Service Manual

Tektronix

1502C
Metallic Time-Domain Reflectometer

071-0678-00

ST642-AB-MMC-020
0910-LP-017-6840

This document applies for firmware version 5.02 and above.

Warning
The servicing instructions are for use by qualified personnel only. To avoid personal injury, do not perform any servicing unless you are qualified to do so. Refer to the Safety Summary prior to performing service.

Serial Number: B020000 and Above

Print Date: November 1999

Instrument Serial Numbers

Each instrument manufactured by Tektronix has a serial number on a panel insert or tag, or stamped on the chassis. The first letter in the serial number designates the country of manufacture. The last five digits of the serial number are assigned sequentially and are unique to each instrument. Those manufactured in the United States of America have six unique digits. The country of manufacture is identified as follows:

B010000	Tektronix, Inc., Beaverton, Oregon, U.S.A.
E200000	Tektronix United Kingdom, Ltd., London, England
J300000	Sony/Tektronix, Japan
H700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Instruments manufactured for Tektronix by external vendors outside the United States are assigned a two-digit alpha code to identify the country of manufacture (e.g., JP for Japan, HL for Honk Kong, IL for Israel, etc.).

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

Printed in U.S.A.

FCC Class A Device

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a commercial environment. This equipment generated, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

Changes or modification not expressly approved by Tektronix can affect emission compliance, and could void the user's authority to operate this equipment.

The 1502C Metallic Time-Domain Reflectometer was designed and manufactured by:

Tektronix, Inc.
100 S.E. Wilson Ave.
Bend, Oregon 97702 U.S.A
Phone: 1-800-835–9433

EC Declaration of Conformity

We Tektronix Holland N.V.
Marktweg 73A
8444 AB Heerenveen
The Netherlands

declare under sole responsibility that the

Tektronix 1502C Metallic Time-Domain Reflectometer

meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the official Journal of the European Communities:

EN 50081–1 Emissions	
EN 55011	Radiated, Class A
EN 55011	Conducted, Class A
EN 60555–2	Power Harmonics
EN 50082–1 Immunity:	
IEC 801–2	Electrostatic Discharge
IEC 801–3	RF Radiated
IEC 801–4	Fast Transients
IEC 801–5	Surge

Australia / New Zealand Declaration of Conformity

EMC Complies with EMC provision of Radiocommunications per the following standard(s):

AN/NZS 2064. 1/2 Industrial, Scientific, and Medical Equipment: 1992

Certificate of the Manufacturer/Importer

We hereby certify that the Tektronix 1502C Metallic TDR complies with the RF Interference Suppression requirements of Amtsbl.-Vfg 1046/1984. The German Postal Service was notified that the equipment is being marketed. The German Postal Service has the right to re-test the series and to verify that it complies.

TEKTRONIX

Bescheinigung des Herstellers/Importeurs

Hiermit wird bescheinigt, daβ das Tektronix 1502C Metallic TDR Übereinstimmung mit den Bertimmungen der Amtsblatt-Verfügung 1046/1984 funkentstört ist. Der Deutschen Bundespost wurde das Inverkehrbringen dieses Gerätes angezeigt und die Bereschtigung zur Überprufung der Serie auf Einhalten der Bestimmungen eingeraümt.

TEKTRONIX

NOTICE to the user/operator:

The German Postal Service requires that this equipment, when used in a test setup, may only be operated if the requirements of Postal Regulation, Vfg. 1046/1984, Par. 2, Sect. 1.7.1 are complied with.

HINWEIS für den Benutzer/Betreiber:

Dieses Gerät darf in Meβaufbauten nur betrieben werden, wenn die Voraussetzungen des Par. 2, Ziff. 1.7.1 der Vfg. 1046/1984 eingehalten werden.

NOTICE to the user/operator:

The German Postal Service requires that systems assembled by the operator/user of this instrument must also comply with Postal Regulation, Vfg. 243/1991, Par. 2, Sect. 1.

HINWEIS für den Benutzer/Betreiber:

Die vom Betreiber zusammengestellte Anlage, innerhalb derer dieses Gerät eingesetzt wird, muß ebenfalls den Voraussetzungen nach Par. 2, Ziff. 1 der Vfg. 243/1991, genügen.

WARRANTY

Tektronix warrants that this product will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If any such product proves defective during this warranty period, Tektronix, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange for the defective product.

In order to obtain service under this warranty, Customer must notify Tektronix of the defect before the expiration of the warranty period and make suitable arrangements for the performance of service. Customer shall be responsible for packaging and shipping the defective product to the service center designated by Tektronix, with shipping charges prepaid. Tektronix shall pay for the return of the product to Customer if the shipment is to a location within the country in which the Tektronix service center is located. Customer shall be responsible for paying all shipping charges, duties, taxes, and any other charges for products returned to any other locations.

This warranty shall not apply to any defect, failure or damage caused by improper use or improper or inadequate maintenance and care. Tektronix shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than Tektronix representatives to install, repair or service the product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TEKTRONIX WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TEKTRONIX AND ITS VENDORS DISCLAIM ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TEKTRONIX' RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCTS IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TEKTRONIX AND ITS VENDORS WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TEKTRONIX OR THE VENDOR HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

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General Safety Summary

The safety information in this summary is for operating personnel. Specific warnings and cautions will be found throughout the manual where they apply, but might not appear in this summary. For specific service safety information, see page xiii.

Safety Terms and Symbols

Terms in this manual:

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

CAUTION. *Caution statements identify conditions or practices that could result in damage to this product or other property.*

Terms on the Product:

DANGER indicates an injury hazard immediately accessible as you read the marking.

WARNING indicates an injury hazard not immediately accessible as you read the marking.

CAUTION indicates a hazard to property including the product.

Symbols in the Manual:

WARNING or CAUTION
Information

Symbols on the Product:

DANGER High Voltage

Protective Ground (Earth) Terminal

ATTENTION Refer to Manual

Double Insulated

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 the 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 appear to be insulating) can render an electric shock.

Use the Proper Power Cord

Use only the power cord and connector specified for this product. Do not use this instrument without a rated AC line cord.

The standard power cord (161–0288–00) is rated for outdoor use. *All other optional power cords are rated for indoor use only.*

Use only a power cord that is in good condition.

Refer cord and connector changes to qualified service personnel.

Use the Proper Fuse

To avoid fire hazard, use only a fuse of the correct type.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmosphere

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

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

Only qualified personnel should perform service procedures. Read this *Service Safety Summary* and the *General Safety Summary* before performing any service procedures.

Do Not Service Alone

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

Disconnect Power

To avoid electric shock, disconnect the main power by means of the power cord or the power switch.

Use Care When Servicing With Power On

Dangerous voltages or currents may exist in this product. Disconnect power, remove battery, and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Disposal of Batteries

This instrument contains a lead-acid battery. Some states and/or local jurisdictions might require special disposition/recycling of this type of material in accordance with Hazardous Waste guidelines. Check your local and state regulations prior to disposing of an old battery.

Tektronix Factory Service will accept 1502C batteries for recycling. If you choose to return the battery to us for recycling, the battery cases must be intact, the battery should be packed with the battery terminals insulated against possible short-circuits, and should be packed in shock-absorbant material.

Send batteries, post-paid, to:

Tektronix, Inc.
Attn: Bend Service
100 S.E. Wilson Ave.
Bend, OR 97702

For additional information, phone: 1–800–TEK-WIDE ext. 2400.

General Information

Product Description

The Tektronix 1502C Metallic-cable Time-Domain Reflectometer (MTDR) is a cable test instrument that uses radar principles to determine the electrical characteristics of metallic cables.

The 1502C generates a half-sine wave signal, applies it to the cable under test, and detects and processes the reflected voltage waveform. These reflections are displayed in the 1502C liquid crystal display (LCD), where distance measurements may be made using a cursor technique. Impedance information may be obtained through interpreting waveform amplitude.

The waveform may be temporarily stored within the 1502C and recalled or may be printed using the optional dot matrix strip chart recorder, which installs into the front-panel Option Port.

Battery Operation

The 1502C may be operated from an AC power source or an internal lead-gel battery, which supplies a minimum of eight hours operating time (see the *Specifications* chapter for specifics).

Options

Options available for the 1502C are explained in the *Options and Accessories* chapter of this manual.

Standards, Documents, and References Used

Terminology used in this manual is in accordance with industry practice. Abbreviations are in accordance with ANSI Y1.1–19722, with exceptions and additions explained in parentheses in the text. Graphic symbology is based on ANSI Y32.2–1975. Logic symbology is based on ANSI Y32.14–1973 and manufacturer's data books or sheets. A copy of ANSI standards may be obtained from the Institute of Electrical and Electronic Engineers, 345 47th Street, New York, NY 10017.

Changes and History Information

Changes that involve manual corrections and/or additional data will be incorporated into the text and that page will show a revision date on the inside bottom edge. History information is included in any diagrams in gray.

Installation and Repacking

Unpacking and InItial Inspection

Before unpacking the 1502C from its shipping container or carton, inspect for signs of external damage. If the carton is damaged, notify the carrier. The shipping carton contains the basic instrument and its standard accessories. Refer to the replaceable parts list in the Service Manual for a complete listing.

If the contents of the shipping container are incomplete, if there is mechanical damage or defect, or if the instrument does not meet operational check requirements, contact your local Tektronix Field Office or representative. If the shipping container is damaged, notify the carrier as well as Tektronix.

The instrument was inspected both mechanically and electrically before shipment. It should be free if mechanical damage and meet or exceed all electrical specifications. Procedures to check operational performance are in the Performance Checks appendix. These checks should satisfy the requirements for most receiving or incoming inspections.

Power Source and Power Requirements

The 1502C is intended to be operated 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.

The AC power connector is a three-way polarized plug with the ground (earth) lead connected directly to the instrument frame to provide electrical shock protection. If the unit is connected to any other power source, the unit frame must be connected to earth ground.

Power and voltage requirements are printed on the back panel. The 1502C can be operated from either 115 VAC or 230 VAC nominal line voltage at 45 Hz to 440 Hz, or a 12 VDC supply, or an internal battery.

Further information on the 1502C power requirements can be found in the Safety Summary in this section and in the Operating Instructions chapter.

Repacking for Shipment

When the 1502C is to be shipped to a Tektronix Service Center for service or repair, attach a tag showing the name and address of the owner, name of the individual at your firm who may be contacted, the complete serial number of the instrument, and a description of the service required. If the original packaging is unfit for use or is not available, repackage the instrument as follows:

1. Obtain a carton of corrugated cardboard having inside dimensions that are at least six inches greater than the equipment dimensions to allow for cushioning. The test strength of the shipping carton should be 275 pounds (102.5 kg). Refer to the following table for test strength requirements:

SHIPPING CARTON TEST STRENGTH

Gross Weight (lb)	Carton Test Strength (lb)
0 – 10	200
11 – 30	275
31 – 120	375
121 – 140	500
141 – 160	600

CAUTION. *The battery pack should be removed from the instrument before shipping. If it is necessary to ship the battery, it should be wrapped and secured separately before being packed with the instrument.*

2. Install the front cover on the 1502C and surround the instrument with polyethylene sheeting to protect the finish.

3. Cushion the instrument on all sides with packing material or urethane foam between the carton and the sides of the instrument.

4. Seal with shipping tape or an industrial stapler.

If you have any questions, contact your local Tektronix Field Office or representative.

Operating Instructions

Overview

Handling

The 1502C front panel is protected by a watertight cover, in which the standard accessories are stored. Secure the front cover by snapping the side latches outward. If the instrument is inadvertently left on, installing the front cover will turn off the POWER switch automatically.

The carrying handle rotates 325° and serves as a stand when positioned beneath the instrument.

Inside the case, at the back of the instrument, is a moisture-absorbing canister containing silica gel. In extremely wet environments, it might be be necessary to periodically remove and dry the canister. This procedure is explained in the *1502C Service Manual*.

The 1502C can be stored in temperatures ranging from –62° C to +85° C. However, if the temperature is below –40° C or above +55° C, the battery pack should be removed and stored separately. Battery storage temperature should be –40° C to +55° C.

Powering the 1502C

In the field, the 1502C can be powered using the internal battery. For AC operation, check the rear panel for proper voltage setting. The voltage selector can be seen through the window of the protective cap. If the setting differs from the voltage available, it can be easily changed. Simply remove the protective cap and select the proper voltage using a screwdriver.

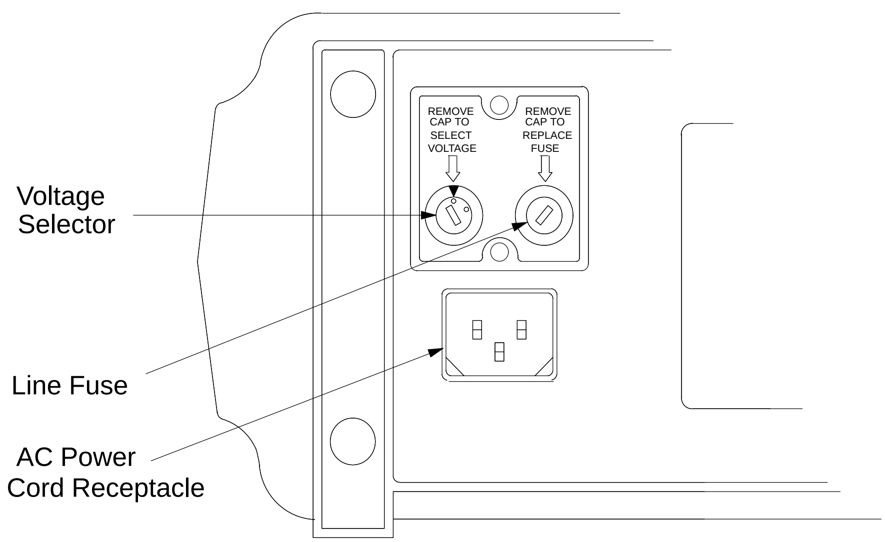


Figure 1–1: Rear Panel Voltage Selector, Fuse, AC Receptacle

The 1502C is intended to be operated from a power source that will not apply more than 250 V 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.

The AC power connector is a three-way polarized plug with the ground (earth) lead connected to the instrument frame to provide electrical shock protection. If the unit is connected to any other power source, the unit frame must be connected to an earth ground. See Safety and Installation section.

⚠ ***CAUTION.*** *If you change the voltage selector, you must change the line fuse to the appropriate value as listed near the fuse holder and in the table below.*

FUSE RATING	VOLTAGE RATING
250 V	*NOMINAL RANGE*
0.3 A T	115 VAC (90 – 132 VAC)
0.15 A T	230 VAC (180 – 250 VAC)

Care of the Battery Pack

⚠ ***CAUTION.*** *Read these instructions concerning the care of the battery pack. They contain instructions that reflect on your safety and the performance of the instrument.*

The 1502C can be powered by a rechargeable lead-gel battery pack that is accessible only by removing the case from the instrument. When AC power is applied, the battery pack is charged at a rate that is dependent on the battery charge state.

The battery pack will operate the 1502C for a minimum of eight continuous hours (including making 30 chart recordings) if the LCD backlight is turned off.

Battery Charging

The battery pack will charge fully in 16 hours when the instrument is connected, via the power cord, to an AC power source with the instrument turned off. The instrument may be turned on and operated while the batteries are charging, but this will increase the charging time. For longest battery life, a full charge is preferred over a partial charge.

For maximum capacity, the batteries should be charged within a temperature range of +20° C to +25° C. However, the batteries can be charged within a temperature range of 0° C to +40° C and operated in temperatures ranging from –10° C to +55° C.

CAUTION. *Do not charge battery pack below 0° C or above +40° C. Do not discharge battery pack below –10° C or above +55° C. If removing the battery pack during or after exposure to these extreme conditions, turn the instrument off and remove the AC power cord.*

The battery pack should be stored within a temperature range of –35° C to +65° C. However, the self-discharge rate will increase as the temperature increases.

If the instrument is stored with the battery pack installed, the battery pack should be charged every 90 days. A fully charged battery pack will lose about 12% of its capacity in three to four months if stored between +20° C and +25° C.

NOTE. *The battery pack in the 1502C is inside the instrument case with no external access. Refer removal and replacement to qualified service personnel.*

Battery Removal

1. Ensure that the instrument power is off.
2. If the instrument is connected to an AC power source, remove the AC power cable from the source and from the instrument.
3. If installed, remove the chart recorder, or other device, from the option port.
4. Loosen the four screws on the back of the case and set the instrument face-up on a flat surface.
5. Swing the handle out of the way of the front panel.
6. Break the chassis seal by pushing downward with both hands on the handle pivots on each side of the case..
7. Grasp the case with one hand and tilt the chassis out with the other. Lift by grasping the outside perimeter of the front panel.

CAUTION. *Do not lift the instrument by the front-panel controls. The controls will be damaged if you do so.*

8. Remove the top shield from the instrument by gently lifting the rear edge near the sides of the instrument.
9. Unplug the battery cable positive lead at the battery.
10. Unplug the battery cable negative lead at the battery.
11. Unplug the battery cable at the power supply.
12. Remove the cable.

13. Remove the two screws mounting the battery clamp to the chassis.

14. Carefully remove the clamp without touching the battery terminals.

15. Lift the battery out.

To re-install or replace the battery, repeat the above steps in reverse order.

Low Battery

If the battery is low, it will be indicated on the LCD (bat/low). If this is the case, protective circuitry will shut down the 1502C within minutes. Either switch to AC power or work very fast. If the instrument is equipped with a chart recorder, using the recorder will further reduce the battery level, or the added load might shut down the instrument.

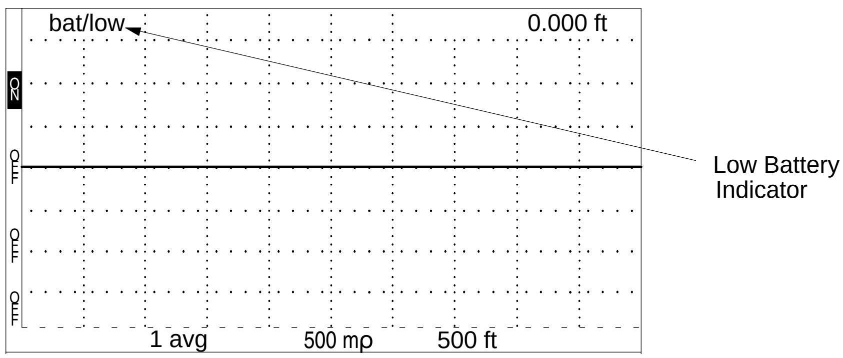


Figure 1–2: Display Showing Low Battery Indication

Protection circuits in the charger prevent deep discharge of the batteries during instrument operation. The circuits automatically shut down the instrument whenever battery voltage falls below approximately 10 V. If shutdown occurs, the batteries should be fully recharged before further use.

***NOTE**. Turn the POWER switch off after instrument shutdown to prevent continued discharge of the batteries.*

Under low AC voltage conditions, AC fuse ratings might be exceeded if the battery if fully discharged and a chart recording is being made. Allow the battery to charge for about one hour before attempting to make a chart recording, or use AC only.

Low Temperature Operation

When operating the 1502C in an environment below +10° C, a heater will activate. The element is built into the LCD module and will heat the display to permit normal operation. Depending on the surrounding temperature, it might take up to 15 minutes to completely warm the crystals in the LCD. Once warmed, the display will operate normally.

Preparing to Use the 1502C

Check the power requirements, remove the front cover, and you are ready to test cables. The following pages explain the front-panel controls.

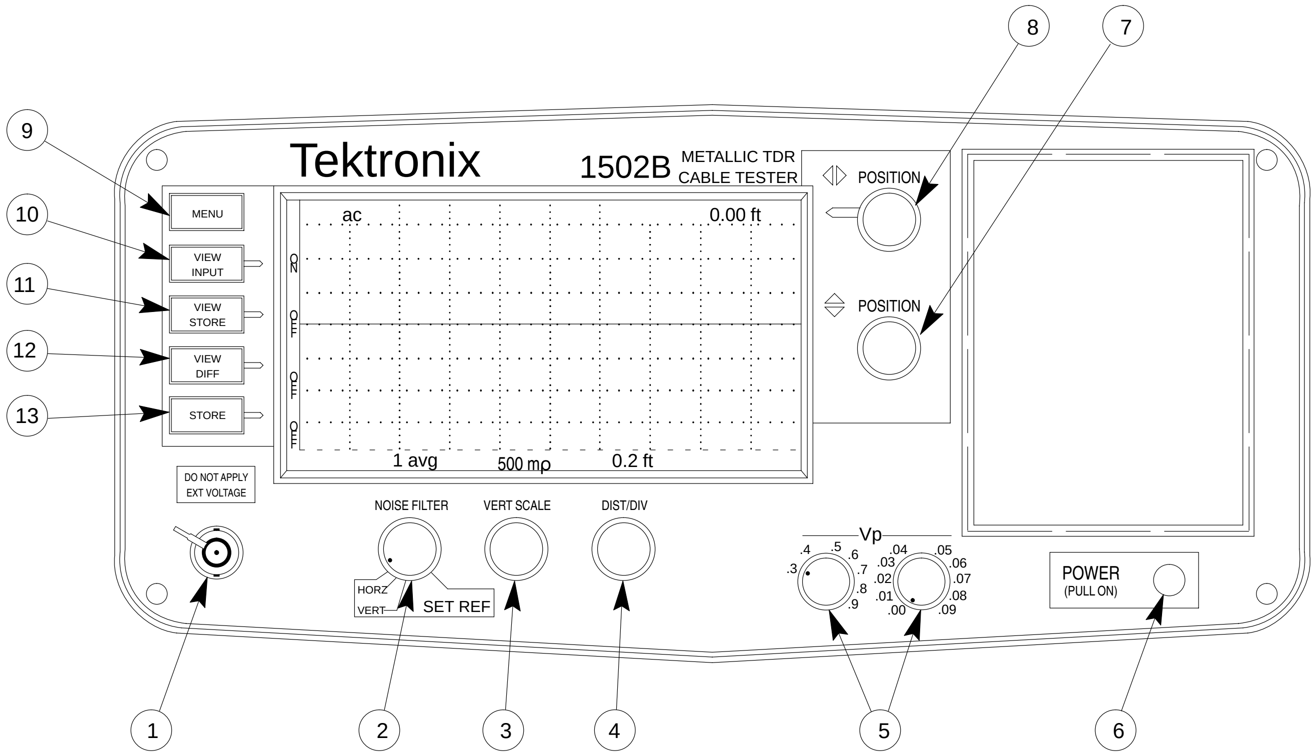


Figure 1–3: 1502C Front-Panel Controls

⚠ ***CAUTION.*** *Do not connect live circuits to the CABLE connector. Voltages exceeding 5 volts can damage the driver or sampler circuits.*

Bleed the test cable of any residual static charge before attaching it to the instrument. To bleed the cable, connect the standard 50Ω terminator and standard female-to-female BNC connector together, then temporarily attach both to the cable. Remove the connectors before attaching the cable to the instrument.

When testing receiving antenna cables, avoid close proximity to transmitters. Voltages may appear on the cable if a nearby transmitter is in use, resulting in damage to the instrument. Before testing, be sure that there are no RF voltages present, or disconnect the cable at both ends.

Display

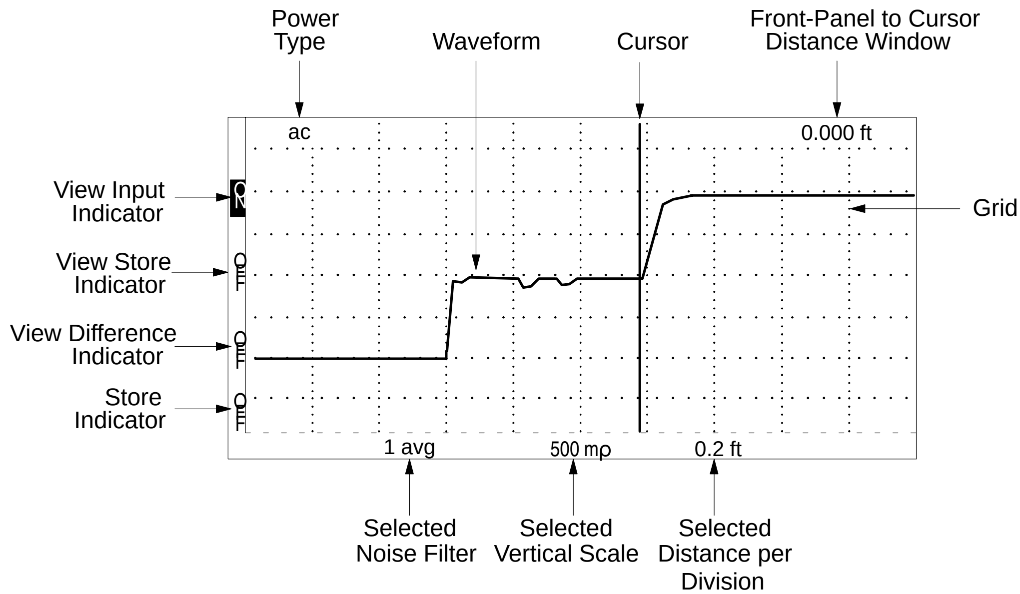
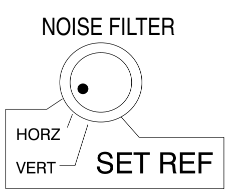


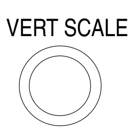
Figure 1–4: Display and Indicators

Front-Panel Controls

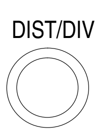
1. **CABLE:** A female BNC connector for attaching a cable to the 1502C for testing.



2. **NOISE FILTER:** If the displayed waveform is noisy, the apparent noise can be reduced by using noise averaging. Averaging settings are between 1 and 128. The time for averaging is directly proportional to the averaging setting chosen. A setting of 128 might take the instrument up to 35 seconds to acquire and display a waveform. The first two positions on the NOISE FILTER control are used for setting the vertical and horizontal reference points. The selected value or function is displayed above the control on the LCD.

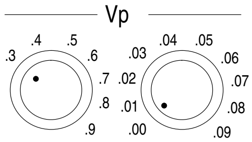


3. **VERT SCALE:** This control sets the vertical sensitivity, displayed in mρ per division, or the vertical gain, displayed in dB. Although the instrument defaults to millirho, you may choose the preferred mode from the *Setup Menu*. The selected value is displayed above the control on the LCD.

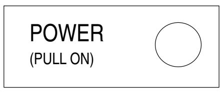


4. **DIST/DIV:** Determines the number of feet (or meters) per division across the display. The minimum setting is 0.1 ft/div (0.025 meters) and the maximum setting is 200 ft/div (50 meters). The selected value is displayed above the control on the LCD.

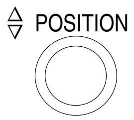
   A standard instrument defaults to ft/div. A metric instrument (Option 05) defaults to m/div, but either may be changed temporarily from the menu. The default can be changed by changing an internal jumper (see *1502C Service Manual* and always refer such changes to qualified service personnel).



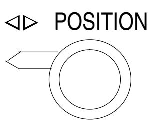
5. **Vp:** The two Velocity of Propagation controls are set according to the propagation velocity factor of the cable being tested. For example, solid polyethylene commonly has a Vp of 0.66. Solid polytetraflourethylene (Teflon ®) is approximately 0.70. Air is 0.99. The controls are decaded: the left control is the first digit and the right control is the second digit. For example, with a Vp of 0.30, the first knob would be set to .3 and the second knob to .00.



6. **POWER:** Pull for power ON and push in for power OFF. When the front cover is installed, this switch is automatically pushed OFF.

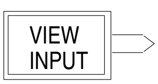


7. △▽ **POSITION:** This is a continuously rotating control that positions the displayed waveform vertically, up or down the LCD.

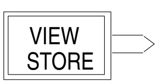


8. ◁▷ **POSITION:** This is a continuously rotating control that moves a vertical cursor completely across the LCD graticule. In addition, the waveform is also moved when the cursor reaches the extreme right or left side of the display. A readout (seven digits maximum) is displayed in the upper right corner of the LCD, showing the distance from the front panel BNC to the current cursor location.

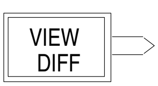
9. **MENU:** This pushbutton provides access to the menus and selects items chosen from the menus.



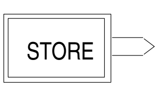
10. **VIEW INPUT:** When pushed momentarily, this button toggles the display of the waveform acquired at the CABLE connector. This function is useful to stop displaying a current waveform to avoid confusion when looking at a stored waveform. This function defaults to ON when the instrument is powered up.



11. **VIEW STORE:** When pushed momentarily, this button toggles the display of the stored waveform.



12. **VIEW DIFF:** When pushed momentarily, this button toggles the display of the current waveform minus the stored waveform and shows the difference between them.



13. **STORE:** When pushed momentarily, the waveform currently displayed will be stored in the instrument memory. If a waveform is already stored, pushing this button will erase it. The settings of the stored waveform are available from the first level menu under *View Stored Waveform Settings*.

Menu Selections

There are several layers of menu, as explained below.

Main Menu

The Main Menu is entered by pushing the MENU button on the front panel.

1. **Return to Normal Operations** puts the instrument into normal operation mode.

2. **Help with Instrument Controls** explains the operation of each control. When a control or switch is adjusted or pushed, a brief explanation appears on the LCD.

3. **Cable Information** has these choices:

   a. **Help with Cables** gives a brief explanation of cable parameters.

   b. **Velocity of Propagation Values** displays a table of common dielectrics and their Vp values. These are nominal values. The manufacturer's listed specifications should be used whenever possible.

   c. **Impedance Values** displays impedances of common cables. In some cases, these values have been rounded off. Manufacturer's specifications should be checked for precise values.

   d. **Finding Unknown Vp Values** describes a procedure for finding an unknown Vp.

4. **Setup Menu** controls the manner in which the instrument obtains and displays its test results.

   a. **Acquisition Control Menu** has these choices:

      i. **Max Hold Is: On/Off**. Turn Max Hold on by pushing MENU then STORE. In this mode, waveforms are accumulated on the display. Max Hold can be deactivated by pushing STORE or the mode exited by using the Setup Menu.

      ii. **Pulse Is: On/Off.** Turns the pulse generator off so the 1502C does not send out pulses.

      iii. **Single Sweep Is: On/Off.** This function is much like a still camera; it will acquire one waveform and hold it.

   b. **Ohms-at-Cursor is: On/Off.** When activated, the impedance at thee point of the cursor is displayed beneath the distance window on the display.

   c. **Vertical Scale Is: dB/mρ**. This offers you a choice as to how the vertical gain of the instrument is displayed. You may choose decibels or millirho. When powered down, the instrument will default to millirho when powered back up.

   d. **Distance/Div Is: ft/m**. Offers you a choice of how the horizontal scale is displayed. You may choose from feet per division or meters per division. When powered up, the instrument will default to feet unless the internal jumper has been moved to the meters position. Instructions on changing this default are contained in the *1502C Service Manual*.

   e. **Light Is: On/Off**. This control turns the electroluminescent backlight behind the LCD on or off.

5. **Diagnostics Menu** lists an extensive selection of diagnostics to test the operation of the instrument.

NOTE*. The Diagnostics Menu is intended for instrument repair and calibration. Proper instrument setup is important for correct diagnostics results. Refer to the 1502C Service Manual for more information on diagnostics.*

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   a. **Service Diagnostics Menu** has these choices:

      i. **Sampling Efficiency Diagnostic** displays a continuous efficiency diagnostic of the sampling circuits.

      ii. **Noise Diagnostic** measures the internal RMS noise levels of the instrument.

      iii. **Offset/Gain Diagnostic** reports out-of–tolerance steps in the programmable gain stage. This can help a service technician to quickly isolate the cause of waveform distortion problems.

      iv. **RAM/ROM Diagnostics Menu** performs tests on the RAM (Random Access Memory) and the ROM (Read Only Memory).

      v. **Timebase Is: Normal - Auto Correction / Diagnostic - No Correction**. When in *Normal - Auto Correction*, the instrument compensates for variations in temperature and voltage. This condition might not be desirable while calibrating the instrument. While in *Diagnostic - No Correction*, the circuits will not correct for these variations.

   b. **Front Panel Diagnostics** aids in testing the front panel.

   c. **LCD Diagnostics Menu** has these choices:

      i. **LCD Alignment Diagnostic** generates a dot pattern of every other pixel on the LCD. These pixels can be alternated to test the LCD.

      ii. **Response Time Diagnostic** generates alternate squares of dark and light, reversing their order. This tests the response time of the LCD and can give an indication of the effectiveness of the LCD heater in a cold environment.

      iii. **LCD Drive Test Diagnostic** generates a moving vertical bar pattern across the LCD.

      iv. **Contrast Adjust** allows you to adjust the contrast of the LCD. It generates an alternating four-pixel pattern. The nominal contrast is set internally. When in *Contrast Adjust* mode, VERT SCALE is used as the contrast adjustment control. This value ranges from 0 to 255 units and is used by the processor to evaluate and correct circuit variations caused by temperature changes in the environment. When the diagnostic menu is exited, the LCD contrast returns to that set by internal adjust.

d. **Chart Diagnostics Menu** offers various tests for the optional chart recorder.

   i. **LCD Chart** allows adjusting the number of dots per segment and the number of prints (strikes) per segment.

   ii. **Head Alignment Chart** generates a pattern to allow mechanical alignment of the optional chart recorder.

6. **View Stored Waveform Settings** displays the instrument settings for the stored waveform.

7. **Option Port Menu** contains three items. Two items allow configuration of the option port for communicating with devices other than the optional chart recorder and one item test the option port.

   a. **Option Port Diagnostic** creates a repeating pattern of signals at the option port to allow service technicians to verify that all signals are present and working correctly.

   b. **Set Option Port Timing** allows adjustment of the data rate used to communicate with external devices. The timing rate between bytes can be set from about 0.05 to 12.8 milliseconds.

   c. **Option Port Debugging Is Off/On**. Off is quiet, On is verbose. This chooses how detailed the error message reporting will be when communicating with an external device.

   It is possible to connect the instrument to a computer through a parallel interface with a unique software driver. Because different computers vary widely in processing speed, the instrument must be able to adapt to differing data rates while communicating with those computers. With user-developed software drivers, the ability to obtain detailed error messages during the development can be very useful. For more information, contact your Tektronix Customer Service representatives. They have information describing the option port hardware and software protocol and custom development methods available.

8. **Display Contrast** (Software Version 5.02 and above)

   a. Press the MENU button firmly once. If the display is very light or very dark, you might not be able to see a change in the contrast.

   b. Turn the VERTICAL SCALE knob slowly clockwise to darken the display or counterclockwise to lighten the display. If you turn the knob far enough, the contrast will wrap from the darkest to lightest value.

c. When the screen is clearly readable, press the MENU button again to return to normal measurement operation. The new contrast value will remain in effect until the instrument is turned off.

Test Preparations

The Importance of Vp (Velocity of Propagation)

Vp is the speed of a signal down the cable given as a percentage of the speed of light in free space. It is sometimes expressed as a whole number (e.g., 66) or a percentage (e.g., 66%). On the 1502C, it is the percentage expressed as a decimal number (e.g., 66% = .66). If you do not know the velocity of propagation, you can get a general idea from the following table, or use the *Help with Cables* section of the *Cable Information* menu. You can also find the Vp with the procedure that follows using a cable sample.

NOTE*. If you do not know the Vp of your cable, it will not prevent you from finding a fault in your cable. However, if the Vp is set wrong, the distance readings will be affected.*

All Vp settings should be set for the cable under test, not the supplied jumper cable.

Vp of Various Dielectric Types

Dielectric	Probable Vp
Jelly Filled	.64
Polyethylene (PIC, PE, or SPE)	.66
PTFE (Teflon ®) or TFE	.70
Pulp Insulation	.72
Foam or Cellular PE (FPE)	.78
Semi-solid PE (SSPE)	.84
Air (helical spacers)	.98

Finding an Unknown Vp

1. Obtain a known length of cable of the exact type you wish to test. Attach the cable to the CABLE connector on the front panel.
2. Pull POWER on.
3. Turn the DIST/DIV to an appropriate setting (e.g., if trying to find the Vp of a three-foot cable, turn the DIST/DIV to 1 ft/div).
4. Turn the ◁▷ POSITION control until the distance reading is the same as the known length of this cable.

5. Turn the Vp controls until the cursor is resting on the rising portion of the reflected pulse. The Vp controls of the instrument are now set to the Vp of the cable.

The following three illustrations show settings too low, too high, and correct for a sample three-foot cable.

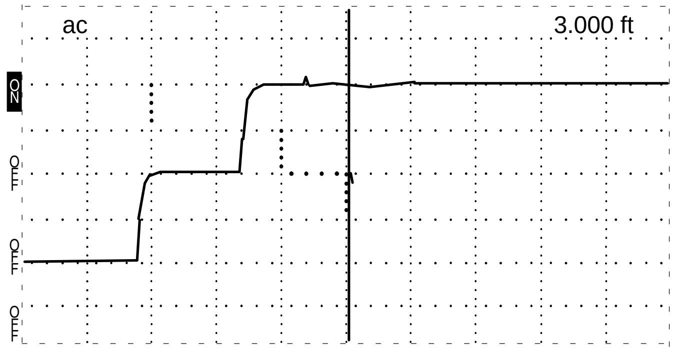


Figure 1–5: Vp Set at .30, Cursor Beyond Reflected Pulse (Set Too Low)

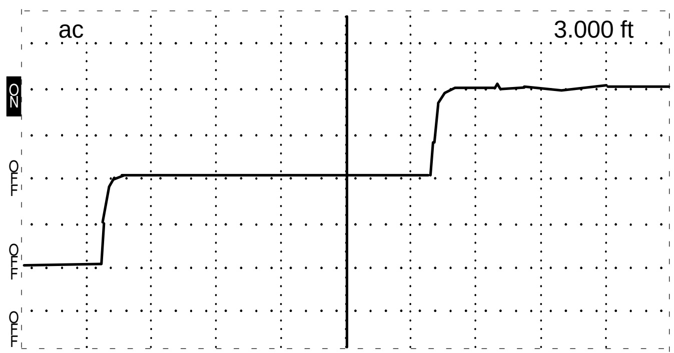


Figure 1–6: Vp Set at .99, Cursor Less Than Reflected Pulse (Set Too High)

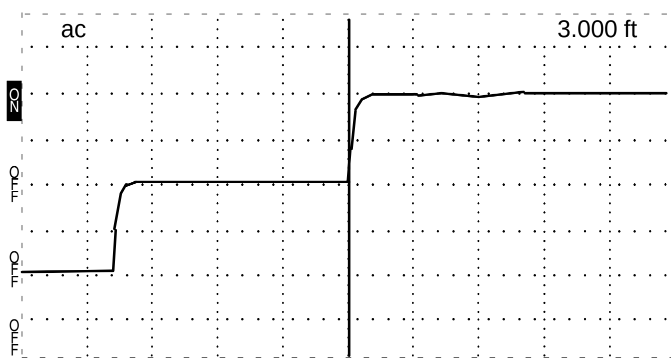


Figure 1–7: Vp Set at .66, Cursor at Reflected Pulse (Set Correctly)

Cable Test Procedure

Distance to the Fault

Be sure to read the previous paragraphs on Vp.

1. Set the 1502C controls:

POWER	On
CABLE	Cable to BNC
NOISE FILTER	1 avg
VERT SCALE	500 mρ
DIST/DIV	(see below)
Vp	(per cable)

2. If you know approximately how long the cable is, set the DIST/DIV appropriately (e.g., 20-ft cable would occupy four divisions on the LCD if 5 ft/div was used). The entire cable should be displayed.

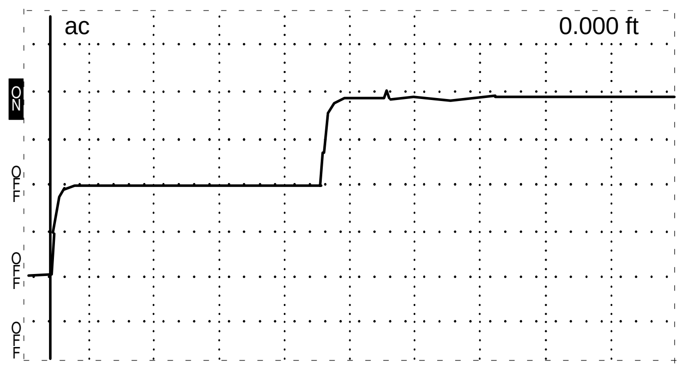


Figure 1–8: 20-ft Cable at 5 ft/div

If the cable length is unknown, set DIST/DIV to 200 ft/div and continue to decrease the setting until the reflected pulse is visible. Depending on the cable length and the amount of pulse energy absorbed by the cable, it might be necessary to increase the VERT SCALE to provide more gain to see the reflected pulse.

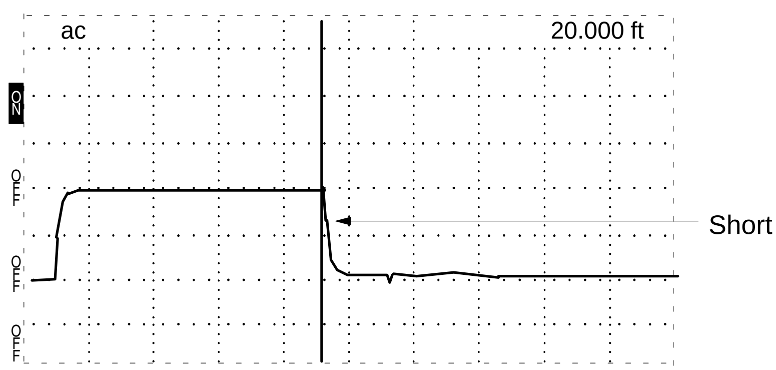


Figure 1–9: Short in the Cable

When the entire cable is displayed, you can tell if there is an open or a short. Essentially, a large downward pulse indicates a short (see Figure 1–9, previous page), while a large upward pulse indicates an open (see Figure 1–10). Less catastrophic faults can bee seen as smaller reflections. Bends and kinks, frays, water, and interweaving all have distinctive signatures.

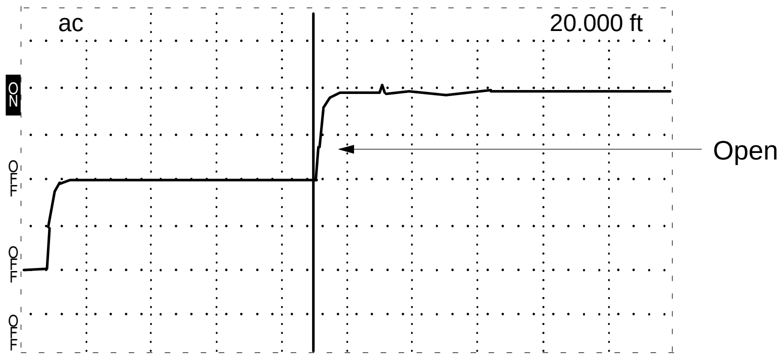


Figure 1–10: Open in the Cable

3. To find the distance to the fault or end of the cable, turn the ◁▷ POSITION control until the cursor rests on the leading edge of the rising or falling reflected pulse (see Figure 1–10). Read the distance in the distance window in the upper right corner of the display.

A more thorough inspection might be required. This example uses a longer cable:

4. When inspecting a 452-foot cable, a setting of 50 ft/div allows a relatively fast inspection. If needed, turn VERT SCALE to increase the gain. The higher the gain, the smaller the faults that can be detected. If noise increases, increase the NOISE FILTER setting.

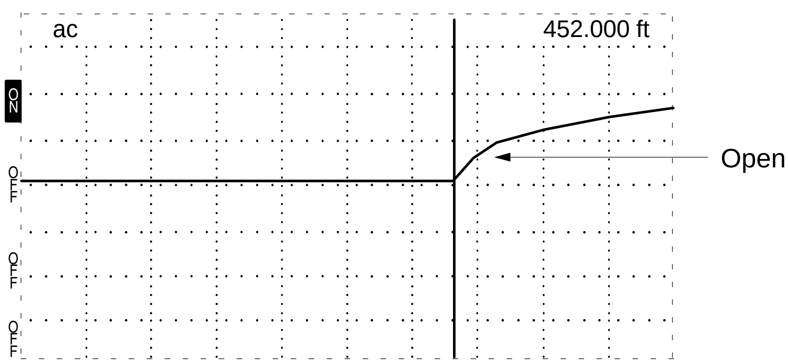


Figure 1–11: 455-ft Cable

5. Change DIST/DIV to 20 ft/div. The entire cable can now be inspected in detail on the LCD. Turn the ◁▷ POSITION control so the cursor travels to the far right side of the LCD. Keep turning and the cable will be “dragged” across the display.

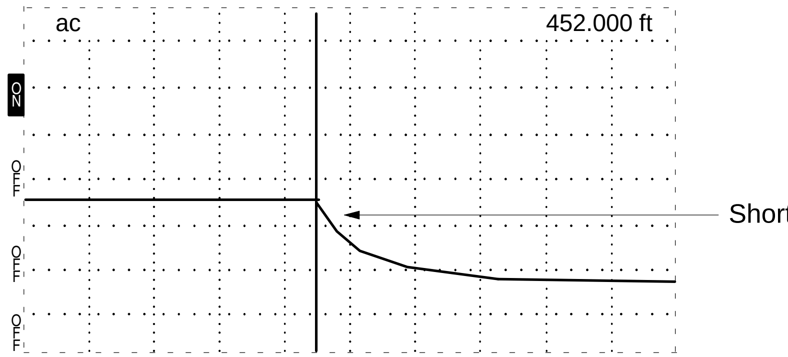


Figure 1–12: 455-ft Cable

A “rise” or “fall” is a signature of an impedance mismatch (fault). A dramatic rise in the pulse indicates and open. A dramatic lowering of the pulse indicates a short. Variations, such as inductive and capacitive effects on the cable, will appears as bumps and dips in the waveform. Capacitive faults appear as a lowering of the pulse (e.g., water in the cable). Inductive faults appear as a rising of the pulse (e.g., fray). Whenever an abnormality is found, set the cursor at the beginning of the fault and read the distance to the fault on the distance window of the LCD.

Reflection Coefficient Measurements

The reflection coefficient is a measure of the impedance change at a point in the cable. It is the ratio of the signal reflected back from a point, divided by the signal going into that point. It is designated by the Greek letter ρ and is written in this manual as rho. The 1502C measures the reflection coefficient in millirho (thousandths of a rho).

To measure a reflection, adjust VERT SCALE to make the reflection one division high. Read the reflection coefficient directly off the display above the VERT SCALE control. For reflections that are greater than 500 mρ/div, adjust VERT SCALE for a reflection that is two divisions high and multiply the VERT SCALE reading by two.

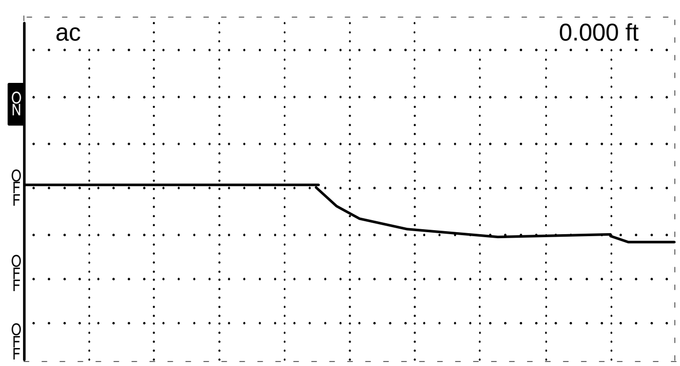


Figure 1–13: Reflection Adjusted to One Division in Height

In an ideal transmission system with no changes in impedance, there will be no reflections, so rho is equal to zero. A good cable that is terminated in its characteristic impedance is close to ideal and will appear as a flat line on the 1502C display.

Small impedance changes, like those from a connector, might have reflections from 10 to 100 mρ. If rho is positive, it indicates an impedance higher than that of the cable before the reflection. It will show as an upward shift or bump on the waveform. If rho is negative, it indicates an impedance lower than that of the cable prior to the reflection. It will show as a downward shift or dip on the waveform.

If the cable has an open or short, all the energy sent out by the 1502C will be reflected. This is a reflection coefficient of rho = 1, or +1000 mρ for the open and –1000 mρ for the short.

Long cables have enough loss to affect the size of reflections. In the 1502C, this loss will usually be apparent as an upward ramping of the waveform along the length of the cable. In some cases, the reflection coefficient measurement can be corrected for this loss. This correction can be made using a procedure very similar to the *Vertical Compensation for Higher Impedance Cable* procedure (see the *VERT SET REF* section).

Return Loss Measurements

Return loss is another was of measuring impedance changes in a cable. Mathematically, return loss is related to rho by the formula:

Return Loss (in dB) = –20 * log (base ten) of Absolute Value of Rho (V_{ref}/V_{inc})

The 1502C can be made to display in dB instead of mρ/div through the menu:

1. Press MENU.

2. Select *Setup Menu*.

3. Press MENU again.

4. Select *Vertical Scale is: Millirho*.

5. Press MENU again. This should change is to *Vertical Scale is: Decibels*.

6. Press MENU twice to return to normal operation.

To measure return loss with the 1502C, adjust the height of the reflected pulse to be two divisions high and read the dB return loss directly off the LCD. The incident pulse is set to be two divisions high at zero dB automatically when the instrument is turned on.

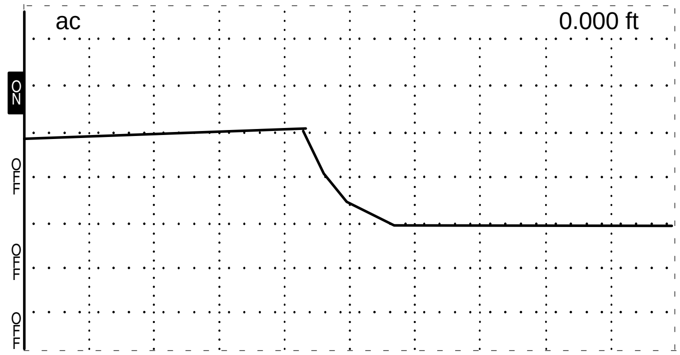


Figure 1–14: Return Loss

A large return loss means that most of the pulse energy was lost instead of being returned as a reflection. The lost energy might have been sent down the cable or absorbed by a terminator or load on the cable. A terminator matched to the cable would absorb most of the pulse, so its return loss would be large. An open or short would reflect all the energy, so its return loss would be zero.

Ohms-at-Cursor

The 1502C can compute and display what impedance mismatch would cause a reflection as high (or low) as the point at the cursor. This measurement is useful for evaluating the first impedance mismatch (first reflection) or small impedance changes along the cable (e.g., connectors, splices).

This function can be selected in the Setup Menu. Once it is enabled, the impedance value will be displayed under the distance in the distance window.

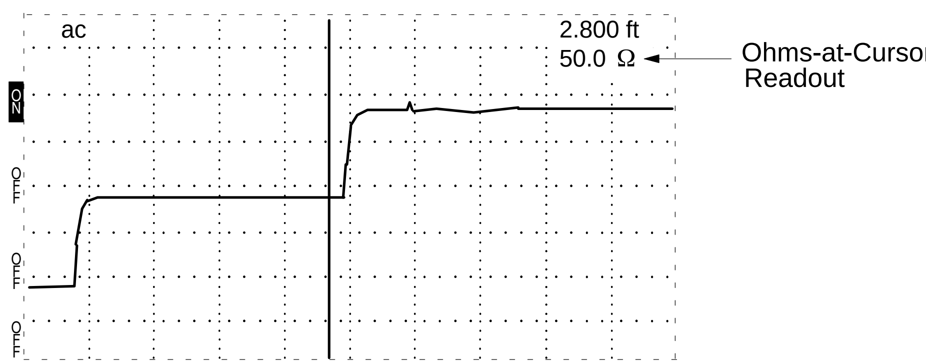


Figure 1–15: Ohms-at-Cursor

The accuracy of the difference measurement in impedance between two points near each other is much better than the absolute accuracy of any single point measurement. For example, a cable might vary from 51.3Ω to 58.4Ω across a connector – the 7.1Ω difference is accurate to about 2%. The 51.3Ω measurement by itself is only specified to be accurate to 10%.

The series resistance of the cable to the point at the cursor affects the accuracy of the impedance measurement directly. In a cable with no large impedance changes, the series resistance is added to the reading. For example, the near end of a long 50Ω coaxial cable might read 51.5Ω, but increase to 57.5Ω several hundred feet along the cable. The 6Ω difference is due to the series resistance of the cable, not to a change in the actual impedance of the cable.

Another limitation to the ohms-at-cursor function is that energy is lost going both directions through a fault. This will cause readings of points farther down the cable to be less accurate than points nearer to the instrument.

In general, it is not wise to try to make absolute measurements past faults because the larger the fault, the less accurate those measurements will be. Although they do not appear as faults, resistive pads (often used to match cable impedances) also affect measurements this way.

Using VIEW INPUT

When pushed, the VIEW INPUT button displays the input at the front panel CABLE connector. When VIEW INPUT is turned off and no other buttons are pushed, the display will not have a waveform on it (see Figure 1–16). The default condition when the instrument is powered up is to have VIEW INPUT on.

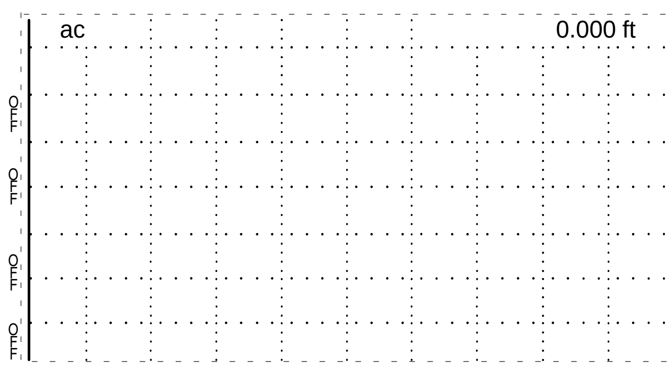


Figure 1–16: Display with VIEW INPUT Turned Off

How to Store the Waveform

When pushed, the STORE button puts the current waveform being displayed into memory. If already stored, pushing STORE again will erase the stored waveform.

The front panel control settings and the menu-accessed settings are also stored. They are accessed under *View Stored Waveform Settings* in the first level of the menu.

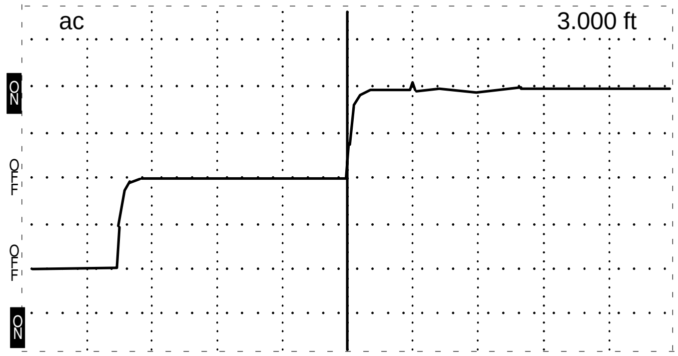


Figure 1–17: Display of a Stored Waveform

Using VIEW STORE

The VIEW STORE button, when pushed on, displays the waveform stored in the memory as a dotted line. If there is no waveform in memory, a message appears on the LCD informing you of this.

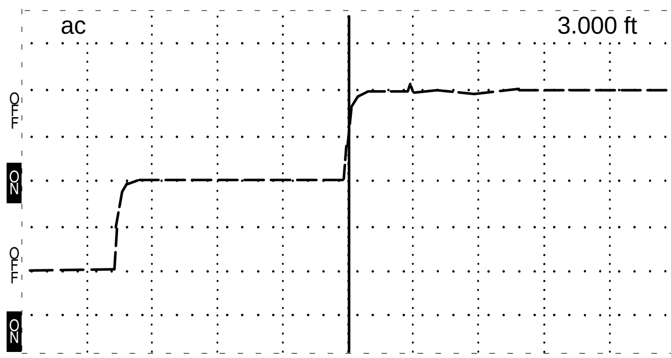


Figure 1–18: Display of a Stored Waveform

Using VIEW DIFF

When pushed on, the VIEW DIFF button displays the difference between the current waveform and the stored waveform as a dotted line. If no waveform has been stored, a message will appear. The difference waveform is made by subtracting each point in the stored waveform from each point in the current waveform.

NOTE*. If the two waveforms are identical (e.g., if STORE is pushed and VIEW DIFF is immediately pushed) the difference would be zero. Therefore you would see the difference waveform as a straight line.*

The VIEW DIFF waveform will move up and down with the current input as you move the △▽POSITION control. Any of the waveforms may be turned on or off independently. You might want to turn off some waveforms if the display becomes too busy or confusing.

***NOTE**. Because the stored waveform is not affected by changes in the instrument controls, care should be taken with current waveform settings or the results could be misleading.*

One method to minimize the overlapping of the waveforms in VIEW DIFF is:

1. Move the waveform to be stored into the top half of the display.

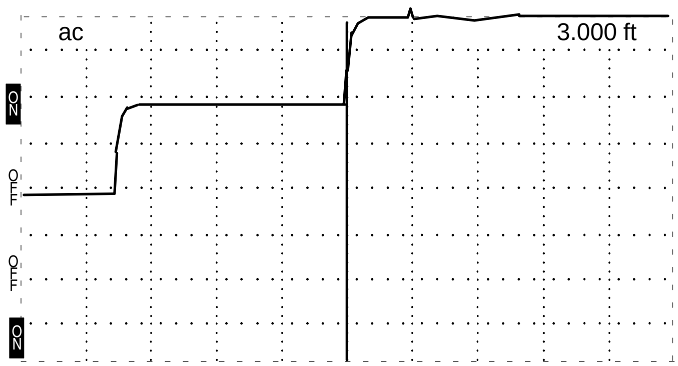


Figure 1–19: Waveform Moved to Top Half of Display

2. Push STORE to capture the waveform. Remember, once it is stored, this waveform cannot be moved on the display.

3. Move the current waveform (the one you want to compare against the stored waveform) to the center of the display.

4. Push VIEW STORE and the stored waveform will appear above the current waveform.

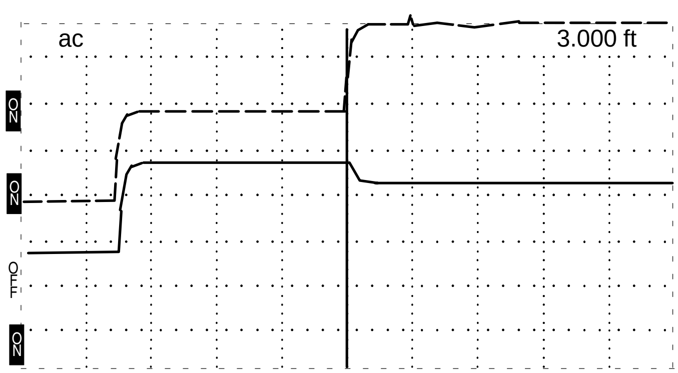


Figure 1–20: Current Waveform Centered, Stored Waveform Above

5. Push VIEW DIFF and the difference waveform will appear below the current waveform.

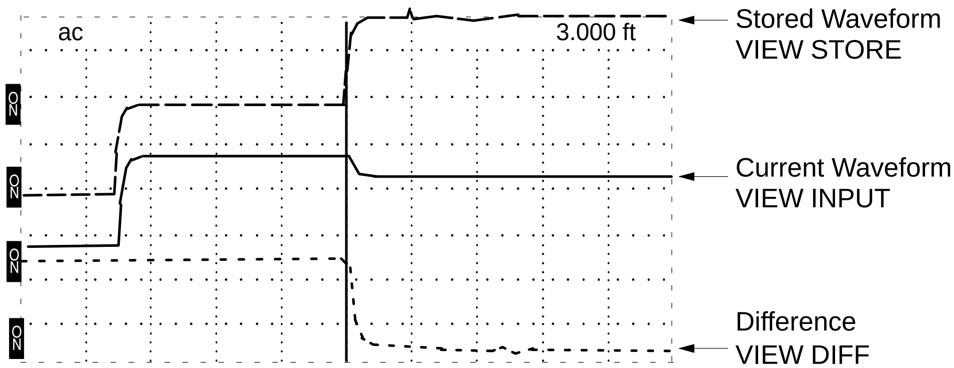


Figure 1–21: Current Waveform Center, Stored Waveform Above, Difference Below

Notice the VIEW INPUT waveform is solid, VIEW DIFF is dotted, and VIEW STORE is dot-dash.

There are many situations where the VIEW DIFF function can be useful. One common situation is to store the waveform of a suspect cable, repair the cable, then compare the two waveforms after the repair. During repairs, the VIEW INPUT, VIEW DIFF, and VIEW STORE waveforms can be used to judge the effectiveness of the repairs. The optional chart recorder can be used to make a chart of the three waveforms to document the repair.

Another valuable use for the VIEW DIFF function is for verifying cable integrity before and after servicing or periodic maintenance that requires moving or disconnecting the cable.

The VIEW DIFF function is useful when you want to see any changes in the cable. In some systems, there might be several reflections coming back from each branch of the network. It might become necessary to disconnect branch lines from the cable under test to determine whether a waveform represents a physical fault or is simply an echo from one of the branches. The STORE and VIEW DIFF functions allow you to see and compare the network with and without branches.

Two important things to be observed when using the VIEW DIFF function:

- If you change either the VERT SCALE or DIST/DIV, you will no longer be comparing features that are the same distance apart or of the same magnitude on the display. It is possible to save a feature (e.g., a connector or tap) at one distance down the cable and compare it to a similar feature at a different distance by moving the ◁▷POSITION and △▽POSITION controls.
- When this is done, great care should be taken to make sure the vertical and horizontal scales are identical for the two waveforms being compared. If either the stored or current waveform is clipped at the top or bottom of the display, the difference waveform will be affected.

Using Horizontal Set Reference

HORZ SET REF (Δ mode) allows you to offset the distance reading. For example, a lead-in cable to a switching network is three feet long and you desire to start the measurement after the end of the lead-in cable. HORZ SET REF makes it simple.

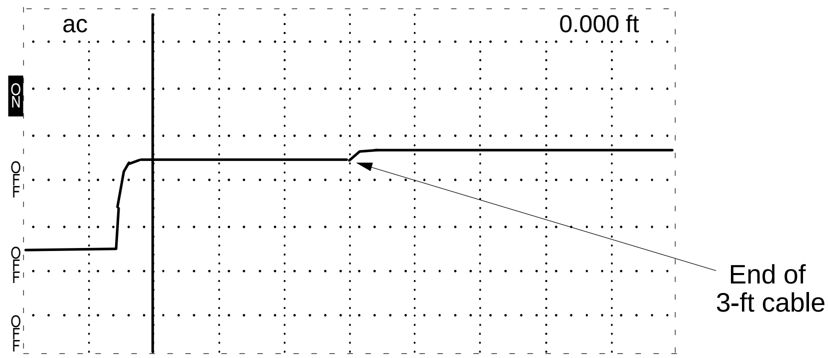


Figure 1–22: Waveform of Three-Foot Lead-in Cable

1. Turn the NOISE FILTER control to HORZ SET REF. The noise readout on the LCD will show: set Δ.

2. Turn the ◁▷POSITION control to set the cursor where you want to start the distance reading. This will be the new zero reference point. For a three-foot lead-in cable, the cursor should be set at 3.00 ft.

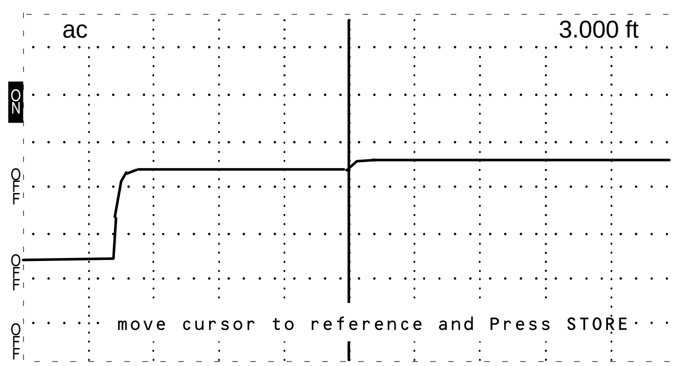


Figure 1–23: Cursor Moved to End of Three-Foot Lead-in Cable

3. Push STORE.

4. Turn the NOISE FILTER control to 1 avg. The instrument is now in HORZ SET REF, or delta mode. The distance window should now read 0.00 ft. As the cursor is scrolled down the cable, the distance reading will now be from the new zero reference point.

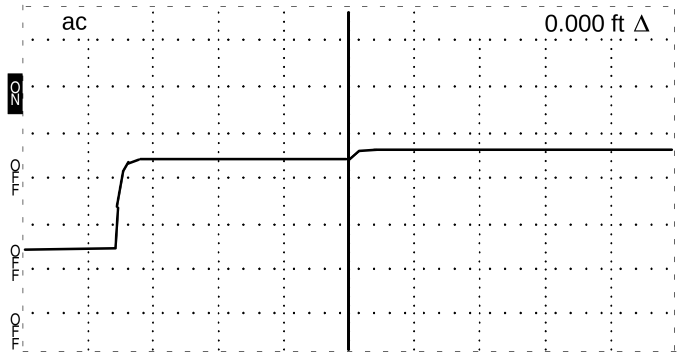


Figure 1–24: Cursor Moved to End of Three-Foot Lead-in Cable

***NOTE**. Vp changes will affect where the reference is set on the cable. Be sure to set the Vp first, then set the delta to the desired location.*

---

5. To exit HORZ SET REF, use the following procedure:

   a. Turn the NOISE FILTER control to HORZ SET REF.

   b. Turn DIST/DIV to .1 ft/div. If the distance reading is extremely high, you might want to use a higher setting initially, then turn to .1 ft/div for the next adjustment.

   c. Turn the ◁▷POSITION control until the distance window reads 0.00 ft.

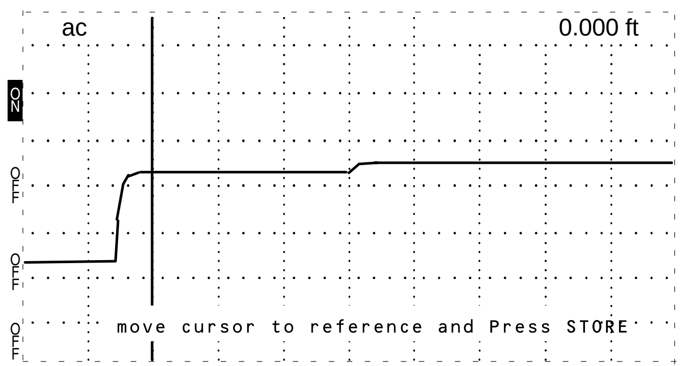


Figure 1–25: Cursor Moved to 0.00 ft

   d. Push STORE.

   e. Turn NOISE FILTER to desired setting.

Using Vertical Set Reference

VERT SET REF works similar to HORZ SET REF except that it sets a reference for gain (pulse height) instead of distance. This feature allows zeroing the dB scale at whatever pulse height is desired.

1. Turn NOISE FILTER fully counterclockwise. “Set Ref” will appear in the noise averaging area of the LCD.

2. Adjust the incident pulse to the desired height (e.g., four divisions). It might be necessary to adjust ≙POSITION.

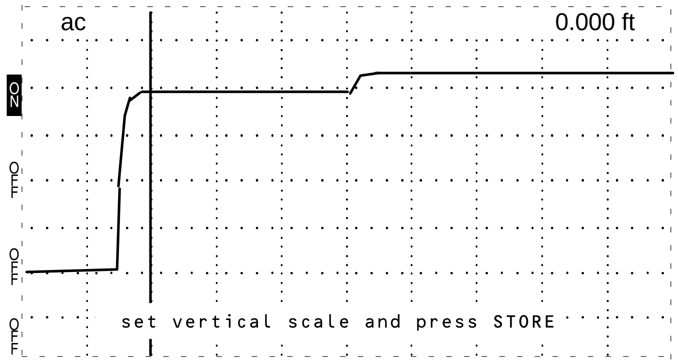


Figure 1–26: Incident Pulse at Three Divisions

3. Push STORE.

4. Return NOISE FILTER to the desired setting. Notice that the vertical scale now reads 500 mρ/div.

***NOTE**. The millirho vertical scale will not be in calibration after arbitrarily adjusting the pulse height.*

The millirho scale is the reciprocal of the number of divisions high the pulse has been set. For example, 1 pulse divided by 4 divisions equals 0.25 or 250 mρ/div.

Vertical Compensation for Higher Impedance Cable

When testing cables other than 50Ω, this procedure allows reflection measurements in millirho.

1. Attach a short sample of the given cable (75Ω in this example)to the instrument.

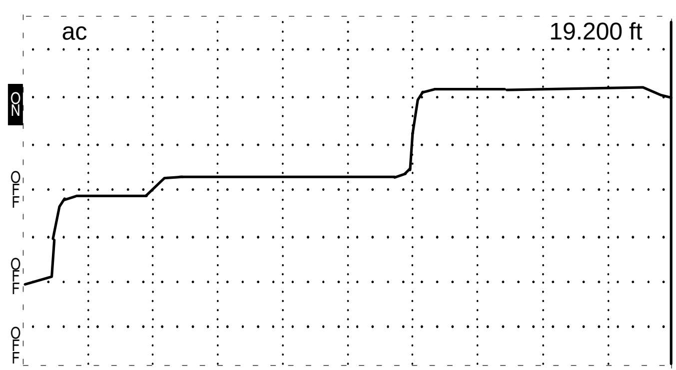


Figure 1–27: Waveform of Short 75Ω Cable

2. Adjust the ◁▷POSITION control to position the reflected pulse at center screen.

3. Turn NOISE FILTER to VERT SET REF.

4. Adjust VERT SCALE so the reflected pulse (from open at far end of cable sample) is two divisions high.

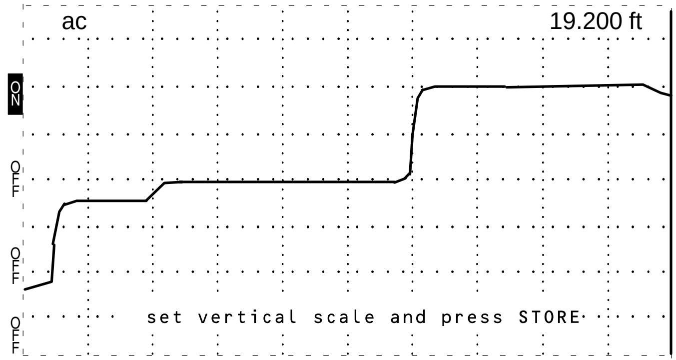


Figure 1–28: Waveform Centered and Adjusted Vertically

5. Press STORE.

6. Return NOISE FILTER to the desired setting.

7. Adjust the ◁▷POSITION control to the desired position on the waveform to measure loss.

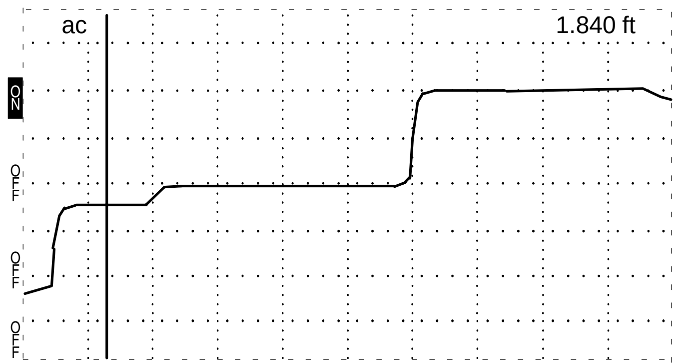


Figure 1–29: Cursor Moved to Desired Position

The instrument is now set to measure reflections in millirho relative to the sample cable impedance.

To measure reflections on a 50Ω cable, the VERT SET REF must be reset.

8. To exit VERT SET REF, use the following procedure:

a. Turn NOISE FILTER to VERT SET REF.

b. Adjust VERT SCALE to obtain an incident pulse height of two divisions.

c. Push STORE.

d. Turn NOISE FILTER to desire filter setting.

The instrument can be turned off and back on to default to the two division pulse height.

Additional Features (Menu Selected)

Max Hold

The 1502C will capture and store waveforms on an ongoing basis. This is useful when the cable or wire is subjected to intermittent or periodic conditions. The 1502C will monitor the line and display any fluctuations on the LCD.

1. Attach the cable to the 1502C front-panel CABLE connector.
2. Push MENU to access the main menu.
3. Scroll to *Setup Menu* and push MENU again.
4. Scroll to *Acquisition Control Menu* and push MENU again.
5. Scroll to *Max Hold is: Off* and push MENU again. This line will change to *Max Hold is: On*. The monitoring function is now ready to activate.
6. Repeatedly push MENU until the instrument returns to normal operation.

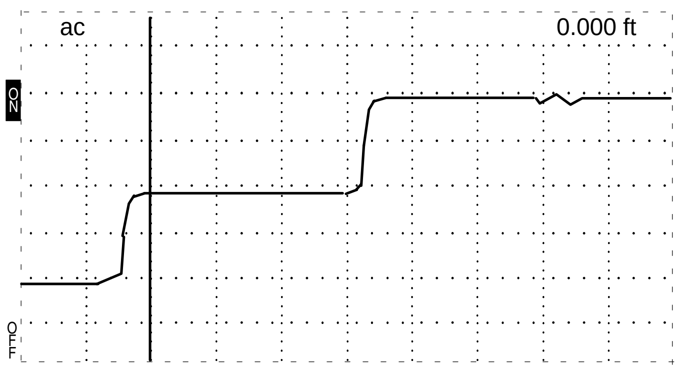


Figure 1–30: Waveform Viewed in Normal Operation

7. When you are ready to monitor this cable for intermittents, push STORE. The 1502C will now capture any changes in the cable.

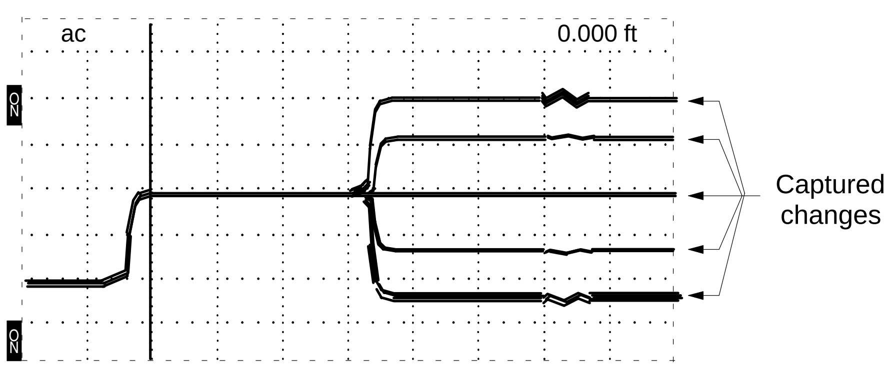


Figure 1–31: Waveform Showing Intermittent Changes

8. To exit monitor mode, push STORE again.

9. To exit Max Hold, access the *Acquisition Control Menu* again, turn off Max Hold, and push MENU repeatedly until the instrument returns to normal operation.

Pulse On/Off

This feature puts the 1502C in a “listening mode” by turning off the pulse generator.

