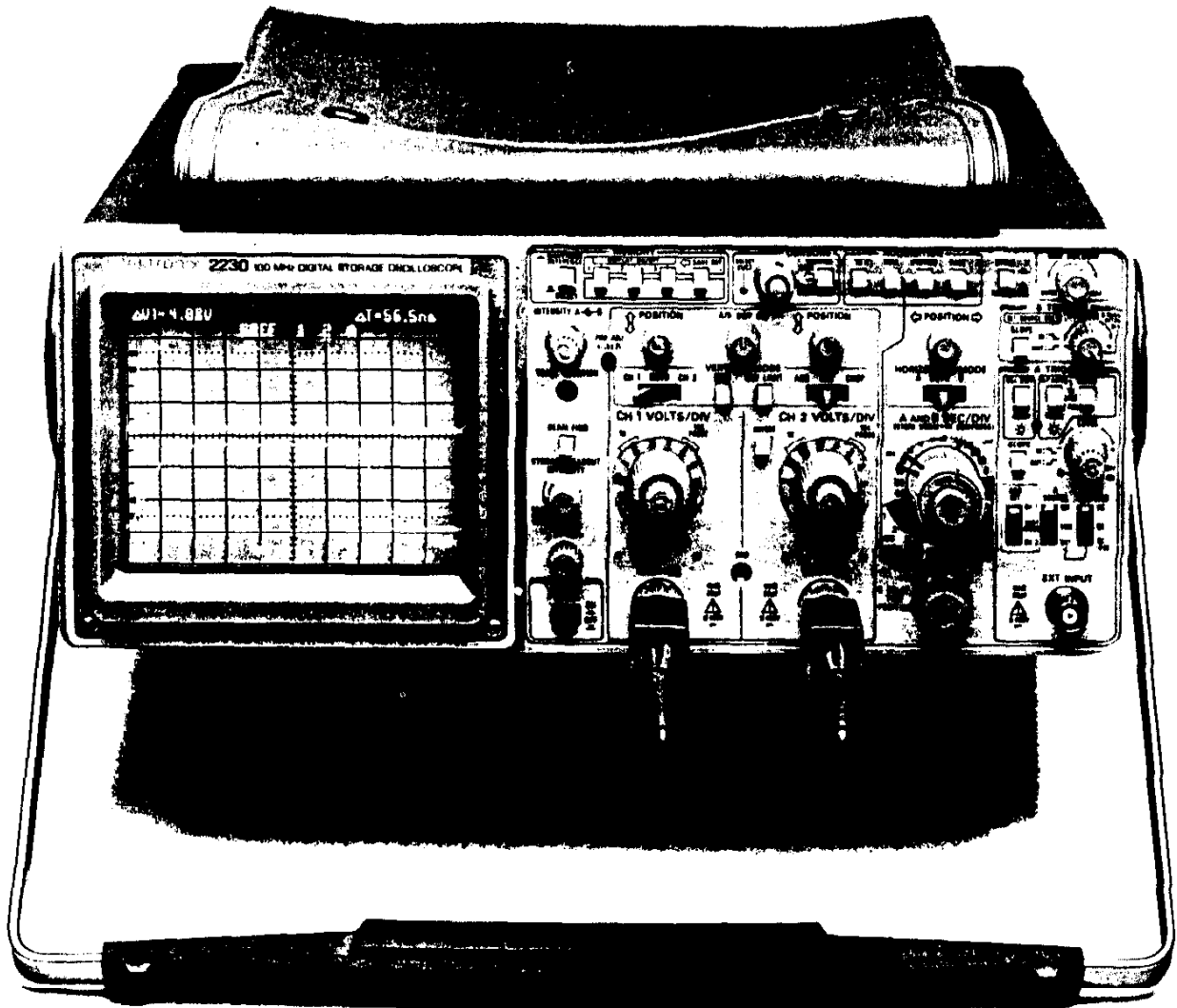




Advanced Test Equipment Corp.

www.atecorp.com 800-404-ATEC (2832)

TEK 2200 Series | 2230 DIGITAL STORAGE OSCILLOSCOPE



2230/2220

The 2230 Option 10/2220 Option 10 comply with IEEE Standard 488-1978 and use Tektronix Standard Codes and Formats. The 2230 Option 12/2220 Option 12 feature Standard RS-232C and use Tektronix Standard Codes and Formats.



