Service Manual

Tektronix

TV110 CableScout
Metallic Time-Domain Reflectometer

070-8815-02

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Instrument Serial Numbers

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

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

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

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

Printed in U.S.A.

FCC Class A Device

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

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

The TV110 CableScout was designed and manufactured by:

Tektronix, Inc.
P.O. Box 1197
625 S.E. Salmon Street
Redmond, Oregon 97756-0227 U.S.A
Telephone: 1-800-835-9433

WARNING

This equipment generates, uses, and can radiate radio-frequency energy, and if not installed and used in accordance with the instructions in the user manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart B of Part 15 of FCC Rules, which are designated to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference, in which case, the user, at his or her own expense, will be required to take whatever measures may be required to correct the interference.

EC Declaration of Conformity

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

declare under sole responsibility that the

TV110 CableScout Metallic Time-Domain Reflectometer

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

EN 55011	Class A Radiated Emissions
EN 55011	Class A Conducted Emissions
EN 50081−1 Emissions	
EN 60555−2	AC Power Conducted Emissions
EN 50082−1 Immunity:	
IEC 801−2	Electrostatic Discharge Immunity
IEC 801−3	RF Electromagnetic Field Immunity
IEC 801−4	Electrical Fast Transients/Burst Immunity, AC Mains
IEC 801−4	Electrical Fast Transients/Burst Immunity, Signal and I/O
IEC 801−5	Power Line Surge Immunity

WARRANTY

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

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

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

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

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Safety Summary

Power Source

The TV110 is designed to operate from an internal 6-volt battery or an external battery charger/adapter supplying 9-to-16 VDC to the instrument.

Battery Pack Do not expose the battery pack to fire or intense heat. Do not open or mutilate the battery pack. Avoid contact with released electrolyte, which is corrosive and might damage eyes, skin, and clothing. Check with local codes for special disposal instructions.

External Power Use only the AC adapter/charger that is specified for the TV110.

Grounding the Instrument

It is not necessary to ground the instrument during normal use. Cases are non-conductive and internal voltages are not accessible to the operator.

Do Not Operate in Explosive Atmosphere

Do not operate the instrument in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Remove Covers or Panels

To avoid personal injury, do not remove the instrument covers or panels, nor operate the instrument without covers and panels in place. Refer service to qualified service personnel.

Disposal of Batteries

This instrument contains a sealed, spill-proof 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 TV110 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 it should be packed in shock-absorbant material.

Send batteries, post-paid, to:

Tektronix, Inc.
Attn: Redmond Service
625 S.E. Salmon, Bldg. X–7
Redmond, OR 97756

For additional information, phone: 1–541–923–4407.

Preface

Manual Structure

This is the Service Manual for the TV110 CableScout Metallic Time-Domain Reflectometer (MTDR). This manual gives information for servicing the instrument to module level.

- The *Introduction* provides strategy for servicing and details Tektronix service offerings.
- If you are not familiar with the operation of the TV110, read the *Operating Information* section to become familiar with the controls prior to attempting any servicing.
- Use the *Theory of Operation* section to learn how the TV110 electronics function. This might give you a better idea of where to look for problems.
- The *Performance Verification* and *Maintenance* sections provide the necessary information you need for putting the instrument back into useful service.
- The *Replaceable Parts* section provides you with part numbers for ordering electrical modules and mechanical parts.

Manual Conventions

In this manual, you will find various procedures that contain steps of instructions for you to perform. To keep those instructions clear and consistent, this manual uses the following conventions:

- Names appear in the same case (all uppercase, upper/lowercase, etc.) in this manual as is used on the MTDR front panel and menus. Front-panel names are all uppercase. For example: POWER, HELP, etc.
- Instruction steps are numbered. The number is omitted if there is only one step.

Definitions of Terms used in this Manual

CAUTION. *statements identify conditions or practices that could result in damage to the equipment or other property, or corruption to or loss of files or software.*

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

Related Manuals

See *TV110 CableScout Metallic Time-Domain Reflectometer User Manual* for complete operating information.

TV110 CableScout Metallic Time-Domain Reflectometer Reference card.

Part numbers for the above are listed in chapter 8, *Options and Accessories*.

If You Need Help

Information about servicing the TV110 is available by calling Tektronix number: **1–800–835–9433.**

The address of the Tektronix product group that manufactures the TV110 is: Tektronix, Inc.,P.O. Box 1197, 625 S.E. Salmon St., Redmond, OR 97756–0227 U.S.A.

Assumptions

The procedures in this manual assume that you are a qualified electronics technician and have a working knowledge of servicing procedures for metallic time-domain reflectometry test equipment.

Introduction

Strategy for Servicing

The TV110 CableScout is intended to be serviced to module level only. That is, service information will indicate that the fault is located in the LCD module, the front-panel keyboard module, the connectors module, battery, or the circuit board. Service to a lower level is not recommended or supported.

Tektronix Service Offerings

Tektronix offers several instrument maintenance solutions that address the problems of instrument downtime:

Agreement Repair Service

This preferred service is a full-featured maintenance support arrangement that allows you to know, up front, your exact annual repair costs. Considerable savings over per-incident prices can be gained with this agreement. We guarantee fast turnaround, unlimited remedial support, up-to-the-minute safety and reliability modifications in accordance with the latest engineering change orders at Tektronix, plus the care and expertise of a world-class service organization.

Standard-Price Repair Service

When you just want the instrument fixed, we offer the standard-price repair service. The problem is identified and repaired promptly, we install up-to-the-minute safety modifications in accordance with the latest engineering change orders, and to ensure optimum performance, we encourage you to have us calibrate your instrument when we repair it. With a few exceptions, standard prices generally cover all labor and parts.

All Tektronix service work is backed by our unconditional service guarantee. If for any reason, our services fail to meet your requirements as promised, we will resolve the problem at our expense.

For more information about Tektronix service, in the U.S. and Canada call toll-free 1–800–835–9433, or Redmond Service at 1–541–923–4407, or contact your local Tektronix representative.

Before You Begin

Read the Safety Summary located at the front of this manual before operating or servicing the TV110 CableScout.

If you do not have experience operating the TV110 CableScout, read the Operating Information chapter. If you are not familiar with servicing this instrument, please read the Theory of Operation chapter and perform Performance Verification procedures prior to starting any internal maintenance.

If you have questions about using or servicing the TV110 CableScout, or have special application problems, in the U.S. and Canada, call our toll-free help line, 1–800–835–9433, or contact your local Tektronix representative.

Specifications

Product Description

The Tektronix TV110 CableScout MTDR is specifically intended for technicians and troubleshooting experts in the outside-plant cable TV and other coaxial cable test environments. The CableScout's uses include: fault identification, fault location, cable installation, and cable maintenance. The TV110 CableScout is easy to use, high in accuracy, and will fully characterize coaxial cable up to 6,000 feet in length.

Characteristics Tables

Physical

REQUIREMENT	SPECIFICATION
Size	3.5" x 10" x 12" (9cm x 25cm x 30cm), nominal
Weight	6.4 pounds (3 kg), nominal

Safety

REQUIREMENT	SPECIFICATION
CSA	Evaluated to CAN/CSA-C22.2 No. 231
UL	Evaluated to UL–1244

Reliability

REQUIREMENT	SPECIFICATION
MTBF	High reliability design for long service life
MTTR	Designed for ease of serviceability

Power Source

REQUIREMENT	SPECIFICATION
Battery	Internal lead-acid, 3-cell, 6VDC, 4.6Amp-hours
Input/Output Maximum current	1 A maximum from charger connector
AC adapter/ charger	Various AC adapter/chargers, 110, 220, or 240 VAC input, 9 VDC output (1 A, 5.5 mm OD, 2.1 mm ID)
Duration of battery operation	6 hours minimum continuous operation (without backlight)

Environmental

REQUIREMENT	SPECIFICATION
Temperature Operating Non-operating	 0°C to +40°C (−15°C to +60°C, typical) −20°C to +65°C
Humidity	Up to 95% RH, non-condensing
Altitude	Operation is not affected by normal changes in air pressure or altitude from sea level to 15,000 feet (4,572 meters). Non-operating, the instrument should not be subjected to air pressures lower than that at 50,000 feet (15,240 meters).
Vibration	Exceeds industry requirements for immunity to damage from vibration.
Shock	Survives impact shock of 6.5 feet (2 m) to concrete in standard soft case.
Packaged Product Vibration/Shock	Exceeds industry standards for immunity to damage during shipping.
ESD Immunity	High ESD immunity, IEC 801−2, −3, −4, −5
EMI Emissions	Low EMI. Complies with: FCC Part 15, subpart B, Class A; EN55011 Class A, EN60555−2
Water / Rain	Operates in the rain

Interface

REQUIREMENT	SPECIFICATION
Printer port	Serial 9-pin D-type connector Pin 1 = DCD Pin 2 = RD Pin 3 = TD Pin 4 = DTR Pin 5 = GND Pin 6 = DSR Pin 7 = RTS Pin 8 = CTS Pin 9 = RI

Operational

REQUIREMENT	SPECIFICATION
Test Signal	1/2 sine, unbalanced
Amplitude	6 ns = 9V ± 2V into 75 Ω 12 ns = 13V ± 2V into 75 Ω
Output Impedance	75 Ω
Pulsewidths	6 ns and 12 ns
Maximum Range	6,000 feet (1828 meters), depending on cable type and condition
Horizontal Accuracy	0 to 2,000 ft = ±2 ft, ± uncertainty in Vp 2,000 to 6,000 ft = ±3 ft, ± uncertainty in Vp
Display Resolution	0.33% of selected range, 4.5cm/0.15ft minimum on 640 X 200 pixel high-resolution LCD.
Display Ranges	8 ranges plus single-key expand window (ranges user-definable in manual mode)
Amplifier	5 mV reflection produces full-screen vertical deflection
Filter	High-pass cutoff frequency 150 kHz, user select
Gain	0 to 63 dB
Input Protection	±200 VDC + peak AC, to maximum of 60 Hz
Waveform Storage	Up to 20 waveforms, with notes
Battery Saver	5 to 30 minutes or disabled, user-selectable
Backlight	User selected ON/OFF (Serial numbers B030000 up)

Operating Information

General Requirements

Before servicing the TV110 CableScout, read the following operating instructions. These instructions are at the level appropriate for servicing this MTDR.

Where to Find Other Information

Refer to the *TV110 CableScout User Manual* for complete operating instructions.

Additional instructions are integrated into the service procedures given in the following chapters. For example, the procedures in the Performance Verification section contains instructions for making front-panel settings required to check each instrument characteristic included there. You might also find the descriptions found in the Theory of Operations chapter useful for understanding how the instrument functions.

Warnings and Cautions

See the Safety Summary at the front of this manual for specific warnings and cautions with regard to operating and servicing this instrument.

General Operating Instructions

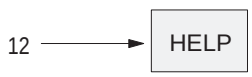
The TV110 controls are described briefly in this section. More detailed information is available in the descriptions of each measurement and function.

The TV110 maintains consistency in all operating modes. If a control is not used in a particular mode of operation and you attempt to use that control, a beep will sound.

General Controls and Indicators

All operator control keys are momentary push buttons.

POWER: This key (see Figure 3–1, callout 11, next page) turns the instrument on and off. It does not turn off the battery power to the memory used for saving setups and measurements.



HELP: Push this key (Figure 3–1, 12) to display information about the current operation being performed by the TV110. The Help function provides information on the current display and the operation of each of the instrument controls.

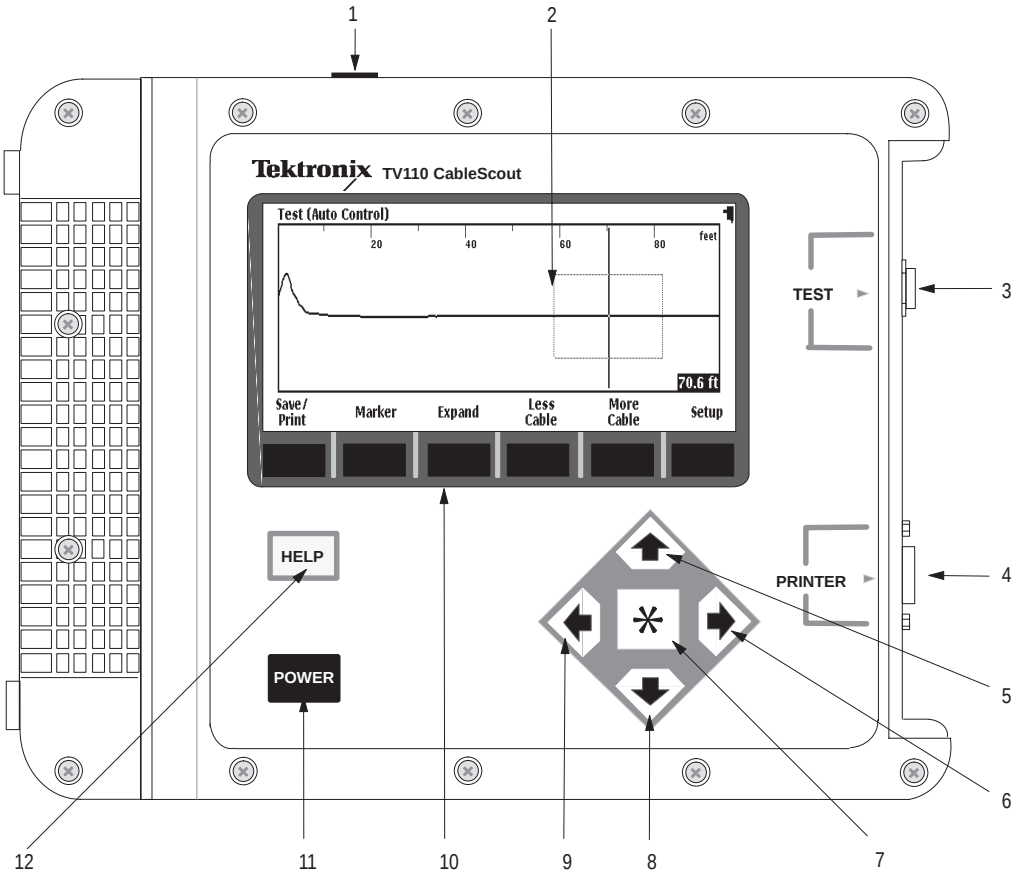
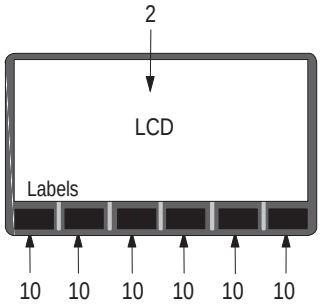


Figure 3–1: Front-Panel Controls, Indicators, and Connectors

The help displays are context-sensitive pop-up windows that overlay the current display when you press the HELP key. In each of the measurement modes, the help display describes the current mode and provides access to additional help on how to use the front-panel controls. In the menu system, the help display describes the current menu.

Push HELP a second time to remove the help display.

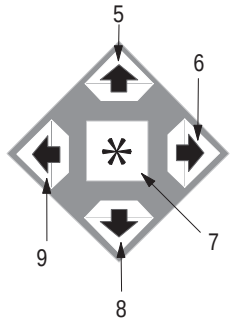
In selected menus, a Lesson softkey is available, which provides tutorial information about making measurements.



LCD: The display (Figure 3–1, 2) is a 640-by-200-pixel reflective liquid crystal display. Organization and content of the display is discussed further under the headings: *Display Organization in Measurement Mode* and *Menu Mode*.

Softkeys: The softkeys (Figure 3–1, 10) have different meanings depending on the current operational state of the instrument, or depending on which menu is active. A label above each key describes its purpose. Push the appropriate softkey to enable the labeled function. Unlabeled keys have no function.

