TEK REFERENCE GUIDE
070-5371-00
Product Group 46

USING THE

2236

OSCILLOSCOPE

COUNTER
TIMER
MULTIMETER

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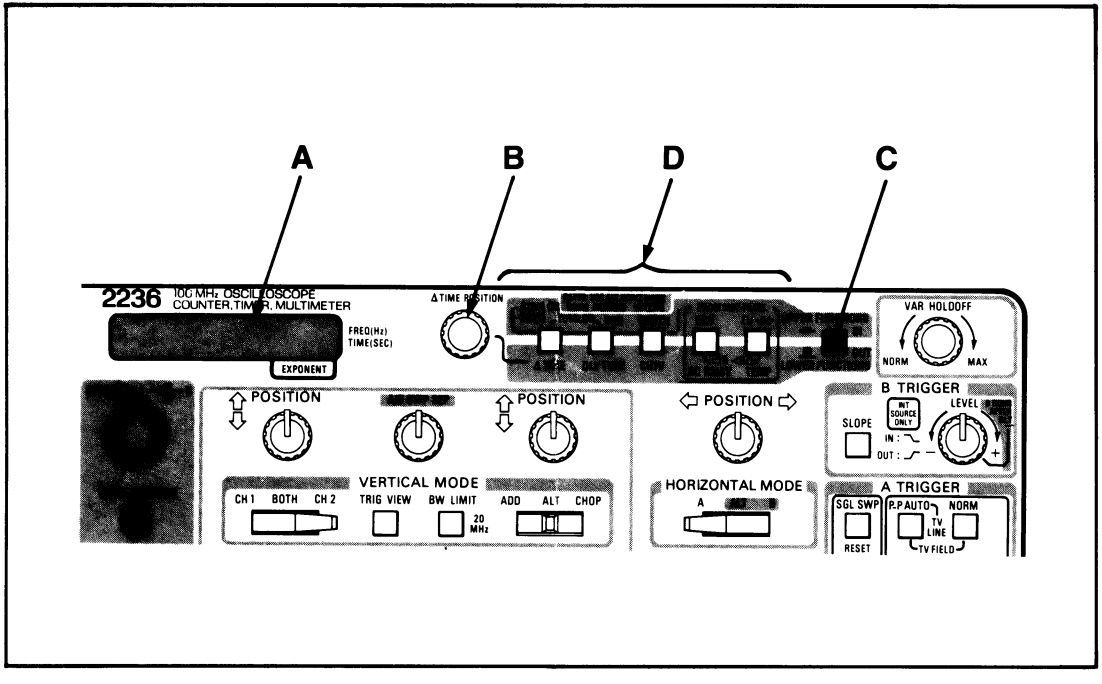
INTRODUCTION

The Tektronix 2236 is more than just a conventional 100 MHz oscilloscope with a counter/timer/multimeter (CTM). The CTM is integrated into the scope's vertical, horizontal, and trigger systems with measurement values displayed on a vacuum fluorescent nine-digit readout.

The counter/timer section of the CTM measures frequency, period, width, totalizes, and provides a digital readout of the B sweep delay time and delta time. It also measures frequency, period, and width, and totalizes on portions of a waveform selected by the intensified zone (gated measurements). Counting and timing measurements are made through the A and the B trigger systems.

The multimeter section of the CTM measures voltages and resistance through the floating input connectors located on the right side of the instrument. Voltages can also be measured through the CH 1 or X & DMM connector. Temperature measurements can be made by connecting the optional temperature probe to the side multimeter input connectors. The multimeter measurement values are displayed with a 3¾-digit (5000 count) format, on the digital readout.



COUNTER/TIMER/MULTIMETER CONTROLS

A. **READOUT**—A nine-digit vacuum fluorescent unit is used to display measurements selected by the CTM. Displays exponents as integer multiples of three, frequency measurements in Hertz, and time measurements in seconds.

B. **Δ TIME POSITION**—In delta time mode, this control determines the time difference between the two intensified zones.

C. **UPPER FUNCTIONS—LOWER FUNCTIONS**—This switch determines which set of CTM functions is activated by the function select switches.

UPPER FUNCTIONS

D. **FREQ**—Measures the frequency of the A trigger signal (in A HORIZONTAL MODE) or the B trigger signal (in ALT or B HORIZONTAL MODE).

PER—Measures the period of the A trigger signal (in A HORIZONTAL MODE) or the B trigger signal (in ALT or B HORIZONTAL MODE).

