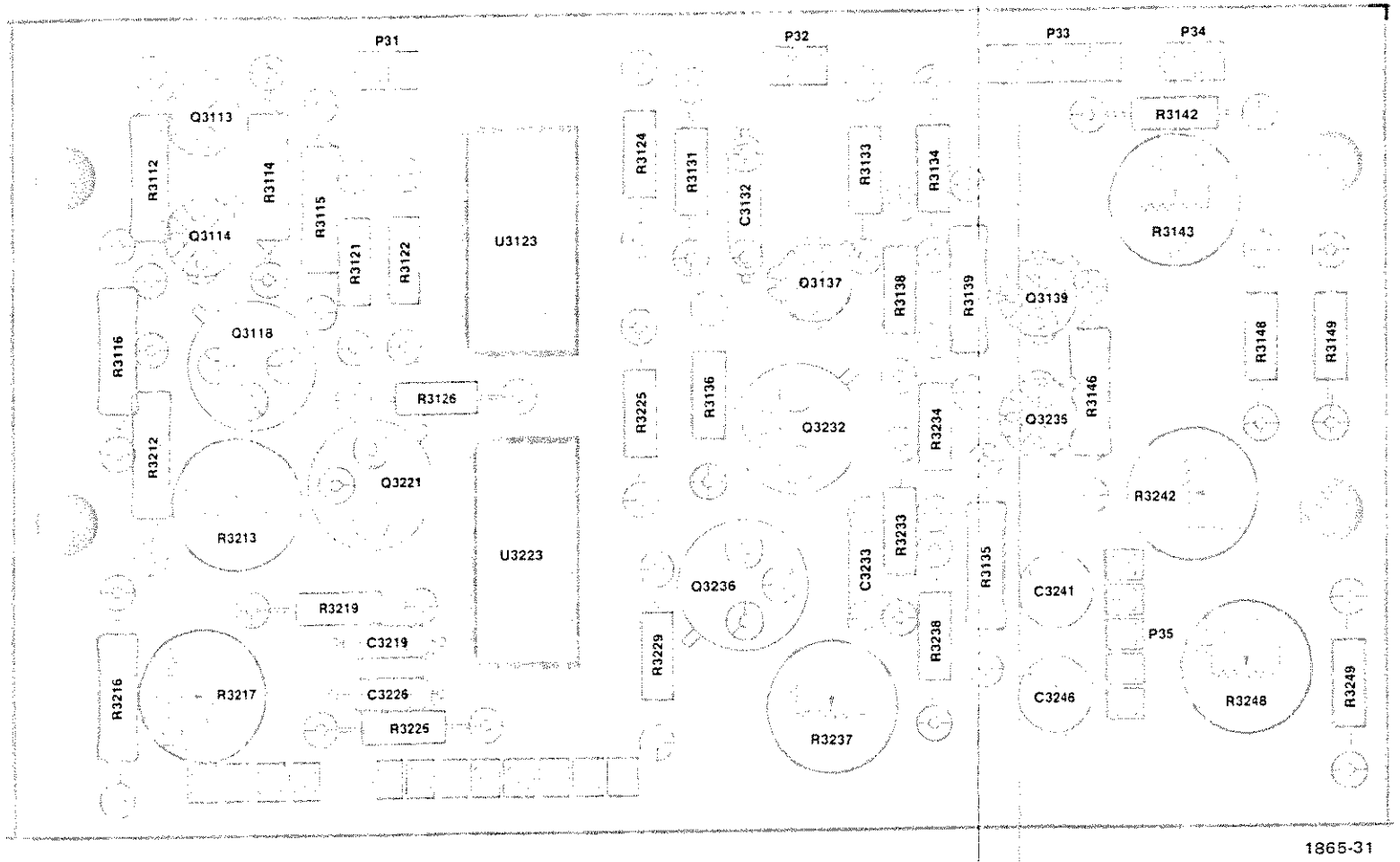
TYPE	+5V	-5V
CD4011	14	7

1503

(1792) 1865-30
REV JUN 1983

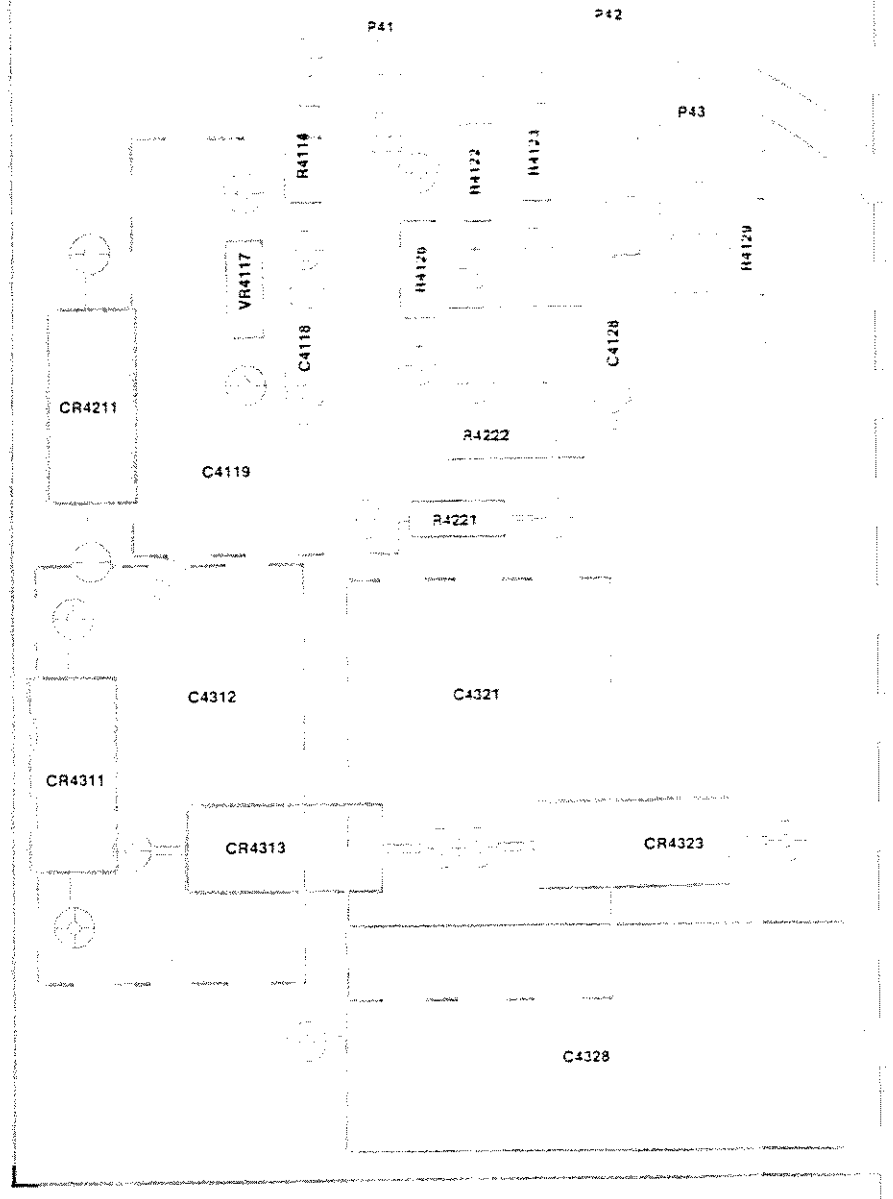
VERT AMP/SLOW RAMP CIRCUIT

Vertical Amp / Slow Ramp 3

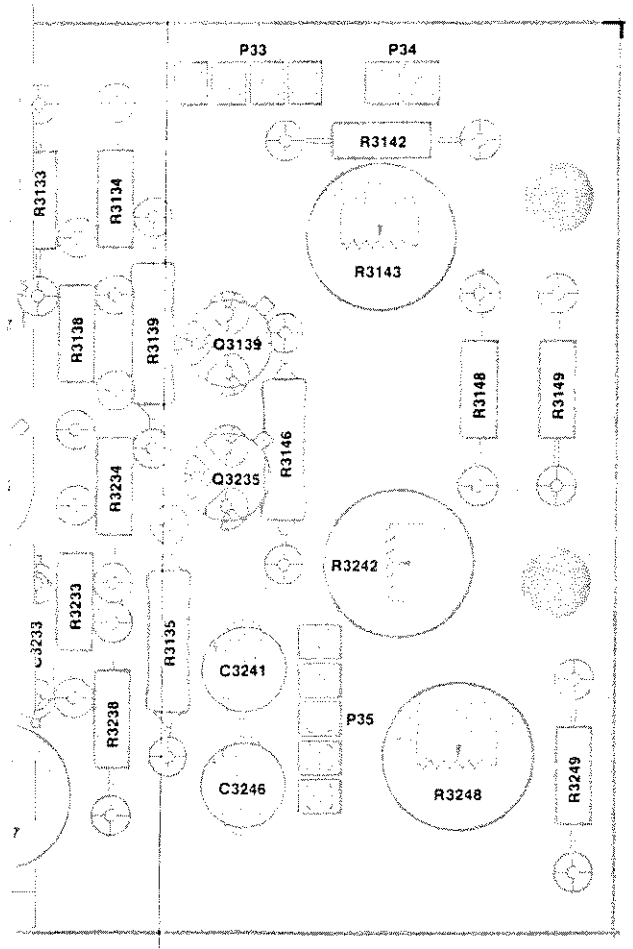


1865-31

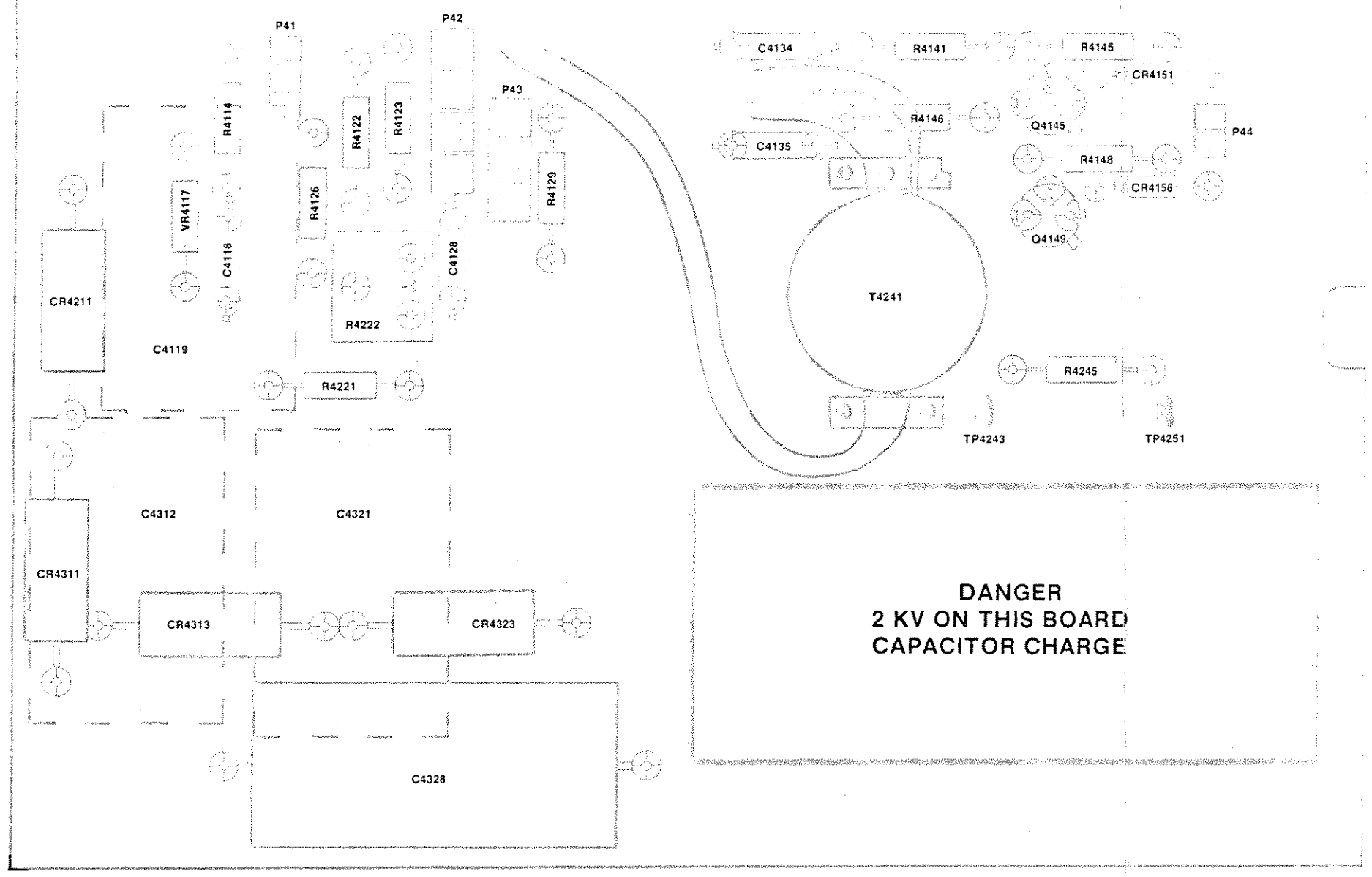
Output Amplifier Board



High



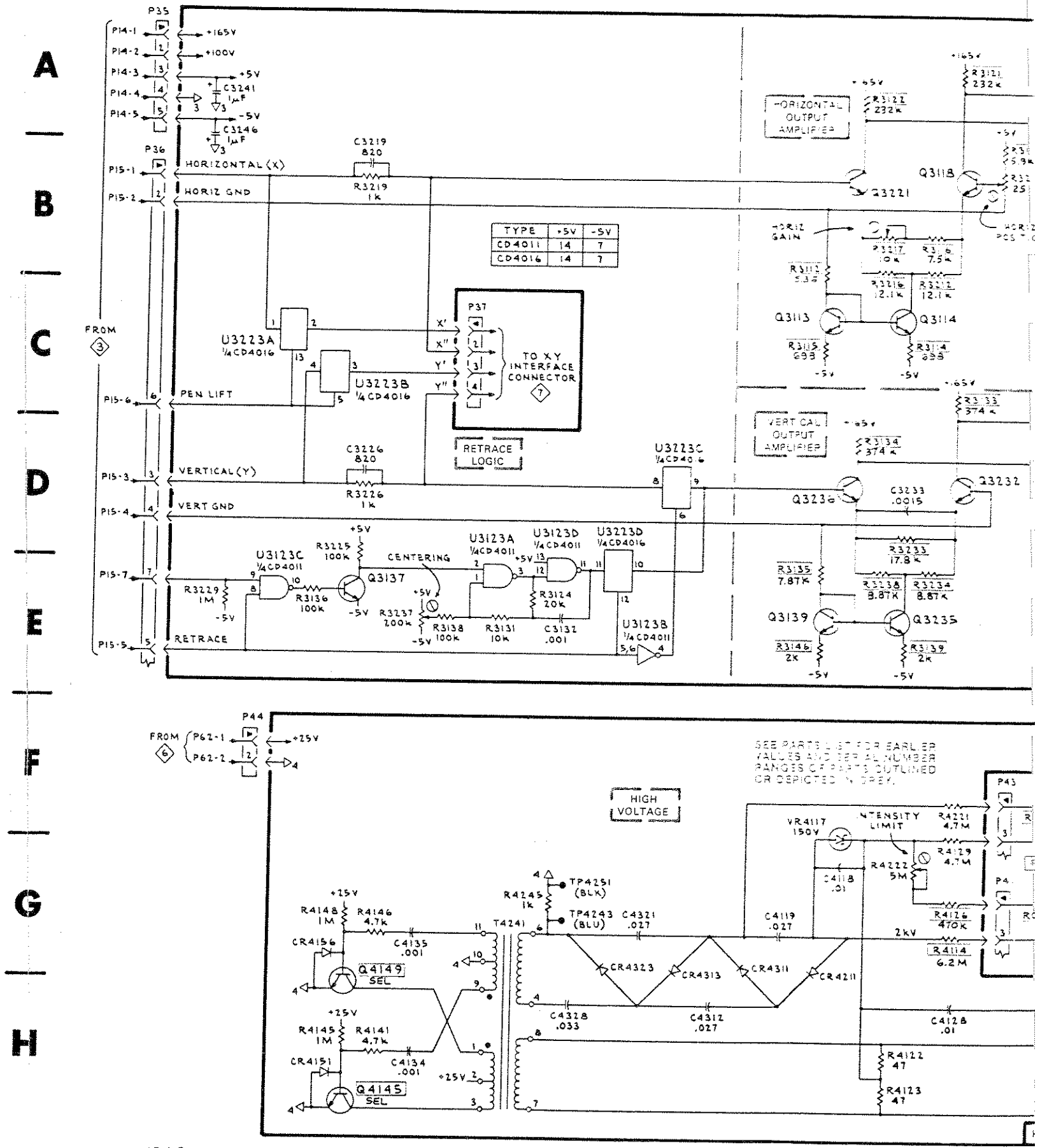
1865-31



1865-32

High Voltage Board

CKT NO	GRID LOC	CKT NO	GRID LOC
C3132	E3	R4114	G6
C3219	B2	R4122	H6
C3226	D2	R4123	H6
C3233	D6	R4126	G6
C3241	A1	R4129	G6
C3246	A1	R4141	H2
		R4145	H2
C4118	G5	R4146	G2
C4119	G5	R4148	G2
C4128	H6	R4221	F6
C4134	H2	R4222	G6
C4135	G2	R4245	G3
C4312	H4		
C4321	G4	T4241	G3
C4328	H3		
		TP4243	G4
CR4151	H2	TP4251	G4
CR4156	G2		
CR4211	G5	U3123	E1,E3
CR4311	G5	U3223	C2,D4
CR4313	G4		
CR4323	G4	V0235	B9
L0234	B9		
P0230	G9		
Q3113	C5		
Q3114	C6		
Q3118	B6		
Q3137	E2		
Q3139	E5		
Q3221	B6		
Q3232	D6		
Q3235	E6		
Q3236	D6		
Q4145	H2		
Q4149	G2		
R0432	F7		
R0442	G7		
R3112	B5		
R3114	C6		
R3115	C5		
R3116	B6		
R3121	A6		
R3122	A6		
R3124	E3		
R3126	B7		
R3131	E3		
R3133	C6		
R3134	D6		
R3135	E5		
R3136	E2		
R3138	E3		
R3139	E6		
R3142	B10		
R3143	B10		
R3146	E5		
R3148	F10		
R3149	F10		
R3212	B6		
R3213	B7		
R3216	B6		
R3217	B6		
R3219	B2		
R3225	D2		
R3226	D2		
R3229	E1		
R3233	D6		
R3234	E6		
R3237	E2		
R3238	E6		
R3242	F10		
R3248	C10		
R3249	D10		



REV JUN 1983
(1792) 1865-33

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10

A — B — C — D — E — F — G — H

P35
P14-1 +165V
P14-2 +100V
P14-3 +5V
P14-4
P14-5 -5V
C3241 1μF
C3146 1μF
P36
P15-1 HORIZONTAL (X)
P15-2 HORIZ GND
C3219 820
R3219 1K
FROM ◇3◇
P15-6 PEN LIFT
P15-3 VERTICAL (Y)
P15-4 VERT GND
P15-7
P15-5 RETRACE
C3226 820
R3226 1K

TYPE	+5V	-5V
CD4011	14	7
CD4016	14	7

U3223A ¼CD4016
U3223B ¼CD4016
P37
X' X'' Y' Y''
TO X-Y INTERFACE CONNECTOR ◇7◇
RETRACE LOGIC
U3223C ¼CD4016
U3123C ¼CD4011
R3225 100K
CENTERING
Q3137
R3229 1M
R3136 100K
R3237 200K
R3138 100K
U3123A ¼CD4011
U3123D ¼CD4011
U3223D ¼CD4016
R3124 20K
R3131 10K
C3132 .001
U3123B ¼CD4011

HORIZONTAL OUTPUT AMPLIFIER
+165V
R3121 232K
R3122 232K
+5V
R3126 5.9K
R3213 25K
Q3118
Q3221
HORIZ GAIN
HORIZ POSITION
R3217 10K
R3116 7.5K
R3112 5.3G
R3116 12.1K
R3212 12.1K
Q3113
Q3114
R3115 698
R3114 698
-5V
HORIZONTAL

VERTICAL OUTPUT AMPLIFIER
+165V
R3133 374K
R3134 374K
VERTICAL
Q3236
Q3232
C3233 .0015
R3233 17.8K
R3135 7.87K
R3238 8.87K
R3134 8.87K
Q3139
Q3235
R3146 2K
R3139 2K

OUTPUT AMPS BD.

