

***T202***  
***PORTABLE***  
***OSCILLOSCOPE***

*Please Check for  
CHANGE INFORMATION  
at the Rear of This Manual*

---


First Printing JUL 1987

**Tektronix**  
COMMITTED TO EXCELLENCE

## TABLE OF CONTENTS

Copyright © 1987 Tektronix, Inc. All rights reserved. Contents of this publication may not be reproduced in any form without the written permission of Tektronix, Inc.

Products of Tektronix, Inc. and its subsidiaries are covered by U.S. and foreign patents and/or pending patents.

TEKTRONIX, TEK, SCOPE-MOBILE and  are registered trademarks of Tektronix, Inc.

Printed in U.S.A. Specification and price change privileges are reserved.

### 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, U.S.A.
100000	Tektronix Guernsey, Ltd., Channel Islands
200000	Tektronix United Kingdom, Ltd., London
300000	Sony/Tektronix, Japan
700000	Tektronix Holland, NV, Heerenveen, The Netherlands

Page

LIST OF ILLUSTRATIONS .....	III
OPERATORS SAFETY SUMMARY .....	IV

### Section 1 GENERAL INFORMATION

Introduction .....	1-1
Preparation For Use .....	1-2
Safety .....	1-2
Ac/Dc Adapter .....	1-3
Battery Pack .....	1-3
Plastic Cover .....	1-11
Power-Up Checks .....	1-12
Repackaging .....	1-12

### Section 2 CONTROLS, CONNECTORS, AND INDICATORS

Input and Display .....	2-1
Channel 1 and Channel 2	
Vertical and Horizontal Keys .....	2-3
Trigger Keys .....	2-4
Source and Change-Over	
Keys .....	2-6
Mode Keys .....	2-7
Positioning, Cursors, and	
Tracking Keys .....	2-8
Save Reference and Signal	
Processing Keys .....	2-8
Display and Sound Keys .....	2-9
Arithmetic, Numeric Entry	
and Dimension Keys .....	2-10
Special-Purpose Keys .....	2-12
Data Readout .....	2-13
DVM/COUNTER Readout .....	2-16

### Section 3 OPERATING CONSIDERATIONS

Grounding .....	3-1
Signal Connections .....	3-1
Audible Tone .....	3-2

## TABLE OF CONTENTS (cont)

	Page
<b>Section 4 OPERATING INSTRUCTIONS</b>	
Using the Keyboard .....	4-1
Turning the Input Channels	
On/Off .....	4-1
Auto Setup .....	4-1
Display .....	4-2
Vertical .....	4-3
Time Base .....	4-5
Delta Time Measurements .....	4-6
Trigger .....	4-7
Cursors Measurements .....	4-10
Channel 1 and Channel 2	
Data Readout .....	4-13
Signal Processing .....	4-14
Saving Front Panel Setups .....	4-16
Save References .....	4-17
X-Y Mode .....	4-20
Digital Voltmeter and	
Counter .....	4-20
<b>Section 5 PERFORMANCE CONDITIONS</b>	
T202 Electrical	
Characteristics .....	5-1
Battery Pack Electrical	
Characteristics .....	5-5
Environmental	
Characteristics .....	5-7
Physical Characteristics .....	5-8
<b>Section 6 OPTIONS AND ACCESSORIES</b>	
Introduction .....	6-1
Option A1-A5 International	
Ac/Dc Adapter .....	6-1
Standard Accessories .....	6-2
Optional Accessories .....	6-2

## LIST OF ILLUSTRATIONS

Figure	Page
	VI
	VI
1-1	Instrument power receptacle and power cord .....
1-2	Battery pack controls, connectors, and indicator .....
1-3	Retaining screw and cover .....
1-4	Battery compartment .....
2-1	Connectors, controls, and display .....
2-2	Vertical and horizontal keys .....
2-3	Trigger keys .....
2-4	Source and change-over keys .....
2-5	Mode, positioning, cursors, and tracking keys .....
2-6	Save reference and signal processing keys .....
2-7	Display and sound keys .....
2-8	Arithmetic, numeric entry, and dimension keys .....
2-9	Special-purpose keys .....
2-10	Channel data readouts .....
2-11	DVM/COUNTER .....

## OPERATORS SAFETY SUMMARY

*The safety information in this summary is for operating personnel. Warnings and cautions will also be found throughout the manual where they apply.*

### Measurement Specifications

Maximum safe operating potential between probe common plus input circuit to earth ground shall not exceed 42 volts dc + peak ac.

Measuring terminal input common references are connected to each other internally. To avoid measurement errors, do not connect voltages of different potentials between input terminals commons.

For floating measurements above 42 volts peak, TEKTRONIX model A6902B is recommended for safe measurement operations.

### Terms in this Manual

**CAUTION** statements identify conditions or practices that could result in damage to the equipment or other property.

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

### Terms as Marked on Equipment

**CAUTION** indicates a personal injury hazard not immediately accessible as one reads the markings, or a hazard to property, including the equipment itself.

**DANGER** indicates a personal injury hazard immediately accessible as one reads the marking.

### Symbols in this Manual



This symbol indicates where applicable cautionary or other information is to be found. For maximum input voltage see the T202 Electrical Characteristics in Section 5.

### Symbols as Marked on Equipment



**ATTENTION** — Refer to Manual

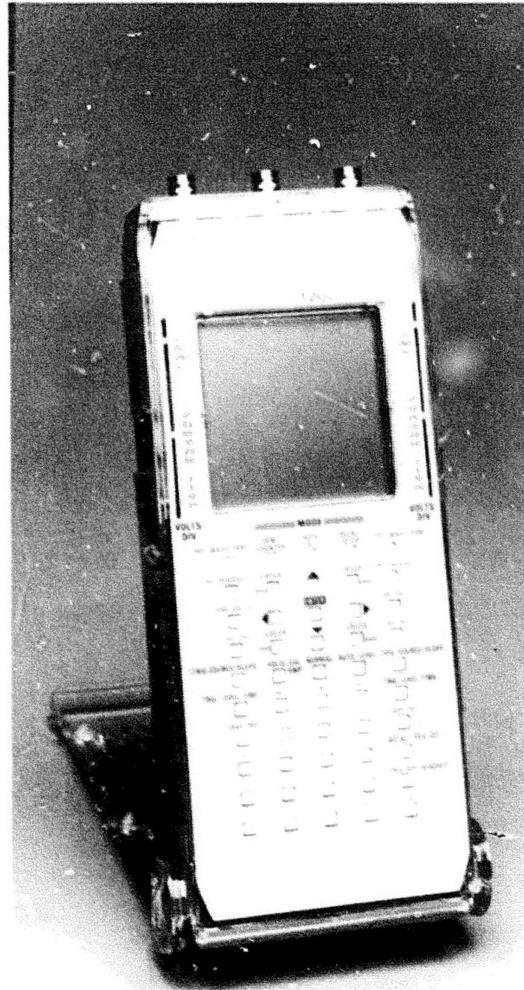
### Power Source

Use only the Ac Power Adapter specified for product input voltage rating. For battery operation, refer to "Battery Pack" in Section 1.

### Do Not Operate in Explosive Atmospheres

### Do Not Remove Covers or Panels

Do not remove the product covers or panels. Do not operate the product without the covers and panels properly installed.



6419-01

The T202 Oscilloscope

## GENERAL INFORMATION

### Introduction

The TEKTRONIX T202 Oscilloscope is a rugged, lightweight digital storage instrument. The instrument performs voltage, time, and frequency measurements on acquired waveforms. The T202 is a microprocessor controlled instrument and may be powered either from its battery pack or, using the supplied adapter, from an ac power source. Waveforms and measurement results are displayed on a Liquid-Crystal Display (LCD) with a 128 x 128 point display matrix.

The dual-channel vertical system has a 5-MHz bandwidth with calibrated deflection factors from 0.01 volt per division to 20 volts per division. The horizontal system has separate timing circuits for each vertical channel and two time bases with horizontal deflection factors from 1 hour per division to 50 nanoseconds per division. Second per division time base provides the timing speed for the signal acquisition and delta time base expands a selected portion of the second per division time base to full display width.

Acquisition triggering setups can be automatically made by the instrument or they may be user selected for each of the two vertical input channels. A selectable trigger point permits the user to set the pretrigger and post-trigger portions of the acquired waveform.

Specified points on an acquired waveform for making voltage, time, frequency, or phase measurements are user selectable with vertical or horizontal measurement cursors. Cursor measurement results are displayed at the top and bottom of the display. Automatic digital voltmeter and counter measurement of the RMS voltage, mean voltage, peak-to-peak voltage, zero-to-peak voltage, period, and frequency of a selected vertical channel signal is also available. Digital voltmeter and counter measurement results are displayed in a table format.

Acquired waveforms may be saved in any of nine nonvolatile memories. The stored waveforms may then be recalled at a later time to compare against the waveforms being acquired. Time base and trigger keyboard settings may also be saved in the nonvolatile memory for later recall. Recalling a frequently used setup speeds up the measurement by reducing the number of keyboard entries needed.

Signal processing of both input channels and save reference information is available. Input Channels or reference in any combination can be added, subtracted, multiplied, or divided.

