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MAINT

R7903
OSCILLOSCOPE

OPERATORS

INSTRUCTION MANUAL

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

Serial Number _____

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INSTRUMENT SERIAL NUMBERS

Each instrument has a serial number on a panel insert, tag, or stamped on the chassis. The first number or letter 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 have six unique digits. The country of manufacture is identified as follows:

B000000	Tektronix, Inc., Beaverton, Oregon, USA
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

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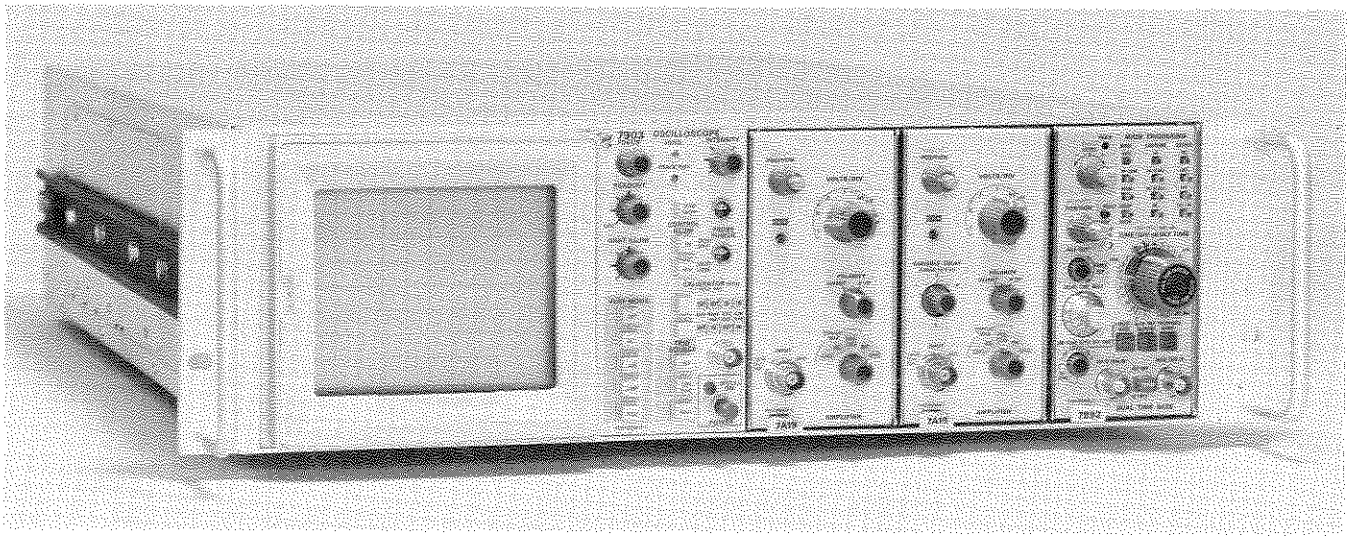
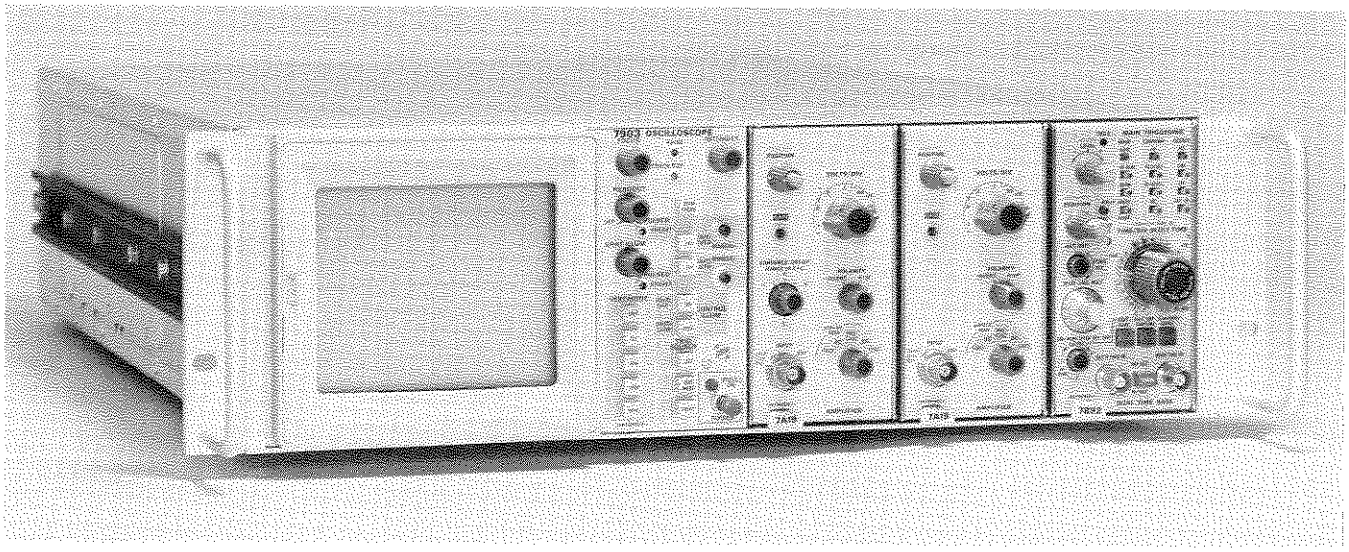


R7903 Features

The TEKTRONIX R7903 Oscilloscope is a solid state, high performance instrument designed for general-purpose applications. This instrument includes a readout system which provides alphanumeric information; encoded by the plug-ins, to be displayed on the cathode-ray tube. This instrument accepts TEKTRONIX 7-series plug-in units to form a complete measurement system.

The two compartments on the left are connected to the vertical deflection system. Electronic switching between the vertical plug-in compartments allows a multi-trace vertical display. The right plug-in compartment is connected to the horizontal deflection system. The flexibility of this plug-in feature and the variety of plug-in units available allow this system to be used for many measurement applications.

The R7903 features a Cathode-ray tube with a fast writing rate and small spot size. The graticule size is 8 X 10 centimeters. An option is available for a pulsed readout display and pulsed graticule lights. This provides maximum use of the photographic speed of the film in the single shot mode. On the rear panel are four signal out connectors (SIG OUT, SAWTOOTH, GATE (MAIN & AUX) and SINGLE SWEEP READY INDICATOR), and four input connector (Z-AXIS INPUT, READOUT SS, SINGLE SWEEP RESET and READOUT INHIBIT).



OPERATING INSTRUCTIONS

To effectively use the R7903, the operation and capabilities of the instrument must be known. This section describes the operation of the front- and rear-panel controls and connectors and gives basic and general operating information.

PRELIMINARY INFORMATION

Operating Voltage

WARNING

This instrument is designed for operation from a power source with its neutral at or near earth (ground) potential with a separate safety-earth conductor. It is not intended for operation from two phases of a multi-phase system, or across the legs of a single-phase, three-wire system. Operation from such ungrounded sources is unsafe.

The R7903 can be operated from either a 115-volt or a 230-volt nominal line voltage source. The Line Selector assembly on the rear panel converts this instrument from one operating voltage to the other. This assembly also includes fuses to provide protection for the line-input portion of this instrument. Use the following procedure to obtain correct instrument operation from the line voltage available.

Line Selector Switch Position	Regulating Range
115 V	90 to 132 volts
230 V	180 to 264 volts

1. Disconnect the instrument from the power source.

2. Loosen the two captive screws which hold the cover onto the selector assembly; then pull to remove the cover.

3. To convert from 115-volts to 230-volts nominal line voltage, or vice versa, pull out the Selector switch bar (see Fig. 1-1) and plug it back into the remaining holes. Change the line-cord power plug to match the power source receptacle or use a 115- or 230-volt adapter.

NOTE

The power cord on Tektronix instruments may conform to either IEC or the older NEC requirements, as follows:

Conductor	USA & Canada	IEC
Line	Black	Brown
Neutral	White	Light Blue
Safety-Earth	Green w/yellow stripe	Green w/yellow stripe

4. Re-install the cover and tighten the captive screws.

5. Before applying power to the instrument, check that the indicator tab on the switch bar is protruding through the correct hole for the desired nominal line voltage.

CAUTION

This instrument may be damaged if operated with the Line Selector assembly set to incorrect positions for the line voltage applied.

The R7903 is designed to be used with a three-wire AC power system. If a three- to two-wire adapter is used to connect this instrument to a two-wire AC power system, be sure to connect the ground lead of the adapter to earth (ground). Failure to complete the ground system may allow the chassis of this instrument to be elevated above ground potential and pose a shock hazard.

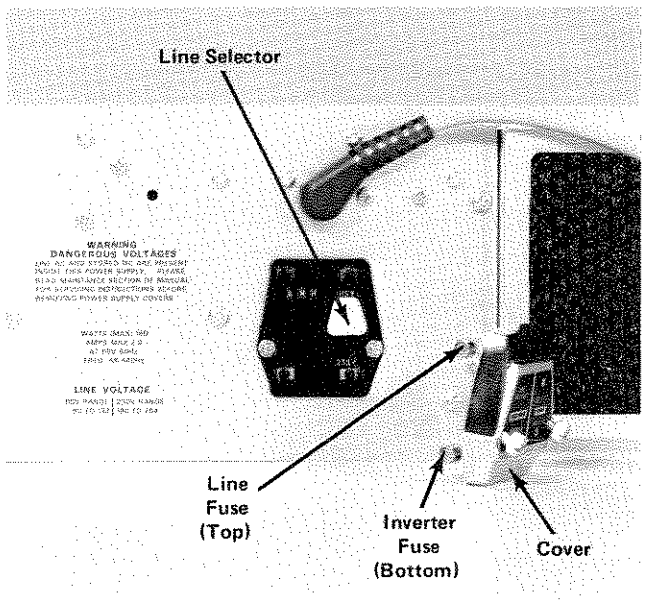


Fig. 1-1. Line selector assembly on rear panel (shown with cover removed).

Operating Temperature

The R7903 can be operated where the ambient air temperature is between 0°C and +50°C. This instrument can be stored in ambient temperatures between −55°C and +75°C. After storage at temperatures beyond the operating limits, allow the chassis temperature to come within the operating limits before power is applied.

The R7903 is cooled by air drawn through the air filter on the rear of the instrument. Adequate clearance must be provided on all sides to allow heat to be dissipated from the instrument. Do not block or restrict the air flow through the holes on the sides of the instrument. Allow about two inches clearance (more if possible) on the sides for adequate ventilation.

A thermal cutout in this instrument provides thermal protection which interrupts the power to the instrument if the internal temperature exceeds a safe operating level. Power is automatically restored when the temperature returns to a safe level. Operation of this instrument in confined areas or in close proximity to heat-producing instruments may cause the thermal cutout to open more frequently.

DISPLAY DEFINITIONS

General

The following definitions describe the types of displays which can be obtained with a R7903 Oscilloscope System with real-time amplifiers, time-base units, or combinations of these. Use of special purpose plug-in units may result in different types of displays, which are defined in the instruction manuals for these special units. The following terminology will be used through this manual.

NOTE

See Simplified Operating Instructions in this section for set-up information to obtain each of the following displays.

Alternate Mode

A time-sharing method of displaying two or more signals on a single cathode-ray tube beam. Channel switching is sequential and occurs at the end of each sweep.

Chopped Mode

A time-sharing method of displaying two or more signals on a single cathode-ray tube beam. Channel switching is sequential and occurs at a rate determined by an internal clock generator (chopping rate).

Single Trace

A repetitive display of a single plot produced by one vertical signal and one sweep.

Single Sweep—Single Trace

A non-repetitive display of a single plot produced by one vertical signal and only one sweep. Use for single-shot photography.

Dual Trace

A display of two plots produced by two vertical signals and one sweep. The two signals time-share a single cathode-ray tube beam.

Dual Sweep

A display of two plots produced by one vertical signal and two sweeps. Both sweeps operate independently. The two sweeps time-share a single cathode-ray tube beam (Dual time-base plug-in units only).

Dual Trace—Dual Sweep

A display of four plots produced by combining two vertical signals and two sweeps. Each vertical signal is displayed against each sweep (Dual time-base plug-in units only).

Delayed Sweep—Single Trace

A display of a single plot produced by one vertical signal and delayed sweep. Two sweeps are used to produce this display; the sweeps are operated with a delaying/delayed relationship where one sweep (identified as the delaying sweep) delays the start of the second sweep (identified as the delayed sweep). This display can be expanded to present two plots, produced by one vertical signal displayed against both the delaying and the delayed sweep (Dual time-base plug-in units only).

Delayed Sweep—Dual Trace

A display of two plots produced by combining two vertical signals and a delayed sweep. Two sweeps are used to produce this display; the sweeps are operated with a delaying-delayed relationship. Each vertical signal is dis-

played against the delayed sweep. This display can be expanded to present four plots, produced by displaying both vertical signals against both the delaying and the delayed sweep.

X–Y

A plot of two variables, neither of which represents time. X refers to the horizontal axis and Y refers to the vertical axis.

