Service Manual

Tektronix

1503C
Metallic Time-Domain Reflectometer

070-7170-05

This document applies to firmware version 5.04 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 all safety summaries prior to performing service.

www.tektronix.com

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

WARRANTY

Tektronix warrants that the products that it manufactures and sells will be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If a 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; c) to repair any damage or malfunction caused by the use of non-Tektronix supplies; or d) 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 IN LIEU OF ANY OTHER WARRANTIES, EXPRESS 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

Review the following safety precautions to avoid injury and prevent damage to this product or any products connected to it. To avoid potential hazards, use this product only as specified.

Only qualified personnel should perform service procedures.

To Avoid Fire or Personal Injury

Use Proper Power Cord. Use only the power cord specified for this product and certified for the country of use.

Use Proper Voltage Setting. Before applying power, ensure that the line selector is in the proper position for the power source being used.

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.

Ground the Product. This product is grounded through the grounding conductor of the power cord. To avoid electric shock, the grounding conductor must be connected to earth ground. Before making connections to the input or output terminals of the product, ensure that the product is properly grounded.

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

Observe All Terminal Ratings. To avoid fire or shock hazard, observe all ratings and markings on the product. Consult the product manual for further ratings information before making connections to the product.

Do not apply a potential to any terminal, including the common terminal, that exceeds the maximum rating of that terminal.

Replace Batteries Properly. Replace batteries only with the proper type and rating specified.

Recharge Batteries Properly. Recharge batteries for the recommended charge cycle only.

Use Proper AC Adapter. Use only the AC adapter specified for this product.

Do Not Operate Without Covers. Do not operate this product with covers or panels removed.

Use Proper Fuse. Use only the fuse type and rating specified for this product.

Avoid Exposed Circuitry. Do not touch exposed connections and components when power is present.

Do Not Operate With Suspected Failures. If you suspect there is damage to this product, have it inspected by qualified service personnel.

Do Not Operate in an Explosive Atmosphere.

Symbols and Terms

Terms in this Manual. These terms may appear 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. These terms may appear 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 on the Product. The following symbols may appear on the product:

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 1503C 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.

Tektronix, Inc.
Attn: Service Department
P.O. Box 500
Beaverton, Oregon 97077 U.S.A.

For more information, call 1-800-833-9200.

General Information

Product Description

The Tektronix 1503C Metallic-cable Time-Domain Reflectometer (MTDR) is a cable test instrument that uses radar principles to determine the electrical characteristics of metallic cables.

The 1503C 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 1503C 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 1503C 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 1503C 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 1503C 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 1503C 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 1503C 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 1503C 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 1503C power requirements can be found in the Safety Summary in this section and in the Operating Instructions chapter.

Repacking for Shipment

When the 1503C 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 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 1503C 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.

Contacting Tektronix

Product Support	For questions about using Tektronix measurement products, call toll free in North America: 1-800-833-9200 6:00 a.m. – 5:00 p.m. Pacific time Or contact us by e-mail: tm_app_supp@tek.com For product support outside of North America, contact your local Tektronix distributor or sales office.
Service support	Tektronix offers a range of services, including Extended Warranty Repair and Calibration services. Contact your local Tektronix distributor or sales office for details. For a listing of worldwide service centers, visit our web site.
Toll-free Number	In North America: 1-800-833-9200 An operator can direct your call.
Postal Address	Tektronix, Inc. Department or name (if known) P.O. Box 500 Beaverton, OR 97077 USA
Web site	www.tektronix.com

Operating Instructions

Overview

Handling

The 1503C 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.

The 1503C can be stored in temperatures ranging from –62° C to +85° C if a battery is not installed. If a battery is installed and the storage temperature is below –35° C or above +65° C, the battery pack should be removed and stored separately (see *1503C Service Manual* for instructions on removing the battery). Battery storage temperature should be between –35° C to +65° C.

Powering the 1503C

In the field, the 1503C 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.

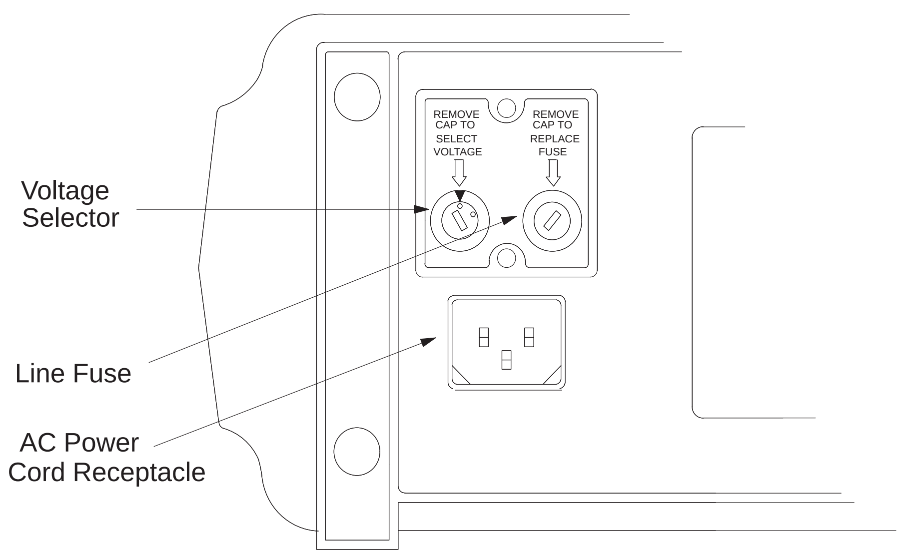


Figure 1–1: Rear Panel Voltage Selector, Fuse, AC Receptacle

The 1503C 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 1503C 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 1503C 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 1503C 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 1503C 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.

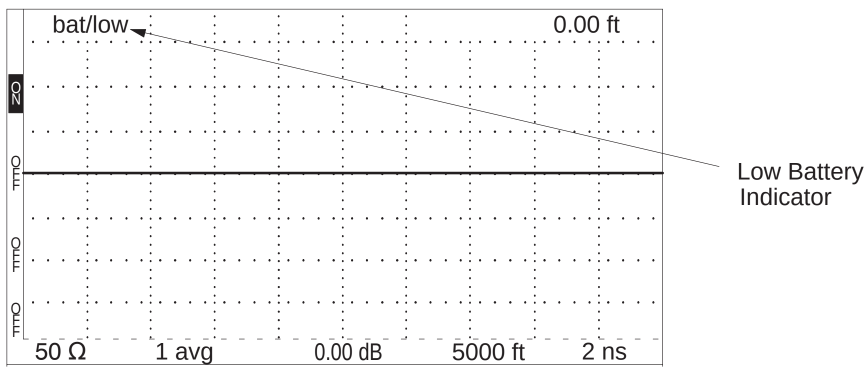


Figure 1–2: Display Showing Low Battery Indication

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.*

Low Temperature Operation

When the instrument is stored at temperatures below –10° C, voids might develop in the liquid crystal display (LCD). These voids should disappear if the instrument is placed in an ambient temperature ≥ +5° C for 24 hours.

When operating the 1503C 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 1503C

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

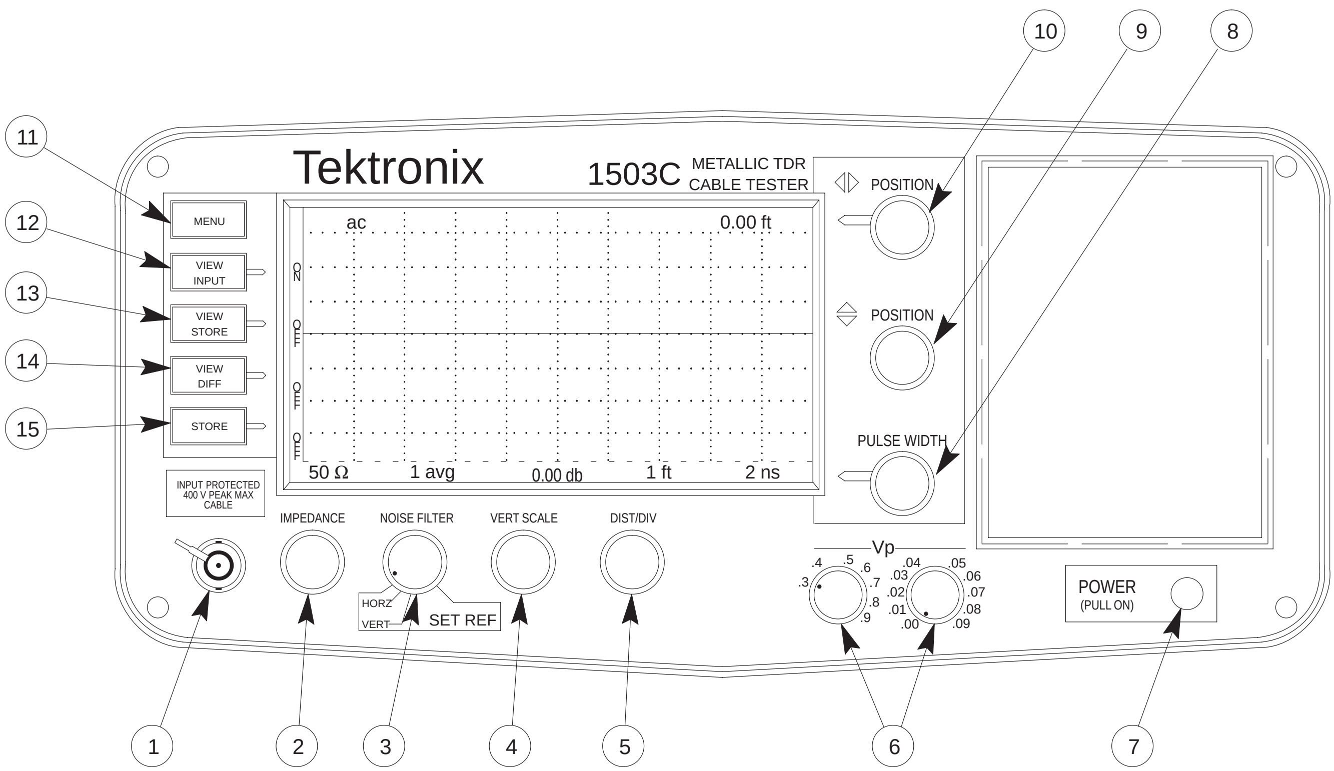


Figure 1–3: 1503C Front-Panel Controls

CAUTION. *Do not connect to circuits or cables with live voltages greater than 400 V peak. Voltages exceeding 400 V might damage the 1503C front-end circuits.*

Display

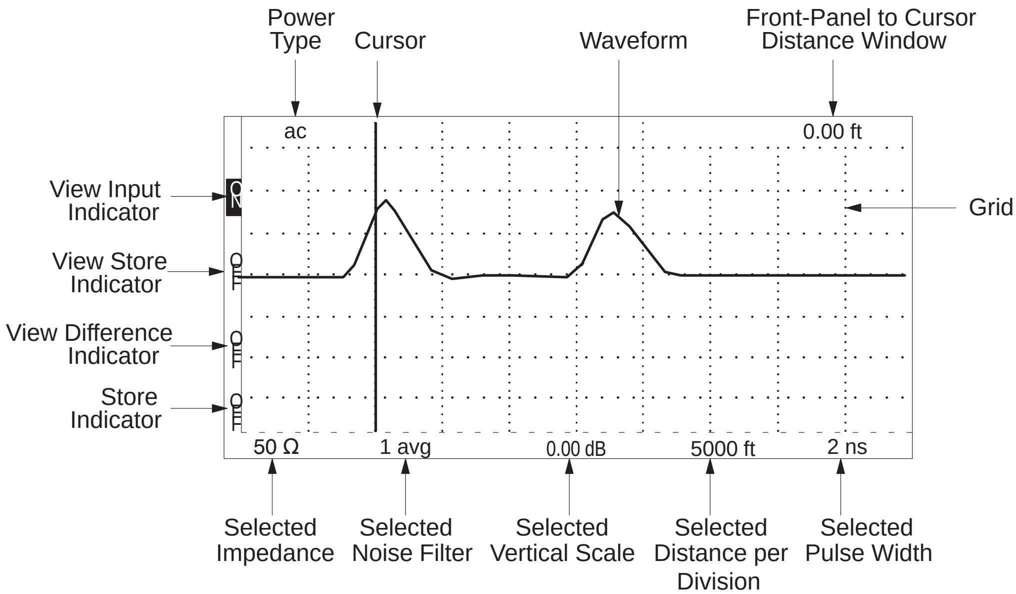
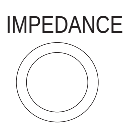


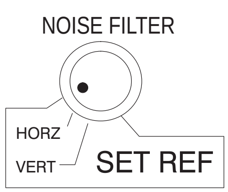
Figure 1–4: Display and Indicators

Front-Panel Controls

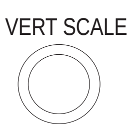
1. **CABLE:** A female BNC connector for attaching a cable to the 1503C for testing.



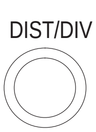
2. **IMPEDANCE:** A four-position rotary switch that selects the output impedance of the cable test signal. Available settings are 50, 75, 93, and 125 Ohms. The selected value is displayed above the control on the LCD.



3. **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.

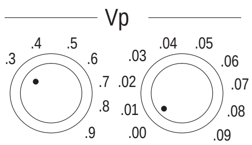


4. **VERT SCALE:** This control sets the vertical gain, displayed in dB, or the vertical sensitivity, displayed in mρ per division. Although the instrument defaults to dB, you may choose the preferred mode from the *Setup Menu*. The selected value is displayed above the control on the LCD.

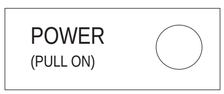


5. **DIST/DIV:** Determines the number of feet (or meters) per division across the display. The minimum setting is 1 ft/div (0.25 meters) and the maximum setting is 5000 ft/div (1000 meters). The selected value is displayed above the control on the LCD.

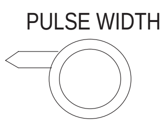
A standard instrument defaults to ft/div. A metric instrument (Option 05) defaults to m/div, but either may be changed temporarily from the menu. The default can be changed by changing an internal jumper (see Chapter 7).



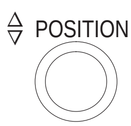
6. **Vp:** The two Velocity of Propagation controls are set according to the propagation velocity factor of the cable being tested. For example, solid polyethylene commonly has a Vp of 0.66. Solid polytetraflourethylene (Teflon ®) is approximately 0.70. Air is 0.99. The controls are decaded: the left 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.



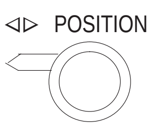
7. **POWER:** Pull for power ON and push in for power OFF. When the front cover is installed, this switch is automatically pushed OFF.



8. **PULSE WIDTH:** This is a five-position rotary switch that selects the pulse width of the cable test signal. The available settings are: 2, 10, 100, 1000 nanoseconds, and AUTO. The selected value is displayed on the LCD adjacent to the control. The AUTO setting sets the pulse width according to the distance registered at the right side of the LCD. The selected value is displayed to the left of this control on the LCD.

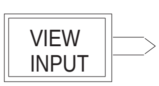


9. △▽ **POSITION:** This is a continuously rotating control that positions the displayed waveform vertically, up or down the LCD.



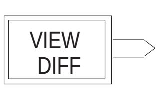
10. ◁▷ **POSITION:** This is a continuously rotating control that moves a vertical cursor completely across the LCD graticule. In addition, the waveform is also moved when the cursor reaches the extreme right or left side of the display. A readout (seven digits maximum) is displayed in the upper right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

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



12. **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.

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



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

15. **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 1503C 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. **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 decibels when powered back up.
   c. **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 Chapter 7.

d. **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.

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. **Impedance Diagnostic** tests the output impedance circuits in the instrument.

iv. **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.

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

vi. **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.

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.

   The SP-232, a serial interface product, also allows for connection of the 1503C to other instrumentation, including computers, via the option port. SP-232 is an RS-232C-compatible interface. For more information, contact your Tektronix Customer Service Representative. They can provide you with additional details on the hardware and software protocol.

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 1503C, 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

Impedance of Various Cable Types

50 Ω	75 Ω	93 Ω	125 Ω
RG–4	RG–6/U	RG–7/U	RG–23/U
RG–8/U	RG–11/U	RG–22/U	RG–63/U
RG–9/U	RG–12/U	RG–62/U	RG–79/U
RG–58/U	RG–13/U	RG–71/U	RG–89/U
RG–62/U	RG–59/U	RG–111/U	Flat Lead
RG–81	RG–124/U	Twisted Pair	Twisted Pair
RG–93	RG–140/U		
RG–142B/U	RG–179/U		
RG–225/U	75 Ω Video		
RG–303B/U			
RG–316/U			
RG–393/U			
Vertebrae Helix			

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 (Setting Too Low)

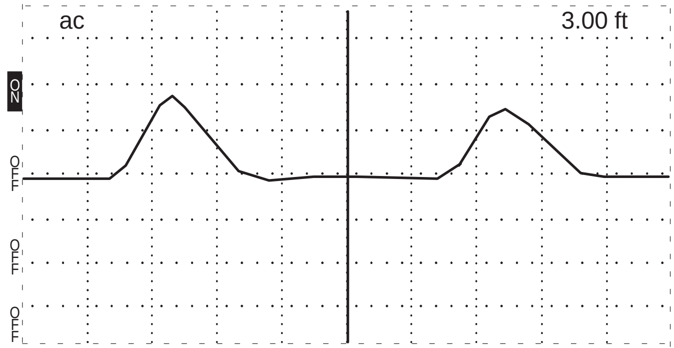


Figure 1–6: Vp Set at .99, Cursor Less Than Reflected Pulse (Setting Too High)

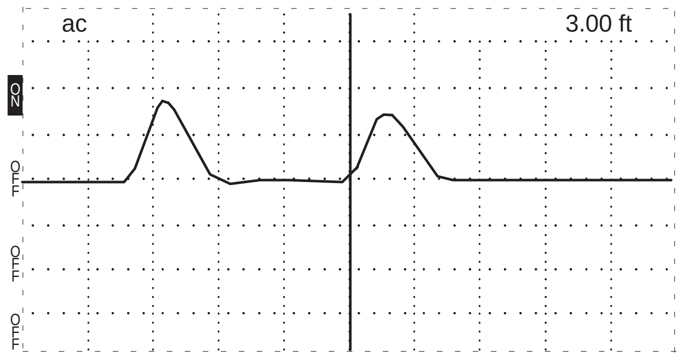


Figure 1–7: Vp Set at .66, Cursor on Rising Edge of Reflected Pulse (Set Correctly)

Cable Test Procedure

Distance to the Fault

Be sure to read the previous paragraphs on Vp.

1. Set the 1503C controls:

POWER	On
CABLE	Cable to BNC
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
DIST/DIV	(see below)
Vp	(per cable)
PULSE WIDTH	(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.

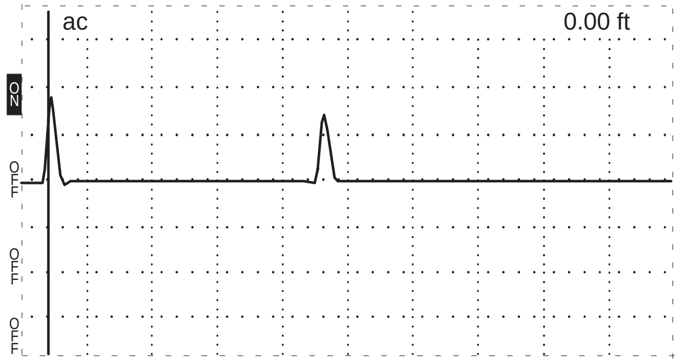


Figure 1–8: 20-ft Cable at 5 ft/div

If the cable length is unknown, set DIST/DIV to 5000 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.

The best pulse width is dependent on the cable length. A short pulse can be completely dissipated in a long cable. Increasing the pulse width will allow the reflected pulse to be more visible when testing long cables. AUTO will select the pulse width for you, depending on the distance on the right side of the LCD.

CABLE LENGTH	SUGGESTED PULSE	SUGGESTED ft/div
0 to 100 ft	2 ns	10 ft/div
51 to 500 ft	10 ns	50 ft/div
501 to 5000 ft	100 ns	500 ft/div
5001 to 50,000 ft	1000 ns	5000 ft/div

When the entire cable is displayed, you can tell if there is an open or a short. Essentially, a drop in the pulse is a short and a rise in the pulse is an open. Less catastrophic faults can be seen as hills and valleys in the waveform. Bends and kinks, frays, water, and interweaving all have distinctive signatures.

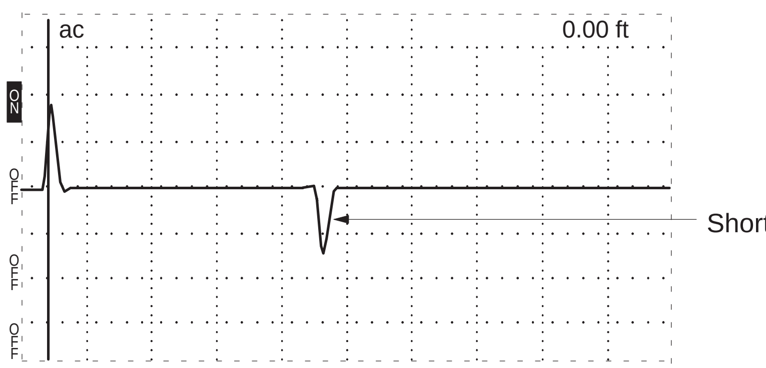


Figure 1–9: Short in the Cable

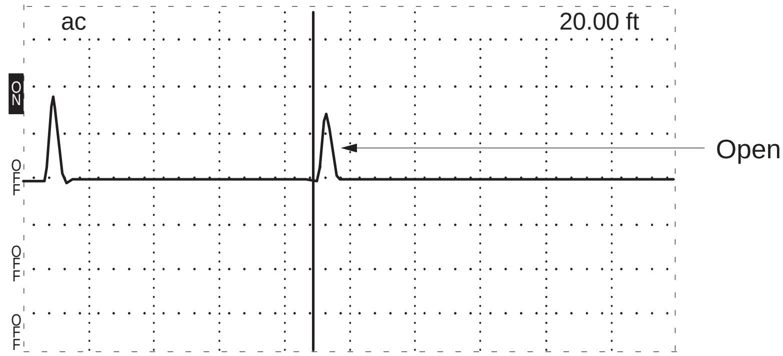


Figure 1–10: Open in the Cable

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 455-foot cable, a setting of 100 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.

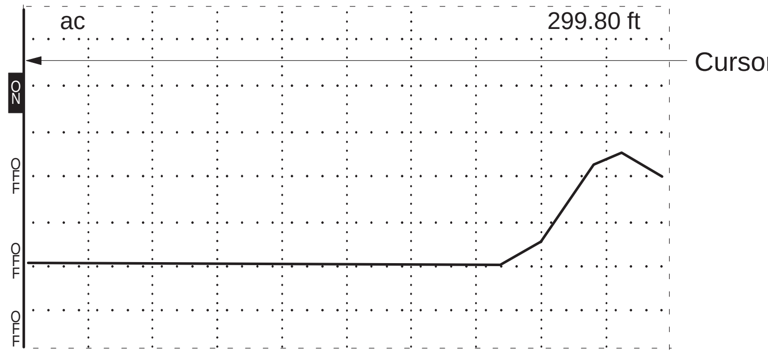


Figure 1–12: 455-ft Cable with 20 ft/div, Cursor Off Screen

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., kinks in the cable). 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.

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})

To measure return loss with the 1503C, note the height of the incident pulse, then adjust the reflected pulse to be the same height that the incident pulse was and read the dB on the LCD display. The amount of vertical scale change that was needed is the return loss in dB.

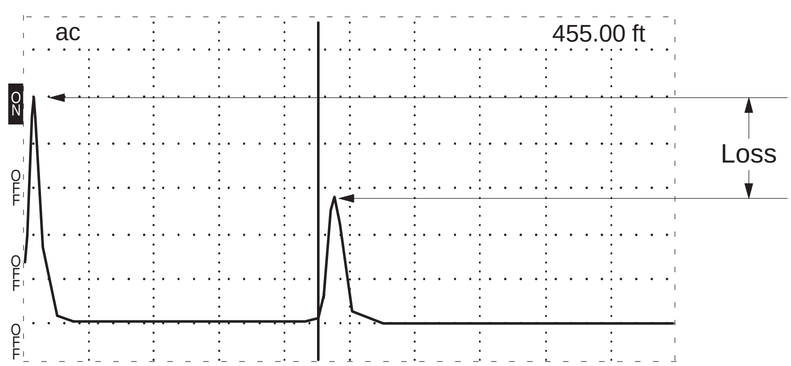


Figure 1–13: Return Loss

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.

Reflection Coefficient Measurements

The 1503C can be made to display in mρ/div instead of dB through MENU.

1. Press MENU.
2. Select *Setup Menu*.
3. Press MENU.
4. Select *Vertical Scale is: Decibels*.
5. Press MENU. This changes the selection to *Vertical Scale is: Millirho*.
6. Press MENU again to exit from the Setup Menu.
7. Press MENU again to return to normal operation.

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 1503C measures 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.

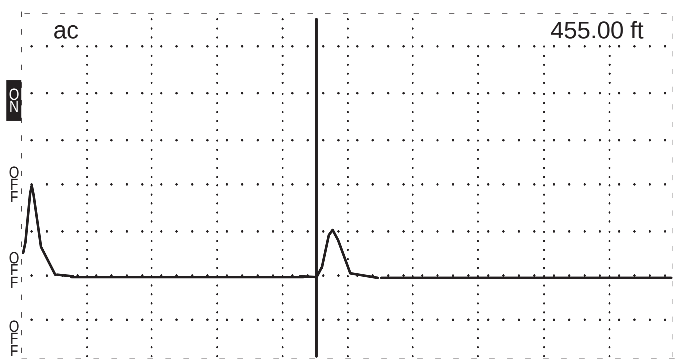


Figure 1–14: Reflection Adjusted to One Division in Height

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 1503C 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 1503C will be reflected. This is a reflection coefficient of rho = 1, or +1000 mρ for the open and –1000 mρ for the short.

Effect of Cable Attenuation on Return Loss and Reflection Coefficient Measurements

Cable attenuation influences the return loss and reflection coefficient measurements made with the 1503C. If you desire to measure the return loss of only an impedance mismatch, the cable attenuation, as measured with an open or short circuit on the cable, must be subtracted from the directly measured value.

For reflection coefficient, the directly measured value of rho must be divided by the value measured with an open or short circuit on the cable. These calculations can be done manually, or the instrument can perform them by proper use of the VERT SET REF function.

It is is not possible to measure the cable under test with an open or short, sometimes another cable of similar type is available to use as a reference. Note that cable attenuation is strongly influenced by signal frequency and, therefore, will be different from one pulse width to another on the 1503C.

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 1–15). The default condition when the instrument is powered up is to have VIEW INPUT on.

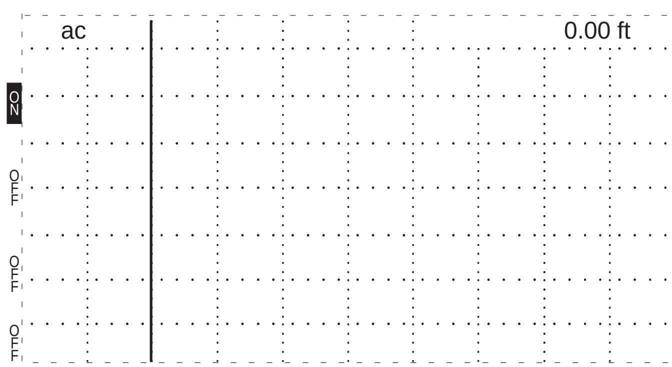


Figure 1–15: Display with VIEW INPUT Turned Off

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.

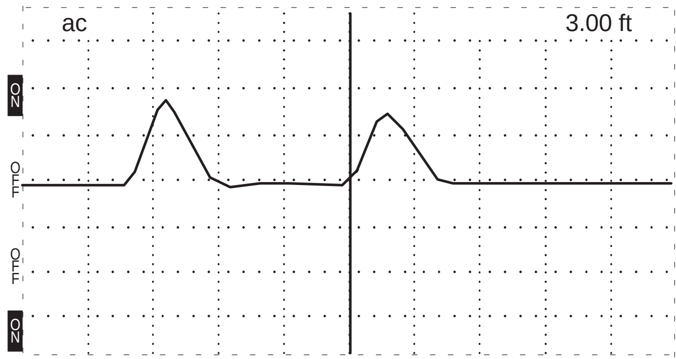


Figure 1–16: Display of a Stored Waveform

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.

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.

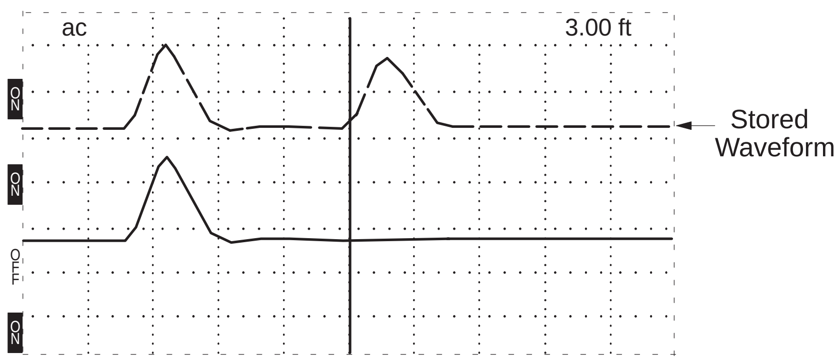


Figure 1–17: Display of a Stored Waveform and Current Waveform

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.*

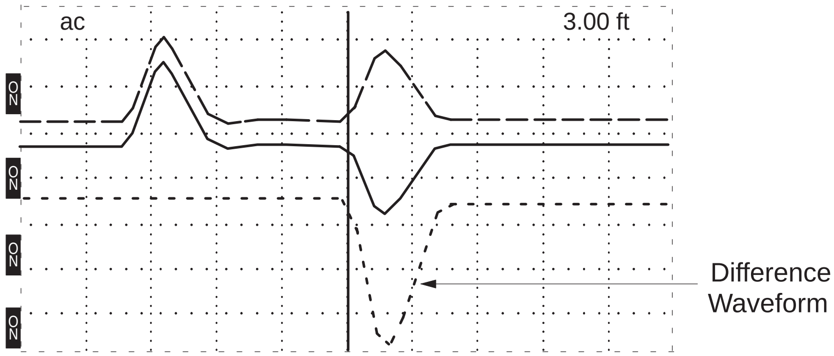


Figure 1–18: Display of a Stored Waveform, Current Waveform, and Difference Waveform

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.

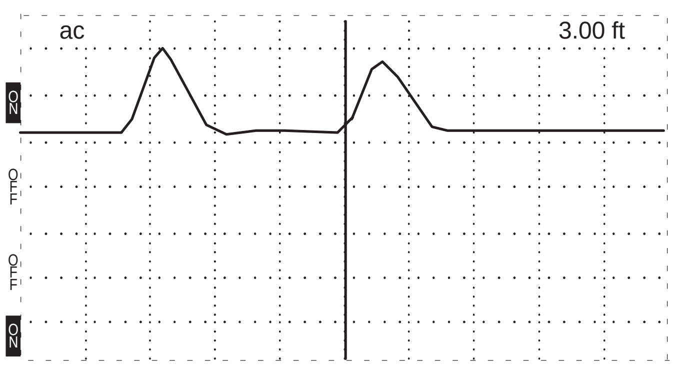


Figure 1–19: Waveform Moved to Top Half of Display

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.

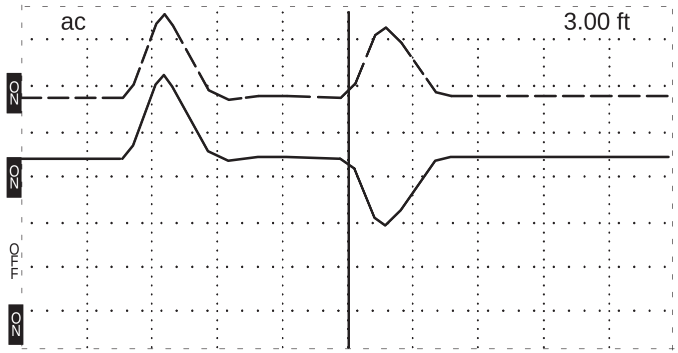


Figure 1–20: Current Waveform Centered, Stored Waveform Above

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

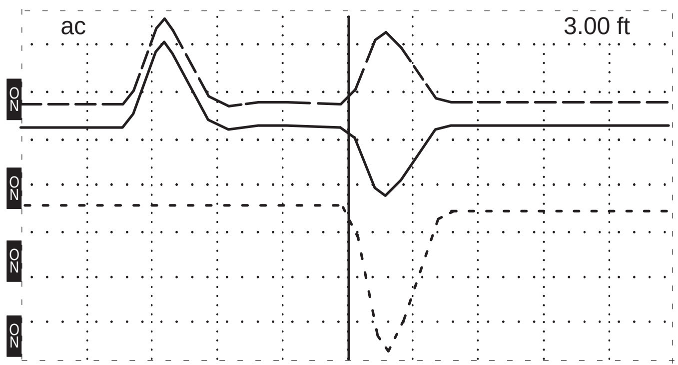


Figure 1–21: Current Waveform Center, Stored Waveform Above, Difference Below

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.

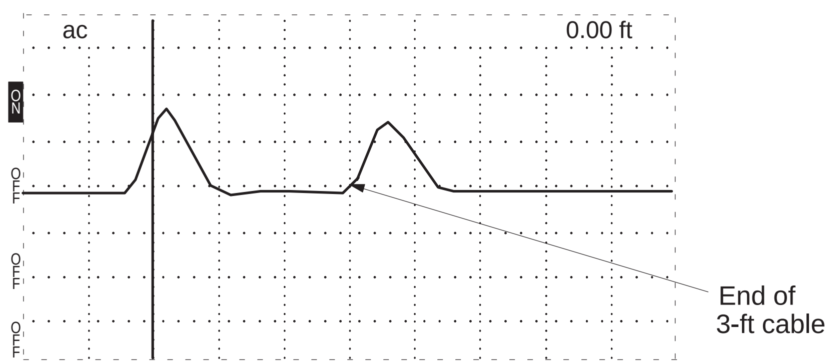


Figure 1–22: Waveform of Three-Foot Lead-in Cable

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.

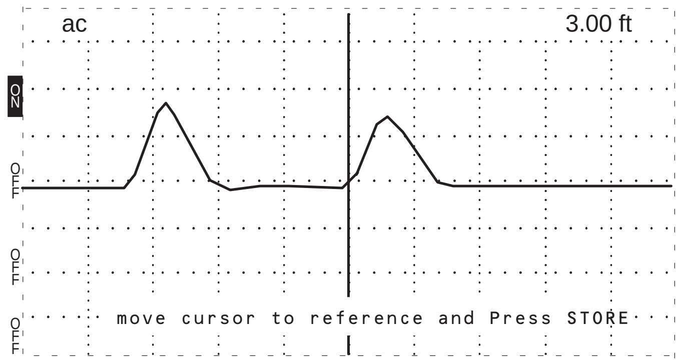


Figure 1–23: Cursor Moved to End of Three-Foot Lead-in Cable

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.

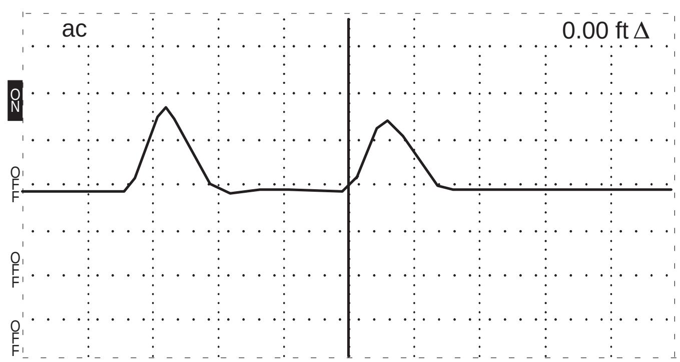


Figure 1–24: Cursor Moved to End of Three-Foot Lead-in Cable

***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.

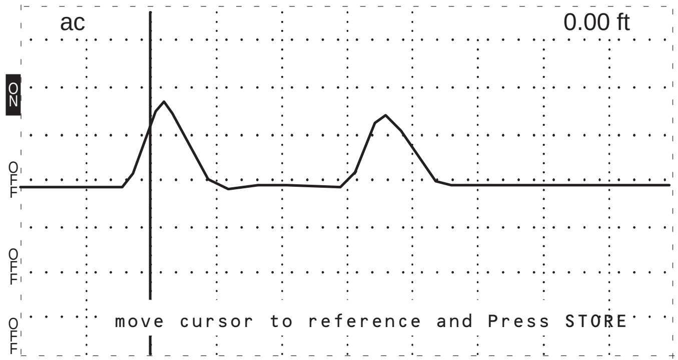


Figure 1–25: Cursor Moved to 0.00 ft

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 $\stackrel{\triangle}{\triangledown}$POSITION.

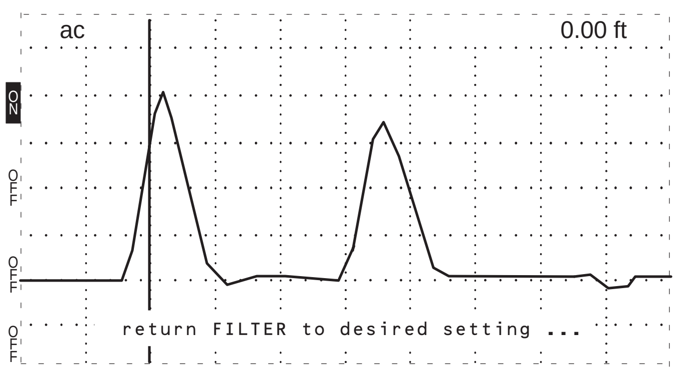


Figure 1–26: Incident Pulse at Four Divisions, FILTER at Desired Setting

3. Push STORE.

4. Return NOISE FILTER to the desired setting. Notice that the dB scale is now set to 0.00 dB.

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

   a. Make sure the vertical scale is in dB mode (access the Setup Menu if change is needed).

b. Turn NOISE FILTER to VERT SET REF.

c. Adjust VERT SCALE to obtain 0.00 dB.

d. Push STORE.

e. Turn NOISE FILTER to desire filter setting.

Because dB is actually a ratio between the energy sent out and the energy reflected back, using VERT SET REF does not affect the dB difference measured.

***NOTE**. Do not use Auto Pulse Width when making measurements in VERT SET REF. Auto Pulse Width changes the pulse width at 100, 500, and 5000 feet. If the pulse width changes while in VERT SET REF, it could result in an erroneous reading. Manually controlling the pulse width assures the pulse width remains the same for both the incident and reflective pulses.*

Additional Features (Menu Selected)

Max Hold

The 1503C 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 1503C will monitor the line and display any fluctuations on the LCD.

1. Attach the cable to the 1503C 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.

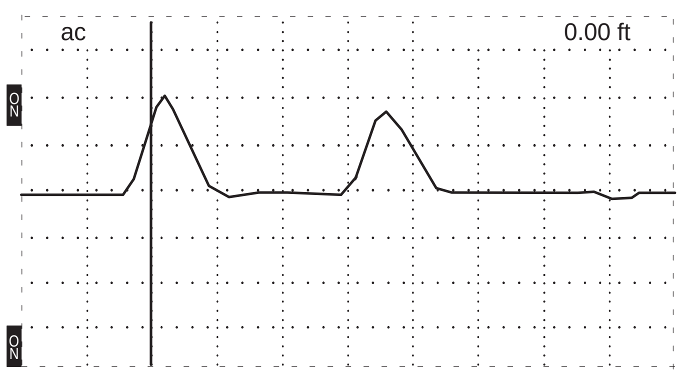


Figure 1–27: Waveform Viewed in Normal Operation

7. When you are ready to monitor this cable for intermittents, push STORE. The 1503C will now capture any changes in the cable.

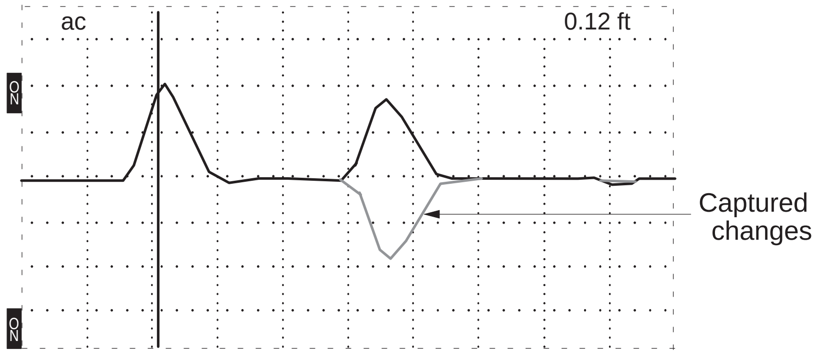


Figure 1–28: Waveform Showing Intermittent Short

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 1503C in a "listening mode" by turning off the pulse generator.

1. Attach a cable to the 1503C 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*.

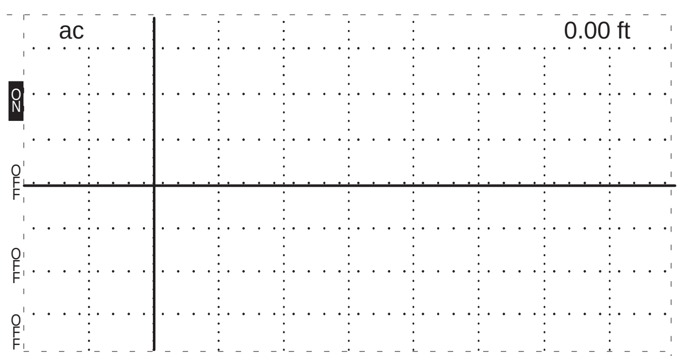


Figure 1–29: Waveform Display with No Outgoing Pulses

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

This feature allows the 1503C to act much like a non-triggered oscilloscope. In this mode, the 1503C 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 the pulse back on, then repeatedly 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 1503C 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.

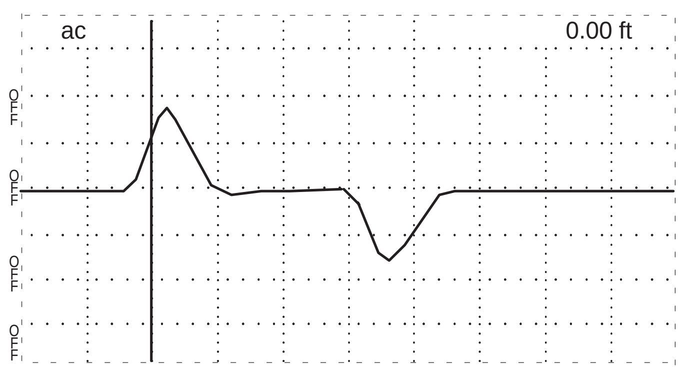


Figure 1–30: A Captured Single Sweep

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 1503C. They are recommended for incoming inspections to verify that the instrument is functioning properly. Procedures to verify the actual performance requirements are provided in the 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
50 Ω precision terminator	011–0123–00
93 Ω 10-foot coaxial cable	012–1351–00

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. Refer to the *Troubleshooting* section of the *Maintenance* chapter in this manual.

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 1503C front-panel controls:

IMPEDANCE	93 Ω
NOISE FILTER	1 avg
VERT SCALE	10.00 dB
DIST/DIV	2 ft/div (0.25 m)
Vp	.84
PULSE WIDTH	2 ns

1. Horizontal Scale (Timebase) Check

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

1. Turn the 1503C power on. The display should look very similar to Figure 2–1.

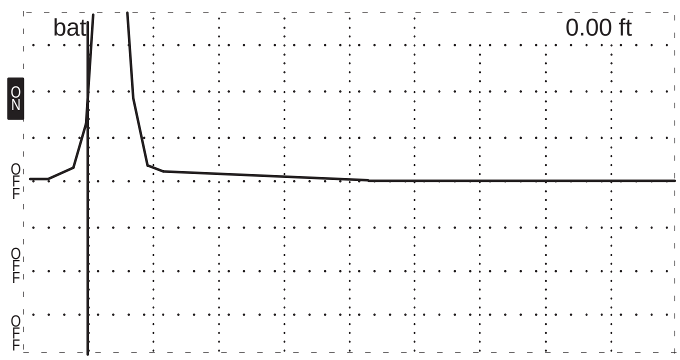


Figure 2–1: Start-up Measurement Display

2. Connect the 10-foot cable to the front-panel CABLE connector. The display should now look like Figure 2–2.

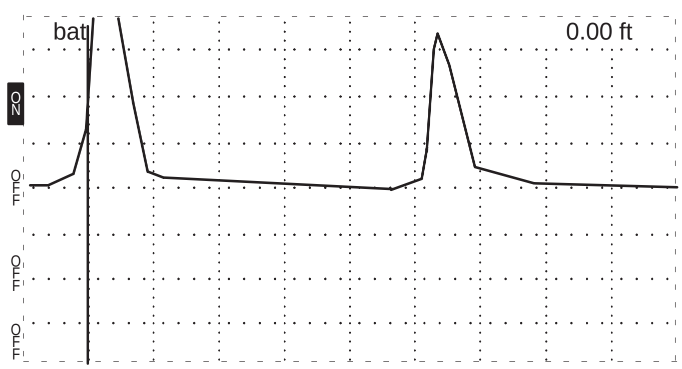


Figure 2–2: Measurement Display with 10-foot Cable

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 9.7 to 10.3 feet (2.95 to 3.14 m).

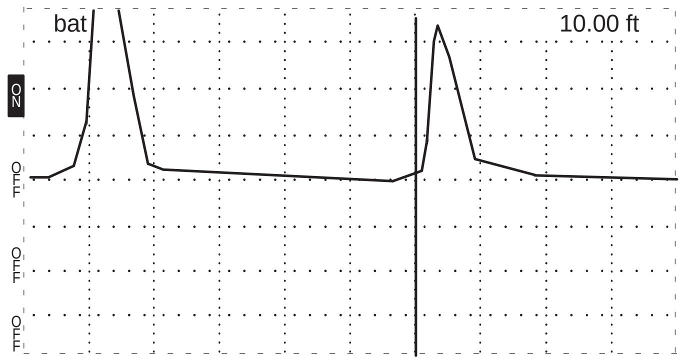


Figure 2–3: Cursor at End of 10-foot Cable

4. Change the Vp to .30. 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 3.50 to 3.70 feet (1.05 to 1.11 m).

Figure 2–4: Cursor at End of 10-foot Cable, Vp Set to .30

5. Remove the 10-foot cable and connect the 50 Ω terminator. Change the 1503C front-panel controls to:

VERT SCALE	0.00 dB
DIST/DIV	5000 ft/div (1000 m/div)
PULSE WIDTH	1000 ns

6. Turn the ◁▷ POSITION control clockwise until the display distance window reads a distance greater the 50,000 feet (15,259 m). The waveform should remain a flat line from zero to this distance.

Figure 2–5: Flatline Display Out to 50,000+ Feet

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).

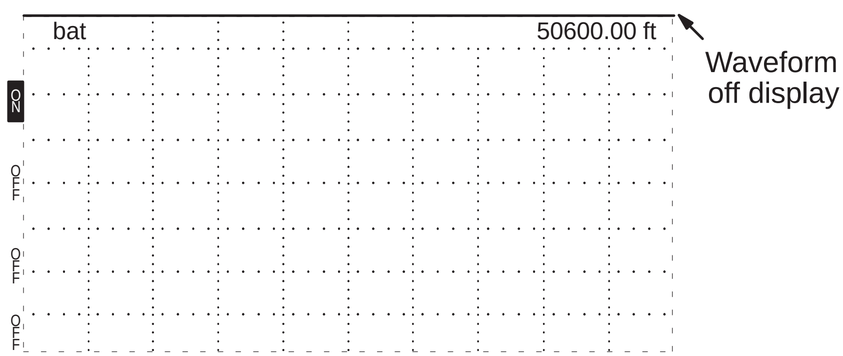


Figure 2–6: Waveform Off the Top of the Display

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).

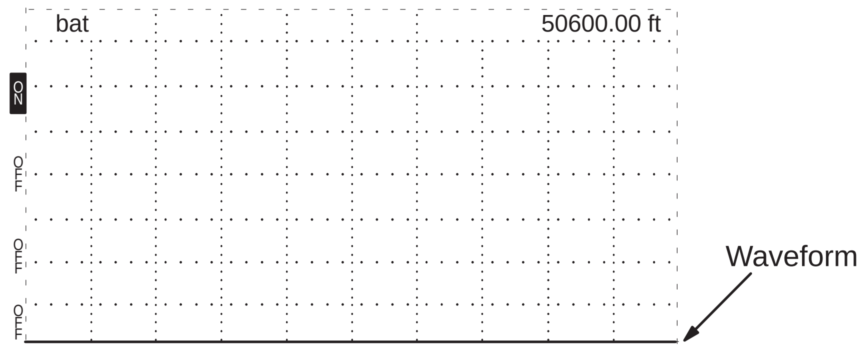


Figure 2–7: Waveform at the Bottom of the Display

3. Noise Check

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

1. Set the PULSE WIDTH to 2 ns. Using the ⇕ POSITION control and VERT SCALE control, set the gain to 57 dB with the waveform centered vertically in the display.

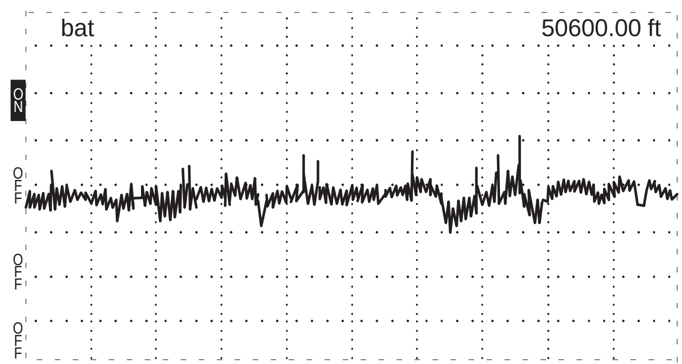


Figure 2–8: Waveform with Gain at 57 dB

2. Press MENU.
3. Using the ⇕ POSITION control, select *Diagnostics Menu*.
4. Press MENU again.
5. Using the ⇕ POSITION control, select *Service Diagnostic Menu*.
6. Press MENU again.
7. Using the ⇕ POSITION control, select *Noise Diagnostics*.
8. Press MENU again and follow the instructions on the display.

9. 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.

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. Impedance Check

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

1. In the *Service Diagnostic Menu*, select the *Impedance Diagnostic* and follow the directions on the screen. Passable tolerances are:

50 Ω	47.0 to 50.0 Ω
75 Ω	71.0 to 75.0 Ω
93 Ω	88 to 93 Ω
125 Ω	118 to 125 Ω

2. Exit from the *Impedance Diagnostic*, but do not leave the *Service Diagnostic Menu* yet.

6. 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.

7. Aberrations Check

If the aberrations are too large, they can be confused with minor faults in the cable near the instrument.

1. Turn the ◁▷ POSITION control counterclockwise until the display distance window reads less than 20.00 ft (6.10 m).

2. Set the DIST/DIV control to 1 ft/div (0.25 m/div).

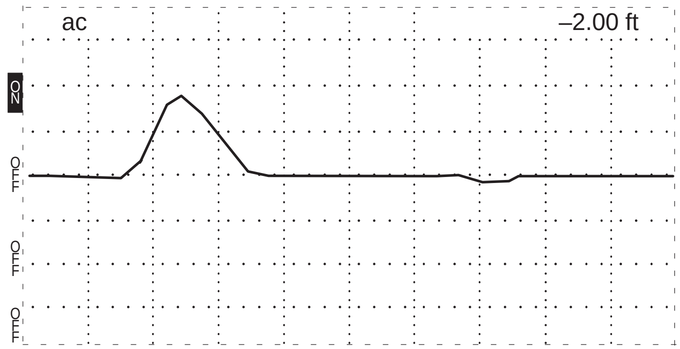


Figure 2–9: Distance at –2.00 ft

3. Turn the ◁▷ POSITION control counterclockwise until the display distance window reads –2.00 ft (–0.62 m).

4. Set the 1503C front-panel controls:

IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
PULSE WIDTH	2 ns
Vp	.99

5. Connect the 50 Ω precision terminator to the front panel.

6. Turn the NOISE FILTER control completely counterclockwise to the VERT SET REF position.

7. Use VERT SCALE to increase the height of the pulse to four major divisions.

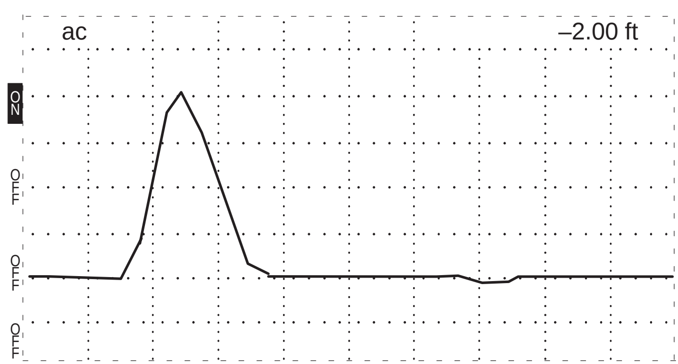


Figure 2–10: Pulse Adjusted to Four Major Divisions in Height

8. Press STORE.

9. Turn the NOISE FILTER control back to 1 avg.

10. Place the baseline of the waveform on the center graticule using the △▽POSITION control.

11. Increase VERT SCALE to 25.00 dB

12. Using the ◁▷ POSITION control, verify that the aberrations are less than four divisions high out to 10 feet (3.05 m).

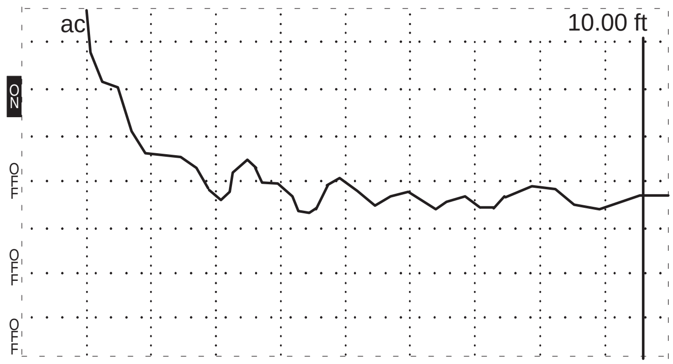


Figure 2–11: Waveform Centered, Cursor at 10.00 ft

13. Return the cursor to –2.00 ft (–0.61 m).

14. Turn NOISE FILTER back to VERT SET REF.

15. Set the DIST/DIV to 2 ft/div (0.5 m/div).

16. Turn PULSE WIDTH to 10 ns.

17. Adjust the pulse height to four major divisions.

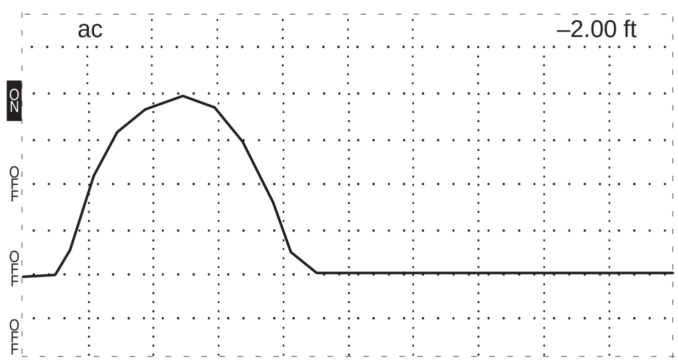


Figure 2–12: Pulse Adjusted to Four Major Divisions in Height

18. Press STORE.

19. Return the NOISE FILTER control to 1 avg.

20. Place the baseline of the waveform on the center graticule using the ≙POSITION control.

21. Increase VERT SCALE to 30.00 dB.

22. Using the ◁▷ POSITION control, verify that the aberrations are less than four divisions high out to 30 feet (9.15 m)

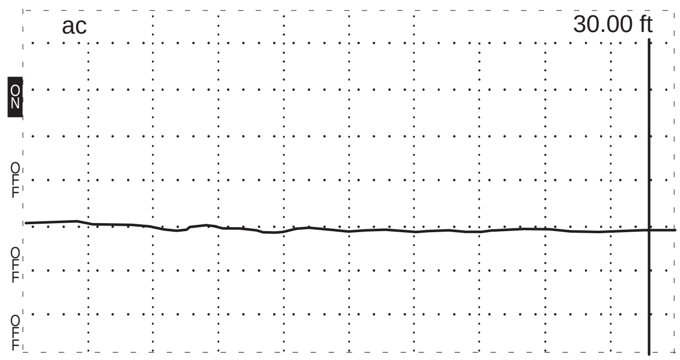


Figure 2–13: Aberrations Less Than Four Divisions Out to 30.00 ft

23. Return the cursor to –2.00 ft (–0.61 m).

24. Turn NOISE FILTER back to VERT SET REF.

25. Set the DIST/DIV to 50 ft/div (10 m/div).

26. Turn PULSE WIDTH to 100 ns.

27. Adjust the pulse height to four major divisions.

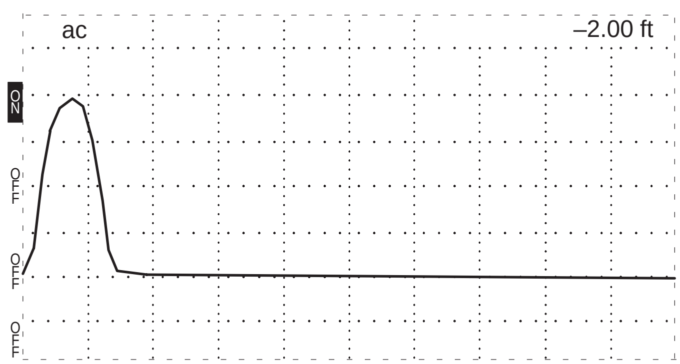


Figure 2–14: Pulse Adjusted to Four Major Divisions in Height

28. Press STORE.

29. Return the NOISE FILTER control to 1 avg.

30. Place the baseline of the waveform on the center graticule using the △▽POSITION control.

31. Increase VERT SCALE to 30.00 dB.

32. Using the ◁▷ POSITION control, verify that the aberrations are less than four divisions high out to 300 feet (91.50 m).

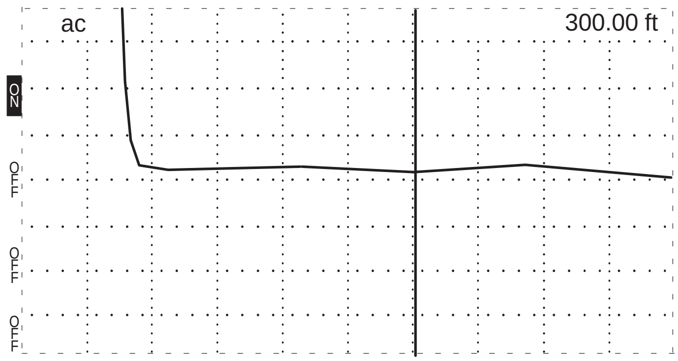


Figure 2–15: Aberrations Less Than Four Divisions Out to 300.00 ft

33. Return the cursor to –2.00 ft (–0.61 m).

34. Turn NOISE FILTER back to VERT SET REF.

35. Set the DIST/DIV to 500 ft/div (10 m/div).

36. Turn PULSE WIDTH to 1000 ns.

37. Adjust the pulse height to four major divisions.

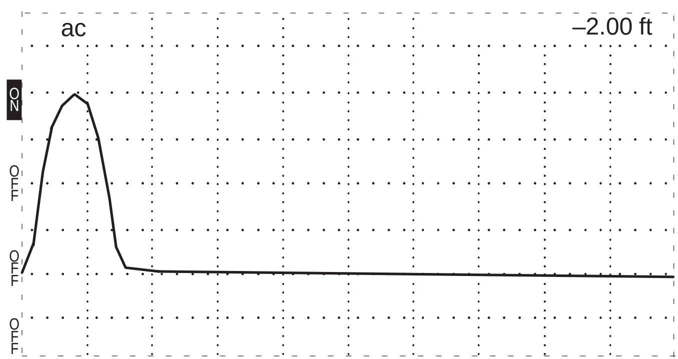


Figure 2–16: Pulse Adjusted to Four Major Divisions in Height

38. Press STORE.

39. Return the NOISE FILTER control to 1 avg.

40. Place the baseline of the waveform on the center graticule using the △▽POSITION control.

41. Increase VERT SCALE to 30.00 dB.

42. Using the ◁▷ POSITION control, verify that the aberrations are less than four divisions high out to 3000 feet (915.00 m)

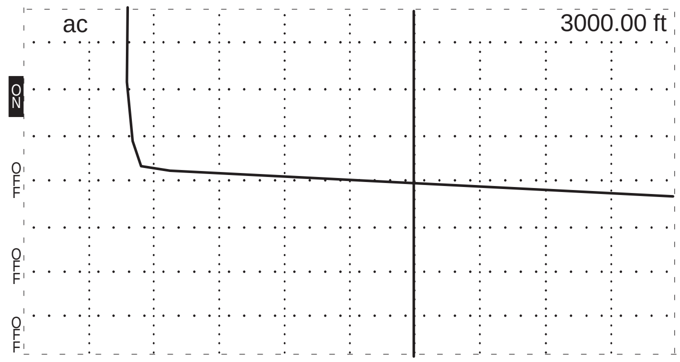


Figure 2–17: Aberrations Less Than Four Divisions Out to 3000.00 ft

Conclusions

If the instrument failed Aberrations or Sampling Efficiency checks, it is probably still adequate for all but extremely minor fault 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.

