

Service Manual



TR 210 Huntron Tracker

071-0113-00

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.



Copyright © Tektronix, Inc. All rights reserved.

Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supercedes that in all previously published material. Specifications and price change privileges reserved.

Printed in the U.S.A.

Tektronix, Inc., P.O. Box 1000, Wilsonville, OR 97070-1000

TEKTRONIX and TEK are registered trademarks of Tektronix, Inc.

Huntron and Tracker are registered trademarks of Huntron, Inc.

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.

Table of Contents

| | |
|-------------------------------------|------------|
| General Safety Summary | v |
| Service Safety Summary | vii |
| Preface | ix |
| Related Manuals | ix |
| Contacting Tektronix | ix |

Specifications

| | |
|--------------------------------------|-----|
| Electrical Specifications | 1-1 |
| Mechanical Specifications | 1-2 |
| Environmental Specifications | 1-2 |
| Certifications and Compliances | 1-3 |

Operating Basics

| | |
|---|------------|
| Installation | 2-1 |
| Power Configuration | 2-1 |
| Oscilloscope Connection | 2-2 |
| Operation | 2-3 |
| Front-Panel Controls and Connectors | 2-3 |
| Operational Check Procedure | 2-4 |

Theory of Operation

| | |
|--------------------------|-----|
| Front Panel Module | 3-1 |
| Main Board Module | 3-1 |
| Line Filter Module | 3-2 |
| Rear Panel Module | 3-2 |

Performance Verification

| | |
|-------------------------------|-----|
| Equipment Required | 4-1 |
| Preparation | 4-2 |
| Logic Section | 4-2 |
| Signal Section | 4-4 |
| Pulse Generator Section | 4-8 |

Adjustment Procedures

| | |
|----------------------------|-----|
| Equipment Required | 5-1 |
| Preparation | 5-1 |
| Adjustment Procedure | 5-3 |

Maintenance

| | |
|--|------------|
| Maintenance | 6-1 |
| Preparation | 6-1 |
| Inspection and Cleaning | 6-2 |
| Removal and Installation Procedures | 6-5 |
| Equipment Required | 6-5 |
| Line Fuse | 6-6 |
| Signal Fuse | 6-6 |
| Front Panel Knobs | 6-7 |
| Top Cover | 6-7 |
| Line Filter | 6-8 |
| Rear Panel Assembly | 6-8 |
| Front Panel Assembly | 6-9 |
| Front Panel Potentiometers and Elastomer | 6-9 |
| Main Board | 6-9 |

Options

Replaceable Electrical Parts

Diagrams

Replaceable Mechanical Parts

List of Figures

| | |
|---|-------------|
| Figure 2–1: TR 210 rear panel | 2–1 |
| Figure 2–2: Connecting the TR 210 Huntron Tracker to an oscilloscope | 2–2 |
| Figure 2–3: Front panel | 2–3 |
| Figure 2–4: Typical open-circuit signature | 2–5 |
| Figure 2–5: Typical short-circuit signature | 2–5 |
| | |
| Figure 3–1: TR 210 block diagram | 3–1 |
| | |
| Figure 4–1: Pulse types | 4–10 |
| | |
| Figure 5–1: TR 210 adjustment locations and test points | 5–3 |
| | |
| Figure 6–1: Accessing the line fuse and spare fuse (159-0414-00) | 6–6 |
| Figure 6–2: Signal fuse (159-0312-00) | 6–6 |
| Figure 6–3: Retainer clips | 6–7 |
| Figure 6–4: Line filter | 6–8 |
| | |
| Figure 10–1: TR 210 replaceable parts and accessories | 10–1 |

List of Tables

| | |
|--|------------|
| Table 1–1: Electrical specifications | 1–1 |
| Table 1–2: Mechanical specifications | 1–2 |
| Table 1–3: Environmental specifications | 1–2 |
| Table 1–4: Certifications and compliances | 1–3 |
| | |
| Table 2–1: Front-panel controls and connectors | 2–3 |
| | |
| Table 4–1: Test equipment, fixtures, and supplies | 4–1 |
| | |
| Table 5–1: Test equipment, fixtures, and supplies | 5–1 |
| | |
| Table 6–1: Internal inspection check list | 6–3 |
| Table 6–2: Tools required for module removal | 6–5 |
| | |
| Table 7–1: Power cord identification | 7–1 |

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.

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.

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.

The common terminal is at ground potential. Do not connect the common terminal to elevated voltages.

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 in Wet/Damp Conditions.

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:



WARNING
High Voltage



Protective Ground
(Earth) Terminal



CAUTION
Refer to Manual



Double
Insulated

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 mains 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 (if applicable), and disconnect test leads before removing protective panels, soldering, or replacing components.

To avoid electric shock, do not touch exposed connections.

Preface

This manual provides information to troubleshoot and repair the TR 210 Huntron Tracker to the module level.

Related Manuals

Additional documentation for the instrument is contained in the *TR 210 Huntron Tracker User Manual* (part number 071-0114-XX).

Contacting Tektronix

| | |
|-----------------------|---|
| Product Support | For application-oriented questions about a Tektronix measurement product, call toll free in North America: 1-800-TEK-WIDE (1-800-835-9433 ext. 2400) 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 | Contact your local Tektronix distributor or sales office. Or visit our web site for a listing of worldwide service locations. http://www.tek.com |
| For other information | In North America: 1-800-TEK-WIDE (1-800-835-9433) An operator will direct your call. |
| To write us | Tektronix, Inc. P.O. Box 1000 Wilsonville, OR 97070-1000 |

Specifications

This chapter contains the specifications for the TR 210 Huntron Tracker. All specifications are guaranteed unless noted as “typical.” Typical specifications are provided for your convenience but are not guaranteed.

Electrical Specifications

Table 1–1 lists the electrical specifications for the TR 210 Huntron Tracker.

Table 1–1: Electrical specifications

| Test Signal | | |
|-----------------------------------|---|--|
| Signal Type | Sine wave | |
| Ranges | <i>Open Circuit Voltage (V_s), typical</i> | <i>Source Resistance (R_s), typical</i> |
| HIGH | 60 V _{pk} | 74 k Ω |
| MED 2 | 20 V _{pk} | 27.6 k Ω |
| MED 1 | 15 V _{pk} | 1.24 k Ω |
| LOW 2 | 10 V _{pk} | 54 Ω |
| LOW 1 | 3 V _{pk} | 10 k Ω |
| Frequency | 50/60 Hz (switch selectable), 200 Hz, or 2 kHz | |
| Channels | 2 | |
| Display Modes | A, B, or ALT | |
| Signal Fuse (overload protection) | 5 mm x 20 mm, F250 mA, 250 V, (IEC127–2/II, type GDB), user replaceable | |
| Overvoltage Category | CAT I | |
| Pulse Generator | | |
| Outputs | 2 | |
| Level Range, typical | 0 V to ± 5 V | |
| DC Mode | \pm DC level | |
| Pulse Mode | \pm or composite | |
| Frequency | Matches selected test signal frequency | |
| Width (pulse mode), typical | 2% to 50% duty cycle | |
| Source Resistance, typical | 100 Ω (each output) | |
| Short Circuit Current | 50 mA maximum (each output) | |

Table 1–1: Electrical specifications (Cont.)

| Power Requirements | |
|--------------------|--|
| Line Voltage | 100/115 VAC or 230 VAC, selector switch on rear panel |
| Frequency | 50 Hz to 60 Hz |
| Power | 15 W maximum |
| Line Fuse | 100/115 V: 5 mm x 20 mm, T125 mA, 250 V,(IEC127-2/III, type GDC), user replaceable |
| | 230 V: 5 mm x 20 mm, T125 mA, 250 V,(IEC127-2/III, type GDC), user replaceable |

Mechanical Specifications

Table 1–2 lists the mechanical specifications for the TR 210 Huntron Tracker.

Table 1–2: Mechanical specifications

| | |
|------------------------|---|
| Dimensions (W x H x D) | 11.5 in x 2.7 in x 10.2 in (29.1 cm x 6.9 cm x 25.9 cm) |
| Weight | 4.6 lbs. (2.1 kg) |
| Shipping Weight | Approximately 7 lbs. (3 kg) |

Environmental Specifications

Table 1–3 lists the environmental specifications for the TR 210 Huntron Tracker.