1. Attach a cable to the 1502C front-panel CABLE connector.

2. Push MENU to access the Main Menu.

3. Scroll to *Setup Menu* and push MENU again.

4. Scroll to *Acquisition Control Menu* and push MENU again.

5. Scroll to *Pulse is: On* and push MENU again. This will change to *Pulse is: Off*.

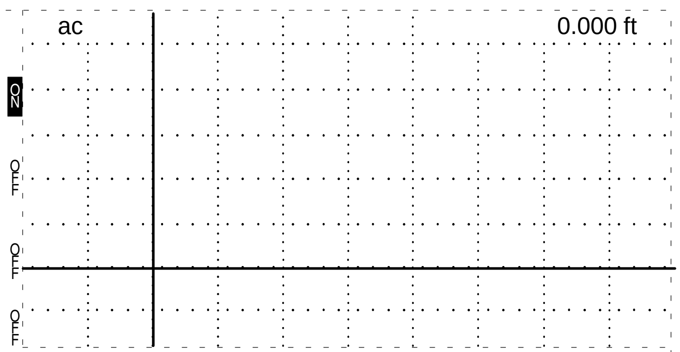


Figure 1–32: Waveform Display with No Outgoing Pulses

6. Repeatedly press MENU until the instrument returns to normal operation.

CAUTION. *This function is used mostly for troubleshooting by qualified technicians. It is not recommended that you use the 1502C as a stand-alone monitoring device. The input circuitry is very sensitive and can be easily damaged by even moderate level signals.*

NOTE. *In this mode, the 1502C is acting as a detector only. Any pulses detected will not originate from the instrument, so any distance readings will be invalid. If you are listening to a local area network, for example, it is possible to detect traffic, but not possible to measure the distance to its origin.*

Pulse is: Off can be used in conjunction with *Max Hold is: On.*

7. To exit *Pulse is: Off*, access the *Acquisition Control Menu* again, turn pulse back on, then push MENU until the instrument returns to normal operation.

Single Sweep

The single sweep function will acquire one waveform only and display it.

1. Attach a cable to the 1502C front-panel CABLE connector.
2. Push MENU to access the Main Menu.
3. Scroll to *Setup Menu* and push MENU again.
4. Scroll to *Acquisition Control Menu* and push MENU again.
5. Scroll to *Single Sweep is: Off* and push MENU again. This will change to *SIngle Sweep is: On*.
6. Repeatedly press MENU until the instrument returns to normal operation.
7. When you are ready to begin a sweep, push VIEW INPUT. A sweep will also be initiated when you change any of the front-panel controls. This allows you to observe front panel changes without exiting the Single Sweep mode.

As in normal operation, averaged waveforms will take longer to acquire.

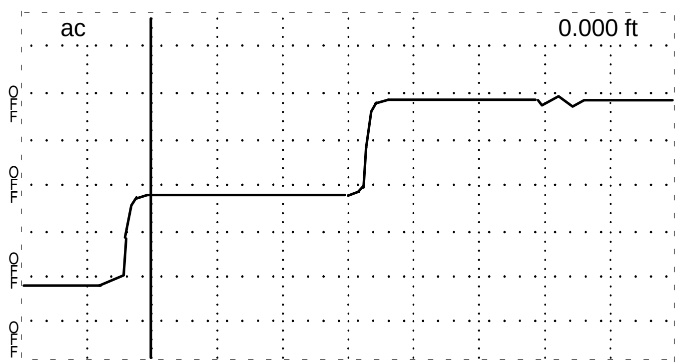


Figure 1–33: A Captured Single Sweep

8. To exit *Single Sweep is: On*, access the *Acquisition Control Menu* again, turn the Single Sweep back off, then repeatedly push MENU until the instrument returns to normal operation.

Operator Performance Checks

This chapter contains performance checks for many of the functions of the 1502C. They are recommended for incoming inspections to verify that the instrument is functioning properly. Procedures to verify the actual performance requirements are provided in chapter 6.

Performing these checks will assure you that your instrument is in good working condition. These checks should be performed upon receipt of a new instrument or one that has been serviced or repaired. It does not test all portions of the instrument to Calibration specifications.

The purpose of these checks is not to familiarize a new operator with the instrument. If you are not experienced with the instrument, you should read the *Operating Instructions* chapter of this manual before going on with these checks.

If the instrument fails any of these checks, it should be serviced. Many failure modes affect only some of the instrument functions.

Equipment Required

Item	Tektronix Part Number
50Ω precision terminator	011–0123–00
3-foot precision coaxial cable	012–1350–00

Getting Ready

Disconnect any cables from the front-panel CABLE connector. Connect the instrument to a suitable power source (a fully charged optional battery pack or AC line source). If you are using AC power, make sure the fuse and power switch are correct for the voltage you are using (115 VAC requires a different fuse than 230 VAC).

Power On

Pull the POWER switch on the front panel. If a message does not appear on the display within a second or two, turn the instrument off. There are some failure modes that could permanently damage or ruin the LCD if the power is left on for more than a minute or so.

Metric Instruments

Option 05 instruments default to metric; however, you can change the metric scale to ft/div in the *Setup Menu* or use the metric numbers provided. To change the readings, press the MENU button. Using the ⇳ POSITION control, scroll down to *Setup Menu* and press MENU again. Scroll down to *Distance/Div is: m/div* and press MENU again. This will change to ft/div. Press the MENU button repeatedly to return to normal operation mode. If the instrument power is turned off, these checks must be repeated again when the instrument is powered on again.

Set Up

Set the 1502C front-panel controls:

NOISE FILTER	1 avg
VERT SCALE	default
DIST/DIV	1 ft/div (0.25 m)
Vp	.66

1. Horizontal Scale (Timebase) Check

If the instrument fails this check, it must be repaired before any distance measurements can be made with it.

1. Turn the 1502C power on. The display should look very similar to Figure B–1.

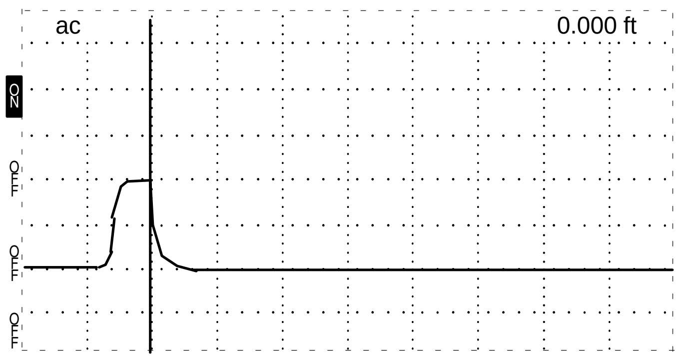


Figure 2–1: Start-up Measurement Display

2. Connect the 3-foot precision cable to the front-panel CABLE connector. The display should now look like Figure B–2.

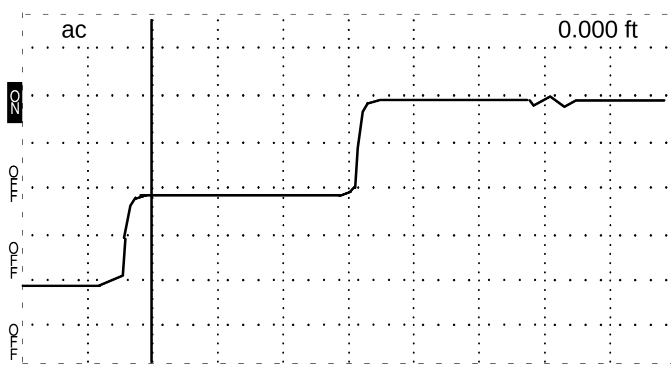


Figure 2–2: Measurement Display with 3-foot Cable

3. Using the ◁▷ POSITION control, measure the distance to the rising edge of the waveform at the open end of the cable. The distance shown on the display distance window (upper right corner of the LCD) should be from 2.87 to 3.13 feet (0.875 to 0.954 m).

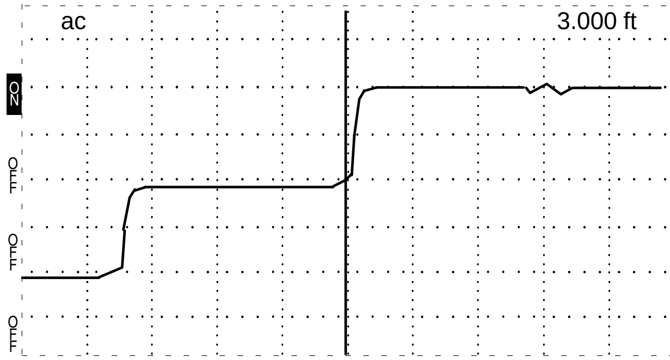


Figure 2–3: Cursor at End of 3-foot Cable

4. Remove the 3-foot cable and connect the 50Ω terminator.

5. Change the DIST/DIV to 200 ft/div (50 m/div)

6. Turn the ◁▷ POSITION control clockwise until the distance window shows a distance greater than 2,000 feet (> 600 m). The waveform should be a flat line from the pulse to this point.

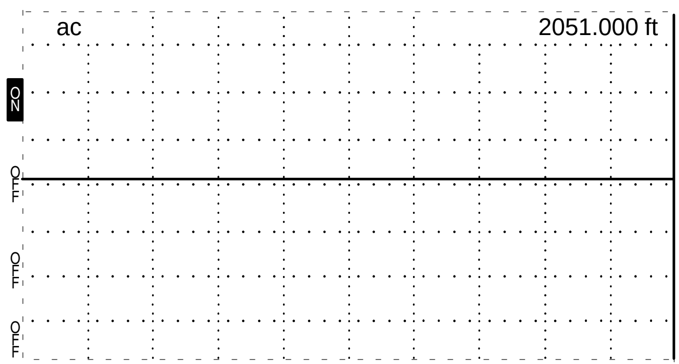


Figure 2–4: Flat-Line Display Out to 50,000+ Feet

7. Turn the ◁▷ POSITION control counterclockwise until the distance window shows a distance less than 10.000 feet (< 3.1 m).

8. Set the DIST/DIV control to .1 ft/div (0.025 m/div).

9. Turn the ◁▷ POSITION control counterclockwise until the distance window shows a distance of –2.000 feet (–0.611 m).

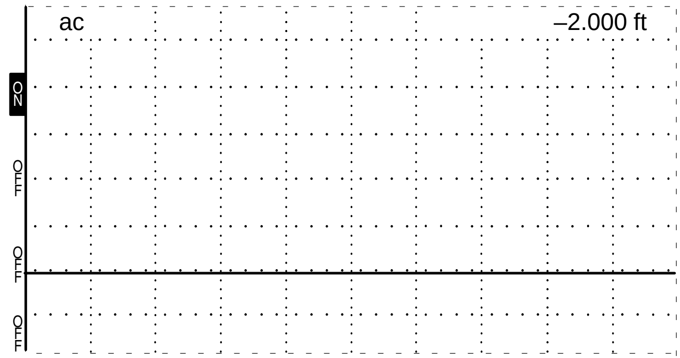


Figure 2–5: Flat-Line Display at –2.000 ft

This last step has set up the instrument for the next check.

2. Vertical Position (Offset) Check

If the instrument fails this test, it can be used, but should be serviced when possible. Not all of the waveforms will be viewable at all gain settings.

1. Using the ≙ POSITION control, verify that the entire waveform can be moved to the very top of the display (off the graticule area).

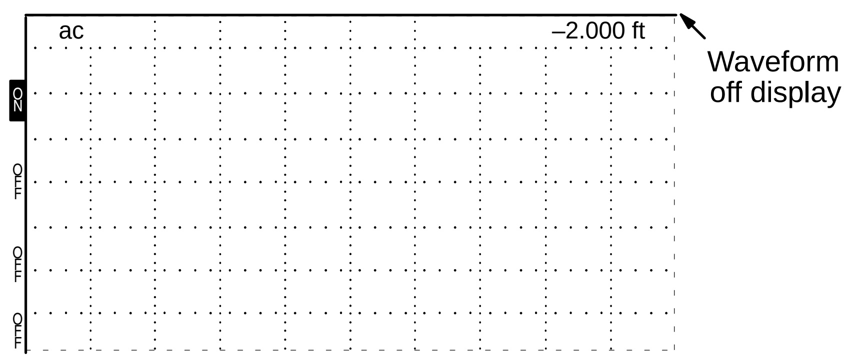


Figure 2–6: Waveform Off the Top of the Display

2. Using the ≙ POSITION control, verify that the entire waveform can be moved to the very bottom of the display (to the bottom graticule line).

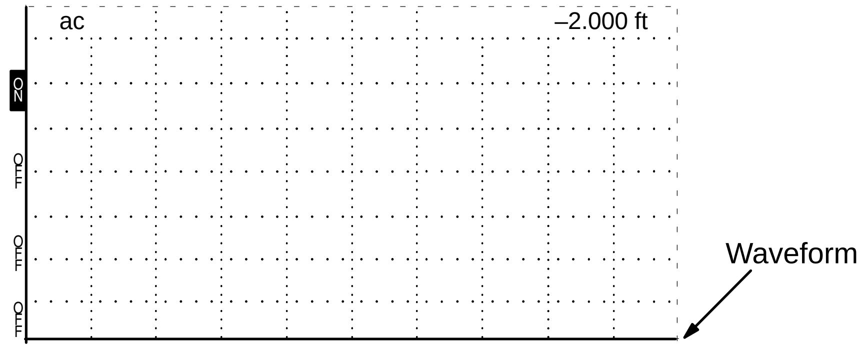


Figure 2–7: Waveform at the Bottom of the Display

3. Noise Check

If the instrument fails this check, it can still be usable for measurements of large faults that do not require a lot of gain, but send the instrument to be serviced when possible. A great deal of noise reduction can be made using the NOISE FILTER control.

1. Adjust the ◁▷ POSITION control to obtain 100.000 ft in the distance window.

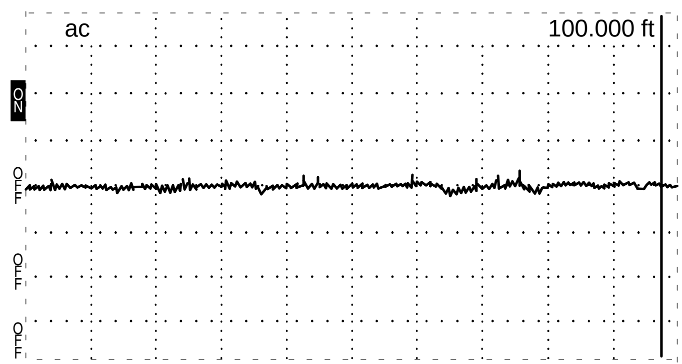


Figure 2–8: Waveform with Gain at 5.00 mρ/div

2. Using the △▽ POSITION control and VERT SCALE control, set the gain to 5.00 mρ/div. Keep the waveform centered vertically in the display.

3. Press MENU.

4. Using the △▽ POSITION control, select *Diagnostics Menu*.

5. Press MENU again.

6. Using the △▽ POSITION control, select *Service Diagnostic Menu*.

7. Press MENU again.

8. Using the △▽ POSITION control, select *Noise Diagnostics*.

9. Press MENU again and follow the instructions on the display.

10. Exit from *Noise Diagnostics*, but do not exit from the *Service Diagnostic Menu* yet.

4. Offset/Gain Check

If the instrument fails this check, it should not be used for loss or impedance measurements. Send it to be serviced when possible.

1. In the *Service Diagnostic Menu*, select the *Offset/Gain Diagnostic* and follow the directions on the display.

***NOTE**. Occasionally, the instrument might not pass the 48 dB step. This is no cause for alarm. If the remainder of the steps do not fail, proceed as normal. Refer to the* 1502C Service Manual *for additional information.*

There are three screens of data presented in this diagnostic. The Pass/Fail level is 3% for any single gain setting tested.

2. Exit from *Offset/Gain Diagnostic*, but do not leave the *Service Diagnostic Menu* yet.

5. Sampling Efficiency Check

If the instrument fails this check, the waveforms might not look normal. If the efficiency is more than 100%, the waveforms will appear noisy. If the efficiency is below the lower limit, the waveform will take longer (more pixels) to move from the bottom to the top of the reflected pulse. This smoothing effect might completely hide some faults that would normally only be one or two pixels wide on the display.

1. In the *Service Diagnostic Menu*, select *Sampling Efficiency* and follow the directions on the screen.
2. When done with the test, press the MENU button repeatedly until the instrument returns to normal operation.

6. Aberrations Check

If the aberrations are out of specification, the ohms-at-cursor function might be less accurate than specified.

1. Connect the 50Ω precision terminator to the front-panel CABLE connector.
2. Set the DIST/DIV control to 5 ft/div (1 m/div).
3. Increase the VERT SCALE control to 50 mρ/div.
4. Using the ⇳ POSITION control, move the top of the pulse to the center graticule line.

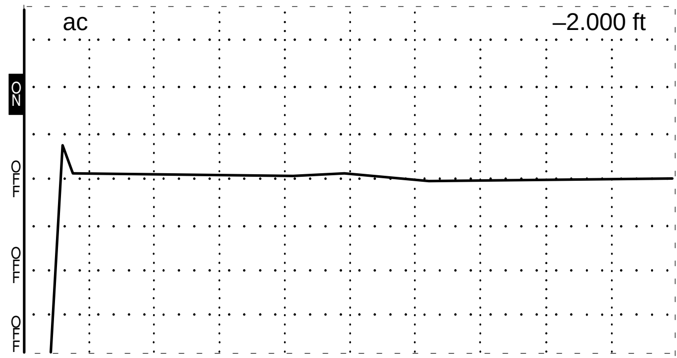


Figure 2–9: Top of Pulse on Center Graticule

5. Set the DIST/DIV control to 0.2 ft/div (0.05 m/div).

6. Turn the ◁▷ POSITION control clockwise until the rising edge of the incident pulse is in the left-most major division on the display.

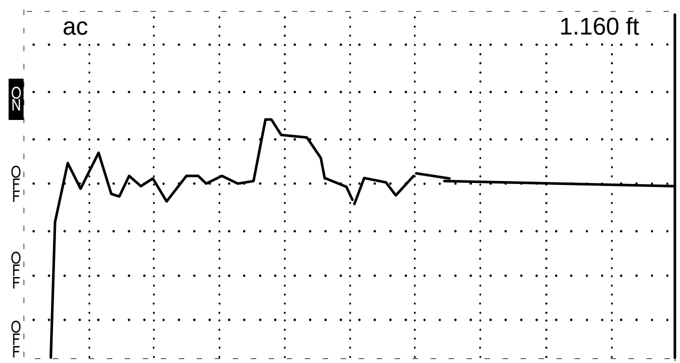


Figure 2–10: Rising Edge of Incident Pulse in Left-most Major Division

7. Using the ◁▷ POSITION control, move the cursor back to 0.000 ft (0.00 m).

   All the aberrations, except the one under the cursor (see Figure 2–11), must be within one division of the center graticule line from out to 10 feet past the rising edge of the pulse.

   To verify distances past the right edge of the display, scroll along the waveform by turning the ◁▷ POSITION control clockwise.

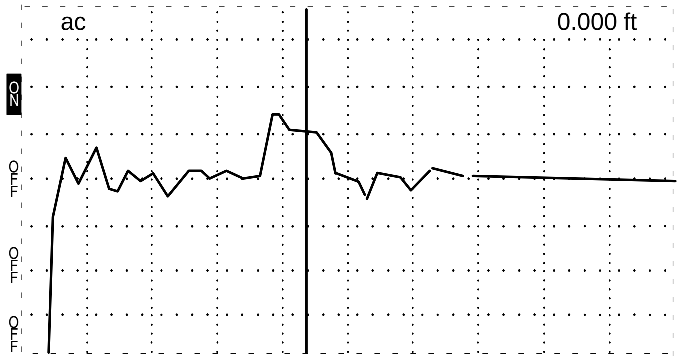


Figure 2–11: Waveform Centered, Cursor at 0.000 ft

7. Risetime Check

If the risetime is out of specification, it might be difficult to make accurate short-distance measurements near the front panel.

1. Set the 1502C front-panel controls:

NOISE FILTER	1 avg
VERT SCALE	500 mρ/div
DIST/DIV	0.2 ft/div (0.05 m)
Vp	.99

2. Using the ◁▷ POSITION control, move the incident pulse to the center of the display as shown below.

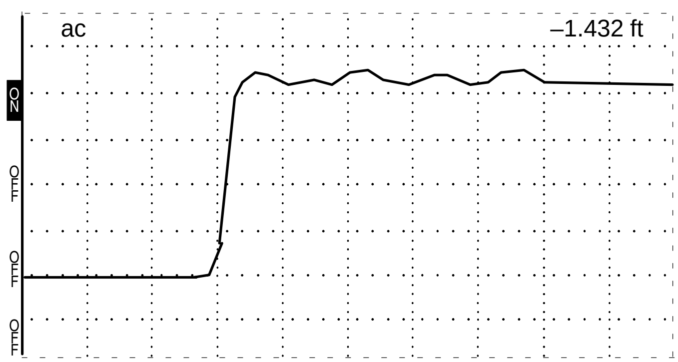


Figure 2–12: Pulse Centered on Display

3. Turn the VERT SCALE control clockwise until the leading edge of the incident pulse is five major divisions high (about 205 mρ).

4. Position the waveform so that it is centered about the middle graticule line.

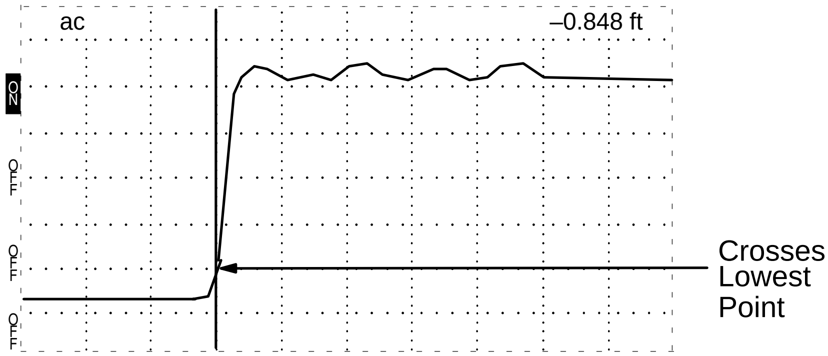


Figure 2–13: Cursor on Lowest Major Graticule that Rising Edge Crosses

5. Using the ◁▷ POSITION control, and noting the distances displayed, verify that the distance between the points where the leading edge crosses the highest and lowest major graticule lines is less than or equal to 0.096 feet (0.029 m).

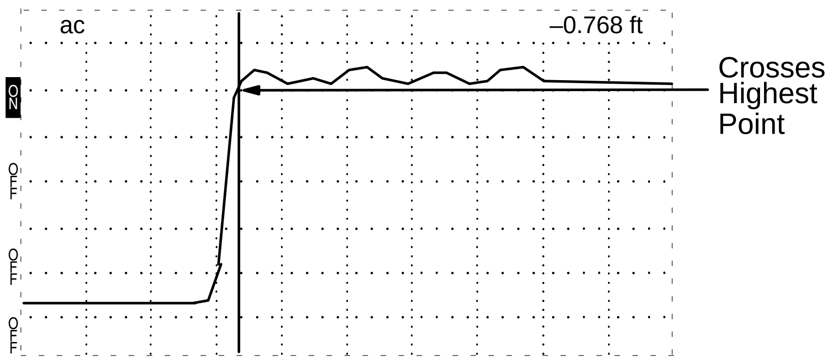


Figure 2–14: Cursor on Highest Major Graticule that Rising Edge Crosses

In the above example, the distances are –0.848 feet and –0.768 feet. The difference between these two measurements is 0.080 feet, which is well within specification.

8. Jitter Check

Jitter is the uncertainty in the timebase. Its main effect is that the waveform appears to move back and forth a very small amount. If the jitter is too great, it will affect the repeatability of very precise distance measurements.

1. Set the VERT SCALE less than or equal to 1.0 mρ/div.

2. Watch the leading edge of the pulse move and verify that this movement is less than five pixels, or < 0.02 ft (0.006 m).

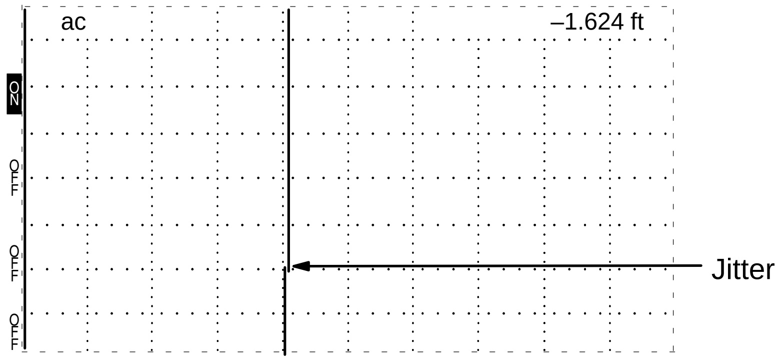


Figure 2–15: Jitter Apparent on Leading Edge of Incident Pulse

Using the Max Hold function (accessed in the *Setup Menu*, *Acquisition Control*) can simplify your observation of jitter. Max Hold allows you to observe the accumulated jitter without having to stare continuously at the display.

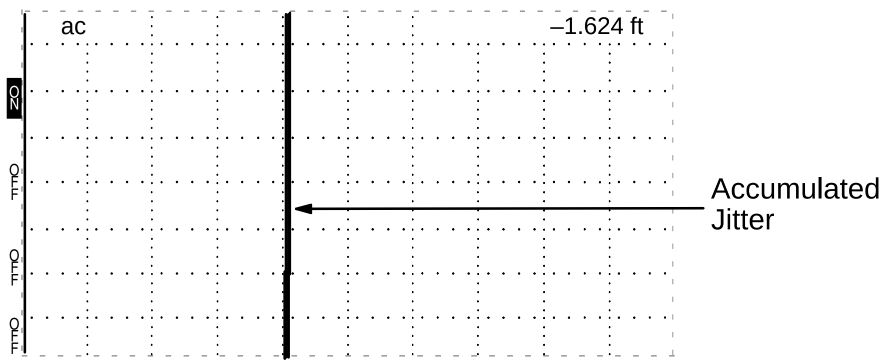


Figure 2–16: Jitter Captured Using Max Hold

Conclusions

If the instrument failed Jitter or Risetime checks, it is probably still adequate for all but extremely precise distance measurements. If it failed the Horizontal Scale check, you should not use the instrument until the cause of the failure has been identified and corrected.

All of the previous checks only test the major functional blocks of the instrument that could prevent you from being able to make measurements. It is possible for the front-panel controls or the LCD to have problems that would interfere with controlling or displaying measurements. Most problems of this type would become evident as you perform the checks. If you suspect a problem of this nature, you should have the instrument checked by a qualified service technician, using the diagnostics in the *1502C Service Manual*.

If the instrument passed all of the previous checks, it is ready for use.

Specifications

The tables in this chapter list the characteristics and features that apply to this instrument after it has had a warm-up period of at least five minutes.

The Performance Requirement column describes the limits of the Characteristic. Supplemental Information describes features and typical values or other helpful information.

Electrical Characteristics

Characteristic	Performance Requirement	Supplemental Information
Excitation Pulse Reflected Pulse	 ≤ 200 ps (0.096 feet)	 Vp set to 0.99; 10 to 90%, into a precision short
Aberrations	± 5% peak within 0 to 10 feet after rise ± 0.5% peak beyond 10 feet	Excluding front panel BNC
Jitter	≤ 0.02 feet (≤ 40 ps) p-p Horz scale 0.1 ft/div ≤ 0.2 feet (≤ 400 ps) p-p Horz scale 1 ft/div	Vp set to 0.99, DIST/DIV set to 0.1 ft/div At 23.4 feet to 46.8 feet, jitter is ≤ 0.4 feet.
Output Impedance	50Ω nominal	While pulse is on, typically ± 2%
Pulse Amplitude		300 mV nominal into 50Ω load
Pulse Width		25 µs nominal
Pulse Repetition Time		200 µs nominal
Vertical Scales Accuracy Set Adj	 0.5 mρ/div to 500 mρ/div, Within ± 3% of full scale	 > 240 values, includes 1, 2, 5 sequences (accuracy depends on reference level) Set incident pulse within 3%. Combined with VERT SCALE control.
Vertical Position		Any waveform point is moveable to center screen
Displayed Noise	± 5 mρ peak or less, filter set to 1 ± 2 mρ peak or less, filter set to 8	
Distance Cursor Resolution		 1/25th of 1 major division
Cursor Readout Range Resolution		 –2 ft to ≥ 2,000 ft 0.004 ft
Distance Measurement Accuracy	 1.6 inches or ± 1% of distance measured, whichever is greater	For cables with Vp = 0.66 For delta mode measurements Error ≤ 0.5% for distance ≥ 27 ft Error ≤ 1.0% for distance ≥ 14 ft Error ≤ 2.0% for distance ≥ 7 ft Error ≤ 10% for distance ≥ 1.5 ft

(continued next page)

Characteristic	Performance Requirement	Supplemental Information
Cursor Ohms Readout		
Range		1 Ω to 1 kΩ
Resolution		3 significant digits
Accuracy		± 10% with serial cable impedance correction (relative impedance measurements ± 2%)
Horizontal		
Scales		0.1 ft/div to 200 ft/div (0.025 m/div to 50 m/div) 11 values, 1, 2, 5 sequence
Range		1 ft to 2,000 ft (2.5 m to 500 m)
Horizontal Position		Any distance to full scale can be moved on screen
Vp		Propagation velocity relative to air
Range		0.30 to 0.99
Resolution		0.01
Accuracy	Within ± 1%	
Custom Option Port		Tektronix Chart Recorders YT–1 and YT–1S are designed to operate with the 1502C. Produces a high resolution thermal dot matrix recording of waveform and switch values.
Line Voltage	115 VAC (90 to 132 VAC) 45 to 440 Hz, or 230 VAC (180 to 250 VAC) 45 to 440 Hz, or 12 VDC through battery pack connector	Fused at 0.3 A Fused at 0.15 A
Battery		
Operation	5 hours minimum, 20 chart recordings maximum	+15° C to +25° C charge and discharge temp, LCD backlight off. Operation of instrument with backlight on or at temps below +10° C will degrade battery operation specification
Full Charge Time		20 hours maximum
Overcharge Protection		Limited to 10 days continuous charge. Battery will charge whenever instrument is plugged in. Battery can be removed during AC operation.
Discharge Protection		Operation terminates prior to cell reversal
Charge Capacity		2 Amp-hours typical
Charge Indicator		Bat/low will be indicated on LCD when capacity reaches approximately 10%

Environmental Characteristics

Characteristic	Performance Requirement	Supplemental Information
Temperature		
Operating	–10° C to +55° C	Battery capacity reduced at other than +15°C to +25°C
Non-operating	–62° C to +85° C	With battery removed. Storage temp with battery in is –20° C to +55° C. Contents on non-volatile memory (stored waveform) might be lost at temps below –40° C.
Humidity	to 100%	
Altitude		MIL–T–28800C, Class 3
Operating	to 15,000 ft	
Non-operating	to 40,000 ft	
Vibration	5 to 15 Hz, 0.06 inch p–p 15 to 25 Hz, 0.04 inch p–p 25 to 55 Hz, 0.013 inch p–p	MIL–T–28800C, Class 3
Shock, Mechanical		
Pulse	30 g, 11 ms 1/2 sine wave, total of 18 shocks	MIL–T–28800C, Class 3
Bench Handling		MIL–STD–810, Method 516, Procedure V
Operating	4 drops each face at 4 inches or 45 degrees with opposite edge as pivot	Cabinet on, front cover off
Non-operating	4 drops each face at 4 inches or 45 degrees with opposite edge as pivot. Satisfactory operation after drops.	Cabinet off, front cover off
Loose Cargo Bounce	1 inch double-amplitude orbital path at 5 Hz, 6 faces	MIL–STD–810, Method 514, Procedure XI, Part 2
Water Resistance		MIL–T–28800C, Style A
Operating	Splash-proof and drip-proof	Front cover off
Non-operating	Watertight with 3 feet of water above top of case	Front cover on
Salt Atmosphere	Withstand 48 hours, 20% solution without corrosion	
Sand and Dust	Operates after test with cover on, non-operating	MIL–STD–810, Method 510, Procedure I
Washability	Capable of being washed	
Fungus Inert	Materials are fungus inert	

(continued next page)

Characteristic	Performance Requirement	Supplemental Information
Electromagnetic Compatibility	VDE 0871 Class B MIL-T-28800C Emission per standard: EN50081–1 EN55022 Class B Radiated Emissions EN55022 Class B Conducted Emissions EN60555–2 AC Power Conducted Emissions Immunity per standard EN50082–1 IEC 801–2 Electrostatic Discharge Immunity IEC 801–3 RF Electromagnetic Field Immunity IEC 801–4 Electrical Fast Transient/Burst Immunity, Signal and I/O IEC 801–5 Power Line Surge Immunity	 CE02, CE04, CS02, CS06, RE02, RE02.1
Radiated Susceptibility	MIL-STD-461A notice 4(EL), method MIL-STD-462 notice 3 for RS03 and RS03.1	RS03, RS03.1 from 14 kHz to 10 GHz Limited to 1 V/m (greater than 1 GHz, displayed noise characteristics performance shall be: ± 10 mρ peak or less, with 50Ω termination connected to RF input (16 averages)).

Physical Characteristics

Characteristic	Description
Weight	
without cover	14.25 lbs (6.46 kg)
with cover	15.75 lbs (7.14 kg)
with cover, chart recorder, and battery pack	19.75 lbs (8.96 kg)
Shipping Weight	
domestic	25.5 lbs (11.57 kg)
export	25.5 lbs (11.57 kg)
Height	5.0 inches (127 mm)
Width	
with handle	12.4 inches (315 mm)
without handle	11.8 inches (300 mm)
Depth	
with cover on	16.5 inches (436 mm)
with handle extended to front	18.7 inches (490 mm)

Options and Accessories

The following options are available for the 1502C MTDR:

Option 04: YT–1 Chart Recorder

Option 04 instruments come equipped with a chart printer. Refer to the *YT–1/ YT–1S Chart Recorder Instruction Manual* that comes with this option for instructions on operation, paper replacement, and maintenance.

Option 05: Metric Default

Option 05 instruments will power up in the metric measurements mode. Standard measurements may be selected from the menu, but metric will be the default.

Option 07: YT–1S Chart Recorder

Option 07 instruments come equipped with a splashproof chart printer. Refer to the *YT–1/ YT–1S Chart Recorder Instruction Manual* that comes with this option for instructions on operation, paper replacement, and maintenance.

Power Cord Options

The following power cord options are available for the 1502C TDR. Note that these options require inserting a 0.15 A fuse in the rear panel fuse holder.

***NOTE**. The only power cord rated for outdoor use is the standard cord included with the instrument (unless otherwise specified). All other optional power cords are rated for indoor use only.*

Option A1: 220 VAC, 16 A, Universal Europe 161–0066–09

Option A2: 240 VAC, 13 A, United Kingdom 161–0066–10

Option A3: 240 VAC, 10 A, Australia 161–0066–11

Option A4: 240 VAC, 15A, North America 161–0066–12

Option A5: 240 VAC, 6 A, Switzerland 161–0154–00

Accessories

Standard Accessories

- Internal Lead–gel Battery Assembly 016–0915–00
- Replacement Fuse (AC line fuse, 115 VAC) 159–0029–01
- Replacement Fuse (AC line fuse, 230 VAC) 159–0054–00
- Power Cord (outdoor rated) 161–0228–00
- Option Port Cover Assembly 200–3737–00
- Precision 50Ω Test Cable (S/N ≥ B021135) 012–1350–00
- 50Ω BNC Terminator 011–0123–00
- BNC Connector, female-to-female 103–0028–00
- Slide Rule Calculator 003–0700–00
- Slide Application Note (bound in this manual) 062–8344–xx
- Accessory Pouch 016–0814–00
- Operator Manual 070–7169–xx

Optional Accessories

- Service Manual 070–6267–xx
- Battery 040–1276–00
- Chart Recorder, YT–1S 119–3616–00
- Chart Paper, single roll 006–7647–00
- Chart Paper, 25-roll pack 006–7677–00
- Chart Paper, 100-roll pack 006–7681–00
- Connector, BNC male to BNC male 103–0029–00
- Connector, BNC female to Alligator Clip (S/N ≥ B025708) . . 013–0261–00
- Connector, BNC female to Hook-tip Leads 013–0076–01
- Connector, BNC female to Dual Banana Plug 103–0090–00
- Connector, BNC male to Dual Binding Post 103–0035–00
- Connector, BNC male to N female 103–0058–00
- Connector, BNC female to N male 103–0045–00
- Connector, BNC female to UHF male 103–0015–00
- Connector, BNC female to UHF female 103–0032–00
- Connector, BNC female to Type F male 103–0158–00

- Connector, BNC male to Type F female 013–0126–00
- Connector, BNC female to GR 017–0063–00
- Connector, BNC male to GR 017–0064–00
- Terminator, 75Ω BNC 011–0102–00
- Adapter, Direct Current 015–0327–00
- * Adapter, 50/75Ω 017–0091–00
- * Adapter, 50/93Ω 017–0092–00
- * Adapter, 50/125Ω 017–0090–00

* . These adapters should be purchased if GR connectors (017–0063–00 and/or 017–0064–00) are purchased.

Circuit Descriptions

Introduction

This chapter describes how the instrument works. First is a circuit overview and how it relates to the block diagram (Figure 5–1, next page). Following that are the separate sections of the instrument, discussed in detail.

The 1502C uses time-domain reflectometry techniques to detect and display the impedance characteristics of a metallic cable from one end of the cable. This is accomplished by applying a rapidly rising step to the cable and monitoring the resulting voltage over a period of time. If the cable has a known propagation velocity, the time delay to a particular reflection can be interpreted in cable distance. Amplitude of the reflected voltage is a function of the cable impedance and the impedance of the termination relative to the cable leading to it. The amplitude can be interpreted in rho or dB. Rho (ρ) is a convenient impedance function defined as the voltage reflection coefficient. It is the ratio between the incident step and the reflected step. For the simple case of a cable with a resistive load:

$$\rho = \frac{R_L - Z_O}{R_L + Z_O}$$

Where:
R_L is the load impedance, and
Z_O is the characteristic impedance.

The 1502C instrument is comprised of several subsections, as shown in the block diagram (Figure 5–1). These are organized as a processor system, which controls several peripheral circuits to achieve overall instrument performance.

The processor system reads the front-panel control settings to determine the cable information that you selected for viewing. Distance settings are converted to equivalent time values and loaded into the timebase circuits.

The timebase generates repetitive strobe signals to trigger the driver/sampler circuits. Pulse strobes cause a step to be applied to the cable under test. Sample strobes causes a single sample of the cable voltage to be taken during a very short interval. The timebase precisely controls the time delay of the sample strobe relative to the pulse strobe. When many sequential samples are recombined, a replica of the cable voltage is formed. This sampling technique allows extremely rapid repetitive waveforms to be viewed in detail.

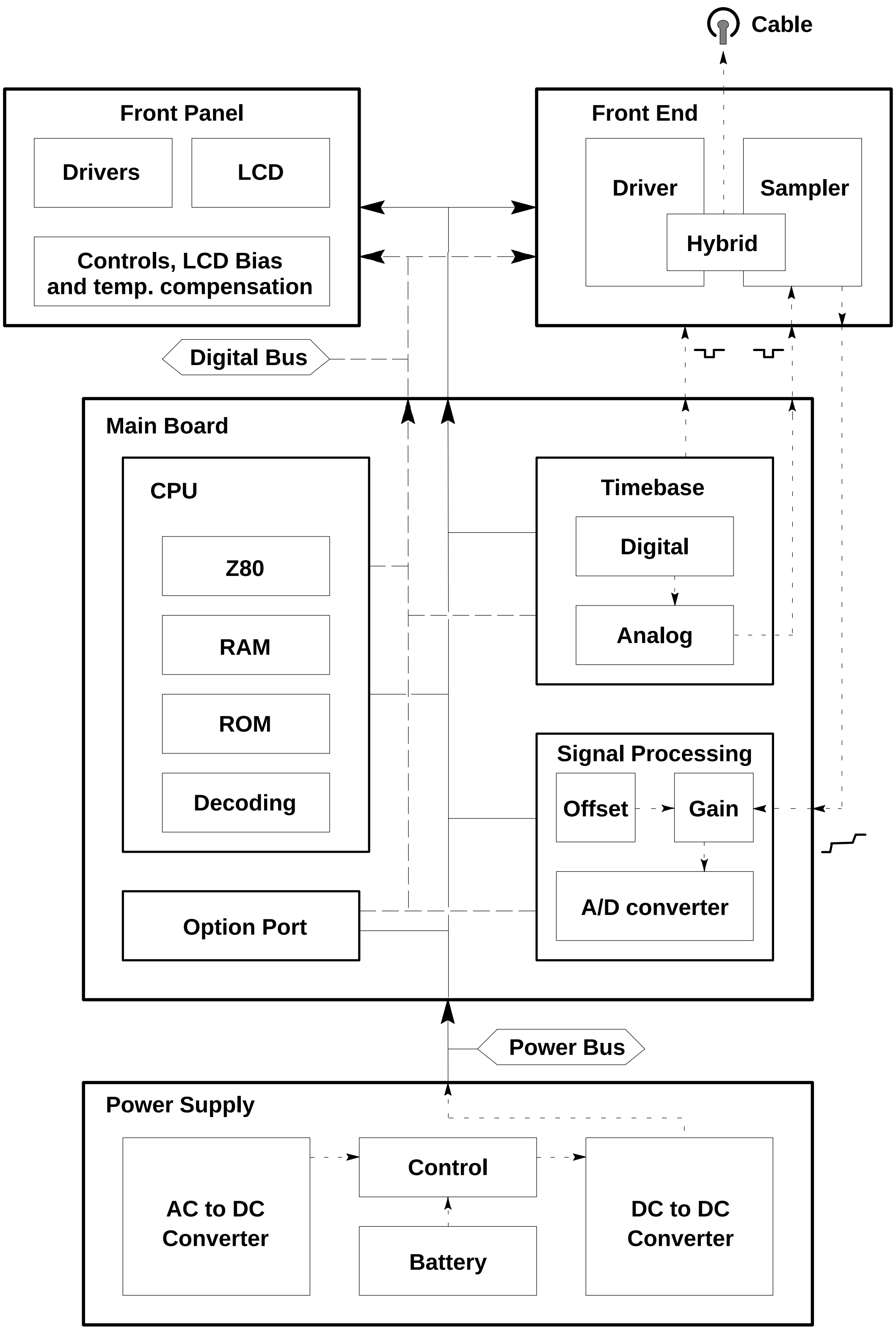


Figure 5–1: System Block Diagram

Referring to the waveforms in Figure 5–2, cable voltage waveforms are shown at the top. Each step is from the pulse generator and all steps are identical. At time delays (t_n, t_{n+1}, t_{n+2}, etc.) after the steps begin, a sample of the step amplitude is taken. Each of these samples is digitized and stored in the processor until sufficient points are accumulated to define the entire period of interest. The samples are then processed and displayed at a much slower rate, forming the recombined waveform as shown. This process allows the presentation of waveforms too rapidly to be viewed directly.

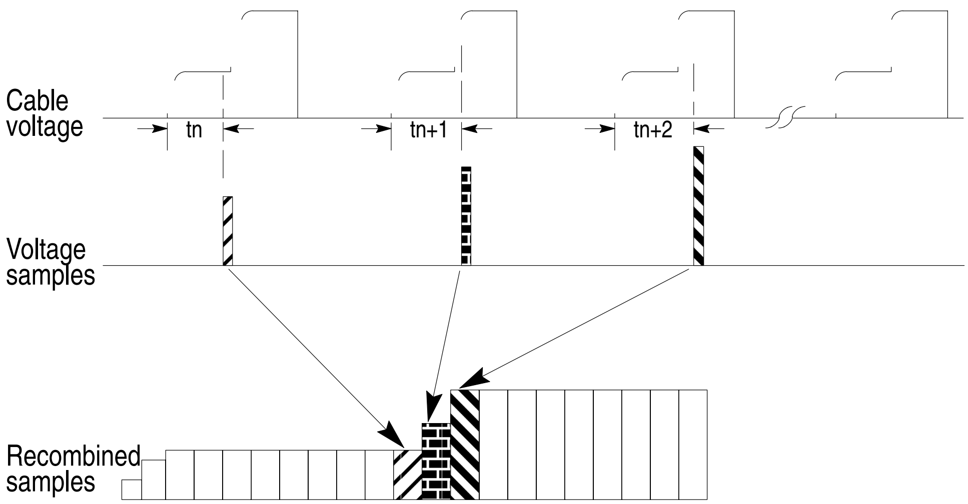


Figure 5–2: Waveform Accumulation Diagram

Voltage samples from the driver/sampler are combined with a vertical position voltage derived from the front-panel control, then amplified. The amplifier gain is programmed by the processor to give the selected vertical sensitivity. Each amplified sample voltage is then digitized by an analog-to-digital converter and stored in the processor memory.

When the processor has accumulated sufficient samples (251) to form the desired waveform, the samples are formatted. This formatted data is then transferred to the display memory. The display logic routes the data to each pixel of the LCD, where each digital data bit determines whether or not a particular pixel is turned on or off.

Between each waveform, samples are taken at the cursor location for the "ohms at cursor" function, and at the leading edge of the incident step for use by the timebase correction circuit.

Cursor and readout display data is determined by the processor and combined with the formatted sample waveform before it is sent to the display.

Power Supply

Introduction

The power supply consists of the following:

- Primary Circuit
- Pre-regulator
- Battery Charger
- Deep Discharge Protection
- Port-regulator
- DC-to-DC Converters

The power supply converts either 115/230 VAC line power, or takes power from a lead-gel battery, and provides the instrument with regulated DC voltages. A block diagram of the power supply is shown in Figure 5–3.

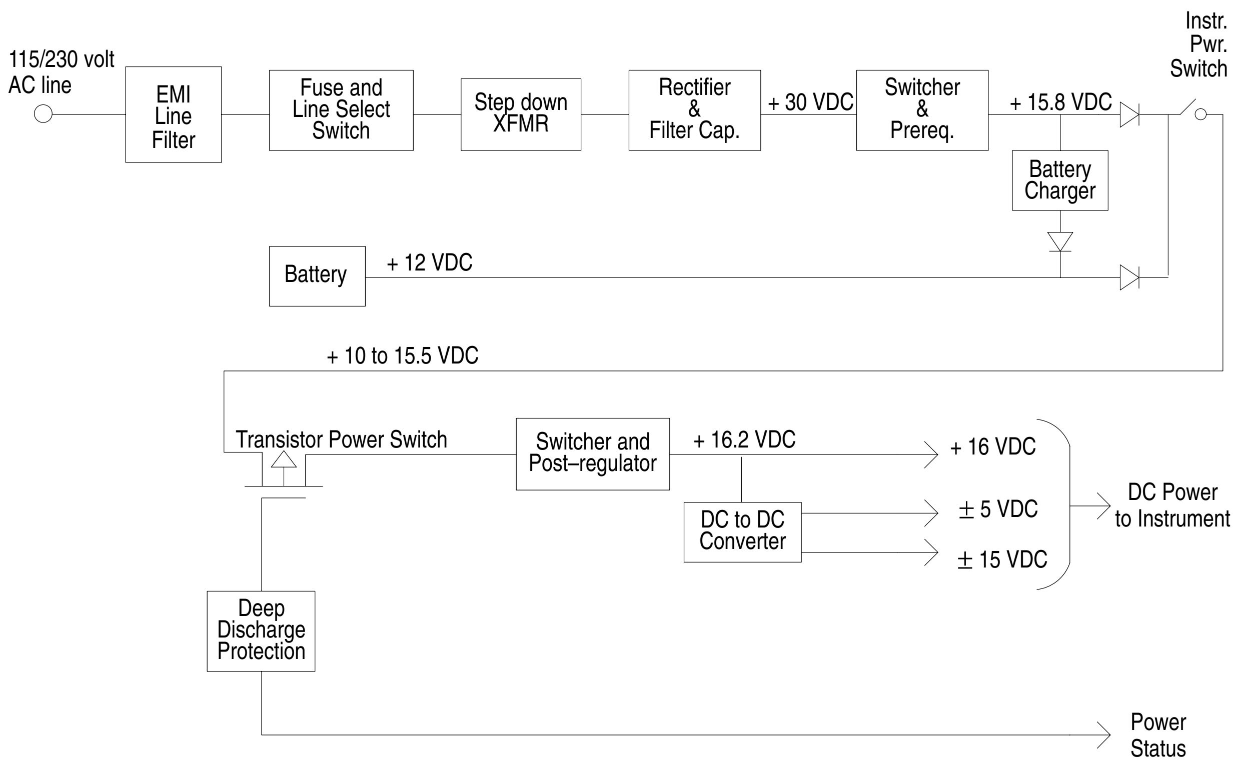


Figure 5–3: Power Supply Block Diagram

Single-phase AC line voltage is applied to the power supply module through a power plug with internal EMI filter. The filtered line voltage is immediately fused, routed through a line selector switch and applied to a stepdown transformer. The transformer secondary voltage is rectified and power switched to power the post regulator.

A switching pre-regulator reduces this voltage to +15.8 VDC and is used to power the battery charger. This voltage is also processed through a rectifier and power switch to power the post-regulator.

If a battery is installed, the battery charger operates as a current source to provide a constant charging current. Voltage limiting circuits in the charger prevent battery overcharge by reducing the charge current as the battery voltages approaches +12.5 VDC.

The battery provides a terminal voltage of 10 to 12.5 VDC, with a nominal capacity of up to 2.0 Amp-Hours. It also is connected through a rectifier to the instrument's power switch and post-regulator.

When the power switch is closed, an FET power transistor is momentarily turned on by the deep discharge protection circuit. If the voltage to the post-regulator rises to +9.7 VDC or greater, the transistor switch remains on. If at any time, the voltage drops below +9.7 VDC, the transistor turns off and the power switch must be recycled to restart the instrument. This operation prevents discharge of the battery below +10 VDC. Such a discharge could cause a reverse charge in a weak cell, resulting in permanent cell damage.

The post-regulator is a boost switching regulator that increases its input voltage to a constant +16.2 VDC output. This voltage is supplied directly to the processor for large loads, such as the display heater, electroluminescent backlight, and options port. The post-regulator also supplies a DC-to-DC converter that generates ±5 VDC and ±15 VDC for use in the instrument.

Status signals indicating whether the instrument is running on AC line voltage or the battery, and if the battery is approaching turn-off level, are supplied to the instrument by the deep-discharge protection circuits.

Primary Circuit

The AC line power is received by the connector in the EMI filter (FL1). This filter prevents high frequency signals generated in the instrument from being conducted back to the AC power line. The line voltage is fused (F101) and switched (S201) to the primary step-down transformer (T201). Both the switch and the fuse can be accessed from the outside of the instrument via covers on the rear of the cabinet.

The primary of T201 is wound in two identical sections. These sections are connected by S201 (in parallel for 110 VAC operation or in series for 220 VAC operation). The secondary of T201 is connected by a short two-wire cable to the Power Supply Board. The MOV (R101), across one of T201's primaries, protects the power supply if 220 VAC is applied while S2011 is in the 110 VAC position. Fuse F101 will open in this event.

Pre-Regulator

The secondary voltage is full-wave rectified by CR1010 and filtered by capacitor C1010. The large value of this capacitor allows it to supply energy to the instrument between half cycles of the line voltage.

Integrated circuit U1010 is a pulse-width modulator switching regulator controller. It oscillates at approximately 70 kHz and provides drive pulses to switching transistors Q1010 and Q1011. The output pulses from these transistors are filtered to DC by flyback rectifier CR2010, choke L1010, and capacitors C2010 and C2012. The resulting +16.6 VDC is fed back to the regulator U1010 by voltage divider R1016 and R1015. It is then compared to a +2.5 VDC reference voltage from, U1011. To increase the output voltage, U1010 increases the pulse width of the drive to Q1010 and Q1011. To reduce the output voltage, U1010 decreases the pulse width to Q1010 and Q1011. This assures that a constant +16.6 VDC is maintained.

Resistor R1010 acts as a current sensing shunt in the pre-regulator return line. In the event that a circuit fault draws excess current, the voltage developed across R1010 (and filtered by R1011, R1012, and C1011) will cause U1010 to reduce the pulse width of the pre-regulator. This protects the pre-regulator from damage due to overload.

Battery Charger

The battery charger consists of a linear regulator integrated circuit, U2010, and associated components. U2010 is connected as a current source, drawing current from the +15.8 VDC and supplying it to the battery through T2012. The voltage drop across T2012 is fed back to U2010 through diode CR2014 to control charging current at a nominal 150 mA. Diode CR2013 and voltage divider R2010 and R2011 provide a voltage clamp to U2010’s feedback terminal to limit the maximum voltage that can be applied to the battery through CR2015. As the voltage R2012 and CR2015 approaches the clamp voltage, battery charging current is gradually reduced to trickle charge.

Rectifier CR2015 prevents battery discharge through the charger when AC line voltage is not present. Rectifier CR2012 allows the battery to power the instrument when AC power is not present.

Deep Discharge Protection

Pre-regulator or battery voltage is applied to Q2011 and Q2012 when the instrument power switch is pulled on. The rising voltage causes Q2011 and Q2012 to turn on due to the momentary low gate voltage while C2011 is charging. During this time, voltage comparator U1020A compares the switched voltage to a +2.5 VDC reference from U1022. If the voltage is greater than +9.7 VDC, U1020A turns on, drawing current through Q2010 and R2015 to keep the gates of Q2011 and Q2012 near ground and the transistors turned on. If the voltage is less than +9.7 VDC (or drops to that value later), U1020A and Q2010 turn off, allowing C2011 to charge to the input voltage and turn off Q2011 and Q2012. When turned off, the deep discharge protection circuit limits current drawn from the battery to only a few microamperes.

Post-Regulator

The post-regulator receives from +9.7 to +15.5 VDC and boosts it to +16.2 VDC by switching Q2022 on and off with a pulse-width modulated signal. When Q2022 is turned on, input voltage is applied across choke L2020, causing the current in L2020 to increase. When Q2022 is turned off, the stored energy in L2020 will cause the current to continue flowing through CR2021 to filter capacitor C2025. Due to its stored energy, the voltage developed across L2020 adds to the input voltage, allowing C2025 to be charged to a voltage greater than the input.

The switching of Q2022 is controlled by pulse-width modulator U1023. The post-regulator output voltage is fed back to U1023 through R1025 and R1024 and compared to the +2.5 VDC reference from U1022. Low output voltage causes wider pulses to be supplied to Q2022, storing more energy in L2020 during each pulse. This results in a higher output voltage. High output voltage, however, reduces pulse width and reverses the preceding process.

U1023 oscillates at approximately 80 kHz and supplies a synchronizing signal to the pre-regulator at that frequency when the instrument is operating on AC power. This raises the pre-regulator frequency to the same 80 kHz. This synchronization eliminates beat frequency interference between the two regulators.

The synchronizing signal from U1023 is also supplied to Q2021, where it is amplified to CMOS levels and buffered by gate U2030A. The signal is then used to clock flip-flop U1024B to produce a 40 kHz square wave output at Q and $\overline{Q}$. These square waves are buffered by other U2030 inverters and used to drive DC-to-DC transistors Q2030 and Q2031.

DC-to-DC Converter

Transistors Q2030 and Q2031 apply push-pull power to the primary of T1030 at 40 kHz by switching the +16.2 VDC alternately between the primary windings. The resulting transformer secondary voltages are rectified and filtered by CR1034, C1032, C1033, and C1034 to produce +15 VDC and –15 VDC. Other secondary voltages are rectified and filtered by CR1030, CR1031, CR1032, CR1033, C1030, C1031, and C1037 to produce +5 VDC and –5 VDC.

Diodes CR2031 and CR2030 rectify the primary voltage and clamp it to the voltage level that is across C2031. This prevents voltage transients caused by the rapid switching of Q2030 and Q2031 and prevents the leakage inductance of T1030’s primary from creating excessive voltage stress. R2030 provides a discharge path from C2031. T1031 and C1036 provide additional filtering of the +16 VDC supply.

Processor System

Introduction

The processor system consists of the following:

- Microprocessor
- Address Decoding and Memory
- Interrupt Logic

The processor system provides control and calculation functions for the instrument. A block diagram of the processor system is shown in Figure 5–4 (next page).

An eight-bit microprocessor, clocked at 5 MHz, provides the processing capability in a bus-organized system. Instructions are read from the program memory EPROM and executed by the microprocessor to accomplish essentially all instrument functions. Random access memory is connected to the microprocessor through its data and address busses, allowing it to store and retrieve control, video, and display data, as required.

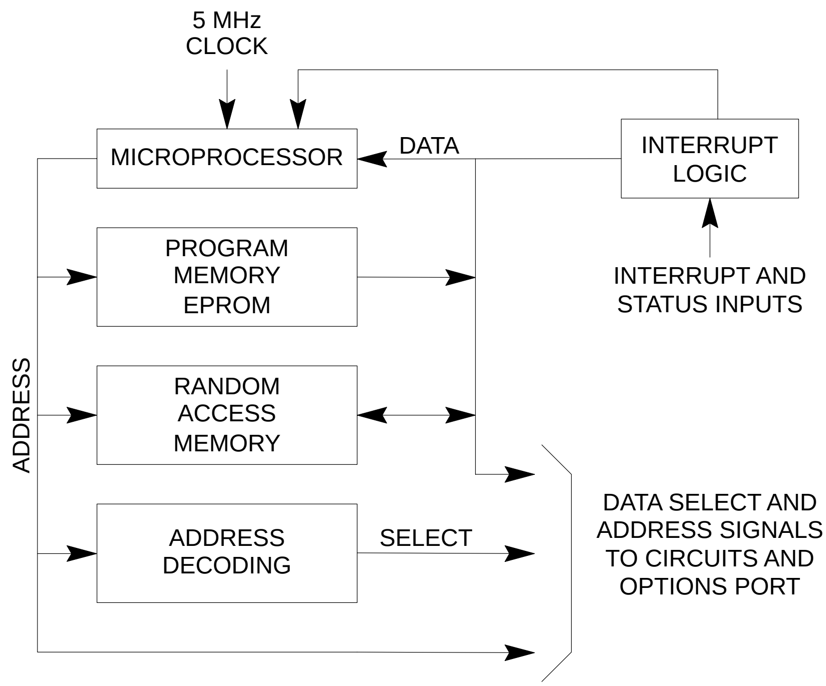


Figure 5–4: Processor Block Diagram

The processor communicates with all other instrument circuits via the address, data, and select signals, and receives requests for service from those circuits via the interrupt and status signals. Select signals are generated in address decoding circuits under control of the processor and used to read or write data from a circuit, or to trigger a circuit function. Interrupts from those circuits are combined in the interrupt logic to generate an interrupt request to the microprocessor. The processor responds by reading a data word from this logic to determine the source of the interrupt, or status data, and then performs the required service routine.

Microprocessor

The microprocessor, U1023, is a single chip processor using Z80 architecture constructed in high-speed CMOS logic. Each data word, or byte, is eight bits wide and the microprocessor has a 16-bit address capability, allowing it to address up to 65,536 memory locations. The processor's 5 MHz clock is derived from a crystal oscillator in the timebase circuits.

When +5 VDC power is applied to C1030 and R1032, the rising voltage momentarily applies a positive signal to the input of gate U1031B. The resulting negative pulse at the gate output is supplied to U1023's reset input, causing the microprocessor to start at the beginning of its programmed routine each time power is applied.

Address Decoding and Memory

The 16-bit address space of Z80 processor U1023 is divided into five primary areas. They are:

- Program Memory (EPROM) space
- RAM space
- Non-volatile RAM space
- Display RAM space
- Enable and Select Signal space

Program Memory (EPROM)

The program memory is stored in 64-kilobyte (kb) EPROM U2020, which is divided into two 32–kb bank-switched halves. Both halves occupy locations OOOOH to 7FFFH in the processor's address space. The most significant address bit on the EPROM, which determines which bank is addressed, is set by flip-flop U2030A. This bank-switching flip-flop can be toggled by the processor with two select lines, decoded in the enable and select signal address space. The select signal for the EPROM is generated by combined address line A15 with the MREQ signal in U1045A. Whenever the processor addresses a location where A15 is not set, the program memory will be selected to place data on the bus.

RAM

The first RAM is eight-kilobyte memory U1021, selected by a signal generated by a 1-of-8 decoder, U1022. This decoder operates on the three most significant address bits (A_{15}, A_{14}, A_{13}) in combination with MREQ. Each of its decodes represents a selection of a particular $^1/_8$ th of addressable locations. The first four decode signals are not used because they are located in the program memory space. The fifth decode is the select signal for the first RAM, occupying locations 8OOOH to 9FFFH.

Non-Volatile RAM Space

The second RAM is also an 8-kb memory, U1020, made non-volatile by lithium battery BT1010 and non-volatile memory controller U1010. The select signal for this RAM is generated similarly to that for the first RAM with the sixth $^1/_8$ th decode of U1022. This decode occupies AOOOH to BFFFH.

Display RAM Space

The display RAM is also an 8-kb memory, U1040, located in the display module. It is selected by the seventh decode of U1022. It occupies locations COOOH to DFFFH.

Enable and Select Signal Space

The remaining addressable space is used to generate enable, select, or trigger signals, which read, write, and control other circuits of the instrument. The eighth $^1/_8$ th decode signal of U1022 is used to enable four other 1-of-8 decoders: U2021, U2022, U2024, and U2026. These four decoders are further selected by the four combinations of A_{12} and A_{11} and operate on A_{10}, A_9, and A_8 to generate the enable, select, and trigger signals CS00 through CS31. These occupy the remaining address space, locations EOOOH to FFFFH.

An automatic wait state is inserted for all circuits selected by U2022. The wait state is used by the processor to compensate for the slow access times of U2041, U2046, and U4020 on the Main Board; U2023 on the Front Panel Board; and U2040 on the display module. The wait request is generated by U1041.

The select signals from U2024 are also modified through U1043B by a 200-ns pulse. This pulse is created from gates U1042B, U1031C, U2040C, and J-K flip-flop U2033A. This circuit creates a write pulse that ends prior to the completion of the processor bus cycle, thus meeting data hold time requirements for some selected ICs.

Additional Decoding

The most significant address bit on the EPROM is set or reset by bank-switching flip-flop U2023A. Another control signal, heat disable, is generated by a similar flip-flop, U2023B. This is also toggled by two select lines.

Interrupt Logic

The interrupt logic consists of an eight-bit tri-state buffer, U1032, and gates U1030 and U1031D. Six interrupt requests signals are logically OR'd by U1030, then inverted by U1031D and applied to the microprocessor interrupt request input. Five of the interrupts are received from the video ADC, the digital timebase, a real-time counter, the front panel control ADC, and from the Option Port connector. The sixth interrupt input is unused.

The six interrupt requests and two power status signals are connected to pull-up resistors R1033 and the inputs of buffer U1032. When the microprocessor responds to an interrupt request, it selects U1032, allowing the eight inputs to that device to be placed on the data bus for reading.

The processor system outputs six control signals to the Driver/Sampler module. These signals are loaded from the data bus into latch U3010 by a select signal from the address decoder. These signals are used by the 1502C Driver/Sampler and the Option 06 adapter (if equipped).

Option Port Interface

Introduction

The option port interface consists of the following:

- Supply Controller
- Buffers
- Output Latch

The option port interface provides the connection between the processor system and external options. This port has a unique protocol that must be followed for proper and safe operation. Further information can be obtained by contacting your Tektronix customer service representative. A block diagram of the option port interface is shown in Figure 5–5.

The processor system provides all the data and control for the interface. Data, Address, and Control lines are all buffered for increased drive. The power to the option port is switchable to reduce power consumption, if necessary. The other outputs are available for control and protocol purposes.

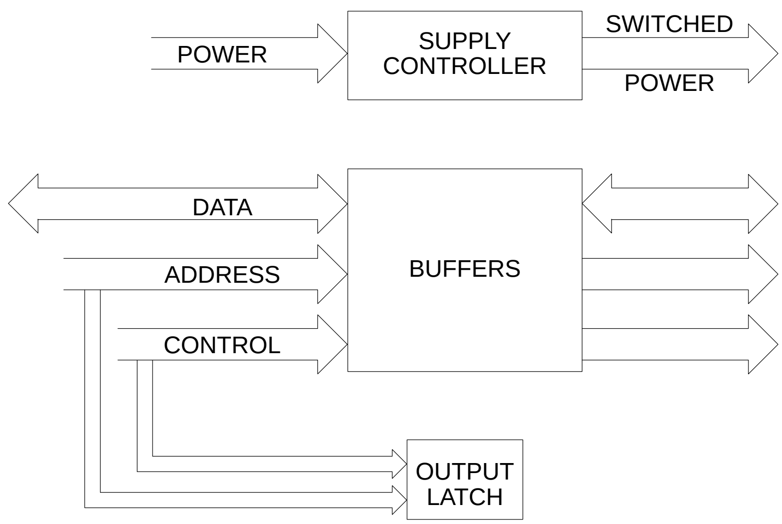


Figure 5–5: Option Port Interface Block Diagram

Supply Control

The +16 VDC and +5 VDC power outputs to the option port are switched supplies controlled by the microprocessor system. $\overline{\text{CS14}}$ and $\overline{\text{CS15}}$ are used to set and clear flip-flop U1011B. This feeds comparators U1012A and U1012B. The positive (+) input to the comparators is set at 2.5 volts, so the CMOS flip-flop will drive the negative (–) terminals above and below that voltage level. The comparators are powered with a +16 VDC and a –12 VDC source to give a good output swing in controlling the FET switches.

The output of U1012A controls the +16 VDC switch and is pulled up via a 20 kΩ resistor, R2011. The output is also passed through two 100 kΩ resistors, R2012 and R2013, to prevent the FETs from being over-driven. Two parallel FETs, Q2011 and Q2012, control the supply.

To reduce the instantaneous draw from the instrument supply when first turning the switch on, capacitive feedback is used (C2016). This feedback slows the turn-on time, allowing a capacitive load to be charged without affecting the instrument supply. A stabilizing 100 Ω resistor, R2010, is also located in the feedback loop.

***NOTE**. There are specified limits to this type of circuitry. Load specifications must be followed.*

The arrangement of the +5 VDC switch is similar except that a 10 kΩ to 100 kΩ resistive divider is used to ensure the switch has a definite turn-on. A single FET, Q1010, controls the +5 VDC output.

Buffers

Data lines to the option port pass through the bus transceiver, U2011. Address lines $\overline{\text{RD'}}$ and $\overline{\text{WR'}}$ are driven by U2012. CS22, from the processor system, enables these drivers with $\overline{\text{RD}}$ controlling the transceiver direction. U2012 outputs are pulled up by the switched +5 VDC supply, via R2015. The data lines are pulled down via R2014.

$\overline{\text{WR'}}$ is a modified write pulse 200 ns long, created to give a rising edge prior to the disabling of the drivers. This pulse is created by flip-flop U2033A.

Output Latch

The output latch U1011A is controlled by A_0 and A_1, with select signal $\overline{\text{CS10}}$. The output of this latch is optionally used in the interface protocol.

Two more lines are used in the option port interface. $\overline{\text{IR4}}$ is an interrupt signal that is active low when creating processor interrupts. R-T $\overline{\text{TRIG}}$ is also available at the interface. This is the trigger pulse generated in the analog timebase.

Option Port Wiring Configuration

Label	J2010 (on Main Board)	Option Port (D-Connector)
D_0	3	2
D_1	1	1
D_2	24	25
D_3	22	24
D_4	20	23
D_5	18	22
D_6	16	21
D_7	14	20
A_0’	12	19
A_1’	10	18
A_2’	8	17
A_3’	6	16
$\overline{\text{RD'}}$	7	4
$\overline{\text{WR'}}$	5	3
$\overline{\text{CS22}}$	9	5

Label	J2010 (on Main Board)	Option Port (D-Connector)
$\overline{IA}$	11	6
$\overline{IR4}$	13	7
R-T $\overline{TRIG}$	2	14
SW+16	25 23	13 12
$+16_{RTN}$	21 19	11 10
SW+5	17	9
$+5_{RTN}$	4 15	15 8

Video Processor

Introduction

The video processor system consists of the following:

- Vertical Position DAC
- Summing Amplifier
- Video Amplifier
- Video DAC

The video processor receives sampled video from the driver/sampler and outputs a digitized video signal to the processor system data bus. A block diagram of the video processor is shown in Figure 5–6.

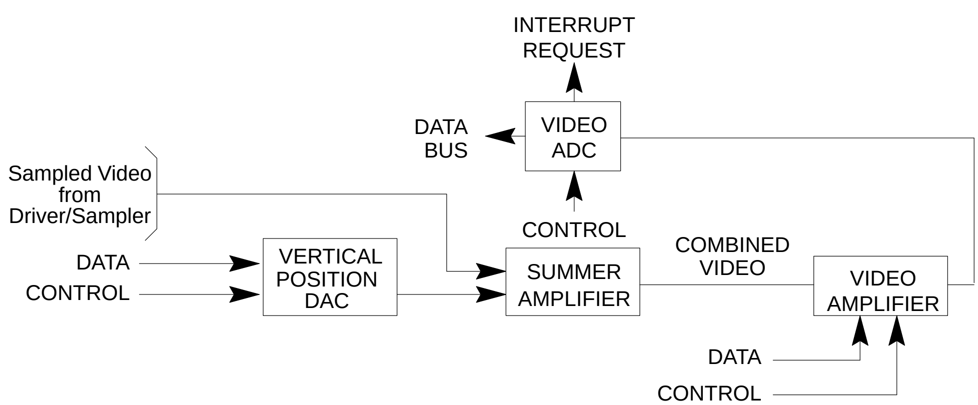


Figure 5–6: Video Processor Block Diagram

Vertical position information is loaded by the processor system into a DAC to generate a DC signal. Sampled video is combined with this vertical position DC voltage in a summing amplifier in order to allow vertical positioning of the displayed waveform.

The combined video and position signal is amplified by the user-selected gain in the video amplifier. Gain of the amplifier is set by the processor system via the data bus and video amplifier select signal.

The amplified video is digitized by the video ADC upon receipt of a control signal from the processor system. The processor is notified by the ADC interrupt request when the conversion has been completed. The processor then reads the value via the data bus.

Vertical Position DAC

The vertical position DC voltage is generated by a digital-to-analog converter consisting if U2046 and U3041. DAC integrated circuit U2046 receives a +2.5 VDC reference voltage from U3040 and multiplies it by a 14-bit digital value loaded from the data bus under control of the processor. The resulting current output of U2046 is amplified by operational amplifier U3041 to a proportional voltage of zero to –2.5 VDC.

Summing Amplifier

The summing amplifier consists of operational amplifier U8041; input resistors R8044, R8046, and R8047; and a feedback resistor, R8045. Summation of the DAC output through R8047 with the +2.5 VDC reference through R8046 causes the vertical position signal range to be enlarged and shifted to achieve an effective output of –2.5 VDC to +2.5 VDC.

Sampled video, through R8044, is summed with the vertical position signal at the input node of U8041. Resistor T8045 determines the gain of U8041 and is paralleled with C8040 to reduce high frequency gain for noise reduction. The sampled video input may be observed at TP9041.

Video Amplifier

Combined video from the summing amplifier is further amplified by a three-stage programmable video amplifier.

The first stage of this amplifier consists of amplifier U7040, voltage divider T8040 through R8043, and analog multiplexer U8040. Voltage gains of 0, 16, 32, or 48 dB are achieved by switching U8040 to connect one of the four points from the resistive voltage divider to the inverting input of U7040. This causes the amplifier gain to be equal to the attenuation factor of the voltage divider point selected.

The second stage consists of amplifier U5040, voltage divider R6040 through R6047, and analog multiplexer U6040. This stage operates similar to the first stage except eight voltage gains are provided from 0 to 14 dB in 2-dB steps.

The third stage consists of amplifier U3042, voltage divider T4040 through R4047, and analog multiplexer U4040. This stage operates similar to the first and second stages except eight voltage gains are provided from 0 to 1.75 dB in 0.25-dB steps.

Gain of each of the three amplifier stages is controlled by the processor system by loading latch U2044 with the appropriate 8-bit word from the data bus. Digital word

00 (all 0s) selects 0 dB gain and word FF (all 1s) selects 63.75 dB gain. All intervening values of 0.25 dB multiples are similarly chosen.

The output of the video amplifier is filtered by R2040 and C2043 for noise reduction, then sent to the analog-to-digital converter. The output may be observed at TP4040 (see Figure 5–7).

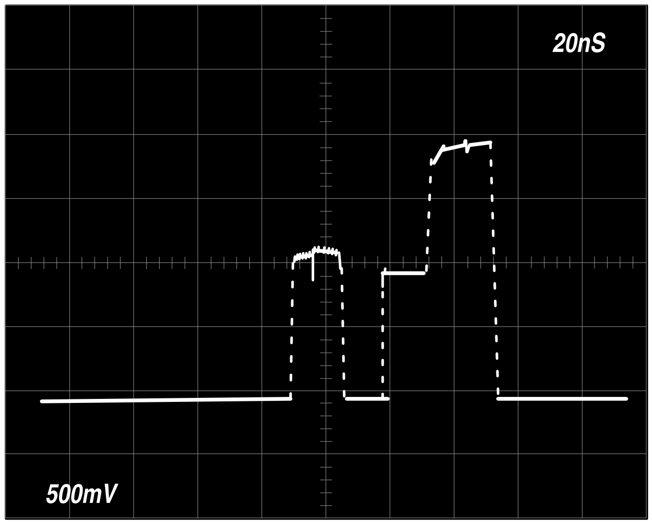


Figure 5–7: Video Processor Output

Video Analog-to-Digital Converter

The output of the video amplifier is converted to its digital equivalent value by ADC device U2041. The conversion is done using successive approximation technique to compare the video voltage to the +2.5 VDC reference from U3040. The device is clocked by a 1.25 MHz clock derived from the timebase oscillator, and completes its 12-bit plus sign conversion in approximately 100 μs.

Gate U2040 provides an OR function for the ADC start conversion trigger and read pulses from the processor system. Either pulse selects the ADC for control and concurrent pulses select the trigger ($\overline{WR}$ input) or read ($\overline{RD}$ input) functions.

Upon completing a conversion, the processor system is notified by an interrupt request ($\overline{IR0}$) from U2041.

Timebase

Introduction

The timebase circuits receive video sample time delay values in digital form from the processor system and generate precisely timed strobes to the driver/sampler circuits. Digital counters determine the delay in 50 ns multiples, and analog circuits further define the delay to fractions of that period. A block diagram of the timebase circuits is shown in Figure 5–8 (next page).

The digital portion of the timebase contains a clock generator that develops all frequencies used in the instrument electronics.

