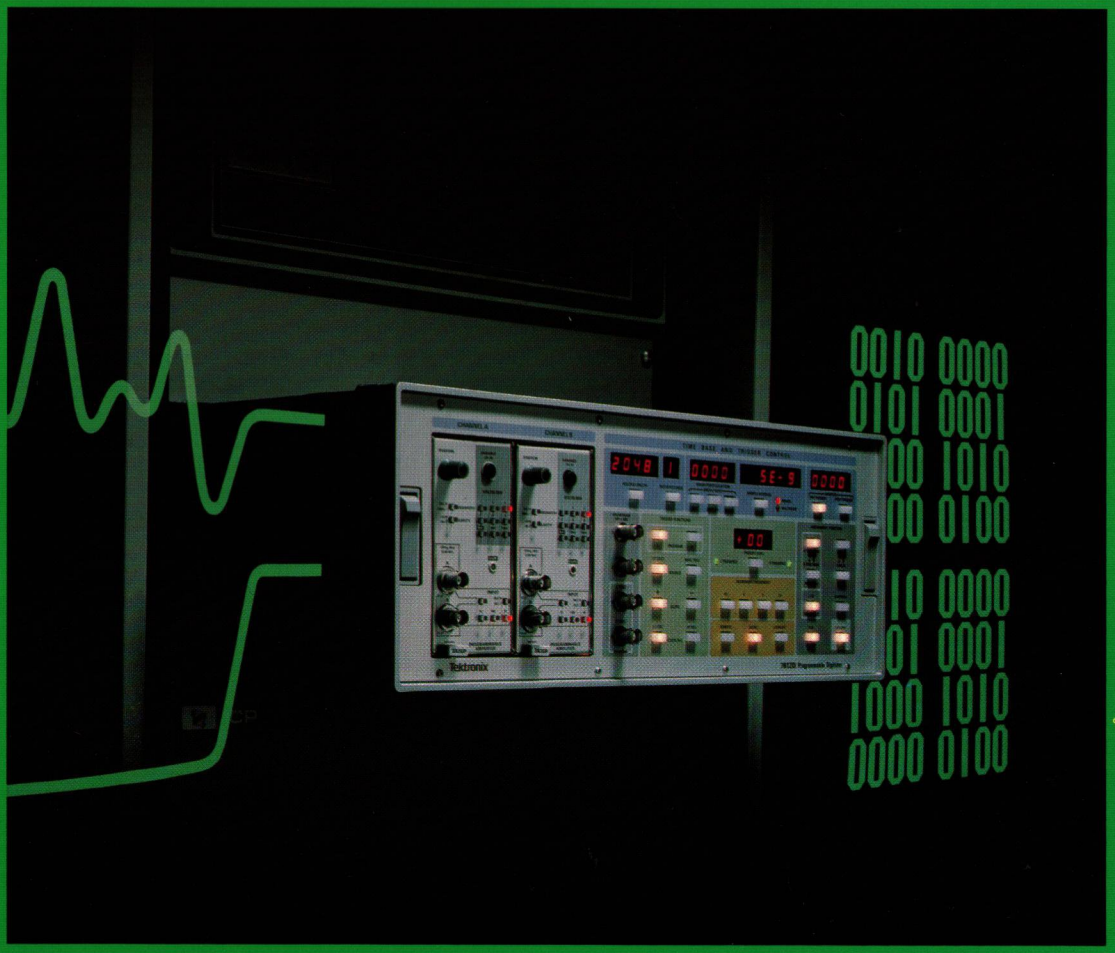
7612D
Programmable Digitizer

Tektronix



Introducing a new standard in Automatic Waveform Measurement:

The Tektronix 7612D Programmable Digitizer.

