USING THE

2230

DIGITAL STORAGE OSCILLOSCOPE

Tektronix
COMMITTED TO EXCELLENCE

INTRODUCTION

The 2230 is not only a powerful digital storage oscilloscope but also provides the analog capability of a conventional non-storage instrument.

In the digital storage mode, the instrument is capable of sampling up to 20 MS/s and has an equivalent time sampling bandwidth of 100 MHz. Acquisitions of either 4K or 1K record length are user selectable and these acquisitions can be stored in either one 4K or one of three 1K save references. The digital storage mode also offers the convenience of cursor measurements, simplifying the calculation of voltage or timing changes. CRT readout in both the digital storage and non-storage modes provides direct measurement readout and front panel setting status allowing fast and accurate calculations and documentation.

In the non-storage mode, the instrument behaves as a conventional 100 MHz analog oscilloscope. The 2230 offers versatility in triggering, high accuracy in both vertical and horizontal systems, and excellent display quality. Although cursor measurements are not available in the non-store mode, front panel settings such as delay time, volts/div, time/div settings are displayed on the CRT.
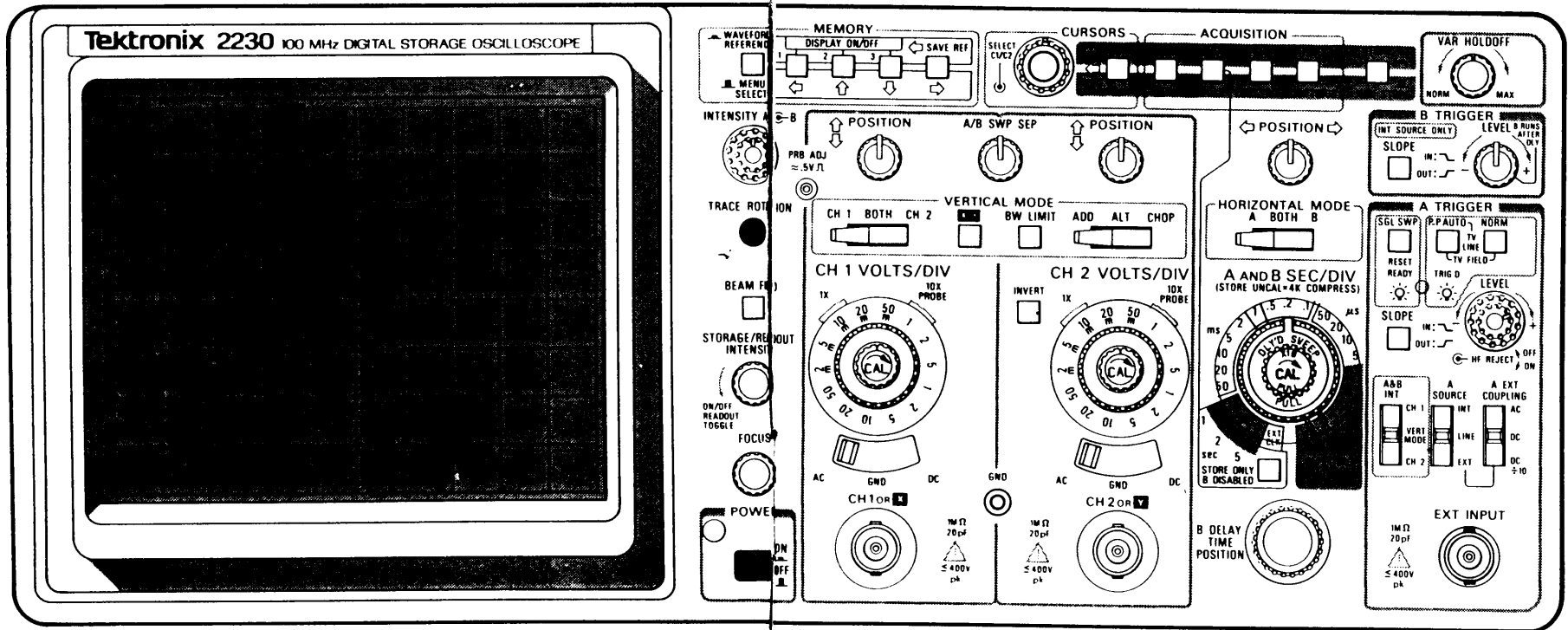
TABLE OF CONTENTS

OSCILLOSCOPE CONTROLS

CRT CONTROLS:

INTENSITY—Determines the level of trace brightness for both the A and B sweep traces.

TRACE ROTATION—Screwdriver adjustment used to align the trace with the center horizontal graticule line.

BEAM FIND—When held in, compresses the display to within the graticule area and provides a visible viewing intensity (regardless of the INTENSITY control setting) to aid in locating off-screen displays.