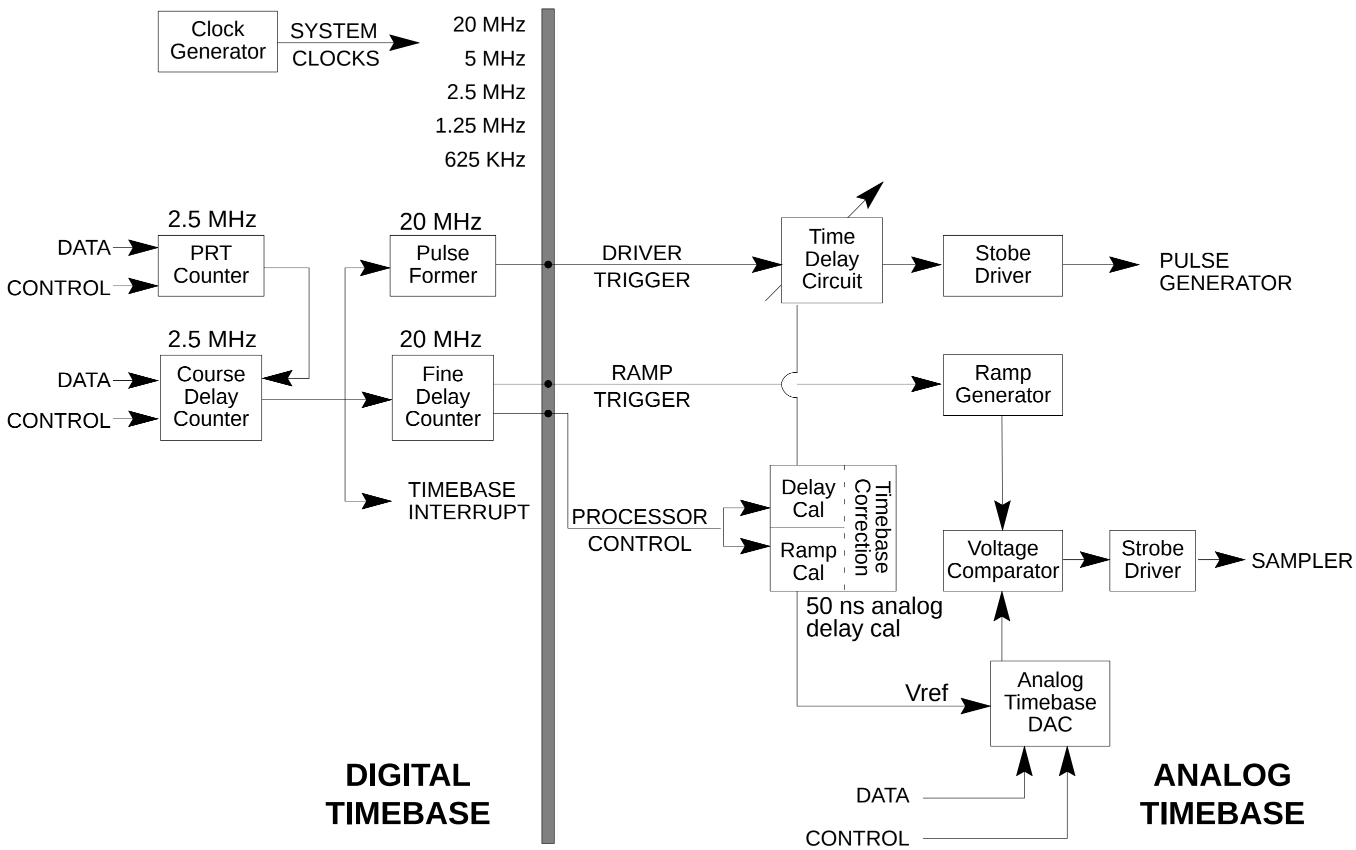


Figure 5–8: Timebase Block Diagram

A programmable digital counter, clocked at 2.5 MHz, is used to determine the PRT (pulse repetition time) of the driver/sampler test pulse. The 1502C is programmed with a PRT of 350 μs. The output of the PRT counter is used to trigger a delay counter, also clocked at 2.5 MHz, to provide coarse (400-ns resolution) digital time delay. The end of this time delay triggers a fine delay counter, which is clocked at 20 MHz, providing 50-ns resolution to the sampler time delay. Both the coarse time delay and the fine delay counters are programmed by the processor via the data bus. The end of the coarse delay is used to generate a timebase interrupt request to the processor to inform it that a sample is being taken and a timebase update is required for the next sample.

The output of the fine delay counter is provided to the analog timebase circuits for further delay control to become the sampler trigger. The beginning of the coarse delay counter period is detected by a pulse former, which generates a driver trigger for the analog timebase.

The analog timebase circuits receive the driver and sampler triggers and provide strobes to the driver/sampler. The driver trigger is delayed by an analog time delay and amplified by a driver circuit to provide the driver strobe.

The ramp trigger is used to start a linear voltage ramp generator. A voltage comparator detects the time when this ramp reaches the programmed voltage of the timebase DAC (digital-to-analog converter) and signals a driver to produce a strobe for the video sampler. The timebase DAC is programmed by the processor to provide a voltage proportional to the portion of the 50-ns time delay period desired.

Timebase control by the processor system is shown in Figure 5–9. Each period of the pulse rate, the processor calculates a new 33-bit digital time delay value for the next sample to be taken. The sixteen most significant bits of this value are loaded into the coarse delay counter, causing it to count that number of 2.5 MHz clock periods before starting the fine delay counter.

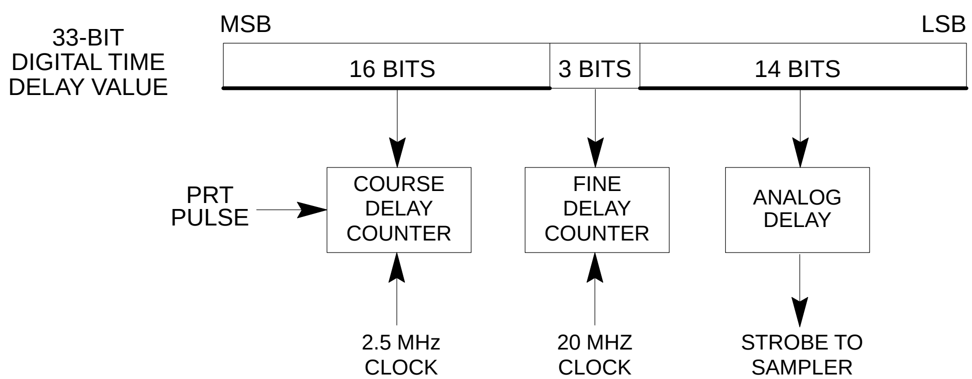


Figure 5–9: Timebase Control

The next three bits from the processor time delay value are loaded into the fine delay counter. This counter starts at the end of the coarse delay, and counts the selected number of 20 MHz clock periods (o through 7) before triggering the analog delay.

The analog delay circuit receives the 14 least significant bits of the time delay word. A digital-to-analog conversion provides a proportional voltage, which is compared to a linear voltage ramp to produce the programmed time delay (o to 50 ns).

The timing diagram in Figure 5–10 (next page) shows the combined effects of the three time delays. The output of the PRT counter, waveform (a), begins the coarse delay (b). The falling edge of this signal triggers the driver strobe (c), which causes a pulse to be applied to the cable test output.

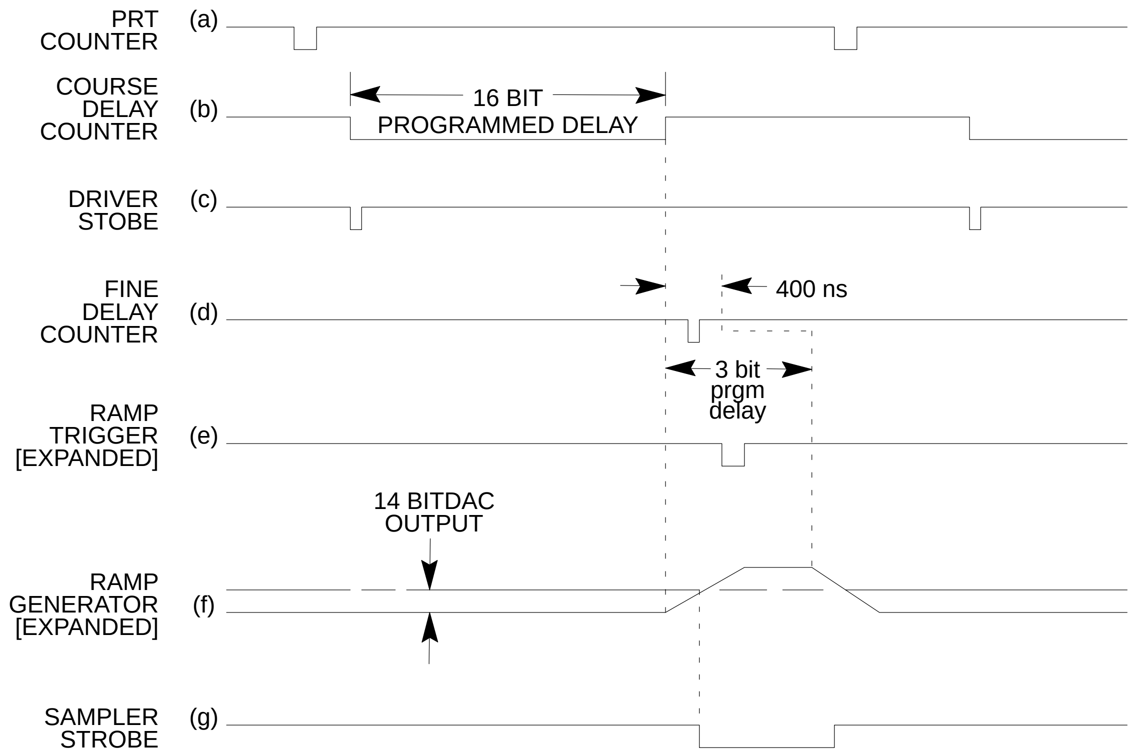


Figure 5–10: Combined Effects of Time Delay

At the end of the coarse delay, the rising edge of this signal enables the fine delay (d), which produces a single ramp trigger pulse after the programmed delay. This pulse is shown expanded in waveform (e). The ramp generator waveform (f), also shown expanded, has a linear voltage ramp beginning on the falling edge of the trigger. This voltage is compared to the voltage from the timebase DAC, such that when the ramp exceeds the DAC voltage, the sampler strobe (g) falls. This falling edge is used as the sampler strobe for video sampling.

At the beginning of each sweep, the zero distance reference is calibrated to the front-panel connector and the length of the analog ramp to 50 ns.

Zero distance reference is calibrated by setting the digital and analog timebase for zero delay. Then the processor adjusts the driver delay so as to sample at the 10% point of the pulse. The ramp is calibrated by removing 50 ns of delay (one 50-ns clock cycle) from the sample trigger and then reinserting it with the analog delay. The processor adjusts the reference for the timebase DAC so as to sample at the previous level. This matches the analog delay to the 50-ns period of the clock.

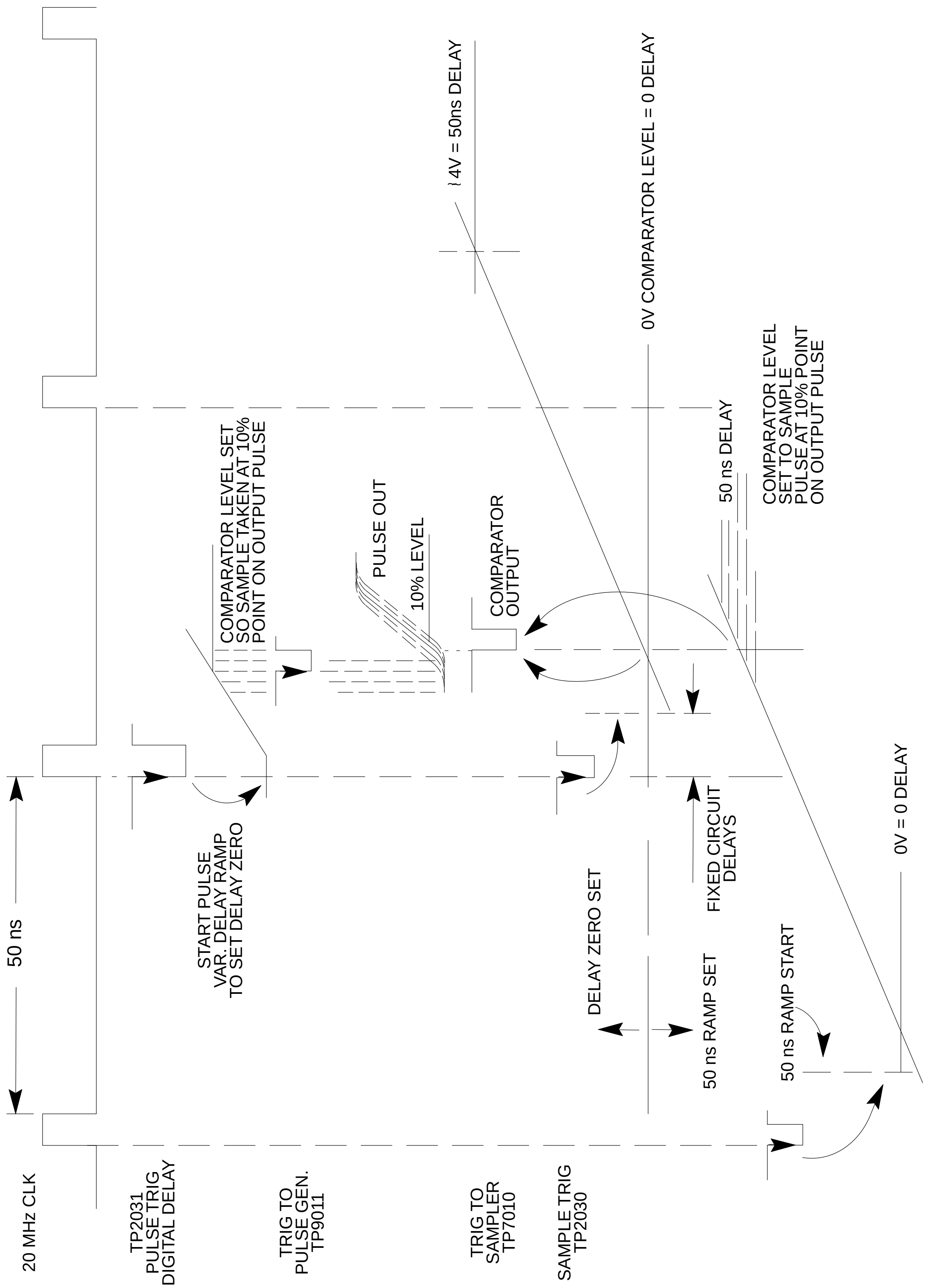


Figure 5–11: Calibration of Delay Zero and 50-ns Analog Delay

Digital Timebase

All digital clocks from the instrument are derived from a 20 MHz crystal oscillator, U2031. Flip-flops U2042A and U2042B divide the clock frequency to 10 MHz and 5 MHz respectively. The 5 MHz output is provided to the microprocessor and to TP2041.

Gate U2034B decodes one of the four states if U2042 and provides a 5 MHz pulse to U2033B. Flip-flop U2033B is clocked by the 20 MHz clock and divides the 5 MHz signals to 2.5 MHz synchronously with the 20 MHz. The 2.5 MHz clock is further divided to 1.25 MHz by U2025A and 625 kHz by U2025B.

The PRT, coarse delay, and real-time counters are contained in a triple, 16-bit, programmable counter device, U2030. The PRT and coarse delay counters are clocked at the 2.5 MHz rate. The output of the PRT counter, pin 10 of U2030, is applied to the trigger input of the coarse delay counter as a start-count signal. The negative-going pulse from the coarse delay counter, pin 13 of U2030, is input to a two-stage shift register, U2032C and U2032D. This shift register is also clocked at 2.5 MHz and serves to delay the signal and reduce its skew relative to the 20 MHz clock. The $\overline{\text{Q}}$ (inverted output) of U2032C is a positive-going pulse that is supplied to a three-stage shift register, U2036B, U2036D, and U2036A, which is clocked at 20 MHz from inverter U2034A. The leading edge of the pulse is decoded by NAND gate U2045B, which also ANDs the signal with the 20 MHz clock from inverter U2045A. The resulting driver trigger pulse is a negative-going pulse of nominally 25 ns width. The falling edge of this pulse is determined by the edge of the 20 MHz input to gate U2045B and is used as the driver trigger.

The coarse delay pulse from shift register U2032D and U2032C us decoded by NOR gate U2034C to detect the pulse rising edge (end of the negative pulse). The resulting positive pulse is 400 ns wide (one cycle of the 2.5 MHz clock). This pulse is shifted through flip-flop U2036C to synchronize it with the 20 MHz clock and applied to the count enable input of U2037, a four-bit programmable counter.

Counter U2037 will have been preset to a count of 8 through 15 by the processor through latch U2043 with $\overline{\text{CS11}}$. While the count enable pulse is present, it will count exactly eight times at the 20 MHz rate, thus passing through count 15 after 0 through 7 clock pulses. The terminal count (TC) output of U2037 is a decode of count 15. Thus this signal creates the fine delay pulse after the programmed delay. This positive-going pulse is gated with the 20 MHz clock by NAND gate U2045C to provide a 25 ns negative-going pulse for the ramp trigger. Ramp timing is derived from the trigger falling edge.

The end of the coarse delay, detected by gate U2034C, is used to clock U2027A, which generates an interrupt request to inform the processor that a sample is being taken. An acknowledge pulse, $\overline{\text{CS16}}$, from the address decoder resets this flip-flop.

Analog Timebase

The logic level driver trigger from the digital timebase is first amplified by transistor stage Q9021. The trigger is capacitively coupled through C8022 and R9027 to shift it to analog levels. The collector of Q9021 is clamped to –0.5 VDC between pulses by CR8020 and rises to +6 VDC peak during the 25 ns pulse. This signal is applied to C8021 through R8025 to generate an exponentially rising pulse of about 4 VDC peak during the pulse width.

Dual transistor Q8020 is a differential amplifier that is used as a voltage comparator to detect when the pulse on C8021 has reached the DC voltage level set through U4021B and R8023 by the zero-distance calibration circuit. This DC voltage level, from zero to 4 VDC, allows setting the time when the voltage comparator switches (a range of about 20 ns). Dual transistor Q9020 is connected as a current source, providing a constant 2-mA bias to the emitters of Q8020. Between pulses, this current flows through Q8020B. When the exponential pulse reaches the adjustable voltage level, the current is rapidly transferred to Q8020A, causing a negative-going pulse at R8020. This pulse is coupled to the output stage, Q9010, through C9020 and R9020. Transistor Q9010 is biased to 0.5 mA between pulses to obtain fast turn-on, and provides a positive-going 5 VDC pulse to U8010B and U8010C. Flip-flop U7010A is set or reset by the processor to steer the pulse either to the option port or the driver. The negative-going pulse from gate U8010B or U8010C is logically OR'd by U8010A, then applied to C9010 and R9010. This pulse is fed back to the input of the gates U8010B and U8010C through CR9010 to obtain a one-shot action, which stretches the driver strobe pulse width to 5 μs. The driver strobe is made available at TP9011.

The ramp trigger pulse from the digital timebase is AC-coupled by C3040 and R3041 to Q4040. Diode CR3031 allows the negative-going pulse to pass directly, while R3040 limits the input current sue to the re-charging of C3040 between pulses. The output of Q4040 is held at ground by L5030 between pulses and rises to 6 VDC during the pulse. Choke L5030 is center tapped to provide an equal negative-going pulse at its undriven end. This pulse is fed through C5033 and R4032 to the emitter of Q4031 to obtain positive feedback to Q4040. This forms a one-shot circuit with the pulse width determined by C5033 and R4032. The 25 ns ramp trigger pulse is thus stretched to about 80 ns at L5030.

Dual transistor Q5032 operates as a current source, providing a constant 5-mA current, which is used to charge C5032 to create a linear voltage ramp. Between ramp trigger pulses, this current is conducted through CR4032 and L5030 to ground, creating a voltage of 0.5 VDC on C5032. The positive one-shot pulse from Q4040 turns off CR4032 and directs the charging current to C5032. The negative-going pulse from L5030 is connected to C5032 through CR5030 to provide a cancelling effect for the positive pulse being coupled through the capacitance of CR4032.

The linear rising voltage pulse from C5032 is buffered by source-follower Q5031 and emitter-follower Q5030 to provide a low output impedance and prevent loading the ramp. Transistor Q7030 provides a constant 2-mA bias current to junction FET Q5031.

The ramp voltage is AC-coupled to voltage comparator Q7021 by C7030 to remove the DC offset voltage developed in the preceding circuits. A small negative DC voltage of approximately –200 mV is added by voltage divider R7032 and R7025 to hold the voltage comparator off between pulses.

Voltage comparator Q7021 is biased at 2 mA by dual transistor Q5020. During the linearly rising ramp voltage, it compares the ramp to a programmed DC sample reference voltage produced by the timebase DAC circuit. When the ramp reaches the sample reference value, Q7021A rapidly turns on to produce a negative-going signal across R7024. This pulse is coupled through C7022 and R7021 to turn on Q6020, providing a positive pulse to the base of Q7020. The negative-going sampler strobe coming from Q7020 is supplied to the sampler and to TP7010.

Timebase DAC U4020 and amplifier U5010 inverts and multiplies V_{REF} by the 14-bit digital word loaded by the processor. It is filtered for noise by R7026 and C5023 and connected to comparator Q7021 through R7027 to set the analog delay (0 to 50 ns).

To calibrate the analog delay to 50 ns, the processor sets $\overline{\text{IR2}}$ (IR2 high) and loads a new 12-bit word in latches U3021 and U3022 (max 1-bit change per sweep) with chip selects $\overline{\text{CS11}}$ and $\overline{\text{CS12}}$. DAC U3023 multiplies the reference current (1 mA set by R3020) by the digital word from the latches. The DAC output current and the current from the last two LSBs (which comes from the latches through R3031, R3033, R3039, and R4020) are summed by U4021A and forced through R4021. This develops a correction voltage at TP4020 of ± 5 VDC and a sensitivity of 2.5 mV per bit (the currents from the LSBs have been complimented by the processor to correct their phase). The DAC circuit is designed to nominally run at half of full dynamic range (2048/4096) of 2 mA, that generate 1 mA of current at the summing node. That current is balanced out by 1 mA of current from R4020, giving a nominal output of zero volts at TP4020 and TP4021.

U5020, R5020, R5021, and C5021 scale the correction signal (up to ± 5 VDC) at TP4020 to ± 0.4 VDC at V_{REF} of U4020. Resistors R5023 and R5022 furnish a current to offset V_{REF} to a –4 VDC ± 0.4 VDC (equivalent to ± 5 ns) correction signal to the 50 ns analog delay.

To calibrate, the zero-distance delay ($\overline{\text{IR2}}$) is set low, and through R3037 and CR3030, turns on Q3030, whose collector (through R3036 and R3035) raises the cathode of CR4030 to +6 VDC. This allows R4023 to turn on Q4030. Capacitor C4022, through R4030 and Q4030, is charged to the new corrected level at TP4020 that was asked for by the processor. The correction voltage on C4022 from buffer amplifier U4021B is scaled by voltage divider R8023, R8022, and R8021 from a range of ± 5 VDC to a range of zero to 3.5 VDC. This voltage is applied to the base of comparator Q8020B, which provides ± 10 ns of zero-distance delay adjustment. Components C3048, R3042, R2032, C3047, R2034, and C8024 are used to reduce jitter and cross-coupling between circuits.

Driver/Sampler

Introduction

The front-end consists of:

- Hybrid Sampler/Step Generator
- Second Sampler
- First Sampler Bridge Bias Generator
- Trigger Pulse Shapers
- Power Supply Conditioning

The function of this board is to generate the step test signal and to sample and hold the reflections from the cable under test. A block diagram of these circuits is shown in Figure 5–12 (next page).

Most of the primary active circuitry is located within the hybrid. The balance of the Driver/Sampler Board is dedicated to interfacing with the rest of the instrument.

The step generator is triggered by a negative pulse from the Main Board. One of the trigger pulse shapers stretches this to 25 μs to set the length of the output step. The 0.6 V adjustable power source sets the "on" voltage for the output step.

The sampler is also triggered by a negative pulse from the Main Board. Inside the hybrid, this trigger causes the strobe generator to apply 50-ps pulses to turn on the bridge, capturing a portion of the input waveform. This sample is stored outside the hybrid in the second sampler to reduce droop rate. The stored signal goes two places: back to the Main Board as the video output, and to the bridge bias circuit, which holds the sampling bridge off between samples.

Second Sampler

The video signal from the hybrid is sent to the second sampler. The second sampler reduces the droop rate to about 1 LSB/ms. This is accomplished by buffering the signal through U2050B and storing it in C2053 via the FET switch, Q1060. The FET is strobed by the one-shot U3030B for 5 μs after the sample is taken. The voltage stored on C2053 is buffered by op-amp U2050A, then inverted and amplified by U1050A. The strobe signal for the FET can be observed at TP2060, and the inverted video output at TP1060. The signal from the second sampler buffer, U2050A, is also fed to the bridge bias amp, U1070, via R1060.

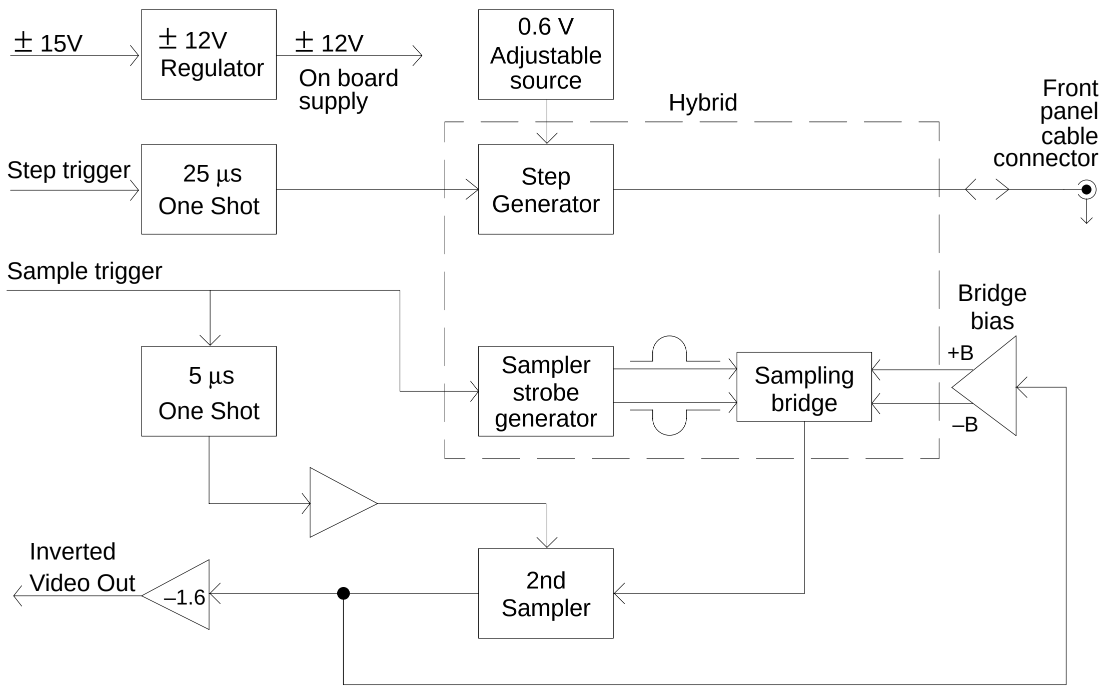


Figure 5–12: Driver/Sampler Block Diagram

Bridge Bias

The bridge bias for the first sampler is set by U1070. With a zero voltage input signal, the circuit holds ± 2.0 V on the bridge inputs. As the input signal moves, the 4 V window also moves to stay centered around it. This centering is accomplished by feeding part of the output of U2050A into the bridge bias circuit. The outputs of the bridge bias circuit are available on TP1020 and TP1021.

Trigger Pulse Shapers

There a\re two incoming triggers: the sample and the step. Both require modification before they are usable by the hybrid. The sample trigger is a 30-to-50-ns negative TTL signal. This pulse is buffered by Q2030, then coupled to the hybrid through T1020. This provides a differential drive that can have common-mode voltage on it. The sampler pulse is also stretched to 5 µs by U3030B to strobe the second sampler. The step trigger, GEN $\overline{\text{TRIG}}$, is a 3-to-5-µs negative TTL signal, stretched to the proper 25 µs pulse length by U3030A. CR3020 and CR3021 provide a logic OR of the incoming signal and the output of the one-shot. This prevents the introduction of jitter on the trigger signal. The OR output can be observed at TP3020.

Power Supply Conditioner

There are seven power supplies for the hybrid: ± 5 V_S, ± 5 V_P, ± 12 V, and +0.6 V. The ± 5 V supplies come on board as 5 V, so they require no regulation, but are merely filtered before being used by the hybrid and the board. The ± 12 V supplies enter the board as ± 15 V, so the necessary filtering and regulation is accomplished by U3070 and associated circuitry. The +0.6 V supply is used by the hybrid to set the output step height. It is referenced to the +5 V supply and controlled by U1050B and Q1030.

The +0.6 V supply is adjustable via R1042 to allow the offset of the step generator to be zeroed out. CR1040 temperature compensates the +0.6 V supply against variations in the hybrid. The test points for these supplies are as follows:

+5 V	TP1083
–5 V	TP1084
+12 V	TP1080
–12 V	TP1081
+0.6 V	TP1030
Ground	TP1082

Front Panel

Introduction

The Front Panel Board consists of the following circuits for these controls:

- Push Button Switches and Latches
- Rotary Binary Switches
- Resistive Shaft Encoders
- Analog-to-Digital Converter for Shaft Encoders

The Front Panel Board consists of the following circuits for the display module:

- Electroluminescent Backlight Switch and Power Supply
- Display Heater Circuitry
- Display Drive Voltage (Contrast) Temperature Compensation

The Front Panel Board contains most of the instrument control as well as some circuitry for the display module. A block diagram of the Front Panel Board is shown in Figure 5–13 (next page).

Push Button Switches and Latches

The push button switches are normally open momentary switches When depressed, these switches tie the inputs of NOR gate latches U3021, U3022, and U3023 to +5 VDC, setting the latches. The latches are reset by control signal ADCRD. The processor updates the instrument configuration by periodically reading the state of the latches through multiplexers U2024, U3025, and U3031.

These switches control:

- MENU
- VIEW INPUT
- VIEW STORE
- VIEW DIFF
- STORE

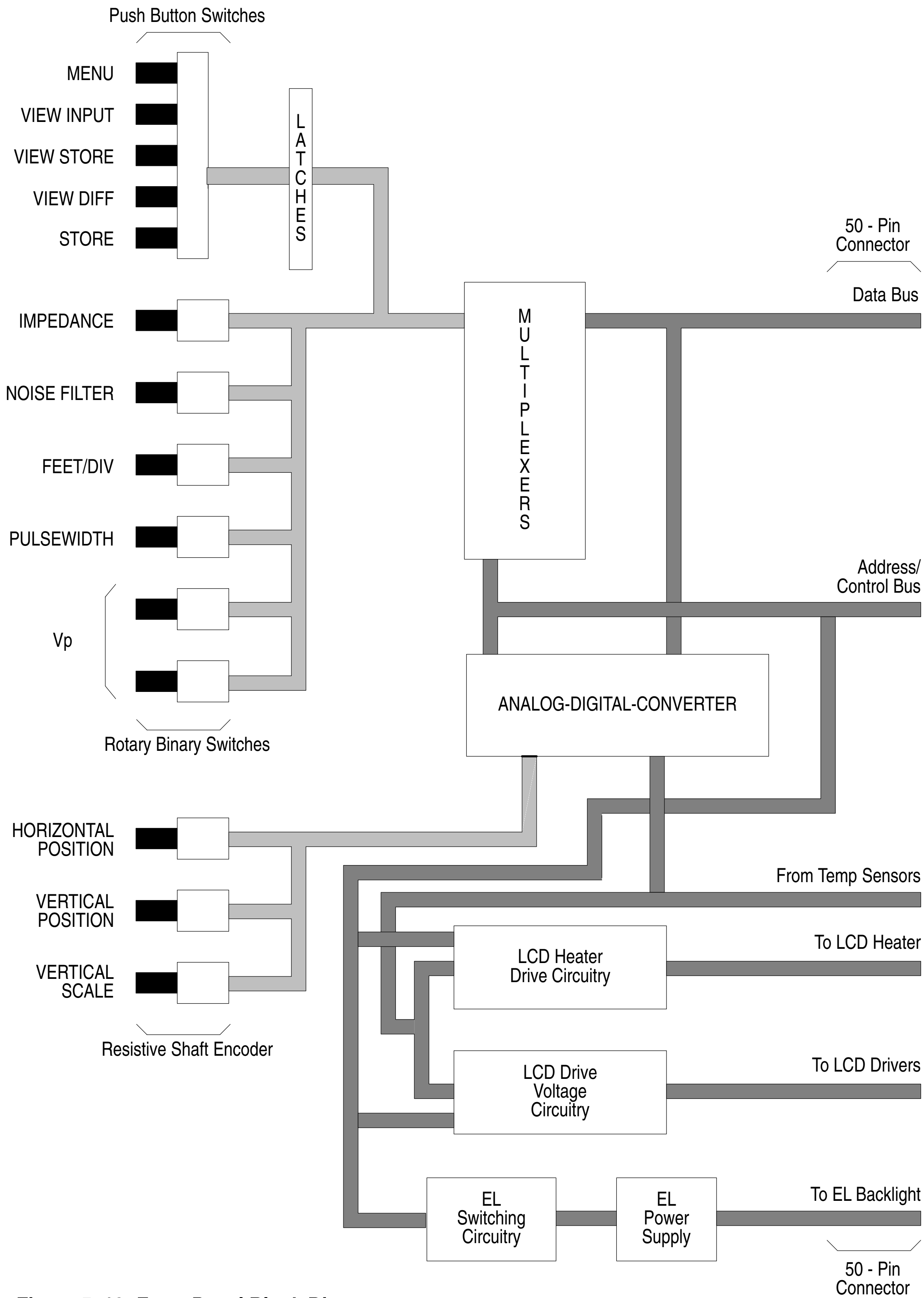


Figure 5–13: Front Panel Block Diagram

Rotary Binary Switches

The rotary binary switches provide a 4-bit binary value, indicating their position. The outputs are tied to the inputs of the multiplexers. The position of the rotary switches control the following functions:

- FILTERING, SET REF, SET DELTA
- HORIZONTAL GAIN (DIST/DIV)
- V_P COARSE
- V_P FINE

Switch Multiplexers

The switch multiplexers are U2024, U2025, U3025, and U3031. These dual four-channel multiplexers multiplex the switch settings of the push button and rotary switches onto the data bus. The control signal $\overline{\text{MUXCS}}$, in conjunction with A_2, selects the multiplexers while A_0 and A_1 determine which switch bank is placed on the data bus.

Resistive Shaft Encoders

The resistive shaft encoders R1022, R2024, and R3020 are dual-concentric, 360° rotation potentiometers, with the wipers set 180° out of phase with respect to each other. The wipers are tied to the analog-to-digital converter inputs of ADC U2023. The three resistive shaft encoders control the following functions:

- VERTICAL GAIN
- VERTICAL POSITION
- HORIZONTAL POSITION (Cursor)

Analog-to-Digital Converter

The ADC, U2023, is an eight-channel analog-to-digital converter. It converts the voltages on the wipers of the resistive shaft encoders to a digital value, depending on the position of the encoders. It also converts the voltage on the display thermistor (T_{SENSE}) and the chart recorder thermistor divider circuits into digital values representing the corresponding temperatures. The temperature data is used by the processor to compensate the LCD drive voltage and chart recorder print parameters for variations in temperature.

The control signal TRIG ADC is used to start a conversion; ADC RD reads the value; and A_0, A_1, and A_2 select one of the eight channels for conversion. Control signal $\overline{\text{EOC}}$ notifies the processor of a conversion completion, via the $\overline{\text{IR3}}$ line.

Electroluminescent Backlight Switch and Power Supply

The EL (electroluminescent) backlight is switched by software. Control signal $\overline{\text{LIGHTCS}}$, with $\overline{\text{RD}}$ or $\overline{\text{WR}}$, sets or resets (respectively) NOR latch U3020. The output of the latch is applied to the + side of comparator U2020B; the – side is held at 2.5 VDC. When the output of the latch is high, the comparator output is +16 VDC, which turns off the gate of P-channel FET Q1030, turning off power to the EL power supply, PS2030. When the output is low, the comparator output is 0V, which turns on the FET, turning on the power to the EL power supply. R1031, C3030, and C3031 serve to filter noise introduced to the +16 VDC supply by the EL power supply.

Display Heater Circuitry

The display heater circuitry regulates the application of power to the display heater (see *Indium Tin Oxide Heater* later in this chapter for more information). When the display thermistor divider senses the display temperature has dropped below +10° C, the heater can be turned on if the control signal $\overline{\text{HEAT ENABLE}}$ is not asserted. For reasons of power economy, the chart recorder and display heater are not allowed to operate concurrently. The processor does this by asserting $\overline{\text{HEAT ENABLE}}$ while making a chart recording. When $\overline{\text{HEAT ENABLE}}$ is low, N–channel FET Q2020 is off, making the voltage on the + side of the comparator, U2020A, approximately +5 VDC. This will allow the + side (chart recorder) to always be greater than the – side (display thermistor divider voltage). The output of the comparator will be +16 VDC, which turns off P-channel FET Q1020. This turns off the power to the display heater..

When $\overline{\text{HEAT DISABLE}}$ is high, Q2020 will turn on and the voltage on the + side of the comparator will be approximately 2.5 volts. When the display thermistor divider voltage (– side) is above 2.5 volts (about +10° C), the comparator output will be 0 V, which will turn on Q1020. This will turn on the heater. As the temperature rises above +10° C, the thermistor divider voltage will be less than 2.5 V and Q1020 will turn off, shutting off power to the heater.

Display Temperature Compensation

The LCD drive voltage compensation circuitry adjusts the drive voltage (contrast) to assure a constant display contrast within the operating temperature range of the instrument. The display thermistor is attached to the LCD and forms the sensor in the display thermistor divider circuit. Its output is a voltage related to the display temperature. This voltage is read by the processor through the analog-to-digital converter, U2023. The processor uses this voltage value to determine a drive voltage. This is sent to digital-to-analog converter U2021 via the data bus. The output of the DAC is amplified to op-amp U2010A and applied as the LCD drive voltage. As the temperature of the display (thermistor divider voltage) changes, the processor modifies the drive voltage via the DAC. In this manner, the drive voltage is compensated due to variations in display temperature. Trimmer potentiometer R1011 is used to offset the drive voltage produced by U2010A to compensate for variations in display cells and thermistors.

Display Module

Introduction

The display module consists of the following:

- LCD Cell
- Row Driver/Controller Board and Column Driver Board
- Electroluminescent Backlight
- Indium Tin Oxide (ITO) Heater
- Mechanical frame, which supports the above subassemblies

The display module function is to take bit pattern data generated by the instrument internal electronics and display it on the LCD. A block diagram of the display module is shown in Figure 5–14.

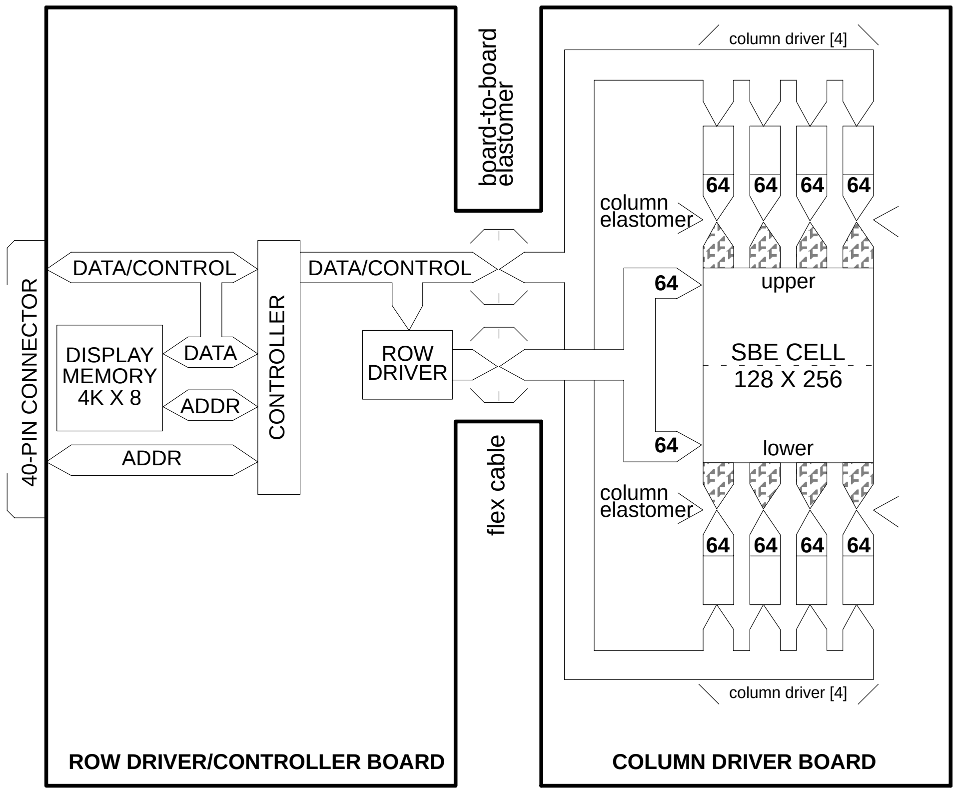


Figure 5–14: Display Module Block Diagram

The LCD cell is the “video screen” that displays information generated by the processor. The processor updates the display memory periodically with a new picture and the display memory holds this bit pattern data. This data is received by the display controller and sent to the drivers along with some control and timing signals that provide operating information to the drivers. The row and column drivers are attached electrically to the LCD cell through elastomeric connectors and a flex cable. These drivers place signal voltages on the electrode matrix in the LCD cell and thus generate the video display.

There are other circuits contained in the display module. An indium tin oxide (ITO) heater warms the display during cold temperatures. A temperature sensor attached to the display provides display temperature data to the heater and drive voltage circuitry (see Front Panel text in this chapter). An electroluminescent backlight provides illumination in low light conditions.

LCD Cell

The LCD cell provided in the 1502C uses an advanced technology known as Superbirefringent Effect (SBE) to obtain greatly improved contrast and viewing angle over conventional LCD cells. The function of the LCD module is to receive bit pattern data from the CPU and display it.

First, the processor generates a 4k X 8-bit pattern image in its own memory. It then writes this bit pattern, via the data bus, to the display memory, U1040, in the form of a block transfer. The bit pattern is mapped in the display memory and later on the LCD cell.

Second, the LCD controller, U2040, reads the bit pattern from the display RAM, formats it, and sends it to the column drivers.

Last, the column drivers and the row drivers generate select and non-select voltages based on the timing, control, and data signals received from the controller. These voltages are applied to the LCD cell matrix, turning off and on pixels that match the bit pattern in the display memory. The pattern of pixels form the image on the display.

The cell is physically composed of two planes of glass, two polarizers, a matrix of transparent electrodes, and a filling of liquid crystal material. A plating of indium tin oxide on the back plane of glass is used as a heater, but is not used in the display process.

Electrically, the cell is a 128 X 256 pixel display, each pixel being an intersection of a row and a column. These intersections are like small capacitors. When a non-select voltage (about 1.5 VRMS) is applied to a row and a column, their intersection is turned off (see Figure 5–15). That is, light is allowed to pass through the display and reflect back from the transflector, creating an “off” pixel. A select voltage (about 1.7 VRMS) turns the intersection on. That is, the light is not allowed to pass through the crystalline material and is, therefore, not reflected back from the transflector, creating an “on” pixel.

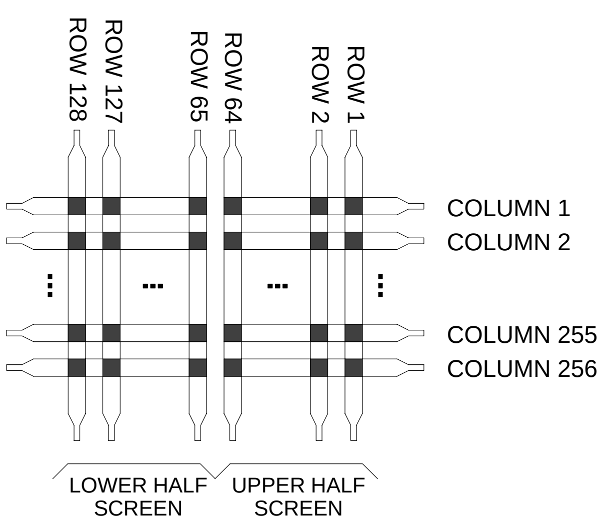


Figure 5–15: SBE Cell

Row and Column Drivers

There is one row driver, located on the Row Driver/Controller Board. There are eight column drivers, located on the Column Driver Board. The row and column drivers receive control, timing, and data signals from the controller and translate them to properly timed voltages that are placed on the pixel matrix. The voltages are placed on the matrix by the flex cable for the rows and by the elastomers for the columns.

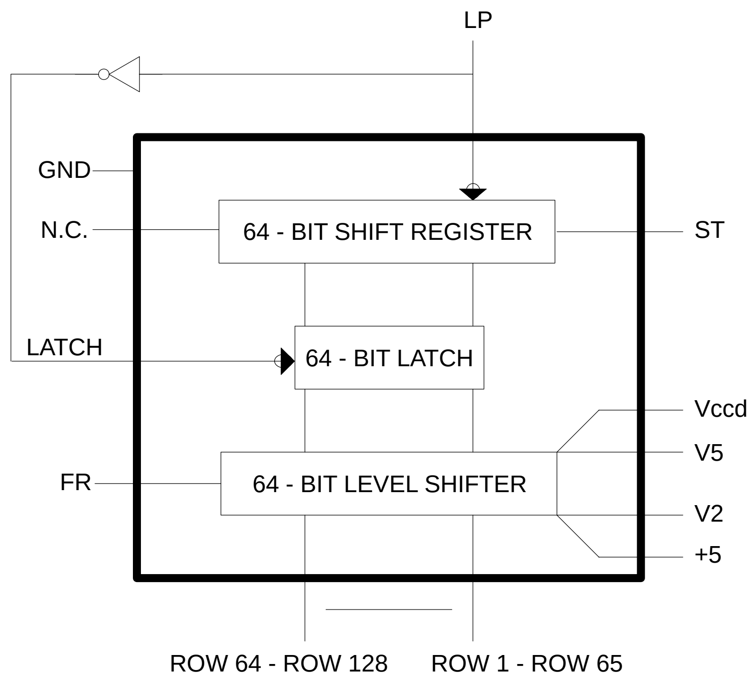


Figure 5–16: Row Driver Block Diagram

The function of the row driver is to sequentially address each of the rows of the display. The on or off state of the pixels on the addressed row is then determined by the voltages on the columns. The row driver addresses each line, one after another, completing the scanning at the refresh rate of 125 Hz.

The column driver is similar to the row driver except bit pattern data is level-shifted rather than the start pulse. The column drivers provide select and non-select voltages to the column electrodes according to the bit pattern data. The presence of select or non-select voltages on the columns, in conjunction with the currently selected row pair determine which pixels are on or off on that row pair. The column drivers regulate the select and non-select voltages as the row drivers select rows. The result is a bit pattern displayed on the screen that represents a waveform.

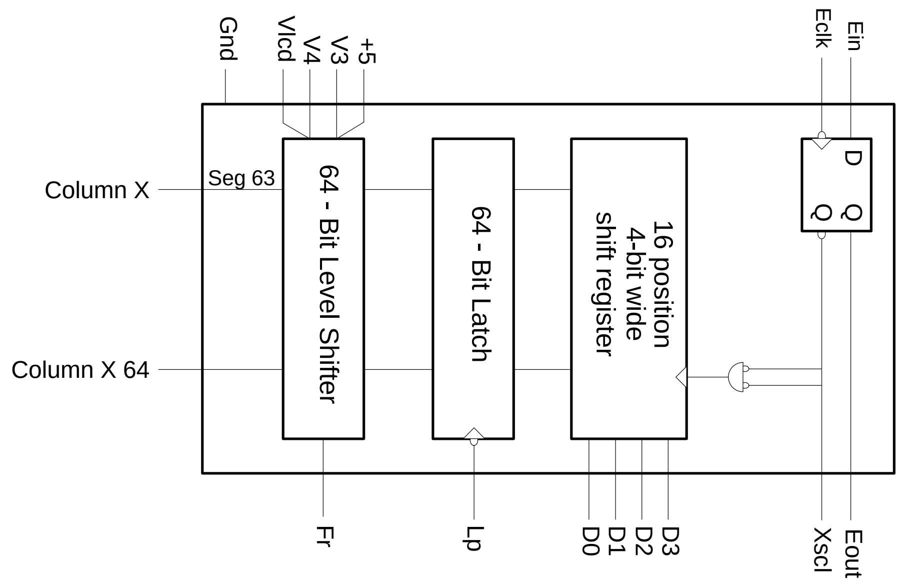


Figure 5–17: Column Driver Block Diagram

Row Driver

The row driver is an 80-pin flat pack located on the Row Driver/Controller Board. It is composed of a 64-bit shift register, U2020, a 64-bit latch, and a 64-bit level shifter. The row driver has the following relevant inputs:

- ST <start pulse>: Input to the shift register <Din on SED 1190>
- LP <latch pulse = $\overline{\text{LATCH}}$>: Falling-edge triggered, this shifts data in the shift register and latches contents of the shift register into the latch <Y S_{CL} on SED 1190>
- FR <frame signal>: Defines the select and non-select voltages.

The relevant outputs:

Row 1 through 64 are paralleled outputs driving both sides of the display. One set of outputs drive rows 1 through 64 and the other set drive rows 65 through 128 on the LCD.

Supply Voltages include the following:

- +5 VDC supply voltage for logic and select drive voltage
- V_2 non-select drive voltage
- V_5 non-select drive voltage
- V_{LCD} select voltage
- GND return for +5 VDC.

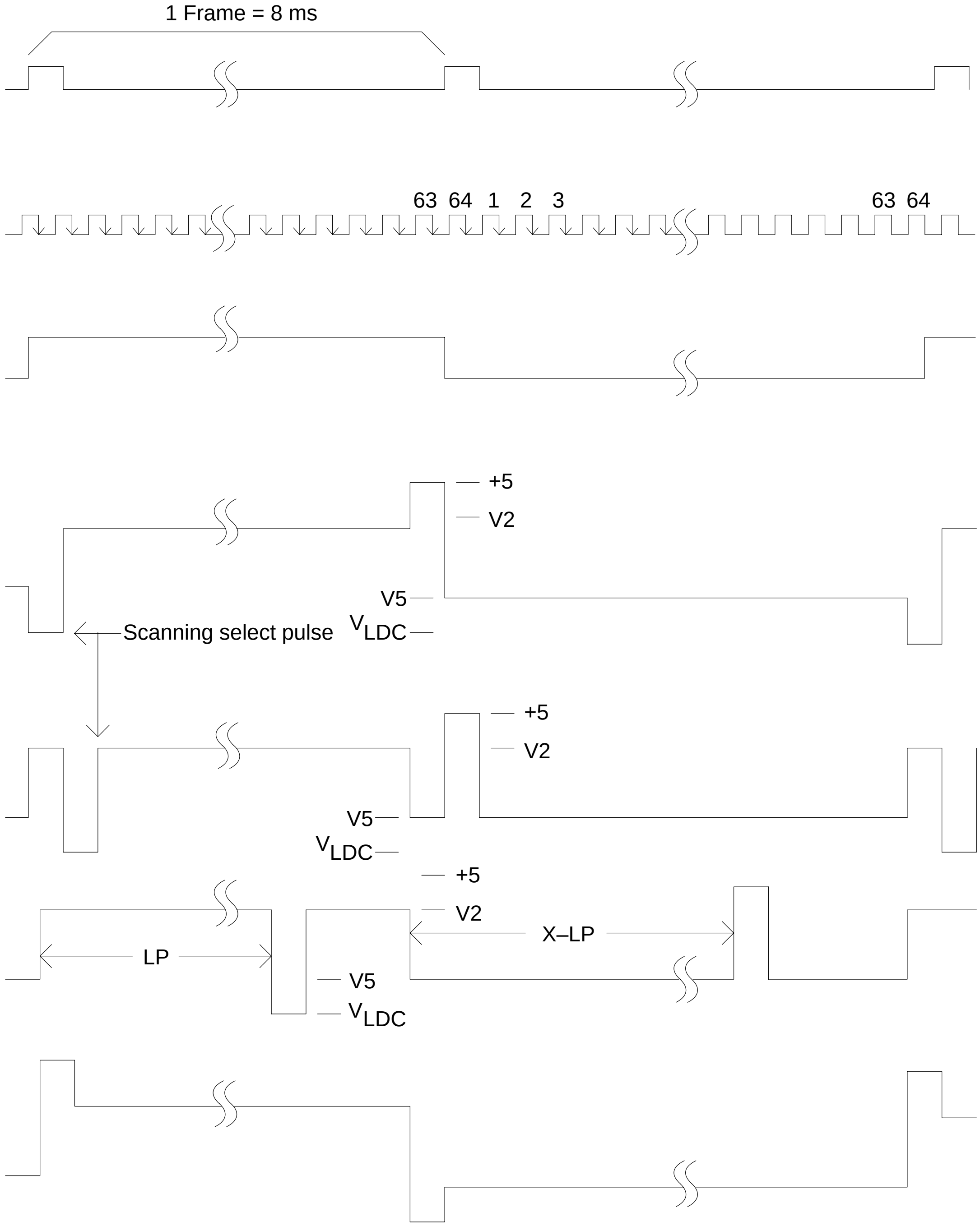


Figure 5–18: Row Timing Diagram

To perform its function, the row driver receives a start pulse at the beginning of a frame. LP shifts this start pulse into the shift register. The contents are then transferred to the latch. The level shifter shifts the logical 1s and 0s in the latch into select and non-select voltages according to FR (see table at top of next page).

FR	Bit X in Latch	Row X Output
0	0	V_5 non-select
0	1	+5 VDC select
1	0	V_2 non-select
1	1	V_{LCD} select

ST, LP, and FR are sent by the controller in such a way that a scanning select voltage is applied sequentially to the rows, with the polarity of the select voltage alternating with FR, every frame. The alteration is required to place an AC voltage on the pixels.

Column Driver

A column driver is composed of several blocks: 16-position, 4-bit wide shift register; 64-bit latch; 64-bit level shifter; and an enable flip-flop.

A column driver has the following relevant inputs:

- D3–D0 <data MSB to data LSB>: Bit pattern data for data formatted and sent by the controller
- XSCL <column (X) shift clock>: Shifts D3–D0 in parallel groups of four bits
- LP <latch pulse>: Latches data in shift register into 64-bit latch
- FR <frame signal>: Defines select and non-select voltages
- E_{IN} <enable in>: Input to the enable flip-flop
- E_{CLK} <enable clock>: Clocks E_{IN} into the enable flip-flop.

The relevant outputs:

- Columns 1 to 64: These are the 64 outputs from the level shifter.

***NOTE**. The manufacturer's pinout of the outputs are numbered in order of shift (seg 63 – seg 0). The nomenclature herein refers to the outputs in column order. Therefore, seg 63 corresponds to Column 1 and seg 0 corresponds to Column 64.*

- EOUT: Output from the enable flip-flop.

Supply Voltages include the following:

- +5 VDC supply voltage for logic and select drive voltage
- V_3 non-select voltage
- V_4 non-select voltage
- V_{LCD} select voltage
- GND return for +5 VDC

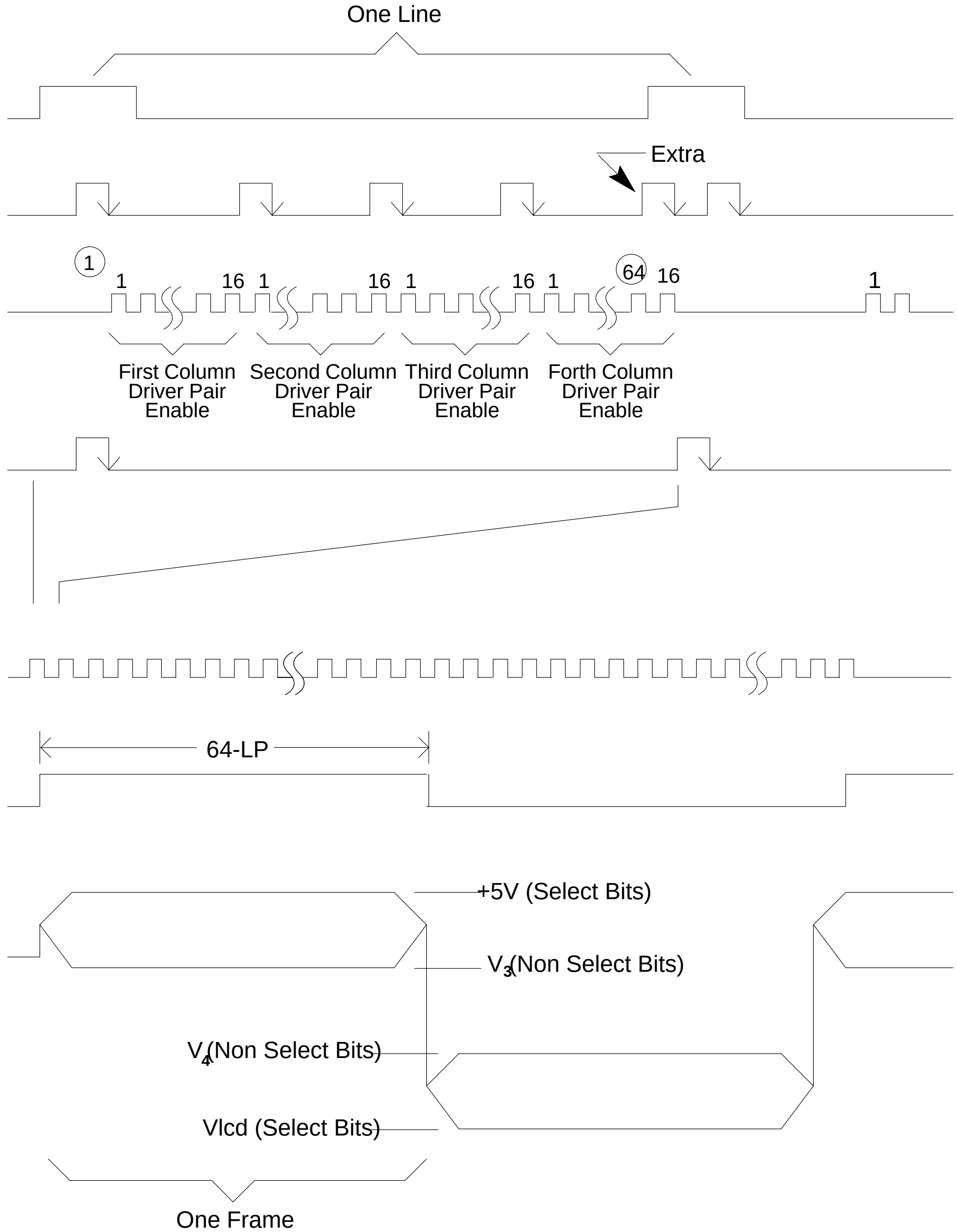


Figure 5–19: Column Timing Diagram

To perform its function, the column driver shift registers are filled with data by receiving data, XSCL, E_{CLK}, and E_{IN} from the controller. LP then latches the contents of the shift registers into the latches. The level shifter translates the logical 1s and 0s in the latch into select and non-select voltages according to FR (see table, next page).

FR	Bit X in Latch	Column X Output
0	0	V_4
0	1	V_{LCD}
1	0	V_3
1	1	+5 VDC

The pixels selected by both the column drivers and the row driver are turned on; all others are off. The process of filling the column drivers is repeated every LP (i.e., for every addressed row until all lines in both screen halves have been refreshed). One frame is thus complete and the entire process is repeated.

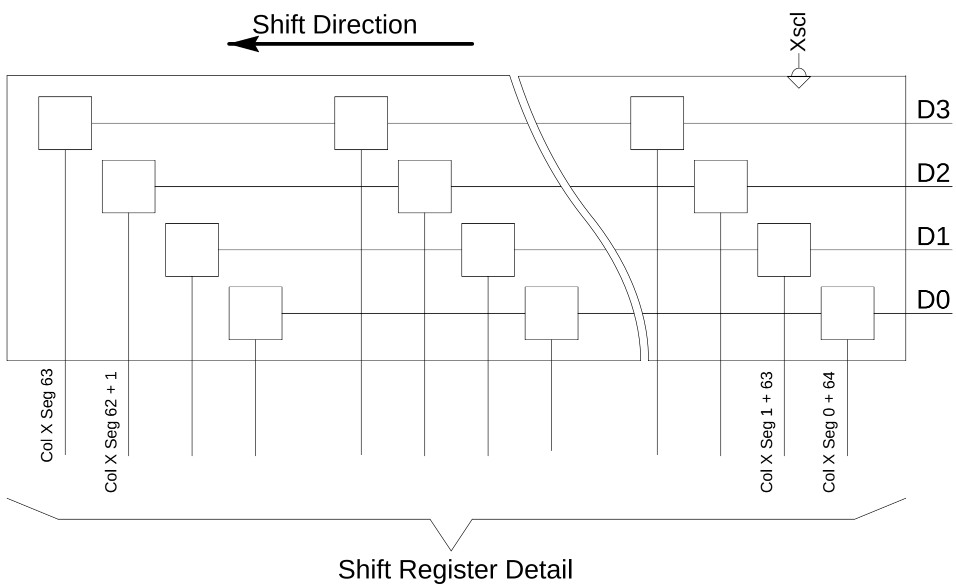


Figure 5–20: Shift Register

Display Memory

The display memory is an 8k X 8 RAM (only 4k X 8 is used), located on the Row Driver/Controller Board. The display memory stores the current bit pattern generated by the processor on the Main Board. The processor interrupts the controller periodically and places a new bit pattern in the display memory. The controller then reads the bit pattern out of the display memory, formats it, and sends it to the column drivers.

Controller

The controller, located on the Row Driver/Controller Board, generates control and timing signals for the row and column drivers, and formats bit pattern data stored in the display memory, which is then sent to the column drivers.

The function of the controller is to read bit pattern data from the display memory and format it. This data is then sent (along with control and timing signals) to the column and row drivers, which drive the LCD to provide the pattern on the display.

Row Driver Interface

The row driver requires a start pulse at the beginning of each frame, 64 latch pulses following that to scan the start pulse down the rows, and a framing signal to generate the AC select voltage. These signals are generated by the controller as shown in the row driver timing diagram (Figure 5–18).

The controller, running at a clock rate of 0.625 MHz, generates ST, LP, and FR with the following periods:

ST	8 ms
LP	125 μs
FR	16 ms

***NOTE**. The manufacturer's nomenclature on the controller differs somewhat: ST = FRP, LP = LIP, and FR = FRMB.*

Column Driver Interface

Thee column drivers require more control and timing signals than the row driver. These include: E_{IN}, E_{CLK}, XSCL, D3 – D0, LP, and FR.

E_{IN} is required at the start of every line to enable the first (leftmost, as seen from the front of the display) column driver pair.

E_{CLK} is required once to latch in E_{IN} and three times after that to enable the successive column driver pairs. Each successive E_{CLK} must occur every 16 XSCL pulses (i.e., after each column driver pair is full of 64 bits (4 X 16 bits)).

XSCL is required 16 times per column driver pair per line to shift in the bit pattern data. Therefore, a total of 64 XSCL are required per line for the four column driver pairs.

XSCL is generated by U3030, a counter clocked by CLP or LP from the controller. It must be generated as such because the controller was designed to use with 80-channel column drivers instead of 64-channel column drivers. The controller version of E_{CLK}, CE0, is generated every 20 XSCL pulses rather than every 16 XSCL pulses as required by the 64-channel column drivers. The counter is used to translate XSCL into E_{CLK}.

As a consequence of generating E_{CLK} as above, E_{IN} must also be generated. This is done with the U3065 flip-flop pair. The flip-flop pair is set when LP and LE0 are asserted and hold set until XSCL (CLP) shifts in a logic 0 after the pulse. E_{IN} is held high for a duration long enough to enable the first column driver pair.

CPU and Display Memory Interface

There are two data buses and two address buses on the controller. The first data bus, DB7 – DB0, is used to access registers internal to the controller. These internal registers are used to initialize the controller.

The second data bus, RD7 – RD0, is used to read bit pattern data from the display memory. The data bus from the display memory is tied directly to the RD7 – RD0 data bus, and indirectly through a bidirectional bus transceiver, U1050, to the DB7 – DB0 data bus. The DB7 – DB0 data bus is tied directly to the CPU data bus through the 40-pin connector.

The first address bus, MA12 – MA0, is tied to the display memory and addresses it. MA12 – MA0 can have one of two sources. The first is an internal address in the controller, which is the address of the currently accessed bit pattern data byte. The second is the address resent on the second address bus, A11 – A0.

This second address bus is tied to the CPU address bus through the 40-pin connector and is used to address the display memory during the time the CPU is updating the display memory.

The control signal DIEN controls the multiplexing of the internal address and A11 – A0 to MA12 – MA0. A15 – A12 are tied low.

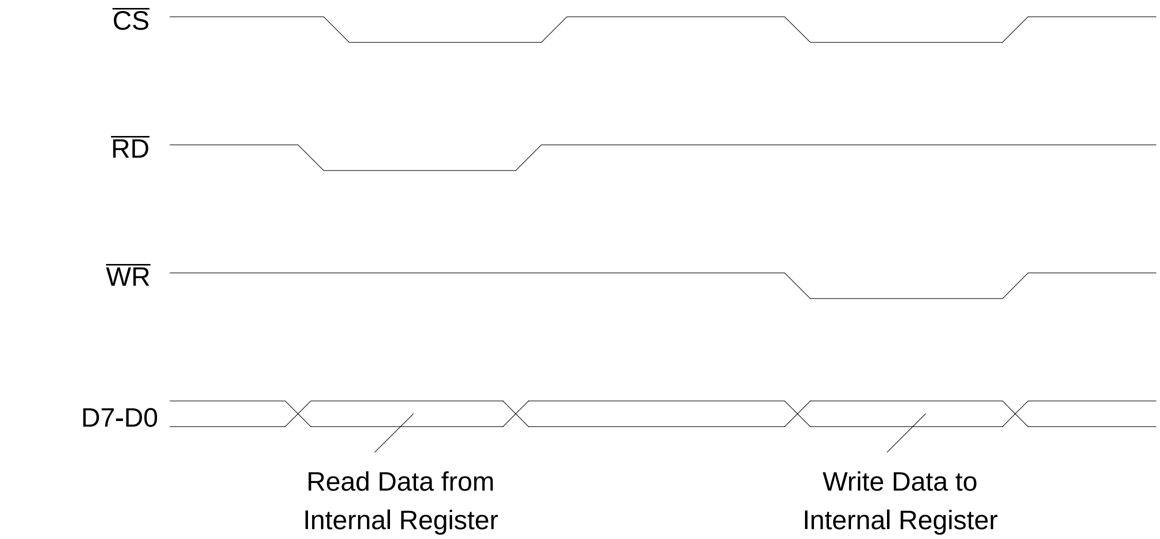
There are several other relevant control signals to the controller: $\overline{CS}$ <chip select>, $\overline{WR}$ <write>, and $\overline{RD}$ <read>.

$\overline{CS}$ and $\overline{WR}$ are used in conjunction with A0 to write to the internal registers. $\overline{CS}$ and $\overline{RD}$ in conjunction with A0 to read them.

XT is the system clock, from which all timing in the controller is derived. It is supplied via the 40-pin connector at 0.625 MHz.

$\overline{DRAM}$ <display memory select> is used with $\overline{WR}$ by the CPU to select and write to the display memory. $\overline{DRAM}$ and $\overline{RD}$ are used to read.

The combinational logic associated with the selection of the display memory is such that the memory is set to the selected read mode at all times except when the CPU accesses it. In that case, it could be either selected read or selected write at the discretion of the CPU. This combinational logic also controls the flow of data through the transceiver.



Read and Write for Internal Register Timing

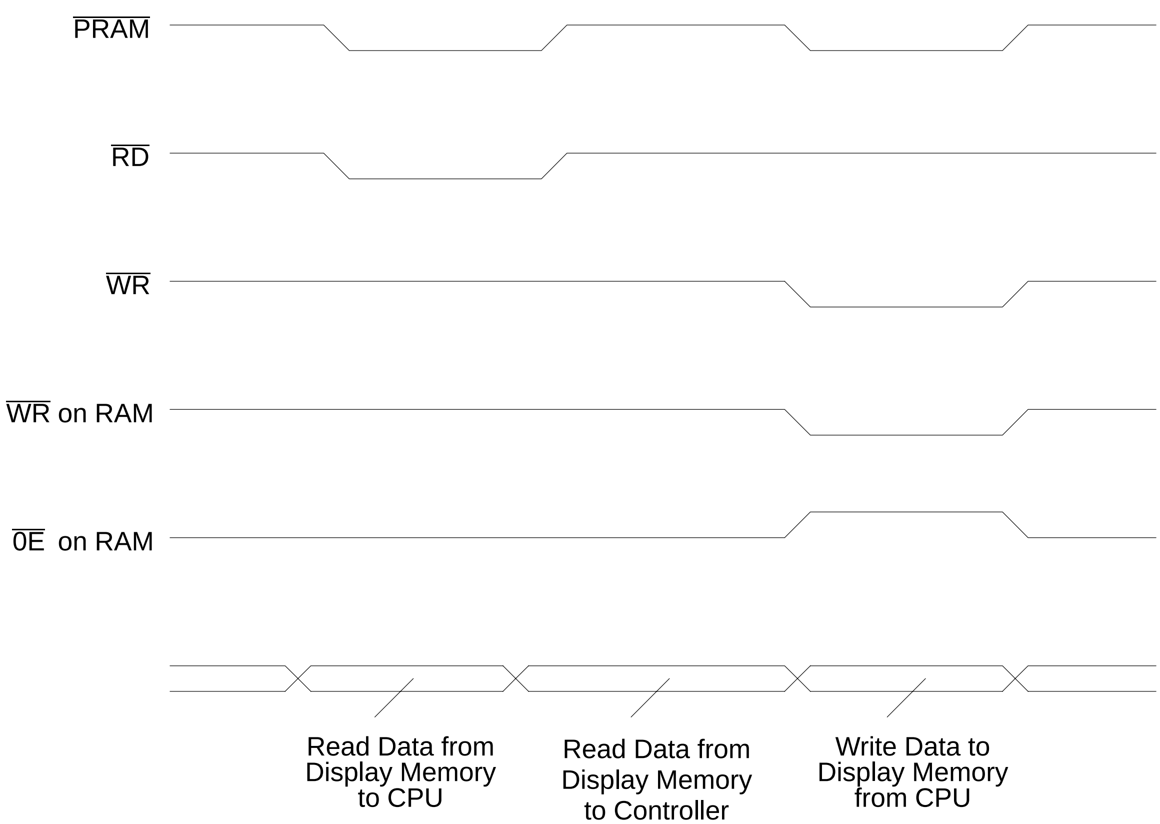


Figure 5–21: CPU and Display Memory Interface

In operation, the controller is usually accessing the display memory and refreshing the screen with the bit pattern data. At the rate of about 10 Hz, the CPU intervenes in the refresh operation to update the bit pattern display memory. This operation occurs as a block transfer of 4k X 8 from the CPU memory to the display memory. This block transfer takes place in about 17 ms. During thew block transfer, the controller cannot access display memory and, therefore, sends null data to the screen.

Electroluminescent Backlight

Because the LCD display is non-emitting, a light source is needed for low light applications. This source is provided by an electroluminescent (EL) backlight behind the transflector. The EL backlight is a long-life device, requiring a 130 VAC, 400 Hz supply. This supply is routed from the Front Panel Board through the 40-pin connector to pads on the Row Driver/Controller Board. The leads on the backlight are then attached to these pads.

CAUTION. *The pads for the EL backlight are exposed when the display module is removed from the front panel. They operate from a high voltage source. Do not turn on the backlight when the pads are exposed.*

Indium Tin Oxide Heater

Because the LCD display response time slows down rapidly at temperatures below +10° C, a heater is required to maintain the temperature of the LCD cell at +10° C when the ambient temperature falls below +10° C.

The heating element is a resistive plating of indium tin oxide (ITO) on the back side of the row pane. This plating has a resistance of about 64Ω. The power for the heater is supplied through the 40-pin connector to pads on the Row Driver/Controller Board, similar to those for the EL backlight.

A thermistor, RT1030, is attached to the lip of the row pane opposite the cable. This thermistor is used to track the temperature of the LCD cell and turn on the heater power (+16 VDC) when the temperature falls below +5° C. With a supply voltage of +16 VDC, the heater dissipates about 4W. The circuitry to control the temperature is located on the Front Panel Board. The thermistor leads are attached to pads on the Row Driver/Controller Board, similar to the heater, and routed through the 40-pin connector.

Calibration

Introduction

This chapter is divided into the *Calibration Performance Check* and the *Adjustment Procedure*.

The *Calibration Performance Check* is a series of checks to compare the instrument parameters to the published specifications. This procedure is similar to the *Operator Performance Check* (Chapter 2), but additionally lists actions to take if the *Calibration Performance Check* is not met.

The *Adjustment Procedure* is a series of steps designed to bring the instrument up to standards after repair or performance check.

Calibration Performance Check

The purpose of this procedure is to assure that the instrument is in good working condition and should be performed on an instrument that has been serviced or repaired, as well as at regular intervals.

This procedure is not intended to familiarize you with the instrument. If you are not experienced with this instrument, you should read the Operation chapter of this manual before going on with these checks.

If the instrument fails any of these tests, it should be calibrated or otherwise serviced. Many failure modes affect only some functions of the instrument.

Equipment Required

Equipment	Tek Part Number
50Ω precision terminator	011–0123–00
3-ft precision coaxial cable	012–1350–00

Getting Ready

Disconnect any cables from the front panel CABLE connector. Connect the instrument to a suitable power source (a fully charged optional battery or AC line source). If you are using AC power, make sure the fuse and power selector switch on the rear panel are correct for the voltage you are using (115 VAC requires a different fuse than 230 VAC).

Metric Instruments

Option 05 (metric) instruments default to m/div instead of ft/div. You can change this in the Setup menu, or you may use the metric numbers provided. To change the readings to ft/div, press the MENU button. Scroll down to *Distance/Div is: m/div* and press MENU again. That menu line will change to *Distance/Div is: ft/div.* Exit by pressing MENU until the instrument returns to normal operation. If the instrument power is turned off, this procedure must be repeated when the instrument is again powered up.

The metric default can be changed to standard default. See the *Maintenance* chapter of this manual for details.

Display Module Check

Liquid Crystal Display

1. Pull the POWER switch on the front panel. If a message does not appear on the display within a few seconds, turn the instrument off.

If start–up assistance needed,
Push MENU button.

1502C ROM version 5.04
Ethernet
Copyright 1992 Tektronix
Redmond, OR

Figure 6–1: Typical Start-Up Display

CAUTION. *There are some failure modes that could permanently damage the LCD if the power is left on more than a minute or so.*

2. Observe that the LCD characters and waveform are legible. If the LCD is too dark or smeared, or if the display has patches of low contrast, refer to the *Adjustment Procedures* section of this chapter.

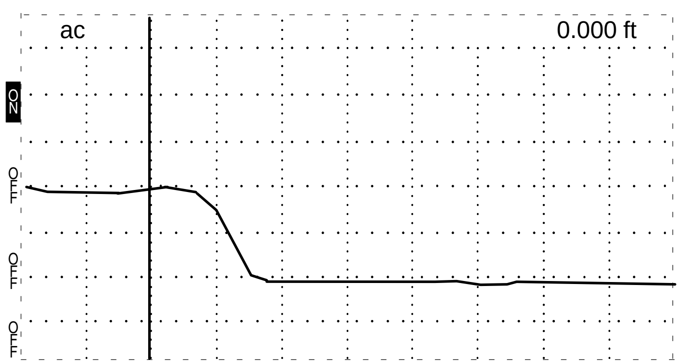


Figure 6–2: Waveform on the Display

***NOTE**. If the LCD does not appear to be working properly, refer to the* Troubleshooting *section in the* Maintenance *chapter as well as the* Circuit Description *chapter of this manual.*

EL Backlight

The EL backlight should come on with power up. The LCD will have a light-green glow.