The following items are standard accessories shipped with the instrument.

- 2 Probe packages
- 1 AC/DC Adapter
- 1 Operators Manual
- 1 Battery Pack/Carrying Case

For information about standard accessories and a list of the optional accessories, refer to "Options and Accessories" (Section 6) in this manual. For additional information on accessories and ordering assistance, contact your Tektronix representative or local Tektronix Field Office.

### Preparation for Use

#### Safety

This section tells how to prepare for and to proceed with the initial start-up of the instrument.

Refer to the Operators Safety Summary at the front of this manual for power source and other safety considerations. Before connecting the instrument to a power source, read both this section and the Safety Summary.

### Ac/Dc Adapter

Instruments are shipped with a detachable ac/dc adapter that plugs into an ac power-source outlet. The adapter converts the alternating-current source voltage to low-direct-current voltage for the operation of the instrument. The ac/dc adapter plugs into the instrument's power cord receptacle as shown in Figure 1-1.

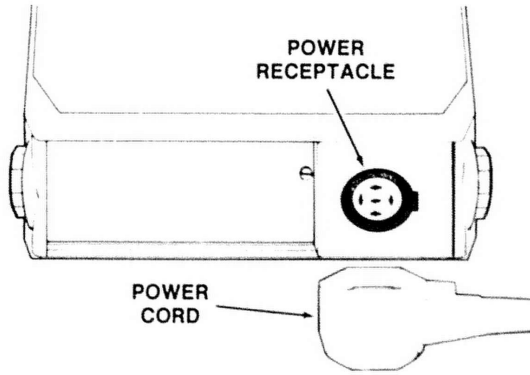


Figure 1-1. Instrument power receptacle and power cord.

Instruments are shipped with the ac/dc adapter as ordered by the customer. Information about the available ac/dc adapter is found in "Options and Accessories" (Section 6 of this manual).

### Battery Pack

#### NOTE

Batteries are not included with the battery pack.

The battery pack in the carrying case permits a choice of battery operation of the T202 when a source of ac power is not available. The battery pack uses four D-size batteries, either alkaline or rechargeable nickel-cadmium.

### WARNING

The battery charger is for use with nickel-cadmium batteries only. Other types may explode or release hazardous materials if recharged.

### Controls and Indicator

See Figure 1-2 for the location of the controls, connectors, and indicator.

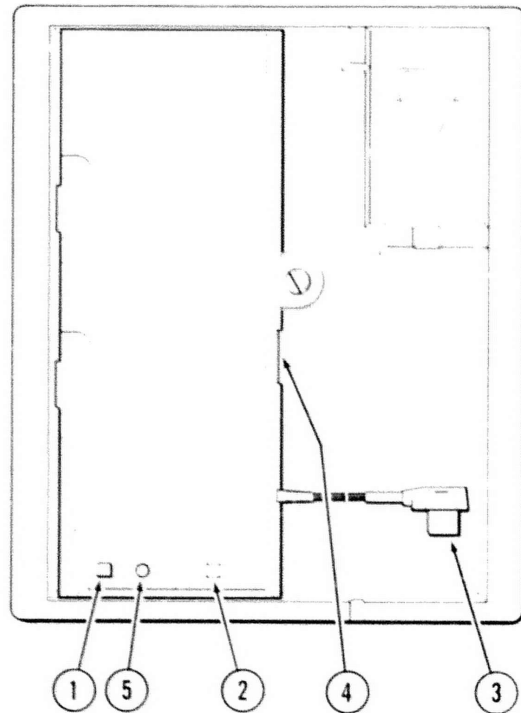


Figure 1-2. Battery pack controls, connectors, and indicator.

- ① **Power Switch**—Turns the battery pack on and off. Press in for on; press again for off.
- ② **High/Low Charge Switch**—Selects charging rate for nickel-cadmium batteries. Press in for high charging rate; press out for low charging rate. This switch is accessible when the battery cover is removed.
- ③ **Dc Power Cord**—Plugs into the instrument power receptacle when battery operation is required.
- ④ **Dc Receptacle**—Provides the connection point for the ac/dc adapter when nickel-cadmium batteries need to be recharged.
- ⑤ **Power Indicator**—Indicates either that battery output voltage is available or that charge current is flowing when nickel-cadmium batteries are being recharged.

**WARNING**

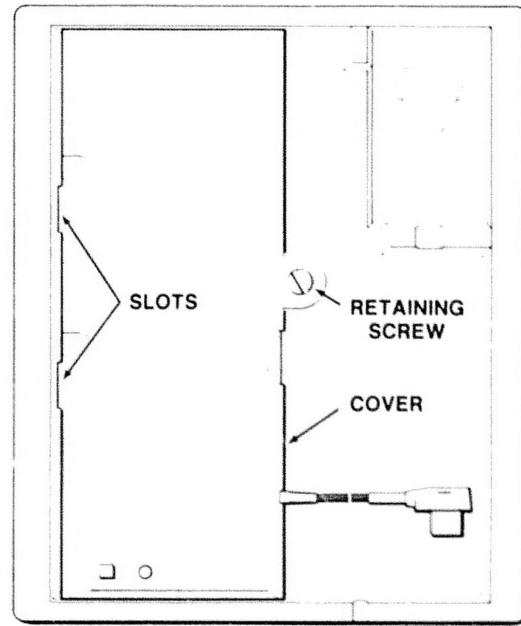
To avoid electric shock, disconnect measuring terminals before attempting to remove batteries.

**Battery Installation**

To install the batteries in the battery compartment, perform the following steps:

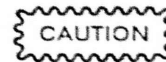
1. Remove all contents from inside the carrying case.
2. Remove the retaining screw from the battery-pack cover (see Figure 1-3).

3. Lift the battery pack cover and pull it out of the slots in the side wall of the carrying case (see Figure 1-3).
4. Remove any dead batteries from the battery compartment.



6419-04

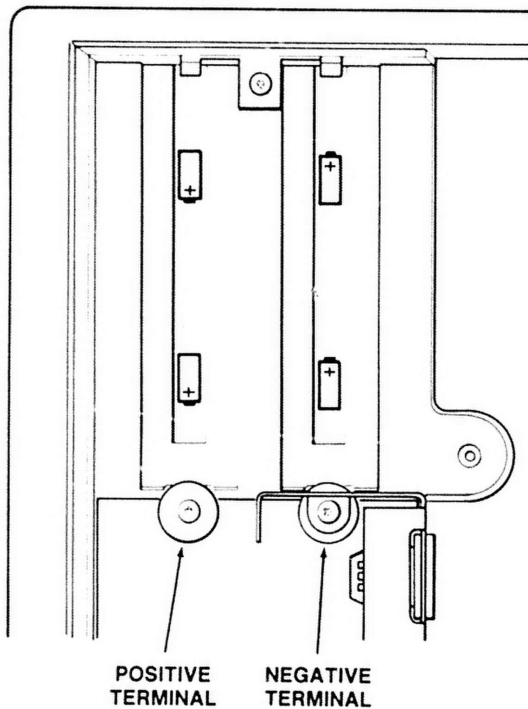
Figure 1-3. Retaining screw and cover.



Observe the correct polarity when inserting batteries in the battery compartment. Putting one or more of the batteries in backwards may cause the internal fuse to open.



5. Place the batteries in the battery compartment. Observe the polarity indications as shown on the bottom of the battery compartment (see Figure 1-4).
6. Replace the battery-pack cover and accessories.



6419-05

Figure 1-4. Battery compartment.

#### NOTE

*When operating the instrument from the battery pack, always set the battery pack power switch to on (button in) before turning on the T202. Failure to do so may result in keyboard lockup and a loss of stored data. The keyboard lockup will not damage the instrument or the battery pack. A lockup condition is corrected by turning all the power switches to off and using the turn-on sequence. Stored data that is lost cannot be recovered.*

#### Turning the Instrument On

1. Set both instrument Input Coupling (OFF, DC, GND, and AC) switches to OFF positions and the battery-pack-power switch to off (button out).
2. Plug the dc-power cord from the battery pack into the instrument dc-power receptacle.
3. Set the battery-pack-power switch to on (button in).
4. Slide one or both instrument Input Coupling switches to a coupling position (DC, GND, or AC position).

#### Turning the Instrument Off

When turning the instrument off, set both Input Coupling switches to OFF position before turning the battery pack off. If the battery pack is mistakenly turned off first, reset all the power switches to off and use the turn on sequence given in "Turning the Instrument On" before attempting to turn the instrument on again.

#### Battery Operation

In battery operating mode, the Power indicator displays a steady light when there is sufficient battery voltage to operate the instrument. A blinking

Power indicator shows that the output voltage of the batteries has dropped below 4.75 volts. At the time the Power indicator starts to blink, there is sufficient battery capacity remaining to operate the instrument for about 30 minutes with both channels being displayed at temperatures between 20°C to 30°C (68°F to 86°F).

#### Operating Time

How long the instrument may be operated from the battery pack depends on the battery condition and the instrument's operating mode. There is as much as two-to-one difference in power requirement depending on operating mode. The longest battery pack operating time is obtained when only one channel is displayed in normal mode. With both channels displayed, the power consumption is increased by about 35%. Worst case occurs when both channels are displayed and the vertical inputs are overdriven (several volts being applied to the input with the Volts per Division switches set at 0.01 V).