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

If your instrument is equipped with Option 06 (Ethernet), refer to *Calibration*, Chapter 6.

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
Test Pulse Width Accuracy	 Selected: 2 ns, 10 ns, 100 ns, 1000 ns 2 ns ±1 ns; 10 ns, 100 ns, 1000 ns ±10%	 Measured at half sine amplitude point with matching termination.
Pulse Amplitude Terminated Unterminated	 –2.5 VDC ±10% for 10 ns, 100 ns, 1000 ns; 2 ns ±20% –5.0 VDC ±10% for 10 ns, 100 ns, 1000 ns	 Internal cable length prevents 2 ns pulse from reaching full unterminated voltage
Pulse Shape	1/2 sine	
Pulse Output Impedance Accuracy	Selected: 50 Ω, 75 Ω, 93 Ω, 125 Ω 1%	
Pulse Repetition Time	350 µs nominal	
Vertical Scale Accuracy Set Adjustment Vertical Position	 0 dB to 63.75 dB gain ±3% Set incident pulse within ±3% Any waveform point moveable to center screen.	 256 values at 0.25 dB increments Combined with vertical scale control.
Displayed Noise Random Aberrations	 ≤ ±1.0 division peak with 57 dB gain, filter set to 1 ≤ ±1.0 division peak with 63 dB gain, filter set to 8 ≤–30 dB p–p for 10 ns, 100 ns, 1000 ns test pulse ≤–25 dB p–p for 2 ns test pulse	With matching terminator at panel. Beyond three test pulse widths after test pulse. Within three test pulse widths after test pulse. dB is relative to test pulse.

(continued next page)

Characteristic	Performance Requirement	Supplemental Information
Cable Connection Coupling Max Input Susceptibility	 Capacitively coupled ± 400 V (DC + peak, AC at maximum frequency of 440 Hz). No damage with application for up to 30 seconds (might affect measurement capability).	
Distance Cursor Resolution	1/25 of 1 major division	
Cursor Readout Range Resolution Accuracy	 –2 ft to ≥ 50,000 ft (–0.61 m to 15,230 m) 0.04 ft Within 2% ± 0.02 ft at 1 ft/div	 5 digit readout Vp must be set within ± 0.5% of cable
Horizontal Scale Range	 1 ft/div to 5000 ft/div (0.25 m/div to 1000 m/div) 12 values: 1, 2, 5 sequence 0 to 50,000 ft (0 to 10,000 m)	
Horizontal Position	Any distance to full scale can be moved on screen	
Vp Range Resolution Accuracy	 0.30 to 0.99 0.01 within ± 1%	 Propagation velocity relative to air
Custom Option Port		Tek chart recorder is designed to operate with the 1503C. Produces a high resolution thermal dot matrix recording and waveform and control values.
Line Voltage	115 VAC (90 to 132 VAC) 45 to 440 Hz 230 VAC (180 to 250 VAC) 45 to 440 Hz	Fused at 0.3 A Fused at 0.15 A
Battery Pack Operation Full Charge Time Overcharge Protection Discharge Protection Charge Capacity Charge Indicator	 8 hours minimum, 30 chart recordings maximum 20 hours maximum Charging discontinues once full charge is attained Operation terminates prior to battery damage 3.4 Amp-hours typical Bat/low will be indicated on LCD when capacity reaches approximately 10%	 +15° C to +25° C charge and discharge temperature, LCD backlight off. Operation of instrument with backlight on or at temperatures below +10° C will degrade battery operation specification

Environmental Characteristics

Characteristic	Performance Requirement	Supplemental Information
Temperature Operating Non-operating	 –10° C to +55° C –62° C to +85° C	 Battery capacity reduced at other than +15°C to +25°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 Operating Non-operating	 to 10,000 ft to 40,000 ft	MIL–T–28800C, Class 3
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 Bench Handling Operating Non-operating	 30 g, 11 ms 1/2 sine wave, total of 18 shocks 4 drops each face at 4 inches or 45 degrees with opposite edge as pivot 4 drops each face at 4 inches or 45 degrees with opposite edge as pivot. Satisfactory operation after drops.	 MIL–T–28800C, Class 3 MIL–STD–810, Method 516, Procedure V Cabinet on, front cover off 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 Operating Non-operating	 Splash-proof and drip-proof Watertight with 3 feet of water above top of case	MIL–T–28800C, Style A Front cover off 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)

Certifications and Compliances

Category	Standard or description
EC Declaration of Conformity – EMC	Meets 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 Union: EN 50081-1 Emissions: EN 55022 Class B Radiated and Conducted Emissions EN 60555-2 AC Power Line Harmonic Emissions EN 50082-1 Immunity: IEC 801-2 Electrostatic Discharge Immunity IEC 801-3 RF Electromagnetic Field Immunity IEC 801-4 Electrical Fast Transient/Burst Immunity IEC 801-5 Power Line Surge Immunity
Australia/New Zealand Declaration of Conformity – EMC	Complies with EMC provision of Radiocommunications Act per the following standard(s): AS/NZS 2064.1/2 Industrial, Scientific, and Medical Equipment: 1992
EMC Compliance	Meets the intent of Directive 89/336/EEC for Electromagnetic Compatibility when it is used with the product(s) stated in the specifications table. Refer to the EMC specification published for the stated products. May not meet the intent of the directive if used with other products.
FCC Compliance	Emissions comply with FCC Code of Federal Regulations 47, Part 15, Subpart B, Class A Limits.
Safety Standards	
U.S. Nationally Recognized Testing Laboratory Listing	UL1244 Standard for electrical and electronic measuring and test equipment.
Canadian Certification	CAN/CSA C22.2 No. 231 CSA safety requirements for electrical and electronic measuring and test equipment.
European Union Compliance	Low Voltage Directive 73/23/EEC, amended by 93/68/EEC EN 61010-1/A2 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Additional Compliance	IEC61010-1/A2 Safety requirements for electrical equipment for measurement, control, and laboratory use.
Safety Certification Compliance	
Equipment Type	Test and measuring
Safety Class	Class 1 (as defined in IEC 61010-1, Annex H) – grounded product
Overvoltage Category	Overvoltage Category II (as defined in IEC 61010-1, Annex J)
Pollution Degree	Pollution Degree 3 (as defined in IEC 61010-1).
Installation (Overvoltage) Category	Terminals on this product may have different installation (overvoltage) category designations. The installation categories are: CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location. CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected. CAT I Secondary (signal level) or battery operated circuits of electronic equipment.

(continued next page)

Category	Standard or description	
Pollution Degree	A measure of the contaminates that could occur in the environment around and within a product. Typically the internal environment inside a product is considered to be the same as the external. Products should be used only in the environment for which they are rated.	
	Pollution Degree 1	No pollution or only dry, nonconductive pollution occurs. Products in this category are generally encapsulated, hermetically sealed, or located in clean rooms.
	Pollution Degree 2	Normally only dry, nonconductive pollution occurs. Occasionally a temporary conductivity that is caused by condensation must be expected. This location is a typical office/home environment. Temporary condensation occurs only when the product is out of service.
	Pollution Degree 3	Conductive pollution, or dry, nonconductive pollution that becomes conductive due to condensation. These are sheltered locations where neither temperature nor humidity is controlled. The area is protected from direct sunshine, rain, or direct wind.
	Pollution Degree 4	Pollution that generates persistent conductivity through conductive dust, rain, or snow. Typical outdoor locations.

Physical Characteristics

Characteristic	Description
Weight	
without cover	14.5 lbs (6.57 kg)
with cover	16 lbs (7.25 kg)
with cover, chart recorder, and battery pack	20 lbs (9.07 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 1503C 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 06: Ethernet®

Option 06 instruments include circuitry that allows the 1503C to test an Ethernet bus using time-domain reflectometry with minimum disruption to the IEEE 802.3 protocol.

What is Ethernet?

Ethernet was invented by the Xerox Corporation in 1973 to allow various data devices to use a common communications bus. In an Ethernet system, signals flow in all directions and the transceivers attached to the Ethernet receive all transmissions.

Ethernet cable is typically 50 Ω with 50 Ω terminators at each end to prevent signal reflections. Reflections can interfere with transmissions sent out by the system.

ThinWire, Cheapernet, and Thin Ethernet are variations of Ethernet. These are usually used as a branch of the main network with a limited number of stations. They use a more flexible cable and are usually connected to each Media Access Unit (MAU) with a T-connector instead of a tap.

Segments are the smaller sub-networks in an Ethernet system. Each segment can be up to 500 meters long and have up to 100 transceiver taps. Each tap must have at least 2.5 meters of cable between itself and the next tap.

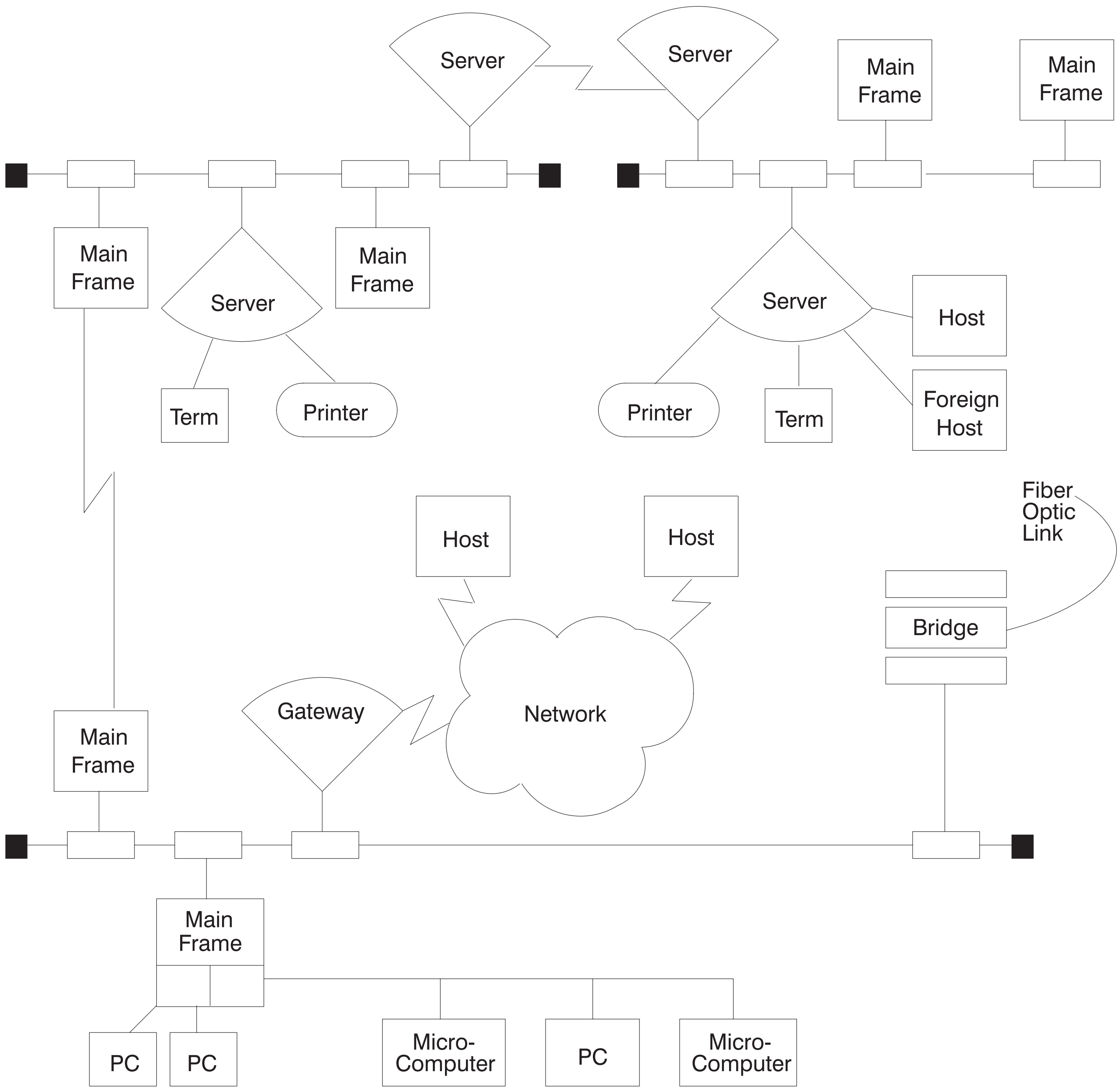


Figure 4–1: A Typical Ethernet System

Transceivers transmit data to and from the stations on the Ethernet bus. The typical Ethernet data rate is 10 million bits per second. At each tap is a transceiver (MAU) sending and receiving this data. They also provide electrical isolation between the coaxial cable and the station as well as housing the electronics that detect carrier signals and recognize the collision of two signals.

Taps are what the transceivers are attached to.

A **bridge** connects several network segments. Depending on the hardware used (e.g., fiber optics), a network might extend up to 22,000 meters.

Repeaters are used to increase the effective length of a cable to allow more transceivers. Due to distance limitations, two transceivers can have a maximum of two repeaters between them.

Servers let a network share resources, such as terminals, disks, printers, etc.

The 1503C with Option 06 allows testing of an Ethernet bus while the network is active. This is important because some installations might be interactive with other installations that are dependent on the Ethernet. Physically, Option 06 is a piggyback circuit board attached to the Sampler/Pulser board in the 1503C. A special EPROM replaces the standard EPROM on the main board, allowing Option 06 to be transparent to the standard instrument, but accessible through the *Ethernet Menu* and the *Setup/Acquisition Menu.*

Option 06 performs three functions:

- A 50 Ω terminator for the network
- Generates a DC signal that emulates the –1.05 VDC carrier signal
- Generates a DC signal that emulates the –1.7 VDC collision signal.

Test Procedures for a Working Network

Before Starting, here are some things you should know to make Ethernet tests easier:

- You need Option 06 for testing an active network.
- Make measurements from the end of a segment.
- If possible, isolate the segment you plan to test.
- Use the shortest pulse width possible.
- Do not use Auto pulse width mode. If it selects the 100 ns or 1000 ns pulse, it might disrupt traffic on working networks.
- Use the simplest possible test first.
- Operate the 1503C on AC power when using the option chart printer.
- Changes made in the menus do not take effect until the instrument is returned to normal operation. This prevents erroneous menu selections from creating disruptions.
- Have the network documentation ready. If available, have prior TDR profiles of the network that you will be comparing.

- If possible, turn off repeaters and bridges to other networks to minimize the extent of a possible disruption the 1503C might cause.
- If you use a jumper cable, make sure that it matches the network cable impedance. The three-foot jumper furnished with the instrument is 50 Ω.

Introduction

The IEEE 802.3 standard recommends only one earth ground per segment. When connected to AC power, the 1503C provides an earth ground to the coaxial shield. There is no connection to ground when the 1503C is used with the optional battery pack and the AC power cord is disconnected.

The first test usually run on an active network is the normal sweep with the 2 ns or 10 ns pulse and the DC *50 Ω termination is: On* from the *Ethernet Menu*. This test provides basic TDR tests with a 50 Ω termination for the net. If the network traffic is low (3 to 4%), this test is very effective. The 2 ns and 10 ns pulses are narrower than the time occupied by a single bit and usually will not cause any collisions. All other tests in the *Ethernet Menu* have potentially destructive effects on working networks.

CAUTION. *The test just described should find most problems. Before going any further, know what you are doing. Carrier and collision tests have the potential of causing problems on an active network. Read the warnings and instructions carefully. Try to limit tests to one segment during times of low traffic.*

The second test is the *Single Sweep with Carrier is: Off/On*. This test asserts the carrier signal of –1.05 V, then single-sweeps the network and drops the carrier signal. The test occupies the network for one to 20 seconds, depending on the NOISE FILTER setting.

The third test, *Carrier Test is: Off/On,* helps track down transceivers suspected if ignoring the carrier sense signal. This test holds the carrier signal of –1.05 V, turns off the pulse, and turns on MAX HOLD. The 1503C then acts as a traffic monitor. If spikes appear on the display, it is likely a transceiver is not responding to the carrier signal and is “babbling.”

Basic Test Procedure

The following procedure describes the fundamental tests with *50 Ω DC termination is: On*. When performing other Ethernet tests, use essentially the same procedure. A full description of individual tests, including custom tests, follows:

If you wish to disconnect and reconnect the 1503C to the cable segment, use a BNC T-connector between the instrument and a 50 Ω jumper cable (e.g., RG-58U). To one side of the T-connector, connect a 50 Ω terminator (the double termination is about a 25 Ω mismatch – much less likely to cause problems than an open circuit). The terminator can be removed during testing, allowing the 1503C to become the 50 Ω load. When removing the 1503C (or there is a power failure), the terminator should be reconnected, restoring the normal 50 Ω load for the network. The BNC T-connector also allows another point of access for an oscilloscope if you need to look for signal quality or noise levels.

Once the 1503C 50 Ω termination has been turned on, tests are similar to standard measurements on an coaxial 50 Ω cable. Remember to use only the 2 ns or 10 ns pulse widths. However, the waveforms might be a little different, due to traffic on the network.

Following are suggestions on how to set up test fixtures that will provide flexibility and provide network safety in case of power interruptions to the 1503C.

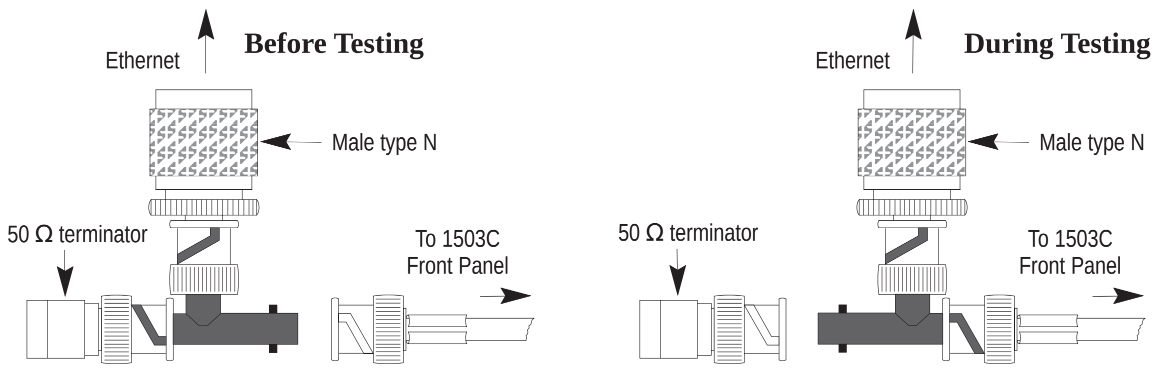


Figure 4–2: N-Type Male T-Connector

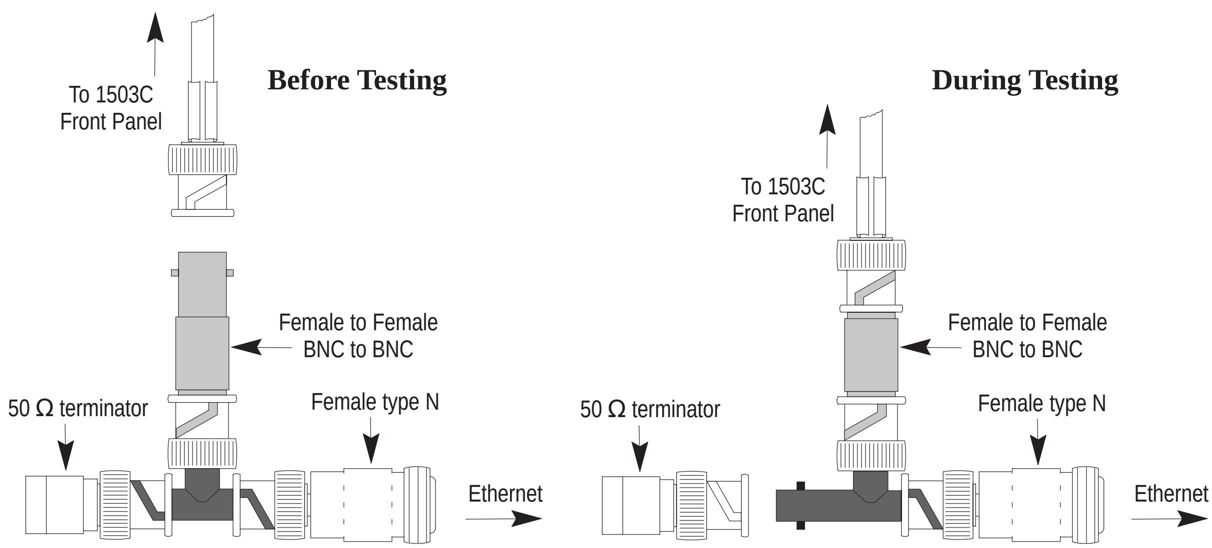


Figure 4–3: N-Type Female T-Connector

1. Before removing the Ethernet cable terminator, make sure you have the correct adapters and cables ready.

2. Set the 1503C front-panel controls:

CABLE	see below
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	see below
DIST/DIV	appropriate setting for cable length
PULSE WIDTH	2 ns or 10 ns *
Vp	to cable specifications
POWER	ON (see below)

CAUTION. ** DO NOT use the Auto pulse width mode. The longer pulses will cause problems on working networks.*

3. Request the system administrator to notify network users of possible disruptions.

4. Using the POSITION control, access the *Ethernet Menu*.

5. Scroll to *50 Ω DC Termination is: Off* and turn it *On*.

6. Return to normal operation.

7. As previously described, connect one end of a 50 Ω jumper cable to the front-panel CABLE connector, then connect the other end to one side of the BNC T-connector (see Figures 4–2 and 4–3).

8. Connect the Ethernet cable to the BNC T-connector.

9. Remove the 50 Ω terminator.

At this point, you are testing on an active network.

CAUTION. *The 50 Ω termination of the 1503C is not maintained with the power off. In case of power failure, immediately replace the 50 Ω terminator on the BNC T-connector.*

10. With the NOISE FILTER set at 1 avg, traffic will appear as large random noise spikes. If the traffic is severe enough to make measurements difficult, increase the NOISE FILTER setting.

NOTE. *The traffic on the display has no relationship to where it came from on the cable. In fact, traffic can appear on the display beyond the end of the cable.*

11. A VERT SCALE setting of 30 dB will normally allow you to see normal taps at the near end of a network. Greater distances might require more gain, depending on the loss of the cable and the pulse width.

Descriptions of Test in the Ethernet Menu

The following tests are composed of several functions found in the *Acquisition Control Menu*. These combinations are displayed in the *Ethernet Menu* as a user convenience. Most of the tests in the *Ethernet Menu* can be recreated or modified. That is explained at the end of this section.

Changes made in the *Ethernet Menu* will affect some of the *Setup Menu* and *Acquisition Control Menu* functions. For example, if *Carrier Test is: Off/On* is turned on, the 50 Ω termination will also be turned on because it is necessary for the carrier test to work.

50 Ω DC Termination is: Off/On

CAUTION. *This must be on when testing on a working network or reflections will cause collisions on the network.*

This entry is a duplicate of the entry in the Setup Menu/Acquisition Control Menu. Its function is to allow direct control of the termination inside the 1503C. With the 50 Ω DC termination on, the 1503C will function normally as a cable tester. This is usually the only test needed to check a network cable.

CAUTION. *The 100 ns and 1000 ns pulses might cause collisions.*

Longer pulses are more likely to generate collisions than shorter pulses. On networks with traffic less than 3 to 4%, a 2 ns pulse causes no measurable change in network statistics. Even on heavily tapped cables, the 2 ns pulse can usually be used for distances to 700 feet. The 10 ns pulse should be suitable for those longer segments that still fall within the 802.3 specifications (under 500 meters).

Single Sweep with Carrier is: Off/On

CAUTION. *This can interrupt prior traffic and cause late collisions. It can also disrupt devices or applications that require periodic network traffic.*

When this test is selected, the 1503C will assert a –1.05 VDC signal on the net long enough to take a single waveform at the NOISE FILTER level selected. This is the equivalent to the average voltage level of a normal transmission and should cause the transceivers to assert Carrier Detect. This has the effect of causing most devices on the net to defer transmission until the 1503C is finished. This takes from about one to 20 seconds, depending on noise averaging, and reduces the traffic displayed on the waveform.

***NOTE**. Movement of any control that would change or move the waveform will start a new sweep and assert the –1.05 VDC. For example, if you use the vertical position control continuously for 20 seconds, you would be asserting the false traffic for that duration and you are likely to disrupt the network.*

Carrier Test is: Off/On

***CAUTION.** This carrier signal will stop traffic on the network. This might abort many application programs and might cause communications problems.*

This test asserts the –1.05 VDC signal on the network, turns off the normal 1503C pulse, and sets up the MAX HOLD mode. This is intended to help find transceivers that have a faulty Carrier Detect.

To use this test, have the network prepared for disruption and turn the test on via the *Ethernet Menu*. Any traffic observed is being transmitted in spite of a signal simulating a carrier. This might be due to a transceiver not asserting its carrier detect line, a host not reading its carrier detect line, or some other reason. This is not unusual with some equipment. One way to isolate which units are doing this is to disconnect them one at a time until it stops.

Collision Test is: Off/On

***CAUTION.** The collision signal will stop traffic on the network. This might abort many application programs and might cause communications problems.*

This test is similar to the carrier test except that it asserts a –1.7 VDC signal to simulate a collision on the network.

Descriptions of Tests in the Setup Menu/ Acquisition Control Menu

The entries in this menu allow you to set up custom tests on networks in addition to the preset ones in the *Ethernet Menu*. This is intended for users who are familiar enough with Ethernet to anticipate the results. Changes in this menu can affect the state of other entries that are mutually exclusive or necessary for the chosen entry. For example, turning on the *Collision Output Signal is: Off/On* will also turn off the carrier output signal because only one voltage can be sent out.

Only the function of the entries unique to Option 06 will be explained. For the others, refer to the *Operating Instructions* chapter of this manual.

50 Ω DC Termination is: Off/On

CAUTION. *This must be on for use on a working network or reflections will cause collisions on the network.*

This entry is a duplicate of the entry in the Ethernet Menu. Its function is to allow direct control of the low frequency termination inside the 1503C. With the *50 Ω DC termination is: On*, the 1503C will functions normally to test the cable. This is usually the only test needed to check a network cable.

Carrier (–1.05V) Output Signal is: Off/On

CAUTION. *The carrier signal will stop most traffic on the network. This might abort many application programs and might cause communications problems.*

When this test is on, the 1503C will assert a –1.05 VDC level on a 50 Ω load (–2.1 VDC open circuit). This signal is intended to be equivalent to the average of a standard Ethernet transmission and should trigger the carrier detect circuit on all the transceivers. Because most applications will defer transmission when this signal is present, it can be used to test transceivers and systems, or to reduce traffic for 1503C testing.

Collision (–1.7V) Output Signal is: Off/On

CAUTION. *The collision signal will stop most traffic on the network. This might abort many application programs and might cause communications problems.*

When this test is on, the 1503C will assert a –1.7 VDC level on a 50 Ω load (–3.4 VDC open circuit). This signal is intended to be equivalent to the average of two colliding Ethernet transmissions and should trigger the collision detect circuit on all the transceivers. This should cause applications to back off and retry, then eventually abort, as defined in the 802.3 standard. Therefore, it can be used to test units that do not respond to this signal or to stop traffic for TDR testing.

Customizing Your Own Tests

Access the *Acquisition Control Menu* located under the *Setup Menu*. The various tests listed can be used in any combination. Remember that the tests will not be activated until you return the 1503C to normal operation, so any combination can be chosen, then activated.

Waveform Signatures

By now you probably have a good idea what traffic looks like on the display and how you can use the NOISE FILTER to reduce it. Other signatures might also appear on the display.

Terminators are small reflections seen as stationary bumps and dips. A perfect terminator would not reflect any energy, and theoretically would be invisible on the 1503C display. Because of small impedance differences between the cable and the terminator, a small amount of energy will be reflected. The signature of a terminator tends to go either up or down. Because a terminator absorbs nearly all the energy of a pulse, the normal ripples in the waveform (minor changes in impedance) will not be present after a terminator. The point where the waveform becomes flat is a clue to the location of a terminator.

Taps commonly have a characteristic down-then-up reflection. The TDR pulse will continue to travel past a tap because only part of the pulse's energy is reflected. This allows the 1503C to read signatures well beyond taps.

Following are examples of tests made on two Ethernet systems:

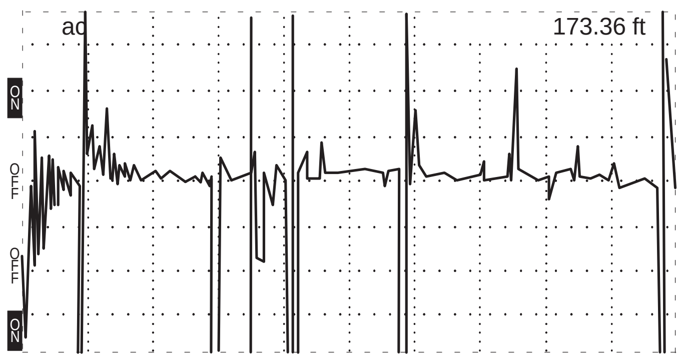


Figure 4–4: System 1 – Tap Hidden by Traffic (1 avg, 50 ft/div, 35 dB)

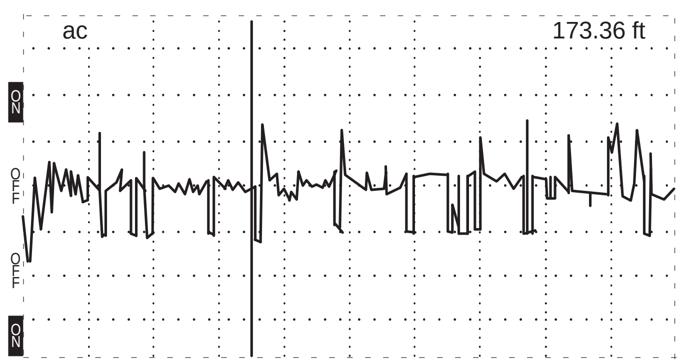


Figure 4–5: System 1 – Traffic and Tap Nearly Identical (4 avg, 50 ft/div, 35 dB)

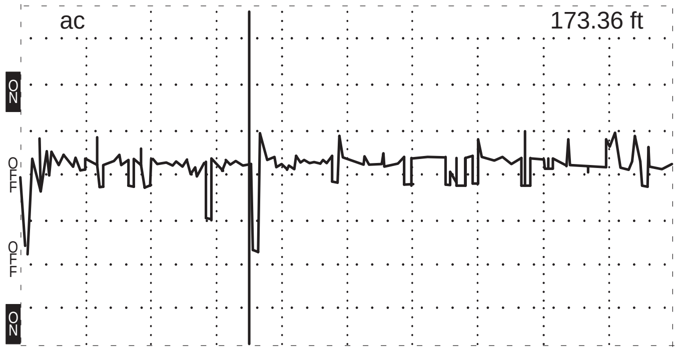


Figure 4–6: System 1 – Tap Becoming Visible (16 avg, 50 ft/div, 35 dB)

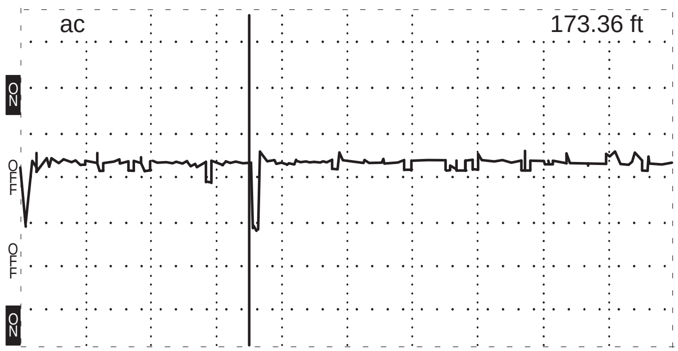


Figure 4–7: System 1 – Tap Quite Visible (128 avg, 50 ft/div, 35 dB)

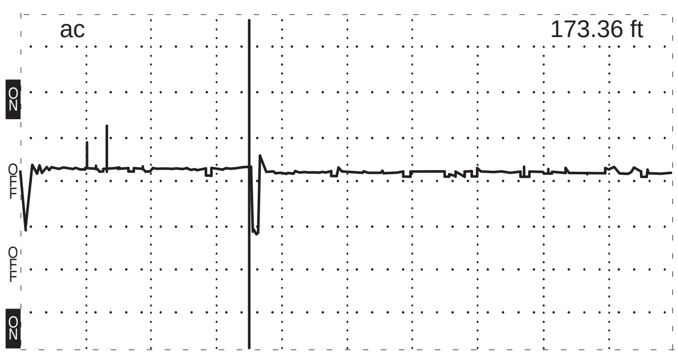


Figure 4–8: System 1 – No Traffic (1 avg, 50 ft/div, 35 dB)

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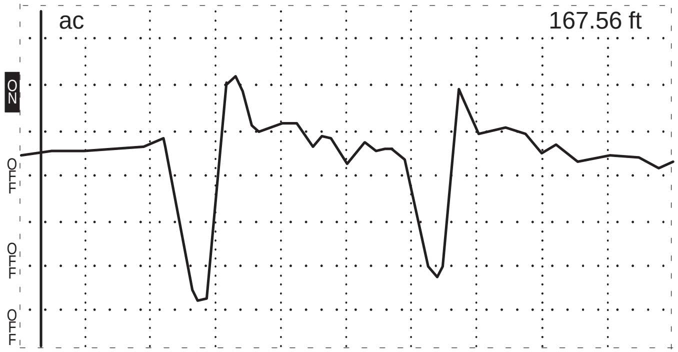


Figure 4–9: System 1 – Tap Expanded, No Traffic (1 avg, 2 ft/div, 35 dB)

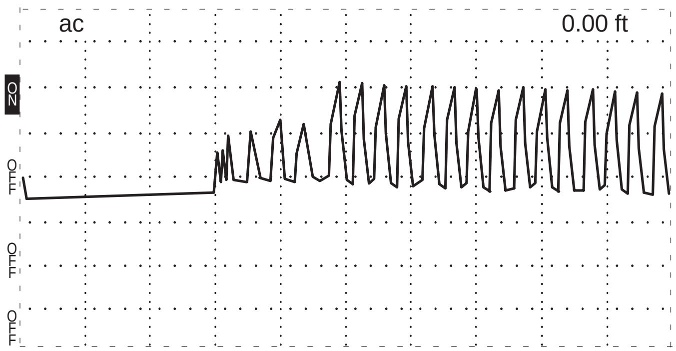


Figure 4–10: System 2 – Cable w/ Revision One Repeater * (1 avg, 200ft/div, 2.25dB)

* Revision One repeaters must sense collisions and place a jam signal on both segments. When using the carrier sense voltage level while sending out pulses (e.g., Single Sweep with Carrier is: On) the pulses might exceed the collision or traffic thresholds of the repeater, causing it to send back jamming packets that are synchronized with the 1503C. This creates an unusual waveform that looks similar to data. As a rule, repeaters should be shut down prior to testing a segment to prevent such occurrences.

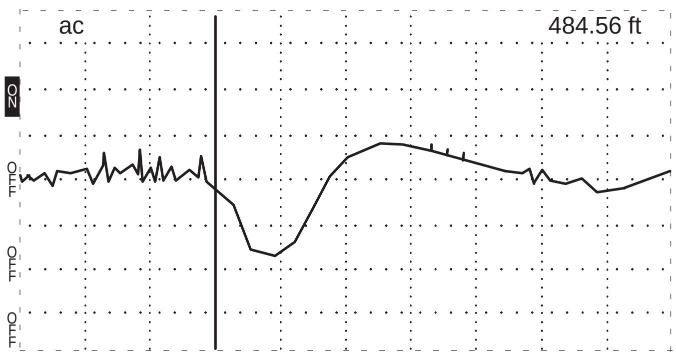


Figure 4–11: System 2 – First Tap, No Traffic (1 avg, 1 ft/div, 44.5 dB)

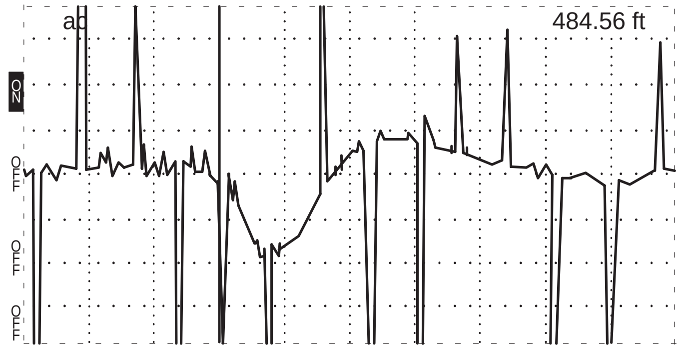


Figure 4–12: System 2 – Same Tap with 5% Traffic (1 avg, 1 ft/div, 44.5 dB)

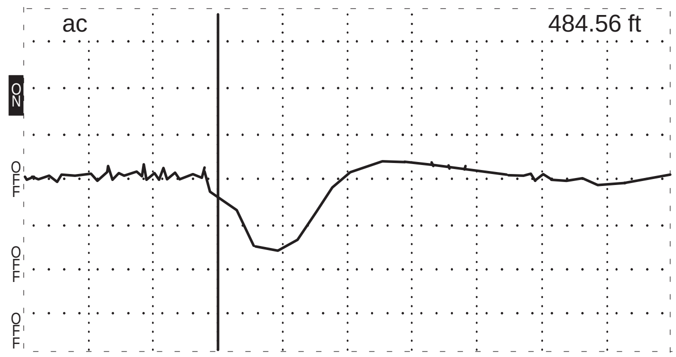


Figure 4–13: System 2 – Same Tap, Increased Averaging (16 avg, 1 ft/div, 44.5 dB)

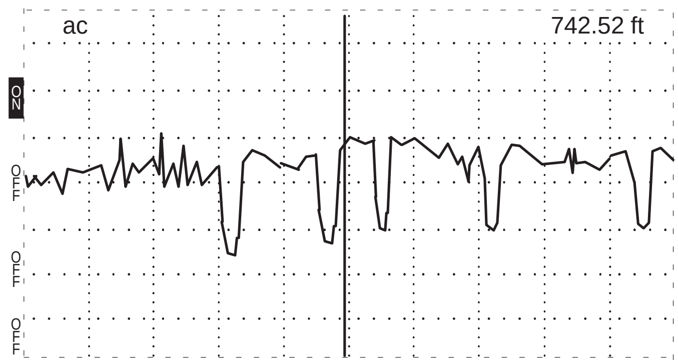


Figure 4–14: System 2 – Farther Out, More Gain (128 avg, 10 ft/div, 53.5 dB)

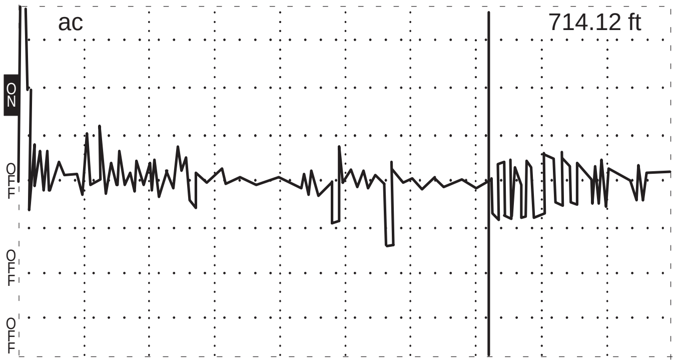


Figure 4–15: System 2 – 1000-ft Cable at 10 ns (128 avg, 100 ft/div, 43.75 dB)

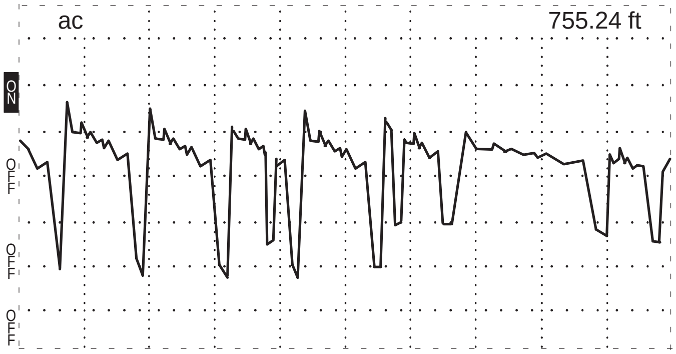


Figure 4–16: System 2 – Previous Waveform Expanded (128 avg, 20 ft/div, 54.75 dB)

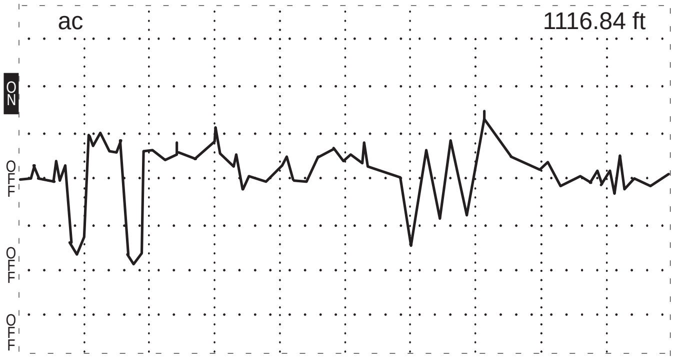


Figure 4–17: System 2 – Next Group of Taps (128 avg, 20 ft/div, 54.75 dB)

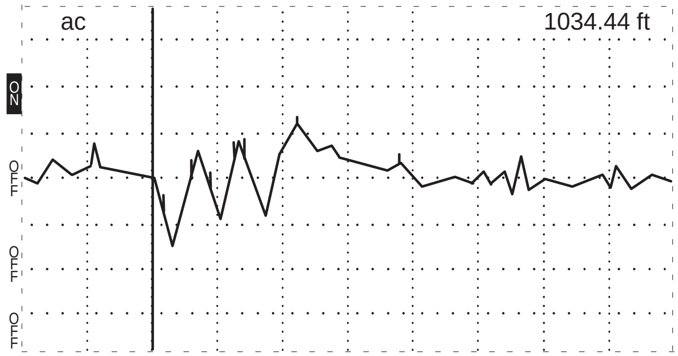


Figure 4–18: System 2 – Group of Taps Expanded (128 avg, 10 ft/div, 54.75 dB)

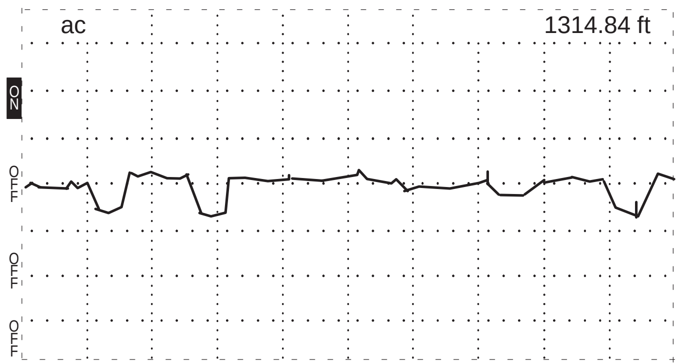


Figure 4–19: System 2 – Another Group of Taps (128 avg, 10 ft/div, 54.75 dB)

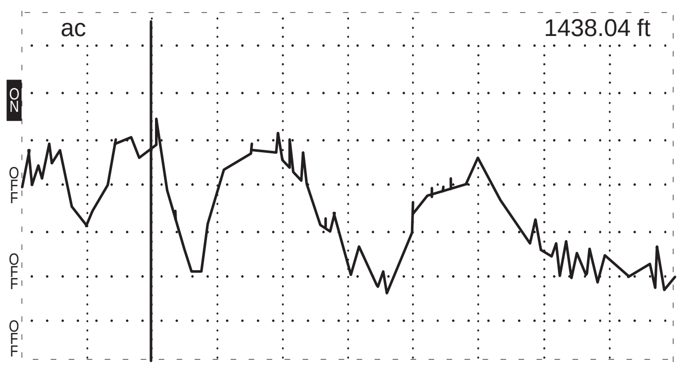


Figure 4–20: System 2 – End of Cable (128 avg, 20 ft/div, 61.25 dB)

Electrical Characteristics

Following are the specifications for the Ethernet board:

Characteristic	Performance Requirement	Supplemental Information
DC Termination	50 Ω, ± 1 Ω	See typical frequency response curve below this table to estimate at other frequencies. Once the termination is turned on, it will remain on until specifically turned off by the operator, at which time a warning to remove the 1503C from the network will be shown on the display. Leaving the TDR on the network with the termination turned off will cause traffic disruption and errors.
DC Voltage Offsets	0.0 V ± 0.02 V –1.05 VDC and –1.7 VDC ± 0.15 V into 50 Ω	AC pulse voltage is present on top of DC offsets while measuring. Voltages only asserted when 50 Ω termination is on.
Overvoltage Protection		Circuit cuts out leaving standard 1503C protection for voltages greater than ± 11 V.
Floating Ground		Only when used with battery pack. IEEE 802.3 specifies a single ground on the bus.

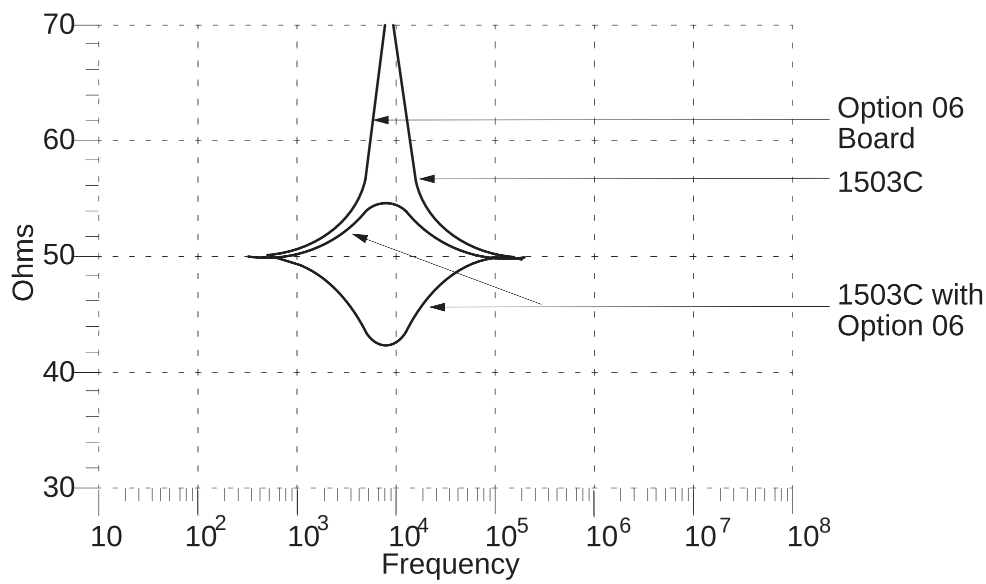


Figure 4–21: Typical Frequency Response Curve with Ethernet Option 06

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.

Option 08: Token Ring Adapter

Option 08 instruments come with an adapter that allows you to connect the 1503C to networks containing ECL connectors. The adapter isolates the receive pair from the transmit pair at the ECL connector and allows you to select one or the other to be routed to the input BNC connector on the 1503C.

Option 09: Universal Service Ordering Code

Option 09 instruments come with an adapter that allows you to connect the 1503C to LANs using type RJ-45 connectors using the Universal Service Ordering Code. The adapter allows selection of each of the four twisted pairs.

CAUTION. *The RJ–45 USOC adapter (Option 09) is the same connector used for many telephone installations. Active telephone wires will have 40 to 60 VDC on one pair and this will destroy the 1502-series instrument. Do not use Option 09 with 1502, 1502B or 1502C instruments.*

Option 10: Token Ring Interface

Option 10 instruments come with an adapter that allows you to connect the 1503C to Token Ring networks via the MAU.

Power Cord Options

The following power cord options are available for the 1503C TDR (for part numbers, refer to the end of the *Replaceable Mechanical Parts* list). 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

Option A2: 240 VAC, 13 A, United Kingdom

Option A3: 240 VAC, 10 A, Australia

Option A4: 240 VAC, 15A, North America

Option A5: 240 VAC, 6 A, Switzerland

Accessories

The Standard and Optional accessory part numbers are provided at the end of the *Replaceable Mechanical Parts* list.

Standard Accessories

Internal lead–gel Battery Assembly

Replacement Fuse (AC line fuse, 115 VAC)

Replacement Fuse (AC line fuse, 230 VAC)

Power Cord (outdoor rated)

Option Port Cover Assembly

50 Ω BNC Terminator

BNC Connector, female-to-female

93 Ω 10-foot Test Cable (S/N ≥ B010625)

Connector, BNC female to Alligator Clips (S/N ≥ B010625)

BNC Connector male to N female (w/ Option 06 only)

50 Ω 3-foot Test Cable (w/ Option 06 only)

Operator Manual

Slide Rule Calculator

Accessory Pouch

Optional Accessories

Service Manual (B01 instrument)

Service Manual (B02 instrument)

Battery

Chart Recorder, YT–1S

Chart Paper, single roll

Chart Paper, 25-roll pack

Chart Paper, 100-roll pack

Cable, Interconnect, 360 inches

Connector, BNC male to BNC male

Connector, BNC female to Alligator Clip (S/N ≥ B010625)

Connector, BNC female to Hook-tip Leads

Connector, BNC female to Dual Banana Plug

Connector, BNC male to Dual Binding Post

Connector, BNC male to N female

Connector, BNC female to N male

Connector, BNC female to UHF male

Connector, BNC female to UHF female

Connector, BNC female to Type F male

Connector, BNC male to Type F female

Connector, BNC female to GR

Connector, BNC male to GR

Precision 50 Ω Cable (S/N ≥ B010625)

Terminator, 75 Ω BNC

Adapter, Direct Current

Isolation Network

Pulse Inverter

Token Ring Network Adapter

Twisted Pair Adapter – USOC Adapter

Star LAN Adapter

Token Ring Interface

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 1503C 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 narrow pulse 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 applied pulse and, therefore, can be interpreted in dB or in rho.

The 1503C 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 pulser/sampler circuits. Pulse strobes cause a single pulse to be applied to the cable under test. Each sampler strobe 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.

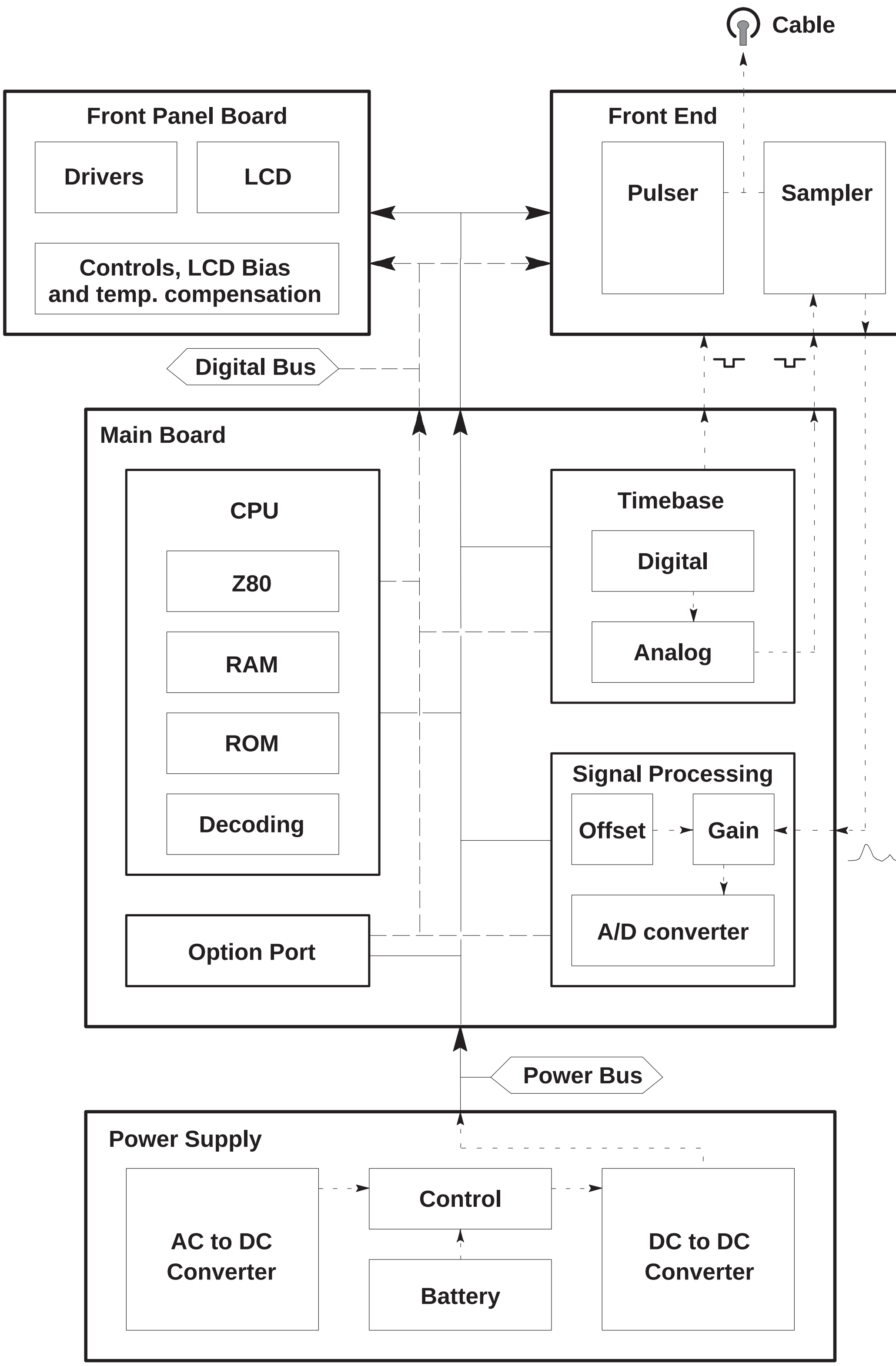


Figure 5–1: System Block Diagram

Referring to the waveforms in Figure 5–2, cable voltage waveforms are shown at the top. Each pulse is the result of a test pulse from the pulse generator and all pulses are identical. At time delays (t_n, t_{n+1}, t_{n+2}, etc.) after the pulses begin, a sample of the pulse 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.

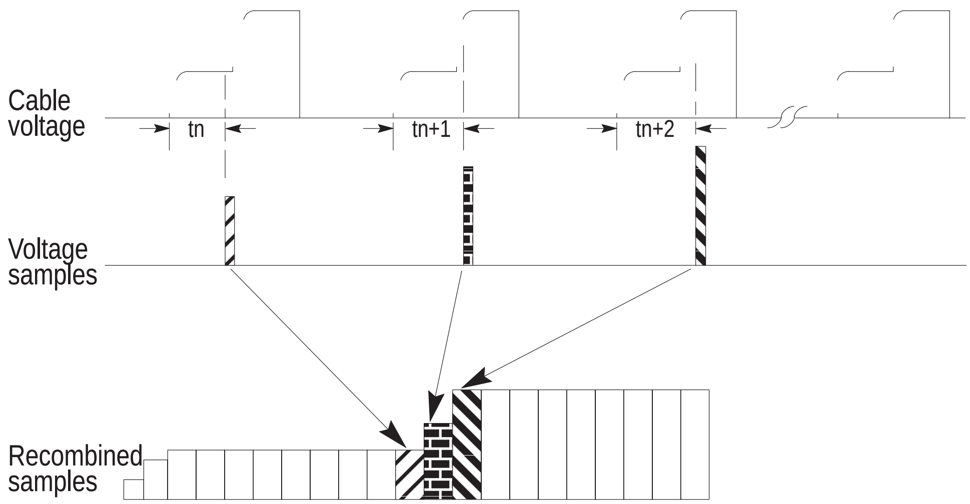


Figure 5–2: Waveform Accumulation Diagram

Voltage samples from the pulser/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 leading edge of the 2 μs pulse for the timebase correction.

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.

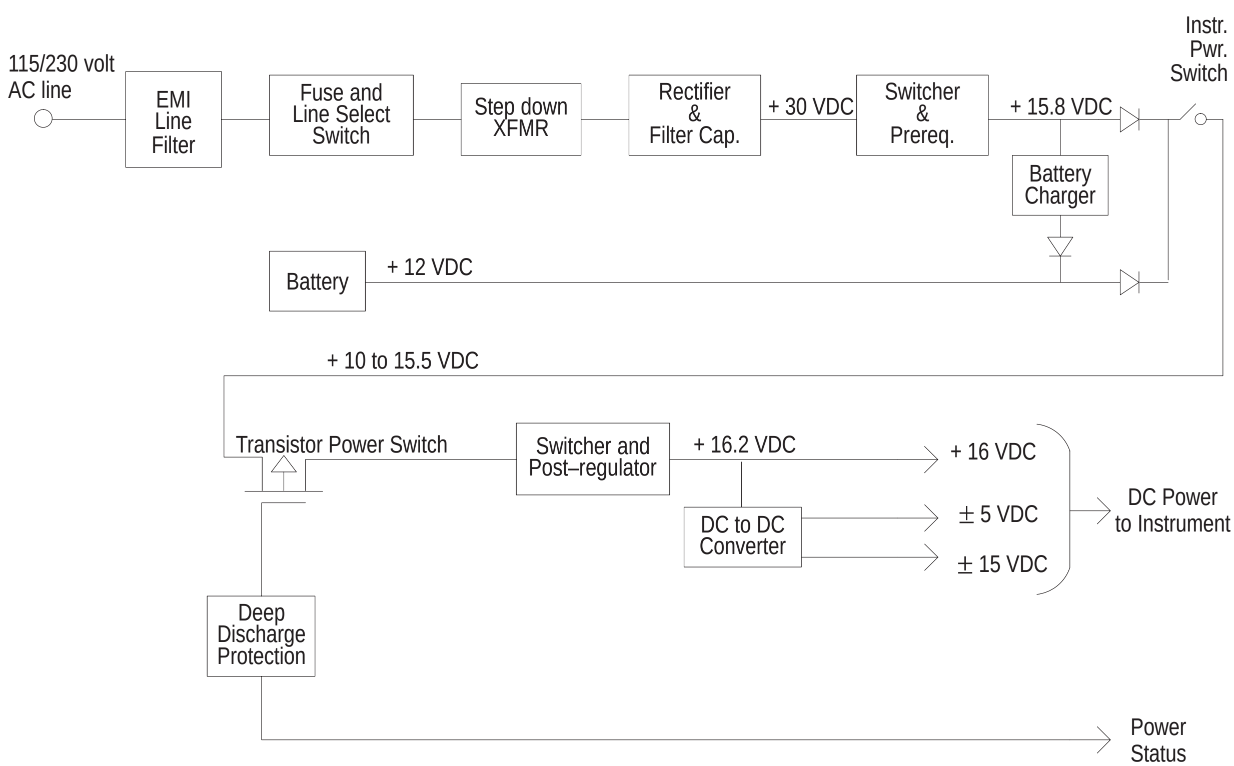


Figure 5–3: Power Supply Block Diagram

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 is lead-gel, providing 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.

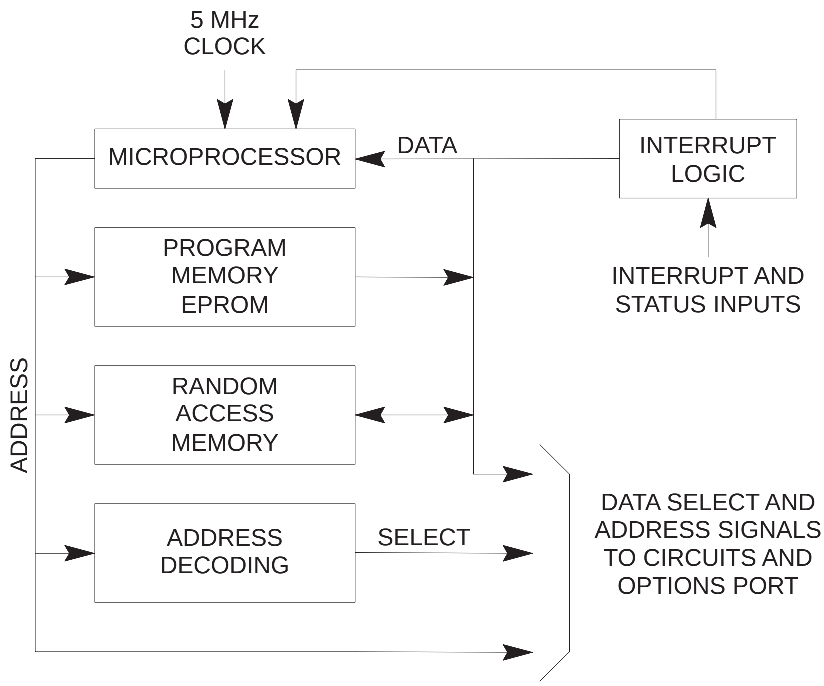


Figure 5–4: Processor Block Diagram

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 1503C 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.