PLUG-IN UNITS

General

The R7903 is designed to accept up to three TEKTRONIX 7-series plug-in units. This plug-in feature allows a variety of display combinations and also allows selection of polarity, sensitivity, display mode, etc. to meet the measurement requirements. In addition, it allows the oscilloscope system to be expanded to meet future measurement requirements. The overall capabilities of the resultant system are in large part determined by the characteristics of the plug-in selected. A list of the currently available plug-ins for this instrument along with their major specifications, is given in Section 2. For more complete information, see the current Tektronix, Inc. catalog.

NOTE

Later production of rackmount oscilloscopes are provided with support posts between the individual plug-in compartments. A post or posts must be removed if a multiwidth plug-in is to be installed. To remove a post, unfasten the screws that secure it at the top and bottom of the plug-in housing.

Installation

To install a plug-in unit into one of the plug-in compartments, align the slots in the top and bottom of the plug-in with the associated guide rails in the plug-in compartment. Push the plug-in unit firmly into the plug-in compartment until it locks into place. To remove a plug-in, pull the release latch on the plug-in unit to disengage it and pull the unit out of the plug-in compartment. Plug-in units can be removed or installed without turning off the instrument power.

It is not necessary that all of the plug-in compartments be filled to operate the instrument; the only plug-ins needed are those required for the measurement to be made. However, at environmental extremes, excess interference may be radiated into and out of this instrument through the open plug-in compartments. Blank plug-in panels are available from Tektronix, Inc. to cover the unused compartments; order TEKTRONIX Part No. 016-0155-00.

When the R7903 is calibrated in accordance with the calibration procedure given in the service manual, the vertical and horizontal gains are normalized. This allows calibrated plug-in units to be changed from one plug-in compartment to another without recalibration. However, the basic calibration of the individual plug-in units should be checked when they are installed in this system to verify their measurement accuracy. See the operating instructions section of the plug-in unit instruction manual for verification procedure.

The plug-in versatility of the R7903 allows a variety of display modes with many different plug-ins. Further information for obtaining these displays is given later in this section. However, the following information is provided here to aid in plug-in installation.

To produce a single-trace display, install a single-channel vertical unit (or dual-channel unit set for single-channel operation) in either of the vertical compartments. For dual-trace displays, either install a dual-channel vertical unit in one of the vertical compartments or install a single-channel vertical unit in each vertical compartment. A combination of a single-channel and dual-channel vertical unit allows a three-trace display; likewise, a combination of two dual-channel vertical units allows a four-trace display.

For single time-base displays, the time-base unit can be placed in the horizontal compartment or a delayed-sweep operation can be obtained with a dual time-base unit installed in the horizontal compartment.

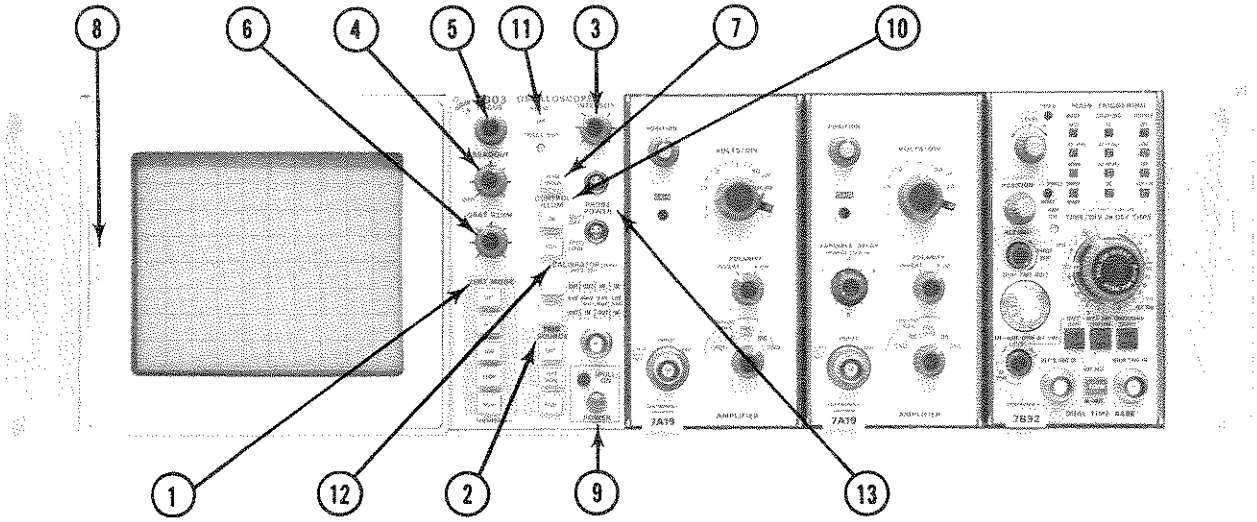
X-Y displays can be obtained in two ways with the R7903 system. If a 7B-series time-base unit is available that has an amplifier feature, the X signal can either be routed through one of the vertical units via the internal-trigger pickoff circuitry to the horizontal system, or connected to the external horizontal input connector of the time-base unit. Then, the vertical signal (Y) is connected to the remaining vertical unit. Also, a 7A-series amplifier plug-in can be installed in one of the horizontal compartments for X-Y operation.

Special purpose plug-ins may have specific restrictions regarding the plug-in compartments in which they can be installed. This information will be given in the instruction manuals for these plug-ins.

CONTROLS AND CONNECTORS

The major controls for operation of the R7903 are located on the front panel. Figs. 1-2, 1-3, and 1-4 provide a brief description of each control and connector. More detailed operating information is given under General Operating Information.

R7903 FUNCTIONS OF CONTROLS AND CONNECTORS



1. VERT—Selects vertical mode of operations.

   LEFT: Signals from the left plug-in compartment are displayed.

   ALT: Signals from both vertical plug-in compartments are displayed (dual trace). Display is switched from one vertical to the other after each sweep.

   ADD: Signals from both vertical plug-in compartments are algebraically added, and the sum is displayed.

   CHOP: Signals from both vertical compartments are displayed (dual trace). Display switches from the left vertical compartment signal to the right vertical compartment signal at a one megahertz rate.

   RIGHT: Signals from the right plug-in compartment are displayed.

2. TRIG MODE—Selects the source of the internal trigger signals for the horizontal compartment.

   LEFT: Trigger signals are from the left vertical plug-in compartment only.

   VERT MODE: Trigger signals are from the vertical plug-in compartment being displayed except in the CHOP mode; then the trigger is automatically switched to the left plug-in compartment.

   RIGHT: Trigger signals are from the right vertical plug-in compartment only.

3. INTENSITY—Controls the brightness of the display.

4. READOUT—Turns on the Readout display, and controls the brightness of the Readout display.

5. FOCUS—Provides adjustment for optimum display definition.

6. GRATICULE ILLUM—Controls graticule illumination.

7. BEAM FINDER—When pressed in the display is limited to within the graticule area. Display is returned to normal when Beam Finder button is out (pressed and released).

8. Camera Power—Three pin connector on the CRT bezel, (top) +15 volt power source, (middle) receives remote signal sweep reset signal from compatible camera system, and (bottom) ground pin.

9. POWER—Switch and indicator; switch turns on instrument, and the indicator is on when the instrument is connected to a power source and turned on.

10. CONTROL-ILLUM—Controls illumination level of the push-button switches of the associated plug-in units. (Top button on-off, button high or low.)

11. ASTIG—Screwdriver adjustment used in conjunction with the FOCUS control to obtain a well-defined display.

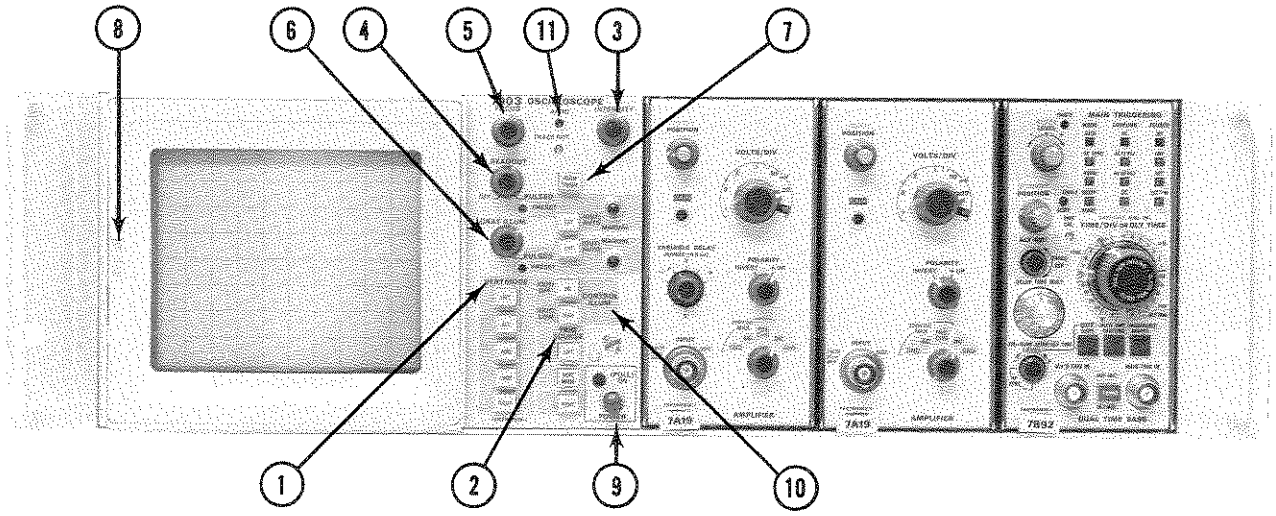
12. CALIBRATOR—Positive-going square-wave. Output selected by pushbuttons.

Top button	In	In	Out	Out
Bottom button	Out	In	Out	In
Output	4 mV	40 mV	0.4 V	4.0 V

13. PROBE POWER—Two power source plugs for active probe system.

Fig. 1-2.

R7903 OPTION 10 FUNCTIONS OF CONTROLS AND CONNECTORS



1. VERT MODE—Selects vertical mode of operation.

   LEFT: Signals from the left plug-in compartment are displayed.

   ALT: Signals from both vertical plug-in compartments are displayed (dual trace). Display is switched from one vertical to the other after each sweep.

   ADD: Signals from both vertical plug-in compartments are algebraically added; and the sum is displayed.

   CHOP: Signals from both vertical compartments are displayed (dual trace). Display switches from the left vertical compartment signal to the right vertical compartment signal at a one megahertz rate.

   RIGHT: Signals from the right plug-in compartment are displayed.

2. TRIG MODE—Selects the source of the internal trigger signals for the horizontal compartment.

   LEFT: Trigger signals are from the left vertical plug-in compartment only.

   VERT MODE: Trigger signals are from the vertical plug-in compartment being displayed except in the CHOP mode; then the trigger is automatically switched to the left plug-in compartment.

   RIGHT: Trigger signals are from the right vertical plug-in compartment only.

3. INTENSITY—Controls the brightness of the display.

4. READOUT—Turns on readout character generator and controls the intensity of the readout display. In the clockwise detent the readout system is in the pulsed mode.

   Pulsed Modes

   a. MANUAL—When pressed, one readout frame will be displayed on the CRT screen.

   b. EXT/AUTO

      AUTO—Displays one frame of characters at the end of each sweep.

      EXT—A remote input to the GRAT/READOUT BNC connector on the rear panel will display one frame of characters.

   c. PRESET—(Screwdriver adjustment) controls the readout intensity in the pulsed mode.

5. FOCUS—Provides adjustment for optimum display definition.

6. GRAT ILLUM—Controls graticule illumination. In the clockwise detent the graticule is in the pulsed mode.

   a. MANUAL—When pressed the graticule will be illuminated for a predetermined period of time.

   b. EXT/AUTO

      AUTO—Graticule will be illuminated for a predetermined period of time at the end of each sweep.

      EXT—A remote input to GRAT/READOUT BNC connector on the rear panel will illuminate the graticule for a predetermined period of time.

   c. PRESET—(Screwdriver adjustment) controls the illumination of the graticule in the pulsed mode.

7. BEAM FINDER—When pressed the display is limited to within the graticule area. Display is returned to normal when BEAM FINDER button is out (pressed and released).

8. Camera Power—Three pin connector on the CRT bezel (top) +15 volt power source, (middle) receives remote single sweep reset signal from compatible camera system, and (bottom) ground pin.