Table 1–3: Environmental specifications

| | |
|-----------------------|---|
| Application | Indoor use |
| Altitude | < 2000 m (< 6560 ft) |
| Operating Temperature | 0 °C to +40 °C (32 °F to 104 °F) |
| Storage Temperature | -50 °C to +60 °C (-58 °F to 140 °F) |
| Relative Humidity | < 80% up to 31 °C, derated linearly to 50% at 40 °C |

Certifications and Compliances

Table 1–4 lists the certifications and compliances for the TR 210 Huntron Tracker.

Table 1–4: Certifications and compliances

| Characteristic | Description |
|--|--|
| EC Declaration of Conformity – EMC | <p>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 Communities:</p> <p>EN 50081-1 Emissions: EN 55011 Class B Radiated and Conducted Emissions</p> <p>EN 50082-1 Immunity: IEC 1000-4-2 Electrostatic Discharge Immunity IEC 1000-4-3 RF Electromagnetic Field Immunity IEC 1000-4-4 Electrical Fast Transient/Burst Immunity IEC 1000-4-5 Power Line Surge Immunity</p> |
| EC Declaration of Conformity – Low Voltage | <p>Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities:</p> <p>Low Voltage Directive 73/23/EEC, as amended by 93/68/EEC</p> <p>EN 61010-1:1993 Safety requirements for electrical equipment for measurement, control, and laboratory use</p> |
| Approvals | <p>UL3111-1 – Standard for electrical measuring and test equipment</p> <p>CAN/CSA C22.2 No. 1010.1 – Safety requirements for electrical equipment for measurement, control and laboratory use</p> |
| Installation Category Descriptions | <p>Terminals on this product may have different installation category designations. The installation categories are:</p> <p>CAT III Distribution-level mains (usually permanently connected). Equipment at this level is typically in a fixed industrial location</p> <p>CAT II Local-level mains (wall sockets). Equipment at this level includes appliances, portable tools, and similar products. Equipment is usually cord-connected</p> <p>CAT I Secondary (signal level) or battery operated circuits of electronic equipment</p> |
| Pollution Degree | 2 |

Installation

This section describes how to configure the TR 210 Huntron Tracker and connect it to an oscilloscope.

Power Configuration

For the following discussion, refer to Figure 2–1 for the location of the rear panel features.



CAUTION. To avoid product damage, set the line selector switch to the correct position and install the correct fuse before applying line power.

Line Selector Switch

Set the line selector switch to the correct position for 100/115 V_{AC} or 230 V_{AC} operation.

Line Fuse

The power entry module has a removeable tray that contains the line fuse and a spare fuse. Install the correct line fuse according to the specification on page 1–2. To replace the fuse, see Figure 6–1 on page 6–6.

50/60 Hz Selector Switch

Set the 50/60 Hz selector switch, located on the rear panel, to the setting that matches your line frequency.

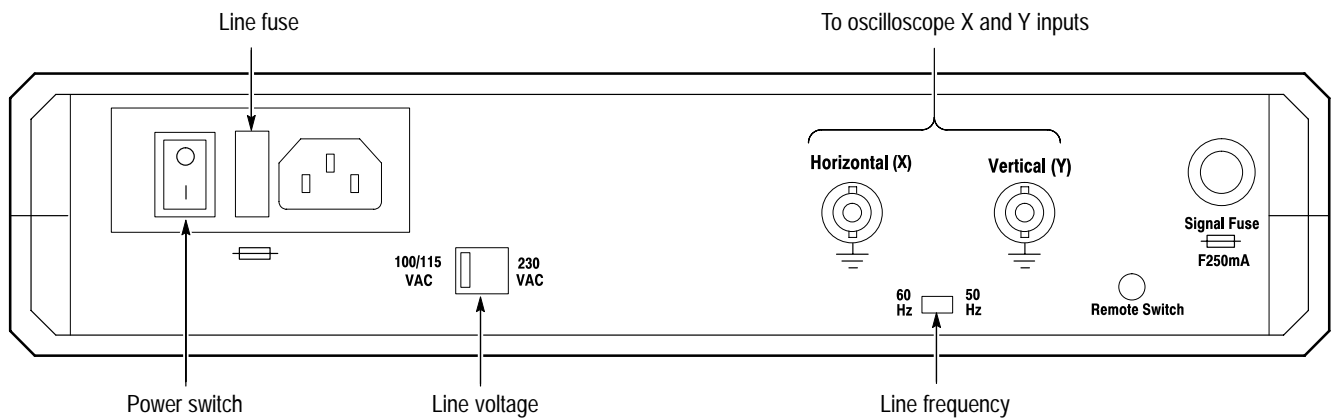


Figure 2–1: TR 210 rear panel

Oscilloscope Connection

The TR 210 Huntron Tracker works with an analog or digital oscilloscope to display component signatures. The oscilloscope must be capable of displaying an untriggered XY waveform that is generated by the TR 210 Huntron Tracker.

Connect the TR 210 Huntron Tracker to the oscilloscope as shown in Figure 2–2.

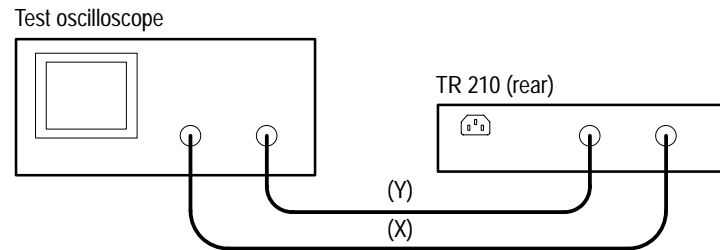


Figure 2–2: Connecting the TR 210 Huntron Tracker to an oscilloscope

When operating the TR 210 Huntron Tracker, set the oscilloscope to the following settings:

1. Set the channel 1 and channel 2 vertical scale to 1 V/div.
2. Set the channel 1 and channel 2 vertical positions to center screen.
3. Set the time base to 5 ms/div.
4. Set the trigger source to channel 1.
5. Turn on XY display mode.

Operation

This section briefly describes the TR 210 operation. For more information, refer to the *TR 210 User Manual*.

Front-Panel Controls and Connectors

Figure 2-3 identifies the front-panel controls and connectors that are described in Table 2-1.

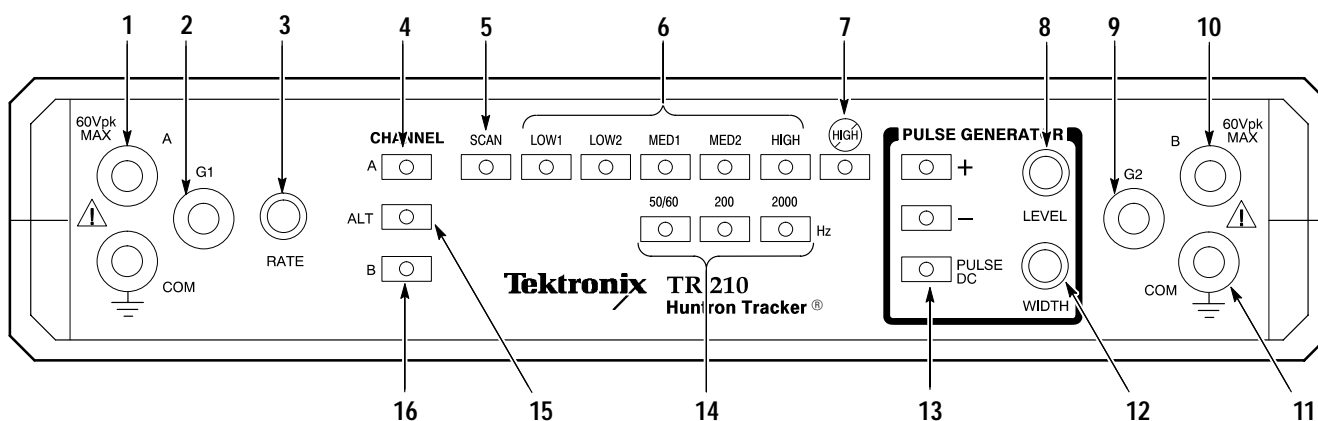


Figure 2-3: Front panel

Table 2-1: Front-panel controls and connectors

| | Name | Function |
|---|-------------------------|---|
| 1 | Channel A test terminal | Safety shrouded banana jack for the channel A test signal. |
| 2 | G1 terminal | Pulse generator output for channel A (electrically connected to G2 terminal). |
| 3 | RATE control | Controls the speed of channel alternation or range scanning. |
| 4 | Channel A button | Selects channel A for display on the oscilloscope. |
| 5 | SCAN button | Initiates automatic scanning of the five ranges from LOW 1 to HIGH. The RATE control determines the scanning speed. |
| 6 | Range selector buttons | Select one of the five ranges: LOW 1, LOW 2, MED 1, MED 2, or HIGH. |