STORAGE/READOUT INTENSITY—Determines the brightness of both the storage waveform and the CRT readout.

PROBE ADJUST—Square wave signal used to properly compensate the X10 probes.

FOCUS—Adjusts for optimum display sharpness.

POWER ON/OFF—Turns instrument power on and off. An LED indicates power is on when illuminated.

VERTICAL SYSTEM CONTROLS:

POSITION—Used to vertically position the waveform display on the CRT. When the X-Y display mode is chosen while in NON STORE mode, the Channel 2 POSITION control moves the display vertically (Y-axis). In the X-Y STORE mode, the Channel 2 POSITION control moves the display vertically and either the Channel 1 POSITION control or the HORIZONTAL POSITION control will move the display horizontally.

CH 1-BOTH-CH 2—Selects the channel or channels to be displayed in both STORE and NON STORE modes. Additionally, in the STORE mode, it selects the channel or channels for acquisition.

> **CH 1**—Only Channel 1 is selected for display or acquisition of the input signal.

> **BOTH**—Selects a combination of Channel 1 and Channel 2 input signals for acquisition or display (works in conjunction with the ALT-ADD-CHOP mode switch).

> **CH 2**—Only Channel 2 is selected for display or acquisition of the input signal.

ALT-ADD-CHOP—Selects the method for display or acquisition of Channel 1 and Channel 2.

ALT—In the NON STORE mode, Channel 1 and Channel 2 are alternately displayed. In STORE mode, signals are acquired on alternate acquisition cycles at one-half the sampling rate of a single channel. Best for SEC/DIV speeds of 0.5 ms per division and faster.

ADD—Displays and acquires the algebraic addition or subtraction of Channel 1 and Channel 2 input signals. The difference between each channel is accomplished with the Channel 2 INVERT mode enabled.

CHOP—In NON STORE mode, Channel 1 and Channel 2 are switched during the sweep at a rate of 500 kHz. In STORE mode settings of 5 s/DIV-10 μs/DIV, Channel 1 and Channel 2 samples are acquired alternately at one-half the sampling rate of a single channel acquisition. CHOP is disabled and ALT mode is enabled for settings of 5 μs/DIV and faster.

X-Y—When depressed, the Channel 1 input provides horizontal deflection and Channel 2 provides vertical deflection. In STORE mode, sampling rate is selected by the SEC/DIV switch. The X-Y acquisition is obtained in either Sampling or Average mode and is displayed with dots. Maximum sample rate is 10 MHz per channel. The Channel 1 signal is sampled before the Channel 2 signal.

BW LIMIT—In NON STORE mode, both the Vertical and A-Trigger bandwidths are limited to approximately 20 MHz. In STORE mode, only the A-Trigger system bandwidth is limited.

INVERT—When depressed, the signal applied to the Channel 2 input is inverted.

CH 1/CH 2 VOLTS/DIV—Used to select the vertical deflection factors from 2 mV to 5 V per division in a 1-2-5 sequence. In STORE mode, SAVE waveforms and waveforms waiting to be updated between trigger events may be vertically expanded or compressed by up to a factor of 10 times (or as many VOLTS/DIV settings remain whichever is less).

VAR VOLTS/DIV (CAL)—Provides continuously variable reduction in deflection factor sensitivity, with a range of 2.5:1. To obtain a calibrated deflection factor, the VAR VOLTS/DIV control must be in the CAL detent position (fully clockwise).

AC-GND-DC (INPUT COUPLING)—Selects the method of coupling the signal to the vertical amplifier and storage acquisition system.

AC—Input signal is capacitively coupled to the vertical amplifier. The dc component of the input signal is blocked. The low-frequency limit is approximately 10 Hz (− 3 dB).

GND—The input of the vertical amplifier is grounded to provide a zero volt (ground) reference point, (input signal is not grounded). In STORE mode, the ground reference is acquired and displayed in the first sample location of the acquisition display.

DC—All input signal components are directly coupled to the vertical amplifier.

HORIZONTAL SYSTEM CONTROLS:

POSITION—Positions the sweep horizontally over one sweep in the NON STORE mode. In STORE mode, waveforms can be positioned over one display window. Use the CURSOR position control for positioning over the entire record length.

A-BOTH-B (HORIZONTAL MODE)—Determines the mode of operation for the horizontal deflection system in both the NON STORE and STORE modes. In STORE mode, the switch selects which time base SEC/DIV setting will control the acquisition time base and sampling mode.

A—In both STORE and NON STORE, only the A sweep is displayed. The STORE mode acquisitions and displays are controlled by the A SEC/DIV setting.