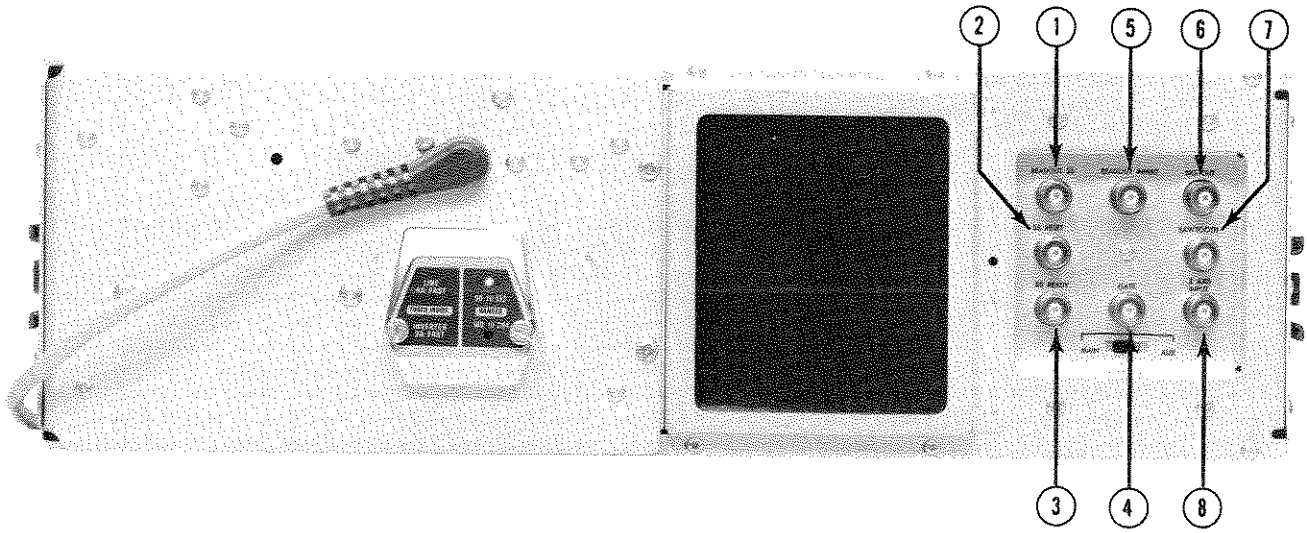
9. POWER—Switch and indicator; switch turns on instrument, and the indicator is on when the instrument is connected to a power source and turned on.

10. CONTROL-ILLUM—Controls illumination level of the push-button switches of the associated plug-in units. (Top button on-off, button high or low.)

11. ASTIG—Screwdriver adjustment used in conjunction with the FOCUS control to obtain a well-defined display.

Fig. 1-3.

REAR PANEL R7903 CONTROLS AND CONNECTORS



1. READOUT SS

   Remote input provides one readout frame.

2. SS RESET

   Remote input to reset single sweep function of the time-base unit.

3. SS READY

   Provides an external single sweep ready indicator signal after single sweep function has been reset.

4. +GATE

   Positive-going gate signal coincident with the respective sweep. Switching allows selection of one of 2 possible gate signals (Main Gate, Aux Gate) from the time-base plug-in unit.

5. READOUT INHIBIT

   Inhibits readout display.

6. SIG OUT

   Provides output signal from the vertical plug-ins. Source of the output signal at the SIG OUT connector is selected by the TRIG SOURCE switch. (Left vert is output when vert mode is in chop and the TRIG SOURCE switch is in VERT MODE.)

7. +SAWTOOTH

   Positive-going sample of the sawtooth signal from the time-base unit in the horizontal compartment.

8. Z-AXIS INPUT

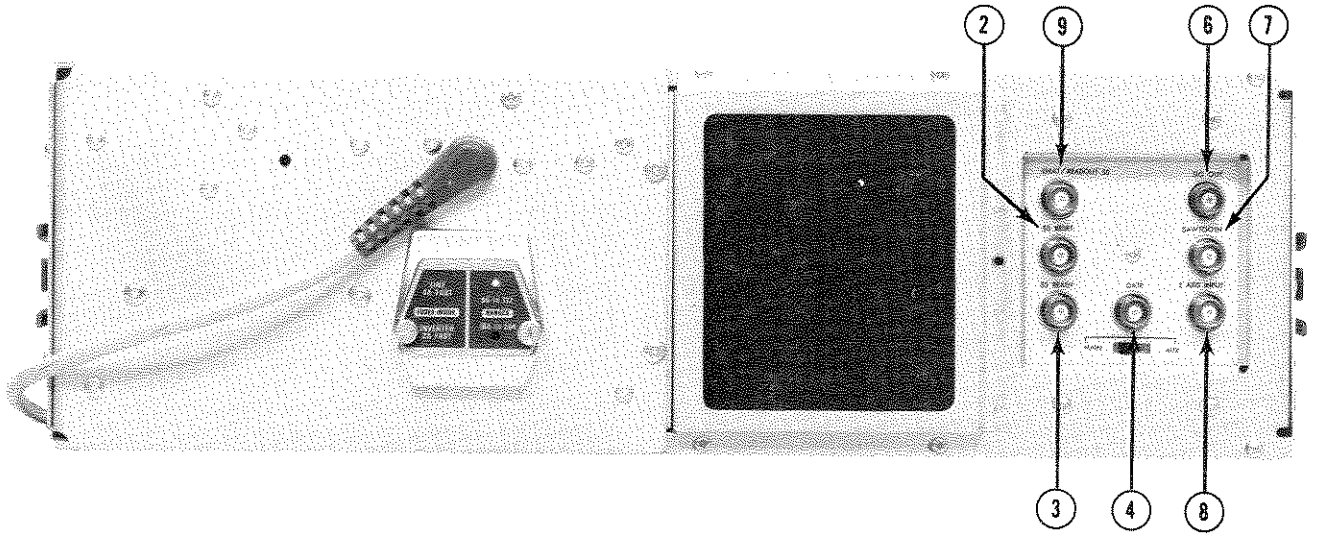
   Input connector for intensity modulation of the CRT display.

9. GRAT/READOUT SS

   Remote input provides one readout frame and turns on graticule lights for predetermined time. (If appropriate Auto/Ext in Ext.)

Line Selector on all instruments (not labeled)

Switching assembly to select the nominal operating voltage (115 or 230 volts). The assembly also includes the line and inverter fuses.



REAR PANEL R7903 OPTION 10 CONTROLS AND CONNECTORS

Fig. 1-4.

OPERATING CHECKOUT

General

The following Operating Checkout provides a means of verifying instrument operation and basic calibration without removing the covers or making internal adjustments. Since it demonstrates the use of all controls and connectors, it can also be used to provide basic training on the operation of this instrument. If re-calibration of the R7903 appears to be necessary, see the Calibration procedure in the Service manual. If re-calibration of a plug-in unit is indicated, see the instruction manual for the appropriate plug-in unit.

Set-Up Information

1. Set the front-panel controls as follows:

INTENSITY	Counterclockwise
READOUT	Off
FOCUS	Midrange
BEAM FINDER	Released (out)
GRATICULE ILLUM	As desired
VERT MODE	LEFT
TRIG SOURCE	VERT MODE
POWER	Pushed in (off)
CONTROL ILLUM	Off (out)
CALIBRATOR	Both buttons in (0.4 V)

2. Connect the R7903 to a power source which meets the voltage and frequency requirements of this instrument.

3. Install TEKTRONIX 7A-series amplifier units into both the left and right vertical plug-in compartments. Install a 7B-series time-base unit into the horizontal compartment.

4. Pull the POWER switch to turn the instrument on. Allow several minutes warmup before proceeding.

5. Set both vertical units for a deflection factor of 0.1 volt/division and center the vertical position controls. Set both vertical units for AC input coupling.

6. Set the time-base unit for a sweep rate of one millisecond/division in the auto, internal trigger mode. Center trigger level control for a triggered display.

7. Advance the INTENSITY control until the trace is at the desired viewing level (near midrange). Advance the READOUT until the readout display is at the desired viewing level.

8. Connect the 0.4 V calibrator signal to the input of the left vertical unit with a BNC Patch card cable (supplied accessory). An external calibrator signal is required for the R7903 option 10.

Display Focus

9. Adjust the FOCUS control for a sharp, well-defined display over the entire trace length. If a properly focused display cannot be obtained with the FOCUS control, the Astigmatism adjustment must be reset:

NOTE

This instrument contains circuitry to automatically protect the CRT phosphor against damage due to excessive CRT beam current. If the INTENSITY control is set to a point where CRT phosphor damage could occur, this circuit limits the beam current to a safe level. Also, this circuit action will cause the trace to de-focus (widen) to indicate that the intensity control setting should be reduced. If the FOCUS and ASTIG adjustments cannot be made as given in step 9, decrease the setting of the INTENSITY control and repeat the step.

Trace Alignment

10. Disconnect the input signal and position the trace with the left vertical unit position control so that it coincides with the center horizontal line of the graticule. If the trace is not parallel to the center horizontal line of the graticule, see Trace Rotation adjustment procedure in Calibration section.

Graticule Illumination

11. Rotate the GRAT ILLUM control throughout its range and notice that the illumination of the graticule lines increases as the control is turned clockwise (most obvious with tinted filter installed). Set the control so the graticule lines are illuminated as desired.

Vertical Deflection System

12. Connect the 0.4 V calibrator signal to the input connector of the left vertical unit with the BNC patch card cable. Set both vertical units for a deflection factor of 0.1 volt/division. The display amplitude should be four divisions. Note the exact display amplitude for step 15.

13. Notice that the position control of only the left vertical unit has an effect on the position of the display. Position the display to the upper half of the graticule.

14. Press the RIGHT button of the VERT MODE switch. Remove the calibrator signal from the left vertical and connect it to the right vertical. The display amplitude should be four divisions within 0.12 division. Note the exact display amplitude for the next step.

15. A correct display in both steps 12 and 14 indicates that the R7903 Vertical Deflection System and the vertical plug-in units are calibrated. If the displays noted previously are both outside the given tolerance in the same direction (i.e., high or low), the Vertical Gain or 400 mV Volts calibrator adjustment probably needs re-adjustment. Otherwise, check the calibration of the vertical plug-in units.

16. Notice that the position control of only the right vertical unit has an effect on the position of the display. Position the display to the lower half of the graticule. Set both vertical units for a deflection factor of 0.2 volt/division. Connect calibrator signal to both vertical units by using a dual input coupler.

17. Press the ALT button of the VERT MODE switch. Notice that two traces are displayed on the CRT. The top trace is produced by the left vertical unit and the bottom trace is produced by the right vertical unit. Set the sweep rate to 50 milliseconds/division. Notice that the display alternates between the left and right vertical units after each sweep. Turn the sweep rate switch throughout its range. Notice that the display alternates between vertical units at all sweep rates.

18. Press the CHOP button of the VERT MODE switch. Turn the sweep rate throughout its range. Notice that a dual-trace display is presented at all sweep rates, but unlike ALT both vertical units are displayed on each sweep in a time-sharing manner. Return the sweep rate to 0.5 millisecond/division.

19. Press the ADD button of the VERT MODE switch. The display should be four divisions in amplitude. Notice that the position control of either vertical unit moves the display. Return the VERT MODE switch to LEFT.

Triggering

20. Center the display on the CRT with the left vertical unit position control. Disconnect the input signal from the right vertical unit input connector. Sequentially press all of the VERT MODE switch buttons. Notice that a stable display is obtained in all positions of the VERT MODE switch (straight line in RIGHT position).

21. Press the LEFT button of the TRIG SOURCE switch. Again, sequentially press all of the VERT MODE buttons. Notice that the display is again stable in all positions, as in the previous step.

22. Press the RIGHT button of the TRIG SOURCE switch. Sequentially press all of the VERT MODE buttons and notice that a stable display cannot be obtained in any position. This is because there is no input signal connected to the right vertical unit. Return the TRIG SOURCE SWITCH to VERT MODE. Remove calibrator signal from left vertical unit and connect it to right vertical unit. Repeat steps 20 to 22. The trigger signal will come from right vertical. When the LEFT button is pressed of the TRIG SOURCE switch the display is not stable because there is no input signal connected to the left vertical. Return the TRIG SOURCE switch to VERT MODE.

Horizontal Deflection System

23. Position the start of the sweep to the left graticule line with the time-base unit position control. Set the time-base unit sweep rate switch to 0.5 millisecond/division.

24. Press the LEFT button of the VERT MODE switch. Change the deflection factor of the left vertical plug-in unit to 0.1 volt/division.

25. The display should show ten complete cycles over the 10 division graticule. The center eight complete cycles of the display waveform should occupy the center eight graticule divisions within 0.25 division.

26. A correct display indicates that the R7903 Horizontal Deflection System is calibrated. Recalibration of the R7903 horizontal system or the horizontal plug-in unit is indicated if the waveform display is outside the given tolerance.

Beam Finder

27. Set the deflection factor of the left vertical unit to 10 mV/division. Notice that a square-wave display is not visible, since the deflection exceeds the scan area of the CRT.

28. Press the BEAM FINDER switch. Notice that the display is returned to the viewing area in compressed form. Increase the vertical and horizontal deflection factors until the display is reduced to about two divisions vertically and horizontally (when the horizontal unit is operated in the time-base mode, change only the deflection factor of the vertical unit). Adjust the position controls of the displayed vertical unit and the time-base unit to center the com-

pressed display about the center lines of the graticule. Press and release the BEAM FINDER switch. Notice that the display remains within the viewing area.

Z-Axis Input

29. If an external signal is available (two volts peak-to-peak minimum at two megahertz or less), the function of the EXT Z AXIS input can be demonstrated. Connect the external signal to both the input of the right vertical unit and the EXT Z AXIS connector with two BNC cables and a BNC T connector. Set the VERT MODE switch to RIGHT and set the vertical unit for a deflection factor of two volts/division. Set the time-base unit for a sweep rate which displays several cycles of the signal. Adjust the amplitude of the signal generator until intensity modulation is visible on the display. The positive peaks of the waveform should be blanked out and the negative peaks intensified. Notice that the setting of the INTENSITY control determines the amount of intensity modulation that is visible.

