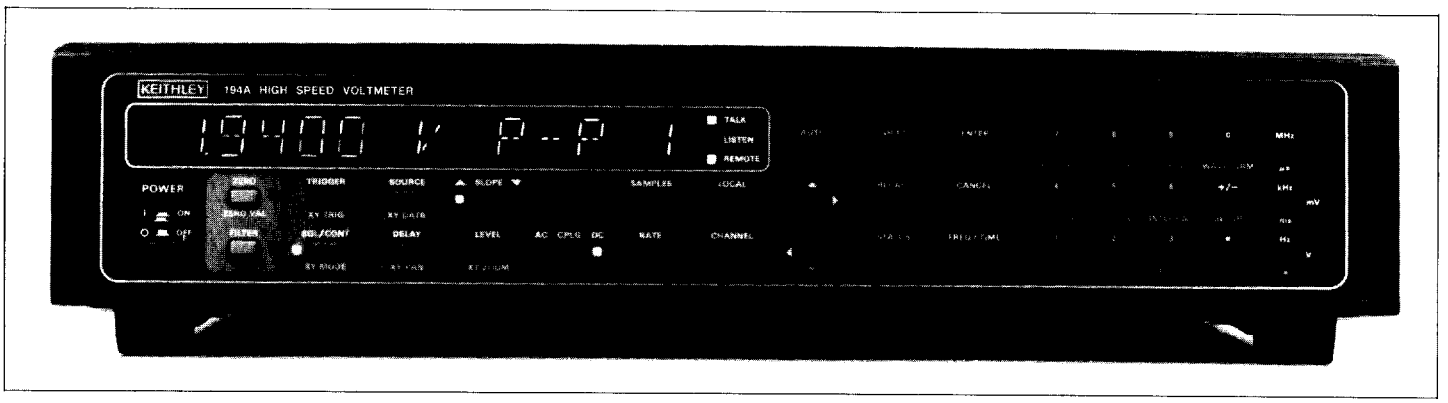

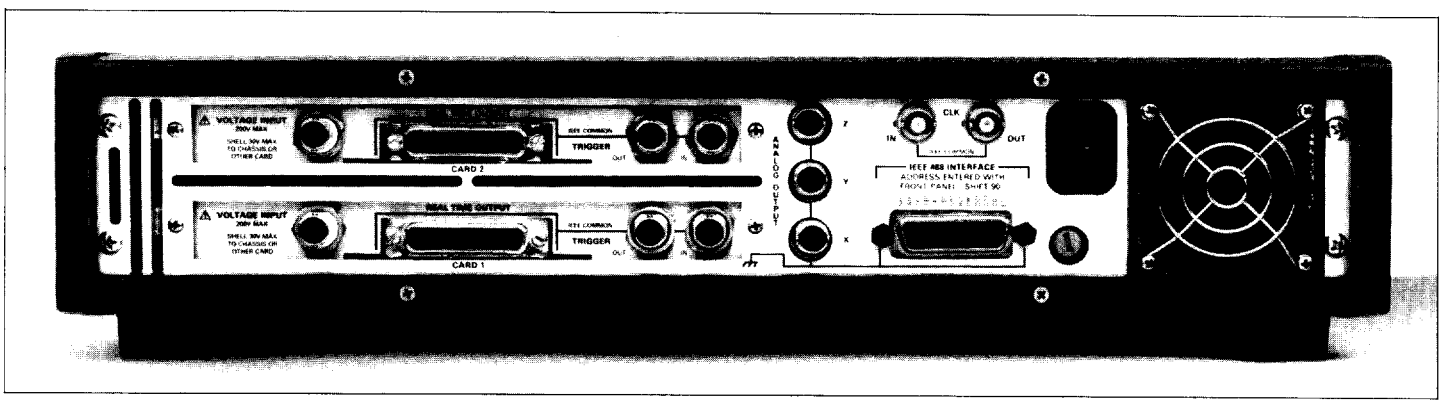

Rear panel of Model 194A shows Model 1944A Channel 2 installed, as well as analog output, IEEE-488, and CLOCK IN/OUT connectors.