V0235
L0234
P34
R3142 +5V
R3143 50K
-5V
TRACE ROTATION
P31
P32
P33
GEOMETRY
+100V
R3248 200K
R3249 200K

FROM ◇6◇ P62-1 P62-2
P44 +25V
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.
HIGH VOLTAGE
VR4117 150V
INTENSITY LIMIT
R4221 4.7M
R4129 4.7M
R4222 5M
C4118 .01
FOCUS
INTENSITY
R0432 5M
R0442 5M
R4126 470K
2kV
R4114 6.2M
P43
P41
P42
TP4251 (BLK)
TP4243 (BLU)
R4245 1K
T4241
C4321 .027
C4119 .027
C4328 .033
C4312 .027
C4128 .01
CR4323
CR4313
CR4311
CR4211
+25V
R4148 1M
R4146 4.7K
C4135 .001
CR4156
Q4149 SEL
R4145 1M
R4141 4.7K
C4134 .001
CR4151
Q4145 SEL
R4122 47
R4123 47

HIGH VOLTAGE BD.

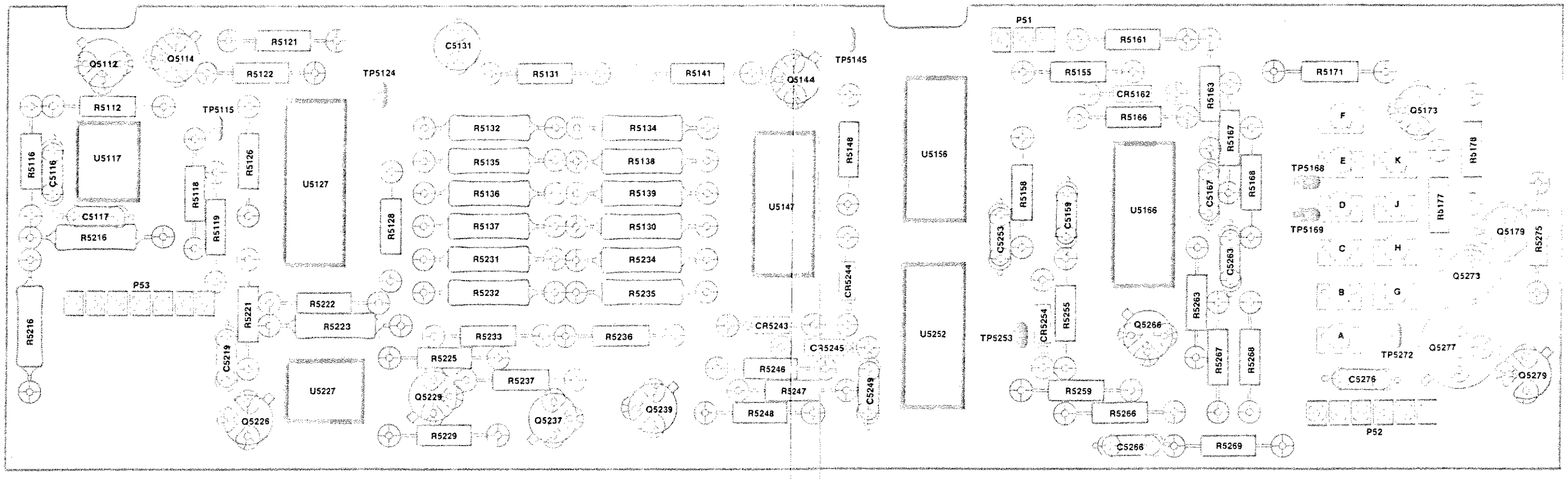
FROM P15-8 ◇1◇
P36
ASTIGMATISM
+100V
R3242 200K
R3149 220K
R3148 200K
NOTE: CRT SOCKET P0230

1503

REV JUN 1983
(1792) 1865-33

Output Amplifiers & High Voltage ◇4◇

NLL



1865-34

Logic Board

CKT NO	GRID LOC
C5116	B5
C5117	B6
C5131	G7
C5159	A5
C5167	A4
C5219	F2
C5249	E7
C5253	F6
C5263	A3
C5266	A2
C5276	A2
CR5162	A4
CR5243	E7
CR5244	E6
CR5245	E6
CR5254	A6
Q5112	F8
Q5114	G7
Q5144	E5
Q5173	G8
Q5179	G9
Q5226	F7
Q5229	F7
Q5237	F6
Q5239	G8
Q5266	E8
Q5273	H8
Q5277	H9
Q5279	H8
R5112	B7
R5116	B5
R5118	B8
R5119	G4
R5121	G6
R5122	G7
R5126	G4
R5128	G5
R5130	C5
R5131	B4
R5132	C6
R5134	C5
R5135	C6
R5136	C6
R5137	C6
R5138	C5
R5139	C5
R5141	E5
R5148	D6
R5155	H2
R5158	E7
R5161	H2
R5163	A4
R5166	A4
R5167	A5
R5168	A3
R5171	G8
R5177	G8
R5178	G9
R5211	B3
R5216	B3
R5221	F2
R5222	G4
R5223	B4
R5225	F6
R5229	F9
R5231	D6
R5232	D6
R5233	G8
R5234	D5
R5235	D5
R5236	F5
R5237	F6
R5246	E6
R5247	E7
R5248	E6
R5255	A5
R5259	E7
R5263	A3
R5266	E8
R5267	A2
R5268	A2
R5269	A2
R5275	H9
S0481B	D1
TP5115	B8
TP5124	F5
TP5145	A6
TP5168	G9
TP5169	E9
TP5253	A7
TP5272	A2
U5117	B6
U5127	G5
U5147	C4
U5156	H2,E6
U5166	A3,A5
U5227	B3
U5252	D5,E8

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10

A

B

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G

H

PULSE SHAPER

FROM CHART RECORDER J0196 9

+5V R5268 4.7k R5269 100k R5267 100k C5276 0.47 C5266 .05 TP5272 (RED) CHART SPEED SENS

C5263 .005 R5263 1M R5168 1M U5166B ¼CD4011 U5166C ¼CD4011 C5167 .02

+5V R5163 1M R5166 100k CR5162 U5166A ¼CD4011 R5255 100k CR5254 C5159 0.47 R5167 1M -5V U5166D ¼CD4011

TP5145 (V10) TP5253 (BLK)

FROM P27-5 2 P53 5 HORIZONTAL

R5211 20.0k R5216 15.0k R5223 38.3k U5227 741 R5131 3.3M -5V

C5116 0.22 R5116 1M U5117 CA3130 C5117 150

R5112 100k TP5115 (YEL) R5118 18M HORIZ CORRECTION P53 6 TO P27-6 3

COUNTER U5147 CD4024

TYPE	+5V	GND	-5V
CD4011 U5156	14	–	7
CD4011 U5166	14	7	–
CD4023	14	7	–
CD4024	14	7	–
CD4027	16	8	–

HORIZONTAL CORRECTION NETWORK W/D-A CONVERTER

R5134 100.0k R5132 50.0k
R5138 100.0k R5135 50.0k
R5139 100.0k R5136 50.0k
R5130 100.0k R5137 50.0k
R5234 100.0k R5231 50.0k
R5235 100.0k R5232 100.0k

U5252B ⅓CD4023

CHART RECORDER LOGIC

R5141 100k Q5144

R5148 100k CR5244 C5249 0.1 R5247 56M U5252C ⅓CD4023
CR5245 R5246 100k CR5243
U5156B ¼CD4011 R5248 1M R5158 1M R5259 1M U5252A ⅓CD4023
U5156C ¼CD4011 C5253 22

TP5169 (GRN) MOTOR CONTROL R5266 47k Q5266 J0196 4 D TO CHART RECORDER

FROM CHART RECORDER J0196 1 A PLUG-IN LOGIC C5219 0.1 R5221 100k Q5226

TP5124 (ORN) R5236 100k Q5237 R5237 100k R5225 100k Q5229 HORIZ CONTROL R5229 100k P53 3 TO P27-3 2

U5127B ½CD4027 R5121 100k Q5114 C5131 Q5112 R5122 100k -5V

R5222 1M R5128 1M U5127A ½CD4027 R5119 1M R5126 1M

TP5168 (BLU) STYLUS HEAT R5233 47k Q5239 J0196 12 J

FROM 2 P53 P27-1 PEN LIFT P27-4 RETRACE 4

P52 P67-3 P67-2 P67-1 P67-4 P67-6 P67-5 FROM 6

R5171 33k Q5173 R5177 1k R5178 1k Q5179 Q5273

R5275 560 Q5277 Q5279

+5V -5V +8V GND -8V

TO CHART RECORDER

FOR DETAIL SEE 7

CHART RECORDER POWER SWITCH

LOGIC BD.

P51 3 S04818 RECORD (SPRING RETURN) 2

+5V R5161 100k U5156D ¼CD4011 ANTI-BOUNCE RECORD

+5V R5155 100k U5156A ¼CD4011 -5V

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS OUTLINED OR DEPICTED IN GREY.

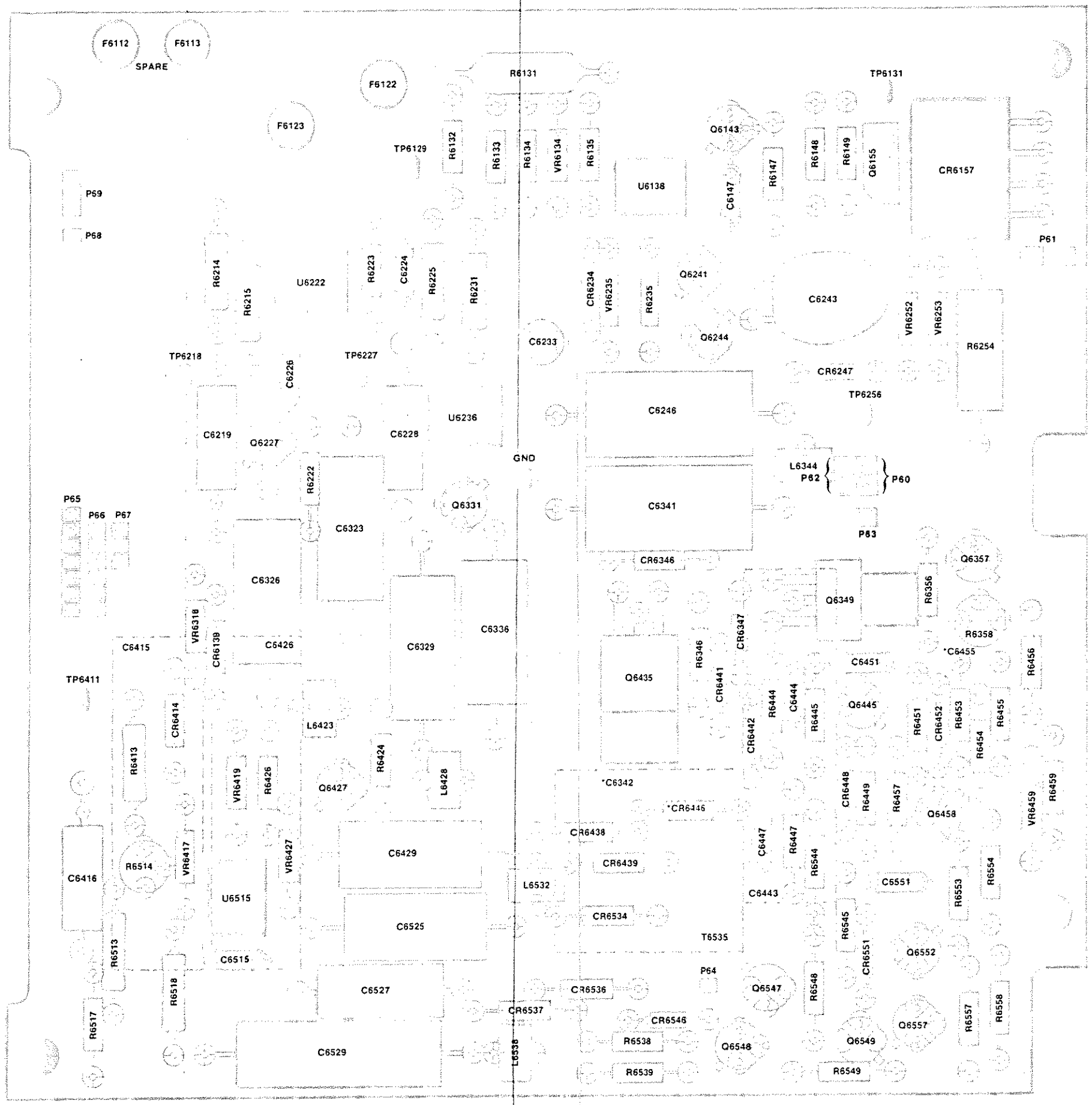
RECORD P53 7 TO P27-7 3

S04818 RECORD (SPRING RETURN) EFF: SN8C40E875 REV W

1503

REV JUN 1983

LOGIC 5 NLL



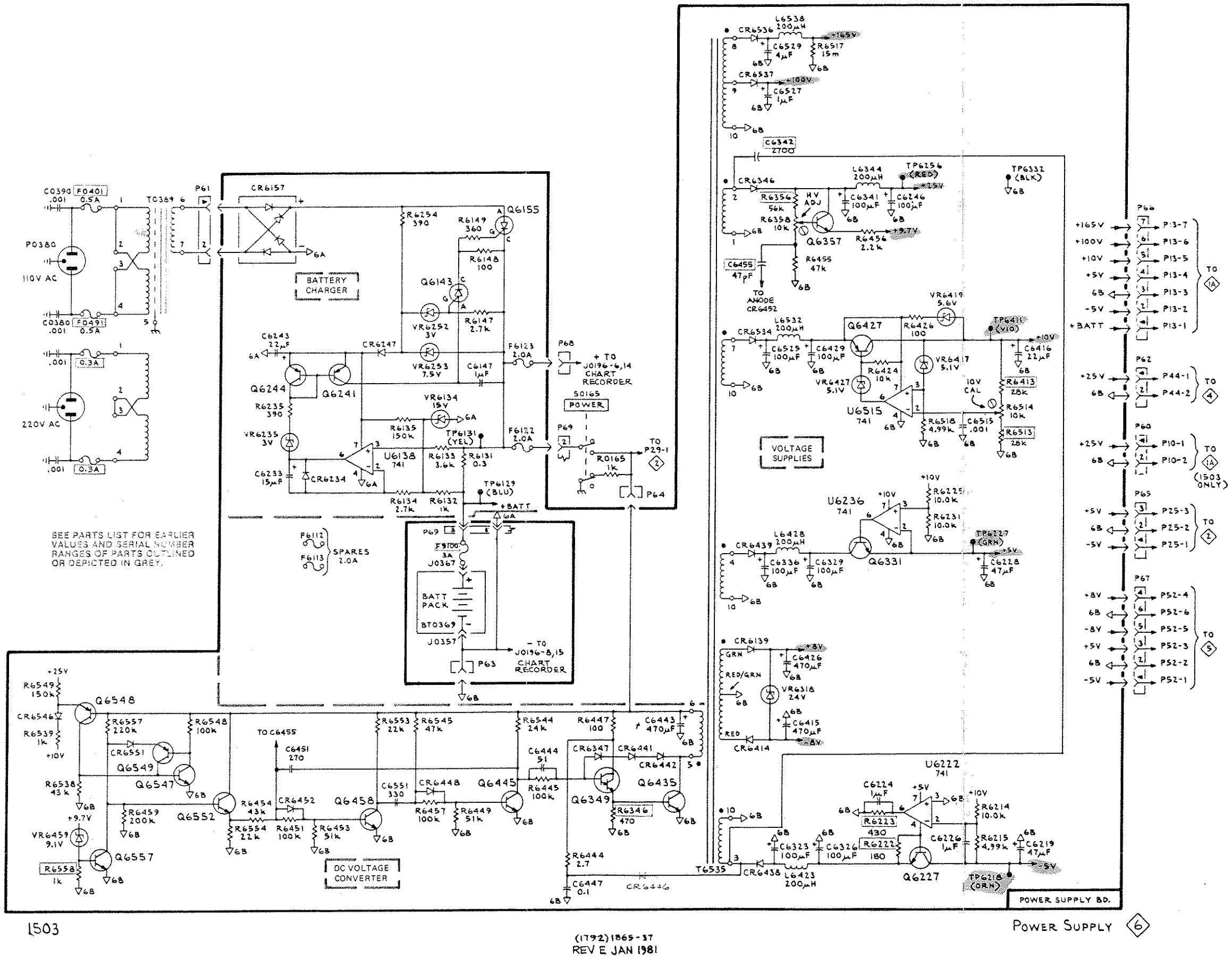
*See Parts List for serial number ranges.