30. Disconnect the signal from the EXT Z AXIS connector, but leave it connected to the right vertical unit input. Check that peak-to-peak amplitude of the displayed signal is four divisions maximum.

31. This completes the Operating Checkout procedure for the R7903 standard instrument.

Option 10 Pulsed graticule/readout

32. Set the time base unit for a sweep rate of 0.2 second/division. Turn the READOUT control clockwise into the detent for the pulsed readout mode. Press the AUTO/EXT button (in). Press the MANUAL button for the readout display. One frame of characters should be displayed. Press the AUTO button (out); after each sweep one frame of characters is displayed. Press the AUTO button (in) for external triggering. Ground the center pin connector on the GRAT/READOUT BNC connector on the rear panel. One frame of characters should be displayed. The readout intensity in the pulsed mode is controlled by the PRESET adjustment (front panel screw driver adjustment). Turn the GRAT ILLUM control clockwise into the detent for the pulsed graticule mode. Press the MANUAL button for pulsed graticule illumination. Press the AUTO button (out); after each sweep the graticule is illuminated for a short interval of time. Press the AUTO button (in) for external triggering. Ground the center pin connector on the GRAT/READOUT SS BNC connector on the rear panel. The graticule will be illuminated for a short interval of time. The brightness in the pulsed mode is controlled by the PRESET adjustment (front panel screw-driver adjustment). Instrument operations not explained here, or operations which need further explanation are discussed under General Operating Information.

SIMPLIFIED OPERATING INSTRUCTIONS

The following information is provided to aid in quickly obtaining the correct setting for the R7903 controls to preset a display. The operator should be familiar with the complete function and operation of this instrument, as described elsewhere in this section, before using this procedure. For detailed operating information for the plug-in unit, see the instruction manuals for the applicable units.

Single-Trace Display

The following procedure will provide a display of a single-trace vertical unit against one time-base unit. For simplicity of explanation, the vertical unit is installed in the left vertical compartment. The right vertical compartment can be used if the procedure is changed accordingly.

1. Install a 7A-series vertical unit in the left vertical compartment.

2. Press the LEFT button of the VERT MODE switch.

3. Install a 7B-series time-base unit in the horizontal compartment.

4. Press the VERT MODE button of the TRIG SOURCE switch.

5. Connect the Calibrator signal to the input connector of the vertical unit. An external calibrator signal is needed for the R7903 option 10.

6. Set the vertical unit for AC input coupling and calibrated deflection factors.

7. Set the time-base unit for auto mode, internal triggering at a calibrated sweep rate of one millisecond/division.

8. Advance the INTENSITY control until a display is visible. (If no display is visible with INTENSITY at about midrange, press the BEAM FINDER switch and adjust the vertical deflection factor until the display is reduced in size vertically. Center the compressed display with vertical and horizontal position controls, then press and release the BEAM FINDER.) Adjust the FOCUS control for a well-defined display. Adjust Readout INTENSITY for the desired viewing level.

9. Set the vertical deflection factor and vertical position control for a display which remains within the graticule area vertically.

10. If necessary, set the time-base triggering controls for a stable display.

11. Adjust the time-base position control so that the display begins at the left edge of the graticule. Set the time-base sweep rate to display the desired number of cycles.

Dual-Trace Display

The following procedure will provide a display of two single-trace vertical units against one time-base unit.

1. Install 7A-series vertical units in both vertical plug-in compartments.

2. Press the LEFT button of the VERT MODE switch.

3. Install the 7B-series time-base unit in the horizontal compartment.

4. Press the VERT MODE button of the TRIG SOURCE switch.

5. Connect the signal to the input connectors of the vertical units.

6. Set the vertical units for AC input coupling and calibrated deflection factors.

7. Set the time-base unit for auto mode, internal triggering, at a sweep rate of one millisecond/division.

8. Advance the INTENSITY control until a display is visible. (If no display is visible with INTENSITY at midrange, press the BEAM FINDER switch and adjust the vertical deflection factor until display is reduced in size vertically. Center the compressed display with the vertical and horizontal position controls, then press and release the BEAM FINDER switch.) Set the FOCUS control for a well-defined display.

9. Set the left vertical unit deflection factor for a display about four divisions in amplitude. Adjust the left vertical position control to move this display to the top of the graticule area.

10. Press the RIGHT button of the VERT MODE switch.

11. Set the RIGHT vertical unit deflection factor for a display about four divisions in amplitude (if display cannot be located, use BEAM FINDER switch). Position this display to the bottom of the graticule area with the right vertical unit position control.

12. Press the ALT or CHOP button of the VERT MODE switch. A dual-trace display of the signal from the left vertical and right vertical plug-in units should be presented on the CRT. (For more information on choice of dual-trace mode, see Vertical Mode in this section.)

13. If necessary, adjust the time-base triggering controls for a stable display.

14. Adjust the time-base position controls so the display begins at the left edge of the graticule. Set the time-base sweep rate for the desired horizontal display.

Delayed Sweep—Single Trace

The following procedure will provide a delayed sweep display of a single-trace vertical unit.

1. Follow the complete procedure given under Single-Trace Displays.

2. Be sure that the time-base unit installed in the horizontal compartment is a dual time-base with delaying and delayed capabilities.

3. Follow the procedure given in the instruction manual for the dual time-base unit to obtain a delayed-sweep display.

Delayed Sweep—Dual Trace

The following procedure will provide a delayed-sweep display of two single-trace vertical units.

1. Follow the complete procedure given under Dual-Trace Display.

2. Be sure that the time-base unit installed in the horizontal compartment is a dual time-base unit with delaying and delayed capabilities.

3. Follow the procedure given in the instruction manual for the dual time-base unit to obtain a delayed-sweep display.

X-Y Display

The following procedure will provide an X-Y display (one signal versus another rather than against time).

NOTE

Some 7B-series time-base units have provisions for amplifier operation in the X-Y mode; see X-Y operation in this section for details of operation in this manner.

1. Install 7A-series amplifier units in both the left vertical and the horizontal compartments.

2. Press the LEFT button of the VERT MODE switch.

3. Connect the X-signal to the amplifier unit in the horizontal compartment.

4. Connect the Y-signal to the amplifier unit in the left vertical compartment.

5. Set both amplifier units for AC input coupling and calibrated deflection factors.

6. Advance the INTENSITY control until a display is visible. (If no display is visible, press BEAM FINDER switch and adjust the deflection factors of both amplifier units until display is reduced in size both vertically and horizontally; then center the compressed display with the position controls; Press and release the BEAM FINDER switch.) Adjust the FOCUS control for a well-defined display.

GENERAL OPERATING INFORMATION

Intensity Control

The setting of the INTENSITY control may affect the correct focus of the display. Slight re-adjustment of the FOCUS control may be necessary, when the intensity level is changed. To protect the CRT phosphor, do not turn the INTENSITY control higher than necessary to provide a satisfactory display. The light filters reduce the observed light output from the CRT. When using these filters, avoid advancing the INTENSITY control to a setting that may burn the phosphor. When the highest intensity display is desired, remove the filters and use only the clear faceplate protector (permanently installed behind bezel). Apparent trace intensity can also be improved in such cases by reducing the ambient light level or using a viewing hood. Also, be careful that the INTENSITY control is not set too high when changing the time-base unit sweep rate from a fast to a slow sweep rate, or when changing to the X-Y mode of operation. The instrument incorporates protection circuitry which automatically reduces the display intensity to a lower level when the time-base unit is set to a slow sweep rate. This reduces the danger of damaging the CRT phosphor at these slower sweep rates.

Display Focus

The FOCUS control allows adjustment for best definition of the CRT display. The Readout intensity should be turned on, when adjusting the Focus control. Slight re-adjustment of this control may be necessary as the display conditions change. If a properly focused display cannot be obtained with the FOCUS control, the internal Astigmatism adjustment must be re-set; see the Calibration section of this manual.

Graticule

The graticule of the R7903 is marked on the inside of the faceplate of the CRT, providing accurate, no-parallax measurements. The graticule is divided into eight vertical and ten horizontal divisions. Each division is 1 centimeter square. In addition, each major division is divided into five minor divisions. The vertical gain and horizontal timing of the plug-in units are calibrated to the graticule so that accurate measurements can be made from the CRT. The illumination of the graticule lines can be varied with the GRATICULE ILLUM control.

NOTE

Two types of crt graticules have been used in some Tektronix oscilloscopes. One graticule has 0% and 100% risetime reference points that are separated by 6 vertical graticule divisions. The other graticule has the 0% and 100% risetime reference points separated by 5 vertical divisions. In your manual, illustrations of the crt face or risetime measurement instructions may not correspond with the graticule markings on your oscilloscope.

Fig. 1-5 shows the graticule of the R7903 and defines the various measurement lines. The terminology defined here will be used in all discussions involving graticule measurements. Notice the 0%, 10%, 90% and 100% markings on the left side of the graticule. These markings are provided to facilitate risetime measurements.

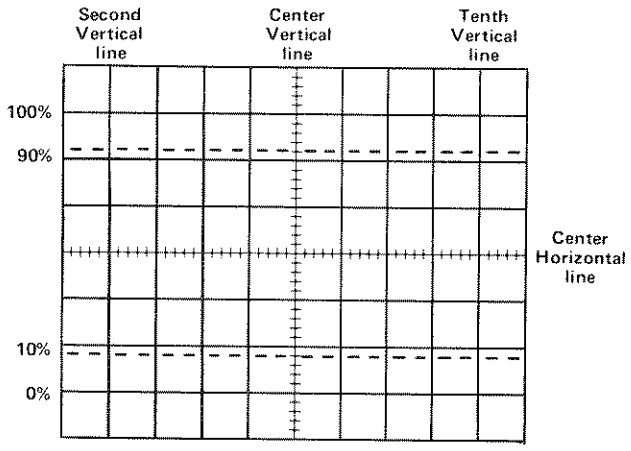


Fig. 1-5. Definition of measurement lines on graticule.

Light Filter

The tinted filter provided with the R7903 reduces light reflections from the face of the CRT to improve contrast when viewing the display under high ambient light conditions. This filter should be removed for waveform photographs or when viewing high writing rate displays. To remove the filter, pull outward on the bottom of the plastic CRT mask and remove it from the CRT. Remove the tinted filter; leave the clear plastic faceplate protector installed and replace the bezel. The faceplate protector should be left in place at all times to protect the CRT faceplate from scratches.

An optional mesh filter is available for use with the R7903. This filter provides shielding against radiated EMI (electromagnetic interference) from the face of the CRT. It also serves as a light filter to make the trace more visible under high ambient light conditions. The mesh filter fits in place of the plastic CRT mask and the tinted filter. The filter can be ordered by TEKTRONIX Part No. 378-0603-00.

Beam Finder

The BEAM FINDER switch provides a means of locating a display which overscans the viewing area either vertically or horizontally. When the BEAM FINDER switch is pressed, the display is compressed within the graticule area. Press and release the BEAM FINDER switch to return to a normal display. To locate and reposition an overscanned display, use the following procedure:

1. Press the BEAM FINDER switch.

2. Increase the vertical and horizontal deflection factors until the vertical deflection is reduced to about two divisions and the horizontal deflection is reduced to about four divisions (the horizontal deflection needs to be reduced only when in the X-Y mode of operation).

3. Adjust the vertical and horizontal position controls to center the display about the vertical and horizontal center lines of the graticule.

4. Press and release the BEAM FINDER switch; the display should remain within the viewing area.

Readout Modes

The characters of the readout display are written by the CRT beam on a time-share basis with signal waveforms. The Readout system operates in a free running mode to randomly interrupt the waveform display to present the readout characters. The readout system can also operate in a GATE TRIG'D mode. No readout signal is produced until after the sweep has occurred. In this mode the sweep must run to have the readout displayed. See Fig. 1-6 for location of Readout Mode Switch.

Display Photography (Standard Instrument)

A permanent record of the CRT display can be obtained with an oscilloscope camera system. The instruction manuals for the TEKTRONIX Oscilloscope Cameras include complete instructions for obtaining waveform photographs. The following specific information applies to the R7903.

The CRT bezel of the R7903 provides integral mounting for a TEKTRONIX Oscilloscope Camera. The three pins located on the left side of the CRT bezel connect power to compatible camera systems. It also receives control signals from TEKTRONIX automatic cameras to allow camera-controlled single-shot photography (see camera manual for further information).