Battery life is prolonged by turning the instrument off when not in use.

#### Rechargeable Batteries

##### WARNING

The battery charger is for use with nickel-cadmium batteries only. Other types may explode or release hazardous materials if recharged.

Before recharging the nickel-cadmium batteries, the high/low charge switch needs to be set to match the ampere-hour rating of the batteries.



Do not leave high/low charge switch in high position (button in) if 1 ampere-hour batteries are used. Too high charge current will damage the batteries.

To recharge batteries with a 1 ampere-hour capacity, set the high/low charge switch to low position (button out). To recharge batteries with 4 ampere-hour capacity, set the high/low charge switch to high position (button in).

Connect the ac/dc adapter from the ac source to the battery pack dc receptacle. Set the battery-pack power switch to off. The Power indicator shows that the charge circuit is on. The charge current is a continuous trickle charge for batteries that are rated at 1 ampere-hour or higher.

Full recharge time for batteries with 1 ampere-hour charge rate is about 12 to 14 hours. For high capacity batteries, full recharge charge time is about 24 to 30 hours. A recharge time of 10 to 16 hours will allow the instrument to operate for one hour with normal operating conditions.

#### Storage

A battery pack not being used for three weeks or more should have the non-chargeable batteries (alkaline batteries) removed from the battery compartment. Alkaline batteries left unused in the Battery pack over a period of time may corrode and damage the interior of the battery compartment.

## Plastic Cover

### NOTE

*The plastic cover is factory installed to protect the instrument front panel from being damaged during shipment. To avoid damaging the plastic cover, do not adjust the position of the cover without first removing it from the instrument.*

The plastic cover may be used either as a stand or as a protective shield when the instrument is not being used.

To use the cover as a stand, perform the following procedure to adjust it to the desired viewing angle.

1. Place the instrument down on a flat surface with the front panel up.
2. Using both thumbs, gently pry both plastic cover locking hinges out far enough to remove the plastic cover from the instrument side-panel securing lugs.
3. Turn the cover over with the locking hinges up and place it on a flat surface.
4. Lay the instrument (front panel up) on the cover with the securing lugs resting on top of the locking hinges.
5. Pry one of the cover locking hinges out slightly and tilt the instrument to the desired viewing position.
6. Place the instrument between the two locking hinges and insert one of the instrument securing lugs into the plastic cover locking hinge.
7. Snap the other cover locking hinge over the side-panel securing lug.

## Power-Up Checks

The instrument does power-up checks when first turned on. These checks provide the user with a means to verify that the instrument is fully functional. Normally, no faults are found during the checks, and the instrument will enter the normal operating mode. If a power-up check fails, the instrument displays the "CONTACT SERVICE" message on the display.

## Repackaging

If the instrument is shipped by commercial transportation, use the original packaging material. If the original packaging cannot be used, repackage the instrument as follows:

1. Obtain a corrugated cardboard shipping carton having inside dimensions at least six inches greater than the instrument. The carton test strength should be at least 200 pounds.
2. If the package is being shipped to a Tektronix Factory Service Center for Warranty service, attach a tag to the instrument showing the following: owner of the instrument (with address), the name of a person who can be contacted, the complete instrument type and serial number, and a description of the service required.
3. Wrap the instrument with polyethylene sheeting or equivalent to protect the outside finish and to prevent packing materials from getting into the instrument.
4. Cushion the instrument on all sides by using packing material or urethane foam between the carton and the instrument. Allow three inches of packing material on all sides.
5. Seal the carton with shipping tape or with an industrial stapler.
6. Mark the address of the Tektronix Service Center and the return address on the carton.

## CONTROLS, CONNECTORS, AND INDICATORS

The following descriptions are intended to familiarize the operator with the location and use of the instrument's controls, connectors, and indicators.

### Input and Display

Refer to Figure 2-1 for the locations of the input controls, connectors and display.

**CH 1 INPUT and CH 2 INPUT Connectors**—Provide for application of signals to the vertical deflection system.

**EXT TRIG INPUT Connector**—Provides for connection of external signals to the trigger circuit.

**Channel Input Coupling Switches**—Select the method of coupling the input signal to the Channel 1 and Channel 2 vertical amplifiers, or removes the channels from the display.

**OFF**—Turns the selected channel off, if both Input Coupling switches are in OFF position, the instrument is turned off.

**DC**—Passes all frequency components of the input signal to the vertical deflection system.

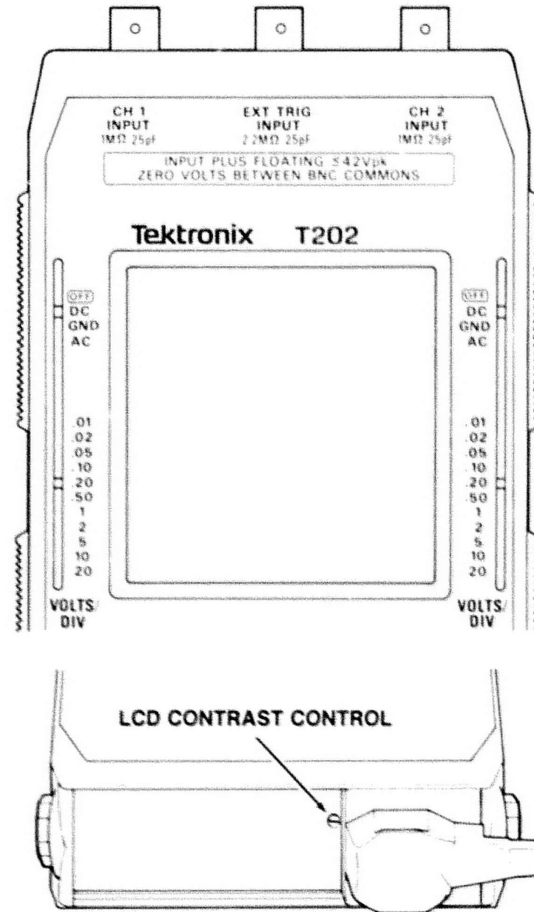
**GND**—Grounds the input of the vertical deflection system to provide a zero (ground) reference voltage display (does not ground the input signal).

**AC**—Capacitively couples signals to the vertical deflection system. The dc component of the input signal is blocked.

**VOLTS/DIV Switches**—Select the Channel 1 and Channel 2 vertical deflection factor from 0.01 V per division to 20 V per division in a 1-2-5 sequence.

**LCD Display**—The display area is 6.4 by 6.4 divisions.

**LCD Contrast Control**—Adjusts the display contrast for the best viewing. The LCD Contrast control is adjusted after finding the best viewing position for the instrument. This adjustment is located at the bottom of the instrument to the left of the power receptacle.



6419-06

Figure 2-1. Connectors, controls, and display.

NOTE

Most front-panel keys performs a dual function. The first function is indicated by the character(s) above the key. The second function is indicated by the character(s) on the side of the key.

Channel 1 and Channel 2 Vertical and Horizontal Keys

Refer to Figure 2-2 for the locations of the vertical and horizontal keys.



6419-07

Figure 2-2. Vertical and horizontal keys.

**POS WAVEFORM** Keys—Start the instruction for vertically positioning the waveform.

**INVERT ON/OFF** Keys—Invert the input signals.

**POS READOUT** Keys—Start the instruction for the channel data readout to be scrolled across the display and vertically positioned on the display.

**VAR VOLTS** Keys—Start the instruction to vertically expand or compress the display waveform.

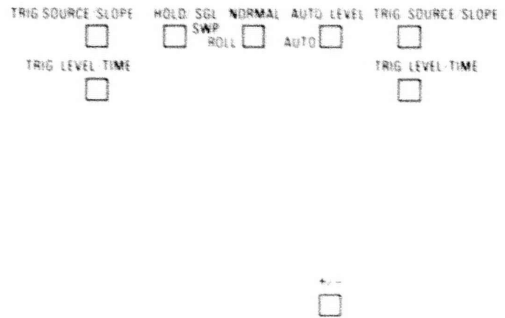
**CAL** Keys—Return the display waveform to original volts per division setting.

**SEC/DIV** Keys—Start the timing instruction for the display waveform.

**Δ TIME EXPAND ON/OFF** Keys—Turn delta time base on and off. Delta time base is used to expand a selected portion of the waveform record to a full display. The X cursors are used to select the portion of the waveform record to be expanded.

Trigger Keys

Refer to Figure 2-3 for the locations of the trigger keys.



6419-08

Figure 2-3. Trigger keys.

CH 1 and CH 2 **TRIG LEVEL/TIME** Keys—start the instruction for adjusting the trigger parameters.

CH 1 and CH 2 **TRIG SOURCE/SLOPE** Keys—Start the trigger source instruction and trigger edge selection instruction.

**+/-** Key—Selects the positive or the negative edge of the trigger source signal that triggers the instrument time base. The trigger edge selection follows the CH 1 and CH 2 **TRIG SOURCE/SLOPE** keystroke.

**HOLD/SGL SWP** Key—Holds the waveform display or arms the trigger for single-sweep operation. In single-sweep operation each additional press of the **HOLD/SGL SWP** key will rearm the trigger.