Scroll Controls

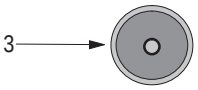


When the TV110 is displaying a waveform, use the arrow keys to move the active distance cursor (6 and 9), or position the waveform vertically (manual mode, 5 and 8). While in a menu, use the arrow keys to select parameter values (5 and 8) and to increment (5) or decrement (8) values. The Star key is used to turn on or off some specific functions. These keys are referred to throughout the manual as:

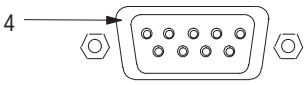
- **Up** arrow (Figure 3–1, 5)
- **Down** arrow (Figure 3–1, 8)
- **Right** arrow (Figure 3–1, 6)
- **Left** arrow (Figure 3–1, 9)
- **Star** (Figure 3–1, 7)

Connectors

AC Adapter/Charger: This connector (Figure 3–1, 1) provides a jack for connecting to the battery charger/adapter.

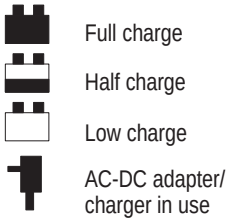


75 Ω: This connector (Figure 3–1, 3) is a 75 Ω CATV-style for connecting to the test pair of the cable under test.



Printer: This connector (Figure 3–1, 4) provides a subminiature DB-9 IBM PC-AT-compatible serial printer port.

Low Battery Warning



A three-level battery-status indicator, located in the upper right corner of all displays, shows the battery-charge level (see icons at left). A low-battery/power-off message is displayed when the battery level is too low for safe operation. When this happens, you should connect the charger/adapter to the instrument. You can continue using the TV110 on AC power while the battery is recharging.

Instrument Settings

When you push POWER to turn the instrument on, the TV110 will show a display indicating that the initialization sequence is in progress. The instrument returns to the same settings in place when the power was last turned off.

Front Panel Controls

When the instrument is in measurement mode, the front-panel controls perform the following functions:

Arrow Keys

Left and right arrows move the cursor along the waveform in normal measurement mode. Up and down arrow function depends on the measurement mode (see below). In menu mode, up and down arrows move the highlight bar through selections and change values (see page 3–6).

Softkeys

The softkeys are used in three different ways: function change, item selection, and item toggle.

In the functional change use, the softkey is briefly displayed in reverse video (black box around white letters) until the function or mode change is complete. After the function or mode change, the softkey label returns to normal (black letters on white background), possibly with a different label. Examples of this type of operation are: changing from measurement mode to setup mode, or full view to expanded view.

In item selection, the softkey label is displayed in reverse video when the key is pushed and remains in that state until pushed again or a different softkey is pushed. Usually, pushing an item-selection softkey enables the up and down arrow keys to change the value of the selected item. Examples of item selections are: span, pulse, position, and gain in the manual measurement mode; baud rate and cable type in the setup mode.

In item toggle, the softkey label is briefly displayed in reverse video as the item toggles, then it returns to normal. An item-toggle softkey might change its label to display the new item value. Examples of this include: smoothing and automatic shutoff time. Value changes may also be displayed in another manner, such as the distance scale change when More Cable or Less Cable is pushed in the normal measurement mode.

Softkey explanations are found within each description of the display types in the Reference chapter of the TV110 CableScout User Manual.

Measurement Mode

Auto Control

The auto-control function automatically increases the acquisition gain and/or pulse width as you increase the range, or span, with the More Cable softkey. As the range is decreased, the gain and/or pulse width automatically decreases.

The gain can also be increased and decreased by using up and down arrows. Once the up or down arrow key is pushed, a dialog box appears showing the

current gain value. Pushing the More Cable or Less Cable softkeys resets the gain to the default value for that scale.

The actual values used for pulse width, gain, and filtering for any given range are dependent on the dielectric and attenuation characteristics of the cable under test. These are determined from the cable type and the wire diameter (gauge) that you select from the Setup menu.

The auto-control measurement mode is designed to be used with a test procedure that starts at minimum range, with highest resolution, and increasing the range until the fault appears on the display. The range selections and gain are such that a strong fault (e.g., an open or short) will appear in the right half of the waveform window with approximately one-quarter display deflection.

Manual Control

Manual control is an advanced function that most operators should not require. It can be used to manually adjust the gain, pulsewidth, and filtering for unusual cables or circumstances.

In manual-control mode, in contrast to auto-control mode, the Span softkey changes the distance range centered around the current distance-cursor location, with the cursor automatically moved to the center of the display, if possible. If the span selected is such that centering the cursor would make the left edge of the display less than zero, the cursor position is moved to keep the left edge at zero.

Instrument settings changed in manual mode are preserved when switching back to auto-control measurement mode until either the More Cable or Less Cable softkey is pushed, at which point the instrument will return to the appropriate automatic settings. If the span is such that the left edge of the display is not at zero, expanded mode is automatically selected upon return to auto-control measurement mode. Use the Full View softkey to see the entire cable at the range that most closely matches what was last used in manual mode.

Display Organization in Measurement Mode

The current operating mode of the instrument is displayed in a status line at the top of the display, above the framed window. The bottom two lines of the display are reserved for softkey labels. When the instrument needs to display additional information in a message to you, it will appear in a dialog box using the bottom line of the data window (see Figure 3–2, next page).

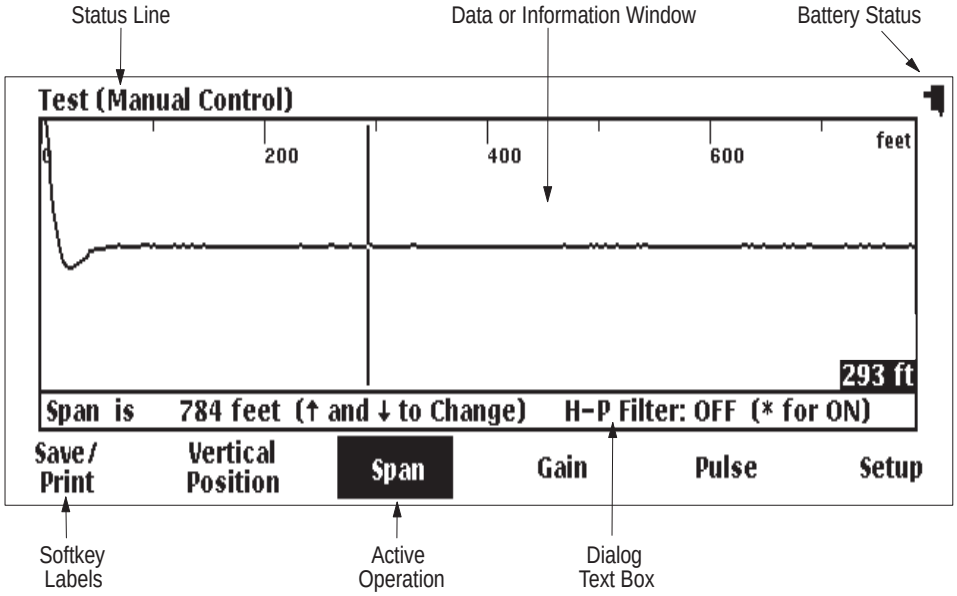


Figure 3–2: Arrangement of Information on the Measurement Display

Menu Mode

All menus are invoked through the softkeys. Press the softkey labeled Setup to get to the first menu level.

When in a menu, the display status line starts with the key word Choose or Define. The choices are displayed one-to-a-line in the data window. The rightmost softkey is labeled Exit and, when pressed, returns the instrument to measurements without the need to backtrack through any other menus. If a menu has more choices than fit on the display, a scrolling icon indicates that there are choices out of view (see Figure 3–3, next page).

Use the Up and Down arrows to scroll through the choices. To make a choice, scroll to the desired line (it becomes highlighted) then press Exit, which returns the instrument to the measurement display or press Previous Menu, which returns to the previously accessed menu.

Additional explanations are found within each description of the other menu types in the Reference chapter of the *TV110 CableScout User Manual*.

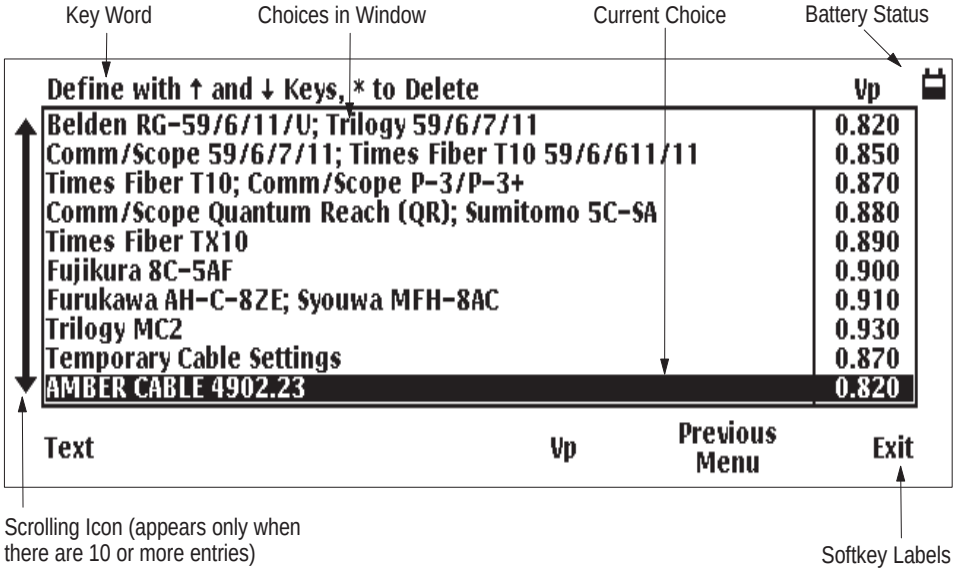


Figure 3–3: Arrangement of Information on a Typical Menu Display

WARNING

The following servicing instructions are for use only by qualified personnel. To avoid injury, do not perform any servicing other than that stated in the operating instructions unless you are qualified to do so. Refer to all Safety Summaries before performing any service.

Theory of Operations

Block Diagram

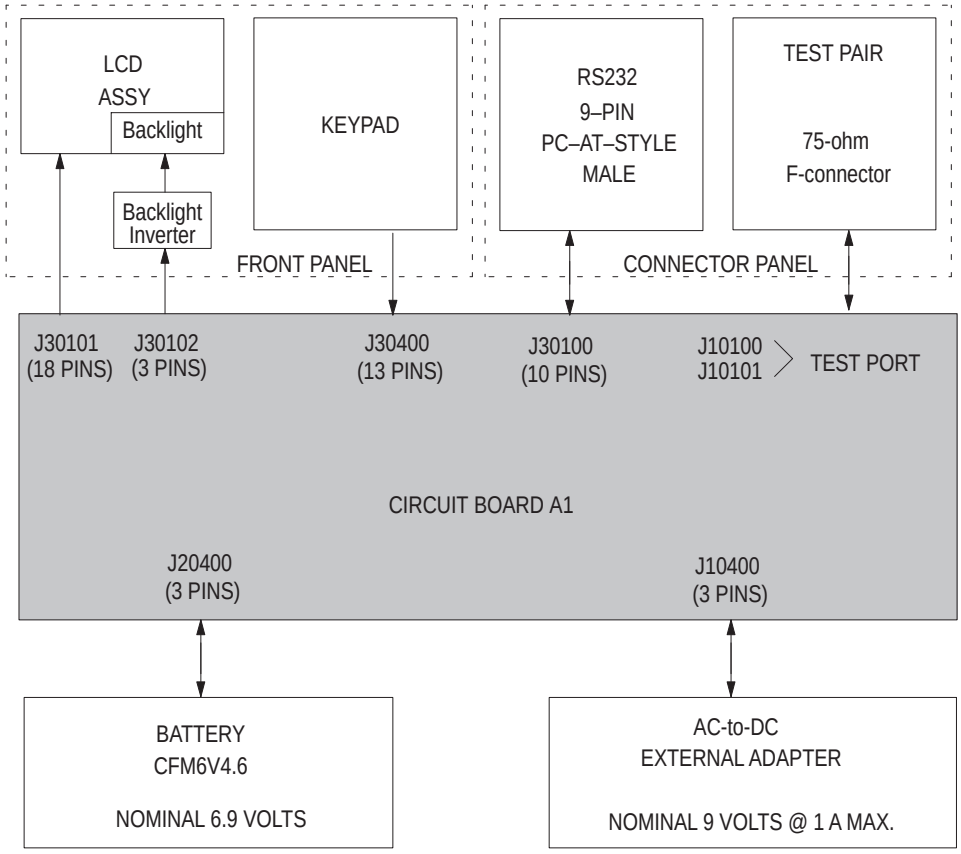


Figure 4–1: TV110 Block Diagram

The TV110 consists of one circuit board, noted as CIRCUIT BOARD A1 in the block diagram above (Figure 4–1), a front-panel assembly, a connector-panel assembly, a battery, and a connector for an AC adapter/charger.

Functional Descriptions

Circuit Board

The circuit board contains all the TDR and user-interface components of the TV110, including the power supply, the microprocessor, the firmware and memory, the serial ports, and the pulser/sampler/timebase TDR circuitry. The circuit board has three programmed parts containing the software that defines how the TV110 operates.

LCD Assembly

The LCD assembly consists of a standard 640x200-pixel LCD, shock mounted to a rigid aluminum base plate, which also serves as the mounting plate for the LCD. The LCD contains the row and column drivers, which interface to the LCD controller on the circuit board via an 18-pin multiplexed bus.

Backlight – B030000 (Version 04) and beyond

The backlight is an electroluminescent light placed within the LCD assembly. The backlight is powered by an inverter secured to the front panel assembly. It interfaces with the circuit board via a cable with a 3–pin connector.

Keypad

The keypad/front-panel assembly is an integrated sandwich of aluminum base plate, mylar layers with the keyboard matrix printed on it, and a Lexan top layer. The keyboard switch mechanisms are stainless-steel snap-domes, sandwiched between the appropriate mylar layers. The keyboard switches are arranged in an X-Y matrix, except for the POWER on/off switch. Connection to the circuit board is via a 13-conductor cable and latching connector.

Battery

The battery is a sealed lead-acid unit, consisting of three cells with a 4.6 amp-hour rating, with an operating voltage range of 5.6 V minimum to 7.3 V maximum. Normal battery life at 25°C is 8-to-10 hours, assuming a fully charged battery. Standby current for memory keep-alive is nominally 170 μA with power off. Normal unit load current with power on ranges from 350 to 450 mA. The battery is connected to the circuit board via a three-conductor cable and latching connector.

AC-to-DC External Adapter

The AC-to-DC external adapter provides 9-to-12 VDC at currents up to 890 mA for operating the TV110 (350 mA) and charging the battery (up to 540 mA). The input jack on the top end of the TV110 is 5.5 mm OD, 2.1 mm ID, with center positive. The circuitry is polarity protected.

Connector Panel

The connector panel provides the mounting points for the 75 Ω connector (cable test interface) as well as the mounting for the RS232 interface serial printer port. The printer port also serves as an access point for internal diagnostics.

Performance Verification

The purpose of these checks is to make sure the 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 clock is the only check that is traceable.

If you are not experienced with the instrument, read the *Operating Information* chapter before going on with these checks.

On the next page is a chart with acceptable results/tolerances for these checks. If the instrument fails any of these checks, it should be serviced. Many failure modes affect only some of the instrument functions.

Required Equipment

The following is to verify that the TV110 is operating correctly:

- One standard AC adapter/charger
- A known length of RG-59 cable with a known Velocity of Propagation (see note below).
- Tektronix DC5009 Universal Counter/Timer or equivalent.
- Tektronix 2440 Oscilloscope or equivalent.

***NOTE**. For these checks, we used 100 feet. of 75 Ω cable. All displays shown in this chapter are for that cable. If you use a cable other than 100 feet. of 75 Ω, your displays will vary accordingly.*

Any known length of cable (100 feet recommended) can be used. Be sure to change the instrument setups for your cable. If the Vp of the cable is known, you should set up the TV110 for the exact parameters of your cable (see Reference chapter if you are not familiar with setups).

Displayed pulse amplitude may vary depending on the version of your TV110.