Display Photography Option 10 Pulsed Grat/ Readout

The R7903 option 10 allows multiple single-shot exposures. The readout display (if option one is not ordered) and graticule illumination are pulsed, before, during, or after the events that are to be photographed. This allows more than one event to be photographed without overexposing the film. The readout display and graticule illumination can be manually triggered as desired, internally triggered before the event, or externally triggered by a remote signal to the GRAT/READOUT SS BNC connector

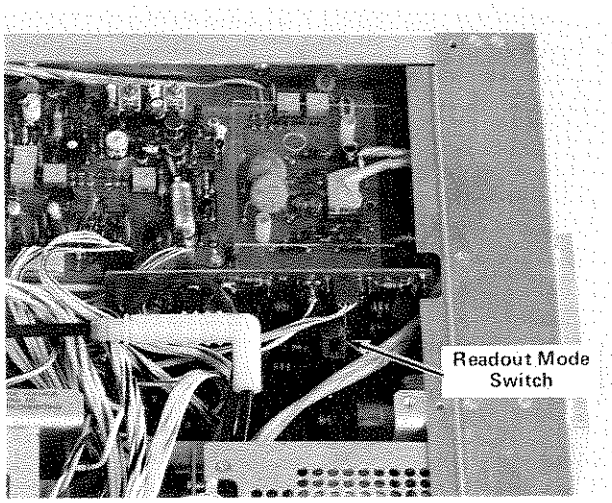


Fig. 1-6. Location of Readout Mode Switch on readout circuit board.

on the rear panel. When the READOUT control is in the pulsed mode (fully clockwise and in the switch detent), a preset adjustment for character brightness permits photos to be taken over an *f* stop range of *f*1.2 to *f*16. When the GRATICULE control is in the pulsed mode (fully clockwise and in the switch detent) a preset adjustment for graticule brightness permits photos to be taken over an *f* stop range of *f*1.2 to *f*16.

Vertical Mode

Left and Right Mode. When the LEFT or RIGHT button of the VERT MODE switch is pressed, only the signal from the plug-in unit in the selected compartment is displayed.

Alternate Mode. The ALT position of the VERT MODE switch produces a display which alternates between the plug-in units in the left vertical and right vertical compartments with each sweep of the CRT. Although the ALT mode can be used at all sweep rates, the CHOP mode provides a more satisfactory display at sweep rates below about 20 milliseconds/division. At these slower sweep rates, alternate-mode switching becomes visually perceptible.

NOTE

This instrument will not operate in the ALT mode if the horizontal plug-in unit is not operated in the time-base mode.

The TRIG SOURCE switch allows selection of the triggering for an alternate display. When this switch is set to the VERT MODE position, each sweep is triggered by the signal displayed on the CRT. This provides a stable display of two unrelated signals, but does not indicate the time relationship between the signals. In either the LEFT or RIGHT positions of the TRIG SOURCE switch, the two signals are displayed showing true time relationship. However, if the signals are not time-related, the display from the plug-in unit that is not providing a trigger signal will appear unstable on the CRT.

Chopped Mode. The CHOP position of the VERT MODE switch produces a display that is electronically switched between channels at a one-megahertz rate. In general, the CHOP mode provides the best display at sweep rates lower than about 20 milliseconds/division, or whenever dual-trace single-shot phenomena are to be displayed. At faster sweep rates, the chopped switching becomes apparent and may interfere with the display.

Correct internal triggering for the CHOP mode can be obtained in any of the three positions of the TRIG SOURCE switch. When the TRIG SOURCE switch is set to VERT MODE, the internal trigger signals from the vertical plug-in units are algebraically added and the time-base unit is triggered from the resultant signal. Use of the LEFT or RIGHT trigger-source positions triggers the time-base unit on the internal trigger signal from the selected vertical unit only. This allows two time-related signals to be displayed showing true time relationship. However, if the signals are not time-related, the display from the channel that is not providing the trigger signal will appear unstable. The CHOP mode can be used to compare two single-shot, transient, or random signals that occur within the time interval determined by the time-base unit (ten times selected sweep rate). To provide correct triggering, the display that provides the trigger signal must precede the second display in time. Since the signals show true time relationship, time-difference measurements can be made from the display.

Algebraic Addition The ADD position of the VERT MODE switch can be used to display the sum of difference of two signals, for common-mode rejection to remove an undesired signal, or for DC offset (applying a DC voltage to one channel to offset the DC component of a signal on the other channel). The common-mode rejection ratio between the vertical plug-in compartments of the R7903 is greater than 5:1 at 500 megahertz. The rejection ratio increases to 100:1 at 100 megahertz.

The overall deflection factor of the CRT in the ADD mode is the resultant of the algebraic addition of the signals from the two vertical plug-in units. It is difficult to determine the voltage amplitude of the resultant display unless the amplitude of the signal applied to one of the plug-in units is known. This is particularly true when the vertical units are set to different deflection factors, since it is not obvious which portion of the display is a result of the signal applied to either plug-in unit. Also, the polarity and repetition rate of the applied signals enters into the calculation.

The following general precautions should be observed to provide the best display when using the ADD mode:

1. Do not exceed the input voltage rating of the plug-in units.

2. Do not apply large signals to the plug-in inputs. A good rule to follow is not to apply a signal which exceeds an equivalent of about eight times the vertical deflection factors. For example, with a vertical deflection factor of 0.5 volt/division, the voltage applied to that plug-in unit should not exceed 4 volts. Larger voltages may result in a distorted display.

3. To ensure the greatest dynamic range in the ADD mode, set the position controls of the plug-in units to a

setting that results in a mid-screen display if viewed in the LEFT or RIGHT positions of the VERT MODE switch.

4. For similar response from each channel, set the plug-in units for the same input coupling.

Trigger Source

The TRIG SOURCE switch allows selection of the internal trigger signal for the time-base unit. For most applications, this switch can be set to the VERT MODE position. This position is the most convenient, since the internal trigger signal is automatically switched as the VERT MODE switch is changed, or as the display is electronically switched between the left vertical and right vertical plug-in units in the ALT position of the VERT MODE switch. The internal trigger signal in the CHOP VERT MODE switch position is automatically switched to the left vertical plug-in unit. Therefore, the VERT MODE position ensures that the time-base unit receives a trigger signal, regardless of the VERT MODE switch setting, without the need to change the trigger source selection.

If correct triggering for the desired display is not obtained in the VERT MODE position, the LEFT or RIGHT positions can be used to obtain the trigger signal from either the left vertical or right vertical plug-in unit. The internal trigger signal is obtained from the selected vertical compartment, whether the plug-in unit in that compartment is selected for display on the CRT or not. If the internal trigger signal is obtained from one of the vertical units, but the other vertical unit is selected for display, the internal trigger signal must be time-related to the displayed signal in order to obtain a triggered (stable) display.

X-Y Operation

In some applications, it is desirable to display one signal versus another (X-Y) rather than against time (internal sweep). The flexibility of the plug-in units available for use with the R7903 provides a means for applying an external signal to the horizontal deflection system for this type of display. Some of the 7B-series time-base units can be operated as amplifiers in addition to their normal use as time-base generators. This feature allows an external signal to provide the horizontal deflection on the CRT. For most of the time-base units with the amplifier function, the X (horizontal) signal can be connected either to an external input connector on the time-base unit or it can be routed to the time-base unit through the internal triggering system (see time-base instruction manual for details). If the latter method is used, the TRIG SOURCE switches must be set so that the X (horizontal) signal is obtained from one of the vertical units and the Y (vertical) signal is obtained from the other vertical unit. The advantages of using the internal trigger system to provide the X signal are that the attenuator switch of the amplifier unit providing the horizontal signal determines the horizontal deflection factor, allowing full-range operation, and that the plug-in units do not have to be moved between compartments when X-Y operation is desired.

Another method of obtaining an X-Y display is to install an amplifier plug-in unit in the horizontal plug-in compartment (check amplifier unit gain as given in the plug-in instruction manual to obtain calibrated horizontal deflection factors). This method provides the best X-Y display, particularly if two identical amplifier units are used, since both X and Y input systems will have the same delay time, gain characteristics, input coupling, etc. For further information on obtaining X-Y displays, see the plug-in unit manuals. Also, the reference books listed under Applications provide information on X-Y measurements and interpreting the resultant displays.

Intensity Modulation

Intensity (Z-axis) modulation can be used to relate a third item of electrical phenomena to the vertical (Y-axis) and the horizontal (X-axis) coordinates, without affecting the waveshape of the displayed signal. The Z-axis modulating signal applied to the CRT circuit changes the intensity of the displayed waveform to provide this type of display. "Gray scale" intensity modulation can be obtained by applying signals that do not completely blank the display. Large amplitude signals of the correct polarity will completely blank the display; the sharpest display is provided by signals with a fast rise and fall. The voltage amplitude required for visible trace modulation depends upon the setting of the INTENSITY control. A two-volt peak-to-peak signal, for instance, will completely blank the display even at maximum intensity levels. Lower amplitude signals can be used to only change the trace brightness rather than completely blank the display. Negative-going modulating signals increase the display intensity and positive-going modulating signals decrease the display intensity. Useful input frequency range is DC to 10 megahertz (input voltage derating necessary above two megahertz). The maximum input voltage should be limited to 10 volts (DC plus peak AC).

Time markers applied to the EXT Z AXIS input connector provide a direct time reference on the display. With uncalibrated horizontal sweep or external horizontal mode operation, the time markers provide a means of reading time directly from the display. However, if the markers are not time-related to the displayed waveform, a single-sweep display should be used (for internal sweep only) to provide a stable display.

Raster Display

A raster-type display can be used to effectively increase the apparent sweep length. For this type of display, the trace is deflected both vertically and horizontally by sawtooth signals. This is accomplished in the R7903 by installing a 7B-series time-base unit in one of the vertical plug-in compartments. Normally, the time-base unit in the vertical compartment should be set to a slower sweep rate than the time-base unit in the horizontal compartment; the number of horizontal traces in the raster depends upon the ratio between the two sweep rates. Information can be displayed on the raster using several different methods. In the ADD position of the VERT MODE switch, the signal from an amplifier unit can be algebraically added to the vertical deflection. With this method, the vertical signal amplitude on the CRT should not exceed the distance between the horizontal lines of the raster. Another method of displaying information on the raster is to use the EXT Z AXIS input to provide intensity modulation of the display. This type of raster display could be used to provide a television-type display. Complete information on operation using the Z-axis feature is given under Intensity Modulation.

To provide a stable raster display, both time-base units must be correctly triggered. Internal triggering is not provided for the time-base units when they are in the vertical compartments, so external triggering must be used. Also, blanking is not provided from the time-base units when they are installed in a vertical compartment. To blank out the retrace portion from the time-base unit in the vertical compartment, special connections must be made from this time-base unit to the blanking network of the R7903. If this mode of operation is desirable, contact your local TEKTRONIX Field Office or representative for specific information on obtaining blanking with the specific time-base unit being used in the vertical compartment.

Calibrator

The internal calibrator of the R7903 provides a convenient signal source for checking basic vertical gain and for adjusting probe compensation as described in the probe instruction manual. In addition, the calibrator can be used as a convenient signal source for application to external equipment.

The calibrator signal is a one kilohertz square-wave. Four selected voltages are available, see Table 1-1.

A 40 milliampere squarewave is provided when the optional current-loop accessory (TEKTRONIX Part No. 012-0341-00) is connected to the calibrator output set at 4.0 volts.

TABLE 1-1

Calibrator Output Voltages

Switch Positions	Output Voltage into 50 ohms	Output Voltage open circuit
out out		4 mV
out in	4 mV	40 mV
in out	40 mV	0.4 V
in in	0.4 V	4.0 V

Signals Out

Vertical Signal. The VERT SIG OUT connector provides a sample of the vertical deflection signal. The source of the output signal is determined and indicated by the TRIG SOURCE switch. When the TRIG SOURCE is at VERT MODE, the output is determined and indicated by the VERTICAL MODE switch, except when in CHOP. Then, the signal is automatically switched to the LEFT VERTICAL. The output signals are LEFT, ALT, ADD, and RIGHT. The output signal into 50 ohms is about 20 millivolts/division of the vertical signal displayed on the system CRT. The output signal into 1 megohm is about 0.5 volt/division of the vertical signal displayed on the system CRT.

+ Gate. The + gate connector provides a sweep gate signal that is generated by the time base plug-in unit. The gate selector switch provides two gates; MAIN and AUXILIARY. The duration of the gate pulse is determined by the respective sweep. The Auxiliary gate can only be produced by dual sweep time base plug-in units. The amplitude of the gate signal is about 500 millivolts in to 50 ohms or 10 volts into 1 megohm.

+ Sawtooth. The + sawtooth connector provides a positive-going sample of the sawtooth from the time base unit in the horizontal compartment. The rate of rise of the sawtooth signal is about 50 millivolts/unit of time, into 50 ohms, or 1 volt/unit of time, into 1 megohm. Unit of time is determined by the time/division switch of the horizontal plug-in unit.

Applications

The R7903 Oscilloscope and its associated plug-in units provide a very flexible measurement system. The capabilities of the overall system depend mainly upon the

plug-in units that are chosen for use with this instrument. Specific applications for the individual plug-in units are described in the plug-in manuals. The overall system can also be used for many applications which are not described in detail either in this manual or in the manuals for the individual plug-in units. Contact your local TEKTRONIX Field Office or representative for assistance in making specific measurements with this instrument.

The following books describe oscilloscope measurement techniques which can be adapted for use with this instrument.

John D. Lenk, "Handbook of Oscilloscopes, Theory, and Application", Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1968.

J. Czech, "Oscilloscope Measuring Techniques", Springer-Verlag, New York, 1965.

J. F. Golding, "Measuring Oscilloscopes", Transatlantic Arts, Inc., 1971.

Charles H. Roth Jr., "Use of the Oscilloscope", A Programmed text, Prentice-Hall Inc., Englewood Cliffs, New Jersey, 1970.