BOTH—Both the A Intensified and the B sweeps are displayed in the NON STORE mode. In the STORE mode, only the A Intensified sweep is displayed. The intensified zone indicates the approxi-

mate length of the B sweep and its delay position. The A SEC/DIV,
B SEC/DIV, and B DELAY TIME POSITION are displayed on the CRT readout.

B — In both STORE and NON STORE, only the B sweep is displayed. The STORE mode acquisitions and displays are controlled by the B SEC/DIV setting.

A AND B SEC/DIV — Determines the SEC/DIV setting for the NON STORE A and B sweeps and the STORE mode time base for acquisition and display. In NON STORE, the calibrated A sweep range is from 0.5 s to 0.05 μs per division and the B sweep range is 50 ms to .05 μs per division in a 1-2-5 sequence. In STORE mode, the A sweep range is extended from 5 s to .05 μs per division. In STORE mode, the SEC/DIV switch determines the default acquisition and display modes, sets the sampling rate, and establishes the time scale factor of the stored display waveforms. 1K of record information is normally displayed on-screen. An on-screen bar graph indicates the displayed record position in 4K acquisition mode. Table 1 lists default storage modes with respect to the SEC/DIV setting, ROLL or SCAN selection, and the Trigger mode selection.

X10 MAGNIFIER — When the VARIABLE SEC/DIV control is pulled to the out position, the horizontal is magnified by a factor of 10 (X10). When pressed in, the magnification factor returns to X1. Magnification registration occurs around the center vertical graticule in NON STORE mode, or the active cursor in STORE mode.

VARIABLE SEC/DIV — Provides continuously variable reduction in sweep speed, with a range of at least 2.5:1 in the NON STORE mode. In STORE mode, the VARIABLE SEC/DIV is disabled, and when rotated out of the detent position, a 4K acquisition is compressed for on-screen display. The CRT readout of SEC/DIV is also affected by a factor of four (4X).

STORE ONLY — When depressed in the STORE mode only, the SEC/DIV settings of 0.1 s, 0.2 s, and 0.5 s are increased by a factor of ten to 1 s, 2 s, and 5 s per

division. When released, the STORE mode time base is returned to X1.

B DELAY TIME POSITION — Adjusts the delay time position of the B sweep from the A trigger event. In RUNS AFTER DELAY, CRT readout indicates this position. In TRIGGERABLE AFTER DLY, the CRT readout indicates the amount of time that must elapse after the A trigger event before the B sweep can be triggered. A 4K record display increases the delay time position by a factor of approximately four. When switching between 1K and 4K records, the delay time position must be readjusted in order to obtain the same amount of delay.

ACQUISITION/PROCESS MODES

PEAK DETECT — The minimum and maximum levels of the input signal within one time base clock period are digitized and stored in acquisition memory as a data pair. The displayed data is connected by vectors, in min-max order.

SAMPLE — At SEC/DIV switch settings of 5 μs per division and slower, the signal is sampled at a rate that produces 100 samples per graticule division and the sample points are connected by vectors. At SEC/DIV switch settings of 2 μs per division and faster, the signal is sampled at 20 Ms/s and the sample points are displayed as dots.

ACC PEAK — The largest maximum and smallest minimum sample acquisitions are retained for each trigger-referenced sample record over multiple acquisition cycles. The display is reset by changing any switch that affects an acquisition parameter. ·

AVERAGE — Multiple record averaging reduces random signal noise by averaging the acquisitions over multiple records. The number of weighted acquisitions included in the AVERAGE display is selected via the menu. The default weight of the current acquisition is 1/4.

SMOOTH — Process applies to PEAK DETECT or ACC PEAK acquisition modes. Data points are reordered for correct slope and interpolated for drawing smooth vectors. Smoothing looks at the change in value of

data points between adjacent sample intervals. If the change in value does not exceed certain limits, the values are interpreted as a continuous slope for drawing vectors. If the value change exceeds the interpreted "no change" limit, the data point value is not modified and the vectors drawn in the display show a discontinuity in the waveform. This method of display of the waveform data provides a smoothed display of the waveform, yet retains the glitch-catching capabilities of the fast sampling that occurs during the time base period.

SWP LIMIT — Selects the number of acquisitions before the acquisition system halts in either ACCPEAK or AVERAGE modes. Adjustable from 1 to 2047 or NO LIMIT can be selected.

WEIGHT — Selects the weight of the last sample in AVERAGE mode. Menu selections include: 1/1, 1/2, 1/4, 1/8, 1/16, 1/32, 1/64, 1/128, or 1/256.