Power Supply REV A NOV 1979

CKT NO	GRID LOC
BT0369	F4
C0380	D1
C0390	C1
C6147	D4
C6219	H9
C6224	H8
C6226	H9
C6228	F9
C6233	E3
C6243	D3
C6246	B8
C6323	H7
C6326	H8
C6329	F7
C6336	F7
C6341	B8
C6342	B7
C6415	G7
C6416	D9
C6426	G7
C6429	D7
C6443	G6
C6444	G5
C6447	H5
C6451	G3
C6455	C7
C6515	D9
C6525	D9
C6527	A7
C6529	A7
C6551	H4
CR6139	F7
CR6157	C3
CR6234	E3
CR6247	D3
CR6346	B7
CR6347	G5
CR6414	G7
CR6438	H7
CR6439	F7
CR6441	G6
CR6442	G6
CR6446	H6
CR6448	H4
CR6452	H3
CR6534	D7
CR6536	A7
CR6537	A7
CR6546	G1
CR6551	G1
F0401	B1
F0401	B1
F0491	C1
F0491	C1
F6112	F3
F6113	E3
F6122	D5
F6123	E5

CKT NO	GRID LOC
L6344	B8
L6423	H7
L6428	F7
L6532	D7
L6538	A7
Q6143	C4
Q6155	C5
Q6227	H8
Q6241	D3
Q6244	D3
Q6331	F8
Q6349	H5
Q6357	C7
Q6427	D8
Q6435	H6
Q6445	H5
Q6458	H3
Q6547	H2
Q6548	G1
Q6549	G1
Q6552	H2
Q6557	H1
R6131	E4
R6132	E4
R6133	E4
R6134	E4
R6135	D4
R6147	C4
R6148	C4
R6149	C4
R6214	H9
R6215	H9
R6222	H8
R6223	H8
R6225	E8
R6231	E8
R6235	D3
R6254	C4
R6254	C4
R6346	H6
R6356	B7
R6358	C7
R6413	D9
R6424	D8
R6426	D8
R6444	H5
R6445	H5
R6447	G5
R6449	H4
R6451	H3
R6453	H3
R6454	H2
R6455	C7
R6456	C8
R6457	H4
R6459	H1
R6513	E9
R6514	D9
R6517	A7

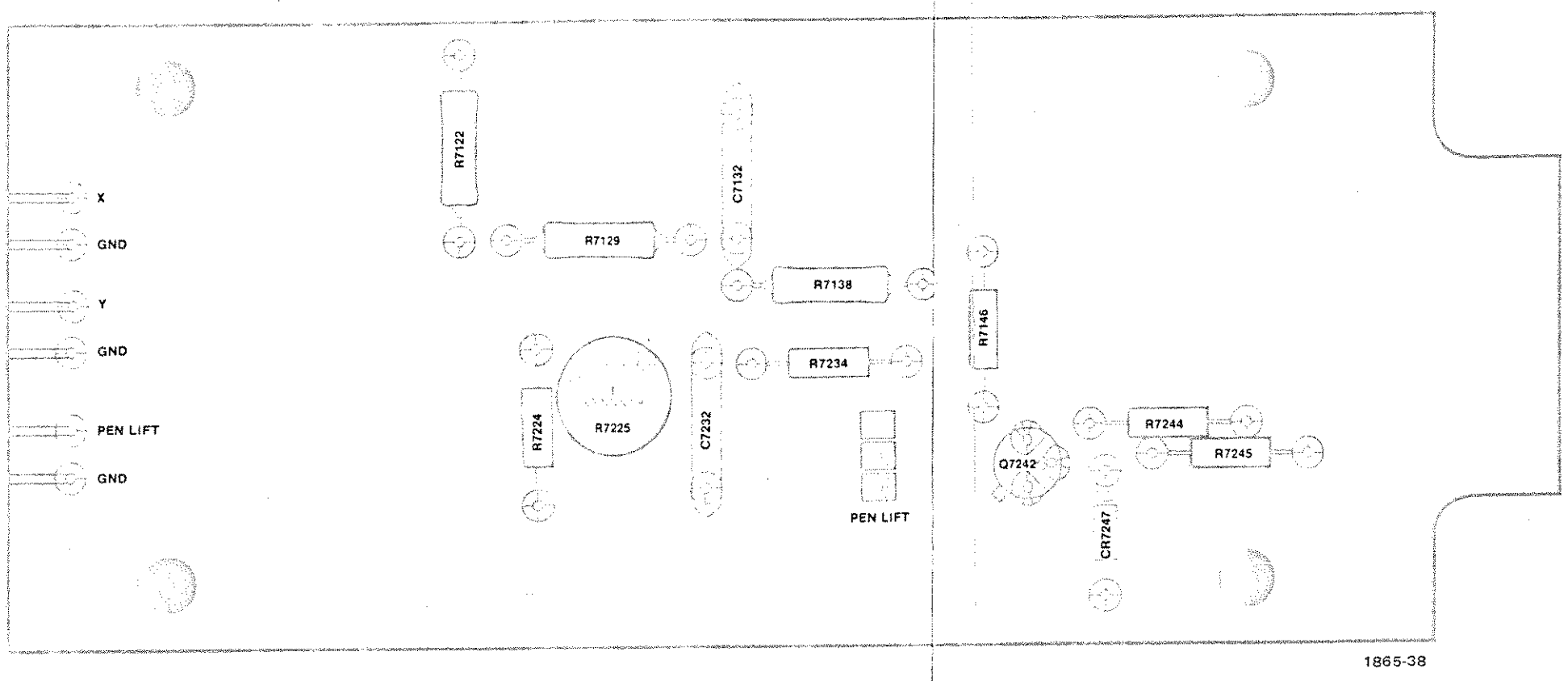
CKT NO	GRID LOC
R6518	D8
R6538	H1
R6539	G1
R6544	G5
R6545	G4
R6548	G2
R6549	G1
R6553	G4
R6554	H2
R6557	G1
R6558	H1
S0165	E5
T6535	H6
TP6129	E4
TP6131	E4
TP6218	H9
TP6227	E9
TP6256	B8
TP6411	D9
U6138	E3
U6222	H8
U6236	E8
U6515	D8
VR6134	D4
VR6235	E3
VR6252	D4
VR6253	D4
VR6318	G7
VR6417	D8
VR6419	D8
VR6427	D8
VR6459	H1



1503

(1792)1865-37
REV E JAN 1981

POWER SUPPLY 6



X-Y Output Module

CKT NO	GRID LOC
C7132	F6
C7232	E6
CR7247	D6
Q7242	E7
R7122	F7
R7129	F7
R7138	F6
R7146	D6
R7224	E7
R7225	E7
R7234	E6
R7244	E6
R7245	D6

OUT OF MODULE
CIRCUIT

1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10

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C

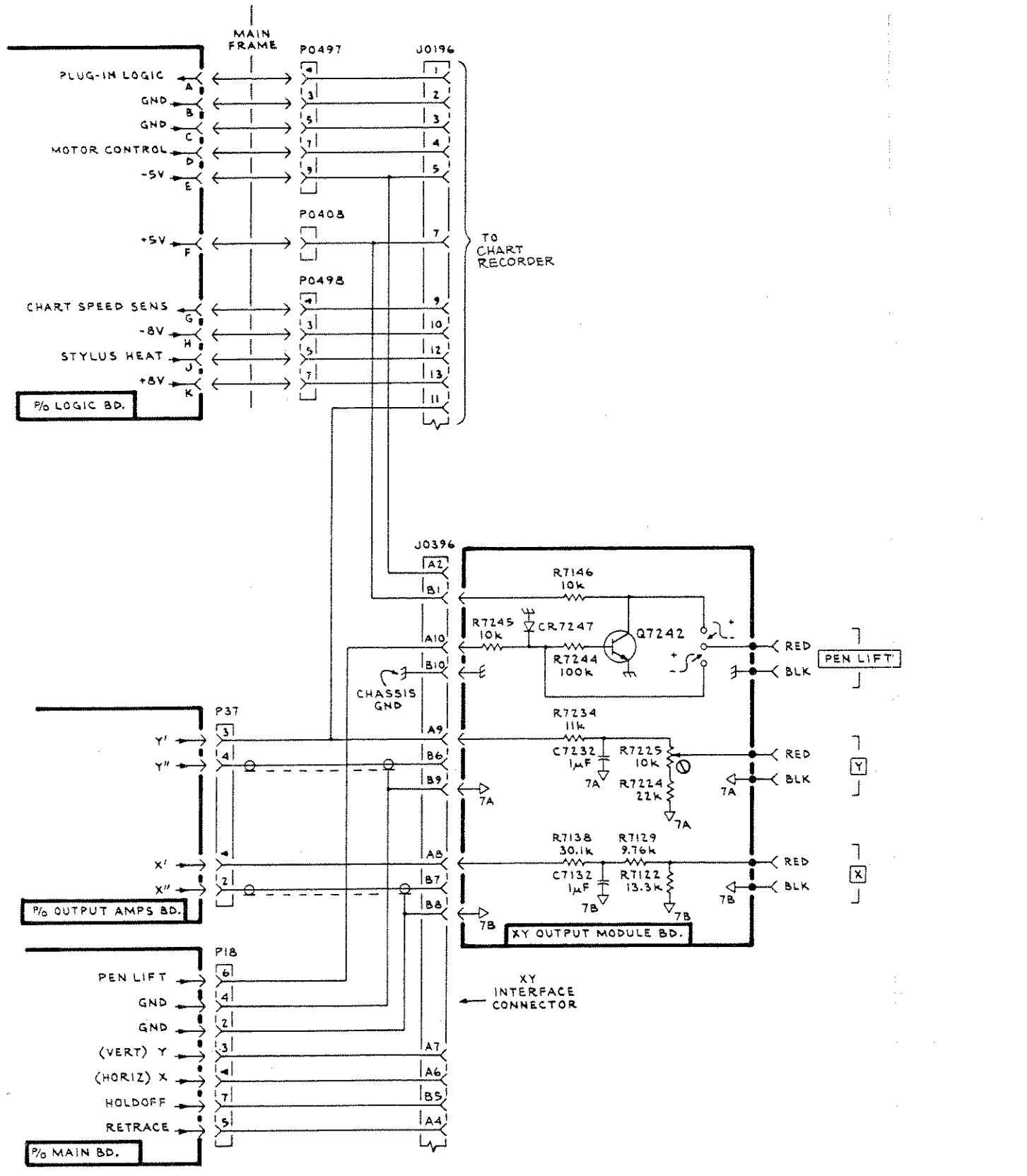
D

E

F

G

H



1503

REV. A, FEB. 1978
(1792)1865-39

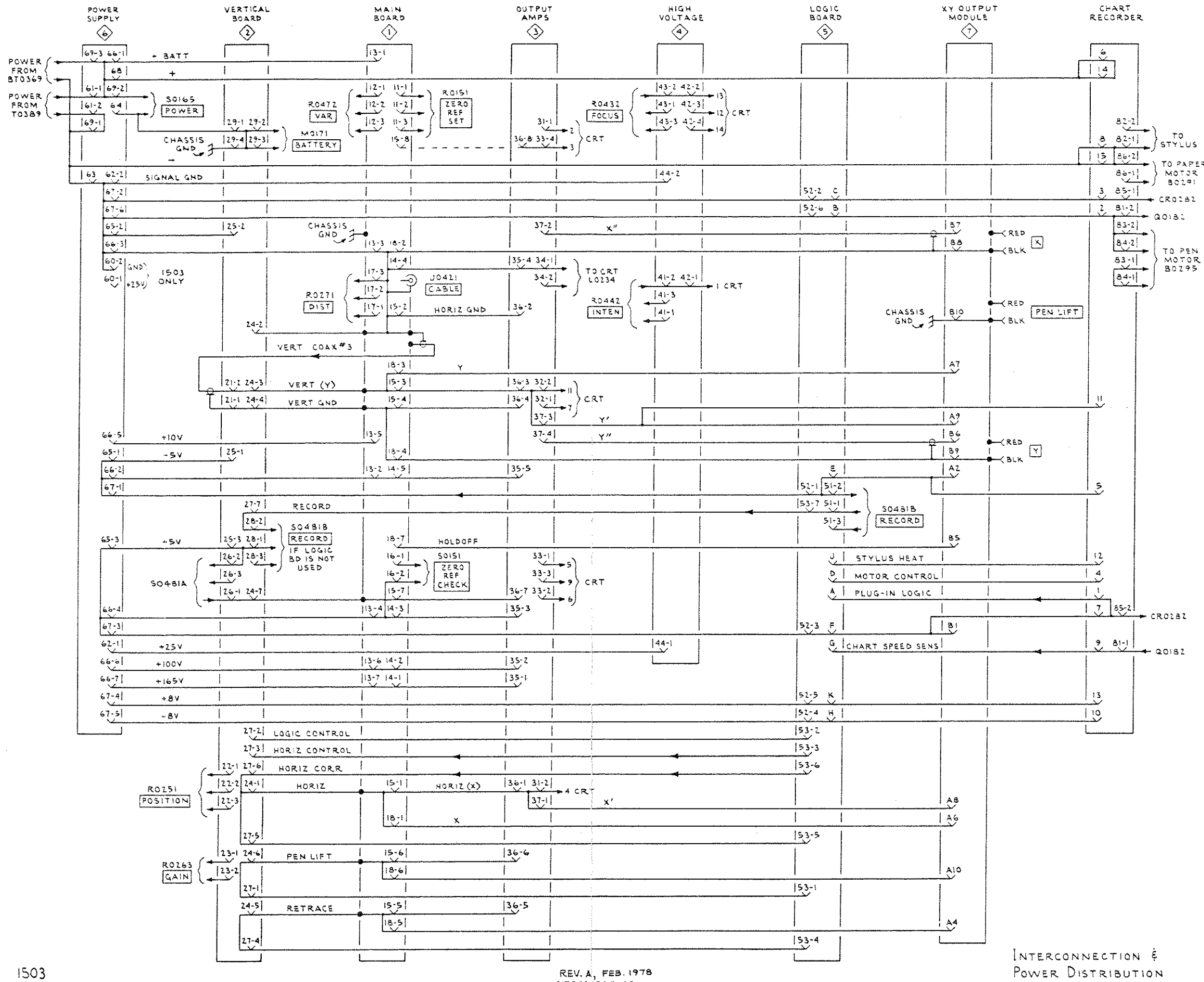
X-Y Output Module & Chart Recorder Interconnect

