

TEK 350 MHz DUAL TRACE OSCILLOSCOPE



485

350 MHz at 5 mV/div

1 ns/div Sweep Rate

3.0 div/ns Writing Speed

1 M Ω and 50 Ω Input Impedances

Input Protection 50 Ω Internal

Automatic Deflection Factor Readout

Pushbutton Ext Trigger View

Battery Operation (Optional)

Weighs ~9.5 kg

At just 21 pounds, the 1 ns/div dual-trace 485 is the only true portable 350 MHz oscilloscope on the market. This wide bandwidth is one reason why the 485 is highly compatible with today's increasing technology.

Many features contribute to the 485's extraordinary overall performance. Fast 3.0 div/ns writing speed is one, making it especially attractive for use in field research environments.

The 485 features a wide bandwidth at its full 5 mV/div vertical sensitivity (350 MHz at 50 Ω and 250 MHz at 1 M Ω). Selectable input impedance provides the capability to measure low and high impedance points with the same scope and without active probes.

Internal detection circuitry protects the 50 Ω input by automatically disconnecting when the signal exceeds approximately 5 V RMS.

You no longer have to mentally compensate for attenuating probes. Automatic vertical scale-factor readout is provided by three light-emitting diodes located around the edge of each input attenuator knob. A quick glance at the readout tells the operator the correct on-screen V/div when the recommended 10X or 100X probes are used.

And you always know exactly where you are in a pulse train when making a delayed sweep measurement. An alternate sweep mode allows the delayed sweep to appear alternately with the intensified main sweep. In this mode, you can view the intensified zone and the delayed display simultaneously.

The external trigger signal can be easily viewed on the 485. A front-panel pushbutton automatically routes the external signal used to trigger Time Base A to the vertical deflection amplifier. This feature can also be used to quickly make time comparisons between the signal of interest and the external trigger signal.

On the 485, focus is always correct in single-shot photography. An autofocus circuit eliminates the need to readjust the focus each time the intensity is changed.

When commercial power is not available, use the 1105 Battery Power Supply. It weighs only 19.5 pounds, and lets you take the high-performance 485 virtually anywhere.

Often chosen as a general-purpose scope for computer and electronic servicing environments because of its fast writing speed and wide bandwidth, the 485 can also be found in specialized and unusual applications. For example, to maintain a groundbased laser/radar acquisition system, the 485's alternate sweep switching mode proved an important factor.

VERTICAL DEFLECTION (2 Identical Channels)

Bandwidth* and Rise Time — (at all deflection factors from 50 Ω terminated source).

	-15°C to +35°C	+35°C to +55°C
50 Ω	Dc to 350 MHz, 1 ns	Dc to 300 MHz, 1.2 ns
1 M Ω	Dc to 250 MHz, 1.4 ns	Dc to 200 MHz, 1.8 ns

*Measured at -3 dB. Bandwidth may be limited to ~20 MHz by bandwidth limit switch.

Lower -3 dB point, ac coupling 1X probe: 1 kHz or less for 50 Ω , and 10 Hz or less for 1 M Ω . 10X probe: 100 Hz or less for 50 Ω , and 1 Hz or less for 1 M Ω .

Deflection Factor — 5 mV/div to 5 V/div (1-2-5 sequence), accurate $\pm 2\%$. Uncalibrated, continuously variable between steps and to at least 12.5 V/div. Gain can be recalibrated at the front panel.

Display Modes — Ch 1, Ch 2 (normal and inverted), alternate, chopped (~ 1 MHz rate), X-Y (Ch 1-Y and Ch 2-X), ADD (Ch 1 + Ch 2).

CMRR — Common-mode rejection ratio at least 20 dB at 50 MHz for common-mode signals of 6 div or less.

Automatic Scale Factor — Probe tip deflection factors for 1X, 10X, and 100X coded probes are automatically indicated by three readout lights at the edge of the knob skirts. All lights are off when the channel is not selected for display or when the trace identification control on the probe is depressed.

Selectable Input Impedance — 50 Ω and 1 M Ω impedances are available at a single BNC connector by pushbutton selection.