1. Press MENU.
2. Use the ⇕POSITION control to scroll to Setup Menu.
3. Press MENU again.
4. Use the ⇕POSITION control to scroll to Light is: ON.

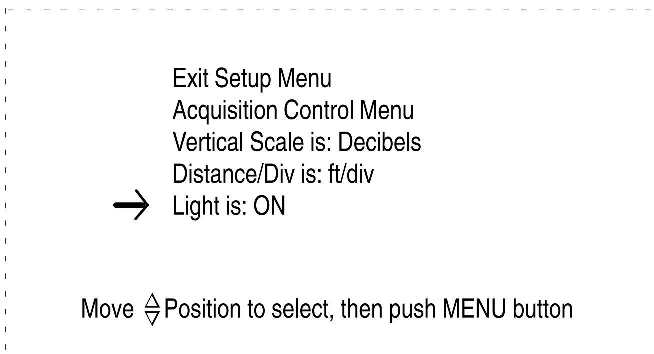


Figure 6–3: Setup Menu

5. Press MENU. The EL backlight should go off and the menu line will change to Light is: OFF.
6. Scroll to Light is: OFF and press MENU to turn the light back on.
7. Press MENU again to exit the Setup Menu.
8. Press MENU again to exit the Main Menu.

You should be able to read the LCD in all conditions of illumination, from full sunlight to a darkened room. The EL backlight might very gradually begin to decrease in brightness after approximately 3,000 hours of use.

***NOTE**. If the EL Backlight is dim or does not work properly, refer to the* Troubleshooting *section or the* EL Backlight Replacement *section in the* Maintenance *chapter of this manual.*

Front Panel Check

If the instrument fails any of these checks, measurements corresponding to the failed control might be inaccurate or unobtainable.

Presets and Menu Access

1. Set the front-panel controls:

CABLE	No connection
NOISE FILTER	Full CW
VERT SCALE	Default (see note below)
DIST/DIV	Full CW
V_P	.30
POWER	Off

***NOTE**. A default setting is where the instrument will be set when power is switched on. For example, VERT SCALE will always be 0.00 dB when the instrument is powered on.*

2. Turn POWER on. Wait for initialization and normal operation display.

3. Press MENU.

4. Use the △▽POSITION control to scroll to Diagnostics Menu.

Return to Normal Operation
Help with Instrument Controls
Cable Information Menu
Setup Menu
→ Diagnostics Menu
View Stored Waveform Settings
Option Port Menu

Move △▽Position to select, then push MENU button

Figure 6–4: Main Menu

5. Press MENU. This will display the Diagnostics Menu.

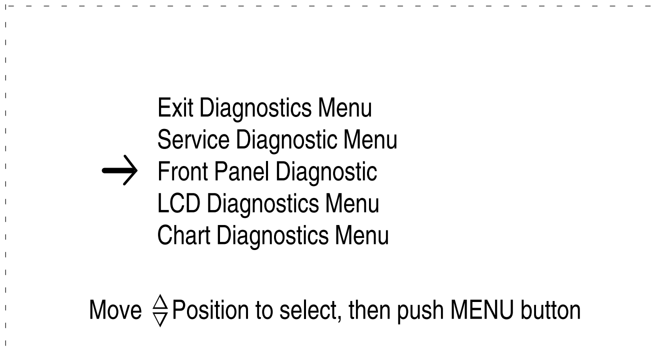


Figure 6–5: Diagnostics Menu

6. Use the POSITION control to scroll to Front Panel Diagnostic.
7. Press MENU. This will display the Front Panel Diagnostics.

Pushbutton Switches

1. Press VIEW INPUT. The LCD switch reading should change to 1 (see Figure 6–6, third line of text).

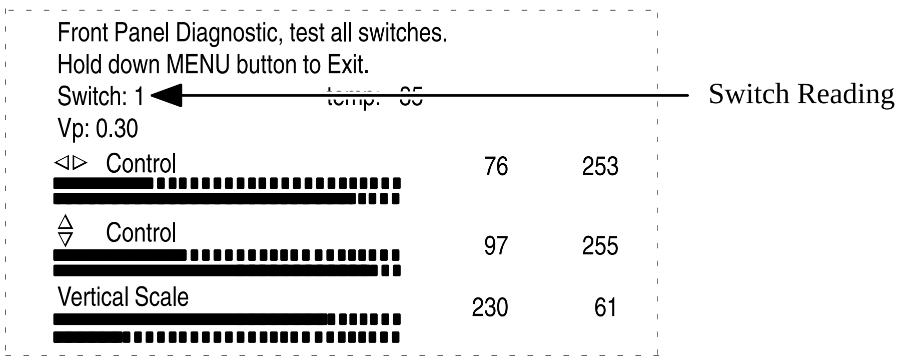


Figure 6–6: Front Panel Diagnostic Display

2. Press VIEW STORE. The LCD switch reading should change to 2.
3. Press VIEW DIFF. The LCD switch reading should change to 3.
4. Press STORE. The LCD switch reading should change to 4.

Rotating Controls

5. Rotate NOISE FILTER counterclockwise to VERT SET REF. The switch reading on the display should be 5.
6. Slowly rotate this control clockwise to its far stop. Each position should increase the switch reading one count, starting at 5 and ending with 14.

7. Rotate DIST/DIV counterclockwise to its far stop. The switch reading on the display should be 15.
8. Slowly rotate this control clockwise to its far stop. Each position should increase the switch reading one count, starting at 15 and ending with 25.
9. The display should currently show a V_P of 0.30. Slowly rotate the left V_P control to full clockwise. Each click should correspond to the front-panel control setting.
10. Rotate the right V_P control to full clockwise. Again, the LCD reading should match the front-panel control setting. The final reading with both controls fully clockwise should be 0.99.

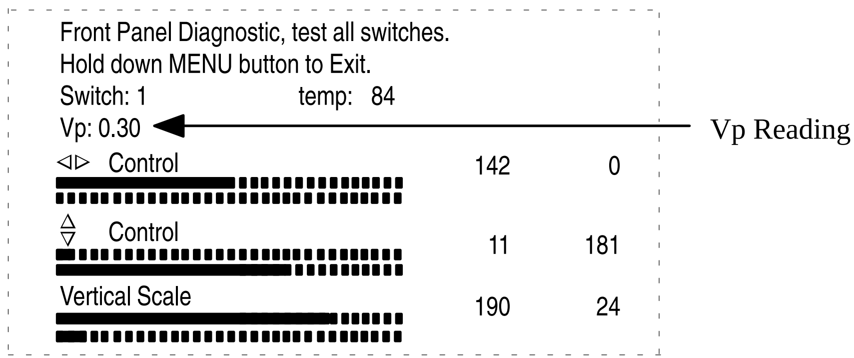


Figure 6–7: Front Panel Diagnostic Display

11. Rotate the ◁▷ POSITION control, slowly in either direction. The bar graph shown on the display represents the two elements of each control. The readings to the right of the bar graph represent numbers used by the instrument to calculate the position of the knob. As the control is rotated, these values and the bar graph will change. The lower value in each column should be between 0 and 10 while the higher number is between 245 and 255.

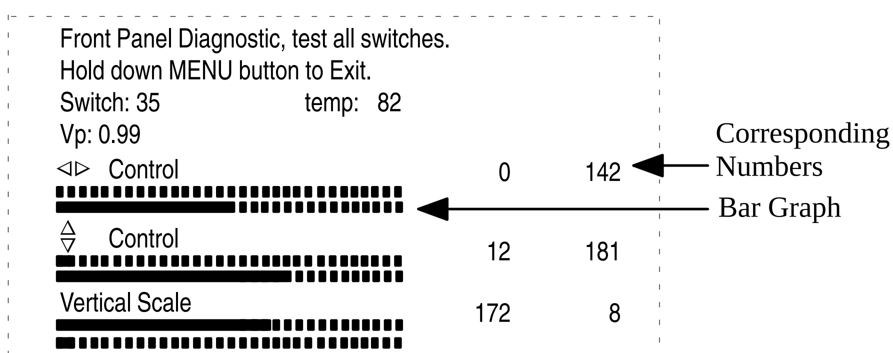


Figure 6–8: Front Panel Diagnostic Display

12. Rotate the △▽POSITION control slowly in either direction. The lower value in each column should be between 0 and 10 while the higher number is between 245 and 255.

13. Rotate the VERT SCALE control slowly in either direction. The lower value in each column should be between 0 and 10 while the higher number is between 245 and 255.

Thermistor

There is a numerical reading from the thermistor located on the LCD. If it is not operating properly, the LCD heater might not come on in cold environments. This could result in slow or unreadable displays.

1. The displayed temperature reading should be between 50 and 90, depending on the ambient temperature. If the thermistor is defective, the reading will be near 0 or 255.

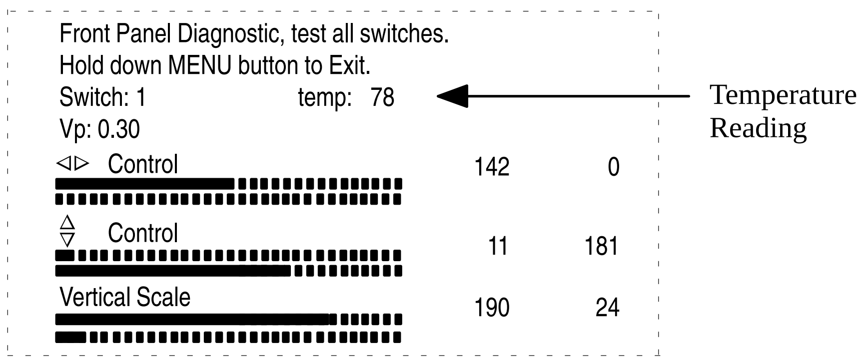


Figure 6–9: Front Panel Diagnostic Display

2. Press MENU repeatedly until the instrument returns to normal operation.

Conclusion

If any of the controls or functions are defective or indicate erratic response, the function affected by that control could be in error. The defective control should be replaced. See the *Maintenance* chapter of this manual.

Horizontal Scale (Timebase) Check

If the instrument fails this check, it must be repaired before any distance measurements are made with it.

1. Set the front-panel controls:

CABLE	No connection (see text)
NOISE FILTER	1 avg
VERT SCALE	500 mρ
DIST/DIV	.1 ft/div
V_P	.66

2. Turn on the instrument. The display should look very similar to Figure 6–10.

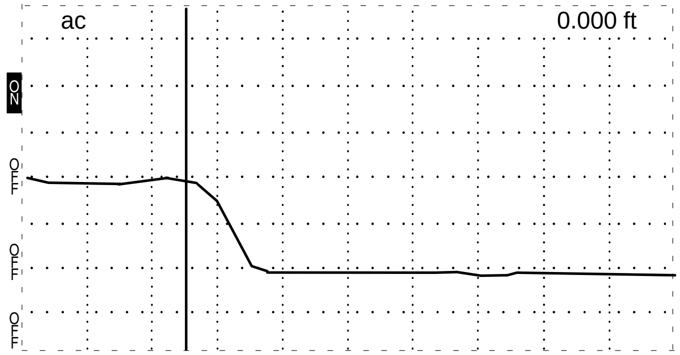


Figure 6–10: Waveform on the Display with No Cable Attached

3. Press STORE.

4. Connect the 3-ft precision test cable to the front-panel CABLE connector.

5. Press VIEW DIFF.

6. Rotate NOISE FILTER to HORZ SET REF. The display should look like Figure 6–11.

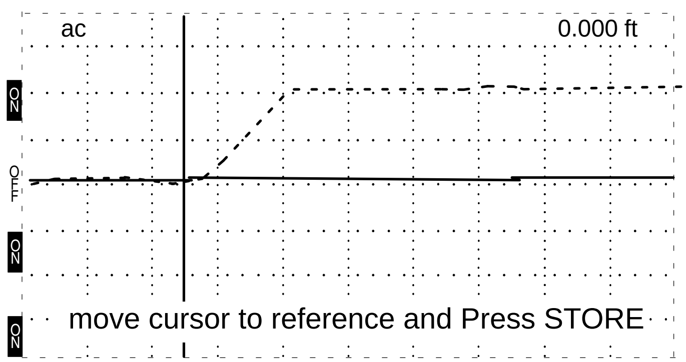


Figure 6–11: Display with 3-ft Cable and Stored Waveform

7. Using the ◁▷ POSITION control, set the cursor on the rising edge of the waveform at the first graticule up from the centerline.

8. Press STORE.

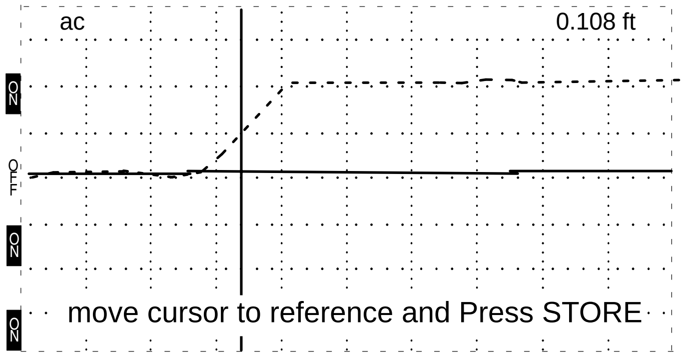


Figure 6–12: Cursor on Rising Edge of Pulse

9. Rotate NOISE FILTER back to 1 avg.

10. Press STORE. The front panel reference has now been set.

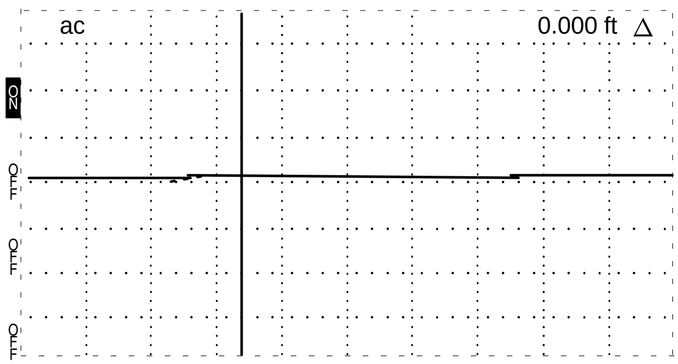


Figure 6–13: Cursor at 0.000 ft △

11. Rotate the ◁▷ POSITION control to the rising edge of the waveform, one graticule above the centerline. This measures the distance from the set point to the end of the 3-ft cable. The measured distance should be between 2.87 and 3.13 feet.

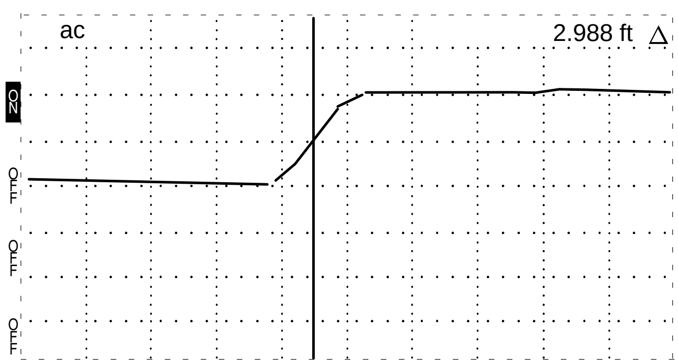


Figure 6–14: Cursor on Rising Edge of Pulse

12. Remove the 3–ft cable and connect the 50Ω terminator.

13. Set the DIST/DIV control to 200 ft/div.

14. Rotate the ◁▷ POSITION control clockwise until the display distance window shows a distance greater than 2,000.000 ft. The waveform should remain flat from zero to this distance.

Figure 6–15: Flatline Display to >2,000 ft

***NOTE**. If the Timebase does not appear to be working properly, refer to the* Circuit Descriptions *chapter and the* Troubleshooting *section of the* Maintenance *chapter of this manual.*

Zero Offset Check

If the instrument fails this check, you might still make some tests, but the offset might change when cable conditions change.

1. Set the front-panel controls:

CABLE	(see * below)
NOISE FILTER	1 avg
VERT SCALE	500 mρ
DIST/DIV	.2 ft/div
V_P	.99
POWER	ON

* Nothing should be connected to the front panel CABLE connector.

2. Adjust the ◁▷ POSITION control so the distance window reads –2.000 ft.

3. Use the △▽POSITION control to center the baseline before the incident pulse.

4. Increase VERT SCALE to 10 mρ, using the △▽POSITION control to keep the baseline centered on the display.

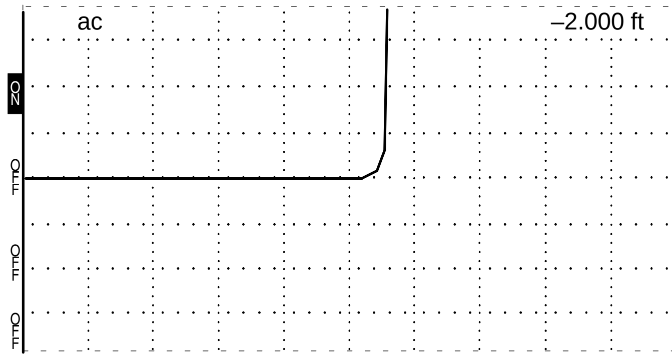


Figure 6–16: Incident Pulse at –2.000 ft

5. The front panel CABLE connector has a shorting bar that shorts the input when a cable is removed. Attach the 3-ft precision cable to the CABLE connector to defeat this shorting bar.

6. Notice any minor changes in the waveform. The waveform prior to the leading edge might change shape slightly, but should not shift more than one division.

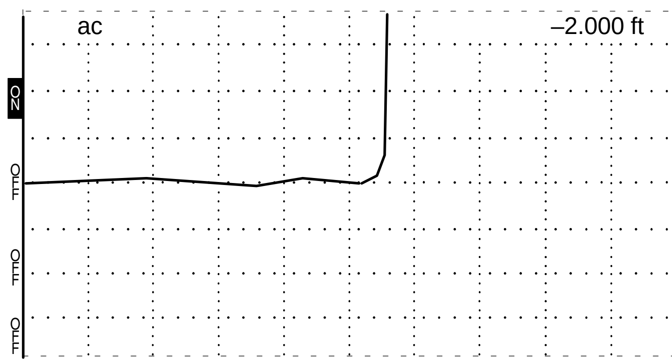


Figure 6–17: Incident Pulse at –2.000 ft with 3-ft Cable Connected

Max Hold can be used to easily monitor any changes, as shown below.

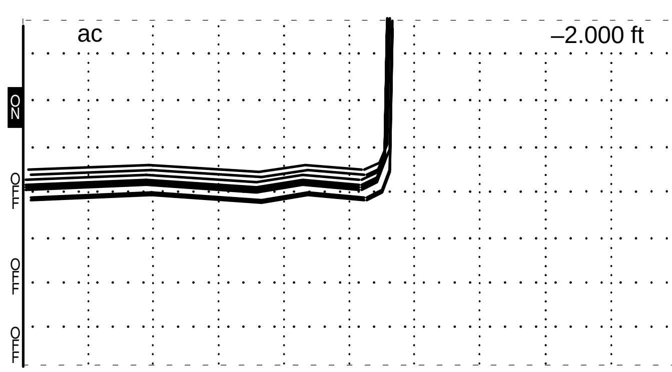


Figure 6–18: Incident Pulse at –2.000 ft with Max Hold

7. Turn the instrument OFF, then ON again. This will reset it for the next check.

***NOTE**. If the instrument fails this check,, first refer to* Zero Offset Adjust *in the* Adjustment Procedures *section of this chapter. If you are unable to adjust this satisfactorily, refer to the* Circuit Descriptions *chapter and the* Troubleshooting *section of the* Maintenance *chapter of this manual.*

Vertical Position (Offset) Check

If the instrument fails only this check, it can be used but should be serviced. Not all waveforms will be viewable at all gain settings.

1. Set the front-panel controls:

CABLE	3-ft precision cable
NOISE FILTER	1 avg
VERT SCALE	500 mρ
DIST/DIV	1 ft/div
V_P	.99

2. Set the ◁▷ POSITION control so the distance window reads –2.000 ft.

3. Using the △▽POSITION control, verify that the entire waveform can be moved upward past the center graticule line.

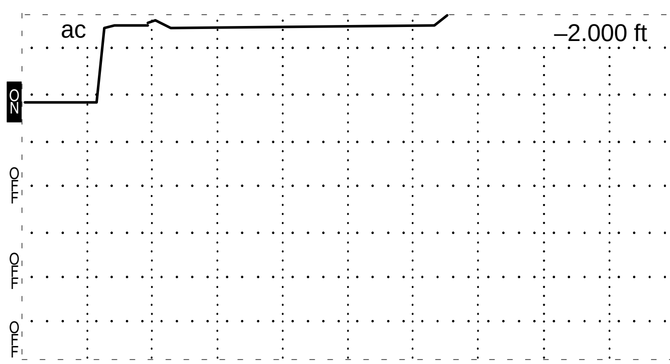


Figure 6–19: Waveform at Top of the Display

4. Using the △▽POSITION control, verify that the entire waveform can be moved to the very bottom of the display. The top of the pulse should be lower than the center graticule line.

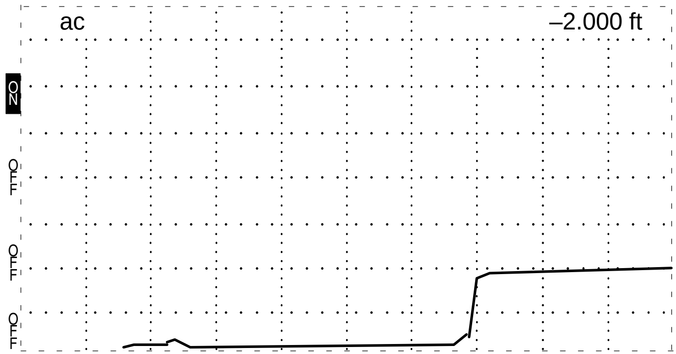


Figure 6–20: Waveform at Bottom of the Display

5. Remove the 3-ft precision cable.
6. Connect the 50Ω terminator to the CABLE connector.
7. Center the pulse in the display. The pulse should be two divisions high.

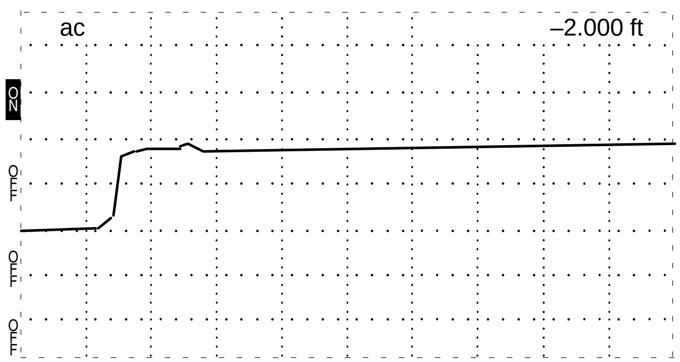


Figure 6–21: Waveform at Centered

NOTE*. If the instrument fails this check, refer to the* Troubleshooting *section of the* Maintenance *chapter of this manual.*

Noise Check

If the instrument fails this check, it might still be usable for measurements of large faults that do not require a lot of gain. A great deal of noise reduction is available with the NOISE FILTER control.

1. Set the front-panel controls:

CABLE	50Ω terminator
NOISE FILTER	1 avg
VERT SCALE	500 mρ
DIST/DIV	10 ft/div
V_P	.99

2. Turn the ◁▷ POSITION control until the distance window reads 100.000 ft.

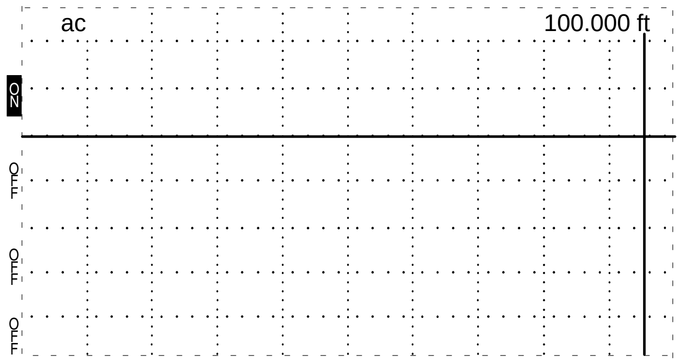


Figure 6–22: Cursor Moved to 100.000 ft

3. Change DIST/DIV to 0.1 ft/div.
4. Using the VERT SCALE control, set the gain to 5.00 mρ/div.
5. Use the △▽POSITION control to keep the waveform centered on the display.

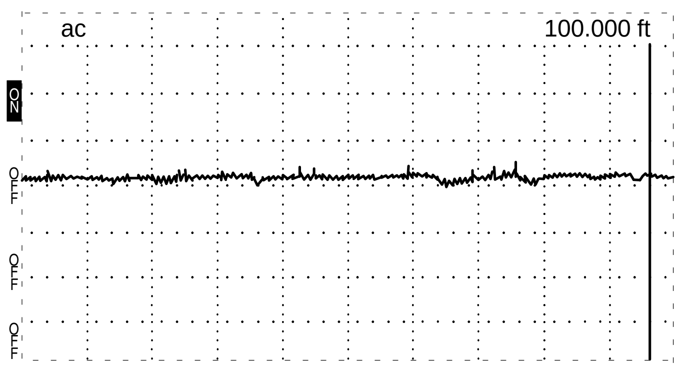


Figure 6–23: Noise with Gain at 5.00 mρ

6. Press MENU.
7. Using the △▽POSITION control, scroll to *Diagnostics Menu*.
8. Press MENU again.
9. Using the same procedure, select *Service Diagnostic Menu*, then *Noise Diagnostic*.
10. Read the results on the display.

Noise Diagnostic
Continuous Result Update

Acceptable Range	Result
0 – 11 Pixels	4

vertical scale at 5.00 mρ
and cursor at location to sample.
– Push MENU button to Exit –

Figure 6–24: Noise Diagnostic Display

***NOTE**. If the instrument does not meet this specification, refer to the* Circuit Descriptions *chapter and the* Troubleshooting *section of the* Maintenance *chapter of this manual.*

---

11. Press MENU once to return to the *Service Diagnostic Menu*. Do not exit from the *Service Diagnostic Menu* because you will use it in the next check.

Sampling Efficiency Check

If the instrument fails this check, the waveforms might not look normal. If the efficiency is more than 100%, the waveforms will appear noisy. If the efficiency is below the lower limit, the waveform will take longer (more pixels) to move from the bottom to the top of the reflected pulse. This smoothing effect might completely hide some events that would normally only be one or two pixels wide on the display.

1. While in the *Service Diagnostic Menu*, select the *Sampling Efficiency Diagnostic* and follow the directions shown on the display.

Exit Service Diagnostic Menu
→ Sampling Efficiency Diagnostic
Noise Diagnostic
Impedance Diagnostic
Offset/Gain Diagnostic
RAM/ROM Diagnostics
Timebase is: Normal – Auto Correction

Move ⇳ Position to select, then push MENU button

Figure 6–25: Service Diagnostic Menu

Sampling Efficiency Diagnostic
Continuous Result Update

Acceptable Range	Result
50% – 90%	63%

– Push MENU button to Exit –

Figure 6–26: Sampling Efficiency Diagnostic

***NOTE**. If the instrument does not pass this check, refer to the* Circuit Descriptions *chapter and the* Troubleshooting *section of the* Maintenance *chapter of this manual.*

2. Press MENU once to return to the *Service Diagnostic Menu*. Do not exit from the *Service Diagnostic Menu* because you will use it in the next check.

Offset/Gain Check

If the instrument fails this check, it should not be used for loss or impedance measurements.

1. While in the *Service Diagnostic Menu*, select the *Offset/Gain Diagnostic* and follow the directions shown on the display.

Exit Service Diagnostic Menu
Sampling Efficiency Diagnostic
Noise Diagnostic
Impedance Diagnostic
→ Offset/Gain Diagnostic
RAM/ROM Diagnostics
Timebase is: Normal – Auto Correction

Move ⇕ Position to select, then push MENU button

Figure 6–27: Service Diagnostic Menu

***NOTE**. The 48 dB step might fail intermittently. If a more accurate reading is desired, TP9041 on the Main Board or TP3051 on the Driver/Sampler Board must be grounded during the check. See the* Maintenance *chapter for the case and EMI shield removal instructions.*

2. There are five screens of data presented in this diagnostic. The Pass/Fail level is 3% for worst case.

3. Press MENU once to return to the *Service Diagnostic Menu*. Do not exit from the *Service Diagnostic Menu* because you will use it in the next check.

RAM/ROM Check

If the instrument fails this check, various functions might be affected. Without the RAM/ROM functions operating correctly, it is doubtful you would have gotten this far. This check will give you assurance that the RAM/ROM circuits are operating properly.

1. In the *Service Diagnostic Menu*, select the *RAM/ROM Diagnostics*.

```
   Exit Service Diagnostic Menu
   Sampling Efficiency Diagnostic
   Noise Diagnostic
   Impedance Diagnostic
   Offset/Gain Diagnostic
→  RAM/ROM Diagnostics
   Timebase is: Normal – Auto Correction

Move ⇕ Position to select, then push MENU button
```

Figure 6–28: Service Diagnostic Menu

2. Press MENU. The diagnostic is automatic and will display the result on the LCD.

3. Turn the instrument off, then on again. This will reset it for the next check.

***NOTE**. If the instrument fails any of the last three checks, refer to the* Circuit Descriptions *chapter and the* Troubleshooting *section of the* Maintenance *chapter of this manual.*

Aberrations Check

If the aberrations are out of spec, the ohms-at-cursor function might be less accurate than specified.

1. Set the front-panel controls:

CABLE	50Ω terminator
NOISE FILTER	1 avg
VERT SCALE	500 mρ
DIST/DIV	5 ft/div
V_P	.99

2. Using the ◁▷ POSITION control, adjust the distance window to read –2.000 ft.

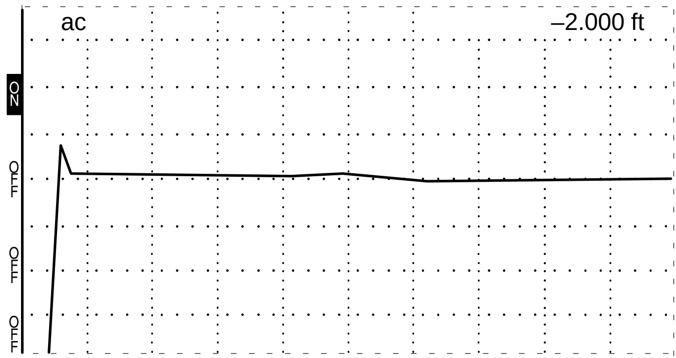


Figure 6–29: Waveform with Cursor at –2.000 ft

3. Increase DIST/DIV to 50 mρ/div.

4. Center the pulse on the display, keeping the trailing baseline on the center graticule

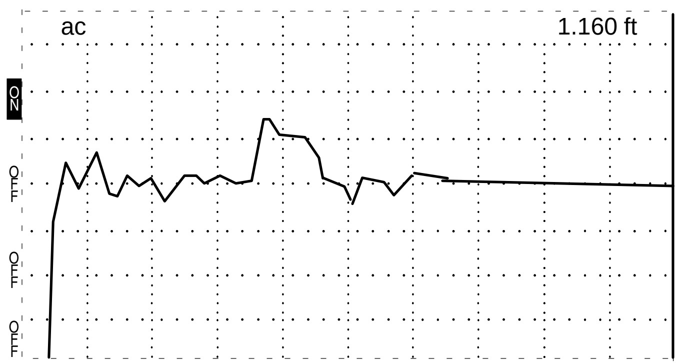


Figure 6–30: Waveform at 50 mρ/div

5. Set the DIST/DIV control to 0.2 ft/div.

6. Adjust the ◁▷ POSITION control until the rising edge of the pulse is in the left-most major division on the display.

7. Move the cursor to 0.000 ft with the ◁▷ POSITION control. All the aberration except the one under the cursor should be within one division of the center graticule line (see Figure 6–31).

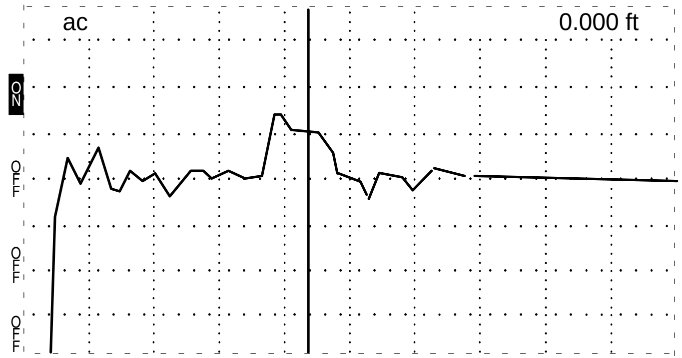


Figure 6–31: Waveform at 5 mρ/div

8. Increase the DIST/DIV to 200 ft/div.

9. Increase the VERT SCALE to 5.00 mρ.

10. Verify the the waveform is flat ± one minor division after the incident step.

***NOTE**. If the instrument fails this check, refer to* Driver/Sampler *in the* Circuit Descriptions *chapter and the* Troubleshooting *section of the* Maintenance *chapter.*

Risetime Check

If the risetime is out of specification, it might be difficult to make accurate short-distance measurements near the front panel and might affect the resolution of the instrument.

1. Set the front-panel controls:

CABLE	50Ω terminator
NOISE FILTER	1 avg
VERT SCALE	500 mρ
DIST/DIV	0.1 ft/div
V_P	.99

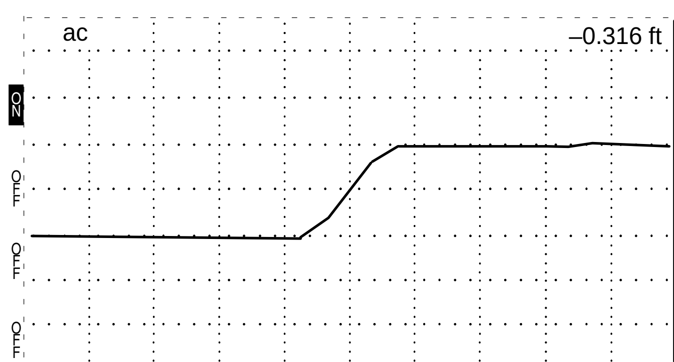


Figure 6–32: Incident Pulse at Center of Display

2. Use the ◁▷ POSITION control to move the incident pulse to the center of the display (as shown in Figure 6–32).

3. Turn the VERT SCALE control clockwise until the leading edge of the incident pulse is five major divisions high (about 200 mρ).

4. Position the waveform so that it is centered horizontally and vertically on the middle graticule lines (2.5 divisions below the center horizontal graticule line and 2.5 divisions above).

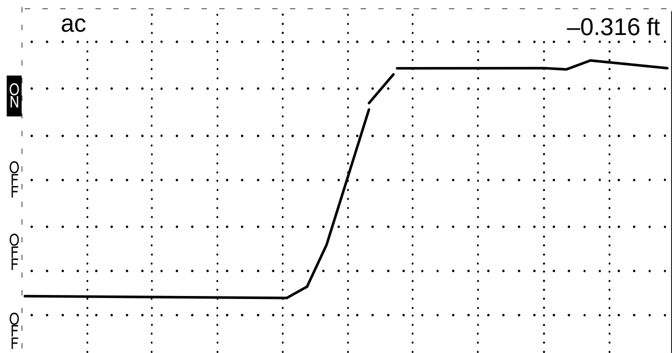


Figure 6–33: Incident Pulse Centered, Vertical Increased

5. Turn the NOISE FILTER control to HORZ SET REF.

6. Using the ◁▷ POSITION control, set the cursor to the point where the lower portion of the pulse's rising edge first crosses a major horizontal graticule line (should be about half a division from the bottom of the pulse).

7. Press STORE.

8. Turn the NOISE FILTER to 1 avg.

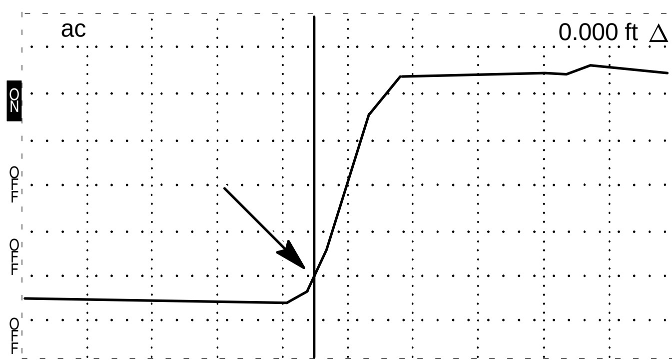


Figure 6–34: Cursor on Rising Edge at First Horizontal Graticule

9. Using the ◁▷ POSITION control, set the cursor to the point where the upper portion of the pulse's rising edge crosses a major horizontal graticule line (should be about half a division from the top of the pulse).

10. Verify that the distance is less than or equal to 0.096 ft Δ.

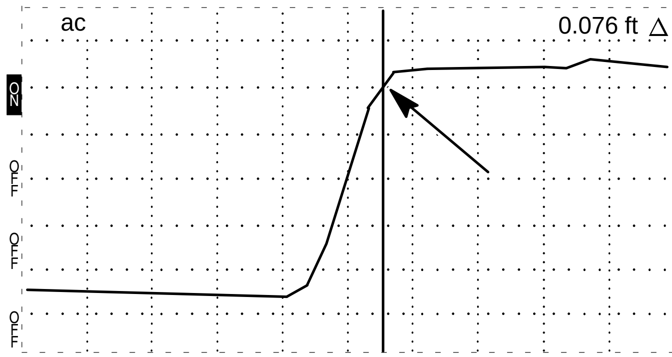


Figure 6–35: Cursor on Rising Edge at Last Horizontal Graticule

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***NOTE**. If the instrument fails this check, refer to* Troubleshooting *in the* Maintenance *chapter and* Driver/Sampler *in the* Circuit Descriptions *chapter of this manual.*

Jitter Check

***NOTE**. If you have just completed the previous check, the instrument might still be in HORZ SET REF mode. This will not have any effect on the Jitter Check. If you wish to exit HORZ SET REF, either turn the power off and on, re-initializing the instrument, or follow the directions for HORZ SET REF in the* Operator *chapter.*

---

1. Set the front-panel controls:

CABLE	50Ω terminator
NOISE FILTER	1 avg
VERT SCALE	500 mρ
DIST/DIV	.1 ft/div
V_P	.99

2. Using the ◁▷ POSITION and the △▽ POSITION controls, center the rising edge of the pulse on the center horizontal graticule line.

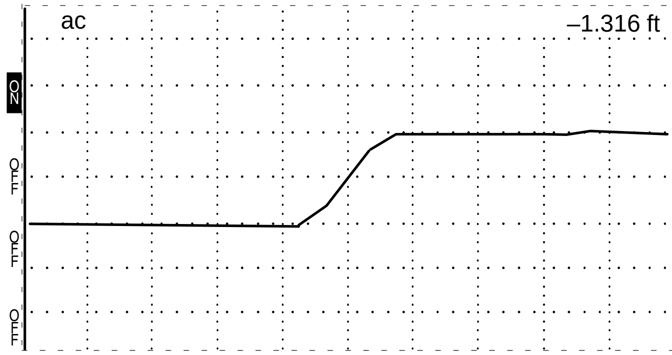


Figure 6–36: Rising Edge at Center of Display

3. Turn the VERT SCALE control clockwise for a reading of more than 1.0 mρ/div.

4. Verify that the leading edge of the pulse moves less than five pixels (0.02 ft).

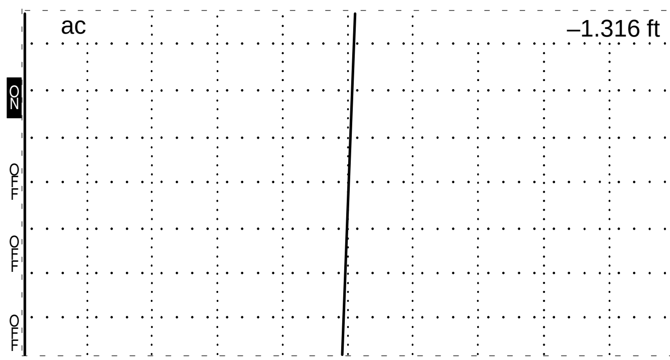


Figure 6–37: Rising Edge with Scale at 1.0 mρ/div

You may also use the Max Hold function found in the Acquisition Control menu, within the Setup menu. This function can simplify this measurement for you by displaying jitter accumulating. See the Operator chapter for directions on using Max Hold.

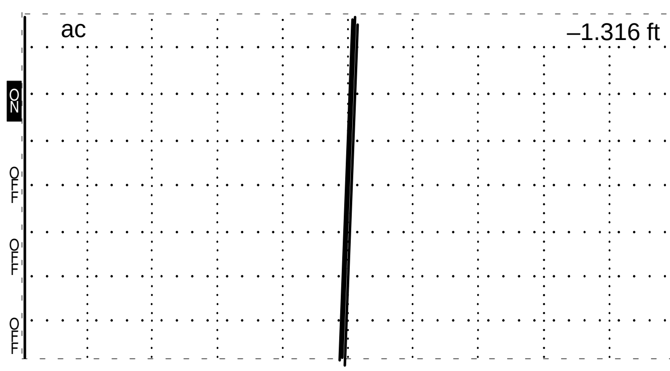


Figure 6–38: Rising Edge with Max Hold on

Option 04/07: YT-1/YT-1S Chart Recorder Check

If the instrument does not pass this check, chart recordings might not be possible.

1. Access the *Chart Diagnostics Menu* found under the *Diagnostics Menu*.

2. Scroll to *Head Alignment Chart* and follow the directions.

3. Press MENU to exit this diagnostic.

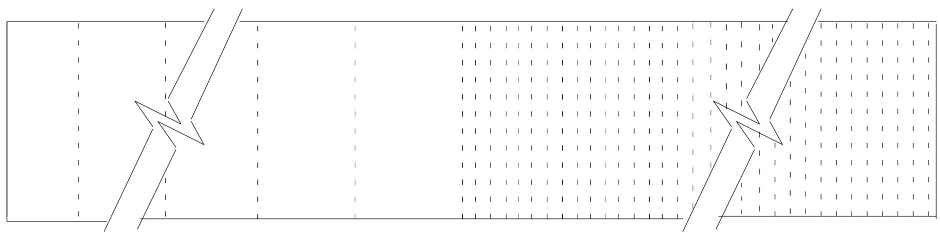


Figure 6–39: Head Alignment Chart Print

4. There should be approximately six inches of narrow-spaced lines and six inches of wide-spaced lines. The total length of both should be between 10.87 and 12.76 inches. Fold the paper at the last narrow-spaced line and the two ends should be of equal length (half narrow, half wide).

***NOTE**. If the chart recorder does not pass this check, refer to the* YT-1/YT-1S Chart Recorder Instruction Manual *(070–6270–xx) for service information.*

Option 05: Metric Default Check

Option 05 requires no check other than to turn on the instrument and see if it displays in meters. Instructions for changing the default can be found in the *Maintenance* chapter of this manual.

Adjustment Procedures

Equipment Required

Equipment	Performance Required	Example or Tek P/N
Digital Multimeter	Range: 0 to 200 VDC	DM501A or equivalent*
Ohmmeter	Resolution to 0.01Ω	DM501A or equivalent*
Variable AC Source	with power meter	GenRad W10MT3W or equiv.
Variable DC Power Supply	0 to 14 VDC, 3 A	
3-foot Coaxial Cable	50Ω	012–1350–00

* must be plugged into power mainframe

Metric Instruments

Metric default timing is made by moving a jumper on the back of the Front Panel Board (see *Maintenance* chapter of this manual). To make the calibration easier, this jumper will be moved to the standard timing position during calibration, then moved back to the metric position when calibration is completed.

Before Starting

On early instruments, there is an adjustment on the Main Board used for timebase compensation, identified as R2034. Because of a slight crosstalk effect between circuits, measurements of a certain length cable would show a small glitch. This adjustment eliminated the problem and subsequent improvements in circuit board design eliminated the need for the adjustment. If your instrument has this adjustment, it has been set at the factory and requires no further attention.

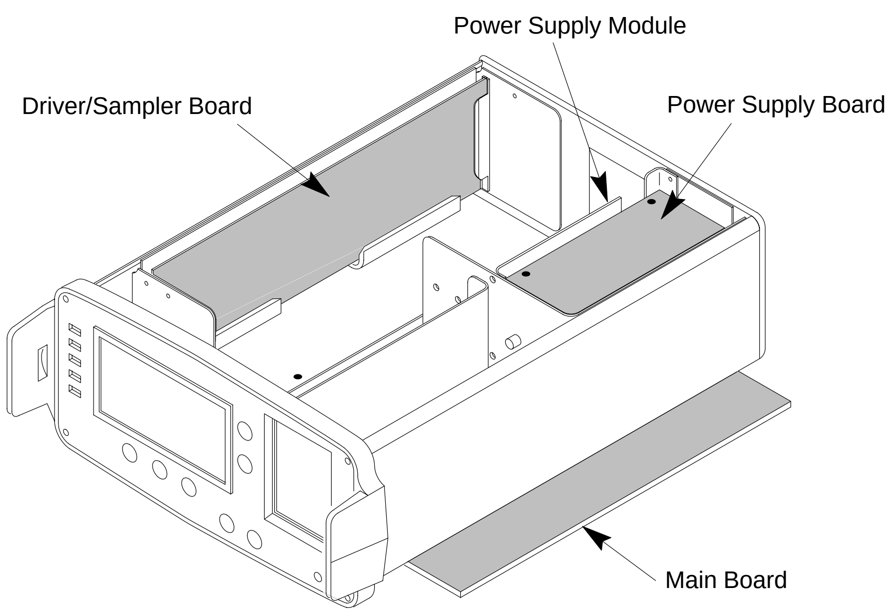


Figure 6–40: Circuit Board Locations in the Instrument

Remove the Case and EMI Shields

To perform the Adjustment Procedure, the instrument must be removed from the case and the EMI shields removed. Instructions on both procedures are located in the *Maintenance* chapter of this manual.

Visual Inspection

If any repairs are made to the instrument, or if it has been disassembled, we recommend a visual inspection be made.

1. Check all screws for tightness and that the screw heads are not burred or rounded.
2. Set the line voltage switch on the rear panel to 110V and check for the proper fuse (0.3 A).
3. Check if the LCD has been cleaned on the outside and the implosion shield of the front panel has been cleaned on the inside.
4. Check that the knobs and buttons work properly. The NOISE FILTER, DIST/DIV, and both V_P knobs have detents; all others should rotate smoothly. Check that the knobs are tight (no loose set screws). Check that the set screw on the POWER switch shaft is tight.
5. Check the cables for proper connection polarity and tightness. Make sure the cables on the front of the Main Board come down from the plug into the instrument instead of curving toward the outside. All cables should have the exposed ends away from the metal chassis.
6. If any components were replaced by soldering, check for solder balls, excess flux, and wire clippings. Good soldering practices must be followed when repairing this instrument.

Power Supply Checks and Adjustments

Power-Up Procedure

1. Set the front-panel controls:

NOISE FILTER	1 avg (3rd stop CW)
DIST/DIV	1 ft/div (4th stop CW)
V_P	.99

2. Make sure the POWER switch is in the OFF position.
3. Connect the 115 VAC output of the Variac® into the AC socket on the rear of the 1502C.

Voltage Checks

1. Pull the POWER switch to the ON position.
2. Observe that the power draw does not exceed 4 Watts on the Variac.

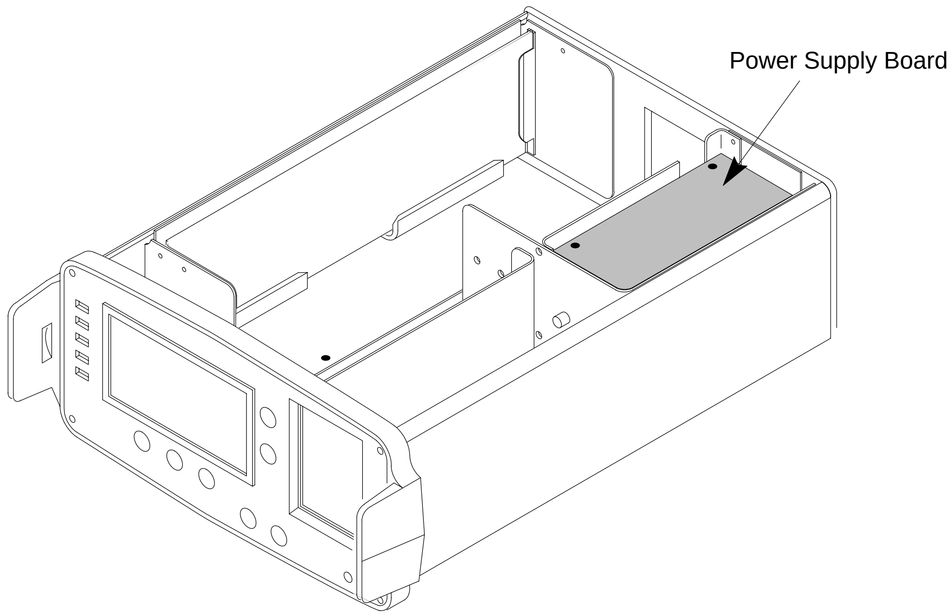


Figure 6–41: Power Supply Board

3. Connect the positive (+) voltmeter probe to TP1020 (+16.6 VDC – it might be marked as 15.8 V on some older power supplies).
4. Connect the negative (–) probe to TP1010 (ground).

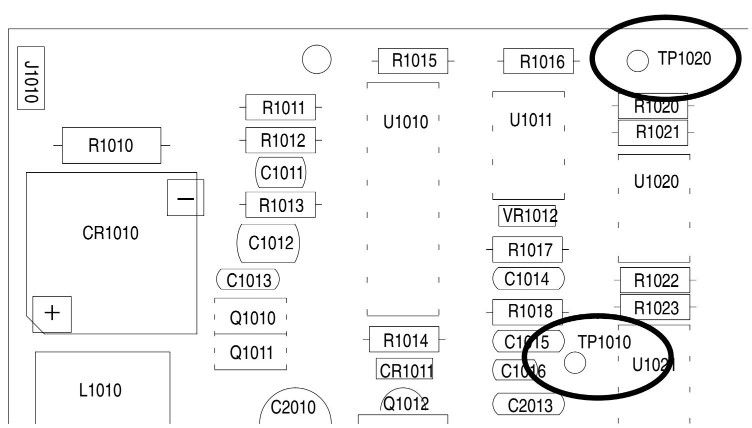


Figure 6–42: Power Supply Test Points TP1020 and TP1010

5. Verify that the supply voltage is 16.6 VDC and there is a minimal current drawn (< 2W) from the Variac.

6. Connect the positive (+) voltmeter probe to TP2030. The negative (–) voltmeter probe should remain connected to ground. The reading should be +16.2 VDC (see following table for tolerances).

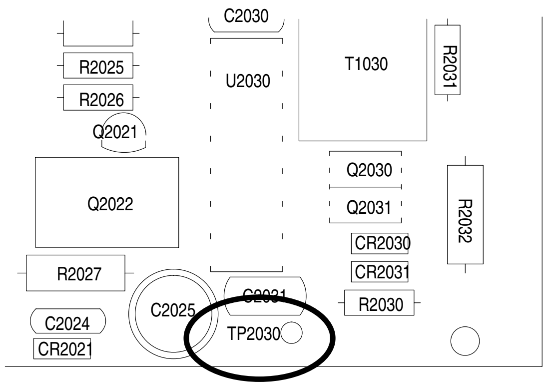


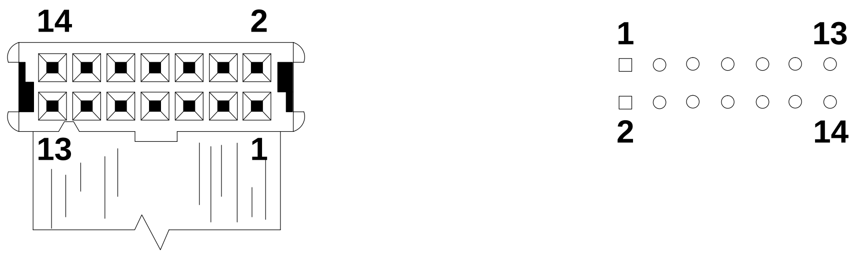
Figure 6–43: Power Supply Test Point TP2030

Supply	Range	Test Point	Location
+16.2 VDC	+15.9 to +16.4 VDC	TP2030	Power Supply Board
+5.0 VDC	+4.85 to +5.25 VDC	Pin 1, J5040	Main Board
–5.0 VDC	–4.85 to –5.25 VDC	Pin 3, J5040	Main Board
+15.0 VDC	+14.7 to +15.3 VDC	Pin 4, J5040	Main Board
–15.0 VDC	–14..7 to –15.3 VDC	Pin 6, J5040	Main Board

7. Make a mental note of the location where the ribbon cable from the power supply is plugged into the Main Board, then turn the instrument over.

NOTE*. When the instrument is turned over, you will be looking at the top (component side) of the Main Board.*

The J5040 pins go through the circuit board and appear on the top (component side) of the Main Board. J5040/P5040 is the input from the power supply. The other end of the cable is J1030/P1030 on the Power Supply Board. Measure the voltages on the pins listed in the table and verify the supply voltages.



Connector plug P5040
on bottom of Main Board.

Connector pin J5040
on top of Main Board.

Figure 6–44: Connector Plug P5040 and Pins J5040 on Bottom of Main Board

Range Check

Test points in this check are located on the Power Supply Board.

1. Connect the positive (+) probe to the +16.6 VDC supply (TP1020) on the Power Supply Board.

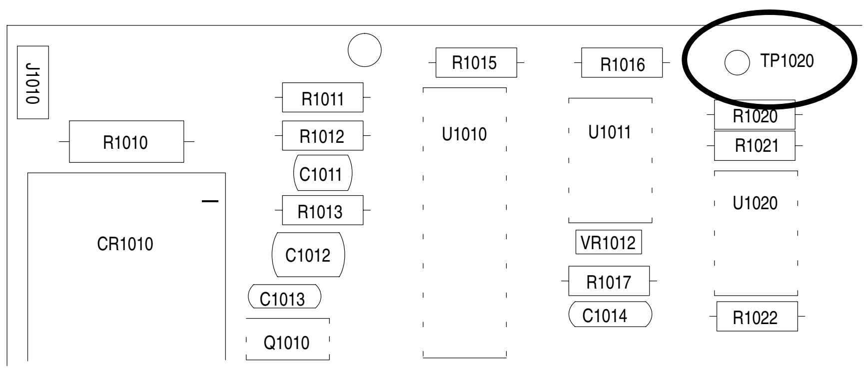


Figure 6–45: Power Supply Test Point TP1020

2. Change the AC output voltage on the Variac to 132 VAC.
3. Verify that the +16.6 VDC supply remains regulated (+16.4 to +16.8 VDC).
4. Reduce the Variac output voltage to 90 VAC.
5. Verify that the +16.6 VDC supply is still regulated (+16.4 to +16.8 VDC).
6. Move the positive (+) probe to the +16.2 VDC supply (TP2030)
7. Reduce the Variac output voltage until the +16.2 VDC (and the instrument) shut down. This voltage must be lower than 90 VAC.

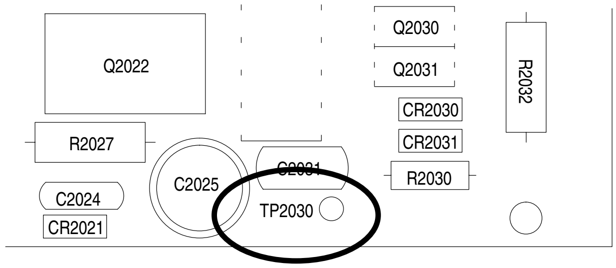


Figure 6–46: Power Supply Test Point TP2030

8. Raise the Variac output voltage to 120 VAC. The instrument should remain shut down.
9. Turn the 1502C POWER off.

Main Board ± 12 VDC Check and Adjust

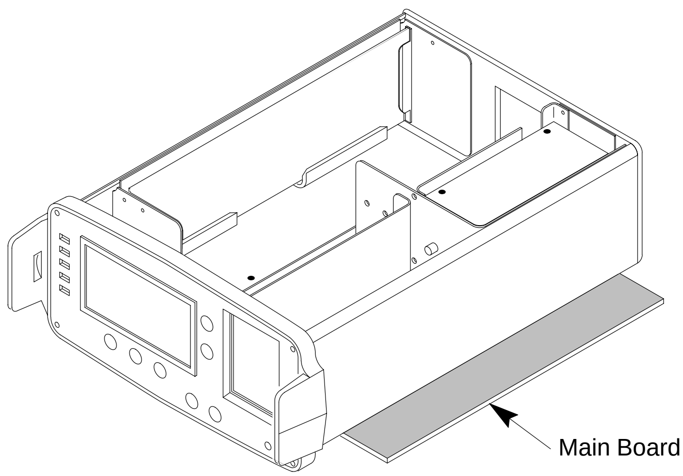


Figure 6–47: Location of Main Board in Instrument

+12 VDC

Test points in this check are located on the Main Board.

1. Turn the instrument over to access the Main Board.
2. Attach the positive (+) probe from the voltmeter to the + side (facing the edge of the board) of C9031.
3. Attach the negative (–) probe to the other side of C9035.
4. Turn the instrument POWER on and check that less than 4 Watts is drawn from the Variac.
5. Adjust R9032 for +12.0 VDC.

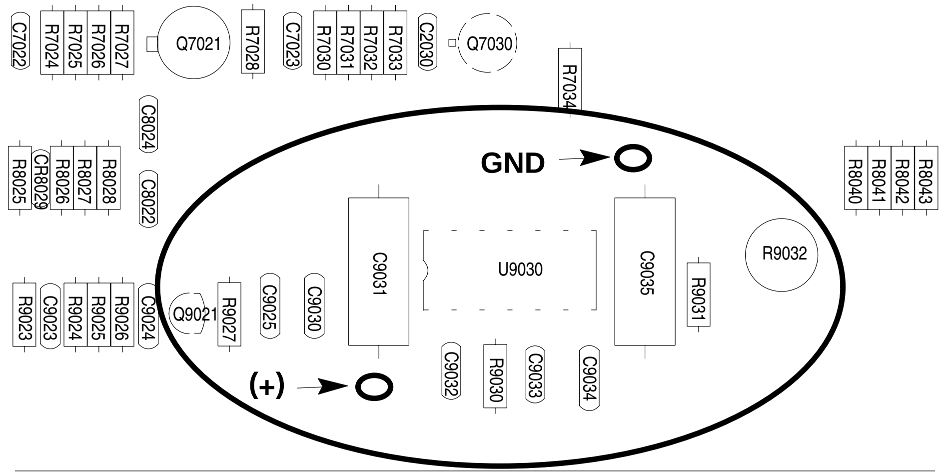


Figure 6–48: Main Board Probe Points

–12 VDC *Test points in this check are located on the Main Board.*

1. Move the positive (+) probe to the ground side of C9035 (the side away from the edge of the board).
2. Verify that the voltage is –11.8 to –12.2 VDC.
3. Verify that the LCD shows the following display:

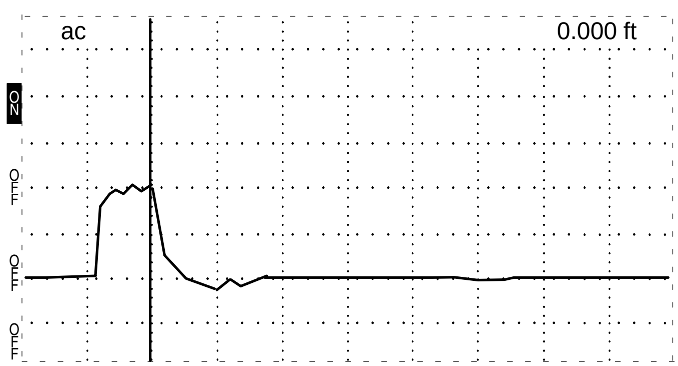


Figure 6–49: Waveform on Display

You might have to adjust R1018 (Contrast Adjust) on the Front Panel Board to get a clear display (see *LCD Check and Adjustments* in this section).

DC Power Check

1. Turn the POWER off.
2. Remove the AC plug from the rear panel of the instrument.
3. If a battery is present, disconnect the wire from the battery to the Power Supply board.
4. Connect an external 12 VDC power supply into the battery connector (see Figure 6–50). Pins 1 and 4 are ground. Pins 2 and 3 are positive (supply) terminals.
5. Adjust the external 12 VDC supply for +11.5 VDC output at the terminals of the battery input.
6. Connect a DC ammeter in series with the positive (+) side of the 12 VDC supply.
7. Turn the power on. The current measurement must not exceed 350 mA.

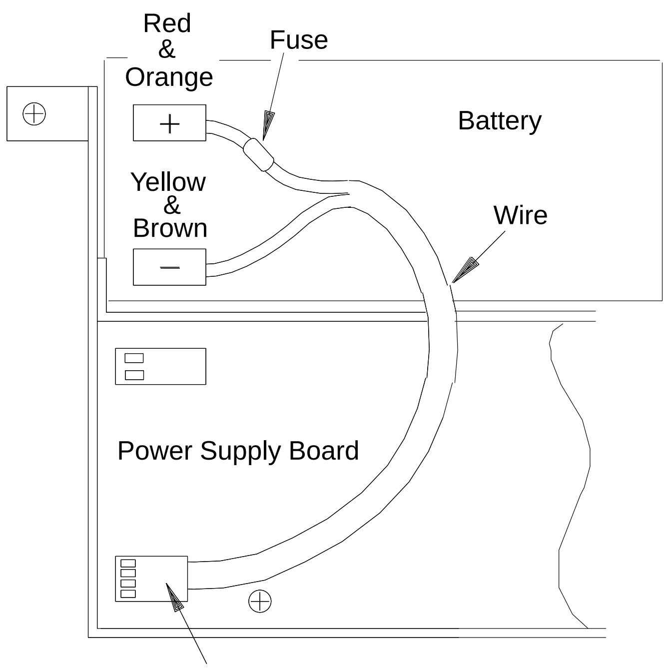


Figure 6–50: Battery Connections to Power Supply Board

8. Connect the positive (+) probe of the voltmeter to the front side of CR2012 on the Power Supply Board (this is the large diode next to J2010. The positive probe should be on the non-banded end of the diode).
9. Connect the negative probe to ground.

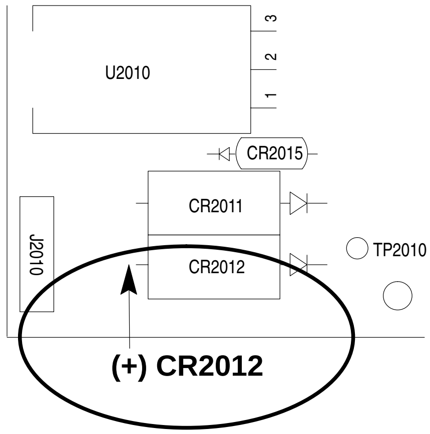


Figure 6–51: CR2012 on Power Supply Board

10. Turn the 1502C POWER on. The instrument should initialize and go into normal operation. The display will be normal except *ac* in the upper left corner will have changed to *bat*.

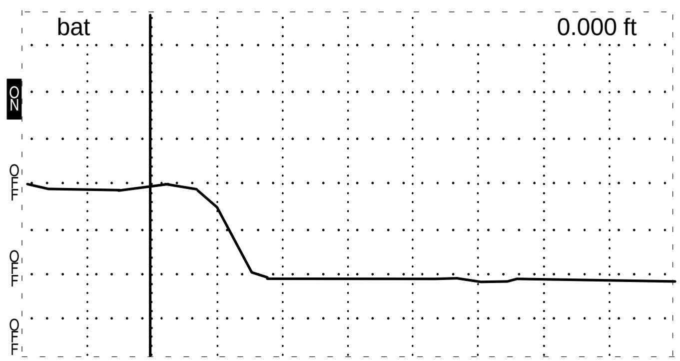


Figure 6–52: Display Showing Power is Battery

11. Reduce the output voltage of the DC power supply until *bat/low* appears in the upper left corner of the display.

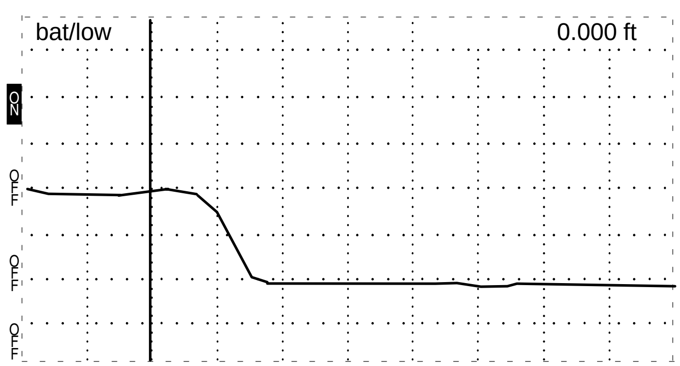


Figure 6–53: Display Showing Battery Voltage is Low

12. Verify that the DC supply voltage is between 10.6 and 11.0 VDC.

13. Remove the voltmeter probes from the 1502C.
14. Remove the external 12 VDC power supply cable from the battery connector.
15. Reconnect the battery wire to the Power Supply board and to the battery.
16. Connect the AC supply cord to the rear panel.

Charging Current Check

(with optional battery)

1. Turn the POWER off.
2. Connect a voltmeter across the 4Ω resistor, R2012, located on the Power Supply Board.
3. Connect the positive (+) probe to the side nearest the front panel and the negative (–) probe to the other end. The voltage drop across R2012 should be between 0.4 and 1.2 VDC.

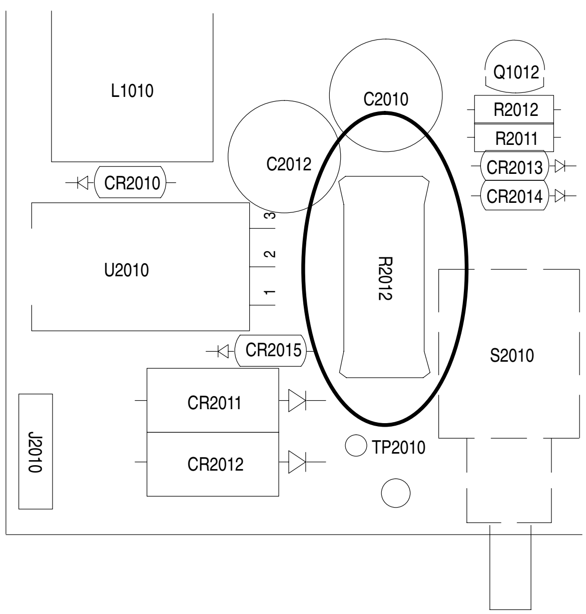


Figure 6–54: R2012 on Power Supply Board

4. Turn the POWER on.

   The voltage reading across R2012 should change only slightly (± 10 mV).

***NOTE**. The charging current will vary according to the level of charge already on the battery. With a fully charged battery, the voltage across R2012 should be approximately 0.4 VDC. With a battery below 11 Volts, R2012 should read approximately 1.2 VDC.*

Impedance Check

If the instrument fails this check, it should not be used for loss or impedance measurements.

The following test points are located on the Driver/Sampler Board.

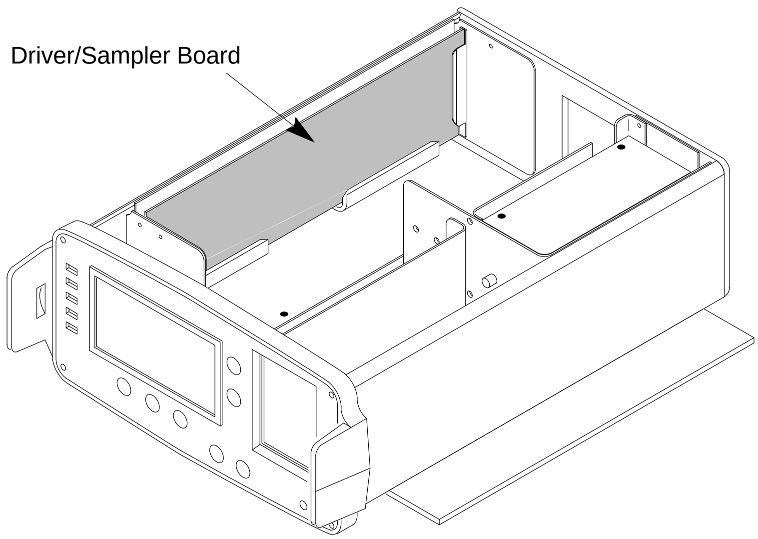


Figure 6–55: Driver/Sampler Board Location

1. Turn off the POWER to the instrument.
2. Remove the cover of the Driver/Sampler Board (see *Maintenance* chapter).

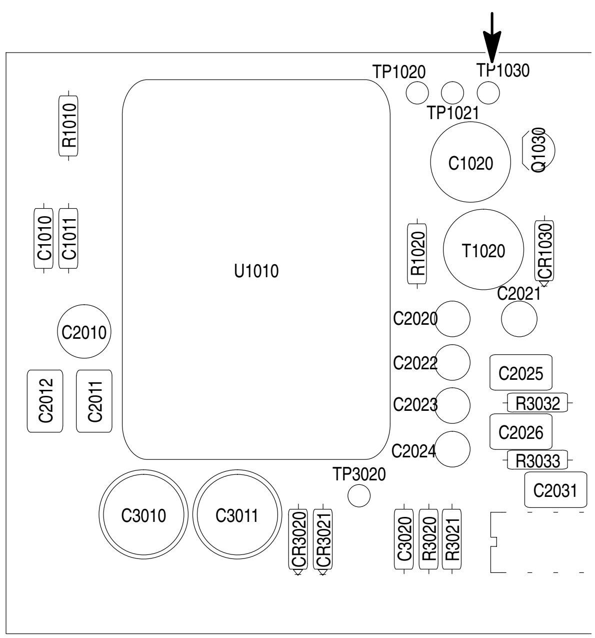


Figure 6–56: TP1030 on Driver/Sampler Board

3. Using a precision Ohmmeter, measure the resistance from the 0.6 VDC supply (TP1030) to the center conductor of the front-panel CABLE connector.

4. Subtract the resistance of the Ohmmeter test probes. The result should be between 49.5 Ω and 50.5 Ω.

LCD Check and Adjustment

1. Turn POWER on.
2. Push MENU.
3. Using the ⇳POSITION control, scroll to *Diagnostics Menu*.
4. Push MENU.
5. Scroll to *LCD Diagnostics Menu*.
6. Push MENU.
7. Scroll to *LCD Alignment Diagnostic*.
8. Push MENU.

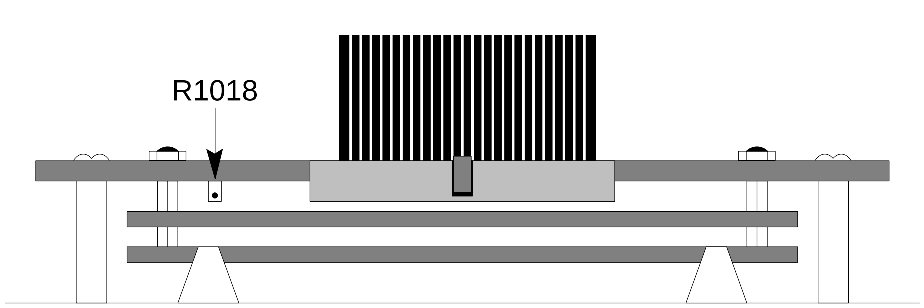


Figure 6–57: R1018 on Front Panel Board

9. Observe the LCD as you adjust R1018 (Contrast Adjust) counterclockwise until the entire pattern starts to dim.

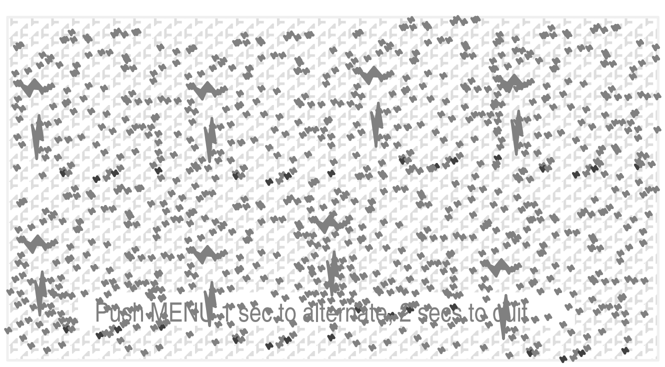


Figure 6–58: LCD Pattern with Contrast Too Light

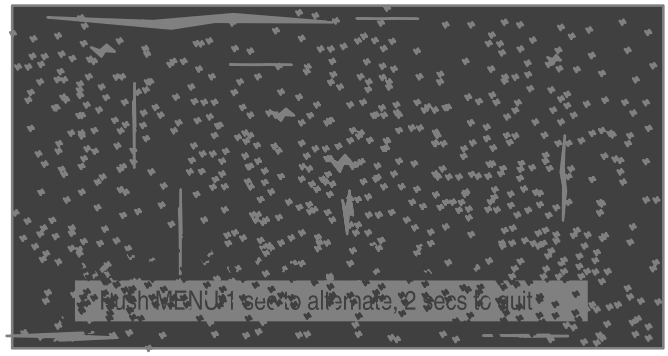


Figure 6–59: LCD Pattern with Contrast Too Dark

10. Turn R1018 clockwise until the entire pattern is clear and sharp.

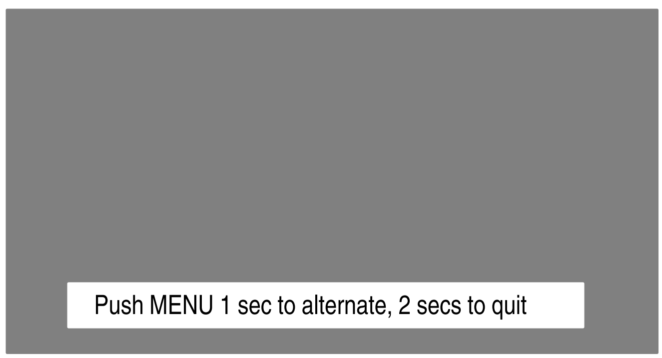


Figure 6–60: LCD Pattern Adjusted for Sharpness

11. Press MENU once quickly. The ON pixels will be toggled off and the OFF pixels will be toggled on. Watch to see if all the pixels are being activated.

12. Once contrast has been set using the LCD pattern, verify it with a normal waveform display.

a. Ensure that the instrument has been at 75° F ± 5° F (25° C ± 3° C) for at least one hour (operating or non-operating).

b. Turn the instrument on and allow it to warm up for at least five minutes. If the instrument was already on (e.g., you are performing this adjustment immediately after steps 1 – 11), then cycle the power off, then back on again to return it to default settings.

c. While a waveform is on the display, adjust R1018 on the Front Panel Board counterclockwise until most of the display has dimmed.

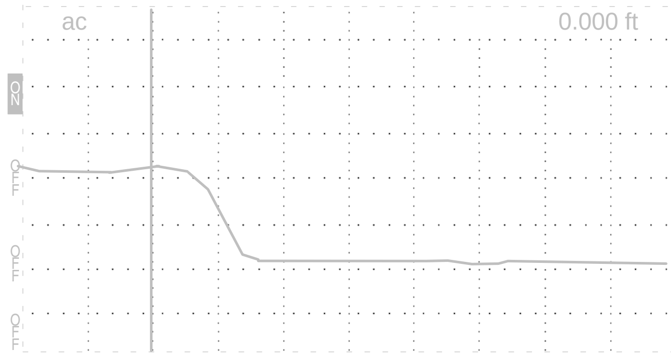


Figure 6–61: Waveform with Contrast Too Light

d. Start rotating R1018 slowly clockwise until all of the pixels are just visible on the display. If you go too far, restart the adjustments at step c.

e. Rotate R1018 one quarter turn clockwise past the point of step d.