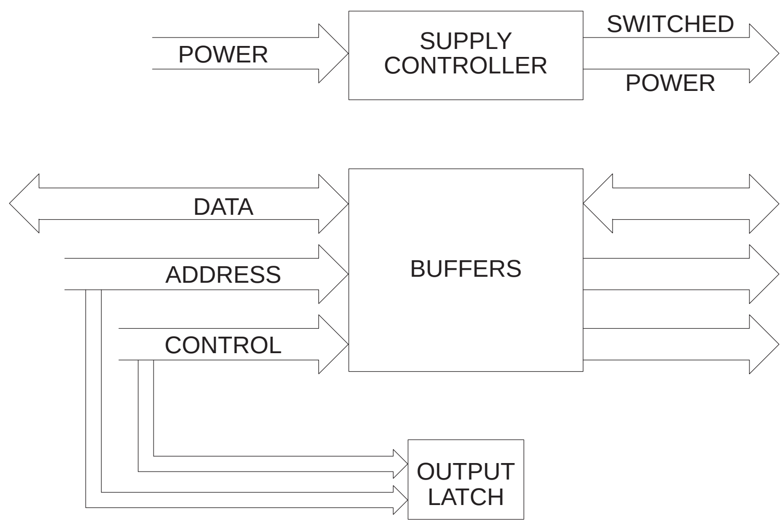


Figure 5–5: Option Port Interface Block Diagram

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 pulser/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.

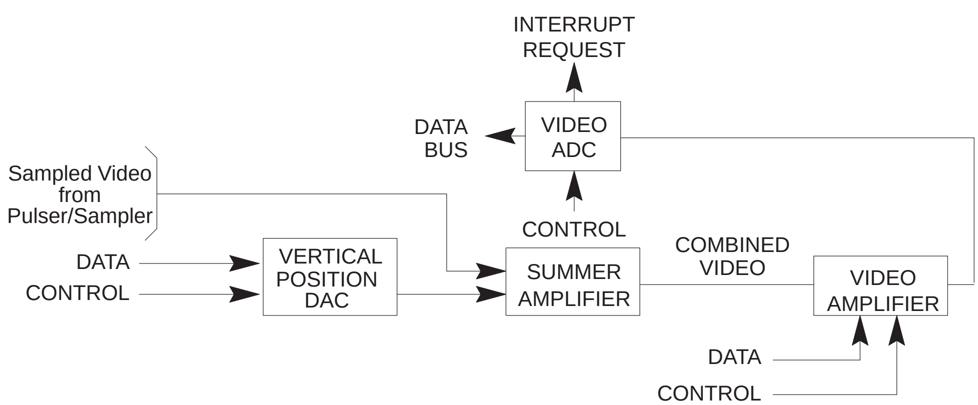


Figure 5–6: Video Processor Block Diagram

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 of 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.

The 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).

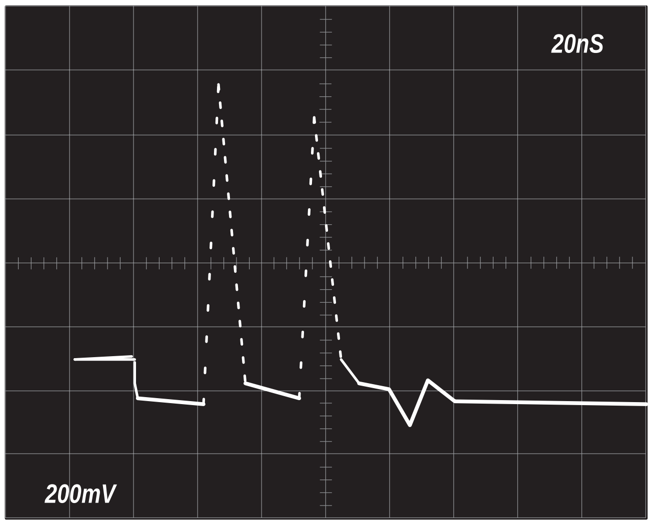


Figure 5–7: Video Processor Output

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 pulser/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.

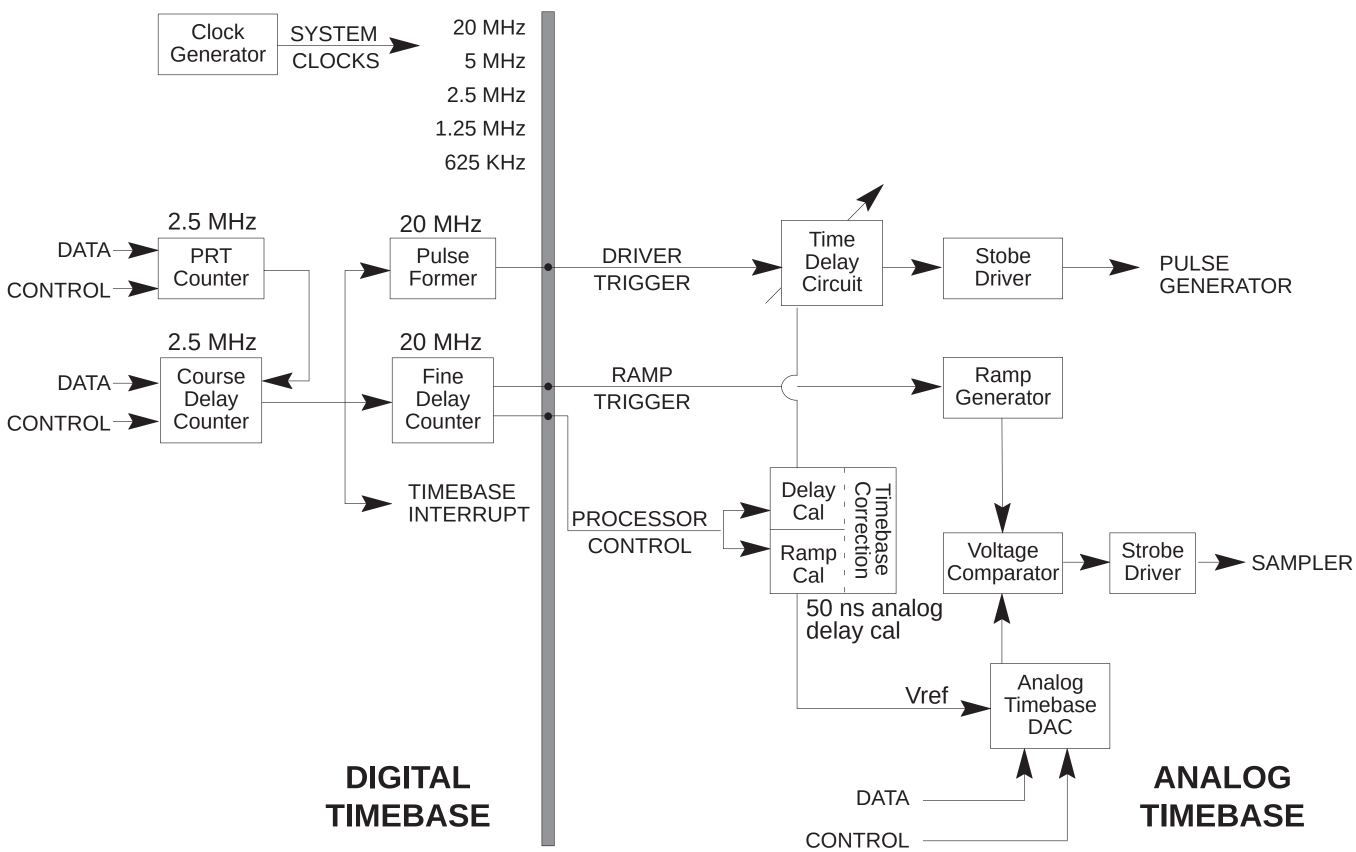


Figure 5–8: Timebase Block Diagram

A programmable digital counter, clocked at 2.5 MHz, is used to determine the PRT (pulse repetition time) of the pulser/sampler test pulse. The 1503C 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 pulser/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.

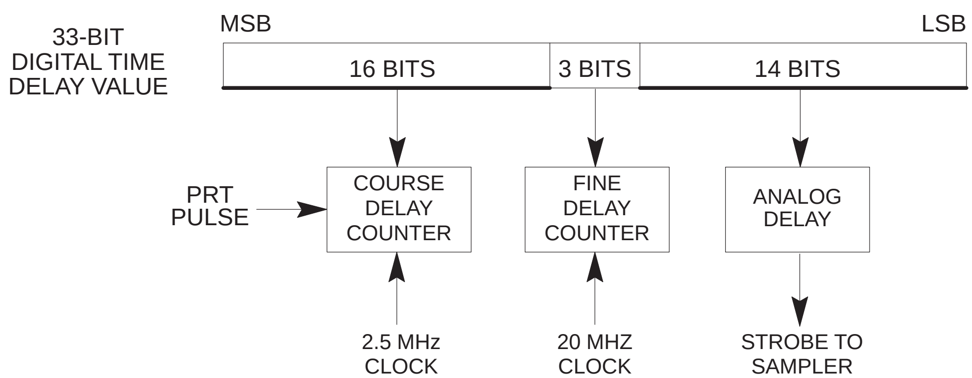


Figure 5–9: Timebase Control

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 (0 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 (0 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.

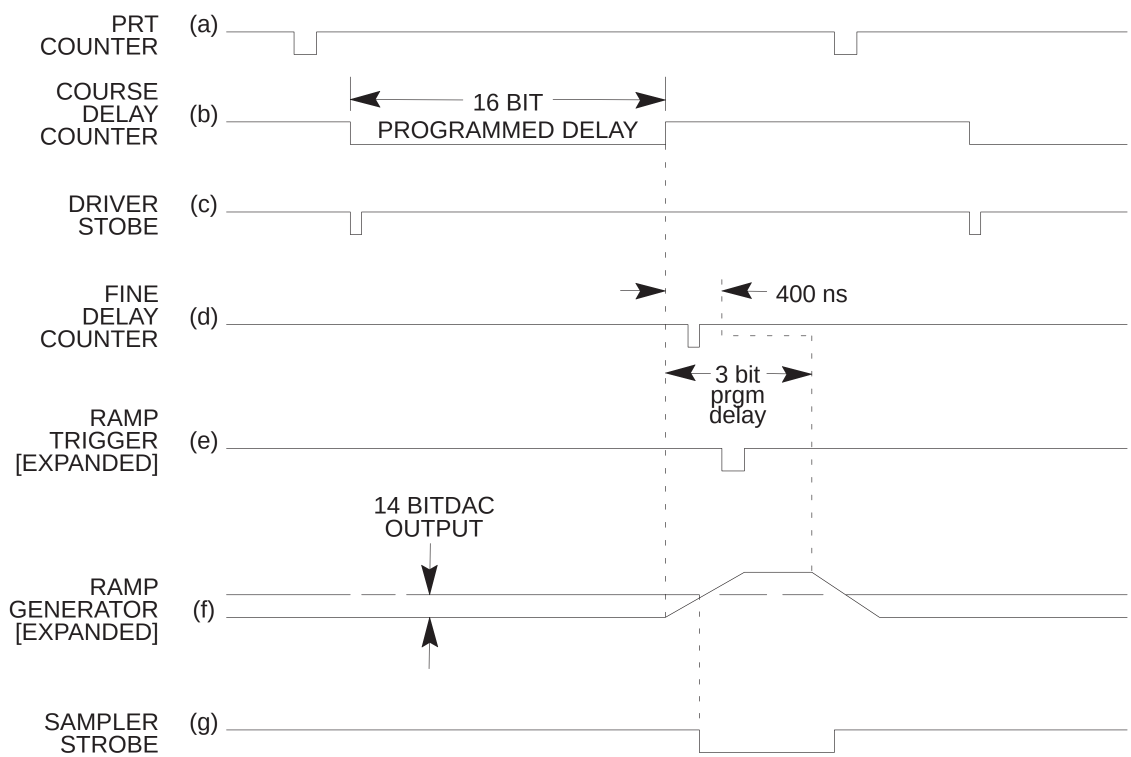


Figure 5–10: Combined Effects of Time Delay

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.

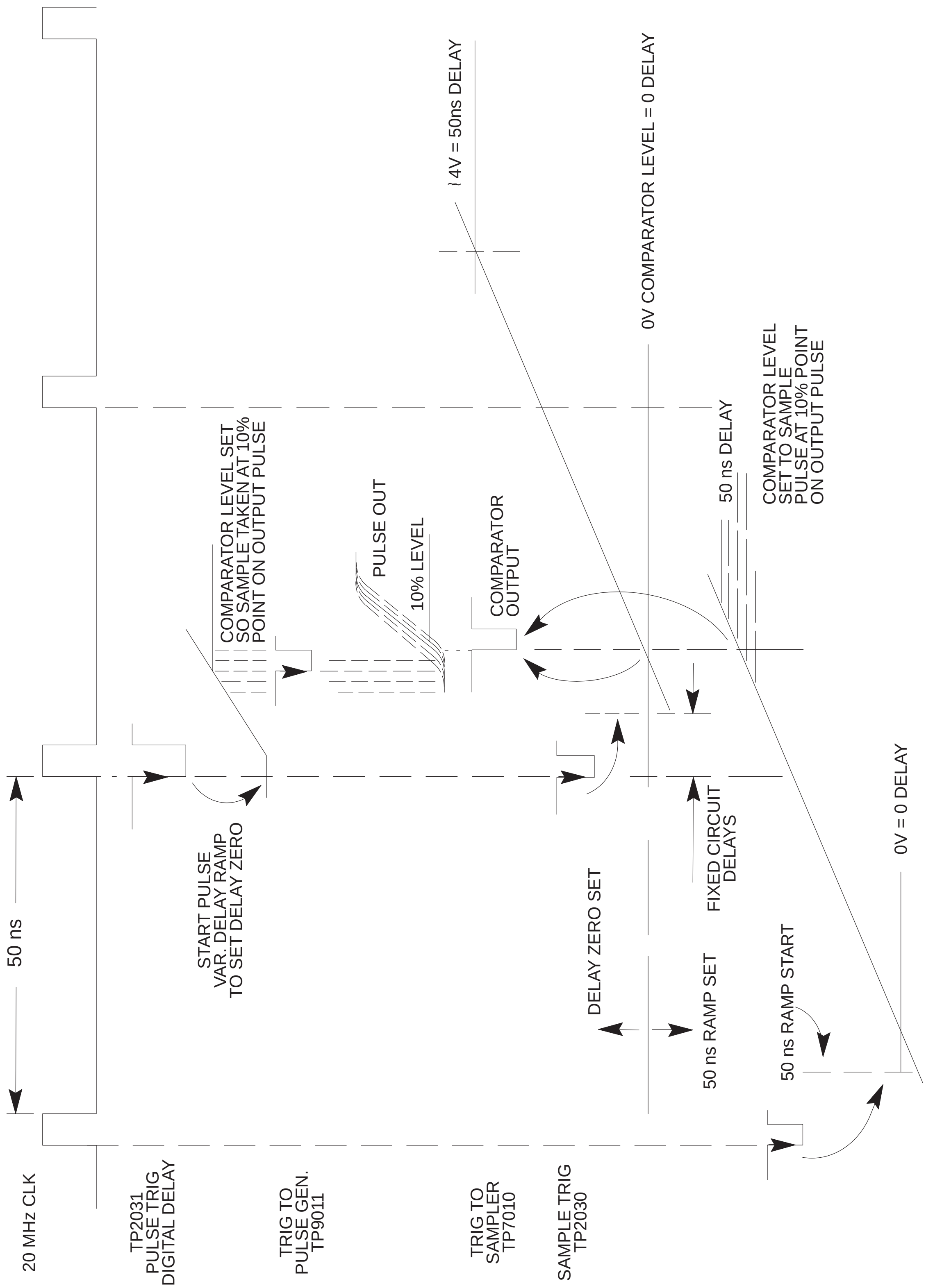


Figure 5–11: Calibration of Delay Zero and 50-ns Analog Delay

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 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.

Pulse Generator/Sampler

Introduction

The front-end consists of two major circuits:

- Pulse Generator
- Sampler

The pulse generator is triggered by a line from the Main Board and sends out a pulse via the front-panel connector. The sampler, which is also triggered from the Main Board, takes its input from the signal returning from the test cable via the front-panel connector, then generates a steady-state sample of a small time segment of the input as its video out. A block diagram of the pulse generator/sampler is shown in Figure 5–12.

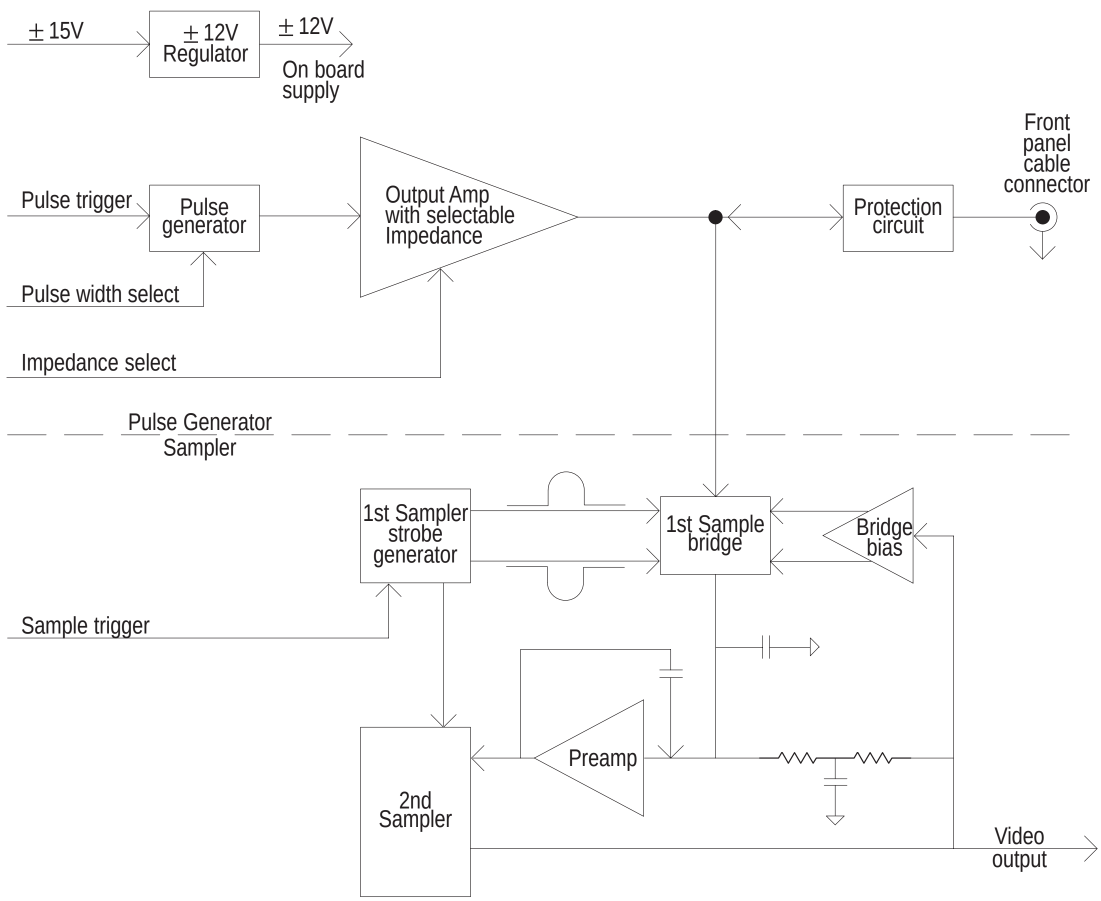


Figure 5–12: Pulse Generator/Sampler Block Diagram

Pulse Generator

The pulse generator has four available pulse widths: 2 ns, 10 ns, 100 ns, and 1000 ns. Four output impedances are also available: 50 Ω, 75 Ω, 93 Ω, and 125 Ω. The pulses are generated by applying a voltage to an LC tank. The tank will then ring or flyback at its resonant frequency. By varying the values of the inductor and capacitor, different pulse widths and heights can be obtained. The 1503C pulse generator has four such tanks, each one having a specific pulse width. One tank circuit at a time is selected by the analog switches in U1050 by turning on one of the four driver transistors (Q2050, Q2051, Q2052, and Q2053), and one of the four buffer transistors (Q2030, Q2031, Q2032, and Q2033). The four output buffers sum together at TP2030. The signal is then amplified by emitter-follower Q2034 and common-base stage Q3021. The final stage is Class C output driver Q3020. The output driver is biased Class C for two reasons: it has lower power consumption and it clips the bottom 1V of signal providing a cleaner output. The output driver is also where the output impedance switching is accomplished. BY changing the collector load resistance with FET switches, the reverse termination changes. The networks on the emitter also change to keep the gain and bandwidth of the stage constant. This circuitry has two limitations: first, a variation in the "on" resistance of the FETs causes slight errors in the termination at low frequencies, and second, the "off" capacitance of the switches makes them effectively partially "on" at high frequencies, causing additional termination errors.

Sampler

Sequential sampling provides a means to display fast-changing signals that are outside the bandwidth capabilities of the vertical display system of the 1503C. One single point of a pulse is measured and stored. During the next pulse, the instantaneous amplitude of the next point on the waveform is measured and stored. This process is repeated for 250 pulses to collect a representative waveform.

Between waveforms, the 1503C samples the leading edge of the 2-ns pulse to get data needed for the timebase correction circuit.

In the 1503C, the input signal is first measured by a fast sampler with about 500 MHz of bandwidth. The output of the first sampler is re-sampled by the second sampler to provide a steady signal for the A-to-D converter on the Main Board.

First Sample Bridge

Diodes CR3090, CR3091, CR3092, and CR3093 form a bridge-style sample gate. Normally, these diodes are back-biased to prevent CR3091 and CR3093 from being turned on by the large input signal expected. Two strobes of opposite polarity have sufficient amplitude to overcome the back-bias. The two strobes turn on all the diodes in the bridge, allowing current to flow from the input to storage capacitor C2090. Operational amplifiers U1090A and U1090B furnish the ±2 VDC of back-bias relative to the feedback from the second sampler to keep the bridge bias centered at the input level.

Preamp

Amplifier U2080 is a positive feedback amplifier with C2080 providing the feedback capacitance. The gain of this amplifier is set by R1080 and R2074 to raise the voltage across C2090 to increase sampling efficiency of the first sampler. Compensation for diode bridge capacitance is via R2097, which feeds a small amount of signal into the negative input of the preamp. Op-Amp U2070A is a buffer amplifier to drive the second sampler.

Second Sampler

The sample of the signal from the preamp is gated through Q2060 to C1064, where it is stored until the next sample is taken. The signal in C1064 is buffered by U2070B and is then used in three places. First, it sets the center of the first sampler bridge bias through R2082. Second, it holds the first sampler capacitor C2090 at the current input voltage through R2080 and R2081. Third, the signal is sent to TP3051 and the Main Board as the video output.

First Sample Gate Strobe Generator

The sample trigger goes to Q3050 and C3065, which form a 7-ns delay needed for compatibility with the Main Board timebase correction circuit. This circuit triggers Q3070, which amplifies the sample trigger to a +12 VDC pulse to trigger the second sample gate strobe trigger through R3071 and to drive Q3080 through common-mode transformer T3070. When Q3080 is turned on, +10 VDC and –10 VDC pulses are generated. This is coupled through C3080, C3081, and common-mode transformer T3080 to the 16 Ω clipping lines, which reduce the pulse width to approximately 500 ps. The pulses are then coupled to the first sample bridge through common-mode transformer T3081, C2081, and C3082.

Second Sample Gate Strobe Generator

Transistors Q3061 and Q3062 form a one-shot pulse generator that produces a 5-μs pulse to drive the second sample gate through Q3060. Diode CR2062 clamps the trailing edge of the strobe at –7 VDC while CR2060 and CR2061 provide transient protection for Q3060.

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).

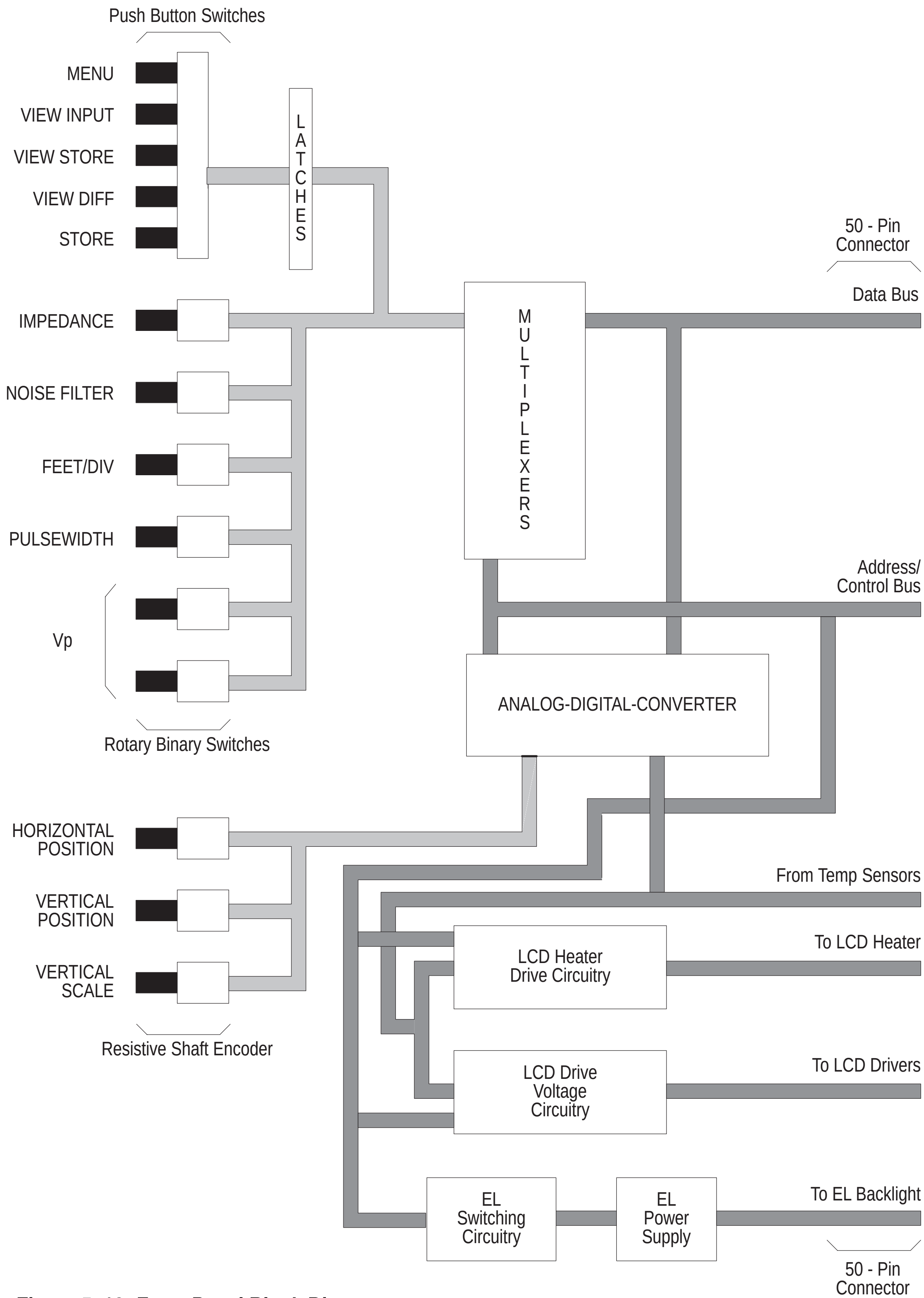


Figure 5–13: Front Panel Block Diagram

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

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
- PULSE WIDTH
- IMPEDANCE

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.

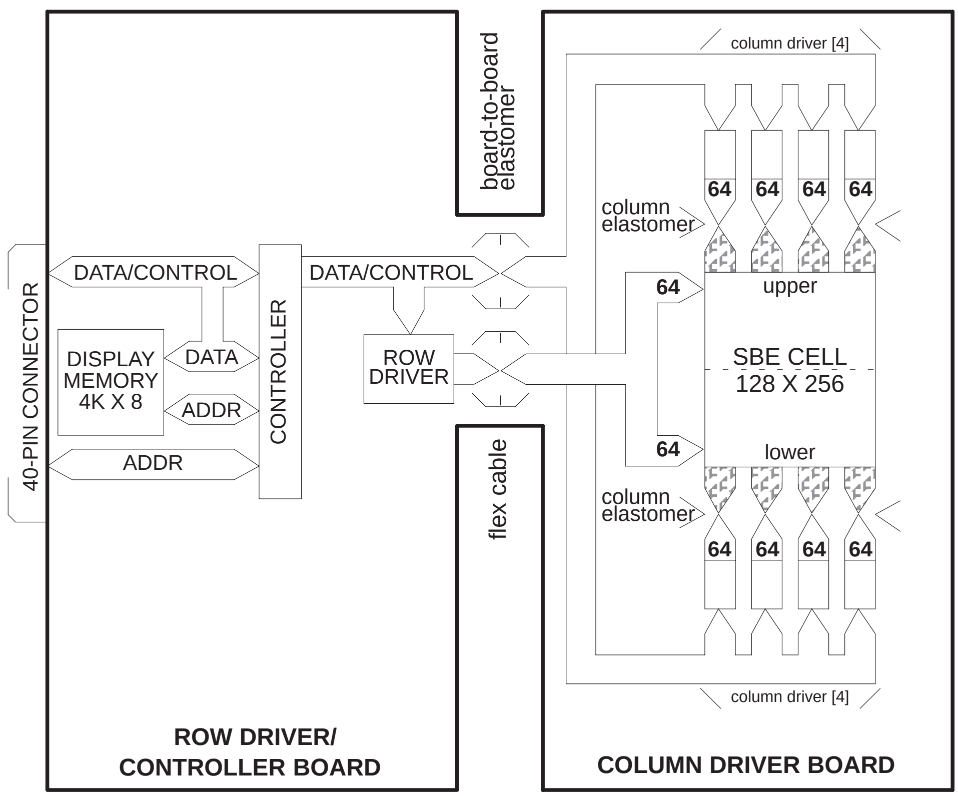


Figure 5–14: Display Module Block Diagram

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 1503C 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, next page). 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.

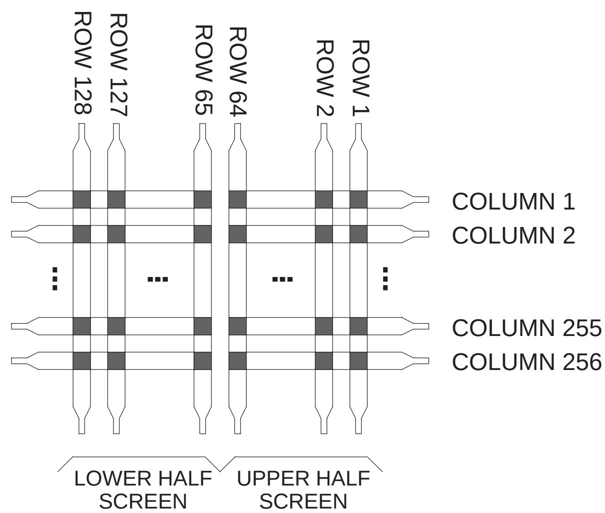


Figure 5–15: SBE Cell

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.

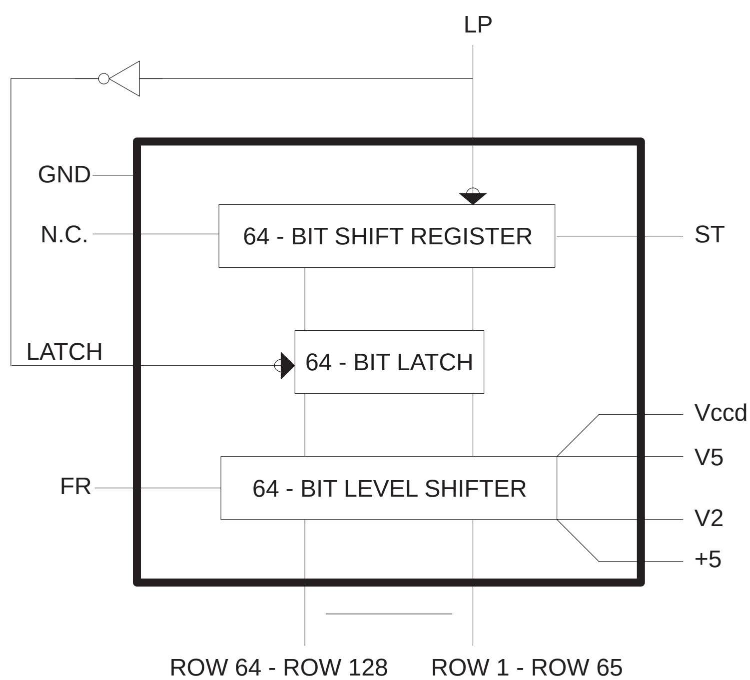


Figure 5–16: Row Driver Block Diagram

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.

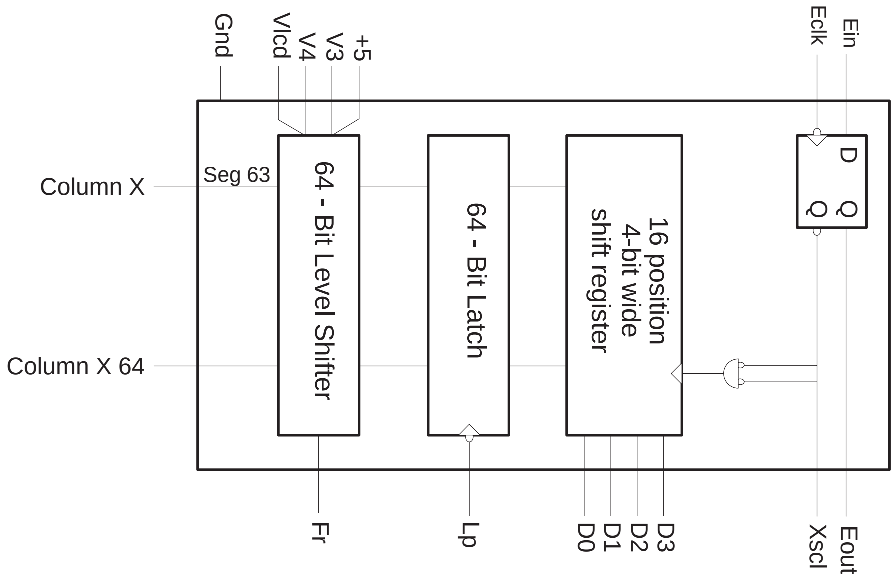


Figure 5–17: Column Driver Block Diagram

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.

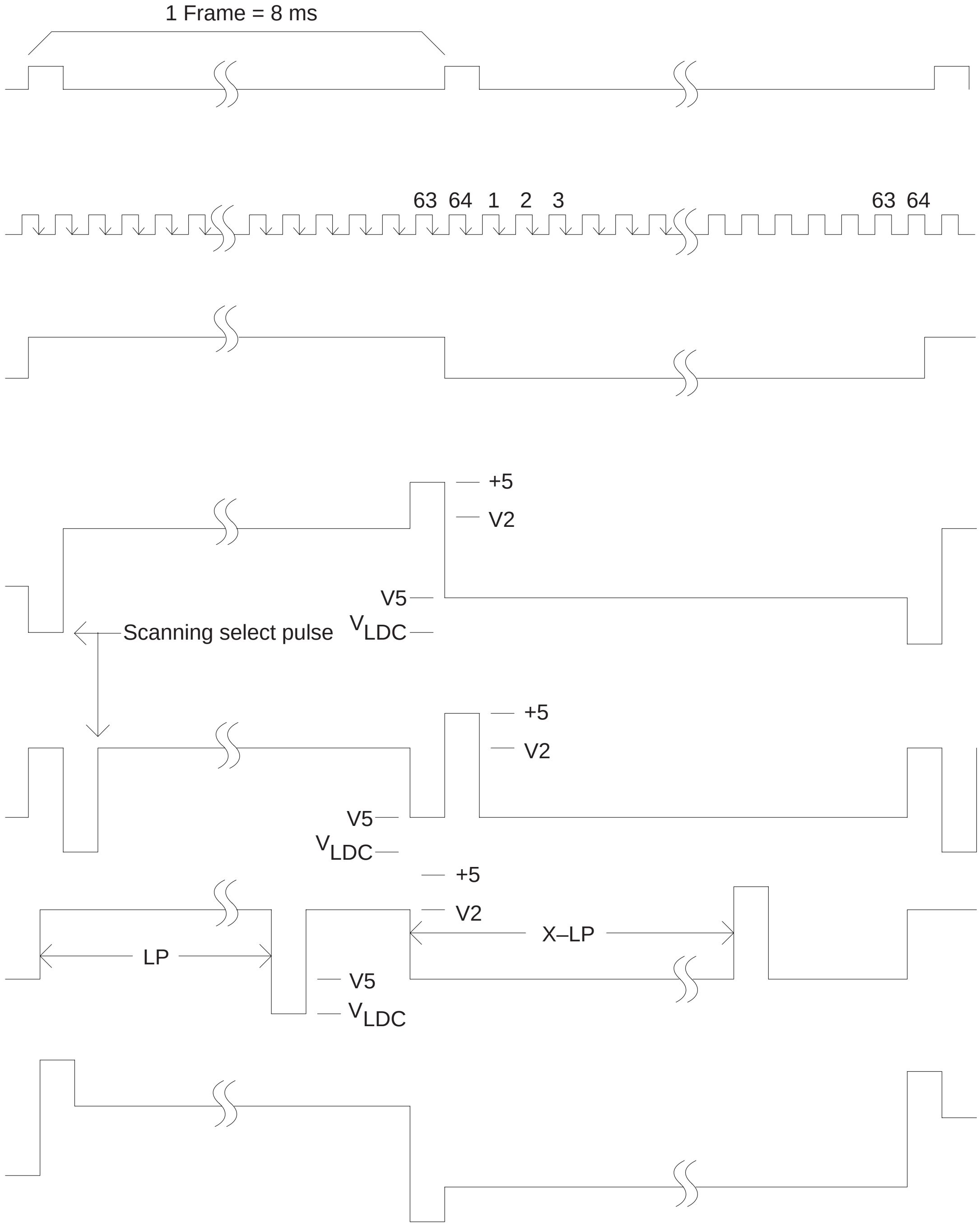


Figure 5–18: Row Timing Diagram

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.

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.

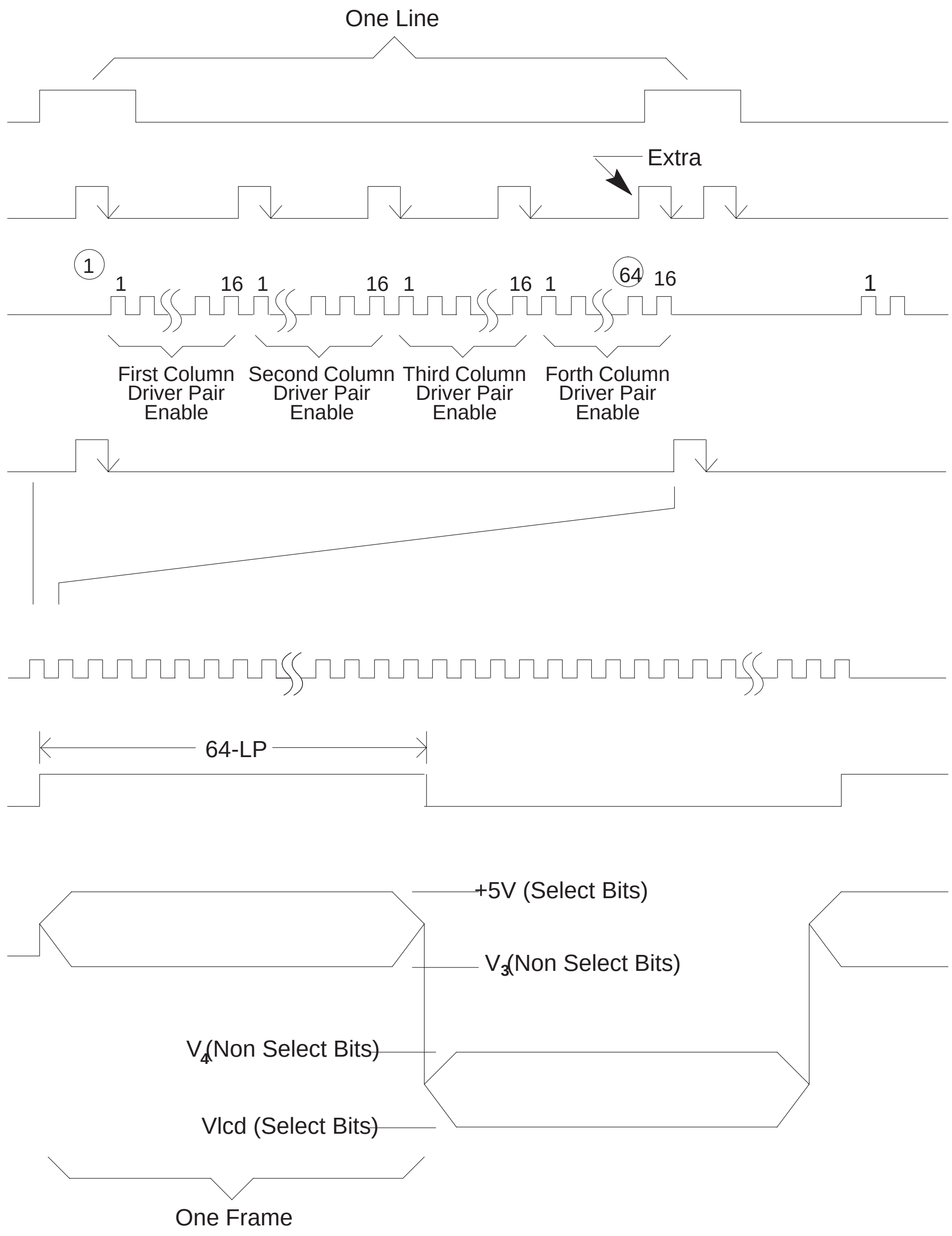


Figure 5–19: Column Timing Diagram

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

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).

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.

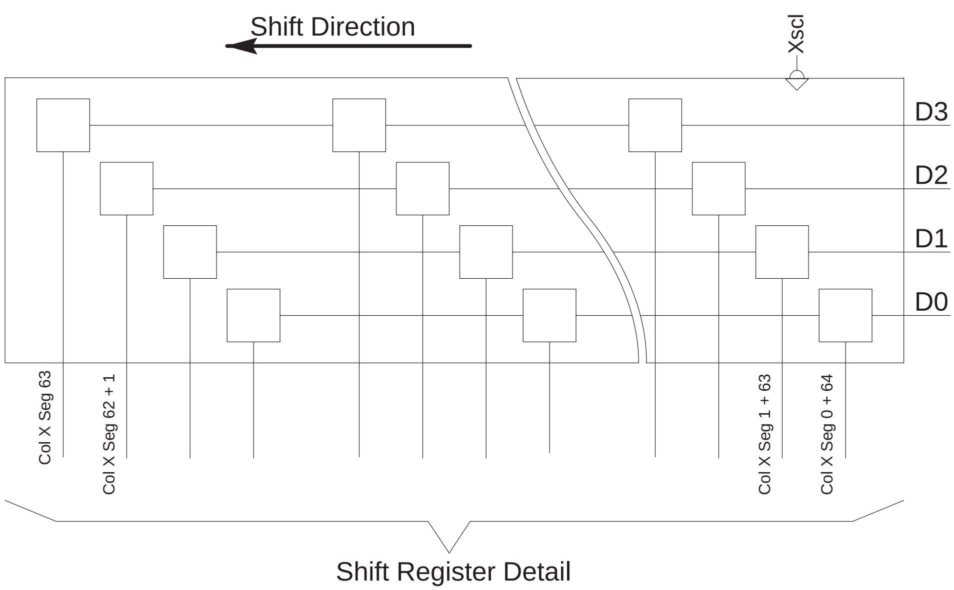


Figure 5–20: Shift Register

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.

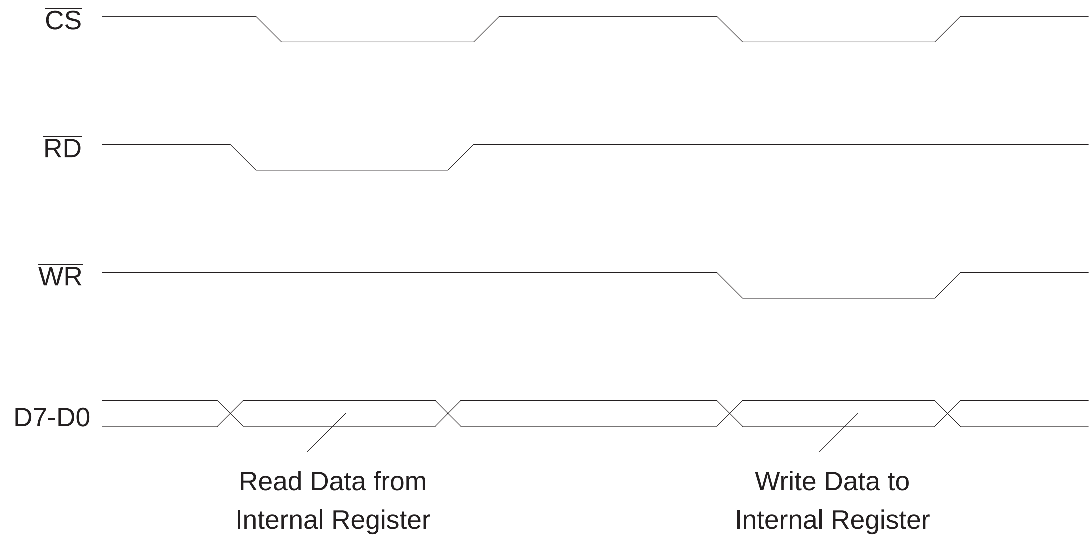
There are several other relevant control signals to the controller: $\overline{\text{CS}}$ <chip select>, $\overline{\text{WR}}$ <write>, and $\overline{\text{RD}}$ <read>.

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

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

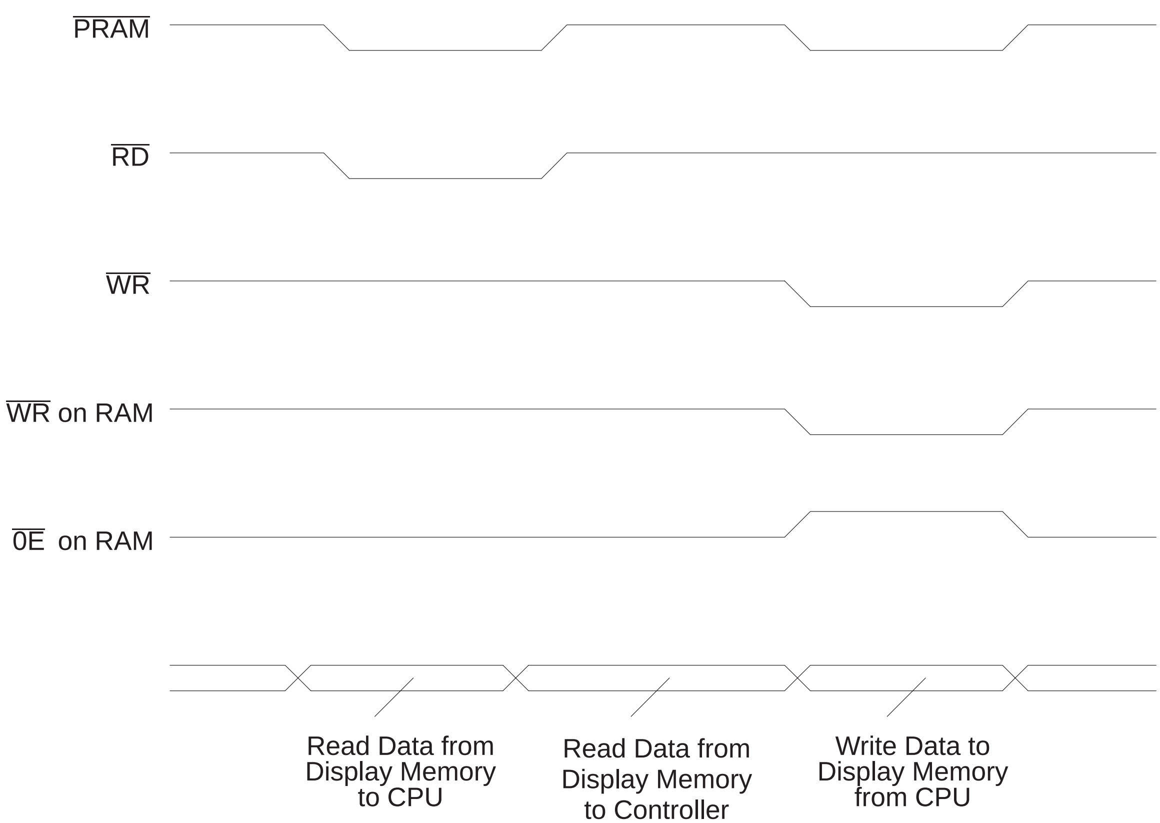


Figure 5–21: CPU and Display Memory Interface

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 64 Ω. 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.

Option 06 (Ethernet®)

Introduction

Option 06 consists of the following:

- Load and Diplexer
- Output Amplifier
- Relay and Driver
- Over-voltage Sensing
- Control Switches

Option 06 extends the frequency range of the standard instrument 50 Ω termination down to DC. This is accomplished via a diplexed load. Two additional DC voltages are allowed to the output by connecting the load to a voltage source. Additionally, the circuit disconnects the DC load if external voltages are applied above a certain limit. A block diagram of Option 06 is shown in Figure 5–22.

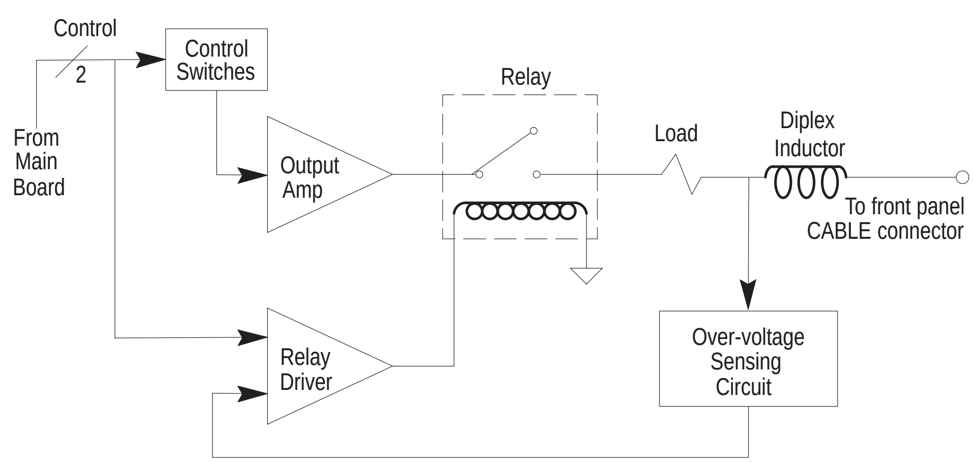


Figure 5–22: Option 06 (Ethernet®) Block Diagram

Ethernet® is a registered trademark of the Xerox Corporation.

Control Lines

The control lines from the Main Board set the normal operation of the instrument as follows:

Control Line Voltages A (Pin 10)	Control Line Voltages B (Pin 11)	Relay	DC Output Voltage into 50 Ω
0	0	Off	AC Coupled
5	0	On	–1.05 VDC
0	5	On	–1.7 VDC
5	5	On	0.0 volts

Output Amplifier

The control of the output voltage is done by selecting which of the analog switches in U1031 is on. The switches connect either R1036 or R1037 to the +5 V_{REF}. This causes Op–Amp U1030B, buffer transistors Q1020 and Q1021, and feedback resistor R1034 to hold either –2.1 or –3.4 VDC at the transistor emitters. If both switches are off, R1035 holds the input of U1030B at ground so the output voltage is 0.0 volts.

Relay and Driver

The control lines are also OR'd together by CR2025 and CR2024 to enable the relay driver. If either or both are high, current flows through R2031 to hold pin 3 of U1030A at 0.6 VDC. Because pin 2 is at –0.6 VDC, the output of U1030A goes high. This turns on Q2020 and drives the relay K1020. If both control lines are low, less current flows through R1031 and pin 3 of U1030A will be at –1.3 VDC. Because this is below pin 2, the output on pin 1 will be low and the relay will be off. The –1.3 VDC and –0.6 VDC on pins 3 and 2 are set by the voltage dividers from the +5 V_{REF} and –10 V_{REF}, composed of R2025, R2026, R2027, and R2030.

Over-Voltage Sensing

The relay can also be turned off by the over-voltage sensing circuit. This works by current flowing from L2010 through R2020. Depending on polarity, this current flows through either CR2020 or CR2021 and charges either C2030 or C2031 as a peak hold circuit. Because C2030 and C2031 are on pins 2 and 3 if U1030A, the voltage change will turn off the relay if it gets bigger than the normal 1.2-volt difference. This happens at about 10 – 12 volts peak-to-peak on L2010. Zener diodes VR2020 and VR2021 clamp these voltages to prevent damage to U1030.

Load and Diplexer

L2010 is the diplexer low-pass element. It creates a corner at about 8 kHz with the 50 Ω load (R1011) to compliment the 0.44 μF capacitor and 50 Ω impedance on the standard 1503C Pulser/Sampler Board. R1012 and trim pot R1013 allow compensation for the series resistance of L2010. Resistor R1010 (2 kΩ) and capacitor C1010 (10 pF) are a damping network to prevent ringing after the test pulses.

Calibration

Introduction

This chapter is divided into the *Calibration Performance Check* and *Additional Checks and Adjustment Procedures*.

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 Procedures* are 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	Performance Required	Tek Part Number
50 Ω precision terminator	± 1%	011–0123–00
10-ft measured cable	93 Ω, V_P .84	012–1351–00

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.

1503C ROM version x.xx
Ethernet
Copyright 1987, 1988 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 *Adjustments* section of this chapter.

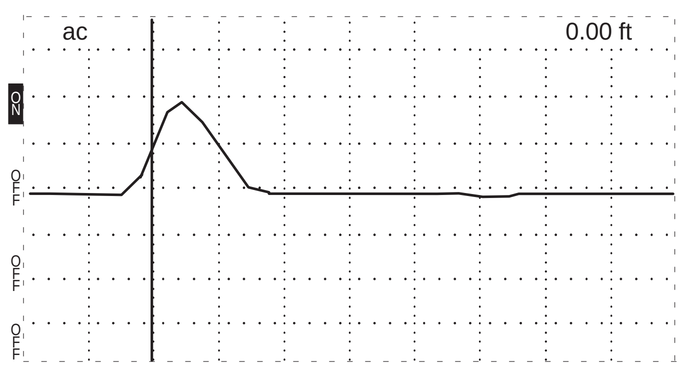


Figure 6–2: Waveform on the Display

***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.

Exit Setup Menu
Acquisition Control Menu
Vertical Scale is: Decibels
Distance/Div is: ft/div
→ Light is: ON

Move △▽Position to select, then push MENU button

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
IMPEDANCE	Full CW (clockwise)
NOISE FILTER	Full CW
VERT SCALE	Default (see note below)
DIST/DIV	Full CW
PULSE WIDTH	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
   Ethernet Menu

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

Figure 6–4: Main Menu

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

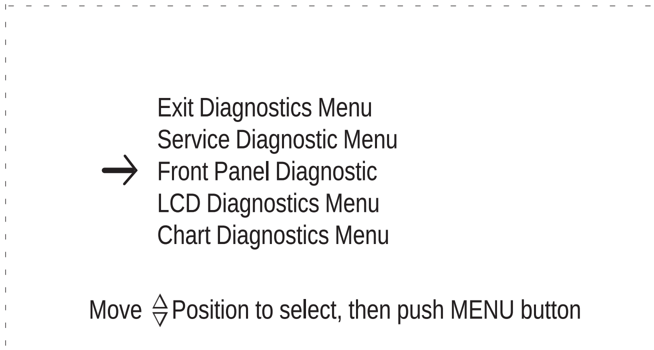


Figure 6–5: Diagnostics Menu

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).

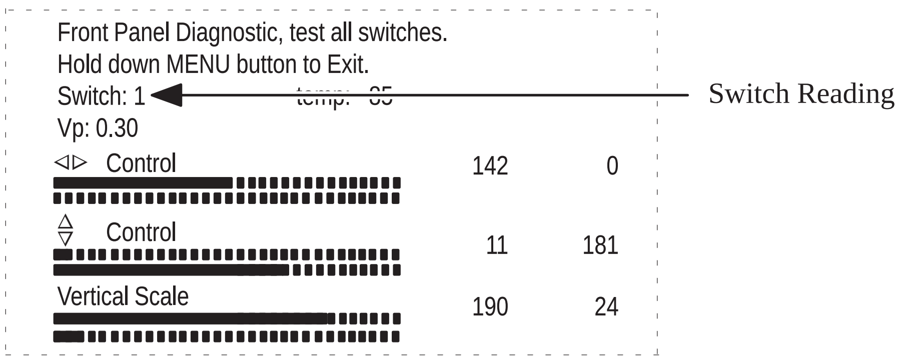


Figure 6–6: Front Panel Diagnostic Display

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

1. Rotate IMPEDANCE counterclockwise to its far stop. The LCD switch reading should be 5.
2. Slowly rotate this control clockwise to its far stop. Each position should increase the switch reading one count, starting at 5 and ending with 8.

3. Rotate NOISE FILTER counterclockwise to VERT SET REF. The switch reading on the display should be 9.

4. Slowly rotate this control clockwise to its far stop. Each position should increase the switch reading one count, starting at 9 and ending with 18.

5. Rotate DIST/DIV counterclockwise to VERT SET REF. The switch reading on the display should be 19.

6. Slowly rotate this control clockwise to its far stop. Each position should increase the switch reading one count, starting at 19 and ending with 30.

7. 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.

8. 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.

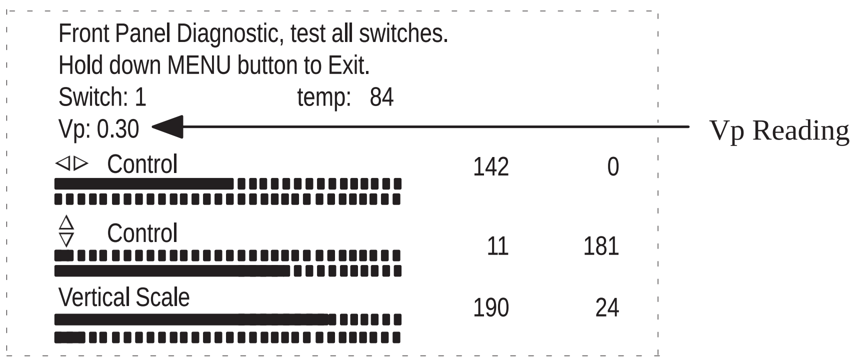


Figure 6–7: Front Panel Diagnostic Display

9. Rotate PULSE WIDTH counterclockwise to its far stop. The switch reading should be 31.

10. Slowly rotate this control clockwise to its far stop. Each position should increase the switch reading one count, starting at 31 and ending with 35.

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.

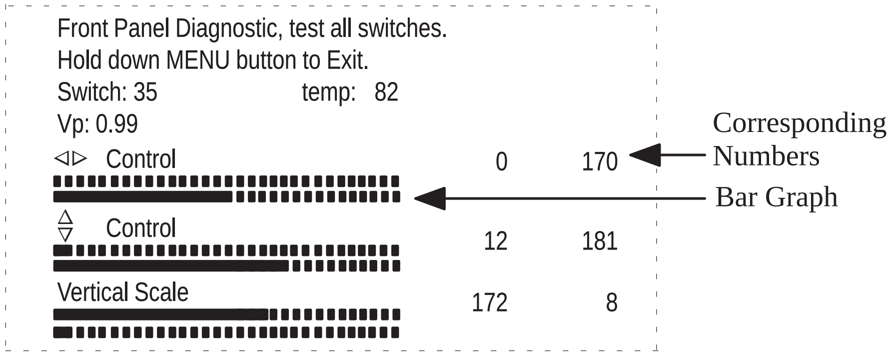


Figure 6–8: Front Panel Diagnostic Display

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

This 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 temp 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.