- 100 MHz Digital Storage/Nonstorage (2230)
- 60 MHz Digital Storage/Nonstorage (2220)
- 100 ns Glitch Capture at Any Speed
- Cursors for Time and Voltage Measurements (2230)
- Pre/Posttriggering (2220)
- Point Selectable Triggering (2230)
- 4K Record Length
- Post Acquisition Expansion, Compression, and Positioning

GPIB or RS-232C Optional

26K Battery-Backed Save Reference Memory (2230 Option 10 or 12)

Three Year Warranty—Five Years Optional

TYPICAL APPLICATIONS

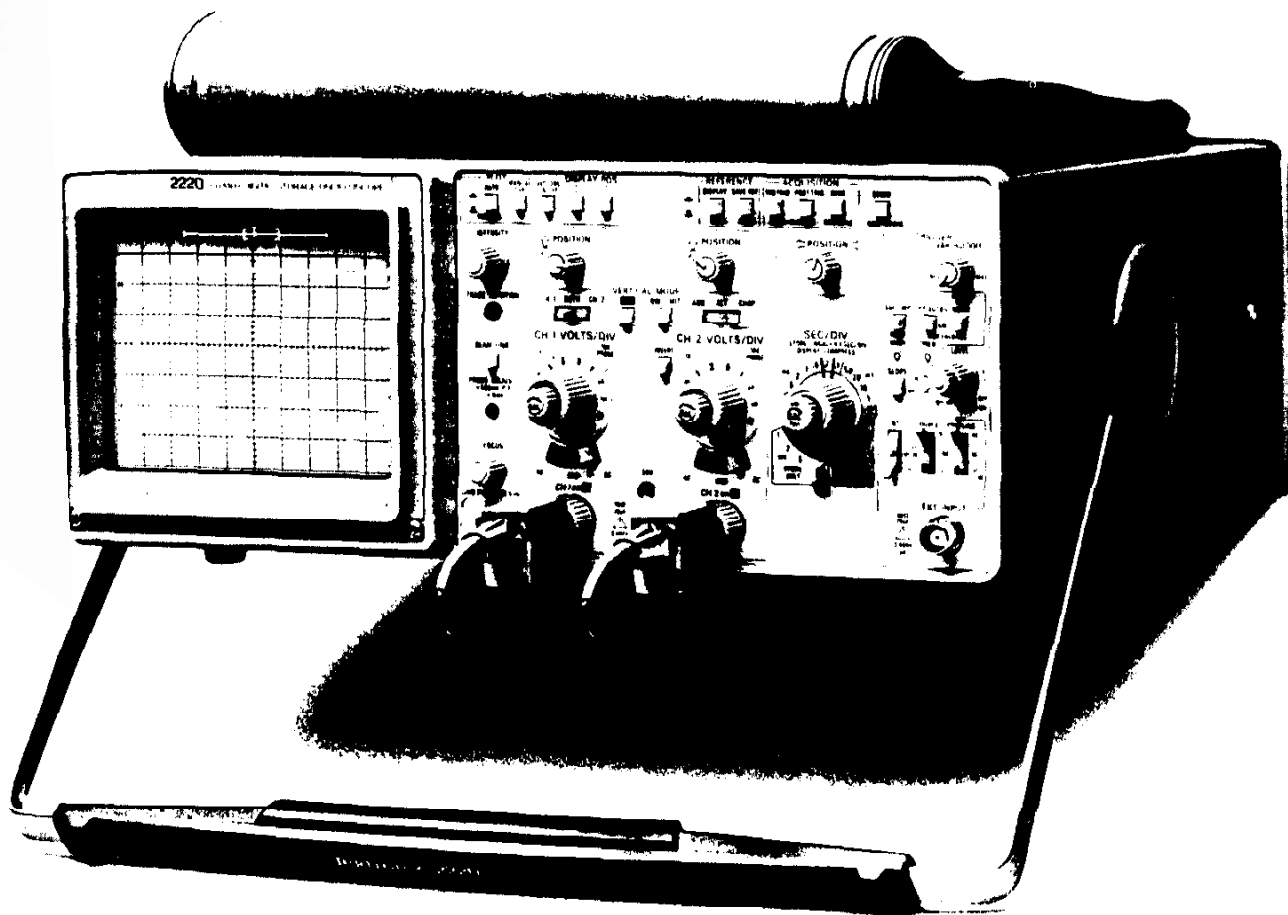
- Medical Equipment Servicing
- Digital Design and Troubleshooting
- Power Supply Design and Troubleshooting
- Electromechanical
- Stress/Vibration Analysis