7

MLL

CIRCUIT

7



1503

REV. A, FEB. 1978
(1792) 1865-42

INTERCONNECTION & POWER DISTRIBUTION

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
\- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
\- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
\- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
0000M	SONY/TEKTRONIX CORPORATION	P O BOX 14, HANEDA AIRPORT	TOKYO 149 JAPAN
000AZ	AIR OIL PROD. CORPORATION	2400 E BURNSIDE	PORTLAND, OR 97214
000BK	STAUFFER SUPPLY	105 SE TAYLOR	PORTLAND, OR 97214
000CY	NORTHWEST FASTENER SALES, INC.	7923 SW CIRRUS DRIVE	BEAVERTON OR 97005
000EX	O'HARA METAL PRODUCT COMPANY	542 BRANNAN STREET	SAN FRANCISCO, CA 94107
000FW	WESTERN SINTERING CO INC	2620 STEVENS DRIVE	RICHLAND, WA 99352
00779	AMP INC	P O BOX 3608	HARRISBURG, PA 17105
05276	ITT, POMONA ELECTRONICS DIVISION	P O BOX 2767, 1500 E 9TH ST.	POMONA, CA 91766
05574	VIKING INDUSTRIES, INC.	21001 NORDHOFF STREET	CHATSWORTH, CA 91311
06090	RAYCHEM CORPORATION	300 CONSTITUTION DRIVE	MENLO PARK, CA 94025
06540	AMATOM ELECTRONIC HARDWARE, DIV OF MITE CORP.	446 BLAKE ST.	NEW HAVEN, CT 06515
07322	MINNESOTA RUBBER CO.	3630 WOODDALE AVENUE	MINNEAPOLIS, MN 55416
07707	USM CORP., USM FASTENER DIV	510 RIVER RD.	SHELTON, CT 06484
08261	SPECTRA-STRIP CORP.	7100 LAMPSON AVE.	GARDEN GROVE, CA 92642
08530	RELIANCE MICA CORP.	342-39TH ST	BROOKLYN, NY 11232
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
12697	CLAROSTAT MFG. CO., INC.	LOWER WASHINGTON STREET	DOVER, NH 03820
19209	GENERAL ELECTRIC CO., ELECTRONIC CAPACITOR AND BATTERY PRODUCTS DEPT. BATTERY PRODUCTS SEC	P O. BOX 114	GAINESVILLE, FL 32601
22526	BERG ELECTRONICS, INC	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
22599	ESNA, DIV OF AMERACE CORPORATION	16150 STAGG STREET	VAN NUYS, CA 91409
24655	GENERAL RADIO CO.	300 BAKER AVE.	CONCORD, MA 01742
24931	SPECIALITY CONNECTOR CO., INC.	2620 ENDRESS PLACE	GREENWOOD, IN 46142
59730	THOMAS AND BETTS COMPANY	36 BUTLER ST.	ELIZABETH, NJ 07207
71126	BRONSON, HOMER D., CO.	250 MAIN ST., P O. BOX 98	BEACON FALLS, CT 06403
71400	BUSSMAN MFG., DIVISION OF MCGRAW-EDISON CO.	2536 W UNIVERSITY ST.	ST LOUIS, MO 63107
71468	ITT CANNON ELECTRIC	666 E. DYER RD.	SANTA ANA, CA 92702
71785	TRW, CINCH CONNECTORS	1501 MORSE AVENUE	ELK GROVE VILLAGE, IL 60007
72228	CONTINENTAL SCREW CO., DIV. OF AMTEL, INC.	459 MT. PLEASANT	NEW BEDFORD, MA 02742
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
73803	TEXAS INSTRUMENTS, INC., METALLURGICAL MATERIALS DIV.	34 FOREST STREET	ATTLEBORO, MA 02703
74445	HOLO-KROME CO.	31 BROOK ST. WEST	HARTFORD, CT 06110
74970	JOHNSON, E. F., CO.	299 10TH AVE. S. W.	WASECA, MN 56093
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
76854	OAK INDUSTRIES, INC., SWITCH DIV.	S. MAIN ST.	CRYSTAL LAKE, IL 60014
77250	PHEOLL MANUFACTURING CO., DIVISION OF ALLIED PRODUCTS CORP	5700 W. ROOSEVELT RD.	CHICAGO, IL 60650
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
78584	STEWART STAMPING CORP.	630 CENTRAL PARK AVE.	YONKERS, NY 10704
79136	WALDES, KOHINOOR, INC.	47-16 AUSTEL PLACE	LONG ISLAND CITY, NY 11101
79807	WROUGHT WASHER MFG. CO.	2100 S. O BAY ST.	MILWAUKEE, WI 53207
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83309	ELECTRICAL SPECIALITY CO., SUBSIDIARY OF BELDEN CORP.	213 E. HARRIS AVE. SOUTH	SAN FRANCISCO, CA 94080
83330	SMITH, HERMAN H., INC.	812 SNEDIKER AVE.	BROOKLYN, NY 11207
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
83553	ASSOCIATED SPRING CORP., SEABOARD DIV.	15001 S BROADWAY, P O BOX 231	GARDENA, CA 90248
85471	BOYD, A. B., CO.	2527 GRANT AVENUE	SAN LEANDRO, CA 94579
86928	SEASTROM MFG. COMPANY, INC.	701 SONORA AVENUE	GLENDALE, CA 91201
87308	N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677
87664	VAN WATERS AND ROGERS, INC.	P. O. BOX 3200 RINCON ANNEX	SAN FRANCISCO, CA 94119
89663	REESE, J. RAMSEY, INC.	71 MURRAY STREET	NEW YORK, NY 10007
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93410	ESSEX INTERNATIONAL, INC., CONTROLS DIV. LEXINGTON PLANT	P. O. BOX 1007	MANSFIELD, OH 44903
95712	BENDIX CORP., THE ELECTRICAL COMPONENTS DIV., MICROWAVE DEVICES PLANT	HURRICANE ROAD	FRANKLIN, IN 46131
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111
97539	APM-HEXSEAL CORP.	44 HONECK ST.	ENGLEWOOD, NJ 07631
S3109	C/O PANEL COMPONENTS CORP.		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
1-	437-0190-01			1	CAB.,TDR ACCESS:	80009	437-0190-01
	105-0684-00	B010100	B082399	2	.LATCH ASSEMBLY:	80009	105-0684-00
	105-0684-01	B082400		2	.LATCH ASSEMBLY:	80009	105-0684-01
					.**********(ATTACHING PARTS)**********		
-1	211-0510-00			4	.SCREW,MACHINE:6-32 X 0.375,PNH,STL,CD PL	83385	OBD
					.**********(END ATTACHING PARTS)**********		
	----- -----			1	..LATCH ASSEMBLY INCLUDES		
-2	367-0212-00	B010100	B082399	1	..HANDLE,LATCH:2.108 L,AL	80009	367-0212-00
	367-0212-01	B082400		1	..HANDLE,LATCH:MOLDING	80009	367-0212-01
					..**********(ATTACHING PARTS)**********		
-3	214-2350-00			1	..PIN,STR,HDLS:0.125 DIA X 2.0 INCH LONG	000BK	OBD
-4	214-2357-00			1	..PIN,SPRING:0.375" L X 0.125 OD,STL	22599	52-028-125-0375
					..**********(END ATTACHING PARTS)**********		
-5	351-0463-00	B010100	B082399	1	..GUIDE,SHAFT:	80009	351-0463-00
	351-0463-01	B082400		1	..GUIDE,SHAFT:STEEL	80009	351-0463-01
					..**********(ATTACHING PARTS)**********		
-6	214-1721-00			1	..PIN,SPRING:0.375 X 0.069	22599	52-012-062-0375
					..**********(END ATTACHING PARTS)**********		
-7	214-2352-00			1	..SPRING,HLCPS:1.0" L X 0.24" OD,MUSIC WIR	83553	C0240-042-100M
-8	354-0324-00			1	..RING,RETAINING:E SHAPE,0.102 ID X 0.270	79136	5133-14-MD
-9	384-1385-00			1	..EXTENSION SHAFT:2.274" L X 0.188 OD,STL	80009	384-1385-00
					..**********(ATTACHING PARTS)**********		
-10	214-2351-00			1	..PIN,SPRING:0.375" L X 0.101" OD,STL	22599	52-022-094-0375
					..**********(END ATTACHING PARTS)**********		
-11	105-0686-00			1	..LATCH,COVER:	80009	105-0686-00
					..**********(ATTACHING PARTS)**********		
-12	214-2349-00			1	..PIN,STR,HDLS:0.125 DIA X 1.0 INCH LONG,S	000BK	OBD
					..**********(END ATTACHING PARTS)**********		
-13	361-0762-00			1	..SPACER,SLEEVE:0.128 ID X 0.15" L,BRASS	80009	361-0762-00
-14	214-2345-00			1	..SPR,HLCL,TRSN:0.665 INCH L X 0.245 OD,SS	80009	214-2345-00
-15	214-2351-00	B010100	B082506	2	..PIN,SPRING:0.375" L X 0.101" OD,STL	22599	52-022-094-0375
-16	426-1271-00	B010100	B082506	1	..FRAME,LATCH:	80009	426-1271-00
	426-1271-02	B082507		1	..FRAME,LATCH:	80009	426-1271-02
-17	214-0787-00			1	.STEM,LATCH:1.110 X 0.185" WHITE PLSTC	80009	214-0787-00
-18	204-0282-00			1	.BODY,LATCH:1.0 X 1.0 X 0.54",BLACK PLS	80009	204-0282-00
-19	214-2389-00			2	.PIN,ACTUATOR:POWER SWITCH	80009	214-2389-00
					.**********(ATTACHING PARTS)**********		
-20	211-0008-00			2	.SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					.**********(END ATTACHING PARTS)**********		
-21	200-1778-00			1	.DOOR,ACCESS:FRONT COVER	80009	200-1778-00
					.**********(ATTACHING PARTS)**********		
-22	211-0101-00			2	.SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
-23	210-0586-00			2	.NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
					.**********(END ATTACHING PARTS)**********		
-24	214-0001-00			1	.HINGE,BUTT:1.5 X 1.0,BRS	71126	B78
					.**********(ATTACHING PARTS)**********		
-25	211-0102-00			2	.SCREW,MACHINE:4-40 X 0.500",FLH,STL	83385	OBD
					.**********(END ATTACHING PARTS)**********		
-26	386-3216-00			1	.SUPPORT,HINGE:ACCESS DOOR	80009	386-3216-00
-27	105-0652-00			1	.STRIKE,CATCH:ACCESS DOOR	80009	105-0652-00
					.**********(ATTACHING PARTS)**********		
-28	211-0102-00			2	.SCREW,MACHINE:4-40 X 0.500",FLH,STL	83385	OBD
					.**********(END ATTACHING PARTS)**********		
-29	200-1759-00			1	.COVER,TDR UNIT:FRONT	80009	200-1759-00
-30	016-0595-00			1	BATTERY SET:	80009	016-0595-00
-31	214-1573-00			2	.THUMBSCREW:6-32 X 0.656 INCH LONG,SST	06540	6130-SS-0632
-32	210-1160-00			2	.WASHER,FLAT:0.129 ID X 0.031 THK,TEFLON	86928	5612-32-31
	334-2665-00			1	MARKER,IDENT:MARKED CAUTION	80009	334-2665-00
	334-2666-00			1	MARKER,IDENT:MKD 110V	80009	334-2666-00
	334-2667-00			1	MARKER,IDENT:MARKED 230V	80009	334-2667-00
	437-0188-01			1	CAB.,TDR UNIT:	80009	437-0188-01
-33	200-1805-00			2	.COV,HDL LATCH:	80009	200-1805-00
					.**********(ATTACHING PARTS)**********		
-34	213-0739-00			4	.SCREW,MACHINE:10-32 X 0.375 INCH,HEX HD,S	83385	OBD
					.**********(END ATTACHING PARTS)**********		
-35	210-1231-00			2	.WASHER,FLAT:0.203 ID X 0.875 OD,STL	86928	5712-82-60-C2
-36	386-3303-01			2	.PLATE,SECURING:HANDLE,STEEL	80009	386-3303-01

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-37	107-0035-00			4		.DISC,FRICTION:0.38 ID X 1.865 OD	80009	107-0035-00
-38	367-0204-01			1		.HANDLE,CARRYING:W/HARDWARE	80009	367-0204-01
-39	334-2468-00			1		..PLATE,IDENT:MARKED 1502	80009	334-2468-00
-40	437-0188-00			1		.CAB,,TDR UNIT:	80009	437-0188-00
-41	348-0419-00			2		..FOOT,CABINET:FRONT	80009	348-0419-00
						.**********(ATTACHING PARTS)**********		
-42	211-0507-00			4		..SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
						..**********(END ATTACHING PARTS)**********		
-43	213-0451-00			4		..SCR,EXT,RLV BOD:FOOT RETAINING	80009	213-0451-00
						.**********(ATTACHING PARTS)**********		
-44	354-0175-00			4		..RING,RETAINING,TYPE EXT,U/O 0.188 ID SFT	79136	5133-18-MI
						..**********(END ATTACHING PARTS)**********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-1	366-0494-00			2	KNOB:GRAY WITH SETSCREW	80009	366-0494-00
	----- -----			-	.EACH KNOB INCLUDES:		
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-2	366-1319-02			1	KNOB:GY,0.79 ID,0.28 OD,0.32 H	80009	366-1319-02
	213-0075-00			1	.SETSCREW:4-40 X 0.094,STL BK OXD,HEX	000BK	OBD
-3	366-1059-00			1	PUSH BUTTON:GRAY	80009	366-1059-00
-4	366-1334-00			2	KNOB:GRAY	80009	366-1344-00
	----- -----			-	.EACH KNOB INCLUDES:		
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-5	366-1031-00			2	KNOB:RED	80009	366-1031-00
	----- -----			-	.EACH KNOB INCLUDES:		
	213-0153-00			1	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-6	366-1408-00			2	KNOB:GRAY	80009	366-1408-00
	----- -----			-	.EACH KNOB INCLUDES:		
	213-0153-00			2	.SETSCREW:5-40 X 0.125,STL BK OXD,HEX	000CY	OBD
-7	366-1620-11			1	PUSH BUTTON:GRAY-SOLID POL	80009	366-1620-11
-8	366-1620-09			1	PUSH BUTTON:GRAY--FOAM POL	80009	366-1620-09
-9	366-1620-02			1	PUSH BUTTON:GRAY--NOISE FILTER	80009	366-1620-02
-10	366-1620-03			1	PUSH BUTTON:GRAY--10	80009	366-1620-03
-11	366-1620-04			1	PUSH BUTTON:GRAY--100	80009	366-1620-04
-12	366-1620-05			1	PUSH BUTTON:GRAY--1000	80009	366-1620-05
-13	366-1620-06			1	PUSH BUTTON:GRAY--50 OHM	80009	366-1620-06
-14	366-1620-07			1	PUSH BUTTON:GRAY--75 OHM	80009	366-1620-07
-15	426-0681-00			8	FR,PUSH BUTTON:GRAY PLASTIC	80009	426-0681-00
-16	366-1269-00	B010100	B039999	1	KNOB:GY,1.041 OD X 0.7 H,ABS	80009	366-1269-00
	366-1269-05	B040000		1	SHELL,KNOB:GY,1.041 OD X 0.7 H,PC W/LE	80009	366-1269-05
-17	384-1159-01			1	EXTENSION SHAFT:4.5 INCH LONG W/KNOB	80009	384-1159-01
-18	358-0216-00			1	BUSHING,PLASTIC:0.257 ID X 0.412 INCH OD	80009	358-0216-00
-19	----- -----			1	RESISTOR,VAR:(SEE R0472 EPL)		
-20	210-0046-00			1	WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
-21	129-0290-00			1	POST,ELEC-MECH:0.635 INCH LONG,HEX	80009	129-0290-00
					**********(ATTACHING PARTS)**********		
-22	358-0342-00			1	BSHG,MACH.THD:0.25 X 32 X 0.352 INCH LONG	80009	358-0342-00
					**********(END ATTACHING PARTS)*********		
-23	----- -----			1	SWITCH,TOGGLE:(SEE S0481A,S0481B EPL)		
					**********(ATTACHING PARTS)**********		
-24	200-1744-00			1	CAP.,TOGGLE SW:SEAL,25-40 THD	97539	N5040
					**********(END ATTACHING PARTS)*********		
-25	162-0593-00	B010100	B051371	FT	INS SLV,ELEC:0.5 INCH DIA,BLUE HEAT SHRI	06090	1004040
	162-0031-00	B051372		FT	INSUL SLVG,ELEC:HEAT SHRINK,0.54 ID	93410	FL25090
-26	352-0362-00			2	FUSEHOLDER: W/MOUNTING HARDWARE	75915	345603
	220-0859-00	B040839		2	NUT,PLAIN,HEX:5-28 THD X 0.688 HEX,STL	80009	220-0859-00
-27	210-1246-00			2	WASHER,FLAT:0.5 ID X 0.688 OD,STL	80009	210-1246-00
-28	210-1242-00			2	WASHER,FLAT:0.51 ID X 0.688 OD,AL	86928	5712-113-90
-29	----- -----			1	RESISTOR,VAR:(SEE R0151,S0151 REPL)		
					**********(ATTACHING PARTS)**********		
-30	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-31	210-0940-00	B010100	B079999	1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
	220-0484-00	B080000		1	NUT,PLAIN,HEX.:0.25-32 X 0.375 INCH AL	80009	220-0484-00
					**********(END ATTACHING PARTS)*********		
-32	----- -----			1	RESISTOR,VAR:(SEE R0251A,R0251B REPL)		
					**********(ATTACHING PARTS)**********		
-33	210-0583-00			2	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-34	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					**********(END ATTACHING PARTS)*********		
-35	----- -----			1	RESISTOR,VAR:(SEE R0263 REPL)		
-36	210-0223-00			1	TERMINAL,LUG:0.25 INCH DIA,SE	86928	A313-136
-37	129-0290-00			1	POST,ELEC-MECH:0.635 INCH LONG,HEX	80009	129-0290-00
					**********(ATTACHING PARTS)**********		
-38	358-0342-00			1	BSHG,MACH.THD:0.25 X 32 X 0.352 INCH LONG	80009	358-0342-00
					**********(END ATTACHING PARTS)*********		
-39	200-1341-00			2	COVER,INS,HV:MOLDE BLACK	80009	200-1341-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-40	----- -----			1	RESISTOR,VAR:(SEE R0432 REPL)		
					**********(ATTACHING PARTS)**********		
-41	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-42	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					**********(END ATTACHING PARTS)**********		
-43	----- -----			1	RESISTOR,VAR:(SEE R0442 REPL)		
					**********(ATTACHING PARTS)**********		
-44	210-0583-00			1	NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-45	210-0940-00			1	WASHER,FLAT:0.25 ID X 0.375 INCH OD,STL	79807	OBD
					**********(END ATTACHING PARTS)**********		
	354-0563-00	B040000		1	PACKING,PREFMD:0.65 ID X 0.74 OD	000AZ	5-64 N506-65
-46	----- -----			1	RESISTOR,VAR:(SEE R0271 REPL),W/HARDWARE		
-47	210-1085-00			1	WASHER,FLAT:0.375 ID X 0.75 INCH OD,STL	12327	OBD
-48	210-0845-00			1	WASHER,FLAT:0.500 ID X 0.625 INCH OD,ST	89663	634-R
-49	333-2003-02			1	PANEL,FRONT:	80009	333-2003-02
	333-2123-00	B010100	B040879	1	PANEL,FRONT,W/PLUG-IN SEAL	80009	333-2123-00
	----- -----			-	(OPTION 5 ONLY)		
	333-2123-02	B040880		1	PANEL,FRONT:	80009	333-2123-02
	----- -----			-	(OPTION 5 ONLY)		
	333-2467-01	B061432		1	PANEL,FRONT:	80009	333-2467-01
	----- -----			-	(OPTION 1 AND 5 ONLY)		
-50	348-0421-00	B010100	B040879	1	.SEAL,INDICATOR:BATTERY LEVEL	80009	348-0421-00
	----- -----	B040880		1	.SEAL,INDICATOR:BATTERY LEVEL		
	----- -----			-	.(PART OF FRONT PANEL ASSY)		
-51	210-1245-00			2	WASHER,FLAT:0.375 ID X 0.562 OD,STL	85471	OBD
-52	348-0409-04			1	SEAL,PB:5 BUTTON	80009	348-0409-04
-53	348-0409-01			1	SEAL,PB:1 BUTTON	80009	348-0409-01
-54	348-0409-02			1	SEAL,PB:2 BUTTON	80009	348-0409-02
-55	348-0422-00			1	SEAL,SWITCH:POWER	80009	348-0422-00
-56	----- -----			1	METER,ELEC FREQ:(SEE M0171 REPL)		
-57	352-0243-00			1	HOLDER,INDICATR:BATTERY LEVEL,PLASTIC	80009	352-0243-00
-58	348-0477-00			2	SEAL,RBR STRIP,0.94 X 28.0 INCH LONG	85471	OBD
-59	213-0738-00			1	SCREW,ADJUSTING:1.188 INCH LONG	80009	213-0738-00
-60	220-0415-00			1	NUT,PLAIN,HEX.:0.312-32 X 0.013" THK,BRS	73743	2X-28046-402
-61	129-0609-00			1	POST,ELEC-MECH:1.598 L,W/6-32 THD,AL	80009	129-0609-00
					**********(ATTACHING PARTS)**********		
-62	212-0507-00			1	SCREW,MACHINE:10-32 X 0.375 INCH,PNH STL	83385	OBD
-63	210-0009-00			1	WASHER,LOCK:EXT,0.193ID X 0.40" OD,STL	78189	1110-00
					**********(END ATTACHING PARTS)**********		
-64	129-0562-00			1	POST,RETAINER:0.892 INCH LONG X 0.375 HEX	80009	129-0562-00
					**********(ATTACHING PARTS)**********		
-65	211-0198-00			1	SCREW,MACHINE:4-40 X 0.438 PNH,STL,POZ	77250	OBD
-66	210-0003-00			1	WASHER,LOCK:EXT,0.123 ID X 0.245" OD,ST	78189	1104-00-00-0541C
					**********(END ATTACHING PARTS)**********		
-67	386-3520-00			1	SUPPORT,CRT:REAR	80009	386-3520-00
					**********(ATTACHING PARTS)**********		
-68	210-0586-00			1	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-69	211-0033-00			6	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-70	386-3153-00			1	SUPPORT,CRT SH:REAR	80009	386-3153-00
					**********(ATTACHING PARTS)**********		
-71	210-0586-00			3	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-72	211-0008-00			6	SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-73	136-0644-00			1	SOCKET ASSY:CRT	80009	136-0644-00
-74	386-1316-00			1	.SUPPORT,CRT:REAR	80009	386-1316-00
-75	136-0266-01			1	.SKT,PL-IN ELEK:ELCTRN TUBE,12 CONT,W/LEAD	0000M	OBD
-76	131-0707-00			55	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
	131-0708-00			2	.CONTACT,ELEC:0.48"L,28-32 AWG WIRE	22526	47437
	131-0621-00			4	.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
-77	352-0171-03			1	.CONN BODY,PL,EL:1 WIRE ORANGE	80009	352-0171-03
	352-0171-08			1	.CONN BODY,PL,EL:1 WIRE GRAY	80009	352-0171-08
	352-0171-09			1	.CONN BODY,PL,EL:1 WIRE WHITE	80009	352-0171-09