TOTALIZE—With both the FREQ and PER buttons pressed, trigger events are counted in either the A trigger system (A HORIZONTAL MODE) or the B trigger system (ALT or B HORIZONTAL MODE). The displayed count can be reset to zero by pressing the SGL SWP RESET button or by switching between A and ALT HORIZONTAL MODE.

WIDTH—Measures the width of the A trigger signal (in A HORIZONTAL MODE) or the B trigger signal (in ALT or B HORIZONTAL MODE). The trigger SLOPE switch determines whether the positive or negative displayed half cycles are measured.

DCV—Measures dc voltage from 0 to 499.9 volts at the side multimeter inputs.

Ω/→| (Resistance/Semiconductor): measures resistance from 0Ω (with 0.01 Ω resolution) to 1.99 GΩ (≈2000 MΩ) or automatically indicates that the device under test is a forward-biased semiconductor. This measurement capability is at the side multimeter inputs.

LOWER FUNCTIONS

D. **Δ TIME**—Provides two intensified zones for differential time measurements. The location of the first intensified zone is determined by the B DELAY TIME POSITION control, and the location of the second intensified zone is determined by the Δ TIME POSITION control. The time difference between the start of the two intensified zones is displayed on the readout.

DLY TIME—Measures and displays on the readout the time difference between the start of the A sweep and the start of the B sweep (start of intensified zone).

CH1V—Measures dc or true ac RMS voltage signals applied to the CH1 input connector. Set the input coupling switch to DCV for dc voltage measurements and to AC RMSV for true ac RMS voltage measurements. In CH1V mode, the CTM has the capability of storing a relative reference value. To set the reference value, press the SGL SWP RESET button; the value on the readout becomes the stored reference value.

AC RMSV—Measures the true ac RMS value of the input signal applied to the side multimeter inputs, from 0 to 349.9 volts RMS.

TEMP—Measures temperature in degrees Celsius when the TEMP button is pressed in or degrees Fahrenheit when both the TEMP and Δ TIME buttons are pressed in. The optional temperature probe is required for these measurements.

◁))<5Ω (Continuity)—Press in both the AC RMSV and TEMP buttons for continuity measurements. For resistance readings below five ohms, the word "SHORT" is displayed and a tone is generated. For resistance readings of five ohms or greater, the word "OPEN" is displayed.

CTM ERROR AND STATUS MESSAGES

AC: Appears on the left side of the readout. When the CH1 input coupling switch is set to AC RMSV, this message indicates a CH1V true ac RMS voltage measurement.

Control button Error: Indicates that the CTM does not recognize the selected combination of buttons pressed.

dC: Appears on the left side of the readout. When the CH1 input coupling switch is set to DCV, this message indicates a CH1V average dc voltage measurement.

diodE: This is a momentary message which appears in the Ω/→| (Resistance/Semiconductor) mode when a nonlinear resistance is measured. At the same time, a tone is sounded, and then the forward voltage drop is measured and displayed.

Fd: Indicates that a "forward voltage drop" of a semiconductor is being measured in the Ω/→| mode.

No ALt H: Indicates "no alternate horizontal" this warns you that when in Δ TIME or DLY TIME mode, the HORIZONTAL MODE must be set to ALT.

no A trig: Indicates that the A sweep and/or CTM is not triggered.

no B trig: Indicates that the B sweep and/or CTM is not triggered after delay when in ALT or B HORIZONTAL MODE.

no dELtA: Appears during a Δ TIME measurement and indicates that the second intensified zone is beyond the end of the trace to the right; use Δ TIME POSITION control to move the zone to the left (ccw). This message can also indicate the second intensified zone is not triggered. To correct this, readjust the B TRIGGER LEVEL control.

O'FLO: "Overflow" in WIDTH mode indicates that the width of the input signal exceeds five seconds and is out of the CTM measurement range.

OPEN: In the Ω/→|←(Resistance/Semiconductor) mode the message indicates that either one or both side DMM leads are disconnected or that the resistance measured exceeds 1.99 GΩ (≈2000 MΩ). In the ◁)) <5Ω (Continuity) mode, this message indicates that the resistance equals or exceeds 5Ω.

OUCH: Indicates that the voltage applied to the side multimeter inputs is greater than 500V in DCV mode, and 350V in AC RMSV mode. In the CH1V mode it indicates over-range.