***NOTE**. It is important to always determine the proper contrast setting by coming from a faded display. It takes a higher threshold voltage to turn a pixel on than it does to turn one off. If it is done from the other direction, the display will be too bright.*

---

f. Inspect the display for any bleeding (areas that are too dark) or any fading (areas that are too light).

g. Turn the instrument off.

h. After waiting a few seconds, turn the instrument back on.

i. Reinspect the display for bleeding or fading.

j. Readjust R1018 if necessary.

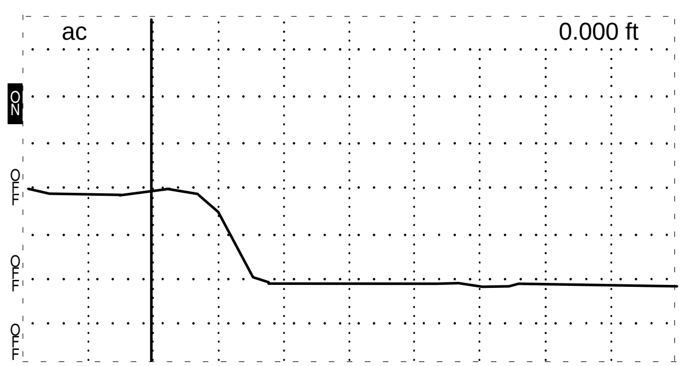


Figure 6–62: Waveform with Contrast Adjusted Correctly

If the Contrast Adjust is set properly, you will be able to see the cursor clearly when it is moved rapidly across the display. If any residual images are made by the cursor movement, they should fade out quickly.

***NOTE**. If you are unable to adjust the contrast, or if pixels are not functioning, see the* Troubleshooting *section in the* Maintenance *chapter of this manual.*

Zero Offset Adjust

The following adjustment is located on the Driver/Sampler Board.

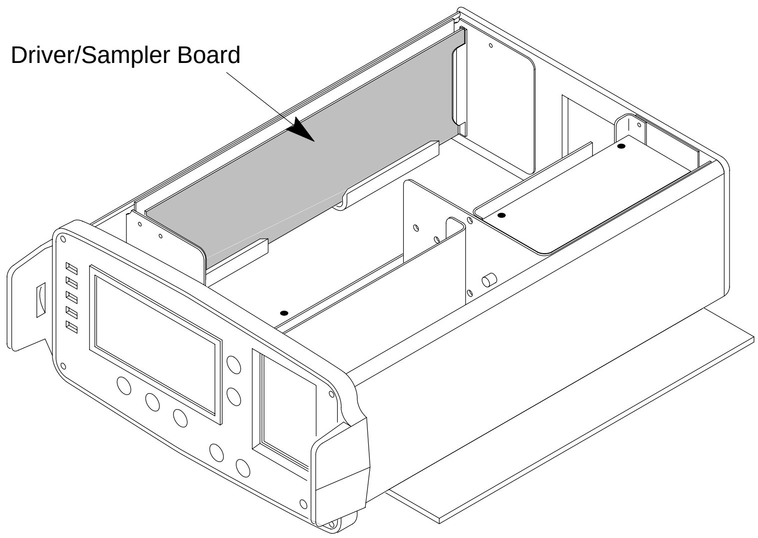


Figure 6–63: Driver/Sampler Board Location

1. Turn off the POWER to the instrument.

2. Remove the EMI shield covering the Driver/Sampler Board (see *Maintenance* chapter).

3. Turn the POWER on.

4. Adjust the ◁▷ POSITION control until the distance window reads –2.000 ft.

5. Adjust the △▽POSITION control to center the baseline on the center horizontal graticule line (see Figure 6–64, next page).

6. Set the front-panel controls:

CABLE	no connection
NOISE FILTER	1 avg
VERT SCALE	10 mρ
DIST/DIV	0.2 ft/div
V_P	.99

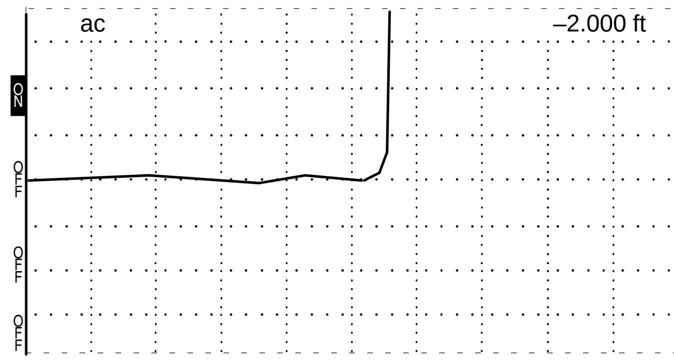


Figure 6–64: Incident Pulse at –2.000 ft

7. If necessary, readjust the ⇕POSITION control to center the baseline on the center horizontal graticule line.
8. Attach the 3-foot precision cable to the front-panel CABLE connector. This will probably cause the waveform to move slightly on the display.
9. Adjust R1042 (Zero Offset) to move the waveform to the same position as when no connector was attached to the front panel.

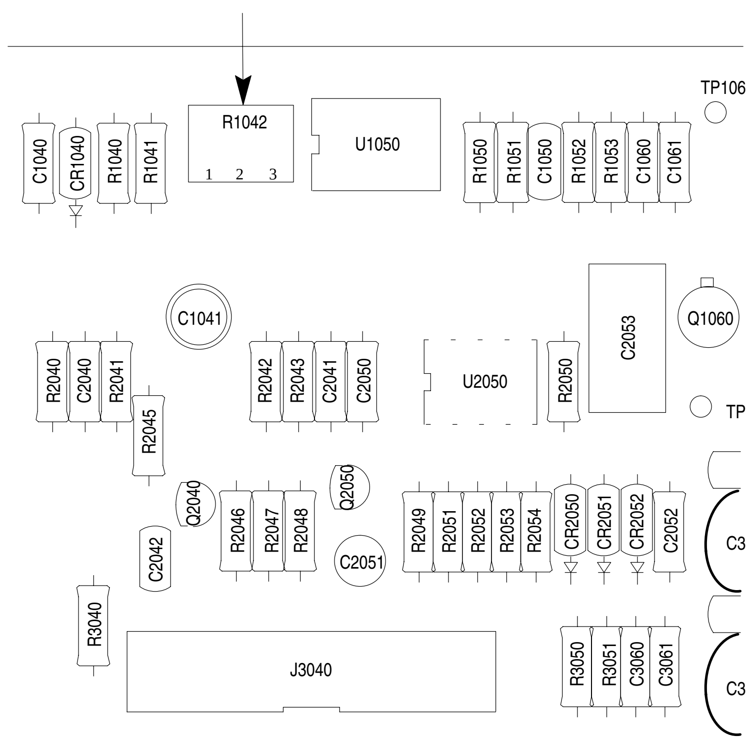


Figure 6–65: R1042 on Driver/Sampler Board

10. Remove the 3-foot precision cable.
11. Verify that the waveform moves less than 0.5 division.

NOTE. *Some changes in shape of the baseline before the leading edge is normal. If this measurement is difficult to make, access the* Service Diagnostic Menu *and change the timebase mode from* Timebase is:Normal – Auto Correction *to* Timebase is: Diagnostic – No Correction. *This will give more stability to the pulse when the cable is connected.*

12. Turn the instrument off.

13. Replace the Driver/Sampler EMI shield. Be sure the ribbon cable is placed in the center slot of the shield so it won't be crushed by the shield.

After Adjustments are Completed

1. If the instrument is Option 05 (metric), refer to the *Maintenance* chapter to return the metric default jumper to its proper position.

2. Reinstall the 1502C in its case (refer to the *Maintenance* chapter of this manual). Care should be taken to follow the directions to maintain watertight integrity of the case.

3. Turn back to the *Calibration* section of this chapter and perform all those *Performance Checks* that did not require case-off adjustments.

Maintenance

Introduction

This chapter contains information on preventive and corrective maintenance, troubleshooting, panel control assembly procedures, and shipping instructions. Please refer to schematics for physical location of circuits and components.

***NOTE**. We recommend that service be performed at an authorized Tektronix Service Center or by a technician skilled in sampling and pulse techniques.*

Equipment Required

This is a list of common tools needed to accomplish all the maintenance procedures that follow:

5/16” hex nut driver	Phillips-head screwdriver
11/32” hex nut driver	Straight-blade screwdriver
1/16” hex wrench	Torque driver
5/16” open-end wrench	Soldering and desoldering tools
7/16” open-end wrench	Cotton swabs, non-woven wipes
1/2” open-end wrench	Isopropyl alcohol, LocTite ®, etc.

Preventive Maintenance

Preventive maintenance includes cleaning, visual inspection, and lubrication. A convenient time to perform preventive maintenance is during the periodic performance check/calibration procedure. If the instrument has been subjected to extreme environments or harsh handling, more frequent maintenance might be necessary.

Cleaning

***CAUTION.** Do not use chemical agents that contain benzene, toluene, xylene, acetone, etc., because of possible damage to plastics in the instrument.*

The exterior case and front panel should be washed gently with mild soap and water.

The faceplate in front of the LCD should be cleaned gently with Kendall Webril non-woven wipes (Tek P/N 006–0164–00), or equivalent, moistened with isopropyl alcohol.

The interior of the 1503C is protected from dirt and dust as long as the option port and case are intact. However, if interior cleaning is necessary, blow off accumulated dust with low-pressure air and remove the remaining dirt with a soft brush, cotton swab, or pipe cleaner moistened with isopropyl alcohol.

Lubrication

All the switches and potentiometers on the 1503C are sealed from external contaminants and, therefore, require little maintenance and no lubrication. Occasionally, blowing out accumulated dust is all that is needed.

Visual Inspection

Obvious defects, such as broken connections, damaged boards, frayed cables, improperly seated components, and heat-damaged components should be corrected first before attempting further troubleshooting. Heat damage usually indicates a deeper problem somewhere in the circuitry and should be traced and corrected immediately.

We do not recommend electrical checks of individual components because defective components will become evident during instrument operation.

Recalibration

After maintenance has been performed, the instrument should be checked as per the procedures in the *Calibration* chapter of this manual.

Part Removal and Replacement

AC Fuse

The fuse is accessible through the rear panel of the case.

1. Unscrew the fuse cover and remove.

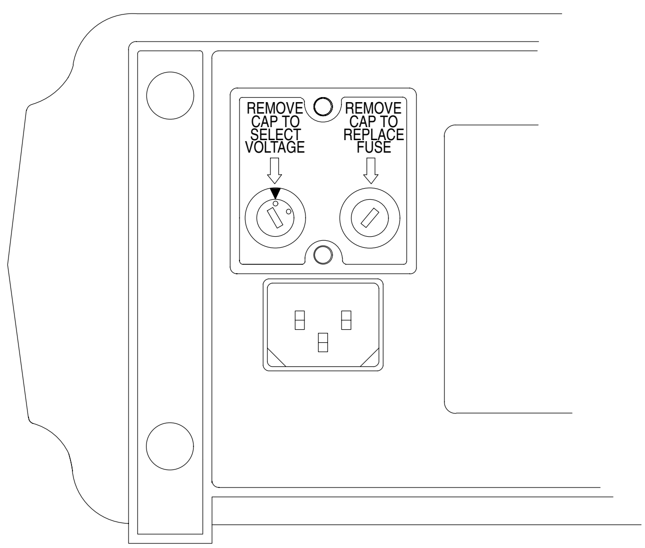


Figure 7–1: Location of Voltage Selector and Fuse Holder on Rear Panel

2. Use a straight-blade screwdriver to remove the fuse holder.
3. Check the voltage selector for proper voltage setting. If the instrument voltage selector is set for 115 VAC, replace the fuse with a 0.3 A fuse (Tek P/N 159–0029–00). If the voltage selector is set for 230 VAC, replace the fuse with a 0.15 A fuse (Tek P/N 159–0054–00).
4. Replace the fuse holder.
5. Replace the access cover.

Removal of Case and EMI Shields

1. Remove the instrument front cover.
2. If installed, remove the chart recorder, or other device, from the option port.
3. Loosen the four screws on the back of the case and set the instrument face-up on a flat surface.
4. Swing the handle out of the way of the front panel.
5. Break the chassis seal by pushing downward with both hands on the handle pivots on each side of the case..
6. Grasp the case with one hand and tilt the chassis out with the other. Lift by grasping the outside perimeter of the front panel.
7. Remove the screw in the middle of the bottom EMI shield. Remove the top and bottom shields from the chassis by carefully running a straight-blade screwdriver between the shield and the groove in the chassis rail.

CAUTION. *Do not lift the instrument by the front-panel controls. The controls will be damaged if you do so.*

Removing the Power Supply Module

1. From the Power Supply Board, remove the 14-conductor ribbon cable. This is a keyed connector, so polarity is guaranteed upon reinstallation (Figure 7–2, 5).
2. Remove the screw and washer located below the power switch on the instrument side panel (Figure 7–2, 7)
3. Remove the screw and washer holding the power supply module to the bottom chassis (Figure 7–2, 4).
4. Remove two screws holding the power supply module to the rear chassis panel. One is located near the AC power receptacle and the other is directly above the fuse holder (Figure 7–2, 6).

5. Remove the power supply module from the instrument by moving it toward the front of the instrument, guiding the power switch away from the mechanical linkage assembly.

***NOTE**. The screws identified as 1 hold the circuit board to the module. They should not be removed until you are ready to remove this circuit board from the module (next procedure).*

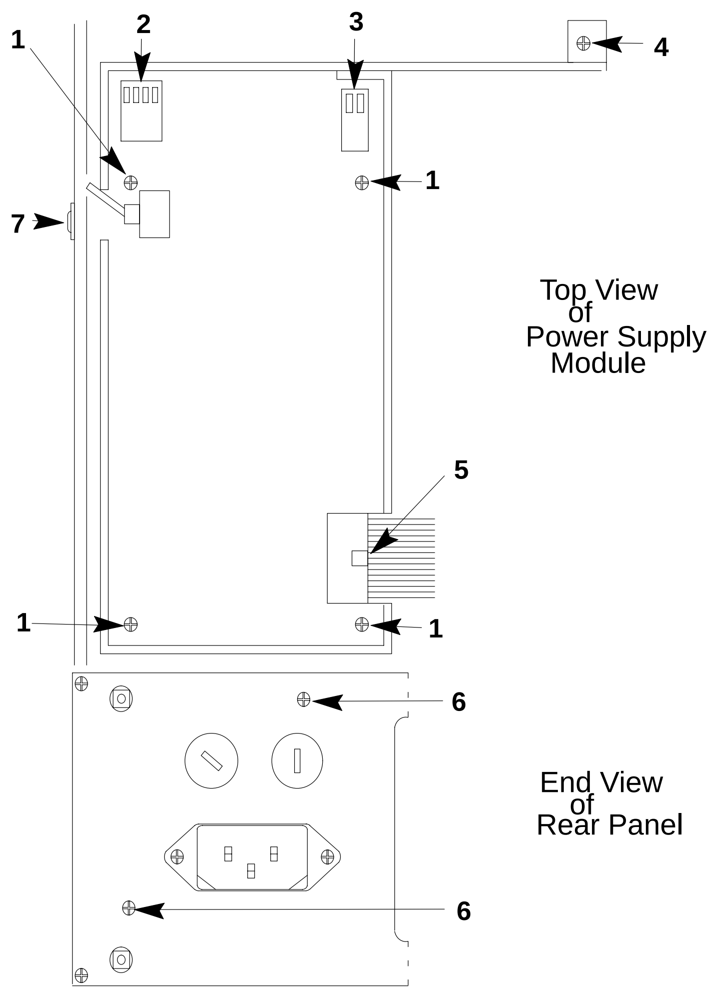


Figure 7–2: Power Supply Module and P/O Rear Panel

Removing the Power Supply Board

1. Remove the power supply module per previous procedure.

2. Remove the two-conductor harmonica connector (Figure 7–2, 3).

3. Remove the four-conductor harmonica connector (Figure 7–2, 2).

4. Remove four screws holding the circuit board to the module (Figure 7–2, 1).

5. Remove the Power Supply Board by carefully lifting up. Be sure the large capacitor on the bottom of the board clears the two nut blocks on the module side panels. If the board or the capacitor binds on either the nut blocks or the chassis side panel screw, remove the nut blocks.

Removing the Power Transformer

1. Remove the power supply module and circuit board per previous procedures.

2. Remove the three screws holding the side panel on the power supply module

3. Remove the side panel. This will provide access to the transformer.

4. Unsolder the six wires attached to the power transformer.

5. Unsolder the varistor (R101) from lugs 4 and 5.

6. Remove the two screws and lock-washers holding the power transformer to the chassis.

7. Lift out the transformer.

NOTE*. When reassembling, add a small amount of LocTite® to the two transformer mounting screws in step 6.*

Removing the Power Cord Receptacle

1. Remove the power supply module, circuit board, and transformer per previous procedures.

2. Unsolder the three wires on the filter unit.

3. Remove the two screws and the spacer holding the receptacle.

4. Remove the filter unit from the rear of the module.

Removing the Fuse Holder and Voltage Selector

1. Remove the power supply module, circuit board, and transformer per previous procedures.

2. Unsolder all four wires from the voltage selector switch.

3. Unsolder the two wires from the fuse holder.

4. Unscrew the hold-down nuts from both units.

5. Remove both units from the rear of the module.

Power Cord Conductor Color Code

Conductor	Color	Alternate Color
Ungrounded (line)	Brown	Black
Grounded (neutral)	Blue	White
Grounded (earth)	Green/Yellow	Green

Removing the Battery

1. Unplug the battery cable at the battery and at the plug on the Power Supply board.
2. Remove the two (2) screws securing the battery clamp to the chassis.
3. Remove the battery clamp, making sure not to short the terminals with the clamp.
4. Carefully lift the battery from the chassis.

Removing the Main Board

1. From the top side of the instrument, remove the multi-colored cable (power supply) from the Main Board.
2. Turn the instrument upside down to expose the top of the Main Board.
3. Remove the three multi-colored cables from the component side of the Main Board. This can be accomplished by inserting a small straight-blade screwdriver in the key and gently prying the connector from the board. Take care to guide the connectors straight off to avoid bending the pins.
4. Remove the eight screws and the center spacer post (with washer and locknut) that fasten the Main Board to the chassis.
5. Remove the Main Board, taking care to avoid binding on the power switch mechanical linkage.

NOTE. *One of the corner screws (see Figure 7–3) holds a ground strap connector.*

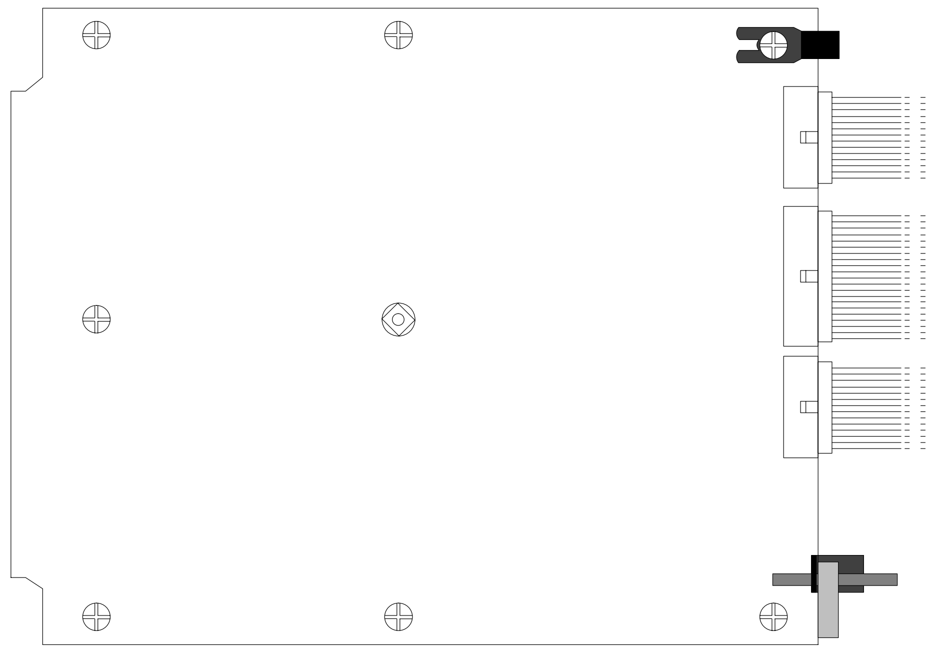


Figure 7–3: Main Board

EPROM Replacement

1. Use an IC puller that is designed to extract multi-pin microcircuits to remove the EPROM from its socket.

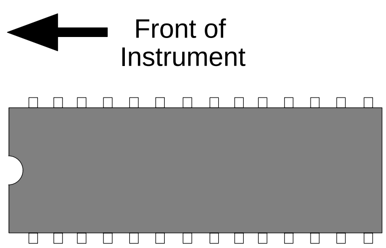


Figure 7–4: EPROM on Main Board

2. When installing a new EPROM, make sure the notch in the IC is facing toward the front of the instrument and all pins are inserted correctly in the socket.

Lithium Battery Replacement

Typically, the lithium battery for the non-volatile memory will last over seven years. If it requires replacement, use the following procedure.

CAUTION. *To avoid personal injury, observe proper procedures for handling and disposal of lithium batteries. Improper handling might cause fire, explosion, or severe burns. Do not recharge, crush, disassemble, heat the battery above 212° F (100° C), incinerate, or expose the contents of the battery to water. Dispose of the battery in accordance with local, state, and federal regulations. Typically, small quantities (less than 20 batteries) can be safely disposed of with ordinary garbage or in a sanitary landfill, but check local regulations before doing this.*

---

1. Remove the Main Board as described in a previous procedure.

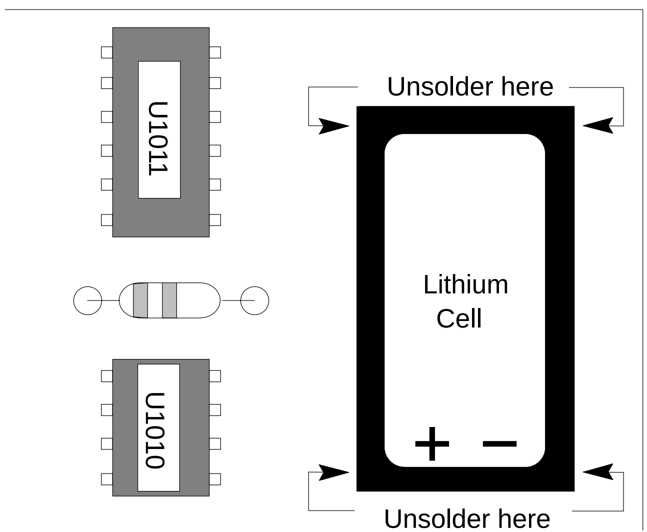


Figure 7–5: Lithium Battery on Main Board

2. Unsolder the four leads of the lithium battery, being careful not to overheat the cell.

3. Remove the cell from the Main Board.

4. Install a new battery and solder the leads to the Main Board.

CAUTION. *Be sure that the new battery is one that is supplied or authorized by Tektronix. An improper replacement cell could cause irreversible damage to the Main Board circuitry.*

Removing the Driver/Sampler Board

1. Remove the two screws and washers holding the cover to the chassis.
2. Remove the cover by sliding it toward the center of the instrument. When re-assembling, make sure the cable is placed under the slot provided.
3. Disconnect the multi-conductor cable from the circuit board.
4. Remove the coaxial cable from the circuit board.
5. Remove the circuit board from the instrument by sliding it out of the card guides.

Removing the Front Panel Assembly

1. Using a hex wrench, disassemble the power switch linkage. This disconnects the front-panel switch shaft from the linkage block.
2. Remove the three multi-conductor cables from the Main Board.
3. Remove the Driver/Sampler Board EMI shield.
4. Remove the coaxial cable from the Driver/Sampler Board.
5. Remove the four corner screws on the instrument front panel.
6. Carefully guide the coaxial cable through the Driver/Sampler card cage.
7. Remove the Front Panel Assembly from the instrument chassis.

Removing the Display Module/Front Panel Board

1. Using the previous procedure, remove the Front Panel Assembly from the instrument.
2. Remove all knobs.
3. Remove the hex nuts and washers from the front-panel controls.
4. Remove the buttons by pressing gently on the rubber boot behind each button.

CAUTION. *Take care not to use a sharp object to remove the buttons because it might puncture the rubber boot, thereby subjecting the instrument to moisture/water intrusion.*

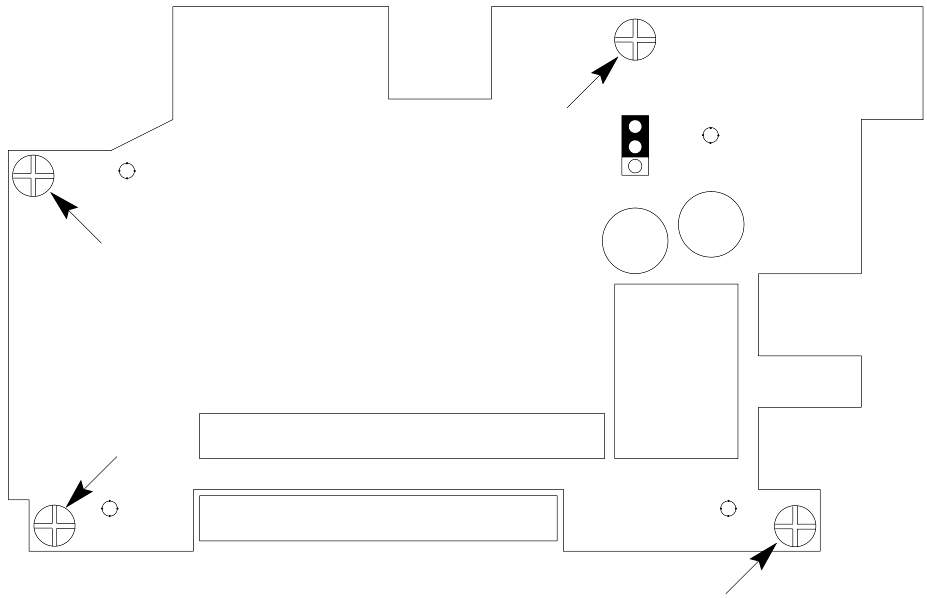


Figure 7–6: Display Module/Front Panel Board Screw Locations

***NOTE**. When re-assembling, push the rubber boot down on the switch shaft so that the switch button can easily be replaced.*

5. Remove the four screws holding the Display Module/Front Panel Board to the front panel (see Figure 7–6).
6. Carefully lift the Display Module/Front Panel Board from the front panel.

Removing the Front Panel Board from the Display Module

1. Remove the four hex nuts (two are shown in Figure 7–7) that hold the Display Module to the Front Panel Board.
2. Disconnect the ribbon cable from the boards.
3. Carefully separate the Display Module from the Front Panel Board.

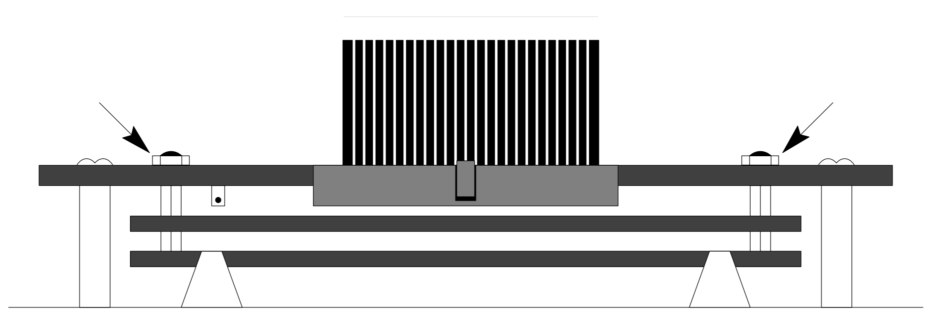


Figure 7–7: Display Module/Front Panel Board Showing Hex Nuts

CAUTION. *Do not further disassemble the Display Module. Elastomeric splices are used between the circuit boards and they require special alignment fixtures. Parts replacement requires special surface-mount technology.*

Changing the Default to Metric

The instrument will power up displaying DIST/DIV measurements as meters (m/div) or feet (ft/div). Although either measurement mode may be chosen from the *Setup Menu*, the default can easily be changed to cause the preferred mode to come up automatically at power up.

1. Remove the instrument from the case.
2. Remove the bottom EMI shield.

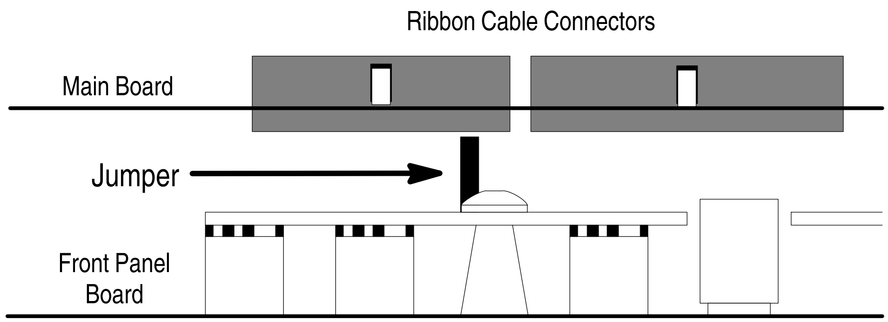


Figure 7–8: Location of Default Jumper on Front Panel Board

3. From the bottom side of the instrument, peer into the space between the Main Board and the Front Panel Board. The default jumper is located behind the screw that holds the Front Panel Assembly to the front-panel mounting stud.

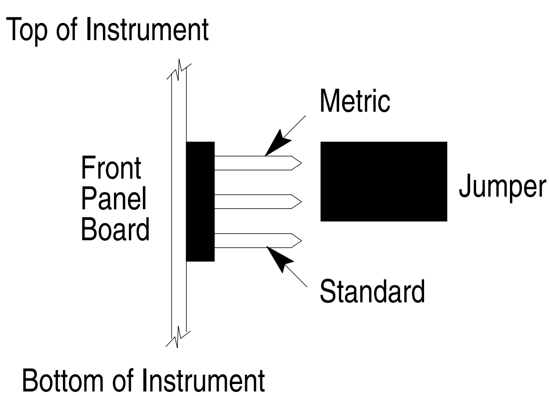


Figure 7–9: Default Jumper Positions

4. Using a needle-nose plier, slip the jumper off the pins and move it to the desired default position (top for meters, bottom for feet).

Removing the Option Port Assembly

1. Remove the Power Supply Module as shown in a previous procedure.
2. Remove the Front Panel Assembly as previously described.
3. Remove the ribbon cable on the Main Board that connects the Main Board to the Option Port Assembly.
4. Remove the screw and washer from the instrument side panel.
5. Remove the nut from the bottom of the instrument.
6. The Option Port Assembly may be disassembled further by removing the four screws from the back of the assembly. This will allow easy access for replacement of the Option Port connector.

Troubleshooting

Troubleshooting Flow Chart

When encountering difficulties with the instrument, first use the troubleshooting chart in the *Operation* chapter. This might eliminate any minor problems such as fuse or power problems.

The following troubleshooting flow charts (next three pages) are designed to give you an idea where to start. The *Circuit Descriptions* and *Schematics* chapters will give further assistance toward solving the problem.

The Main Board waveforms represented on the flow chart are representative of an instrument in operation per the setup at the top of the flow chart. Additional Main Board waveforms are also included in this section.

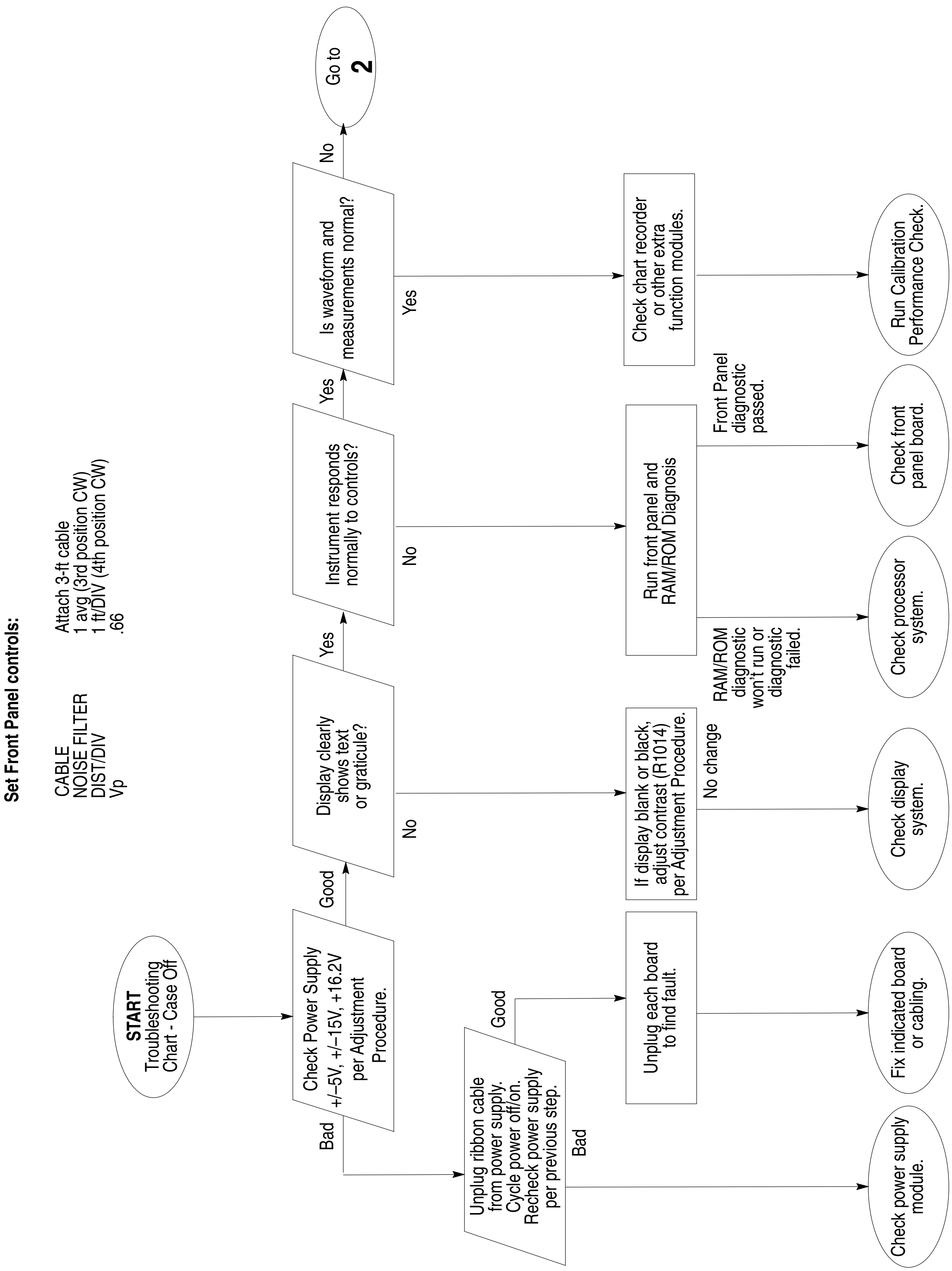
Test Point Waveforms

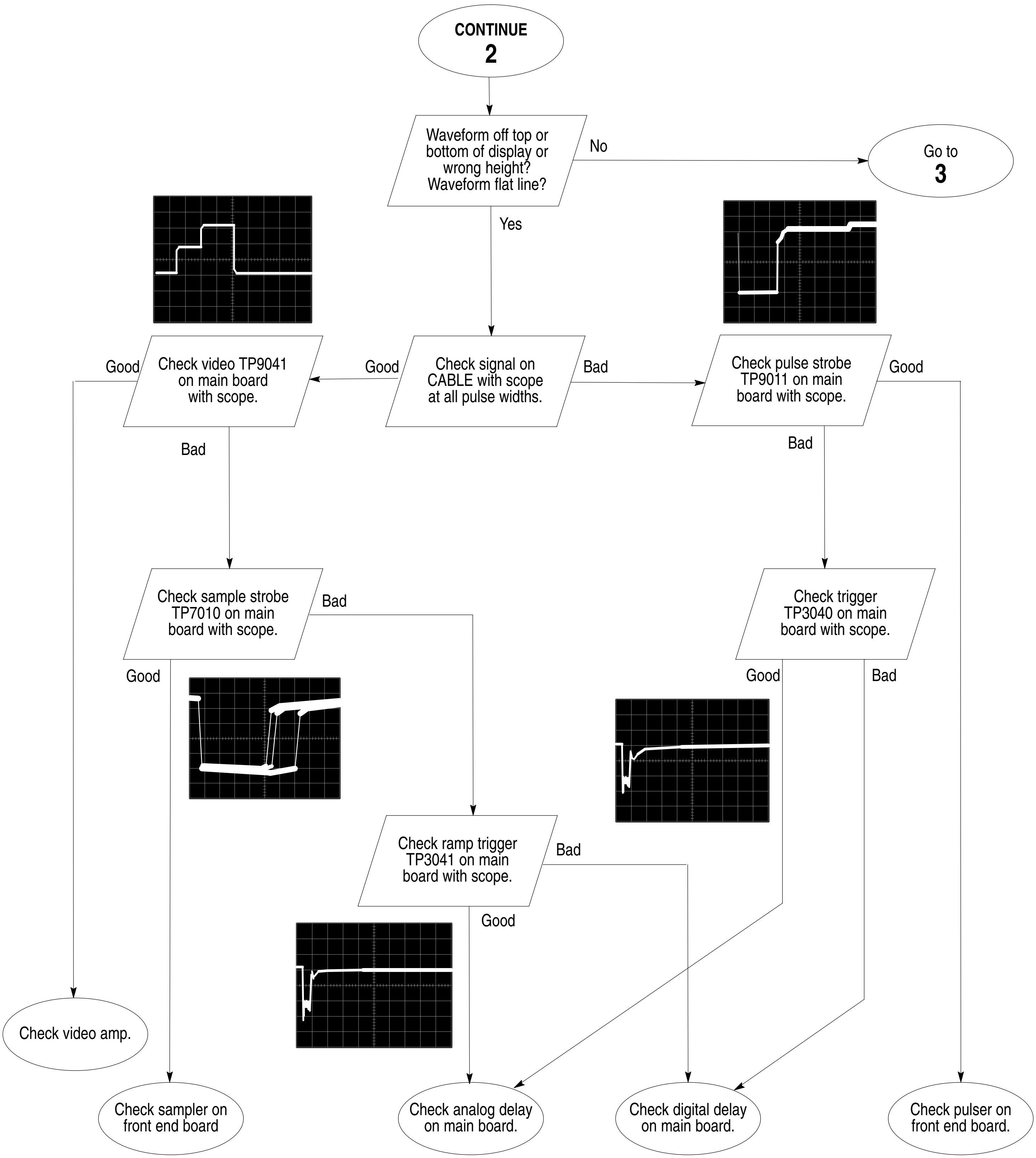
The following Main Board waveforms are similar to the waveforms found on the troubleshooting flow chart. In some cases, however, the oscilloscope was set to show timing rather than the detail of the waveform. For example, TP7010 on the flow chart shows the detail of the pulse, but the same test point in the following figures shows the repetition rate.

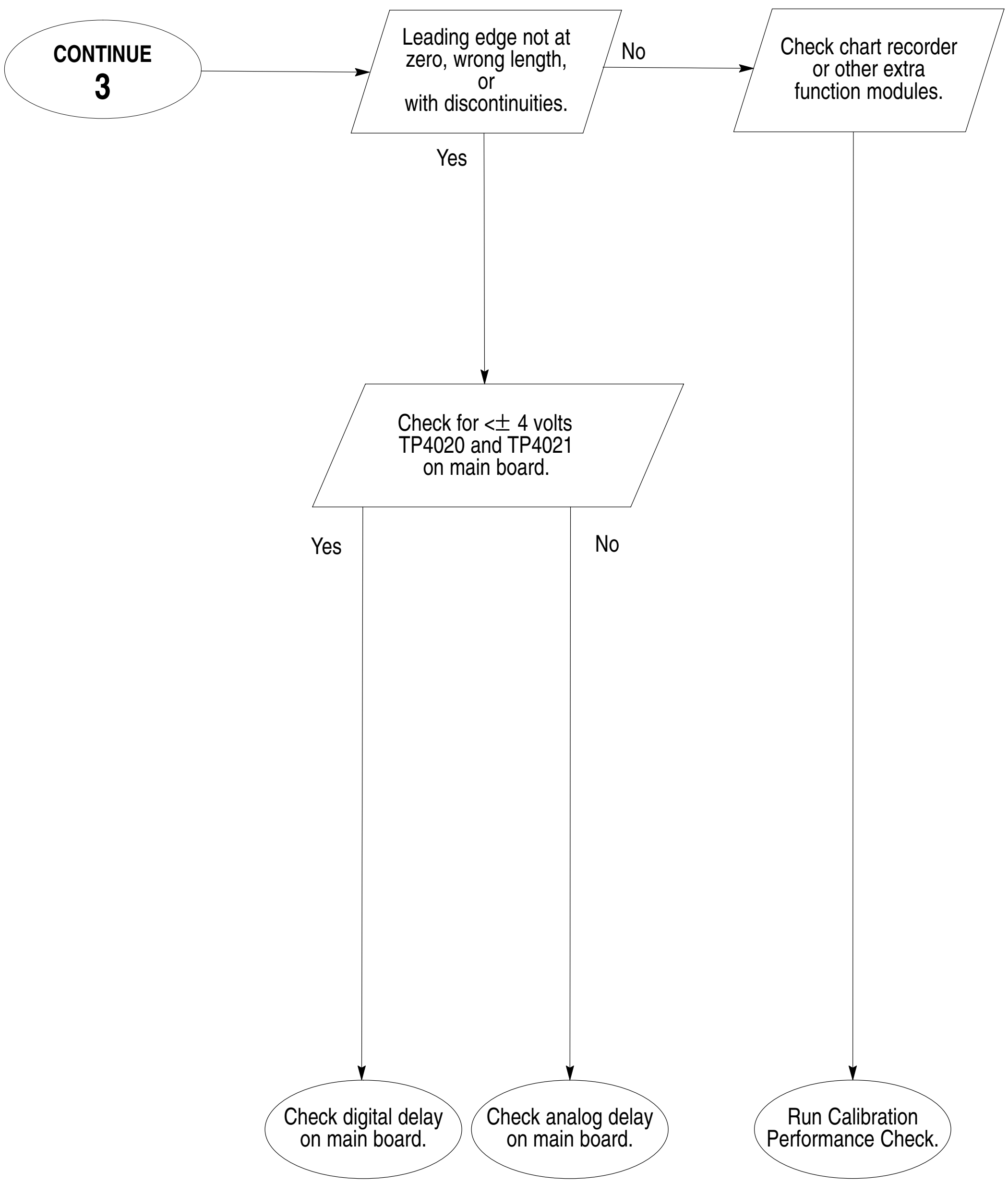
Set the 1503C front-panel controls:

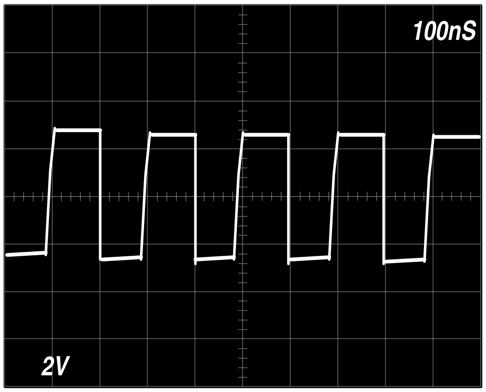
CABLE	Attach 10-ft cable
NOISE FILTER	1 avg (3rd position CW)
VERT SCALE	default
DIST/DIV	1 ft/div (4th position CW)
Vp	.84
Vertical Position	default
Horizontal Position	default

(waveform figures located on page 7–16)


Set Front Panel controls:
CABLE
NOISE FILTER
DIST/DIV
Vp
Attach 3-ft cable
1 avg (3rd position CW)
1 ft/DIV (4th position CW)
.66
START
Troubleshooting
Chart - Case Off
Check Power Supply
+/–5V, +/–15V, +16.2V
per Adjustment
Procedure.
Good
Bad
Unplug ribbon cable
from power supply.
Cycle power off/on.
Recheck power supply
per previous step.
Good
Bad
Unplug each board
to find fault.
Fix indicated board
or cabling.
Check power supply
module.
Display clearly
shows text
or graticule?
Yes
No
If display blank or black,
adjust contrast (R1014)
per Adjustment Procedure.
No change
Check display
system.
Instrument responds
normally to controls?
Yes
No
Run front panel and
RAM/ROM Diagnosis
RAM/ROM
diagnostic
won't run or
diagnostic
failed.
Check processor
system.
Front Panel
diagnostic
passed.
Check front
panel board.
Is waveform and
measurements normal?
No
Go to
2
Yes
Check chart recorder
or other extra
function modules.
Run Calibration
Performance Check.


CONTINUE
2
Waveform off top or bottom of display or wrong height? Waveform flat line?
No
Go to
3
Yes
Check signal on CABLE with scope at all pulse widths.
Good
Bad
Check video TP9041 on main board with scope.
Good
Bad
Check pulse strobe TP9011 on main board with scope.
Good
Bad
Check sample strobe TP7010 on main board with scope.
Bad
Good
Check trigger TP3040 on main board with scope.
Good
Bad
Check ramp trigger TP3041 on main board with scope.
Bad
Good
Check video amp.
Check sampler on front end board
Check analog delay on main board.
Check digital delay on main board.
Check pulser on front end board.


CONTINUE
3
Leading edge not at zero, wrong length, or with discontinuities.
No
Check chart recorder or other extra function modules.
Yes
Check for <± 4 volts TP4020 and TP4021 on main board.
Yes
No
Check digital delay on main board.
Check analog delay on main board.
Run Calibration Performance Check.



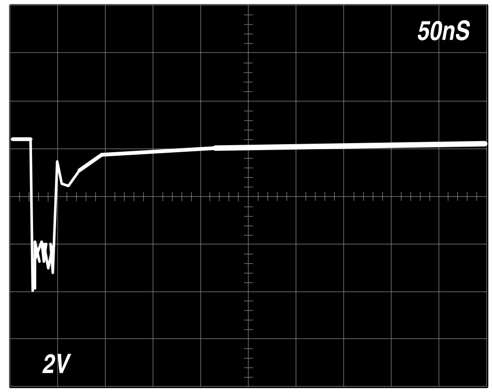
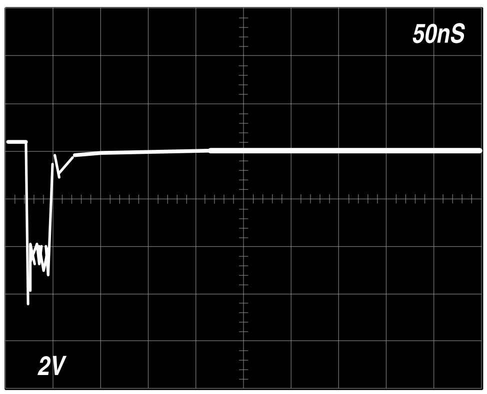


Figure 7–10: Main Board TP1041 **Main Board TP3040**



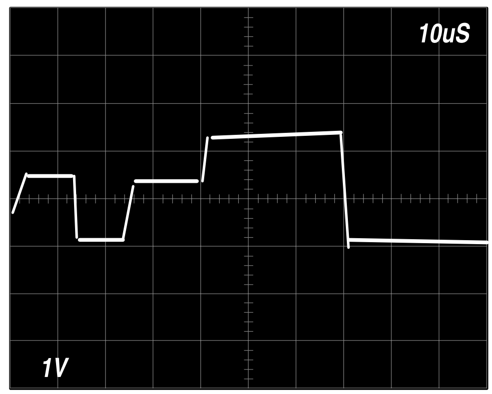
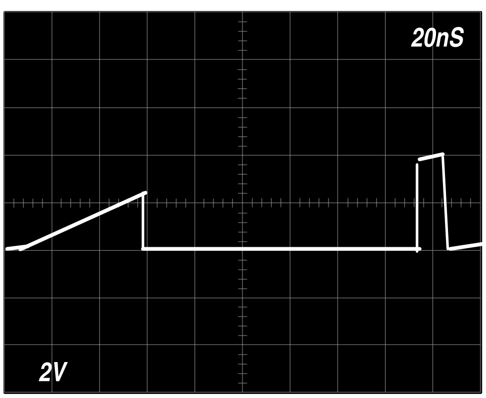


Figure 7–11: Main Board TP3041 **Main Board TP4040**

(waveforms continued next page)



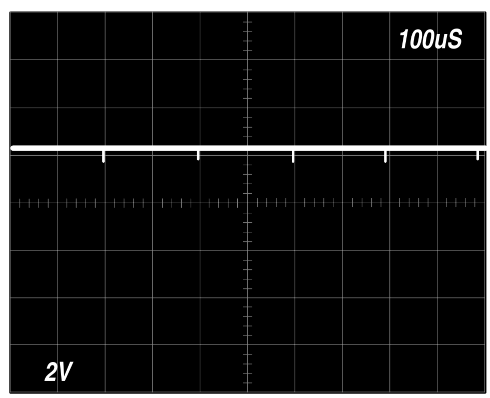


Figure 7–12: Main Board TP6010 **Main Board TP7010**

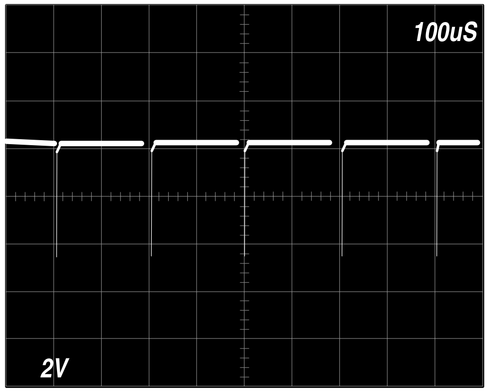
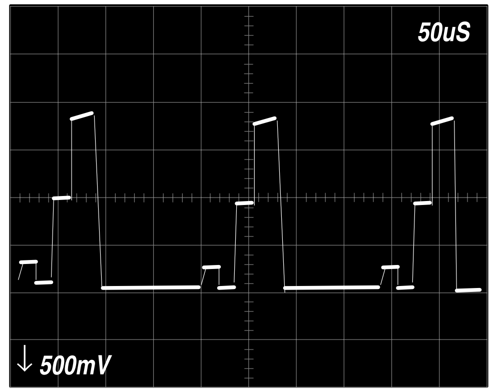


Figure 7–13: Main Board TP9011



Main Board TP9041

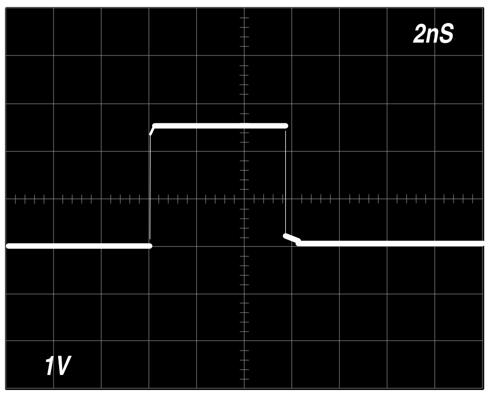


Figure 7–14: Front Panel CABLE Connector

When All Else Fails

If it becomes necessary to ship the instrument to an authorized Tektronix Service Center, follow the packing instructions as described in *Repacking for Shipment* on page xiv.

Control Panel Installation

Watertight Seals

To prevent moisture and dirt from getting into the 1503C, special seals are used around the LCD faceplate, options port, front panel, and front-panel button boot. Removing the front-panel button boot or other rubber seals will require special resealing procedures to retain the instrument weathertightness.

A list of sealants is provided on the next page to aid in reinstallation. However, we recommend that resealing be done only by an authorized Tektronix Service Center.

The front panel/cover seal should be inspected regularly and replaced every six to eight months, depending on the operating environment and use.

All other seals should be inspected during normal adjustment/calibration periods, paying special attention to the front panel/case seal and option port seal.

CAUTION. *If the case, option port, or a front panel control is removed, the weathertight integrity of the instrument will be compromised.*

Sealing Materials

Tek Part No.	Sealant	Comments
006–2302–00	Dow Corning 3145 Adhesive Sealant	Use to secure rubber boot around buttons, implosion shield to front panel
252–0199–00	Dow Corning 3140 Coating	Use to secure case gaskets to chassis (more fluid sealant than 3145 with 24-hour cure time)
006–2207–00	GE G–661 Silicon Grease	Light coating on case gaskets to prevent sticking and provide a good seal
006–0034–00	Isopropyl alcohol	Cleaning agent

If a rubber boot or gasket is replaced:

1. Remove the old gasket.
2. Remove all dried adhesive.
3. Clean area with alcohol and let dry.
4. Run a small bead of 3140 Coating/Adhesive in the cutout where the new gasket will go.
5. Smooth the adhesive into an even, thin layer.
6. Clean the new gasket with alcohol and let dry.
7. Place the gasket on the adhesive and smooth into place. Make sure the edges are secure and there are no air bubbles under the gasket.
8. Let dry for 24 hours before using or reassembling the front panel.
9. Use silicon grease on the outer side of the front panel gasket and the battery gasket where they contact the instrument case.

The instrument rotary controls, the fuse and line voltage select access covers are sealed with rubber O-rings. These are not glued in place, but should be inspected and replaced if necessary.

Installing the Case Cover Over the Chassis

1. Place the instrument chassis face down on a solid, non-slip surface so that the rear panel is facing upward.
2. Reach inside the case and use your fingers to push the four captive mounting screws out so that their heads stick up and out of the rear feet.
3. Align the case with the chassis.
4. Gently lower the case over the chassis until the front of the case makes contact with the groove that surrounds the front panel casting.

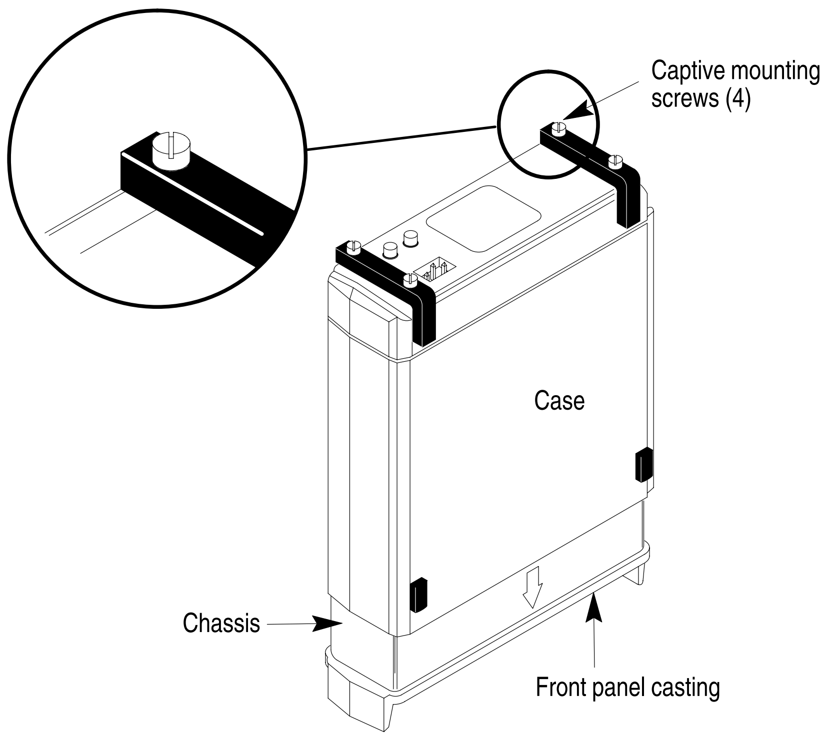


Figure 7–15: Installing the Case Cover Over the Chassis

5. Using a flat-blade screwdriver, secure the four mounting screws (seven inch-pounds of torque). Each screw should be started by turning it counterclockwise once, then clockwise. Alternately tighten each screw, gradually, a few turns at a time.
6. Check the gap between the case and the front panel casting to make sure that the case and front panel are mated evenly all around. If not mated properly, loosen the screws, reposition the case, then tighten the screws again.

Replaceable Electrical Parts

Parts Ordering Information

Replacement parts are available from your Tektronix field office or representative. When ordering parts, include the part number plus instrument type, serial number, and modification number (if applicable).

If a part is replaced with a new or improved part, your Tektronix representative will contact you regarding any change in part number.

List of Assemblies

A list of assemblies is found at the beginning of the replaceable electrical parts list. Assemblies are listed in numerical order. When the complete component number of a part is known, this list identifies the assembly in which the part is located.

Mfr. Code Number-to-Manufacturer Cross Index

The manufacturer code number-to-manufacturer cross index provides codes, names, and addresses of manufacturers of components listed in the replaceable electrical parts list.

Abbreviations

Abbreviations conform to ANSI standard Y1.1.

Component Number

(Column 1 of electrical parts list)

A numbering method is used to identify assemblies, subassemblies, and parts. An example of this numbering method and typical expansions is as follows:

A23A2R1234 =	A23	A2	R1234
	↓	↓	↓
	Assembly Number	Subassembly Number	Circuit Number

Read: resistor 1234 of subassembly 2 of assy 23.

Only circuit numbers appear on the schematics and circuit board illustrations. Each schematic and illustration is marked with its assembly number. Assembly numbers are also marked on the mechanical exploded view located in the replaceable mechanical parts list. A component number is obtained by adding the assembly number prefix to the circuit number.

This parts list is arranged by assemblies in numerical sequence (e.g., assembly A1 with its subassemblies and parts precedes A2 with its subassemblies and parts).

Chassis-mounted parts have no assembly number prefix and are illustrated at the end of the replaceable mechanical parts list.

Tektronix Part No.

(Column 2)

This column lists the part number used when ordering a replacement part from Tektronix.

Serial/Model No.

(Columns 3 and 4)

Column 3 lists the serial number of the first instrument or the suffix number of the circuit board in which the part was used.

Column 4 lists the serial number of the last instrument or the suffix number of the circuit board in which the part was used. No entry indicates that the part is used in all instruments.

Name and Description

(Column 5)

In this parts list, the item name is separated from its description by a colon (:). Because of space limitations, the item name may appear to be incomplete. For further item name identification, refer to the U.S. Federal Cataloging Handbook, H6–1.

Mfg. Code

(Column 6)

This column lists the code number of the manufacturer of the part.

Mfg. Part Number

(Column 7)

This column lists the manufacturer's part number.

Manufacturers Cross Index

Mfr. Code	Manufacturer	Address	City, State, Zip Code
TK2460	VIKAY AMERICA INC	195 WEST MAIN ST SUITE 19	AVON CT 06001
TK2582	TUFF CAT USA LLC	814 N HAYDEN MEADOWS DRIVE	PORTLAND, OR 97217
TK6181	IMC PLASTICS INC	19400 SW TETON AVE	TUALATIN, OR 97062
01002	GENERAL ELECTRIC CO	381 UPPER BROADWAY	FORT EDWARDS NY 12828–1021
01121	ALLEN–BRADLEY CO	1201 S 2ND ST	MILWAUKEE WI 53204–2410
01295	TEXAS INSTRUMENTS INC	13500 N CENTRAL EXPY PO BOX 655303	DALLAS TX 75262–5303
01686	RCL ELECTRONICS/SHALLCROSS INC	195 MCGREGOR ST	MANCHESTER NH 03102–3731
02111	SPECTROL ELECTRONICS CORP	4051 GREYSTONE DRIVE	ONTARIO CA 91761
04222	AVX CERAMICS	19TH AVE SOUTH PO BOX 867	MYRTLE BEACH SC 29577
04426	ITW SWITCHES	6615 W IRVING PARK RD	CHICAGO IL 60634–2410
04713	MOTOROLA INC	5005 E MCDOWELL RD	PHOENIX AZ 85008–4229
049S6	FUJITSU COMPUTER PRODUCTS OF AMERICA INC	2904 ORCHARD PARKWAY	SAN JOSE, CA 95134–2009
060D9	UNITREK CORPORATION	3000 COLUMBIA HOUSE BLDG SUITE 120	VANCOUVER WA 98661
07716	IRC, INC	2850 MT PLEASANT AVE	BURLINGTON IA 52601
09353	C AND K COMPONENTS INC	15 RIVERDALE AVE	NEWTON MA 02158–1057
09922	FRAMATOME CONNECTORS USA INC	51 RICHARDS AVE PO BOX 5200	NORWALK CT 06856
0B0A9	DALLAS SEMICONDUCTOR CORP	4350 BELTWOOD PKWY SOUTH	DALLAS TX 75244
0GV52	SCHAFFNER EMC INC	9–B FADEM ROAD	SPRINGFIELD NJ 07081
0H1N5	UNITED CHEMI–CON INC	9801 W HIGGINS RD	ROSEMONT, IL 60018–4771
0JR03	ZMAN MAGNETICS INC	7633 S 180th	KENT WA 98032
0JR04	TOSHIBA AMERICA INC	9775 TOLEDO WAY	IRVINE CA 92718
0YZS5	HANTRONIX INCORPORATED	10080 BUBB ROAD	CUPERTINO, CA 95014–4132
10392	GENERAL STAPLE CO INC	59–12 37TH ST	WOODSIDE NY 11377–2523
12697	CLAROSTAT MFG CO INC	12055 ROJAS DRIVE SUITE K	EL PASE TX 79936
12954	MICROSEMI CORP – SCOTTSDALE	8700 E THOMAS RD PO BOX 1390	SCOTTSDALE AZ 85252
12969	MICROSEMI CORP – WATERTOWN	530 PLEASANT STREET	WATERTOWN MA 02172
13409	SENSITRON SEMICONDUCTOR	221 W INDUSTRY COURT	DEER PARK NY 11729–4605
14433	ITT SEMICONDUCTORS DIV	2540 N 1ST ST SUITE 203	SAN JOSE CA 95131–1016
14552	MICROSEMI CORP	2830 S FAIRVIEW ST	SANTA ANA CA 92704–5948
14936	GENERAL INSTRUMENT CORP	600 W JOHN ST	HICKSVILLE NY 11802–0709
16546	PHILIPS COMPONENTS	4561 COLORADO BLVD	LOS ANGELES CA 90039–1103
17856	TEMIC NORTH AMERICA SILICONIX	2201 LAURELWOOD RD	SANTA CLARA CA 95054–1516
18324	PHILIPS SEMICONDUCTORS	830 STEWARD RD	SUNNYVALE CA 94088
18796	MURATA ERIE NORTH AMERICAN INC	1900 W COLLEGE AVE	STATE COLLEGE PA 16801–2723
19701	PHILIPS COMPONENTS DISCRETE PRODUCT	AIRPORT RD PO BOX 760	MINERAL WELLS TX 76067–0760
21845	SOLITRON DEVICES INC	3301 ELECTRONICS WAY	WEST PALM BEACH FL 33407
21847	FEI MICROWAVE INC	825 STEWART DR	SUNNYVALE CA 94086–4514
22526	BERG ELECTRONICS	825 OLD TRAIL RD	ETTERS PA 17319

Manufacturers Cross Index (Cont.)

Mfr. Code	Manufacturer	Address	City, State, Zip Code
24165	SPRAGUE ELECTRIC CO	267 LOWELL ROAD	HUDSON NH 03051
24355	ANALOG DEVICES INC	1 TECHNOLOGY DR	NORWOOD MA 02062
26003	MARTEK POWER MDI	4115 SPENCER STREET	TORRANCE, CA 90503–2489
27014	NATIONAL SEMICONDUCTOR CORP	2900 SEMICONDUCTOR DR	SANTA CLARA CA 95051–0606
31433	KEMET ELECTRONICS CORP	PO BOX 5928	GREENVILLE SC 29606
32997	BOURNS INC TRIMPOT DIV	1200 COLUMBIA AVE	RIVERSIDE CA 92507–2114
34333	LINFINITY MICROELECTRONICS	11861 WESTERN AVE	GARDEN GROVE CA 92641
34371	HARRIS CORP	PO BOX 883	MELBOURNE FL 32902–0883
34649	INTEL CORP	3065 BOWERS AVE PO BOX 58130	SANTA CLARA CA 95051
4T165	NEC ELECTRONICS, INC.	2880 SCOTT BLVD PO BOX 58062	SANTA CLARA, CA 95052–8062
50434	HEWLETT–PACKARD CO	370 W TRIMBLE RD	SAN JOSE CA 95131–1008
53387	3M COMPANY	3M AUSTIN CENTER	AUSTIN TX 78769–2963
54937	DEYOUNG MANUFACTURING INC	12920 NE 125TH WAY	KIRKLAND WA 98034–7716
55680	NICHICON /AMERICA/ CORP	927 E STATE PKY	SCHAUMBURG IL 60195–4526
56637	RCD COMPONENTS INC	520 E INDUSTRIAL PARK DR	MANCHESTER NH 03103
56845	DALE ELECTRONICS INC	2300 RIVERSIDE BLVD PO BOX 74	NORFOLK NE 68701–2242
56866	QUALITY THERMISTOR INC	2096 SOUTH COLE RD SUITE 7	BOISE ID 83705
57668	ROHM CORP	15375 BARRANCA PARKWAY SUITE B207	IRVINE CA 92718
58050	TEKA PRODUCTS INC	45 SALEM ST	PROVIDENCE RI 02907
61935	SCHURTER INC	1016 CLEGG COURT	PETALUMA CA 94952–1152
62643	UNITED CHEMICON INC	9801 W HIGGINS RD	ROSEMONT IL 60018–4771
63312	ENDICOTT RESEARCH GROUP INC	2601 WAYNE ST PO BOX 269	ENDICOTT NY 13760–3272
64537	KDI/TRIANGLE ELECTRONICS	60 S JEFFERSON RD	WHIPPANY NJ 07981
71400	BUSSMAN	114 OLD STATE RD PO BOX 14460	ST LOUIS MO 63178
71590	CGE SWITCHES – USA	PO BOX 1587	FORT DODGE IA 50501
75042	IRC ELECTRONIC COMPONENTS	401 N BROAD ST	PHILADELPHIA PA 19108–1001
75378	CTS KNIGHTS INC	400 REIMANN AVE	SANDWICH IL 60548–1846
75915	LITTLEFUSE TRACOR INC	800 E NORTHWEST HWY	DES PLAINES, IL 60016–3049
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001
81073	GRAYHILL INC	561 HILLGROVE AVE PO BOX 10373	LA GRANGE IL 60525–5914
81855	EAGLE–PICHER INDUSTRIES INC	COUPLES DEPT C – PORTER STS PO BOX 47	JOPLIN MO 64801
91637	DALE ELECTRONICS INC	2064 12TH AVE PO BOX 609	COLUMBUS NE 68601–3632

Replaceable Parts List

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
					CIRCUIT BOARD ASSEMBLIES		
A1	672–1392–00				CKT BD ASSY:MAIN W/EPROM & BATTERY	80009	672–1392–00
A1A1	670–9285–04	B020000	B021283		CKT BD ASSYLMAIN W/O EPROM	80009	670–9285–04
	670–9285–05	B021284			CKT BD ASSYLMAIN W/O EPROM	80009	670–9285–05
A2	672–1391–00				CKT BD ASSY:FRONT PANEL W/SWITCHES	80009	672–1391–00
A3	650-3715-01	B025588			POWER SUPPLY: MODULE	80009	650-3715-01
	650-3715-02	B025588			POWER SUPPLY: MODULE	80009	650-3715-02
A3A1	670–9286–04	B020000	B021283		CKT BD ASSY:POWER SUPPLY	80009	670–9286–04
	670–9286–05	B021284			CKT BD ASSY:POWER SUPPLY (SCHEMATIC SET INCLUDES CHASSIS MOUNTED PARTS)	80009	670–9286–05
A4	670–9291–03	B020000	B021283		CKT BD ASSY:S/R DRIVER SAMPLER	80009	670–9291–03
	670–9291–04	B021284			CKT BD ASSY:S/R DRIVER SAMPLER	80009	670–9291–04
A5	672–1241–00	B020000	B021404		CKT BD ASSY:DISPLAY MODULE	80009	672–1241–00
	118–9050–01	B021405			CKT BD ASSY:DISPLAY MODULE	80009	118–9050–01
					(REPLACEABLE AS A UNIT ONLY)		
	––––– –––––				CABLE/WIRE ASSEMBLIES		

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1	**672–1392–XX**				**CKT BD ASSY:MAIN BD W/EPROM & BATTERY**		
A1U2020	160–9010–00				IC,MEMORY:EPROM,PROG	80009	160–9010–00
A1BT1010	146–0049–00				BATTERY,STORAGE:3.5V,750MAH SFTY CONT	81855	LTC–7P
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN**		
A1A1C1010	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C1011	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C1020	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C1021	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C1022	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C1023	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C1024	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C1030	283–0190–00				CAP,FXD,CER DI:0.47UF,5%,50V SQ	04222	SR305C474JAA
A1A1C1031	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C1032	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C1040	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C1041	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C1042	290–1087–00				CAP,FXD,ELCTLT:100UF,25V,AXIAL	62643	KME35T101M8X16LL
A1A1C1043	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2010	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2011	290–0748–00				CAP,FXD,ELCTLT:10UF,+50–20%,25W VDC	55680	TVX1E100MAA1LS
A1A1C2012	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2013	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2014	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2015	283–0111–04				CAP,FXD,CER DI:0.1UF,20%,50V SQ	04222	SR595C104MAAAP1
A1A1C2016	283–0238–00				CAP,FXD,CER DI:0.01UF,10%,50V SQ	04222	SR155C103KAA
A1A1C2020	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2021	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2030	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2031	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2032	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2033	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1C2034	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2035	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2036	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2037	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2038	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2039	283–0067–00				CAP,FXD,CER DI:0.001UF,10%,200V	18796	DD09B10 Y5F 102K 200V
A1A1C2040	283–0059–02				CAP,FXD,CER DI:1UF,20%,50V	04222	SR305C105MAATRSTDII
A1A1C2041	283–0059–02				CAP,FXD,CER DI:1UF,20%,50V	04222	SR305C105MAATRSTDII
A1A1C2042	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2043	283–0238–00				CAP,FXD,CER DI:0.01UF,10%,50V SQ	04222	SR155C103KAA
A1A1C2044	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C2045	281–0272–00				CAP,FXD,CER DI:0.1UF,10%,50V	04222	SA115C104KAA
A1A1C2046	283–0067–00				CAP,FXD,CER DI:0.001UF,10%,200V	18796	DD09B10 Y5F 102K 200V
A1A1C3020	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C3021	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C3022	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C3023	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C3030	283–0181–00				CAP,FXD,CER DI:1.8PF,+/–0.1%,100V SQ	24165	5024E0200RD221K
A1A1C3040	283–0107–00				CAP,FXD,CER DI:51PF,5%,200V SQ	04222	SR202A510JAA
A1A1C3041	283–0167–00				CAP,FXD,CER DI:0.1UF,10%,100V SQ	04222	SR211C104KAA
A1A1C3042	283–0108–02				CAP,FXD,CER DI:220PF,10%,200V SQ	04222	SR075A221KAAAP1
A1A1C3043	283–0330–00				CAP,FXD,CER DI:100PF,5%,50V SQ	16546	CN15C101J
A1A1C3044	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C3045	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C3046	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C3047	283–0181–00				CAP,FXD,CER DI:1.8PF,+/–0.1%,100V SQ	24165	5024E0200RD221K
A1A1C3048	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C4020	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C4021	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C4022	285–1241–00				CAP,FXD,PLASTIC:0.22UF,10%,100V	12954	B32571.22/10/100
A1A1C4030	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C4040	281–0813–00				CAP,FXD,CER DI:MLC,0.04UF,20%,50V	04222	SA105E473MAA

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1C4041	290–0748–00				CAP,FXD,ELCTLT:10UF,+50–20%,25W VDC	62643	CEUST1E100
A1A1C5010	283–0330–00				CAP,FXD,CER DI:100PF,5%,50V SQ	16546	CN15C101J
A1A1C5020	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C5021	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C5022	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C5023	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C5024	283–0177–00				CAP,FXD,CER DI:1UF,+80–20%,25V	04222	SR305E105ZAA
A1A1C5025	283–0177–00				CAP,FXD,CER DI:1UF,+80–20%,25V	04222	SR305E105ZAA
A1A1C5030	281–0813–00				CAP,FXD,CER DI:MLC,0.04UF,20%,50V	04222	SA105E473MAA
A1A1C5031	281–0813–00				CAP,FXD,CER DI:MLC,0.04UF,20%,50V	04222	SA105E473MAA
A1A1C5032	281–0798–00				CAP,FXD,CER DI:51PF,1%,100V TUBULAR,MI	04222	SA101A510GAA
A1A1C5033	283–0330–00				CAP,FXD,CER DI:100PF,5%,50V SQ	16546	CN15C101J
A1A1C5040	283–0330–00				CAP,FXD,CER DI:100PF,5%,50V SQ	16546	CN15C101J
A1A1C5041	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C5042	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C6030	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C6031	283–0177–00				CAP,FXD,CER DI:1UF,+80–20%,25V	04222	SR305E105ZAA
A1A1C6032	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C7010	283–0111–04				CAP,FXD,CER DI:0.1UF,20%,50V SQ	04222	SR595C104MAAAP1
A1A1C7020	281–0813–00				CAP,FXD,CER DI:MLC,0.04UF,20%,50V	04222	SA105E473MAA
A1A1C7021	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C7022	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C7023	283–0177–00				CAP,FXD,CER DI:1UF,+80–20%,25V	04222	SR305E105ZAA
A1A1C7030	283–0059–02				CAP,FXD,CER DI:1UF,20%,50V	04222	SR305C105MAATRSTDII
A1A1C7040	283–0330–00				CAP,FXD,CER DI:100PF,5%,50V SQ	16546	CN15C101J
A1A1C7041	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C7042	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C7043	290–0748–00				CAP,FXD,ELCTLT:10UF,+50–20%,25W VDC	62643	CEUST1E100
A1A1C8010	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C8020	283–0010–00				CAP,FXD,CER DI:0.05UF,+80–20%,50V SQ	04222	SR305E503ZAA
A1A1C8021	281–0798–00				CAP,FXD,CER DI:51PF,1%,100V TUBULAR,MI	04222	SA101A510GAA
A1A1C8022	283–0330–00				CAP,FXD,CER DI:100PF,5%,50V SQ	16546	CN15C101J