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
2-78	352-0169-01			1	.HLDR TERM CONN:2 WIRE,BROWN	80009	352-0169-01
	352-0169-02			1	.CONN BODY,PL,EL:2 WIRE RED	80009	352-0169-00
-79	352-0162-03			1	.CONN BODY,PL,EL:4 WIRE ORANGE	80009	352-0162-03
	352-0162-07			1	.CONN BODY,PL,EL:4 WIRE VIOLET	80009	352-0162-07
-80	352-0163-04			1	.CONN BODY,PL,EL:5 WIRE YELLOW	80009	352-0163-04
	352-0163-05			1	.CONN BODY,PL,EL:5 WIRE GREEN	80009	352-0163-05
-81	352-0165-08			1	.CONN BODY,PL,EL:7 WIRE GRAY	80009	352-0165-08
	352-0165-09			1	.CONN BODY,PL,EL:7 WIRE WHITE	80009	352-0165-09
-82	352-0166-05			1	.CONN BODY,PL,EL:8 WIRE GREEN	80009	352-0166-05
	352-0166-06			1	.CONN BODY,PL,EL:8 WIRE BLUE	80009	352-0166-06
-83	352-0168-09			1	.CONN BODY,PL,EL:10 WIRE WHITE	80009	352-0168-09
-84	352-0200-02			1	.CONN BODY,PL EL:4 WIRE RED	80009	352-0200-02
-85	386-3113-00			1	SUPPORT,CRT:REAR	80009	386-3113-00
-86	348-0239-00			1	GROMMET,PLASTIC:DK GRAY,U-SHAPE,0.27 ID	80009	348-0239-00
-87	348-0067-00			1	GROMMET,PLASTIC:0.312 INCH DIA	80009	348-0067-00
-88	337-2085-00			1	SHIELD,CRT:	80009	337-2085-00
-89	386-3112-00			1	SUPPORT,CRT:FRONT	80009	386-3112-00
-90	343-0610-00			1	RETAINER,SHLD:IMPLOSION	80009	343-0610-00
-91	337-2206-00			1	SHLD,IMPLOSION:CRT,CLEAR	80009	337-2206-00
-92	407-1589-00			1	BRACKET,ANGLE:PLUG IN GUIDE,ALUMINUM	80009	407-1589-00
					**********(ATTACHING PARTS)**********		
-93	211-0008-00			2	SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-94	210-1251-00			1	WASHER,FLAT:0.5 ID X 0.688 OD,SPONGE	80009	210-1251-00
-95	129-0554-00	B010100	B094449	1	SPACER,POST:0.975" L W/4-40 THD,PLSTC	80009	129-0554-00
	129-0554-01	B010100	B094450	1	SPACER,POST:0.975L,W/4-40 EA END PLSTC	80009	129-0554-01
					**********(ATTACHING PARTS)**********		
-96	211-0008-00	B010100	B094449	2	SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
	213-0912-00	B094450		2	SCREW,TPG,TF:4-20 X 0.25L,PAN HEAD STL	72228	OBD
					**********(END ATTACHING PARTS)**********		
-97	384-1101-00			3	EXTENSION SHAFT:4 14 INCH LONG	80009	384-1101-00
-98	384-1099-00			2	EXTENSION SHAFT:PUSH BUTTON,1.54 INCH LONG	80009	384-1099-00
-99	384-1368-00			3	EXTENSION SHAFT:3.31 INCH L,MOLDED PLASTIC	80009	384-1368-00
	334-2450-00			1	MARKER,IDENT:MKD DANGER 165	80009	334-2450-00
	672-0498-00			1	CKT BOARD ASSY:MAIN-VERT AMP W/CAM SWITCH	80009	672-0498-00
	672-0575-00			1	CKT BOARD ASSY:MAIN-VERT AMP W/CAM SWITCH	80009	672-0575-00
	----- -----			-	(OPTION 5 ONLY)		
					**********(ATTACHING PARTS)**********		
-100	377-0451-00			2	INSERT SFT SEAL:0.625 OD X 0.407,0.562-18	80009	377-0451-00
-101	354-0555-00			2	PACKING,PREFMD:0.25 ID X 0.375 INCH OD	07322	8010-559AN
-102	211-0116-00			2	SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
-103	213-0088-00			1	SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
					**********(END ATTACHING PARTS)**********		
	----- -----			-	.MAIN AND VERTICAL BOARD ASSY INCLUDES:		
-104	----- -----			1	.CKT BOARD ASSY:VERTICAL(SEE A2 EPL)		
					.**********(ATTACHING PARTS)**********		
-105	211-0148-01			10	.SCREW,MACHINE:4-40 X 0.312 INCH,PNH,SST	83385	OBD
-106	210-1002-00			10	.WASHER,FLAT:0.125 ID X 0.25 INCH OD,BRS	12327	OBD
					.**********(END ATTACHING PARTS)**********		
	----- -----			-	..CKT BOARD ASSEMBLY INCLUDES:		
-107	131-0604-00			7	..CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-108	131-0608-00			34	..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-109	136-0252-04	B010100	B082958	36	..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-110	136-0269-02	B010100	B082958	1	..SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW C	73803	CS9002-14
-111	136-0514-00	B010100	B082958	3	..SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-112	----- -----			1	..SWITCH,PUSH:(SEE S2254 EPL)		
-113	361-0384-00			2	..SPACER,PB SW:0.133 INCH LONG	80009	361-0384-00
-114	214-0579-00			6	..TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	162-0504-00			FT	..INSUL SLVG,ELEC:0.034 ID,BLACK,0.067 OD	93410	F5B2011
	162-0510-00			FT	..INSUL SLVG,ELEC:FIBERGLASS,RED,0.079 OD	93410	F5B2021
	162-0516-00			FT	..INSUL SLVG,ELEC:0.034 ID,YELLOW,0.079 OD	93410	F5B2041
	162-0520-00			FT	..INSUL SLVG,ELEC:0.034 ID,GREEN,0.079 OD	93410	F5B2031
	162-0524-00			FT	..INSUL SLVG,ELEC:0.034 ID,BLUE,0.079 OD	93410	F5B2051
	162-0578-00			FT	..INSUL SLVG,ELEC:0.034 ID,VIOLET,0.079 OD	93410	F5B1861

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-115	----- -----			1		.ACTR ASSY,PB:(SEE S1624 REPL)		
-116	----- -----			1		.ACTR ASSY,PB:(SEE S1625 REPL)		
-117	----- -----			1		.ACTR ASSY,PB:(SEE S1343 REPL)		
	----- -----			1		.ACTR ASSY,CAM S:(SEE S1215 REPL)		
						.**********(ATTACHING PARTS)**********		
	211-0148-01			4		.SCREW,MACHINE:4-40 X 0.312 INCH,PNH,SST	83385	OBD
	210-1002-00			4		.WASHER,FLAT:0.125 ID X 0.25 INCH OD,BRS	12327	OBD
						.**********(END ATTACHING PARTS)**********		
	----- -----			-		.ACTUATOR ASSEMBLY INCLUDES:		
-118	311-1005-00			1		.RES,VAR,NONWIR:15K OHM,10%,0.50W	12697	382-CM40952
-119	210-0583-00			1		.NUT,PLAIN,HEX:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-120	210-0046-00			1		.WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						.**********(END ATTACHING PARTS)**********		
-121	386-1792-00			1		.PL,VAR RES MTG:STEEL CD PL	80009	386-1792-00
						.**********(ATTACHING PARTS)**********		
-122	211-0001-00			2		.SCREW,MACHINE:2-56 X 0.25 INCH,PNH STL	87308	OBD
-123	210-0001-00			2		.WASHER,LOCK:INTL,0.092 ID X 0.18"OD,ST	78189	1202-00-00-0541C
						.**********(END ATTACHING PARTS)**********		
-124	129-0586-00			2		.SPACER,POST:0.875 L,W/2-56 THD,BRS	80009	129-0586-00
-125	376-0029-01			1		.CPLG,SHAFT,RGD:0.125 SHAFT	80009	376-0029-01
-126	213-0075-00			2		....SETSCREW:4-40 X 0.094,STL BK OXD,HEX	000BK	OBD
	354-0561-00	B020311		1		.PACKING,PREFMD:0.176 ID X 0.312 OD	000AZ	2-008-N674-7
-127	105-0683-00			1		.STOP,ELEC SW:	80009	105-0683-00
-128	384-0313-00			1		.EXTENSION SHAFT:0.125 DIA X 3.375 INCH L	80009	384-0313-00
-129	210-0406-00			4		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-130	401-0113-01			1		.BEARING,CAM SW:REAR	80009	401-0113-01
-131	131-0963-00			2		.CONTACT,ELEC:GROUNDING	000EX	OBD
-132	214-1139-02			2		.SPRING,FLAT:GREEN COLORED	80009	214-1139-02
-133	214-1127-00			2		.ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-134	210-0406-00			4		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-135	401-0081-02			1		.BEARING,CAM SW:FRONT	80009	401-0081-02
						.**********(ATTACHING PARTS)**********		
-136	354-0391-00			1		.RING,RETAINING:0.395"FREE ID X 0.025" S	97464	3100-43-CD
						.**********(END ATTACHING PARTS)**********		
-137	105-0687-00			1		.ACTUATOR,SWITCH:CAM SWITCH	80009	105-0687-00
	----- -----			-		.ACTR ASSY,RTRY:(SEE S2126 EPL)		
						.**********(ATTACHING PARTS)**********		
-138	211-0148-01			6		.SCREW,MACHINE:4-40 X 0.312 INCH,PNH,SST	83385	OBD
-139	210-1002-00			6		.WASHER,FLAT:0.125 ID X 0.25 INCH OD,BRS	12327	OBD
						.**********(END ATTACHING PARTS)**********		
	----- -----			-		.ACTR ASSEMBLY INCLUDES:		
-140	214-1139-00			2		.SPRING,FLAT:0.885 X 0.156 CU BE GLD CLR	80009	214-1139-00
-141	214-1127-00			2		.ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-142	210-0406-00			4		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-143	401-0081-02			1		.BEARING,CAM SW:FRONT	80009	401-0081-02
						.**********(ATTACHING PARTS)**********		
-144	354-0391-00			1		.RING,RETAINING:0.395"FREE ID X 0.025" S	97464	3100-43-CD
						.**********(END ATTACHING PARTS)**********		
-145	105-0648-00			1		.ACTUATOR,CAM SW:X.1-X1	80009	105-0648-00
-146	210-0406-00			4		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-147	401-0115-00			1		.BEARING,CAM SW:CENTER	80009	401-0115-00
-148	131-0963-00			1		.CONTACT,ELEC:GROUNDING	000EX	OBD
-149	214-1139-00			2		.SPRING,FLAT:0.885 X 0.156 CU BE GLD CLR	80009	214-1139-00
-150	214-1127-00			2		.ROLLER,DETENT:0.125 DIA X 0.125,SST	80009	214-1127-00
-151	210-0406-00			4		.NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-152	401-0115-00			1		.BEARING,CAM SW:CENTER	80009	401-0115-00
						.**********(ATTACHING PARTS)**********		
-153	354-0391-00			1		.RING,RETAINING:0.395"FREE ID X 0.025" S	97464	3100-43-CD
						.**********(END ATTACHING PARTS)**********		
-154	105-0659-00			1		.ACTUATOR,SWITCH:CAM SWITCH	80009	105-0659-00
-155	----- -----			1		.CKT BOARD ASSY:MAIN(SEE A1 EPL)		
-156	337-2135-00			1		.SHIELD,ELEC:PULSER,SAMPLER,REAR	80009	337-2135-00
-157	337-2157-00			1		.SHIELD,ELEC:PULSER SAMPLER	80009	337-2157-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-158	337-2313-00			1		..SHIELD,ELEC:CIRCUIT CARD,TOP	80009	337-2313-00
						..**********(ATTACHING PARTS)**********		
-159	211-0008-00			3		..SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						..*********(END ATTACHING PARTS)*********		
-160	337-2314-00			1		..SHIELD,ELEC:CIRCUIT CARD,BOTTOM	80009	337-2314-00
						..**********(ATTACHING PARTS)**********		
-161	210-0406-00			3		..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
						..*********(END ATTACHING PARTS)*********		
-162	166-0233-00			3		..SPACER,SLEEVE:0.312 L X 0.129 ID BRS	76854	3-5165-263
-163	129-0605-00			3		..POST,ELEC-MECH:0.735 W/4-40 THD,INT/EXT,	80009	129-0605-00
-164	129-0353-00			2		..POST,ELEC-MECH:0.188 HEX X 0.385 INCH LO	80009	129-0353-00
						..**********(ATTACHING PARTS)**********		
-165	211-0116-00			2		..SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						..*********(END ATTACHING PARTS)*********		
-166	131-0604-00			13		..CONTACT,ELEC:CKT BD SW,SPR,CU BE	80009	131-0604-00
-167	131-0608-00			45		..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0827-00			2		..CONTACT,ELEC:0.55 INCH LONG	22526	48283-028
-168	131-0993-00			1		..BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-169	131-1003-00			2		..CONN,RCPT,ELEC:CKT BD MT,3 PRONG	80009	131-1003-00
-170	131-1691-00			1		..CONN,RCPT,ELEC:BNC,FEMALE	24931	28JR269-1
-171	136-0252-04	B010100	B061461	86		..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
	136-0252-04	B061462	B082958X	100		..SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-172	136-0269-02			2		..SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW C	73803	CS9002-14
-173	136-0514-00	B010100	B061461	4		..SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
	136-0514-00	B061462	B082958	2		..SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-174	214-0579-00			4		..TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-175	343-0495-01			2		..CLIP,SWITCH:FRONT,7.5 MM,1 UNIT	80009	343-0495-01
						..**********(ATTACHING PARTS)**********		
-176	210-3050-00			1		..EYELET,METALLIC:0.218 L X 0.059 OD,BRS	07707	SE-27
						..*********(END ATTACHING PARTS)*********		
-177	343-0499-01			2		..CLIP,SWITCH:REAR,7.5 MM,1 UNIT	80009	343-0499-01
						..**********(ATTACHING PARTS)**********		
-178	210-3050-00			1		..EYELET,METALLIC:0.218 L X 0.059 OD,BRS	07707	SE-27
						..*********(END ATTACHING PARTS)*********		
-179	343-0496-02			1		..CLIP,SWITCH:FRONT	80009	343-0496-02
						..**********(ATTACHING PARTS)**********		
-180	210-3033-00			2		..EYELET,METALLIC:0.59 OD X 0.156 INCH LON	07707	SE-25
						..*********(END ATTACHING PARTS)*********		
-181	343-0497-02			1		..CLIP,SWITCH:REAR	80009	343-0497-02
						..**********(ATTACHING PARTS)**********		
-182	210-3033-00			2		..EYELET,METALLIC:0.59 OD X 0.156 INCH LON	07707	SE-25
						..*********(END ATTACHING PARTS)*********		
-183	343-0496-03			1		..CLIP,SWITCH:FRONT,10 MM X 3 UNIT	80009	343-0496-03
						..**********(ATTACHING PARTS)**********		
-184	210-3033-00			3		..EYELET,METALLIC:0.59 OD X 0.156 INCH LON	07707	SE-25
						..*********(END ATTACHING PARTS)*********		
-185	343-0497-03			1		..CLIP,SWITCH:REAR,10 MM X 3 UNIT	80009	343-0497-03
						..**********(ATTACHING PARTS)**********		
-186	210-3033-00			3		..EYELET,METALLIC:0.59 OD X 0.156 INCH LON	07707	SE-25
						..*********(END ATTACHING PARTS)*********		
-187	131-0707-00			15		..CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOL	22526	47439
-188	352-0169-01			1		..HLDR TERM CONN:2 WIRE,BROWN	80009	352-0169-01
	352-0169-05			1		..CONN BODY,PL,EL:2 WIRE GREEN	80009	352-0169-05
-189	352-0165-04			1		..CONN BODY,PL,EL:7 WIRE YELLOW	80009	352-0165-04
-190	352-0162-09			1		..CONN BODY,PL,EL:4 WIRE WHITE	80009	352-0162-09
-191	210-0774-00			1		..EYELET,METALLIC:0.152 OD X 0.245 INCH L,	80009	210-0774-00
-192	210-0775-00			1		..EYELET,METALLIC:0.126 OD X 0.23 INCH L,B	80009	210-0775-00
-193	175-0830-00			FT		..WIRE,ELECTRICAL:7 WIRE RIBBON	08261	SS-0726-710610C
	162-0510-00			FT		..INSUL SLVG,ELEC:FIBERGLASS,RED,0.079 OD	93410	F5B2021
	162-0520-00			FT		..INSUL SLVG,ELEC:0.034 ID,GREEN,0.079 OD	93410	F5B2031
	162-0576-00			FT		..INSUL SLVG,ELEC:0.034 ID,ORANGE,0.079 OD	93410	F5B2071
	162-0578-00			FT		..INSUL SLVG,ELEC:0.034 ID,VIOLET,0.079 OD	93410	F5B1861

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
2-194	220-0547-01			2		NUT,BLOCK:0.38 X 0.26 X 0.282 (2)4-40	000FW	OBD
						**********(ATTACHING PARTS)**********		
-195	211-0101-00			2		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						**********(END ATTACHING PARTS)**********		
	198-2257-00			1		WIRE SET,ELEC:	80009	198-2257-00
-196	131-0707-00			37		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
	352-0169-02			1		.CONN BODY,PL,EL:2 WIRE RED	80009	352-0169-00
	352-0169-04			1		.CONN BODY,PL,EL:2 WIRE YELLOW	80009	352-0169-04
-198	352-0161-01			1		.CONN BODY,PL,EL:3 WIRE BROWN	80009	352-0161-01
	352-0161-05			2		.CONN BODY,PL,EL:3 WIRE GREEN	80009	352-0161-05
-199	352-0165-03			1		.CONN BODY,PL,EL:7 WIRE ORANGE	80009	352-0165-03
	352-0165-06			1		.CONN BODY,PL,EL:7 WIRE BLUE	80009	352-0165-06
-200	352-0164-02			1		.CONN BODY,PL,EL:6 WIRE RED	80009	352-0164-02
	352-0164-07			1		.HLDR,TERM CONN:6 WIRE VIOLET	80009	352-0164-07
-201	175-0825-00			FT		.WIRE,ELECTRICAL:2 WIRE RIBBON	80009	175-0825-00
-202	175-0826-00			FT		.WIRE,ELECTRICAL:3 WIRE RIBBON	80009	175-0826-00
-203	175-0829-00			FT		.WIRE,ELECTRICAL:6 WIRE RIBBON	08261	SS-0626-710610C
-204	175-0830-00			FT		.WIRE,ELECTRICAL:7 WIRE RIBBON	08261	SS-0726-710610C