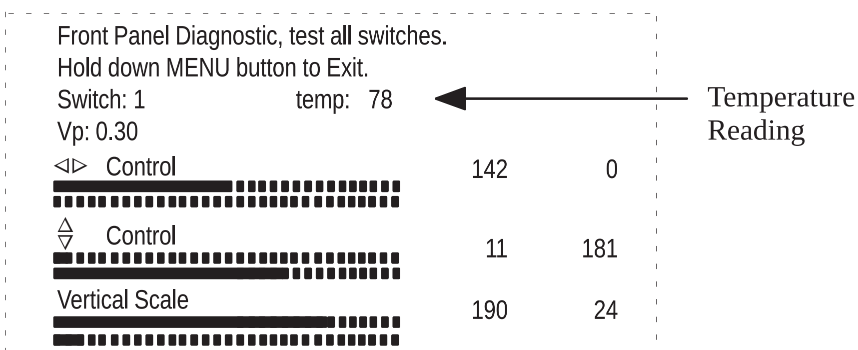


Figure 6–9: Front Panel Diagnostic Display

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)
IMPEDANCE	93Ω
NOISE FILTER	1 avg
VERT SCALE	10.00 dB
DIST/DIV	5 ft/div
PULSE WIDTH	2 ns
V_P	.99

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

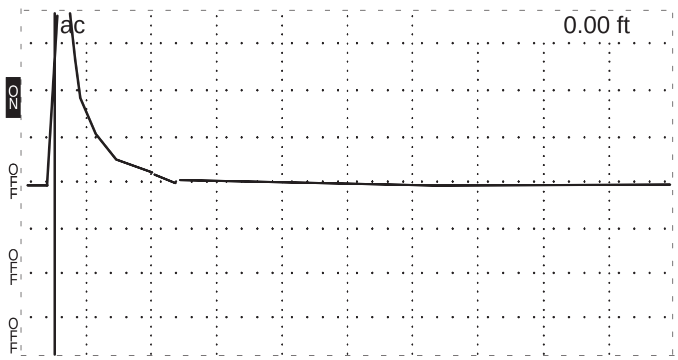


Figure 6–10: Waveform on the Display with No Cable Attached

3. Connect the 10-ft test cable to the front-panel CABLE connector. The display should look like Figure 6–11.

***NOTE**. If a cable other than the 10-ft test lead with a V_P other than .84 is used, the distance numbers in this check will vary.*

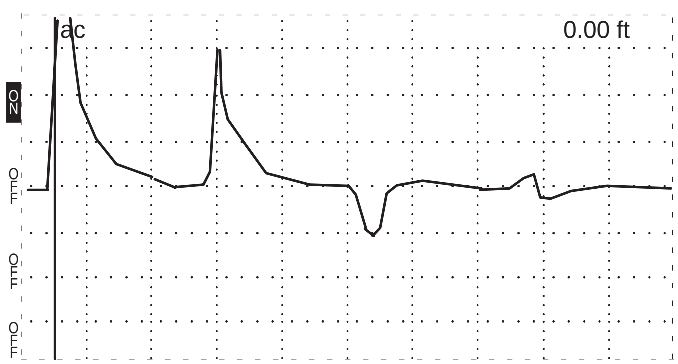


Figure 6–11: Waveform on the Display with 10-ft Cable Attached

4. Using the ◁▷ POSITION control, set the cursor on the rising edge of the reflected pulse.

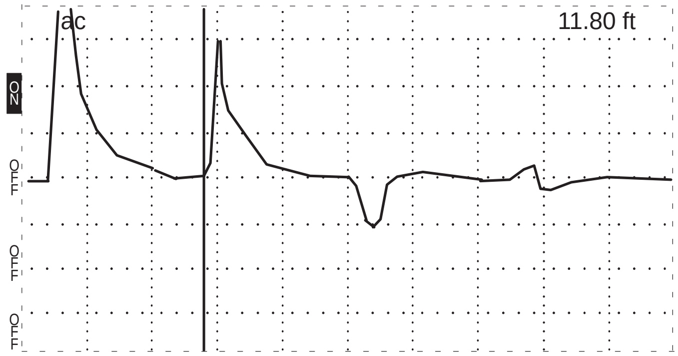


Figure 6–12: Cursor on Rising Edge of Reflected Pulse at 5 ft/div

5. Change the DIST/DIV to 1 ft/div and again place the cursor on the rising edge of the reflected pulse. The distance window should read between 11.30 and 12.20 ft.

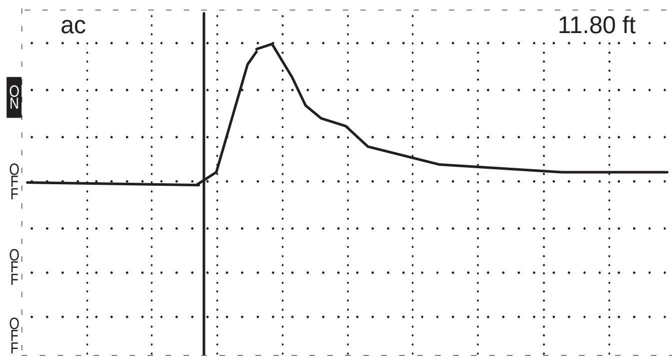


Figure 6–13: Cursor on Rising Edge of Reflected Pulse at 1 ft/div

6. Change the V_P to .84 and reposition the cursor to the rising edge of the reflected pulse. The distance window should read between 9.70 and 10.3 ft.

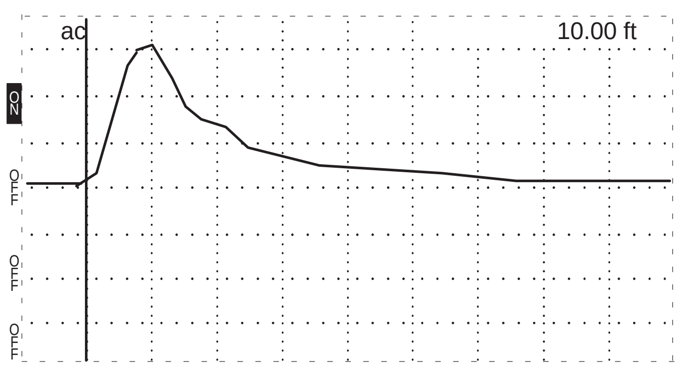


Figure 6–14: Cursor on Rising Edge of Reflected Pulse with Vp at .84

7. Remove the 10–ft cable and connect the 50 Ω terminator.

8. Set the DIST/DIV control to 5000 ft/div.

9. Change the PULSE WIDTH to 1000 ns.

10. Rotate the ◁▷ POSITION control clockwise until the display distance window shows a distance greater than 50,000 ft. The waveform should remain flat from zero to this distance.

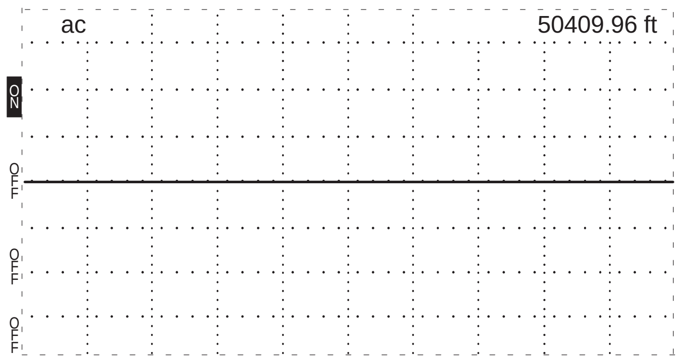


Figure 6–15: Flatline Display to >50,000 ft

***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.*

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	50 Ω terminator
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
DIST/DIV	(see text)
PULSE WIDTH	2 ns
V_P	.99

2. Set the ◁▷ POSITION control so the distance window reads –2.00 ft.

3. Set DIST/DIV to 1 ft/div.

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

5. Remover the terminator.

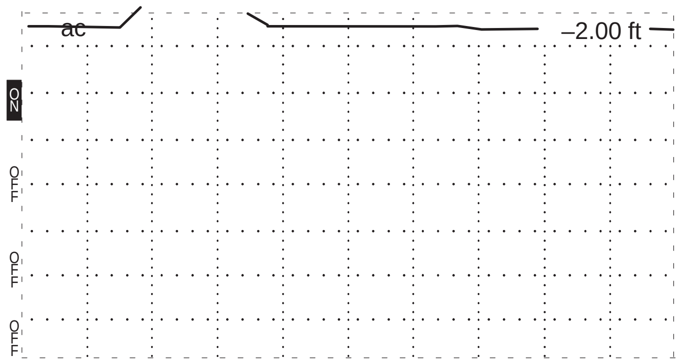


Figure 6–16: Waveform at Top of the Display

6. 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.

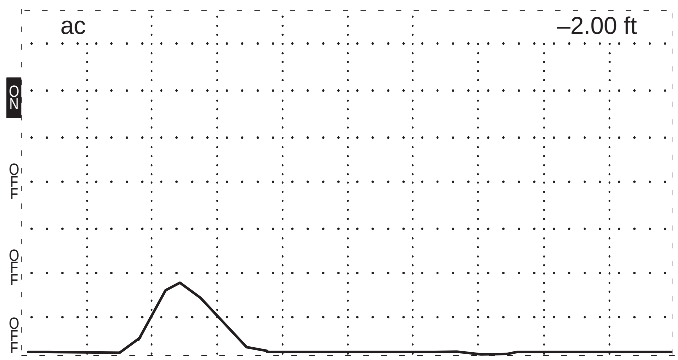


Figure 6–17: Waveform at Bottom of the Display

7. Center the pulse in the display. The pulse should be about two divisions high.

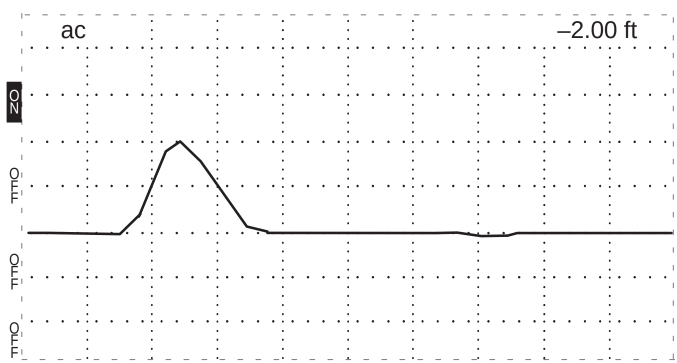


Figure 6–18: Waveform at Center of the Display

***NOTE**. If the instrument fails this check, refer to the* Circuit Descriptions *chapter and 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	50 Ω terminator
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
DIST/DIV	50 ft/div
PULSE WIDTH	2 ns
V_P	.99

2. Turn the ◁▷ POSITION control until the distance window reads between 200.00 and 250.00 ft.

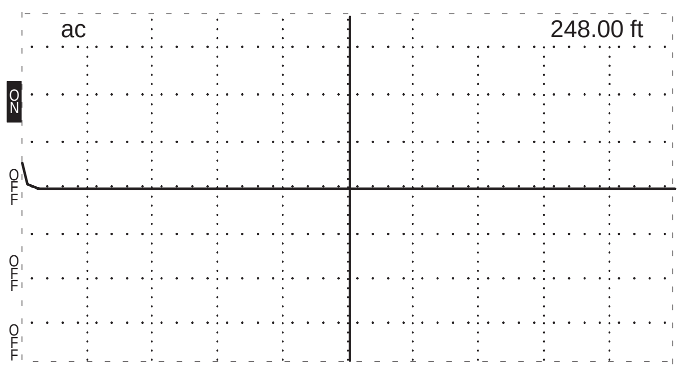


Figure 6–19: Distance Moved Beyond Trailing Edge of Pulse

3. Change DIST/DIV to 1 ft/div.

4. Using the VERT SCALE control, set the gain to 57 dB.

5. Use the △▽ POSITION control to keep the waveform centered on the display.

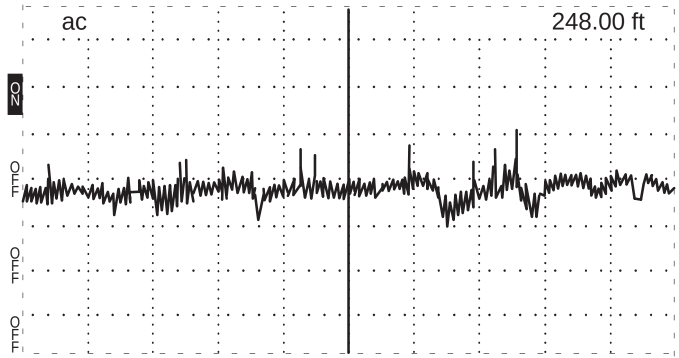


Figure 6–20: Noise with Gain at 57 dB

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 57 dB, 2 ns Pulse width,
and cursor at location to sample.
– Push MENU button to Exit –

Figure 6–21: 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.

Impedance 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 *Impedance 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 6–22: Service Diagnostic Menu

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 6–23: Service Diagnostic Menu

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

NOTE. The 48 dB step might fail intermittently. If a more accurate reading is desired, TP9041 on the Main Board or TP1060 on the Pulser/Sampler Board must be grounded during the check. See the Maintenance *chapter for the case and EMI shield removal instructions.*

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 6–24: 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.*

Pulse Balance Check

If the instrument fails this check, the pulse balance might be too small to be useful at some ranges. It might also be a clue to problems in the pulser/sampler board.

1. Set the front-panel controls:

CABLE	no connection
IMPEDANCE	50 Ω
VERT SCALE	5.00 dB
DIST/DIV	10 ft/div
PULSE WIDTH	1000 ns
V_P	.99

2. Using the ◁▷ POSITION control, adjust the distance window to read –2.00 ft.

3. Increase DIST/DIV to 100 ft/div.

4. Center the pulse on the display.

5. Verify that the pulse is between 4.5 and 6.5 divisions high.

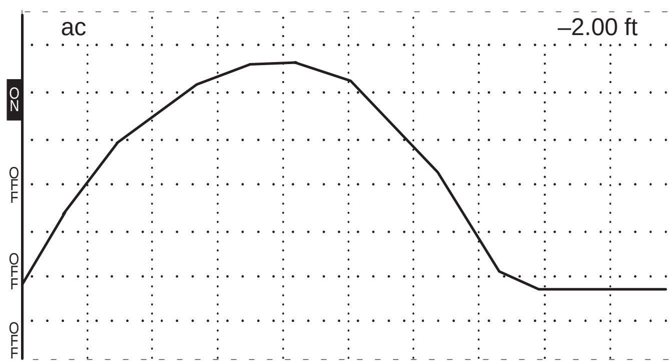


Figure 6–25: Pulse Appx. Five Divisions High

6. Press STORE.

7. Press VIEW STORE.

8. Change IMPEDANCE to 75 Ω.

9. Verify that no more than 0.5 dB gain is needed to equalize the current waveform and the stored waveform.

***NOTE**. Use the △▽ POSITION control to move the current waveform slightly for easier comparison.*

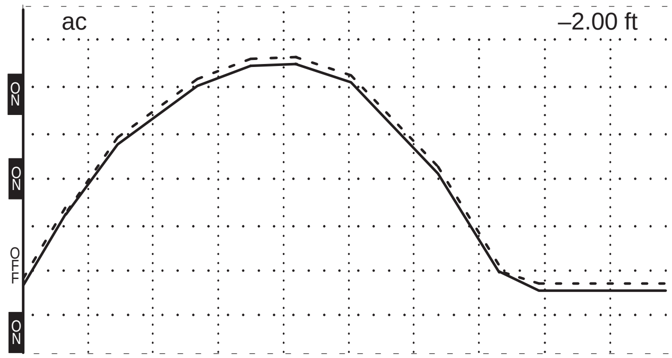


Figure 6–26: Current Waveform Shifted Slightly from Stored Waveform

10. Change IMPEDANCE to 93 Ω.
11. Verify that no more than 0.5 dB gain is needed to equalize the current waveform and the stored waveform.
12. Change IMPEDANCE to 125 Ω.
13. Verify that no more than 0.5 dB gain is needed to equalize the current waveform and the stored waveform.
14. Press STORE to return to normal viewing mode and erase the stored waveform.

NOTE. *If the instrument fails any portion of this check, refer to the* Circuit Descriptions *chapter for help in troubleshooting the pulser/sampler board.*

Pulse Width Check

If the pulse width is out of specification, resolution and range might be affected.

1. Set the front-panel controls:

CABLE	50 Ω terminator
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	see text
DIST/DIV	1 ft/div
PULSE WIDTH	2 ns
V_P	.99

2. Using the ◁▷ POSITION control, set the distance window to –2.00 ft.

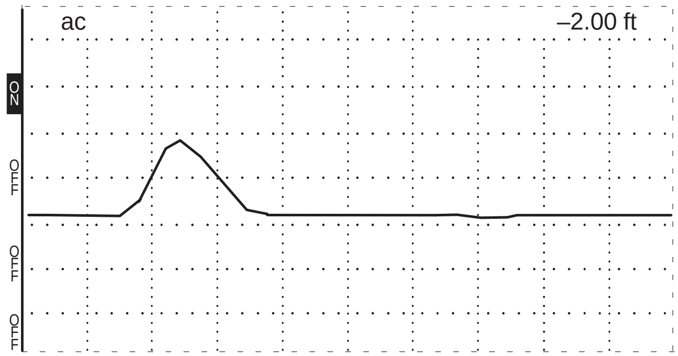


Figure 6–27: Initial Pulse

3. Adjust VERT SCALE for a pulse height of six divisions.
4. Keep the pulse centered on the display with the ⇳POSITION control so the pulse is three divisions above and three below the center horizontal graticule line.

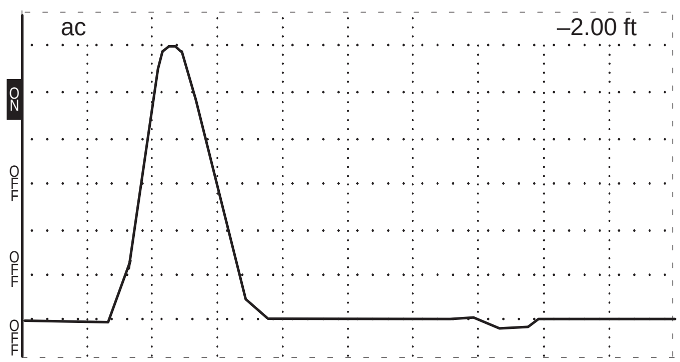


Figure 6–28: Pulse Adjusted to Six Divisions High

5. Turn NOISE FILTER to HORZ SET REF.
6. Position the cursor at the point where the leading edge of the pulse crosses the center horizontal graticule line.
7. Press STORE.
8. Set NOISE FILTER back to 1 avg.

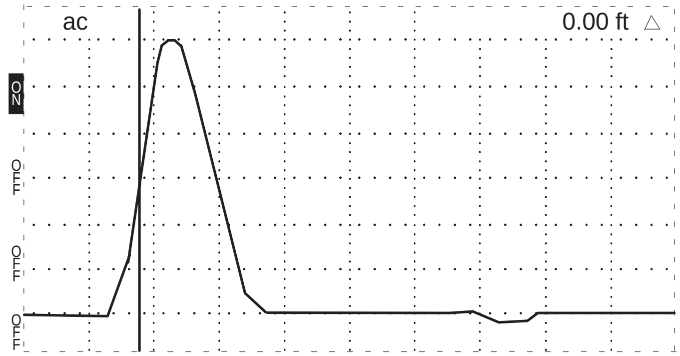


Figure 6–29: Cursor on Leading Edge at Center Graticule

9. Using the ◁▷ POSITION control, position the cursor at the point where the trailing edge of the pulse crosses the center horizontal graticule line.

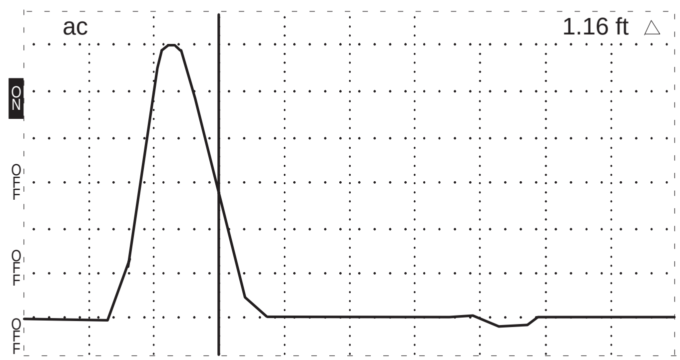


Figure 6–30: Cursor on Trailing Edge at Center Graticule

10. Read the distance in the distance window. The pulse widths and allowable tolerances are listed in the table below.

PULSE	DIST/DIV	MINIMUM △ (ft)	MAXIMUM △ (ft)
2 ns	1	0.500	1.460
10 ns	1	4.390	5.320
100 ns	10	43.900	53.220
1000 ns	100	439.000	537.000

11. Repeat the above procedures for each pulse width.

***NOTE**. If the instrument fails any portion of this check, refer to the* Circuit Descriptions *chapter for help in troubleshooting the pulser/sampler board.*

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

Auto Pulse Select Check

If the auto pulse circuit is not working, the pulse width will have to be manually selected.

1. Set the front-panel controls:

CABLE	50 Ω terminator
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
DIST/DIV	1 ft/div
PULSE WIDTH	Auto
V_P	.99

NOTE*. The instrument should not be in HORZ SET REF (∆ mode).*

2. Set the distance window first to –2.00 ft to make sure the pulse is on screen, then to 0.00 ft. The distance window directly affects which pulse that Auto Pulse selects.

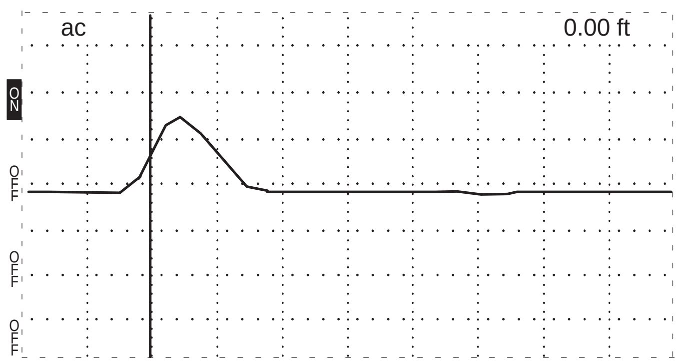


Figure 6–31: Initial Pulse with Cursor at 0.00 ft

3. Slowly turn DIST/DIV and observe the pulse width reading on the display, as well as the actual pulse. The readings should increase and the pulse width should widen. Readings should match the table below.

DIST / DIV	PULSE WIDTH	DIST / DIV	PULSE WIDTH
1 ft	2 ns	100 ft	100 ns
2 ft	2 ns	200 ft	100 ns
5 ft	2 ns	500 ft	1000 ns
10 ft	2 ns	1000 ft	1000 ns
20 ft	10 ns	2000 ft	1000 ns
50 ft	10 ns	5000 ft	1000 ns

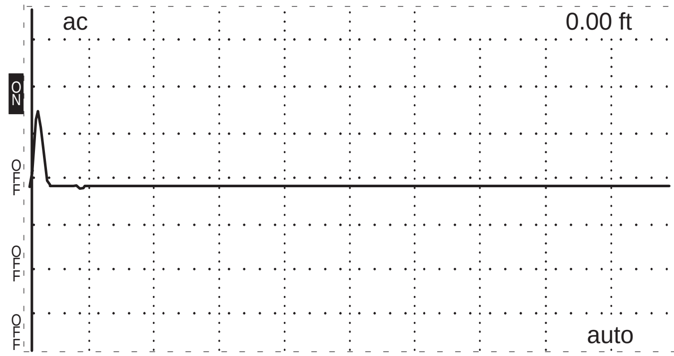


Figure 6–32: Waveform on Auto Pulse Select

***NOTE**. If the Auto Pulse Select check fails, refer to the* Circuit Descriptions *chapter describing the software of the instrument.*

Jitter Check

1. Set the front-panel controls:

CABLE	50 Ω terminator
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
DIST/DIV	1 ft/div
PULSE WIDTH	2 ns
V_P	.99

2. Center the rising edge of the pulse on the center horizontal graticule line.

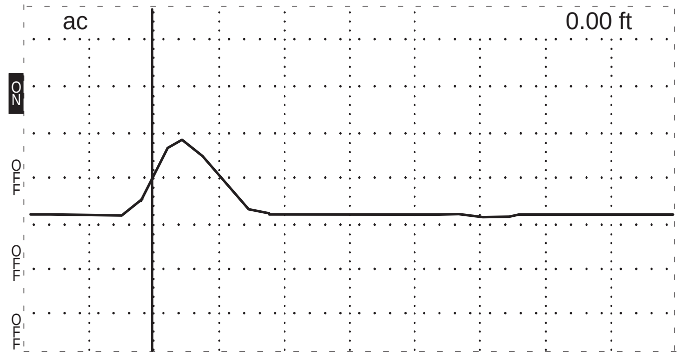


Figure 6–33: Initial Pulse Centered on Horizontal Graticule

3. Increase the VERT SCALE control to 30.00 dB.

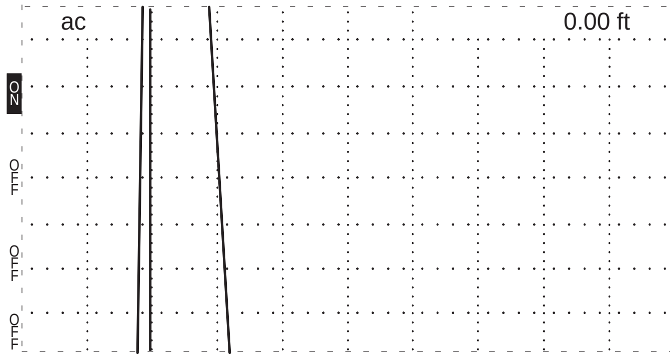


Figure 6–34: Gain Increased to 30.00 dB

4. Verify that the leading edge of the pulse moves less than one minor division horizontally (< 0.2 ft).

NOTE. *Use the Max Hold function found in the* Acquisition Control *menu within the* Setup Menu. *It can simplify this measurement for you by displaying jitter accumulating in the waveform over a period of time (more than 30 seconds). See the* Operation *chapter for directions on using Max Hold.*

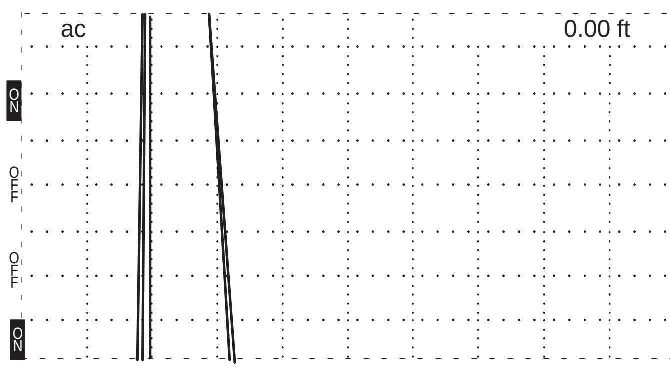


Figure 6–35: Jitter Apparent Using Max Hold

NOTE. *If the instrument does not pass this check, potential problem areas are the Pulser/Sampler board and the Timebase circuitry. Refer to the* Circuit Descriptions *chapter and the* Maintenance *chapter of this manual.*

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

Aberrations Check

If the aberrations are out of specification, small discontinuities might not be seen and accuracy of the instrument might be affected.

1. Turn the ◁▷ POSITION control counterclockwise until the display distance window reads less than 20.00 ft.
2. Set the DIST/DIV control to 1 ft/div.
3. Turn the ◁▷ POSITION control counterclockwise until the distance window reads –2.00 ft.
4. Set the front-panel controls:

IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
PULSE WIDTH	2 ns
V_P	.99

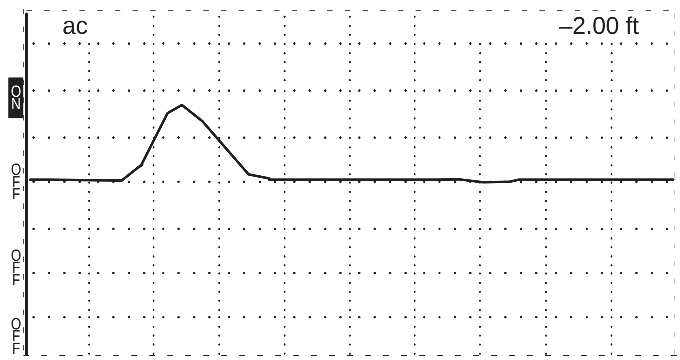


Figure 6–36: Cursor at –2.00 ft

5. Connect the 50 Ω precision terminator to the front panel.
6. Turn the NOISE FILTER control completely counterclockwise to the VERT SET REF position.
7. Using VERT SCALE, increase the height of the pulse to four major divisions.
8. Press STORE.
9. Turn NOISE FILTER back to 1 avg.

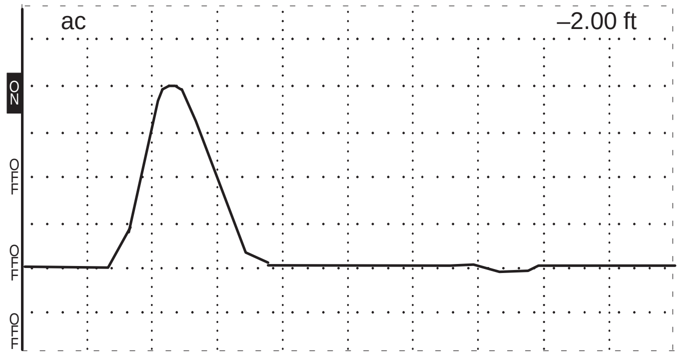


Figure 6–37: Pulse Height at Four Divisions at 1 ft/div

10. Using the ⇕POSITION control, place the baseline of the waveform on the center graticule.

11. Increase VERT SCALE to 25.00 dB.

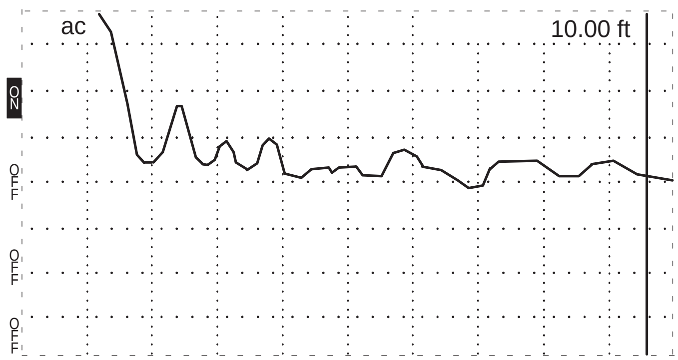


Figure 6–38: Gain Increased to 25.00 dB

12. Using the ◁▷ POSITION control, scroll along the waveform and verify the aberrations are less than four divisions high out to 10 feet, excluding any aberration that is part of the initial pulse.

13. Return the cursor to –2.00 ft.

14. Turn NOISE FILTER back to VERT SET REF again.

15. Set DIST/DIV to 2 ft/div.

16. Turn PULSE WIDTH to 10 ns.

17. Adjust the pulse height to four major divisions.

18. Press STORE.

19. Return the NOISE FILTER control to 1 avg.

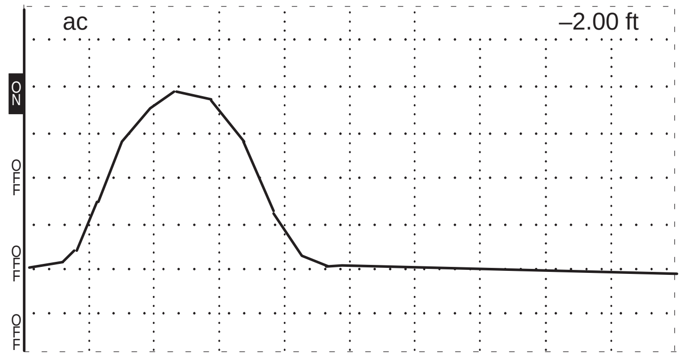


Figure 6–39: Pulse Height at Four Divisions at 2 ft/div

20. Move the baseline of the waveform to the center graticule.

21. Increase VERT SCALE to 30.00 dB.

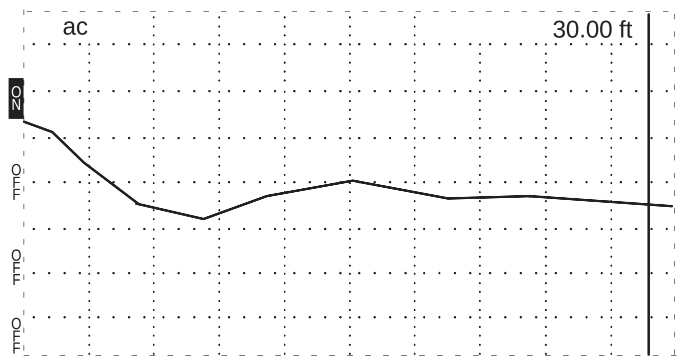


Figure 6–40: Gain Increased to 30.00 dB

22. Using the ◁▷ POSITION control, scroll along the waveform and verify that all of the aberrations are less than four divisions high out to 30 feet.

23. Return the cursor to –2.00 ft.

24. Turn NOISE FILTER back to VERT SET REF again.

25. Set DIST/DIV to 50 ft/div.

26. Turn PULSE WIDTH to 100 ns.

27. Adjust the pulse height to four major divisions.

28. Press STORE.

29. Return the NOISE FILTER control to 1 avg.

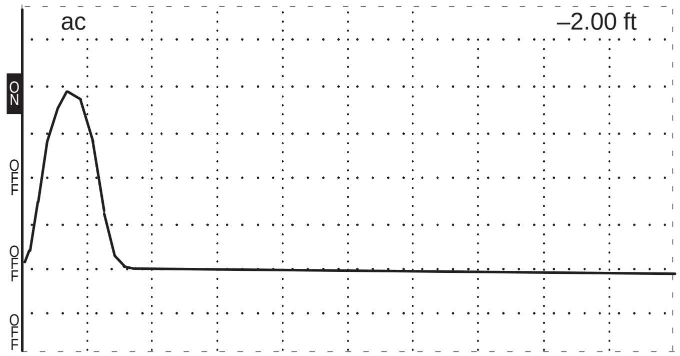


Figure 6–41: Pulse Height at Four Divisions at 50 ft/div

30. Using the ◬POSITION control, place the baseline of the waveform on the center graticule.
31. Increase VERT SCALE to 30.00 dB.

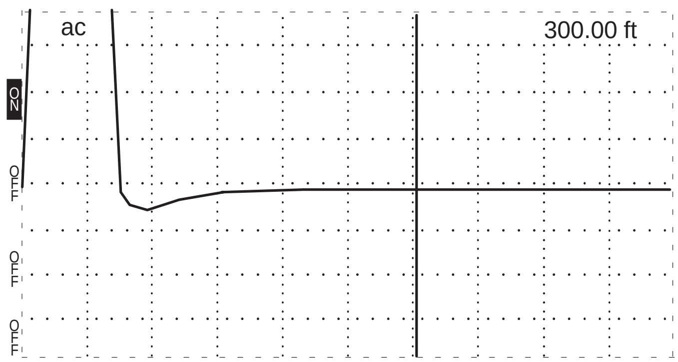


Figure 6–42: Gain Increased to 30.00 dB

32. Using the ◁▷ POSITION control, scroll along the waveform and verify that all of the aberrations are less than four divisions high out to 300 feet.
33. Return the cursor to –2.00 ft.
34. Turn NOISE FILTER back to VERT SET REF again.
35. Set DIST/DIV to 500 ft/div.
36. Turn PULSE WIDTH to 1000 ns.
37. Adjust the pulse height to four major divisions.
38. Press STORE.
39. Return the NOISE FILTER control to 1 avg.

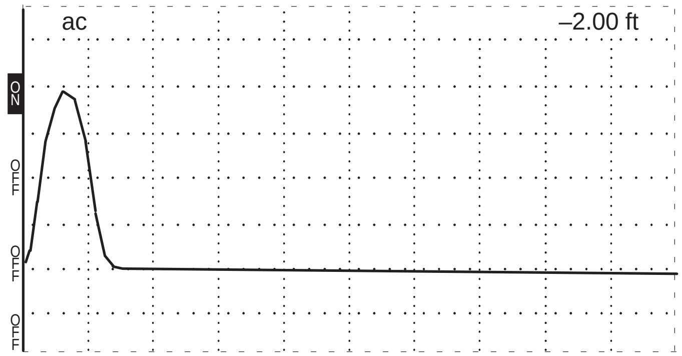


Figure 6–43: Pulse Height at Four Divisions at 500 ft/div

40. Using the ⇕POSITION control, place the baseline of the waveform on the center graticule.

41. Increase VERT SCALE to 30.00 dB.

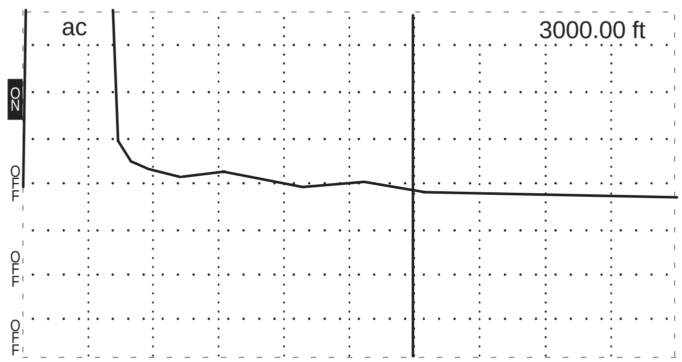


Figure 6–44: Gain Increased to 30.00 dB

42. Using the ◁▷ POSITION control, scroll along the waveform and verify that all of the aberrations are less than four divisions high out to 3000 feet.

***NOTE**. If the instrument fails the aberrations checks, potential problems exist in the Pulser/Sampler circuitry. Refer to the* Circuit Descriptions *chapter and the* Troubleshooting *section of the* Maintenance *chapter of this manual.*

Pulse Amplitude Check

If the instrument does not pass the Pulse Amplitude check, range and the Impedance Diagnostic might be affected. Additionally, loss measurements might not be accurate.

1. Set the 1503C front-panel controls:

CABLE	10-ft test cable
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	10.00 dB
DIST/DIV	1 ft/div
PULSE WIDTH	1000 ns
V_P	.66
POWER	On

2. On the far end of the test cable, attach the 50 Ω through-terminator.

3. Then attach the through-terminator to Channel 1 of the oscilloscope.

4. Set the scope controls:

Vertical	0.5 Volts/div
Horizontal Timing	0.2 µs
Trigger	– slope

5. Using the ◁▷ POSITION control, set the distance window to –2.00 ft.

6. Change DIST/DIV to 100 ft/div.

7. Measure the pulse height on the scope.

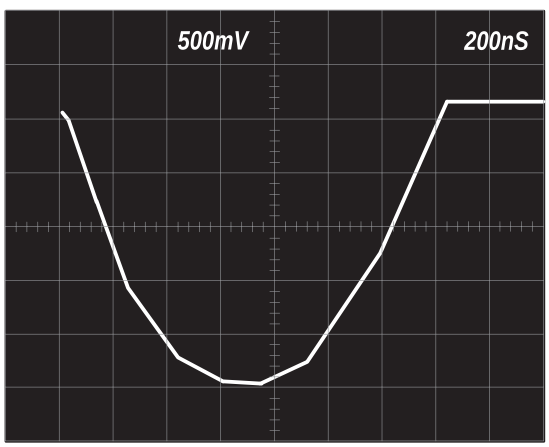


Figure 6–45: Oscilloscope Waveform

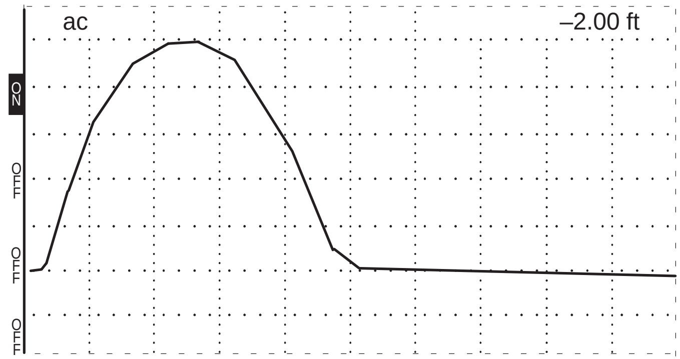


Figure 6–46: 1503C Waveform of 1000-ns Pulse

8. Using VERT SCALE, adjust the pulse height on the 1503C to match the pulse height on the scope. The pulse height on both instruments should be between 4.5 and 5.5 divisions.

   The 1503C is now set for 0.5 Volts per division.

***NOTE**. Once the 1000 ns pulse has been checked, the 1503C display is used to confirm the rest of the pulse widths. If desired, however, the scope can be used. While pulses can be measured directly with the scope, a fairly fast (500 MHz) scope is necessary for the shorter pulses.*

---

9. Change PULSE WIDTH to 100 ns.
10. Change DIST/DIV to 10 ft/div.
11. Verify that the pulse height on the 1503C is between 4.5 and 5.5 divisions.

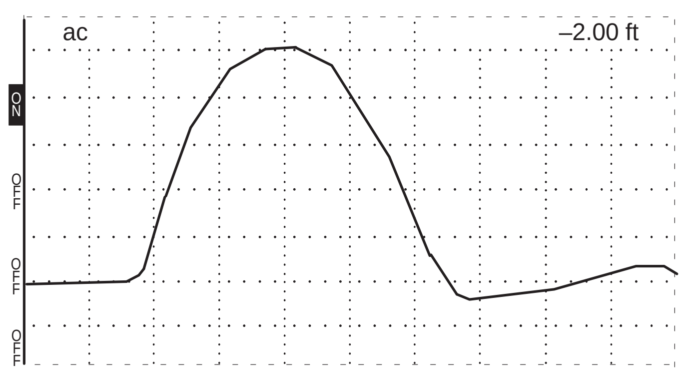


Figure 6–47: 1503C Waveform of 100-ns Pulse

12. Change PULSE WIDTH to 10 ns.

13. Change DIST/DIV to 1 ft/div.

14. Verify that the pulse height on the 1503C is between 4.5 and 5.5 divisions.

15. Change PULSE WIDTH to 2 ns.

16. Leave DIST/DIV at 1 ft/div.

17. Verify that the pulse height on the 1503C is between 4 and 6 divisions.

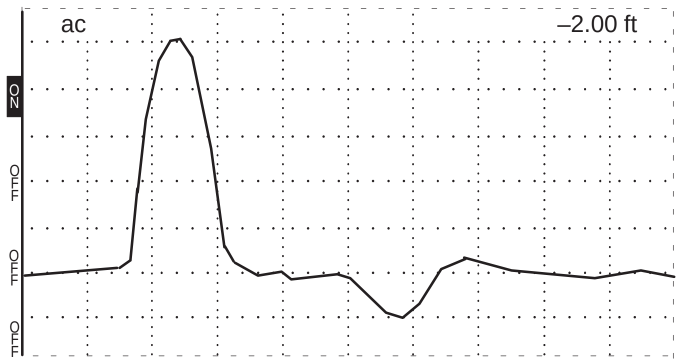


Figure 6–48: 1503C Waveform of 2-ns Pulse

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.

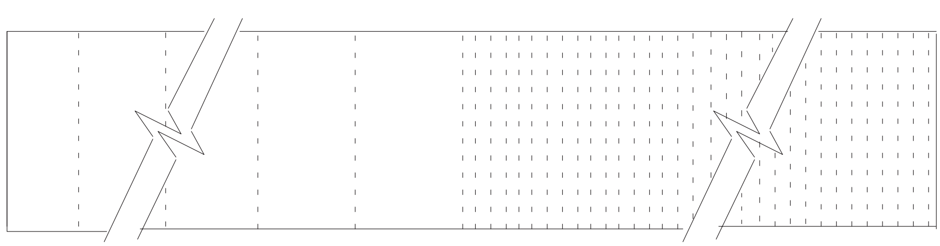


Figure 6–49: Head Alignment Chart Print

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.

Option 06: Ethernet® Adapter Checks

***NOTE**. If your instrument does not have Option 06, proceed to the* Final Performance Check. *This procedure is to check the Option 06 circuit board after it has been serviced or repaired.*

If the instrument does not pass this check, measurements might be affected for both Ethernet systems and standard cable tests. Adjustments for Option 06 are included at the end of this section.

This procedure should be performed at the time the standard instrument performance checks are performed or whenever you suspect possible incorrect operation of the Ethernet option. Correct operation of the Option 06 depends on correct operation of the basic instrument.

Equipment Required

Equipment	Example or Tek P/N
Digital Multimeter	DM502
BNC T-connector	Tek 103–0030–xx

Equipment Setup

1. Connect a BNC T-connector to the front panel CABLE connector of the 1503C.
2. On one side of the adapter, connect a 50 Ω terminator.
3. Connect the other side to the digital multimeter.

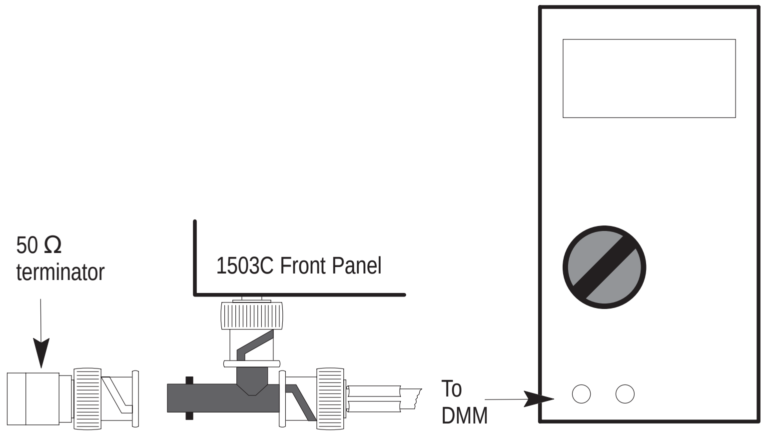


Figure 6–50: Equipment Setup

4. Set the 1503C front-panel controls:

IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
PULSE WIDTH	2 ns

(settings for other controls do not affect this check)

5. Turn POWER on.

6. Press MENU.

7. Scroll to *Ethernet Menu*.

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

Move ⇕ Position to select, then push MENU button

Figure 6–51: Main Menu

8. Press MENU again.

9. Scroll to *50 Ω termination is: Off*.

10. Press MENU. This will change that selection to *50 Ω termination is: On*.

Exit Ethernet Menu
→ 50 Ω DC termination is: On
Single Sweep with Carrier is: Off
Carrier Test is: Off
Collision Test is: Off

Move ⇳ Position to select, then push MENU button

Figure 6–52: Ethernet Menu

11. Exit the menus. Returning to normal operation mode activates the menu selection.

12. Set the DMM to measure Volts DC.

13. Verify that the voltage measured is less than 0.2 VDC.

Carrier Offset Voltage Check

1. Re-enter the *Ethernet Menu*.

2. Scroll to *Carrier Test is: Off*.

3. Press MENU. This will change that selection to *Carrier Test is: On.*

Exit Ethernet Menu
50 Ω DC termination is: On
Single Sweep with Carrier is: Off
→ Carrier Test is: On
Collision Test is: Off

Move ⇳ Position to select, then push MENU button

Figure 6–53: Ethernet Menu

4. Exit the menus. Returning to normal operation mode activates the menu selection.

5. Verify that the voltage measured is between –0.9 VDC and –1.2 VDC.

Collision Offset Voltage Check

1. Re-enter the *Ethernet Menu*.
2. Scroll to *Collision Test is: Off*.
3. Press MENU. This will change that selection to *Collision Test is: On.*

```
   Exit Ethernet Menu
   50 Ω DC termination is: On
   Single Sweep with Carrier is: Off
   Carrier Test is: On
→  Collision Test is: Off

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

Figure 6–54: Ethernet Menu

4. Exit the menus. Returning to normal operation mode activates the menu selection.
5. Verify that the voltage measured is between –1.55 VDC and –1.85 VDC.
6. Write your results on a piece of paper because you will use this reading in the *Impedance Check*.
7. Remove the 50 Ω terminator from the T-connector.
8. The voltage displayed should now be between –3.2 VDC and –3.8 VDC.
9. Also write this reading down for the next check.
10. Enter the *Ethernet Menu* again.

```
   Exit Ethernet Menu
→  50 Ω DC termination is: Off
   Single Sweep with Carrier is: Off
   Carrier Test is: Off
   Collision Test is: Off

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

Figure 6–55: Ethernet Menu

11. Scroll to *50 Ω termination is: On*.

12. Press MENU. This will change that selection to *50Ω termination is: Off*.

13. Exit the menus. Returning to normal operation mode activates the menu selection.

14. The DC voltage should drop to a nominal zero Volts. If it remains at –1.7 VDC, the relay is not working correctly on the option board and requires service.

DC Impedance Check

1. Enter the *Ethernet Menu*.

2. Scroll to *50 Ω termination is: Off*.

3. Press MENU. This will change that selection to *50 Ω termination is: On*.

Exit Ethernet Menu
→ 50 Ω DC termination is: On
Single Sweep with Carrier is: Off
Carrier Test is: Off
Collision Test is: Off

Move △▽ Position to select, then push MENU button

Figure 6–56: Ethernet Menu

4. Exit the menus. Returning to normal operation mode activates the menu selection.

5. Set the DMM to measure resistance.

6. Measure the output resistance of the 1503C by connecting the DMM to one side of the BNC T-connector. Note this number.

7. Reverse the leads and make another measurement. Note this number.

8. Add the two numbers and divide by two to get the average. The result should be between 49 Ω and 51 Ω.

An alternate method is to measure the carrier or collision DC voltage, as follows:

1. Measure the resistance on the BNC T-connector with the 50 Ω terminator connected to the opposite side

2. Disconnect the terminator and measure the resistance again.

3. The DC output impedance can then be calculated as follows:

$$Zo = \left[\left(\frac{Vo}{Vt} \right) -1 \right] * Zt$$

Where:
Zo is the output impedance
Vo is the open circuit voltage
Vt is the terminated voltage and
Zt is the 50 Ω terminator resistance.

NOTE. *If the instrument passes these checks, the Option 06 board is functioning correctly. For adjustments, refer to the procedure immediately following this. Any other problems will require troubleshooting the circuitry. Refer to the* Circuit Descriptions *and* Maintenance *chapters of this manual.*

Adjustment Procedures

Equipment Required

Equipment	Performance Required	Example or Tek P/N
Digital Multimeter	Range: 0 to 200 VDC	DM502
Oscilloscope	> 10 MHz, 7.5 V/cm	Tek 2465B or equivalent
Variable AC Source	with power meter	GenRad W10MT3W or equiv.
Variable DC Power Supply	0 to 14 VDC, 3 A	
50 Ω Feed-through Terminator		011–0049–01
3-foot Coaxial Cable	50 Ω	012–1350–00

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.

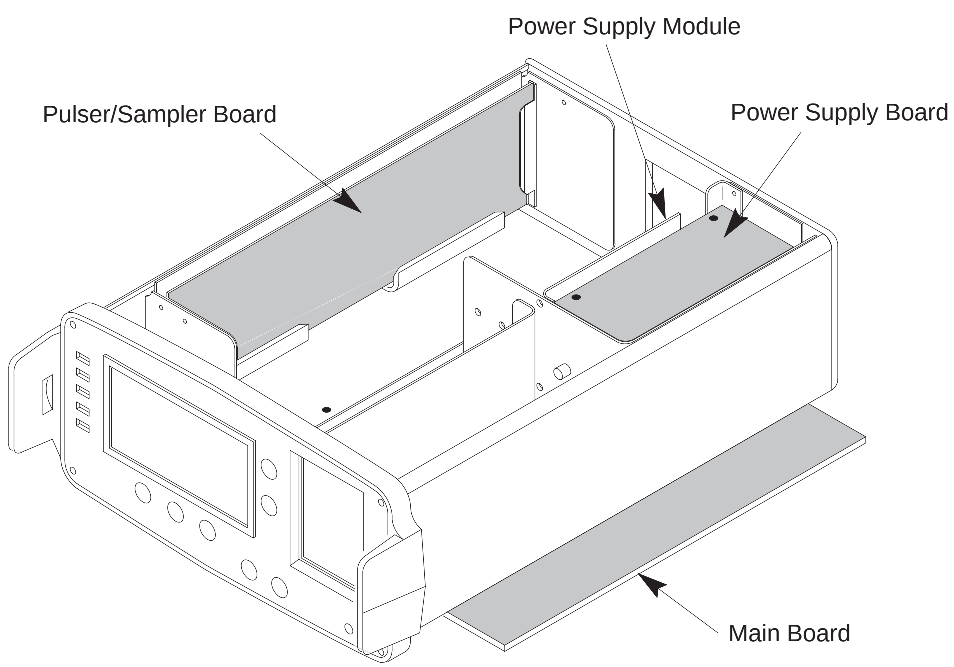


Figure 6–57: Circuit Board Locations in the Instrument

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
DIST/DIV	1 ft/div
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 1503C.

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.

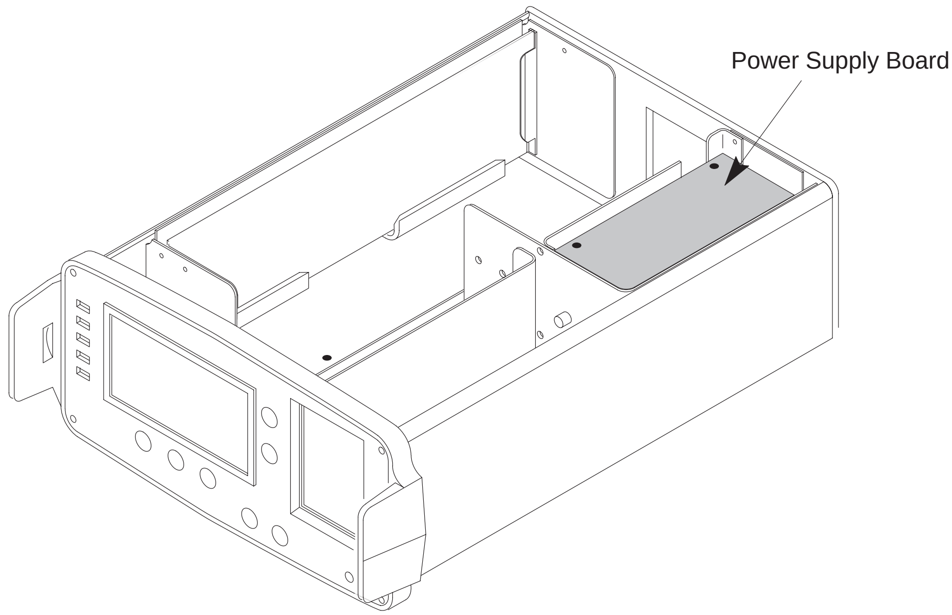


Figure 6–58: Power Supply Board

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).

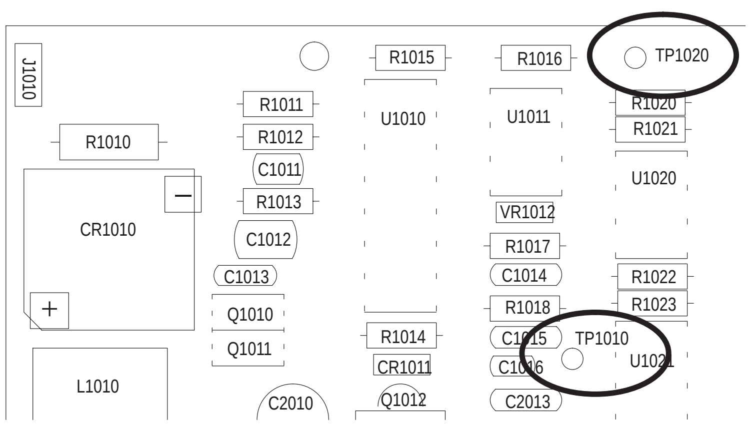


Figure 6–59: Power Supply Test Points TP1020 and TP1010

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).

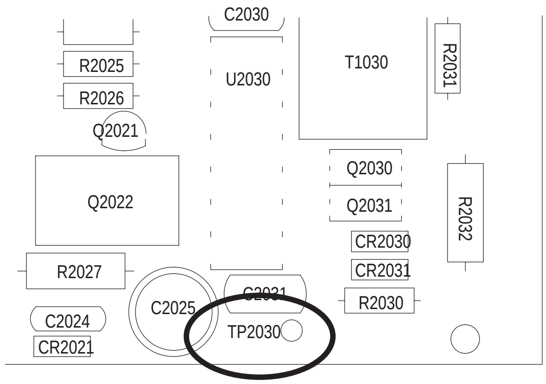


Figure 6–60: Power Supply Test Point TP2030

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.*

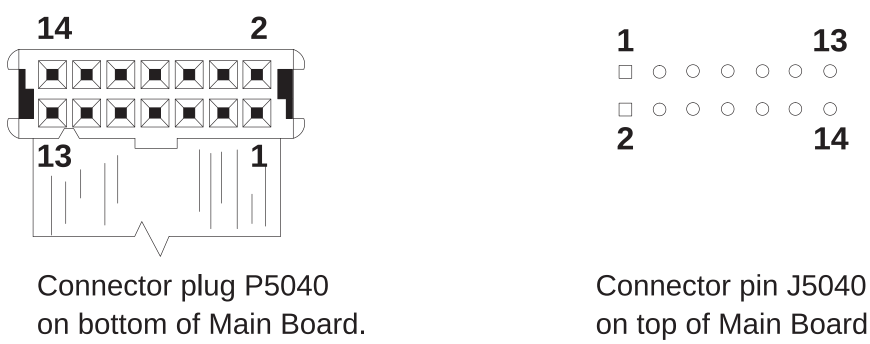


Figure 6–61: Connector Plug P5040 and Pins J5040 on Bottom of Main Board

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.

Range Check

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

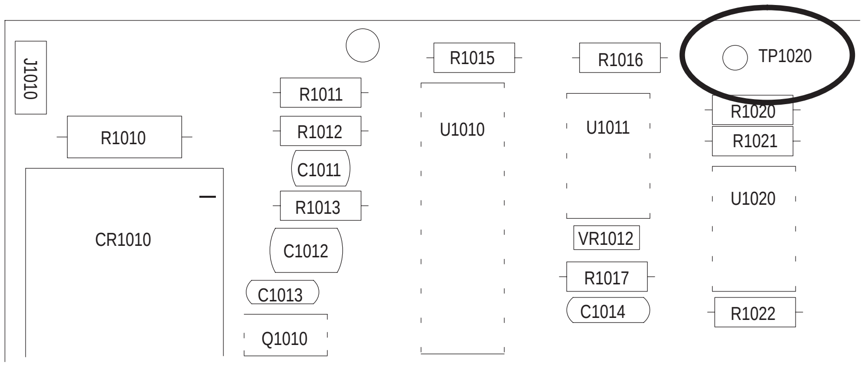


Figure 6–62: Power Supply Test Point TP1020

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)

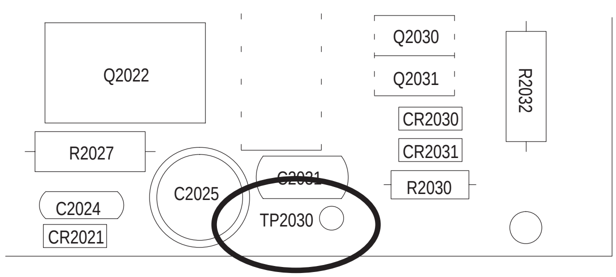


Figure 6–63: Power Supply Test Point TP2030

7. Reduce the Variac output voltage until the +16.2 VDC (and the instrument) shut down. This voltage must be lower than 90 VAC.
8. Raise the Variac output voltage to 120 VAC. The instrument should remain shut down.
9. Turn the 1503C POWER off.

Main Board ± 12 VDC Check and Adjust

+12 VDC

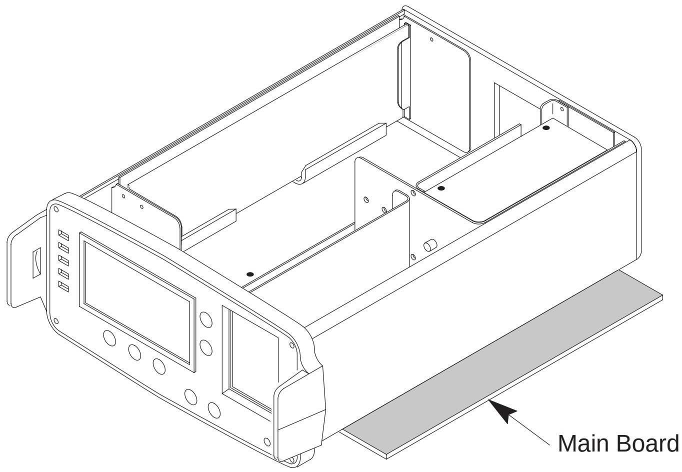


Figure 6–64: Location of Main Board in Instrument

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.

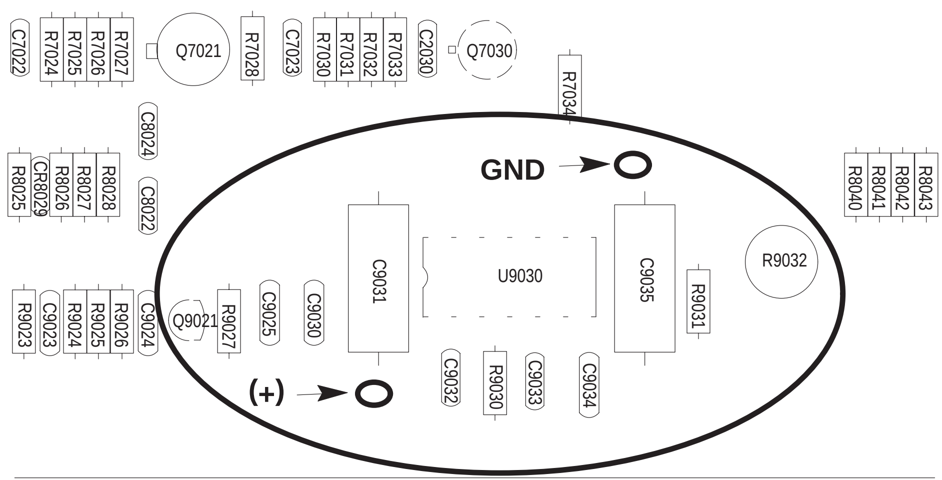


Figure 6–65: Main Board Probe Points

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.