ProbE-?: Indicates that a temperature measurement is selected but a temperature probe is either not connected or is faulty.

r: Indicates CH1V "Relative Reference" mode is active; this is selected by pressing the SGL SWP RESET button.

SELF-tESt: Appears at the beginning of the CTM diagnostic routine; the routine and the other messages associated with it are described in the 2236 Service Manual.

Short: Indicates a resistance less than five ohms in the ◁)) <5Ω (Continuity) mode.

MEASUREMENTS TIME AND FREQUENCY (NONGATED)

FREQUENCY:

SET: HORIZONTAL MODE to A.

SET: VERTICAL MODE, VOLTS/DIV and A SEC/DIV switches to display the desired waveform on the CRT.

SET: A SOURCE to the desired position that is to be measured.

ADJUST: A TRIGGER LEVEL to obtain a stable display.

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to IN and press in the FREQ button.

READ: The trigger signal frequency on the readout.

PERIOD:

REPEAT: The same procedure as described for FREQUENCY measurements except press in the PER button.

WIDTH:

SET: HORIZONTAL MODE to A.

SET: VERTICAL MODE, VOLTS/DIV and A SEC/DIV switches to display the desired waveform on the CRT.

SET: A SOURCE to desired position that is to be measured.

SET: A TRIGGER SLOPE switch to OUT: ⌐‾ to measure positive half cycles and to IN: ‾⌐ for negative half cycles.

ADJUST: A TRIGGER LEVEL so the start of the trace is at the 50% point of the rising or falling edge of the waveform.

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to IN and press in the WIDTH button.

READ: The trigger signal width on the readout.

TOTALIZE:

SET: HORIZONTAL MODE to A.

SET: VERTICAL MODE, VOLTS/DIV and A SEC/DIV switches to display desired waveform on the CRT.

SET: A SOURCE to desired position that is to be measured.

ADJUST: A TRIGGER LEVEL to obtain a stable display.

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to IN and press in both FREQ and PER buttons.

READ: The cumulative total of all A trigger events. Pressing the SGL SWP RESET button will zero the readout for another count.

NOTE: The SGL SWP mode can be used when making a GATED TOTALIZE measurement. This allows the B trigger events to be counted a single time.

GATED MEASUREMENTS:

Gated measurements of frequency, period, width, and totalize are performed through the B trigger system. With the B sweep triggered, the intensified zone duration indicates the gate interval over which the CTM samples the displayed waveform. The intensified zone will blink at the measurement rate.

REPEAT: Nongated procedure for function desired, then perform steps below.

SET: HORIZONTAL MODE to ALT and A SEC/DIV to display the desired waveform on the CRT.

SET: B TRIGGER LEVEL to B RUNS AFTER DLY (fully cw).

SET: Gate interval by pulling the B SEC/DIV knob out and rotate it clockwise to set length of the intensified zone.

ADJUST: B DELAY TIME POSITION to place intensified zone over the waveform features to be measured.

ADJUST: B TRIGGER LEVEL control counter clockwise away from B RUNS AFTER DLY to obtain a stable display (for WIDTH, use B SLOPE to select desired half cycle and adjust B TRIGGER LEVEL so trace start is at the 50% point of the waveform).

READ: Gated measurement on the readout.

NOTE: Maximum resolution will be reduced depending on the number of events inside the intensified zone.

Δ TIME (NON-TRIGGERED WITH ONE SIGNAL)

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in the Δ TIME button.

SET: HORIZONTAL MODE to ALT and B TRIGGER LEVEL to B RUNS AFTER DLY (fully cw).

SET: Vertical mode to the desired channel.

SET: B SEC/DIV to the fastest setting that provides a usable intensified zone and displayable B sweep.

ADJUST: B DELAY TIME POSITION to set the "reference" intensified zone (left most) to the starting point of interest.

ADJUST: Δ TIME POSITION to set the "measurement" intensified zone (right most) to the ending point of interest.

ADJUST: Both B DELAY TIME POSITION and Δ TIME POSITION until both points of interest on the B sweep intersect at any convenient vertical graticule line (NOTE: this step not used in triggered procedure).

READ: The delta time interval on the readout.

NOTE: All Δ TIME measurements are taken from the start of each intensified zone.

Δ TIME (TRIGGERED WITH ONE SIGNAL)

REPEAT: The Δ TIME (NON-TRIGGERED WITH ONE SIGNAL) procedure, then adjust the B TRIGGER LEVEL and B SLOPE to trigger the B sweep.