**NORMAL** Key—Selects Normal Trigger mode for the instrument. Trigger parameters (voltage level and timing locations) are keyboard selected.

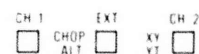
**ROLL** Key—Disables the triggers causing the input signal to roll across the display. Roll mode is valid for second per division settings of 1 second and slower.

**AUTO LEVEL** Key—Sets automatically the trigger level at the center amplitude point of the vertical input signal.

**AUTO** Key—Selects Auto mode for the instrument. Trigger parameters (voltage level and timing locations) are keyboard selected. Trigger free runs when input signal does not match the preset trigger parameters.

### Source and Change-Over Keys

Refer to Figure 2-4 for the locations of the source and change-over keys.



6419-09

Figure 2-4. Source and change-over keys.

**CH 1** Key—Selects Channel 1 as the signal source for the trigger, Digital Voltmeter and Counter mode, and Signal Processing instruction.

**EXT** Key—Selects external signal as trigger source. The external signal selection follows the **TRIG SOURCE/SELECT** keystroke.

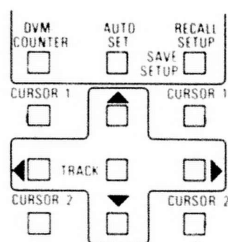
**CH 2** Key—Selects Channel 2 as the signal source for the trigger, Digital Voltmeter and Counter mode, and Signal Processing instruction.

**CHOP/ALT** Key—Switches between Chop mode and Alternate mode. When in Chop mode, Channel 2 second per division settings and trigger source are defaulted to that of Channel 1. The fastest second per division setting allowed for chop mode is 20  $\mu$ s per division.

**XY/YT** Key—Switches between X-Y mode and Y-T mode. In X-Y mode, signals applied to CH 1 INPUT connector produces the horizontal (X-axis) deflection and signals applied to CH 2 INPUT connector produces the vertical (Y-axis) deflection. Both Channel 1 and Channel 2 must be displayed before selecting X-Y mode.

### Mode Keys

Refer to Figure 2-5 for the locations of the MODE keys.



6419-10

Figure 2-5. MODE, positioning, cursors, and tracking keys.

**DVM/COUNTER** Key—Starts the Digital Voltmeter and Counter mode for the selected input channel. The voltmeter and counter fields are displayed in place of the waveform display.

**AUTO SET** Key—Automatically sets the trigger parameters, second per division setting, and cursors for the displayed waveform.

**RECALL SETUP** Key—Starts the instruction to recall up to nine keyboard setups.

**SAVE SETUP** Key—Starts the instruction to save up to nine keyboard setups in nonvolatile memory. The save keyboard setups are second per division settings and trigger parameters.

### Positioning, Cursors, and Tracking Keys

Refer to Figure 2-5 for the locations of the positioning, cursors, and tracking keys.

Positioning Keys , , , and —Position the cursors, readouts, and trigger points.

**CURSOR 1** and **CURSOR 2** Keys—Start the instruction to position the selected vertical (X) cursors or the horizontal (Y) cursors.

**TRACK** Key—Used after the cursor selection in the instruction to track the two X cursors or the Y cursors.

### Save Reference and Signal Processing

Refer to Figure 2-6 for the locations of the save reference and signal processing keys.



6419-11

Figure 2-6. Save reference and signal processing keys.

CH 1 and CH 2 **SAVE REF** Key—Starts the instruction to save a display waveform in one of nine reference memory locations.

**RECALL/POS REF** Key—Starts the instruction to call up a saved waveform from one of nine reference memory locations.

**REF #** Key—Removes individual save reference waveforms from the display.

**POS REF READOUT** Key—Used in the instruction to horizontally scroll and vertically position the save reference or signal processing readout.

**REFS ON/OFF** Key—Recalls or removes all save reference waveforms from the display.

**SIG PROC #** Key—Starts the signal processing mode. Signals from input channels or reference memories in any combination can be added, subtracted, multiplied, or divided.

#### Display and Sound Keys

Refer to Figure 2-7 for the locations of the display and sound keys.

**$\Delta T / 1/\Delta T$**  Key—Switches between measuring the time difference between the two X cursors in seconds or in hertz. Time difference is displayed in the channel data readout. In  $\Delta T$  mode the time difference is displayed in seconds and in  $1/\Delta T$  mode the time difference is displayed in hertz.

**VECTOR ON/OFF** Key—Turns the continuous trace between the dot displays on and off.



6419-12

Figure 2-7. Display and sound keys.

**CURS ON/OFF** Key—Turns the X and Y cursors on or off in the display.

**READOUT ON/OFF** Key—Turns the channel data readouts on or off in the display.

**INVERT DISPL** Key—Switches the display background from white to black and the waveform display from black to white.

**GRAT ON/OFF** Key—Turns the graticule markers on or off in the display.

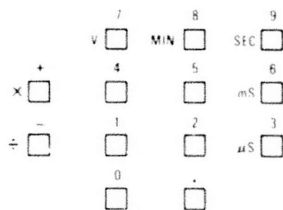
**SOUND ON/OFF** Key—Turns the instrument beeper on or off. Does not turn off the double beep for an invalid keystroke.

#### Arithmetic, Numeric Entry, and Dimension Keys

Refer to Figure 2-8 for the locations of the arithmetic, numeric entry, and dimension keys.

Arithmetic Keys—Used to perform arithmetic operations on the input signals and save reference signals.





6419-13

Figure 2-8. Arithmetic, numeric entry, and dimension keys.

**+** Used for addition of signals and as sign for positioning the display and trigger time points.

**-** Used for subtraction of signals and as a sign for positioning the display and trigger time points.

**x** Used for multiplication of signals.

**÷** Used for division of signals.

**Numeric Entry (0 through 9) and Decimal Point (.) Keys**—Used with Multiplier keys and Dimension keys for inputting numeric values in the instruction. The numeric entries from 1 through 9 are used as reference memory locations and keyboard setup memory locations.

**Dimension Keys**—End second per division setting, vertical deflection factor, and positioning instructions.

**V** Volt

**MIN** Minute

**SEC** Second

**mS** Millisecond

**μS** Microsecond

**Special-Purpose Keys**

Refer to Figure 2-9 for the locations of the special-purpose keys.



6419-14

Figure 2-9. Special purpose keys.

**ENTER** Key—Enters an instruction that ends with a numeric entry.

**CE** Key—Clears the last command entry of an instruction with each keystroke.

**ON/OFF** Key—Turns Channel 1 and Channel 2 displays on or off when the selected Input Coupling switch is not in the OFF position. The **ON/OFF** key is also used to remove signal processing results from the display.

**SHIFT** Key—Activates a second function of a dual-function key. The **SHIFT** key must be pressed first before selecting the second function of a dual-function key. The second function is indicated by the character(s) on the side of the key.

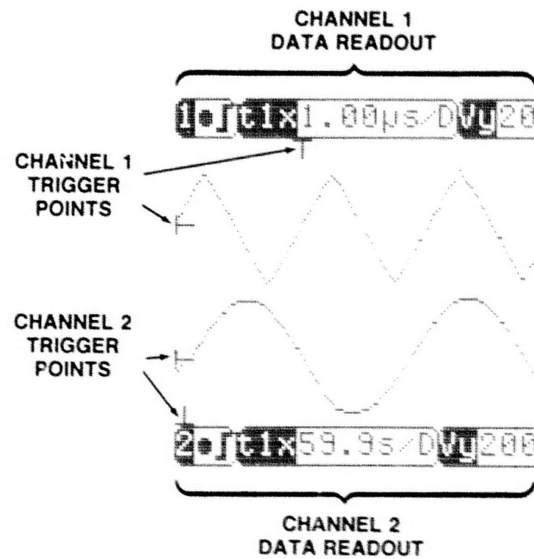
### Data Readout

The data readout fields display Channel 1, Channel 2, save reference, and signal processing results. The data readout display shows the horizontal timing, trigger, setups, and the channel waveform measurement results. Channel 1 readout fields are shown across the top of the display area, and the Channel 2 and save reference readout fields are shown at the bottom of the display area. Save reference readout fields are displayed directly above the Channel 2 readout fields when a saved waveform is displayed. Signal processing readout fields are displayed directly above the save reference data field. Figure 2-10 shows the locations of the Channel 1 and Channel 2 readout fields.

The number of fields needed to display all the data available exceeds the width of the display area. To view all the data, the fields must be scrolled horizontally. The data readout fields may also be vertically positioned within the display area. Scrolling and vertical positioning are described in "Operating the Instrument" in Section 4. The description of the channel data readout fields are from left to right as follows:















Displays the waveform source, trigger status dot, trigger slope, and vertical mode in the first two data fields. In the first data field, the waveform source displays an input channel number, an "M" for memory, or signal processing number. In the second data field, a steady trigger status dot indicates trigger signal is available. A blinking trigger status dot indicates an absence of a trigger signal. When Stop mode is selected, an S is superimposed over the selected channel trigger dot. When Chop mode is selected, a "CP" is inserted to the right of the Channel 2 trigger slope. In X-Y mode, an X is inserted to the right of the Channel 1 trigger slope and a Y is inserted to the right of the Channel 2 trigger slope. The first two data fields do not scroll across display.