50 Ω $\pm 0.5\%$; VSWR 1.15:1 or less from 20 mV/div to 5 V/div. 1.25:1 or less at 5 mV/div and 10 mV/div to 350 MHz.

Input R and C — 1 M Ω $\pm 1\%$ parallel by ~ 20 pF.

50 Ω Protection — Internal detection circuitry provides protection by automatically disconnecting excessive signals of up to 50 V. The "disconnected" condition is indicated, and has manual reset.

Max Input Voltage

	Protection disconnect occurs for voltages that exceed approx:
50 Ω	5 V RMS continuous 0.1 watt-second for instantaneous voltages of 5 V to 50 V. Signals in excess of 100 V will damage the instrument.
1 M Ω	Dc coupled: 250 V (dc + peak ac), 500 V p-p to 1 kHz. Ac coupled: 500 V (dc + peak ac), 500 V p-p to 1 kHz.

Selectable Input Coupling — Ac; dc; GND (provides zero reference, precharges coupling capacitor, disconnects 50 Ω load in 50 Ω mode).

Delay Line — Permits viewing leading edge of displayed waveform.

Probe Power — Connectors provide correct voltages for two optional P6201 FET Probes.

HORIZONTAL DEFLECTION

Time Base A and B — Calibrated sweep range; 1 ns/div to 0.5 s/div (1-2-5 sequence).

Variable Time Control — Time Base A provides continuously variable uncalibrated sweep rates between steps and to at least 1.25 s/div.

Time Base A and B Accuracy, center B div

Sweep Rate	+15°C to +35°C	-15°C to +55°C
1 ns/div to 20 ns/div	$\pm 3\%$	$\pm 5\%$
50 ns/div to 0.1 s/div	$\pm 2\%$	$\pm 4\%$
0.2 s/div and 0.5 s/div	$\pm 3\%$	$\pm 5\%$

Horizontal Display Modes — A, intensified, alternate, and B (delayed sweep). A only is displayed for A sweep rates of 1, 2, and 5 ns/div. B ends A for increased intensity in the delayed mode.

Alternate Display Modes — Allows the B delayed sweep to appear alternately with the intensified A sweep. Trace separation control positions B (delayed sweep ~ 4 div from the A sweep).

CALIBRATED SWEEP DELAY

Delay Time Range — 0 to 10X delay time/div setting of 10 ns/div to 0.5 s/div

Differential Delay Time Measurement Accuracy

Delay Time Setting	+15°C to +35°C
10 ns/div and 20 ns/div	± (1% of measurement + 0.2% of full scale)
50 ns/div to 1 ms/div	± (0.5% of measurement + 0.1% of full scale)
2 ms/div to 0.5 s/div	± (1% of measurement + 0.1% of full scale)

Full scale is 10 times the delay time/div setting.

Jitter — 1 part or less in 20,000 of 10X the time/div setting.

TRIGGERING A and B

A Trigger Modes — Normal (sweep runs when triggered) Automatic (sweep free-runs in the absence of a triggering signal and for signals below 20 Hz). Single sweep (sweep runs one time on the first triggering event after the reset selector is pressed). Lights indicate when sweep is triggered and when single sweep is ready.

A Trigger Holdoff — Adjustable control permits a stable presentation of repetitive complex waveforms. The control covers at least the time of one full sweep for faster than 0.2 s/div.

B Trigger Modes — B runs after delay time (starts automatically at the end of the delay time) and B triggerable after delay time (runs when triggered). The B (delayed) sweep runs once in each of these modes, following the A sweep delay time.

Time Base A and B Trigger Sensitivity

Coupling	To 50 MHz	To 350 MHz
Dc Internal	0.3 div deflection	1.5 div deflection
External	20 mV	100 mV
Ac	Signals below 16 Hz are attenuated	
Ac Lf Reject	Signals below 16 kHz are attenuated	
Ac Hf Reject	Signals below 16 Hz and above 50 kHz are attenuated	

Jitter — 0.1 ns or less at 350 MHz at 1 ns/div.