–12 VDC

1. Move the positive (+) probe to the – 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:

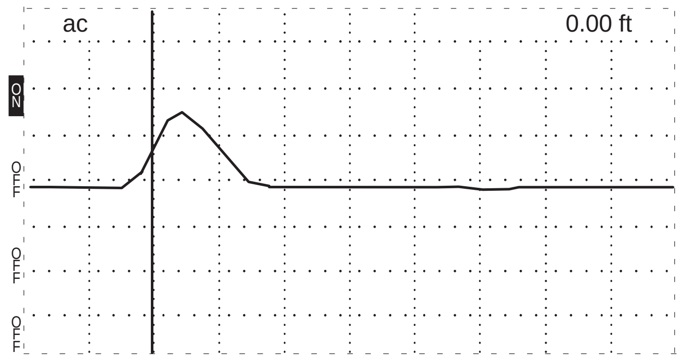


Figure 6–66: Waveform on Display

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 6–67, next page). 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.

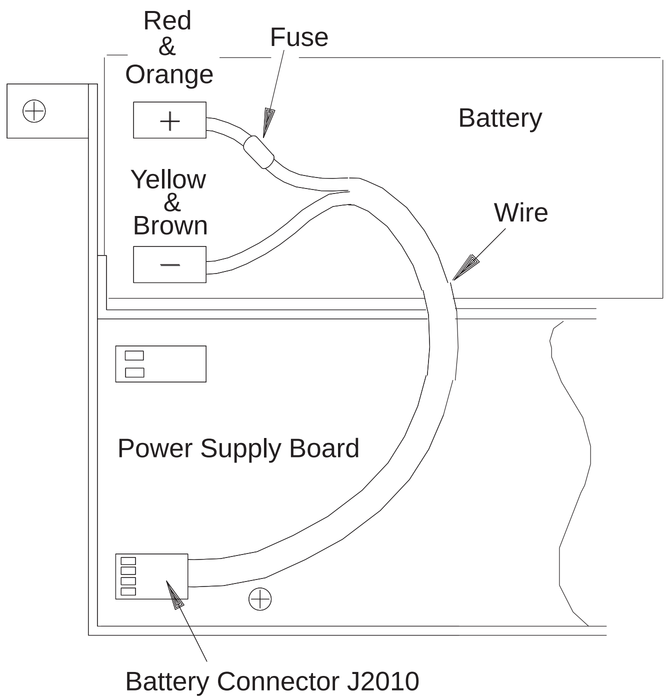


Figure 6–67: Battery Connections to Power Supply Board

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.

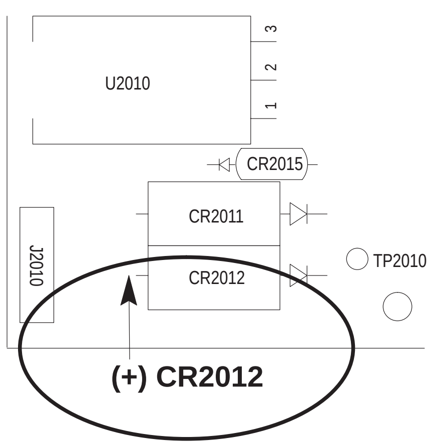


Figure 6–68: CR2012 on Power Supply Board

10. Turn the 1503C 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*.

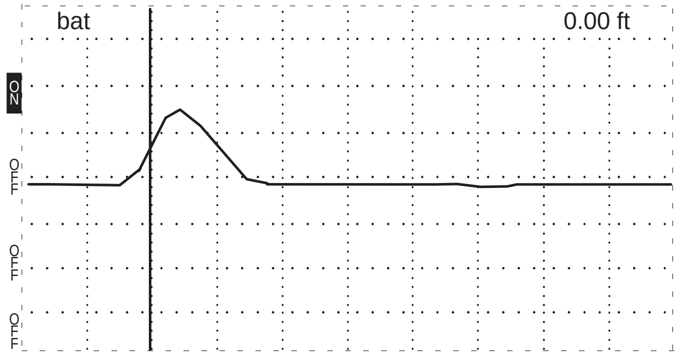


Figure 6–69: Display Showing Power is Battery

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

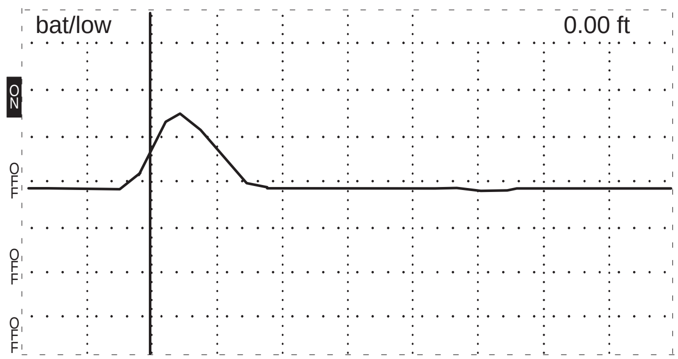


Figure 6–70: Display Showing Battery Voltage is Low

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

13. Remove the voltmeter probes from the 1503C.

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 4 Ω 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.

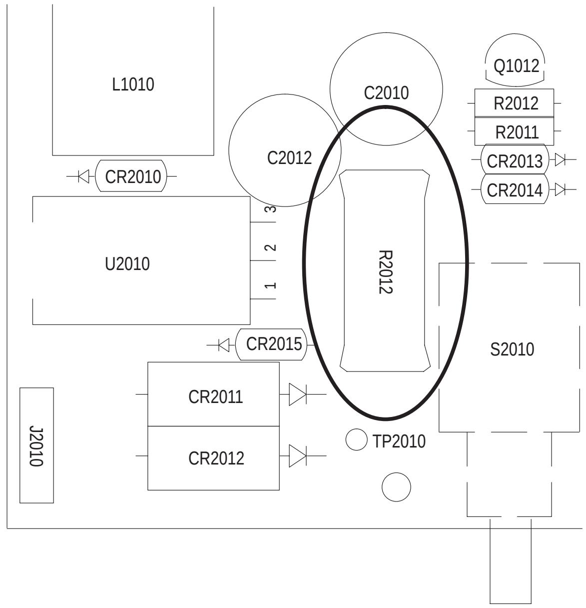


Figure 6–71: R2012 on Power Supply Board

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.*

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.

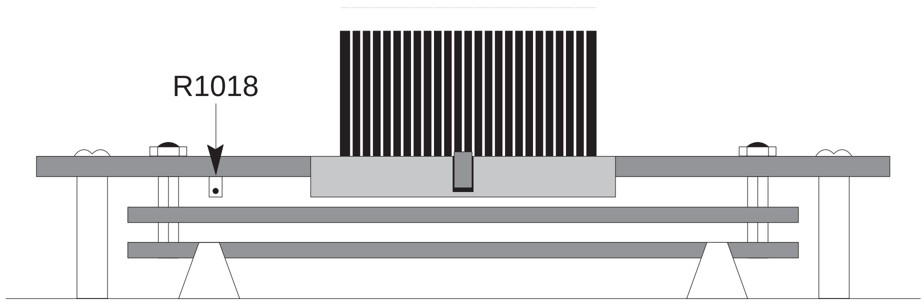


Figure 6–72: R1018 on Front Panel Board

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

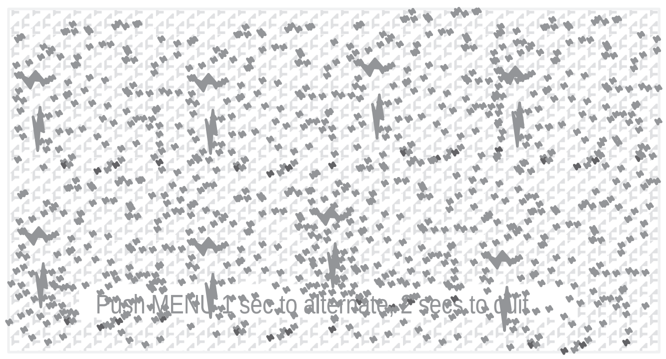


Figure 6–73: LCD Pattern with Contrast Too Light

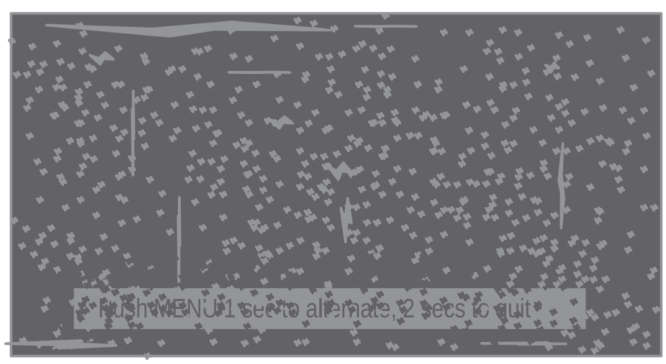


Figure 6–74: LCD Pattern with Contrast Too Dark

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

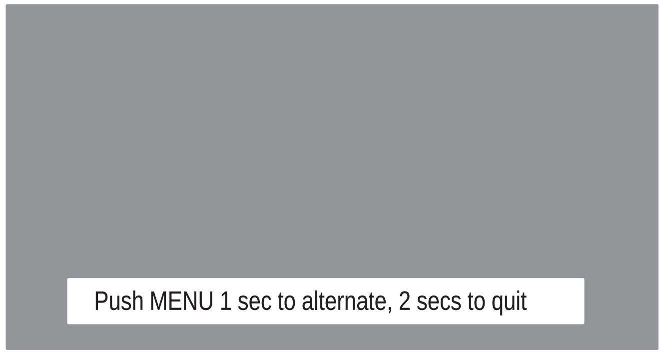


Figure 6–75: LCD Pattern Adjusted for Sharpness

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.

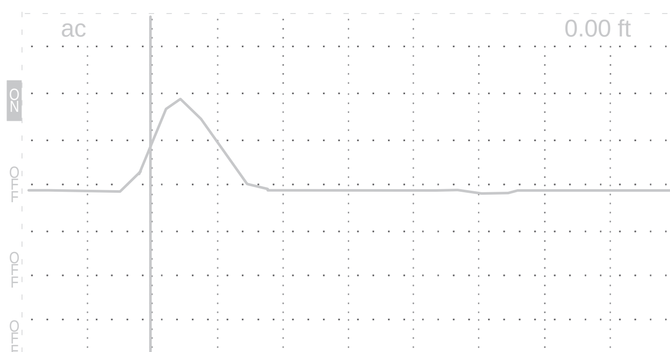


Figure 6–76: Waveform with Contrast Too Light

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.

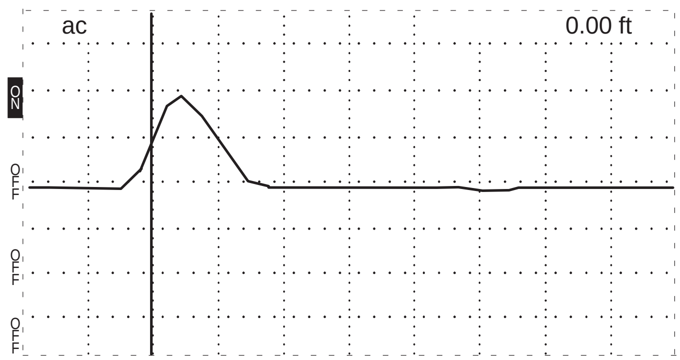


Figure 6–77: Waveform with Contrast Adjusted Correctly

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.*

Pulser/Sampler Voltage Check

No front panel adjustments are necessary for this check.

1. Remove the EMI shield covering the Pulser/Sampler Board.

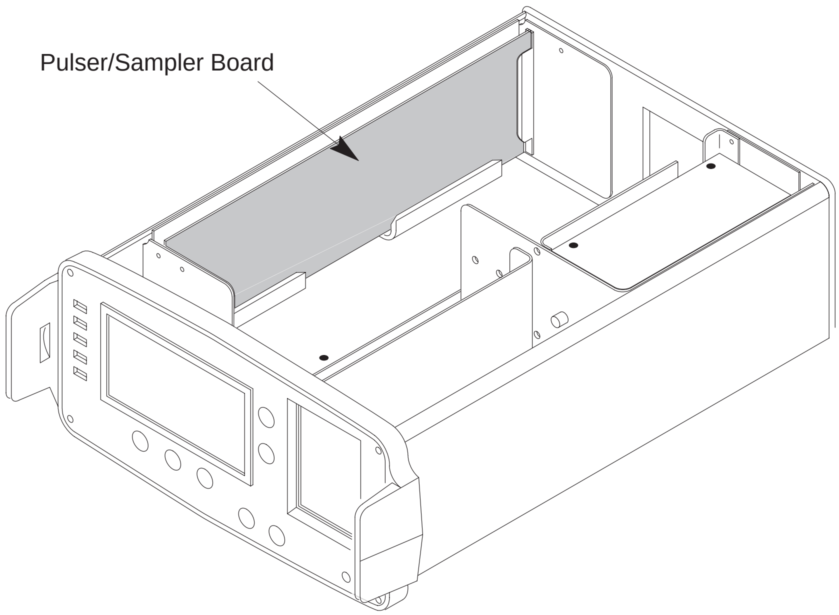


Figure 6–78: Location of Pulser/Sampler Board in Instrument

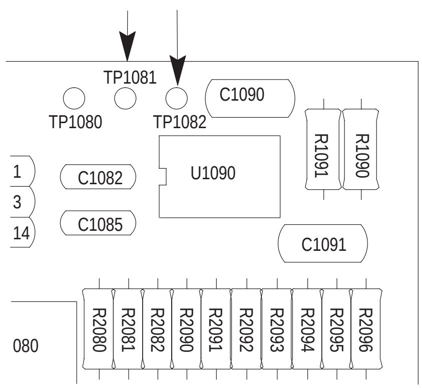


Figure 6–79: TP1081 and TP1082 on Pulser/Sampler Board

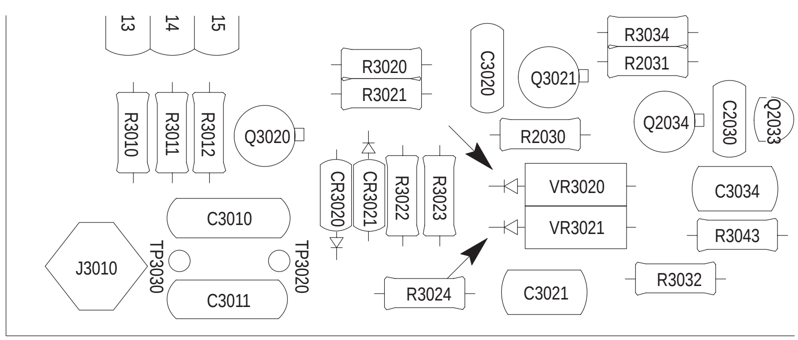


Figure 6–80: VR3020 and VR30212 on Pulser/Sampler Board

2. Using a voltmeter, verify the voltages at the test points listed in the following table:

Test Point	Voltage
TP1081	+12 VDC +0.3 VDC
TP1082	–12 VDC +0.3 VDC
Anode of VR3020	–4.9 VDC to –5.7 VDC
Cathode of VR3021	+4.9 VDC to +5.7 VDC

***NOTE**. If you intend to proceed to the* Sampling Efficiency Adjustment *from this point, leave the EMI shield off. If you are now finished, proceed to step 4 below.*

3. Replace the EMI shield. Be sure to dress the ribbon cable properly in the cutout provided in order to prevent it from being smashed when securing the shield.

Sampling Efficiency Adjustment

1. Set the front-panel controls:

CABLE	no connection
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
DIST/DIV	1 ft/div
PULSE WIDTH	2 ns
V_P	.99
POWER	On

2. Press MENU.

3. Scroll to *Diagnostics Menu*.

4. Press MENU.

5. Scroll to *Service Diagnostic Menu*.

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

Move ≑ Position to select, then push MENU button

Figure 6–81: Service Diagnostic Menu

6. Press MENU.
7. Scroll to *Sampling Efficiency Diagnostic*.
8. Press MENU.
9. Follow the directions on the display.

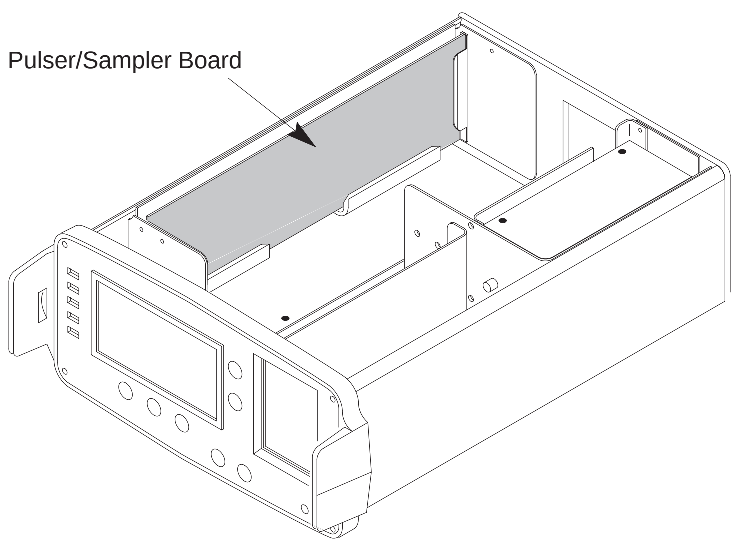


Figure 6–82: Location of Pulser/Sampler Board in Instrument

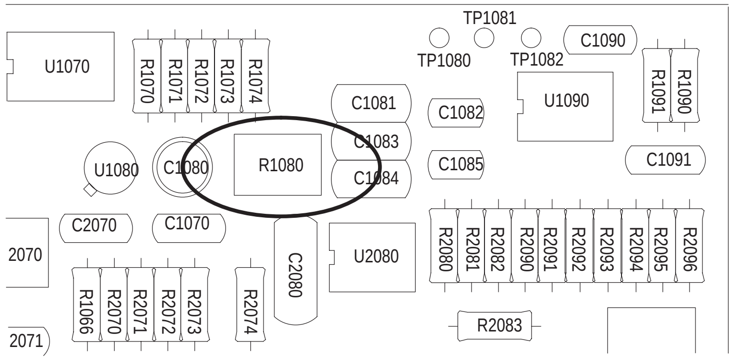


Figure 6–83: Location of R1080 on Pulser/Sampler Board

10. Adjust R1080 on the Pulser/Sampler Board for an efficiency reading of 80%.

Sampling Efficiency Diagnostic
Continuous Result Update

Acceptable Range	Result
70% – 90%	80%

– Push MENU button to Exit –

Figure 6–84: Service Diagnostic Efficiency Readout

11. If 80% is exceeded when making the adjustment, go back to the minimum reading and slowly move upward again.

12. Press MENU to return to normal operations.

NOTE*. If you intend to proceed to the* 1st Blow-by Compensation Adjustment *from this point, leave the EMI shield off. If you are now finished, proceed to step 13 below.*

13. Replace the EMI shield. Be sure to dress the ribbon cable properly in the cutout provided in order to prevent it from being smashed when securing the shield.

1st Blow-By Compensation Adjustment

1. Set the front-panel controls:

CABLE	no connection
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	35.00 dB
DIST/DIV	200 ft/div
PULSE WIDTH	1000 ns
V_P	.99
POWER	On

2. Adjust the ◁▷ POSITION control to center the trailing edge of the pulse on the display.

3. Use the △▽POSITION control to center the baseline of the waveform.

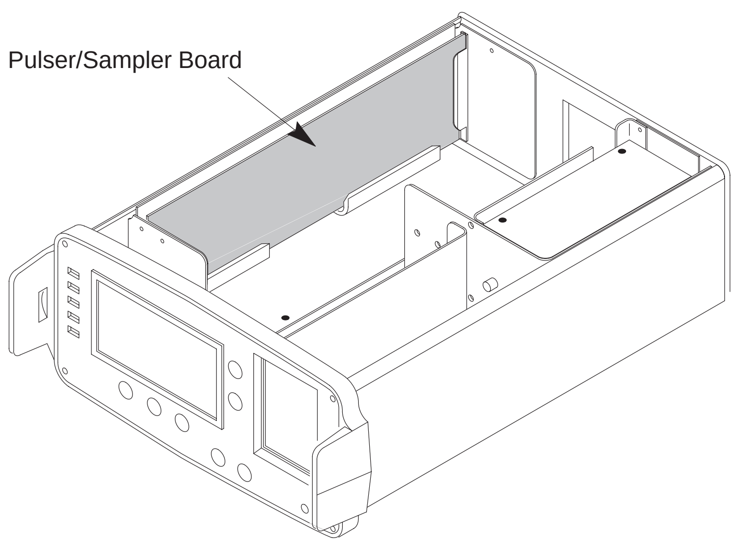


Figure 6–85: Location of Pulser/Sampler Board in Instrument

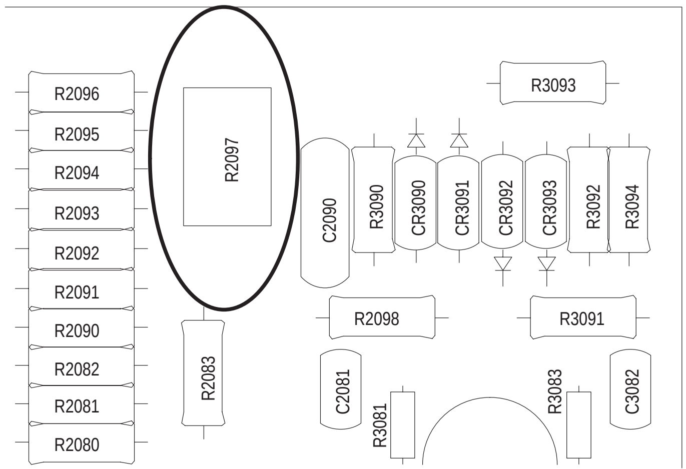


Figure 6–86: Location of R2097 on Pulser/Sampler Board

4. While observing the baseline near the trailing edge of the pulse, adjust R2097 (1st Blow-by Compensation) on the Pulser/Sampler Board until the line following the pulse is as flat as possible.

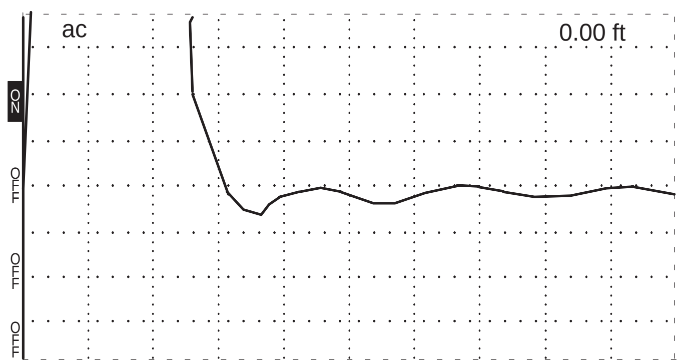


Figure 6–87: Over-Compensated

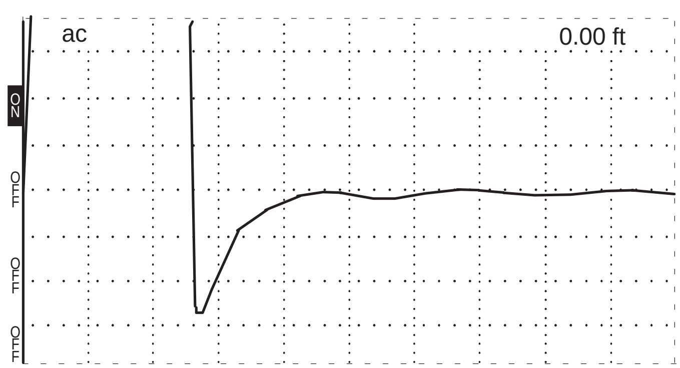


Figure 6–88: Under-Compensated

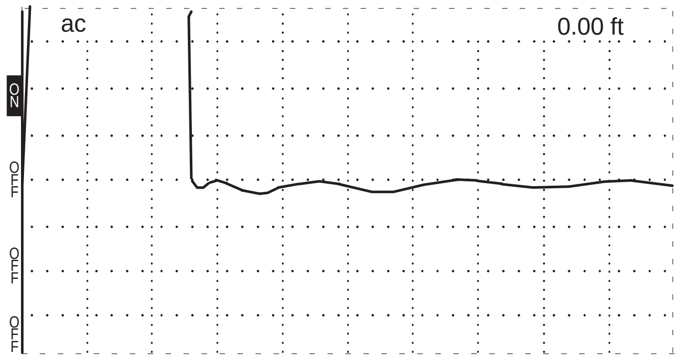


Figure 6–89: Correctly Compensated

***NOTE**. If you intend to proceed to the* Output Impedance Check *from this point, leave the EMI shield off. If you are now finished, proceed to step 5 below.*

---

5. Replace the EMI shield. Be sure to dress the ribbon cable properly in the cutout provided in order to prevent it from being smashed when securing the shield.

Output Impedance Check

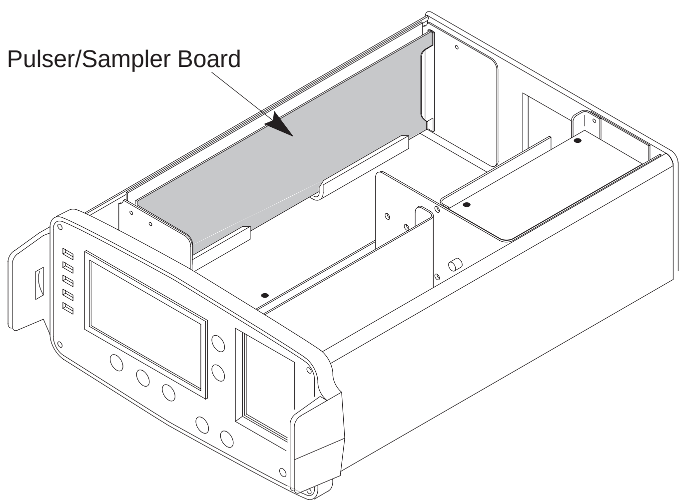


Figure 6–90: Location of Pulser/Sampler Board in Instrument

1. Set the front-panel controls:

CABLE	see below
IMPEDANCE	50 Ω
NOISE FILTER	1 avg
VERT SCALE	0.00 dB
DIST/DIV	1 ft/div
PULSE WIDTH	2 ns
V_P	.99
POWER	Off

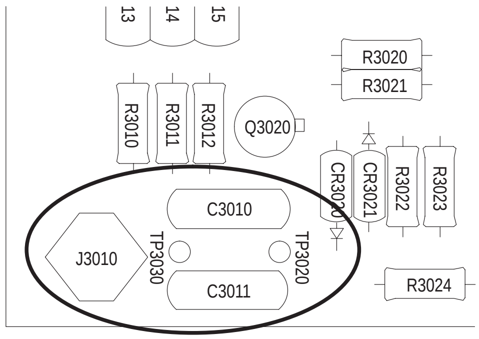


Figure 6–91: Location of C3010, TP3020, and TP3030 on Pulser/Sampler Board

2. If your instrument has a serial number of B035922 or lower, use a small jumper wire to short across C3010 on the Pulser/Sampler Board.

   If your instrument has a serial number of B035923 or higher, use a small jumper wire to short between TP3030 and TP3020 on the Pulser/Sampler Board.

3. Turn POWER on.

4. Push MENU.

5. Scroll to *Service Diagnostic Menu*.

6. Push MENU.

7. Scroll to *Impedance Diagnostic*.

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

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

Figure 6–92: Main Menu

8. Push MENU.

9. Follow the instructions on the display.

10. Note the results of the *Impedance Diagnostic* test and compare them with the table below.

Range	Specification
50 Ω	49.50 Ω to 50.50 Ω
75 Ω	74.25 Ω to 75.75 Ω
93 Ω	92.07 Ω to 93.93 Ω
125 Ω	123.75 Ω to 126.25 Ω

11. Remove the jumper.

12. Press MENU to return to normal operations.

13. Replace the EMI shield covering the Pulser/Sampler board. Be sure to dress the ribbon cable properly in the cutout provided in order to prevent it from being smashed when securing the shield.

Option 06: Ethernet® Adapter Adjustments

If your instrument does not have Option 06, proceed to *After Adjustments are Completed*. This procedure is to adjust the Option 06 board after it has been serviced or repaired.

1. Make sure the 1503C power is off.

2. Because this adjustment requires a critical resistance measurement, note the resistance of the leads used with your DMM.

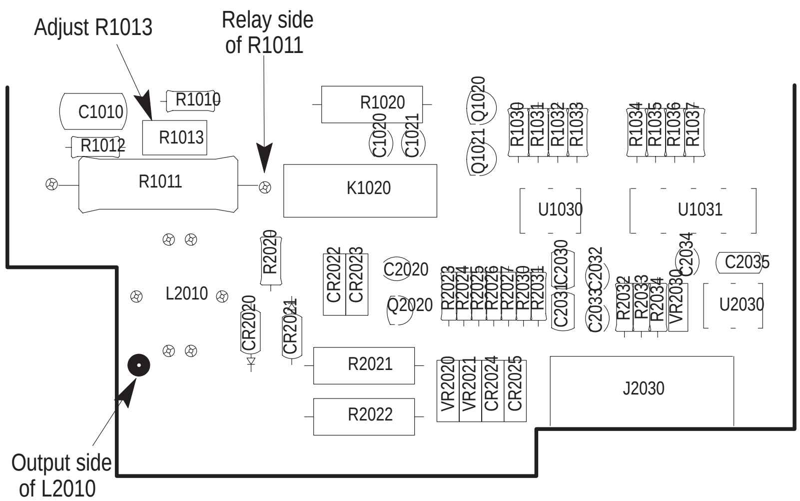


Figure 6–93: L2010, R1011, and R1013 on Option 06 Board

3. Connect one lead of the DMM to the output side of L2010 (the jumper wire between the Option 06 Board and the Pulser/Sampler Board).

4. Connect the other DMM lead to the relay side of R1011.

5. Adjust R1013 for a resistance measurement between 49.9 Ω and 50.1 Ω. Do not forget to take into account the DMM lead resistance.

6. Double check your measurement, then seal R1013 with a small amount of Humiseal (Tek part 006–1744–xx) or trim-pot glue.

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 1503C 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.

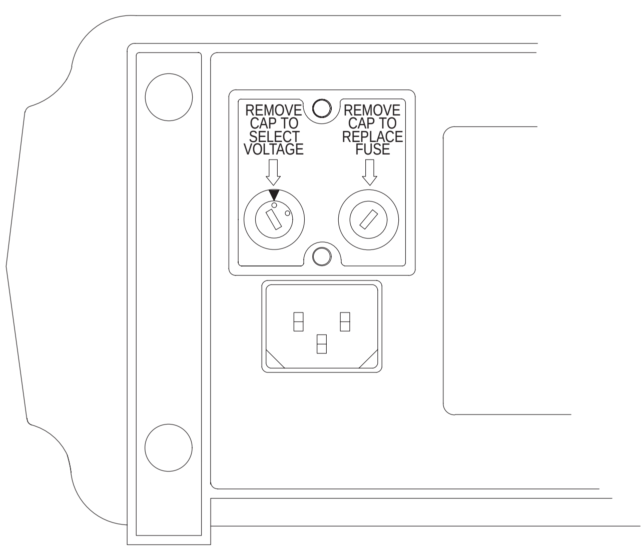


Figure 7–1: Location of Voltage Selector and Fuse Holder on Rear Panel

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, callout 5, next page).
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).*

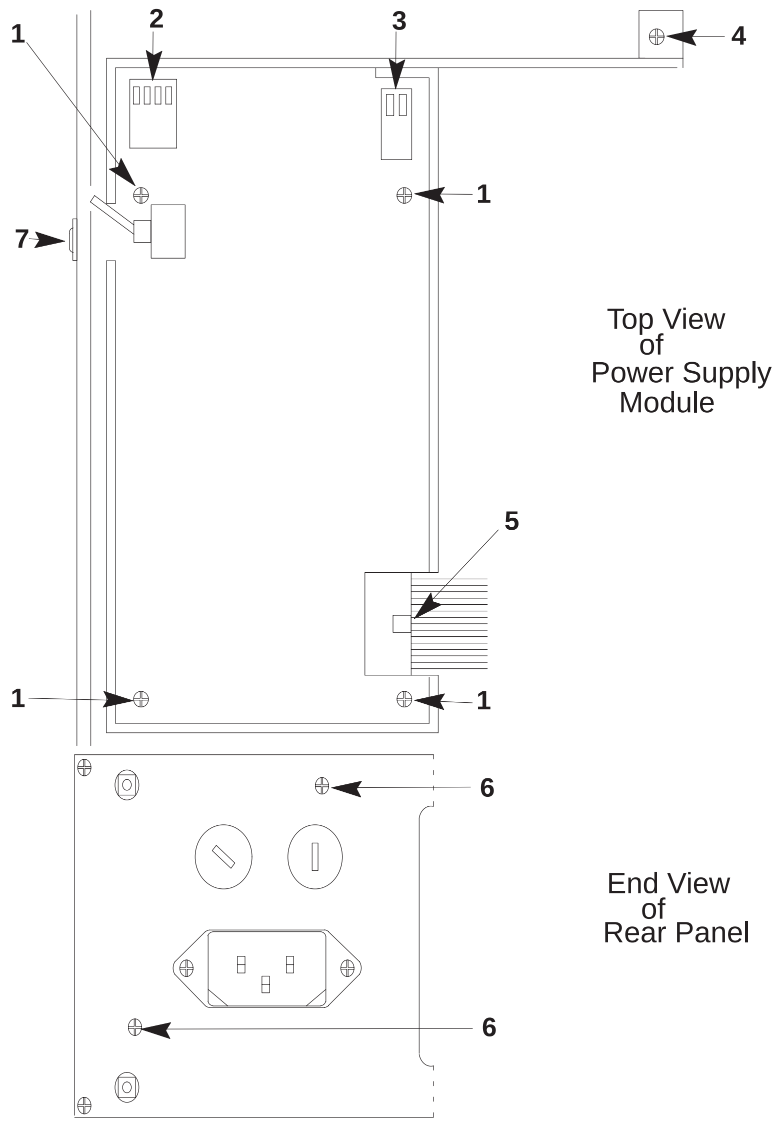


Figure 7–2: Power Supply Module and P/O Rear Panel

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, previous page).
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, next page) holds a ground strap connector.*

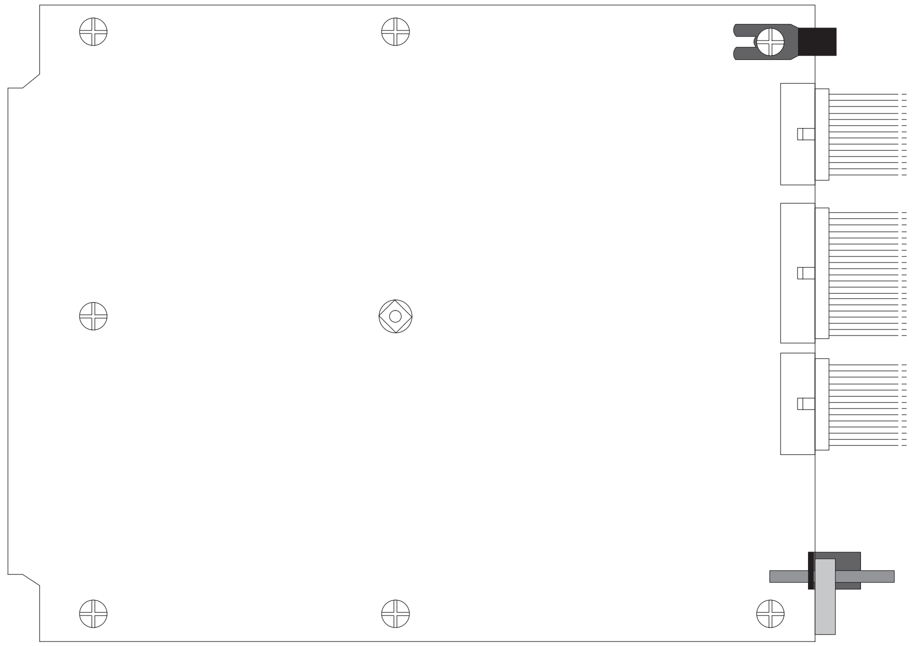


Figure 7–3: Main Board

EPROM Replacement

1. Use an IC puller that is designed to extract multi-pin microcircuits to remove the EPROM from its socket.

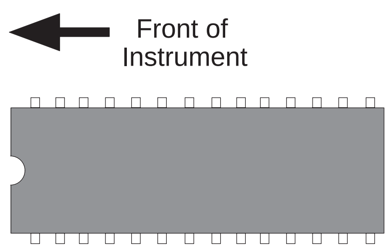


Figure 7–4: EPROM on Main Board

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.

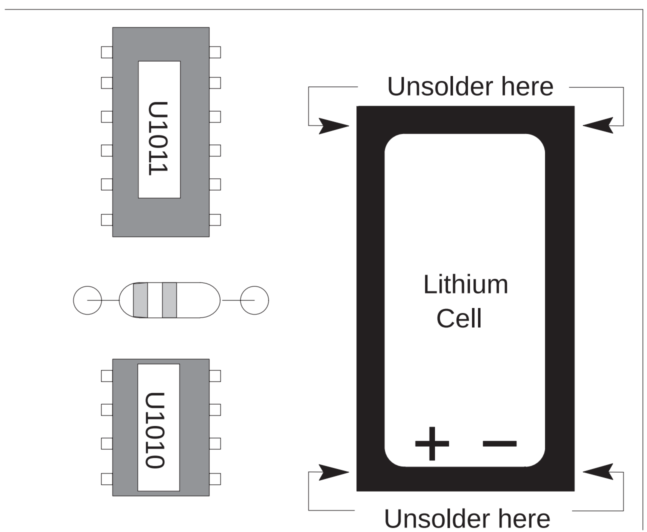


Figure 7–5: Lithium Battery on Main Board

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 Pulser/Sampler Board

***NOTE**. If the instrument is equipped with Option 06, Ethernet Adapter Board, follow the instructions under* Option 06 *in this chapter. There is an illustration in the* Replaceable Mechanical Parts *chapter showing the Option 06 and Pulser/Sampler Boards.*

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.

Option 06 (Ethernet®)

Option 06 is a piggyback board mounted on the Pulser/Sampler Board. The following instructions describe the removal of the two boards as they are installed in the instrument. If you have purchased an Option 06 kit to be installed in an existing non-Option 06 1503C instrument, the instructions for installation are provided in that kit. There is an illustration in the *Replaceable Mechanical Parts* chapter showing the Option 06 and Pulser/Sampler Boards.

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 ground strap and SMC connector from the Pulser/Sampler Board.
4. Disconnect the ribbon cable from both boards.
5. Remove the circuit boards from the instrument by sliding them out of the card guides.
6. Unsolder the jumper wire between the Option 06 and the Pulser/Sampler Boards.
7. Remove the standoff between the Option 06 and the Pulser/Sampler Boards.

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 Pulser/Sampler Board EMI shield.
4. Remove the coaxial cable from the Pulser/Sampler Board.
5. Remove the four corner screws on the instrument front panel.
6. Carefully guide the coaxial cable through the Pulser/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.*

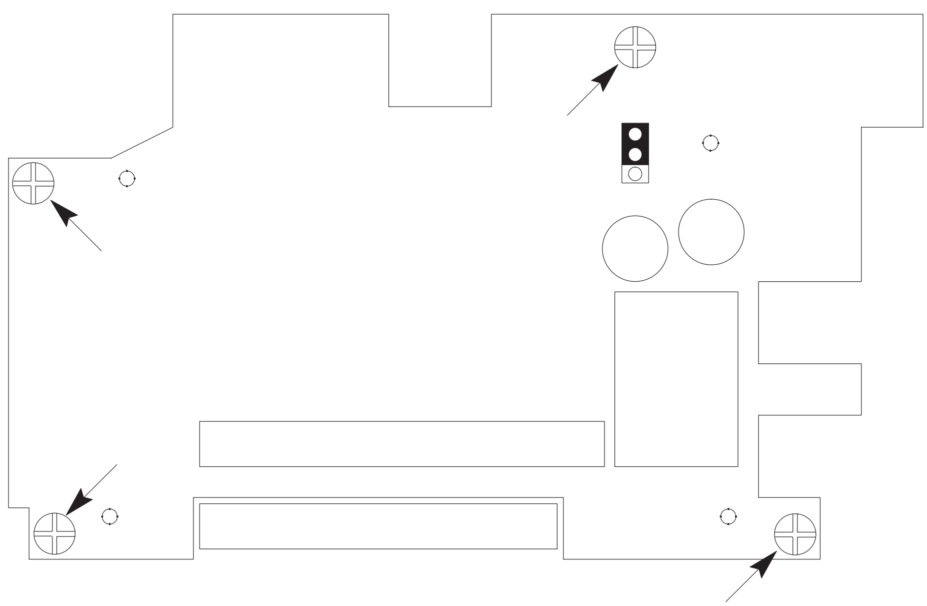


Figure 7–6: Display Module/Front Panel Board Screw Locations

***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, previous page).

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.

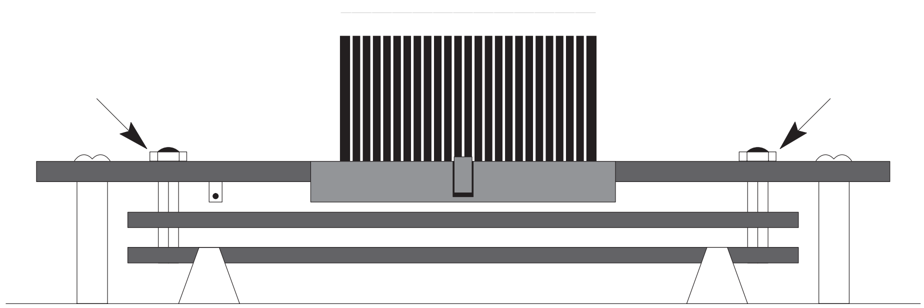


Figure 7–7: Display Module/Front Panel Board Showing Hex Nuts

***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.

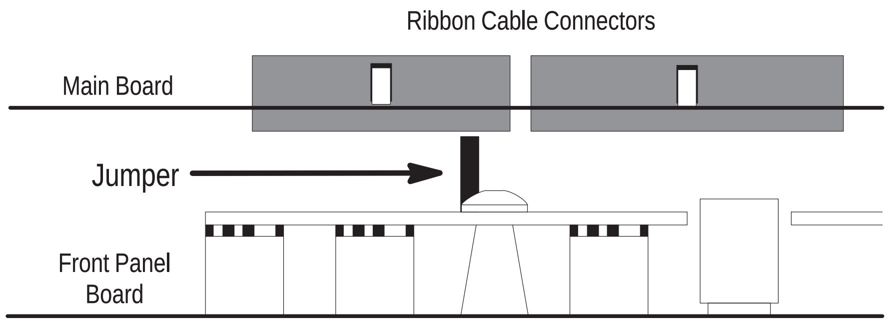


Figure 7–8: Location of Default Jumper on Front Panel Board

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.

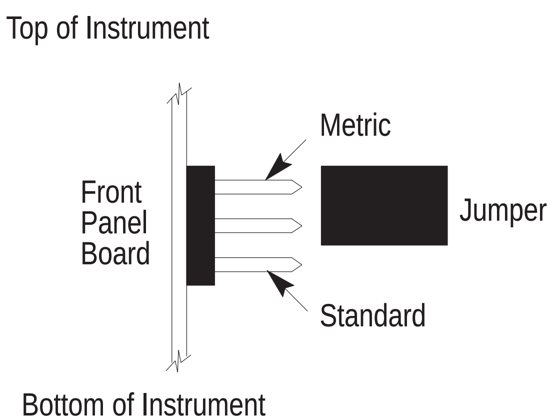


Figure 7–9: Default Jumper Positions

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

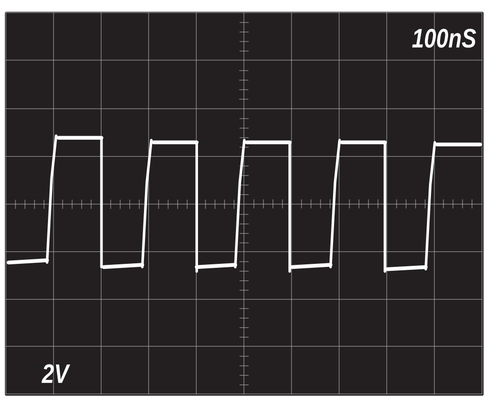
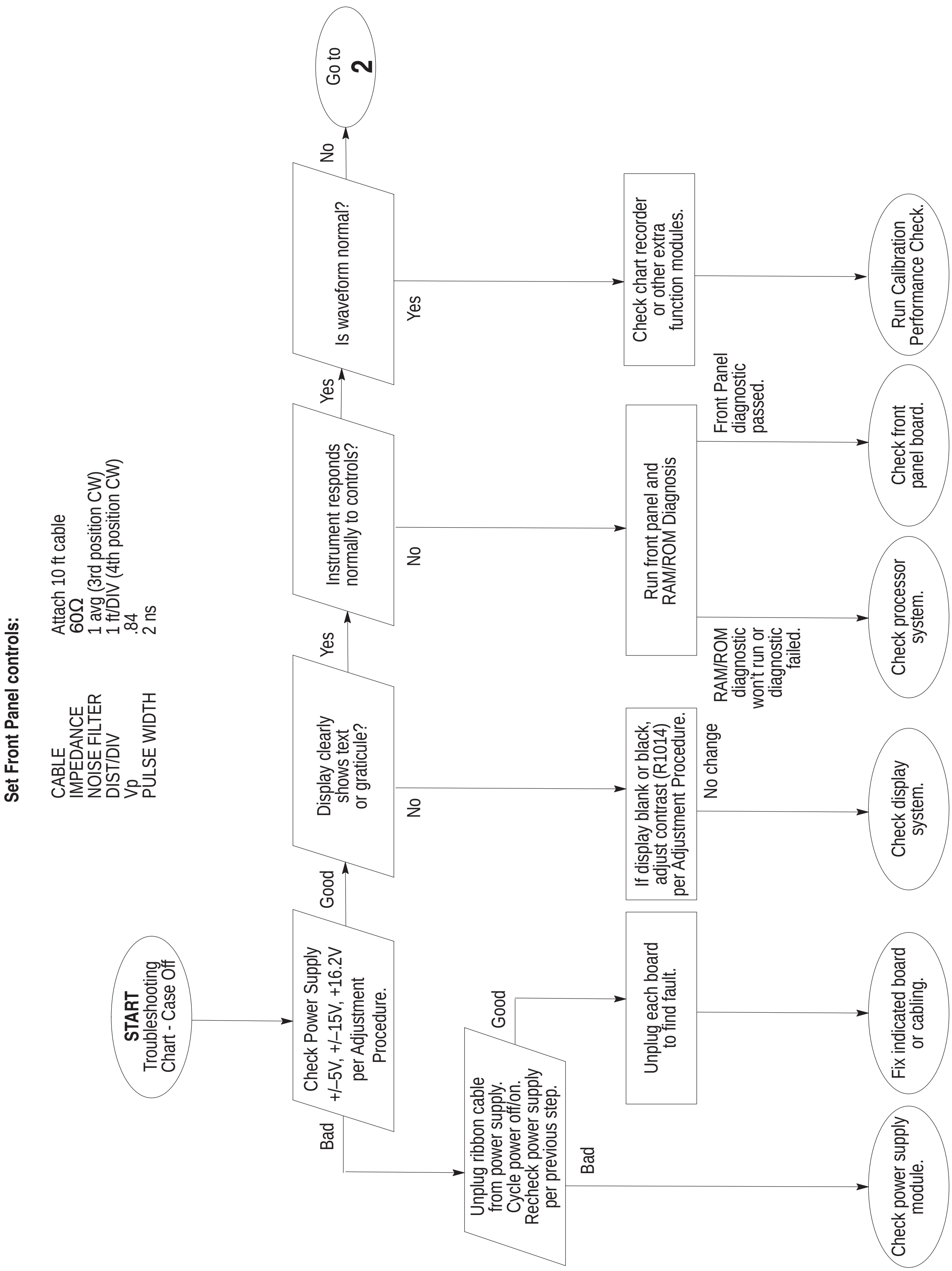
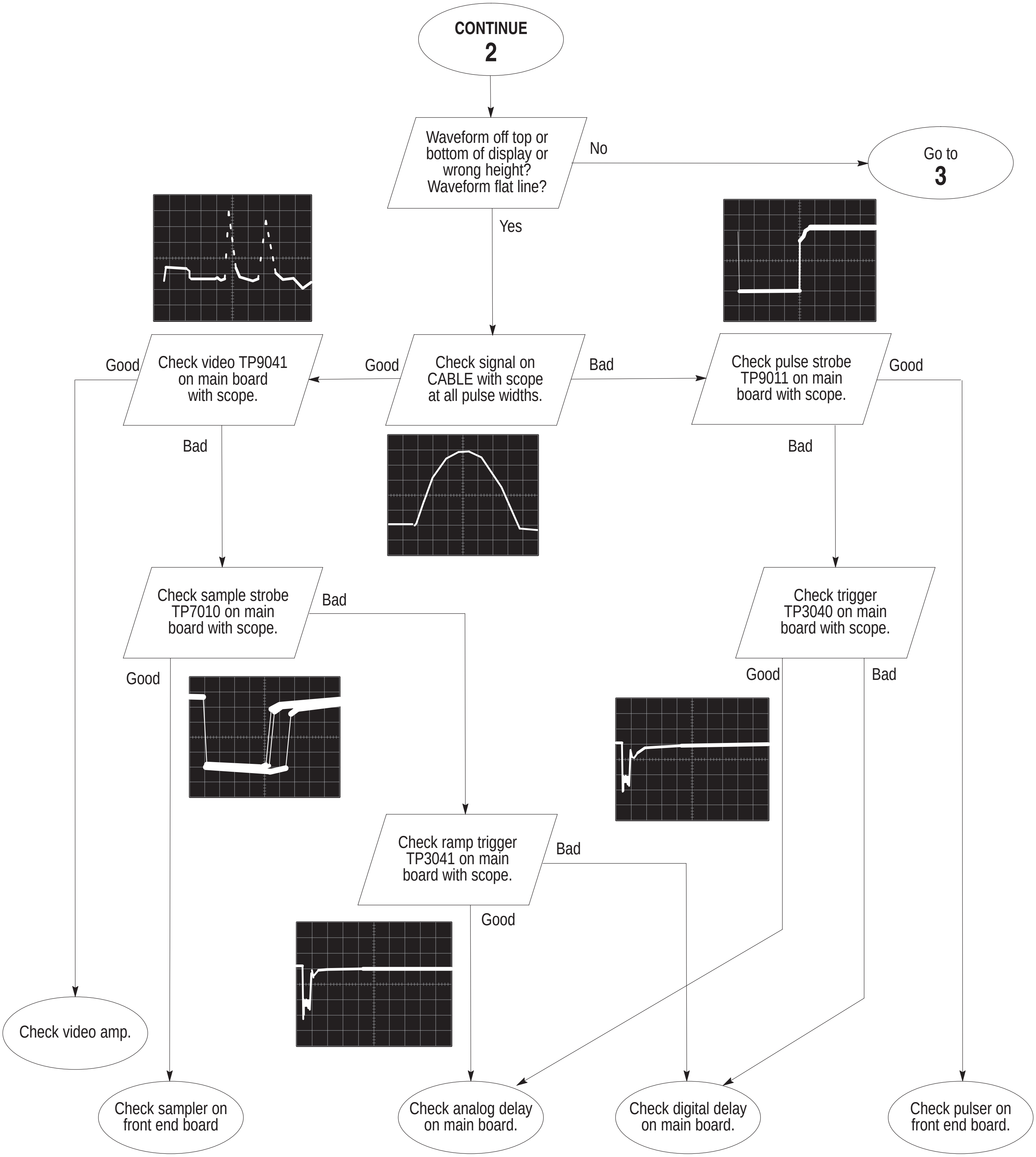
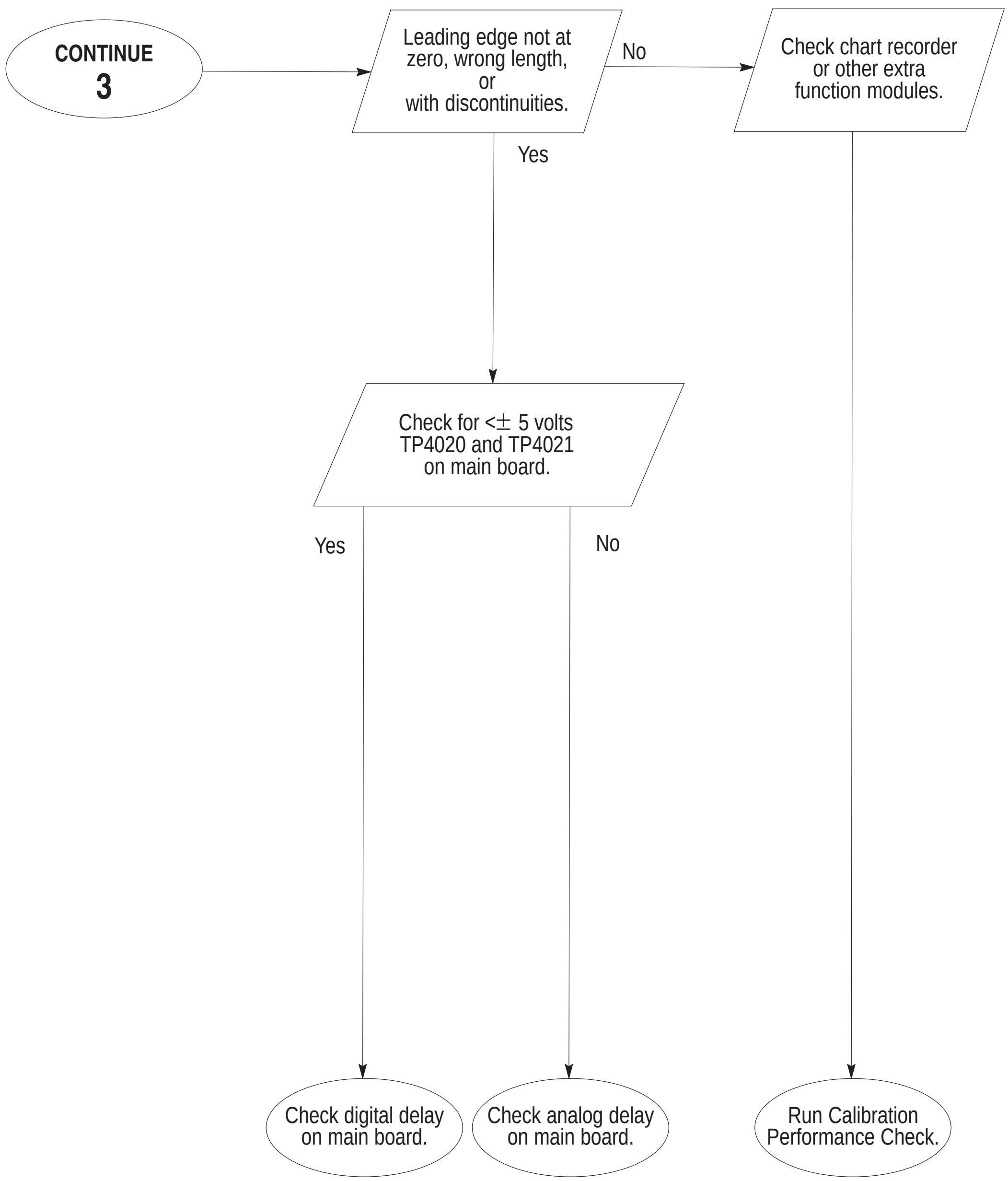


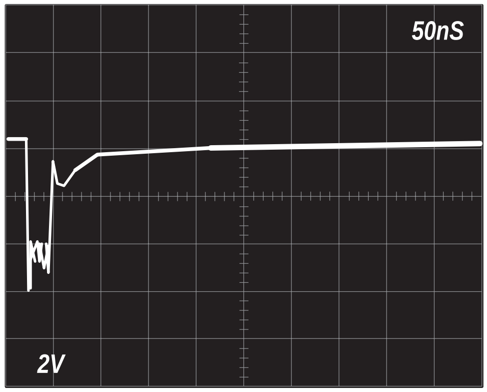
Figure 7–10: Main Board TP1041

(waveforms continued on page 7–17)


Set Front Panel controls:
CABLE Attach 10 ft cable
IMPEDANCE 60Ω
NOISE FILTER 1 avg (3rd position CW)
DIST/DIV 1 ft/DIV (4th position CW)
Vp .84
PULSE WIDTH 2 ns
START
Troubleshooting Chart - Case Off
Check Power Supply +/–5V, +/–15V, +16.2V per Adjustment Procedure.
Bad
Good
Unplug ribbon cable from power supply. Cycle power off/on. Recheck power supply per previous step.
Good
Bad
Unplug each board to find fault.
Check power supply module.
Fix indicated board or cabling.
Display clearly shows text or graticule?
No
Yes
If display blank or black, adjust contrast (R1014) per Adjustment Procedure.
No change
Check display system.
Instrument responds normally to controls?
No
Yes
Run front panel and RAM/ROM Diagnosis
RAM/ROM diagnostic won't run or diagnostic failed.
Front Panel diagnostic passed.
Check processor system.
Check front panel board.
Is waveform normal?
No
Yes
Go to 2
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
Good
Check video TP9041 on main board with scope.
Good
Check signal on CABLE with scope at all pulse widths.
Bad
Check pulse strobe TP9011 on main board with scope.
Good
Bad
Bad
Check sample strobe TP7010 on main board with scope.
Bad
Check trigger TP3040 on main board with scope.
Good
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 <± 5 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.



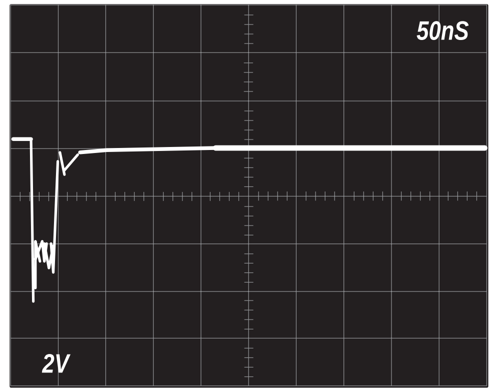
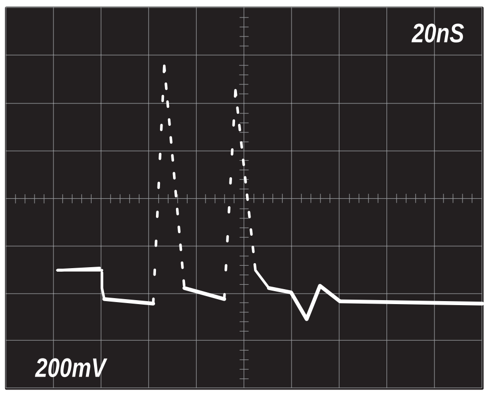


Figure 7–11: Main Board TP3040 **Main Board TP3041**



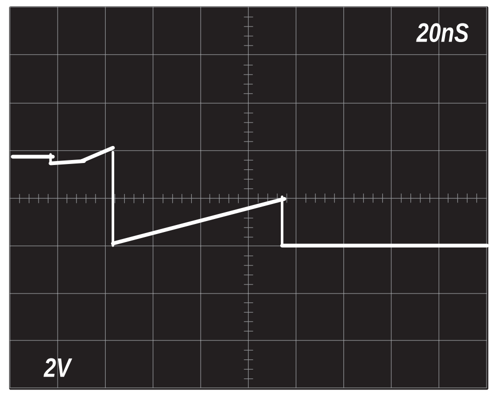
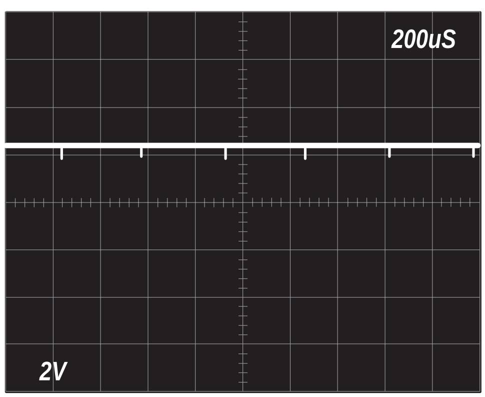


Figure 7–12: Main Board TP4040 **Main Board TP6010**



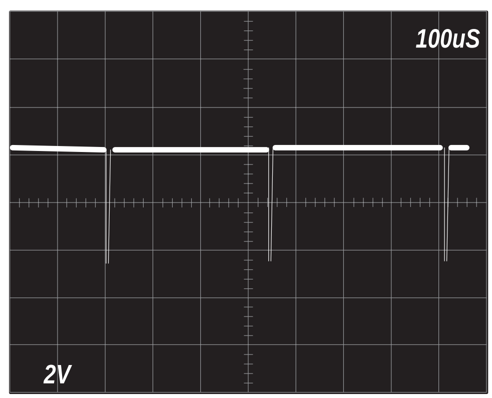


Figure 7–13: Main Board TP7010 **Main Board TP9011**

(waveforms continued next page)

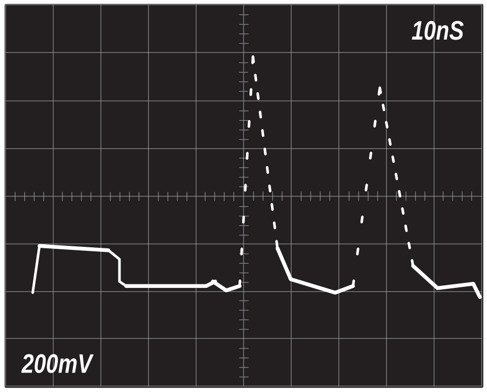
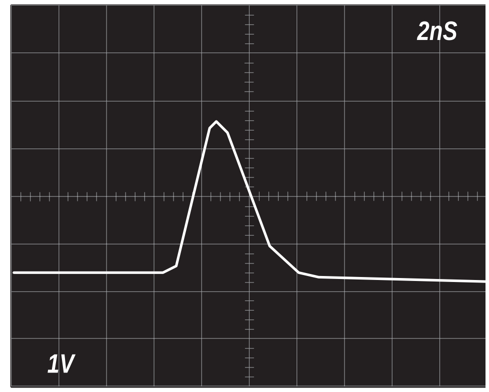


Figure 7–14: Main Board TP9041



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 xvi.