6419-15

Figure 2-10. Channel data readouts.

-  Displays horizontal scale factor in time per division.
-  Displays time difference between the X1 and X2 cursors when using time base T1.
-  Displays the reciprocal of time difference between X1 and X2 cursors in frequency. Replaces delta time indicator with 1/Δt when selected.
-  Displays the sweep speed of the second time base when t2 is selected. The t2x indicator will appear between Δt and ΔV fields when selected.
-  Displays voltage difference between the Y1 and Y2 cursors.
-  Displays true rms voltage between the X1 and X2 cursors.
-  Displays Volts/Div setting.
-  Displays trigger source and mode for the display. The left trigger fields shows the trigger source, and the right field displays the trigger mode. The trigger source and mode for the display are as follows:

-  Channel 1 signal source.
-  Channel 2 signal source.
-  External trigger signal source.
-  Fully automatic trigger mode.

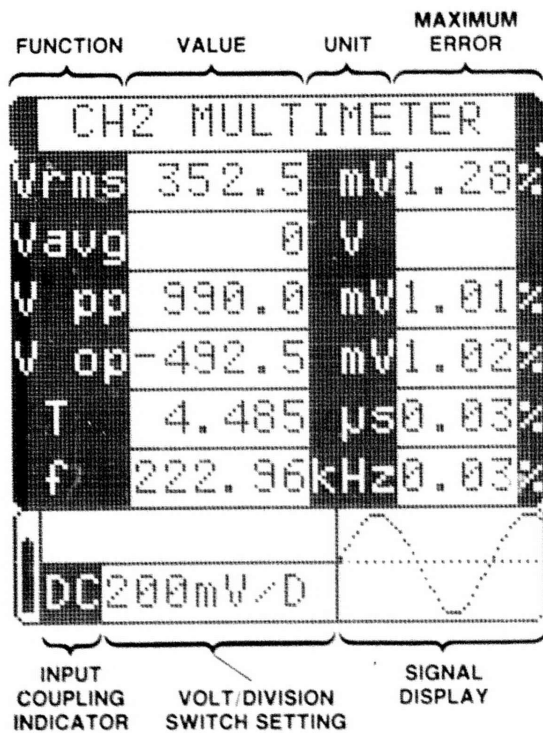
-  Normal trigger mode.
-  Auto-normal trigger mode.
-  Single sweep trigger mode.
-  The sweep free runs and the trigger is disabled.

-  Displays trigger voltage level with reference to ground (0 volts).
-  Displays horizontal position (trigger delay) of the trigger referenced from the fourth pixel from left edge of display.

#### DVM/COUNTER Readout

The instrument will automatically carry out a wide range of measurements and display the results. The measurement results are displayed as shown in Figure 2-11. If the signal amplitude is either too high or low, the pointer after the words "Voltage Range" shows the direction to set the Volts/Division switch to get a good measurement. The waveform display is located at the bottom right corner of the display. The input coupling mode and sensitivity is located at the bottom left corner of the display. The function descriptions in the readout are as follows:

- Vrms—True rms voltage value of the waveform.
- Vavg—Arithmetic mean average (dc component).
- Vpp—Peak-to-peak voltage.
- Vop—Zero-to-peak voltage.
- T—Signal period.
- f—Signal frequency.



6419-16

Figure 2-11. DVM/COUNTER readout.

## OPERATING CONSIDERATIONS

This section contains basic operating information and techniques that should be considered before attempting to make any measurements with the instrument.

### Grounding

The most reliable signal measurements are made when the oscilloscope and the unit under test are connected by a common reference (ground lead) in addition to the signal lead or probe. The probe's ground lead provides the best grounding method for signal interconnection and ensures the maximum amount of signal-lead shielding in the probe cable.

### Signal Connections

#### Probes

Generally, the accessory probes supplied with the instrument provide the most convenient means of connecting a signal to the vertical inputs of the instrument. The probe and probe lead are shielded to prevent pickup of electromagnetic interference.

Both the probe itself and the probe accessories should be handled carefully at all times to prevent damage. Striking a hard surface or dropping the probe body can cause damage to both the probe body and the probe tip. Use care to prevent the cable from being crushed or kinked, and do not place excessive strain on the cable by pulling it.

#### Coaxial Cables

Cables used to connect signals to the vertical input may have considerable effect on the accuracy of a displayed waveform. To maintain the original frequency characteristics of an applied signal, only high-quality, low-loss coaxial cables should be used. Coaxial cables should be terminated at both ends in their characteristic impedance to prevent signal reflections within the cable.

### Audible Tone

Each time a front panel key is pressed, a single or a double audible beep is generated. A single beep indicates a valid selection, a double beep indicates an invalid keystroke or the chosen selection was not compatible with the preceding keystroke commands. A single beep is also heard when the logotype "TEKTRONIX" is displayed on the screen.

## OPERATING INSTRUCTIONS

### Using the Keyboard

This section will familiarize the first-time user with the capabilities of the instrument. The following operating procedure describes the sequence in which the keys are used to perform a particular mode of operation. The keyboard commands are displayed in the instruction message on the display unless noted.

#### Turning the Input Channels On/Off

##### NOTE

*When the instrument is first turned on the word "TEKTRONIX" will be displayed for approximately 30 seconds or until a front panel key is pressed.*

To turn Channel 1 and Channel 2 on, slide the selected Channel Input Coupling switch(s) to the AC, GND, or DC position.

To turn a selected input channel off, or the instrument off (both channels off), slide the selected Input Coupling switch(s) to the OFF position.

#### Auto Setup

The Auto Setup mode automatically presets the channel sweep speed, trigger parameters, and cursors. It will preset the display vertically with respect to ground and return the vertical amplitude to its calibrated Volts per Division switch setting.

Press **AUTO SET**

Display: AUTO SET

4-1

## Display

### Vectors

The instrument provides a continuous trace between dots on the displayed waveform when Vector mode is on. On power-up, the instrument defaults to Vector mode. To call up or remove vectors from the display, perform the following instruction:

Press: **SHIFT** **VECTOR ON/OFF**

Display: VECT OFF or VECT ON

### Invert Video Display

The video display background can be changed from white to black and the baseline from black to white. To return to normal video display, press the **SHIFT** and **INVERT DISPL** keys once again.

Press: **SHIFT** **INVERT DISPL**

Display: None

### Graticule

The crosshatch is used to divide the display area into six horizontal and six vertical divisions. To call up or remove the crosshatch from the display, perform the following instruction:

Press: **SHIFT** **GRAT ON/OFF**

Display: None

4-2

---

### Keyboard Sound

The keyboard acknowledge beep (not the double error beep) can be alternately turned off or on with the following instruction:

Press: **SHIFT** **SOUND ON/OFF**

Display: SOUND ON or SOUND OFF

### Vertical

### Positioning

A displayed trace can be vertically positioned either by using the up-arrow and down-arrow keys or entering a numeric value in the instruction.

### UP-ARROW AND DOWN-ARROW KEYS

Press: **POS WAVEFORM** **▲** or **▼**

Display: POS WVFM **▲** or **▼**

### NUMERIC ENTRY

Press: **POS WAVEFORM** or **+** **-** **.**  
**1** **0** **SHIFT** **V**

Display: POS WVFM + or - .10 V

### Expanding and Compressing the Waveform

The waveform display can be adjusted to volts per division settings other than those provided by the VOLTS/DIV switch settings. To adjust the waveform display, use the up-arrow and down-arrow keys or enter a numerical value in the instruction.

### UP-ARROW AND DOWN-ARROW KEYS

Press: **VAR VOLTS** **▲** or **▼**

Display: VAR VOLTS **▲** or **▼**

### NUMERIC ENTRY

Press: **VAR VOLTS** **.** **4** **0** **2**  
**SHIFT** **V**

Display: VAR VOLTS .402 V

### Return to VOLTS/DIV Switch Setting

To return the vertical deflection factor to original VOLTS/DIV switch setting, perform the following instruction:

Press: **SHIFT** **CAL**

Display: CAL

### Inverting the Input Signals

Channel 1 and Channel 2 input signals can be inverted with the following instruction:

Press: **SHIFT** **INVERT ON/OFF**

Display: INV ON or INV OFF

### Chop and Alternate Mode

#### NOTE

*When entering Chop mode, the Channel 2 seconds per division settings will automatically be set to the same value as Channel 1. Chop mode is not allowed at sweep settings faster than 20  $\mu$ s per division settings.*

In Chop mode, Channel 1 and Channel 2 are alternately sampled many times during a single sweep, as determined by the chop rate. In Alternate mode, only one channel is sampled during any one sweep, and the other channel is sampled on the next sweep. The instrument can be toggled between Chop and Alternate mode by entering the following instruction:

Press: **SHIFT** **CHOP/ALT**

Display: None

#### Turning the Input Channels Off and On

One or both input channels can be removed from the display. To recall an input channel for display, press any of the keys associated with the selected input channel, except for the POS READOUT key. To remove an input channel enter the following instruction.