SPECIFICATIONS

The R7903 will meet the electrical characteristics listed in the Performance Requirement column of Table 2-1 following complete calibration as given in the Service Manual. The following electrical characteristics apply over an ambient temperature range of 0°C to +50°C, except as otherwise indicated. Warmup time for given accuracy is 20 minutes.

NOTE

Many of the measurement capabilities of this instrument are determined by the choice of plug-in units. The following characteristics apply to the R7903 Oscilloscope only. See the Systems Specifications at the end of this section for the characteristics of the complete system.

TABLE 2-1

ELECTRICAL CHARACTERISTICS

Characteristic	Performance Requirement	Supplemental Information
	VERTICAL DEFLECTION SYSTEM	
Deflection Factor	Compatible with all 7-Series plug-in units	
Accuracy	1% or less difference between vertical compartments	
Low-Frequency linearity	0.1 division or less compression or expansion of a center-screen, two-division signal positioned anywhere vertically within the graticule area	
System Bandwidth	See 7-Series Oscilloscope Systems Specifications	
Isolation between Vertical Compartments		
All Vertical Modes	At least 100:1 from DC to 250 megahertz 40:1 from 250 megahertz to 500 megahertz	
Chopped Mode		
Repetition Rate		One megahertz within 20%
Time Segment for each compartment		0.4 to 0.6 microsecond
Delay Line		Permits viewing of leading edge of triggering signal

TABLE 2-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
	VERTICAL DEFLECTION SYSTEM (cont)	
Difference in signal delay between Vertical compartments		0.1 nanosecond or less
Vertical Display Modes	LEFT: Left Vertical unit only ALT: Dual-trace, alternates between vertical units ADD: Added algebraically CHOP: Dual-trace, chopped between vertical units RIGHT: Right vertical unit only	Selected by front panel VERTICAL MODE switch
	HORIZONTAL DEFLECTION SYSTEM	
Deflection Factor	Compatible with all 7-Series plug-in units	
Low-Frequency linearity	0.1 division or less compression or expansion of a center-screen, two-division signal positioned anywhere horizontally	
Fastest Calibrated Sweep Rate (with 7B92A Timebase)	0.5 nanosecond/division	
Bandwidth of R7903 horizontal system only (10 division reference)	DC to at least 1 megahertz	
	TRIGGERING SYSTEM	
TRIGGER SOURCE	LEFT VERT: From LEFT VERT unit only VERT MODE: Determined by VERT MODE switch, except in CHOP; then LEFT VERT supplies trigger signal RIGHT VERT: From RIGHT VERT unit only	Selected by front panel TRIG SOURCE switch
	CALIBRATOR SIGNAL	
Waveshape	Squarewave	
Polarity	Positive-going with baseline at ground	
Output Voltage		Selected by front-panel pushbutton switches
Open Circuit	4 mV, 40 mV, 0.4 V, 4 V	
Into 50 Ohms	4 mV, 40 mV, 0.4 V	

TABLE 2-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
	CALIBRATOR SIGNAL (cont)	
Amplitude Accuracy (Voltage and Current)		
+15°C to +35°C	Within 1%	
0°C to +50°C	Within 2%	
Repetition Rate	One kilohertz	
One-Kilohertz Accuracy (Voltage and Current)		
+15°C to +35°C	Within 0.25%	
0°C to +50°C	Within 0.5%	
Duty Cycle	50% within 10%	
Risetime and Falltime		
4 mV through 4 V and 40 mA	0.25 microsecond or less	
	SIGNAL OUTPUTS	
+GATE		
Source	Main Gate Aux Gate	Selected by rear-panel GATE switch
Polarity		Positive-going with baseline at zero volts within 0.1 volt (into one megohm load)
Output Voltage		
Into 50 Ohms	0.5 volts within 10%	
Into One Megohm	10 volts within 10%	
Risetime Into 50 Ohms	7 nanoseconds or less	
Output Resistance		950 ohms within 10%
SIG OUT		
Source	LEFT VERT: From LEFT VERT unit only VERT MODE: Determined by VERT MODE switch, except in CHOP; then LEFT VERT supplies trigger signal RIGHT VERT: From RIGHT VERT unit only	Selected by TRIG SOURCE SWITCH

TABLE 2-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
	SIGNAL OUTPUTS (cont)	
Output Voltage		
Into 50 Ohms	25 millivolts/division of vertical deflection within 25%	
Into One Megohm	0.5 volt/division of vertical deflection within 25%	
Bandwidth	Varies with vertical plug-in selected. See 7000-Series Oscilloscope Systems Specification	
Output Resistance		950 ohms within 10%
+ SAWTOOTH		
Source	Horizontal time-base unit in right plug-in compartment	
Polarity		Positive-going with baseline at zero volts within 1 volt (into 1 megohm)
Output Voltage		
Rate of Rise		
Into 50 Ohms	50 millivolts/unit of time selected by the time-base time/division switch, within 15%. 10 nanoseconds/division maximum	
Into One Megohm	One volt/unit of time selected by the time-base time/division switch, within 10%. 10 nanoseconds/division maximum	
Peak Voltage		
Into 50 Ohms	At least 500 millivolts	
Into One Megohm	At least 10 volts	
Output Resistance		950 ohms within 10%
SS READY		
Ready	+5 V within 5%	
Not ready	Open or ground	

TABLE 2-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
	PULSED READOUT SYSTEM (Option 10 only)	
PRESET (Screw driver adj)	Allows for adjustment of brightness to permit photos over an *f* stop range of *f*1.2 to *f*1.6	When READOUT control is in the pulsed mode (cw detent)
AUTO/EXT		
AUTO	When in the pulsed mode, one frame of characters will be displayed following each sweep	Initiated by the horizontal plug-in unit gate
EXT	When in the pulsed mode one frame of characters will be displayed when a remote signal is connected to the READOUT/GRAT SS BNC connector	
MANUAL	When in the pulsed mode one frame of characters will be displayed each time the MANUAL button is pressed	
	PULSED GRATICULE (Option 10 only)	
PRESET (Screw driver adj)	Allows for adjustment of GRATICULE ILLUMINATION to permit photos over an *f* stop range of *f*1.2 to *f*16	When GRATICULE control is in the pulsed mode (cw detent)
AUTO/EXT		
AUTO	When in the pulsed mode, GRATICULE is illuminated to the PRESET intensity following each sweep	
EXT	When in the pulsed mode, the GRATICULE is illuminated to the PRESET intensity when a remote signal is applied to GRAT/READOUT SS BNC connector	
MANUAL	When in the pulsed mode the GRATICULE will be illuminated each time the MANUAL button is pressed	
	SIGNAL INPUTS	
READOUT SS	Closure to ground within 0.4 volts	Input connector for initiating one frame of characters
Sinking Current	3 mA maximum	
Maximum Open Circuit Voltage	10 V	
Maximum Safe Input	+10 V, –5 V (DC to AC)	
Minimum Rate of Fall	0.1 V/μs	

TABLE 2-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
	SIGNAL INPUTS (cont)	
READOUT INHIBIT	Input for locking out readout	
Free Run Inhibit	Closure to ground within 0.1 V	
Sinking Current	2 mA maximum	
Maximum Safe Input	+5, –1 V (DC to AC)	
Maximum Open Current Voltage	+2 volts.	
SS RESET		
Reset	Closure to ground within –5 volts to +0.5 volt sinking 10 mA	Input connector for resetting time-base
Minimum Pulse	10 μs at 50% amplitude points	
Maximum Input Voltage	15 V	
GRAT/READOUT SS Option 10	Closure to ground within 0.4 volts	Input connector for initiating one frame of characters and illuminates the graticule for a pre-determined time.
Sinking current	3 mA maximum	
Maximum open circuit voltage	10 V	
	CHARACTER GENERATOR	
Character Size	Adjustable	
Mode	Free-run independent of sweep Triggered at end of sweep Single-shot controlled through rear panel READOUT SS BNC connector	Selected by internal Readout Mode switch
	EXTERNAL Z-AXIS	
Sensitivity	Two volts peak-to-peak provides trace modulation over full intensity range	
Polarity of Operation	Positive-going signal decreases trace intensity; negative-going signal increases trace intensity	
Intensity Circuit Pulse Performance (Between Rear-Panel Connector and CRT)		
Low-Frequency Limit		DC

TABLE 2-1 (cont)

Characteristic	Performance Requirement	Supplemental Information	
EXTERNAL Z-AXIS (cont)			
Response to Negative-Going Input		Approximately 10 nanoseconds	
Response to Positive-Going Input		Approximately 20 nanoseconds	
Propagation Delay		Approximately 25 nanoseconds	
Recovery Time in Response to Positive Input Step		Approximately 50 nanoseconds	
Recovery Time in Response to Negative Input Step		Zero nanoseconds	
Input Resistance at DC		Approximately 500 ohms	
Maximum Safe Input Voltage		15 volts (DC + peak AC)	
DISPLAY (CRT)			
Graticule			
Type	Internal, with variable illumination		
Area (standard)	8 X 10 divisions Each division equals 1 cm		
Area (option 4)	8 X 10 divisions Each division equals 0.5 cm		
Phosphor	P31 standard	Others available on request	
BEAM FINDER	Limits display to within graticule area when actuated		
Minimum Photographic Writing Speed with Polaroid[1] Type 410 Film (without film fogging techniques)			
Standard instrument		P31	P11
TEKTRONIX C-51R camera with f1.2 lens and 1:0.5 object-to-image ratio		2.8 centimeters/ nanosecond	6.1 centimeters/ nanosecond
TEKTRONIX C-27R camera with f1.3 lens and 1:0.5 object-to-image ratio		2.0 centimeters/ nanosecond	4.3 centimeters/ nanosecond

[1] **Registered trademark Polaroid Corporation.**

TABLE 2-1 (cont)

Characteristic	Performance Requirement	Supplemental Information	
DISPLAY (CRT) (cont)			
Option 4		P31	P11
TEKTRONIX C-27R camera with *f*1.2 lens and 1:0.5 object-to-image ratio		5.0 centimeters/ nanosecond	10.0 centimeters/ nanosecond
TEKTRONIX C-27R camera with *f*1.3 lens and 1:0.5 object-to-image ratio		3.65 centimeters/ nanosecond	7.1 centimeters/ nanosecond
POWER SOURCE			
Line Voltage Range (AC, RMS)			
115 Volts Nominal	90 to 132 volts	Selected by rear-panel Line Selector assembly	
230 Volts Nominal	180 to 264 volts		
Line Frequency		48 to 440 hertz	
Maximum Power Consumption		160 watts, 2.0 amperes at 60 hertz, 115-volt line	
Fuse Data			
Line (F1200)	4 A fast blow		
Inverter (F1223)	2 A fast blow		

TABLE 2-2

ENVIRONMENTAL CHARACTERISTICS

Characteristic	Performance
NOTE *This instrument will meet the electrical characteristics given in the Performance Requirement column of Table 2-1 over the following environmental limits, except as otherwise indicated.*	
Temperature Range	
Operating	0°C to +50°C.
Non-operating	−55°C to +75°C.
Altitude	
Operating	15,000 feet.
Non-operating	Test limit 50,000 feet.
Electro-magnetic Interference (EMI) as tested in MIL-I-618D (when equipped with option 3 only)	
Radiated interference	Interference radiated from the instrument under test within the given limits from 150 kilohertz to 1000 megahertz.
Conducted interference	Interference conducted out of the instrument under test through the power cord within the given limits from 150 kilohertz to 25 megahertz.
Transportation (packaged instrument, without plug-ins)	Qualifies under National Safe Transit Committee test procedure 1A, Category II.

TABLE 2-3

PHYSICAL CHARACTERISTICS

Characteristic	Performance
Ventilation	Safe operating temperature maintained by forced air. Automatic resetting thermal cutout protects instrument from overheating.
Warm-up Time	20 minutes for rated accuracy.
Finish	Anodized front panel. Blue-vinyl painted aluminum cabinet.

TABLE 2-3 (cont)

Characteristic	Performance
Overall Dimensions (measured at maximum points)	
Height	5.25 inches (13.34 centimeters).
Width	19.0 inches (48.26 centimeters).
Length	22.5 inches (57.15 centimeters).
Net Weight (instrument only)	30 pounds (13.5 kilograms).

STANDARD ACCESSORIES

Standard accessories supplied with the R7903 are given in the Mechanical Parts List illustrations in the Service manual. For optional accessories available for use with this instrument, see the Tektronix, Inc. catalog.

INSTRUMENT OPTIONS

The following options are available for the R7903, and can be installed as part of the instrument when ordered, or they can be installed at a later time. For further information on instrument options, see your Tektronix, Inc. catalog or contact your local TEKTRONIX Field Office or Representative. The following options are available for the R7903.

Option 1

This option deletes the Readout System. Operation of the instrument is unchanged, except there is no alphanumeric display on the CRT and the READOUT control is nonfunctional. The Readout System can be added at any time by ordering the Readout System kit.

Option 3

With Option 3 installed, the instrument will meet the EMI interference specifications given in Section 2.