See page 277 for available Application Notes.

The 2230 and 2220 are the answer for general and special purpose storage needs. These high performance portable scopes have storage and nonstorage bandwidths of 100 MHz (2230) and 60 MHz (2220).

Both scopes have been designed with many features which enhance their usefulness in your applications. The 2230 offers cursors and CRT readout enabling you to measure time or voltage differences easily and accurately. The multiple Save Reference memories allow you to view both stored and current waveform acquisitions onscreen simultaneously. Weighted signal averaging can be used to remove random noise from a signal and improve measurement accuracy.

Peak detection makes 100 ns glitch capture possible at any sweep speed. This mode digitizes and stores, in acquisition memory as a data pair, the minimum and maximum levels of the input signal. The resulting display can be used to catch glitches, as narrow as 100 ns, view frequency drift and amplitude modulation, or detect aliasing.



Unlimited storage time; expandable, compressible, repositionable stored traces; save reference memory; pre/post trigger viewing; roll mode; standard X-Y plotter output; and optional interfaces make the 2230 and 2220 the most sensible digital storage oscilloscopes to own.

CHARACTERISTICS

The following characteristics are common to the 2230 and 2220 except where indicated.

DIGITIZER AND MEMORY

Speed — Digitizing rates from 20 MS/s at 5 μ s/div and faster to 20 samples/s at 5 s/div. CHOP/ALT modes effectively halves the digitizing rate/waveform. The effective sampling rate in Repetitive Storage mode is 2 GS/s.

Useful Storage Bandwidth — Single Shot: Useful storage bandwidth is defined as the maximum sampling rate (20 MS/s) divided by the desired points/signal period. Repetitive Storage Mode: Dc to 100 MHz (2230); Dc to 60 MHz (2220).

Resolution — Vertical: 8 bits, 25 levels/division. Horizontal: 10 bits.

Acquisition/Process Modes — Sample, Peak Detect, Accumulated Peak Detect, Average, Smoothing.

Peak Detect (Enhanced Envelope) Mode — 100 ns minimum pulse width for 100% probability

of 50% signal amplitude capture. 10 MS/s sampling rate.

Average Mode — (2230) Normalized Average weight is selectable from $1/1$, $1/2$, $1/4$, $1/8$, $1/16$, $1/32$, $1/64$, $1/128$, $1/256$. Number of sweeps averaged is adjustable from 1 to 2047 or to an unlimited number. (2220) Average is active from 2 μ s/div and faster. Normalized weight of average is $1/4$.

Pre/Posttrigger — (2230) $1/8$ (PRETRIG) or $1/8$ (POSTTRIG) of waveform acquisition is prior to the trigger event. Trigger position is menu selectable over the entire record. (2220) PRETRIG: $1/8$ of waveform acquisition window prior to the trigger event. POSTTRIG: $1/8$ of waveform acquisition window prior to the trigger event. MIDTRIG: $1/2$ of the waveform acquisition window prior to the trigger event.

Record Length — (2230) 4K or 1K record length selectable. (2220) 4K record length.

Save Reference Memory — (2230) One 4K or three 1K acquisitions may be saved in reference memory. Options 10 and 12 offer 26K of battery-backed reference memory, allowing 26 waveform sets to be saved. (2220) One 4K acquisition may be saved in reference memory.