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1C8023	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C8024	283–0348–00				CAP,FXD,CER DI:0.5PF,+/–0.1PF,100V	31433	C312C109D1G5EA
A1A1C8040	283–0156–00				CAP,FXD,CER DI:1000PF,+80–20%,200V SQ	04222	SR152E102ZAA
A1A1C9010	283–0111–04				CAP,FXD,CER DI:0.1UF,20%,50V SQ	04222	SR595C104MAAAP1
A1A1C9011	281–0813–00				CAP,FXD,CER DI:MLC,0.047UF,20%,50V	04222	SA105E473MAA
A1A1C9020	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C9021	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C9022	281–0813–00				CAP,FXD,CER DI:MLC,0.04UF,20%,50V	04222	SA105E473MAA
A1A1C9023	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C9024	281–0813–00				CAP,FXD,CER DI:MLC,0.04UF,20%,50V	04222	SA105E473MAA
A1A1C9025	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C9030	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C9031	290–0748–00				CAP,FXD,ELCTLT:10UF,+50–20%,25W VDC	62643	CEUST1E100
A1A1C9032	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C9033	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A1A1C9034	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,Z5U	31433	C114C224M5Y5CA
A1A1C9035	290–0748–00				CAP,FXD,ELCTLT:10UF,+50–20%,25W VDC	62643	CEUST1E100
A1A1CR1020	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A1A1CR1021	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A1A1CR1022	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A1A1CR1023	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A1A1CR3031	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A1A1CR4030	152–0141–02				DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	01295	1N4152R
A1A1CR4031	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A1A1CR4032	152–0725–00				DIODE DVC,DI:SI,SCHOTTKY,20V,1.2PF	21847	A2X1582
A1A1CR5030	152–0725–00				DIODE DVC,DI:SI,SCHOTTKY,20V,1.2PF	21847	A2X1582
A1A1CR5040	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A1A1CR8020	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A1A1CR9010	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1J2010	131–3361–00				CONN,HDR:PCB,MALE,RTANG,2 X 13,0.1 CTR	53387	3593–5002
A1A1J5040	131–4183–00				CONN,HDR:PCB,MALE,STR,2 X 7,0.1 CTR	53387	3598–6002
A1A1J9010	131–3359–00				CONN,HDR:PCB,MALE,RTANG,2 X 10,0.1 CTR	53387	3592–5002
A1A1L5030	120–1606–00				XFMR,RF:INDUCTOR 86–10	0JR03	120–1606–00
A1A1L5040	108–0509–01				COIL,RF:FIXED,2.45UH +/–10%,AXIAL LEAD	0JR03	108–0509–01
A1A1Q1010	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A1A1Q1020	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A1A1Q1021	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	34371	X39H3162
A1A1Q1030	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A1A1Q1031	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	34371	X39H3162
A1A1Q2011	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A1A1Q2012	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A1A1Q3030	151–0276–01				XSTR,SIG:BIPOLAR,PNP;50V,50MA,40MHZ,AMP	04713	2N5087RLRP
A1A1Q4030	151–1078–00				XSTR,SIG:JFET,N–CH;3.5V,75MA,90 OHM;TO–92	04713	SPF3040
A1A1Q4031	151–0441–00				XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
A1A1Q4040	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A1A1Q5020	151–0308–00				XSTR,SIG:BIPOLAR,NPN;45V,30MA,60MHZ,AMP	04713	2N2918
A1A1Q5030	151–0441–00				XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
A1A1Q5031	151–1012–00				XSTR,SIG:JFET,N–CH,6V,15MA,AMP	21845	F1585
A1A1Q5032	151–0261–00				XSTR,SIG:BIPOLAR,PNP;60V,50MA,100MHZ,AMP	04713	2N3810
A1A1Q6020	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A1A1Q7020	151–0441–00				XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
A1A1Q7021	151–0139–00				XSTR,SIG:BIPOLAR,NPN;15V,50MA,600MHZ,AMP	04713	MD918
A1A1Q7030	151–0441–00				XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
A1A1Q8020	151–0139–00				XSTR,SIG:BIPOLAR,NPN;15V,50MA,600MHZ,AMP	04713	MD918
A1A1Q9010	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A1A1Q9020	151–0308–00				XSTR,SIG:BIPOLAR,NPN;45V,30MA,60MHZ,AMP	04713	2N2918
A1A1Q9021	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A1A1R1010	322–3162–00				RES,FXD:METAL FILM:475 OHM,1%,0.2W	57668	CRB20 FXE 475E
A1A1R1011	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1R1012	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R1013	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R1014	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A1A1R1015	322–3318–00				RES,FXD:METAL FILM:20.0K OHM,1%,0.2W	57668	CRB20 FXE 20K0
A1A1R1016	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R1020	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R1021	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R1022	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R1023	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R1032	322–3437–00				RES,FXD,FILM:348K OHM,1%,0.2W	57668	CRB20 FXE 348K
A1A1R1033	307–0446–00				RES NTWK,FXD,FI:10K OHM,20%,(9)RES	01121	210A103
A1A1R1035	321–0756–00				RES,FXD,FILM:50K OHM,1%,0.125W	01121	ADVISE
A1A1R2010	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R2011	322–3318–00				RES,FXD:METAL FILM:20.0K OHM,1%,0.2W	57668	CRB20 FXE 20K0
A1A1R2012	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A1A1R2013	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A1A1R2014	307–0446–00				RES NTWK,FXD,FI:10K OHM,20%,(9)RES	01121	210A103
A1A1R2015	307–0446–00				RES NTWK,FXD,FI:10K OHM,20%,(9)RES	01121	210A103
A1A1R2030	322–3239–00				RES,FXD,FILM:3.01K OHM,1%,0.2W	57668	CRB20 FXE 3K01
A1A1R2031	322–3239–00				RES,FXD,FILM:3.01K OHM,1%,0.2W	57668	CRB20 FXE 3K01
A1A1R2033	322–3293–00				RES,FXD:METAL FILM:11.0K OHM,1%,0.2W	57668	CRB20 FXE 11K0
A1A1R2034	311–0634–00				RES,VAR,NONWW:TRMR,500 OHM,0.5W CERMET	32997	3329H–L58–501
A1A1R2040	322–3139–00				RES,FXD:METAL FILM:274 OHM,1%,0.2W	57668	CRB20 FXE 274E
A1A1R2041	322–3134–00				RES,FXD,FILM:243 OHM,1%,0.2W	57668	CRB20 FXE243E
A1A1R2042	322–3134–00				RES,FXD,FILM:243 OHM,1%,0.2W	57668	CRB20 FXE243E
A1A1R2043	322–3126–00				RES,FXD,FILM:200 OHM,1%,0.2W	91637	CCF501G200R0F
A1A1R3010	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R3020	322–3297–00				RES,FXD:METAL FILM:12.1K OHM,1%,0.2W	57668	CRB20 FXE 12K1
A1A1R3030	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R3031	322–3356–00				RES,FXD,FILM:49.9K OHM,1%,0.2W	57668	CRB20 FXE 49K9
A1A1R3032	322–3327–00				RES,FXD,FILM:24.9K OHM,1%,0.2W	57668	CRB20 FXE 24K9
A1A1R3033	322–3165–00				RES,FXD,FILM:511 OHM,1%,0.2W	57668	CRB20 FXE 511E

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1R3034	322–3261–00				RES,FXD,FILM:5.11K OHM,1%,0.2W	91637	CCF50G5111FT
A1A1R3035	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R3036	322–3243–00				RES,FXD:METAL FILM:3.32K OHM,1%,0.2W	91637	CCF50–1–G33200F
A1A1R3037	322–3314–00				RES,FXD:METAL FILM:18.2K OHM,1%,0.2W	57668	CRB20 FXE 18K2
A1A1R3038	322–3306–00				RES,FXD:METAL FILM:15.0K OHM,1%,0.2W	57668	CRB20 FXE 15K0
A1A1R3039	322–3327–00				RES,FXD,FILM:24.9K OHM,1%,0.2W	57668	CRB20 FXE 24K9
A1A1R3040	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A1A1R3041	322–3126–00				RES,FXD,FILM:200 OHM,1%,0.2W	91637	CCF501G200R0F
A1A1R3042	322–3173–00				RES,FXD,FILM:619 OHM,1%,0.2W	91637	CCF50–2F619R0F
A1A1R4020	322–3297–00				RES,FXD:METAL FILM:12.1K OHM,1%,0.2W	57668	CRB20 FXE 12K1
A1A1R4021	322–3261–00				RES,FXD,FILM:5.11K OHM,1%,0.2W	91637	CCF50G5111FT
A1A1R4022	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A1A1R4023	322–3347–00				RES,FXD,FILM:40.2K OHM,1%,0.2W	91637	CCF50–2–G40201F
A1A1R4030	322–3126–00				RES,FXD,FILM:200 OHM,1%,0.2W	91637	CCF501G200R0F
A1A1R4031	322–3325–00				RES,FXD,FILM:23.7K OHM,1%,0.2W	57668	CRB20 FXE 23K7
A1A1R4032	322–3261–00				RES,FXD,FILM:5.11K OHM,1%,0.2W	91637	CCF50G5111FT
A1A1R4040	322–3281–00				RES,FXD:METAL FILM:8.25K OHM,1%,0.2W	57668	CRB20 FXE 8K25
A1A1R4041	322–3134–00				RES,FXD,FILM:243 OHM,1%,0.2W	57668	CRB20 FXE243E
A1A1R4042	322–3135–00				RES,FXD,FILM:249 OHM,1%,0.2W	57668	CRB20 FXE 249E
A1A1R4043	321–0136–00				RES,FXD,FILM:255 OHM,1%,0.125W	19701	5043ED255R0F
A1A1R4044	322–3137–00				RES,FXD,FILM:261 OHM,1%,0.2W	57668	CRB20 FXE 261E
A1A1R4045	322–3138–00				RES,FXD,FILM:267 OHM,1%,0.2W	57668	CRB20 FXE 267E
A1A1R4046	322–3139–00				RES,FXD:METAL FILM:274 OHM,1%,0.2W	57668	CRB20 FXE 274E
A1A1R4047	322–3141–00				RES,FXD,FILM:287 OHM,1%,0.2W	57668	CRB20 FXE 287E
A1A1R4048	322–3001–00				RES,FXD:METAL FILM:10 OHM,1%,0.2W	57668	CRB20 FXE10E0
A1A1R5020	322–3395–07				RES,FXD,FILM:127K OHM,1%,0.2W	57668	BZE127K
A1A1R5021	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R5022	322–3337–00				RES,FXD,FILM:31.6K OHM,1%,0.2W	91637	CCF502G31601FT
A1A1R5023	322–3164–00				RES,FXD,FILM:499 OHM,1%,0.2W	57668	CRB20 FXE 499E
A1A1R5024	322–3001–00				RES,FXD:METAL FILM:10 OHM,1%,0.2W	57668	CRB20 FXE10E0
A1A1R5025	322–3001–00				RES,FXD:METAL FILM:10 OHM,1%,0.2W	57668	CRB20 FXE10E0
A1A1R5026	322–3068–00				RES,FXD:METAL FILM:49.9 OHM,0.1%,0.2W	57668	CRB20 FXE 49E9

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1R5030	322–3280–00				RES,FXD,FILM:8.06K OHM,1%,0.2W	57668	CRB20 FXE 8K06
A1A1R5031	322–3222–00				RES,FXD:METAL FILM:2.00K OHM,1%,0.2W	57668	CRB20 FXE 2K00
A1A1R5032	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R5033	322–3068–00				RES,FXD:METAL FILM:49.9 OHM,0.1%,0.2W	57668	CRB20 FXE 49E9
A1A1R5034	322–3184–00				RES,FXD,FILM:806 OHM,1%,0.2W	57668	CRB20 FXE 806E
A1A1R5035	322–3250–00				RES,FXD:METAL FILM:3.92K OHM,1%,0.2W	91637	CCF50–2F39200F
A1A1R6030	322–3068–00				RES,FXD:METAL FILM:49.9 OHM,0.1%,0.2W	57668	CRB20 FXE 49E9
A1A1R6031	322–3262–00				RES,FXD,FILM:5.23K OHM,1,0.2W	57668	CRB20 FXE 5K23
A1A1R6032	322–3251–00				RES,FXD,FILM:4.02K OHM,1%,0.2W	57668	CRB20 FXE 4K02
A1A1R6033	322–3139–00				RES,FXD:METAL FILM:274 OHM,1%,0.2W	57668	CRB20 FXE 274E
A1A1R6040	322–3222–00				RES,FXD:METAL FILM:2.00K OHM,1%,0.2W	57668	CRB20 FXE 2K00
A1A1R6041	321–0960–07				RES,FXD,FILM:513 OHM,0.1%,0.125W	01121	ADVISE
A1A1R6042	322–3175–00				RES,FXD,FILM:649 OHM,1%,0.2W	57668	CRB20 FXE 649E
A1A1R6043	322–3185–00				RES,FXD:METAL FILM:825 OHM,1%,0.2W	57668	CRB20 FXE 825E
A1A1R6044	322–3194–00				RES,FXD,FILM:1.02K OHM,1%,0.2W	91637	CCF50–2G10200F
A1A1R6045	322–3204–00				RES,FXD,FILM:1.30K OHM,1%,0.2W	57668	CRB20 FXE 1K30
A1A1R6046	322–3213–00				RES,FXD,FILM:1.62K OHM,1%,0.2W	57668	CRB20 FXE 1K62
A1A1R6047	322–3223–00				RES,FXD,FILM:2.05K OHM,1%,0.2W	57668	CRB20 FXE 2K05
A1A1R7010	322–3114–00				RES,FXD:METAL FILM:150 OHM,1%,0.2W	57668	CRB20–FX150E
A1A1R7011	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R7012	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R7013	322–3105–00				RES,FXDMETAL FILM:121 OHM 1%,0.2W	57668	CRB20 FXE 121E
A1A1R7014	322–3154–00				RES,FXD:METAL FILM:392 OHM,1%,0.2W	57668	RB20 FX392E
A1A1R7015	322–3154–00				RES,FXD:METAL FILM:392 OHM,1%,0.2W	57668	RB20 FX392E
A1A1R7020	322–3310–00				RES,FXD,FILM:16.5K OHM,1%,0.2W	57668	CRB20 FXE 16K5
A1A1R7021	321–0038–00				RES,FXD,FILM:24.3 OHM,1%,0.125W	57668	CRB14 FXE 24.3
A1A1R7022	322–3306–00				RES,FXD:METAL FILM:15.0K OHM,1%,0.2W	57668	CRB20 FXE 15K0
A1A1R7023	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R7024	322–3193–00				RES,FXD:METAL FILM:1K OHM,1%,0.2W	57668	CRB20 FXE 1K00
A1A1R7025	322–3193–00				RES,FXD:METAL FILM:1K OHM,1%,0.2W	57668	CRB20 FXE 1K00
A1A1R7026	322–3193–00				RES,FXD:METAL FILM:1K OHM,1%,0.2W	57668	CRB20 FXE 1K00
A1A1R7027	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1R7028	322–3068–00				RES,FXD:METAL FILM:49.9 OHM,0.1%,0.2W	57668	CRB20 FXE 49E9
A1A1R7029	322–3342–00				RES,FXD,FILM:35.7K OHM,1%,0.2W	57668	CRB20 FXE 35K7
A1A1R7030	322–3222–00				RES,FXD:METAL FILM:2.00K OHM,1%,0.2W	57668	CRB20 FXE 2K00
A1A1R7031	322–3306–00				RES,FXD:METAL FILM:15.0K OHM,1%,0.2W	57668	CRB20 FXE 15K0
A1A1R7032	321–0720–00				RES,FXD,FILM:60K OHM,1%,0.125W	91637	CMF55–116–G–60001FT
A1A1R7033	322–3269–00				RES,FXD,FILM:6.19K OHM,1%,0.2W	91637	CCF501G61900F
A1A1R7034	322–3068–00				RES,FXD:METAL FILM:49.9 OHM,0.1%,0.2W	57668	CRB20 FXE 49E9
A1A1R7040	322–3001–00				RES,FXD:METAL FILM:10 OHM,1%,0.2W	57668	CRB20 FXE10E0
A1A1R8010	321–0038–00				RES,FXD,FILM:24.3 OHM,1%,0.125W	57668	CRB14 FXE 24.3
A1A1R8011	321–0312–00				RES,FXD,FILM:17.4K OHM,1%,0.125W	07716	CEAD17401F
A1A1R8012	321–0631–00				RES,FXD,FILM:12.5K OHM,1%,0.125W	07716	CEA T0 1% 12.5K
A1A1R8013	322–3126–00				RES,FXD,FILM:200 OHM,1%,0.2W	91637	CCF501G200R0F
A1A1R8014	322–3068–00				RES,FXD:METAL FILM:49.9 OHM,0.1%,0.2W	57668	CRB20 FXE 49E9
A1A1R8020	322–3193–00				RES,FXD:METAL FILM:1K OHM,1%,0.2W	57668	CRB20 FXE 1K00
A1A1R8021	322–3325–00				RES,FXD,FILM:23.7K OHM,1%,0.2W	57668	CRB20 FXE 23K7
A1A1R8022	322–3283–00				RES,FXD,FILM:8.66K OHM,1%,0.2W	57668	CRB20 FXE 8K66
A1A1R8023	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R8024	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R8025	321–0174–00				RES,FXD,FILM:634 OHM,1%,0.125W	19701	5043ED634ROF
A1A1R8026	322–3306–00				RES,FXD:METAL FILM:15.0K OHM,1%,0.2W	57668	CRB20 FXE 15K0
A1A1R8027	322–3306–00				RES,FXD:METAL FILM:15.0K OHM,1%,0.2W	57668	CRB20 FXE 15K0
A1A1R8028	322–3306–00				RES,FXD:METAL FILM:15.0K OHM,1%,0.2W	57668	CRB20 FXE 15K0
A1A1R8040	321–0782–03				RES,FXD,FILM:40 OHM,0.25%,0.125W	57668	CRB14CYE40OHM
A1A1R8041	322–3128–00				RES,FXD,FILM:210 OHM,1%,0.2W	57668	CRB20 FXE210E
A1A1R8042	322–3205–00				RES,FXD,FILM:1.33K OHM,1%,0.2W	57668	CRB20 FXE 1K33
A1A1R8043	321–0620–00				RES,FXD,FILM:8.45K OHM,0.25%,0.125W	91637	CMF55–116–D–84500CT
A1A1R8044	322–3318–00				RES,FXD:METAL FILM:20.0K OHM,1%,0.2W	57668	CRB20 FXE 20K0
A1A1R8045	322–3318–00				RES,FXD:METAL FILM:20.0K OHM,1%,0.2W	57668	CRB20 FXE 20K0
A1A1R8046	322–3318–00				RES,FXD:METAL FILM:20.0K OHM,1%,0.2W	57668	CRB20 FXE 20K0
A1A1R8047	322–3289–00				RES,FXD:METAL FILM:10.0K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A1A1R9010	322–3114–00				RES,FXD:METAL FILM:150 OHM,1%,0.2W	57668	CRB20–FX150E
A1A1R9011	322–3258–00				RES,FXD:METAL FILM:4.75K OHM,1%,0.2W	56845	CCF50–2–G4751FT

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1R9012	322–3143–00				RES,FXD,FILM:301 OHM,1%,0.2W	57668	CRB20 FXE 301E
A1A1R9013	322–3306–00				RES,FXD:METAL FILM:15.0K OHM,1%,0.2W	57668	CRB20 FXE 15K0
A1A1R9014	322–3310–00				RES,FXD,FILM:16.5K OHM,1%,0.2W	57668	CRB20 FXE 16K5
A1A1R9015	322–3342–00				RES,FXD,FILM:35.7K OHM,1%,0.2W	57668	CRB20 FXE 35K7
A1A1R9020	321–0038–00				RES,FXD,FILM:24.3 OHM,1%,0.125W	57668	CRB14 FXE 24.3
A1A1R9021	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R9022	322–3280–00				RES,FXD,FILM:8.06K OHM,1%,0.2W	57668	CRB20 FXE 8K06
A1A1R9023	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A1A1R9024	322–3222–00				RES,FXD:METAL FILM:2.00K OHM,1%,0.2W	57668	CRB20 FXE 2K00
A1A1R9025	322–3306–00				RES,FXD:METAL FILM:15.0K OHM,1%,0.2W	57668	CRB20 FXE 15K0
A1A1R9026	322–3234–00				RES,FXD,FILM:2.67K OHM,1%,0.2W	91637	CCF50–2F26700F
A1A1R9027	322–3126–00				RES,FXD,FILM:200 OHM,1%,0.2W	91637	CCF501G200R0F
A1A1R9030	322–3371–00				RES,FXD,FILM:71.5K OHM,1%,0.2W	57668	CRB20 FXE 71K5
A1A1R9031	322–3331–00				RES,FXD:METAL FILM:27.4K OHM,1%,0.2W	57668	CRB20 FXE 27K4
A1A1R9032	311–0633–00				RES,VAR,NONWW:TRMR,5K OHM,0.5W CERMET	32997	3329H–L58–502
A1A1TP1040	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP1041	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP2040	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP3040	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP3041	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP4020	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP4021	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP4040	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP6010	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP7010	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP9010	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP9011	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP9040	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP9041	214–0579–02	B010100	B037261		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1U1010	156–2760–00				IC,DIGITAL:CMOS,MISC;NONVOLATILE CONTROL	0B0A9	DS1210
A1A1U1011	156–2763–00				IC,DIGITAL:HCMOS,FLIP FLOP;DUAL J–K	04713	MC74HC113N
A1A1U1012	156–1225–00				IC,LINEAR:BIPOLAR,COMPARATOR;DUAL	01295	LM393P
A1A1U1020	156–2473–00				IC,MEMORY:CMOS,SRAM;8K X 8,200NS,200NA	0JR04	TC5564PL–20
A1A1U1021	156–2473–00				IC,MEMORY:CMOS,SRAM;8K X 8,200NS,200NA	0JR04	TC5564PL–20
A1A1U1022	156–2583–00				IC,DIGITAL:HCMOS,DEMUX/DECODER	01295	SN74HC138N
A1A1U1023	156–2587–00				IC,DGTL:CPU 6MHZ,Z–80 DIP40	0JR04	TMPZ84C00AP–6
A1A1U1030	156–1397–00				IC,DIGITAL:CMOS,GATES;8–INPUT NAND	27014	MM74C30N
A1A1U1031	156–2392–00				IC,DIGITAL:HCMOS,GATE;HEX INV, SCHMITT TRIG	04713	MC74HC14N
A1A1U1032	156–1994–00				IC,DIGITAL:CMOS,BUFFER/DRIVER;OCTAL INV	27014	MM74C240
A1A1U1034	156–0991–02				IC,LINEAR:VOLTAGE REGULATOR	04713	MC78L05ACPRP
A1A1U1040	156–3058–00				IC,DIGITAL:HCMOS,GATE;DUAL 4–INPUT NAND	01295	SN74HC20N
A1A1U1041	156–2009–00				IC,DIGITAL:HCMOS,FLIP FLOP;DUAL D–TYP	01295	SN74HC74N
A1A1U1042	156–3180–00				IC,DIGITAL:HCMOS,GATE;TRIPLE 3–INPUT NOR	04713	MC74HC27N
A1A1U1043	156–2463–00				IC,DITIAL:HCMOS,GATE;QUAD 2–INPUT OR	01295	SN74HC32N
A1A1U2011	156–2415–00				IC,DIGITAL:HCMOS,TRANSCEIVER;OCTAL,NONINV	04713	MC74HC245AN
A1A1U2012	156–3110–00				IC,DIGITAL:HCMOS,BUFFER;NONINV OCTAL	27014	MM74HC244N
	136–0755–00				SOCKET,DIP:PCB,28 POS,2 X 14,0.1 X 0.6 CTR	09922	DILB28P–108
A1A1U2021	156–2583–00				IC,DIGITAL:HCMOS,DEMUX/DECODER	01295	SN74HC138N
A1A1U2022	156–2583–00				IC,DIGITAL:HCMOS,DEMUX/DECODER	01295	SN74HC138N
A1A1U2023	156–2009–00				IC,DIGITAL:HCMOS,FLIP FLOP;DUAL D–TYP	01295	SN74HC74N
A1A1U2024	156–2583–00				IC,DIGITAL:HCMOS,DEMUX/DECODER	01295	SN74HC138N
A1A1U2025	156–2763–00				IC,DIGITAL:HCMOS,FLIP FLOP;DUAL J–K	04713	MC74HC113N
A1A1U2026	156–2583–00				IC,DIGITAL:HCMOS,DEMUX/DECODER	01295	SN74HC138N
A1A1U2027	156–2763–00				IC,DIGITAL:HCMOS,FLIP FLOP;DUAL J–K	04713	MC74HC113N
A1A1U2030	156–2767–00				IC,DGTL:CHMOS,COUNTER TIMER 82C54	34649	P82C54
A1A1U2031	119–2736–00				CRYSTAL,SCOPE	75378	MXO–55GA–3I–20M
A1A1U2032	156–2096–00				IC,DIGITAL:ALSTTL,FLIP FLOP;QUAD D–TYPE	01295	SN74ALS175N
A1A1U2033	156–2759–00				IC,DIGITAL:ALSTTL,FLIP FLOP;DUAL J–K	01295	74ALS113
A1A1U2034	156–2092–00				IC,DIGITAL:ALSTTL,GATE;QUAD 2–INPUT NOR	01295	SN74ALS02N
A1A1U2036	156–2096–00				IC,DIGITAL:ALSTTL,FLIP FLOP;QUAD D–TYPE	01295	SN74ALS175N
A1A1U2037	156–2098–00				IC,DIGITAL:ALSTTL,COUNTER;SYNCH 4–BIT	01295	SN74ALS161BN

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A1A1	**670–9285–XX**				**CIRCUIT BD ASSY:MAIN (Con't)**		
A1A1U2040	156–2437–00				IC,DIGITAL:HCTCMOS,GATE;QUAD 2–INPUT AND	34371	CD74HCT08E17
A1A1U2041	156–2768–00				IC,LINEAR:12 BIT PLUS SIGN 1205	27014	ADC1205
A1A1U2042	156–2759–00				IC,DIGITAL:ALSTTL,FLIP FLOP;DUAL J–K	01295	74ALS113
A1A1U2043	156–2421–00				IC,DIGITAL:HCMOS,FLIP FLOP;QUAD D–TYPE	04713	MC74HC175N
A1A1U2044	156–3107–00				IC,DIGITAL:HCMOS,FLIP FLOP;OCTAL D–TYPE	01295	SN74HC374N
A1A1U2045	156–1752–00				IC,DIGITAL:FTTL,GATE;TRIPLE 3–INPUT NAND	04713	MC 74F10N
A1A1U2046	156–3151–00				IC,INTFC:CMOS,D/A CONVERTER	24355	AD7534JN
A1A1U3010	156–3107–00				IC,DIGITAL:HCMOS,FLIP FLOP;OCTAL D–TYPE	01295	SN74HC374N
A1A1U3020	156–2026–00				IC,DIGITAL:HCMOS,GATE;QUAD 2–INPUT NOR	04713	MC74HC02AN
A1A1U3021	156–3107–00				IC,DIGITAL:HCMOS,FLIP FLOP;OCTAL D–TYPE	01295	SN74HC374N
A1A1U3022	156–2421–00				IC,DIGITAL:HCMOS,FLIP FLOP;QUAD D–TYPE	04713	MC74HC175N
A1A1U3023	156–0927–00				IC,LINEAR:DIGITAL TO ANALOG CONVERTER	04713	MC3410CL
A1A1U3040	156–1173–00				IC,LINEAR:BIPOLAR,VOLT REF;POS,2.5V,1.0%	04713	MC1403U
A1A1U3041	156–0854–00				IC,LINEAR:BIPOLAR,OP–AMP	24355	OP08FP OR PM308–026P
A1A1U3042	156–1114–00				IC,LINEAR:MOS/FET INP,COS/MOS OUT,OP AMP	34371	CA3160E
A1A1U4020	156–3151–00				IC,INTFC:CMOS,D/A CONVERTER	24355	AD7534JN
A1A1U4021	156–1699–00				IC,LINEAR:DUAL BI–FET,OPNL AMPL,LOW OFFSET	01295	TL288CP
A1A1U4040	156–0513–00				IC,MISC:CMOS,ANALOG MUX;8 CHANNEL	04713	MC14051BCP
A1A1U5010	156–0854–00				IC,LINEAR:BIPOLAR,OP–AMP	24355	OP08FP OR PM308–026P
A1A1U5020	156–1156–00				IC,LINEAR:BIFET,OP–AMP;;LF356N,DIP08.3	04713	LF356N
A1A1U5040	156–1114–00				IC,LINEAR:MOS/FET INP,COS/MOS OUT,OP AMP	34371	CA3160E
A1A1U6040	156–0513–00				IC,MISC:CMOS,ANALOG MUX;8 CHANNEL	04713	MC14051BCP
A1A1U7010	156–2763–00				IC,DIGITAL:HCMOS,FLIP FLOP;DUAL J–K	04713	MC74HC113N
A1A1U7040	156–1114–00				IC,LINEAR:MOS/FET INP,COS/MOS OUT,OP AMP	34371	CA3160E
A1A1U8010	156–1707–00				IC,DIGITAL:FTTL,GATE;QUAD 2–INPUT NAND	04713	MC74F00 (N OR J)
A1A1U8040	156–0513–00				IC,MISC:CMOS,ANALOG MUX;8 CHANNEL	04713	MC14051BCP
A1A1U8041	156–1114–00				IC,LINEAR:MOS/FET INP,COS/MOS OUT,OP AMP	34371	CA3160E
A1A1U9030	156–0496–00				IC,LINEAR:VOLTAGE REGULATOR RC4194D,MI	34333	SG4194CJ
A1A1VR3030	152–0647–00				DIODE,ZENER:6.8V,5%,0.4W;1N957B	04713	1N957B
A1A1VR6030	152–0514–00				DIODE,ZENER:10V,1%,0.4W;MZ4104D	04713	MZ4104D

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A2	**672–1391–XX**				**CIRCUIT BD ASSY:FRONT PANEL**		
A2C1011	283–0359–00				CAP,FXD,CER DI:1000PF,10%,200V SQUARE	18796	RPE112NPO102K200V
A2C1015	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQUARE	31433	C322C102J2G5CA
A2C2010	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C2011	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C2020	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C2021	290–0974–00				CAP,FXD,ELCTLT:10UF,20%,50VDC AL	55680	UVX1H100MAA
A2C2022	290–0974–00				CAP,FXD,ELCTLT:10UF,20%,50VDC AL	55680	UVX1H100MAA
A2C2023	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C2024	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C2025	283–0492–00				CAP,FXD,CER DI:1000PF,20% DIP STYLE	04222	MD015C102MAA
A2C2026	283–0492–00				CAP,FXD,CER DI:1000PF,20% DIP STYLE	04222	MD015C102MAA
A2C2027	283–0492–00				CAP,FXD,CER DI:1000PF,20% DIP STYLE	04222	MD015C102MAA
A2C2028	283–0492–00				CAP,FXD,CER DI:1000PF,20% DIP STYLE	04222	MD015C102MAA
A2C2030	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C2031	283–0492–00				CAP,FXD,CER DI:1000PF,20% DIP STYLE	04222	MD015C102MAA
A2C2032	283–0492–00				CAP,FXD,CER DI:1000PF,20% DIP STYLE	04222	MD015C102MAA
A2C2033	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C2034	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C3010	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C3020	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C3021	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C3022	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C3023	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C3030	290–0919–00				CAP,FXD,ELCTLT:470UF,+50–20%,35V AL	62643	KME35VB471M10X20LL
A2C3031	290–0919–00				CAP,FXD,ELCTLT:470UF,+50–20%,35V AL	62643	KME35VB471M10X20LL
A2C3032	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C3033	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2C3034	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V,ZRU	31433	C114C224M5Y5CA
A2J1020	131–3147–00				CONN,HDR:PCB,MALE,STR,2 X 25,0.1 CTR	22526	66506–032
A2J3030	131–1857–00				CONN,HDR:PCB,MALE,STR,1 X 36,0.1 CTR	58050	082–3644–SS10

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A2	**672–1391–XX**				**CIRCUIT BD ASSY:FRONT PANEL (Con't)**		
A2PS2030	119–2370–00				CONVERTER:DC – AC,15V IN,80V AT 400 HZ	63312	LPS15–1–2
A2Q1020	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A2Q1030	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A2Q2020	151–1121–01				XSTR,PWR:MOS,N–CH,60V,0.5A,3.0 OHM	17856	VN0606L–TA
A2R1010	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R1011	321–0816–00				RES,FXD,FILM:5K OHM,1%,0.125W	01121	ADVISE
A2R1012	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A2R1013	322–3347–00				RES,FXD,FILM:40.2K OHM,1%,0.2W	91637	CCF50–2–G40201F
A2R1018	311–1337–00				RES,VAR,NONWW:TRMR,25K OHM,0.5W CERMET	02111	43P253T672
A2R1020	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A2R1021	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R1022	311–2400–00				RES,VAR,PLASTIC:DUAL 10K,10% NO STOPS	12697	CM45241
A2R1023	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R1024	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R1025	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R1026	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R1027	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R1030	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R1031	322–3059–00				RES,FXD,FILM:40.2 OHM,1%,0.2W	91637	CCF50–2G40R020FT
A2R2010	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R2020	322–3001–00				RES,FXD:METAL FILM:10 OHM,1%,0.2W	57668	CRB20 FXE 10E0
A2R2021	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R2022	321–0523–00				RES,FXD,FILM:2.74M OHM,1%,0.125W	07716	CEA 2.74 M OHM
A2R2024	311–2400–00				RES,VAR,PLASTIC:DUAL 10K,10% NO STOPS	12697	CM45241
A2R2030	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R2031	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R2032	322–3347–00				RES,FXD,FILM:40.2K OHM,1%,0.2W	91637	CCF50–2–G40201F
A2R2034	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R2035	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R2036	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R2037	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A2	**672–1391–XX**				**CIRCUIT BD ASSY:FRONT PANEL (Con't)**		
A2R3010	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R3011	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A2R3020	311–2400–00				RES,VAR,PLASTIC:DUAL 10K,10% NO STOPS	12697	CM45241
A2R3024	307–0504–00				RES NTWK,FXD,FI:(15) 300K OHM,2%,0.125W	01121	316A304
A2R3031	307–0504–00				RES NTWK,FXD,FI:(15) 300K OHM,2%,0.125W	01121	316A304
A2RT2038	307–0751–00				RES,THERMAL:20K OHM,5%	56866	QTMC–19J
A2S1010	260–2091–00				SWITCH,PUSH:1 BTN,1 POLE RECORD/SWEEP	71590	2LL199NB021074
A2S1011	260–2091–00				SWITCH,PUSH:1 BTN,1 POLE RECORD/SWEEP	71590	2LL199NB021074
A2S2010	260–2091–00				SWITCH,PUSH:1 BTN,1 POLE RECORD/SWEEP	71590	2LL199NB021074
A2S2011	260–2091–00				SWITCH,PUSH:1 BTN,1 POLE RECORD/SWEEP	71590	2LL199NB021074
A2S3010	260–2091–00				SWITCH,PUSH:1 BTN,1 POLE RECORD/SWEEP	71590	2LL199NB021074
A2S3012	260–2269–01				SWITCH,ROTARY:NOISE PC MOUNT	04426	47–012–0014
A2S3020	260–2270–01				SWITCH,ROTARY:HORIZONTAL SCALE	04426	47–006–0065
A2S3021	260–2287–01				SWITCH,ROTARY:VP COURSE	04426	47–012–0011
A2S3022	260–2269–01				SWITCH,ROTARY:NOISE PC MOUNT	04426	47–012–0014
A2U2010	156–0853–00				IC,LINEAR:BIPOLAR,OP–AMP;DUAL	18324	NE532
A2U2020	156–1225–00				IC,LINEAR:BIPOLAR,COMPARATOR;DUAL	04713	LM393N
A2U2021	156–1367–00				IC,CONVERTER:CMOS,D/A;8 BIT,400NS	24355	AD7524JN
A2U2022	156–2463–00				IC,DIGTIAL:HCMOS,GATE;QUAD 2–INPUT OR	01295	SN74HC32N
A2U2023	156–2589–00				IC,CONVERTER:TTL,A/D;8–BIT,100US,SAR	80009	156–2589–00
A2U2024	156–2758–00				IC,DIGITAL:HCMOS,MUX/ENCODER;DUAL	0JR04	TC74HC253AP
A2U2025	156–2758–00				IC,DIGITAL:HCMOS,MUX/ENCODER;DUAL	0JR04	TC74HC253AP
A2U3020	156–2026–00				IC,DIGITAL:HCMOS,GATE;QUAD 2–INPUT NOR	04713	MC74HC02AN
A2U3021	156–2026–00				IC,DIGITAL:HCMOS,GATE;QUAD 2–INPUT NOR	04713	MC74HC02AN
A2U3022	156–2026–00				IC,DIGITAL:HCMOS,GATE;QUAD 2–INPUT NOR	04713	MC74HC02AN
A2U3023	156–2026–00				IC,DIGITAL:HCMOS,GATE;QUAD 2–INPUT NOR	04713	MC74HC02AN
A2U3025	156–2758–00				IC,DIGITAL:HCMOS,MUX/ENCODER;DUAL	0JR04	TC74HC253AP
A2U3031	156–2758–00				IC,DIGITAL:HCMOS,MUX/ENCODER;DUAL	0JR04	TC74HC253AP

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A3	**650–3715–01**				**POWER SUPPLY: MODULE**		
					CHASSIS MNT ELEC PARTS – SEE FIG. 10–3 RMPL		
A3C201	283–0167–00	B020000	B021232		CAP, FXD, CER DI:0.1UF,10%, 100V	8009	283–0167–00
A3F101	159–0029–01				FUSE CARTRIDGE:BUSSMAN ONLY	71400	MDL3/10
A3F101	159–0054–00				FUSE CARTRIDGE:3AG, 0.15A, 250V	75915	313.150
A3FL1	119–3488–00				FILTER, RFI:1A, 115V/230VAC, 50/60HW	OGV52	FN328–1/01
A3L201	120–1458–00	B020000	B021232		XFMR,RF:TOROID 1980PF, 100A, 130V	80009	120–1458–00
A3R101	307–0449–00				RES, V SENSITIVE:1900PF, 100A, 130V	34371	V130LA20A
A3S201	260–2372–00				SWITCH,ROTARY:VOLTAGE SELECTOR	61935	033–4501
A3T201	120–1607–00	B020000	B021232		XFMR,PWR:DUAL PRI 115/230VAC, 5060HZ	80009	120–1607–00
	120–1922–00	B021233			XFMR,PWR:DUAL PRI 115/230VAC, 5060HZ	0JR03	Z–9 1260A
A3A1	**670–9286–XX**				**CIRCUIT BD ASSY:POWER SUPPLY**		
A3A1C1010	290–0997–00				CAP,FXD,ELCTLT:3000UF,–10% +75%,75V	24165	53D268
A3A1C1011	283–0220–02				CAP,FXD,CER DI:0.01UF,20%,50V	04222	AR205C103MAATRSTDII
A3A1C1012	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A3A1C1013	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V	31433	C114C224M5Y5CA
A3A1C1014	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A3A1C1015	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A3A1C1016	283–0107–00				CAP,FXD,CER DI:51PF,5%,200V	04222	SR202A510JAA
A3A1C1030	283–0059–02				CAP,FXD,CER DI:1UF,20%,50V	04222	SR305C105MAATRSTDII
A3A1C1031	283–0059–02				CAP,FXD,CER DI:1UF,20%,50V	04222	SR305C105MAATRSTDII
A3A1C1032	290–0536–04				CAP,FXD,ELCTLT:10UF,20%,25V	24165	199D106X0025CA1
A3A1C1033	290–0536–04				CAP,FXD,ELCTLT:10UF,20%,25V	24165	199D106X0025CA1
A3A1C1034	283–0177–00				CAP,FXD,CER DI:1UF,+80–20%,25V	04222	SR305E105ZAA
A3A1C1035	283–0177–00				CAP,FXD,CER DI:1UF,+80–20%,25V	04222	SR305E105ZAA
A3A1C1036	283–0177–00				CAP,FXD,CER DI:1UF,+80–20%,25V	04222	SR305E105ZAA
A3A1C1037	290–0973–01				CAP,FXD,ELCTLT:100UF,20%,25VDC AL	62643	SME35VB101M8X11FT
A3A1C1038	283–0177–00				CAP,FXD,CER DI:1UF,+80–20%,25V	04222	SR305E105ZAA
A3A1C2010	290–0973–01				CAP,FXD,ELCTLT:100UF,20%,25VDC AL	62643	SME35VB101M8X11FT
A3A1C2011	290–0517–00				CAP,FXD,ELCTLT:6.8UF,20%,35V	24165	199D685X0035DA1
A3A1C2012	290–0973–01				CAP,FXD,ELCTLT:100UF,20%,25VDC AL	62643	SME35VB101M8X11FT
A3A1C2013	283–0198–00				CAP,FXD,CER DI:0.22UF,20%,50V	04222	SR305C224MAA
A3A1C2020	283–0051–00				CAP,FXD,CER DI:0.0033UF,5%,100V	04222	SR301A332JAA
A3A1C2021	290–0745–02				CAP,FXD,ELCTLT:22UF,+50–10%,25V,AL	55680	UVX2A220MPA

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A3A1C2022	283–0010–00				CAP,FXD,CER DI:0.05UF,+80–20%,50V	04222	SR305E503ZAA
A3A1C2023	283–0220–02				CAP,FXD,CER DI:0.01UF,20%,50V	04222	AR205C103MAATRSTDII
A3A1C2024	281–0925–01				CAP,FXD,CER DI:0.22UF,20%,50V	31433	C114C224M5Y5CA
A3A1C2025	290–0846–00				CAP,FXD,ELCTLT:47UF,+75–20%,35V AL	62643	CEUSM1J470
A3A1C2030	281–0925–01				CAP,FXD,CER DI:0.22UF,20%,50V	31433	C114C224M5Y5CA
A3A1C2031	283–0059–02				CAP,FXD,CER DI:1UF,20%,50V	04222	SR305C105MAATRSTDII
A3A1	**670–9286–XX**				**CIRCUIT BD ASSY:POWER SUPPLY (Con't)**		
A3A1CR1010	152–0406–00				DIODE,RECT:BRIDGE,250V,3A,1.2VF	14936	GBPC604
A3A1CR1011	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	50434	5082–2672
A3A1CR1030	152–0582–00				DIODE,RECT:SCHTKY,20V,3A,.475VF,80A	04713	1N5820
A3A1CR1031	152–0582–00				DIODE,RECT:SCHTKY,20V,3A,.475VF,80A	04713	1N5820
A3A1CR1032	152–0581–00				DIODE,RECT:SCHTKY,20V,1A,.450VF,25A	14936	SB120–5
A3A1CR1033	152–0581–00				DIODE,RECT:SCHTKY,20V,1A,.450VF,25A	14936	SB120–5
A3A1CR1034	152–0779–00				DIODE,RECT:FAST RCVRY;BRIDGE,200V	80009	152–0779–00
A3A1CR2010	152–0601–00				DIODE,RECT:ULTRA FAST;150V,25NS,35A	04713	MUR115
A3A1CR2011	152–1165–00				DIODE,RECT:600V,4A,50NS	04713	MUR460RL
A3A1CR2012	152–0582–00				DIODE,RECT:SCHTKY,20V,3A,.475VF,80A	04713	1N5820
A3A1CR2013	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	50434	5082–2672
A3A1CR2014	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	50434	5082–2672
A3A1CR2015	152–0836–00				DIODE DVC,DI:RECT,SI,1A,40V 1N5819	80009	152–0836–00
A3A1CR2016	152–0141–02				DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	14433	1N4152
A3A1CR2020	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	50434	5082–2672
A3A1CR2021	152–0601–00				DIODE,RECT:ULTRA FAST;150V,25NS,35A	04713	MUR115
A3A1CR2030	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	12969	NDP261
A3A1CR2031	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	12969	NDP261
A3A1J1010	131–4177–00				CONN,HDR:PCB,MALE,STR,1 X 31,0.15 CTR	80009	131–4177–00
A3A1J1030	131–3445–00				CONN,HDR:PCB,MALE,RTANG,2 X 7,0.1 CTR	80009	131–3445–00
A3A1J2010	131–1857–00				CONN,HDR:PCB,MALE,STR,1 X 36,0.1 CTR	58050	082–3644–SS10
A3A1	**670–9286–XX**				**CIRCUIT BD ASSY:POWER SUPPLY (Con't)**		
A3A1L1010	108–1230–00				COIL,RF:FIXED,100UH,5% POT CORE	54937	500–3990
A3A1L2020	108–1230–00				COIL,RF:FIXED,100UH,5% POT CORE	54937	500–3990

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A3A1Q1010	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A3A1Q1011	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A3A1Q1012	151–0736–00				XSTR:NPN,SI,TO–92 2N4401	04713	2N4401
A3A1Q2010	151–0736–00				XSTR:NPN,SI,TO–92 2N4401	04713	2N4401
A3A1Q2011	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A3A1Q2012	151–1176–00				XSTR,PWR:MOS,P–CH;100V,1.0A,0.6 OHM	04713	IRFD9120
A3A1Q2020	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	04713	2N3906
A3A1Q2021	151–0424–00				XSTR:NPN,SI,TO–92 MPS2369A	04713	MPS2369A
A3A1Q2022	151–1136–00				XSTR,PWR:MOS,N–CH;100V,14A,0.16 OHM	04713	MTP12N10E
A3A1Q2030	151–1063–00				XSTR,PWR:MOS,N–CH;60V,0.8A,0.8 OHM	04713	IRFD113
A3A1Q2031	151–1063–00				XSTR,PWR:MOS,N–CH;60V,0.8A,0.8 OHM	04713	IRFD113
A3A1R1010	308–0839–00				RES,FXD:0.1 OHM,5%,1.0W MI	56637	BW1 0.1 OHM
A3A1R1011	322–3193–00				RES,FXD:METAL FILM:1K OHM,1%,0.2W	57668	CRB20 FXE 1K00
A3A1R1012	322–3222–00				RES,FXD:METAL FILM:2K OHM,1%,0.2W	57668	CRB20 FXE 2K00
A3A1R1013	322–3309–00				RES,FXD,FILM:16.2K OHM,1%,0.2W	91637	CCF50–2–G16201FT
A3A1R1014	322–3243–00				RES,FXD:METAL FILM:3.32K OHM,1%,0.2W	91637	CCF50–1–G3200F
A3A1R1015	322–3231–00				RES,FXD,FILM:2.49K OHM,1%,0.2W	57668	CRB20 FXE 2K49
A3A1R1016	322–3303–00				RES,FXD,FILM:14K OHM,1%,0.2W	57668	CRB20 FXE 14K0
A3A1R1017	322–3243–00				RES,FXD:METAL FILM:3.32K OHM,1%,0.2W	91637	CCF50–1–G3200F
A3A1R1018	322–3318–00				RES,FXD:METAL FILM:20K OHM,1%,0.2W	57668	CRB20 FXE 20K0
A3A1R1020	322–3189–00				RES,FXD,FILM:909 OHM,1%,0.2W	57668	CRB20 FXE 909E
A3A1R1021	322–3293–00				RES,FXD,FILM:11K OHM,1%,0.2W	57668	CRB20 FXE 11K0
A3A1R1022	322–3191–00				RES,FXD,FILM:953 OHM,1%,0.2W	57668	CRB20 FXE 953E
A3A1R1023	322–3235–00				RES,FXD:METAL FILM:2.74K OHM,1%,0.2W	57668	CRB20 FXE 2K74
A3A1R1024	322–3231–00				RES,FXD,FILM:2.49K OHM,1%,0.2W	57668	CRB20 FXE 2K49
A3A1R1025	321–0302–00				RES,FXD,FILM:13.7K OHM,1%,0.125W	57668	CRB20 FXE 13K7
A3A1R1026	322–3193–00				RES,FXD:METAL FILM:1K OHM,1%,0.2W	57668	CRB20 FXE 1K00
A3A1R1030	317–0027–00				RES,FXD,CMPSN:2.7 OHM,5%,0.125W	01121	BB27G5
A3A1	**670–9286–XX**				**CIRCUIT BD ASSY:POWER SUPPLY (Con't)**		
A3A1R2010	322–3257–00				RES,FXD,FILM:4.64K OHM,1%,0.2W	91637	CCF50–2–G46400FT
A3A1R2011	322–3300–02				RES,FXD,FILM:13K OHM,1%,0.2W	57668	CRB20 DYE 13K0
A3A1R2012	308–0739–00				RES,FXD,WW:4 OHM,1%,3W	01686	T2B–79–4
A3A1R2013	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A3A1R2014	322–3357–00				RES,FXD,FILM:51.1K OHM,1%,0.2W	57668	CRB20 FXE 51K1
A3A1R2015	322–3289–00				RES,FXD:METAL FILM:10K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A3A1R2016	322–3097–00				RES,FXD:METAL FILM:100 OHM,1%,0.2W	57668	CRB20 FXE 100E
A3A1R2017	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A3A1R2018	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A3A1R2020	321–0253–00				RES,FXD,FILM:4.22K OHM,1%,0.125W	19701	5033ED 4K 220F
A3A1R2021	322–3222–00				RES,FXD:METAL FILM:2K OHM,1%,0.2W	57668	CRB20 FXE 2K00
A3A1R2022	322–3193–00				RES,FXD:METAL FILM:1K OHM,1%,0.2W	57668	CRB20 FXE 1K00
A3A1R2023	322–3261–00				RES,FXD,FILM:5.11K OHM,1%,0.2W	91637	CCF50G5111FT
A3A1R2024	322–3239–00				RES,FXD,FILM:3.01K OHM,1%,0.2W	57668	CRB20 FXE 3K01
A3A1R2025	322–3239–00				RES,FXD,FILM:3.01K OHM,1%,0.2W	57668	CRB20 FXE 3K01
A3A1R2026	322–3289–00				RES,FXD:METAL FILM:10K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A3A1R2027	308–0839–00				RES,FXD:0.1 OHM,5%,1.0W MI	56637	BW1 0.1 OHM
A3A1R2030	322–3326–00				RES,FXD,FILM:24.3K OHM,1%,0.2W	91637	CCF50–2F24301F
A3A1R2031	317–0027–00				RES,FXD,CMPSN:2.7 OHM,5%,0.125W	01121	BB27G5
A3A1R2032	308–0767–00				RES,FXD:1.1 OHM,5%,1W MI	75042	SP–20–1.1 OHM –5%
A3A1S2010	260–2370–00				SWITCH,TOGGLE:SPDT,3A,250VAC	09353	E101SD1AQE
A3A1T1030	120–1608–00				XFMR,PWR:SW,40KHZ,IN 16.2V,OUT +/–15V 34MA	0JR03	120–1608–00
A3A1T1031	120–0487–00				XFMR,TOROID:5 TURNS,BIFILAR,3T2	0JR03	120–0487–00
A3A1TP1010	214–0579–02	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A3A1TP1020	214–0579–02	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A3A1TP2010	214–0579–02	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A3A1TP2030	214–0579–02	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A3A1U1010	156–0933–00				IC,LINEAR:REGULATOR,PULSE WIDTH	34333	SG3524N
A3A1U1011	156–1173–00				IC,LINEAR:BIPOLAR,VOLT REF;POS,2.5V,1.0%	04713	MC1403U
A3A1	**670–9286–XX**				**CIRCUIT BD ASSY:POWER SUPPLY (Con't)**		
A3A1U1020	156–1225–00				IC,LINEAR:BIPOLAR,COMPARATOR;DUAL	04713	LM393N
A3A1U1021	156–1225–00				IC,LINEAR:BIPOLAR,COMPARATOR;DUAL	04713	LM393N
A3A1U1022	156–1173–00				IC,LINEAR:BIPOLAR,VOLT REF;POS,2.5V,1.0%	04713	MC1403U
A3A1U1023	156–0933–00				IC,LINEAR:REGULATOR,PULSE WIDTH	34333	SG3524N

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A3A1U1024	156–0366–00				IC,DIGITAL:CMOS,FLIP FLOP;DUAL D–TYPE	04713	MC14013BCP
A3A1U2010	156–1161–00				IC,LINEAR:BIPOLAR,VOLT REG;POS,ADJ	04713	LM317T
A3A1U2030	156–0494–00				IC,DIGITAL:CMOS,BUFFER/DRIVER;HEX INV	04713	MC14049UBCP
A3A1VR1012	152–0217–00				DIODE,ZENER:8.2V,5%,0.4W	14552	TD3810979
A4	**670–9291–XX**				**CKT BD ASSY:S/R DRIVER SAMPLER**		
A4C1010	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C1011	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C1020	290–0723–00				CAP,FXD,ELCTLT:150UF,20%,6V	24165	196D157X0006PE3
A4C1030	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C1040	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C1041	290–0804–01				CAP,FXD,ELCTLT:10UF,20%,25V AL	0H1N5	CEUSM1E100T12
A4C1050	281–0765–00				CAP,FXD,CER DI:100PF,5%,100V	04222	SA102A101JAA
A4C1060	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C1061	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C1070	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C1071	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C2010	290–0536–04				CAP,FXD,ELCTLT:10UF,20%,25V	24165	199D106X0025CA1
A4C2011	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A4C2012	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A4C2020	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V	24165	196D225X0020HA1
A4C2021	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V	24165	196D225X0020HA1
A4C2022	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V	24165	196D225X0020HA1
A4C2023	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V	24165	196D225X0020HA1
A4C2024	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V	24165	196D225X0020HA1
A4C2025	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A4C2026	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A4C2030	281–0861–00				CAP,FXD,CER DI:270PF,5%,50V	04222	SA101A271JAA
A4C2031	283–0193–00				CAP,FXD,CER DI:510PF,2%,100V	04222	SR201A511GAA
A4C2040	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C2041	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C2042	281–0861–00				CAP,FXD,CER DI:270PF,5%,50V	04222	SA101A271JAA
A4C2050	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C2051	290–0522–01				CAP,FXD,ELCTLT:1UF,20%,50V	31433	T355B105M050AS

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4C2052	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C2053	285–0627–00				CAP,FXD,PLASTIC:0.0033UF,5%,100V	01002	61F10AC332
A4C2072	290–0782–01				CAP,FXD,ELCTLT:4.7UF,20%,35VDC AL	55680	UVX1V4R7MAA1TD
A4C2080	290–0844–00				CAP,FXD,ELCTLT:100UF,+75–20%,35WVDC AL	62643	CEUSM1V101
A4	**670–9291–XX**				**CKT BD ASSY:S/R DRIVER SAMPLER**		
A4C2081	290–0844–00				CAP,FXD,ELCTLT:100UF,+75–20%,35WVDC AL	62643	CEUSM1V101
A4C2082	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A4C2083	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A4C3010	290–0844–00				CAP,FXD,ELCTLT:100UF,+75–20%,35WVDC AL	62643	CEUSM1V101
A4C3011	290–0844–00				CAP,FXD,ELCTLT:100UF,+75–20%,35WVDC AL	62643	CEUSM1V101
A4C3020	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C3030	283–0193–00				CAP,FXD,CER DI:510PF,2%,100V	04222	SR201A511GAA
A4C3060	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C3061	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C3062	290–0844–00				CAP,FXD,ELCTLT:100UF,+75–20%,35WVDC AL	62643	CEUSM1V101
A4C3063	290–0844–00				CAP,FXD,ELCTLT:100UF,+75–20%,35WVDC AL	62643	CEUSM1V101
A4C3064	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A4C3065	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V	31433	C322C102J2G5CA
A4C3070	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4C3080	281–0775–00				CAP,FXD,CER DI:0.1UF,20%,50V	04222	SA105E104MAA
A4CR1030	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A4CR1031	152–0141–02				DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	01295	1N4152R
A4CR1032	152–0141–02				DIODE,SIG:ULTRA FAST;40V,150MA,4NS,2PF	01295	1N4152R
A4CR1040	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A4CR2050	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA,DO–351N461D	12969	NDP261
A4CR2051	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA,DO–351N461D	12969	NDP261
A4CR2052	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA,DO–351N461D	12969	NDP261
A4CR3020	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A4CR3021	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A4J3040	131–3360–00				CONN,HDR:PCB,MALE,STR,2 X 10,0.1 CTR	53387	3592–6002
A4L2080	108–1032–00				COIL,RF:FXD,225UH,20% TOROIDAL	0JR03	108–1032–00

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4L2081	108–1032–00				COIL,RF:FXD,225UH,20% TOROIDAL	0JR03	108–1032–00
A4	**670–9291–XX**				**CKT BD ASSY:S/R DRIVER SAMPLER**		
A4Q1030	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q1060	151–1103–00				XSTR,SIG:DMOS,N–CH;ENH,30V,50MA,45 OHM	17856	DM1140/SD210DE
A4Q2030	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A4Q2040	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q2050	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	04713	2N3906
A4R1010	315–0301–00				RES,FXD,FILM:300 OHM,5%,0.25W	01121	CB3015
A4R1020	315–0102–00				RES,FXD,FILM:1K OHM,5%,0.25W	01121	CB1025
A4R1030	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1031	315–0103–00				RES,FXD,FILM:10K OHM,5%,0.25W	01121	CB1035
A4R1040	321–1249–00				RES,FXD,FILM:3.88K OHM,1%,0.125W	01121	ADVISE
A4R1041	321–0612–03				RES,FXD,FILM:500 OHM,0.25,0.125W	19701	5033RC500R0C
A4R1042	311–1921–00				RES,VAR,NONWW:TRMR,250 OHM,10%,0.5W	02111	63S251T602
A4R1050	322–3308–00				RES,FXD,FILM:15.8K OHM,1%,0.2W	57668	CRB20 FXE 15K8
A4R1051	322–3289–00				RES,FXD:METAL FILM:10K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A4R1052	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1053	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1060	322–3331–00				RES,FXD:METAL FILM:27.4K OHM,1%,0.2W	57668	CRB20 FXE 27K4
A4R1061	322–3289–00				RES,FXD:METAL FILM:10K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A4R1062	322–3364–00				RES,FXD,FILM:60.4K OHM,1%,0.2W	57668	CRB20 FXE 60K4
A4R1063	322–3297–00				RES,FXD,FILM:12.1K OHM,1%,0.2W	57668	CRB20 FXE 12K1
A4R1064	322–3289–00				RES,FXD:METAL FILM:10K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A4R1065	322–3364–00				RES,FXD,FILM:60.4K OHM,1%,0.2W	57668	CRB20 FXE 60K4
A4R1066	322–3297–00				RES,FXD,FILM:12.1K OHM,1%,0.2W	57668	CRB20 FXE 12K1
A4R1070	322–3289–00				RES,FXD:METAL FILM:10K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A4R1071	315–0100–00				RES,FXD,FILM:10 OHM,5%,0.25W	01121	CB1005
A4R1072	315–0100–00				RES,FXD,FILM:10 OHM,5%,0.25W	01121	CB1005
A4R2030	315–0300–00				RES,FXD,FILM:30 OHM,5%,0.25W	01121	CB3005
A4R2031	315–0103–00				RES,FXD,FILM:10K OHM,5%,0.25W	01121	CB1035
A4R2040	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2041	315–0511–00				RES,FXD,FILM:510 OHM,5%,0.25W	01121	CB5115
A4R2042	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4	**670–9291–XX**				**CKT BD ASSY:S/R DRIVER SAMPLER (Con't)**		
A4R2043	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2045	315–0121–00				RES,FXD,FILM:120 OHM,5%,0.25W	01121	CB1215
A4R2046	315–0473–00				RES,FXD,FILM:47K OHM,5%,0.25W	01121	CB4735
A4R2047	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R2048	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2049	315–0562–00				RES,FXD,FILM:5.6K OHM,5%,0.25W	01121	CB5625
A4R2050	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2051	315–0203–00				RES,FXD,FILM:20K OHM,5%,0.25W	01121	CB2035
A4R2052	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2053	315–0562–00				RES,FXD,FILM:5.6K OHM,5%,0.25W	01121	CB5625
A4R2054	315–0752–00				RES,FXD,FILM:7.5K OHM,5%,0.25W	01121	CB7525
A4R3020	315–0100–00				RES,FXD,FILM:10 OHM,5%,0.25W	01121	CB1005
A4R3021	322–3344–00				RES,FXD,FILM:37.4K OHM,1%,0.2W	57668	CRB20 FXE 37K4
A4R3032	317–0027–00				RES,FXD,CMPSN:2.7 OHM,5%,0.125W	01121	BB27G5
A4R3033	317–0027–00				RES,FXD,CMPSN:2.7 OHM,5%,0.125W	01121	BB27G5
A4R3040	322–3268–00				RES,FXD,FILM:6.04K OHM,1%,0.2W	57668	CRB20 FXE 6K04
A4R3050	315–0100–00				RES,FXD,FILM:10 OHM,5%,0.25W	01121	CB1005
A4R3051	315–0100–00				RES,FXD,FILM:10 OHM,5%,0.25W	01121	CB1005
A4R3061	322–3396–00				RES,FXD,FILM:130K OHM,1%,0.2W	57668	CRB20 FXE 130K
A4R3062	321–0631–03				RES,FXD,FILM:12.5K OHM,0.25%,0.125W	01121	ADVISE
A4R3070	322–3389–00				RES,FXD,FILM:110K OHM,0.25%,0.2W	56845	CCF–50–2–1103F
A4R3071	321–0645–00				RES,FXD,FILM:100K OHM,0.5%,0.125W	19701	5033RC1003D
A4R3080	321–0645–00				RES,FXD,FILM:100K OHM,0.5%,0.125W	19701	5033RC1003D
A4T1020	120–0582–00				XFMR,TOROID:2 WINDINGS,067–0572–00	0JR03	120–0582–00
A4TP1020	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP1021	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP1030	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP1060	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP1080	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP1081	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4	**670–9291–XX**				**CKT BD ASSY:S/R DRIVER SAMPLER (Con't)**		
A4TP1082	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP1083	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP1084	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP2060	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4TP3020	214–0579–00	B020000	B021172		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	80009	214–0579–00
A4U1010	119–2369–01				HYBRID:TDR FRONT END	80009	119–2369–01
A4U1050	156–0853–00				IC,LINEAR:BIPOLAR,OP–AMP;DUAL	04713	LM358N
A4U1070	156–0853–00				IC,LINEAR:BIPOLAR,OP–AMP;DUAL	04713	LM358N
A4U2050	156–1291–00				IC,LINEAR:BIFET,OP–AMP;DUAL,LOW PWR	01295	TL062CP
A4U2070	156–1490–00				IC,LINEAR:VOLTAGE REFERENCE 2–PIN	34371	ICL8069CCSQ
A4U3030	156–2761–00				IC,DIGITAL:HCMOS,MULTIVIBRATOR	04713	MC74HC221N
A4U3070	156–0853–00				IC,LINEAR:BIPOLAR,OP–AMP;DUAL	04713	LM358N
					WIRE ASSEMBLIES		
W1010	174–0955–00				CA ASSY,RF:50 OHM COAX,4.75 L (FROM A4U1010 TO FRONT PANEL J100)	060D9	174–0955–00
W2010	174–0950–00				CA ASSY,SP,ELEC:26,28 AWG,11.0 L (TO OPTION PORT)	060D9	174–0950–00
W2020	174–1539–00				CA ASSY,SP,ELEC:4,22 AWG,9.0 L,RIBBON (P0WER SUPPLY A3A1J2010 TO BATTERY INCLUDES 5A FUSE)	060D9	174–1539–00
W5040	174–0953–00				CA ASSY,SP,ELEC:14,26 AWG,6.125 L (FROM A3A1J1030 TO A1A1J5040)	060D9	174–0953–00
W6010	174–0951–00				CA ASSY,SP,ELEC:20,28 AWG,300V,RMS (FROM DISPLAY MODULE A5 AND A2A1J1020 TO A1A1J6010)	060D9	174–0951–00
W9010	174–0952–00				CA ASSY,SP,ELEC:20,28 AWG,6.125 L,RIBBON (FROM A4J3040 TO A1A1J9010)	060D9	174–0952–00
J101	174–0957–00	B010100	B021232		CA ASSY,PWR:2 STRAND W/CONNECTOR (FROM A3T201 TO POWER SUPPLY)	80009	174–0957–00
	198–5460–01				WIRE SET,ELEC:POWER SUPPLY MODULE (CONN AND GROUND WIRE, SET OF TWO)	060D9	198–5460–01

Diagrams

General Information

Assembly Numbers

Each assembly in the instrument is assigned an assembly number (e.g., A1). The assembly number appears in the title block of the schematic diagram, in the title for the circuit board component location illustration, and in the lookup table for the schematic diagram component locator. The replacable parts list is arranged by assemblies in numerical sequence: the components are listed by component number.

Grid Coordinates

The schematic diagram and circuit board component location illistration have grids. A lookup table with the grid coordinates is provided for to help you locate the component.

Electrical Parts Locator

The component locator lookup table provides an alphanumeric listing of all cirucit numbers for the circuit boards in the instrument. Corresponding to each circuit number is a schematic page reference, the locator for that schematic page, and the locator for the circuit board.

The locator lists are given for each circuit board, ordered by that board's assembly number:

An example entry is as follows:

	Schematic Page ↓	Schematic Locator ↓	Board Locator ↓
C10306	2B	D8	C1

Read: Capacitor C10306 is found on schematic 2B in grid D8. Its physical location is grid C1 on the circuit board.

A locator list and circuit board grid are also given on each circuit board illustration.

Schematic Symbols

Graphic symbols and class designation letters are based on ANSI standards.

Logic symbology reflects the actual part function, not the logic function performed. Therefore, logic symbols should reflect manufacturer's data.

Component Values

Electrical components shown on the diagrams are in the following units:

Resitstors = Ohm (Ω)

Capacitors = Farad (F)
Inductors = Henry (H)

All capacitors and inductors indicatate their units; resistors only indicate the appropriate scale factor.

Scale factors are given by the following standard:

M	mega	10^{6}
k	kilo	10^{3}
m	milli	10^{-3}
u	micro (μ)	10^{-6}
n	nano	10^{-9}
p	pico	10^{-12}

Component Number

A numbering method is used to identify assemblies, subassemblies, and parts. An example of this numbering method and typical expansions is as follows:

A23A2R1234 =	A23	A2	R1234
	↓	↓	↓
	Assembly Number	Subassembly Number	Circuit Number

Read: resistor 1234 of subassembly 2 of assy 23.

Only circuit numbers appear on the schematics, circuit board illustrations, and electrical parts locator lists. Each schematic and illustration is marked with its assembly number. Assembly numbers are also marked on the mechanical exploded view located in the replaceable mechanical parts list. A component number is obtained by adding the assembly number prefix to the circuit number. The component number may then be used to reference a part in the replaceable electrical parts list.