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-1	337-2194-00			1	SHIELD,ELEC:EMI,TOP	80009	337-2194-00
-2	342-0309-00			1	INSULATOR,FILM:EMI,TOP,PLASTIC	80009	342-0309-00
-3	337-2193-00			1	SHIELD,ELEC:EMI,BOTTOM	80009	337-2193-00
-4	342-0310-00			1	INSULATOR,FILM:EMI,BOTTOM:PLASTIC	80009	342-0310-00
	016-0606-00			1	MODULE:X-Y OUTPUT	80009	016-0606-00
-5	131-1726-00			3	.JACK,TIP:BLACK,W/HARDWARE	83330	256-103
-6	131-1726-01			3	.JACK,TIP:RED,W/HARDWARE	83330	21293-RED
-7	366-1368-00			2	.KNOB:PLUG-IN,SECURING	80009	366-1368-00
	----- -----			-	..EACH KNOB INCLUDES:		
	213-0076-00			1	..SETSCREW:2-56 X 0.125 INCH,HEX.SOC S	74445	OBD
-8	384-1349-00			2	.PIN,STR,THD:0.125 DIA X 6.417" LONG	80009	384-1349-00
					.**********(ATTACHING PARTS)**********		
-9	210-1011-00			2	.WASHER,NONMETAL:0.13 ID X 0.375 " OD,PLST	83309	OBD
-10	354-0538-00			2	.PACKING,PREFMD:0.119 ID X 0.125" OD,NPRN	07322	8006-366Y
-11	210-0803-00			2	.WASHER,FLAT:0.15 ID X 0.032 THK,STL CD	12327	OBD
	----- -----			-	..PIN INCLUDES:		
-12	354-0163-00			1	..RING,RETAINING:TRUARC,CAD PLATE	79136	5133-12MD
					..*********(END ATTACHING PARTS)*********		
-13	333-2021-00			1	.PANEL,FRONT:	80009	333-2021-00
-14	386-3229-00	B010100	B030819	1	.SUBPANEL,FRONT:	80009	386-3229-00
	386-3229-03	B030820		1	.SUBPANEL,FRONT:	80009	386-3229-03
					.**********(ATTACHING PARTS)**********		
-15	211-0101-00			4	.SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
					.**********(END ATTACHING PARTS)*********		
-16	----- -----			1	.CKT BOARD ASSY:X-Y MODULE(SEE A7 EPL)		
					.**********(ATTACHING PARTS)**********		
-17	211-0116-00			4	.SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
					.**********(END ATTACHING PARTS)*********		
	----- -----			1	..CKT BOARD ASSY INCLUDES:		
-18	131-0608-00			3	..TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-19	131-0993-00			1	..BUS,CONDUCTOR:2 WIRE BLACK	00779	850100-01
-20	136-0220-00	B010100	B082958	1	..SKT,PL-IN ELEK:TRANSISTOR 3 CONTACT,PCB	71785	133-23-11-034
-21	407-1633-00			1	.BRACKET,FR SECT:ALUMINUM	80009	407-1633-00
					.**********(ATTACHING PARTS)**********		
-22	211-0101-00			2	.SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
					.**********(END ATTACHING PARTS)*********		
-23	220-0547-01			4	.NUT,BLOCK:0.38 X 0.26 X 0.282 (2)4-40	000FW	OBD
					.**********(ATTACHING PARTS)**********		
-24	211-0101-00			4	.SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
					.**********(END ATTACHING PARTS)*********		
-25	426-1204-00			2	.FRAME SECTION:LEFT AND RIGHT	80009	426-1204-00
	334-1418-00			1	PLATE,INDENT:BLANK	80009	334-1418-00
-26	426-1187-02			1	SUBPANEL,FRONT:	80009	426-1187-02
					**********(ATTACHING PARTS)**********		
-27	213-0718-00			1	SCR,TPG,THD FOR:6-20 X 0.625 INCH,OVH STL	83385	OBD
-28	213-0227-00			5	SCR,TPG,THD FOR:6-32 X 0.50 DEG,FLH ST	83385	OBD
					**********(END ATTACHING PARTS)*********		
-29	----- -----			1	CKT BOARD ASSY:OUTPUT AMP(SEE A3 EPL)		
					**********(ATTACHING PARTS)**********		
-30	213-0088-00			4	SCR,TPG,THD CTG:4-24 X 0.25 INCH,PNH STL	83385	OBD
					**********(END ATTACHING PARTS)*********		
	----- -----			-	.CKT BOARD ASSEMBLY INCLUDES:		
-31	136-0252-04	B010100	B082958	27	.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-32	136-0269-02	B010100	B082958	2	.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CL	73803	CS9002-14
-33	131-0608-00			22	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0589-00			5	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-34	346-0127-00	B010100	B094903	2	STRAP,TIE DOWN:4.0" L X 0.091" WIDE	59730	TY53M
	343-0775-00	B094904		1	CLIP,SPR TNSN	TK017	343-0775-00
-35	214-1756-00			1	ACTUATOR,SWITCH:POWER	80009	214-1756-00
-36	----- -----			1	SWITCH,TOGGLE:(SEE S0165 EPL)		
-37	210-0269-00			1	TERMINAL,LUG:NON LOCKING,0.257" MTG HOLE	78584	905-020
-38	407-1590-00			1	BRACKET,ANGLE:POWER SWITCH,ALUMINUM	80009	407-1590-00
					**********(ATTACHING PARTS)**********		
-39	211-0101-00			2	SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
					**********(END ATTACHING PARTS)*********		

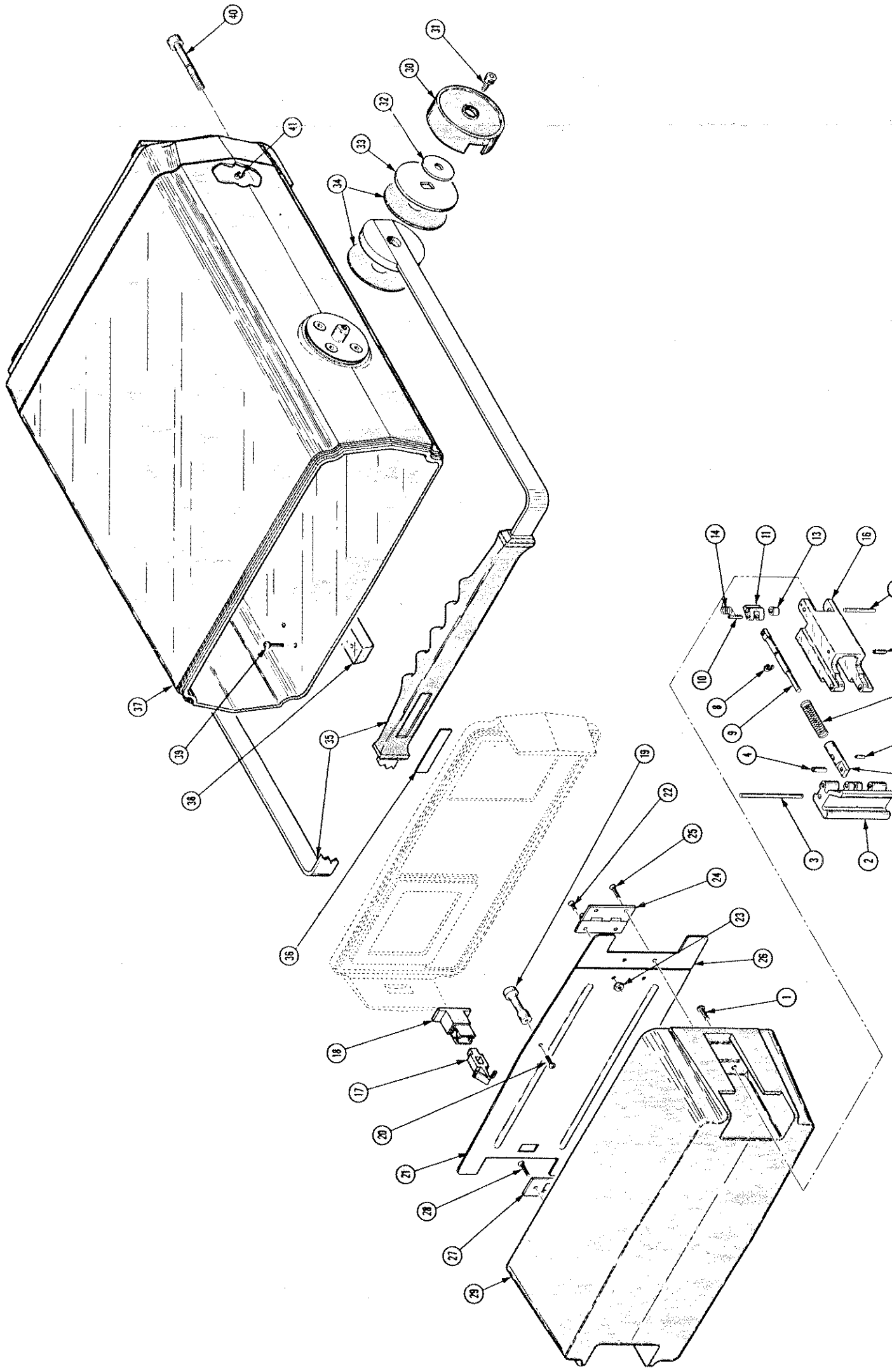
Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-40	351-0436-00			1		GUIDE,PL-IN UNI:UPPER RIGHT	80009	351-0436-00
						**********(ATTACHING PARTS)**********		
-41	213-0192-00			1		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
						**********(END ATTACHING PARTS)*********		
-42	----- -----			1		CKT BOARD ASSY:LOGIC(SEE A5 EPL)		
						**********(ATTACHING PARTS)**********		
-43	211-0008-00			4		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						**********(END ATTACHING PARTS)*********		
	----- -----			-		.CKT BOARD ASSEMBLY INCLUDES:		
-44	131-0589-00			16		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-45	136-0514-00	B010100	B082958	1		.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-46	136-0269-02	B010100	B082958	4		.SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP,LOW CL	73803	CS9002-14
-47	136-0252-04	B010100	B082958	47		.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-48	136-0263-04			10		.SOCKET,PIN TERM:FOR 0.025 INCH SQUARE PIN	22526	75377-001
-49	136-0260-02	B010100	B082958	1		.SKT,PL-IN ELEK:MICROCIRCUIT,16 DIP,LOW CL	71785	133-51-92-008
-50	214-0579-00			7		.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	162-0504-00			FT		.INSUL SLVG,ELEC:0.034 ID,BLACK,0.067 OD	93410	F5B2011
	162-0510-00			FT		.INSUL SLVG,ELEC:FIBERGLASS,RED,0.079 OD	93410	F5B2021
	162-0516-00			FT		.INSUL SLVG,ELEC:0.034 ID,YELLOW,0.079 OD	93410	F5B2041
	162-0520-00			FT		.INSUL SLVG,ELEC:0.034 ID,GREEN,0.079 OD	93410	F5B2031
	162-0524-00			FT		.INSUL SLVG,ELEC:0.034 ID,BLUE,0.079 OD	93410	F5B2051
	162-0576-00			FT		.INSUL SLVG,ELEC:0.034 ID,ORANGE,0.079 OD	93410	F5B2071
	162-0578-00			FT		.INSUL SLVG,ELEC:0.034 ID,VIOLET,0.079 OD	93410	F5B1861
-51	220-0729-00			1		NUT BLOCK:0.25 X 0.471 INCH LONG	80009	220-0729-00
						**********(ATTACHING PARTS)**********		
-52	211-0101-00			1		SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
						**********(END ATTACHING PARTS)*********		
	334-2452-00			1		MARKER,IDENT:MKD DANGER 165V	80009	334-2452-00
-53	351-0435-00			1		GUIDE,PL-IN:LOVER LEFT	80009	351-0435-00
						**********(ATTACHING PARTS)**********		
-54	213-0192-00			1		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
						**********(END ATTACHING PARTS)*********		
-55	131-1165-00			1		CONNECTOR,RCPT,.15 PIN FEMALE,FLOATING	71468	DAF-15S
						**********(ATTACHING PARTS)**********		
-56	211-0034-00			2		SCREW,MACHINE:2-56 X 0.50 INCH,PNH	83385	OBD
-57	361-0742-00			2		SPACER,SLEEVE:0.094 ID X 0.2 INCH LONG	80009	361-0742-00
						**********(END ATTACHING PARTS)*********		
-58	134-0014-00			2		PLUG,TIP:MALE	74970	023-0026-001
						**********(ATTACHING PARTS)**********		
-59	210-0457-00			2		NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
-60	210-0202-00			2		TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
-61	210-0975-00			2		WSHR,SHOULDERED:0.14 ID X 0.247" OD,PLSTC	80009	210-0975-00
-62	210-0933-00			2		WASHER,NONMETAL:0.625"DIA,0.002 MICA	08530	OBD
						**********(END ATTACHING PARTS)*********		
-63	343-0089-00			1		CLAMP,LOOP:LARGE	80009	343-0089-00
-64	343-0213-00			1		CLAMP,LOOP:0.2 ID,PLASTIC	80009	343-0213-00
-65	348-0064-00			1		GROMMET,PLASTIC:0.625 INCH DIA	80009	348-0064-00
-66	348-0417-00			1		GROMMET,PLASTIC:0.75 INCH DIA	80009	348-0417-00
-67	----- -----			1		CKT BOARD ASSY:POWER(SEE A6 EPL)		
						**********(ATTACHING PARTS)**********		
-68	211-0008-00			4		SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
						**********(END ATTACHING PARTS)*********		
	----- -----			-		.CKT BOARD ASSEMBLY INCLUDES:		
-69	136-0514-00	B010100	B082958	4		.SKT,PL-IN ELEC:MICROCIRCUIT,8 DIP	73803	CS9002-8
-70	136-0252-04	B010100	B082958	42		.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
	136-0352-00			8		.CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50462-7
-71	131-0589-00			5		.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-72	131-0608-00			21		.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
	131-0590-00			2		.CONTACT,ELEC:0.71 INCH LONG	22526	47351
-73	214-0579-00			7		.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
	334-2451-00			1		MARKER,IDENT:MKD DANGER 2KV	80009	334-2451-00
-74	----- -----			1		CKT BOARD ASSY:HIGH VOLTAGE(SEE A4 EPL)		
						**********(ATTACHING PARTS)**********		
-75	211-0116-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH BRS	83385	OBD
						**********(END ATTACHING PARTS)*********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
3-	----- -----			-	.CKT BOARD ASSEMBLY INCLUDES:		
-76	136-0252-04	B010100	B082958	6	.SOCKET,PIN TERM:U/W 0.016-0.018 DIA PINS	22526	75060-007
-77	131-0589-00			7	.TERMINAL,PIN:0.46 L X 0.025 SQ	22526	48283-029
-78	131-0608-00			5	.TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-79	214-0579-00			2	.TERM,TEST POINT:BRS CD PL	80009	214-0579-00
-80	129-0541-00			1	POST,ELEC-MECH:1.53" L W/4-40 THD,NYLON	80009	129-0541-00
	334-2501-00			1	MARKER,IDENT:MKD CAUTION 48 TO 410HZ	80009	334-2501-00
-81	----- -----			1	XFMR,PWR,STPDN:(SEE T0389 EPL)		
					**********(ATTACHING PARTS)**********		
-82	210-0457-00			1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
-83	210-0202-00			1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
-84	211-0529-00			1	SCREW,MACHINE:6-32 X 1.25 INCHES,PNH STL	83385	OBD
-85	211-0628-00			3	SCREW,MACHINE:6-32 X 1.125 INCH,PNH,STL	83385	OBD
-86	210-1133-00			4	WASHER,FLAT:0.142 ID X 0.058 THK,FBR	80009	210-1133-00
					**********(END ATTACHING PARTS)**********		
-87	358-0329-00			10	BSHG,FEED THRU:FUSEHOLDER TERM,DELRIN	80009	358-0329-00
-88	131-0513-03			10	TERM,FEEDTHRU:0.89 L X 0.025 SQ EA END	00779	1-86074-3
-89	131-1360-00			1	CONN,RCPT,ELEC:CKT BD,10/20 CONTACT	05574	600201-3197
					**********(ATTACHING PARTS)**********		
-90	210-0406-00			2	NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-91	210-0201-00			2	TERMINAL,LUG:0.12 ID,LOCKING,BRZ TIN PL	86928	OBD
-92	211-0014-00			2	SCREW,MACHINE:4-40 X 0.50 INCH,PNH STL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-93	220-0547-01			1	NUT,BLOCK:0.38 X 0.26 X 0.282 (2)4-40	000FW	OBD
					**********(ATTACHING PARTS)**********		
-94	211-0008-00			1	SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-95	441-1262-00			1	CHAS,TDR UNIT:MAIN	80009	441-1262-00
					**********(ATTACHING PARTS)**********		
-96	211-0008-00			8	SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-97	256-0570-00			1	SILICA,PULVERIZ:2.375 INCH DIA	87664	X1009-43G
					**********(ATTACHING PARTS)**********		
-98	211-0513-00			1	SCREW,MACHINE:6-32 X 0.625 INCH,PNH STL	83385	OBD
-99	210-0055-00			1	WASHER,LOCK:SPLIT,0.145 ID X 0.253 OD,S	83385	OBD
-100	407-1694-00			1	BRACKET,RTNR:ALUMINUM	80009	407-1694-00
					**********(END ATTACHING PARTS)**********		
-101	129-0562-00			1	POST,RETAINER:0.892 INCH LONG X 0.375 HEX	80009	129-0562-00
					**********(ATTACHING PARTS)**********		
-102	211-0097-00			1	SCREW,MACHINE:4-40 X 0.312 INCH,PNH STL	83385	OBD
	211-0033-00			1	SCR,ASSEM WSHR:4-40 X 0.312 PNH,STL,CD PL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-103	131-1084-01			1	CONNECTOR,RCPT,:3 BLADE,6A,250V,W/0.203 ID	80009	131-1084-01
					**********(ATTACHING PARTS)**********		
-104	210-0586-00			2	NUT,PL,ASSEM WA:4-40 X 0.25,STL	83385	OBD
-105	211-0012-00			2	SCREW,MACHINE:4-40 X 0.375,PNH STL CD PL	83385	OBD
-106	210-0994-00			2	WASHER,FLAT:0.125 ID X 0.25" OD,STL	86928	5702-201-20
-107	361-0764-00			2	SPACER,SLEEVE:0.135 INCH L X 0.132 ID,BRS	80009	361-0764-00
					**********(END ATTACHING PARTS)**********		
-108	220-0547-01			3	NUT,BLOCK:0.38 X 0.26 X 0.282 (2)4-40	000FW	OBD
					**********(ATTACHING PARTS)**********		
-109	211-0101-00			3	SCREW,MACHINE:4-40 X 0.25,100 DEG,FLH STL	83385	OBD
					**********(END ATTACHING PARTS)**********		
-110	210-0202-00			1	TERMINAL,LUG:0.146 ID,LOCKING,BRZ TINNED	78189	2104-06-00-2520N
					**********(ATTACHING PARTS)**********		
-111	210-0457-00	B010100	B059999	1	NUT,PL,ASSEM WA:6-32 X 0.312,STL CD PL	83385	OBD
	210-0407-00	B060000		2	NUT,PLAIN,HEX.:6-32 X 0.25 INCH,BRS	73743	3038-0228-402
-112	211-0507-00			1	SCREW,MACHINE:6-32 X 0.312 INCH,PNH STL	83385	OBD
					**********(END ATTACHING PARTS)**********		
	334-2529-00			1	MARKER,IDENT:MKD CAUTION,BATTERY PACK	80009	334-2529-00
-113	386-3154-01			1	PANEL,REAR:	80009	386-3154-01
					**********(ATTACHING PARTS)**********		
-114	213-0192-00			5	SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
					**********(END ATTACHING PARTS)**********		
					**********(END ATTACHING PARTS)**********		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
3-115	426-1184-00			1		FRAME SECT,TDR:LEFT	80009	426-1184-00
-116	426-1185-00			1		FRAME SECT,TDR:CENTER	80009	426-1185-00
-117	426-1186-00			1		FRAME SECT,TDR:RIGHT	80009	426-1186-00
-118	179-2178-00	B010100	B040879	1		WIRING HARNESS,:FRONT PANEL	80009	179-2178-00
	179-2178-01	B040880		1		WIRING HARNESS,:FRONT PANEL	80009	179-2178-01
-119	131-0707-00			34		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
-120	352-0169-03			1		.CONN BODY,PL,EL:2 WIRE ORANGE	80009	352-0169-03
	352-0169-06			1		.CONN BODY,PL,EL:2 WIRE BLUE	80009	352-0169-06
-121	352-0161-01			1		.CONN BODY,PL,EL:3 WIRE BROWN	80009	352-0161-01
	352-0162-02			2		.CONN BODY,PL,EL:4 WIRE RED	80009	352-0162-02
	352-0161-06			1		.CONN BODY,PL,EL:3 WIRE BLUE	80009	352-0161-06
	352-0161-07			1		.CONN BODY,PL,EL:3 WIRE VIOLET	80009	352-0161-07
-122	352-0165-03			1		.CONN BODY,PL,EL:7 WIRE ORANGE	80009	352-0165-03
	352-0165-07			1		.CONN BODY,PL,EL:7 WIRE VIOLET	80009	352-0165-07
	198-2386-00			1		WIRE SET,ELEC:	80009	198-2386-00
	131-0707-00			7		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
	131-0621-00			3		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	46231
-123	352-0171-04			1		.CONN BODY,PL,EL:1 WIRE YELLOW	80009	352-0171-04
	352-0161-01			1		.CONN BODY,PL,EL:3 WIRE BROWN	80009	352-0161-01
	352-0161-09			1		.CONN BODY,PL,EL:3 WIRE WHITE	80009	352-0161-09
-124	352-0199-03			1		.CONN BODY,PL,EL:3 WIRE ORANGE	80009	352-0199-03
	198-2796-00			1		WIRE SET,ELEC:	80009	198-2796-00
	131-0707-00			9		.CONNECTOR,TERM:22-26 AWG,BRS & CU BE GOLD	22526	47439
	175-0830-00			FT		.WIRE,ELECTRICAL:7 WIRE RIBBON	08261	SS-0726-710610C
	352-0165-04			1		.CONN BODY,PL,EL:7 WIRE YELLOW	80009	352-0165-04
	352-0169-01			1		.HLDR TERM CONN:2 WIRE,BROWN	80009	352-0169-01
	179-2349-00	B010100	B082957	1		WIRING HARNESS,:AC	80009	179-2349-00
	175-2492-00	B082958		1		CA ASSY,SP,ELEC:4,22 AWG,17.0 L	80009	175-2492-00
	195-0389-00	B082959		1		LEAD,ELECTRICAL:18 AWG,4.0 L,5-4	80009	195-0389-00