Total Cursor Accuracy — Voltage: $\pm 3\%$ of delta voltage reading. Time difference is within $\pm [1 \text{ display interval} + 1 \text{ display interval if in ACC PEAK}]$ from 5 s to 5 μ s/div and within $\pm [(2 \text{ display intervals} + (2 \text{ display intervals if in ACC PEAK}) + 500 \text{ ps})]$ from 2 μ s/div to 0.05 μ s/div.

X-Y Plotter Output — Standard on both the 2230 and 2220. The oscilloscopes plot all displayed waveform(s) and readout information. The plotting of the graticule is selectable on the 2230. Plotter pen lift is adjustable with a relative speed range of 1 div/s to 10 div/s.

External Clock — Provides an input for EXT CLOCK signals, dc to 1 kHz, to the storage acquisition system.

VERTICAL SYSTEM (2 Identical Channels)

Bandwidth (-3 dB) and Rise Time (Nonstore) — (2230) 100 MHz and 3.5 ns, derated to 80 MHz and 4.4 ns at 2 mV/div and outside 0 °C to +35 °C. (2220) 60 MHz and 5.8 ns, derated to 50 MHz and 7.0 ns at 2 mV/div and outside 0 °C to +35 °C.

Bandwidth Limit — (2230) 20 MHz $\pm 10\%$. (2220) 10 MHz $\pm 15\%$.

Nonstore Deflection Factor and Accuracy — 2 mV to 5 V/div 1-2-5 sequence, accuracy is $\pm 2\%$ (0 °C to +35 °C). Uncalibrated: Continuously variable between steps to at least 2.5:1.

Store Deflection Factor and Accuracy — 2 mV to 5 V/div. Displayed signal amplitude is within $\pm 3\%$ of the input voltage over the dynamic range of the A/D converter.

Vertical System Operating Modes — CH 1, CH 2, CH 2 Invert, ADD, ALT, CHOP (500 kHz nonstore).

Common-Mode Rejection Ratio — For signals of 6 div or less, at least 10.1 (at 50 MHz).

Input R and C — 1 MΩ, 20 pF.

Maximum Input Voltage (Ac and Dc Coupled) — 400 V (dc + peak ac) or 600 V (p-p to 10 kHz).

Channel 1/Channel 2 Isolation — 100:1 at 50 MHz.

Ac-Coupled Lower Cutoff Frequency — 10 Hz or less at -3 dB.

Automatic Scale Factor — (2230) Probe tip deflection factors for coded probes are automatically indicated in the CRT readout.

HORIZONTAL SYSTEM

A Time Base — 0.05 μs to 0.5 s/div in 1-2-5 sequence. 10X magnifier extends the maximum sweep speed to 5 ns/div. In STORE mode, lower sweep speed is extended to 5 s/div.

B Time Base — (2230) 0.05 μs to 50 ms/div in 1-2-5 sequence. 10X magnifier extends the maximum sweep speed to 5 ns/div.

Variable Sec/Div Control — In Nonstorage mode, uncalibrated variable extends sweeps by at least 2.5:1. In storage mode, a 4K acquisition is compressed to 1K for on-screen viewing.

Sweep Linearity — ±5% over any two of the center eight divisions.

Time Base Accuracy — Storage mode: 0.1% over full 10 cm (or div).

Nonstorage Mode	+15°C to +35°C	0 to +50°C
Unmagnified	±2%	±3%
Magnified	±3%	±4%

Horizontal Operating Modes — (2230) Nonstorage: A, Alternate with A intensified by B, and B; Storage: A, A intensified by B, and B.

DELAYED SWEEP

Delayed Sweep Delay Times — (2230) Continuously variable with 10-turn control from less than 0.5 div plus 300 ns to greater than 10 div.

Differential Delay Time Accuracy — (2230) ±1% (0°C to +35°C, ±2% (0°C to +50°C).

Delay Jitter — (2230) 5,000:1 (0.02%), nonstore mode only.

TRIGGERING

A Trigger Sensitivity

	Internal	External
2230		
10 MHz	0.35 div	40 mV
100 MHz	1.5 div	200 mV
2220		
5 MHz	0.3 div	40 mV
60 MHz	1.0 div	120 mV

B Trigger (Internal Only) Sensitivity — (2230) 0.35 div at 10 MHz, 1.5 div at 100 MHz.