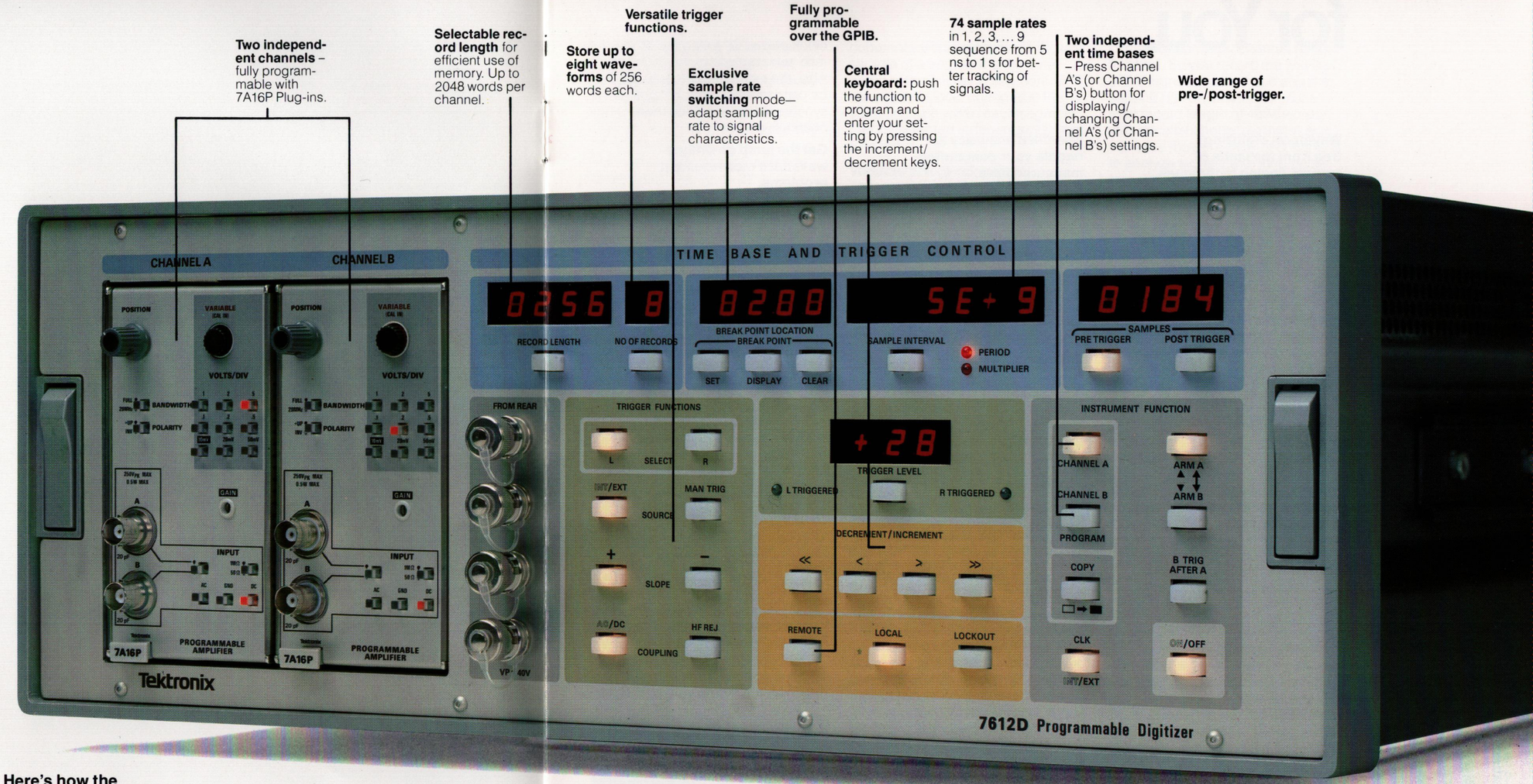
Precise and automatic waveform measurement for demanding applications in R&D and production environments.

As a digitizer, it makes better measurements – faster.

- Capture single shot or repetitive signals from submicroseconds to seconds in duration.
- Perform time measurements on waveforms with crystal-controlled clock accuracy.
- Make accurate measurements with 8-bit resolution – up to 0.4% of full scale (dynamic range of 48 dB).
- Analyze waveform components up to 100 MHz with 200 MHz sampling rate.

Use full performance on two channels.

- Choose instrument settings for each channel independently.
- Vary sampling rates (within records) to resolve high frequency signal components of interest, then record remaining portions at lower rates.
- Use the unique memory partitioning capability to capture fast successive events.
- Observe signals on either side of the trigger using the variable pre-/post-trigger.