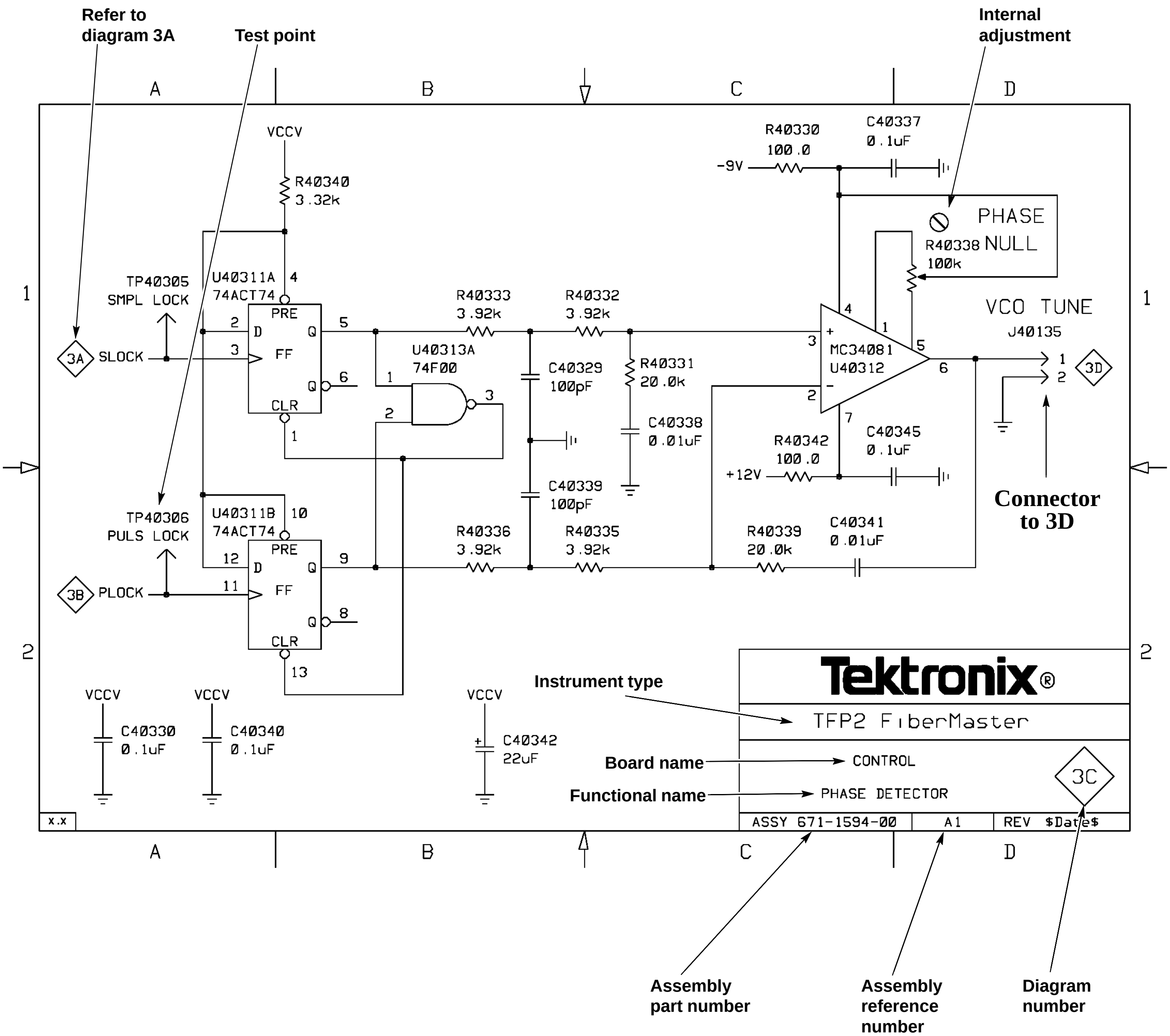


Figure 9–1: Special Schematic Symbols

A1 – MAIN

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
BT1010	2	G2	A1
C1010	2	G4	A1
C1011	2	A4	A1
C1020	2	B4	B1
C1021	2	D1	B1
C1022	2	E2	B1
C1023	2	E1	B1
C1024	2	F1	B1
C1030	2	C1	C1
C1031	2	A4	C1
C1032	2	F1	C1
C1040	3	B4	D1
C1041	3	B4	D1
C1042	1	G2	D1
C1043	2	A4	D1
C2010	5	G3	A2
C2011	5	G2	A2
C2012	2	B4	A2
C2013	4	A4	A2
C2014	4	B4	A2
C2015	5	F3	A2
C2016	5	F2	A2
C2020	3	B4	B2
C2021	7	B4	B2
C2030	7	C4	C2
C2031	7	B2	C2
C2032	7	C4	C2
C2033	7	C4	C2
C2034	7	D4	C2
C2035	7	D4	C2
C2036	7	D4	C2
C2037	7	E4	C2
C2038	7	E4	C2
C2039	6	B1	C2
C2040	6	C3	D2
C2041	6	D3	D2
C2042	6	B3	D2
C2043	6	E4	D2
C2044	7	E4	D2
C2045	7	B2	D2
C2046	6	D3	D2

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
C3020	2	B4	B3
C3021	8A	E4	B3
C3022	8A	E4	B3
C3023	8A	D3	B3
C3030	8B	A1	C3
C3040	8B	A2	D3
C3041	6	C3	D3
C3042	6	G2	D3
C3043	6	B2	D3
C3044	6	B2	D3
C3045	6	H1	D3
C3046	6	H1	D3
C3047	8B	A2	D3
C3048	8B	A1	D3
C4020	8B	D3	B4
C4021	8A	E3	B4
C4022	8A	G3	B4
C4030	8B	B1	C4
C4040	8B	C2	D4
C4041	1	F2	D4
C5010	8B	E3	A5
C5020	8B	D4	B5
C5021	8B	B4	B5
C5022	8B	B3	B5
C5023	8B	F2	B5
C5024	8B	G3	B5
C5025	8B	G3	B5
C5030	8B	E3	C5
C5031	8B	C1	C5
C5032	8B	C2	C5
C5033	8B	B3	C5
C5040	6	F2	D5
C5041	6	G1	D5
C5042	6	G1	D5
C6030	8B	E2	C6
C6031	8B	B1	C6
C6032	8B	D1	C6
C7010	8B	G1	A7
C7020	8B	G1	B7
C7021	8B	E1	B7
C7022	8B	F2	B7
C7023	8B	D2	B7

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
C7030	8B	D2	C7
C7040	6	D2	D7
C7041	6	G1	D7
C7042	6	G1	D7
C7043	1	F2	D7
C8010	8A	F2	A8
C8020	8A	D2	B8
C8021	8A	C2	B8
C8022	8A	A1	B8
C8023	8B	G4	B8
C8024	8B	E2	B8
C8040	6	C2	D8
C9010	8A	G2	A9
C9011	8A	F1	A9
C9020	8A	D1	B9
C9021	8A	C1	B9
C9022	8A	D2	B9
C9023	8A	C2	B9
C9024	8A	C1	B9
C9025	8B	G4	B9
C9030	5	B1	C9
C9031	5	C1	C9
C9032	5	B1	C9
C9033	5	B2	C9
C9034	5	B1	C9
C9035	5	C1	C9
CR1020	2	F2	B1
CR1021	2	F2	B1
CR1022	2	F1	B1
CR1023	2	F1	B1
CR3031	8B	B2	C3
CR4030	8A	F3	C4
CR4031	8B	A3	C4
CR4032	8B	C2	C4
CR5030	8B	C3	C5
CR5040	8B	B2	D5
CR8020	8A	C2	B8
CR9010	8A	G2	A9
J2010	1	C3	A2
J5040 †	1	E2	D5
J6010	1	F3	A6

† Back Side Components

A1 – MAIN

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
J9010	1	B2	A9
L5030	8B	C2	C5
L5040	1	G2	D5
Q1010	5	F3	A1
Q1020	2	F1	B1
Q1021	2	F2	B1
Q1030	2	F1	C1
Q1031	2	F1	C1
Q2011	5	F2	A2
Q2012	5	G2	A2
Q3030	8A	E3	C3
Q4030	8A	F3	C4
Q4031	8B	B2	C4
Q4040	8B	B2	D4
Q5020A	8B	E2	B5
Q5020B	8B	E2	B5
Q5030	8B	D2	C5
Q5031	8B	D2	C5
Q5032A	8B	C2	C5
Q5032B	8B	C2	C5
Q6020	8B	F2	B6
Q7020	8B	G2	B7
Q7021	8B	E2	B7
Q7030	8B	D2	C7
Q8020	8A	D2	B8
Q9010	8A	E2	A9
Q9020A	8A	C2	B9
Q9020B	8A	D2	B9
Q9021	8A	B1	B9
R1010	2	G2	A1
R1011	5	D3	A1
R1012	5	D3	A1
R1013	5	E3	A1
R1014	5	F3	A1
R1015	5	E3	A1
R1016	5	F3	A1
R1020	2	E2	B1
R1021	2	F1	B1
R1022	2	F1	B1
R1023	2	E1	B1
R1032	2	C1	C1
R1033	2	B2	C1
R1035	2	C1	C1
R2010	5	F2	A2
R2011	5	E2	A2
R2012	5	F1	A2
R2013	5	F2	A2
R2014	4	F2	A2
R2015	4	F3	A2
R2030	7	F1	C2
R2031	7	D3	C2
R2033	8B	C1	C2
R2034	8B	B1	C2
R2040	6	E4	D2
R2041	7	G3	D2
R2042	7	G2	D2
R2043	7	A2	D2
R3010	2	C2	A3
R3020	8A	C4	B3
R3030	8A	D3	C3
R3031	8A	C3	C3
R3032	8A	C3	C3
R3033	8A	C3	C3
R3034	8A	E3	C3
R3035	8A	F3	C3
R3036	8A	F3	C3
R3037	8A	B3	C3
R3038	8B	B2	C3
R3039	8B	B2	C3
R3040	8B	B2	D3
R3041	8B	A2	D3
R3042	8B	A1	D3
R4020	8A	D4	B4
R4021	8A	E3	B4
R4022	8A	C3	B4
R4023	8A	F3	B4
R4030	8A	G3	C4
R4031	8B	B2	C4
R4032	8B	B3	C4
R4040	6	H4	D4
R4041	6	H3	D4
R4042	6	H3	D4
R4043	6	H3	D4
R4044	6	H3	D4
R4045	6	H3	D4
R4046	6	H2	D4
R4047	6	H2	D4
R4048	1	E2	D4
R5020	8B	A4	B5
R5021	8B	B3	B5
R5022	8B	B3	B5
R5023	8B	A3	B5
R5024	8B	G3	B5
R5025	8B	G3	B5
R5026	8B	E2	B5
R5030	8B	E2	C5
R5031	8B	D2	C5
R5032	8B	D1	C5
R5033	8B	C2	C5
R5034	8B	C1	C5
R5035	8B	C2	C5
R6030	8B	D2	C6
R6031	8B	C2	C6
R6032	8B	C1	C6
R6033	8B	D1	C6
R6040	6	F4	D6
R6041	6	F3	D6
R6042	6	F3	D6
R6043	6	F3	D6
R6044	6	F3	D6
R6045	6	F3	D6
R6046	6	F2	D6
R6047	6	F2	D6
R7010	8A	G2	A7
R7011	5	E2	A7
R7012	8B	G1	A7
R7013	8B	G1	A7
R7014	8B	F2	A7
R7015	8B	G2	A7
R7020	8B	F2	B7
R7021	8B	F2	B7
R7022	8B	F1	B7
R7023	8B	E1	B7
R7024	8B	F1	B7

† Back Side Components

A1 – MAIN

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
R7025	8B	E2	B7	R9023	8A	D2	B9	U1034	7	B1	C1
R7026	8B	F2	B7	R9024	8A	D2	B9	U1040A	3	B3	D1
R7027	8B	F2	B7	R9025	8A	C2	B9	U1040B	3	C3	D1
R7028	8B	F3	B7	R9026	8A	B1	B9	U1041A	3	D4	D1
R7029	8B	F1	B7	R9027	8A	B1	B9	U1041B	3	E4	D1
R7030	8B	F2	C7	R9030	5	B2	C9	U1042A	3	C4	D1
R7031	8B	E2	C7	R9031	5	B2	C9	U1042B	3	B1	D1
R7032	8B	D2	C7	R9032	5	B2	C9	U1042C	3	B3	D1
R7033	8B	D2	C7					U1043A	2	D2	D1
R7034	8B	D2	C7	TP1040	2	C1	D1	U1043B	3	E2	D1
R7040	1	F2	D7	TP1041	7	E1	D1	U1043C	2	B3	D1
R8010	8A	F2	A8	TP2040	7	B1	D2	U1043D	2	C3	D1
				TP3040	7	G3	D3				
R8011	8A	E2	A8	TP3041	7	G3	D3	U2011	4	D1	A2
R8012	8A	E2	A8	TP4020	8A	H4	B4	U2012A	4	D3	A2
R8013	8A	E2	A8					U2012B	4	D2	A2
R8014	8A	D2	A8	TP4021	8A	H3	B4	U2020	2	D3	B2
R8020	8A	D1	B8	TP4040	6	H2	D4	U2021	3	E3	B2
R8021	8A	E2	B8	TP6010	8B	F4	A6	U2022	3	G1	B2
				TP7010	8B	G2	A7				
R8022	8A	E2	B8	TP9010	8B	E3	A9	U2023A	2	C4	B2
R8023	8A	E2	B8	TP9011	8A	G2	A9	U2023B	3	G3	B2
R8024	8A	D2	B8					U2024	3	F2	B2
R8025	8A	C2	B8	TP9040	8A	B2	D9	U2025A	7	F1	B2
R8026	8A	B2	B8	TP9041	6	A2	D9	U2025B	7	G1	B2
R8027	8A	B1	B8					U2026	3	F2	B2
				U1010	2	G2	A1				
R8028	8A	B1	B8	U1011A	4	D4	A1	U2027A	7	C4	B2
R8040	6	E3	D8	U1011B	5	C3	A1	U2027B	7	A4	B2
R8041	6	E3	D8	U1012A	5	E2	A1	U2030	7	B2	C2
R8042	6	E3	D8	U1012B	5	E3	A1	U2031	7	C1	C2
R8043	6	E2	D8	U1020	2	G3	B1	U2032	7	C2	C2
R8044	6	C2	D8					U2033A	3	B2	C2
				U1021	2	E3	B1				
R8045	6	C2	D8	U1022	2	E2	B1	U2033B	7	F1	C2
R8046	6	C2	D8	U1023	2	D1	B1	U2034A	7	G1	C2
R8047	6	C2	D8	U1030	2	B1	C1	U2034B	7	E2	C2
R9010	8A	H2	A9	U1031A	2	G2	C1	U2034C	7	C3	C2
R9011	8A	H2	A9	U1031B	2	C1	C1	U2034D	7	B4	C2
R9012	8A	F2	A9					U2036	7	E2	C2
				U1031C	3	B2	C1				
R9013	8A	F1	A9	U1031D	2	C1	C1	U2037	7	E3	C2
R9014	8A	E2	A9	U1031E	2	A2	C1	U2040A	6	B3	D2
R9015	8A	E1	A9	U1031F	2	A3	C1	U2040B	5	B3	D2
R9020	8A	E1	B9	U1032A	2	B1	C1	U2040C	3	C2	D2
R9021	8A	C1	B9	U1032B	2	B2	C1	U2040D	7	E1	D2
R9022	8A	C2	B9					U2041	6	C3	D2

† Back Side Components

A1 – MAIN

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
U2042A	7	D1	D2
U2042B	7	D1	D2
U2043	7	D3	D2
U2044	6	B1	D2
U2045A	7	G2	D2
U2045B	7	G3	D2
U2045C	7	G3	D2
U2046	6	B3	D2
U3010	2	B3	A3
U3020A	3	F4	B3
U3020B	3	F4	B3
U3020C	3	B3	B3
U3020D	3	B4	B3
U3021	8A	B3	B3
U3022	8A	B4	B3
U3023	8A	C3	B3
U3040	6	B3	D3
U3041	6	B2	D3
U3042	6	G2	D3
U4020	8B	C3	B4
U4021A	8A	D4	B4
U4021B	8A	G3	B4
U4040	6	G3	D4
U5010	8B	E4	A5
U5020	8B	B4	B5
U5040	6	E2	D5
U6040	6	E3	D6
U7010A	8A	G1	A7
U7010B	8A	D3	A7
U7040	6	D2	D7
U8010A	8A	G2	A8
U8010B	8A	F2	A8
U8010C	8A	F2	A8
U8040	6	D3	D8
U8041	6	C2	D8
U9030	5	C1	C9
VR3030	8A	B3	C3
VR6030	8B	C1	C6

† Back Side Components

A2 – FRONT PANEL

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
C1011	10	D1	A1	R1021	10	C1	B1	U2020A	10	B1	B2
C1015	10	B1	A1	R1022A	10	C3	B1	U2020B	10	C3	B2
C2010	10	A3	A2	R1022B	10	C4	B1	U2021	10	C1	B2
C2011	10	A3	A2	R1023	10	C2	B1	U2022A	99	F2	B2
C2020	10	C1	B2	R1024	10	B1	B1	U2022B	10	B1	B2
C2021	10	E1	B2	R1025	10	B1	B1	U2022B	99	F2	B2
C2022	10	E2	B2	R1026	10	A1	B1	U2022C	10	B2	B2
C2023	10	G4	B2	R1027	10	C3	B1	U2023	10	E3	B2
C2024	10	B1	B2	R1030	10	D2	C1	U2024	10	G1	B2
C2025	10	B3	B2	R1031	10	D2	C1	U2025	10	G2	B2
C2026	10	E4	B2	R2010	10	B2	A2	U3020A	10	B3	B3
C2027	10	B3	B2	R2020	10	F1	B2	U3020B	10	B3	B3
C2028	10	E4	B2	R2021	10	B3	B2	U3020C	10	B3	B3
C2030	10	C1	C2	R2022	10	C1	B2	U3020D	10	B3	B3
C2031	10	C3	C2	R2024A	10	A3	B2	U3021A	10	B1	B3
C2032	10	C4	C2	R2024B	10	A3	B2	U3021B	99	C2	B3
C2033	10	D3	C2	R2030	10	D4	C2	U3021C	10	B2	B3
C2034	10	D4	C2	R2031	10	E4	C2	U3021D	10	B2	B3
C3010	10	A4	A3	R2032	10	D3	C2	U3022A	10	B3	B3
C3020	10	H4	B3	R2034	10	B3	C2	U3022B	10	B3	B3
C3021	10	C1	B3	R2035	10	B3	C2	U3022C	10	B2	B3
C3022	10	C1	B3	R2036	10	C3	C2	U3022D	10	B3	B3
C3023	10	B1	B3	R2037	10	C4	C2	U3023A	10	B4	B3
C3030 †	10	D3	C3	R2038	10	D3	C2	U3023B	10	B3	B3
C3031 †	10	D3	C3	R3010	10	B4	A3	U3023C	10	B4	B3
C3032	10	C3	C3	R3011	10	B3	A3	U3023D	10	B4	B3
C3033	10	C3	C3	R3020A	10	D4	B3	U3025	10	G2	B3
C3034	10	B4	C3	R3020B	10	D4	B3	U3031	10	G3	C3
				R3024	10	D1	B3				
J1020 †	10	F1	C1	R3031	10	E1	C3				
J3030 †	10	H1	C3								
				S1010	10	A2	A1				
PS2030 †	10	F2	C2	S1011	10	A2	A1				
				S2010	10	A3	A2				
Q1020	10	C1	B1	S2011	10	A3	A2				
Q1030	10	D3	C1	S3010	10	A4	A3				
Q2020	10	A1	B2	S3012	10	C2	A3				
R1010	10	B2	A1	S3020	10	E2	B3				
R1011	10	D1	A1	S3021	10	D3	B3				
R1012	10	E2	A1	S3022	10	C4	B3				
R1013	10	B2	A1								
R1014	10	D1	A1	U2010A	10	D1	A2				
R1020	10	D1	B1	U2010B	99	D2	A2				

† Back Side Components

A3A1 – POWER SUPPLY

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
C1010 †	1A	B2	A1	CR2010	1A	E3	A2	R1017	1A	D3	A1
C1011	1A	B3	A1	CR2011	1A	G2	A2	R1018	1A	C4	A1
C1012	1A	C4	A1	CR2012	1A	G2	A2	R1020	1A	B6	B1
C1013	1A	F2	A1	CR2013	1A	G2	A2	R1021	1A	B5	B1
C1014	1A	D3	A1	CR2014	1A	G2	A2	R1022	1A	B7	B1
C1015	1A	C4	A1	CR2015	1A	G2	A2	R1023	1A	B7	B1
C1016	1A	C4	A1	CR2016	1A	A5	A2	R1024	1A	C7	B1
C1030	1A	G5	C1	CR2020	1A	D7	B2	R1025	1A	C6	B1
C1031	1A	G5	C1	CR2021	1A	D6	B2	R1026	1A	E7	B1
C1032	1A	F4	C1	CR2030	1A	F6	C2	R1030	1A	G5	C1
C1033	1A	F4	C1	CR2031	1A	F6	C2	R2010	1A	F2	A2
C1034	1A	F3	C1					R2011	1A	F2	A2
				J1010	1A	B2	A1				
C1035	1A	F4	C1	J1030	1A	G4	C1	R2012	1A	G2	A2
C1036	1A	G5	C1	J2010	1A	H2	A2	R2013	1A	A6	A2
C1037	1A	G5	C1					R2014	1A	A6	A2
C1038	1A	F6	C1	L1010	1A	E3	A1	R2015	1A	B6	A2
C2010	1A	F3	A2	L2020	1A	D6	B2	R2016	1A	A5	A2
C2011	1A	A5	A2					R2017	1A	A5	A2
				Q1010	1A	E2	A1				
C2012	1A	F3	A2	Q1011	1A	F2	A1	R2018	1A	B5	A2
C2013	1A	B6	A2	Q1012	1A	E2	A1	R2020	1A	C7	B2
C2020	1A	C7	B2	Q2010	1A	B6	A2	R2021	1A	D7	B2
C2021	1A	D5	B2	Q2011	1A	B5	A2	R2022	1A	D7	B2
C2022	1A	C7	B2	Q2012	1A	B5	A2	R2023	1A	D7	B2
C2023	1A	C7	B2					R2024	1A	C7	B2
				Q2020	1A	D7	B2				
C2024	1A	E7	B2	Q2021	1A	D8	B2	R2025	1A	D7	B2
C2025	1A	E6	B2	Q2022	1A	D7	B2	R2026	1A	D8	B2
C2030	1A	E8	C2	Q2030	1A	F6	C2	R2027	1A	D7	B2
C2031	1A	G6	C2	Q2031	1A	F6	C2	R2030	1A	G6	C2
								R2031	1A	G4	C2
CR1010	1A	B2	A1	R1010	1A	B3	A1	R2032	1A	G7	C2
CR1011	1A	E3	A1	R1011	1A	B3	A1				
CR1030	1A	F4	C1	R1012	1A	B3	A1	S2010	1A	A5	A2
CR1031	1A	F5	C1	R1013	1A	C3	A1				
CR1032	1A	F5	C1	R1014	1A	D2	A1	T1030	1A	F5	C1
CR1033	1A	F5	C1	R1015	1A	B3	A1	T1031	1A	G6	C1
CR1034	1A	F3	C1	R1016	1A	B3	A1	TP1010	1A	A3	A1

† Back Side Components

A3A1 – POWER SUPPLY

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
TP1020	1A	G2	B1
TP2010	1A	B2	A2
TP2030	1A	E6	C2
U1010	1A	C4	A1
U1011	1A	D3	A1
U1020A	1A	B6	B1
U1020B	1A	B6	B1
U1021A	1A	B7	B1
U1021B	1A	B8	B1
U1022	1A	C6	B1
U1023	1A	C7	B1
U1024B	1A	E7	B1
U2010	1A	G2	A2
U2030A	1A	E8	C2
U2030B	1A	F7	C2
U2030C	1A	F7	C2
U2030D	1A	F7	C2
U2030E	1A	F7	C2
VR1012	1A	D2	A1

† Back Side Components

A4– S/R DRIVER SAMPLER

CIRCUIT	SCHEM	LOCATION		CIRCUIT	SCHEM	LOCATION		CIRCUIT	SCHEM	LOCATION	
NUMBER	PAGE	SCHEM	BRD	NUMBER	PAGE	SCHEM	BRD	NUMBER	PAGE	SCHEM	BRD
C1010	9A	E5	A1	C3061	9A	B2	F3	R1062	9A	C5	F1
C1011	9A	E5	A1	C3062	9A	A1	F3	R1063	9A	C5	F1
C1020	9A	D2	B1	C3063	9A	C2	F3	R1064	9A	C5	F1
C1030	9A	F2	C1	C3064	9A	A1	F3	R1065	9A	D4	F1
C1040	9A	D2	D1	C3065	9A	B2	F3	R1066	9A	D5	F1
C1041	9A	B3	D1	C3070	9A	A2	G3	R1070	9A	D4	G1
C1050	9A	F7	E1	C3080	9A	B2	H3	R1071	9A	D4	G1
C1060	9A	G7	F1					R1072	9A	D5	G1
C1061	9A	F8	F1	CR1030	9A	B4	C1	R2030	9A	B4	C2
C1070	9A	D4	G1	CR1031	9A	F2	C1	R2031	9A	B4	C2
C1071	9A	D5	G1	CR1032	9A	F3	C1	R2040	9A	B3	D2
C2010	9A	E2	A2	CR1040	9A	D1	D1	R2041	9A	B4	D2
				CR2050	9A	E7	E2				
C2011	9A	E5	A2	CR2051	9A	E6	E2	R2042	9A	F6	D2
C2012	9A	E4	A2					R2043	9A	F7	D2
C2020	9A	E3	B2	CR2052	9A	E7	E2	R2045	9A	A4	D2
C2021	9A	E3	B2	CR3020	9A	B5	B3	R2046	9A	C6	D2
C2022	9A	E3	B2	CR3021	9A	C5	B3	R2047	9A	D6	D2
C2023	9A	E4	B2					R2048	9A	D6	D2
				J3040	9A	G3	D3				
C2024	9A	E4	B2					R2049	9A	D6	D2
C2025	9A	E3	B2	L2080	9A	A7	H2	R2050	9A	E7	E2
C2026	9A	E4	B2	L2081	9A	A7	H2	R2051	9A	D6	E2
C2030	9A	B4	C2					R2052	9A	D7	E2
C2031	9A	B6	C2	Q1030	9A	E2	C1	R2053	9A	E7	E2
C2040	9A	B4	D2	Q1060	9A	E6	F1	R2054	9A	E7	E2
				Q2030	9A	B4	C2				
C2041	9A	F6	D2	Q2040	9A	D6	D2	R3020	9A	B5	B3
C2042	9A	A4	D2	Q2050	9A	D6	E2	R3021	9A	B6	B3
C2050	9A	F7	E2					R3032	9A	F4	C3
C2051	9A	D6	E2	R1010	9A	E4	A1	R3033	9A	E4	C3
C2052	9A	D7	E2	R1020	9A	C4	B1	R3040	9A	B7	D3
C2053	9A	E7	E2	R1030	9A	E1	C1	R3050	9A	A1	E3
				R1031	9A	E2	C1				
C2072	9A	A2	G2	R1040	9A	D1	D1	R3051	9A	B2	E3
C2080	9A	B8	H2	R1041	9A	D2	D1	R3061	9A	A1	F3
C2081	9A	B7	H2					R3062	9A	A2	F3
C2082	9A	B8	H2	R1042	9A	D2	D1	R3070	9A	A2	G3
C2083	9A	B7	H2	R1050	9A	F7	E1	R3071	9A	B2	G3
C3010	9A	E5	A3	R1051	9A	F7	E1	R3080	9A	B1	H3
				R1052	9A	G7	E1				
C3011	9A	E5	A3	R1053	9A	F8	E1	T1020	9A	C4	B1
C3020	9A	B5	B3	R1060	9A	F6	F1				
C3030	9A	C7	C3					TP1020	9A	E5	B1
C3060	9A	A1	F3	R1061	9A	D6	F1	TP1021	9A	D4	B1

† Back Side Components

A4 – S/R DRIVER SAMPLER

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
TP1030	9A	E2	C1
TP1060	9A	G7	F1
TP1080	9A	B2	H1
TP1081	9A	C2	H1
TP1082	9A	F2	H1
TP1083	9A	B7	H1
TP1084	9A	B7	H1
TP2060	9A	E6	F2
TP3020	9A	B5	B3
U1010	9A	E5	A1
U1050A	9A	F7	E1
U1050B	9A	D2	E1
U1070A	9A	D5	G1
U1070B	9A	C5	G1
U2050A	9A	F6	E2
U2050B	9A	F5	E2
U2070	9A	A2	G2
U3030A	9A	B5	C3
U3030B	9A	C6	C3
U3070A	9A	B2	G3
U3070B	9A	A2	G3

† Back Side Components

A1 - MAIN

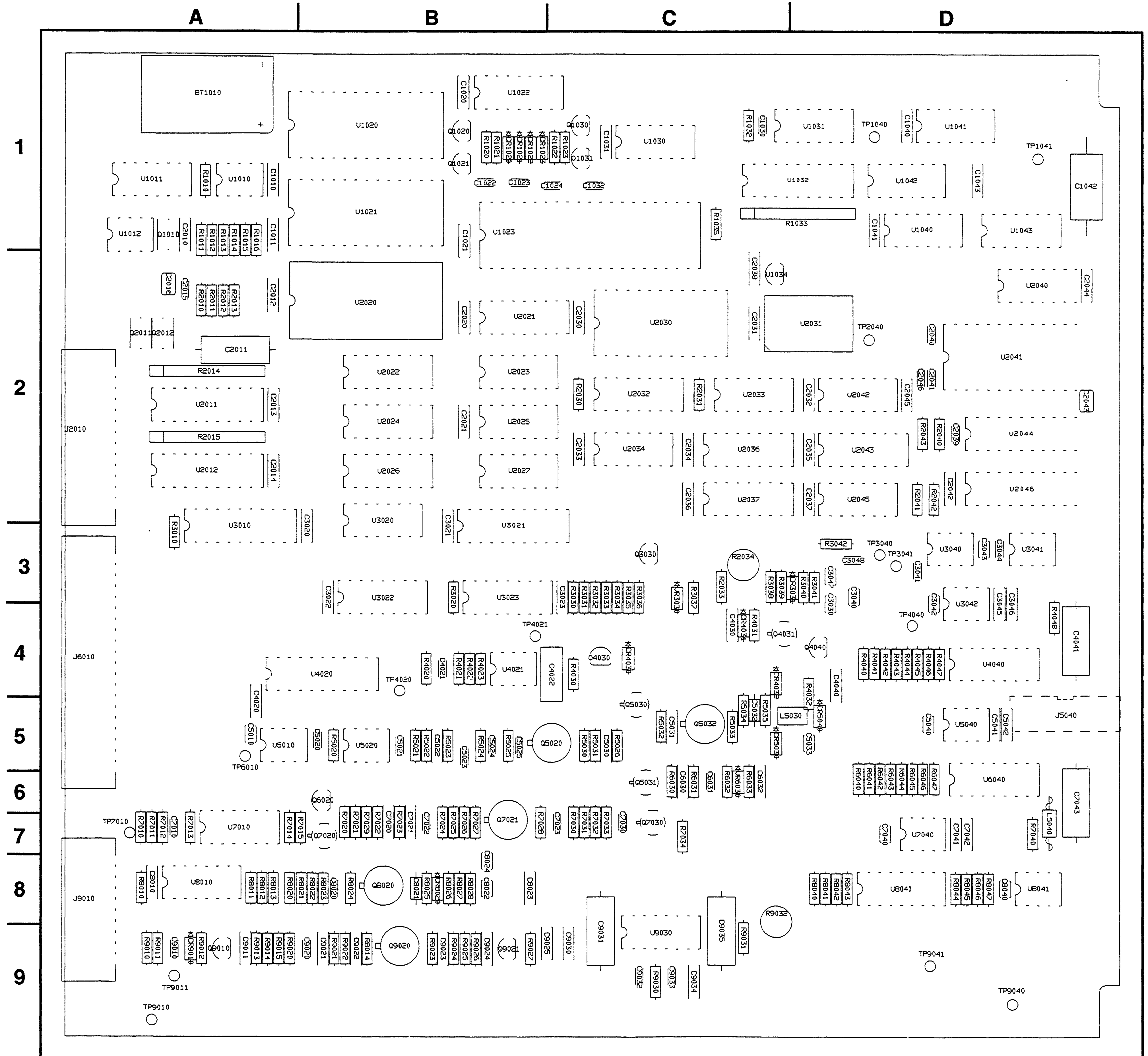
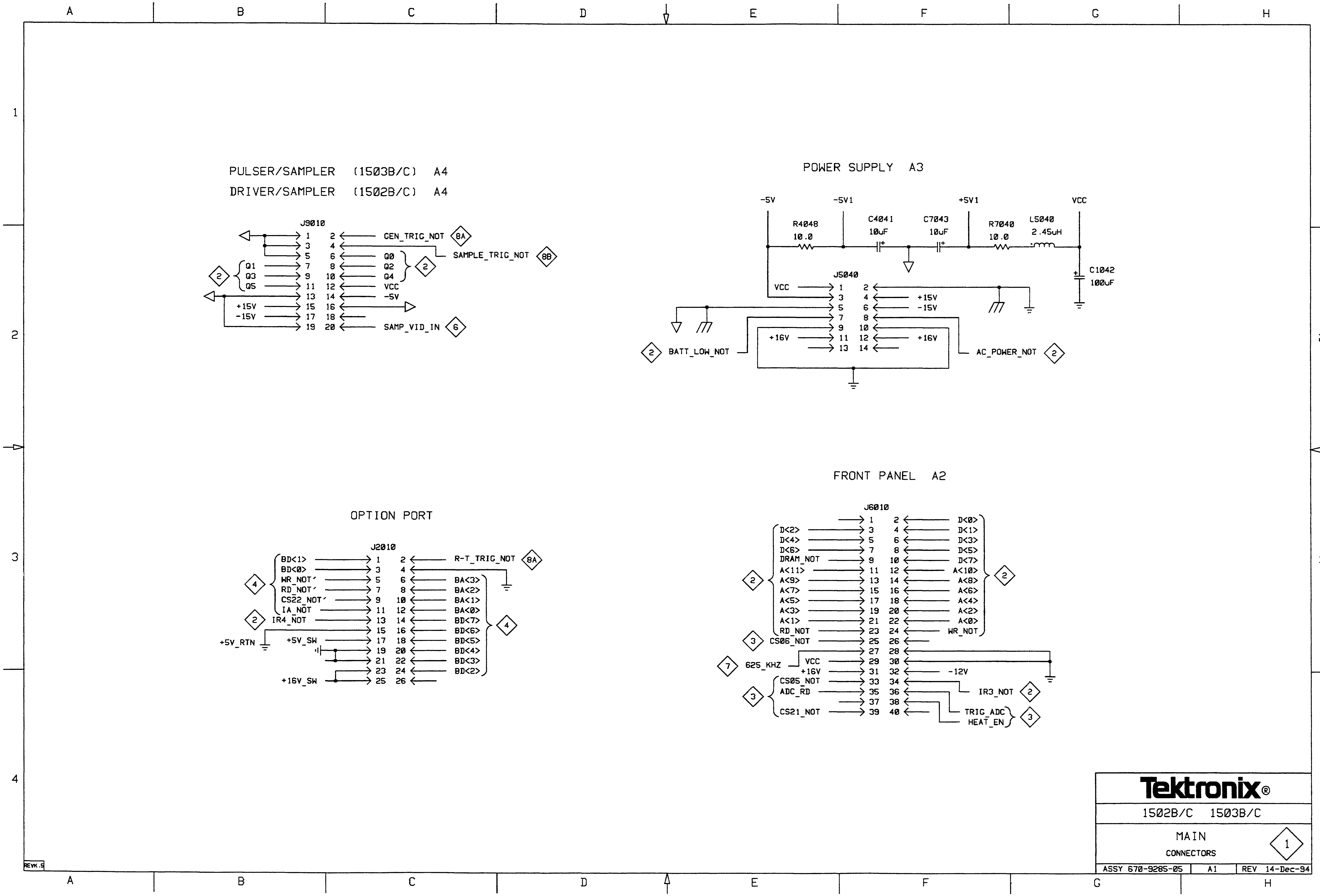
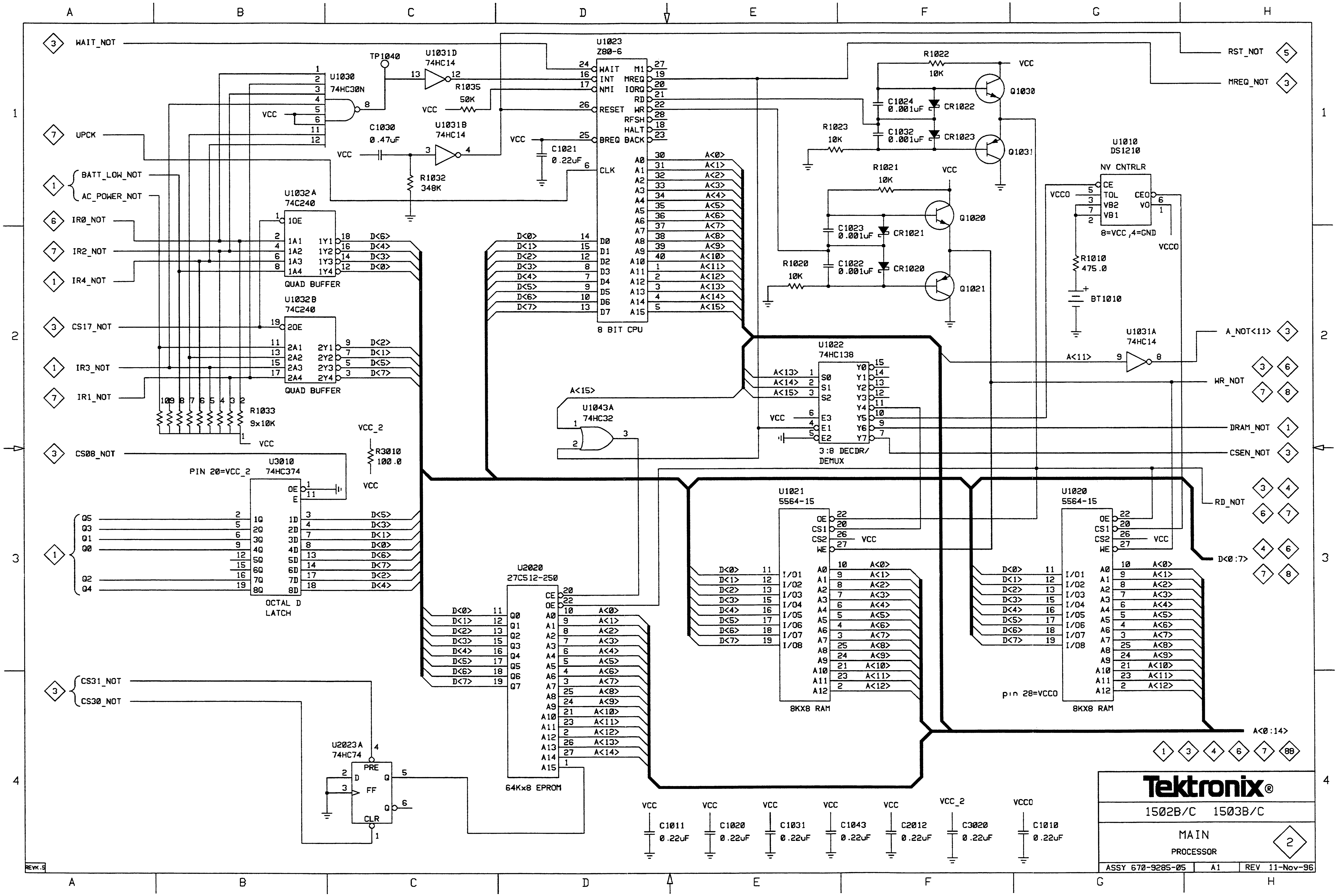
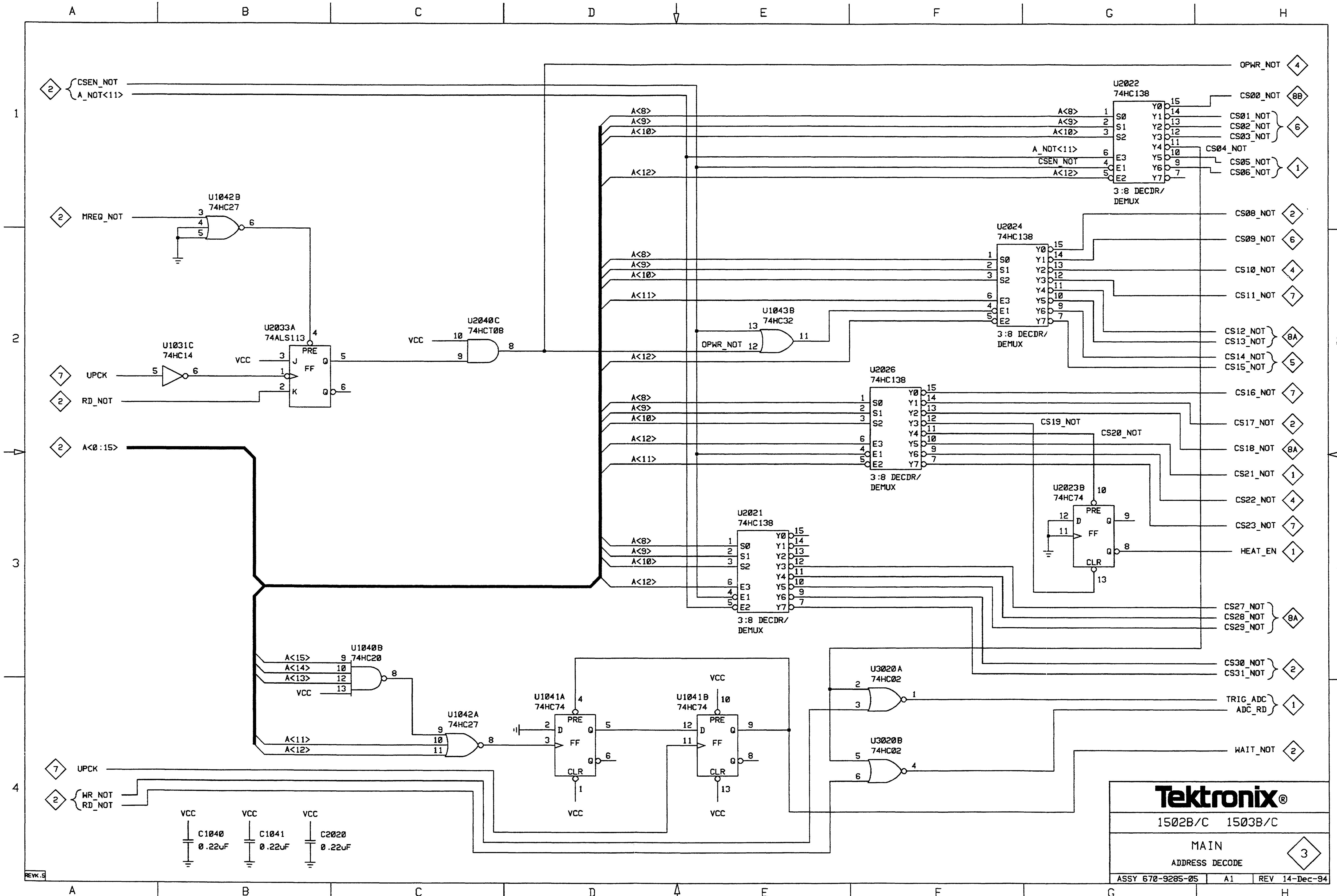
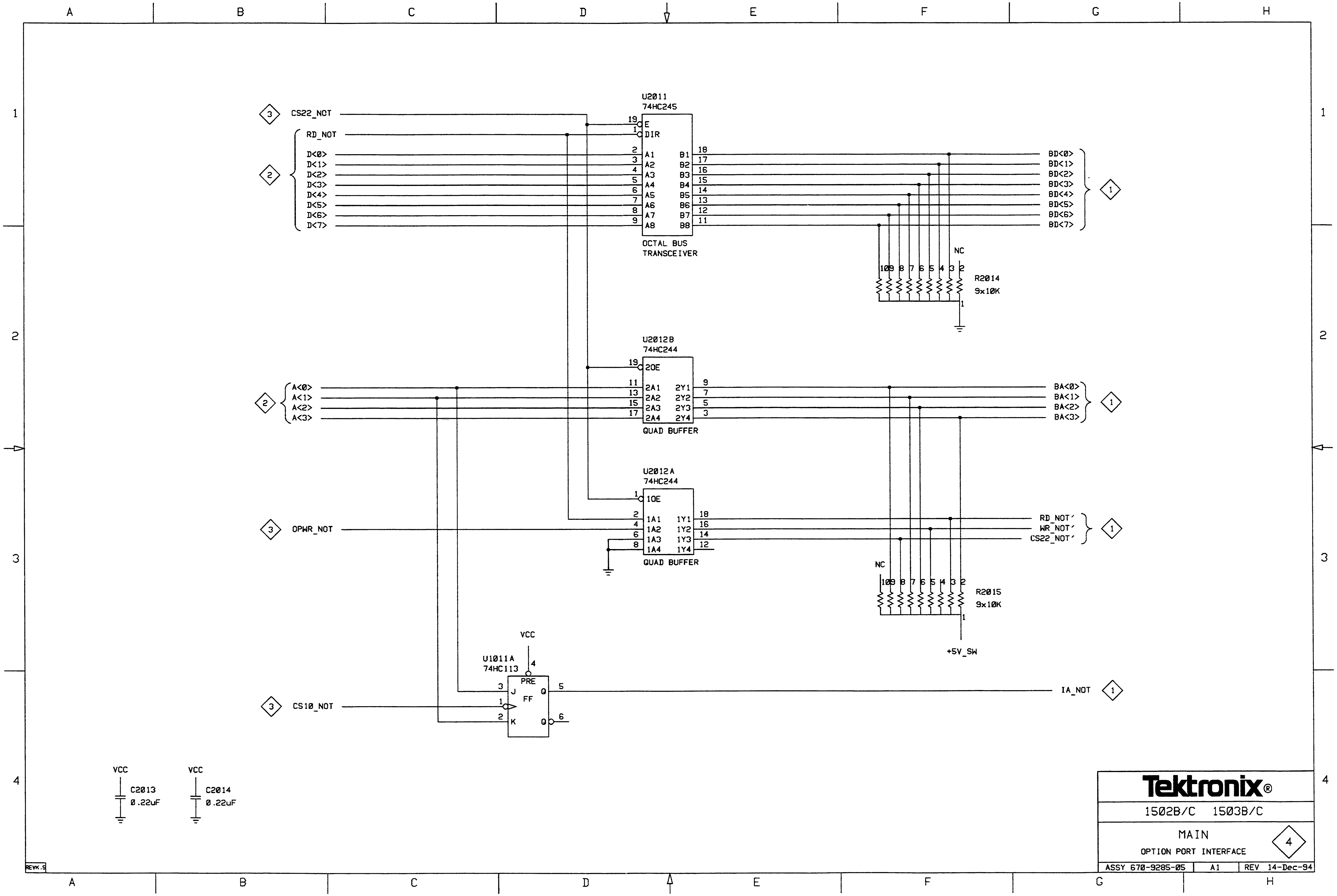


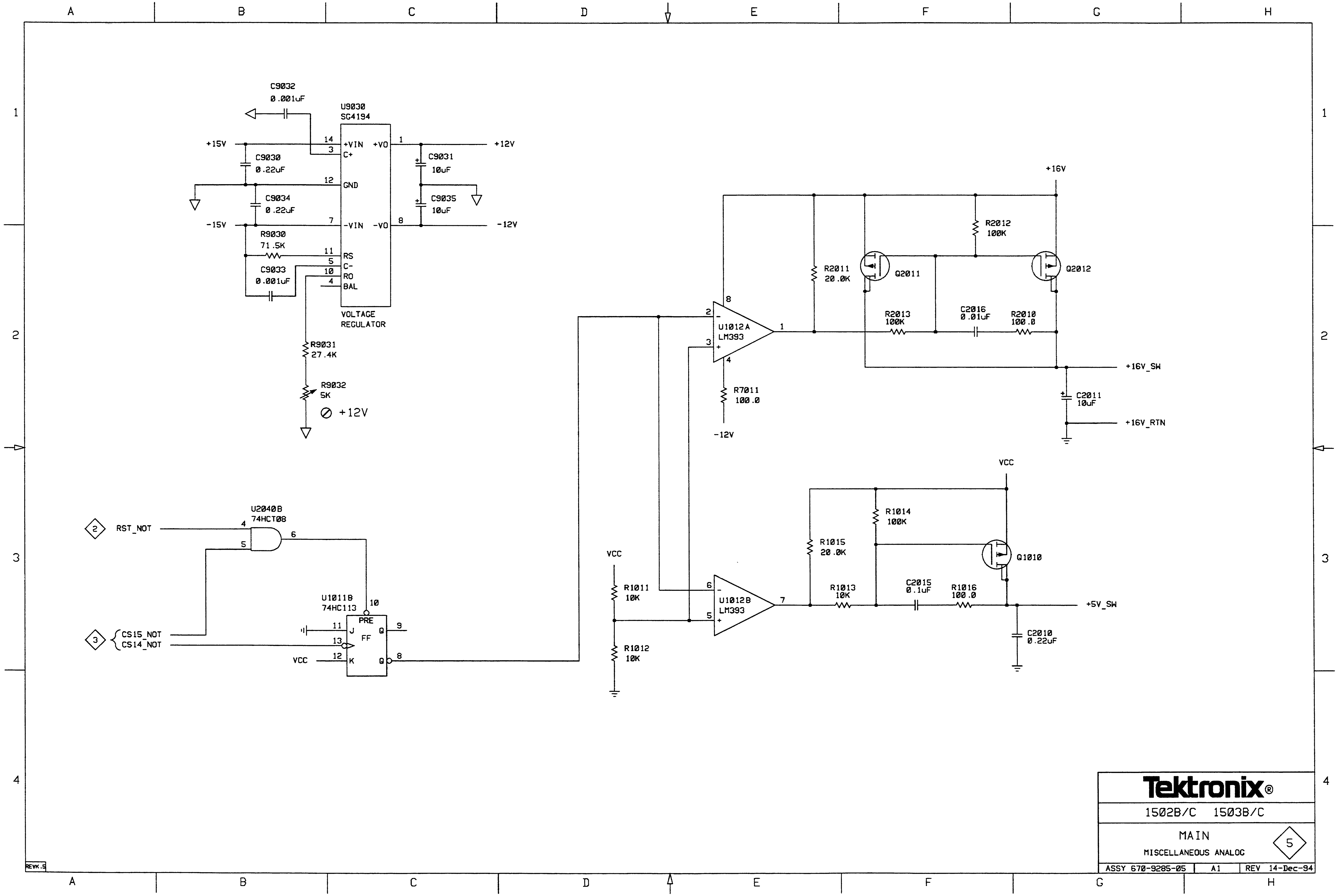
Fig. 9-2. Component Locator - Main Board

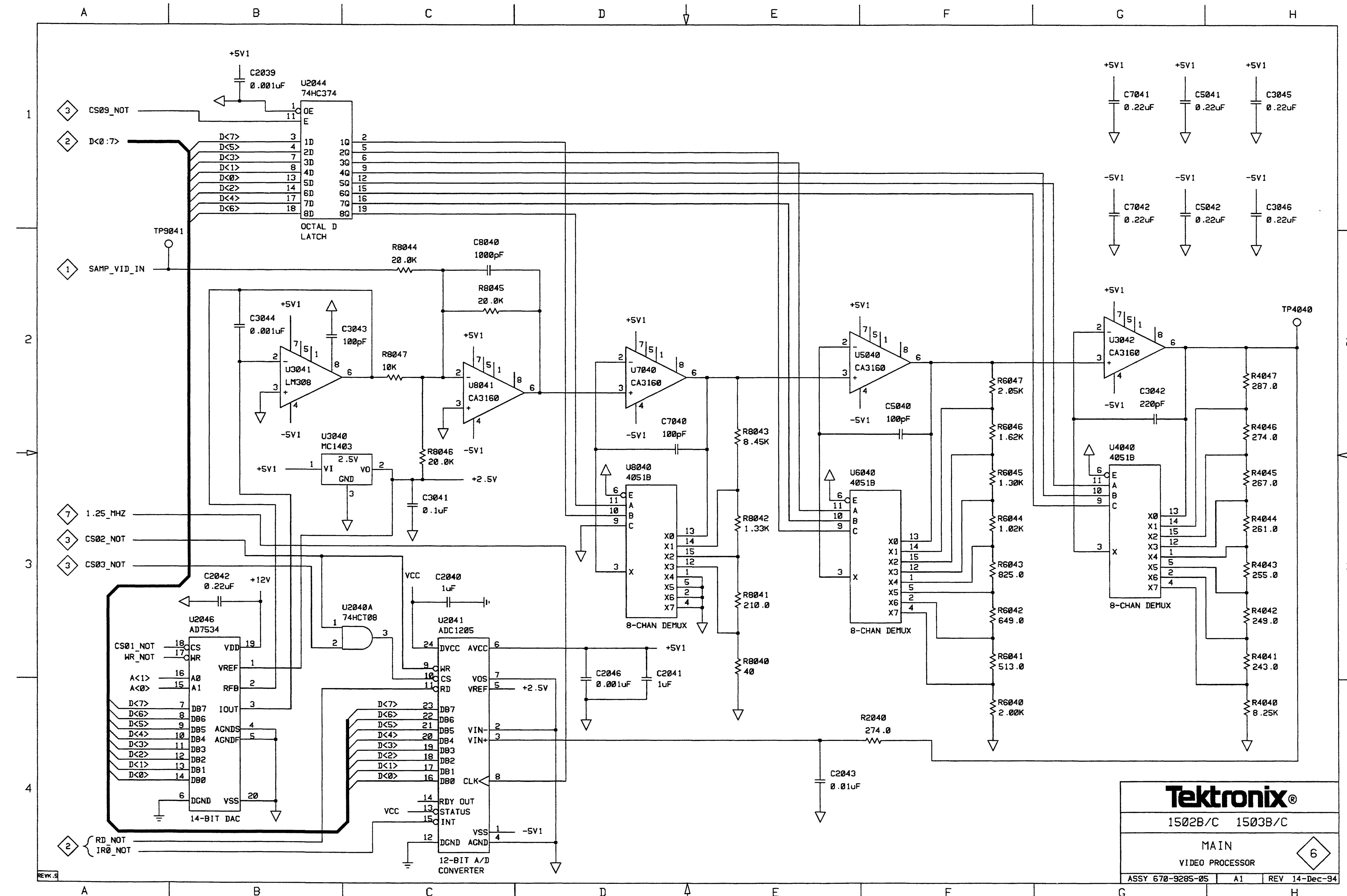

PULSER/SAMPLER (1503B/C) A4
DRIVER/SAMPLER (1502B/C) A4
J9010
GEN_TRIG_NOT
SAMPLE_TRIG_NOT
Q0
Q1
Q2
Q3
Q4
Q5
VCC
-5V
+15V
-15V
SAMP_VID_IN
POWER SUPPLY A3
-5V
-5V1
+5V1
VCC
R4048
10.0
C4041
10uF
C7043
10uF
R7040
10.0
L5040
2.45uH
C1042
100uF
J5040
+15V
-15V
+16V
BATT_LOW_NOT
AC_POWER_NOT
OPTION PORT
J2010
BD<1>
BD<0>
WR_NOT'
RD_NOT'
CS22_NOT'
IA_NOT
IR4_NOT
R-T_TRIG_NOT
BA<3>
BA<2>
BA<1>
BA<0>
BD<7>
BD<6>
BD<5>
BD<4>
BD<3>
BD<2>
+5V_RTN
+5V_SW
+16V_SW
FRONT PANEL A2
J6010
D<0>
D<1>
D<2>
D<3>
D<4>
D<5>
D<6>
D<7>
DRAM_NOT
A<11>
A<10>
A<9>
A<8>
A<7>
A<6>
A<5>
A<4>
A<3>
A<2>
A<1>
A<0>
RD_NOT
WR_NOT
CS06_NOT
625_KHZ
VCC
+16V
-12V
CS05_NOT
ADC_RD
CS21_NOT
IR3_NOT
TRIG_ADC
HEAT_EN
Tektronix
1502B/C 1503B/C
MAIN
CONNECTORS
ASSY 670-9285-05
A1
REV 14-Dec-94

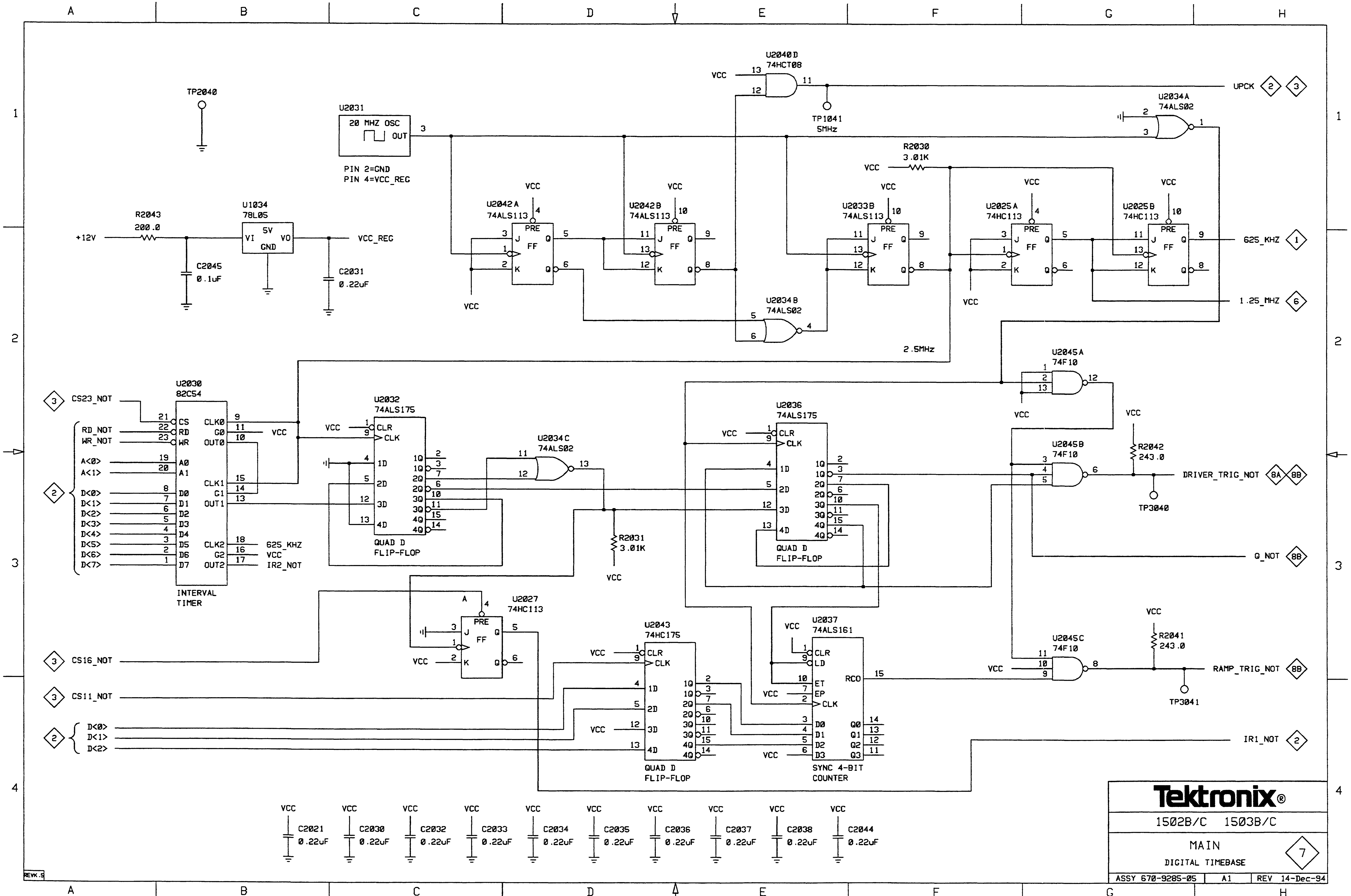

WAIT_NOT
UPCK
BATT_LOW_NOT
AC_POWER_NOT
IR0_NOT
IR2_NOT
IR4_NOT
CS17_NOT
IR3_NOT
IR1_NOT
CS08_NOT
CS31_NOT
CS30_NOT
RST_NOT
MREQ_NOT
A_NOT<11>
WR_NOT
DRAM_NOT
CSEN_NOT
RD_NOT
D<0:7>
A<0:14>
U1023 Z80-6
8 BIT CPU
U1030 74HC30N
U1031D 74HC14
U1031B 74HC14
U1031A 74HC14
TP1040
R1035 50K
C1030 0.47uF
R1032 348K
C1021 0.22uF
U1032A 74C240
QUAD BUFFER
U1032B 74C240
QUAD BUFFER
R1033 9x10K
U3010 74HC374
PIN 20=VCC_2
OCTAL D LATCH
VCC_2
R3010 100.0
U2023A 74HC74
U2020 27C512-250
64Kx8 EPROM
U1043A 74HC32
U1022 74HC138
3:8 DECDR/ DEMUX
U1021 5564-15
8KX8 RAM
U1020 5564-15
8KX8 RAM
pin 28=VCCO
R1022 10K
C1024 0.001uF
CR1022
C1032 0.001uF
CR1023
R1023 10K
Q1030
Q1031
R1021 10K
Q1020
C1023 0.001uF
CR1021
C1022 0.001uF
CR1020
R1020 10K
Q1021
U1010 DS1210
NV CNTRLR
8=VCC,4=GND
R1010 475.0
BT1010
C1011 0.22uF
C1020 0.22uF
C1031 0.22uF
C1043 0.22uF
C2012 0.22uF
C3020 0.22uF
C1010 0.22uF
Tektronix®
1502B/C 1503B/C
MAIN
PROCESSOR
ASSY 670-9285-05
A1
REV 11-Nov-96

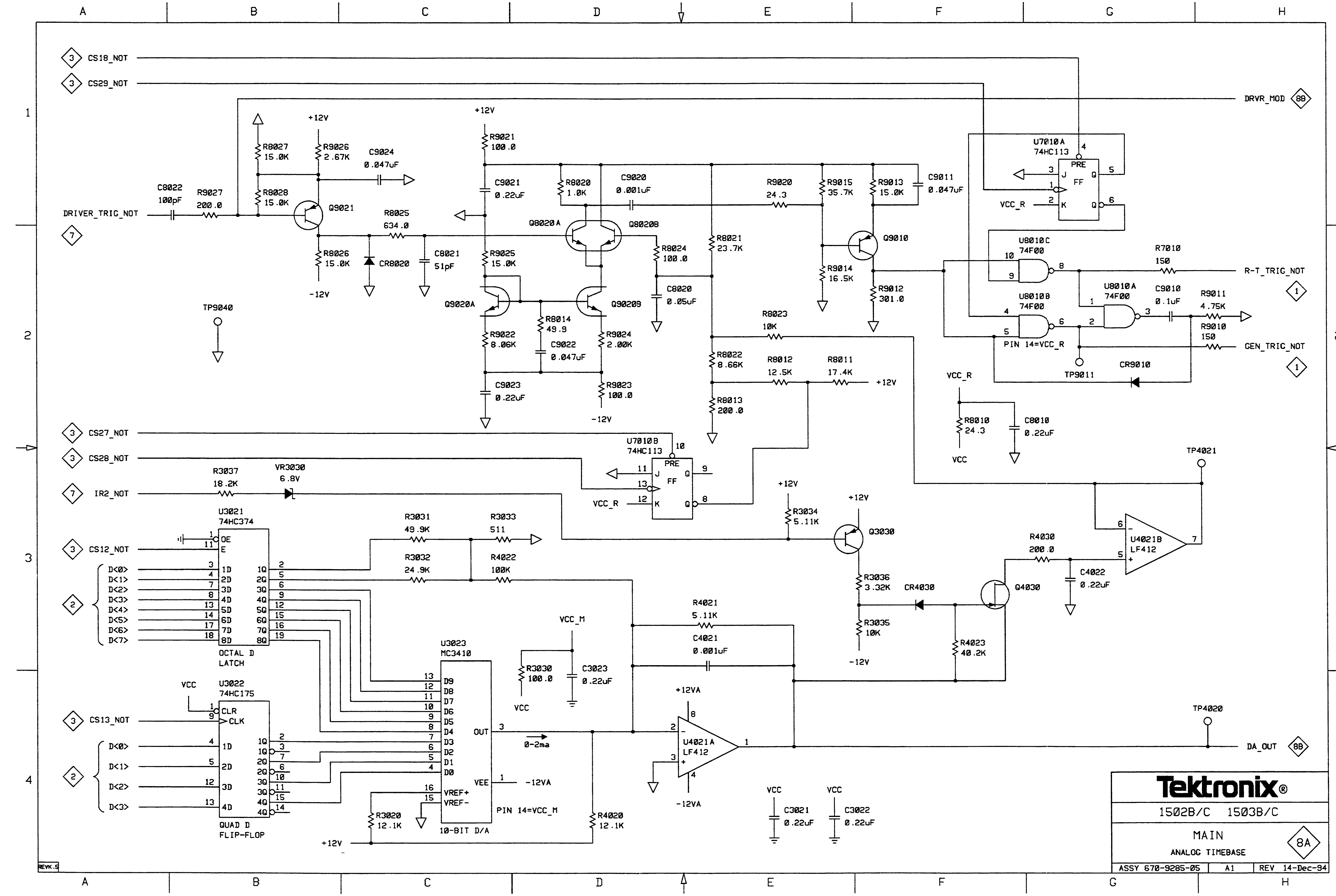

CSEN_NOT
A_NOT<11>
MREQ_NOT
UPCK
RD_NOT
A<0:15>
WR_NOT
U1042B 74HC27
U2033A 74ALS113
U1031C 74HC14
U2040C 74HCT08
U1043B 74HC32
U2022 74HC138
U2024 74HC138
U2026 74HC138
U2021 74HC138
3:8 DECDR/ DEMUX
U2023B 74HC74
U1040B 74HC20
U1042A 74HC27
U1041A 74HC74
U1041B 74HC74
U3020A 74HC02
U3020B 74HC02
OPWR_NOT
CS00_NOT
CS01_NOT
CS02_NOT
CS03_NOT
CS04_NOT
CS05_NOT
CS06_NOT
CS08_NOT
CS09_NOT
CS10_NOT
CS11_NOT
CS12_NOT
CS13_NOT
CS14_NOT
CS15_NOT
CS16_NOT
CS17_NOT
CS18_NOT
CS19_NOT
CS20_NOT
CS21_NOT
CS22_NOT
CS23_NOT
HEAT_EN
CS27_NOT
CS28_NOT
CS29_NOT
CS30_NOT
CS31_NOT
TRIG_ADC
ADC_RD
WAIT_NOT
C1040 0.22uF
C1041 0.22uF
C2020 0.22uF
VCC
Tektronix
1502B/C 1503B/C
MAIN
ADDRESS DECODE
ASSY 670-9285-05
A1
REV 14-Dec-94

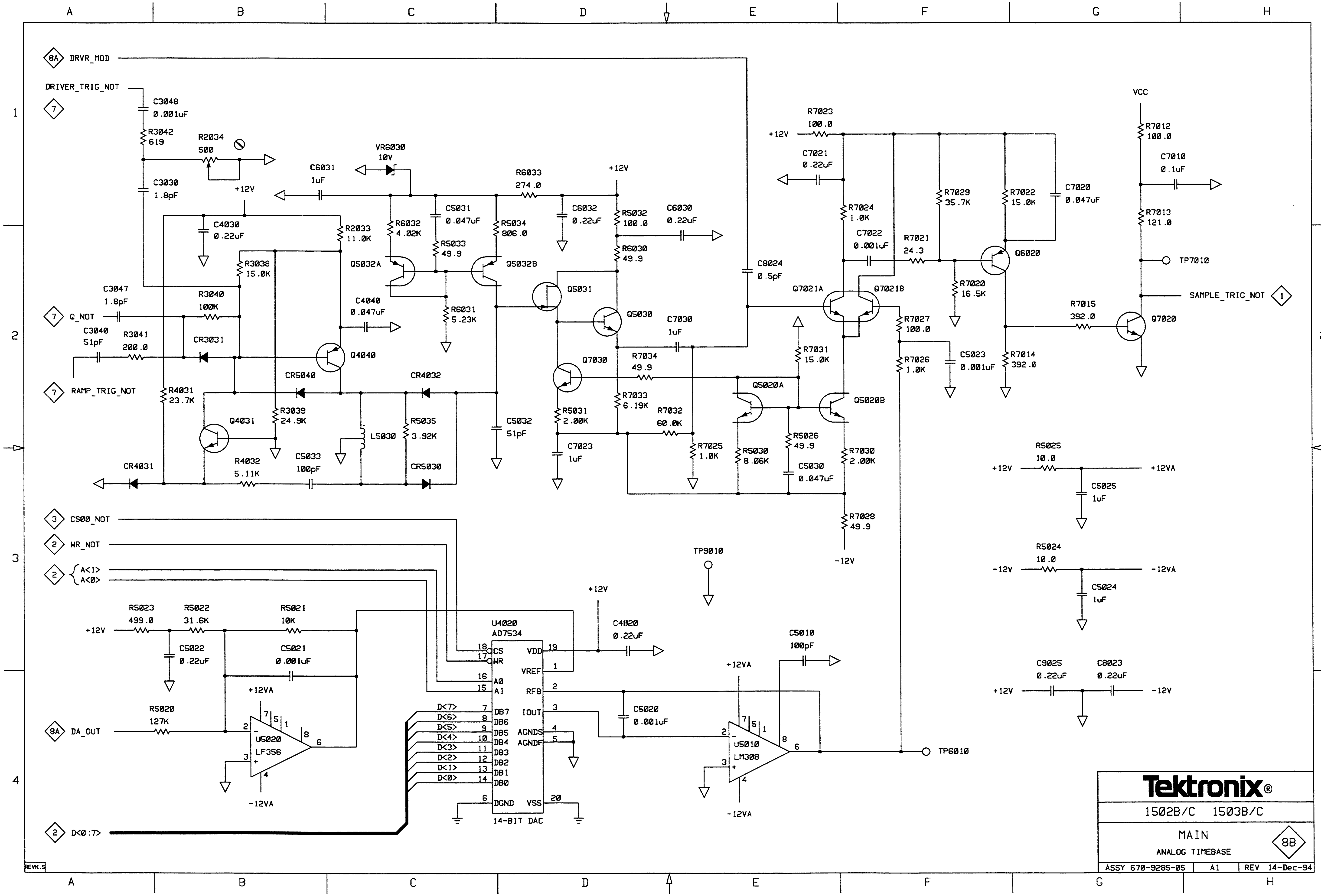

U2011
74HC245
OCTAL BUS TRANSCEIVER
CS22_NOT
RD_NOT
D<0> D<1> D<2> D<3> D<4> D<5> D<6> D<7>
BD<0> BD<1> BD<2> BD<3> BD<4> BD<5> BD<6> BD<7>
R2014
9x10K
NC
U2012B
74HC244
QUAD BUFFER
A<0> A<1> A<2> A<3>
BA<0> BA<1> BA<2> BA<3>
U2012A
74HC244
QUAD BUFFER
OPWR_NOT
RD_NOT' WR_NOT' CS22_NOT'
R2015
9x10K
+5V_SW
U1011A
74HC113
VCC
CS10_NOT
IA_NOT
C2013 0.22uF
C2014 0.22uF
Tektronix
1502B/C 1503B/C
MAIN
OPTION PORT INTERFACE
ASSY 670-9285-05 A1 REV 14-Dec-94


C9032
0.001uF
U9030
SG4194
+15V
+VIN
+VO
+12V
C+
C9030
0.22uF
C9031
10uF
GND
C9034
0.22uF
C9035
10uF
-15V
-VIN
-VO
-12V
R9030
71.5K
RS
C-
RO
BAL
C9033
0.001uF
VOLTAGE
REGULATOR
R9031
27.4K
R9032
5K
+12V
+16V
R2012
100K
R2011
20.0K
Q2011
Q2012
U1012A
LM393
R2013
100K
C2016
0.01uF
R2010
100.0
+16V_SW
R7011
100.0
C2011
10uF
+16V_RTN
-12V
VCC
R1014
100K
R1015
20.0K
Q1010
U2040B
74HCT08
RST_NOT
CS15_NOT
CS14_NOT
U1011B
74HC113
PRE
FF
VCC
R1011
10K
R1012
10K
U1012B
LM393
R1013
10K
C2015
0.1uF
R1016
100.0
+5V_SW
C2010
0.22uF
Tektronix®
1502B/C 1503B/C
MAIN
MISCELLANEOUS ANALOG
5
ASSY 670-9285-05
A1
REV 14-Dec-94


CS09_NOT
D<0:7>
TP9041
SAMP_VID_IN
1.25_MHZ
CS02_NOT
CS03_NOT
CS01_NOT
WR_NOT
A<1>
A<0>
RD_NOT
IR0_NOT
+5V1
C2039
0.001uF
U2044
74HC374
OCTAL D
LATCH
R8044
20.0K
C8040
1000pF
R8045
20.0K
C3044
0.001uF
C3043
100pF
U3041
LM308
R8047
10K
U8041
CA3160
U3040
MC1403
2.5V
GND
R8046
20.0K
+2.5V
C3041
0.1uF
U7040
CA3160
C7040
100pF
U8040
4051B
8-CHAN DEMUX
R8043
8.45K
R8042
1.33K
R8041
210.0
R8040
40
U5040
CA3160
C5040
100pF
U6040
4051B
8-CHAN DEMUX
R6047
2.05K
R6046
1.62K
R6045
1.30K
R6044
1.02K
R6043
825.0
R6042
649.0
R6041
513.0
R6040
2.00K
U3042
CA3160
C3042
220pF
U4040
4051B
8-CHAN DEMUX
TP4040
R4047
287.0
R4046
274.0
R4045
267.0
R4044
261.0
R4043
255.0
R4042
249.0
R4041
243.0
R4040
8.25K
C7041
0.22uF
C5041
0.22uF
C3045
0.22uF
-5V1
C7042
0.22uF
C5042
0.22uF
C3046
0.22uF
C2042
0.22uF
+12V
U2046
AD7534
14-BIT DAC
U2040A
74HCT08
VCC
C2040
1uF
U2041
ADC1205
12-BIT A/D
CONVERTER
C2046
0.001uF
C2041
1uF
R2040
274.0
C2043
0.01uF
Tektronix
1502B/C 1503B/C
MAIN
VIDEO PROCESSOR
6
ASSY 670-9285-05
A1
REV 14-Dec-94


TP2040
U2031
20 MHZ OSC
OUT
PIN 2=GND
PIN 4=VCC_REG
R2043
200.0
+12V
U1034
78L05
VI
VO
5V
GND
VCC_REG
C2045
0.1uF
C2031
0.22uF
U2040D
74HCT08
VCC
UPCK
TP1041
5MHz
U2034A
74ALS02
R2030
3.01K
U2042A
74ALS113
U2042B
74ALS113
U2033B
74ALS113
U2025A
74HC113
U2025B
74HC113
PRE
FF
625_KHZ
1.25_MHZ
U2034B
74ALS02
2.5MHz
U2045A
74F10
U2030
82C54
CS23_NOT
RD_NOT
WR_NOT
A<0>
A<1>
D<0>
D<1>
D<2>
D<3>
D<4>
D<5>
D<6>
D<7>
CLK0
G0
OUT0
CLK1
G1
OUT1
CLK2
G2
OUT2
IR2_NOT
INTERVAL
TIMER
U2032
74ALS175
CLR
CLK
QUAD D
FLIP-FLOP
U2034C
74ALS02
R2031
3.01K
U2036
74ALS175
U2045B
74F10
R2042
243.0
DRIVER_TRIG_NOT
TP3040
Q_NOT
U2027
74HC113
CS16_NOT
CS11_NOT
U2043
74HC175
U2037
74ALS161
LD
ET
EP
RCO
SYNC 4-BIT
COUNTER
U2045C
74F10
R2041
243.0
RAMP_TRIG_NOT
TP3041
IR1_NOT
C2021
C2030
C2032
C2033
C2034
C2035
C2036
C2037
C2038
C2044
0.22uF
Tektronix
1502B/C 1503B/C
MAIN
DIGITAL TIMEBASE
ASSY 670-9285-05
A1
REV 14-Dec-94


CS18_NOT
CS29_NOT
DRVR_MOD
DRIVER_TRIG_NOT
C8022 100pF
R9027 200.0
R8027 15.0K
R8028 15.0K
+12V
R9026 2.67K
C9024 0.047uF
Q9021
R8025 634.0
R8026 15.0K
-12V
CR8020
C8021 51pF
R9021 100.0
C9021 0.22uF
R9025 15.0K
Q9020A
R9022 8.06K
C9023 0.22uF
R8020 1.0K
Q8020A
Q8020B
C9020 0.001uF
R8014 49.9
C9022 0.047uF
Q9020B
R9024 2.00K
R9023 100.0
R8024 100.0
C8020 0.05uF
R8021 23.7K
R8022 8.66K
R8013 200.0
R9020 24.3
R9015 35.7K
R9014 16.5K
R9013 15.0K
Q9010
R9012 301.0
C9011 0.047uF
R8023 10K
R8012 12.5K
R8011 17.4K
U7010A 74HC113
PRE J FF K Q
VCC_R
U8010C 74F00
U8010B 74F00
U8010A 74F00
PIN 14=VCC_R
R7010 150
R-T_TRIG_NOT
C9010 0.1uF
R9011 4.75K
R9010 150
GEN_TRIG_NOT
TP9011
CR9010
R8010 24.3
C8010 0.22uF
VCC
TP9040
CS27_NOT
CS28_NOT
IR2_NOT
R3037 18.2K
VR3030 6.8V
U7010B 74HC113
TP4021
U3021 74HC374
OCTAL D LATCH
CS12_NOT
D<0> D<1> D<2> D<3> D<4> D<5> D<6> D<7>
R3031 49.9K
R3032 24.9K
R3033 511
R4022 100K
R3034 5.11K
Q3030
R3036 3.32K
R3035 10K
CR4030
Q4030
R4030 200.0
C4022 0.22uF
U4021B LF412
R4023 40.2K
R4021 5.11K
C4021 0.001uF
VCC_M
R3030 100.0
C3023 0.22uF
U3023 MC3410
10-BIT D/A
OUT 0-2ma
VEE -12VA
VREF+ VREF-
PIN 14=VCC_M
U3022 74HC175
QUAD D FLIP-FLOP
CS13_NOT
CLR CLK
R3020 12.1K
R4020 12.1K
+12VA
U4021A LF412
-12VA
TP4020
DA_OUT
C3021 0.22uF
C3022 0.22uF
Tektronix
1502B/C 1503B/C
MAIN
ANALOG TIMEBASE
8A
ASSY 670-9285-05 A1 REV 14-Dec-94


DRVR_MOD
DRIVER_TRIG_NOT
Q_NOT
RAMP_TRIG_NOT
CS00_NOT
WR_NOT
A<1>
A<0>
DA_OUT
D<0:7>
SAMPLE_TRIG_NOT
VCC
TP7010
TP9010
TP6010
U4020 AD7534
14-BIT DAC
U5020 LF356
U5010 LM308
Tektronix®
1502B/C 1503B/C
MAIN
ANALOG TIMEBASE
8B
ASSY 670-9285-05
A1
REV 14-Dec-94