Trigger System Operating Modes — Normal, P-P Automatic, TV Line, TV Field, and Single Sweep. HF REJ triggering attenuates signals above 40 kHz. Lowest usable frequency for P-P Automatic is 20 Hz.

Trigger Coupling — Automatic coupling with internal signal sources: Ac with P-P Automatic and TV Field; Dc with Normal and Single Sweep.

Trigger Sources — A trigger: Internal, external, and line. B trigger (2230): Internal only.

External Trigger Input — Input Coupling: Ac, dc, or dc divide by 10. Bandwidth: 100 MHz (2230), 60 MHz (2220); Ac-coupled lower cutoff

frequency is 10 Hz or less at -3 dB. Maximum safe input voltage same as scope's vertical channels.

X-Y MEASUREMENTS

Deflection Factors — Same as scope's vertical system with the Volts/div switch in calibrated detent.

Accuracy — Storage Mode is same as digital storage vertical deflection system.

2230 Nonstorage	Y-Axis	X-Axis
+15°C to +35°C	±2%	±3%
0°C to +50°C	±3%	±4%

Storage Mode Bandwidth — (2230) dc to 100 MHz. (2220) dc to 60 MHz. Bandwidth changes proportionate to sweep speed.

Nonstorage Bandwidth — Y-axis same as scope's vertical system, X-axis: 3.0 MHz.

Nonstorage Phase Difference — Between X and Y amplifiers: ±3° from dc to 150 kHz.

Storage Mode Phase Difference — Time difference between Y-axis and X-axis is no more than 100 ns. The X-axis is sampled before the Y-axis. Between X and Y amplifiers: Less than ±2° referenced to a 10 division signal period.

CRT AND DISPLAY FEATURES

CRT — 8 x 10 cm display, internal graticule, non-illuminated, accelerating potential is 14 kV, GH (P31) phosphor standard.

Controls — Beam finder, focus, separate A and B sweep intensity (2230), Storage/Readout intensity (2230), trace rotation.

Z-Axis — Sensitivity: 5 V causes noticeable modulation, positive voltage decreases intensity. Usable frequency range is dc to 20 MHz (2230), to 10 MHz (2220). Maximum safe input voltage is 30 V (dc + peak ac) or 10 V ac p-p at 1 kHz or less. Input resistance is approximately 10 kΩ.

OTHER CHARACTERISTICS

Probe Adjustment Signal — 0.5 V ±5% squarewave at 1 kHz ±20%.

POWER REQUIREMENTS

Line Voltage Range — 90 V ac to 250 V ac.

Line Frequency — 48 Hz to 440 Hz.

Maximum Power Consumption — 85 W, 2.0 A, at 250 V (slow blow).

ENVIRONMENTAL

Temperature — Operating: 0°C to +50°C; Nonoperating: -55°C to +75°C.

Altitude — Operating: to 4500 meters (15,000 ft), maximum operating temperature decreased 1°C per 1,000 ft above 5,000 ft. Nonoperating: to 15,000 m (50,000 ft).

Humidity — Operating and Nonoperating: 5 cycles (120 hours) referenced to MIL-T-28800C, for Type III, Class 5 instruments.

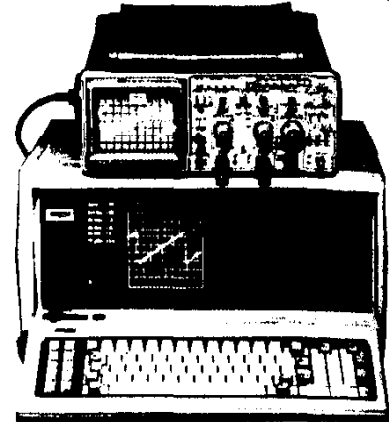
Radiated and Conducted Emission — Requirements per VDE-0871. Meets Class B.

Vibration — Operating: 15 minutes along each of three axes at a total displacement of 0.015 inch p-p (2.4 g's at 55 Hz) with frequency varied from 10 to 55 to 10 Hz in one minute sweeps; hold for 10 minutes at 55 Hz in each axis; all major resonances must be above 55 Hz.