Table 2-1: Front-panel controls and connectors (Cont.)

| | Name | Function |
|----|-------------------------|---|
| 7 | NO HIGH button | Prevents entering the HIGH range either manually or during scanning. |
| 8 | LEVEL control | Sets the pulse generator output amplitude. |
| 9 | G2 terminal | Pulse generator output for channel B (electrically connected to G1 terminal). |
| 10 | Channel B terminal | Safety shrouded banana jack for the channel B test signal. |
| 11 | COM terminal | Safety shrouded banana jack that is the instrument common. |
| 12 | WIDTH terminal | Controls the pulse generator duty cycle. |
| 13 | Pulse generator buttons | Select the output modes for the pulse generator: + pulse, – pulse, composite + and – pulse, or DC level. The PULSE/DC button lights steadily when the pulse generator output is DC. The PULSE/DC button flashes when the pulse generator output is a pulse. |
| 14 | Frequency buttons | Select the test signal frequency: 50/60 Hz (depends on rear-panel switch setting), 200 Hz, or 2 kHz. |
| 15 | ALT button | Causes channel A and channel B to alternate in the oscilloscope display. |
| 16 | Channel B button | Selects channel B for display on the oscilloscope. |

Operational Check Procedure

The following procedure verifies that the TR 210 and the oscilloscope are set up and connected correctly.

1. Connect the TR 210 and oscilloscope together and set up the oscilloscope as described in *Oscilloscope Connection* on page 2–2. Power on both instruments.
2. Verify that a horizontal line is displayed on the oscilloscope screen similar to that shown in Figure 2–4. This is the open-circuit signature.
3. Fine tune the oscilloscope vertical position controls to center the signature waveform. The channel 1 vertical position control affects the horizontal position of the signature. The channel 2 vertical position control affects the vertical position of the signature.

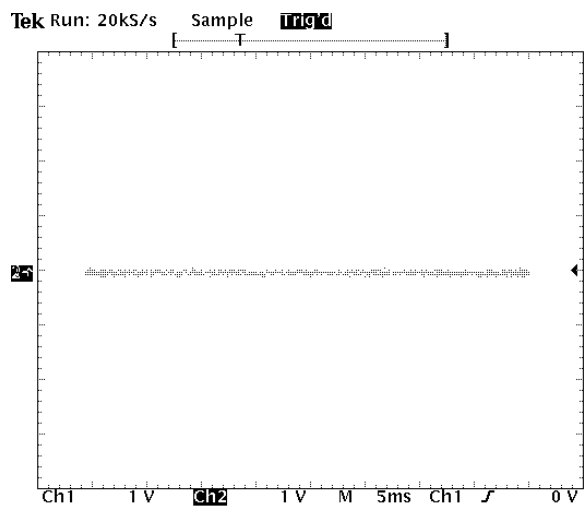


Figure 2-4: Typical open-circuit signature

4. On the TR 210, short the channel A test terminal to the COM test terminal.
5. Verify that a vertical line is now displayed on the oscilloscope screen similar to that shown in Figure 2-5. This is the short-circuit signature.

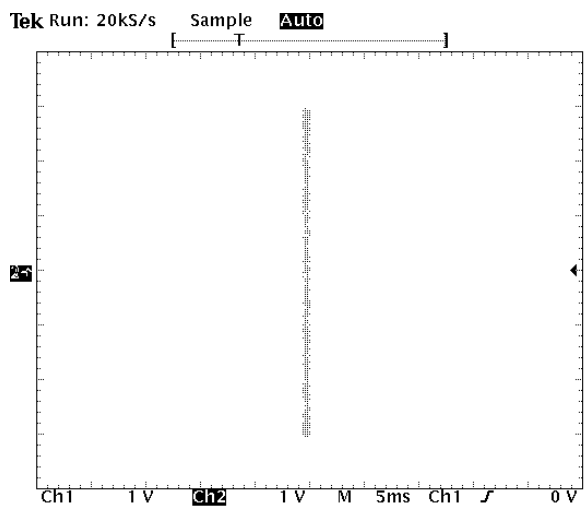


Figure 2-5: Typical short-circuit signature

This completes the operational check procedure.

Theory of Operation

Figure 3–1 shows a block diagram of the TR 210 Huntron Tracker and replaceable modules.

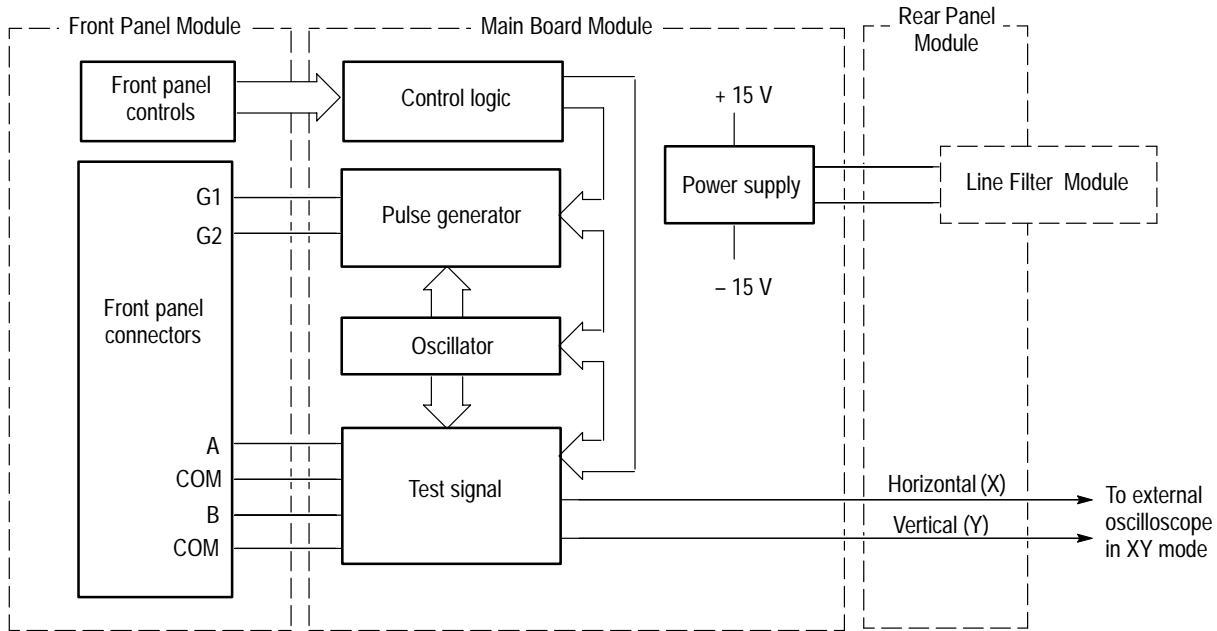


Figure 3–1: TR 210 block diagram

Front Panel Module

The front panel module contains all the probe connections and front panel controls for the TR 210 Huntron Tracker. Wiring harnesses connect the front panel controls to the main board.

Main Board Module

Control logic circuitry reads the front panel switches and generates the test signal for Analog Signature Analysis (ASA). An oscillator circuit generates the signal that alternates the A and B test signals and produces the pulse signals.

To display the signature, the TR 210 Huntron Tracker outputs voltage (V) and current (I) signals to the horizontal (X) and vertical (Y) inputs of an oscilloscope.

A line selector switch changes the winding ratio of power transformer. The power supply circuitry rectifies and filters the transformer output to + and – 15 VDC.

Line Filter Module

The line filter module contains the AC input socket, power switch, and line fuse. The line filter connects to the main board with a 3-wide socket.

Rear Panel Module

The rear panel module contains the rear panel X and Y BNC connectors, signal fuse, and line filter module.

Performance Verification

The performance verification procedures in this section verify the basic operation of the TR 210 Huntron Tracker. Because all specifications are either typical or guaranteed nominal, no measurement tolerances are given.

Equipment Required

The equipment listed in Table 4–1 is required to verify the performance of the the TR 210 Huntron Tracker.