NOTE: B TRIGGER LEVEL and B SLOPE are the same for both the initial and final trigger points.

Δ TIME (NON-TRIGGERED WITH TWO SIGNALS)

REPEAT: The Δ TIME (NON-TRIGGERED WITH ONE SIGNAL) procedure except now the "reference" intensified zone is slaved to CH1 and the "measurement" intensified zone is slaved to CH2. Set VERTICAL MODE to BOTH-ALT.

NOTE: For nonsynchronous signals, set A & B INT to VERT MODE.

Δ TIME (TRIGGERED WITH TWO SIGNALS)

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in the Δ TIME button.

SET: A SOURCE to EXT, A & B INT to VERT MODE, HORIZONTAL MODE to ALT, and B TRIGGER LEVEL to B RUNS AFTER DLY (fully cw).

SET: B SEC/DIV to the fastest setting that provides a usable intensified zone and displayable B sweep.

CONNECT: The signal that will be the reference to the EXT and CH1 input via a T-connector. (Another probe may be used in place of the T-connector).

ADJUST: B DELAY TIME POSITION to set the "Reference" intensified zone (CH1) to the starting point of interest.

ADJUST: Δ TIME POSITION to set the "measurement" intensified zone (CH2) to the ending point of interest.

ADJUST: B TRIGGER LEVEL and B SLOPE to trigger the B sweep on both the CH1 and CH2 signals.

READ: The delta time interval between the triggered intensified zone on CH1 and the triggered intensified zone on CH2 on the readout.

NOTE: B TRIGGER LEVEL and B SLOPE are the same for both the initial and final trigger points.

DLY TIME (NON-TRIGGERED)

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in the DLY TIME button.

SET: HORIZONTAL MODE to ALT and B TRIGGER LEVEL to B RUNS AFTER DLY (fully cw).

SET: A SOURCE and SLOPE to desired position that will start the A sweep (measurement reference).

SET: B SEC/DIV to the fastest setting that provides a usable intensified zone and displayable B sweep.

ADJUST: B DELAY TIME POSITION to set the intensified zone to the point of interest.

READ: The amount of delay from the A sweep start (reference) to the start of the intensified zone (start of B sweep) on the readout.

DLY TIME (TRIGGERED WITH ONE SIGNAL)

REPEAT: The DLY TIME (NON-TRIGGERED) procedure, then adjust the B TRIGGER LEVEL and B SLOPE to trigger the B sweep.

DLY TIME (TRIGGERED WITH TWO SIGNALS)

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in the DLY TIME button.

SET: HORIZONTAL MODE to ALT, A SOURCE to EXT, A & B INT to CH2, and B TRIGGER LEVEL to B RUNS AFTER DLY (fully cw).

CONNECT: The signal that will be the reference to the EXT and CH1 input via a T-connector. (Another probe may be used in place of the T-connector).

CONNECT: The signal that will be measured to the CH2 input.

SET: B SEC/DIV to the fastest setting that provides a usable intensified zone and displayable B sweep.

ADJUST: B DELAY TIME POSITION to set the intensified zone on the CH2 trace to the point of interest.

ADJUST: B TRIGGER LEVEL and B SLOPE to trigger the B sweep on the CH2 signal.

READ: The amount of delay from the A sweep start (EXTernally triggered reference) to the B sweep start (start of intensified zone) on the readout.

CHANNEL ONE VOLTAGE MEASUREMENTS

CH1V (DC)

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in the CH1V button.

SET: CH1 input coupling to DCV.

CONNECT: Signal to be measured to the CH1 input via a probe or cable.

SET: CH1 VOLTS/DIV switch to a higher setting if "OUCH" is displayed.

SET: CH1 VOLTS/DIV switch to a lower setting if more resolution is desired.

READ: The average dc voltage component of the signal on the readout.

CH1V (AC RMSV)

REPEAT: CH1V (DC) procedure, except set CH1 input coupling to AC RMSV.

NOTE: Probe compensation must be completed before making AC RMSV measurements (see Operators Manual, Section 3).

NOTE: Direct measurements of 50Hz signals and below use of the P6121 X10 probe is recommended.

CH1V RELATIVE REFERENCE

REPEAT: CH1V (DC) or (AC RMSV) procedure to obtain the reference voltage reading.

SET: Reference by pressing the SGL SWP RESET button while the reference voltage is applied. (NOTE: pressing P-P AUTO or NORM will return the sweep).