- **16-bit (4½-digit) resolution up to 100k samples/second**
- **64k bytes memory/channel**
- **Two independent, fully programmable channels**
- **External sample trigger rate to 1MHz**

The Model 194A high resolution digitizer can both acquire waveforms whose frequency components are below 500 kHz and take externally triggered samples at rates as high as 1M samples/second. With the Model 1944A Channel 2 option, two waveforms or two externally-triggered sets of samples can be taken simultaneously. In addition to waveform acquisition, the Model 194A also provides waveform analysis capability with eight built-in computation functions.

The 194A is a fully programmable IEEE-488 interfaceable instrument. The interface enables use in an automated system, where its full power can be realized.

High Resolution Digitizer. At sampling rates up to 100kHz, the 194A provides 16-bit (4½-digit) resolution. Thus the 194A is capable of detecting changes as small as 1 part in 32,000. This is far greater resolution than is provided by most other digitizing instruments, and enables the 194A to extract more information from a waveform. The 194A also accepts a wider range of input signals: it can detect as low as 10μV, and is designed to digitize up to 200V. Because its input is isolated, input signals need not be referenced to ground.

When greater speed is more important than high resolution, the 194A can sample at rates between 100kHz and 1MHz with 8-bit resolution. Unlike some digitizers, it is not limited to a fixed set of rate options: Any sampling time interval from 1.0μs to 1.0s can be programmed, and resolution is 0.1μs over the complete range of time intervals.

Extensive Memory. A total of 64k bytes of memory is available for sample storage. In 16-bit resolution mode, the 194A can store 32k samples; with 8-bit resolution, storage capacity increases to 64k samples. This is 16 times greater than the available memory in many other digitizing instruments.

The 194A can store data prior to a trigger event (pre-trigger) or delay the onset of data storage for a fixed time after a trigger event (post-trigger). Pre-triggering enables the investigation of phenomena that occurred prior to an event being studied; post-triggering avoids the collecting of an unwanted segment of information, such as a switching-related transient, following a trigger event.

Two Independent Channels. Two waveforms or two sets of samples can be acquired simultaneously or in time synchronization with the addition of the optional Model 1944A Channel 2. With the second channel installed, the Model

becomes two entirely independent waveform acquisition channels, each with 64k of memory.

Measurement Triggers. For waveform acquisition, there is a choice of five trigger sources which are independently programmed for each channel: 1.) an input waveform at any level or slope; 2.) an external TTL control signal; 3.) an IEEE-488 command; 4.) the other channel; and 5.) manual, pushbutton trigger. Once triggered, the 194A digitizes at the programmed sampling rate.

External Sample Trigger. When high speed measurements synchronized to external events must be acquired, the Model 194A offers the fastest sample trigger rate available: 1MHz. For high throughput in component test systems or for data acquisition at varying sample intervals, the 194A can respond to external sample trigger pulses generated at intervals as short as 1μs. Examples of applications where fast external triggering is necessary include dynamic testing of A/D and D/A converter operation, in which sample acquisition must be synchronized to input source transitions, and measurements synchronized to non-constant mechanical rotations from a motor drive.

Waveform Analysis. The 194A directly computes and displays waveform parameters. It supplies a waveform's positive and negative peaks, the peak-peak, an average, or an RMS value. The RMS computation is accurate for any type of waveform. Unlike conventional DMMs, which convert an ac signal to a dc signal with a non-linear circuit, the 194A digitizes directly and mathematically computes the RMS. The RMS computation is not affected by non-linear circuit effects, and is not limited to signals of specific crest factors, as is a DMM.

The INTEGRATE function can be used to convert an acceleration waveform into a velocity. For statistical analysis, the standard deviation of a set of samples can be taken. With two channels, RATIO and DIFFERENCE functions can provide comparison information on two waveforms.

For test set-up and troubleshooting, or for hard copy output without a computer, analog outputs can transmit a stored waveform to an oscilloscope, a CRT monitor, a chart recorder, or an analog X-Y recorder.

High Speed IEEE-488 Bus Performance. The 194A is optimized to handle the large quantity of data that can be stored. In binary format, data can be transmitted over the IEEE-488 bus at 90k bytes/second. At this speed, the 194A can transfer the total contents of the 64k memory to a computer in under 1 second. Furthermore, each channel has a real time output port, so that data can be transferred as it is digitized. At the fastest sampling rate, samples can be output over the real time output port at 1M samples/second.