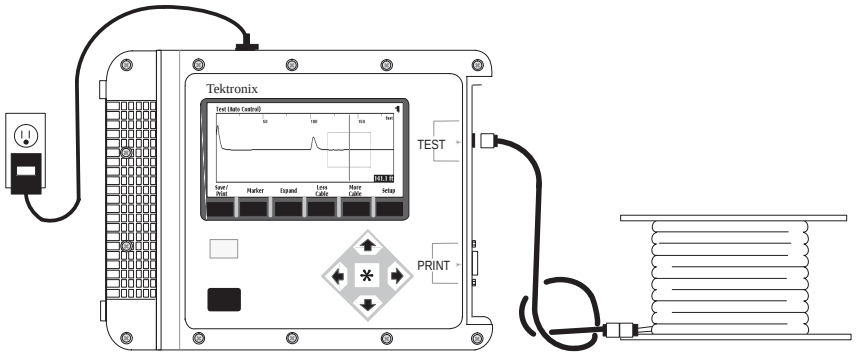


Figure 5–1: Typical Equipment Setup for Performance Verification

Check Start-up Display/Power Indicators

1. Push the POWER key to turn on the TV110. At initialization, there will be two tests performed by the instrument: ROM and RAM. These tests must pass. If they are not passed, an error message will be displayed. Note the error message and send the instrument in to be serviced.

2. During the first display, at the top right corner, there will be a symbol indicating whether the TV110 is on AC or DC power. A battery icon is used for DC and an AC-adapter icon is used for AC. Verify that the correct icon appears when the AC adapter is plugged into the unit and removed.

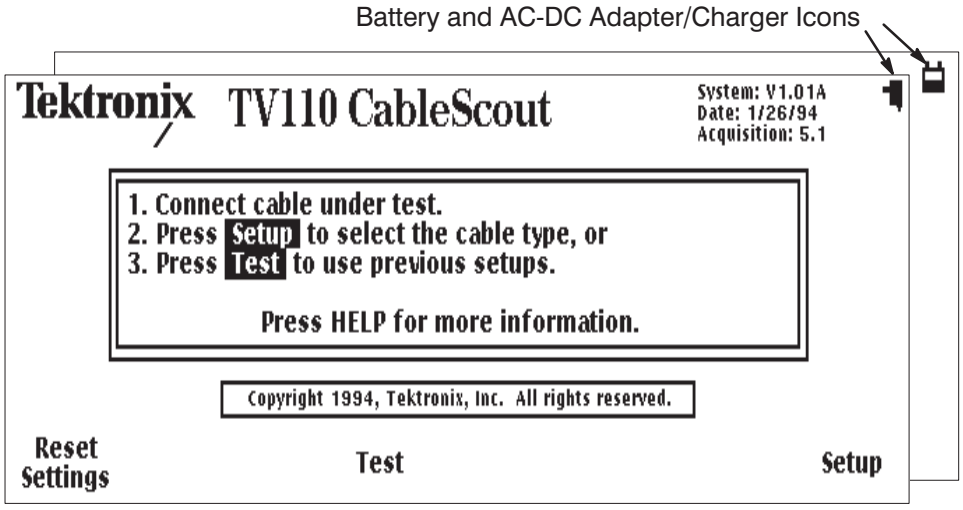


Figure 5–2: Start-up Display with Power Indicator Icons

NOTE. *When switching power sources, it might take as long as 10 seconds for the icon to change.*

Check Distance Readouts

3. Press the Setup softkey and verify that the proper cable type is highlighted. If not, move the highlight bar with the up and down arrow keys until your cable is highlighted.

4. Press the Exit softkey. You should see a display like Figure 5–3.

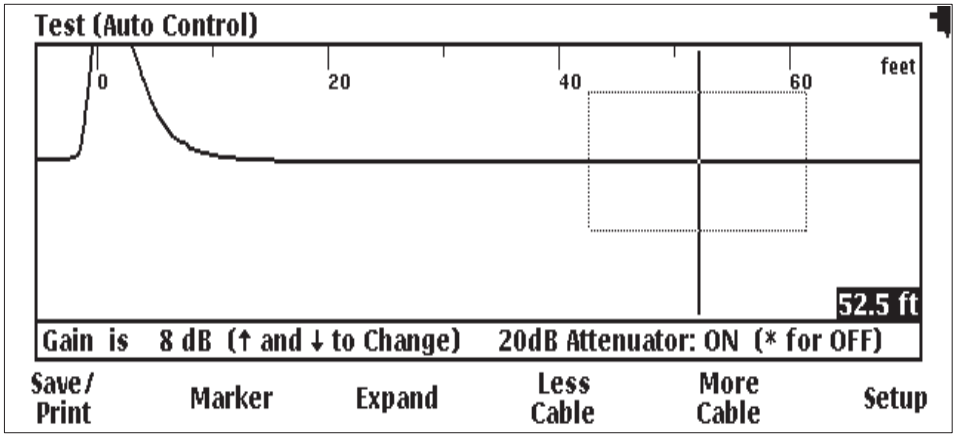


Figure 5–3: Waveform without Test Cable Attached

5. Connect the 100-foot cable to the TEST port. The display should not change because the end of the cable is not visible.

6. Press the More Cable softkey. The display should now look like Figure 5–4 (next page).

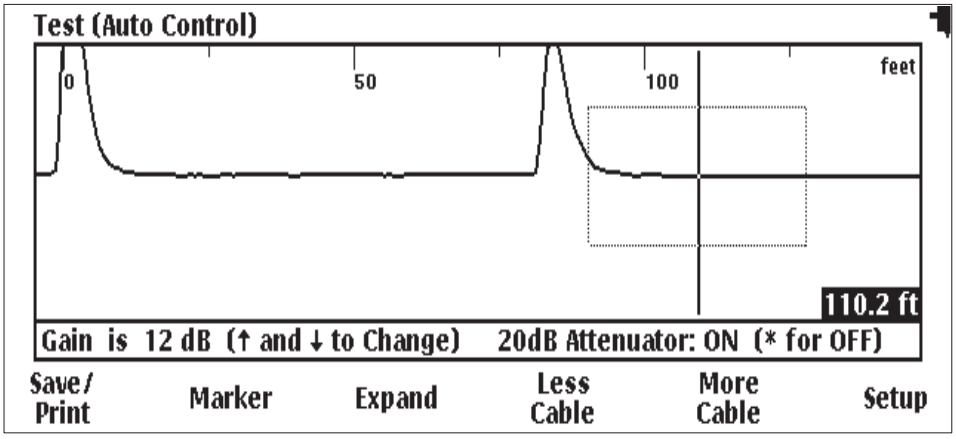


Figure 5–4: Waveform with Test Cable – More Cable Display

7. Using left and right arrow keys, move cursor to the leading edge of the end reflection. The display should look like Figure 5–5.

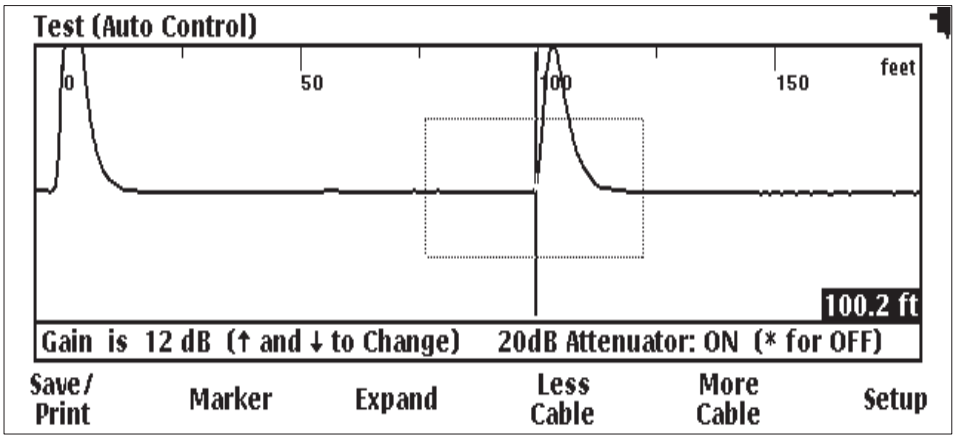


Figure 5–5: Waveform with Test Cable – Cursor at Leading Edge of End Reflection

8. Press the Expand softkey. The display should now look like Figure 5–6 (next page).

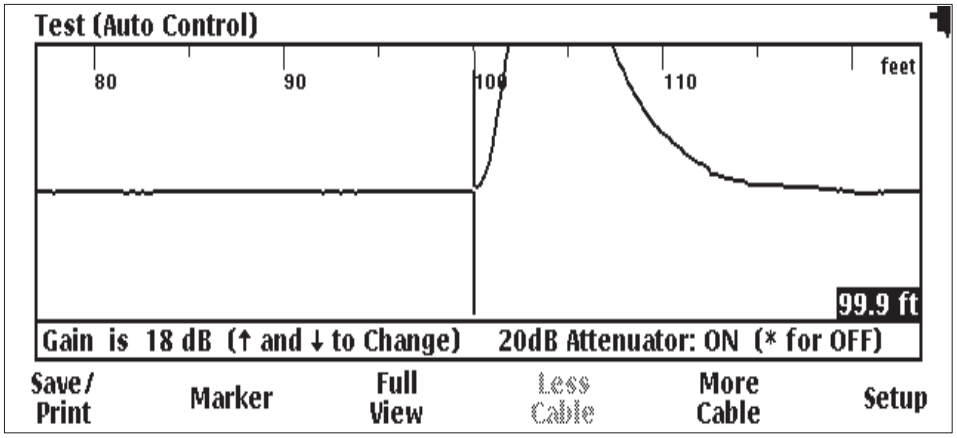


Figure 5–6: Waveform with Test Cable – Expanded View

9. Press the Setup softkey.

10. When the Setup menu is displayed, press the softkey labeled Auto Control. Verify that the label changed to Manual Control.

11. Press the Exit softkey. This will return the display to measurement mode. Note that the status line shows: Test (Manual Control).

12. Press the Pulse softkey.

13. Using the up arrow key, change the pulse width to 12 ns (the readout is in the dialog box at the bottom of the display).

14. Press the Span softkey.

15. Using the up arrow key, increase the span to just beyond the length of your test cable.

16. Using the right arrow key, move the cursor to the leading edge of the end reflection.

17. Check that the distance readout is still within specification. The display should look like Figure 5–7 (next page).

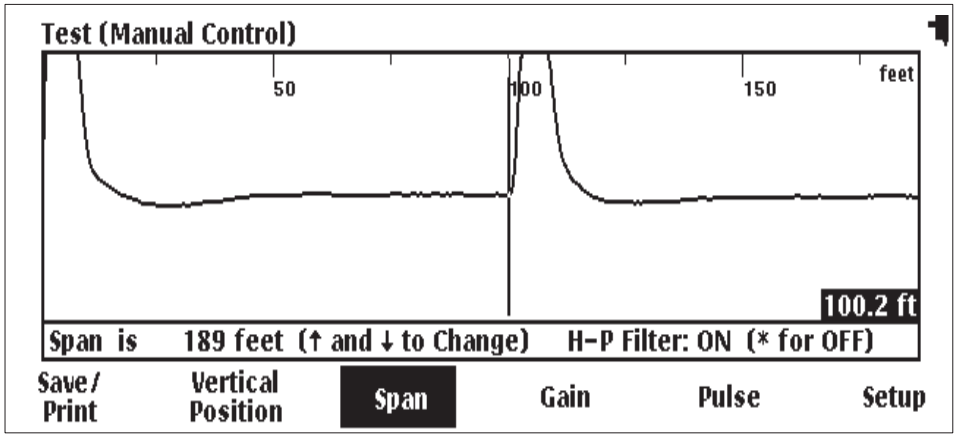


Figure 5–7: Manual Mode, 12 ns Pulse, Span Increased

Check Dual Displays

18. Press the Setup softkey.

19. When the Setup Type menu is displayed, press the Test Type softkey.

20. When the Test Type menu is displayed, press the down arrow twice to highlight TEST / SAVED WAVEFORM.

21. Press the Exit softkey. The display should look like Figure 5–8.

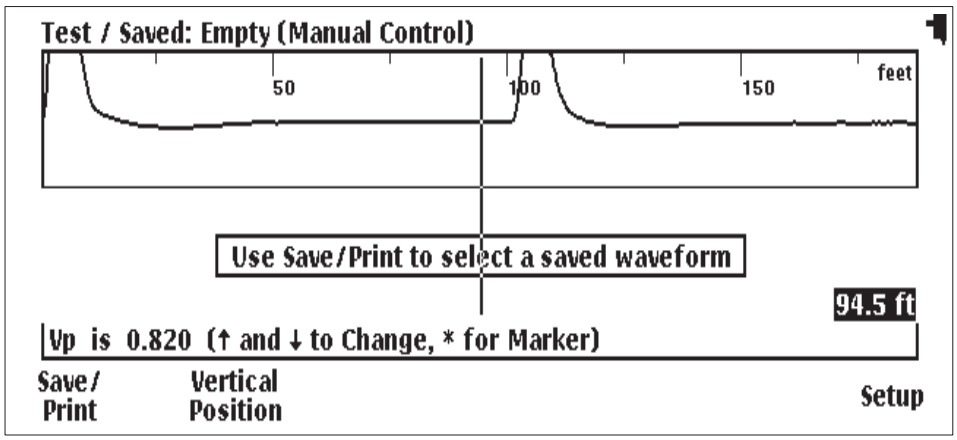


Figure 5–8: Dual Waveform Display

22. Press the Save/Print softkey.

23. When the Save/Print menu is displayed, use the up or down arrow keys to select a saved waveform.

24. Press the Exit softkey. The display should look like Figure 5–9 (next page).

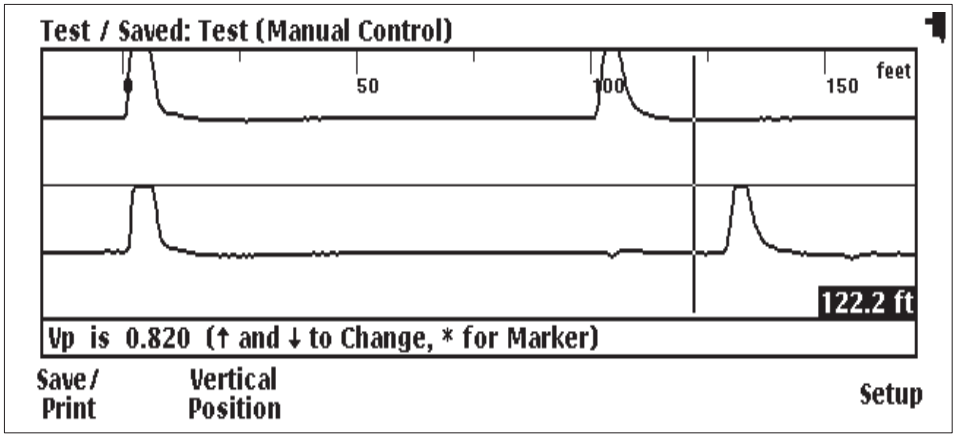


Figure 5–9: Dual Waveform Display – Test and Saved Waveforms

Check Pulse Widths

25. Disconnect the 100-foot cable from the TV110 port.

26. Press the Setup softkey.

27. When the Setup menu is displayed, press the Test Type softkey.

28. Using the up arrow, position the highlight bar on TEST.

29. Press the Exit softkey.

30. Connect a 75 Ω resistive load to the side panel connector.

31. Set the oscilloscope to: 2 V per division and 5 ns per division.

32. Connect the scope probe to the 75 Ω load (ground to shield).

33. Press the Pulse softkey on the TV110.

34. Using up or down arrows, change the pulse width to 6 nanoseconds.

35. The oscilloscope measurement, at the half-power point, should be 6 ns, ± 25% (4.50 to 7.5 ns).

36. Check peak pulse height for 9 V ± 2 V, loaded.

37. Using the up arrow, change the pulse to 12 nanoseconds.

38. The oscilloscope measurement, at the half power point, should be 12 ns, ± 20% (9.60 to 14.4 ns).

39. Check peak pulse height for 13 V ± 2 V, loaded.

40. Disconnect the oscilloscope from the TV110.

Check Smoothing

41. Press the Setup softkey.

42. When the Setup menu is displayed, press the More Setups softkey.

43. When the More Setups menu is displayed, move the highlight bar (if necessary) to Distance Units.

44. Press the Change Setting softkey.

45. Using the up or down arrow key, change the units to FEET.

46. Press the Exit softkey.

47. Press the Pulse softkey.

48. Press the down arrow once to set the pulse width to 6 ns.

49. Press the Span softkey.

50. Push the up arrow key until the distance ruler shows at least 2000 feet.

51. Using the right arrow key, move the cursor out to approximately 2000 feet using the right arrow.

52. Press the Gain softkey.

53. Press the up arrow until the gain, as shown in the dialog box on the display, is 50 dB, 20dB Attenuator: OFF.

54. Press the Span key.

55. Press the down arrow twice.

56. Press the Vertical Position softkey.

57. If the automatic centering is not on (dialog box on the display will show Vertical Position [Manual] if it is not on), press the star key once to turn on auto-centering and wait for the noise to center.