TABLE 1

SWEEP SPEED	Trigger Selection	SCAN/ ROLL	SAMPLE MODE	Process Options
0.05 μs 2 μs DIV	ALL	N/A	AVERAGE* ACC PEAK SAMPLE	WEIGHT SWP LIMIT SMOOTH
5 μs 10 μs DIV	ALL	N/A	AVERAGE ACC PEAK SAMPLE*	WEIGHT SWP LIMIT SMOOTH
20 μs 50 ms DIV	ALL	N/A	PEAK DETECT* ACC PEAK SAMPLE	WEIGHT SWP LIMIT SMOOTH*
0.1 s S/DIV EXT CLOCK	Sgl Swp	N/A	PEAK DETECT* SAMPLE	SMOOTH*
	NORM	SCAN	PEAK DETECT* ACC PEAK SAMPLE AVERAGE	WEIGHT SWP LIMIT SMOOTH*
	P-P AUTO	SCAN	PEAK DETECT* SAMPLE	SMOOTH*
	P-P AUTO NORM	ROLL	PEAK DETECT* SAMPLE	SMOOTH*

*Indicates default modes. Other modes are menu selectable

TRIGGER SYSTEM CONTROLS:

VAR HOLDOFF — Adjusts the amount of analog holdoff time before a trigger can be accepted to start the sweep in NON STORE mode. In STORE mode the analog holdoff time is in addition to fixed digital storage holdoff time.

B TRIGGER LEVEL — Selects the amplitude point on the B Trigger signal where triggering occurs in TRIGGERABLE AFTER DLY mode, the trigger point is displayed as a "T" symbol on the STORE mode waveform display. The fully clockwise position of the B LEVEL control selects the RUNS AFTER DELAY mode of operation for the B Trigger circuitry. Out of the detent, B Sweep is triggerable after the delay time.

B SLOPE — Selects either the positive or the negative slope of the B Trigger signal that starts the NON STORE sweep or completes the STORE acquisition.

A TRIGGER MODES — These switches determine the NON STORE sweep triggering mode. In STORE mode, triggering operation depends on the position of the A SEC/DIV setting, the SCAN/ROLL button, and the trigger mode selected.

The trigger position is marked by a "T" symbol on acquired waveforms.

NORM — Permits triggering at all sweep rates. In the absence of adequate trigger signal an auto trigger is not generated. NORM is best used for low frequency and low repetition rate signals.

In STORE mode, the last acquired waveform is held on display between trigger events. Pretrigger data is continually acquired until a trigger event occurs.

P-P AUTO/TV LINE — In NON STORE mode, triggering occurs on trigger signals having adequate amplitude and a repetition rate of 20 Hz or faster. In the absence of a proper trigger signal, an auto trigger is generated causing the sweep to free run. The range of the A TRIGGER LEVEL control is automatically restricted to the p-p limits of the trigger signal for ease in obtaining triggered displays and acquisitions. P-P AUTO is the usual Trigger mode selection to obtain stable displays of TV line information.

In STORE mode, for SEC/DIV settings of 5 s to 0.1 s per division, the P-P AUTO mode is disabled and the acquisition is free running. At faster settings, triggering occurs under the same conditions as NON STORE mode P-P AUTO triggering, and acquisitions are auto triggered if proper trigger signal conditions are not met. The manner in which the display is filled and updated is the same as in NORM mode.

TV FIELD—Permits stable triggering on a TV field (vertical sync) signal. In the absence of an adequate trigger signal the sweep (or acquisition) will free run.

In STORE mode, TV FIELD behaves the same as P-P AUTO.

SGL SWP—Arms the Trigger system for a single sweep in NON STORE mode or a single acquisition in STORE mode. After the completion of a triggered NON STORE sweep or a STORE SGL SWEEP acquisition, pressing in the SGL SWP button rearms the trigger circuitry to accept the next triggering event or start the next storage acquisition. Pressing SGL SWP in storage mode erases the last acquired waveform.

Display update depends on the SEC/DIV setting.

In STORE mode for SEC/DIV settings of 5 s/DIV to 0.1 s/DIV, the storage process is known as SCAN-ROLL-SCAN. The pretrigger acquisition scans from the left to the trigger position. At that point, the pretrigger portion of the display is rolled left from the trigger position until a triggering event occurs. Upon receiving an adequate trigger, the post-trigger portion of the display scans from the trigger point to the right until the remaining data points are filled and then the display freezes.

For settings of 50 ms/div and faster the display is updated at the point when the post trigger data acquisition is completed. The last acquired waveform remains until that point, then the new waveform is displayed in its entirety.

A SLOPE—Selects either the positive or negative slope of the trigger signal to start the sweep in NON STORE or to reference the next acquisition cycle in STORE.

A TRIGGER LEVEL—Selects the amplitude point on the trigger signal where the sweep is to start. In STORE mode the trigger point is marked with a "T" on the acquired waveform.

HF REJECT—Provides for rejection of high-frequency components of the trigger signal (-3 dB at approx. 40 kHz).