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.

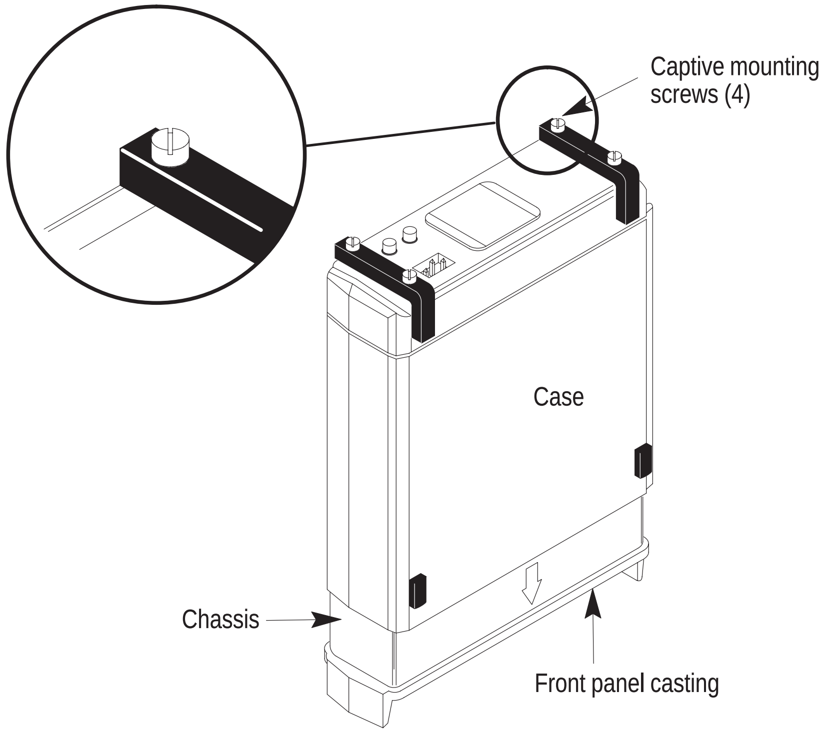


Figure 7–15: Installing the Case Cover Over the Chassis

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 assembly 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
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
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
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
24165	SPRAGUE ELECTRIC CO	267 LOWELL ROAD	HUDSON NH 03051
24355	ANALOG DEVICES INC	1 TECHNOLOGY DR	NORWOOD MA 02062

Manufacturers Cross Index (Cont.)

Mfr. Code	Manufacturer	Address	City, State, Zip Code
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
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	672–1388–00				CKT BD ASSY:MAIN W/EPROM	80009	672–1388–00
A1	672–1390–00				CKT BD ASSY:MAIN W/EPROM (ETHERNET OPTION 06 ONLY)	80009	672–1390–00
A1A1	670–9285–04	B020000	B023542		CKT BD ASSY:MAIN W/O EPROM	80009	670–9285–04
	670–9285–05	B023543			CKT BD ASSY:MAIN W/O EPROM	80009	670–9285–05
A2	672–1389–00				CKT BD ASSY:FRONT PANEL	80009	672–1389–00
A3A1	670–9286–04	B020000	B023542		CKT BD ASSY:POWER SUPPLY	80009	670–9286–04
	670–9286–05	B023543			CKT BD ASSY:POWER SUPPLY	80009	670–9286–05
A4	670—9290–03	B020000	B023542		CKT BD ASSY:L/R PULSER SAMPLER	80009	670–9290–03
	670—9290–04	B023543	B024251		CKT BD ASSY:L/R PULSER SAMPLER	80009	670–9290–04
	670—9290–05	B024252	B024700		CKT BD ASSY:L/R PULSER SAMPLER	80009	670–9290–05
	670—9290–06	B024701	B025257		CKT BD ASSY:L/R PULSER SAMPLER	80009	670–9290–06
	670—9290–07	B025258	B025371		CKT BD ASSY:L/R PULSER SAMPLER	80009	670–9290–07
	670—9290–08	B025372			CKT BD ASSY:L/R PULSER SAMPLER	80009	670–9290–08
A5	672–1241–00	B020000	B023853		CKT BD ASSY:DISPLAY MODULE	80009	672–1241–00
	118–9050–01	B023854			CKT BD ASSY:DISPLAY MODULE	80009	118–9050–01
A6	671–0443–00	B010100	B023647		CKT BD ASSY:ETHERNET	80009	671–0443–00
	671–0443–01	B023648			CKT BD ASSY:ETHERNET	80009	671–0443–01
––––– –––––					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	**672–1388–XX**				**CKT BD ASSY:MAIN BOARD W/EPROM & BATTERY (STANDARD INSTRUMENT)**		
A1U2020	160–9008–00				IC,DGTL:EPROM,PRGM	80009	160–9008–00
A1BT1010	146–0049–00				BATTERY,STORAGE:3.5V,750MAH SFTY CONT	81855	LTC–7P
A1	**672–1390–XX**				**CKT BD ASSY:MAIN BOARD E/EPROM & BATTERY (ETHERNET OPTION 06 ONLY)**		
A1U2020	160–4411–06				IC,DGTL:EPROM,PRGM	80009	160–4411–06
A1BT1010	146–0049–00				BATTERY,STORAGE:3.5V,750MAH SFTY CONT	81855	LTC–7P
A1A1	**670–9285–XX**				**CKT 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	1W344	KMC25T101M8X11LL
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	0J9R5	CEUST1E100
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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
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 DIP	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
A1A1C4041	290–0748–00				CAP,FXD,ELCTLT:10UF,+50–20%,25W VDC	0J9R5	CEUST1E100

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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	0J9R5	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
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,0.04UF,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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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	0J9R5	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	0J9R5	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
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	03508	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	03508	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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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	B020000	B026005		XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
	151–0711–00	B026006			XSTR,SIG:BIPOLAR,NPN,25V,50MA,650MHZ,TO–92	04713	MPSH10
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	B020000	B026005		XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
	151–0711–00	B026006			XSTR,SIG:BIPOLAR,NPN,25V,50MA,650MHZ,TO–92	04713	MPSH10
A1A1Q5031	151–1012–00				XSTR,SIG:JFET,N–CH,6V,15MA,4.5MS,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	B020000	B026005		XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
	151–0711–00	B026006			XSTR,SIG:BIPOLAR,NPN,25V,50MA,650MHZ,TO–92	04713	MPSH10
A1A1Q7021	151–0139–00				XSTR,SIG:BIPOLAR,NPN;15V,50MA,600MHZ,AMP	04713	MD918
A1A1Q7030	151–0441–00	B020000	B026005		XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
	151–0711–00	B026006			XSTR,SIG:BIPOLAR,NPN,25V,50MA,650MHZ,TO–92	04713	MPSH10
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
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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
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	03888	PME5540 OHM 0.25
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
A1A1R9012	322–3143–00				RES,FXD,FILM:301 OHM,1%,0.2W	57668	CRB20 FXE 301E

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP1041	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP2040	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP3040	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP3041	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP4020	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP4021	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP4040	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP6010	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP7010	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP9010	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP9011	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP9040	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A1A1TP9041	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
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	156–3059–00				IC,DIGITAL:HCMOS,GATES;8–INPUT NAND	27014	MM74HC30N
A1A1U1031	156–2392–00				IC,DIGITAL:HCMOS,GATE;HEX INV, SCHMITT TRIG	04713	MC74HC14N

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
A2	**672–1389–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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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	1W344	KME35VB471M10X20LL
A2C3031	290–0919–00				CAP,FXD,ELCTLT:470UF,+50–20%,35V AL	1W344	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
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	5768	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	5768	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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
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
A2S3011	260–2286–01				SWITCH,ROTARY:IMPEDENCE STOP	04426	47–012–0012
A2S3012	260–2269–01				SWITCH,ROTARY:NOISE PC MOUNT	04426	47–012–0014
A2S3020	260–2368–01				SWITCH,ROTARY:HORIZONTAL SCALE	80009	260–2368–01
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
A2S3023	260–2369–01				SWITCH,ROTARY:PULSE WIDTH	80009	260–2369–01
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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
A3A1	**670–9286–XX**				**CIRCUIT BD ASSY:POWER SUPPLY**		
					POWER SUPPLY ASSEMBLY – CHASSIS MNT ELEC PARTS – SEE FIG. 10–4 RMPL		
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	1W344	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	1W344	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	1W344	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
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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A3A1C2024	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V	31433	C114C224M5Y5CA
A3A1C2025	290–0846–00				CAP,FXD,ELCTLT:47UF,+75–20%,35V AL	0J9R5	CEUSM1J470
A3A1C2030	281–0925–01				CAP,FXD,CER DI:MLC,0.22UF,20%,50V	31433	C114C224M5Y5CA
A3A1C2031	283–0059–02				CAP,FXD,CER DI:1UF,20%,50V	04222	SR305C105MAATRSTDII
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
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
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	03508	X39H3162

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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
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
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

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
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	80009	260–2370–00
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	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A3A1TP1020	214–0579–02	B020000	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A3A1TP2010	214–0579–02	B020000	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A3A1TP2030	214–0579–02	B020000	B023052		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
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
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	**670–9290–XX**				**CKT BD ASSY:L/R PULSER SAMPLER**		
A4C1040	283–0845–00				CAP,FXD,MICA:3600PF,500V	00853	D195E362GO
A4C1060	290–0523–00	B010100	B020257		CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
	290–0536–00	B020258			CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	24165	199D106X0025CA1
A4C1061	290–0523–00	B010100	B020257		CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
	290–0536–00	B020258			CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	24165	199D106X0025CA1
A4C1062	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C1063	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4C1064	285–0627–00				CAP,FXD,PLASTIC:0.0033UF,5%,100V MI	01002	61F10AC332
A4C1065	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A4C1066	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A4C1070	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C1080	290–0782–00				CAP,FXD,ELCTLT:4.7UF,+75–20%,35VDC AL	55680	UVX1V4R7MAA
A4C1081	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C1082	283–0330–00				CAP,FXD,CER DI:100PF,5%,50V SQ	16546	CN15C101J
A4C1083	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C1084	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C1085	283–0154–00				CAP,FXD,CER DI:22PF,5%,50V SQ	04222	SR155A220JAA
A4C1090	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C1091	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C2013	283–0203–00				CAP,FXD,CER DI:0.47UF,20%,50V SQ	04222	SR305SC474MAA
A4C2014	283–0203–00				CAP,FXD,CER DI:0.47UF,20%,50V SQ	04222	SR305SC474MAA
A4C2015	283–0203–00				CAP,FXD,CER DI:0.47UF,20%,50V SQ	04222	SR305SC474MAA
A4C2020	290–0536–00				CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	24165	199D106X0025CA1
A4C2021	283–0203–00				CAP,FXD,CER DI:0.47UF,20%,50V SQ	04222	SR305SC474MAA
A4C2022	283–0203–00				CAP,FXD,CER DI:0.47UF,20%,50V SQ	04222	SR305SC474MAA
A4C2023	283–0203–00				CAP,FXD,CER DI:0.47UF,20%,50V SQ	04222	SR305SC474MAA
A4C2030	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C2040	283–0175–00				CAP,FXD,CER DI:10PF,5%,200V SQ	04222	ADVISE
A4C2041	283–0670–00				CAP,FXD,MICA DI:375PF,1%,500V	00853	D155F3750F0
A4C2042	283–0743–00				CAP,FXD,MICA DI:43PF,2%,500V	00853	D105E430G0
A4C2043	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C2050	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C2051	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
A4C2060	281–0851–00				CAP,FXD,CER DI:180PF,5%,100VDC TUBULAR	04222	SA101A181JAA
A4C2070	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C2071	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C2072	290–0536–00				CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	24165	199D106X0025CA1
A4C2073	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C2080	283–0779–00				CAP,FXD,MICA DI:27 PF,2%,500V	00853	D155E270G0
A4C2081	283–0139–00				CAP,FXD,CER DI:150PF,20%,50V SQ	18796	RPE110COG151K50V
A4C2090	283–0779–00				CAP,FXD,MICA DI:27 PF,2%,500V	00853	D155E270G0
A4C3010	283–0417–00				CAP,FXD,CER DI:0.22UF,20%,400V SQ	04222	SR501E224MAA
A4C3011	283–0417–00				CAP,FXD,CER DI:0.22UF,20%,400V SQ	04222	SR501E224MAA
A4C3020	283–0203–00				CAP,FXD,CER DI:0.47UF,20%,50V SQ	04222	SR305SC474MAA
A4C3021	283–0190–00				CAP,FXD,CER DI:0.47UF,5%,50V SQ	04222	SR305C474JAA

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4C3030	283–0024–03	B020000	B023755		CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
	283–0328–00	B023756			CAP,FXD,CER DI:0.033UF,+80–20%,200V	18796	RPE122166Z5U303Z200V
A4C3031	283–0024–03	B020000	B023755		CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
	283–0328–00	B023756			CAP,FXD,CER DI:0.033UF,+80–20%,200V	18796	RPE122166Z5U303Z200V
A4C3032	290–0536–00				CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	24165	199D106X0025CA1
A4C3033	290–0536–00				CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	24165	199D106X0025CA1
A4C3034	283–0359–01				CAP,FXD,CER DI:1000PF,5%,200V SQ	31433	C322C102J2G5CA
A4C3040	283–0203–00				CAP,FXD,CER DI:0.47UF,20%,50V SQ	04222	SR305SC474MAA
A4C3050	290–0536–00				CAP,FXD,ELCTLT:10UF,20%,25V TANTALUM	24165	199D106X0025CA1
A4C3051	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C3052	283–0156–00				CAP,FXD,CER DI:1000PF,+80–20%,200V SQ	04222	SR152E102ZAA
A4C3060	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C3061	283–0175–00				CAP,FXD,CER DI:10PF,5%,200V SQ	31433	C315C100D2G5CA
A4C3062	283–0175–00				CAP,FXD,CER DI:10PF,5%,200V SQ	31433	C315C100D2G5CA
A4C3063	283–0196–00				CAP,FXD,CER DI:270PF,10%,50V	16299	SR155C271KAA
A4C3064	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
A4C3065	283–0175–00				CAP,FXD,CER DI:10PF,5%,200V SQ	31433	C315C100D2G5CA
A4C3070	283–0196–00				CAP,FXD,CER DI:270PF,10%,50V	16299	SR155C271KAA
A4C3071	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C3072	283–0024–03				CAP,FXD,CER DI:0.1UF,+80–20%,50V	04222	SR215E104ZAATR
A4C3080	283–0196–00	B020000	B025371		CAP,FXD,CER DI:270PF,10%,50V	16299	SR155C271KAA
	283–0107–01	B025372			CAP,FXD,CER DI:51PF,5%,200V	04222	SR292A510JAA
A4C3081	283–0196–00	B020000	B025371		CAP,FXD,CER DI:270PF,10%,50V	16299	SR155C271KAA
	283–0107–01	B025372			CAP,FXD,CER DI:51PF,5%,200V	04222	SR292A510JAA
A4C3082	283–0139–00				CAP,FXD,CER DI:150PF,20%,50V SQ	18796	RPE110COG151K50V
A4CR1010	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A4CR1030	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A4CR1031	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A4CR2050	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A4CR2060	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A4CR2061	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A4CR2062	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A4CR2063	152–0322–00				DIODE DVC,DI:SCHOTTKY,SI,15V,1.2PF	21847	A2X600
A4CR3020	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A4CR3021	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A4CR3040	152–0503–00				DIODE,SIG:SRD;35V,500PS TS,250NS TL,4.65PF	28480	5082–8872
A4CR3070	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
A4CR3090	153–0044–00				DIODE DVC SE:SIGNAL,4 MTCH 152–0322–03	80009	153–0044–00
A4CR3091	153–0044–00				DIODE DVC SE:SIGNAL,4 MTCH 152–0322–03	80009	153–0044–00
A4CR3092	153–0044–00				DIODE DVC SE:SIGNAL,4 MTCH 152–0322–03	80009	153–0044–00
A4CR3093	153–0044–00				DIODE DVC SE:SIGNAL,4 MTCH 152–0322–03	80009	153–0044–00
A4J3010	131–0391–00				CONN,RF,JACK:MALE	24931	32JR105–1
A4J3040	131–3360–00				CONN,HDR:PCB,MALE,STR,2 X 10	53387	3592–6002
A4L1040	108–1277–00				COIL,RF:80UH,5%,INDUCTOR	54937	108–1277–00
A4L2040	108–1278–00				COIL,RF:7.5UH,5%,INDUCTOR	0JR03	Z611
A4L2041	108–1279–00				COIL,RF:590UH,5%,INDUCTOR	0JR03	Z612
A4Q1010	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q1020	151–0567–00				XSTR,SIG:MOS,N–CH;ENH,60V,200MA,5 OHM	04713	2N7000
A4Q1021	151–0567–00				XSTR,SIG:MOS,N–CH;ENH,60V,200MA,5 OHM	04713	2N7000
A4Q1022	151–0567–00				XSTR,SIG:MOS,N–CH;ENH,60V,200MA,5 OHM	04713	2N7000
A4Q1030	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q1031	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q1060	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q2010	151–0567–00				XSTR,SIG:MOS,N–CH;ENH,60V,200MA,5 OHM	04713	2N7000
A4Q2011	151–0567–00				XSTR,SIG:MOS,N–CH;ENH,60V,200MA,5 OHM	04713	2N7000
A4Q2012	151–0567–00				XSTR,SIG:MOS,N–CH;ENH,60V,200MA,5 OHM	04713	2N7000
A4Q2030	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	03508	X39H3162
A4Q2031	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	03508	X39H3162
A4Q2032	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A4Q2033	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A4Q2034	151–0448–00	B020000	B023755		XSTR:NPN,SI,TO–46 2N5836 FAMILY	04713	SRF504
	151–0965–00	B023756	B024251		XSTR,SIG:BIPOLAR,NPN,10V,80MA,6.0GHZ,AMP	04713	MPS571
	151–0951–00	B024252			XSTR,SIG:BIPOLAR,NPN,15V,75MA,4.5GHZ,AMP	80009	151–0951–00
A4Q2040	151–0441–00				XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
A4Q2050	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q2051	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q2052	151–0441–00				XSTR,SIG:BIPOLAR,NPN;15V,40MA,1.0GHZ,AMP	04713	2N3839
A4Q2053	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A4Q2060	151–1103–00				XSTR,SIG:DMOS,N–CH;ENH,30V,50MA,45 OHM	17856	DM1140/SD210DE
A4Q3020	151–1174–00	B020000	B023755		XSTR:NPN,RF BFR96,TO–46	04713	MRF–965
	151–0965–00	B023756	B024251		XSTR,SIG:BIPOLAR,NPN,10V,80MA,6.0GHZ,AMP	04713	MPS571
	151–0951–00	B024252			XSTR,SIG:BIPOLAR,NPN,15V,75MA,4.5GHZ,AMP	80009	151–0951–00

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4Q3021	151–0296–00				XSTR,SIG:BIPOLAR,PNP;10V,30MA,4.0GHZ,AMP	04713	SS443
A4Q3035	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	03508	X39H3162
A4Q3050	151–0448–00	B020000	B023755		XSTR:NPN,SI,TO–46 2N5836 FAMILY	04713	SRF504
	151–0965–00	B023756	B024251		XSTR,SIG:BIPOLAR,NPN,10V,80MA,6.0GHZ,AMP	04713	MPS571
	151–0951–00	B024252			XSTR,SIG:BIPOLAR,NPN,15V,75MA,4.5GHZ,AMP	80009	151–0951–00
A4Q3060	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	03508	X39H3162
A4Q3061	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q3062	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A4Q3070	151–0271–00				XSTR,SIG:BIPOLAR,PNP;15V,30MA,2.0GHZ,AMP	01295	SKA4504
A4Q3080	151–1174–00	B020000	B023755		XSTR:NPN,RF BFR96,TO–46	04713	MRF–965
	151–0965–00	B023756	B024251		XSTR,SIG:BIPOLAR,NPN,10V,80MA,6.0GHZ,AMP	04713	MPS571
	151–0951–00	B024252			XSTR,SIG:BIPOLAR,NPN,15V,75MA,4.5GHZ,AMP	80009	151–0951–00
A4R1010	315–0204–00				RES,FXD,FILM:200K OHM,5%,0.25W	01121	CB2045
A4R1011	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R1012	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R1013	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1022	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R1023	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R1030	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R1031	315–0204–00				RES,FXD,FILM:200K OHM,5%,0.25W	01121	CB2045
A4R1032	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R1033	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R1034	315–0204–00				RES,FXD,FILM:200K OHM,5%,0.25W	01121	CB2045
A4R1035	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R1036	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R1037	315–0470–00				RES,FXD,FILM:47 OHM,5%,0.25W	01121	CB4705
A4R1038	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1050	315–0204–00				RES,FXD,FILM:200K OHM,5%,0.25W	01121	CB2045
A4R1051	315–0204–00				RES,FXD,FILM:200K OHM,5%,0.25W	01121	CB2045
A4R1052	315–0242–00				RES,FXD,FILM:2.4K OHM,5%,0.25W	01121	CB2425
A4R1053	315–0204–00				RES,FXD,FILM:200K OHM,5%,0.25W	01121	CB2045
A4R1054	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1060	315–0204–00				RES,FXD,FILM:200K OHM,5%,0.25W	01121	CB2045
A4R1061	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R1062	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1063	315–0204–00				RES,FXD,FILM:200K OHM,5%,0.25W	01121	CB2045
A4R1064	315–0101–00	B010100	B025257		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
	315–0220–00	B020258			RES,FXD,FILM:20 OHM,5%,0.25W	50139	CB2005
A4R1065	315–0101–00	B010100	B020257		RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
	315–0220–00	B020258			RES,FXD,FILM:20 OHM,5%,0.25W	50139	CB2005
A4R1066	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1070	321–0631–03				RES,FXD,FILM:12.5K OHM,0.25%,0.125W	19701	5033RC12K500C
A4R1071	322–3389–00				RES,FXD,FILM:110K OHM,0.25%,0.2W	56845	CCF–50–2–1103F
A4R1072	321–0645–00				RES,FXD,FILM:100K OHM,0.5%,0.125W	19701	5033RC1003D
A4R1073	321–0645–00				RES,FXD,FILM:100K OHM,0.5%,0.125W	19701	5033RC1003D
A4R1074	322–3396–00				RES,FXD,FILM:130K OHM,1%,0.2W	57668	CRB20 FXE 130K
A4R1080	311–1917–00				RES,VAR,NONWW:TRMR,5K OHM,10%,0.5 W	32997	3386C–1–502
A4R1090	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R1091	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2010	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R2011	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R2012	315–0104–00				RES,FXD,FILM:100K OHM,5%,0.25W	01121	CB1045
A4R2020	322–3093–00				RES,FXD,FILM:90.9 OHM,1%,0.2W	91637	CCF50–2F90R90F
A4R2021	322–3093–00				RES,FXD,FILM:90.9 OHM,1%,0.2W	91637	CCF50–2F90R90F
A4R2022	322–3135–00				RES,FXD,FILM:249 OHM,1%,0.2W	57668	CRB20 FXE 249E
A4R2023	322–3133–00				RES,FXD,FILM:237 OHM,1%,0.2W	91637	CCF50–2F237R0F
A4R2030	315–0470–00				RES,FXD,FILM:47 OHM,5%,0.25W	01121	CB4705
A4R2031	315–0300–00				RES,FXD,FILM:30 OHM,5%,0.25W	01121	CB3005
A4R2040	315–0432–00				RES,FXD,FILM:4.3K OHM,5%,0.25W	01121	CB4325
A4R2041	315–0432–00				RES,FXD,FILM:4.3K OHM,5%,0.25W	01121	CB4325
A4R2042	315–0470–00				RES,FXD,FILM:47 OHM,5%,0.25W	01121	CB4705
A4R2043	315–0432–00				RES,FXD,FILM:4.3K OHM,5%,0.25W	01121	CB4325
A4R2044	315–0432–00				RES,FXD,FILM:4.3K OHM,5%,0.25W	01121	CB4325
A4R2050	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R2051	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2052	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R2053	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R2054	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2055	315–0103–00				RES,FXD,FILM:10K OHM,5%,0.25W	01121	CB1035
A4R2060	315–0752–00				RES,FXD,FILM:7.5K OHM,5%,0.25W	01121	CB7525
A4R2061	315–0562–00				RES,FXD,FILM:5.6K OHM,5%,0.25W	01121	CB5625
A4R2062	315–0562–00				RES,FXD,FILM:5.6K OHM,5%,0.25W	01121	CB5625
A4R2063	322–3385–00				RES,FXD:METAL FILM:100K OHM,1%,0.2W	57668	CRB20 FXE 100K
A4R2064	315–0273–00				RES,FXD,FILM:27K OHM,5%,0.25W	01121	CB2735
A4R2065	315–0333–00				RES,FXD,FILM:33K OHM,5%,0.25W	01121	CB3335

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4R2066	315–0102–00				RES,FXD,FILM:1K OHM,5%,0.25W	01121	CB1025
A4R2067	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2070	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2071	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2072	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2073	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R2074	322–3242–00				RES,FXD,FILM:3.24K OHM,1%,0.2W	57668	CRB20 FXE 3K24
A4R2075	315–0102–00				RES,FXD,FILM:1K OHM,5%,0.25W	01121	CB1025
A4R2076	315–0472–00				RES,FXD,FILM:4.7K OHM,5%,0.25W	01121	CB4725
A4R2080	315–0105–00				RES,FXD,FILM:1M OHM,5%,0.25W	01121	CB1055
A4R2081	315–0105–00				RES,FXD,FILM:1M OHM,5%,0.25W	01121	CB1055
A4R2082	322–3260–00				RES,FXD,FILM:4.99K OHM,1%,0.2W	57668	CRB20 FXE 4K99
A4R2083	315–0473–00				RES,FXD,FILM:47K OHM,5%,0.25W	01121	CB4735
A4R2090	322–3260–00				RES,FXD,FILM:4.99K OHM,1%,0.2W	57668	CRB20 FXE 4K99
A4R2091	322–3297–00				RES,FXD:METAL FILM:12.1K OHM,1%,0.2W	57668	CRB20 FXE 12K1
A4R2092	322–3364–00				RES,FXD,FILM:60.4K OHM,1%,0.2W	57668	CRB20 FXE 60K4
A4R2093	322–3289–00				RES,FXD,FILM:10K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A4R2094	322–3297–00				RES,FXD:METAL FILM:12.1K OHM,1%,0.2W	57668	CRB20 FXE 12K1
A4R2095	322–3364–00				RES,FXD,FILM:60.4K OHM,1%,0.2W	57668	CRB20 FXE 60K4
A4R2096	322–3289–00				RES,FXD,FILM:10K OHM,1%,0.2W	57668	CRB20 FXE 10K0
A4R2097	311–1917–00				RES,VAR,NONWW:TRMR,5K OHM,10%,0.5 W	32997	3386C–1–502
A4R2098	315–0390–00				RES,FXD,FILM:39 OHM,5%,0.25W	01121	CB3905
A4R3010	321–0799–02				RES,FXD,FILM:146.8 OHM,0.5%,0.125W	01121	ADVISE
A4R3011	321–0153–00				RES,FXD,FILM:383 OHM,1%,0.125W	19701	5043ED383R0F
A4R3012	321–0857–01				RES,FXD,FILM:360 OHM,0.5%,0.125W	19701	5033RD360R0F
A4R3020	315–0472–00				RES,FXD,FILM:4.7K OHM,5%,0.25W	01121	CB4725
A4R3021	315–0470–00				RES,FXD,FILM:47 OHM,5%,0.25W	01121	CB4705
A4R3022	315–0243–00	B020000	B024700		RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
	315–0472–00	B024701			RES,FXD,FILM:4.7K OHM,5%,0.25W	01121	CB4725
A4R3023	315–0243–00	B020000	B024700		RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
	315–0472–00	B024701			RES,FXD,FILM:4.7K OHM,5%,0.25W	01121	CB4725
A4R3024	321–1087–01				RES,FXD,FILM:79.6 OHM,0.5%,0.125W	07716	CEAD79R60D
A4R3030	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R3031	315–0151–00	B020000	B024700		RES,FXD,FILM:150 OHM,5%,0.25W	01121	CB1515
	315–0131–00	B024701			RES,FXD,FILM:130 OHM,5%,0.25W	19701	5043CX130R0J
A4R3032	321–0612–00				RES,FXD,FILM:500 OHM,1%,0.125W	07716	CEAD500R0F
A4R3033	315–0471–00				RES,FXD,FILM:470 OHM,5%,0.25W	01121	CB4715
A4R3034	315–0472–00				RES,FXD,FILM:4.7K OHM,5%,0.25W	01121	CB4725

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4R3035	315–0162–00				RES,FXD,FILM:1.6K OHM,5%,0.25W	19701	5043EMIK600J
A4R3036	315–0332–00				RES,FXD,FILM:3.3K OHM,5%,0.25W	01121	CB3325
A4R3040	315–0470–00				RES,FXD,FILM:47 OHM,5%,0.25W	01121	CB4705
A4R3041	321–0063–00				RES,FXD,FILM:44.2 OHM,0.5%,0.125W	01121	CC
A4R3042	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R3043	315–0100–00				RES,FXD,FILM:10 OHM,5%,0.25W	01121	CB1005
A4R3044	315–0243–00				RES,FXD,FILM:24K OHM,5%,0.25W	01121	CB2435
A4R3045	315–0121–00				RES,FXD,FILM:120 OHM,5%,0.25W	01121	CB1215
A4R3046	315–0102–00				RES,FXD,FILM:1K OHM,5%,0.25W	01121	CB1025
A4R3050	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R3051	315–0102–00				RES,FXD,FILM:1K OHM,5%,0.25W	01121	CB1025
A4R3052	315–0121–00				RES,FXD,FILM:120 OHM,5%,0.25W	01121	CB1215
A4R3060	315–0203–00				RES,FXD,FILM:20K OHM,5%,0.25W	01121	CB2035
A4R3061	315–0153–00				RES,FXD,FILM:15K OHM,5%,0.25W	01121	CB1535
A4R3062	315–0163–00				RES,FXD,FILM:16K OHM,5%,0.25W	01121	CB1635
A4R3063	315–0562–00				RES,FXD,FILM:5.6K OHM,5%,0.25W	01121	CB5625
A4R3064	315–0103–00				RES,FXD,FILM:10K OHM,5%,0.25W	01121	CB1035
A4R3070	315–0301–00				RES,FXD,FILM:300 OHM,5%,0.25W	01121	CB3015
A4R3071	315–0102–00				RES,FXD,FILM:1K OHM,5%,0.25W	01121	CB1025
A4R3072	315–0103–00				RES,FXD,FILM:10K OHM,5%,0.25W	01121	CB1035
A4R3073	315–0752–00				RES,FXD,FILM:7.5K OHM,5%,0.25W	01121	CB7525
A4R3074	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R3075	315–0472–00				RES,FXD,FILM:4.7K OHM,5%,0.25W	57668	NTR25J–E04K7
A4R3076	315–0102–00				RES,FXD,FILM:1K OHM,5%,0.25W	01121	CB1025
A4R3077	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4R3080	317–0160–00				RES,FXD,CMPSN:16 OHM,5%,0.125W	01121	BB1605
A4R3081	317–0821–00				RES,FXD,CMPSN:820 OHM,5%,0.125W	01121	BB8215
A4R3082	317–0160–00				RES,FXD,CMPSN:16 OHM,5%,0.125W	01121	BB1605
A4R3083	317–0821–00				RES,FXD,CMPSN:820 OHM,5%,0.125W	01121	BB8215
A4R3090	315–0103–00				RES,FXD,FILM:10K OHM,5%,0.25W	01121	CB1035
A4R3091	315–0390–00				RES,FXD,FILM:39 OHM,5%,0.25W	01121	CB3905
A4R3092	315–0103–00				RES,FXD,FILM:10K OHM,5%,0.25W	01121	CB1035
A4R3093	321–1068–07				RES,FXD,FILM:50.5 OHM,0.1%,0.125W	07716	CEA
A4R3094	315–0101–00				RES,FXD,FILM:100 OHM,5%,0.25W	01121	CB1015
A4T3070	120–1394–01				XFMR,RF:TOROID,1:1,5 TURNS,3UH +/–30%	0JR03	120–1394–01
A4T3080	120–1397–01				XFMR,SIG:BIFILAR,460NH,30%,2T,TOROID CORE	0JR03	120–1394–01
A4T3081	120–1396–01				XFMR,RF:TOROID,1:1,4 TURNS,1.9UH +/–30%	0JR03	120–1396–01

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A4TP1060	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP1080	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP1081	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP1082	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP2030	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP3020	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP3030	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP3040	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP3050	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4TP3051	214–0579–02	B010100	B023052		TERM,TEST POINT:0.052 ID,0.169 H,0.465 L	10392	7–16150–8
A4U1040	156–0941–01				IC,DIGITAL:CMOS,GATES;QUAD 2–INPUT NAND	27014	MM74C00N/A+
A4U1050	156–0514–00				IC,MISC:CMOS,ANALOG MUX;DUAL 4 CHANNEL	04713	MC14052BCP
A4U1070	156–0853–00				IC,LINEAR:BIPOLAR,OP–AMP;DUAL,SINGLE SUPP	04713	LM358N
A4U1080	156–1490–00				IC,LINEAR:VOLTAGE REFERENCE 2–PIN TO 52	1ES66	ICL8069CCSQ2
A4U1090	156–1291–00				IC,LINEAR:BIFET,OP–AMP;DUAL,LOW POWER	01295	TL062CP
A4U2070	156–1291–00				IC,LINEAR:BIFET,OP–AMP;DUAL,LOW POWER	01295	TL062CP
A4U2080	156–1149–00				IC,LINEAR:BIFET,OP–AMP,LF351N	27014	LF351N
A4VR2080	152–0055–00				DIODE,ZENER:11V,5%,0.4W;1N962B	04713	SZG35009K1 1N962BRL
A4VR3020	152–0892–00				DIODE,ZENER:5.6V,5%,5W;1N5339B	04713	1N5339B
A4VR3021	152–0892–00				DIODE,ZENER:5.6V,5%,5W;1N5339B	04713	1N5339B
A4VR3080	152–0055–00				DIODE,ZENER:11V,5%,0.4W;1N962B	04713	SZG35009K1 1N962BRL
A6	**671–0443–XX**				**CKT BD ASSY:ETHERNET**		
A6C1010	283–0648–00				CAP,FXD,MICA DI:10PF,+/–0.5PF,500V	09023	CD15CD100D03
A6C1020	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
A6C10201	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
A6C2020	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
A6C2030	283–0024–03				CAP,FXD,CER DI:0.1UF,20%,50V,5ZU	04222	SR595E104MAAAP1
A6C2031	283–0024–03				CAP,FXD,CER DI:0.1UF,20%,50V,5ZU	04222	SR595E104MAAAP1
A6C2032	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
A6C2033	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
A6C2034	290–0523–00				CAP,FXD,ELCTLT:2.2UF,20%,20V TANTALUM	24165	196D225X0020HA1
A6C2035	283–0024–03				CAP,FXD,CER DI:0.1UF,20%,50V,5ZU	04222	SR595E104MAAAP1

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A6CR2020	152–0752–00				DIODE DVC,DI:RECT,SI,1A,1500V	04713	MR1–1600
A6CR2021	152–0752–00				DIODE DVC,DI:RECT,SI,1A,1500V	04713	MR1–1600
A6CR2022	152–0333–00				DIODE DVC,DI:SW,SI,55V,200MA	03508	DJ2011
A6CR2023	152–0141–02				DIODE,SIG:ULTRA FAST;40V,150MA	01295	1N4152R
A6CR20234	152–0141–02				DIODE,SIG:ULTRA FAST;40V,150MA	01295	1N4152R
A6CR2025	152–0141–02				DIODE,SIG:ULTRA FAST;40V,150MA	01295	1N4152R
A6J2030	131–3359–00				CONN,HDR:PCB;MALE,RTANG,2 X 10,0.1 CTR	80009	131–3359–00
A6K1020	148–0146–00				RELAY,REED:1 FORM A,500VDC,COIL 5VDC	12617	ORDER BY DESCR
A6L2010	114–0342–00				COIL,RF:VARIABLE,0.95–1.05MH POT CORE	54937	114–0342–00
A6Q1020	151–0188–00				XSTR,SIG:BIPOLAR,PNP;40V,200MA,250MHZ,AMP	03508	X39H3162
A6Q1021	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A6Q2020	151–0190–00				XSTR,SIG:BIPOLAR,NPN;40V,200MA,300MHZ,AMP	01295	SKA3703
A6R1010	321–0222–00				RES,FXD,FILM:2.00K OHM,1%,0.125W	07716	CEAD20000F
A6R1011	308–0585–00				RES,FXD,WW:50 OHM,0.5%,5W AXIAL LEADS	14193	SA5050R0D
A6R1012	321–0159–00				RES,FXD,FILM:442 OHM,1%,0.125W	19701	5043ED442R0F
A6R1013	311–1261–00				RES,VAR,NONWW:TRMR,500 OHM,0.5W CERMET	73138	62MR500346D
A6R1020	303–0330–00				RES,FXD,CMPSN:33 OHM,5%,1W	01121	GB3305
A6R1030	308–0431–00				RES,FXD,WW:120 OHM,5%,3W AXIAL LEADS	14193	SA31–1200J
A6R1031	321–0756–00				RES,FXD,FILM:50K OHM,1%,0.125W	19701	5033RD50K00F
A6R1032	321–0193–00				RES,FXD,FILM:1K OHM,1%,0.125W	07716	CEAD10000F
A6R1033	321–0260–00				RES,FXD,FILM:4.99K OHM,1%,0.125W	07716	CEAD 49900F
A6R1034	321–0318–00				RES,FXD,FILM:20.0K OHM,1%,0.125W	07716	CEAD20001F
A6R1035	321–0318–00				RES,FXD,FILM:20.0K OHM,1%,0.125W	07716	CEAD20001F
A6R1036	321–0354–00				RES,FXD,FILM:47.5K OHM,1%,0.125W	07716	CEAD47501F
A6R1037	321–0334–00				RES,FXD,FILM:29.4K OHM,1%,0.125W	07716	CEAD29401F
A6R2020	321–0289–00				RES,FXD,FILM:10.0K OHM,1%,0.125W	07716	CEAD10001F
A6R2021	303–0184–00				RES,FXD,CMPSN:180K OHM,5%,1W	01121	GB1845
A6R2022	303–0184–00				RES,FXD,CMPSN:180K OHM,5%,1W	01121	GB1845
A6R2023	321–0318–00				RES,FXD,FILM:20.0K OHM,1%,0.125W	07716	CEAD20001F
A6R2024	321–0983–00				RES,FXD,FILM:4.5 MEG OHM,1%,0.125W	07716	CEA 4.5M 1 PERCENT
A6R2025	321–0385–00				RES,FXD,FILM:100K OHM,1%,0.125W	07716	CEAD10002F
A6R2026	321–0391–00				RES,FXD,FILM:115K OHM,1%,0.125W	07716	CEAD11502F
A6R2027	321–0756–00				RES,FXD,FILM:50K OHM,1%,0.125W	19701	5033RD50K00F

Replaceable Parts List (Cont.)

Assy Number	Tektronix Part Number	Serial No. Effective	Serial No. Discont'd	Qty	Name & Description	Mfr. Code	Mfr. Part Number
A6R2030	321–0373–00				RES,FXD,FILM:75.0K OHM,1%,0.125W	07716	CEAD75001F
A6R2031	321–0367–00				RES,FXD,FILM:64.9K OHM,1%,0.125W	07716	CEAD64901F
A6R2032	321–0097–00				RES,FXD,FILM:100 OHM,1%,0.125W	07716	CEAD100R0F
A6R2033	321–0097–00				RES,FXD,FILM:100 OHM,1%,0.125W	07716	CEAD100R0F
A6R2034	321–0260–00				RES,FXD,FILM:4.99K OHM,1%,0.125W	07716	CEAD 49900F
A6U1030	156–1699–00				IC,LINEAR:DUAL BI–FET,OPNL AMP	01295	TL288CP
A6U1031	156–0514–00				IC,MISC:CMOS,ANALOG MUX;DUAL 4 CHANNEL	04713	MC14052BCP
A6U2030	156–1437–00				IC,LINEAR:BIPOLAR,VOLT REF;POS,5V,1.0%	04713	MC1404AU5
A6VR2020	152–0055–00				DIODE,ZENER:11V,5%,0.4W	04713	SZG35009K1 1N962BRL
A6VR2021	152–0055–00				DIODE,ZENER:11V,5%,0.4W	04713	SZG35009K1 1N962BRL
A6VR2030	152–0514–00				DIODE,ZENER:10V,1%,0.4W	04713	MZ4104D
					WIRE ASSEMBLIES		
W2010	174–0950–00				CA ASSY,SP,ELEC:26,28 AWG,11.0L	80009	174–0950–00
W2020	174–1539–00				CA ASSY,SP,ELEC:4,22 AWG,9.0 L,RIBBON (FROM A3A1J2010 TO BATT – INCLUDES 5A FUSE)	80009	174–1539–00
W3010	174–0956–00				CA ASSY,RF:50 OHM COAX,2.9L (FROM A4J3010 TO J100 FRONT PANEL)	80009	174–0956–00
W5040	174–0953–00				CA ASSY,SP,ELEC:14,26 AWG,6.125L (FROM A3A1J1030 TO A1A1J5040)	80009	174–0953–00
W6010	174–0951–00				CA ASSY,SP,ELEC:20,28 AWG,300V,RMS (FROM DISPLAY MODULE A5 AND A2A1J1020 TO A1A1J6010)	80009	174–0951–00
W9010	174–1014–00				CA ASSY,SP,ELEC:20,28 AWG,RIBBON (FOR STANDARD INSTRUMENT AND OPTION 06) (FROM A4J3040 TO A6J2030 TO A1A1J9010)	80009	174–1014–00
J101	174–0957–00	B010100	B023217		CA ASSY,PWR:2 STRAND W/CONN (FROM A3A1J1010 TO TRANS A3T201)	80009	174–0957–00
	198–5460–01				WIRE SET,ELEC:POWER SUPPLY MODULE (CONN AND GROUND WIRES, SET OF TWO)	80009	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 replaceable 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 illustration 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 circuit 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:

Resistors = Ohm (Ω)

Capacitors = Farad (F)
Inductors = Henry (H)

All capacitors and inductors indicate 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 assembly 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.

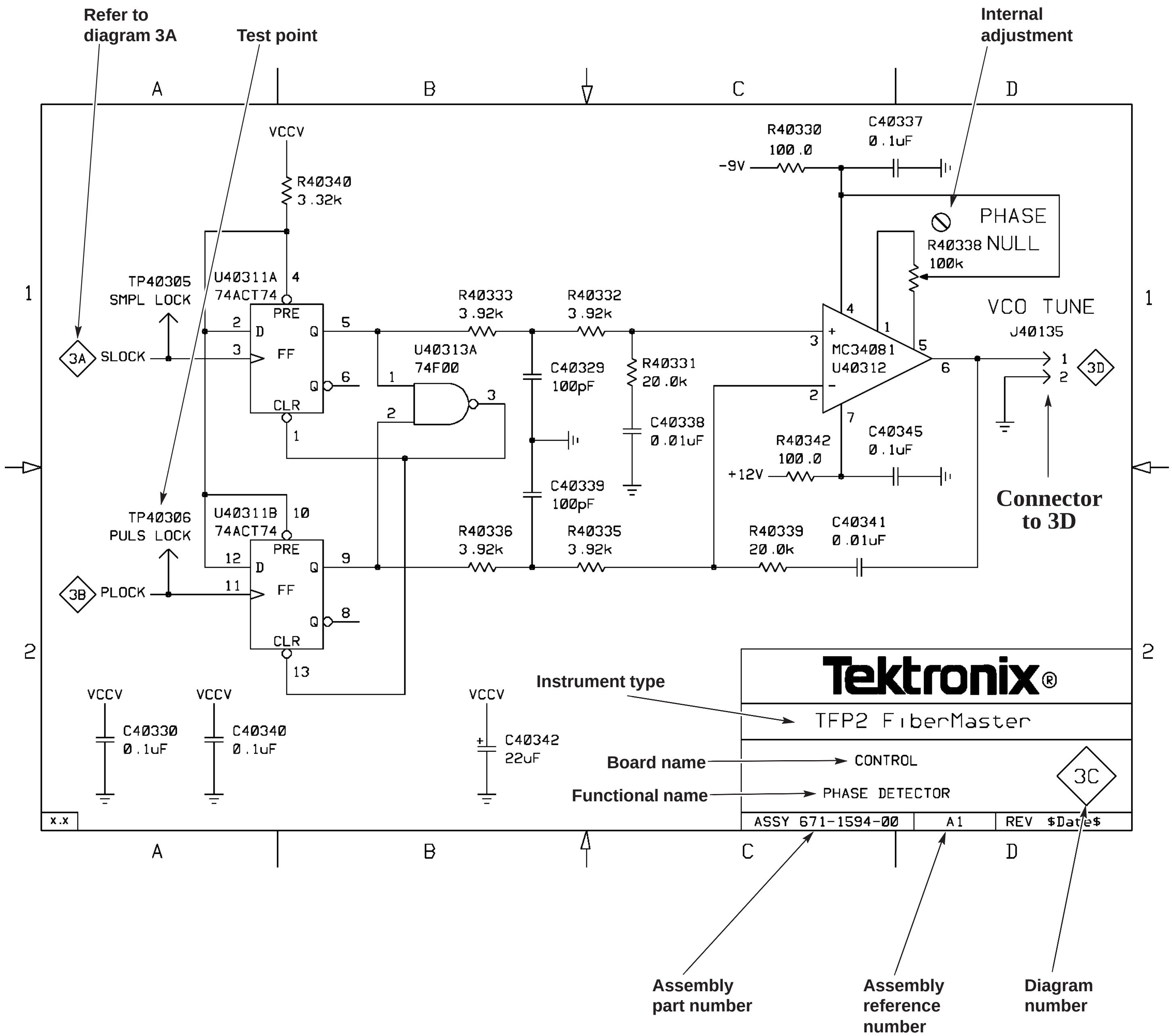


Figure 9–1: Special Schematic Symbols

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
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
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	SCHEM	LOCATION	
NUMBER	PAGE	SCHEM	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

CIRCUIT	SCHEM	LOCATION	
NUMBER	PAGE	SCHEM	BRD
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

CIRCUIT	SCHEM	LOCATION	
NUMBER	PAGE	SCHEM	BRD
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

A1 – MAIN

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
R7025	8B	E2	B7
R7026	8B	F2	B7
R7027	8B	F2	B7
R7028	8B	F3	B7
R7029	8B	F1	B7
R7030	8B	F2	C7
R7031	8B	E2	C7
R7032	8B	D2	C7
R7033	8B	D2	C7
R7034	8B	D2	C7
R7040	1	F2	D7
R8010	8A	F2	A8
R8011	8A	E2	A8
R8012	8A	E2	A8
R8013	8A	E2	A8
R8014	8A	D2	A8
R8020	8A	D1	B8
R8021	8A	E2	B8
R8022	8A	E2	B8
R8023	8A	E2	B8
R8024	8A	D2	B8
R8025	8A	C2	B8
R8026	8A	B2	B8
R8027	8A	B1	B8
R8028	8A	B1	B8
R8040	6	E3	D8
R8041	6	E3	D8
R8042	6	E3	D8
R8043	6	E2	D8
R8044	6	C2	D8
R8045	6	C2	D8
R8046	6	C2	D8
R8047	6	C2	D8
R9010	8A	H2	A9
R9011	8A	H2	A9
R9012	8A	F2	A9
R9013	8A	F1	A9
R9014	8A	E2	A9
R9015	8A	E1	A9
R9020	8A	E1	B9
R9021	8A	C1	B9
R9022	8A	C2	B9

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
R9023	8A	D2	B9
R9024	8A	D2	B9
R9025	8A	C2	B9
R9026	8A	B1	B9
R9027	8A	B1	B9
R9030	5	B2	C9
R9031	5	B2	C9
R9032	5	B2	C9
TP1040	2	C1	D1
TP1041	7	E1	D1
TP2040	7	B1	D2
TP3040	7	G3	D3
TP3041	7	G3	D3
TP4020	8A	H4	B4
TP4021	8A	H3	B4
TP4040	6	H2	D4
TP6010	8B	F4	A6
TP7010	8B	G2	A7
TP9010	8B	E3	A9
TP9011	8A	G2	A9
TP9040	8A	B2	D9
TP9041	6	A2	D9
U1010	2	G2	A1
U1011A	4	D4	A1
U1011B	5	C3	A1
U1012A	5	E2	A1
U1012B	5	E3	A1
U1020	2	G3	B1
U1021	2	E3	B1
U1022	2	E2	B1
U1023	2	D1	B1
U1030	2	B1	C1
U1031A	2	G2	C1
U1031B	2	C1	C1
U1031C	3	B2	C1
U1031D	2	C1	C1
U1031E	2	A2	C1
U1031F	2	A3	C1
U1032A	2	B1	C1
U1032B	2	B2	C1

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
U1034	7	B1	C1
U1040A	3	B3	D1
U1040B	3	C3	D1
U1041A	3	D4	D1
U1041B	3	E4	D1
U1042A	3	C4	D1
U1042B	3	B1	D1
U1042C	3	B3	D1
U1043A	2	D2	D1
U1043B	3	E2	D1
U1043C	2	B3	D1
U1043D	2	C3	D1
U2011	4	D1	A2
U2012A	4	D3	A2
U2012B	4	D2	A2
U2020	2	D3	B2
U2021	3	E3	B2
U2022	3	G1	B2
U2023A	2	C4	B2
U2023B	3	G3	B2
U2024	3	F2	B2
U2025A	7	F1	B2
U2025B	7	G1	B2
U2026	3	F2	B2
U2027A	7	C4	B2
U2027B	7	A4	B2
U2030	7	B2	C2
U2031	7	C1	C2
U2032	7	C2	C2
U2033A	3	B2	C2
U2033B	7	F1	C2
U2034A	7	G1	C2
U2034B	7	E2	C2
U2034C	7	C3	C2
U2034D	7	B4	C2
U2036	7	E2	C2
U2037	7	E3	C2
U2040A	6	B3	D2
U2040B	5	B3	D2
U2040C	3	C2	D2
U2040D	7	E1	D2
U2041	6	C3	D2

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

A2 – FRONT PANEL

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
C1011	10B	D1	A1
C1015	10A	B1	A1
C2010	10A	A3	A2
C2011	10A	A3	A2
C2020	10A	C1	B2
C2021	10B	E1	B2
C2022	10B	E2	B2
C2023	10B	G4	B2
C2024	10A	B1	B2
C2025	10B	B3	B2
C2026	10B	E4	B2
C2027	10B	B3	B2
C2028	10B	E4	B2
C2030	10A	C1	C2
C2031	10B	C3	C2
C2032	10B	C4	C2
C2033	10B	D3	C2
C2034	10B	D4	C2
C3010	10A	A4	A3
C3020	10B	H4	B3
C3021	10A	C1	B3
C3022	10A	C1	B3
C3023	10A	B1	B3
C3030 †	10B	D3	C3
C3031 †	10B	D3	C3
C3032	10A	C3	C3
C3033	10A	C3	C3
C3034	10B	B4	C3
J1020 †	10B	F1	C1
J3030 †	10A	H1	C3
PS2030 †	10B	F2	C2
Q1020	10A	C1	B1
Q1030	10B	D3	C1
Q2020	10A	A1	B2
R1010	10A	B2	A1
R1011	10B	D1	A1
R1012	10B	E2	A1
R1013	10A	B2	A1
R1018	10B	D1	A1
R1020	10B	D1	B1
R1021	10A	C1	B1
R1022A	10B	C3	B1
R1022B	10B	C4	B1
R1023	10B	C2	B1
R1024	10A	B1	B1
R1025	10A	B1	B1
R1026	10A	A1	B1
R1027	10B	C3	B1
R1030	10B	D2	C1
R1031	10B	D2	C1
R2010	10A	B2	A2
R2020	10B	F1	B2
R2021	10A	B3	B2
R2022	10A	C1	B2
R2024A	10B	A3	B2
R2024B	10B	A3	B2
R2030	10B	D4	C2
R2031	10B	E4	C2
R2032	10B	D3	C2
R2034	10B	B3	C2
R2035	10B	B3	C2
R2036	10B	C3	C2
R2037	10B	C4	C2
R3010	10A	B4	A3
R3011	10A	B3	A3
R3020A	10B	D4	B3
R3020B	10B	D4	B3
R3024	10A	D1	B3
R3031	10A	E1	C3
RT2038	10B	D3	C2
S1010	10A	A2	A1
S1011	10A	A2	A1
S2010	10A	A3	A2
S2011	10A	A3	A2
S3010	10A	A4	A3
S3011	10A	D1	A3
S3012	10A	C2	A3
S3020	10A	E2	B3
S3021	10A	D3	B3
S3022	10A	C4	B3
S3023	10A	C3	B3
U2010A	10B	D1	A2
U2010B	10C	D2	A2
U2020A	10A	B1	B2
U2020B	10B	C3	B2
U2021	10B	C1	B2
U2022A	10C	F2	B2
U2022B	10B	B1	B2
U2022B	10C	F2	B2
U2022C	10B	B2	B2
U2023	10B	E3	B2
U2024	10A	G1	B2
U2025	10A	G2	B2
U3020A	10B	B3	B3
U3020B	10B	B3	B3
U3020C	10B	B3	B3
U3020D	10B	B3	B3
U3021A	10B	B1	B3
U3021B	10C	C2	B3
U3021C	10A	B2	B3
U3021D	10A	B2	B3
U3022A	10A	B3	B3
U3022B	10A	B3	B3
U3022C	10A	B2	B3
U3022D	10A	B3	B3
U3023A	10A	B4	B3
U3023B	10A	B3	B3
U3023C	10A	B4	B3
U3023D	10A	B4	B3
U3025	10A	G2	B3
U3031	10A	G3	C3

† 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

A4 – L/R PULSER SAMPLER

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
C1040	4B	C7	D1
C1060	4A	A2	F1
C1061	4A	B4	F1
C1062	4A	B4	F1
C1063	4B	B3	F1
C1064	4A	E3	F1
C1065	4A	A2	F1
C1066	4A	A4	F1
C1070	4A	E4	G1
C1080	4A	A3	H1
C1081	4A	B5	H1
C1082	4A	H4	H1
C1083	4A	E5	H1
C1084	4A	E4	H1
C1085	4A	F4	H1
C1090	4A	H3	I1
C1091	4A	H4	I1
C2013	4B	G2	A2
C2014	4B	F2	A2
C2015	4B	F2	A2
C2020	4B	E4	B2
C2021	4B	G4	B2
C2022	4B	F4	B2
C2023	4B	F4	B2
C2030	4B	D3	C2
C2040	4B	C3	D2
C2041	4B	C6	D2
C2042	4B	C5	D2
C2043	4B	C2	D2
C2050	4B	C4	E2
C2051	4B	C5	E2
C2060	4A	C4	F2
C2070	4A	E5	G2
C2071	4A	C5	G2
C2072	4A	D5	G2
C2073	4A	D7	G2
C2080	4A	E5	H2
C2081	4A	F6	H2
C2090	4A	F6	I2
C3010	4B	H3	A3
C3011	4B	H3	A3
C3020	4B	E3	B3

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
C3021	4B	H4	B3
C3030	4B	E2	C3
C3031	4B	E2	C3
C3032	4B	E2	C3
C3033	4B	A6	C3
C3034	4B	A6	C3
C3040	4B	D7	D3
C3050	4B	B2	E3
C3051	4B	B1	E3
C3052	4A	A6	E3
C3060	4A	D3	F3
C3061	4A	C4	F3
C3062	4A	C4	F3
C3063	4A	B6	F3
C3064	4A	B2	F3
C3065	4A	B6	F3
C3070	4A	D6	G3
C3071	4A	B5	G3
C3072	4A	D5	G3
C3080	4A	D6	H3
C3081	4A	D6	H3
C3082	4A	F6	H3
CR1010	4B	G7	A1
CR1030	4B	G6	C1
CR1031	4B	F5	C1
CR2050	4B	B2	E2
CR2060	4A	D2	F2
CR2061	4A	D3	F2
CR2062	4A	D3	F2
CR2063	4A	C4	F2
CR3020	4B	H2	B3
CR3021	4B	H2	B3
CR3040	4B	C3	D3
CR3070	4A	B6	G3
CR3090	4A	F6	I3
CR3091	4A	G6	I3
CR3092	4A	G6	I3
CR3093	4A	G6	I3
J3010	4B	H3	A3
J3040	4A	B7	D3

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
L1040	4B	C7	D1
L2040	4B	C6	D2
L2041	4B	C5	D2
Q1010	4B	F7	A1
Q1020	4B	G4	B1
Q1021	4B	F4	B1
Q1022	4B	F5	B1
Q1030	4B	F7	C1
Q1031	4B	F6	C1
Q1060	4B	A4	F1
Q2010	4B	G2	A2
Q2011	4B	F2	A2
Q2012	4B	F2	A2
Q2030	4B	D7	C2
Q2031	4B	D6	C2
Q2032	4B	D5	C2
Q2033	4B	D3	C2
Q2034	4B	D2	C2
Q2040	4B	C3	D2
Q2050	4B	B6	E2
Q2051	4B	C5	E2
Q2052	4B	C5	E2
Q2053	4B	B2	E2
Q2060	4A	D3	F2
Q3020	4B	E3	B3
Q3021	4B	E3	B3
Q3035	4B	D2	C3
Q3050	4A	B6	E3
Q3060	4A	C3	F3
Q3061	4A	C4	F3
Q3062	4A	C4	F3
Q3070	4A	C6	G3
Q3080	4A	D6	H3
R1010	4B	G7	A1
R1011	4B	F7	A1
R1012	4B	F8	A1
R1013	4B	E4	A1
R1022	4B	F4	B1
R1023	4B	F4	B1
R1030	4B	G4	C1
R1031	4B	G7	C1

A4 – L/R PULSER SAMPLER

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
R1032	4B	F7	C1	R2051	4B	C2	E2	R3031	4B	E2	C3
R1033	4B	E6	C1	R2052	4B	C5	E2	R3032	4B	G4	C3
R1034	4B	F6	C1	R2053	4B	B3	E2	R3033	4B	D1	C3
R1035	4B	F6	C1	R2054	4B	B1	E2	R3034	4B	D2	C3
R1036	4B	E5	C1	R2055	4B	B5	E2	R3035	4B	C1	C3
R1037	4B	D6	C1	R2060	4A	D4	F2	R3036	4B	C2	C3
R1038	4B	D7	C1	R2061	4A	D4	F2	R3040	4B	D3	D3
R1050	4B	B7	E1	R2062	4A	C2	F2	R3041	4B	D7	D3
R1051	4B	B7	E1	R2063	4A	C4	F2	R3042	4B	D7	D3
R1052	4B	B7	E1	R2064	4A	D3	F2	R3043	4B	A6	D3
R1053	4B	B5	E1	R2065	4A	C4	F2	R3044	4B	C4	D3
R1054	4B	B6	E1	R2066	4A	D4	F2	R3045	4B	A2	D3
R1060	4B	A5	F1	R2067	4A	C5	F2	R3046	4B	B2	D3
R1061	4B	A3	F1	R2070	4A	D4	G2	R3050	4A	B7	E3
R1062	4B	A3	F1	R2071	4A	E5	G2	R3051	4A	B6	E3
R1063	4B	A4	F1	R2072	4A	E3	G2	R3052	4A	A6	E3
R1064	4A	A3	F1	R2073	4A	E5	G2	R3060	4A	C3	F3
R1065	4A	A2	F1	R2074	4A	E4	G2	R3061	4A	C3	F3
R1066	4A	D2	F1	R2075	4A	D7	G2	R3062	4A	B6	F3
R1070	4A	A4	G1	R2076	4A	D6	G2	R3063	4A	C4	F3
R1071	4A	B4	G1	R2080	4A	F4	H2	R3064	4A	B6	F3
R1072	4A	B4	G1	R2081	4A	F4	H2	R3070	4A	C6	G3
R1073	4A	B4	G1	R2082	4A	G4	H2	R3071	4A	C6	G3
R1074	4A	A2	G1	R2083	4A	F5	H2	R3072	4A	C6	G3
R1080	4A	E4	H1	R2090	4A	G5	I2	R3073	4A	B6	G3
R1090	4A	H4	I1	R2091	4A	G4	I2	R3074	4A	C2	G3
R1091	4A	H3	I1	R2092	4A	G3	I2	R3075	4A	D5	G3
R2010	4B	F2	A2	R2093	4A	H3	I2	R3076	4A	D5	G3
R2011	4B	F2	A2	R2094	4A	G5	I2	R3077	4A	B5	G3
R2012	4B	G2	A2	R2095	4A	G4	I2	R3080	4A	E6	H3
R2020	4B	E4	B2	R2096	4A	H5	I2	R3081	4A	E6	H3
R2021	4B	G3	B2	R2097	4A	G5	I2	R3082	4A	E6	H3
R2022	4B	F3	B2	R2098	4A	F6	I2	R3083	4A	E6	H3
R2023	4B	F4	B2	R3010	4B	G3	A3	R3090	4A	F7	I3
R2030	4B	E3	C2	R3011	4B	F3	A3	R3091	4A	F6	I3
R2031	4B	D2	C2	R3012	4B	F3	A3	R3092	4A	F5	I3
R2040	4B	D7	D2	R3020	4B	E3	B3	R3093	4A	G6	I3
R2041	4B	D6	D2	R3021	4B	E3	B3	R3094	4A	G6	I3
R2042	4B	D5	D2	R3022	4B	H2	B3				
R2043	4B	C4	D2	R3023	4B	H2	B3	T3070	4A	D6	G3
R2044	4B	C5	D2	R3024	4B	G3	B3	T3080	4A	E6	H3
R2050	4B	B6	E2	R3030	4B	E1	C3	T3081	4A	E6	H3