Table 4–1: Test equipment, fixtures, and supplies

| Item number and description | Minimum requirements | Example | Purpose |
|--|--|--|--|
| 1. Multimeter with test leads | AC volts, AC current, 50 Hz to 2 kHz frequency | Tektronix DMM 916 | Measure tracker output voltage, frequency, and current |
| 2. One (1) pair shrouded red and black banana leads (male-to-male) | As per description | Tektronix ATL21 | Connect DMM to tracker test terminals and short tracker test terminals |
| 3. Oscilloscope with X/Y display mode | As per description and purpose | Tektronix TDS 210 | Display tracker signals |
| 4. Two (2) coaxial cables | BNC male-to-male | Tektronix part number 012-0057-01 | Connect tracker signals to oscilloscope inputs |
| 5. BNC male to dual binding post adapter | As per description | Tektronix part number 103-0035-00 | Adapt female BNC to banana patch cord |
| 6. BNC female to dual male banana | As per description | Tektronix part number 103-0090-00 | Adapt male BNC to dual banana connections |
| 7. Banana plug patch cord | As per description | Tektronix part number 012-0031-00 or 012-0039-00 | Patch connection |

Preparation

Prepare the TR 210 Huntron Tracker for the verification as follows:

1. Make sure the line frequency and line voltage switches on the back panel are set correctly.
2. Plug the TR 210 Huntron Tracker in and turn the power on.

The control indicators of the tracker under test should power up in the following states:

| Control name | Indicator status |
|--------------|--------------------------------|
| CHANNEL A | On (Channel B and ALT are off) |
| LOW 2 | On (all other ranges off) |
| 50/60 (Hz) | On (all other frequencies off) |
| PULSE DC | On (+ and - off) |

3. Turn the RATE control to midrange.
4. Turn the LEVEL and WIDTH controls fully counterclockwise.

Logic Section

1. Check the frequency selection buttons.
 - a. Press the 200 Hz, 2000 Hz and 50/60 Hz button in that order.
 - b. Check that each corresponding LED lights when the button is pressed and that it stays on until another frequency button is pressed.
2. Check the ALT mode.
 - a. Press the ALT button. Check that the ALT LED lights and the Channel A and Channel B LEDs alternate.
 - b. Verify that the alternation rate increases with clockwise rotation of the RATE control and decreases with counterclockwise rotation of the RATE control. Return the RATE control to midrange.
 - c. Press the Channel A button. The ALT LED should go off and the Channel A LED should stay on.
 - d. Press the ALT button again and then press the Channel B button to make sure it also cancels the ALT function.

3. Check the SCAN mode.
 - a. Press the SCAN button. The SCAN LED should light and the tracker should scan through the ranges as follows: LOW1, LOW2, MED1, MED2, HIGH, back to LOW1 and repeat.
 - b. Verify that the scanning rate increases with clockwise rotation of the RATE control and decreases with counterclockwise rotation of the RATE control. Return the RATE control to midrange.
 - c. Press the LOW1 button. This should cancel the SCAN function and set the tracker to the LOW1 range.
 - d. Repeat this procedure for the other 4 ranges (i.e. select SCAN, then select a range).
4. Check the HIGH lock features
 - a. Press the HIGH range button. The HIGH range LED should be on.
 - b. Press the HIGH lock button. The HIGH lock LED should be on and the HIGH range LED should go off. The MED2 range LED should turn on.
 - c. Press the SCAN button. The tracker should scan through all the ranges except the HIGH range.
 - d. Press the LOW1 button to cancel scanning.
 - e. Press the HIGH lock button to remove the lock.
5. Check the combined operation of ALT and SCAN.
 - a. Press the SCAN button. Press the ALT button. The ALT LED should be on and the Channel A and Channel B LEDs should alternate on and off. The SCAN LED should be on and all the test ranges should be scanned. Ranges should change on the B to A transition of the channels.
 - b. Verify that the scanning and alternation rates increase with clockwise rotation of the RATE control and decreases with counterclockwise rotation of the RATE control. Return the RATE control to midrange.
6. Check the PULSE GENERATOR buttons.
 - a. The PULSE/DC LED should be on.
 - b. Press the + (positive) button several times. The + LED should toggle between on and off each time the button is pressed.
 - c. With the + LED off, repeat the above procedure using the – (negative) button. The LED should toggle on and off each time the button is pressed.

- d. Turn + on and – off. The PULSE/DC LED should be on and not flashing which indicates DC mode.
- e. Press the PULSE/DC button once. The PULSE/DC LED should flash on and off to indicate Pulse mode.
- f. Press the + and – button so that both the + and – LEDs are on and the PULSE/DC LED is flashing. Press the PULSE/DC button once so that the LED is continuously on. The – LED should go off (all three LEDs cannot be continuously on).
- g. Press the + button several times. With each press, the + LED should go off and the –LED should come on, or visa versa.

Signal Section

Verify the signal voltages on the Channel A and Channel B test terminals and the X/Y outputs.

Test Terminals

1. Make sure that the HIGH lock LED is off.
2. Select Channel A, HIGH range, and 50/60 Hz.
3. Connect the DMM between the Channel A and COM test terminals with the red and black banana leads (items 1 and 2 on page 4–1).
4. Measure the RMS sine wave voltage for each range listed below:

| DMM range | Tracker range selector | Measured voltage (typical) |
|-----------|------------------------|----------------------------|
| 200 VAC | HIGH | 42.1 VAC _{RMS} |
| 20 VAC | MED2 | 14.1 VAC _{RMS} |
| 20 VAC | MED1 | 10.6 VAC _{RMS} |
| 20 VAC | LOW2 | 7.1 VAC _{RMS} |
| 20 VAC | LOW1 | 2.1 VAC _{RMS} |

5. Select Channel B and HIGH range.
6. Connect the DMM between the Channel B and COM test terminals. Repeat the measurements for each range listed.
7. Remove the connections.

X/Y Output Signals

1. Connect the tracker under test to an oscilloscope (item 3) using two BNC cables (item 4):
 - a. The Horizontal (X) output connects to the Channel 1 (X) input on the oscilloscope.
 - b. The Vertical (Y) output connects to the Channel 2 (Y) input on the oscilloscope.
2. With Channel B selected, select the HIGH range and 2000 Hz range on the tracker under test.
3. Make the following oscilloscope settings:

| Mode | Setting |
|------------------|---|
| Time base | 100 μ s |
| Channel 1 and 2 | 1 V/div |
| Trigger source | Channel 1 |
| XY mode | On |
| X and Y position | Adjust open circuit trace to center graticule |

NOTE. If a horizontal and a diagonal trace is displayed, turn channel 1 off to eliminate the diagonal trace.

4. Press each test range selector in turn (MED2, MED1, ...). The total horizontal trace length should be about 8 divisions for opens in any test range. Select Channel A and repeat the test.
5. With Channel A selected, short the A to COM terminals with a banana lead (item 2). The total vertical trace length should be about 6 divisions for shorts in any test range.
6. Remove the short from the A to COM terminals, short the B to COM terminals, select channel B and repeat the test.
7. Remove the short from the B to COM terminals.

X/Y Output Voltages

1. Connect the Horizontal (X) output to the DMM voltage input with a coax cable and female BNC to banana adapter (items 4 and 6).
2. Measure the following voltages for each tracker range listed (Channel B):

| DMM range | Tracker range (open circuit) | Measured voltage (X) (typical) |
|-----------|------------------------------|--------------------------------|
| 20 VAC | HIGH | 2.8 VAC _{RMS} |
| 20 VAC | MED2 | 2.8 VAC _{RMS} |
| 20 VAC | MED1 | 2.8 VAC _{RMS} |
| 20 VAC | LOW2 | 2.8 VAC _{RMS} |
| 20 VAC | LOW1 | 2.8 VAC _{RMS} |

3. Select Channel A and repeat the test.
4. Connect the Vertical (Y) output to the DMM voltage input with a coax cable and female BNC to banana adapter (items 4 and 6).
5. Short the Channel A to COM terminals with a banana lead and measure the following voltages for each tracker range listed:

| DMM range | Tracker range (short circuit) | Measured voltage (Y) (typical) |
|-----------|-------------------------------|--------------------------------|
| 20 VAC | HIGH | 2.1 VAC _{RMS} |
| 20 VAC | MED2 | 2.1 VAC _{RMS} |
| 20 VAC | MED1 | 2.1 VAC _{RMS} |
| 20 VAC | LOW2 | 2.1 VAC _{RMS} |
| 20 VAC | LOW1 | 2.1 VAC _{RMS} |

6. Select Channel B, short the Channel B to COM terminals, and repeat the test.
7. Disconnect the banana lead, coax, and BNC adapter.