Option 4

This option substitutes the standard CRT with a one-half scan CRT (4 X 5 centimeter graticule area) to provide maximum trace brightness and optimum photographic writing speed.

Option 8

Change phosphor to P11 (on request).

Option 10

This option provides pulsed Graticule/Readout capability, for multiple signal-shot exposures. Pulsed Readout if Option 1 is not ordered.

SYSTEM SPECIFICATIONS

Your TEKTRONIX 7900-Series Oscilloscope System provides exceptional flexibility in operation with a wide choice of general and special purpose plug-in units. The type number of a particular plug-in unit identifies its usage as follows:

The first digit (7) denotes the oscilloscope system for which the plug-in unit is designed (7000-series).

The second letter describes the purpose of the plug-in unit:

A – Amplifier unit.

B – "Real time" time-base unit.

D – Digital unit.

J – Spectrum analyzer, single width.

K – Spectrum analyzer, single width.

L – Spectrum analyzer, double width.

M – Miscellaneous.

S – Sampling Unit.

T – Sampling time-base unit.

The third and fourth digits of the plug-in type number are sequence numbers and do not carry any special connotation.

An "N" suffix letter added to the normal four digit type number identifies a unit not equipped with the circuitry necessary to encode data for the 7000-series readout system.

7900-SERIES OSCILLOSCOPE SYSTEM VERTICAL SPECIFICATIONS

This table lists the vertical specifications which are system dependent. For more complete specifications on plug-in units for the 7000-Series Oscilloscope System, refer to the TEKTRONIX Catalog.

Amplifier Plug-In Unit	Probe	BW	T_r	Vertical System Deflection Factor Accuracy*			SIG OUT	
				EXT CAL 0 to 50°C	INT CAL 15 to 35°C	INT CAL 0 to 50°C	BW	T_r
7A11	Integral	250 MHz	1.4 ns	2%	3%	4%	140 MHz	2.5 ns
7A12	None	120 MHz	2.9 ns	2%	3%	4%	110 MHz	3.2 ns
	P6053	120 MHz	2.9 ns	3%	4%	5%	110 MHz	3.2 ns
7A13	None	105 MHz	3.4 ns	1.5%	2.5%	3.5%	100 MHz	3.5 ns
	P6053	105 MHz	3.4 ns	1.5%	2.5%	3.5%	100 MHz	3.5 ns
	P6055	65 MHz	5.4 ns	1.5%	2.5%	3.5%	65 MHz	5.4 ns
7A14	P6021	55 MHz	6.4 ns	2%	3%	4%	50 MHz	7.0 ns
	P6022	120 MHz	2.9 ns	2%	3%	4%	100 MHz	3.5 ns
7A15A	None	80 MHz	4.4 ns	2%	3%	4%	70 MHz	5.0 ns
	P6053	80 MHz	4.4 ns	3%	4%	5%	70 MHz	5.0 ns
7A16	None	225 MHz	1.6 ns	2%	3%	4%	140 MHz	2.5 ns
	P6053	225 MHz	1.6 ns	3%	4%	5%	140 MHz	2.5 ns
7A18	None	80 MHz	4.4 ns	2%	3%	4%	70 MHz	5.0 ns
	P6053	80 MHz	4.4 ns	3%	4%	5%	70 MHz	5.0 ns
7A19	None	500 MHz	0.8 ns**	2%	3%	4%	300 MHz	1.2 ns
	P6051	450 MHz	8.5 ns**	2%	3%	4%	300 MHz	1.2 ns
	P6056/P6057	500 MHz	0.8 ns**	3%	4%	5%	300 MHz	1.2 ns
7A22	None or any	1.0 MHz	350 ns	2%	3%	4%	1.0 MHz	350 ns
		±10%	±9%				±10%	±9%

*Deflection Factor accuracy is checked as follows:

EXT CAL 0°C to 50°C—Plug-in gain set at a temperature within 10°C of operating temperature, using an external calibrator whose accuracy is within 0.25%.

INT CAL 15°C to 35°C—Plug-in gain set while operating within a temperature range of +15°C to +35°C, using the oscilloscope calibrator.

INT CAL 0°C to 50°C—Plug-in gain set using the oscilloscope calibrator (within 10°C of the operating temperature) in a temperature range between 0°C and +50°C.

**+20°C to +30°C.

SYSTEM SPECIFICATIONS (cont)

The bandwidth of a vertical plug-in used in the horizontal compartment is 2 MHz except for the 7A22 which has a bandwidth of 850 kHz. The X-Y phase shift between 2 similar units is 2° at 35 kHz.

TIME BASE PLUG-INS

Time Base	Performance Feature	Max Sweep Rate	Triggering Freq Range
7B50	Delayed Sweep & Ext Amplifier	5 ns/div	DC to 100 MHz
7B51	Delaying Sweep	5 ns/div	DC to 100 MHz
7B52	Delayed & Mixed Sweeps	5 ns/div	DC to 100 MHz
7B53N	Delayed & Mixed Sweeps	5 ns/div	DC to 100 MHz
7B70	Delayed Sweeps & Ext Amplifier	2 ns/div	DC to 200 MHz
7B71	Delaying Sweep	2 ns/div	DC to 200 MHz
7B92	Display Switching	2 ns/div	DC to 250 MHz

SPECIAL PURPOSE and SAMPLING PLUG-INS

Plug-In	Performance Feature
7CT1N	Low Power Semiconductor Curve Tracer
7D13	Measures: Temperature, Voltage, Current, and Resistance
7D14	Directly Gated Counter to 525 MHz
7L12	1 MHz to 1.8 GHz Spectrum Analyzer
7M11	High Quality Dual Delay Line
7S11	Accepts Plug-In Sampling Heads
7S12	TDR and Sampling Applications
7T11	Random or Sequential; Equivalent or Real-Time Sampling

For more complete specifications on plug-in units for the 7600-Series Oscilloscope System, refer to the TEKTRONIX Catalog.

NOTES

WARNING

During rackmount installation, interchanging the left and right slide-out track assemblies defeats the extension stop (safety latch) feature of the tracks. Equipment could, when extended, come out of the slides and fall from the rack, possibly causing personal injury and equipment damage.

When mounting the supplied slide-out tracks, inspect both assemblies to find the LH (left hand) and RH (right hand) designations to determine correct placement. Install the LH assembly to your left side as you face the front of the rack and install the RH assembly to your right side. Refer to the rackmounting instructions in this manual for complete information.

RACKMOUNTING INSTRUCTIONS

Introduction

The R7903 Oscilloscope is designed to be installed in a standard 19-inch wide rack. It can be mounted in racks with Universal, EIA, RETMA, or Western Electric mounting-hole spacing. The following information provides complete rackmounting instructions for this instrument.

Instrument Dimensions

A dimensional drawing showing the major dimensions of the R7903 is shown in Fig. 3-6.

Rack Dimensions

Height. At least 5 1/4 inches of vertical space is required to mount this instrument in a rack. This allows sufficient clearance for adjacent instruments or panels. Additional height may be necessary if an oscilloscope camera system is to be used with this instrument.

Width. Minimum dimension between the front rails of the rack is 17 5/8 inches. This allows room on each side of the instrument for the slide-out tracks to operate freely, permitting the instrument to move in and out of the rack.

Depth. Total depth necessary to mount this instrument in an enclosed cabinet rack is 24 inches. This allows sufficient room for air circulation, power cord and signal connections, and for necessary mounting hardware.

NOTE

If this instrument is mounted in a shallow rack where the rear mounting brackets must extend behind the instrument, a maximum of 26 inches clearance behind the front rails is required.

The rear mounting brackets supplied allow mounting this instrument in racks which have rear rails spaced between 14 5/8 and 28 1/2 inches from the front rail. Do not mount the R7903 in an installation where it is not correctly supported at the rear, as the instrument may be damaged.

Slide-Out Tracks

The slide-out tracks provided with this instrument permit it to be extended out of the rack for maintenance and calibration without removing it from the rack. To operate this instrument in the extended position, be sure the power cord and any signal cables are long enough for this purpose.

The slide-out tracks consist of two assemblies; one for the left side of the instrument and one for the right side. Fig. 3-1 shows the complete slide-out tracks assemblies. The stationary section of each assembly attaches to the front and rear rails of the rack, and the chassis section is attached to the instrument. The intermediate section slides between

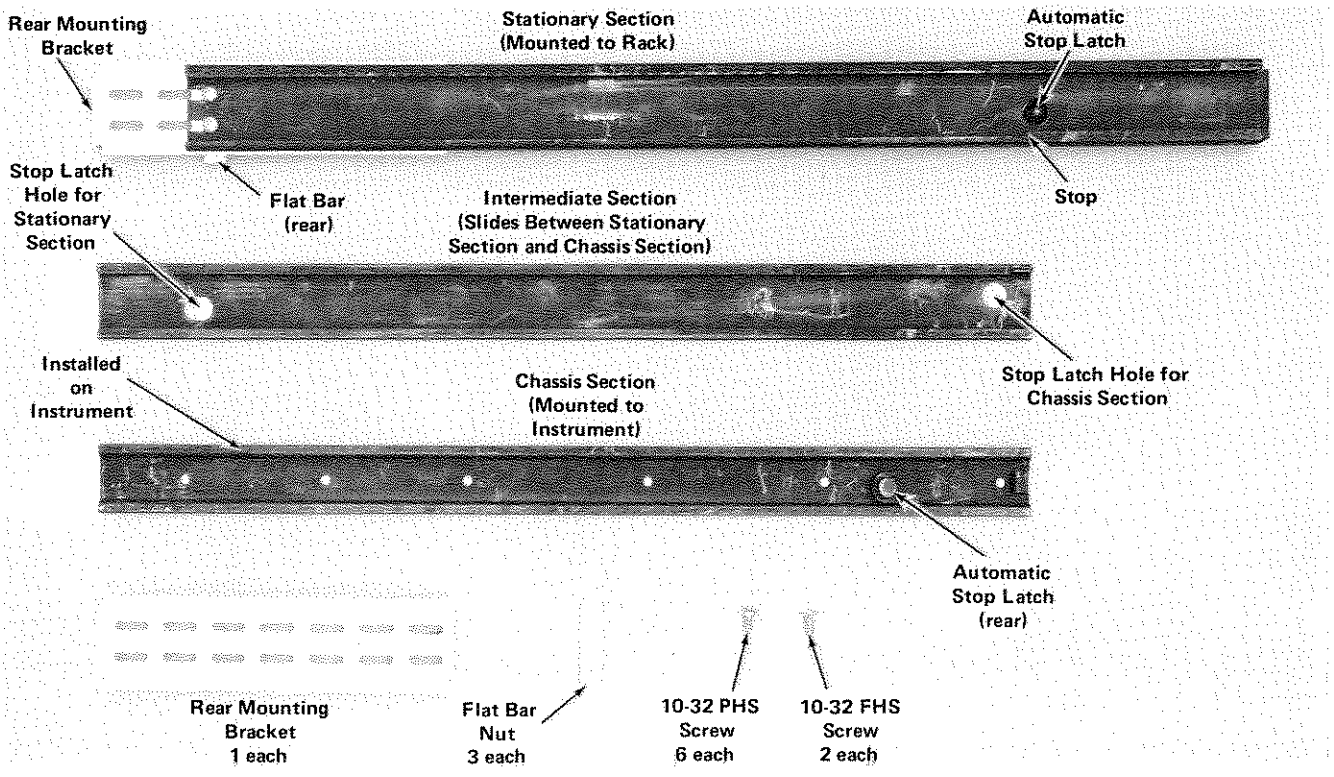


Fig. 3-1. Slide-out track assemblies and small hardware components for mounting the stationary section to the rack rails.

the stationary and chassis sections to allow the instrument to be extended out of the rack.

The hardware needed to mount the slide-out track to the rack is shown in Fig. 3-1. Since the hardware supplied is intended to make the tracks compatible with a variety of cabinet racks and installation methods, not all of it will be needed for this installation. Use only the hardware that is required for the mounting method used.

Mounting Procedure

Use the following procedure to install this instrument in a rack:

1. Select the proper front-rail mounting holes for the stationary sections using the measurements shown in Fig. 3-2.

2. Mount the front-flanges of the stationary sections to the front rails of the rack with a bar nut and two pan-head screws (see Fig. 3-3A).

NOTE

If the rails of the rack are tapped, drill out these three holes with a 0.196-inch drill.

3. Mount the rear of the stationary sections to the rear rails using the method shown in either Fig. 3-3B or 3-3C. Be sure the tracks are mounted level.