A4 – L/R PULSER SAMPLER

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
TP1060	4A	D2	F1
TP1080	4A	B3	H1
TP1081	4A	B3	H1
TP1082	4A	B5	H1
TP2030	4B	D5	C2
TP3020	4B	H3	B3
TP3030	4B	H3	C3
TP3040	4B	A2	D3
TP3050	4A	A6	E3
TP3051	4A	G2	E3
U1040A	4B	E5	D1
U1040B	4B	E6	D1
U1040C	4B	E7	D1
U1040D	4B	E7	D1
U1050	4B	A7	E1
U1070A	4A	B3	G1
U1070B	4A	B5	G1
U1080	4A	A3	H1
U1090A	4A	H3	I1
U1090B	4A	H5	I1
U2070A	4A	E4	G2
U2070B	4A	E3	G2
U2080	4A	E4	H2
VR2080	4A	D7	H2
VR3020	4B	H2	B3
VR3021	4B	H2	B3
VR3080	4A	D5	H3

A6 – ETHERNET – OPTION 06

CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD	CIRCUIT NUMBER	SCHEM PAGE	LOCATION SCHEM	LOCATION BRD
C1010	13	G2	A1	R2021	13	D3	B2
C1020	13	E2	B1	R2022	13	D3	B2
C1021	13	E1	B1	R2023	13	F4	B2
C2020	13	G4	B2	R2024	13	E3	B2
C2030	13	D4	C2	R2025	13	D3	B2
C2031	13	D3	C2	R2026	13	C4	B2
C2032	13	E3	C2	R2027	13	D3	B2
C2033	13	E4	C2	R2030	13	D4	C2
C2034	13	C4	C2	R2031	13	C2	C2
C2035	13	C3	C2	R2032	13	E4	C2
				R2033	13	E3	C2
CR2020	13	D3	B2	R2034	13	B4	C2
CR2021	13	D3	B2				
CR2022	13	F3	B2	U1030A	13	E4	C1
CR2023	13	G3	B2	U1030B	13	E2	C1
CR2024	13	C2	B2	U1031	13	C1	C1
CR2025	13	B2	B2	U2030	13	B3	C2
J2030	13	B2	C2	VR2020	13	D3	B2
				VR2021	13	E4	B2
K1020	13	G2	B1	VR2030	13	B4	C2
L2010	13	H2	A2				
Q1020	13	F2	B1				
Q1021	13	F2	B1				
Q2020	13	F4	B2				
R1010	13	G2	A1				
R1011	13	G2	A1				
R1012	13	G2	A1				
R1013	13	G1	A1				
R1020	13	F2	B1				
R1030	13	F1	C1				
R1031	13	E1	C1				
R1032	13	E2	C1				
R1033	13	E2	C1				
R1034	13	E3	C1				
R1035	13	D2	C1				
R1036	13	D2	C1				
R1037	13	D2	C1				
R2020	13	G2	B2				

A1 - MAIN

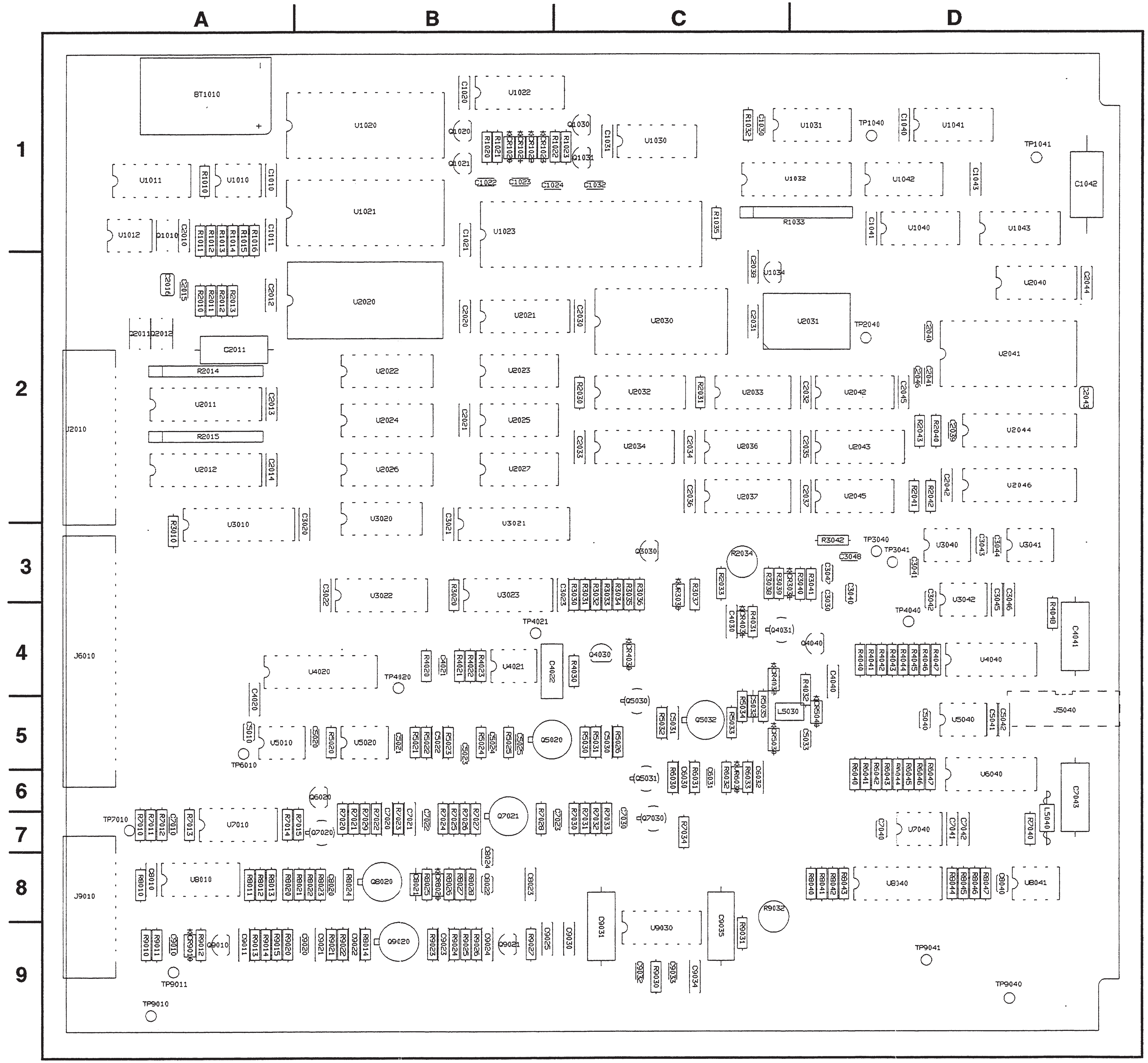
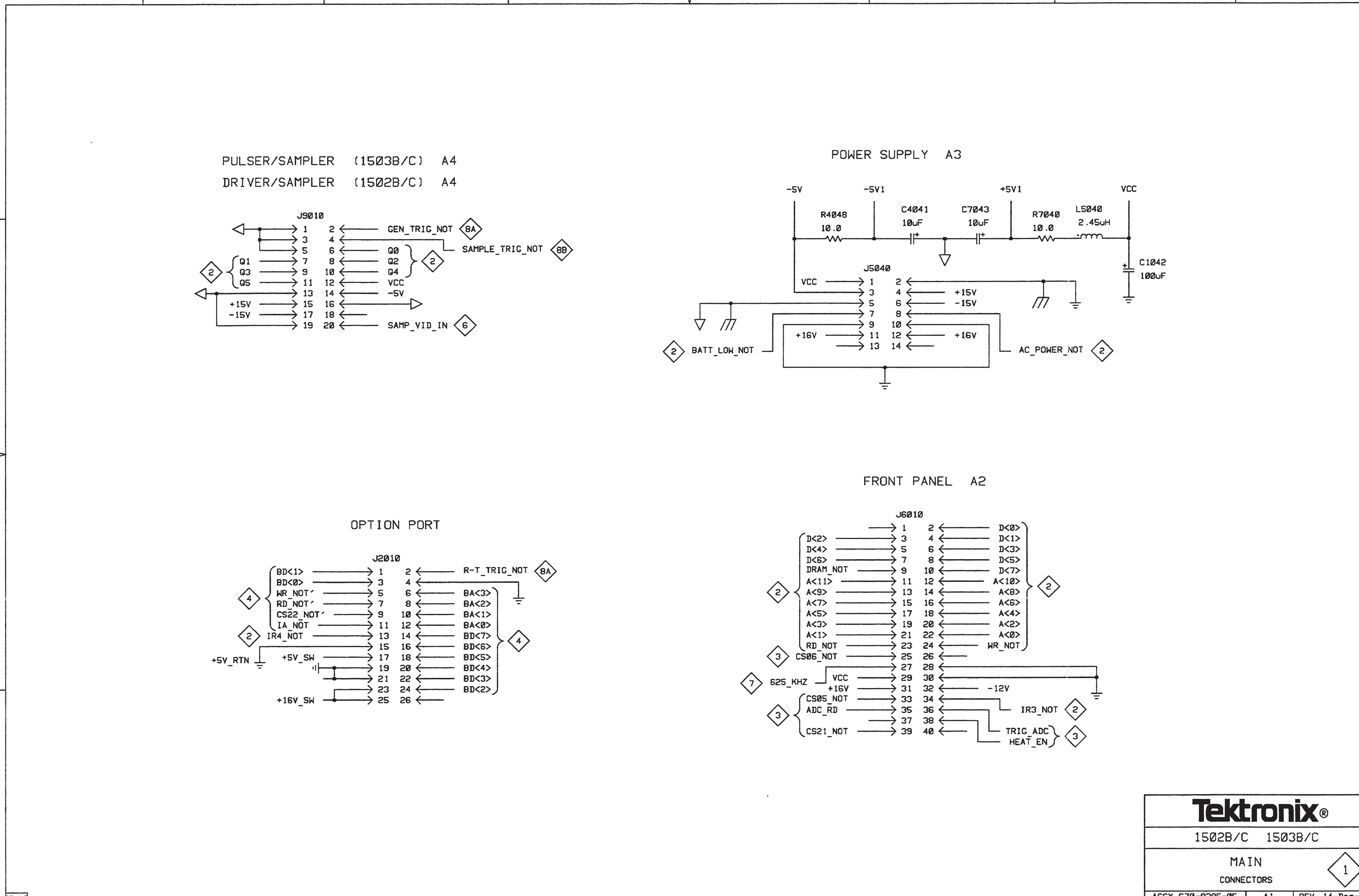
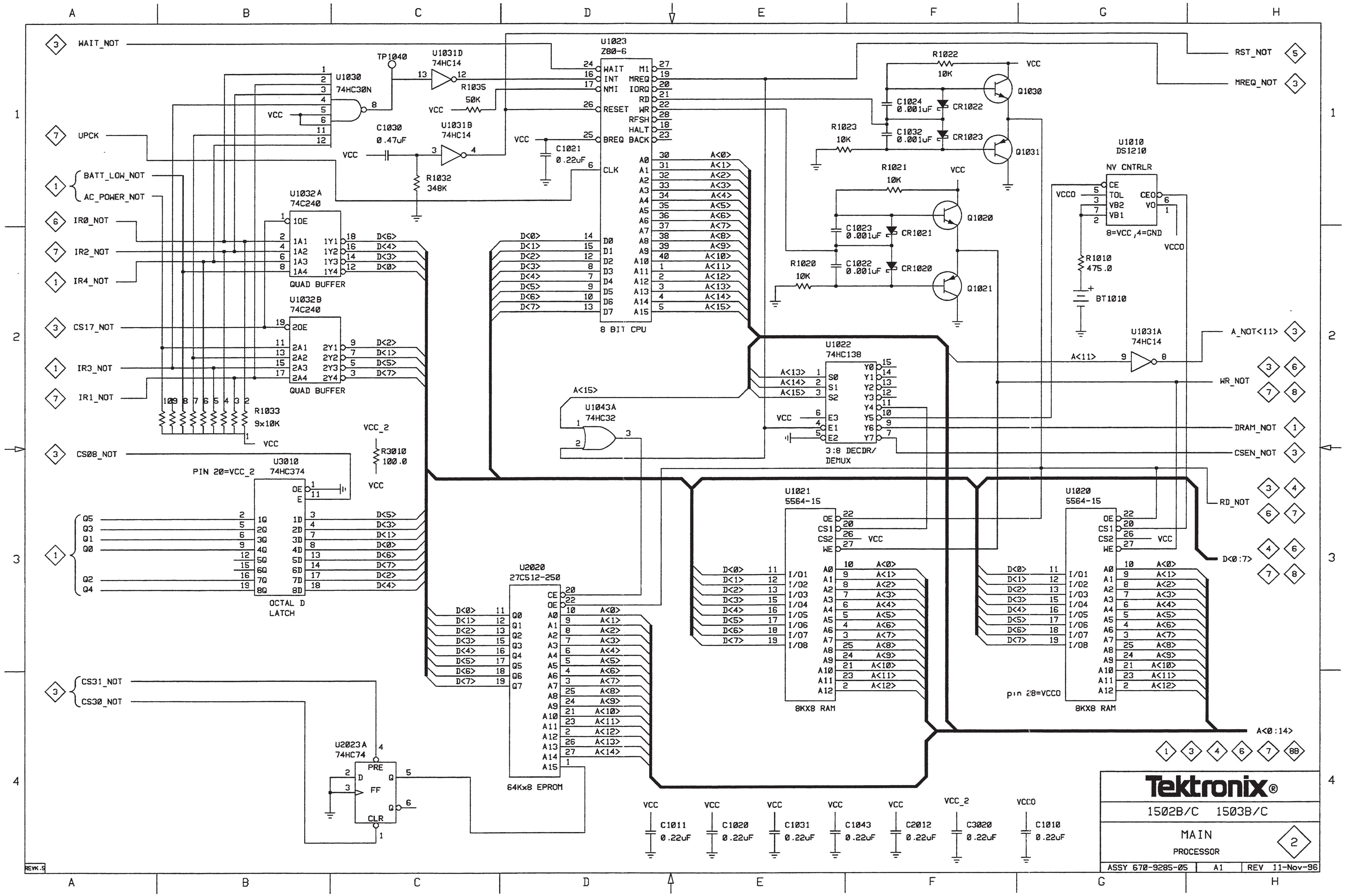
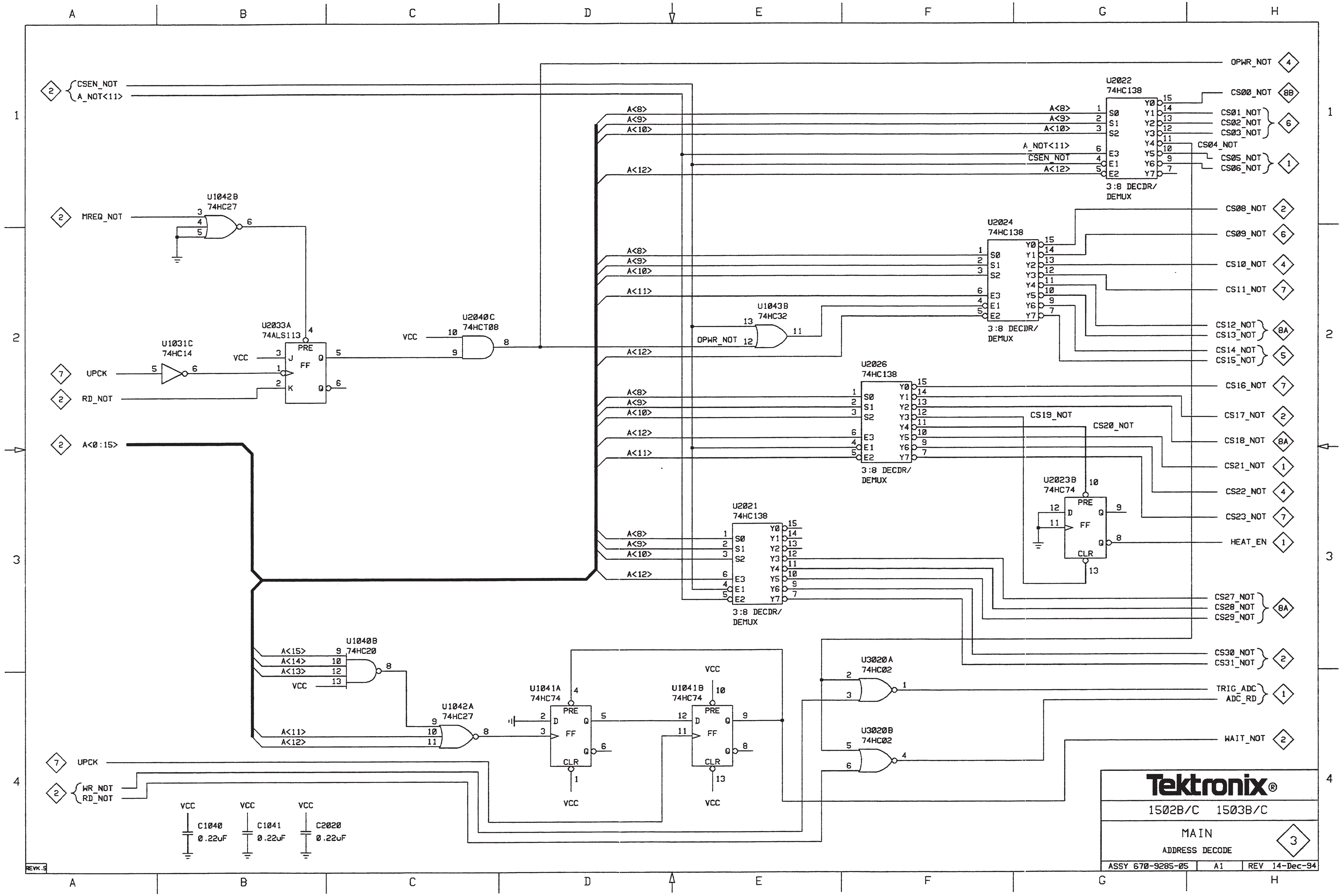


Fig. 9-2. Component Locator - Main Board

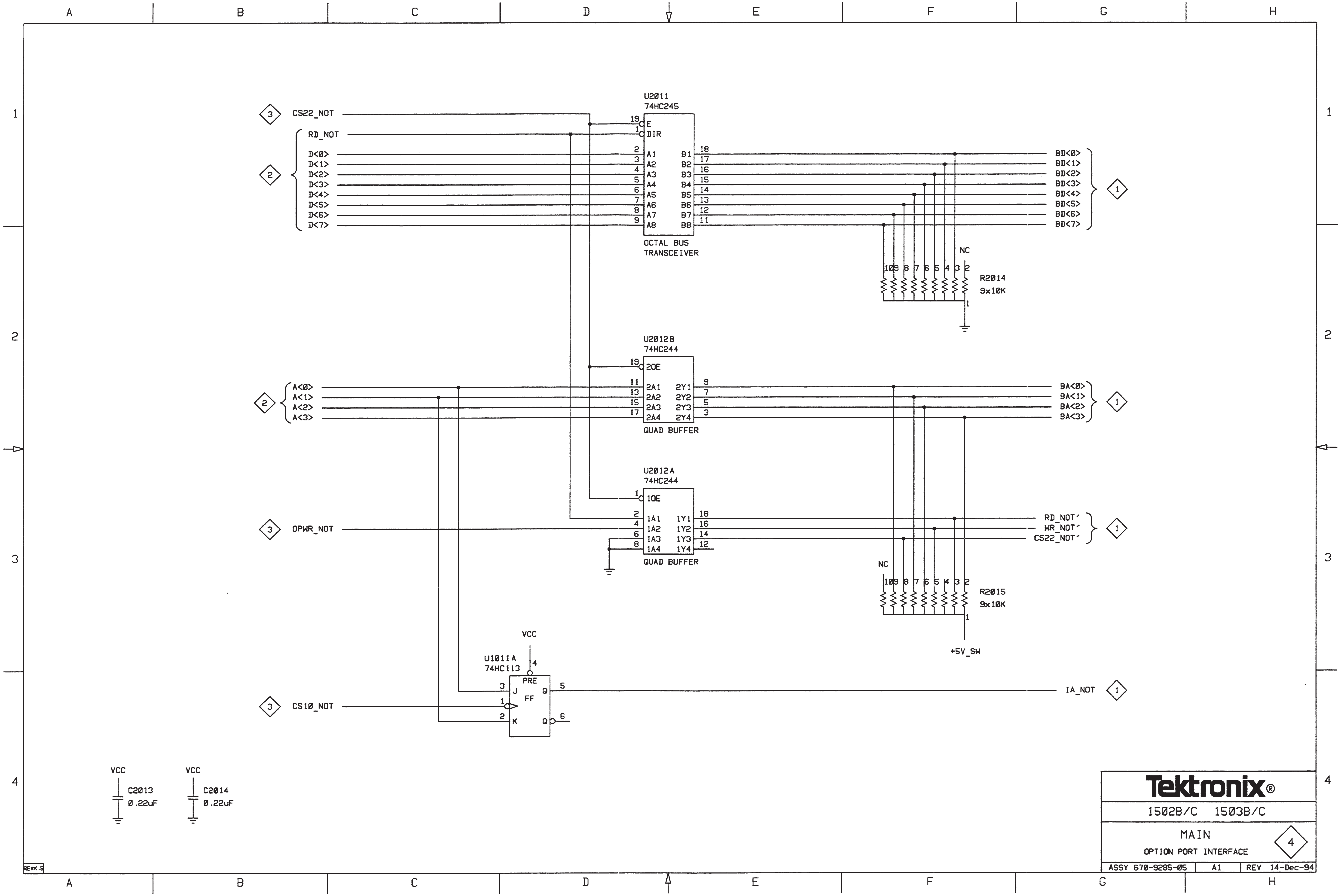


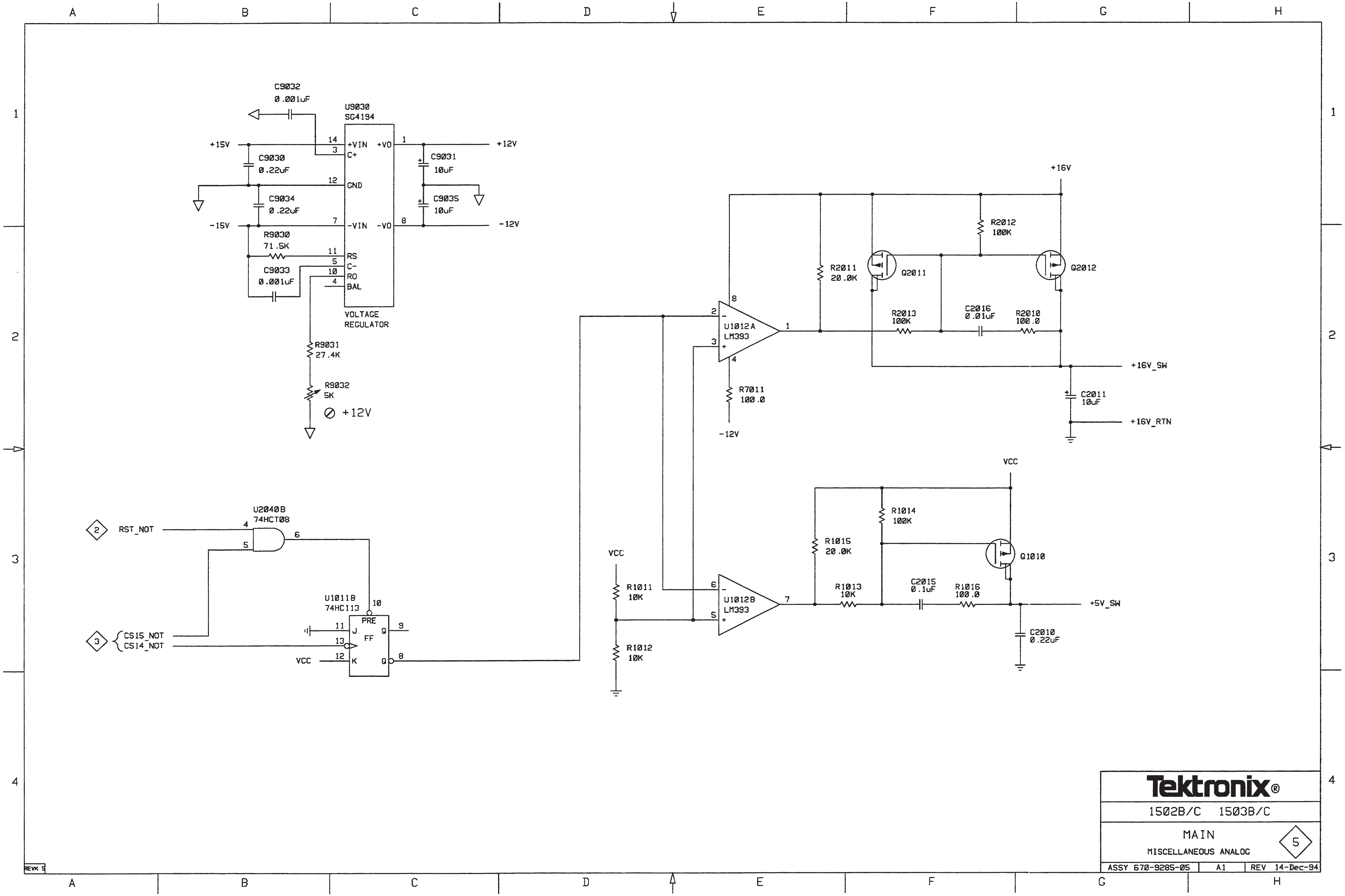
Tektronix®
1502B/C 1503B/C
MAIN
CONNECTORS
ASSY 670-9285-05 A1 REV 14-Dec-94

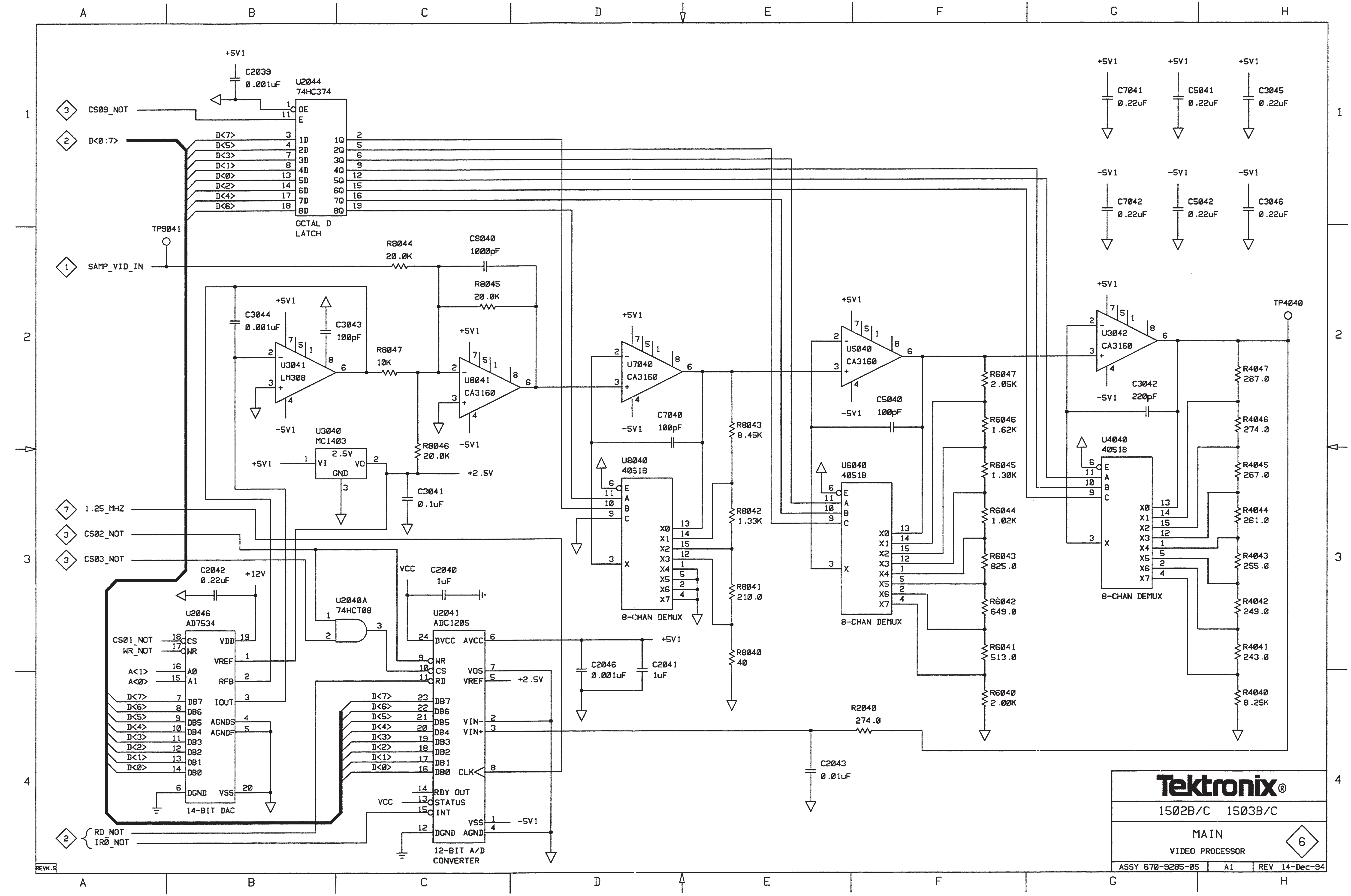

WAIT_NOT
UPCK
BATT_LOW_NOT
AC_POWER_NOT
IR0_NOT
IR2_NOT
IR4_NOT
CS17_NOT
IR3_NOT
IR1_NOT
CS08_NOT
CS31_NOT
CS30_NOT
U1030
74HC30N
TP1040
U1031D
74HC14
R1035
50K
C1030
0.47uF
U1031B
74HC14
R1032
348K
C1021
0.22uF
U1023
Z80-6
WAIT
INT
NMI
RESET
BREQ
CLK
M1
MREQ
IORQ
RD
WR
RFSH
HALT
BACK
8 BIT CPU
U1032A
74C240
QUAD BUFFER
U1032B
74C240
QUAD BUFFER
R1033
9x10K
U3010
74HC374
PIN 20=VCC_2
OCTAL D LATCH
VCC_2
R3010
100.0
U1043A
74HC32
U1022
74HC138
3:8 DECDR/ DEMUX
U2020
27C512-250
64Kx8 EPROM
U2023A
74HC74
PRE
CLR
FF
U1021
5564-15
8KX8 RAM
U1020
5564-15
8KX8 RAM
pin 28=VCCO
R1022
10K
C1024
0.001uF
CR1022
Q1030
C1032
0.001uF
CR1023
R1023
10K
Q1031
R1021
10K
Q1020
C1023
0.001uF
CR1021
R1020
10K
C1022
0.001uF
CR1020
Q1021
U1010
DS1210
NV CNTRLR
8=VCC,4=GND
R1010
475.0
BT1010
U1031A
74HC14
RST_NOT
MREQ_NOT
A_NOT<11>
WR_NOT
DRAM_NOT
CSEN_NOT
RD_NOT
D<0:7>
A<0:14>
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

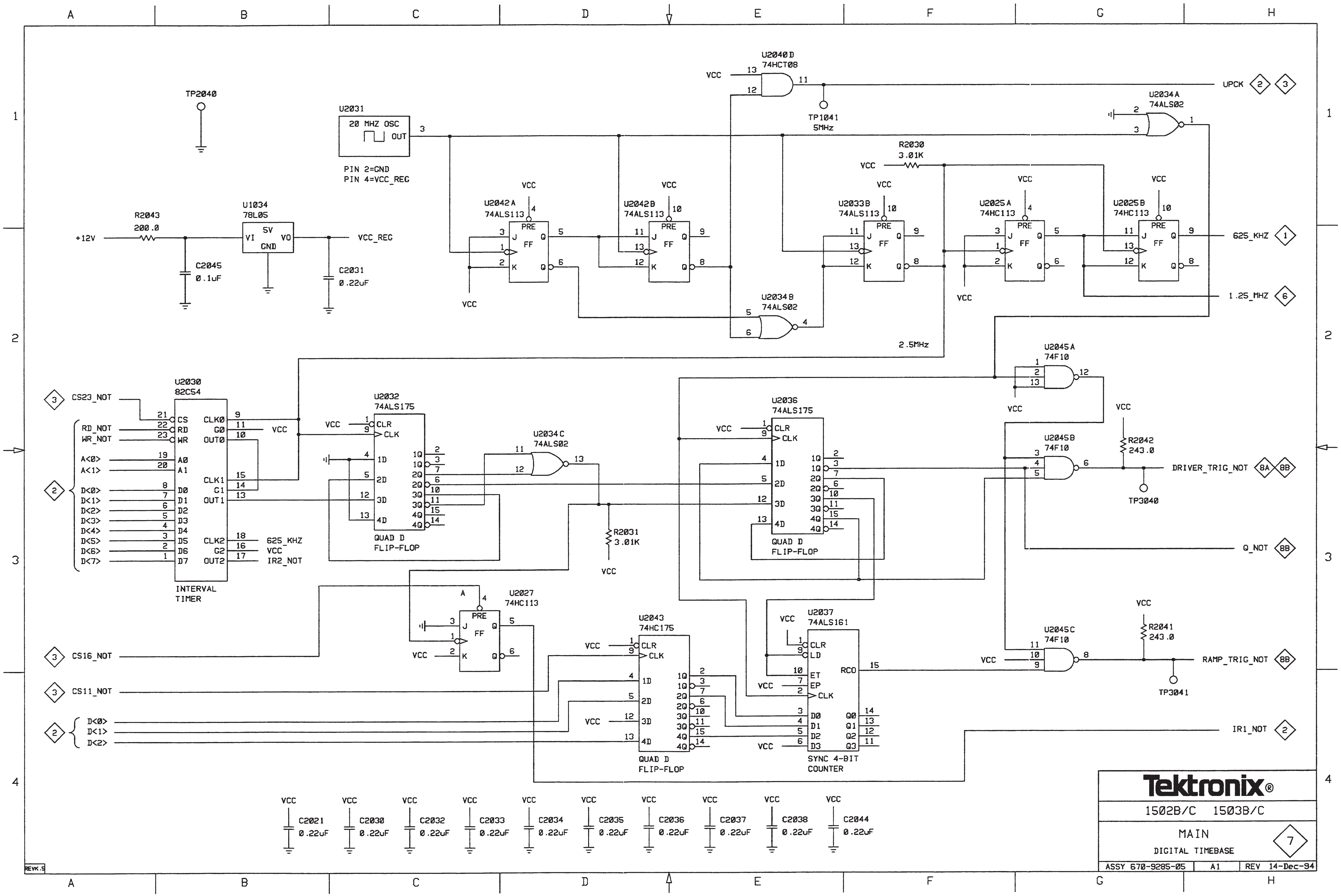


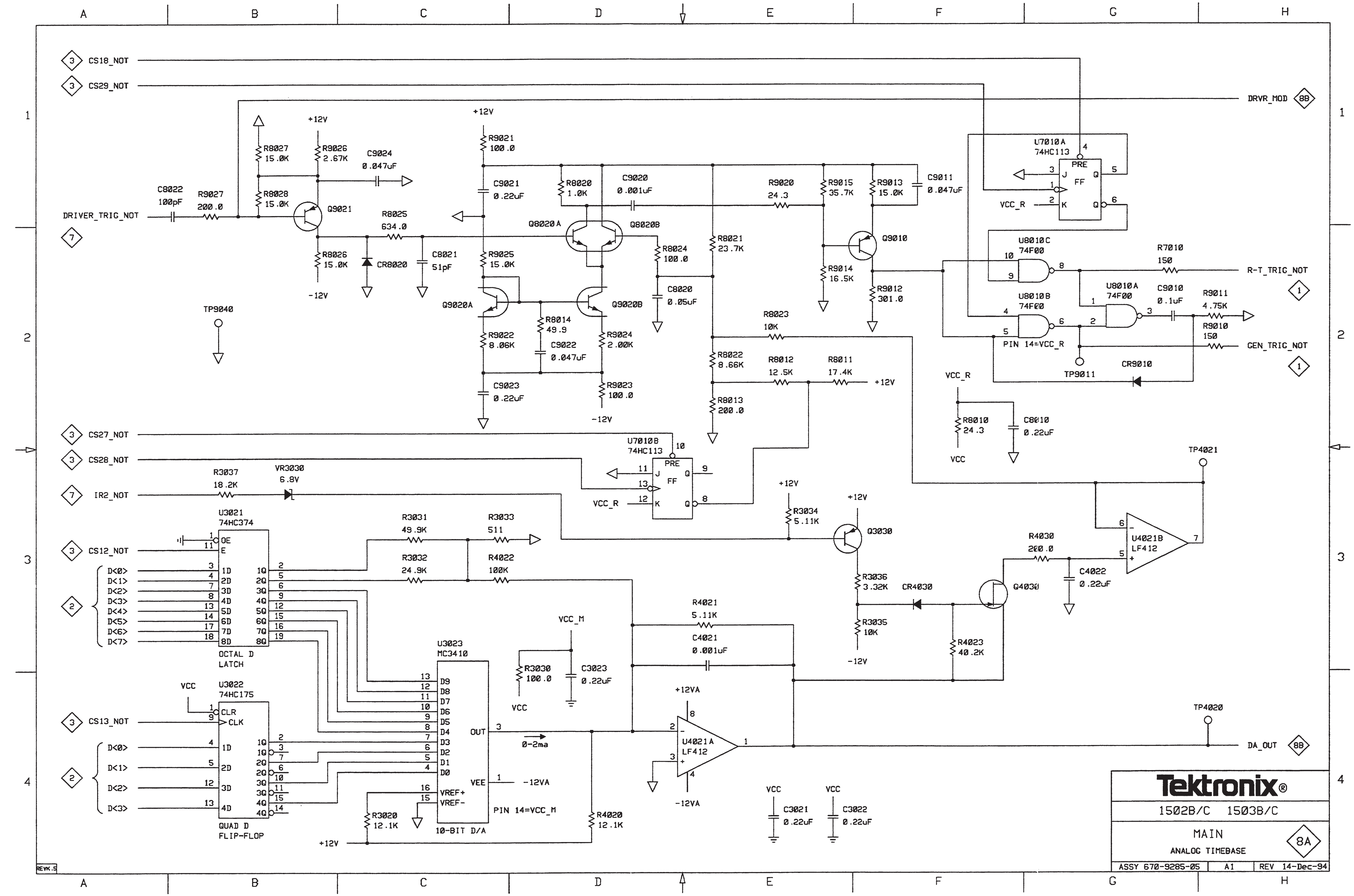
CSEN_NOT
A_NOT<11>
MREQ_NOT
U1042B 74HC27
U2033A 74ALS113
U1031C 74HC14
UPCK
RD_NOT
A<0:15>
U2040C 74HCT08
VCC
U2022 74HC138
3:8 DECDR/ DEMUX
U2024 74HC138
U1043B 74HC32
OPWR_NOT
U2026 74HC138
U2021 74HC138
U2023B 74HC74
CS19_NOT
CS20_NOT
OPWR_NOT
CS00_NOT
CS01_NOT
CS02_NOT
CS03_NOT
CS04_NOT
CS05_NOT
CS06_NOT
CS08_NOT
CS09_NOT
CS10_NOT
CS11_NOT
CS12_NOT
CS13_NOT
CS14_NOT
CS15_NOT
CS16_NOT
CS17_NOT
CS18_NOT
CS21_NOT
CS22_NOT
CS23_NOT
HEAT_EN
CS27_NOT
CS28_NOT
CS29_NOT
CS30_NOT
CS31_NOT
TRIG_ADC
ADC_RD
WAIT_NOT
U1040B 74HC20
U1042A 74HC27
U1041A 74HC74
U1041B 74HC74
U3020A 74HC02
U3020B 74HC02
WR_NOT
RD_NOT
C1040 0.22uF
C1041 0.22uF
C2020 0.22uF
Tektronix
1502B/C 1503B/C
MAIN
ADDRESS DECODE
ASSY 670-9285-05
A1
REV 14-Dec-94

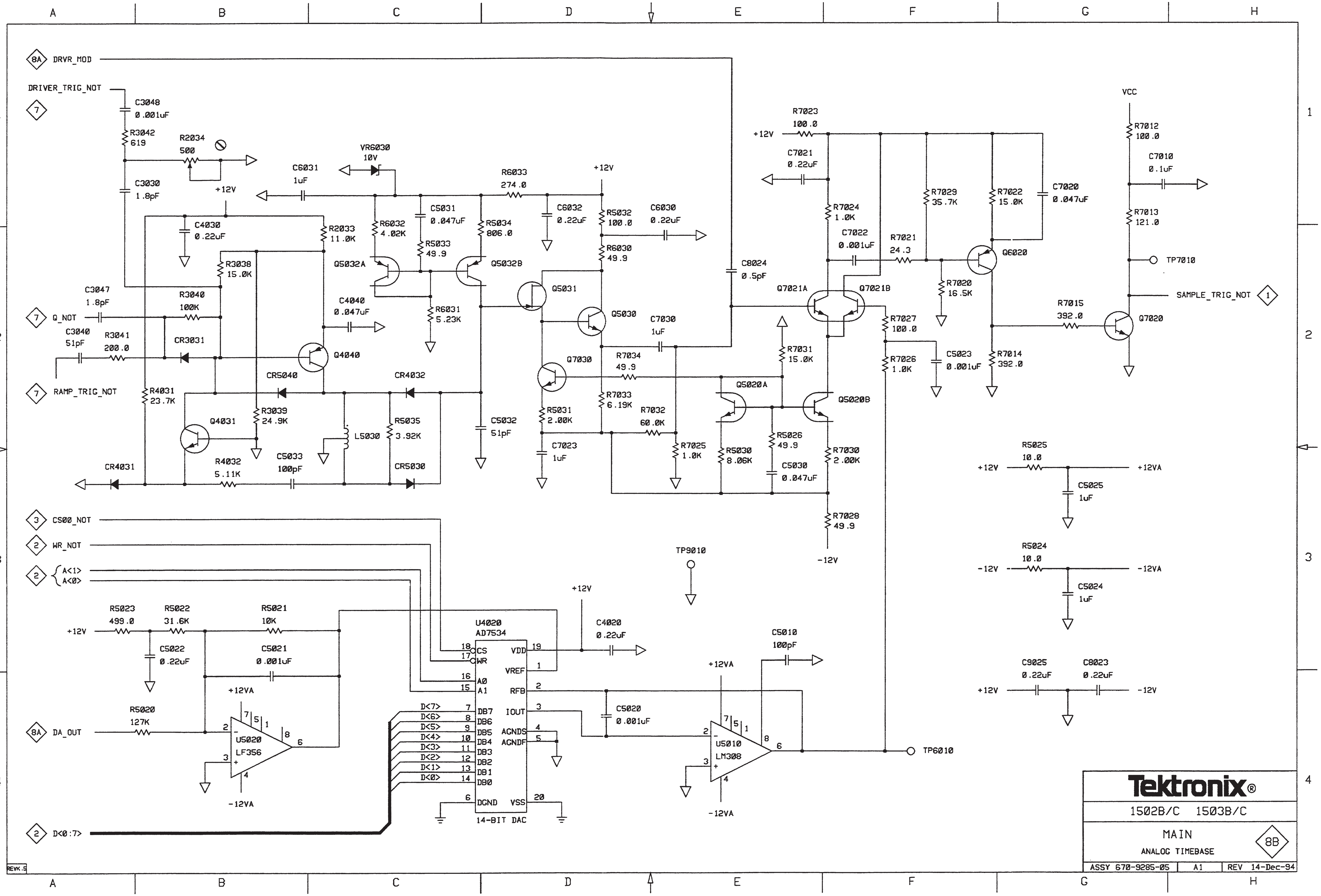

CS22_NOT
RD_NOT
D<0> D<1> D<2> D<3> D<4> D<5> D<6> D<7>
U2011
74HC245
OCTAL BUS TRANSCEIVER
BD<0> BD<1> BD<2> BD<3> BD<4> BD<5> BD<6> BD<7>
R2014
9x10K
U2012B
74HC244
A<0> A<1> A<2> A<3>
QUAD BUFFER
BA<0> BA<1> BA<2> BA<3>
U2012A
74HC244
OPWR_NOT
RD_NOT'
WR_NOT'
CS22_NOT'
R2015
9x10K
+5V_SW
VCC
U1011A
74HC113
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
C+
+12V
C9030
0.22uF
C9031
10uF
GND
C9034
0.22uF
C9035
10uF
-15V
-VIN
-VO
-12V
R9030
71.5K
RS
C-
C9033
0.001uF
RO
BAL
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
U2040B
74HCT08
RST_NOT
R1015
20.0K
Q1010
VCC
R1011
10K
U1012B
LM393
R1013
10K
C2015
0.1uF
R1016
100.0
+5V_SW
U1011B
74HC113
PRE
FF
CS15_NOT
CS14_NOT
VCC
C2010
0.22uF
R1012
10K
Tektronix®
1502B/C 1503B/C
MAIN
MISCELLANEOUS ANALOG
ASSY 670-9285-05
A1
REV 14-Dec-94


CS09_NOT
D<0:7>
SAMP_VID_IN
1.25_MHZ
CS02_NOT
CS03_NOT
RD_NOT
IR0_NOT
U2044
74HC374
OCTAL D LATCH
C2039
0.001uF
TP9041
R8044
20.0K
C8040
1000pF
R8045
20.0K
C3044
0.001uF
C3043
100pF
U3041
LM308
R8047
10K
U8041
CA3160
U3040
MC1403
2.5V
R8046
20.0K
C3041
0.1uF
+2.5V
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
C5041
C3045
C7042
C5042
C3046
0.22uF
C2042
0.22uF
+12V
U2046
AD7534
14-BIT DAC
CS01_NOT
WR_NOT
A<1>
A<0>
U2040A
74HCT08
VCC
C2040
1uF
U2041
ADC1205
12-BIT A/D CONVERTER
C2046
0.001uF
C2041
1uF
+5V1
-5V1
R2040
274.0
C2043
0.01uF
Tektronix
1502B/C 1503B/C
MAIN
VIDEO PROCESSOR
ASSY 670-9285-05
A1
REV 14-Dec-94


TP2040
U2031
20 MHZ OSC
OUT
PIN 2=GND
PIN 4=VCC_REG
U1034
78L05
VI
VO
GND
5V
R2043
200.0
+12V
VCC_REG
C2045
0.1uF
C2031
0.22uF
U2040D
74HCT08
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
U2045B
74F10
U2045C
74F10
R2042
243.0
R2041
243.0
DRIVER_TRIG_NOT
TP3040
Q_NOT
RAMP_TRIG_NOT
TP3041
IR1_NOT
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
QUAD D FLIP-FLOP
U2034C
74ALS02
R2031
3.01K
U2036
74ALS175
QUAD D FLIP-FLOP
U2027
74HC113
CS16_NOT
CS11_NOT
U2043
74HC175
QUAD D FLIP-FLOP
U2037
74ALS161
SYNC 4-BIT COUNTER
RCO
C2021 0.22uF
C2030 0.22uF
C2032 0.22uF
C2033 0.22uF
C2034 0.22uF
C2035 0.22uF
C2036 0.22uF
C2037 0.22uF
C2038 0.22uF
C2044 0.22uF
VCC
Tektronix
1502B/C 1503B/C
MAIN
DIGITAL TIMEBASE
7
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
R9026 2.67K
C9024 0.047uF
Q9021
R8025 634.0
R8026 15.0K
CR8020
C8021 51pF
TP9040
R9021 100.0
C9021 0.22uF
R8020 1.0K
C9020 0.001uF
Q8020A
Q8020B
R9025 15.0K
Q9020A
Q9020B
R8014 49.9
C9022 0.047uF
R9022 8.06K
R9024 2.00K
C9023 0.22uF
R9023 100.0
R8024 100.0
C8020 0.05uF
R8021 23.7K
R9020 24.3
R9015 35.7K
R9013 15.0K
C9011 0.047uF
Q9010
R9014 16.5K
R9012 301.0
U7010A 74HC113
VCC_R
U8010C 74F00
U8010B 74F00
U8010A 74F00
R7010 150
R-T_TRIG_NOT
C9010 0.1uF
R9011 4.75K
R9010 150
GEN_TRIG_NOT
PIN 14=VCC_R
TP9011
CR9010
R8023 10K
R8022 8.66K
R8012 12.5K
R8011 17.4K
R8013 200.0
R8010 24.3
C8010 0.22uF
CS27_NOT
CS28_NOT
IR2_NOT
U7010B 74HC113
R3037 18.2K
VR3030 6.8V
TP4021
R3034 5.11K
Q3030
U4021B LF412
R4030 200.0
C4022 0.22uF
R3036 3.32K
CR4030
Q4030
R3035 10K
R4023 40.2K
U3021 74HC374
CS12_NOT
OCTAL D LATCH
R3031 49.9K
R3033 511
R3032 24.9K
R4022 100K
R4021 5.11K
C4021 0.001uF
U3023 MC3410
VCC_M
R3030 100.0
C3023 0.22uF
U3022 74HC175
CS13_NOT
QUAD D FLIP-FLOP
0-2ma
U4021A LF412
TP4020
DA_OUT
PIN 14=VCC_M
10-BIT D/A
R3020 12.1K
R4020 12.1K
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
C3048 0.001uF
R3042 619
R2034 500
C3030 1.8pF
+12V
C4030 0.22uF
R2033 11.0K
R3038 15.0K
C3047 1.8pF
R3040 100K
Q_NOT
C3040 51pF
R3041 200.0
CR3031
Q4040
RAMP_TRIG_NOT
R4031 23.7K
Q4031
CR5040
R3039 24.9K
C4040 0.047uF
CR4032
R4032 5.11K
C5033 100pF
L5030
R5035 3.92K
CR5030
CR4031
C6031 1uF
VR6030 10V
R6032 4.02K
C5031 0.047uF
R5033 49.9
Q5032A
Q5032B
R6031 5.23K
R5034 806.0
C5032 51pF
R6033 274.0
C6032 0.22uF
R5032 100.0
C6030 0.22uF
R6030 49.9
Q5031
Q5030
C7030 1uF
Q7030
R7034 49.9
R7033 6.19K
R5031 2.00K
C7023 1uF
R7032 60.0K
R7025 1.0K
C8024 0.5pF
R7023 100.0
C7021 0.22uF
R7024 1.0K
C7022 0.001uF
R7021 24.3
R7029 35.7K
R7022 15.0K
C7020 0.047uF
Q6020
R7020 16.5K
Q7021A
Q7021B
R7027 100.0
R7026 1.0K
C5023 0.001uF
R7014 392.0
R7031 15.0K
Q5020A
Q5020B
R5026 49.9
R5030 8.06K
C5030 0.047uF
R7030 2.00K
R7028 49.9
-12V
VCC
R7012 100.0
C7010 0.1uF
R7013 121.0
TP7010
SAMPLE_TRIG_NOT
R7015 392.0
Q7020
R5025 10.0
+12VA
C5025 1uF
R5024 10.0
-12VA
C5024 1uF
C9025 0.22uF
C8023 0.22uF
CS00_NOT
WR_NOT
A<1>
A<0>
R5023 499.0
R5022 31.6K
R5021 10K
C5022 0.22uF
C5021 0.001uF
DA_OUT
R5020 127K
U5020 LF356
D<0:7>
U4020 AD7534
CS WR A0 A1 VDD VREF RFB IOUT AGNDS AGNDF DGND VSS
DB7 DB6 DB5 DB4 DB3 DB2 DB1 DB0
14-BIT DAC
C4020 0.22uF
TP9010
C5020 0.001uF
C5010 100pF
U5010 LM308
TP6010
Tektronix
1502B/C 1503B/C
MAIN
ANALOG TIMEBASE
8B
ASSY 670-9285-05 A1 REV 14-Dec-94

A2 - FRONT PANEL

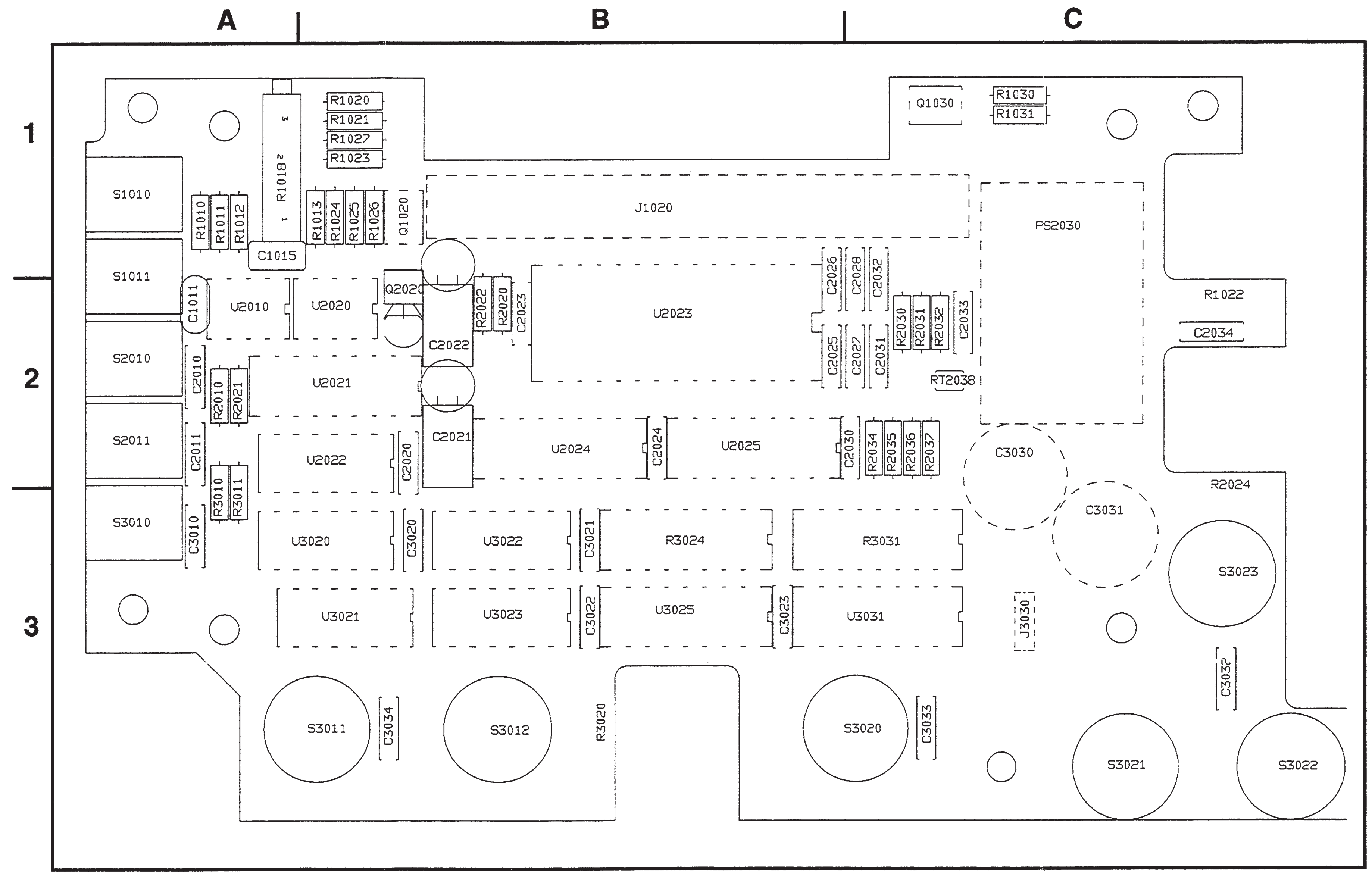
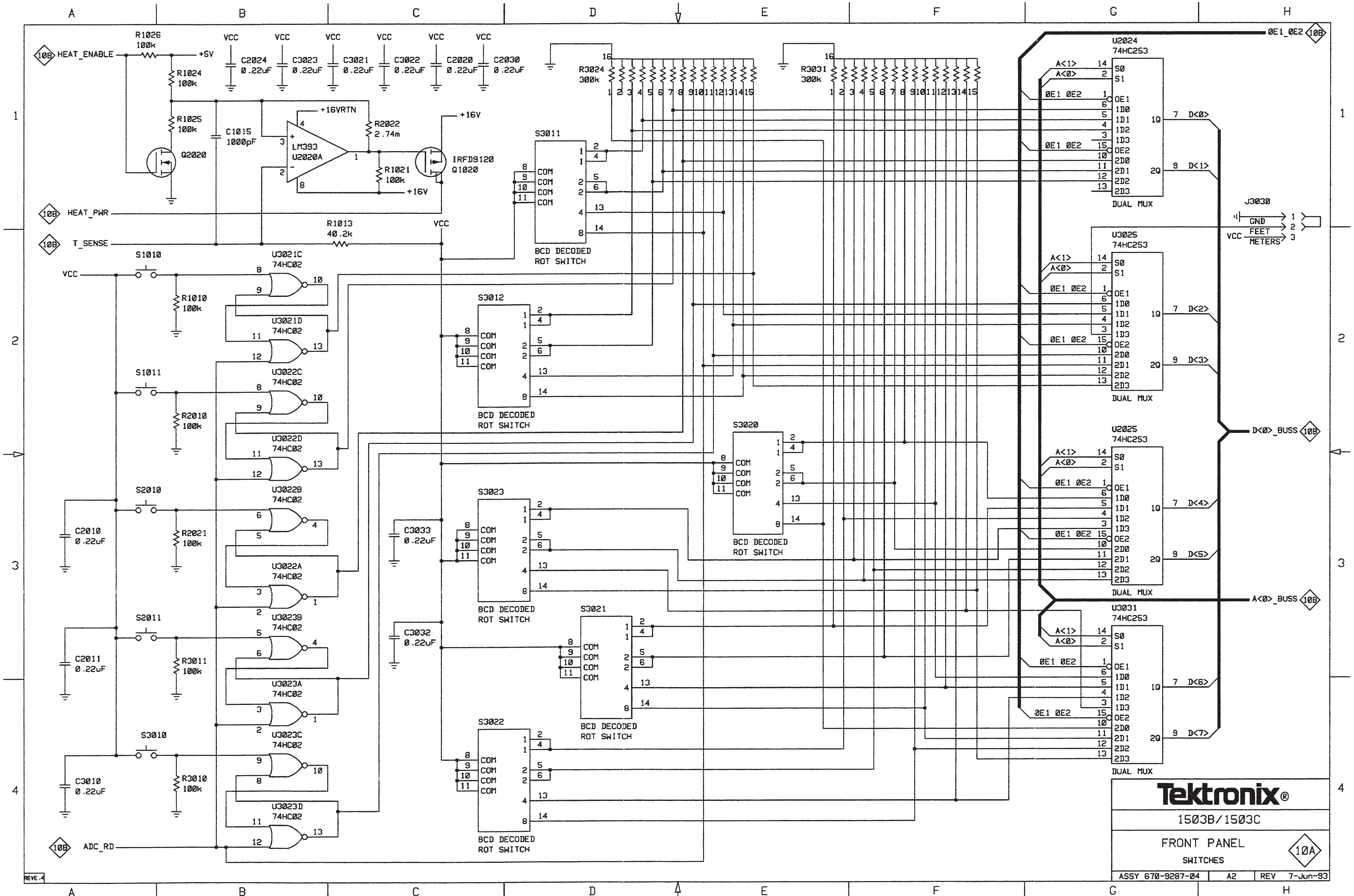
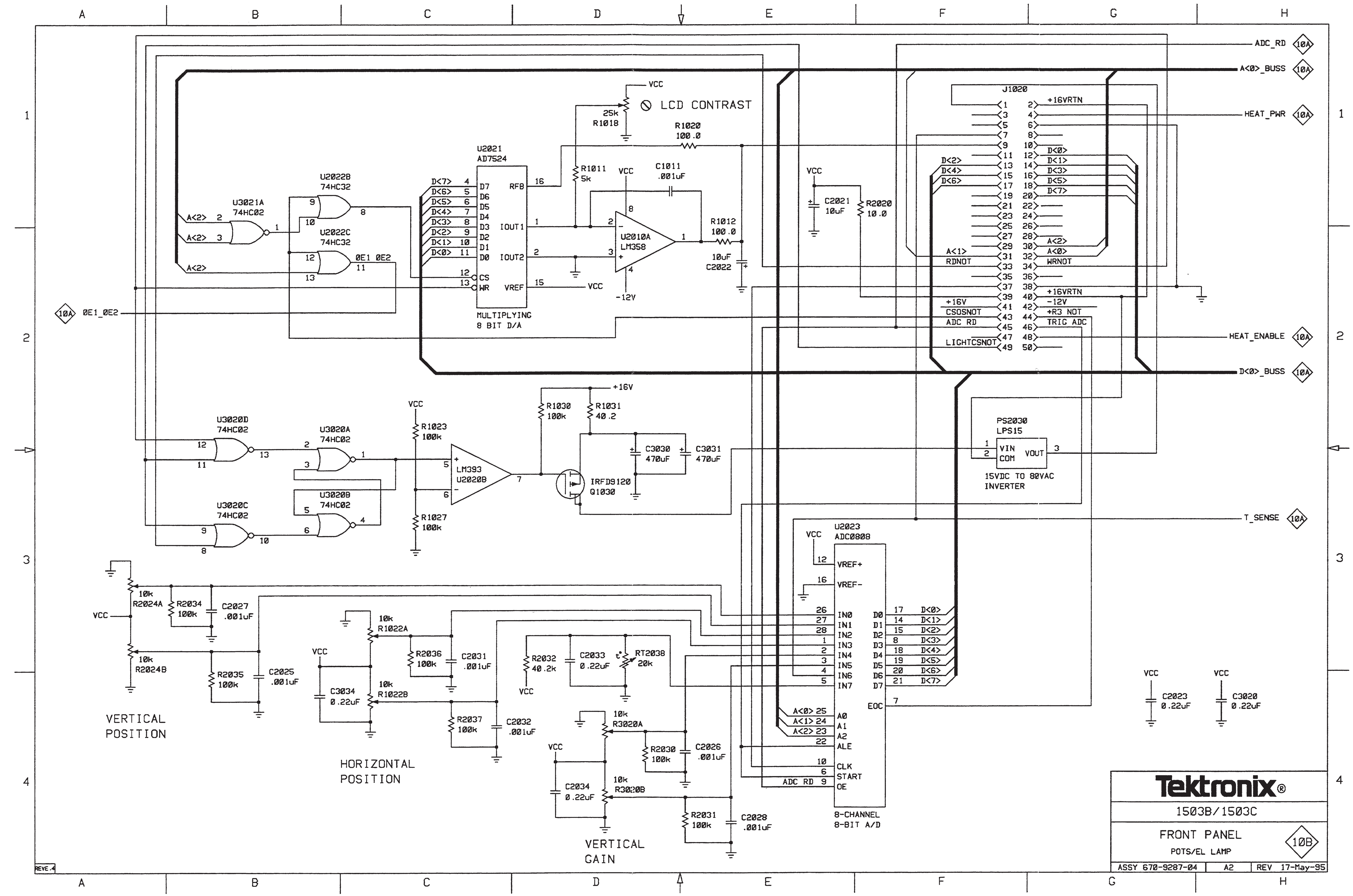
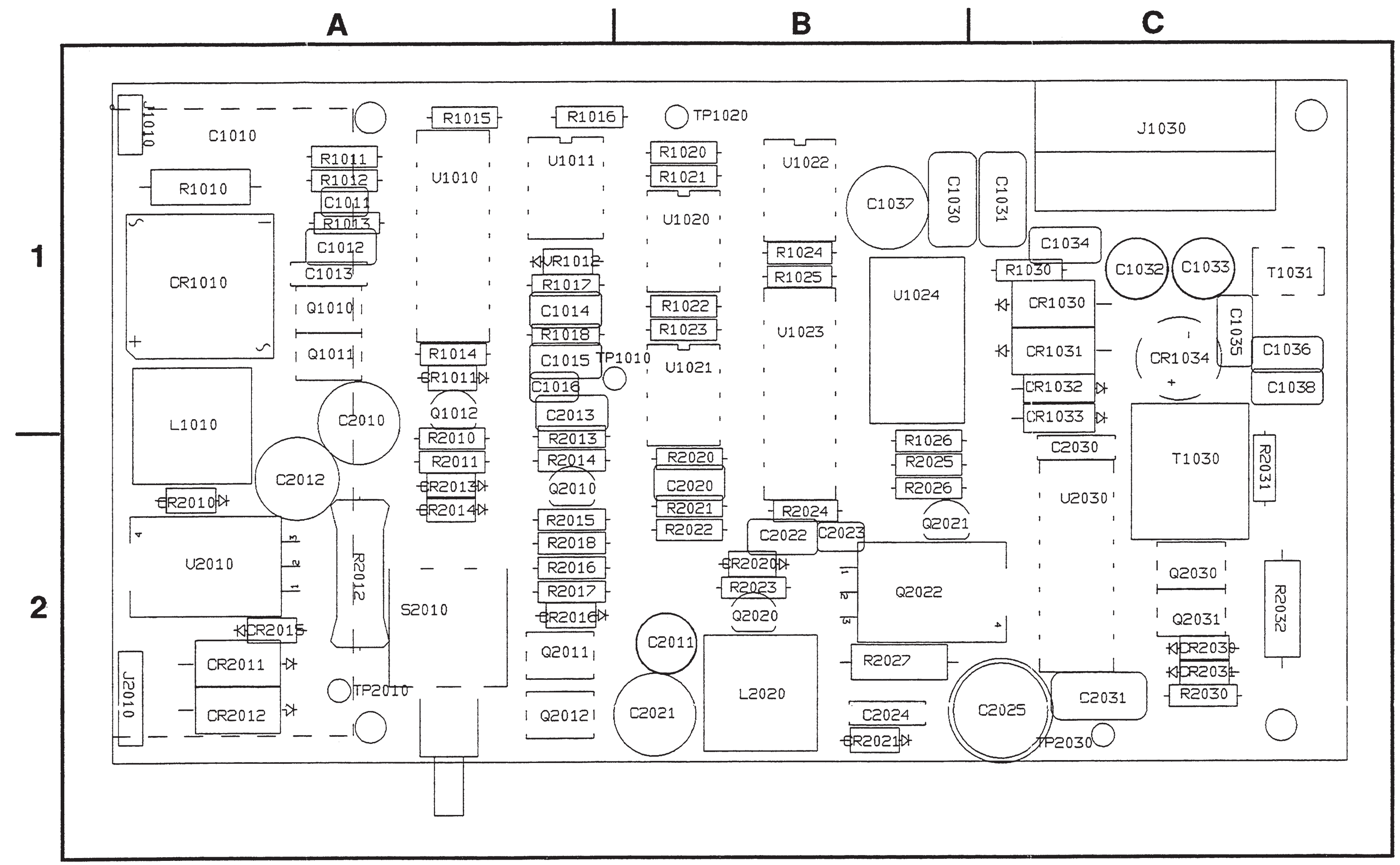