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5 Name & Description	Mfr Code	Mfr Part Number
4-	016-0595-00	B010100	B089999	1	BATTERY SET:	80009	016-0595-00
	016-0595-01	B090000		1	BATTERY SET:	80009	016-0595-01
					**********(ATTACHING PARTS)**********		
-1	214-1573-00			2	THUMBSCREW:6-32 X 0.656 INCH LONG,SST	06540	6130-SS-0632
-2	210-1160-00			2	WASHER,FLAT:0.129 ID X 0.031 THK,TEFLON	86928	5612-32-31
					**********(END ATTACHING PARTS)**********		
	----- -----			-	BATTERY PACK ASSY INCLUDES:		
-3	333-1990-00			1	..PANEL,FRONT:	80009	333-1990-00
					..**********(ATTACHING PARTS)**********		
-4	211-0198-00			4	..SCREW,MACHINE:4-40 X 0.438 PNH,STL,POZ	77250	OBD
-5	213-0267-00			2	..SCREW,MACHINE:4-24 X 0.375 INCH,PNH STL	83385	OBD
					..**********(END ATTACHING PARTS)**********		
-6	348-0432-00			1	..GASKET:FRONT PANEL	80009	348-0432-00
-7	337-2862-00			1	..SHIELD,ELEC:CRT	80009	337-2862-00
					..**********(ATTACHING PARTS)**********		
-8	211-0008-00			4	..SCREW,MACHINE:4-40 X 0.250,PNH,STL,CD PL	83385	OBD
					..**********(END ATTACHING PARTS)**********		
-9	343-0349-01			2	..CLAMP,BAT RTNG:W/HOLES,DELRIN	80009	343-0349-01
					..**********(ATTACHING PARTS)**********		
-10	210-0406-00			4	..NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	12161-50
-11	211-0194-00			4	..SCREW,MACHINE:4-40 X 47.5MM,PNH,ST	0000M	211-0194-00
					..**********(END ATTACHING PARTS)**********		
-12	361-0776-00			4	..SPACER,SLEEVE:1.248 L X 0.118 ID,NYLON	80009	361-0776-00
-13	214-2344-00			1	..HEAT SINK,ELEC:BATTERY SUPPLY,LOWER,AL	80009	214-2344-00
-14	----- -----			1	..CKT BOARD ASSY:POWER FUSE JACK(SEE A9 RE		
-15	136-0352-00			4	..CONTACT,ELEC:FOR 0.02 INCH DIAMETER PIN	00779	50462-7
-16	386-2435-00			2	..PLATE,METALLIC:W/TAPS	0000M	386-2435-00
-17	146-0018-01			1	..BATTERY SET:10.8V,1.5AH,9 C CELLS	19209	41B002K33G1
-18	214-2343-00			1	..HEAT SINK,ELEC:BATTERY SUPPLY,UPPER,AL	80009	214-2343-00

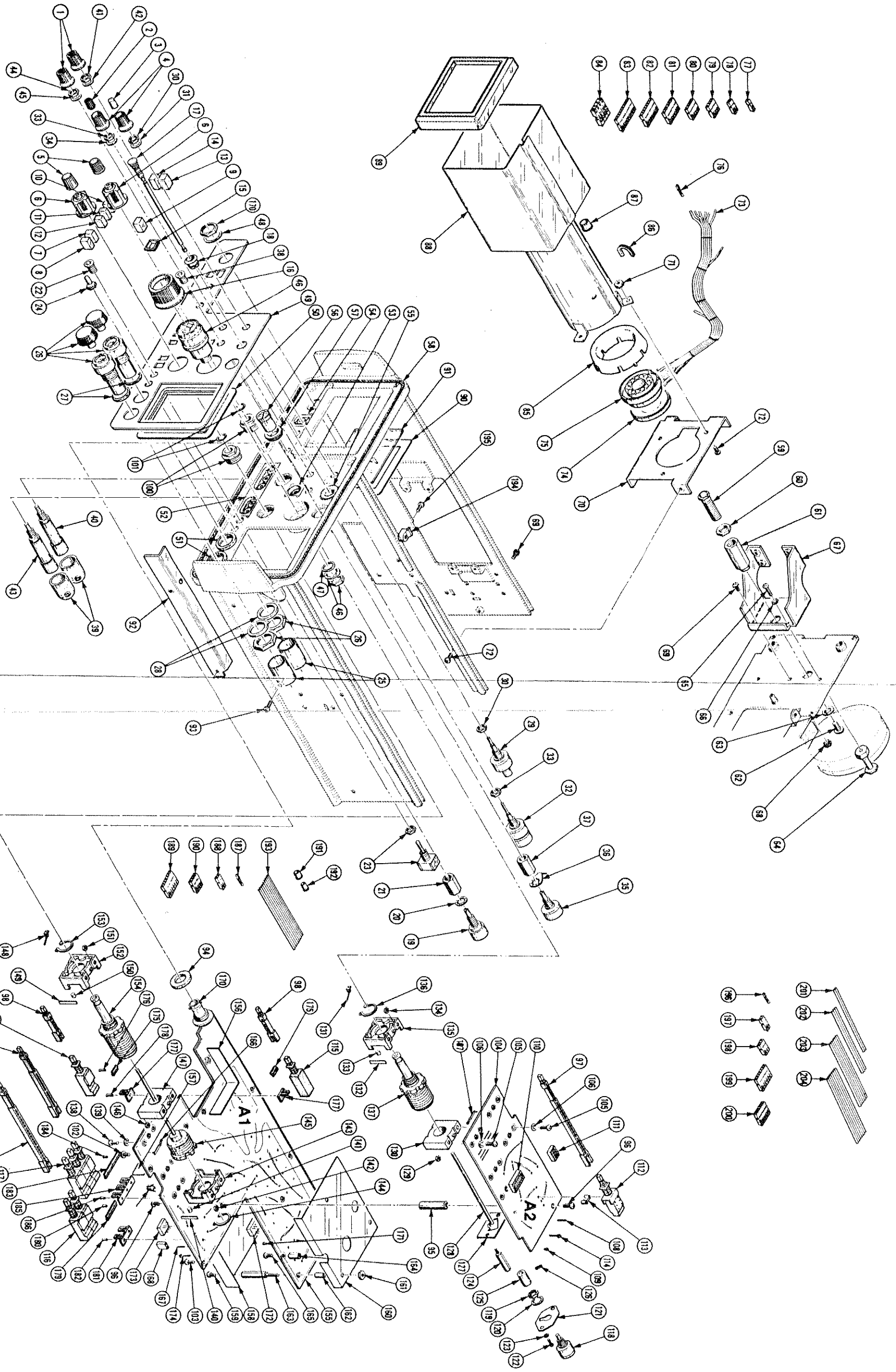
FIG 1 CABINET



1503 TIME DOMAIN REFLECTOMETER

REV A DEC 1980

1503 TIME DOMAIN REFLECTOMETER



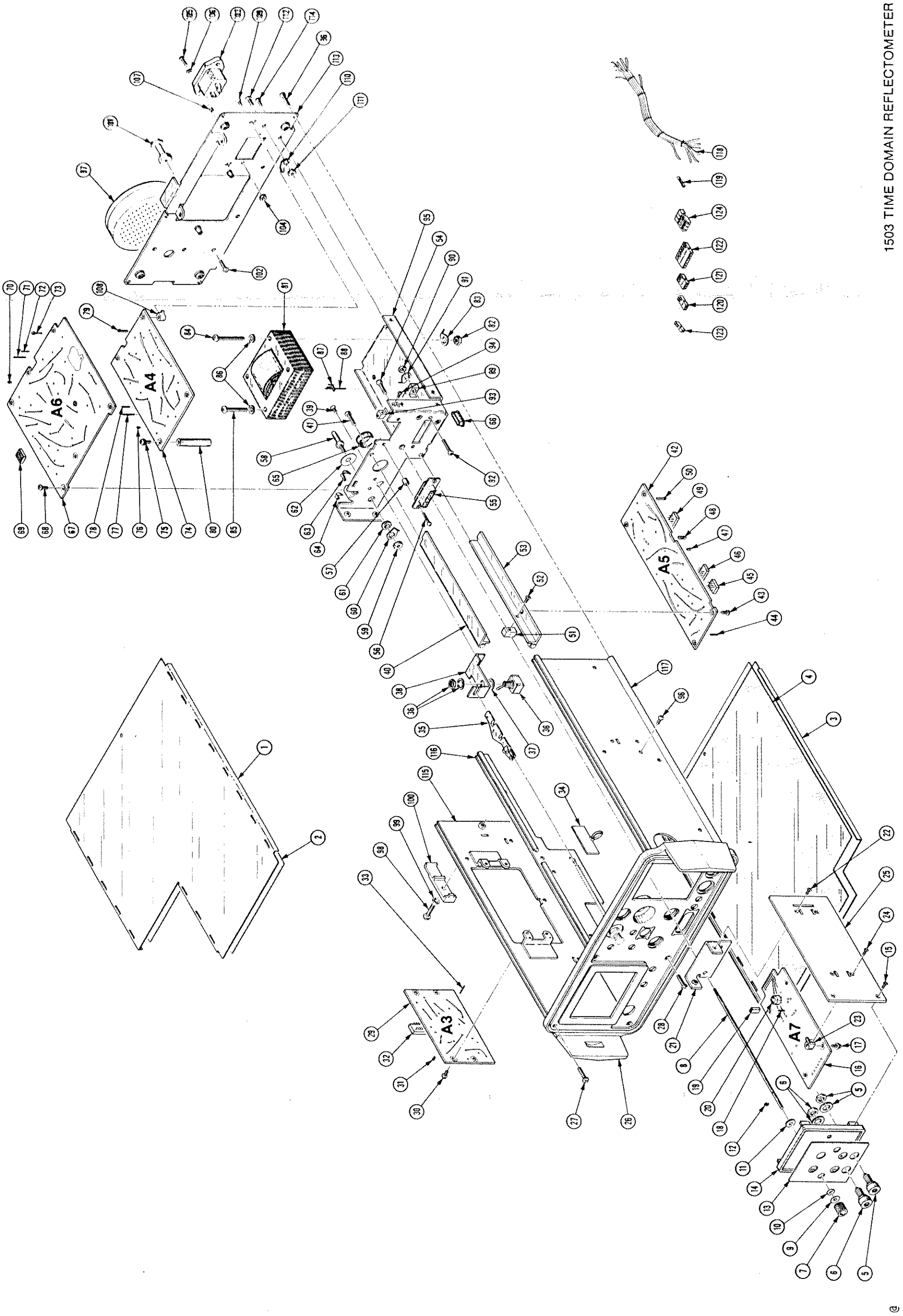
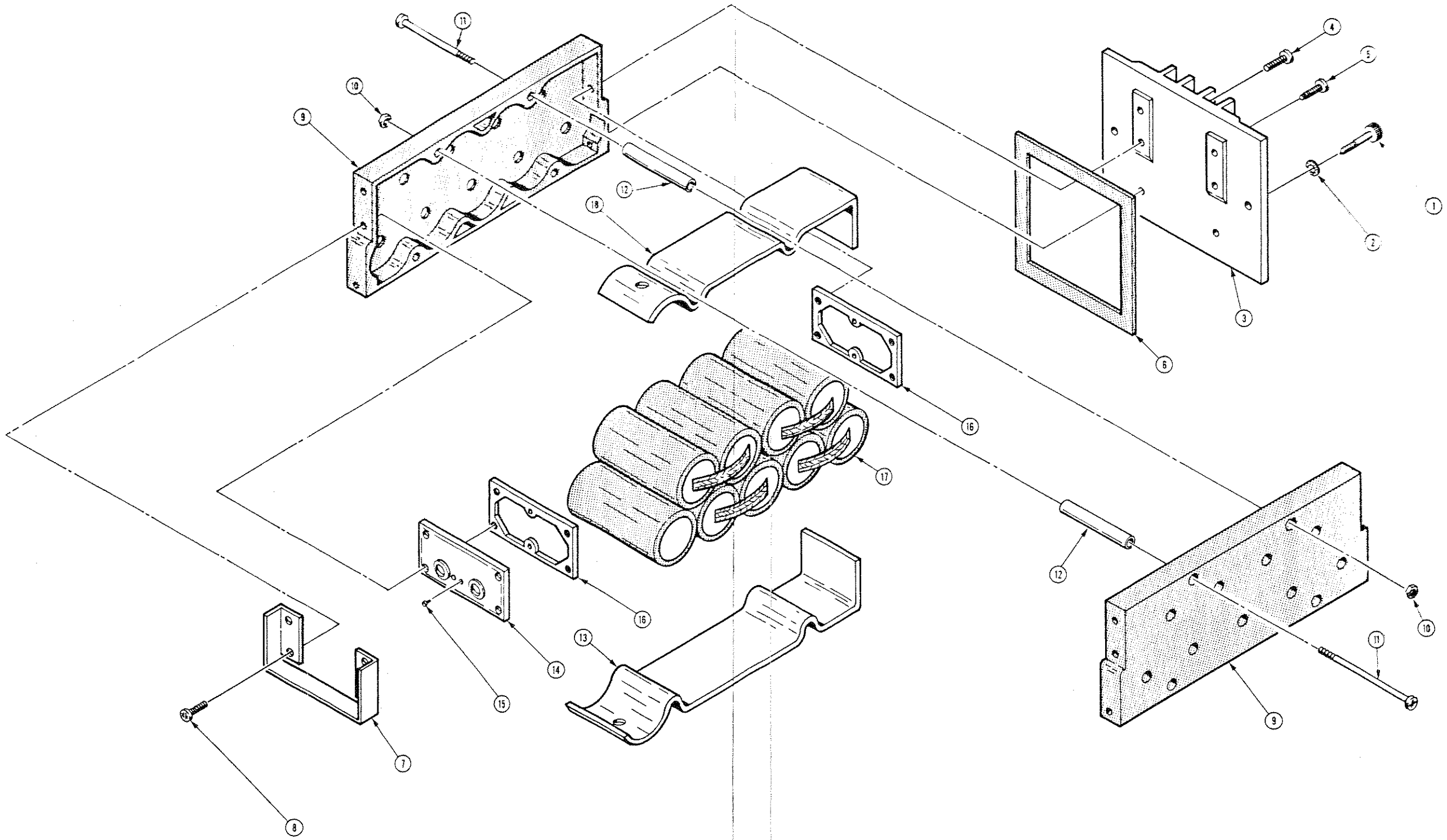