Press: **POS WAVEFORM** **SHIFT**  
**ON/OFF**

Display: CH 1 or CH 2 OFF

#### Time Base

##### Second per Division Settings

To select a sweep setting, enter a numeric value in the instruction or use the left-arrow or right-arrow keys.

Numeric Entry

Press: **SEC/DIV** **1** **0** **0**  
**SHIFT** **μS**

Display: SEC/DIV 100 μs

LEFT-ARROW AND RIGHT-ARROW KEYS

Press: **SEC/DIV** **◀** or **▶**

Display: SEC/DIV **◀** or **▶**

#### Expanding the Record Between the Timing Cursors

The delta-time feature of the instrument can be used to expand a portion of the waveform record to full display width on the delta time sweep. The expansion of the waveform record of interest is inversely proportional to the settings of the X cursors. Repeat the delta-time instruction to return to the original mode of operation.

Press: **SHIFT** **Δ TIME EXPAND ON/OFF**

Display: None

#### Positioning

An acquisition record is 12.8 divisions in length, of which the center 6.4 divisions are normally displayed. Horizontal positioning of the display to observe the first or last 3.2 divisions of an acquisition record can only be performed after the record has been stored in save reference memory. See "Positioning a Reference Signal" in the Save References part of this section.

#### Delta Time Measurements

##### Time Difference

Time difference between the X (timing) cursors are automatically measured in seconds and displayed in the channel data readout. To measure the time difference between the X cursors in hertz, press the **SHIFT** and **ΔT/1ΔT** keys and read the results from the channel data readout. To return to time difference in seconds, press the **SHIFT** and **ΔT/1ΔT** keys once again.



## Trigger

### Source

The trigger source for each channel can be selected by pressing the **CH 1** , **EXT** , or **CH 2** key in the following instruction:

Press: **TRIG SOURCE/SLOPE** **CH 1**

Display: TRIG S/S CH 1

### Auto Level

In Auto Level mode, the trigger level is automatically set at the center amplitude point of the vertical input signal. The Auto Level mode is not allowed for external trigger source.

Press: **AUTO LEVEL**

Display: AUTO LVL

#### NOTE

*The voltage level for external trigger is set at about 1.5 V in Normal Trigger mode, Auto Trigger mode, and Single Sweep mode.*

### Normal

When in Normal Trigger mode, the trigger voltage level points are manually adjusted. Triggers only if the voltage level pointer falls within the peak-to-peak limits of the applied signal.

Press: **NORMAL**

Display: NORM

### Auto

Just as in Normal Trigger mode, the trigger voltage level is manually adjusted. The time base free runs when the instrument is not triggered.

Press: **SHIFT** **AUTO**

Display: AUTO

### Hold/Sgl Swp

Holds the current acquisition and display update in progress with the first keystroke.

Press: **HOLD/SGL SWP**

Display: SGL SWP

Press the **HOLD/SGL SWP** key a second time to arm the trigger circuit for a single sweep acquisition. Following keystrokes will continue to rearm the trigger circuit for single sweep acquisition. In single sweep mode the instrument will only trigger once after it is armed (or rearmed), otherwise operation is identical to Normal Trigger mode.

Press: **HOLD/SGL SWP**

Display: HLD/REARM

### Roll

In Roll mode, the triggers are disabled and the waveform is allowed to scroll across the display. The voltage level and timing trigger points are removed from the display. The sweep settings must be set to 1 second per division or slower when using Roll mode.

Press: **SHIFT** **ROLL**

Display: ROLL

## Slope

The trigger slope is selected with the  $\boxed{+/-}$  key-stroke at the end of the instruction.

Press:  $\boxed{\text{TRIG SOURCE/SLOPE}} \boxed{+/-}$

Display: TRIG S/S +/-

## Trigger Voltage Level Points

The trigger level sets the amplitude at which an input signal will trigger the instrument time base. The trigger voltage level is indicated by a pointer at the left side of the display, as well as numerically in the trigger voltage "Vt" field of the channel data readout. The voltage level can be adjusted either with the up-arrow and down-arrow keys or by entering a numeric value in the instruction.

### UP-ARROW AND DOWN-ARROW KEYS

Press:  $\boxed{\text{TRIG LEVEL/TIME}} \boxed{\blacktriangle}$  or  $\boxed{\blacktriangledown}$

Display: TRIG L/T  $\blacktriangle$  or  $\blacktriangledown$

### NUMERIC ENTRY

Press:  $\boxed{\text{TRIG LEVEL/TIME}} \boxed{+}$  or  $\boxed{-}$   $\boxed{.}$   
 $\boxed{1} \boxed{2} \boxed{2} \boxed{\text{SHIFT}} \boxed{\vee}$

Display: TRIG L/T + or - .122 V

## Trigger Delay

The trigger delay sets the time difference between the start of an acquisition record and an actual trigger event. The range of the trigger delay allows the displayed portion of the acquisition record to start from 12.2 divisions (pretrigger) before the next trigger event and up to 193.8 divisions (post-trigger) after the next trigger event. The trigger delay pointer indicates where the trigger event occurs on the display (only for pretrigger up to 6 divisions, otherwise the pointer is not displayed). The amount of trigger delay is indicated in seconds in the "tT" field of both channel readouts.

The trigger delay can be positioned either with the left-arrow and right-arrow keys or by entering a numeric value in the instruction.

### LEFT-ARROW AND RIGHT-ARROW KEYS

Press:  $\boxed{\text{TRIG LEVEL/TIME}} \boxed{\blacktriangleleft}$  or  $\boxed{\blacktriangleright}$

Display: TRIG L/T  $\blacktriangleleft$  or  $\blacktriangleright$

### NUMERIC ENTRY

Press:  $\boxed{\text{TRIG LEVEL/TIME}} \boxed{+}$  or  $\boxed{-}$   $\boxed{5}$   
 $\boxed{.}$   $\boxed{3} \boxed{\text{SHIFT}} \boxed{\text{mS}}$

Display: TRIG L/T + or - 5.3 ms

## Cursors Measurements

### Displaying and Removing Cursors

To call up or remove the cursors for Channel 1 and Channel 2, perform the following instruction:

Press:  $\boxed{\text{SHIFT}} \boxed{\text{CURS ON/OFF}}$

Display: CURS ON or CURS OFF

### NOTE

To simplify the following cursors instructions, "CH" is used to represent either CH 1 or CH 2.

#### Positioning the X Cursors

The two X (timing) cursors for Channel 1 and Channel 2 can be positioned either with the left-arrow and right-arrow keys or by entering a numeric value in the instruction.

#### LEFT-ARROW AND RIGHT-ARROW KEYS

Press: **CURSOR 1** or **CURSOR 2** **◀** or **▶**

Display: CH C1 or C2 **◀** or **▶**

#### NUMERIC ENTRY

Press: **CURSOR 1** or **CURSOR 2** **+** or **-** **8** **0** **2** **SHIFT** **mS**

Display: CH C1 or C2 + or - 802 ms

#### Positioning the Y Cursors

The two Y (voltage) cursors for Channel 1 and Channel 2 can be positioned either with the up-arrow and down-arrow keys or by entering a numeric value in the instruction.

#### UP-ARROW AND DOWN-ARROW KEYS

Press: **CURSOR 1** or **CURSOR 2** **▲** or **▼**

Display: CH C1 or C2 **▲** or **▼**

#### NUMERIC INPUT

Press: **CURSOR 1** or **CURSOR 2** **+** or **-** **.** **0** **5** **0** **SHIFT** **V**

Display: CH X1 or X2 + or - .050 V

#### Track Cursor

The track command allows both of the X cursors and both of the Y cursors to be positioned at the same time. The voltage relationship of the X cursors and timing relationship of the Y cursors remains constant when repositioned.

#### TRACKING X CURSORS WITH UP-ARROW AND DOWN-ARROW KEYS

Press: **CURSOR 1** or **CURSOR 2** **SHIFT** **TRACK** **▲** or **▼**

Display: CH C1 or C2 CURS/TRK **▲** or **▼**

#### TRACKING X CURSORS WITH NUMERIC ENTRY

Press: **CURSOR 1** or **CURSOR 2** **SHIFT** **TRACK** **+** or **-** **SHIFT** **.** **1** **8** **2** **SHIFT** **V**

Display: CH C1 or C2 CURS/TRACK + or - .182 V

#### TRACKING Y CURSORS WITH LEFT-ARROW AND RIGHT-ARROW KEYS

Press: **CURSOR 1** or **CURSOR 2** **SHIFT** **TRACK** **◀** or **▶**

Display: CH C1 or C2 CURS/TRACK **◀** or **▶**

## TRACKING Y CURSORS WITH NUMERIC ENTRY

Press: **CURSOR 1** or **CURSOR 2**  
**SHIFT TRACK +** or **- SHIFT 1**  
**8 2 mS**

Display: CH C1 or C2 CURS/TRACK + or -  
182 ms

### Channel 1 and Channel 2 Data Readout

#### Readout Display

The data readouts can be either called up or removed from the display by the following instruction:

Press: **SHIFT READOUT ON/OFF**

Display: RDOUT ON or RDOUT OFF

#### Scrolling and Vertical Positioning

The channel readout can be scrolled across the display using the left-arrow and right-arrow keys and vertically positioned using the up-arrow and down-arrow keys.