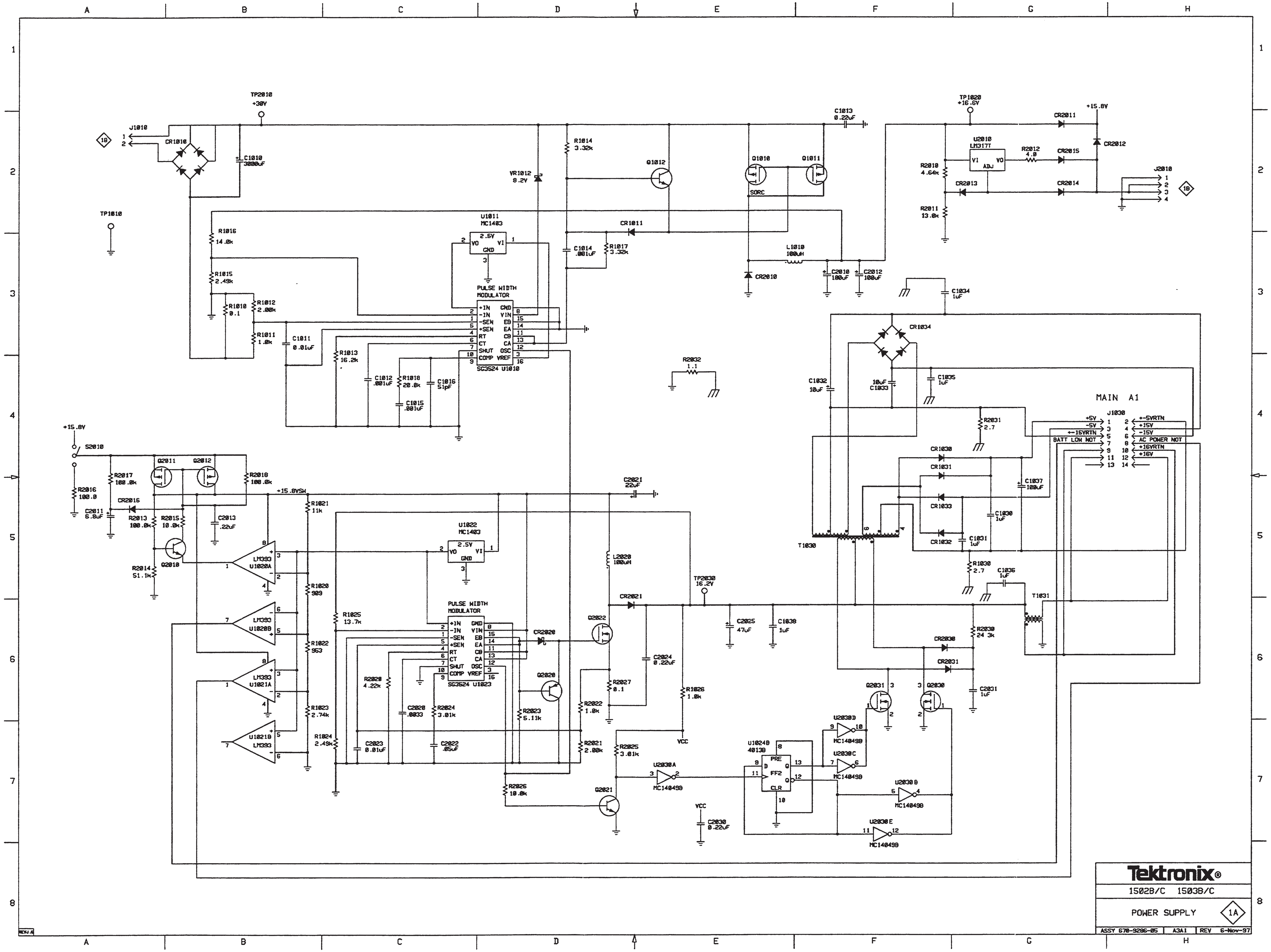
Fig. 9-3. Component Locator - Front Panel Board

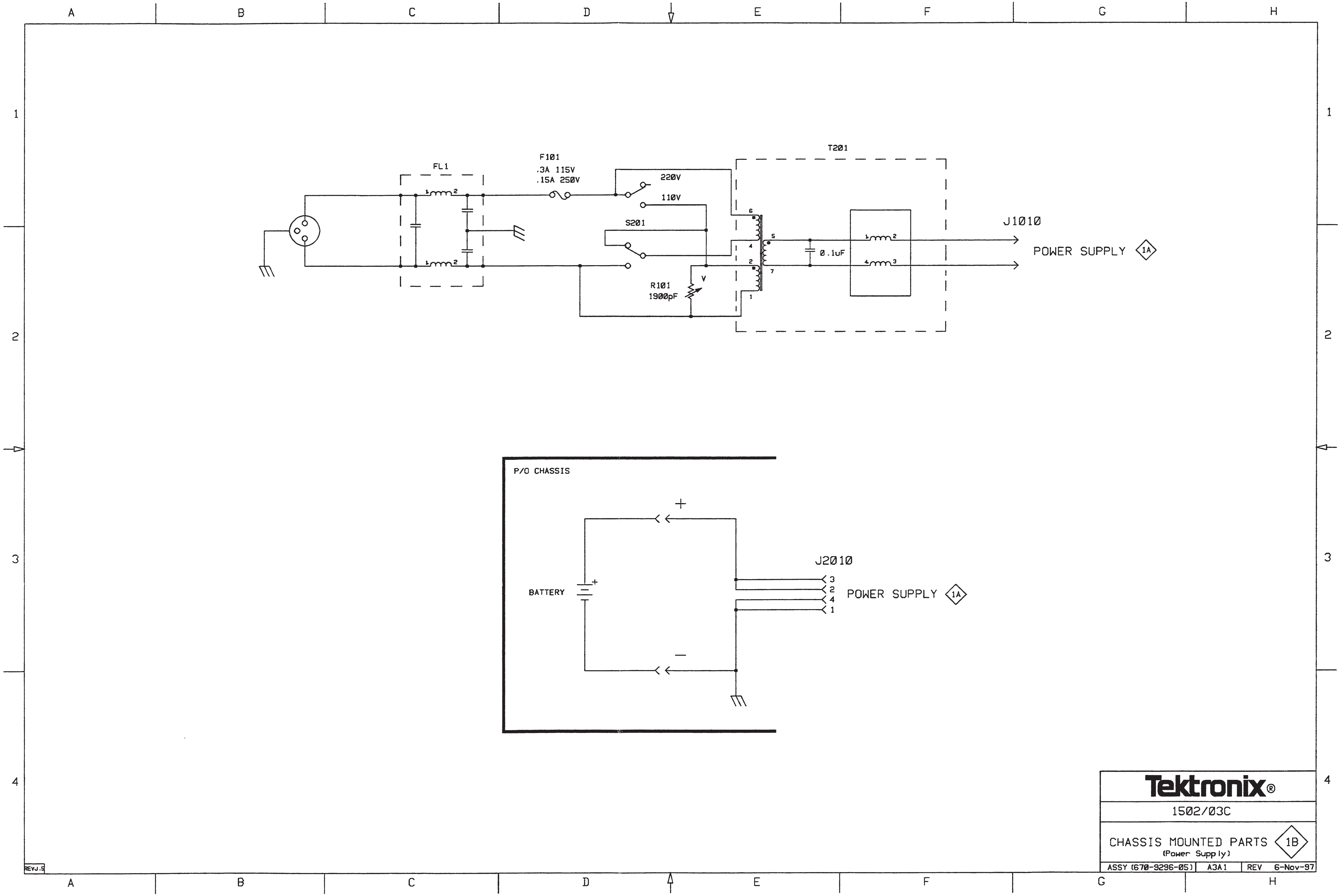

Tektronix®
1503B/1503C
FRONT PANEL
SWITCHES
10A
ASSY 670-9287-04
A2
REV
7-Jun-93
HEAT_ENABLE
HEAT_PWR
T_SENSE
ADC_RD
VCC
+5V
+16V
+16VRTN
LM393
U2020A
Q2020
IRFD9120
Q1020
S1010
S1011
S2010
S2011
S3010
S3011
S3012
S3020
S3021
S3022
S3023
BCD DECODED
ROT SWITCH
COM
R3024
300k
R3031
300k
U2024
U3025
U2025
U3031
74HC253
DUAL MUX
74HC02
J3030
GND
FEET
METERS
D<0>_BUSS
A<0>_BUSS
0E1_0E2
REVE.4


LCD CONTRAST
U2021 AD7524
MULTIPLYING 8 BIT D/A
U2010A LM358
U3021A 74HC02
U2022B 74HC32
U2022C 74HC32
J1020
PS2030 LPS15
15VDC TO 80VAC INVERTER
U3020D 74HC02
U3020A 74HC02
U3020B 74HC02
U3020C 74HC02
LM393 U2020B
IRFD9120 Q1030
U2023 ADC0808
8-CHANNEL 8-BIT A/D
VERTICAL POSITION
HORIZONTAL POSITION
VERTICAL GAIN
ADC_RD
A<0>_BUSS
HEAT_PWR
HEAT_ENABLE
D<0>_BUSS
T_SENSE
0E1_0E2
Tektronix
1503B/1503C
FRONT PANEL
POTS/EL LAMP
10B
ASSY 670-9287-04
A2
REV 17-May-95

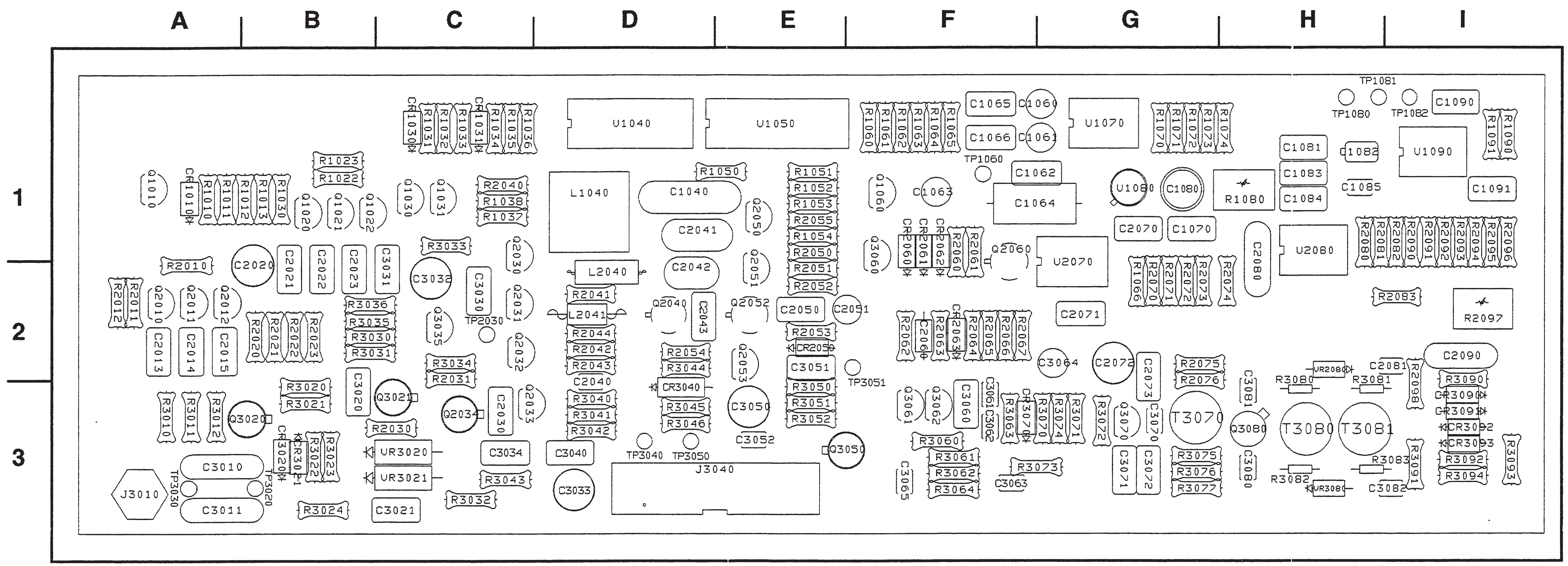
A3A1 - POWER SUPPLY

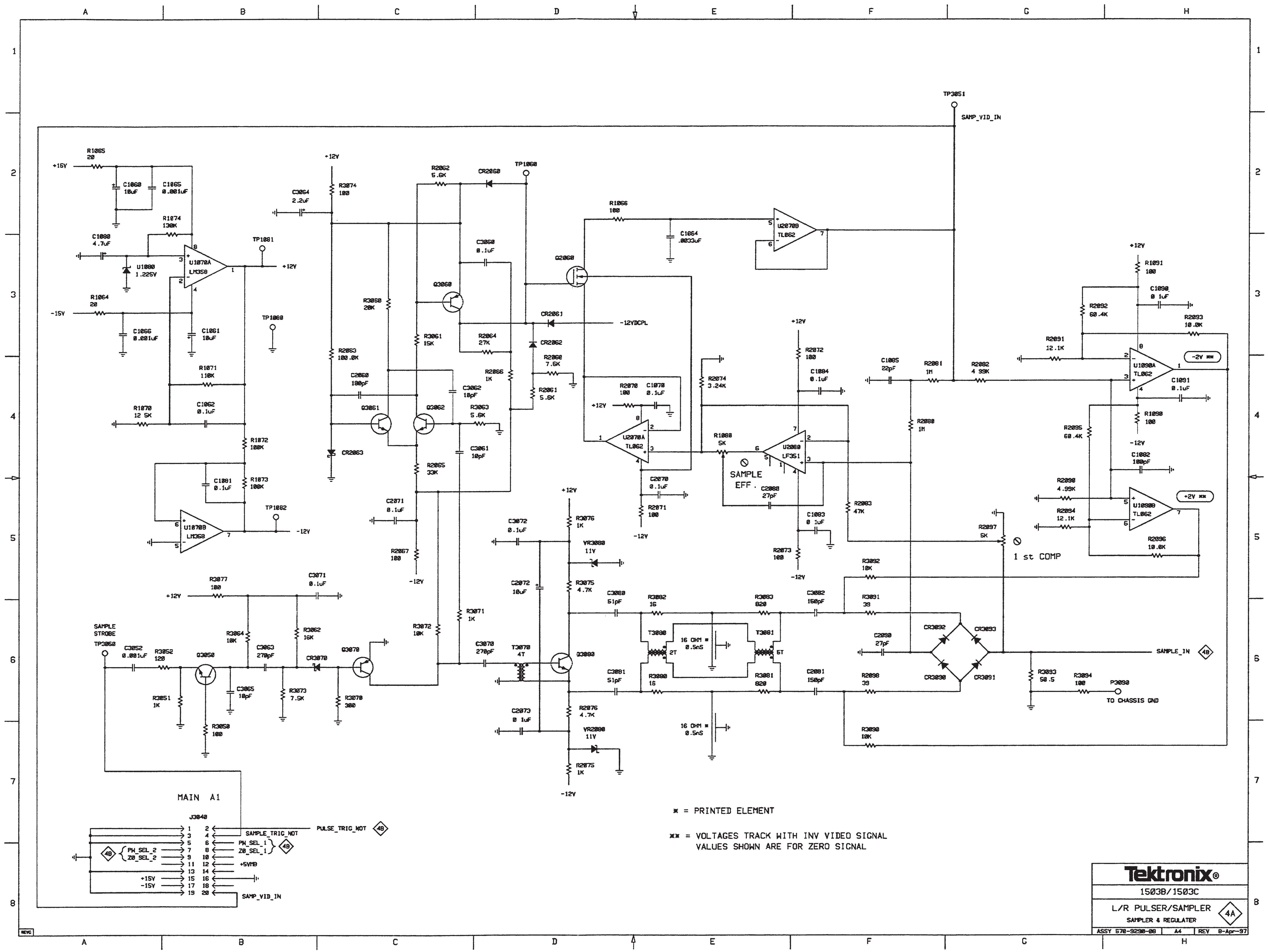


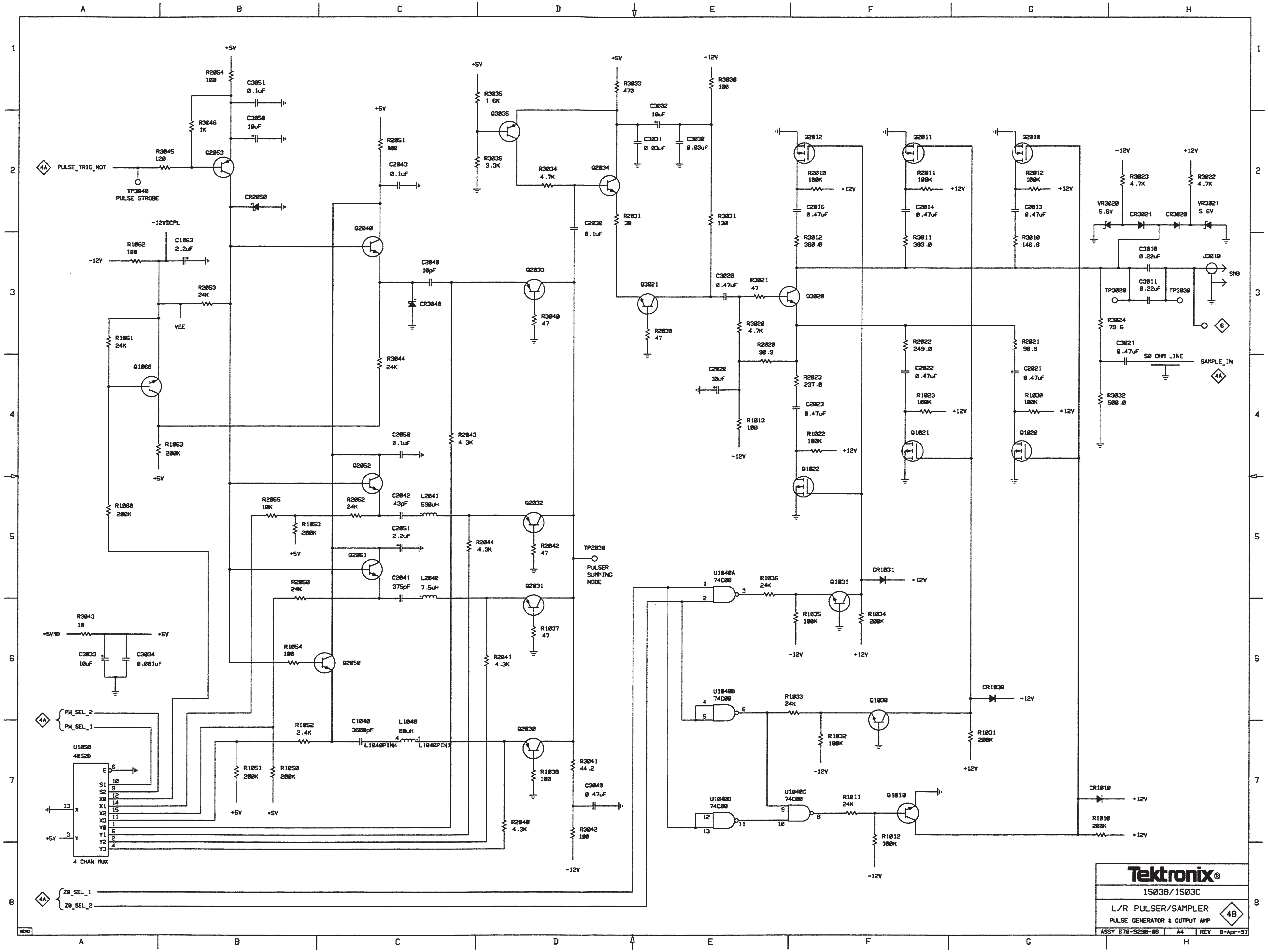

MAIN A1
Tektronix
1502B/C 1503B/C
POWER SUPPLY
1A
ASSY 670-9286-05
A3A1
REV
6-Nov-97


A
B
C
D
E
F
G
H
1
2
3
4
FL1
F101
.3A 115V
.15A 250V
220V
110V
S201
R101
1900pF
T201
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

A4 - L/R PULSER SAMPLER




MAIN A1
J3040
SAMPLE_TRIG_NOT
PULSE_TRIG_NOT
PW_SEL_1
ZØ_SEL_1
PW_SEL_2
ZØ_SEL_2
+5VMB
+15V
-15V
SAMP_VID_IN
SAMPLE STROBE
TP3050
TP3051
SAMPLE_IN
TO CHASSIS GND
SAMPLE EFF.
1 st COMP
-2V **
+2V **
16 OHM = Ø.5nS
* = PRINTED ELEMENT
** = VOLTAGES TRACK WITH INV VIDEO SIGNAL
VALUES SHOWN ARE FOR ZERO SIGNAL
Tektronix
1503B/1503C
L/R PULSER/SAMPLER
SAMPLER & REGULATER
4A


Tektronix
1503B/1503C
L/R PULSER/SAMPLER
PULSE GENERATOR & OUTPUT AMP
ASSY 670-9290-00 A4 REV 8-Apr-97

A6 - ETHERNET - OPTION 06

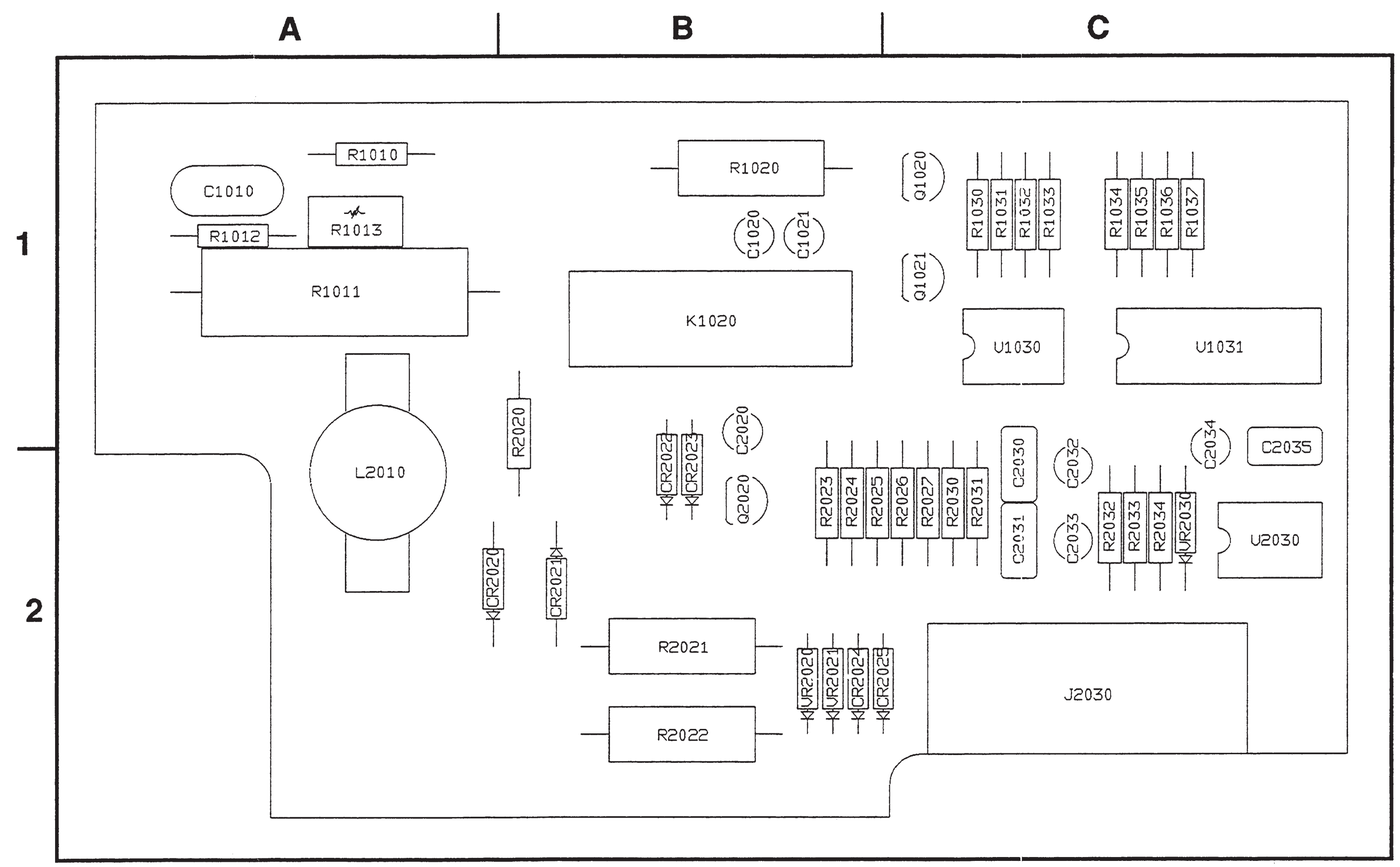
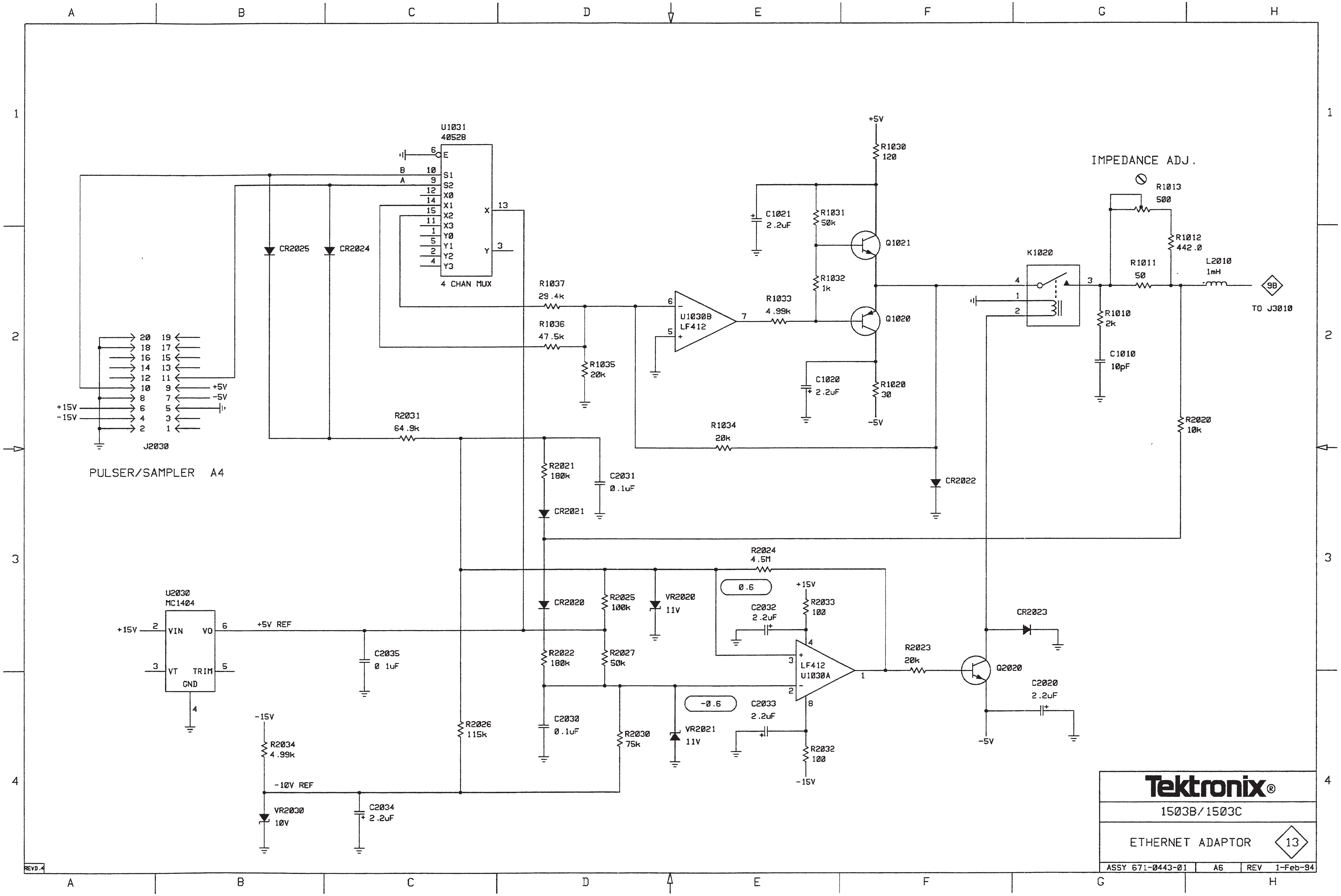


Fig. 9-6. Component Locator - Ethernet Board (Option 06)


U1031
4052B
4 CHAN MUX
IMPEDANCE ADJ.
R1013
500
R1012
442.0
R1011
50
L2010
1mH
TO J3010
K1020
R1010
2k
C1010
10pF
R2020
10k
+5V
R1030
120
C1021
2.2uF
R1031
50k
Q1021
R1032
1k
Q1020
R1033
4.99k
C1020
2.2uF
R1020
30
-5V
U1030B
LF412
R1037
29.4k
R1036
47.5k
R1035
20k
R1034
20k
CR2022
CR2025
CR2024
J2030
PULSER/SAMPLER A4
R2031
64.9k
R2021
180k
C2031
0.1uF
CR2021
R2024
4.5M
0.6
-0.6
+15V
R2033
100
C2032
2.2uF
LF412
U1030A
C2033
2.2uF
R2032
100
-15V
R2023
20k
Q2020
CR2023
C2020
2.2uF
U2030
MC1404
+5V REF
C2035
0 1uF
CR2020
R2025
100k
VR2020
11V
R2022
180k
R2027
50k
C2030
0.1uF
R2030
75k
VR2021
11V
R2026
115k
R2034
4.99k
-10V REF
VR2030
10V
C2034
2.2uF
Tektronix®
1503B/1503C
ETHERNET ADAPTOR
13
ASSY 671-0443-01
A6
REV
1-Feb-94

Replaceable Mechanical Parts

This section contains a list of the replaceable mechanical components for the 1503C. 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
TK2233	AMERICAN SLIDE CHART CORPORATION	14827 NEEDLES ST.	SEPULVEDA, CA 91343
TK2548	XEROX CORPORATION	14181 SW MILLIKAN WAY	BEAVERTON, OR 97005
TK2582	TUFF CAT USA LLC	814 N HAYDEN MEADOWS DRIVE	PORTLAND, OR 97217
TK6159	ARROW/RICHEY ELECTRONICS	ARROW/RICHEY VALUE ADDED 3601 SW MURRY BLVD SUITE 60	BEAVERTON, OR 97005
TK6372	VOLEX INTERCONNECT INC	POWER CORD PRODUCTS 5350 LAKEVIEW PARKWAY SOUTH DRIVE, SUITE D	INDIANAPOLIS, IN 46268
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

Manufacturers Cross Index (Cont.)

Mfr. Code	Manufacturer	Address	City, State, Zip Code
03877	GILBERT ENGINEERING CO INC	5310 W CAMELBACK RD	GLENDALE, AZ 85301–7503
05276	ITT POMONA ELECTRONICS	1500 E NINTH ST	POMONA, CA 91766–3835
060D9	UNITREK CORPORATION	3000 COLUMBIA HOUSE BLVD, SUITE 1 20	VANCOUVER, WA 98661
24931	FCI/BERG ELECTRONICS INC	RF/COAXIAL DIV 2100 EARLYWOOD DR PO BOX 547	FRANKLIN, IN 46131
54318	ASTRO–MED INC	600 EAST GREENWICH AVE	WEST WARWICK, RI 02893
57793	UNITED MICROWAVE PRODUCTS INC	22129 S VERMONT AVE PO BOX V	TORRANCE, CA 90507
64537	KDI/TRIANGLE CORPORATION	60 S JEFFERSON RD	WHIPPANY, NJ 07981
71400	BUSSMANN	DIVISION COOPER INDUSTRIES INC PO BOX 14460	ST LOUIS, MO 63178
74868	AMPHENOL CORP	RF/MICROWAVE OPERATIONS 1 KENNEDY AVE	DANBURY, CT 06810–5803
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	B023241		4	. WSHR,FRICTION:1.820 X 0.388,304SS 20GA	0J9P4	210–1501–00
–15	367–0204–01	B010100	B023240	1	. HANDLE,CARRY:11.7 L,BLK VINYL W/HDW	0J9P4	367–0204–01
	367–0449–00	B023241		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 A2S3011 REPL)		
	——— ———			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
–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)		

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
–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)		
	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)		

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
–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	B024162		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
–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)		
	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					**1503C OPTION 06**		
–1	––––– –––––			1	CKT BD ASSY: (SEE A6 REPL)		
–2	211–0658–00			2	*SCR,ASSEM WSHR:6–32 X 0.312,PNH,POZ*	78189	S51–060545–0X
–3	385–0122–00			1	*SPACER,POST:0.937 L W/6–32THD,AL 0.25 HEX*	80009	385–0122–00
–4	131–3359–00			1	. CONN,HDR:MALE,RTANG,2 X 10	53387	2520–5002UB
–5	351–0755–00			2	GUIDE,CKT BD:POLYCARBONATE,2.5 L	06915	TCG1–2.500–03
FIG. 10-4					**POWER SUPPLY**		
–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	B023217	1	. **A3T201** XFMR: PWR,115/230VAC,50/60HZ	08779	DP241–6–24
	120–1922–00	B023218		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

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
	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	. *SCR,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
					POWER CORD OPTIONS		
	161–0066–00			1	CA ASSY,PWR:3,18 AWG,250V/10A,98 INCH,STR,IEC320,RCPT X NEMA 5–15P,US	0B445	ECM–161–0066–00
	161–0066–10			1	CA ASSY,PWR:3,1.0 MM SQ,250V/10A,2.5 METER,STR,IEC320,RCPT X 13A,FUSED UK PLUG (13A FUSE),UNI	TK2541	ORD BY DESCR
	161–0066–11			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER,STR,IEC320,RCPT,AUSTRALIA	80126	ORD BY DESCR
	161–0066–12			1	CA ASSY,PWR:3,18 AWG,250V/10A,98 INCH,STR,IEC320,RCPT X NEMA 6–15P,US	S3109	ORD BY DESCR
	161–0154–00			1	CA ASSY,PWR:3,1.0MM SQ,250V/10A,2.5 METER,STR,IEC320,RCPT,SWISS	5F520	86515030
					STANDARD ACCESSORIES		
	016–0915–00			1	BATTERY ASSY:1502C/1503C	80009	016–0915–00
	159–0029–01			1	FUSE,CARTRIDGE:3AG,0.3A,250V,12 MIN,BUSSMAN ONLY	71400	MDL3/10
	159–0054–00			1	FUSE,CARTRIDGE:3AG,0.15A,250V,25SEC	71400	MDL 15/100
	161–0228–00			1	CABLE ASSY,PWR:3,18 AWG,98 L,SJTWA,BLK, 60 DEG C,MC–6–3C X STR,BME,10A/125V	TK6372	FH49061
	200–3737–00			1	COVER,FRONT:OPTION PORT	0J260	
	011–0123–00			1	TERMN,COAXIAL:50 OHM,BNC,VSWR DC–4GHZ 1.15	64537	T190CS
	103–0028–00			1	ADAPTER, CONNEC:BNC FEMALE TO FEMALE, 1.3 L, GOLD/NICKEL	24931	28A100–2
	012–1351–00			1	CABLE,INTCON:93 OHM,10 FEET L,W/STR RELIEF	TK6159	ASI 65293
	013–0261–00			1	ACCESS,ADAPTER:2 WIRE,FEMALE,BNC/W STR RELIEF TO ALLIGATOR CLIPS,7.0 L	TK6159	PAMONA #2630
	103–0058–00			1	ADAPTER,CONN:N FEMALE TO BNC MALE	91836	KN–99–46
	012–1350–00			1	CABLE,INTCON:50 OHM,3 FEET L,W/STR RELIEF	TK6159	ASI 65289
	070–7323–XX			1	MANUAL,TECH:OPERATORS,1503C	80009	
	003–1419–00			1	SLIDE RULE:TDR W/MANUAL	TK2233	

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
					OPTIONAL ACCESSORIES		
	016–0814–00			1	POUCH,ACCESSORY:11.5 L X 9.5 W X 1.75 H,VINYL	TK2582	
	070–7170–01			1	MANUAL,TECH:SERVICE,1503C S/N B01	TK2548	070–7170–01
	070–7170–XX			1	MANUAL,TECH:SERVICE,1503C S/N B02	80009	070–7170–00
	040–1276–00			1	MOD KIT:150XC OPTION 03 BATTERY INCLUDING INSTRUCTIONS	80009	040–1276–00
	119–3616–00			1	CHART RECORDER:SPLASH PROOF YTIS	54318	YT–1S
	006–7647–00			1	PAPER,CHART:THERMAL,YT1,SINGLE (100 FEET)	54318	40952–903
	006–7677–00			1	PAPER,CHART:THERMAL,YT1,BOX OF 25	80009	
	006–7681–00			1	PAPER,CHART:THERMAL,YT1,BOX OF 100	80009	006–7681–00
	012–0671–03			1	CABLE,INTCON:360.0 L PA1 TO OPTION	060D9	012–0671–03
	103–0029–00			1	ADAPTER, CONN:BNC MALE TO MALE	24931	28A101–4
	013–0261–00			1	ACCESS,ADAPTER:2 WIRE,FEMALE,BNC/W STR RELIEF TO ALLIGATOR CLIPS,7.0 L	TK6159	PAMONA #2630
	013–0076–01			1	ADAPTER,CONN:BNC TO RETRACTABLE HOOK TIP	05276	MODEL 3788
	103–0090–00			1	ADAPTER, CONNEC:BNC FEMALE TO DUAL BANANA PLUG	05276	1269 ADAPTER
	103–0035–00			1	ADAPTER, CONNEC:BNC DUAL BINDING POST	05276	1296
	103–0058–00			1	ADAPTER,CONN:N FEMALE TO BNC MALE	91836	KN–99–46
	103–0045–00			1	ADAPTER, CONN:N MALE TO BNC FEMALE	24931	29 JP104–3
	103–0015–00			1	ADAPTER,CONN:BNC TO UHF	24931	29JP100–3
	103–0032–00			1	ADAPTER,CONN:BNC MALE TO UHF FEMALE	74868	30429–2
	103–0158–00			1	ADAPTER, CONN:BNC FEMALE TO F SERIES MALE	24931	29JP151–1
	013–0126–00			1	ADAPTER,CONN:BNC PLUG TO F JACK (BNC MALE TO F TYPE FEMALE)	80009	013–0126–00
	017–0063–00			1	ADAPTER,CONN:GR TO TEK CONN,W/PNL MT NUT	03877	0874–9700
	017–0064–00			1	ADAPTER,CONN:TYPE BNC TO GR,MALE	57793	ORD BY DESCR
	012–1350–00			1	CABLE,INTCON:50 OHM,3 FEET L,W/STR RELIEF	TK6159	ASI 65289
	011–0102–00			1	TERMN,COAXIAL:75 OHM,BNC	80009	011–0102–00
	015–0327–00			1	FILTER,DIR CUR:1502	80009	015–0327–00
	013–0169–00			1	ADAPTER ASSY:ISLN XFMR,BALANCED OUTPUT	80009	013–0169–00
	015–0495–00			1	XFMR,PULSE:INVERTER,TORIOD,1503,8 BIFILAR TURNS	80009	015–0495–00
	015–0500–00			1	ADAPTER KIT:TOKEN RING NETWORK	80009	015–0500–00
	015–0579–00			1	ADAPTER,TDR:USOC NETWORK	80009	
	015–0578–00			1	ADAPTER KIT:STARLAN NETWORK	060D9	
	015–0600–00			1	ADAPTER,RING:TOKEN RING INTERFACE	80009	015–0600–00

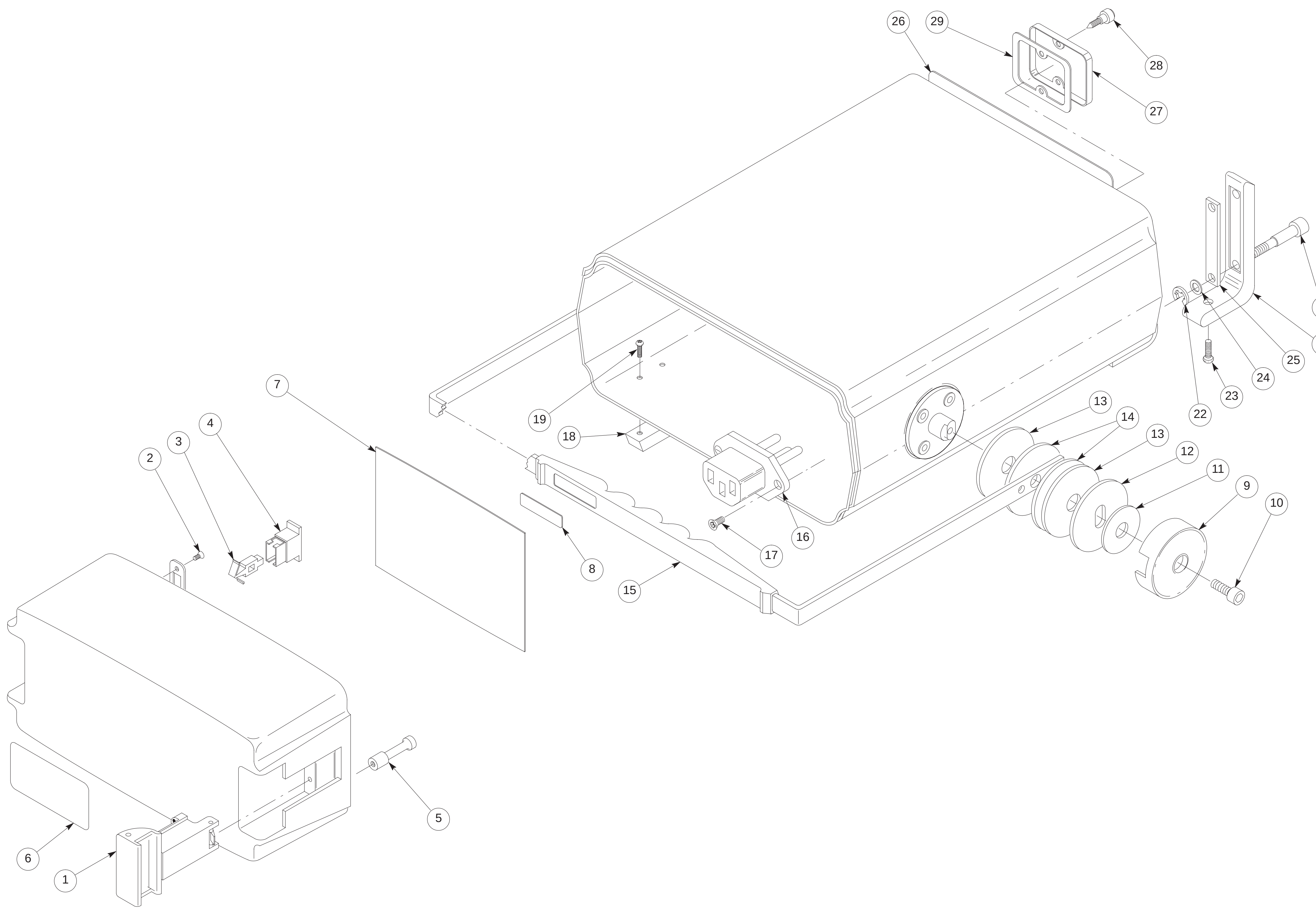


Figure 10-1: 1503C Cabinet

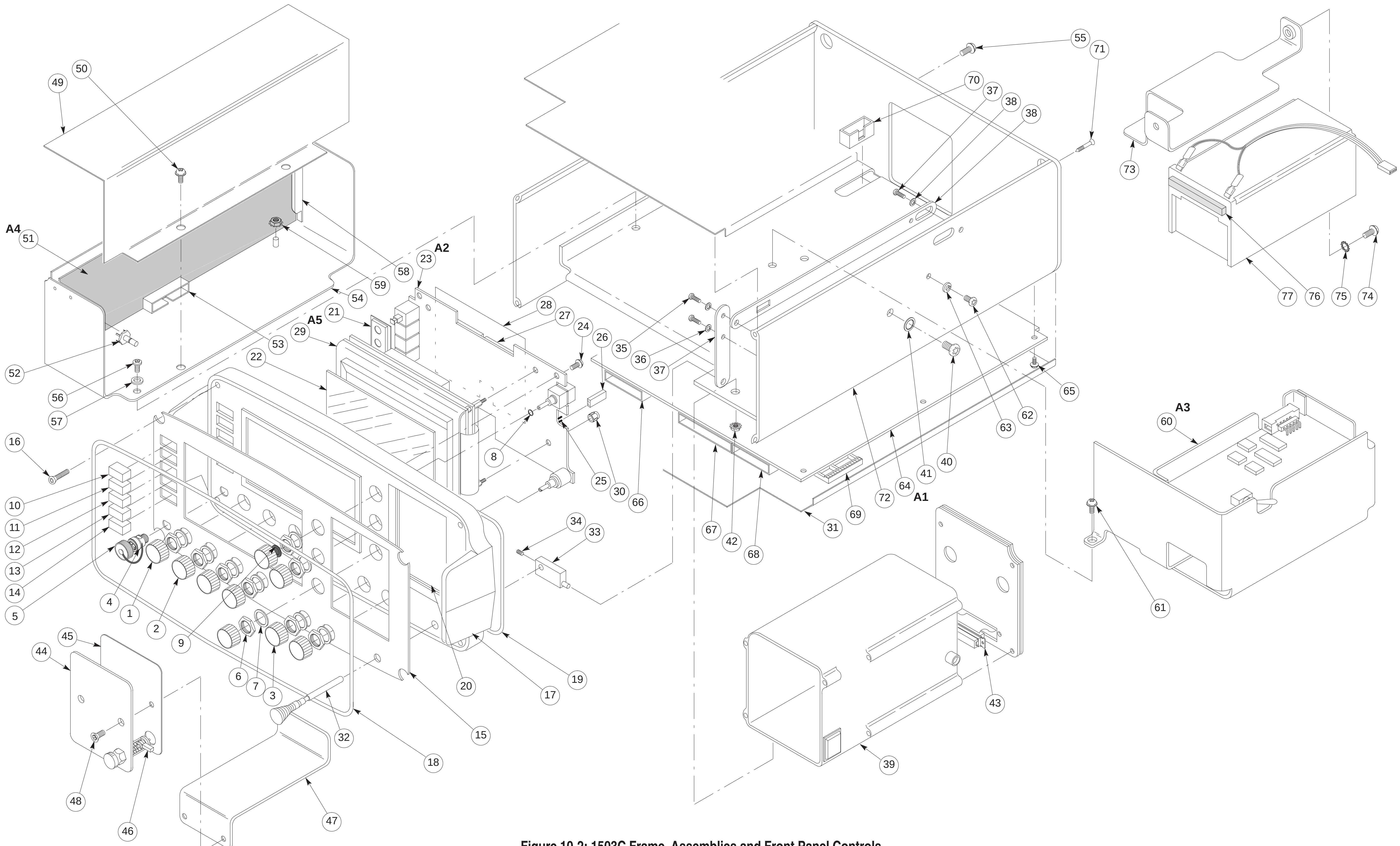


Figure 10-2: 1503C Frame, Assemblies and Front Panel Controls

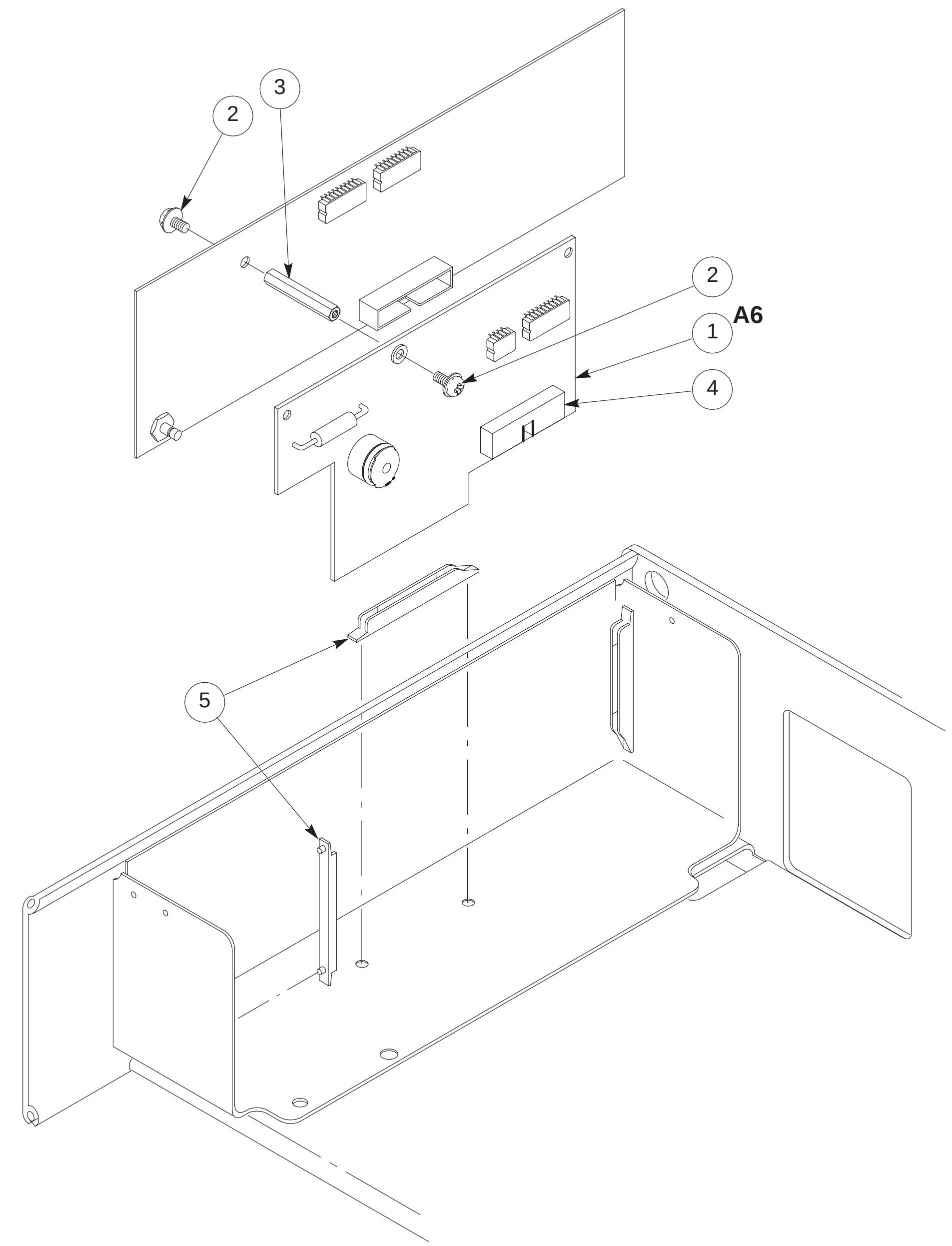


Figure 10-3: 1503C Option 06 (Ethernet)

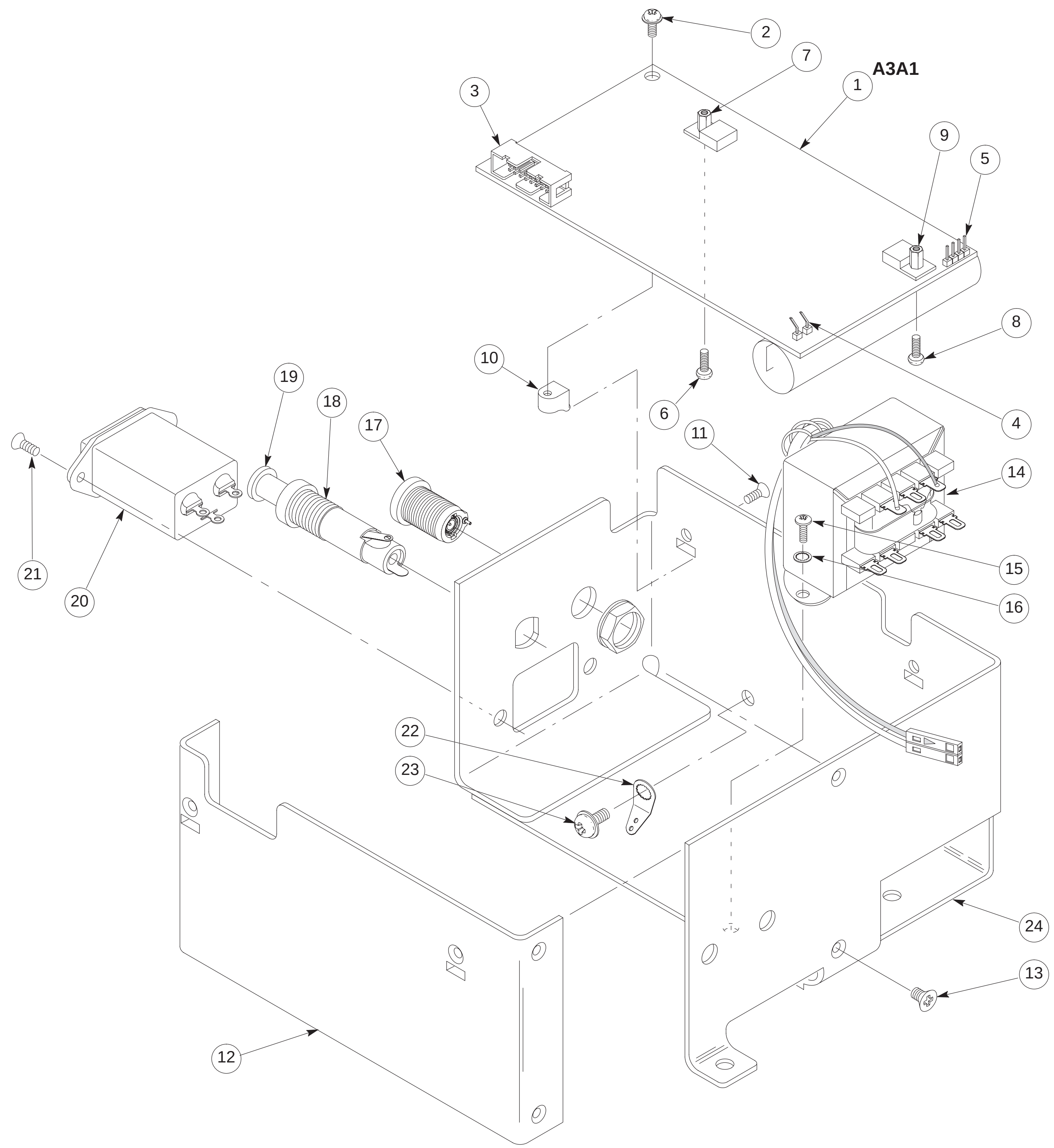


Figure 10-4: 1503C Power Supply

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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