NOTE. *Auto-centering at high gain could take several seconds to achieve.*

58. Note the height of the noise. It should be approximately 1/8 of the display window. The display should look like Figure 5–10 (next page).

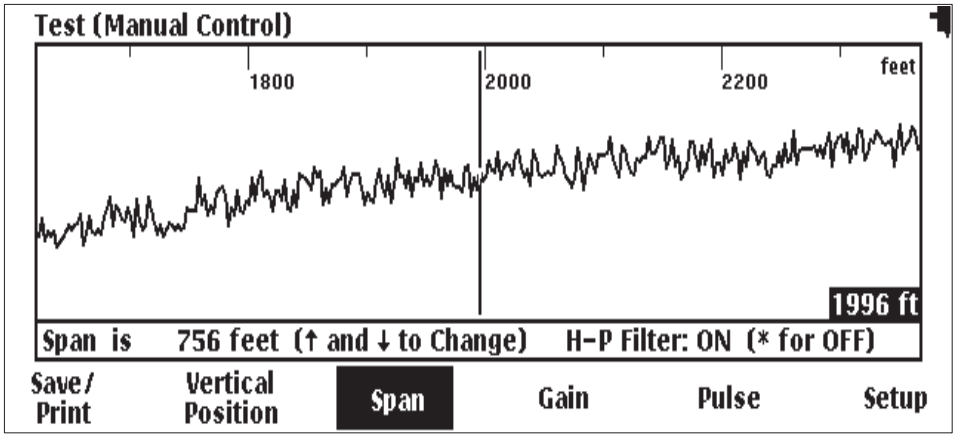


Figure 5–10: Noise

59. Press the Setup softkey.

60. When the Setup menu is displayed, press the Test Type softkey.

61. When the Test Type menu is displayed, press the Smooth softkey until the label reads Smooth 7.

62. Press the Exit softkey. The display should look similar to Figure 5–11 when the waveform reappears.

NOTE*. The TV110 is now averaging the noise and it could take several seconds to achieve maximum smoothing. Once the display updates there will be a significant reduction in the noise level.*

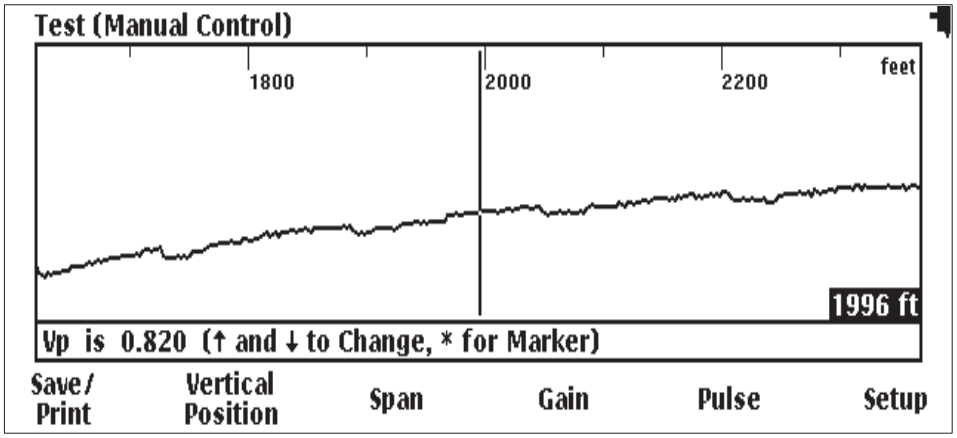


Figure 5–11: Maximum Smoothing

63. Turn off the TV110.

Verify Clock Signal Accuracy

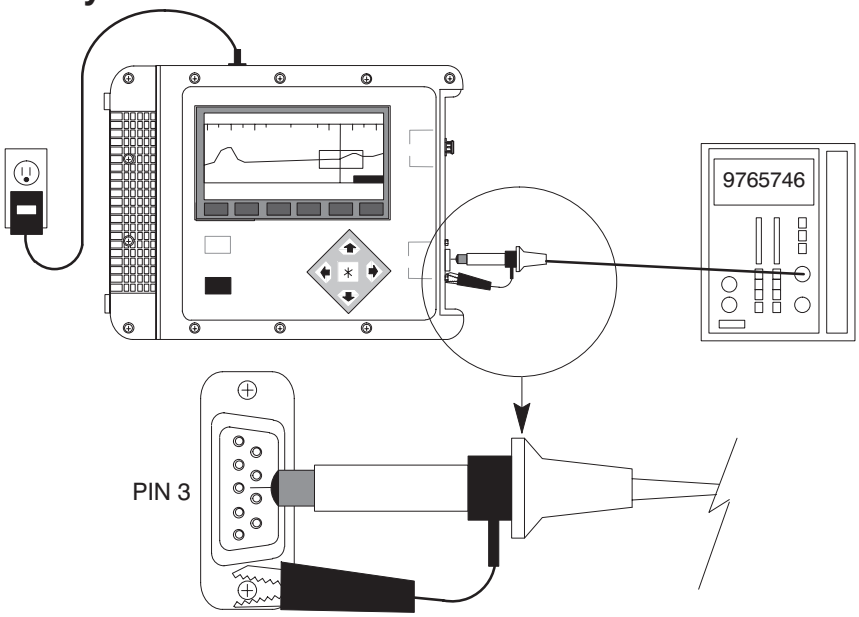


Figure 5–12: Equipment Setup for Verifying Clock Signal

64. Set up the equipment as in Figure 5–12.

65. Connect the ground probe of the frequency counter to a mounting nut (or pin 5 of the RS-232 connector if the TV110 is in a partially disassembled state) and the signal probe to pin 3 of the RS-232 connector.

66. Push the POWER key to turn the TV110 on.

67. When the start-up display is shown, hold down the Star key and press the Reset Settings softkey. This will place the TV110 in Diagnostics mode.

68. When the Diagnostics menu is displayed, push the down arrow key once to move the highlight bar to Timebase Frequency.

69. Press the softkey labeled Run Test.

The DC5009 Universal Counter/Timer display should read between 9764.648 and 9766.302 Hz.

***NOTE**. The 10 MHz clock signal is divided by 1024, which is 9765.625 Hz, ± 0.01%.*

70. Push the POWER key to turn the TV110 off (this is the only way to get it out of Diagnostics mode).

This completes performance verification for the TV110 CableScout MTDR. In the event that any of these checks was failed, refer to the Troubleshooting section in the Maintenance chapter.

Adjustment Procedure

There are no externally accessible adjustments on the TV110.

There is only one internally adjustable component: timebase linearity, R10300.

Locate R10300 on the circuit board locator (see Diagrams chapter), then on the actual circuit board. Note whether the factory RTV sealant is still securely covering the screwdriver slot in this potentiometer. If so, it is highly unlikely that any adjustment is necessary. If RTV is missing or disturbed, proceed with the adjustment procedure.

Required Equipment

- One small-blade slot-type screwdriver for adjustment
- Dow Corning 3145 RTV Sealant
- (All equipment required for disassembly as listed in the Maintenance chapter.)

Procedure

1. Perform Preliminary Disassembly per instructions in Maintenance section.
2. With all electrical connections still intact, power on the TV110.
3. When the Start-Up display is shown, press the Test softkey.
4. Using the left arrow key, move the cursor to 35 feet.
5. Press the up arrow key once.
6. Press the star key.
7. If the waveform is not smooth, use the small slot-type screwdriver to rotate R10300 in either direction to deliberately misadjust this potentiometer. You should notice a “step” in the waveform by doing this.
8. While watching the waveform, readjust R10300 to minimize the steps (smooth the waveform).
9. When the waveform is as smooth as you can get it, place a small amount of RTV in the screwdriver slot. Use just enough to touch the edges of the potentiometer housing.
10. Press POWER to turn the instrument off.

This completes the adjustment procedure. Reassemble the instrument using the reassembly instructions in the Maintenance chapter.

Maintenance

Preparatory Information

This chapter contains information you need to do periodic and corrective maintenance on the TV110 CableScout MTDR. These maintenance instructions are for qualified service personnel only. Prior to performing any maintenance on this instrument, read the *Safety Summary* and the *Strategy for Servicing* at the beginning of this manual. If you have not used the TV110 before, please read the *Operating Information* section.

CAUTION. *Static discharge can damage any semiconductor component in this instrument.*

When performing any service that requires internal access to the instrument, take the following precautions to avoid damaging internal modules and their components with electrostatic discharge (ESD):

- Minimize handling of static-sensitive modules.
- Transport and store static-sensitive modules in static-protected containers. Label any package that contains static-sensitive modules.
- Discharge the static voltage from your body by wearing a grounded wrist strap while handling these modules. Service the modules only at a static-free workstation.
- Do not allow anything capable of generating or holding a static charge on the workstation surface.
- Handle the circuit board by the edges whenever possible.
- Do not slide the modules over any surface.
- Avoid handling the modules in areas that have carpeted floors or work surfaces capable of generating static charges.

Inspection and Cleaning

The TV110 CableScout's enclosure minimizes dust accumulation inside the instrument. Never operate the MTDR without the covers properly installed. When storing or transporting the instrument, it is a good idea to keep it in the soft carry case to protect it from dust and accidental damage.

Inspect and clean your TV110 CableScout as often as operating conditions require. If used indoors, this might be once every 1000 hours of use. If used outdoors, this might be after each use, depending on field conditions, but should be inspected and cleaned after no more than 500 hours of use. Dirt acts as a thermal insulator, which could cause overheating and component breakdown. It also provides an electrical conduction path that could cause instrument failure, especially under high-humidity conditions.

Exterior Inspection

- Inspect the exterior of the TV110 for wear, missing parts, or cracks in the enclosure. Replace any defective parts.
- Inspect all connectors for cracked insulation, broken shells, deformed contacts, or dirt in the connectors. Clean or replace as necessary.

Exterior Cleaning

CAUTION. *To avoid the possibility getting water in the instrument, use only enough liquid to dampen the cloth. Do not use abrasive cleaners or harsh chemicals (e.g., alcohol, acetone) as damage to the Lexan covers might result.*

- Remove dust from the outside of the instrument by wiping with a lint-free cloth or small brush. Use the brush to remove dust from the connectors.
- Clean the remaining dirt with a lint-free cloth, dampened in a general-purpose mild-detergent-and-water solution.
- Clean the display with a lint-free cloth and a standard commercial window cleaner.

Interior Inspection

To gain access to the inside of the MTDR for inspection and cleaning, refer to the *Removal and Replacement Procedures* given later in this chapter.

- Inspect the circuit board for loose, broken, or corroded solder connections and burned, broken, or cracked circuit plating. Replace the circuit board if these conditions exist.
- Inspect resistors for burns, cracks, blisters, or breaks. Replace the circuit board if these conditions exist.
- Inspect capacitors for damaged or leaking cases, or corroded solder on leads. Replace the circuit board if these conditions exist.
- Inspect all solder joints for cold or rosin joints. Replace the circuit board if these conditions exist.
- Inspect all semiconductor devices for loose socket connections or bent/damaged leads. If the device is socketed, attempt to reseat the device properly. If device is soldered on the board, replace the circuit board.

- Inspect wiring and cables for loose plugs or connectors and burned, broken, or frayed wiring. Reseat connector or replace wiring as necessary.
- Inspect interior of enclosure for deformation, cracking, or damaged hardware. Replace as necessary.

Interior Cleaning

- Blow any dust found in the interior of the instrument out using dry, low pressure (appx. 9psi), de-ionized air.
- Remove any remaining dust using a lint-free cloth dampened in de-ionized water. Lint-free swabs are useful for cleaning narrow spaces and on the circuit board.

Battery

- Fully charge the battery after each use.
- Disconnect the battery if the unit is to be stored an extended period of time.

Functional Testing

Follow the *Performance Verification Procedure* in Chapter 5 to test the TV110 CableScout for functionality.

Removal and Reinstallation Procedures

Required Equipment

- Static-free workstation
- Phillips screwdriver, medium point
- Pozidriv screwdriver, PZ1
- Flat-blade screwdriver, medium
- 3/16” nut driver
- 1/4” nut driver

Preliminary Disassembly

1. With the TV110 on the static-free workstation, display-side up, remove 14 4–40 X 0.25 in., flat-head Pozidriv screws from the connector panel (see Figure 7–1, next page).

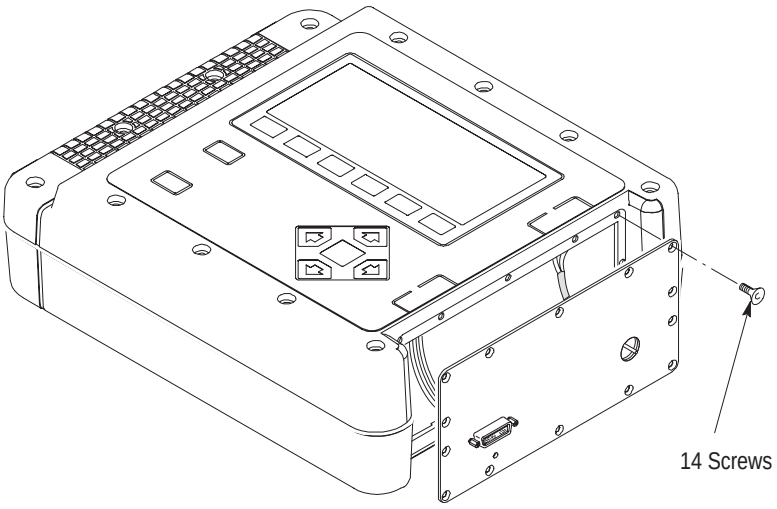


Figure 7–1: Connector Panel Screws Removal/Installation

2. Lay connector panel on table, leaving connections intact.

3. Remove eight 6–32 X 2.0 in. truss-head phillips screws and four 6–32 X 1.0 in. truss-head phillips screws from the top of the TV110 (see Figure 7–2).

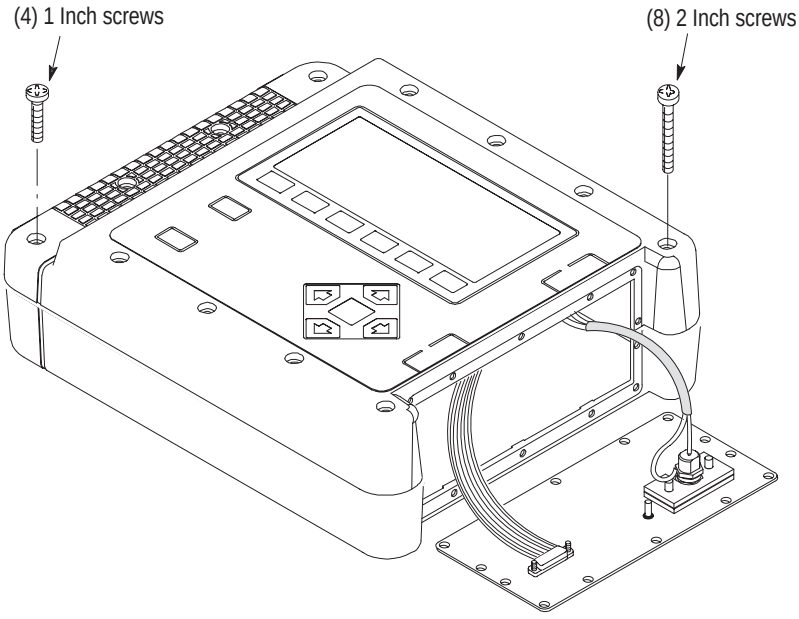


Figure 7–2: Top Case-Half Screws Removal/Installation

4. Gently raise the top case half and unscrew the cable clamp from the battery compartment.

5. When the battery cable and charger cable are free of the clamp, flip the top case half over and lay it face down on the work surface (see Figure 7–3). In this position, with all connections intact, you can perform modular troubleshooting.