TRANSLATOR. Our exclusive TRANSLATOR software can reduce IEEE-488 bus traffic by converting long command strings into short, understandable mnemonics. For example, instead of having to transfer a long command string like:

```
F2R1S0/10E-6N1/250E-1I1P0X
```

you can send:

```
TEST1
```

Your code becomes more readable and, in this case, only 5 characters must be transferred over the bus as opposed to 26.

DC CHARACTERISTICS

	16 BIT		8 BIT	
RANGE	RESOLUTION	ACCURACY* ±(%rdg + offset) (1 Yr., 18°-28°C)	RESOLUTION	ACCURACY* ±(%rdg + offset) (1 Yr., 18°-28°C)
320 mV	10 μV	0.030% + 200 μV	2.56 mV	0.42% + 2.56 mV
3.2 V	100 μV	0.025% + 2 mV	25.6 mV	0.42% + 25.6 mV
32 V	1 mV	0.035% + 20 mV	256 mV	0.42% + 256 mV
200 V	10 mV	0.035% + 200 mV	2.56 V	0.42% + 2.56 V

*After pushbutton or bus zeroing, and using average function (10,000 samples, 10μs sample rate).

INPUT IMPEDANCE: 1.1MΩ (1.0MΩ on 200V range) shunted by <47pF.

MAXIMUM ALLOWABLE INPUT: 250V peak, 2×10^7V•Hz.

MAXIMUM COMMON MODE VOLTAGE: 30V rms, 42V peak, 5×10^5 V•Hz.

COMMON MODE REJECTION RATIO: >60dB at dc to 1kHz, 1kΩ unbalance.

DIFFERENTIAL NONLINEARITY: 16-Bit: ≤2 LSB. 8 Bit: ≤0.5 LSB.

TEMPERATURE COEFFICIENT (0°-18°C & 28°-50°C): < ±(0.1 × applicable accuracy specification)/°C.

DYNAMIC CHARACTERISTICS

SAMPLE TRIGGER: Initiates each A/D conversion.

EXTERNAL SAMPLE TRIGGER INPUT: Rising edge, TTL compatible. DB-25 connector.

	INTERNAL SAMPLE TRIGGER		EXTERNAL SAMPLE TRIGGER	
	16 BIT	8 BIT	16 BIT	8 BIT
SAMPLE RATE				
Maximum	100 kHz	1 MHz	100 kHz	1 MHz
SAMPLE INTERVAL				
Minimum	10 μs	1 μs	10μs	1 μs
Maximum	1 s	1 s	No limit	
Resolution	100 ns	100 ns	—	—
Jitter (typical)	±0.4 ns	±2 ns	±2 ns	±2 ns
TIMEBASE ACCURACY	±0.02%	±0.02%	±0.02%	±0.02%
NUMBER OF SAMPLES				
Minimum	1	1	1	1
Maximum	32k	64k	32k	64k

SIGNAL/NOISE RATIO (sinewave curve fit): 50dB for full range 100kHz sine input; 72dB typical at 10kHz.

SLEW RATE: 13V/μs minimum.

SETTLING TIME: 1 μs to 0.1% of final value.

CHANNEL CROSSTALK: <60dB at 500kHz.

INPUT COUPLING: Ac, dc, ground.

FREQUENCY RESPONSE (Filter Off):

0.2 dB	1 dB	3 dB
dc (15 Hz) - 20 kHz	dc (5 Hz) - 200 kHz	dc (2 Hz) - 750 kHz

( ) Indicates ac coupled performance.

LOW PASS FILTER: 50kHz, 500kHz, single pole.

MEASUREMENT TRIGGER

MEASUREMENT TRIGGER: Initiates acquisition of a set of samples.

DELAY:

Pre-Trigger: $-32k < n < -1$, 16-bit mode; $-64k < n < -1$, 8-bit mode. $|n|$ samples are stored prior to measurement trigger.

Post-Trigger: $1 < n < 1 \times 10^7$. Storage begins "n" samples after measurement trigger.

SOURCE:	Description
Input Signal	Slope: + or − Level: Selectable over input voltage range and resolution.
External:	Negative TTL edge, rear panel BNC.
Front Panel:	Manual pushbutton.
IEEE-488 Interface:	16 programmable trigger modes.
Other Channel:	Internally generated.