Test Terminal Frequency

Check the frequency of the test terminal signal.

1. Set the 60/50 Hz switch on the back of the tracker to 60 Hz.

2. Select the frequency mode on the DMM and select the 20 VAC range.
3. Select Channel A, LOW2, and 2000 Hz on the tracker.
4. Connect the A and COM terminals of the tracker under test to the frequency (voltage) inputs of the DMM with the banana leads (item 2).
5. On the front panel of the tracker, select the test signal frequencies listed below and measure the corresponding frequencies.

| DMM range (frequency mode) | Selected test signal frequency | Measured test signal frequency (typical) |
|----------------------------|--------------------------------|--|
| 20 VAC | 2000 Hz | 2000 Hz |
| 20 VAC | 200 Hz | 200 Hz |
| 20 VAC | 50/60 Hz | 60 Hz |

6. Set the 60/50 Hz switch on the back of the tracker to 50 Hz.
7. Verify that the frequency on the output measures 50 Hz nominal.
8. Move the 60/50 Hz switch back to the line frequency.

Test Terminal Current

Measure the RMS value of the test terminal short circuit current in each range.

1. Connect Channel A and COM inputs of the tracker under test to the DMM 200 mA current and common inputs with the banana leads (item 2).
2. Set the DMM to read mA-AC.
3. Verify the following RMS current readings:

| DMM range (current mode) | Tracker range | Measured current (typical) |
|--------------------------|---------------|----------------------------|
| 20 mA | HIGH | 0.57 mA |
| 20 mA | MED2 | 0.53 mA |
| 20 mA | MED1 | 8.2 mA |
| 200 mA | LOW2 | 132 mA |
| 20 mA | LOW1 | 0.21 mA |

Pulse Generator Section

1. Setup the Oscilloscope for measuring the positive and negative DC levels (X/Y off).
 - a. Connect Channel A of the tracker to Channel 1 of the oscilloscope with the coax cable and BNC female to dual banana adapter (items 4 and 6).
 - b. Connect G1 (PULSE GENERATOR terminal) of tracker to Channel 2 of the oscilloscope with a banana patch cord and a male BNC to banana adapter (items 7 and 5). Connect the patch cord to the red side of the adapter.
 - c. Setup the equipment controls as follows:

| Tracker control | Setting |
|----------------------|-----------|
| 50/60 Hz | On |
| Channel A | On |
| LOW2 button | On |
| Oscilloscope control | Setting |
| Trigger source | Channel 1 |
| Channel 1 | 5 V/div |
| Channel 2 | 2 V/div |
| Time base | 10 ms/div |

2. Measure the + DC levels of G1.
 - a. Press the PULSE/DC button so that it is on continuously.
 - b. Press the + button so that it is on. Rotate the LEVEL knob clockwise to its maximum position.
 - c. Verify that the DC voltage level is approximately 5 volts on Channel 2 of the oscilloscope.
 - d. Rotate the LEVEL knob counterclockwise and verify that the DC voltage drops to near zero.
3. Verify that G1 stays at zero.
 - a. Press the + and – buttons so that both + and – LEDs are off. Verify that the voltage level is near zero for this condition.
 - b. Rotate the LEVEL knob in both directions. The voltage level on Channel 2 of the oscilloscope should remain near zero.

- c. Press the PULSE/DC button once so that the PULSE/DC LED is flashing. The + and – LEDs should still be off.
 - d. Rotate the LEVEL knob in both directions and verify that the voltage level remains near zero.
4. Check the width control of G1.
- a. Press the + and – buttons. Both + and – LEDs should be on and the PULSE/DC LED should be flashing.
 - b. Rotate the LEVEL control knob all the way clockwise.
 - c. Set the tracker to 50/60 Hz and the oscilloscope time base to 5 ms/div.
 - d. Vary the Width control and change the + and – settings to display the waveforms for each of the three pulse types shown in Figure 4–1 on page 4–10.
 - e. The rising edge of a positive pulse should always coincide with each positive going zero-crossing of the sine wave test signal.
 - f. The falling edge of a negative pulse should always start at each negative-going zero-crossing of the test signal.
 - g. Repeat this step for 200 and 2000 Hz. A slight slope in the rising and falling edges of the pulses is acceptable for 2000 Hz. Set the oscilloscope time base as follows for each frequency range:

| Tracker frequency range | Oscilloscope time base setting |
|-------------------------|--------------------------------|
| 50/60 Hz | 5 ms/div |
| 200 Hz | 1 ms/div |
| 2000 Hz | 250 μ s/div |

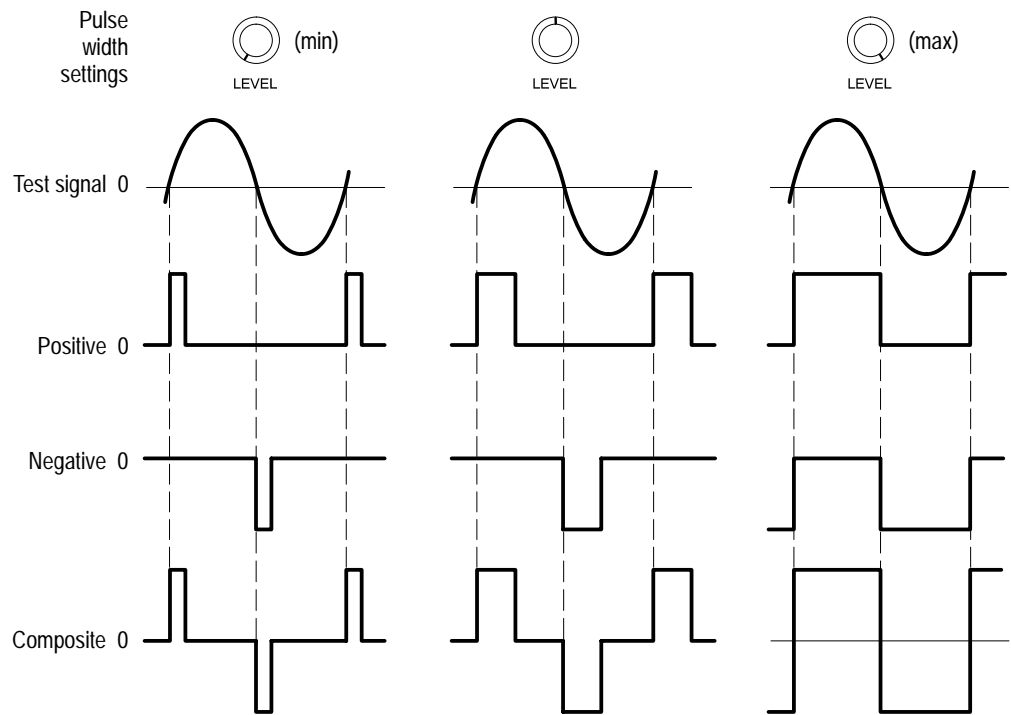


Figure 4-1: Pulse types

Adjustment Procedures

This section contains information needed to adjust the TR 210 Huntron Tracker.

NOTE. *This procedure is for trained service technicians only*

Equipment Required

The equipment listed in Table 5–1 is required to adjust the TR 210 Huntron Tracker.

Table 5–1: Test equipment, fixtures, and supplies

| Item number and description | Minimum requirements | Example | Purpose |
|--|--------------------------------|-----------------------------------|--|
| 1. Multimeter with test leads | AC/DC volts | Tektronix DMM 916 | Measure tracker voltages |
| 2. One (1) pair shrouded red and black banana leads (male-to-male) | As per description | Tektronix ATL21 | Connect DMM to tracker test terminals |
| 3. Oscilloscope with X/Y display mode | As per description and purpose | Tektronix TDS 210 | Display tracker signals |
| 4. Two (2) coaxial cables | BNC male-to-male | Tektronix part number 012-0057-01 | Connect tracker signals to oscilloscope inputs |
| 5. Insulated adjustment tool | As per description | | Electrical adjustments |

Preparation

Prepare the TR 210 Huntron Tracker for adjustment as follows:

1. Make sure the line frequency and line voltage switches on the back panel are set correctly.
2. Refer to the procedure on page 6–7 and remove the top cover.
3. Plug the TR 210 Huntron Tracker in and turn the power on.