CAUTION. *To prevent possible damage to the front panel or display, be sure the work surface is clear of debris (e.g., screws, wire clippings, etc.) prior to laying the top case-half face-down. One way to do this would be to place a clean soft cloth on the flat work surface.*

NOTE*. The rubber gasket between case halves is important to the case integrity to maintain water resistance. Be very careful not to damage this gasket.*

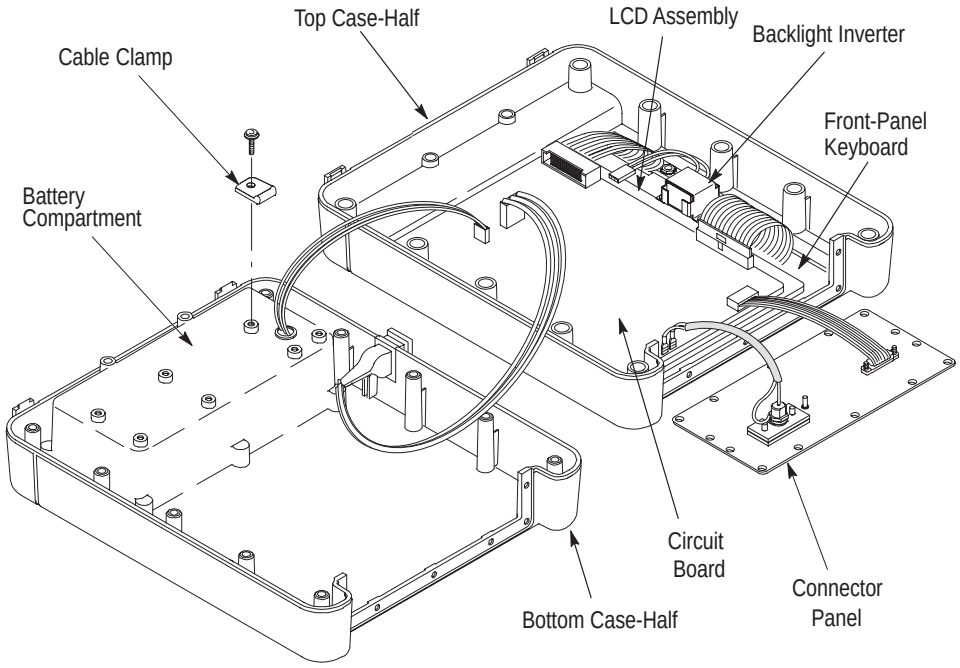


Figure 7–3: TV110 Open on Work Surface for Troubleshooting

Battery Removal

1. With the instrument face down, unscrew six machine screws (they are held on the access panel with retaining clips). If the preliminary disassembly has already been done, turn the bottom case half over to do this (see Figure 7–4, next page).

2. Remove the access panel.

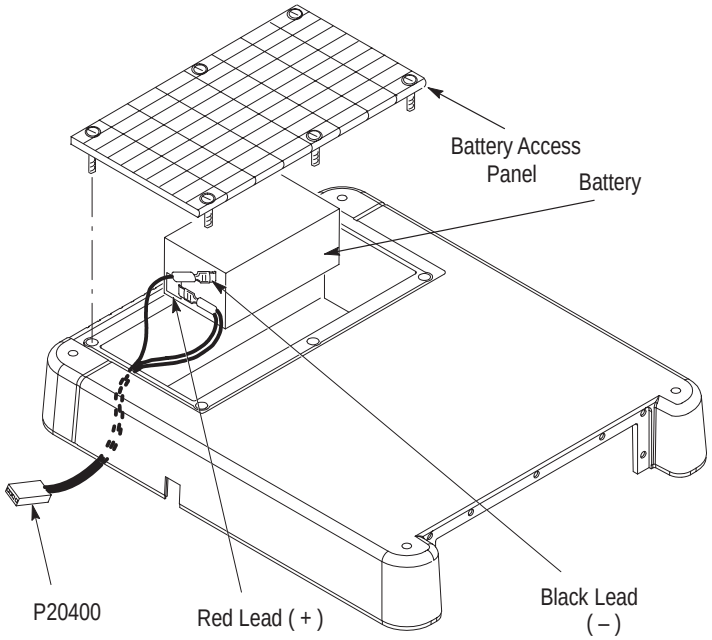


Figure 7–4: TV110 Battery Removal/Installation

3. Pull the battery up from its horizontal position and disconnect the battery cable from the battery (see Figure 7–4).
4. Remove the battery.

***NOTE**. In the event that the battery cable must be removed from the case, push the leads through the grommet from the battery side, one at a time.*

Connector Panel Disassembly

1. Perform Preliminary Disassembly steps 1 – 4.
2. Disconnect the wires from the 75 Ω connector and the RS-232 at the circuit board.
3. Disconnect the wires at the 75 Ω connector.
4. Unscrew retaining nut from connector and remove.
5. Using the 3/16” nut driver, remove two 4–40 X 0.312” hex-head screws from the RS-232 connector.

Circuit Board Removal

1. Perform Preliminary Disassembly.

CAUTION. *Static discharge can damage any semiconductor component in this instrument.*

2. Disconnect any remaining cable connectors from the circuit board.

NOTE*. Special consideration should be given to the front-panel cable. The connector lock is depressed and pulled out slightly, then the flex cable slips away from the connector. No connector remains on the end of this cable.*

3. Using a PZ1 screw driver, remove eight 4–40 X 0.25” screws from the circuit board (see Figure 7–5).

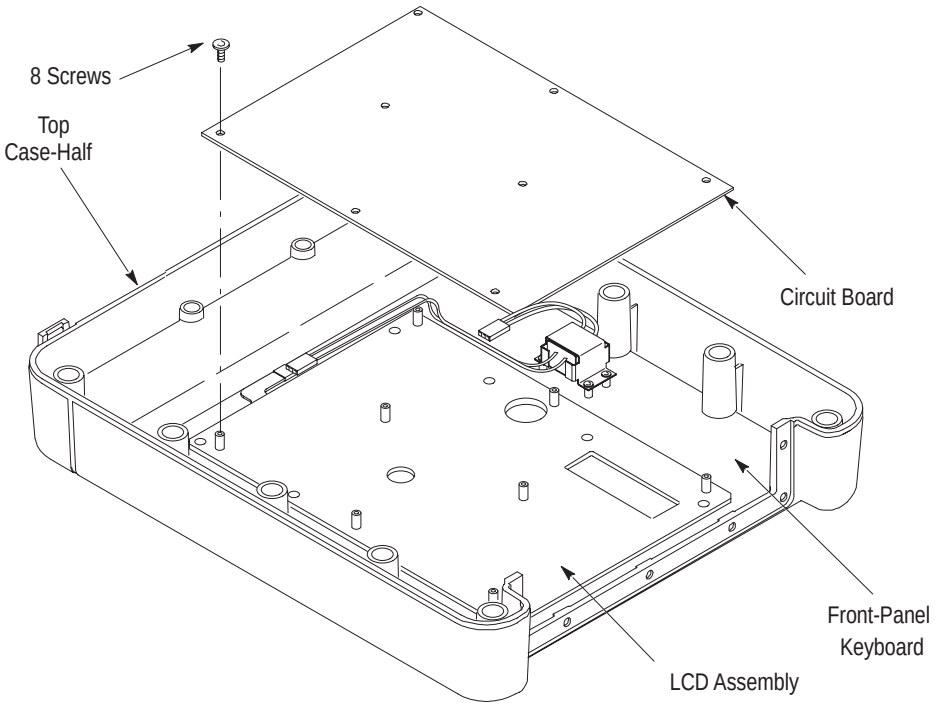


Figure 7–5: Circuit Board Removal/Installation

4. Carefully remove the circuit board from the front-panel assembly.

LCD Assembly Removal

1. Perform Preliminary Disassembly and Circuit Board Removal.

2. Using a PZ1 screw driver, remove eight 4–40 X 0.25” pan-head screws from the LCD module (see Figure 7–6, next page).

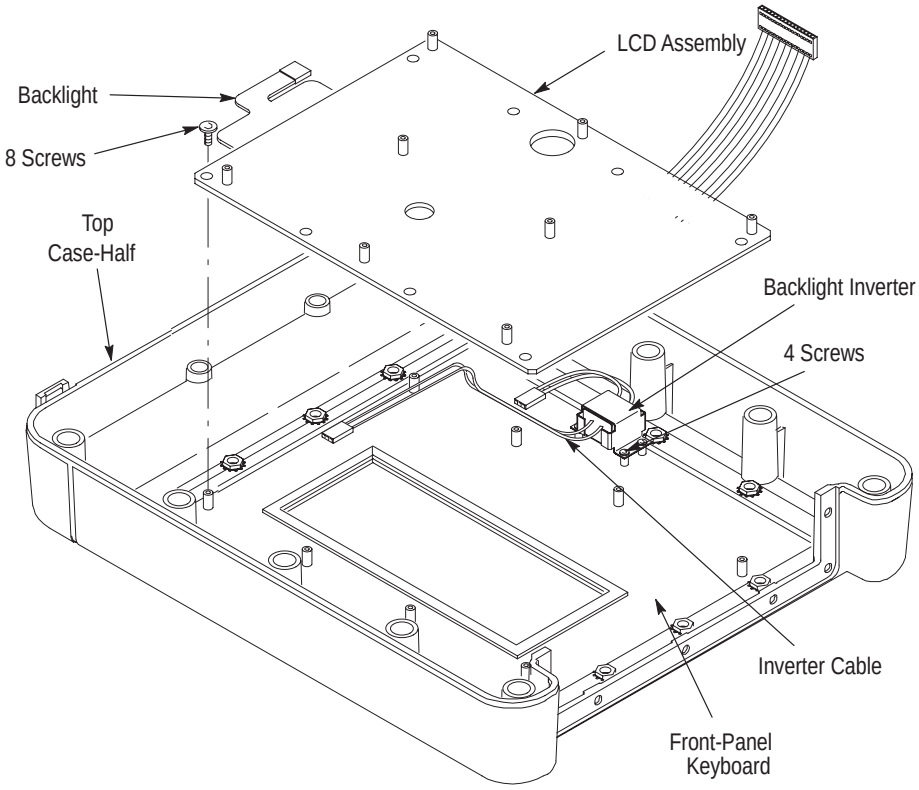


Figure 7–6: LCD Assembly Removal/Installation

3. Unplug the backlight from the inverter cable.
4. Carefully lift out the LCD Assembly.
5. Grip the backlight tail and gently slip the backlight out.
6. Using a PZ1 screw driver, remove four 4–40 X 0.25” pan-head screws from the backlight inverter

Front-Panel Keyboard Removal

1. Perform Preliminary Disassembly, Circuit Board Removal, and LCD Removal.
2. Using 1/4” nut driver, remove 16 4–40 X 0.25” nuts from around the front panel (see Figure 7–7, next page).

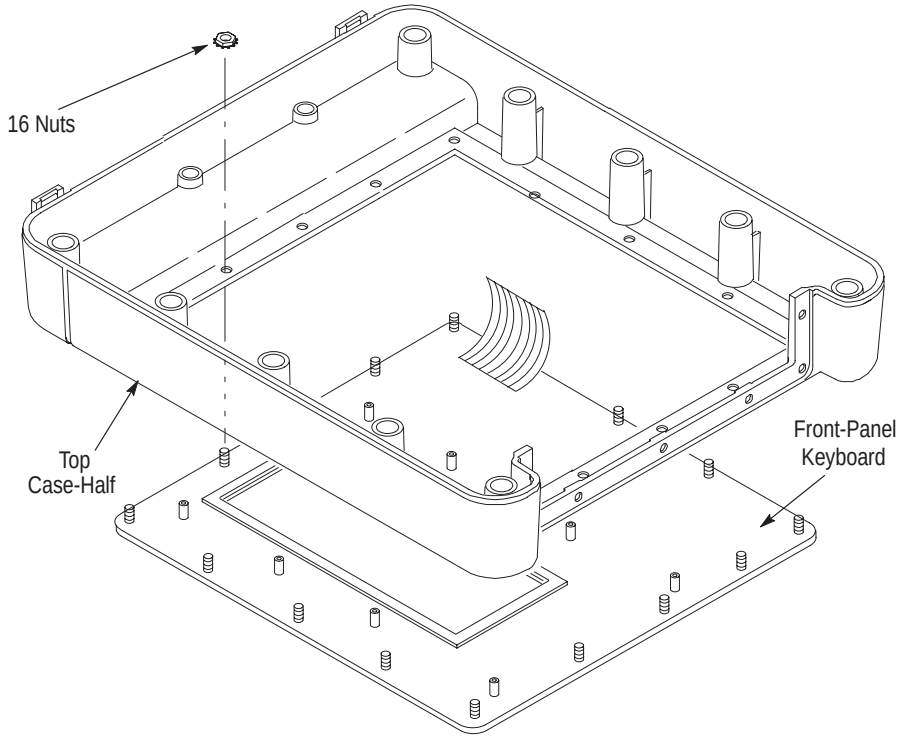


Figure 7–7: Front-Panel Keyboard Removal/Installation

3. Because front panel is mounted on the outside of the enclosure, which is currently lying on its face, carefully lift the case half up and away from the front panel.

This completes the disassembly and removal of all modules from the TV110.

Front-Panel Keyboard Installation

1. Place the front-panel keyboard in the top case half, making sure the connector cutout is on the right as you view the front panel in normal operating position.
2. Carefully turn the unit over and place it flat on the workstation surface.
3. Using 1/4” nut driver, install 16 4–40 X 0.25” nuts from around the front panel (see Figure 7–7).

LCD Assembly Installation

1. If the front-panel keyboard is not already in place, perform Front-Panel Keyboard Installation.
2. Slip the backlight between the LCD and the LCD stiffener plate and position flush with the edge of the LCD module.

3. Carefully place the LCD module, face down, on the stand-offs of the front panel (see Figure 7–6).
4. Using a PZ1 screw driver, install eight 4–40 X 0.25" pan-head screws from the LCD module.
5. Connect the backlight inverter cable to the backlight.

Circuit Board Installation

CAUTION. *Static discharge can damage any semiconductor component in this instrument.*

1. If front panel and LCD are not already in place, perform Front-Panel Keyboard Installation and LCD Installation.
2. Carefully place the circuit board on the stand-offs on the LCD module (see Figure 7–5). Make sure the two large connectors are facing the two ribbon cables coming from the front panel and LCD.
3. Using a PZ1 screw driver, install eight 4–40 X 0.25" screws on the circuit board.
4. Reconnect all cable connectors to the circuit board.

NOTE*. Special consideration should be given to the front-panel cable. This flex cable slips into the board connector, the cut-outs hook over the locators, then the connector lock is clicked in place.*

Connector Panel Reassembly

1. Place the RS-232 connector in its mounting hole and, using the 3/16" nut driver, install two 4–40 X 0.312" hex-head screws.
2. Place 75 Ω connector in mounting hole and screw down retaining nut on back side.
3. Reconnect the wires on the 75 Ω connector.
4. Reconnect the wires from the banana jacks and the RS-232 to the circuit board.

Battery Installation

NOTE*. In the event that the battery cable was removed from the case, push the battery-connector ends through the grommet from the inside of the bottom case half, one at a time.*

1. Place the battery in the battery compartment of the bottom case half (see Figure 7–4).

2. Before sliding the battery down in its horizontal position, connect the battery cable to the appropriate terminals (red to +, black to –).