A Trigger View — A spring-loaded pushbutton overrides other vertical controls and displays the external signal used for A sweep triggering. This provides quick verification of the external signal and time comparison between a vertical signal and the external trigger signal. The deflection factor is ≈ 50 mV/div (0.5 V/div with external ≈ 10 source).

Level and Slope — Internal, permits selection of triggering at any point on the positive or negative slope of the displayed waveform. External, level is adjustable through at least ± 0.5 V for either polarity; ≈ 5 V for Ext ≈ 10 .

A Sources — Internal, line, external, external ≈ 10 .

B Sources — B runs after delay time, internal, external, external ≈ 10 .

External Inputs — R and C approx 1 M Ω paralleled by ≈ 20 pF. Max input voltage: 500 V (dc + peak ac), 500 V p-p to 1 kHz.

X-Y OPERATION

Full Sensitivity X-Y (Ch 1 Vert, Ch 2 Horiz) — 5 mV/div to 5 V/div, accurate $\pm 2\%$. Y-axis bandwidth identical to Channel 1. X-axis bandwidth is dc to at least 4 MHz (≈ 3 dB). Phase difference between amplifiers is 3° or less to 4 MHz.

DISPLAY

CRT — 8 x 10 div display, each div is 0.8 cm. Horizontal and vertical centerlines further marked in 0.2 div increments. P31 Phosphor standard; P11 optional. 21 kV accelerating potential.

Photographic Writing Speed — At least 3 divs with standard P31 Phosphor and at least 6 divs with optional P11 Phosphor using the TEKTRONIX C-31R Camera and 3000 speed film.

Auto Focus — Automatically maintains beam focus for all intensity settings.

Graticule — Internal, nonparallax; variable edge lighting; markings for measurement of rise time.

Beam Finder — Compresses trace to within graticule area for ease in determining the location of an off-screen signal.

Z-Axis Input — Rise time ≈ 15 ns. Input R $\approx 500 \Omega$; ≈ 0.2 V (dc to 20 MHz) decreases intensity. ≈ 2 V (dc to 2 MHz) blanks max intensity trace.

ENVIRONMENTAL CAPABILITIES

Ambient Temperature — Operating: -15°C to $+55^\circ\text{C}$. Nonoperating: -35°C to $+75^\circ\text{C}$. Filtered forced air ventilation is provided.

Altitude — Operating: to 15,000 ft; max allowable ambient temperature decreased by $1^\circ\text{C}/1000$ ft from 5000 to 15,000 ft. Nonoperating: to 50,000 ft.

Vibration — Operating: 15 minutes along each of the three axes, 0.06 cm (0.025 in) p-p displacement (4 g's at 55 Hz) 10 to 55 to 10 Hz in 1 minute cycles.

Humidity — Operating and nonoperating: 5 cycles (120 hours) to 95% relative humidity referenced to MIL-E-16400F (par 4.5.9 through 4.5.9.5.1, class 4).

Shock — Operating and nonoperating: 30 g's, 1/2 sine, 11 ms duration, 2 shocks per axis in each direction for a total of 12 shocks.

OTHER CHARACTERISTICS

Two-Frequency, Fast-Rise Calibrator — Output resistance is 450 Ω with a rise time (positive slope) into 50 Ω of 1 ns or less. 1 kHz, duty cycle 49.8% to 50.2%. Amplitude is 5 V $\pm 0.5\%$ into 1 M Ω and 0.5 V $\pm 1\%$ into 50 Ω ($\pm 0.5\%$). Optional BNC accessory current loop provides 50 mA $\pm 1\%$. Selectable repetition rates are 1 kHz and 1 MHz $\pm 0.25\%$. Specifications apply over $+15^\circ\text{C}$ to -35°C range.

A Sweep Output — Open circuit, ≈ 10 V positive-going sawtooth; into 50 Ω , ≈ 0.5 V.

A and B Gate Outputs — Open circuit, ≈ 4 V positive-going rectangular pulse; into 50 Ω , ≈ 0.5 V.

Power Requirements — Recessed slide switch selects nominal operating line range. Line voltage range is 90 V to 136 V and 180 V to 272 V. 60 W max power consumption at 115 V. Line frequency 48 to 440 Hz.