INT—Determines the source of the internal trigger signal for the Trigger System.

CH 1—Trigger signal is obtained from the CH 1 input.

VERT MODE—Trigger signals are obtained alternately from CH 1 and CH 2 when in BOTH-ALT mode. In BOTH-CHOP and BOTH-ADD the trigger signal is the sum of CH 1 and CH 2.

CH 2—Trigger signal is obtained from the CH 2 input. The CH 2 INVERT switch also inverts the trigger signal.

SOURCE—Determines the source of the trigger signal for the Trigger System.

INT—Routes the internal trigger signal selected by the INT switch to the Trigger system.

LINE—Routes a shaped sample of the AC power line signal to the Trigger system.

EXT—Routes the signal applied to the EXT INPUT to the Trigger system.

EXT COUPLING—Determines the method of coupling of the trigger signal applied to the EXT INPUT.

AC—Input signal is capacitively coupled, and the dc component is blocked. The low-frequency limit is approximately 10 Hz (-3 dB).

DC—All input signal components are coupled to the Trigger system.

DC ÷ 10—All input signal components are coupled to the Trigger system after the signal is attenuated by a factor of 10.

STORAGE CONTROLS

DIGITAL STORAGE SYSTEM CONTROLS:

STORE/NON STORE — Selects either the NON STORE mode or the STORE mode for waveform display. In the NON STORE mode the acquisition system is deactivated, and last stored waveform will remain in memory.

ACQUISITION CONTROLS — Determines acquisition length and display method.

SAVE — When depressed, the current acquisition and display update is stopped. In SEC/DIV settings 0.1 s/div and slower, the SAVE state is entered immediately upon pressing the button. At 50 ms/div and faster, if an acquisition has been triggered, the acquisition is allowed to finish before the SAVE state is entered. The pretrigger portion of an untriggered acquisition stops filling in SAVE mode. Upon leaving SAVE, a new acquisition begins and a trigger will not be accepted until the pretrigger data has been acquired.

CONTINUE — The acquisition and display are updated continuously.

PRETRIG — ⅞ of the waveform acquisition window is prior to the trigger event.

POST TRIG — ⅛ of the waveform acquisition window is prior to the trigger event.

ROLL — Active for sweep speed settings of .1 s to 5 s/DIV. This mode disables triggers in either the NORM or P-P AUTO modes and signal data is continuously acquired and displayed. The waveform display scrolls from right to left across the CRT with the latest samples appearing at the right edge of the CRT.

SCAN — Active for sweep speed settings of .1 s to 5 s/DIV. The A Trigger mode controls are functional and behave normally as a triggered display. Triggers are disabled in P-P Auto mode. When a trigger occurs, the pre-trigger portion of the waveform updates, then the post-trigger portion scans from the trigger point to the right edge of the screen.

1K — Selects an acquisition record length of 1K or one screen in length. The displayed waveform has 100 data points per horizontal graticule division (50 points per division if a dual trace acquisition is made).

4K — Selects an acquisition record length of 4K or four screens in length. A one-screen window of the acquisition is displayed, and a bar graph is used to indicate the position of the displayed window within the 4K record. Turn the CURSOR position control to move the display window to any position within the record. If the SAVE REF feature is used to store the waveform, only the displayed 1K window of the 4K acquisition is saved in memory.

The 4K acquisition record can be compressed in length to 1K by rotating the Variable SEC/DIV control out of the CAL detent position. The SEC/DIV readout is adjusted to reflect the increased time per division (4 times the original sweep speed of the 1K displayed window) of the displayed waveform. If the SAVE REF feature is used to store the waveform, the 4K acquisition is saved in memory.

SELECT WAVEFORM — The CURSOR Position control is used to position the cursor(s) to the desired waveform(s).

POSITION CURS — The CURSOR Position control functions as a horizontal positioning control for the active cursor.

CURSOR POSITION CONTROL — Provides for either horizontal positioning of the active cursor(s) or for switching the cursors between waveform display sets. When cursors are positioned to a new waveform set, they maintain their previously set horizontal positioning. Cursor positioning continues to function during SAVE mode, and measurements can be made on any displayed waveform. The CURSOR position control is also used in the menu to select non-default conditions such as WEIGHT of Average, SWP LIMIT, and STORAGE MODES.

SELECT C1/C2 — Selects the cursor(s) that can be positioned by the CURSOR Position control. Cursors are activated alternately with each press of this button. Each selected cursor is enclosed in a box on the display.

MENU—Menu selection allows the change of acquisition parameters and modes that override the default front-panel settings.

WAVEFORM REFERENCE—Controls the storage and display of the SAVE REFERENCE waveforms.