3. Replace the access panel.

4. With the instrument face down, tighten the six machine screws (they are held on to the access panel with retaining clips).

***NOTE**. If the instrument is still in a state of partial disassembly when this is done, make sure the battery cable from the bottom case half gets reconnected to the circuit board (see Figure 7–5).*

Final Reassembly

1. With the case halves and connector panel positioned as per Figure 7–3, flip the top case half over, reinstall the battery cable and charger cable in the cable clamp, and screw the cable clamp down to the battery compartment.

***NOTE**. For EMI purposes, it is important that the battery cable and charger cable be routed through the cable clamp. If you do not route these cables through the clamp, the instrument might exceed EMI specs.*

2. Gently fit the top case half onto the bottom case half, making sure not to pinch the rubber gasket in the top case half.

***NOTE**. The rubber gasket between case halves is important to the case integrity to maintain water resistance. Be very careful not to damage this gasket.*

3. Install eight 6–32 X 2.0”, truss-head phillips screws and four 6–32 X 1.0”, truss-head phillips screws in the top of the TV110 (see Figure 7–2).

4. Place the connector panel against the connector-panel cutout, being sure that the RS-232 connector lines up under the front-panel label: PRINTER.

5. Install 14 4–40 X 0.25”, flat-head Pozidriv screws in the connector panel (see Figure 7–1).

This completes reassembly of the TV110.

Troubleshooting

Required Equipment

- Static-free workstation
- Digital Multimeter

(All equipment required for disassembly/reassembly is listed on page 7–3)

Setup for Troubleshooting

- Perform Preliminary Disassembly (see page 7–4).
- Leave all electrical connections intact.
- Connect AC adapter/charger and plug into known good AC source.

NOTE. *See Diagrams section for block diagram and circuit board locator to be used with troubleshooting to modular level.*

Troubleshooting Table 7–1

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

1. TV110 WILL NOT POWER ON, or WILL NOT STAY POWERED ON, or BATTERY LIFE IS TOO SHORT, or BATTERY WILL NOT CHARGE

   Step 1. Measure voltage at the External DC adapter connection. The voltage should be 9 to 16 VDC at a load current of 50 to 550 mA with the TV110 powered off and the battery charging. The voltage should be 9 to 16 VDC at a load current of 400 to 900 mA with the TV110 powered on and the battery charging.

   - ♦ If the adapter/charger voltage is acceptable, go to step 6.
   - ♦ If the adapter/charger voltage is not acceptable, replace the AC adapter/charger.
   - ♦ If the adapter/charger voltage is acceptable, but the adapter/charger load current is not acceptable, go to step 2.

   Step 2. Verify that the battery is charging by measuring the charge current at the battery with the AC adapter connected and the TV110 powered off. The bulk charge current at the battery should be between 400 and 540 mA for a battery voltage of 5 to 7 VDC. The trickle charge (float charge) should be between 35 and 160 mA for a battery voltage of 7 to 7.5 V.

   - ♦ If the current is acceptable, go to step 6.
   - ♦ If the current is not acceptable, go to step 3.

Troubleshooting Table 7–1 (continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 3. Verify that the battery voltage, at the battery, after a minimum of eight hours charging with a known-good AC adapter/charger (12 hours to charge up from a fully discharged battery is recommended), is greater than 6.6 VDC at a load current of 350 to 450 mA with the TV110 powered on.

- If the battery voltage and current is acceptable, go to step 6.
- If the battery voltage is not acceptable, replace the battery.
- If the battery standby current or load current is not acceptable, replace circuit board, then go to step 4.

Step 4. Verify that the standby memory-keep-alive current from the battery, with unit powered off, is between 100 to 200 μA (typical 170 μA).

- If current is acceptable, go to step 6.
- If current is not acceptable, go to step 5.

Step 5. Swap out the circuit board and recheck for higher-than-normal load current.

- If current is acceptable, troubleshooting is complete.
- If current is not acceptable, swap the circuit board back and replace the LCD assembly.

Step 6. Disconnect the keyboard cable from the circuit board at J30400. With ohmmeter probes on pins 8 and 9 of the cable, verify that the power switch contact resistance is greater than 10 MΩ with the key up and less than 100 Ω with the key down.

- If the power switch resistance is not acceptable, replace the front-panel keyboard assembly.
- If the power switch resistance is acceptable, replace the circuit board.

2. DISPLAY HAS POOR CONTRAST (too dark or too light) or INFORMATION SHOWN APPEARS INCORRECT

Step 1. Verify manual contrast adjustment using Display Setup Menu.

- If manual contrast adjustment works and information is correct, go to step 2.
- If manual contrast adjustment works, but information is incorrect, go to step 4.
- If manual contrast adjustment does not work, go to step 3..

Troubleshooting Table 7−1 (continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

Step 2. Turn TV110 off and back on. Adjust contrast again.

- If contrast is acceptable, troubleshooting is complete.
- If contrast is not acceptable, replace the circuit board.

Step 3. Check display supply voltage (VLCD) on pin 17 of the LCD cable, connector J30101, for change in range from approximately −12 to −18 VDC during manual contrast adjustment.

- If VLCD voltage is not acceptable, replace the circuit board.
- If VLCD voltage is acceptable, go to step 4.

Step 4. Verify voltages on pins 12−16 of J30101 per table 10−1 (see Diagrams section).

- If voltages are acceptable, replace the LCD assembly.
- If voltages are not acceptable, replace the circuit board.

3. DISPLAY HAS MISSING SECTIONS/PIXELS, or UNREADABLE INFORMATION, or RANDOM SPOTTING ON DISPLAY

Step 1. Verify all power supply, timing, data, and control signals are correct on pins 1−18 of connector J30101 with the LCD connected (see Table 10−1 in Diagrams section).

- If all signals are correct, go to step 2.
- If any signals are incorrect, go to step 3.

Step 2. Check mating cable connector to J30101.

- If continuity problems are found, reinsert cable and try again. If continuity problems persist, replace the circuit board.
- If no continuity problems are found, replace LCD assembly.

Step 3. Disconnect the LCD cable and repeat voltage checks. There should be no measurable difference between J30101 voltages and signals with or without the LCD connected.

- If any signals are incorrect, replace the circuit board.
- If signals return to normal when the LCD is disconnected, replace the LCD assembly.

Troubleshooting Table 7–1 (continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

4. TV110 FORGETS CURRENT SETTINGS AND/OR SAVED WAVEFORMS

   Step 1. Check battery connections and connector J20400 for intermittent or corroded connections. Verify continuity.

   - If connectors are damaged or corroded and cannot be cleaned, replace the battery cable assembly.
   - If connectors are acceptable, go to step 2.

   Step 2. Check battery (perform Malfunction 1)

   - Replace any defective parts found in Malfunction 1.
   - If the battery is acceptable, replace the circuit board.

5. TDR WAVEFORM IS DISPLAYED, BUT IS INCORRECT OR FLAT

   Step 1. Check connections on test leads for continuity. These should read less than 1 Ω per lead.

   - If test lead is not acceptable, replace the test lead.
   - If test lead is acceptable, go to step 2.

   Step 2. Check wire connections from circuit board J10100, J10101, J20100, J20101 to banana jacks on connector panel. These should read less than 0.1 Ω per lead.

   - If wire/cable is not acceptable, replace the wire/cable.
   - If wire/cable is acceptable, replace the circuit board.

6. TDR TESTS OK ON ONE PORT BUT NOT ON THE OTHER

   Step 1. Check connections on test leads for continuity. These should read less than 1 Ω per lead

   - If test lead is not acceptable, replace the test lead.
   - If test lead is acceptable, go to step 2.

   Step 2. Check wire connections from circuit board to connector panel. These should read less than 0.1 Ω per lead.

   - If wire/cable is not acceptable, replace the wire/cable.
   - If wire/cable is acceptable, replace the circuit board.

Troubleshooting Table 7–1 (continued)

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

7. SERIAL PRINTER PORT NOT WORKING; ALL OTHER FUNCTIONS OK

   Check cable connections from circuit board connector J30100 to connector panel. These should read less than 0.2 Ω per lead.

   - If wire/cable is not acceptable, replace the wire/cable.
   - If wire/cable is acceptable, replace the circuit board.

8. SPECIFIC KEYS DO NOT WORK OR WORK ONLY INTERMITTENTLY

   Disconnect the keyboard cable from the circuit board at J30400, then test the keyboard-switch continuity at the cable end (see Table 10–2, Diagrams section, for pinout). Verify that the offending switch contact resistance is greater than 10 MΩ with the key up and less than 100 Ω with the key down.

   - If the switch resistance is not acceptable, replace the front-panel keyboard assembly.
   - If the switch resistance is acceptable, replace the circuit board.

9. TV110 WAS WORKING, THEN LOCKED UP and WILL NOT RESPOND TO ANY KEY-PRESS (Display OK, Keyboard OK, Power Supply OK)

   Check the ROMs (U30200, U30300, U10309) on the circuit board for proper seating in the sockets.

   - If the ROMs are not seated correctly in the sockets, reseat.
   - If the ROMs are seated correctly in the sockets, replace the circuit board.

10. BEEPER DOES NOT WORK or BEEPER ON ALL THE TIME (ALL OTHER FUNCTIONS OK)

    Check the ROMs (U30200, U30300, U10309) on the circuit board for proper seating in the sockets.

    - If the ROMs are not seated correctly in the sockets, reseat.
    - If the ROMs are seated correctly in the sockets, replace the circuit board.

Troubleshooting Table 7–1 (continued)

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
11. TDR DISTANCE READINGS ARE NOT ACCURATE Verify distance accuracy using a standard 100-foot cable with a known Vp, or compare readings to known good TV110 or Tektronix 1503B/C MTDR. ♦ If measurement agrees within ±1%, cable does have that fault. Troubleshooting complete. ♦ If measurement error appears >1%, replace the circuit board.
12. WHILE CONNECTING TDR TO ACTIVE LINE, TELEPHONE LINE STOPS WORKING Check TV110 TEST and REFERENCE ports for capacitive open between red and black (tip and ring) leads; should be > 10 MΩ DC and you should see capacitive charging effect using DMM. Be sure the TV110 is set for testing on each port on which you are checking continuity. ♦ If TEST or REFERENCE port continuity is not acceptable, replace circuit board.

Power-Up Information Messages

POWER-UP SELF TEST

The power-up self tests are starting.

ROM test: PASSED

The ROM checksums and IDs are okay.

RAM test: PASSED

The RAM data, cell, byte, and address tests have passed.

POWER CONTROL RESET... POWERING DOWN...

The power control circuit needs to be reset by powering down; TV110 will turn itself off in 10 seconds.

BATTERY IS LOW... POWERING DOWN...

The battery is too low to operate; TV110 will turn itself off in 10 seconds. Plug in the AC adapter to initiate battery charging. You can use the TV110 while the battery is being charged.

EXTERNAL POWER IS LOW... POWERING DOWN...

The voltage from the switching regulator is too low to operate; the TV110 will turn itself off in 10 seconds. Verify that the AC adapter is functional and plugged into the TV110 correctly.

Error Messages

If there is a power-up error, the TV110 will beep twice, display an error message, and turn itself off after five minutes.

Error Messages Table 7–2

ERROR MESSAGE EXPLANATION CORRECTIVE ACTION
ROM test: FAILED The ROM test has failed; additional message follows. ROM A ID ERROR bad data bits : XXXXXXXX XXXXXXXX ROM B ID ERROR bad data bits : XXXXXXXX XXXXXXXX ROM ID ERROR bad data bits : XXXXXXXX XXXXXXXX ROM A CHECKSUM ERROR stored checksum : XXXX XXXX calculated checksum : XXXX XXXX ROM B CHECKSUM ERROR stored checksum : XXXX XXXX calculated checksum : XXXX XXXX ROM CHECKSUM ERROR stored checksum : XXXX XXXX calculated checksum : XXXX XXXX Replace circuit board.

Error Messages Table 7–2 (continued)

ERROR MESSAGE
EXPLANATION
CORRECTIVE ACTION

RAM test: FAILED

The RAM test has failed; additional message follows.

RAM DATA ERROR
write: data= XXXXXXXX XXXXXXXX address= XXXXXXXX XXXXXXXX XXXXXXXX
read: data= XXXXXXXX XXXXXXXX address= XXXXXXXX XXXXXXXX XXXXXXXX

RAM BYTE ERROR
write: data= XXXXXXXX XXXXXXXX address= XXXXXXXX XXXXXXXX XXXXXXXX
read: data= XXXXXXXX XXXXXXXX address= XXXXXXXX XXXXXXXX XXXXXXXX

RAM CELL ERROR
write: data= XXXXXXXX XXXXXXXX address= XXXXXXXX XXXXXXXX XXXXXXXX
read: data= XXXXXXXX XXXXXXXX address= XXXXXXXX XXXXXXXX XXXXXXXX

RAM ADDRESS ERROR
write: data= XXXXXXXX XXXXXXXX address= XXXXXXXX XXXXXXXX XXXXXXXX
read: data= XXXXXXXX XXXXXXXX address= XXXXXXXX XXXXXXXX XXXXXXXX

Replace circuit board.

SUPPLY OFF ERROR

The Supply signal went low, which normally indicates the power supply controller is in reset. However, because the TV110 still has power, the power supply can't be in reset.

Replace the circuit board.

CLOCK ERROR

The main CPU lost its clock reference.

Replace circuit board.

BREAKPOINT ERROR

The breakpoint signal went low.

Replace circuit board.

BUS ERROR

The bus error signal went low, or there was a software error.

Replace circuit board.

Error Messages Table 7–2 (continued)

ERROR MESSAGE EXPLANATION	CORRECTIVE ACTION
HALT ERROR	
Halt signal went low, or there was a software error.	Replace circuit board.
SOFTWARE ERROR n (where n is some number)	
Indicates that the main CPU isn't reading the ROMs correctly.	Replace circuit board.
OS RETURN ERROR	
Indicates that the main CPU isn't reading the ROMs correctly.	Replace circuit board.
WATCHDOG ERROR	
Indicates that the main CPU isn't reading the ROMs correctly.	Replace circuit board.

Options and Accessories

Options

Option 1C: Changes US AC adapter/charger to 119–4240–00 Universal Euro adapter/charger, 220VAC, 6A, 50Hz

Option 2C: Changes US AC adapter/charger to 119–4239–00 United Kingdom adapter/charger, 240VAC, 5A, 50Hz

Option 3C: Changes US AC adapter/charger to 119–4238–00 Australia adapter/charger, 240VAC, 6A, 50Hz

Option 6C: Changes US AC adapter/charger to 119–4241–00 Japan adapter/charger, 100VAC in, MITI approved

Accessories

Standard Accessories

- US AC adapter/charger, input: 120 VAC, 60 Hz, output: 9 VDC, 1 A 119–4242–00
- Test cable, BNC female to alligator clips 013–0261–00
- Coaxial jumper cable, F-type male to F-type male. 174–3246–00
- Adapter connector, F-type female to F-type female 103–0364–00
- Adapter connector, F-type female to BNC male 013–0288–00
- Soft carrying case w/Battery storage label (334–9394–xx) . . . 016–1215–01
- Shoulder strap for carrying case 346–0285–00
- User Manual 070–8981–xx
- Reference Card 063–1811–xx

Optional Accessories

- TV110 Service Manual 070–8815–xx
- Extra Battery 146–0098–00
- Cigarette-Lighter Charger Cable 174–1734–01

Optional Accessories **con't**

- Strand Hook (retaining ring, two required) 354–0745–00
- Connector, adapter, serial–to–parallel converter, 25-pin male to 36-pin female 131–6004–00
- Cable, Printer, general 012–1313–00
- Cable, Printer, Seiko-style 012–1462–00
- Printer, Seiko DPU-411 119–4594–00
  Paper, Thermal, for Seiko printer 006–7840–00
  AC Adapter/Charger, 220 VAC, for Seiko printer 119–4648–00

Replaceable Parts List

This section contains a list of replaceable modules in the TV110. Use this list to identify and order replacement parts.