CONNECT: Probe or cable to the second voltage to be measured.

READ: The voltage level on the readout. The displayed value equals the second measurement minus the reference measurement.

MULTIMETER MEASUREMENTS

DCV

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to IN and press in the DCV button.

CONNECT: Side floating leads to circuit being measured.

READ: The average dc voltage on the readout.

NOTE: If the word "OUCH" is displayed (for inputs >500 V) disconnect floating leads from the circuit to prevent damage.

AC RMSV

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in the AC RMSV button.

CONNECT: Side floating leads to circuit being measured.

READ: The true ac RMS voltage on the readout.

NOTE: If the word "OUCH" is displayed (for inputs >350 V) disconnect floating leads from the circuit to prevent damage.

Ω/→|← (RESISTANCE/SEMICONDUCTOR)

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to IN and press in the Ω/→|← button.

CONNECT: Side floating leads to circuit being measured.

NOTE: For automatic semiconductor detection, allow time for the word "OPEN" to be displayed before connecting to the circuit.

READ: The resistance on the readout.

NOTE: If a semiconductor is detected the CTM will momentarily display "diodE" and generate a tone. Then the forward voltage drop "Fd" will be displayed.

NOTE: The RED lead applies a positive bias voltage with respect to the BLACK lead.

◁)) <5Ω (CONTINUITY)

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in both AC RMSV and TEMP buttons.

CONNECT: Side floating leads to circuit being measured.

READ: The word "OPEN" on the readout for resistances greater than 5 ohms.

READ: The word "Short" along with the audible tone that is generated for resistances less than 5 ohms.

TEMP

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in the TEMP button.

CONNECT: The optional P6602 Temperature Probe to the side inputs.

READ: The temperature in degrees Celsius on the readout.

SET: UPPER FUNCTIONS-LOWER FUNCTIONS switch to OUT and press in both TEMP and Δ TIME buttons.

READ: The temperature in degrees Fahrenheit on the readout.

APPLICATIONS

CONTINUOUS FREQUENCY: Use the Frequency mode to accurately set the frequency of system clocks or similar timing circuits.

SWEPT OR BURST FREQUENCIES: Use the gated Frequency cabability. With a short intensified zone (i.e., one cycle) for a burst measurement. Sweep the signal with the B DELAY TIME POSITION control to analyze changing frequencies.

LINE FREQUENCY: Use the Frequency mode and set the A SOURCE to LINE triggering.

COMPARING PULSE WIDTHS: Use the gated Width measurement. Changing the B TRIGGER LEVEL to B RUNS AFTER DLY will hold the reading while you move the intensified zone to the next pulse.

TOTALIZE THE NUMBER OF EVENTS IN A BURST: Use the Gated Single Sweep Totalize mode, and the CTM will count all B trigger events within the intensified zone a single time.

BABYSITTING GLITCHES: Use the Totalize or Gated Single Sweep Totalize mode.

RISE TIME: Use the Nontriggered Δ TIME mode. Adjust the signal for 5.0 divisions and position at the 0% and 100% points. Adjust the B DELAY TIME POSITION and Δ TIME POSITION controls so the displayed waveforms on the B sweep intersect the center vertical graticule line at the 10% and 90% points.

TIME FROM ONE EVENT TO AN UNKNOWN SINGLE EVENT: Use the Triggered Delay Time mode. Connect reference signal to CH1 and EXT. Connect unknown single event to CH2 and adjust the B TRIGGER LEVEL so it will trigger on CH2. Set the SEC/DIV slow enough so the unknown event will be on screen. Adjust B DELAY TIME POSITION to minimum (fully ccw).

TRANSFORMER INSULATION AND ELECTROLYTIC CAPACITOR LEAKAGE RESISTANCE: Use the Ω/→|←(Resistance/Semiconductor) mode. The ohmmeter will autorange to 2 GΩ (≈2000 MΩ).

SHORTS: Use the low-ohm (0.01 Ω resolution) capability of the Ω/→|← (Resistance/Semiconductor) mode to locate shorted circuit board runs or components.

TRANSISTOR AND DIODE CHECKING: Use the Ω/→|←(Resistance/Semiconductor) mode to check forward voltage drops and reverse-leakage resistance. (See Operators Manual, page 4-12,13).

TRANSISTOR Vbe MATCHING: Use the Ω/→|←(Resistance/Semiconductor) mode to match Base-Emitter forward voltage drops.