The control indicators of the tracker under test should power up in the following states:

| Control name | Indicator status |
|--------------|--------------------------------|
| CHANNEL A | On (Channel B and ALT are off) |
| LOW 2 | On (all other ranges off) |
| 50/60 (Hz) | On (all other frequencies off) |
| PULSE DC | On (+ and - off) |

4. Turn the RATE control to midrange.
5. Turn the LEVEL and WIDTH controls fully counterclockwise.

Adjustment Procedure

The illustration in Figure 5–1 shows the adjustment locations for the TR 210 Huntron Tracker.

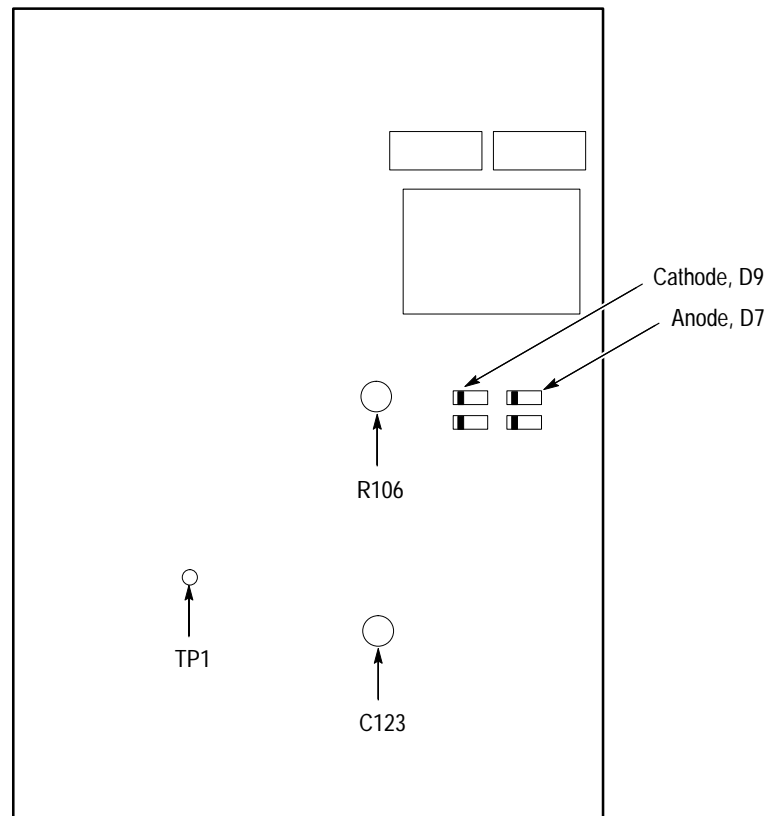


Figure 5–1: TR 210 adjustment locations and test points

1. Using a DMM (item 1), verify the following voltages with respect to TP1 (com):
 - a. Cathode of D9 is between +12 VDC and +18 VDC.
 - b. Anode of D7 is between –12 VDC and –18 VDC.
2. Make sure that the HIGH lock LED is off.
3. Connect the Channel A and COM test terminals to the voltage inputs of the DMM with banana leads (items 1 and 2 on page 5–1). Measure the sine wave voltage.
4. Adjust R106 so that the RMS voltage reads between 7.070 and 7.072 V_{RMS} .

5. Connect the tracker under test to an oscilloscope (item 3) using the 2 BNC cables (item 4):
 - a. The Horizontal (X) output connects to the Channel 1 (X) input on the oscilloscope.
 - b. The Vertical (Y) output connects to the Channel 2 (Y) input on the oscilloscope.
6. Select the HIGH range and 2000 Hz settings.
7. Make the following oscilloscope settings:

| Mode | Setting |
|------------------|---|
| Time base | 100 μ s/div |
| Channel 1 and 2 | 1 V/div |
| Trigger source | Channel 1 |
| XY mode | On |
| X and Y position | Adjust open circuit trace to center graticule |

NOTE. *If a horizontal and a diagonal trace is displayed, turn channel 1 off to eliminate the diagonal trace.*

8. Adjust the trim cap C123 to eliminate any split trace.

NOTE. *Some split trace is normal in all other ranges at 2000 Hz.*

Maintenance

This section contains the information needed to do periodic and corrective maintenance on the TR 210 Huntron Tracker.

Preparation

Before servicing this product, read the *Safety Summary* and *Introduction* at the front of the manual and the ESD information below.



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

When performing any service which requires internal access to the instrument, adhere to the following precautions to avoid damaging internal modules and their components due to electrostatic discharge (ESD).

1. Minimize handling of static-sensitive modules.
2. Transport and store static-sensitive modules in their static protected containers or on a metal rail. Label any package that contains static-sensitive modules.
3. Discharge the static voltage from your body by wearing a grounded antistatic wrist strap while handling these modules. Do service of static-sensitive modules only at a static-free work station.
4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.
5. Handle circuit boards by the edges when possible.
6. Do not slide the modules over any surface.
7. Avoid handling modules in areas that have a floor or work-surface covering capable of generating a static charge.

Inspection and Cleaning

How often to do maintenance depends on the severity of the environment in which the instrument is used. A proper time to perform preventive maintenance is just before instrument adjustment.

Exterior

Inspect the outside of the instrument for damage, wear, and missing parts. Instruments that appear to have been dropped or otherwise abused should be checked thoroughly to verify correct operation and performance. Immediately repair defects that could cause personal injury or lead to further damage to the instrument.

To clean the instrument exterior, do the following steps:

1. Remove loose dust on the outside of the instrument with a lint free cloth.
2. Remove remaining dirt with a lint free cloth dampened in a general purpose detergent-and-water solution. Do not use abrasive cleaners.



CAUTION. *To prevent getting moisture inside the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.*

Internal

To access the inside of the instrument for inspection and repair, refer to the *Removal and Installation Procedures* in this section.

No periodic cleaning of internal components is necessary. Cleaning of internal components should only be necessary after repair. There is no periodic lubrication required for this instrument.



CAUTION. *Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. For interior components, use a 75% isopropyl alcohol solution as a cleaner and rinse with deionized water. Before using any other type of cleaner, consult your Tektronix Service Center or representative.*

Inspect the internal portions of the instrument for damage using Table 6–1 as a guide. Defects found should be repaired immediately.

Table 6–1: Internal inspection check list

| Item | Inspect For | Repair Action |
|--------------------|---|---|
| Circuit boards | Loose, broken, or corroded solder connections. Burned circuit boards. Burned, broken, or cracked circuit-run plating. | Remove failed module and replace with a fresh module. |
| Resistors | Burned, cracked, broken, blistered condition. | Remove failed module and replace with a fresh module. |
| Solder connections | Cold solder or rosin joints. | Resolder joint and clean with isopropyl alcohol. |
| Capacitors | Damaged or leaking cases. Corroded solder on leads or terminals. | Remove damaged module and replace with a fresh module from the factory. |
| Wiring and cables | Loose plugs or connectors. Burned, broken, or frayed wiring. | Firmly seat connectors. Repair or replace modules with defective wires or cables. |
| Chassis | Dents, deformations, and damaged hardware. | Straighten, repair, or replace defective hardware. |

Removal and Installation Procedures

This section contains procedures for removal and installation of all replaceable mechanical and electrical parts. For an exploded view and list of these parts, refer to the *Mechanical Parts List* on page 10–1.



WARNING. Before doing this or any other procedure in this manual, read the *Safety Summary* found at the beginning of this manual. Also, to prevent possible injury to service personnel or damage to this instrument's components, read *Installation in Section 2*, and *Preventing ESD in this section*.

Before doing any procedure in this subsection, disconnect the power cord from the line voltage source. Failure to do so could cause serious injury or death.

Unless indicated otherwise, perform installation in reverse order of removal.

Equipment Required

Refer to Table 6–2 for a list of all equipment required to perform the procedures.

Table 6–2: Tools required for module removal

| Item No. | Name | Description |
|----------|-------------------------------|---------------|
| 1 | # 1 Phillips screwdriver | Standard tool |
| 2 | # 1 Pozidrive screwdriver | Standard tool |
| 3 | Small, flat-blade screwdriver | Standard tool |
| 4 | Angle-Tip Tweezers | Standard tool |
| 5 | Soldering Iron | Standard tool |
| 6 | Pliers | Standard tool |
| 7 | 11/32 hex wrench | Standard tool |

Line Fuse

1. Insert a small flat-blade screwdriver into the notch just inside the power cord socket of the line filter. Use the notch to pull the fuse holder straight out to remove the fuse.
2. To access the spare fuse, push out the fuse drawer located inside the fuse holder.
3. Replace the fuse in the fuse holder and snap the fuse holder back into the lined filter.