Parts Ordering Information

Replacement parts information is available from your Tektronix service center or representative. Parts can be ordered through your local Tektronix field office.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to provide benefit of the latest circuit improvements developed by our engineers.

When ordering parts, include the following information:

- Part number
- Instrument type or model number
- Instrument serial number
- Instrument modification number (if applicable)

If a part has been replaced with a new or improved part, Tektronix will contact you regarding any change in part number.

Module Replacement

The TV110 is serviced by replacing defective modules. There are three options you should consider:

Module Exchange In some cases you may exchange the defective module for a remanufactured module. Remanufactured modules cost significantly less than new modules, and meet the same factory specifications. For more information about the module exchange program, call 1–800–835–9433.

Module Repair You may ship the defective module to Tektronix for repair. We will repair and return the same module to you.

New Modules New modules can be purchased like other replacement parts.

Using the Replaceable Parts List

The tabular information in the parts List is arranged for easy use.

The parts list is indented to indicate item relationships. The following is an example of the indentation system used in the Name and Description column:

Assembly and/or component
. Detail part of assembly or component
.. Parts of detail part

Abbreviations conform to American Nation Standards Institute (ANSI) standard.

Tektronix Part Number Use the part number when ordering a replacement part from Tektronix.

Serial/Model No. These columns show the serial numbers of the first and last instruments in which a part was used. No entry in these columns indicates that the part is used in all instruments.

Name and Description In the parts list, an item name is separated from its description by a colon (:). Because of space limitations, an item name may be incomplete. For item name identification, refer to the U.S. Federal Cataloging Handbook H6–1.

Mfr. Code and Mfg. Part Number These columns list the code number of the manufacturer of the part, and the manufacturer's part number for the part. Refer to the Cross Index, Mfg. Code Number to Manufacturer for names and addresses of manufacturers.

CROSS INDEX – MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip Code
H5479	HIRSCHMANN ELECTRONICA NEDERLAND BV RICHARD PAMPUSLAAN	90 POSTBUSNR 92 1382 JR WEESP	NETHERLANDS
TK0IT	CASIO ELECTRONIC DEVISE COMPANY LTD	6–1, NISHI–SHINJUKU, 2–CHROME	SINJUKU–KU TOKYO 163 JAPAN
TK1401	DIMENSIONAL FABRICATORS	PO BOX 23247	TIGARD OR 97223
TK1989	GASKET SPECIALITIES	4968 NE 122ND AVE	PORTLAND OR 97220
TK2532	TECH LITE	2121 N LANCASTER – HUTCHINS RD	LANCASTER TX 75134
00779	AMP INC	2800 FULLING MILL PO BOX 3608	HARRISBURG PA 17105
0JRZ5	GASKET TECHNOLOGY	478 NE 219TH AVE	TROUTDALE OR 97060
0J4Z2	PRECISION PRINTERS	PO BOX 36	CEDAR RIDGE CA 95924
0J7N9	MCX INC	30608 SAN ANTONIO ST	HAYWARD CA 94544
0J9P4	DELTA ENGINEERING	19500 SW TETON	TUALATIN OR 97062
0KB01	STAUFFER SUPPLY	810 SE SHERMAN	PORTLAND OR 97214
01536	TEXTRON INC, CAMCAR DIV SEMS PRODUCTS UNIT	1818 CHRISTINA ST	ROCKFORD IL 61108
1Y013	ACACIA/DEANCO	3101 SW 153RD DRIVE	BEAVERTON OR 97006
2K262	BOYD CORP	6136 NE 87TH AVE PO BOX 20038	PORTLAND OR 97220
5H194	AIR–OIL PRODUCTS CORP (DIST)	2400 E BURNSIDE	PORTLAND OR 97214–1752
5Y400	TRIAX METAL PRODUCTS INC DIV OF BEAVERTON PARTS MFG CO	1800 NW 216TH AVE	HILLSBORO OR 97124–6629
53421	TYTON CORPORATION	7930 N FAULKNER ROAD PO BOX 23005	MILWAUKEE WI 53223
70485	ATLANTIC INDIA RUBBER WORKS INC	571 W POLK ST	CHICAGO IL 60607
71643	CHR INDUSTRIES INC AN ARMCO CO	407 EAST ST	NEW HAVEN CT 06509
73743	FISCHER SPECIAL MFG CO	111 INDUSTRIAL RD	COLD SPRING KY 41076–9749
77252	PHILADELPHIA STEEL AND WIRE CORP	2828 CHARTER ROAD	PHILADELPHIA PA 19154–2111
78189	ILLINOIS TOOL WORKS INC SHAKEPROOF DIV	ST CHARLES ROAD	ELGIN IL 60120
7X318	KASO PLASTICS	11015 A NE 39TH	VANCOUVER WA 98662
80009	TEKTRONIX INC	14150 SW KARL BRAUN DR PO BOX 500	BEAVERTON OR 97077–0001
81855	EAGLE–PICHER INDUSTRIES INC ELECTRONICS DIV	COUPLES DEPT C AND PORTER STS PO BOX 47	JOPLIN MO 64801
93907	TEXTRON INC, CAMCAR DIV	600 18TH AVE	ROCKFORD IL 61108–5181

Component Number	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Name & Description	Mfr. Code	Mfr. Part No.
				TV110 ELECTRICAL ASSYS.		
A1	671–3231–00	B010100	B010179	CIRCUIT BD ASSY:MAIN, TV110	80009	671–3231–00
	671–3231–01	B010180	B010205	CIRCUIT BD ASSY:MAIN, TV110	80009	671–3231–01
	671–3231–02	B010206	B010272	CIRCUIT BD ASSY:MAIN, TV110	80009	671–3231–02
	671–3231–03	B010273	B010301	CIRCUIT BD ASSY:MAIN, TV110	80009	671–3231–03
	671–3231–04	B010302	B019999	CIRCUIT BD ASSY:MAIN, TV110	80009	671–3231–04
	671–3839–01	B020000	B021043	CIRCUIT BD ASSY:MAIN, TV110	80009	671–3839–01
	671–3839–02	B021044		CIRCUIT BD ASSY:MAIN, TV110	80009	671–3839–02
A2	119–4595–00	B010100	B019999	LCD ASSEMBLY:	80009	119–4595–00
	119–5416–00	B020000		LCD ASSEMBLY:	80009	119–5416–00

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	Name & Description	Mfr. Code	Mfr. Part No.
FIG. 9–1					TOP CASE HALF AND SIDE PANEL		
–1	333–4141–00	B010100	B020966	1	PANEL,FRONT:TV110	0J4Z2	333–4141–00
	333–4141–01	B020967	B029999	1	PANEL,FRONT:TV110	0J4Z2	333–4141–01
	333–4141–02	B030000		1	PANEL,FRONT:TV110	0J4Z2	333–4141–02
–2	119–5652–00	B030000		1	. LAMP,PANEL:BACKLIGHT;EL,100 VAC,400HS,17 MA	0JRZ3	119–5652–00
–3	——— ———			1	LCD ASSY: SEE A2 REPL		
–4	348–1374–00			2	FOAM,HT SK:0.130 THK THERMAL CONDUCT FOAM W/SPA	TK1989	348–1374–00
–5	——— ———			1	CIRCUIT BD ASSY:MAIN SEE A1 REPL		
–6	174–3245–00			1	CA ASSY,SP,ELEC:9.0 L,22 AWG,300V W/TERMINAL	80009	174–3245–00
–7	131–0890–01			2	LOCK, CONNECTOR:4–40 X 0.312 L,HEX	00779	205818–2
–8	386–6563–00			1	PLATE,HT SK:0.062 THKCK 5052–H32.ALUM	0J9P4	386–6563–00
–9	390–1116–00	B010100	B020966	1	CABINET ASSY:TOP CASE HALF,POLYCARBONATE	7X318	390–1116–00
	390–1169–00	B020967		1	CABINET ASSY:TOP CASE HALF,POLYCARBONATE	7X318	390–1169–00
–10	211–3003–00	B010100	B020966	8	SCR,MACH:6–32 X 2.0,POZ,TRUSS HD,SS	0KB01	211–3003–00
	211–0881–00	B020967		8	SCR,MACH:6–32 X 2.0,TRUSS HD,SS,BLK	0KB01	211–0881–00
–11	348–1312–00			1	GASKET,PANEL:6.768 X 3.229,0.045 THK,PORON	2K262	348–1312–00
–12	386–6770–00	B010100	B020966	1	PANEL,SIDE:ALUMINUM	TK1401	386–6770–00
	386–6770–01	B020967	B021014	1	PANEL,SIDE:ALUMINUM	TK1401	386–6770–01
	386–0086–00	B021015		1	PANEL,SIDE:ALUMINUM	80009	386–0086–00
					NOTE:ORDER LABEL 334–9366–00 WHEN ORDERING SIDE PANEL FOR INSTRUMENTS B021044 AND BEYOND		
–13	211–0101–00	B010100	B020966	14	SCR,MACH:4–40 X 0.25,FLH,1OO DEG,POZ	93907	ORD BY DESCR
	211–0917–00	B020967	B021014	14	SCR,MACH:4–40 X 0.25,PNH,TORX,BLK OXIDE	0KB01	211–0917–00
	211–0908–00	B021015		14	SCR,MACH:4–40 X 0.25,PNH,TORX,BLK OXIDE	0KB01	211–0908–00
–14	——— ———				F–F;F TYPE FEMALE (SEE STANDARD ACCESSORIES)		
–15	131–0890–01			2	LOCK.CONN:4–40 X 0.312 L,HEX HD,W/O WSHR & HEX NUT	00779	205818–2
–16	200–4125–00			1	CAP,DUST:PLASTIC ASSY	80009	200–4125–00
–17	174–3021–00			1	CA ASSY,SP,ELEC:28 AWG,3.0 L,10 CONDUCTOR RIBBON	1Y013	174–3021–00
–18	214–4586–00			1	SPRING,GROUND:BE–CU,CONTACT STRIP	80009	214–4586–00
–19	354–0728–00			1	O–RING:0.062 +/–0.005 DIA,40 +/–5SHORE,BLACK	0JRZ5	354–0728–00
–20	211–3002–00	B010100	B020966	4	SCR,MACH:6–32 X 1.0,POZ,TRUSS HD,SS	0KB01	211–3002–00
	211–0882–00	B020967		4	SCR,MACH:6–32 X 1.0,TRUSS HD,BLK	0KB01	211–0882–00
–21	386–6962–00	B030000		1	BRACKET,INVRTR:0.031 THK ALUM ALLOY	0J9P4	386–6962–00
–22	253–0451–00	B030000		1	FOAM PAD,INVRTR:0.700 X 0.700 X 0.125 W/2 MIL ADH	2K262	253–0451–00
–23	119–5653–01	B030000		1	POWER SUPPLY:TO BACKLIGHT	80009	119–5653–01

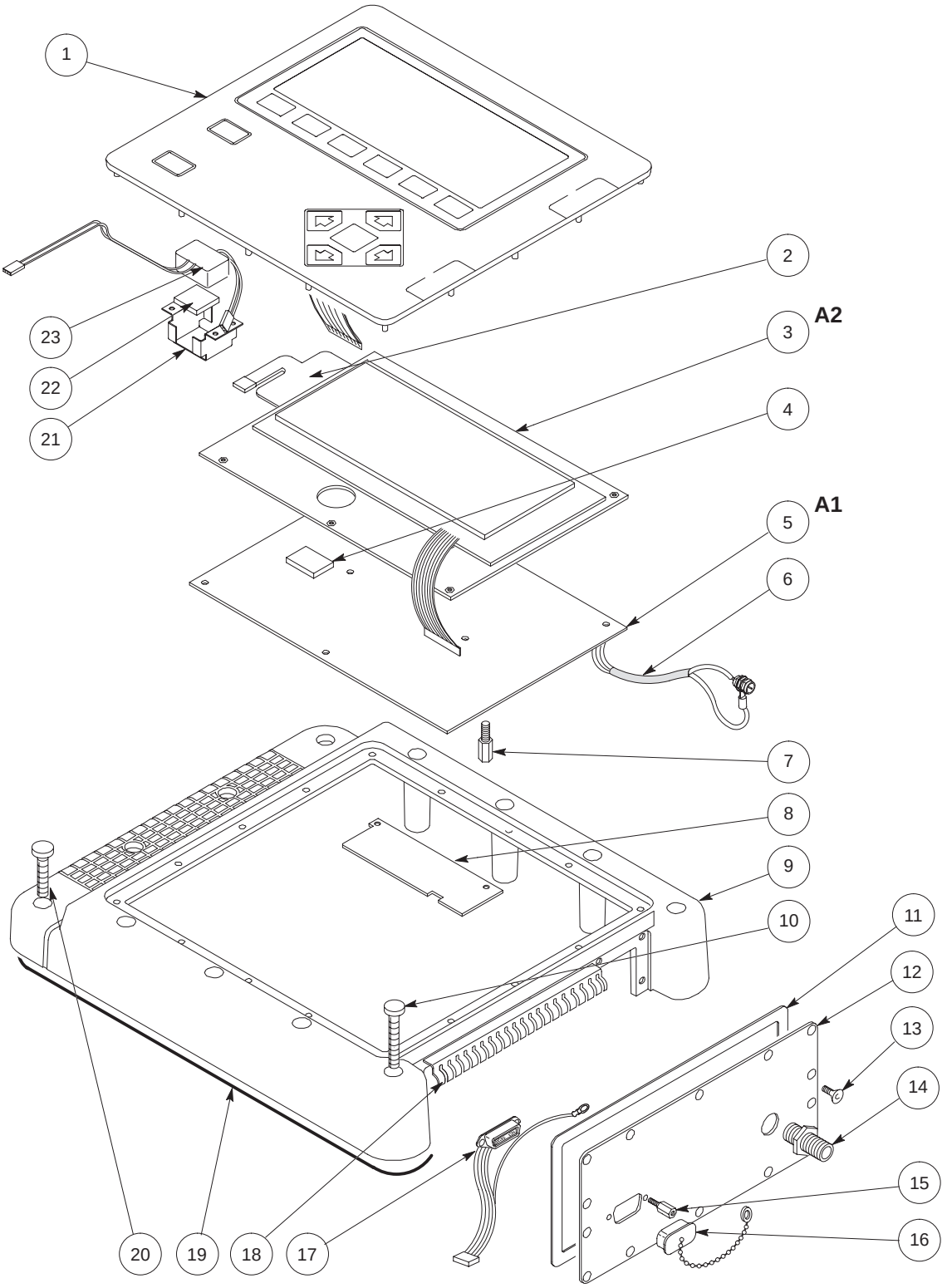


Figure 9–1: Top Case Half and Side Panel

Fig. & Index No.	Tektronix Part No.	Serial No. Effective	Serial No. Dscont	Qty	Name & Description	Mfr. Code	Mfr. Part No.
FIG 9–2					BOTTOM CASE HALF WITH BATTERY		
	650–3701–00				CASE ASSY:BOTTOM		
–1	390–1119–00	B010100	B020966	1	. CABINET,,BOTTOM:0.125 POLYCARBONATE	7X318	390–1119–00
	390–1170–00	B020967		1	. CABINET,,BOTTOM:0.15 POLYCARBONATE	7X318	390–1170–00
–2	343–1502–00			1	. CLAMP,CABLE:0.188 ID X 0.25 W,0.141 MT HOLE	53421	NX1
–3	348–0005–00			1	. GROMMET,RUBBER:BLACK,ROUND,0.375 ID	70485	230X–36017
–4	174–3020–00			1	. CABLE ASSY:22 AWG,150V,RMS,9.0 L,DC TO TERMINAL	1Y013	174–3020–00
–5	348–1348–00			1	. GROMMET:12MM ID X 1MM CROSS SECTION,NITRILE	5H194	348–1348–00
–6	334–8572–01	B010100	B020966	1	MARKER,IDENT:SAFETY MARKINGS	0KB01	334–8572–01
	334–8572–02	B020967		1	MARKER,IDENT:SAFETY MARKINGS	0KB05	334–8572–02
–7	361–1650–00			1	. SPACER, FOAM:0.125 X 1.8 X 2.7 POLYURETHANE FOAM (SUBPART OF BOTTOM CASE ASSEMBLY)	2K262	348–1650–00
–8	361–1642–00			2	SPACER,BATTERY:1.250 POLYURETHANE FOAM W/SPA	2K262	361–1642–00
–9	146–0098–00			1	BATTERY,LEAD AC:6V,4.6 AHR,CFM 6V 4.6–55	81855	CFM6V4.6–55
–10	174–3019–00			1	CA ASSY,SP,ELEC:STRD,22 AWG,150V RMS WHITE,PVC	1Y013	174–3019–00
–11	348–1320–00			1	. GASKET,BTRY DOOR:0.062 PORON,7.38 X 3.98 (SUBPART OF BOTTOM CASE ASSEMBLY)	2K262	348–1320–00
–12	200–4074–00	B010100	B020966	1	COVER,BATTERY:MAKROBLEND DP4–1368	7X318	200–4074–00
	650–3675–00	B020967		1	COVER,ASSEMBLY:BATTERY COVER	7X318	650–3675–00
–13	211–3004–00	B010100	B020966	6	. SCR,MACH:6–32 X 0.5625,62 DEG COUNTERSINK	0KB01	211–3004–00
	211–0889–00	B020967		6	. THUMBSCREW:6–32 X 0.656 MACHINE	0KB01	211–0889–00
–14	354–0163–00			6	. RING,RETAINING:TYPE E EXT,U/O 0.125 ID SFT	79136	5133–12ZD