A2 - FRONT PANEL

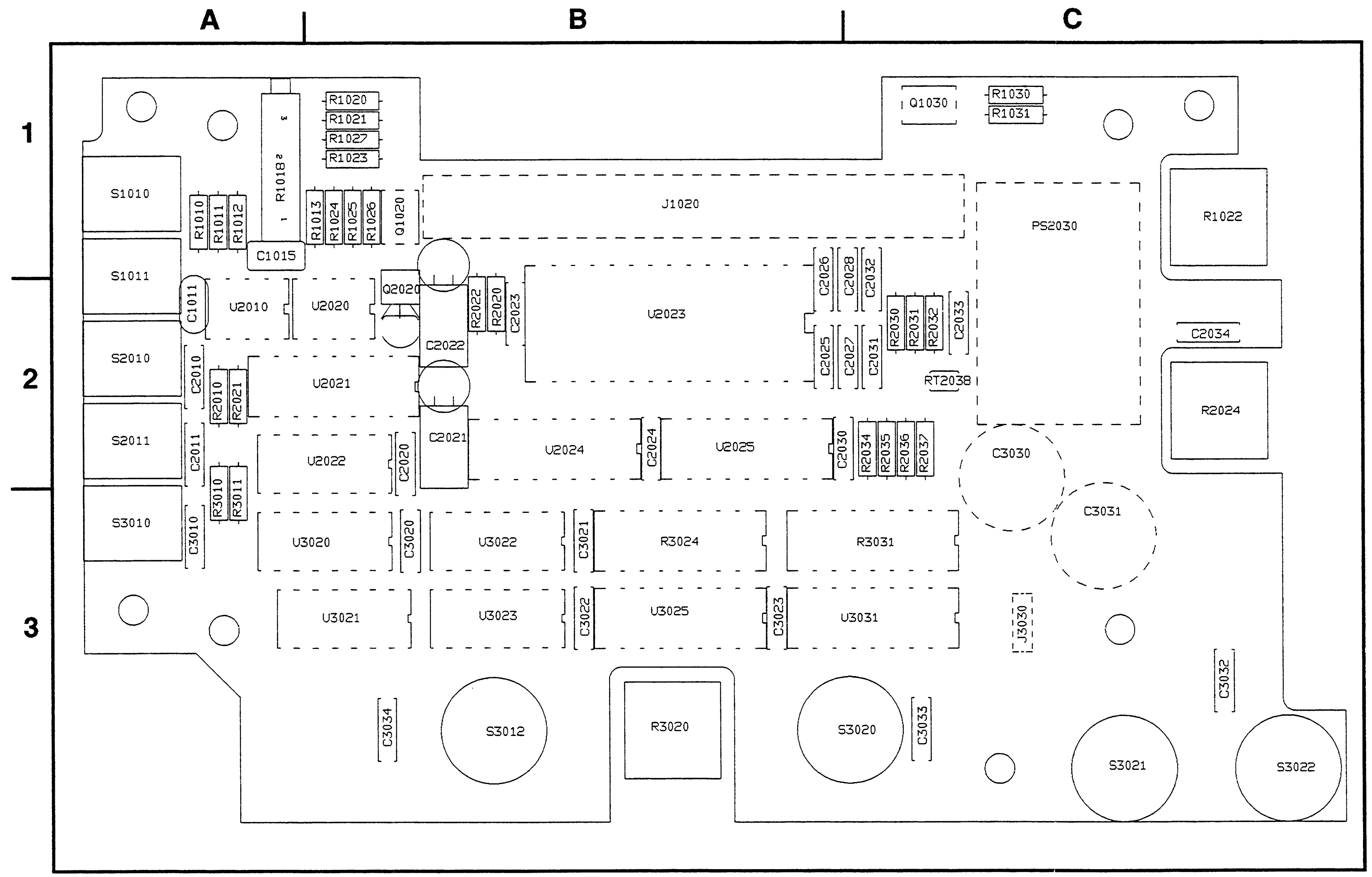
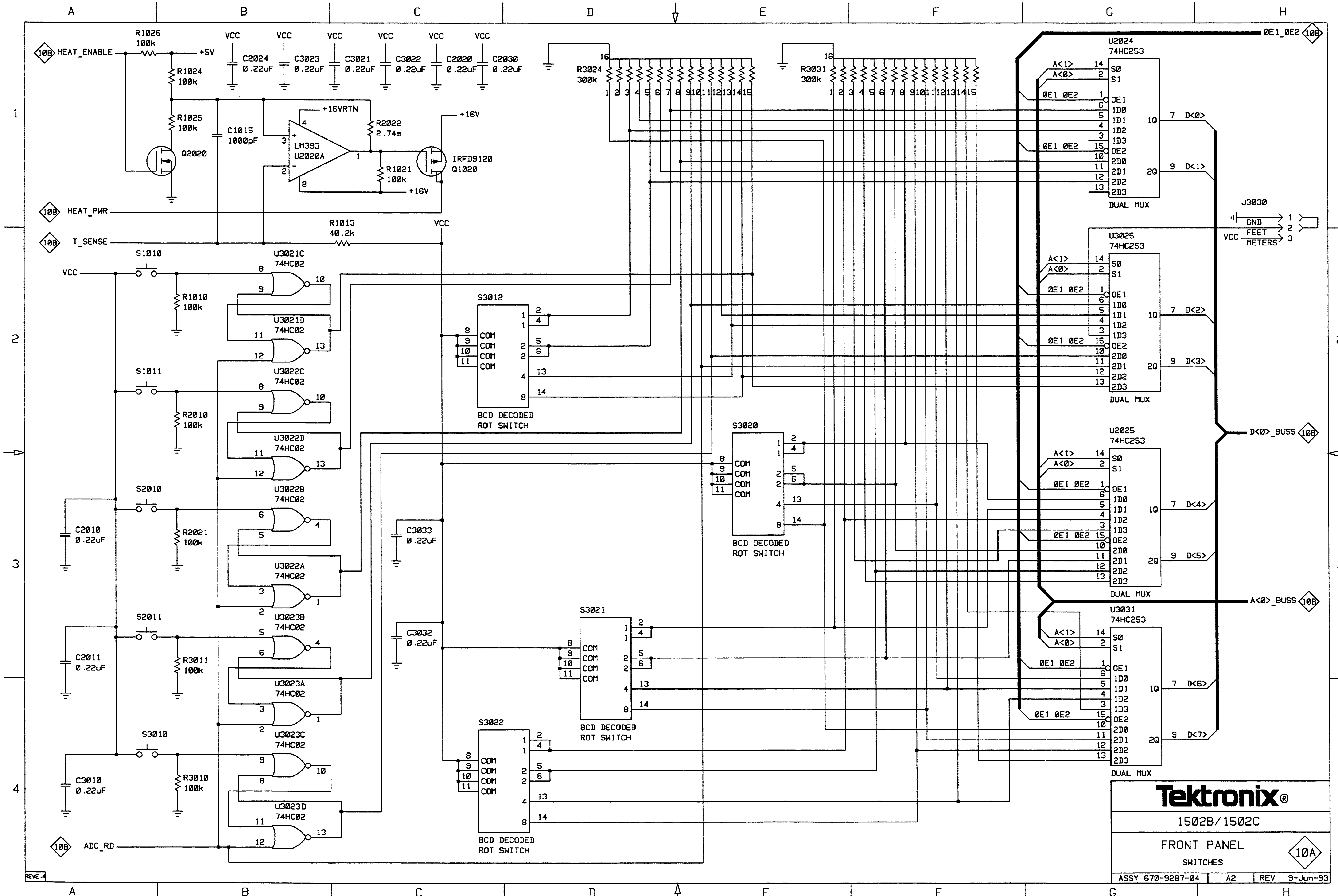
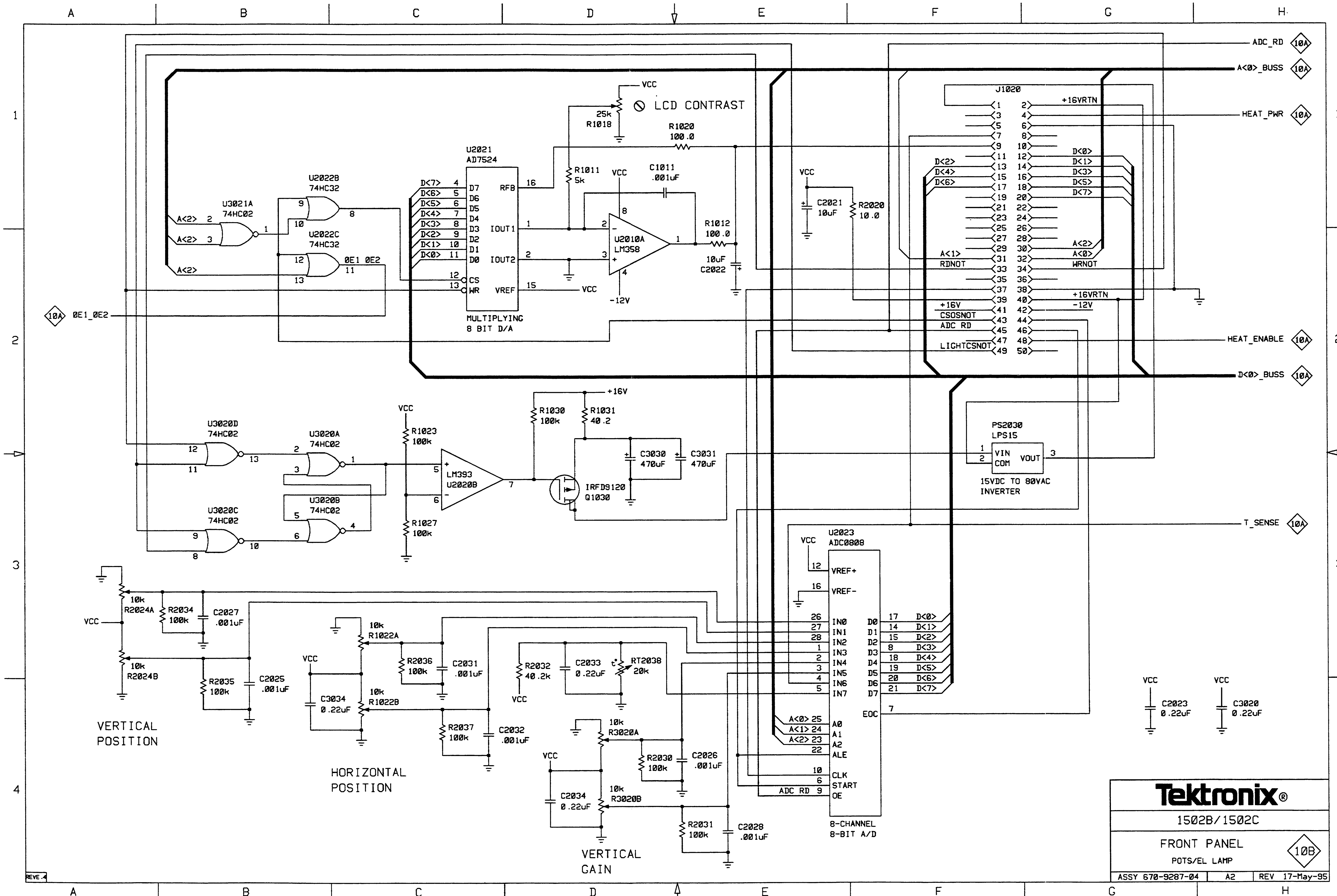


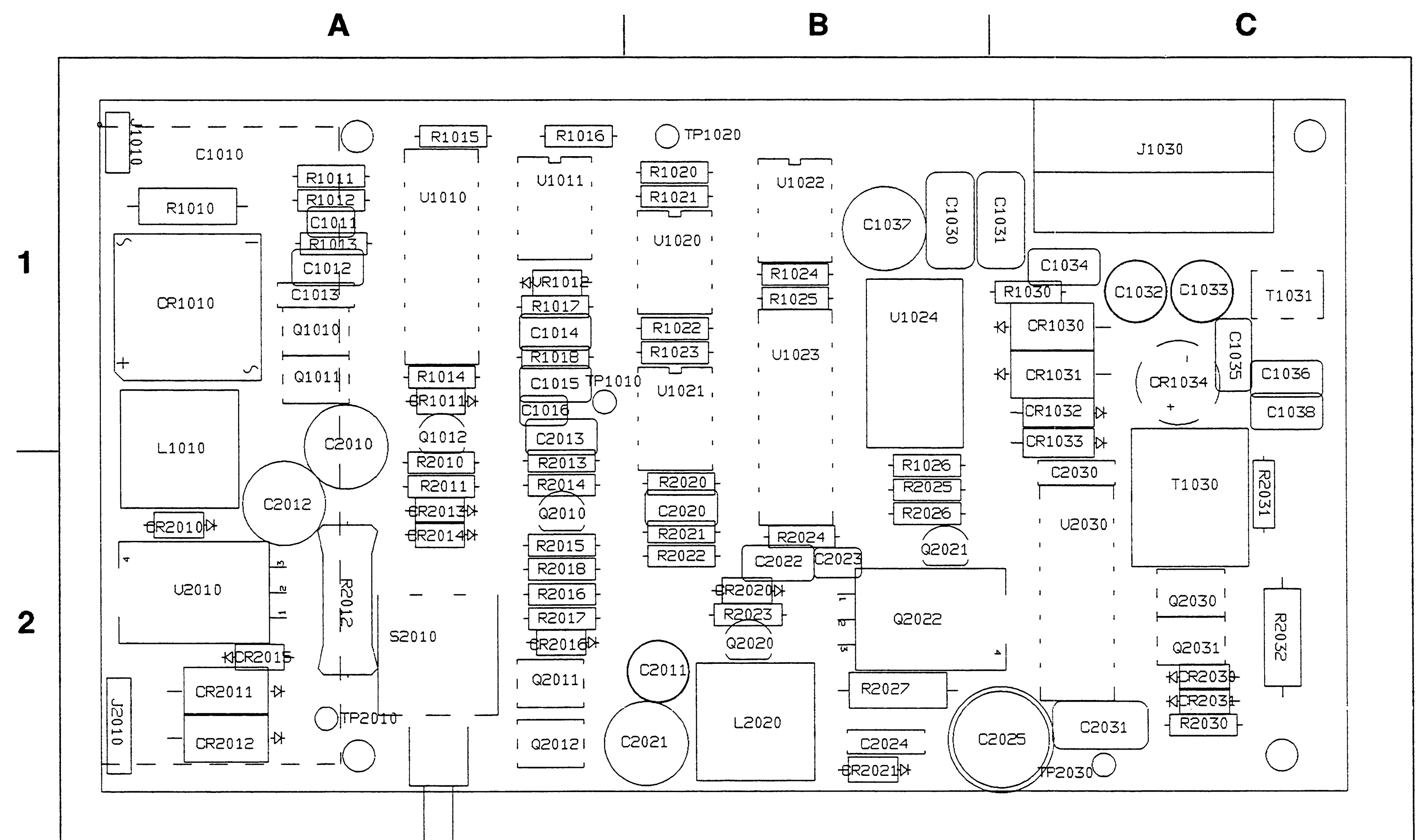
Fig. 9-3. Component Locator - Front Panel Board

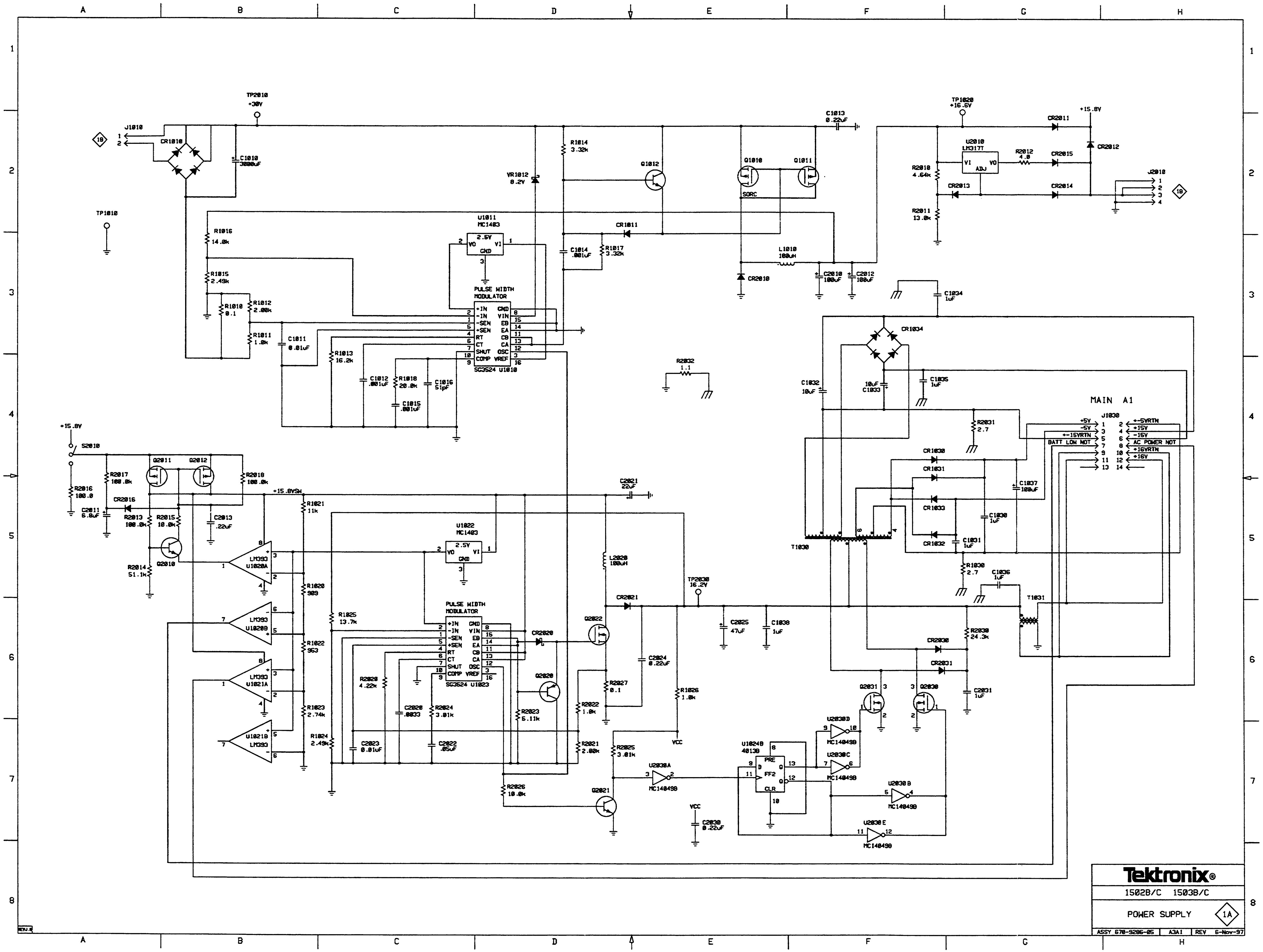

HEAT_ENABLE
R1026 100k
+5V
R1024 100k
R1025 100k
Q2020
C2024 0.22uF
C3023 0.22uF
C3021 0.22uF
C3022 0.22uF
C2020 0.22uF
C2030 0.22uF
VCC
C1015 1000pF
+16VRTN
LM393 U2020A
R2022 2.74m
R1021 100k
+16V
IRFD9120 Q1020
HEAT_PWR
T_SENSE
R1013 40.2k
S1010
R1010 100k
S1011
R2010 100k
S2010
R2021 100k
C2010 0.22uF
S2011
R3011 100k
C2011 0.22uF
S3010
R3010 100k
C3010 0.22uF
ADC_RD
U3021C 74HC02
U3021D 74HC02
U3022C 74HC02
U3022D 74HC02
U3022B 74HC02
U3022A 74HC02
U3023B 74HC02
U3023A 74HC02
U3023C 74HC02
U3023D 74HC02
C3033 0.22uF
C3032 0.22uF
R3024 300k
R3031 300k
S3012
S3020
S3021
S3022
COM
BCD DECODED ROT SWITCH
U2024 74HC253
U3025 74HC253
U2025 74HC253
U3031 74HC253
DUAL MUX
0E1_0E2
A<1>
A<0>
D<0>
D<1>
D<2>
D<3>
D<4>
D<5>
D<6>
D<7>
D<0>_BUSS
A<0>_BUSS
J3030
GND
FEET
METERS
Tektronix
1502B/1502C
FRONT PANEL
SWITCHES
10A
ASSY 670-9287-04
A2
REV
9-Jun-93

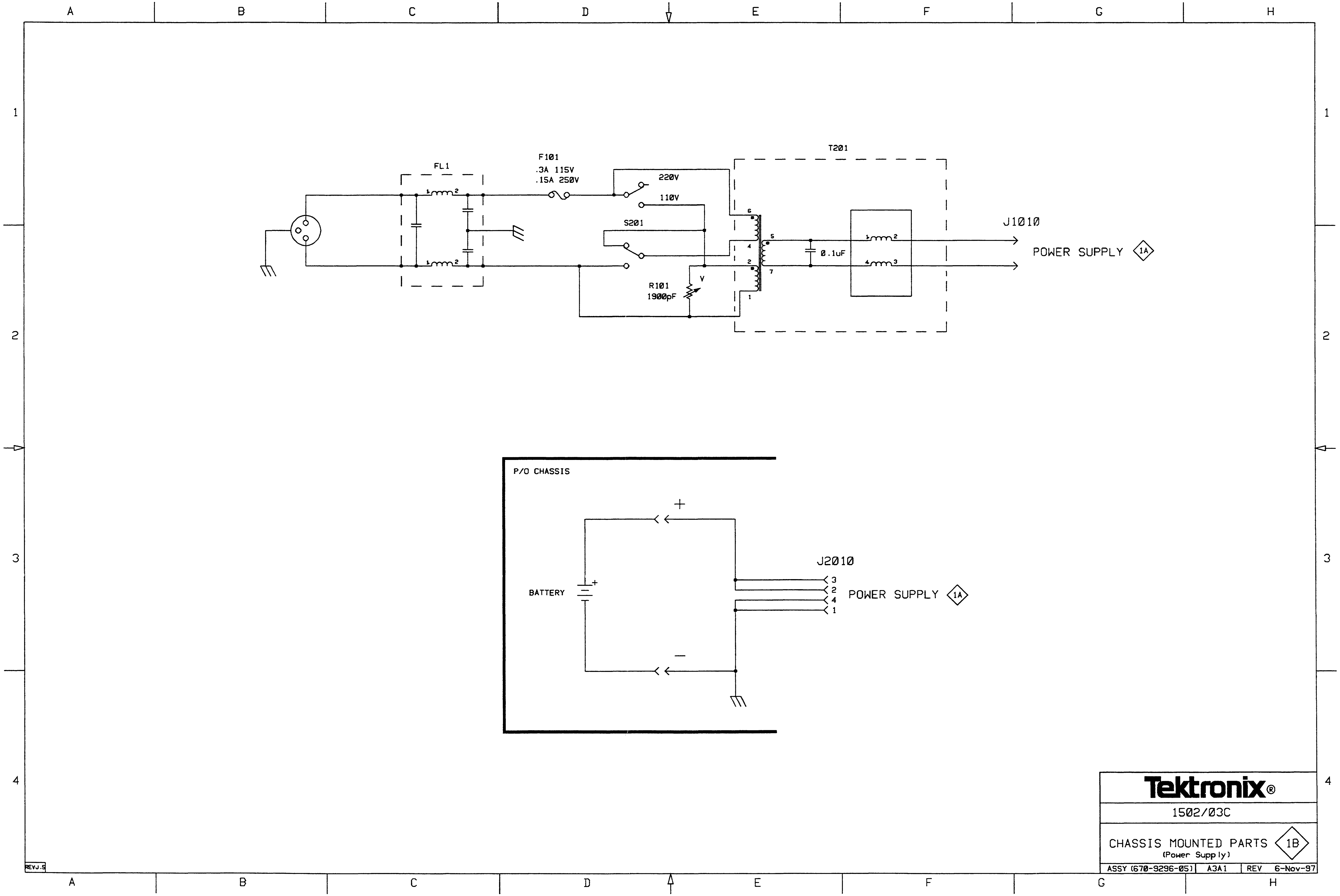


ADC_RD
A<0>_BUSS
HEAT_PWR
HEAT_ENABLE
D<0>_BUSS
T_SENSE
0E1_0E2
LCD CONTRAST
VCC
25k
R1018
R1020
100.0
U2021
AD7524
RFB
IOUT1
IOUT2
VREF
CS
WR
MULTIPLYING
8 BIT D/A
U2022B
74HC32
U2022C
74HC32
U3021A
74HC02
R1011
5k
C1011
.001uF
U2010A
LM358
-12V
R1012
100.0
10uF
C2022
C2021
10uF
R2020
10.0
J1020
+16VRTN
D<2>
D<4>
D<6>
D<0>
D<1>
D<3>
D<5>
D<7>
A<1>
RDNOT
A<2>
A<0>
WRNOT
+16V
CSOSNOT
ADC RD
LIGHTCSNOT
-12V
+16V
R1030
100k
R1031
40.2
C3030
470uF
C3031
470uF
IRFD9120
Q1030
PS2030
LPS15
VIN
COM
VOUT
15VDC TO 80VAC
INVERTER
U3020D
74HC02
U3020A
74HC02
U3020B
74HC02
U3020C
74HC02
R1023
100k
LM393
U2020B
R1027
100k
U2023
ADC0808
VREF+
VREF-
IN0
IN1
IN2
IN3
IN4
IN5
IN6
IN7
A0
A1
A2
ALE
CLK
START
OE
EOC
8-CHANNEL
8-BIT A/D
10k
R2024A
R2034
100k
C2027
.001uF
10k
R2024B
R2035
100k
C2025
.001uF
VERTICAL
POSITION
10k
R1022A
R2036
100k
C2031
.001uF
C3034
0.22uF
10k
R1022B
R2037
100k
C2032
.001uF
HORIZONTAL
POSITION
R2032
40.2k
C2033
0.22uF
RT2038
20k
10k
R3020A
R2030
100k
C2026
.001uF
C2034
0.22uF
10k
R3020B
R2031
100k
C2028
.001uF
VERTICAL
GAIN
C2023
0.22uF
C3020
0.22uF
Tektronix
1502B/1502C
FRONT PANEL
POTS/EL LAMP
10B
ASSY 670-9287-04
A2
REV 17-May-95

A3A1 - POWER SUPPLY




Tektronix
1502B/C 1503B/C
POWER SUPPLY
1A
MAIN A1
PULSE WIDTH MODULATOR
SG3524 U1010
SG3524 U1023
MC1403
LM317T
+30V
+16.6V
+15.8V
+15.8VSW


FL1
F101
.3A 115V
.15A 250V
220V
110V
S201
T201
R101
1900pF
V
0.1uF
J1010
POWER SUPPLY
1A
P/O CHASSIS
BATTERY
J2010
POWER SUPPLY
1A
Tektronix
1502/03C
CHASSIS MOUNTED PARTS
(Power Supply)
1B
ASSY (670-9296-05)
A3A1
REV
6-Nov-97
REVJ.S

A4 - S/R DRIVER SAMPLER

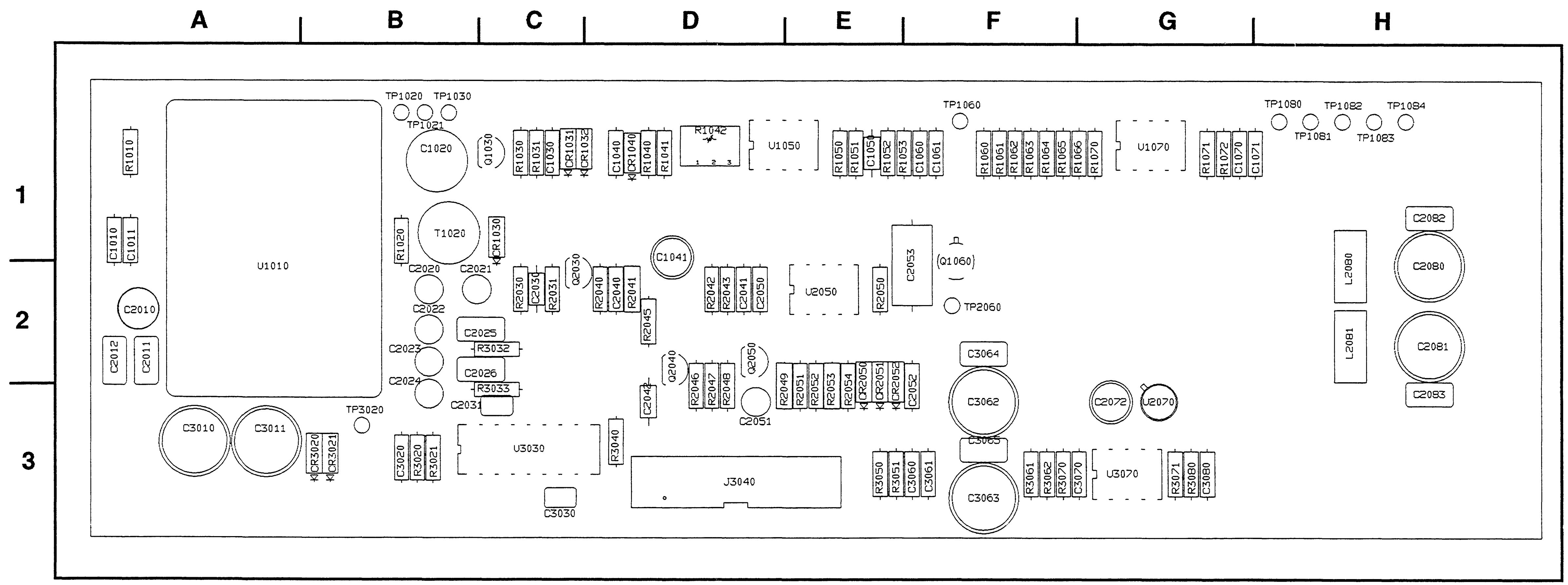
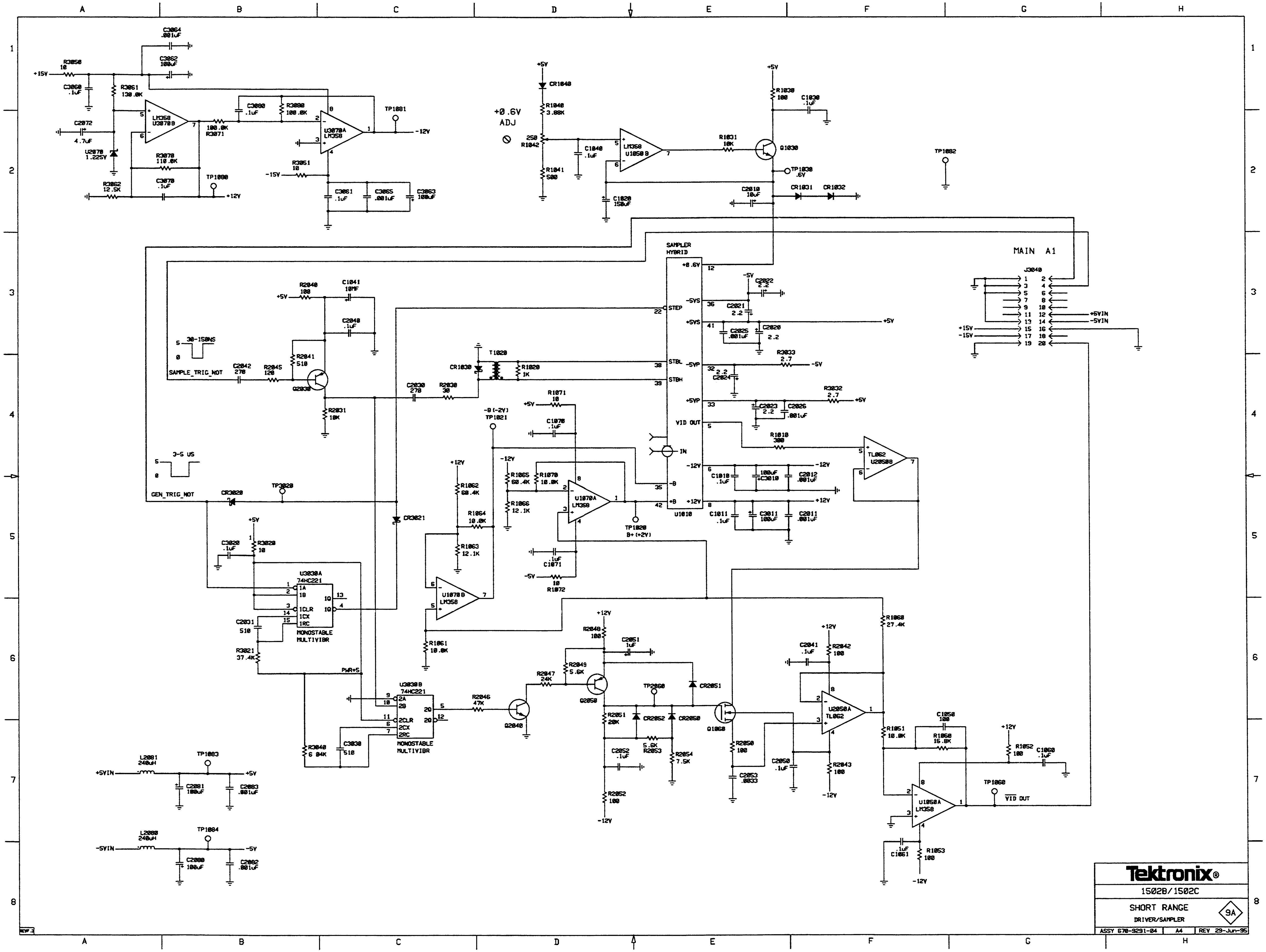


Fig. 9-5. Component Locator - S/R Driver Sampler


Tektronix
1502B/1502C
SHORT RANGE
DRIVER/SAMPLER
9A
MAIN A1
SAMPLER HYBRID

Replaceable Mechanical Parts

This section contains a list of the replaceable mechanical components for the 1502C. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts are available through your local Tektronix 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. Therefore, when ordering parts, it is important to include the following information in your order.

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number, if applicable

If you order a part that has been replaced with a different or improved part, your local Tektronix 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.

Using the Replaceable Mechanical Parts List

The tabular information in the Replaceable Mechanical Parts List is arranged for quick retrieval. Understanding the structure and features of the list will help you find all of the information you need for ordering replacement parts. The following table describes the content of each column in the parts list.

Parts List Column Descriptions

Column	Column Name	Description
1	Figure & Index Number	Items in this section are referenced by figure and index numbers to the exploded view illustrations that follow.
2	Tektronix Part Number	Use this part number when ordering replacement parts from Tektronix.
3 and 4	Serial Number	Column three indicates the serial number at which the part was first effective. Column four indicates the serial number at which the part was discontinued. No entries indicates the part is good for all serial numbers.
5	Qty	This indicates the quantity of parts used.
6	Name & Description	An item name is separated from the description by a colon (:). Because of space limitations, an item name may sometimes appear as incomplete. Use the U.S. Federal Catalog handbook H6-1 for further item name identification.
7	Mfr. Code	This indicates the code of the actual manufacturer of the part.
8	Mfr. Part Number	This indicates the actual manufacturer's or vendor's part number.

Abbreviations

Abbreviations conform to American National Standard ANSI Y1.1–1972.

Chassis Parts

Chassis-mounted parts and cable assemblies are located at the end of the Replaceable Electrical Parts List.

Mfr. Code to Manufacturer Cross Index

The table titled Manufacturers Cross Index shows codes, names, and addresses of manufacturers or vendors of components listed in the parts list.

Manufacturers Cross Index

Mfr. Code	Manufacturer	Address	City, State, Zip Code
TK0588	UNIVERSAL PRECISION PRODUCTS	1775 NW 216TH	HILLSBORO, OR 97123
TK0914	WESTERN SINTERING CO INC	2620 STEVENS DRIVE	RICHLAND, WA 99352
TK1423	WACHTEL CO INC THE	1100–B L AVENIDA ST	MOUNTAIN VIEW, CA 94043
TK1943	NEILSEN MANUFACTURING INC	3501 PORTLAND ROAD NE	SALEM, OR 97303
TK2324	RMS COMPANY	7645 BAKER ST NE	MINNEAPOOLIS, MN 55432–3421
TK2545	ORNELAS INTERPRISES INC	7275 NW EVERGREEN PKWY #100	HILLSBORO, OR 97124
TK2624	ROSS OPTICAL INDUSTRIES INC	1410 GAIL BORDEN PLACE	EL PASO, TX 79935
0J260	COMTEK MANUF OF OREGON	PO BOX 4200	BEAVERTON ,OR 97076–4200
0J4C1	TVT DIECASTING AND MFG INC	7330 SW LANDMARK LANE	PORTLAND, OR 97223
0DWW6	MICRO PWER ELECTRONICS	7973 SW CIRRUS DRIVE,BLDG. #22	BEAVERTON, OR 97005
0J4Z2	PRECISION PRINTERS	165 SPRINGHILL DRIVE	GRAND VALLEY, CA 95945
0J7N9	MCX INC	30608 SAN ANTONIO ST	HAYWARD, CA 94544
OJ9P4	DELTA ENGINEERING	19500 SW TETON	TUALATIN, OR 97062
0JR05	TRIQUEST CORP	3000 LEWIS AND CLARK HWY	VANCOUVER, WA 98661–2999
0JRZ5	GASKET TECHNOLOGY	478 NE 219TH AVENUE	TROUTDALE, OR 97060
OKB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND, OR 97214
0KB05	NORTH STAR NAMEPLATE	5750 NE MOORE COURT	HILLSBORO, OR 97124–6474
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG, PA 17105
06915	RICHCO PLASTIC CO	5825 N TRIPP AVE	CHICAGO, IL 60646–6013
22526	BERG ELECTRONICS INC	825 OLD TRAIL RD	ETTERS, PA 17319
04963	MINNESOTA MINING AND MFG CO	3M CENTER	ST PAUL, MN 55101–1428
28334	3–D POLYMERS	13026 NORMANDIE AVE	GARDENA, CA 90249–2126
2K262	BOYD CORP	6136 NE 87TH AVE PO BOX 20038	PORTLAND, OR 97220
2X013	MCGUIRE BEARING CO	947 SE MARKET ST	PORTLAND, OR 97214–3556
53387	MINNESOTA MINING MFG CO	PO BOX 2963	AUSTIN, TX 78769–2963
58474	SUPERIOR ELECTRIC CO THE	383 MIDDLE ST	BRISTOL, CT 06010–7438
5H194	AIR–OIL PRODUCTS CORP	2400 E BURNSIDE	PORTLAND, OR 97214–1752
5Y400	TRIAX METAL PRODUCTS INC	1800 216TH AVE NW	HILLSBORO, OR 97124–6629
61935	SCHURTER INC	1016 CLEGG COURT	PETALUMA, CA 94952–1152
73893	MICRODOT INC	50631 E RUSSELL SCHMIDT BLVD	MT CLEMENS, MI 48045
7X318	KASO PLASTICS INC	11015 A NE 39TH	VANCOUVER, WA 98662
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON, OR 97077–0001
85471	BOYD CORP	13885 RAMONA AVE	CHINO, CA 91710
91094	ESSEX GROUP INC SUFLEX/IWP DIV	BAY RD	NEWMARKET, NH 03857–9601
91836	KINGS ELECTRONICS CO INC	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707–3420
98291	ITT CANNON RF PRODUCTS	585 E MAIN ST	NEW BRITAIN, CT 06051

Replaceable Mechanical Parts List

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
FIG. 10-1					**CABINET**		
	650–3676–00			1	**COVER,LID ASSY:LID/COVER ASSEMBLY**	7X318	650–3676–00
–1	105–0684–01			2	. LATCH ASSEMBLY:	0J4C1	105–0684–01
–2	213–0839–00			2	. SCR,TPG,TF:4–24 X 0.5 L,FLH,POZ	0KB01	213–0839–00
–3	214–0787–00			1	. STEM,LATCH:ACCESS BOX	7X318	1082
–4	204–0282–00			1	. BODY LATCH:ACCESS BOX,DELRIN	7X318	1267
–5	214–2389–00			2	. PIN,ACTUATOR:POWER SWITCH	TK0588	214–2389–00
–6	334–9302–00			1	MARKER,IDENT:MARKED TEKTRONIX	0J4Z2	334–9302–00
–7	062–9363–00			1	CARD,INFO:QUICK REFERENCE	0J4Z2	062–9363–00
–8	334–7475–00			1	MARKER,IDENT:MARKED 1502C	0KB05	334–7475–00
	334–8896–00			1	MARKER,IDENT:VOLTAGE WARNING LABEL	0KB05	334–8896–00
	650–3677–00			1	**CABINET ASSY:BUCKET/HANDLE ASSEMBLY**	7X318	650–3677–00
–9	200–1805–00			2	. COVER,HDL LATCH:	0JR05	200–1805–00
–10	213–0739–00			2	. *SCR,MACH:10–32 X 0.375,HEX HD,SSTW/NYLON*	OKB01	213–0739–00
–11	210–1231–00			2	. WSHR,SHLDR:0.82 X 0.9 X 0.07,FBR	0KB01	210–1231–00
–12	386–3303–01			2	. PLATE,SECURING:HANDLE,STEEL	TK1943	386–3303–01
–13	107–0035–00			4	. DISC,FRICTION:0.38 X 1.865 X 0.031,ASB	2K262	107–0035–00
–14	210–1501–00	B021236		4	. WSHR,FRICTION:1.820 X 0.388,304SS 20GA	0J9P4	210–1501–00
–15	367–0204–01	B020000	B021235	1	. HANDLE,CARRY:11.7 L,BLK VINYL W/HDW	0J9P4	367–0204–01
	367–0449–00	B021236		1	. HANDLE,CARRY:BLACK VINYL, 302 SST	0J9P4	367–0449–00
–16	131–1705–01			1	. CONN,RCPT,ELEC:POWER INTERCONNECT	7X318	131–1705–01
–17	213–0012–00			2	. SCREW,TPG,TC:4–40 X 0.375,TYPE T,FLH 100 DEG	73893	ORD BY DESCR
–18	348–0419–00			2	. FOOT,CABINET:FRONT,BLK POLYURETHANE	7X318	1046
–19	211–0507–00			4	. *SCR,MACH:6–32 X 0.312,PNH,POZ*	0KB01	211–0507–00
–20	348–0420–01			2	. FOOT,CABINET:REAR,BLK POLYURETHANE	7X318	1048
–21	213–0451–02			4	. *SCR,EXT,RLV:10–24 X 1.75,SST,PSVT*	0KB01	213–0451–02
–22	354–0175–00			4	. *RING,RTNG:TYPE E EXT,U/O 0.188*	2X013	1000–18–ST–CD
–23	213–0183–00			2	. SC*R,TPG,TF:6–20 X 0.5,TYPEB,PNH,POZ*	0KB01	213–0183–00
–24	348–0444–00			4	. *SEAL,BOLT:0.186 X 0.443,0.05 THK*	80009	348–0444–00
–25	386–4704–00			2	. *PLATE,REINF:3.8 X 0.434,STL*	7X318	386–4704–00
–26	334–7662–02			1	. MARKER,IDENT:MKD REMOVE COVER TO; & W/VOLT INFO	0KB05	334–7662–02
–27	200–3805–00			1	. COVER,FUSE:VOLTAGE SELECT,PC,CLEAR	0JR05	200–3805–00
–28	214–4276–00			2	. THUMBSCREW:6–32 X 0.50,0.317 OD,SST	TK2324	214–4276–00
–29	348–1167–00			1	. GASKET:FUSE & VOLTAGE SELECT COVER	0JRZ5	348–1167–00

Replaceable Mechanical Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
FIG. 10-2.					**FRAME AND FRONT PANEL**		
–1	366–2097–00			4	SHELL,KNOB:DOVE GRAY,0.060 X 0.375	7X318	1076
–2	366–2104–00			1	KNOB:SET REF/W DOT SET FOR 90	7X318	1078
–3	366–2098–00			2	SHELL,KNOB:DOVE GRAY W/INDEX DOT	7X318	1077
					EACH KNOB INCLUDES:		
	213–0153–00			1	. SETSCREW:5–40 X 0.125,STL,HEX SKT	0KB01	ORDER BY DESCR
–4	131–4178–00			1	CONN,RCPT,ELEC:BNC,FEMALE SHORTING	91836	752–17–9
–5	650–3697–00			1	DUST COVER ASSEMBLY W/STRAP	7X318	650–3697–00
	––––– –––––			1	SWITCH,ROTARY (SEE A2S3012 REPL)		
	––––– –––––			1	RESISTOR,VARIABLE (SEE A2R3020 REPL)		
	––––– –––––			1	SWITCH ROTARY (SEE A2S3020 REPL)		
	––––– –––––			1	SWITCH ROTARY (SEE A2S3021 REPL)		
	––––– –––––			1	SWITCH ROTARY (SEE A2S3022 REPL)		
	––––– –––––			1	SWITCH ROTARY (SEE A2S3023)		
	––––– –––––			1	RESISTOR,VARIABLE (SEE A2R2024 REPL)		
	––––– –––––			1	RESISTOR,VARIABLE (SEE A2R1022 REPL)		
					EACH SWITCH AND VARIABLE RESISTOR INCLUDES:		
–6	210–0583–00			1	. NUT,PLAIN HEX:0.25–32 X 0.312	0KB01	210–0583–00
–7	210–0940–00			1	. WSHR,FLAT:0.25 X 0.375 X 0.02,STL CD PL	0KB01	210–0940–00
					EACH VARIABLE RESISTOR INCLUDES:		
–8	354–0581–00			1	. O–RING:0.25 X 0.062 OD XSECT	5H194	2–010–S455–70
–9	348–1145–01				. SEAL,CONT SHAFT:0.125 X 0.187 OD X 0.3 L	80009	348–1145–01
–10	366–0655–05			1	PUSH BUTTON:MENU,0.523 X 0.253	0JR05	366–0655–05
–11	366–0655–01			1	PUSH BUTTON:VIEW INPUT	0JR05	366–0655–01
–12	366–0655–02			1	PUSH BUTTON:VIEW STORE	0JR05	366–0655–02
–13	366–0655–03			1	PUSH BUTTON:VIEW DIFF	0JR05	366–0655–03
–14	366–0655–04			1	PUSH BUTTON:STORE	0JR05	366–0655–04
–15	334–7111–01			1	MARKER,IDENT:MARKED 1502C	0KB05	334–7111–01
–16	213–1089–00			4	*SCREW,TYPE–F:6–32 X .500,FLH,POS,410 SS*	OKB01	213–1089–00
–17	614–0389–01			1	FRONT PANEL ASSEMBLY	80009	614–0389–01
–18	348–0477–00			1	. SEAL,RBR STRIP:0.94W X 0.062THK X 28.0L	2K262	R–10460

Replaceable Mechanical Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
FIG. 10-2.					FRAME AND FRONT PANEL (Con't)		
–19	348–0477–00			1	. SEAL,RBR STRIP:0.94W X 0.062THK X 28.0L	2K262	R–10460
–20	348–1144–00			1	. GASKET,COND:ELASTOMER W/AL	0JRZ5	348–1144–00
–21	348–0920–00			1	. SHLD GSKT,ELEC:PUSH BUTTON	28334	348–0920–00
–22	331–0502–00			1	. WINDOW,DSP,PORT:2.335 X 4.357 X 0.125,GLASS	TK2624	331–0502–00
–23	––––– –––––			1	CKT BD ASSY:FRONT PANEL (SEE A2 REPL)		
–24	211–0658–00			4	*SCR,ASSEM WSHR:6–32 X 0.312,PNH,POZ*	0KB01	211–0658–00
–25	––––– –––––			AR	. CONN,HDR:PCB,MALE (SEE A2 REPL)		
–26	131–0993–00			1	. . BUS CONDUCTOR:SHUNT/SHORTING,FEMALE	22526	65474–006
–27	––––– –––––			1	. CONN,HDR:PCB,MALE (SEE A2 REPL)		
–28	342–0731–00			1	INSULATOR:FISHPAPER,3.6 X 3.0	80009	342–0731–00
–29	––––– –––––			1	DISPLAY MODULE:(SEE A5 REPL)		
–30	220–0407–00			4	*NUT,SLFLKG,HEX:6–32 X 0.312 HEX*	0KB01	220–0407–00
–31	337–2193–05			2	SHIELD,ELEC:EMI,BOTTOM	TK1943	337–2193–05
	211–0661–00			7	*SCR,ASSEM WSHR:4–40 X 0.25,PNH,POZ*	0KB01	211–0661–00
	129–1092–00			1	*SPACER,POST:0.605 L,4–40,HEX*	58474	BP21BLACK
	210–1307–00			1	*WHSR,LOCK:0.115 ID,SPLIT*	0KB01	210–1307–00
	210–1002–00			1	*WSHR,FLAT:0.125 X 0.25 OD X 0.022*	0KB01	210–1002–00
	334–8135–00			1	MKR,IDENT:MKD EMI SHIELD INSTRU	0J4Z2	334–8135–00
					(NOT ILLUSTRATED AT THIS TIME)		
–32	650–3714–00			1	ON/OFF SHAFT ASSEMBLY	TK2545	650–3714–00
–33	220–0961–00			1	NUT BLOCK:6–32 X 0.438,AL,CHROMATE	5Y400	220–0961–00
–34	213–0966–00			1	. SETSCREW:6–32 X 0.188 HEX,W/NYLON	80009	213–0966–00
					NOTE: THE FOLLOWING FOUR COMPONENTS ARE SUBPARTS OF THE CHASSIS ASSEMBLY		
–35	211–0005–00			3	. SCR,MACH:4–40 X 0.125,PNH,POZ	0KB01	211–0005–00
–36	210–0851–00			3	. WSHR,FLAT:0.119 X 0.375 OD X 0.025	0KB01	210–0851–00
–37	105–0954–01			1	. LEVER:3.25L X 0.5W X 0.05,AL	80009	105–0954–01
–38	384–1674–01			1	. EXTENSION SHAFT:7.59 L X 0.5,AL	80009	384–1674–01
–39	650–3699–00			1	CHART EXTRUSION ASSEMBLY	0J7N9	650–3699–00
–40	212–0001–00			2	*SCR,MACH:8–32 X 0.25,PNH,POZ*	0KB01	212–0001–00
–41	210–0008–00			2	*WSHR,LOCK:#8,INTL,0.02 THK*	0KB01	ORD BY DESCR
–42	210–0458–00			1	*NUT,PL,ASSEM WA:8–32 X 0.344*	0KB01	ORD BY DESCR
–43	––––– –––––			1	CA ASSY: (SEE WIRE ASSEMBLIES)		

Replaceable Mechanical Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
FIG. 10-2.					**FRAME AND FRONT PANEL (Con't)**		
	200–3737–00			1	COVER,FRONT:OPTION PORT	0J9P4	200–3737–00
					COVER PORT INCLUDES:		
–44	200–3451–01				. COVER,PORT:	5Y400	200–3451–01
–45	348–1118–01			1	. GASKET:OPTION PORT COVER,0.062 THK	0JRZ5	348–1118–01
–46	105–0959–01			1	. LCH,OPT PORT COVER:STEEL,ZINC PLATE	TK1423	DZUSDP109SMOD
–47	407–3675–00			1	. FRAME:OPTION PORT COVER	0J9P4	407–3675–00
–48	213–0123–00			2	. SCR,TPG,TF:6–32 X 0.375,FLH100 DEG,POZ	0KB01	ORD BY DESCR
–49	650–3742–00			1	COVER,GASKET ASSY:RANGE BOARD	0J9P4	650–3742–00
–50	211–0661–00			2	*SCR,ASSEM WSHR:4–40 X 0.25,PNH,POZ*	0KB01	211–0661–00
–51	——— ———			1	CKT BD ASSY: (SEE A4 REPL)		
–52	131–0391–00			1	. CONN,RF JACK:SMB,50 OHM	98291	051–051–0049
–53	131–3360–00			1	. CONN,HDR:PCB,MALE,SHRD/4SIDES	53387	N2520–6002UB
–54	441–1683–00			1	CHASSIS,FRONT:AL NOTE: FRONT CHASSIS IS A SUBPART TO CHASSIS ASSY	0J260	441–1683–00
–55	211–0661–00			2	*SCR,ASSEM WSHR:4–40 X 0.25,PNH,POZ*	0KB01	211–0661–00
	210–1307–00			2	*WSHR,LOCK:0.115 ID,SPLIT*	0KB01	ORD BY DESCR
–56	211–0007–00			1	*SCR,MACH:4–40 X 0.188,PNH,POZ*	0KB01	211–0007–00
–57	210–1307–00	B021764		1	*WSHR,LOCK:0.115 ID,SPLIT*	0KB01	ORD BY DESCR
–58	351–0755–00			4	*GUIDE,CKT BD:POLYCARBONATE,2.5 L* NOTE: CKT BD GUIDES ARE SUBPARTS OF CHASSIS ASSY	06915	TCG1–2.500–03
–59	210–0586–00			1	*NUT,PL,ASSEM W:4–40 X 0.25*	0KB01	ORD BY DESCR
–60	——— ———			1	POWER SUPPLY ASSY: (SEE A3 REPL)		
–61	211–0007–00			1	*SCR,MACH:4–40 X 0.188,PNH,POZ*	0KB01	211–0007–00
	211–0105–00			1	*SCR,MACH:4–40 X 0.188,FLH,POZ*	0KB01	ORD BY DESCR
	211–0661–00			1	*SCR,ASSEM WSHR:4–40 X 0.25,PNH,POZ*	0KB01	211–0661–00
–62	211–0198–00			2	*SCR,MACH:4–40 X 0..438,PNH,POZ*	0KB01	211–0198–00
–63	210–0005–00			1	*WSHR,LOCK:#6 EXT,0.02 THK,STL,CD PL*	0KB01	210–0005–00
–64	——— ———			1	CKT BD ASSY: (SEE A1 REPL)		
–65	211–0661–00			9	*SCR,ASSEM WSHR:4–40 X 0.25,PNH,POZ*	0KB01	211–0661–00
–66	131–3361–00			1	. CONN,HDR:PCD,MALE,RTANG W/SHRD	53387	2526–5002UB
–67	131–3181–00			1	. CONN,HDR:PCB,MALE,RTANG W.SHRD	53387	2540–5002UB
–68	131–3359–00			1	. CONN,HDR:PCB,MALE,2 X 10	53387	2520–5002UB
–69	136–0755–00			1	. SKT,DIP:FEMALE,2 X 14	00779	2–641605–3
–70	131–4183–00			1	. CONN,HDR:PCB,MALE,2 X 7	53387	2514–6002UB

Replaceable Mechanical Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
FIG. 10-2.					**FRAME AND FRONT PANEL (Con't)**		
–71	213–0904–00			4	SCR,TPG,TR:6–32 X 0.5 PNH,TORX	0KB01	213–0904–00
–72	——— ———			1	CHASSIS,MAIN:AL (SEE PWR SUPPLY ASSY)	0J9P4	650–2183–02
	040–1276–01				**BATTERY ASSY**	80009	040–1276–01
–73	343–1436–00			1	. CLAMP,BTRY MT:ALUMINUM	0J260	343–1436–00
–74	212–0001–00			2	*. SCREW,MACH:8–32 X 0.25,PNH,STL CD PL,POZ*	0KB01	212–0001–00
–75	210–0007–00			2	*. WSHR,LOCK:#8 EXT,0.02 THK,CD PL STL*	0KB01	ORD BY DESCR
–76	348–0090–00			3	. PAD,CUSHIONING:2.03 X 0.69 X 0.312 SI RBR	85471	R–1047OMED/PSA
–77	146–0066–00			1	. BATTERY:12V LEAD ACID,3.4AH,5.28 X 2.36 X 2.6 RECT	0DWW6	LCR–12V3.4P
	——— ———			1	. CA ASSY:(SEE WIRE ASSYS)		

Replaceable Mechanical Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
FIG. 10-3	**650–3715-01**				**POWER SUPPLY MODULE**		
–1	––––– –––––			1	**CKT BD ASSY:(SEE A3A1 REPL)**		
–2	211–0661–00			4	*SCR,ASSEM WSHR:4–40 X 0.25,PNH,POZ*	0KB01	211–0661–00
–3	131–3445–00			1	. CONN,HDR:MALE,RTANG,2 X 7	53387	2514–5002UB
–4	131–4177–00			AR	. CONN,HDR:MALE,STR,1 X 31 W/INSUL	22562	65576–131
–5	131–1857–00			AR	. CONN,HDR:MALE,STR,1 X 36	22526	65507–B6
	––––– –––––			1	. XSTR: (SEE CHASSIS MOUNTED PARTS)		
–6	211–0507–00			1	. *SCR,MACH:6–32 X 0.312,PNH,POZ*	0KB01	211–0507–00
–7	210–0561–00			1	. *NUT,PL,HEEX:6–32 X 0.188*	0KB01	210–0561–00
	––––– –––––			1	. IC: (SEE A3A1U2010 REPL)		
–8	211–0507–00			1	. *SCR,MACH:6–32 X 0.312,PNH,POZ*	0KB01	211–0507–00
–9	210–0561–00			1	. *NUT,PL,HEX:6–32 X 0.188*	0KB01	210–0561–00
	253–0188–00			1	. TAPE,PRESS SENS:URETHANE FOAM	24963	4008 3/4
	162–0503–00			AR	. INSUL SLVG,ELEC:0.042 ID/ACRYLIC/FBRGLASS	91094	ORD BY DESCR
	650–3715–00				**POWER SUPPLY ASSEMBLY WITH CHASSIS MOUNTED ELECTRICAL PARTS**	0J7N9	650–3715–00
–10	220–0547–01			4	. NUT BLOCK:4–40 X 0.282	TK0914	ORD BY DESCR
–11	211–0105–00			4	. *SCR,MACH:4–40 X 0.188,FLH,POZ*	0KB01	211–0105–00
–12	––––– –––––			1	. CHASSIS,PWR SUPPLY:SIDE		
–13	211–0105–00			3	. *SCR,MACH:4–40 X 0.188,FLH,POZ*	OKB01	211–0105–00
–14	120–1607–00	B020000	B021232	1	. **A3T201** XFMR: PWR,115/230VAC,50/60HZ	08779	DP241–6–24
	120–1922–00	B021233		1	. **A3T201** XFMR: PWR,115/230VAC,50/60HZ	0JR03	Z–91260A
	307–0449–00			1	. **A3R101** RES, V SENSITIVE:1900PF,100A,130V	34371	V130LA20A
–15	212–0112–00			2	. *SCR,MACH:8–32 X 0.188,TRH,SST,POZ*	0KBO1	ORD BY DESCR
–16	210–0002–00			2	. *WSHR,LOCK:#8 EXT,0.02 THK*	0KBO1	ORD BY DESCR
–17	260–2372–00			1	. **A3S201** SWITCH,ROTARY:	61935	033–4501
–18	204–0832–00			1	. BODY,FUSEHLDR:3AG & 5 X 20MM FUSES	61935	031 1673
	159–0029–01			1	. **A3F101** FUSE CARTRIDGE:BUSSMAN ONLY	71400	MDL3/10
	159–0054–00			1	. **A3F101** FUSE CARTRIDGE:3AG,0.15A,250V	71400	MDL 15/100
–19	200–2264–00			1	. CAP,FUSEHLDR:3AG FUSES,SFTY CONTROL	61935	FEK 031 1666
–20	119–3488–00			1	. **A3FL1** FILTER,RFI: 1A,115/230VAC,50/60HZ	0GV52	FN328–1/01
–21	211–0101–00			2	. S*CR,MACH:4–40 X 0.25,FLH,100 DEG,POZ*	0KB01	ORD BY DESCR
–22	210–0202–00			1	. TERMINAL,LUG:0.146 ID,LOCKING	0KB01	210–0202–00
–23	211–0658–00			1	. *SCR,ASSEM,WA:6–32 X 0.312,PNH,POZ*	0KB01	211–0658–00
–24	––––– –––––			1	. CHASSIS,PWR SUPPLY:		
	334–3379–01			1	. MARKER,IDENT:MKD GROUND SYMBOL	0KB05	334–3379–01

Replaceable Mechanical Parts List (Cont.)

Fig. & Index Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number

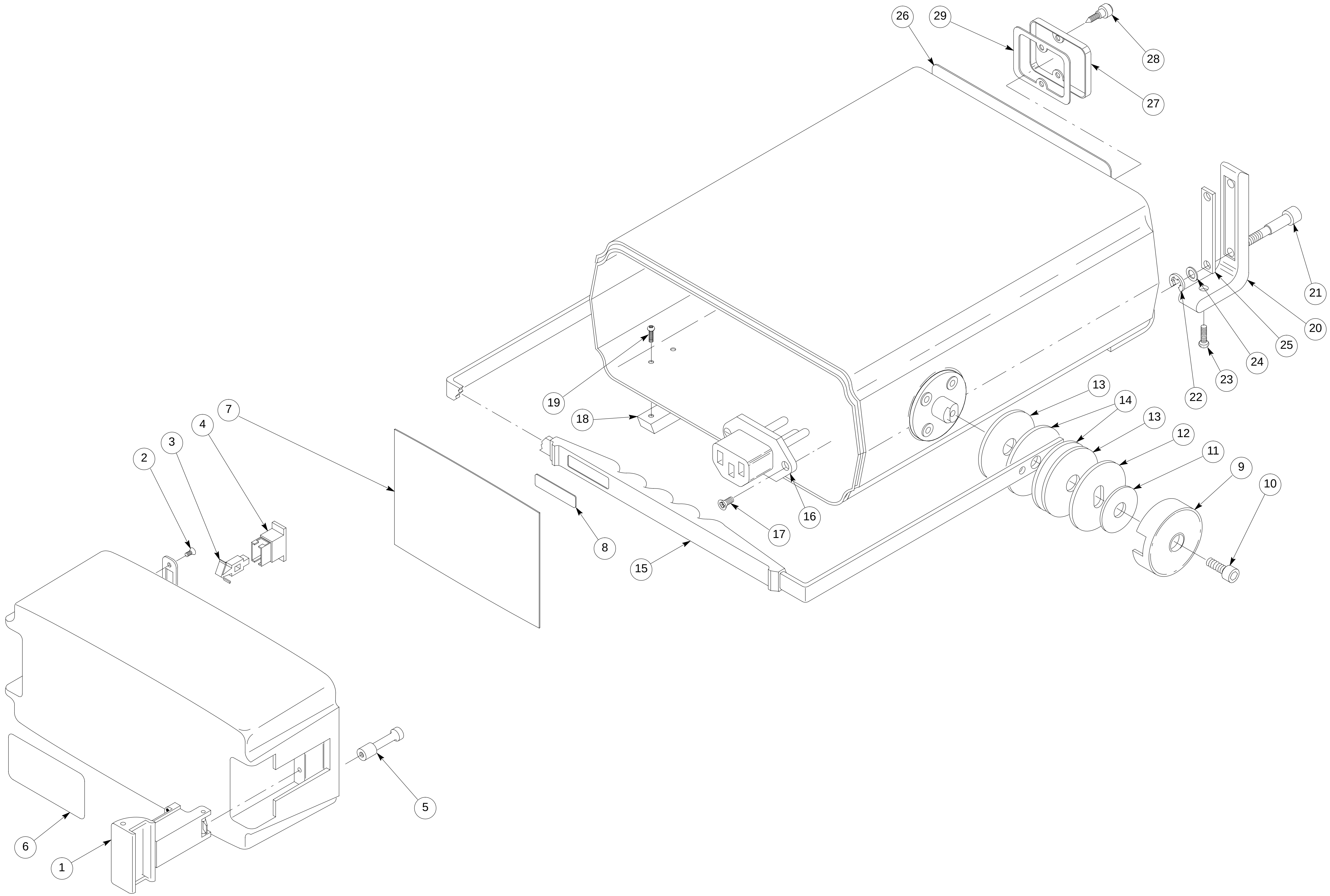


Figure 10-1: 1502C Cabinet

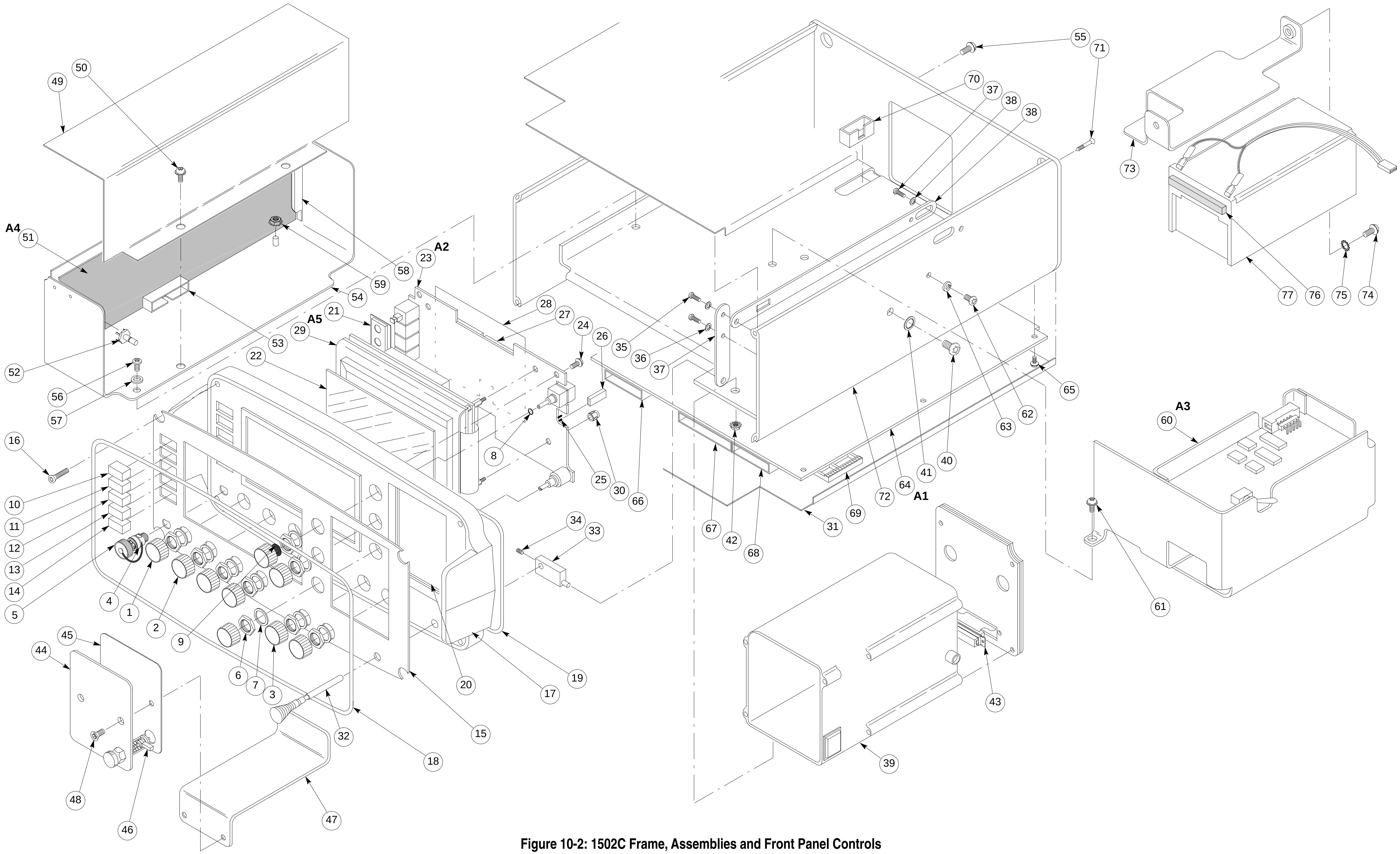


Figure 10-2: 1502C Frame, Assemblies and Front Panel Controls

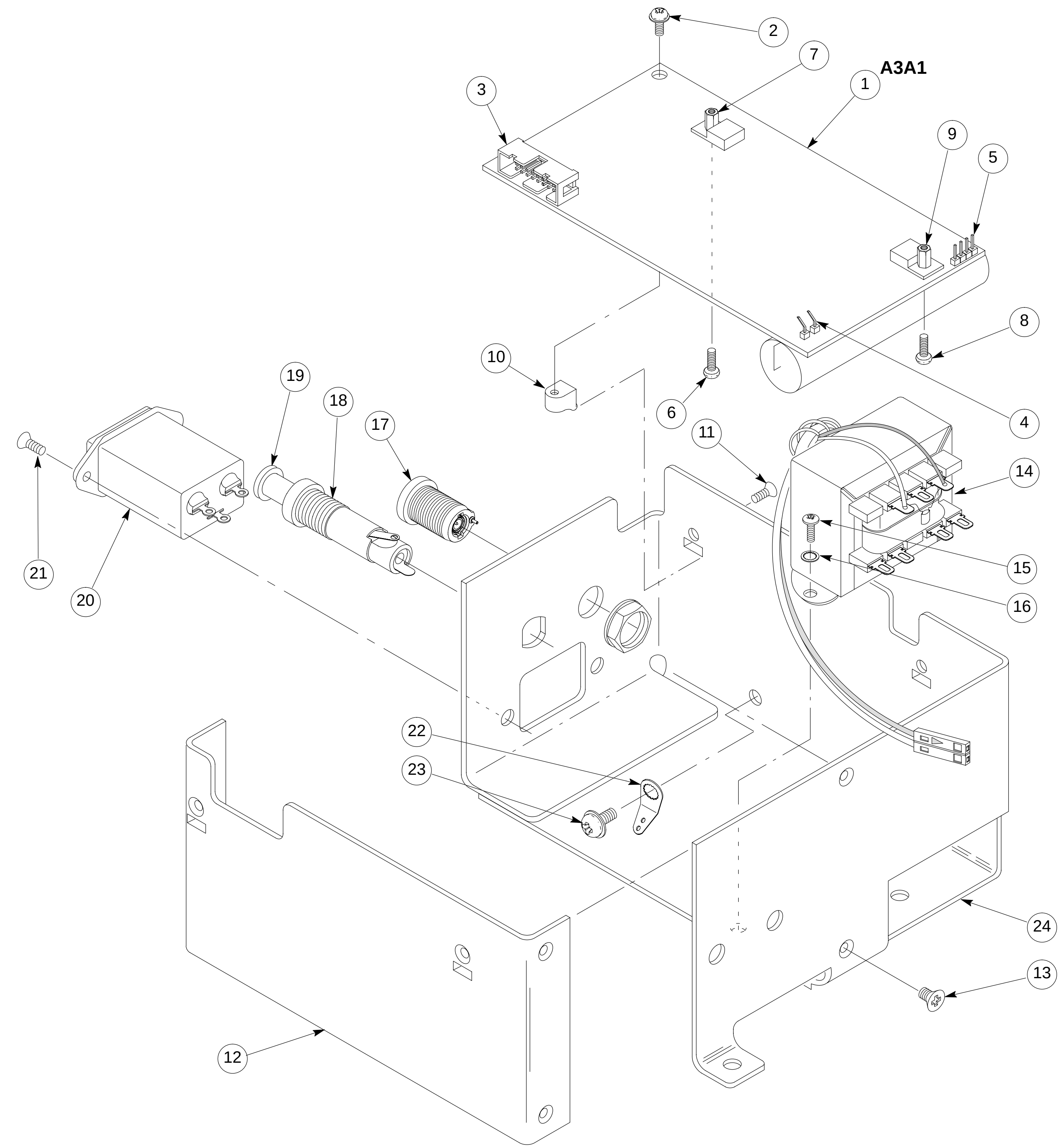


Figure 10-3: Power Supply

Glossary

Aberrations Imperfections or variations from a desired signal. In TDRs, a pulse of electrical energy is sent out over the cable. As the pulse-generating circuitry is turned on and off, the pulse is often distorted slightly and no longer is a perfect step or sine-shaped waveform.

AC Alternating current is a method of delivering electrical energy by periodically changing the direction of the flow of electrons in the circuit or cable. Even electrical signals designed to deliver direct current (DC) usually fluctuate enough to have an AC component.

Accuracy The difference between a measured, generated, or displayed value and the true value.

Cable Electrical conductors that are usually insulated and often shielded. Most cables are made of metal and are designed to deliver electrical energy from a source (such as a radio transmitter) across a distance to a load (such as an antenna) with minimal energy loss. Most cables consist of two conductors, one to deliver the electrical signal and another to act as a return path, which keeps both ends of the circuit at nearly the same electrical potential. In early electrical systems and modern systems that over long distances use the earth and/or air as the return path, and the term “ground” or “ground wire” is often used to describe one of the wires in a cable pair.

Cable Attenuation The amount of signal that is absorbed in the cable as the signal propagates down it. Cable attenuation is typically low at low frequencies and higher at high frequencies and should be corrected for in some TDR measurements. Cable attenuation is usually expressed in decibels at one or several frequencies. See also: dB and Series Loss.

Cable Fault Any condition that makes the cable less efficient at delivering electrical energy than it was designed to be. Water leaking through the insulation, poorly mated connectors, and bad splices are typical types cable faults.

Capacitance (see Reactance)

Characteristic Impedance Cables are designed to match the source and load for the electrical energy that they carry. The designed impedance is often called the characteristic impedance of the cable. The arrangement of the conductors with respect to each other is the major factor in designing the impedance of cables.

Conductor Any substance that will readily allow electricity to flow through it. Good conductors are metals such as silver, copper, gold, aluminum, and zinc (in that order).

dB dB is an abbreviation for decibel. Decibels are a method of expressing power or voltage ratios. The decibel scale is logarithmic. It is often used to express the efficiency of power distribution systems when the ratio consists of the energy put into the system divided by the energy delivered (or is some cases, lost) by the system. Our instrument measures return loss. The formula for decibels is: dB = 2– log (Vi/Vl) where Vi is the voltage of the incident pulse, Vl is the voltage reflected back by the load, and log is the decimal-based logarithmic function. The dB vertical scale on our instrument refers to the amount of voltage gain (amplification) the instrument applies to the signal before displaying it. For example, when the instrument is amplifying the voltage by one hundred, the dB scale would read 40 dB, which is 20 log 100.

DC Direct current is a method of delivering electrical energy by maintaining a constant flow of electrons in one direction. Even circuits designed to generate only AC often have a DC component.

Dielectric (see Insulation)

Domain A mathematical term that refers to the set of numbers that can be put into a function (the set of numbers that comes out of the function is called the “range”). A time-domain instrument performs its function by measuring time.

Impedance The total opposition to the flow of electrical energy is a cable or circuit. Impedance is made partly of resistance (frequency independent) and partly of reactance (frequency dependent). Although impedance is expressed in units of Ohms, it must not be confused with the simple resistance that only applies to DC signals. Technically, impedance is a function of the frequency of the electrical signal, so it should be specified at a frequency. As a practical matter, the impedance of most cables changes very little over the range of frequencies they are designed for.

Impedance Mismatch A point in a cable or system where the incident electrical energy is redistributed into absorbed, reflected, and/or transmitted electrical energy. The transmitted electrical energy after the mismatch is less than the incident electrical energy.

Incident Pulse The pulse of electrical energy sent out by the TDR. The waveform shown by the TDR consists of this pulse and the reflections of it coming back from the cable or circuit being tested.

Inductance (see Reactance)

Insulation A protective coating on an electrical conductor that will not readily allow electrical energy to flow away from the conductive part of the cable or circuit. Insulation is also called dielectric. The kind of dielectric used in a cable determines how fast electricity can travel through the cable (see Velocity of Propagation).

Jitter The short term error or uncertainty in the clock (timebase) of a TDR. If the timing from sample to sample is not exact, the waveform will appear to move back and forth rapidly.

LCD An acronym for Liquid Crystal Display. It is the kind of display used on this instrument, so the terms display and LCD are often used interchangeably.

Millirho rho (ρ) is the reflection coefficient of a cable or power delivery system. It is the ratio of the voltage reflected back from the cable or circuit due to cable faults or an impedance mismatch at the load, divided by the voltage applied to the cable. Millirho are thousandths of one rho. Rho measurements are often used to judge how well the cable is matched to the load at the other end of the cable. If there is an open circuit in the cable, nearly all the energy will be reflected back when a pulse is sent down the cable. The reflected voltage will equal the incident pulse voltage and rho will be +1. If there is a short circuit in the cable, nearly all the energy will be delivered back to the instrument through the ground or return conductor instead of being sent to the load. The polarity of the reflected pulse will be the opposite of the incident pulse and rho will be –1. If there is no mismatch between the cable and the load, almost no energy will be reflected back and rho will be 0. In general, a load or fault with higher impedance than the cable will return a rho measurement of 0 to +1, and a load or fault with a lower impedance will return a rho measurement of 0 to –1. The scale for rho measurements is determined by the height of the incident pulse. A pulse two divisions high means that each division is 0.5 rho (500 millirho). A pulse set to be four divisions high would make each division 0.25 rho (250 millirho).

Noise Any unwanted electrical energy that interferes with a signal or measurement. Most noise is random with respect to the signals sent by the TDR to make a measurement and will appear on the waveform, constantly constantly moving up and down on the display. The NOISE FILTER control sets how many waveforms will be averaged together to make the waveform displayed. Noisy waveforms appear to fluctuate around the real signal. Because it is random, noise will sometimes add to the real signal and sometimes subtract energy from the real signal. By adding several noisy waveforms together, the noise can be “averaged” out of the signal because the average amount of noise adding to the signal will be nearly the same as the average amount of noise subtracting from the signal. More waveforms in an average are more likely to approach the real signal (although it takes longer to acquire and add together more waveforms).

Open Circuit In a cable, a broken conductor will not allow electrical energy to flow through it. These circuits are also called broken circuits. The circuit is open to the air (which looks like a very high impedance).

Precision The statistical spread or variation in a value repeatedly measured, generated, or displayed under constant conditions. Also called repeatability.

Reactance A conductor's opposition to the flow of AC electrical energy through it. All conductors have some reactance. Reactance is made up of capacitance and inductance. Capacitance is the ability of conductors separated by thin layers if insulation (dielectric) to store energy between them. Inductance is the ability of a conductor to produce induced voltage when the electrical current through it varies. All conductors have some capacitance and inductance, so all conductors have some reactance, which means they all have impedance.

Reflectometer An instrument that uses reflections to make measurements. Our reflectometers use electrical energy that is reflected back from points along a cable.

Resistance A conductor's opposition to the flow of DC electrical energy through it. All conductors have a certain amount of resistance. Resistance is the low (or zero) frequency part of impedance.

Resolution For a given parameter, the smallest increment or change in value that can be measured, generated, or displayed.

Return Loss The amount of energy reflected or returned from a cable indicates how much the impedance in the system is mismatched. The ratio of the energy sent out by the TDR, divided by the energy reflected back, expressed in the logarithmic dB scale, is called return loss.

Rho (ρ) (see Millirho)

Risetime The time it takes a pulse signal to go from 10% to 90% of the change in voltage.

RMS An acronym for Root Mean Squared. RMS is a way of measuring how much deviation there is from a known (or desired) waveform. It is also the method used to calculate how much power is contained in an AC waveform.

Sampling Efficiency Our instruments make measurements by taking a succession of samples in time and displaying them as a waveform with voltage on the vertical scale (up and down) and time along the horizontal scale (across the display). The circuitry that captures and holds the samples cannot instantly change from one voltage level to another. It might take the circuit several samples to settle in at the new voltage after a rapid change in the waveform. How efficiently the circuit moves from one sampled voltage level to the next is called sampling efficiency. If the efficiency is too low, the waveforms will be smoothed or rounded. If the efficiency is too high (above 100%), the circuit will actually move beyond the new voltage level in a phenomenon known as overshoot, which becomes an unwanted source of noise in the waveform.

Series Loss

Conductors all have some DC resistance to the flow of electrical energy through them. The amount of resistance per unit length is usually nearly constant for a cable. The energy lost overcoming this series resistance is called series loss. The series loss must be compensated for when measuring the return loss or impedance mismatch at the far end of long cables.

Short Circuit

In a cable, a short circuit is a place where the signal conductor comes into electrical contact with the return path or ground conductor. The electrical circuit is actually shorter than was intended. Short circuits are caused by worn, leaky, or missing insulation.

Stability

The change in accuracy of a standard or item of test equipment over an extended period of time. Unless otherwise specified, the period of time is assumed to be the calibration interval (might also apply to range, resolution, or precision as a function of time). The term stability might also be used to denote changes resulting from environmental influences, such as temperature, humidity, vibration, and shock.

TDR

An acronym for Time-Domain Reflectometer. These instruments are also called cable radar. They send out pulses of energy and time the interval to reflections. If the velocity of the energy through the cable is known, distances to faults in the cable can be displayed or computed. Conversely, the speed that the energy travels through a cable of known length can also be computed. The way in which the energy is reflected and the amount of the energy reflected indicate the condition of the cable.

Velocity of Propagation (Vp)

Electrical energy travels at the same speed as light in a vacuum. It travels slower than that everywhere else. The speed that it travels in a cable is often expressed as the relative velocity of propagation. This value is just a ration of the speed in the cable to the speed of light (so it is always a number between 0 and 1). A velocity of propagation value of 0.50 indicates that the electrical energy moves through the cable at half the speed of light.

Waveform Averaging

(see Noise)

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