SAVE REF/—In the Menu Select mode, pressing this button enters the next lower menu level. In the Memory Waveform Reference mode, pressing the button 5 s prior to pressing one of the DISPLAY ON/OFF buttons writes the displayed waveform into the selected SAVE REFERENCE memory. The written waveform remains displayed on the CRT.

MENU SELECT/DISPLAY ON/OFF—In Menu mode, these three buttons select choices presented in the MENU. The "◀" button recalls the previous higher Menu level. The "▲" button selects the menu entry that is immediately above the current entry **on the same menu level.** The "▼" selects the menu entry that is immediately below the current entry **on the same menu level.** The "▶" button selects the next lower menu level.

In WAVEFORM REFERENCE mode, these buttons select memories that are capable of storing up to three 1K acquisitions or one 4K acquisition (if SAVE REF has been pressed 5 s prior to their selection). Any combination of the SAVE REF memories and the current acquisition can be displayed on-screen.

MENU:

The 2230 Menu provides an extension of the capability offered on the front panel of the instrument. It allows the user to select various sampling methods, manipulate save reference memory, adjust display parameters, vary the pre/post trigger setting of the instrument, plot waveforms, and more.

The menu is based on a left/right, up/down movement. The second level of a menu is located to the right of the first level. Menu selections on the same level are made by moving up or down in the same level. In order to move to the next higher level of the menu, the user must move to the left. **The main level of the menu can always be reached by moving left a maximum of three (3) times.**

16

The menu always returns to the last displayed level. If this is not desired, the user should return to the main level of the menu before exiting.

TREE:

ACQUISITION MODE SETUP TABLE

DEFAULT—Resets sampling modes to default conditions.

SELECT MODE—Selects alternate sampling modes.

WEIGHT—Selects the weight of average.

SWP LIMIT—Selects the number of sweeps after which the acquisition mode halts in ACCPEAK and AVERAGE mode.

DISPLAY

DELTA T MODE

DELTA TIME—Selects delta time for cursor display.

1/DELTA TIME—Selects 1/delta time for cursor display.

VECTORS

ON—Selects vectors as the display mode.

OFF—Selects dots as the display mode.

SMOOTHING

ON—Selects smoothing in PEAK DET and ACCPEAK.

OFF—Turns smoothing off in PEAK DET and ACCPEAK.

A TRIG POS—Selects the number of points to be displayed before/after (PRE/POST) the trigger event.

FORMATTING—Selects a SAVE REF memory for formatting.

TARGET REFERENCE—Selects the save reference memory location to be formatted.

VGAIN—Changes the selected SAVE REF vertical gain.

V POS—Changes the selected SAVE REF vertical position.

HMAG — Expands the selected SAVE REF horizontal gain by ten.

MODE — Displays the selected SAVE REF acquired sampling mode, displayed and acquired gain settings, pre/post trigger position, other information.

PLOT — Controls X-Y Plotter output transmission.

START — Initiates the X-Y plot.

GRATICULE ON/OFF — Enables or disables graticule printing.

ADVANCED FUNCTIONS — Diagnostics, and GPIB or RS-232-C menu controls only.

MAKING MEASUREMENTS

Note: If the menu is exited, it always returns to the last displayed level. If this is not desired, the user should return to the main level of the menu by pressing ◀ until the main level is displayed.

4K ACQUISITION:

Note: If a 1K acquisition is desired, simply set the 1K-4K switch to the IN position (1K selected). A bar graph will not be displayed.

SET: STORE-NON STORE switch to IN (STORE selected).

SET: 1K-4K switch to OUT (4K selected).

SET: SAVE-CONTINUE switch to OUT (CONTINUE selected). (A 1K portion of the 4K record will be displayed on-screen. A bar graph at the top of the screen indicates the position of the display window within the acquisition record.)

SET: VERTICAL MODE switches to display either CH 1, CH2, or BOTH (CH 1 and CH 2).

ADJUST: TRIGGER LEVEL, TRIGGER MODES, and TRIGGER SOURCES in order to provide a stable display.

SET: PRETRIG-POST TRIG switch as desired.

ADJUST: The CURSOR POSITION control to position the active (boxed) cursor to either edge of the display window. Further positioning of the cursor will cause the display window to move in the direction of the cursor positioning. The display window can be positioned throughout the entire record.

VECTOR/DOT DISPLAY:

NOTE: For SEC/DIV settings of 2 μs/DIV and faster, a vector display is not possible.

REPEAT: The 4K ACQUISITION procedure.

PRESS: WAVEFORM REFERENCE-MENU SELECT switch to OUT (MENU SELECT selected).

PRESS: ▲ or ▼ in order to select DISPLAY.

PRESS: ▶ in order to select the second level of the menu.

PRESS: ▲ or ▼ in order to select VECTORS.