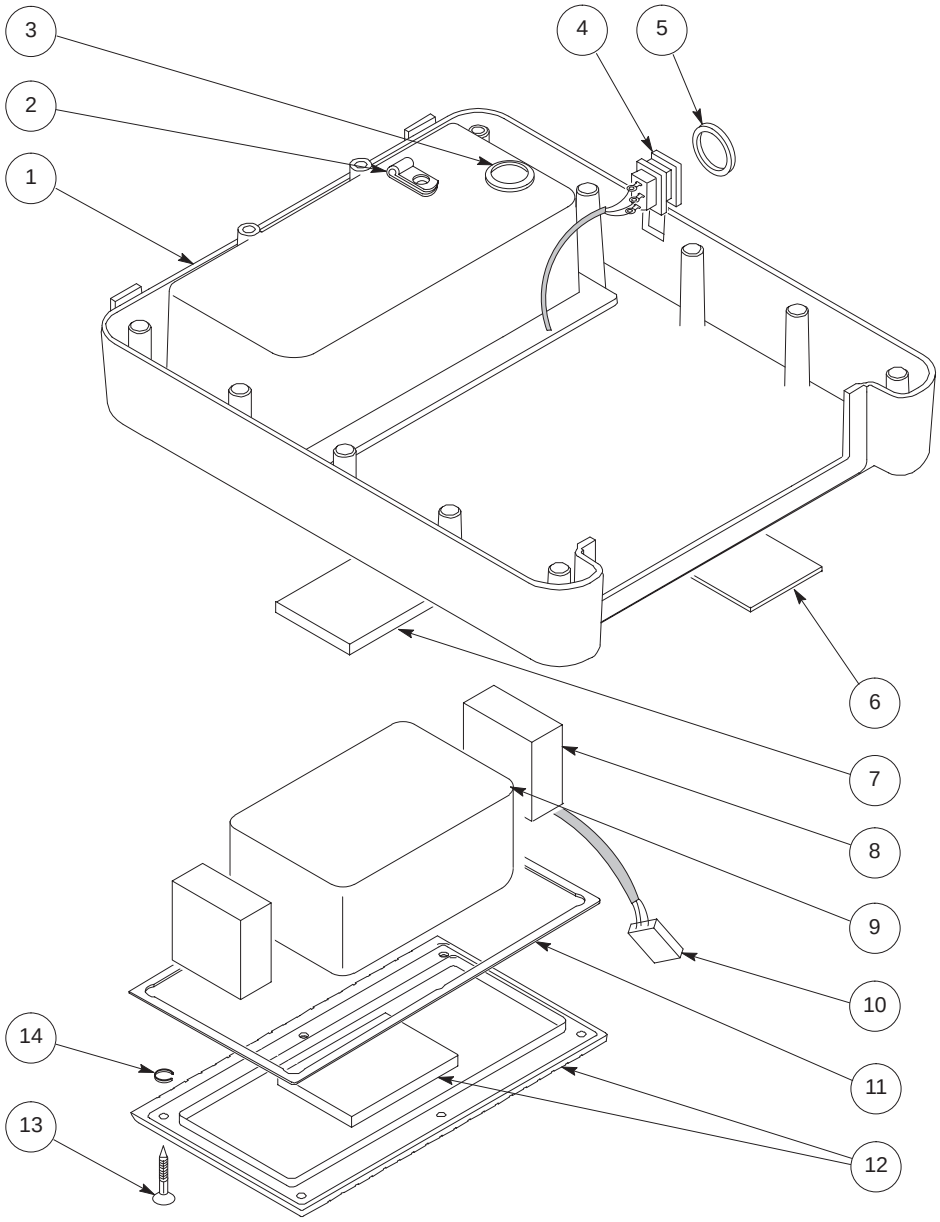


Figure 9–2: Bottom Case Half with Battery

Diagrams

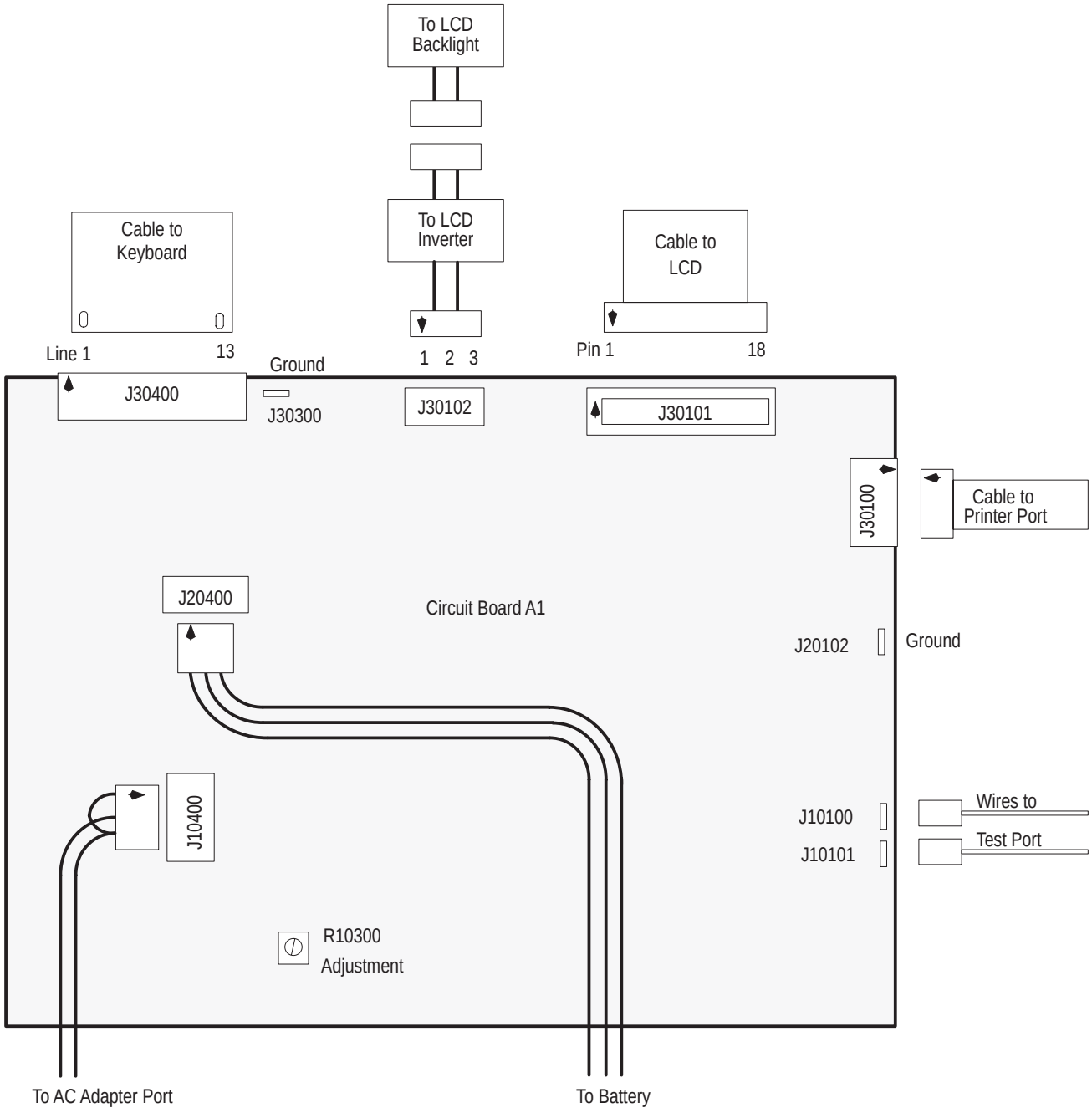


Figure 10–1: Circuit Board Connections, Adjustment, and Test Points

Table 10–1. J30101 Voltages

Pin	Voltage	Pin	Voltage
1	no connection	10	0.536 VDC ±2%
2	+5 VDC ±2%	11	0.533 VDC ±2%
3	ground	12	+5 VDC ±2%
4	0.028 VDC ±2%	13	+3.2 VDC ±2%
5	0.027 VDC ±2%	14	+1.4 VDC ±2%
6	2.21 VDC ±2%	15	–12.0 VDC ±2%
7	2.49 VDC ±2%	16	–13.9 VDC ±2%
8	0.546 VDC ±2%	17	–15.7 VDC ±2%
9	0.541 VDC ±2%	18	no connection

Notes for Table 10-1.

1. *These measurements were made using the start–up display. Any other display will produce different results.*
2. *Voltages on pins 13 – 17 are proportional to the ambient temperature. These results were obtained at approximately 22°C.*
3. *Voltages on pins 5 – 11 are digitally multiplexed control signals and are switching from 0 V to 5 V. The values shown are the DC average voltages as measured with a digital multimeter. Actual timing diagram is shown on the next page.*

Table 10–2. J30400 Pinout

Front-Panel Key	Pins	Front-Panel Key	Pins
POWER Key	8 and 9	Left Arrow	1 and 4
HELP Key	3 and 4	Right Arrow	1 and 6
Softkey 1 (left)	3 and 5	Up Arrow	2 and 7
Softkey 2	3 and 6	Down Arrow	1 and 5
Softkey 3	3 and 7	Star Key	1 and 7
Softkey 4	2 and 6	no connection	10
Softkey 5	2 and 5	no connection	11
Softkey 6 (right)	2 and 4	no connection	12
		no connection	13

Table 10-3. J30102 Voltages

Pin	Voltage
1	6.0 V
2	ground
3	6.0 V

Notes for Table 10-3.

1. The backlight inverter output is 60 – 75 VAC, RMS.

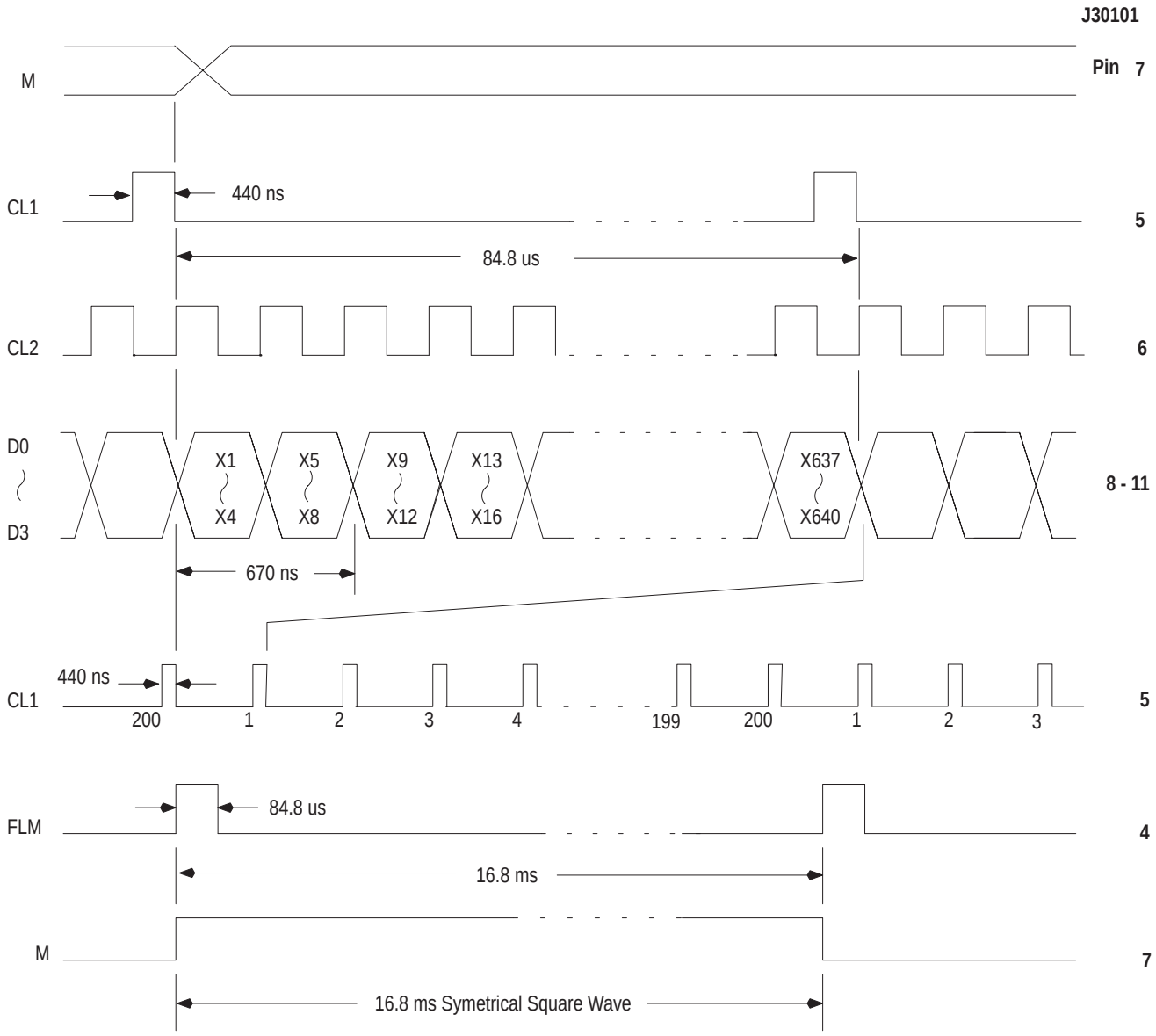


Figure 10–2: TV110 Typical LCD Interface Timing Chart

Glossary

AC

Alternating current: 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 its true value.

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, which should be corrected for in some TDR measurements. Cable attenuation is usually expressed in decibels (dB) 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. Water leaking through the insulation, poorly mated connectors, and bad splices are typical types of cable faults.

dB

Decibel: 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 in some cases, lost) by the system. Our instrument measures return loss. The formula for decibels is: dB = 20 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.

DC

Direct current: a method of delivering electrical energy by maintaining a constant flow of electrons in one direction. Even circuits designed to generate only alternating current (AC) often have a DC component.

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 under test.

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).

LCD

Liquid Crystal Display: a kind of display used in this instrument. Therefore, the terms *LCD* and *display* are often used interchangeably in this manual.

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 as the waveform moving up and down on the display.

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 appears on the display like very high impedance.

TDR

Time-Domain Reflectometer: an instrument that sends out pulses of energy and times the interval to reflections (also called cable radar). If the velocity of the energy through the cable is known, distances to faults in the cable can be computed and displayed. Conversely, the speed that 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)

The speed that electricity travels in a cable is often expressed as the relative velocity of propagation. This value is just a ratio of the speed in the cable to the speed of light. This is always a number between 0 and 1. A velocity of propagation value of 0.50 indicates that the electrical energy moves through that particular cable at half the speed of light.

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