#### SCROLLING

Press: **POS READOUT** **◀** or **▶**

Display: POS RDOUT **◀** or **▶**

#### VERTICAL POSITIONING

Press: **POS READOUT** **▲** or **▼**

Display: POS RDOUT **▲** or **▼**

## Signal Processing

Signal processing for the input channels and save references can be performed in any combination of addition, subtraction, multiplication, and division. To maintain phase and time relationships with multiple signals, ensure that the instrument is in Chop mode and the sweep speed for both channels is identical. Ensure that the VOLTS/DIV settings for the multiple signals are identical. For save references signals read volts per division settings in the "V" field of the save memory readout. When dividing one channel by another, division by zero is invalid. Up to nine signal processing functions can be defined. Only one signal processing result can be displayed at a time. It is important to give an arithmetic operation a label, so it can be recalled for future references. This is done by entering a numeric value from 1 to 9 after pressing the **SIG PROC #** key in the arithmetic instruction. For example: Entering a Numeric Entry 2 after pressing the **SIG PROC #** key will give the result of the signal processing operation the label "2".

The **-** key, **SHIFT X** key, and **SHIFT ÷** key may be used in place of the **+** key in the following arithmetic instructions:

#### NOTE

After the **ENTER** keystroke, the displayed commands are removed and replaced with a SP# followed by the assigned label number.

#### Signal Processing Between Two Input Channels

Press: **SHIFT SIG PROC # 2 CH 1**  
**+ CH 2 ENTER**

Display: SP# 2 CH 1 + CH 2

### Signal Processing Between Input Channel and Saved Reference

Press: **SHIFT** **SIG PROC #** **2** **CH 1**  
**+** **RECALL POS REF** **9** **ENTER**

Display: SP# 2 CH 1 + RCL REF 9

### Signal Processing Between Any Two Saved References

Press: **SHIFT** **SIG PROC #** **2**  
**RECALL POS REF** **9** **+**  
**RECALL POS REF** **8** **ENTER**

DISPLAY: SP# 2 RCL REF 9 + RCL REF 8

### Removing Signal Processing Functions

Before removing a Channel Arithmetic or a Save Reference Arithmetic display, it may be necessary to press the **CE** key a couple of times if the previous instruction started with a **RECALL POS REF** keystroke.

Press: **SHIFT** **SIG PROC #** **SHIFT**  
**ON/OFF**

Display: SP# ON/OFF

### Recall Channel Arithmetic or Save Reference Arithmetic

Press: **RECALL POS REF** **SHIFT**  
**SIG PROC #** **2** **ENTER**

Display: RCL REF SP# 2

### Signal Processing Cursors

#### UP-ARROW AND DOWN-ARROW KEYS

Press: **SHIFT** **SIG PROC #**  
**CURSOR 1** or **CURSOR 2** **▲** or **▼**

Display: SP# C1 or C2 **▲** or **▼**

#### LEFT-ARROW AND RIGHT-ARROW KEYS

Press: **SHIFT** **SIG PROC #** **CURSOR 1**  
or **CURSOR 2**

Display: SP# C1 or C2

#### Signal Process Readout On

Press: **SHIFT** **SIG PROC #**  
**POS REF READOUT**

Display: SP# 4 POS REF RDOUT

#### Signal Process Readout Position

Press: **SHIFT** **SIG PROC #**  
**POS REF READOUT** **◀** or **▶**

Display: SP# POS REF RDOUT **◀** or **▶**

#### Saving Front Panel Setups

Up to nine keyboard setups may be saved in non-volatile memories for recall at a later time. This is done by entering a numeric value from 1 to 9 in the following instruction:

EXAMPLE: Entering Numeric Entry 5 after pressing the **SAVE SETUP** key will give a particular keyboard setup the label "5".

### Save

Press: **SHIFT** **SAVE SETUP** **5** **ENTER**

Display: SAVE SETUP 5

### Recall

Press: **RECALL SETUP** **5** **ENTER**

Display: RCL SETUP 5

### Save References

Displayed waveforms can be stored in one of nine memory locations (1 through 9 numerical keys).

EXAMPLE: Entering Numeric Entry 6 followed by an **ENTER** keystroke after pressing the **SAVE REF** key will store the signal in save reference memory "6".

### Saving a Signal

Press: **SAVE REF** **6** **ENTER**

Display: SAVE REF 6

### Recall Selected Reference Signal and Readout

Press: **RECALL POS REF** **6** **ENTER**

Display: RCL REF 6

### Remove Selected Reference Signals From Display

The numeric entry for the highest memory location that is filled will be displayed.

Press: **SHIFT** **REF #** **1 through 9**  
**ENTER**

Display: REF# (1 through 9)

### Recall or Remove All Saved Reference Signal(s)

Display all saved reference signals and readout of the highest saved reference signal. Repeat the instruction to remove all save reference from the display.

EXAMPLE: Highest memory location to have a saved reference signal is 6 when calling up the save reference signals.

Press: **SHIFT** **REFS ON/OFF**

Display: REFS (1 through 6) (6) ON or REFS OFF

### Display or Remove Selected Reference Signal Readout

For a single reference display, a save reference numeric entry is not necessary after the **POS REF READOUT** keystroke.

Press: **POS REF READOUT** **1 through 9**  
**SHIFT** **ON/OFF**

Display: POS REF RDOUT (6) 6 ON/OFF

### Positioning a Reference Signal

For a single reference display, a save reference numeric entry is not necessary after the **RECALL POS REF** keystroke.

#### UP-ARROW AND DOWN-ARROW KEYS

Press: **RECALL POS REF** **6** **ENTER**  
**▲** or **▼**

Display: RCL 6 **▲** or **▼**

#### LEFT-ARROW AND RIGHT-ARROW KEYS

Press: **RECALL POS REF** **6** **ENTER**  
**◀** or **▶**

Display: RCL 6 **◀** or **▶**

### Position Reference Readout

#### UP-ARROW AND DOWN-ARROW KEYS

Press: **POS REF READOUT** **▲** or **▼**

Display: POS REF RDOUT **▲** or **▼**

#### LEFT-ARROW AND RIGHT-ARROW KEYS

Press: **POS REF READOUT** **◀** or **▶**

Display: POS REF RDOUT **◀** or **▶**

### Cursor Measurements

#### UP-ARROW AND DOWN-ARROW KEYS

Press: **RECALL REF READOUT** **6**  
**CURSOR 1** or **CURSOR 2** **▲** or **▼**

Display: RCL REF 6 C1 or C2 **▲** or **▼**

#### LEFT-ARROW AND RIGHT-ARROW KEYS

Press: **RECALL REF READOUT** **6**  
**CURSOR 1** or **CURSOR 2** **◀** or **▶**

Display: RCL REF 6 C1 or C2 **◀** or **▶**

### X-Y Mode

The signal applied to CH 1 INPUT Connector produces the horizontal (X-Axis) deflection and the signal applied to the CH 2 INPUT Connector produces the vertical (Y-Axis) deflection. Both vertical channels must be displayed before selecting the X-Y mode. Press the **SHIFT** key and **XY/YT** key a second time to return the instrument to a baseline trace display.

#### XY On

Press: **SHIFT** **XY/YT**

Display: None

### Digital Voltmeter and Counter

The Digital Voltmeter and Counter mode will automatically carry out a range of measurements and display the results. To maximize accuracy, use the highest vertical sensitivity possible without overload. The Digital Voltmeter and Counter mode will select to the channel that is displayed. If both input channels are displayed, the Digital Voltmeter and Counter mode will select Channel 1. To measure Channel 2, press the **CH 2** key after the **DVM/COUNTER** key is pressed.

#### On

Press: **DVM/COUNTER**

Display: None

Off

Press:

Display: None

Freeze

Press:

Display: None

Continue

Press:

Display: None



## PERFORMANCE CONDITIONS

This section consists of Electrical, Environmental, and Physical characteristics.

The electrical characteristics are valid when the instrument has been adjusted at an ambient temperature between 20°C and 30°C, has had a warm-up period of at least 20 minutes, and is operating at an ambient temperature between 0°C and +40°C (unless otherwise noted).

The performance requirements for the characteristics are verifiable; qualitative or quantitative limits that define the measurement capabilities of the instrument.

### T202 Electrical Characteristics

#### Vertical Deflection System

##### Deflection Factor

Range—0.01 volts per division to 20 volts per division in a 1-2-5 sequence of 11 steps.

Dc Accuracy—Within 1% +/- 1 LSB to 6 divisions full scale. Increases +/- 0.1% per degree Celsius above 20°C.

Linearity— +/- 0.5 LSB

Step Response—70 ns.

Maximum Sample Rate—20 mega samples per second for single channel acquisitions or 10 mega samples per second in chop or alternate mode.

Vertical System Bandwidth (-3 dB)—Dc to greater than 5 MHz

Useful Bandwidth—Up to 5 MHz for repetitive signals and up to 2 MHz for single shot events (determined by requiring 10 samples per signal period)

Resolution—7 bits, 20 levels per division.