PRESS: ▼ in order to select the opposite display condition (ie., OFF if a dot display is desired, ON if a vector display is desired).

PRESS: WAVEFORM REFERENCE-MENU SELECT switch IN (menu is no longer displayed).

4K ACQUISITION SAVE:

REPEAT: The 4K ACQUISITION procedure.

PRESS: SAVE-CONTINUE switch IN when the desired display is obtained on screen. (A 1K window of the saved 4K record is displayed on-screen.)

4K ACQUISITION SAVE REFERENCE:

REPEAT: The 4K ACQUISITION SAVE procedure.

SET: The SEC/DIV VARIABLE control to the detent (cal) position.

PRESS: ◀ SAVE REF switch IN momentarily.

PRESS: SAVE REF 1 switch IN momentarily. (This chooses the only memory location that permits a 4K record to be saved.)

PRESS: SAVE REF 1 switch IN momentarily (Save reference memory 1 will contain the entire 4K record).

1K ACQUISITION SAVE REFERENCE (4K RECORD):

REPEAT: The 4K ACQUISITION SAVE procedure.

PRESS: ◀ SAVE REF switch IN momentarily.

PRESS: Desired save reference memory location. If SAVE REF 1 is selected, proceed to the next step. If either SAVE REF 2 or SAVE REF 3 is selected, the 1K displayed window has been saved in that memory location.

PRESS: SAVE REF 2 switch IN momentarily (the 1K displayed window has been saved in SAVE REF 1).

PRESS: The save reference switch IN momentarily that contains the saved waveform(s) and note that it is no longer displayed on-screen. Press the same switch again and note that the waveform(s) are once again displayed.

POST ACQUISITION EXPANSION, COMPRESSION, AND POSITIONING:

REPEAT: 1K ACQUISITION SAVE REFERENCE (4K RECORD).

PRESS: WAVEFORM REFERENCE-MENU SELECT switch IN (MENU SELECT selected).

PRESS: ▲ or ▼ to select FORMATTING.

PRESS: ◀ once to select the second level of the menu.

PRESS: ▲ or ▼ to select TARGET REFERENCE.

ADJUST: CURSOR POSITION control to select the save reference that is to be formatted. PRESS CURSOR SELECT to select the channel of the waveform that is to be formatted.

PRESS: ▼ once to select VGAIN.

ADJUST: CURSOR POSITION control to change the voltage gain of the selected save reference waveform by a factor of ten (10). The voltage gain can be either increased or decreased by a factor of ten in a 1-2-5 sequence. This is limited by the available gain settings of the instrument.

PRESS: ▼ to select V POS.

ADJUST: CURSOR POSITION control to vertically position the selected save reference waveform.

PRESS: ▼ to select HMAG.

ADJUST: CURSOR POSITION control to magnify the selected save reference by a factor of ten (X10 MAG) or to turn the ten times magnification off.

PRESS: ▼ to select MODE.

READ: acquisition and current display information regarding the selected save reference waveform.

ADJUST: CURSOR POSITION control to select a different save reference memory, and PRESS CURSOR SELECT to select a channel for which current MODE information will be displayed.

4K COMPRESS to 1K:

REPEAT: The 4K ACQUISITION SAVE procedure.

SET: The SEC/DIV VARIABLE control out of the detent (CAL) position. (The display will now contain the 4K acquisition compressed to 1K for on-screen full-record viewing. Entire 4K record is still saved.)

PRE/POST TRIGGER SELECTION:

SET: WAVEFORM REFERENCE-MENU SELECT switch to OUT (MENU SELECT selected).

PRESS: ▲ or ▼ switch to select A TRIG POS (current selection is underlined in the menu).

ADJUST: CURSOR POSITION control to select the appropriate amount of pre/post trigger (the number of points of pre or post trigger information for either a 1K or 4K is displayed "points 1K"/"points 4K").

SET: PRETRIG-POSTRIG switch to IN to select PRETRIG or OUT to select POSTRIG.

SET: WAVEFORM REFERENCE-MENU SELECT switch to IN (MENU is no longer displayed).

SAMPLING MODE SELECTION (PEAK DETECT, AVERAGE, ACC PEAK, SAMPLE):

SET: WAVEFORM REFERENCE-MENU SELECT switch to OUT (MENU SELECT selected).

PRESS: ▲ or ▼ switch to select <u>ACQ MODE SETUP TABLE</u>.

PRESS: ▶ switch once to select the second level of the menu.

PRESS: ▲ or ▼ switch to select <u>SELECT MODE</u>. (A sampling mode table should be displayed. The columns represent sweep speed ranges. The rows indicate the sampling mode selections that are available. A dash indicates that the corresponding sampling mode is unavailable at the sweep speed/trigger selection. The word ON indicates the current sampling mode for the corresponding sweep speed range. The box indicates the sweep speed range that the horizontal SEC/DIV switch is currently set.)