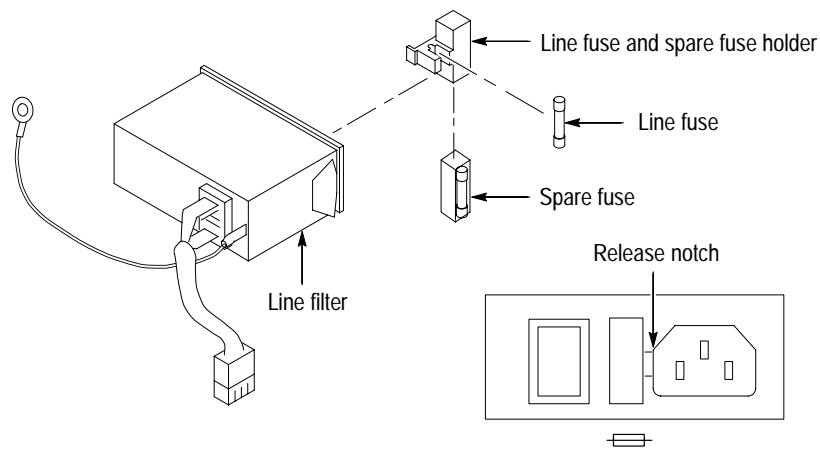


Figure 6-1: Accessing the line fuse and spare fuse (159-0414-00)

Signal Fuse

1. Unscrew the fuse holder located on the right rear panel.
2. Remove and replace the signal fuse from the fuse clip. Use a fuse that has the same size and rating. The rating for the fuse is listed on the rear panel below the fuse holder.

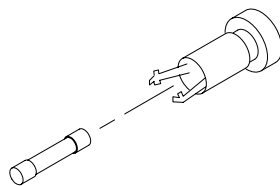


Figure 6-2: Signal fuse (159-0312-00)

Front Panel Knobs

1. Set the instrument bottom down on the work surface and face the front to you.
2. Grasp any knob you want to remove and pull it straight out from the front panel. If the knob is difficult to remove, insert a pair of angle-tip tweezers between the knob and front panel and carefully pry the knob forward off the shaft.
3. To reinstall, align the knob to the shaft and push it on.

Top Cover

1. Lay the instrument upside down on the top cover.
2. Use a small flat-blade screwdriver to unsnap the four retainer clips on the bottom cover that have the rubber feet. See Figure 6-3.

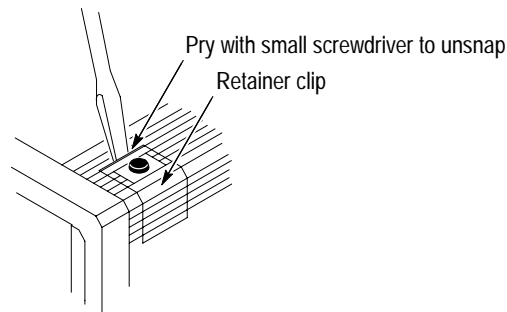


Figure 6-3: Retainer clips

3. Use a #1 Phillips screwdriver to unscrew the four cabinet screws.
4. Turn the instrument over and lay it on the bottom cover.
5. Separate the top cover from the front and rear panel assemblies and lift it off the instrument.
6. To replace the cover, turn the cover so that the tongue and groove features in the sides of the top cover align with those in the bottom cover and that both sides fit snugly together. Tighten the screws and reinstall the bottom cover clips.

Line Filter

1. Remove the top cover.
2. Disconnect the wiring harness of the line fuse from the connector receptacle on the main board.
3. Disconnect the ground wire from the stud on the back chassis using a $1\frac{1}{32}$ inch hex wrench.
4. Use a small flat-blade screwdriver to press in the spring clips on the sides of the line filter as you pull the line filter out.

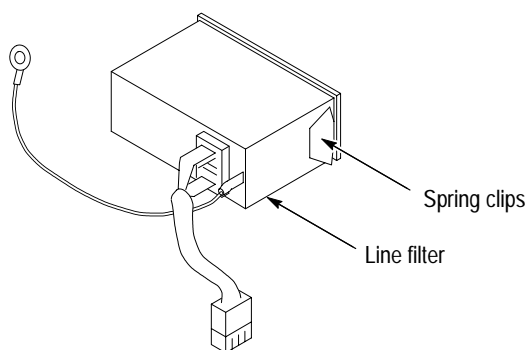


Figure 6-4: Line filter

Rear Panel Assembly

1. Remove the top cover.
2. Disconnect the rear panel wiring harnesses and from the main circuit board.
3. Disconnect the ground wire on the main board from the stud on the back chassis using a $1\frac{1}{32}$ inch hex wrench.
4. Unscrew the main circuit board from the bottom cover with a #1 Pozidrive screwdriver.
5. To protect the line frequency switch and remote control socket, keep the rear of the main board and the rear panel assembly together lifting the back of the main board only far enough to remove the rear panel assembly.
6. Remove and replace the rear panel assembly.
7. Reinstall the main circuit board and rear panel assembly in the bottom cover and tighten the screws so they are just snug (about 2 inch/lbs). Do not overtighten

Front Panel Assembly

1. Remove the top cover.
2. Disconnect the ribbon cable from the front panel circuit board.
3. Disconnect the 4-wire and 2-wire harnesses from the main board.
4. Use a #1 Pozidrive screwdriver to disconnect the ground wire from the front panel assembly.
5. Remove the front panel assembly from the bottom cover.

Front Panel Potentiometers and Elastomer

1. Remove the top cover.
2. Remove the front panel knobs.
3. Remove the front panel circuit board.
4. Remove the elastomer for the front panel push buttons.
5. Desolder the potentiometer(s) from the circuit board.
6. Using pliers, untwist the tabs that secure the potentiometer(s) to the circuit board and remove the potentiometer(s).

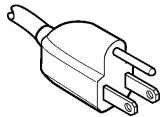
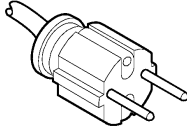
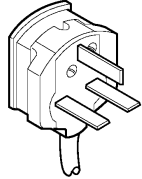
Main Board

1. Remove the top cover.
2. Disconnect the front and rear panel wiring from the main circuit board.
3. Remove the front panel assembly.
4. Unscrew the main circuit board from the bottom cover with a #1 Pozidrive screwdriver.
5. To protect the line frequency switch and remote control socket, keep the rear of the main board and the rear panel assembly together as you lift them out of the bottom cover.
6. Reinstall the main circuit board in the bottom cover and tighten the screws so they are just snug (about 2 inch/lbs). Do not overtighten

Options

Table 7-1 shows the power cord options available with the TR 210 Huntron Tracker at the time of purchase. Besides the power cord options, no other options are available at the time of purchase.

Table 7-1: Power cord identification

| Plug configuration | Normal usage | Option number |
|--|--|---------------|
|  | North America 125 V/15 A Plug NEMA 5-15P | Standard |
|  | Europe 230 V | A1 |
|  | United Kingdom 230 V | A2 |



Replaceable Electrical Parts

For a list of all replaceable parts, refer to the *Mechanical Parts List* on page 10-1.

Diagrams

For an exploded view diagram of the TR 210 Huntron Tracker, refer to the *Mechanical Parts List* on page 10-1.