Shock — Operating and Nonoperating: 30 g's, half-sine, 11 ms duration, 3 shocks per axis for a total of 18 shocks.

PHYSICAL CHARACTERISTICS

Dimensions	mm	in
Width		
With handle	360	14.2
Without handle	328	12.9
Height, with feet and handle	137	5.4
Depth		
With front cover	445	17.5
With front cover	440	17.3
With front cover	511	20.1
Weight—	kg	lb
Net, without cover, accessories, and pouch	8.3	18.0



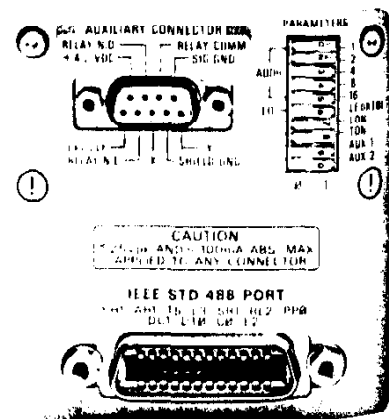
Option 10 GPIB Interface

Option 12 RS-232C Interface

GPIB (Option 10) and RS-232C (Option 12) interfaces are available for the 2230 and 2220. Either interface can transmit and receive waveform data. Most front panel settings can be queried and many functions can be controlled via the interface e.g., single sweep reset.

2230 Option 10 or 12 interfaces also allow messages or computed results to be displayed on screen, and include a battery-backed reference memory (minimum lifetime 3 years) for storage of up to 26 additional waveform sets.

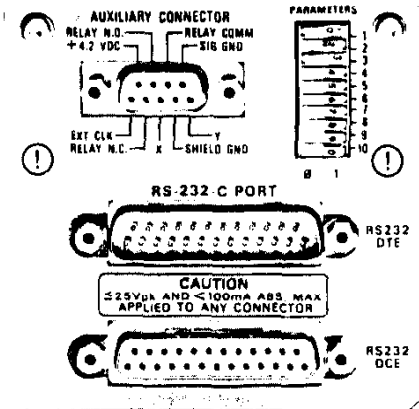
Option 10 GPIB Interface



The Option 10 GPIB interface conforms to IEEE Standard 488-1978. It is fully compatible with Tektronix Standard Codes and Formats. Primary address (0-30), message terminator (EOI or LF/EOI) and talk/listen mode are selected by a switch on the oscilloscope side panel. Maskable interrupts for RQS and OPC can be programmed.

**IEEE Standard 488-1978 Interface Function
Subsets Implemented** — SHI, AHI, T6, L3, SRI,
RL2, PP0, DCI, DT0, C0.

Option 12 RS-232C Interface



Model 2230

The Option 12 RS-232C interface has both DCE and DTE connectors. It is compatible with an extension of Tektronix *Standard Codes and Formats*. Baud rate (50-4800), parity (Odd, Even, Mark, Space, or none), line termination (CR or CR-LF), and SRO generation on parity error (ON or OFF) are selected by a switch on the oscilloscope side panel. Number of bits per character (7 or 8), number of stop bits (1 or 2), and CTRL-S/CTRL-Q handshaking (enable/disable) may be changed by remote commands. The interface automatically senses the presence of Clear to Send (CTS)/Request to Send (RTS) or Data Set Ready (DSR)/Data Terminal Ready (DTR) handshaking lines.

Option 12 for the 2230 also includes 26K of battery-backed reference memory for the storage of up to 26 waveform sets.

Direct Connection to Printers and Plotters via GPIB or RS-232C.

A 2230 or 2220 equipped with either Option 10 or Option 12 interface is fully compatible with any Digital X-Y plotter that uses Hewlett-Packard Graphics Language (HPGL). The GPIB interface is also compatible with the HP ThinkJet 2225A printer. The RS-232C interface also supports any Epson FX-Series format printer or the HP Thinkjet 2225D printer. Plotter output is directed to the interface if its control switches are set for the appropriate plotter or printer. Otherwise, plotting is directed to the X-Y outputs.