4. Refer to Fig. 3-4 to install the instrument into the rack.

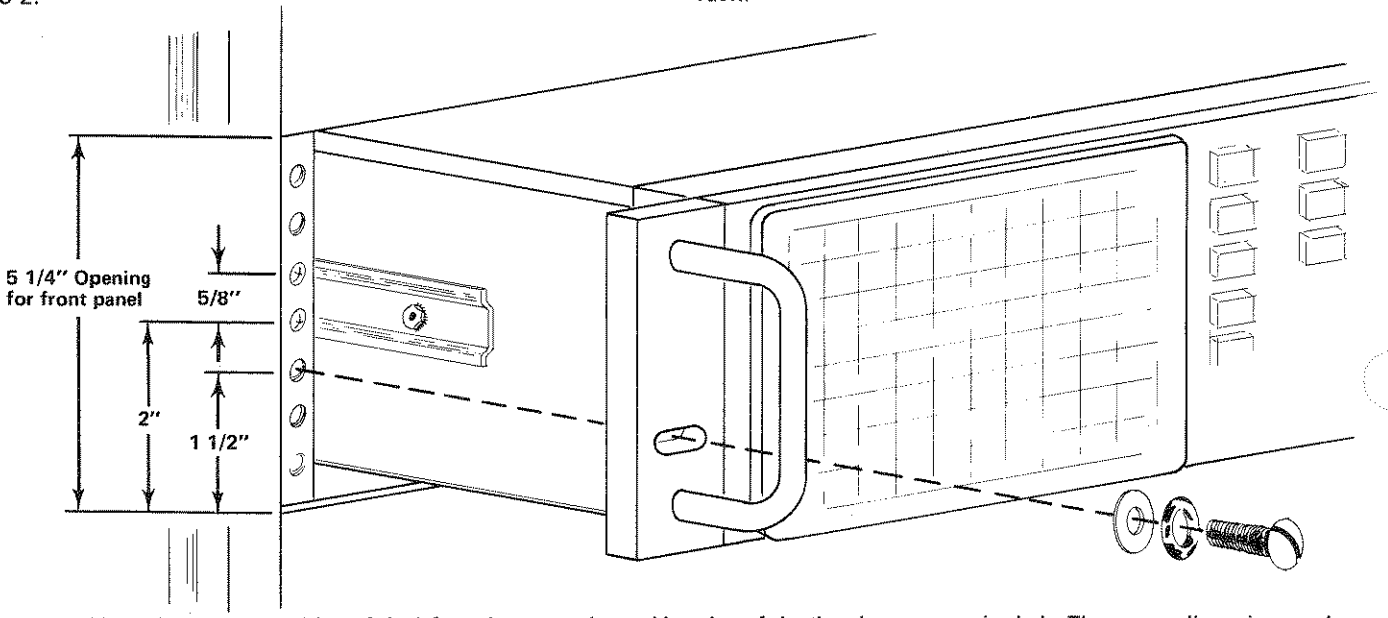


Fig. 3-2. Vertical mounting position of the left stationary section and location of the thumb screw securing hole. These same dimensions apply to the right front rail.

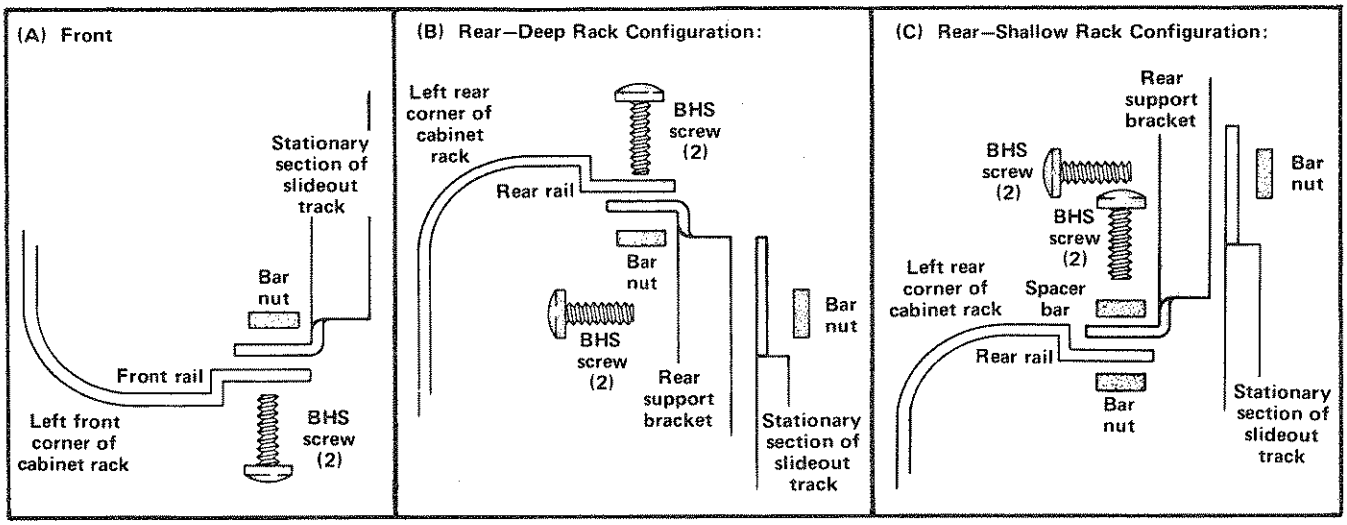


Fig. 3-3. Details for mounting stationary sections.

5. Follow the procedure given in Fig. 3-5 to adjust the alignment of the stationary sections.

6. After the tracks operate smoothly, connect the power cord to the power source and connect any necessary cables to the rear panel connectors.

7. Push the instrument all the way into the rack and secure it to the front-rail of the rack with the securing screws and washers shown in Fig. 3-2. If the securing hole is not tapped, use a "speed-nut" or similar item to install the securing screw.

Removing or Installing the Instrument

After initial installation and adjustment of the slide-out tracks, the instrument can be removed or installed by following the instructions given in Fig. 3-4. No further adjustments are required under normal conditions.

Slide-Out Track Lubrication

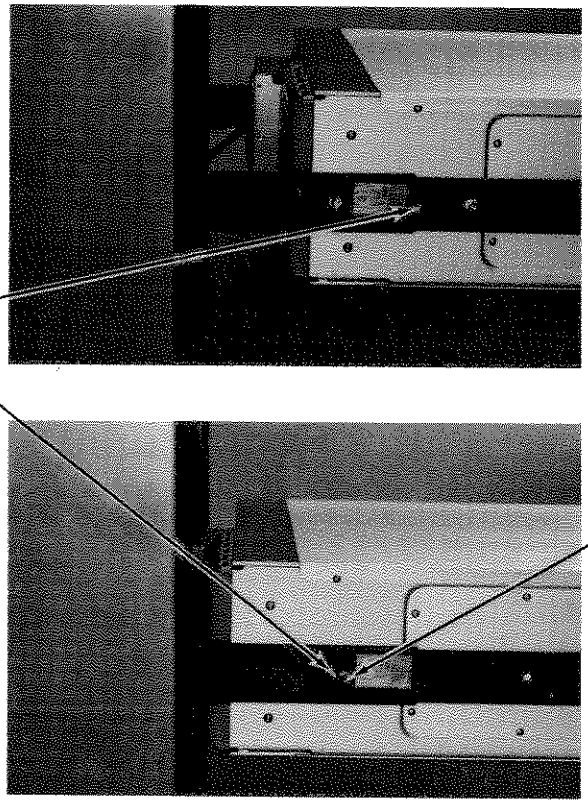
The special finish on the sliding surfaces of the slide-out tracks provides permanent lubrication. However, if the tracks do not slide smoothly even after proper adjustment, a thin coat of paraffin can be rubbed onto the sliding surfaces for additional lubrication.

TO INSTALL

1. Pull the slideout track intermediate sections out to the fully extended position.
2. Insert the instrument chassis sections into the intermediate sections.
3. Press stop latches and push instrument toward rack until the latches snap into their holes.
4. Again press stop latches and push instrument into rack.
5. Secure the instrument in place with the front-panel securing screws.

NOTE

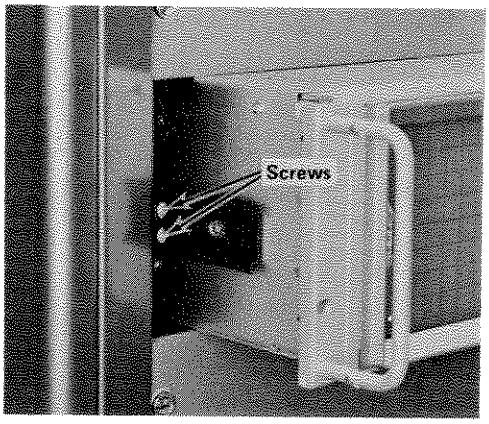
If the instrument does not slide all the way into the rack, loosen the screws used to join the stationary section and rear mounting bracket. Push the instrument into the rack and tighten the screws.



TO REMOVE

1. Remove the front-panel securing screws.
2. Pull the instrument outward until the stop latches snap into the holes.
3. Press stop latches and remove the instrument.

Fig. 3-4. Installing and removing the instrument.



1. Loosen screws on both sides.
2. Allow slides to seek proper width.
3. Center instrument.
4. Retighten screws.

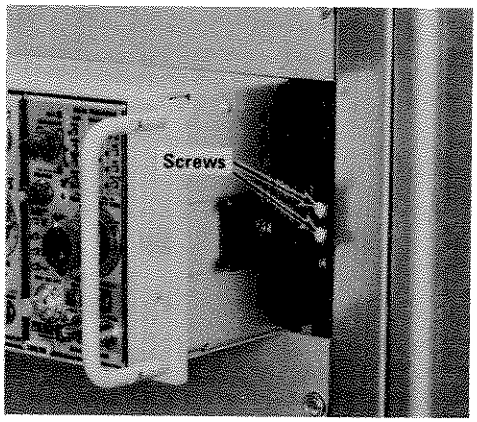


Fig. 3-5. Adjusting the slide-out tracks for smooth sliding action.

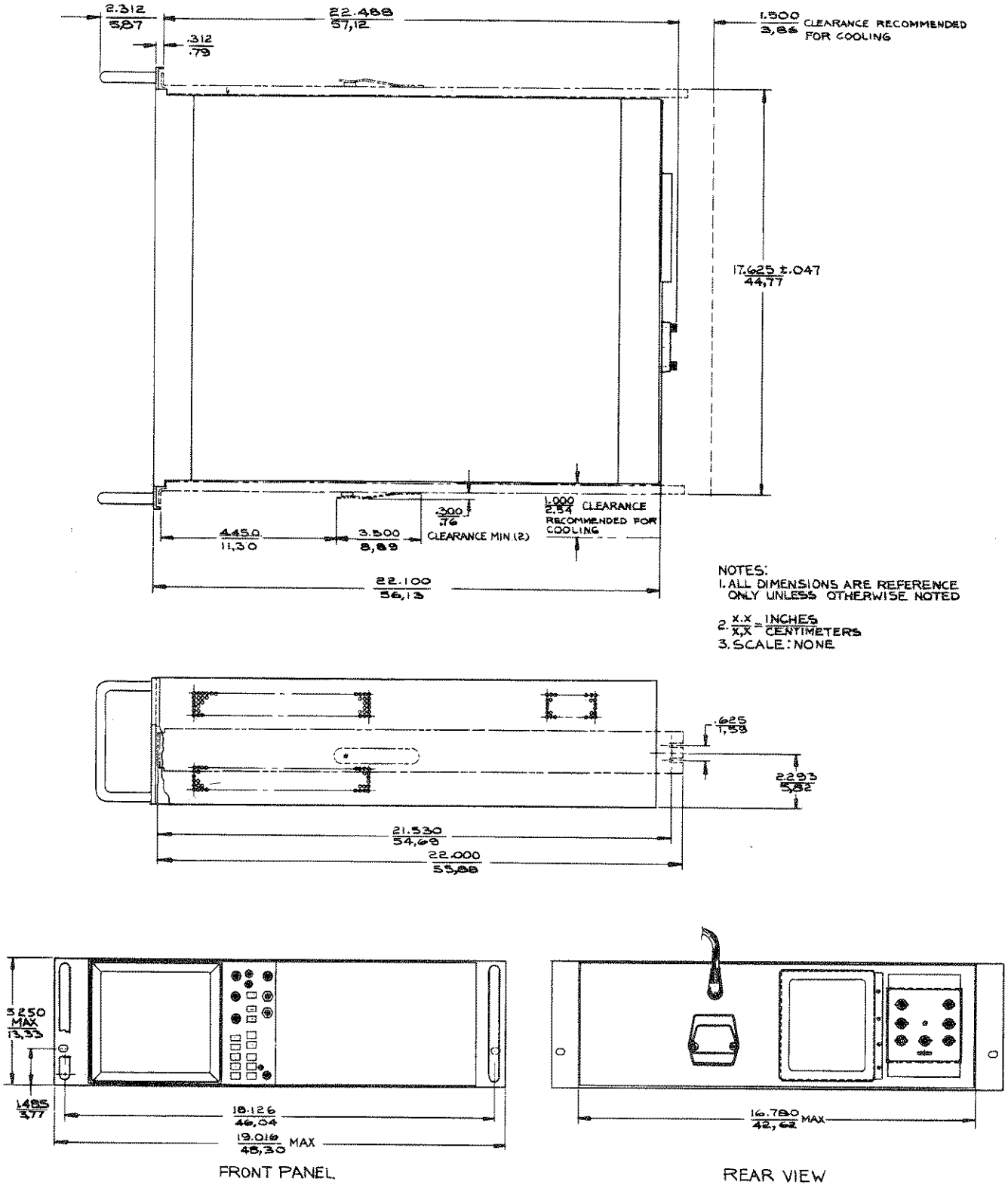


Fig. 3-6. Dimensional drawing.