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FIG. 4. BATTERY PACK



@ DEC 1980

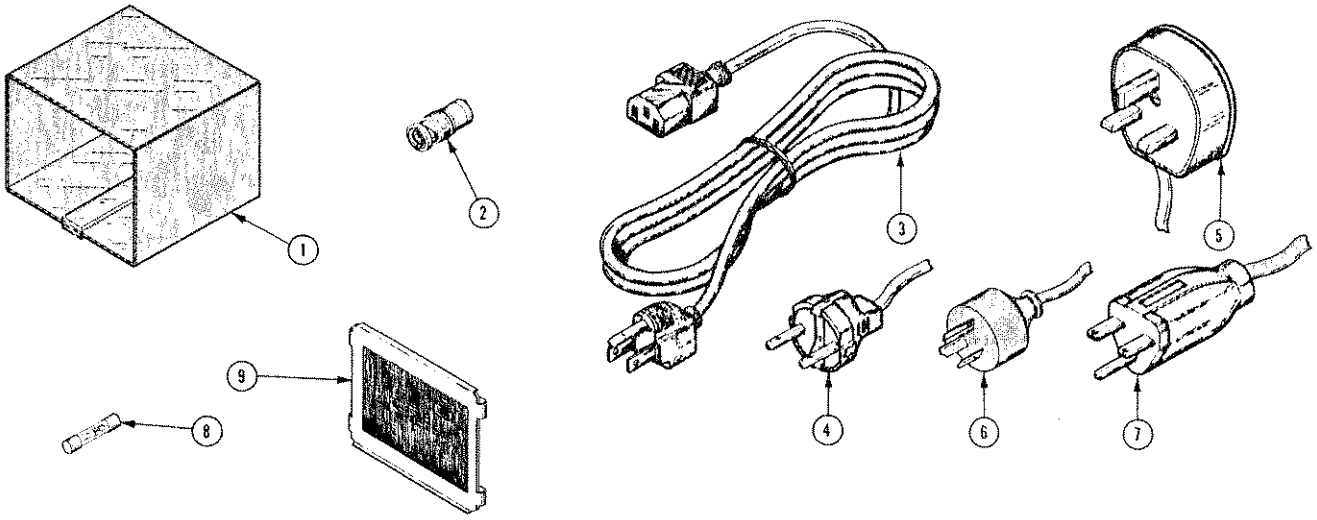


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty 1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
					STANDARD ACCESSORIES		
-1	016-0297-00			1	VISOR,CRT:	80009	016-0297-00
-2	011-0123-00			1	CONNECTOR,PLUG,:50 OHM,BNC	80009	011-0123-00
-3	161-0066-00			1	CABLE ASSY,PWR,:3,18 AWG,115V,98.0 L	16428	KH8481
-4	161-0066-09	XB102860		1	CABLE ASSY,PWR:3,0.75MM SQ,220V,96.0 L	80126	OBD
	----- -----			-	(OPTION A1 EUROPEAN ONLY)		
-5	161-0066-10	XB102860		1	CABLE ASSY,PWR:3,0.75MM SQ,240V,96.0 L	80126	OBD
	----- -----			-	(OPTION A2 UNITED KINGDOM ONLY)		
-6	161-0066-11	XB102860		1	CABLE ASSY,PWR:3,0.75MM,240V,96.0L	S3109	OBD
	----- -----			-	(OPTION A3 AUSTRALIAN ONLY)		
-7	161-0066-12	XB102860		1	CABLE ASSY,PWR:3,18 AWG,240V,96.0 L	80126	OBD
	----- -----			-	(OPTION A4 NORTH AMERICAN ONLY)		
-8	159-0029-00	B010100	B049999	1	FUSE,CARTRIDGE:3AG,0.3A,250V,SLOW-BLOW	71400	MDL3/10
	159-0032-00	B050000		1	FUSE,CARTRIDGE:3AG,0.5A,250V,SLOW-BLOW	71400	MDL 1/2
	159-0054-00	B010100	B049999	1	FUSE,CARTRIDGE:3AG,0.15A,250V,SLOW-BLOW	71400	MDL 15/100
	159-0029-01	B050000		1	FUSE,CARTRIDGE:BUSSMAN ONLY	71400	MDL3/10
-9	378-0055-00			1	FILTER,MESH:CRT	80009	378-0055-00
	016-0606-00			1	MODULE:X-Y OUTPUT	80009	016-0606-00
	070-1864-01			1	MANUAL,TECH:OPERATORS	80009	070-1864-01
	070-1865-01			1	MANUAL,TECH:INSTRUCTION	80009	070-1865-01
	012-0671-02	XB020320		1	CABLE,INTCON:108.0 INCHES L	80009	012-0671-02
	003-0700-01	XB040840		1	RULE,SLIDE:TIME DOMAIN REFLECTOMETER	80009	003-0700-01
					OPTIONAL ACCESSORIES		
	011-0102-00			1	TERMN,COAXIAL:75 OHM,BNC	80009	011-0102-00
	013-0076-00			1	ADAPTER,CONN:BNC FEMALE TO CLIP LEADS	80009	013-0076-00
	016-0327-00			1	ADAPTER,CAMERA:EXTENSION	80009	016-0327-00
	017-0063-00			1	ADAPTER,CONN:BNC TO GR	24655	0874-9700
	017-0064-00			1	ADAPTER,CONN:TYPE BNC TO GR,MALE	24655	0874-9800-QBPA
	017-0090-00			1	FIXTURE,CAL:50 OHM TO 125OHM	80009	017-0090-00
	017-0091-00			1	FIXTURE,CAL:50 OHM TO 75 OHM	80009	017-0091-00
	017-0092-00			1	ADPTR,TDR IMPD:50 OHM TO 93 OHM	80009	017-0092-00
	103-0015-00			1	ADAPTER,CONN:BNC TO UHF	95712	470-3NT34
	103-0090-00			1	ADAPTER,CONN:FEMALE TO DUAL MALE BANANA	05276	1269
	103-0029-00			1	ADAPTER,CONN:BNC MALE TO MALE	80009	103-0029-00
	103-0032-00			1	ADAPTER,CONN:BNC MALE TO UHF FEMALE	24931	29-JP116-1
	103-0035-00			1	ADAPTER,CONN:BNC DUAL BINDING POST	05276	1296
	103-0058-00			1	ADAPTER,CONN:N FEMALE TO BNC MALE	91836	KN99-46TR5
	103-0169-00			1	ADAPTER,CONN:PROBE	80009	103-0169-00
	012-0671-03	XB020320		1	CABLE,INTCON:360.0 INCHES L	80009	012-0671-03
	013-0169-00	XB020320		1	ADAPTER ASSY:ISLN XFMR,BALANCED OUTPUT	80009	013-0169-00
	015-0327-00			1	FILTER,DIR CUR:	80009	015-0327-00

MANUAL CHANGE INFORMATION

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

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

A single change may affect several sections. 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 following this page, your manual is correct as printed.

Tektronix
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MANUAL CHANGE INFORMATION

Date: 3-31-82 Change Reference: M38055

Product: 1503 Manual Part No.: 070-1865-01

DESCRIPTION

EFF SN B090000

ELECTRICAL PARTS LIST CHANGE

ADD:

F9100	159-0124-00	FUSE,WIRE LEAD:3A,125V,0.05SEC

Tektronix
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MANUAL CHANGE INFORMATION

Date: 6-24-82 Change Reference: M44546

Product: see below Manual Part No.: see below

DESCRIPTION

EFF SN B113810 (070-1792-01) 1502

EFF SN B094380 (070-1865-01) 1503

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

A3	670-3130-04	CKT BOARD ASSY:OUTPUT AMPLIFIER
R3112	321-0263-00	RES.,FXD,FILM:5.36K OHM,1%,0.125W
R3114	321-0178-00	RES.,FXD,FILM:698 OHM,1%,0.125W
R3115	321-0178-00	RES.,FXD,FILM:698 OHM,1%,0.125W

The above parts are located on the OUTPUT AMPS BD and shown on diagram 4 OUTPUT AMPL & HIGH VOLTAGE CIRCUITS

TEKTRONIX MANUALS CHANGE INFORMATION

Date: 12/14/83

Product: 1503 TDR Service Product Group 22

Manual Part Number: 070-1865-01

Change Reference: IMCR120883 (Text changes)

DESCRIPTION

Pages 4-12 & 4-13, Section Headed: X-Y OUTPUT MODULE
Should read as follows:

Connect the 50Ω terminator to the 1503 CABLE connector.

Control Settings

RET LOSS	0 dB
NOISE FILTER	Out
0-dB SET	4 div pulse
DISTANCE Dial	000
FEET/DIV	.5
(METERS/DIV)	(1)
Multiplier	X10 (X1)
CABLE DIELECTRIC	SOLID POLY
IMPLS WIDTH	10

TEKTRONIX MANUALS CHANGE INFORMATION

Date 8/3/83
Product 1503 Opt.1
Manual Part No. 070-1865-01
Change Reference M44994

DESCRIPTION

Eff. S/N B094858

CHANGE:

198-2386-00 Wire Set, Elec. (Fig&Index #-122)

to

1ea 175-5732-00 CA Assy,SP,Elec, 3, 26AWG, 15.0L, 9N
1ea 195-5904-00 Lead, Elec, 22AWG, 10.0L, 9-03
1ea 198-4722-00 Wire Set, Elec.

Date: 10/3/83
Product: 1503 Option 1 and Option 5
Manual Part Number: 070-1865-01
Change Reference: M45135

DESCRIPTION

Eff S/N: B094920

Electrical Parts List- Standard and Option 5

Values for R1317 are reversed between standard and option 5

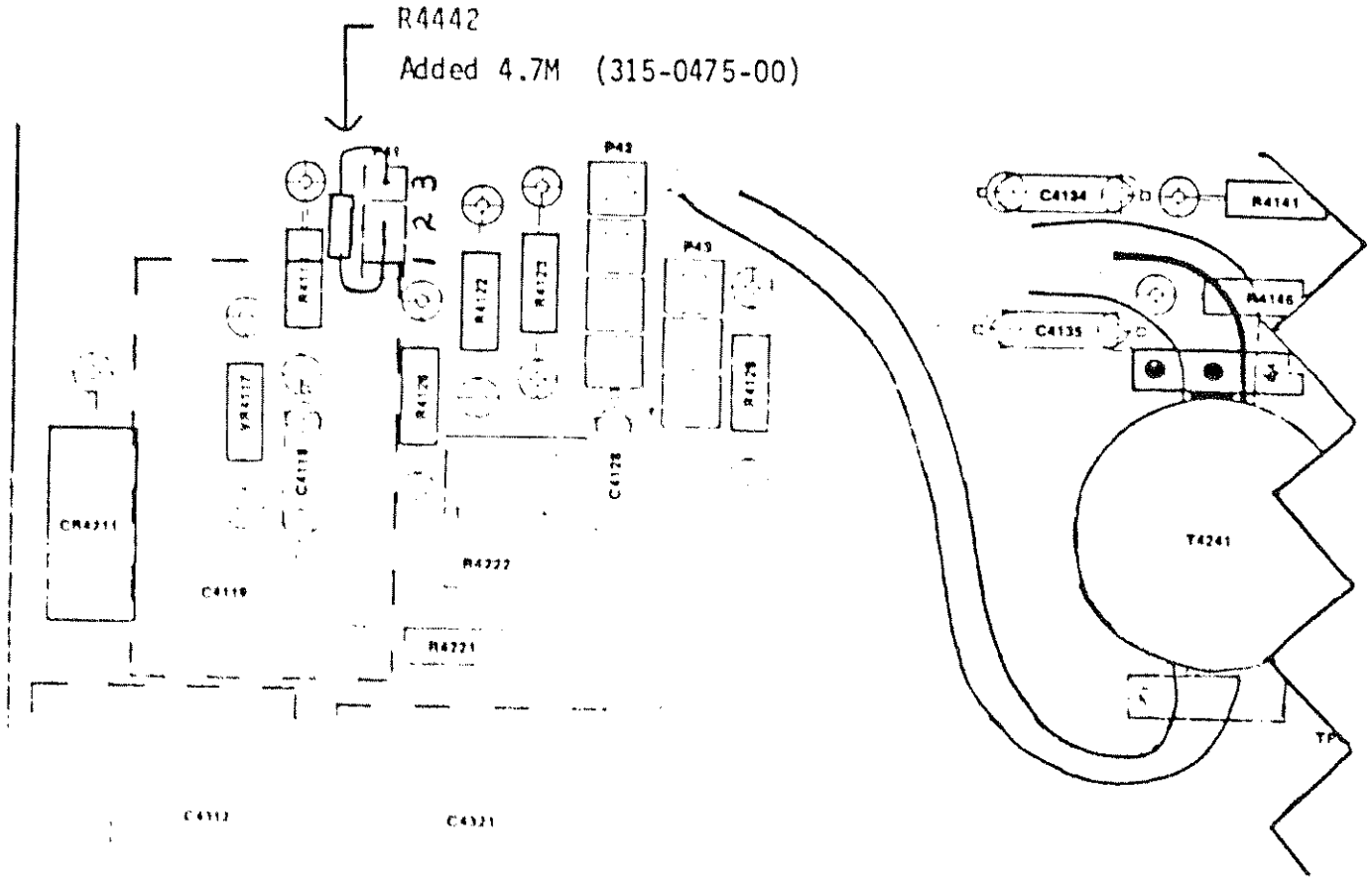
REMOVE

R1317	315-0243-00	RES.,FXD,CMPSN:24K OHM,5%,0.25W (OPTION 5 ONLY)
R1317	315-0563-00	RES.,FXD,CMPSN:56K OHM,5%,0.25W

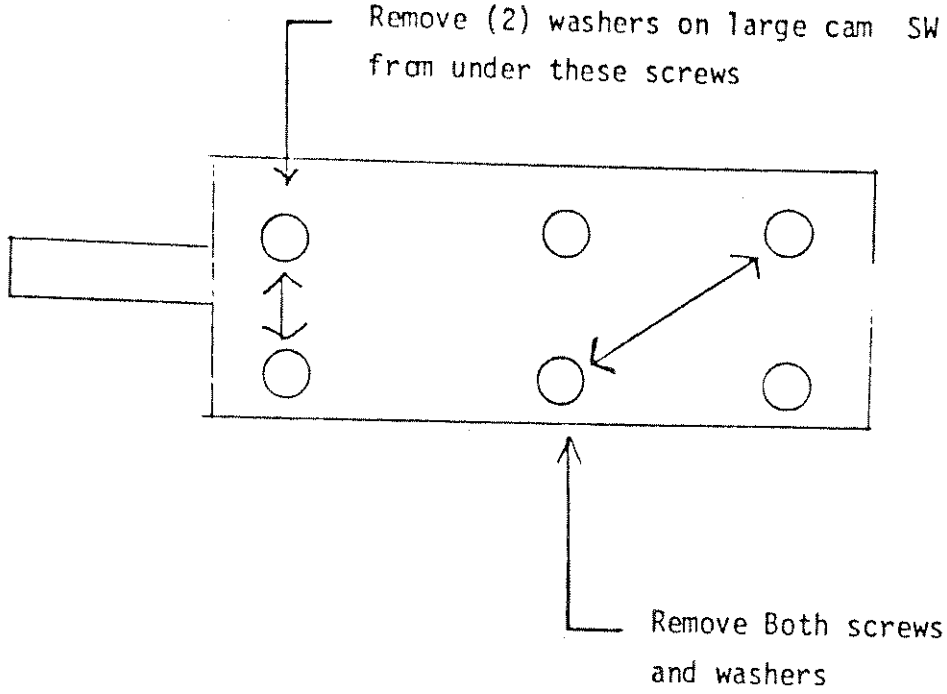
ADD

R1317	315-0243-00	RES.,FXD,CMPSN:24K OHM,5%,0.25W
R1317	315-0563-00	RES.,FXD,CMPSN:56K OHM,5%,0.25W (OPTION 5 ONLY)

Sweep Generator Ckt Brd 670-3010-03 (Partial View)
Schematics are correct in 1503 Manual Option 1 info. (Parts List correct)



Mechanical: 1503 Main Board Option 1



TEKTRONIX MANUALS CHANGE INFORMATION

Date: 12/6/83

Product: 1503 TDR Product Group 22

Manual Part Number: 070-1865-01

Change Reference: Text changes (IMC request)20843

DESCRIPTION

==========

Page 4-9, 11. Timing
Delete:
Paragraph f. CHECK - For 8 time marks in 7.9 divisions.
Change:
Paragraph g. ADJUST...
to:
Paragraph f. ADJUST...

ADD:

NOTE

If the instrument is to be used with the optional Chart Recorder, continue with the remainder of this step. If the instrument is not to be used with a chart recorder, proceed with Step 12.

g. CHECK - That the chart paper in the recorder has a bold line next to the hole in the paper that shows a red line through the hole. If the red line is not aligned with a bold line on the chart paper, pull enough chart paper through the recorder to line them up.

h. PRESS - The RECORD switch to obtain a recording of the time marks. The recording should show the same timing as seen on the CRT between the second and tenth graticule lines, ±2%.

i. ADJUST - R3213 (H POS - located on the OUTPUT AMP board) and R3217 (HORIZ GAIN - located on OUTPUT AMP board) to match the timing and position of the time marks on the CRT to the chart recording.

Page. 4-8, Step 9. Horizontal Gain and OFFSET
Change: c. ADJUST - R3221...
to c. ADJUST - R3213...

Page 7-3, Replacable Electrical Parts-1503
REMOVE:

A4	670-3010-00	B010100	B069999	CKT BOARD ASSY:SWEEP GEN
A4	670-3010-01	B070000	B082958	CKT BOARD ASSY:SWEEP GEN
A4	670-3010-02	B082959		CKT BOARD ASSY:SWEEP GEN

ADD:

A4	670-3010-00	B010100	B069999	CKT BOARD ASSY:HIGH VOLTAGE POWER
A4	670-3010-01	B070000	B082958	CKT BOARD ASSY:HIGH VOLTAGE POWER
A4	670-3010-02	B082959		CKT BOARD ASSY:HIGH VOLTAGE POWER

TEKTRONIX MANUALS CHANGE INFORMATION

Date: Feb 8, 1984

Product: 1502/1503 Service/1500 Sealing Procedures Product Group 22

Manual Part Number: 070-1792-01 / 070-1865-01 / 070-2178-00

Change Reference: CNA 0178

DESCRIPTION

Change:

All references to RTV sealant 3144 should be RTV 3145.

Part number 006-2302-00 is valid now for RTV 3145, clear silicone sealant (remove 3144 entirely).

Date: Aug.16,1984
Product: 1503 TDR
Manual Part Number: 070-1865-01
Change Reference: IMC 840816

DESCRIPTION

Effective S/N: N/R

Text change to CALIBRATION PROCEDURE:

Page 4-2, Part 1, Step c., change "200 Hz sine wave" to read "50-100 Hz square wave."

Page 4-6, Part 5, Step c., change "200 Hz sine wave" to read "50-100 Hz square wave."

Schematic 1, grid C-3, resistor labelled R1127 should be R1227

ADD:

Page 7-4, Replaceable Electrical Parts

CR1574 152-0169-00 SEMICOND DEVICE:TUNNEL,1mA,10pF 03508 STD962

(this device is located on schematic 2, E-11 (Sampler Comparator section of Pulser/Sampler Board)

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