PHYSICAL CHARACTERISTICS

Dimensions	Cabinet		Rackmount	
	cm	in	cm	in
Height	16.8	6.6	17.7	7.0
Width	30.5	12.0	48.3	19.0
Depth			45.7	18.0
(handle extended)	52.3	20.6		
(handle not extended)	47.0	18.5		
Weights (Approx)	kg	lb	kg	lb
Net (with accessories)	10.9	24		
Net (without accessories)	9.5	21	11.9	26.2
Shipping	15	33	24.5	54

INCLUDED ACCESSORIES

50 Ω , 18 inch BNC cable (012-0076-00), two BNC jack posts (012-0092-00), two 50 Ω terminators (011-0049-01) clear filter (386-0118-00), four 3 amp fuses (159-0015-00), accessory pouch (016-0535-00) or (016-0537-00). Rack models also include mounting hardware and slide out assemblies.

ORDERING INFORMATION

485 Oscilloscope

R485 Oscilloscope, 7 in Rack Model

INSTRUMENT OPTIONS

Option 04 Emc Modification for 485

Option 04 Emc Modification for R485

Option 78 P11 Phosphor

INTERNATIONAL POWER CORDS AND PLUG OPTIONS

Option A1 Universal Euro 220 V/16A

Option A2 UK 224 V/13A

Option A3 Australian 240 V/10A

Option A4 North American 240 V/15A

For more information on instrument options, see your Tektronix Sales Engineer, Distributor, or Representative.

OPTIONAL ACCESSORIES

Probes —

Input Terminal	Probe Type	Attenuation	Input Impedance	Bandwidth* with 485
50 Ω Input	P6056 6 ft	10X	500 Ω 1 pF	350 MHz
	P6057 6 ft	100X	5000 Ω 1 pF	350 MHz
	P6201 FET 2 Meter	1X	100 k Ω 3 pF	300 MHz
		10X Head	1 M Ω 1.5 pF	
50 Ω or 1 M Ω	P6202 2 Meter	10X	10 M Ω 2 pF	285 MHz
		100X Head (optional)	10 M Ω 13 pF	250 MHz
1 M Ω Input	P6063B 6 ft	1X	1 M Ω 12 pF	6 MHz
		Switchable 10X	10 M Ω 14 pF	200 MHz
Current Probe	Probe Type	Calibration	Insertion Impedance	Bandwidth* with 485
	P6022	1 mA/mV 10 mA/mV (Selectable)	0.00 Ω @ 1 MHz In- creasing to 0.2 Ω @ 120 MHz	130 MHz

*Bandwidths are measured at the upper -3 dB, and apply only to the cable length shown. Generally, shorter cable lengths increase bandwidth, longer ones decrease bandwidth.

Current Loop Adaptor — The adaptor provides an accurate 50 mA squarewave calibrator when connected to the 485 voltage calibrator. The rise time is ≈ 25 ns.

Order 012-0341-00

50 Ω 5X Pad — Provides reverse termination for the calibrator.

Order 011-0050-02

Folding Viewing Hoods — Folds to 7/16 x 4 1/2 x 7 1/2 in (1.2 x 11.5 x 18.1 cm).

Order 016-0274-00

Folds to 9/16 x 6 3/4 x 13 3/4 in (1.4 x 17.2 x 34.9 cm).

Order 016-0082-00

SCOPE-MOBILE® Cart — Occupies < 18 in aisle space, has storage area in back.

Order 200C

1105 Battery Power Supply —

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Rack Adapter — 016-0558-00

RECOMMENDED CAMERAS

C-30BP General Purpose Camera — Includes 016-0306-01 mounting adapter.

Order C-30BP

C-31BP High Speed Camera — Includes 016-0306-00 mounting adapter.

Order C-31BP

For further information see Camera section.

Tektronix offers maintenance training classes on instruments in the 400 Series and multi-media training packages on Digital Counter and Meter Concepts and Basic Oscilloscope Maintenance Concepts. For further training information, contact your local Sales Office or request a copy of the Tektronix Customer Training Catalog on the return card.