CHANNEL 2 (Option 1944A)

Permits synchronous or asynchronous sampling of data. Specifications are identical to those of Channel 1. All Channel 2 measurement parameters are independently selectable.

MATH FUNCTIONS

AVERAGE: $\frac{\sum_{i=0}^{n-1} V_i}{n} = V_{avg}$

PEAK TO PEAK: Difference between maximum and minimum values of samples.

PLUS PEAK: Maximum value of samples.

MINUS PEAK: Minimum value of samples.

STANDARD DEVIATION: $\sqrt{\frac{\sum_{i=0}^{n-1} (V_i - V_{avg})^2}{n}}$

TRUE ROOT MEAN SQUARE: $\sqrt{\frac{\sum_{i=0}^{n-1} (V_i)^2}{n}}$

INTEGRAL: $(\frac{1}{2}V_0 + \frac{1}{2}V_{n-1} + \sum_{i=1}^{n-2} V_i)\, t_s$.

DIFFERENCE: Channel 1 − Channel 2.

RATIO: Channel 1 / Channel 2.

NOTE: V_i: Voltage of sample i. **n:** Total number of samples. **i:** Location of individual sample. t_s: Sample interval.

REAL TIME (DMA) OUTPUT

FORMAT: Binary, 16-bit or 8-bit. **RATE:** Same as Sample Rate.

CONTROL LINES: End of Sample, Overrun, High Byte, Low Byte.

ANALOG OUTPUT

MODES	OUTPUTS USED
CRT	x, y, z (blanking)
Oscilloscope	y, z (trigger)
Slow Plot	x, y, z (pen up/down)
Strip Chart	y

X OUTPUT: 0-10V full scale, 2.44mV resolution.

Y OUTPUT: 0-10V full scale, 2.44mV resolution.

Z OUTPUT: 0V, 5V or 15V.

ZOOM MAGNIFICATION: 0.1:1 to 1000:1.

PAN: Across entire memory.

FRONT PANEL PROGRAMS

0 IEEE ADDRESS: Set IEEE-488 address.

1 SELF TEST: Performs internal RAM and ROM check.

2 DIGITAL CALIBRATION: Executes calibration procedure.

3 CALIBRATION STORAGE: Stores calibration constants in NVRAM.

4 X OUTPUT FULL SCALE: Sets full scale X output voltage.

5 Y OUTPUT FULL SCALE: Sets full scale Y output voltage.

6 Z OUTPUT BLANKING LEVEL: Sets high or low blanking level.

IEEE-488 BUS IMPLEMENTATION

MULTILINE COMMANDS: DCL, LLO, SDC, GET, GTL, UNT, UNL, SPE, SPD, MLA, MTA.

UNILINE COMMANDS: IFC, REN, EOI, SRQ, ATN.

INTERFACE FUNCTIONS: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1.

PROGRAMMABLE PARAMETERS: Range, Math Functions, Zero, Delay, Sample Rate, Number of Samples, Trigger, Calibration, Output Format, Self Test, Display, Status, Service Request, Storage, Filter, Terminator, Input Coupling, Buffer Size, Channel, Save and Recall Setups, Front Panel Programs 1-6, Key Sequence, Slope, Analog Outputs, EOI.

BINARY TRANSFER RATE: 90k bytes/second.

GENERAL

DISPLAY: 14-digit alphanumeric LED display; function, bus status also displayed.

RANGING: Manual or autoranging.

WARMUP: One hour to rated accuracy.

OPERATING ENVIRONMENT: 0° to 50°C, 0% to 80% relative humidity up to 35°C.

STORAGE ENVIRONMENT: −25° to 65°C.

POWER: 105-125V or 210-250V (internal switch selectable), 50Hz or 60Hz, 120VA maximum. 90-110V and 180-220V version available.

CONNECTORS: All I/O connectors are BNC except Real Time Output (DB-25) and IEEE-488 connectors.

DIMENSIONS, WEIGHT: 89mm high × 435mm wide × 448mm deep (3½ in. × 17⅛ in. × 17⅝ in.). Net weight 9.1kg (20 lbs.), Dual Channel.

ACCESSORIES AVAILABLE: See Selector Guide on page 24.