Replaceable Mechanical Parts

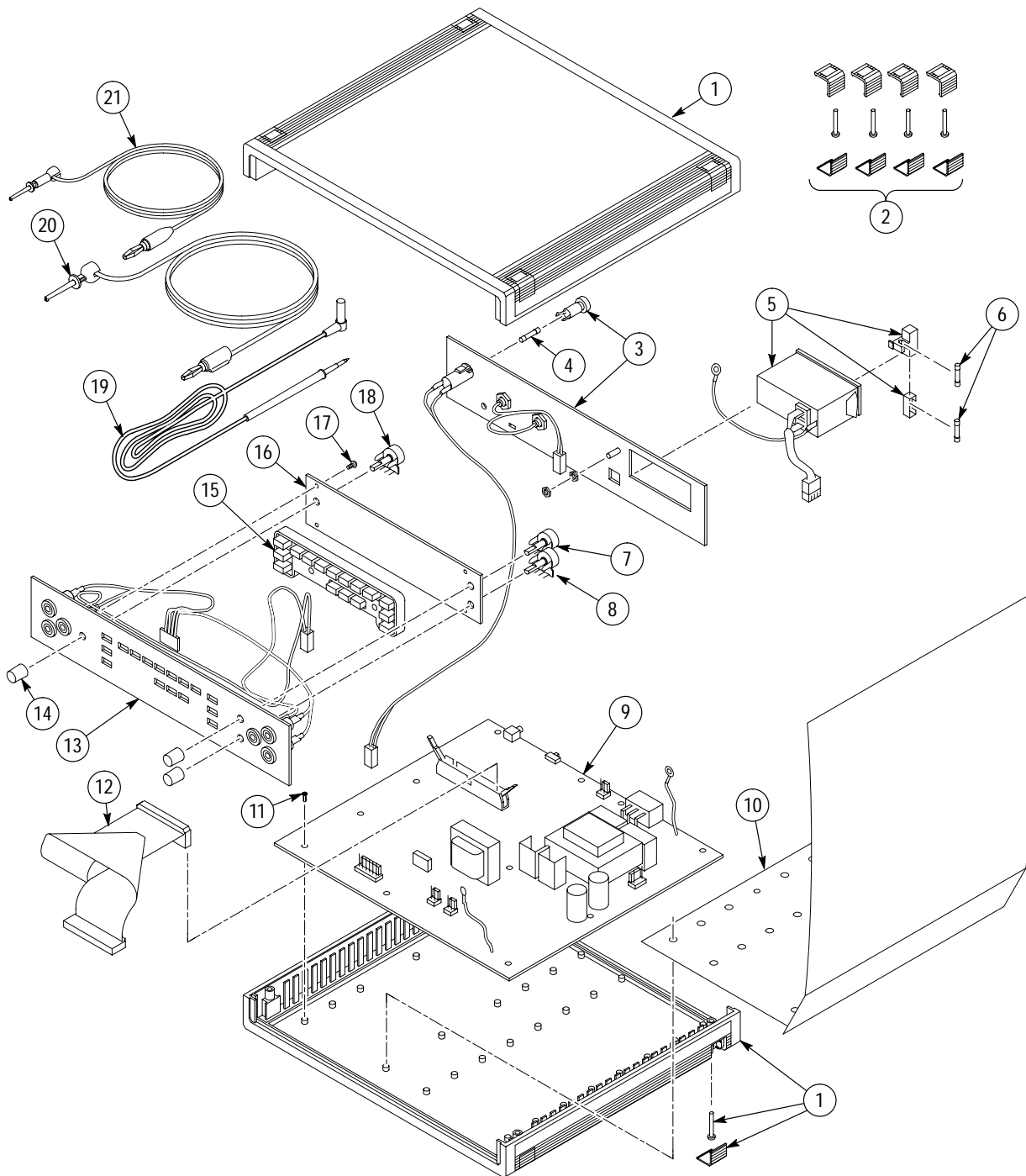


Figure 10-1: TR 210 replaceable parts and accessories

Replaceable Mechanical Parts

Replaceable parts list

| Fig. & index number | Tektronix part number | Serial no. effective | Serial no. discont'd | Qty | Name & description | Mfr. code | Mfr. part number |
|---------------------|-----------------------|----------------------|----------------------|-----|---|-----------|----------------------|
| 10-1-1 | 390-1188-00 | | | 1 | CABINET ASSY:PLASTIC, TOP & BOTTOM CABINET,W/CLIPS & SCREWS | 57705 | 01-1241 |
| -2 | 050-3319-00 | | | 1 | PARTS REPL KIT:SERVICE REPLACEMENT,BOTTOM & TOP PLASTIC CLIP W/FOOT,8 EA,CASE SCREWS 4 EA | 57705 | 050-3319-00 |
| -3 | 650-3815-00 | | | 1 | PANEL ASSY:REAR,INCLUDES,BNC'S W/WIRING, CONNECTORS,FUSE HOLDER & CONNECT,AC LINE FILTER | 57705 | 06-2135 |
| -4 | 159-0312-00 | | | 1 | FUSE,CARTRIDGE:METRIC,250MA,250V,FAST | 57705 | 02-0022 |
| -5 | 119-5867-00 | | | 1 | FILTER,RFI:POWER MODULE | 57705 | 06-2136 |
| -6 | 159-0414-00 | | | 1 | FUSE:250V,0.125 A RMS,FAST BLOW,PERIEC125, | 57705 | 02-0023 |
| -7 | 311-2555-00 | | | 1 | RES,VAR:CONTROL POT,50K,0.5W,5/8 X 1/8 SHAFT | 57705 | 02-1056 |
| -8 | 311-2556-00 | | | 1 | RES,VAR:LIN CONTROL POT,1M,0.5W,5/8 X 1/8 SHAFT | 57705 | 02-1057 |
| -9 | 671-4458-00 | | | 1 | CIRCUIT BD ASSY:MAIN,HUNTRON PN 06-3106 | 57705 | 06-3106 |
| -10 | 342-1040-00 | | | 1 | INSULATOR:PCB,NOMEX,MAIN BD | 57705 | 01-1242 |
| -11 | 211-0963-00 | | | 12 | SCREW:W/O WASHER,MAIN ECB | 57705 | 07-3205 |
| -12 | 174-3944-00 | | | 1 | CABLE ASSY:FLAT,MAIN TO FRONT | 57705 | 06-4142 |
| -13 | 644-0922-00 | | | 1 | PANEL ASSY:FRONT,INPUT JACKS,WIRING&CONNECTORS,ELASTOMERIC KEY PAD,PCB CONTROL BD W/POTS, CABLE ASSY FLAT (Includes Figures 13, 15 & 16) | 57705 | 06-2134 |
| -14 | 366-0801-00 | | | 3 | KNOB:GREY,W/O INDEX,FRONT PANEL | 57705 | 07-2142 |
| -15 | 260-2707-00 | | | 1 | SWITCH:ELASTOMERIC KEY PAD | 57705 | 01-1243 |
| -16 | 671-4457-00 | | | 1 | CIRCUIT BD ASSY:PCA CONTROL | 57705 | 06-3105 |
| -17 | 211-0962-00 | | | 6 | SCREW:ECB,PCA CNTL,4-40 X 1/4,PH PHI, W/WASHER | 57705 | 07-3050 |
| -18 | 311-2557-00 | | | 1 | RES,VAR:CCW AUD CONTROL POT,1M OHM,0.5W,5/8 X 1/8 SHAFT | 57705 | 02-1058 |
| -19 | ATL25 | | | 1 | TRACKER PROBES: 1 EA RED AND BLACK | 57705 | ATL25 |
| -20 | ----- | | | 2 | Black ground leads | 57705 | 98-0043 |
| -21 | ----- | | | 2 | Blue Clip Leads | 57705 | 98-0036 |
| | 161-0230-01 | | | 1 | CABLE ASSY,PWR:3,18 AWG,92 L,SVT,TAN,60 DEG C,MC-6-3C/G X RTANG BME,10A/125V, | 2W733 | ORDER BY DESCRIPTION |
| | 071-0113-00 | | | 1 | MANUAL,TECH:SERVICE,TR210 | 80009 | 071-0113-00 |
| | 071-0114-00 | | | 1 | MANUAL,TECH:USER,ENGLISH,TR210 | 80009 | 071-0114-00 |

Manufacturers cross index

| Mfr. code | Manufacturer | Address | City, state, zip code |
|----------------------|-----------------------------|--|------------------------------|
| 2W733 | BELDEN WIRE & CABLE COMPANY | 2200 US HWY 27 SOUTH PO BOX 1980 | RICHMOND, IN 47374 |
| 57705 | HUNTRON INC | 15720 MILL CREEK BLVD | MILL CREEK, WA 98012 |
| 80009 | TEKTRONIX INC | 14150 SW KARL BRAUN DR PO BOX 500 | BEAVERTON, OR 97077-0001 |
| TK2280 | ESCORT INSTRUMENTS CORP | NO. 6, ALLEY 6, LANE 45 PAO-HSIN RD | HSIN TIEN, TAIPEI, TAIWAN CN |