ADJUST: The CURSOR POSITION control in order to select an alternate sampling mode.

PRESS: CURSOR SELECT once to select the sampling mode selected by the box. The word ON should now be displayed within that box.

SET: WAVEFORM REFERENCE-MENU SELECT switch to IN (MENU is no longer displayed).

CURSOR MEASUREMENTS:

SET: STORE-NON STORE switch to IN (STORE selected). (Cursors are on-screen at all times in the STORE mode.)

SET: VERTICAL MODE switches and TRIGGER MODE, SOURCE and LEVEL to obtain a stable display.

SET: POSITION CURS-SELECT WAVEFORM switch to IN (POSITION CURSOR selected).

ADJUST: CURSOR POSITION control to move the active cursor (the boxed cursor is the active cursor) to the appropriate location.

PRESS: CURSOR SELECT C1/C2 button once to select the other cursor as the active cursor and position that cursor to the desired screen location.

READ: the delta time and delta volts interval on the CRT readout.

ONE OVER DELTA TIME (FREQUENCY) CURSOR MEASUREMENT:

SET: STORE-NON STORE switch to IN (STORE selected). (Cursors are on-screen at all times in the STORE mode.)

SET: VERTICAL MODE switches and TRIGGER MODE, SOURCE, and LEVEL to obtain a stable display.

SET: WAVEFORM REFERENCE-MENU SELECT switch to OUT (MENU SELECT selected).

PRESS: ▲ or ▼ to select <u>DISPLAY</u>.

PRESS: ▶ once to select the second level of the menu.

PRESS: ▲ or ▼ to select <u>DELTA T MODE</u>.

PRESS: ▶ once to select the next level of the menu.

PRESS: ▲ or ▼ to select <u>ONE OVER DELTA TIME</u>.

SET: WAVEFORM REFERENCE-MENU SELECT switch to IN (Menu is no longer displayed).

READ: The one over delta time and delta volts interval on the CRT readout.

DISPLAY SAVE REFERENCE WAVEFORMS WITH CURRENT ACQUISITION:

REPEAT: 1K ACQUISITION SAVE REFERENCE procedure saving reference 1K waveforms in locations 1, 2, and 3.

REPEAT: 4K ACQUISITION SAVE procedure.

PRESS: each SAVE REF memory location switch that is desired to be viewed IN momentarily.

ADJUST: the vertical position of the current acquisition if necessary, to easily view both stored and current acquisitions.

XY STORAGE DISPLAY MODE:

REPEAT: The 4K ACQUISITION procedure for a dual trace display (VERTICAL MODE BOTH, ALT/CHOP).

PRESS: X-Y switch IN (X-Y display selected). (A dot display is obtained with the sampling mode of SAMPLE.)

ROLL STORAGE MODE:

SET: SEC/DIV setting within 0.1 s/DIV to 5 s/DIV. (In storage mode, the STORE ONLY switch multiplies the sweep speeds of 0.1 s, 0.2 s, and 0.5 s/DIV by a factor of ten (10) to 1 s, 2 s, and 5 s/DIV respectively.)

SET: ROLL-SCAN switch to IN (ROLL selected).

SET: TRIGGER MODE switch to P-P AUTO, TV FIELD, or NORM. (The waveform display scrolls from right to left across the CRT with the latest samples appearing at the right.)

SCAN STORAGE MODE:

SET: SEC/DIV setting within 0.1 s/DIV to 5 s/DIV. (In storage mode, the STORE ONLY switch multiplies the sweep speeds of 0.1 s, 0.2 s, and 0.5 s/DIV by a factor, of ten (10) to 1 s, 2 s, and 5 s/DIV respectively.)

SET: ROLL-SCAN switch to OUT (SCAN selected).

SET: TRIGGER MODE switch to P-P AUTO. (The waveform display is continuously updated serially as each data point is acquired. New data writes over previous data from left to right.)

SCAN-ROLL-SCAN SINGLE SWEEP STORAGE MODE:

SET: SEC/DIV setting within 0.1 s/DIV to 5 s/DIV. (In storage mode, the STORE ONLY switch multiplies the sweep speeds of 0.1 s, 0.2 s, and 0.5 s/DIV by a factor of ten (10) to 1 s, 2 s, and 5 s/DIV respectively.)

SET: ROLL-SCAN switch to either IN or OUT (switch position does not affect the display).

SET: TRIGGER MODE switch to SGL SWEEP. (The waveform display SCANS left to right until the pretrigger record is filled, and then ROLLS right to left until a trigger is received. It then SCANS left to right again to fill the post-trigger acquisition record and then freezes.)