Chop Mode Switching Rate (Chop mode not allowed above 20  $\mu$ s/div)

20  $\mu$ s per division to 8 ms per division—Chop Mode switching rate is calculated from

$$\frac{40}{\text{second per division}}$$

8 ms per division or less—5 kHz

#### Input Characteristics

Resistance—1M $\Omega$  +/- 0.25%

Capacitance—25 pF +/- 5 pF

Channel Isolation—100:1 at 5 MHz



Maximum Safe Input Voltage Potential Between Probe Common Plus Input Circuit to Earth Ground—Shall not exceed 42 V (dc + peak ac) at 5 MHz or less.

Measuring terminal input common references are connected to each other internally. To avoid measurement errors or damage to the instrument or device under test, do not connect voltages of different potentials between input terminals commons.

#### Triggering System

##### Sensitivity

Internal—0.5 division

External—The voltage level is set at 1.5 volts

Jitter—+/- 2 display points

Level Range—At least +/- 2.5 divisions from zero volts

### Trigger Delay

Pretrigger—Up to 12.8 divisions (two displays) of pretrigger information are available.

Post-Trigger—Up to 198.4 divisions (31 displays) of post-trigger information are available.

### EXT TRIG INPUT



Maximum Safe Input Voltage Potential Between Probe Common Plus Input Circuit to Earth Ground—Shall not exceed 42 V (dc + peak ac) at 5 MHz or less.

Measuring terminal input common references are connected to each other internally. To avoid measurement errors or damage to the instrument or device under test, do not connect voltages of different potentials between input terminals commons.

Input Resistance— $2.2M\Omega$   $\pm 0.25\%$

Input Capacitance—25 pF  $\pm 5$  pF

### Horizontal Deflection System

Sweep Rate SEC/DIV and  $\Delta$  TIME

Calibrated Range—1 hour per division to 50 ns per division settable to within at least 1.0% of range or 50 ns per division, whichever is greater.

Accuracy— $\pm 0.1\%$  of calibrated range.

Time Difference between SEC/DIV and  $\Delta$  TIME— $\pm 0.1$  division of SEC/DIV.

Resolution—7 bits, 128 display points.

Record Length—256 points for CH 1 and CH 2 in single and alternating operation; 128 points each in chop operation.

Minimum Resolution in Time Measurement (at 50 ns per division)

Continuous Sweeps—2.5 ns per data point.

Single Sweep—50 ns per data point.

Reference System of Time Base—40 MHz  $\pm 50$  parts per million and is Quartz crystal controlled.

### Memory

Save Reference Memory—Nine 256 point single channel acquisitions may be saved in reference memory.

Save Setup Memory—Memory locations are available for storage of up to nine keyboard setups; vertical sensitivity and coupling are not capable of being saved.

### Cursors

Delta Time Measurement Accuracy— $\pm 0.1$  division of SEC/DIV.

Delta Voltage Measurement Accuracy—Same as vertical system.

### X-Y Operation

Deflection Factors—Same as vertical deflection system.

Accuracy—Same as vertical deflection system.

## DVM COUNTER (voltage and time)

### Frequency and Period

1 Hz to 100 Hz at +/-0.5%

101 Hz to 500 kHz at +/-0.08%

500 kHz to 5 MHz at +/-0.04%

Frequency and period is automatically calculated if signal duty cycle is greater than 33%.

Voltage Measurement of True RMS, Average, Peak to Peak, and Zero to Peak—Refer to display accuracy

### Display

Dimensions of Display Area—5.76 cm x 5.76 cm with 6.4 divisions x 6.4 divisions with 20 display points per division.

Usable Signal Area—100 points vertically by 128 points horizontally

### Battery Pack Electrical Characteristics

#### Battery Charging

Charging Current (switch selectable)

Low—100 mA (1 ampere-hour batteries)

High—200 mA (4 ampere-hour batteries)

Charging Time (full recharge of nickel-cadmium batteries)

1 Ampere-hour Batteries—12 hours to 14 hours

4 Ampere-hour Batteries—24 hours to 30 hours

Battery Charger Power Source—Input power to the battery charger is supplied by the ac power source.

Battery Overcurrent Protection Fuse—3 A

### Battery Operation

#### Voltage Range

Normal Operation— +3.5 V to +6.5 V

Non-destructive Limits— -0.5 V to +15.0 V

Battery Current Drain—Approximately 0.6 A to a maximum of 2.8 A, dependent upon the battery voltage and load.

Leakage Current from Battery to Internal Circuitry—300  $\mu$ A maximum, when battery output is 6 V

#### Low Battery Voltage Warning

Threshold—4.75 V +/- 5%

Flashing Frequency—Approximately: 1 Hz

Typical Battery Operating Time (operating a T202 between 20°C to 30°C)

Nickel-Cadmium (4 ampere-hour batteries)

Single-Channel Operation—5 hours

Dual-Channel Operation—3 hours

Alkaline

Single-Channel Operation—6 hours

Dual-Channel Operation—2.5 hours

## Battery Pack Outputs

### Accuracy of Output Voltages

Supply	Range
+12 V	+11.4 V to +12.6 V
-12 V	-11.4 V to -12.6 V
+5 V	+4.8 V to +5.3 V

Maximum Operating Output Current From Each Supply (total power not to exceed 3.6 watts).

Supply	Maximum Current
+12 V	150 mA
-12 V	150 mA
+5 V	200 mA

Short Circuit Current, any Output(s) to Common or to Each Other—750 mA maximum, 600 mA typical

### Environmental Characteristics

#### Temperature

Operating—0°C to +40°C.

Storage—-30°C to +75°C.

#### Altitude

Operating—To 4500 meters (15,000 feet)  
Maximum operating temperature decreased 1°C per 1,000 feet above 5,000 feet

Nonoperating—To 15,000 meters (50,000 feet)

Humidity (operating and nonoperating)—5 cycles (120 hours) referenced to MIL-T-28800C paragraph 4.5.5.1.2.2. for Type III, Class 5 instruments. Nonoperating and operating at 90% -5% to +0% relative humidity. Operating at +30°C and +40°C. Nonoperating at +30°C to +60°C.

EMI (electromagnetic interference)—Does not meet radiated or conducted emission requirements per VDE 0871, Class B.

Vibration (operating)—Sinusoidal vibration in the X, Y, and Z axis with the frequency varied 10 Hz to 55 Hz in one minute cycles for duration of 15 minutes. Total displacement 0.025 inch p-p (4 g at 55 Hz)

Shock (operating and nonoperating)—150 g, half-sine, 2 ms duration, 2 shocks per axis for a total of 12 shocks

### Physical Characteristics

#### Weight

Instrument—0.85 kg (1.9 lb)

Battery Pack/Carrying Case with Accessories and Batteries (without T202)—2.3 kg (5.0 lb)

#### Dimensions

Length—257 mm (10.12 in)

Width—111 mm (4.36 in)

Depth—48 mm (1.89 in)

## OPTIONS AND ACCESSORIES

### Introduction

This section contains a general description of instrument options available at the time of publication of this manual. Also included is a complete list of standard accessories (with Tektronix part numbers) included with each instrument. Additional information about instrument options, option availability, and other accessories can be obtained either by consulting the current Tektronix Product Catalog or by contacting your local Tektronix Field Office or representative.

### Options A1-A5 International AC/DC Adapters

Instruments are shipped with the detachable ac/dc adapter ordered by the customer. Information on using the ac/dc adapters is provided in "Preparation For Use" part of Section 1. The following list identifies the Tektronix part numbers for the available ac/dc adapters.

Description	Order
North American 120V, 60 Hz	A1
Universal Euro 240 V, 50Hz	A2
United Kingdom 240 V, 50 Hz	A3
Australian 240 V, 50 Hz	A4
North American 240 V, 60 Hz	A5

### Standard Accessories

The following standard accessories are provided with each instrument.

Qty	Description	Order
2	Probe packages, each with a P6115 probe, 1X2-meter length, with accessories	015-0531-00
1	AC/DC Adapter	As Ordered
1	Operators Manual	070-6419-00
1	Battery Pack/Carrying Case	119-2652-00

### Optional Accessories

There are currently no optional accessories available for the instrument.

**Tektronix**  
CORPORATION

**MANUAL CHANGE  
INFORMATION**

Product: T202 OPERATORS  
Date: 10-24-90

Change Reference: C111090  
Manual Part No: 070-6419-00

**DESCRIPTION**

Product Group: 40

**EFFECTIVE ALL SERIAL NUMBERS**

**Page 1-3 Replace Note with the following:**

*NOTE*

*Batteries are included with the battery pack, and may need to be charged. See page 1-9 for charging instructions.*

**Page 6-1 Replace Options A1-A5 International AC/DC Adapters with the following:**

**Options A1-A2 International AC/DC Adapters**

Instruments are shipped with the detachable ac/dc adapter ordered by the customer. Information on using the ac/dc adapters is provided in the "Preparation for Use" part of Section 1. The following list identifies the Tektronix part numbers for the available ac/dc adapters.

Description	Order
Universal Euro 220V (161-0233-03)	A1
United Kingdom 240 V, 50 Hz (161-0233-01)	A2

**Page 6-2 Add part number to AC/DC Adapter**

1	AC/DC Adapter	161-0233-04
---	---------------	-------------