Here's how the 7612D measures up.

The 7612D Programmable Digitizer gives you better data so you get better results, whether you're working in research and development or automated testing environments. It is a dual channel/dual time-base waveform digitizer for use under computer control. Each channel has its own analog to digital converter, a new type designed by Tektronix for accurately digitizing high speed signals. Each channel also has its own built-in time-base operating from a 200 MHz crystal-controlled clock.

The result: two independent digitizers in one compact instrument.

You can vary the sampling rate from 5 ns to 1 s in a 1, 2, 3,...9 sequence (excluding 6, 7, 8, and 9 ns) to optimize the number of useful samples stored in each memory. For capturing complex signals, or when high time resolution is needed, use the full 2048 words of memory per channel. For less demanding applications, you can set the record length at 256, 512, or 1024 words to save computer memory and increase measurement speed.

Within one record you can set the sampling rate to be switched instantaneously from one value to another at a specific time location for detailed digitization of a specific portion of a signal. You can vary the sampling rate up to 13 times per record. Several fast successive signals can be stored in each memory channel with minimum dead time between records – and without having to send out previous data.

The 7612D is compatible with all 7000 Series Vertical Amplifier Plug-ins – one per channel. The 7A16P Plug-in provides full programmability through the 7612D's GPIB interface.

Modern microprocessor technology makes the 7612D simple to use...microprocessor control provides a friendly front panel...sets instrument controls at the touch of a button...and automatically detects or corrects input errors.

The microprocessor also controls the 7612D when it is programmed over the GPIB. You can use simple commands to program instrument functions. Even query the 7612D to return the function's status. Waveform transfer is triggered by a single command and can occur on one channel while the other is acquiring data.

All these features make the 7612D a new standard in automatic waveform measurement.

Put unbeatable Waveform Measurement Power to Work for You.

Waveform digitizing: free from the limits of manual analog techniques.

Waveform digitizing is a measurement technique that is used to make measurements or process waveforms with speed, accuracy and repeatability unattainable with manual analog methods.

The 7612D's ability to acquire and store waveforms in digital format gives you features and measurement capabilities that analog instruments can't provide. By adding the power of a desktop computer or minicomputer, common measurements like rise time, fall time, pulse width, time interval, RMS, or peak-to-peak are made automatically, quickly, and accurately.

These capabilities make the 7612D ideal for use with Automatic Test Equipment – for making complex measurements on sophisticated avionics and computer equipment... or anywhere you need to automatically make time-domain measurements with accuracy and high measurement throughput.

The 7612D gives you access to many highly sophisticated analytical techniques that would otherwise be impractical. You can extract more information from an acquired signal than is readily available by examining its shape alone. For example, you can process the 7612D's recorded information using Fourier Transforms to characterize your devices or physical phenomena in the frequency domain.

The Tektronix 7612D Programmable Digitizer gives you all the benefits of waveform digitizing plus state-of-the-art performance not previously available. And it's fully programmable and easy to integrate into complete measurement or waveform processing systems.

Specified accuracy to handle your demanding measurements.

To give the 7612D the digitizing accuracy you require, Tektronix developed a new type of analog-to-digital converter. For each channel, an EBS (Electron Bombarded Semiconductor) tube continually converts the analog signal into eight-bit words available on eight-signal lines. Eight ultra-high-speed comparators strobe these lines every five nanoseconds. Depending on the time-base settings, internal logic selects these samples to be stored in the 7612D's internal memory. The result: a high performance eight-bit 200 MHz dual-channel programmable digitizer.

Specified dynamic accuracy. Tektronix specifies the 7612D at eight-bit resolution. But this number does not tell the whole story of the 7612D's performance. The accuracy of any analog-to-digital converter is dependent upon the input signal frequency. To achieve the highest attainable sampling rate and maximize the performance at high input signal speeds, Tektronix developed the EBS A/D converter. And, to help you determine how this superior performance relates to your application, Tektronix specifies the 7612D's performance at designated frequencies.

Further, the crystal-controlled clock accuracy of the time-base ensures highly reliable measurements, absolute or relative. This feature makes the instrument ideal for manufacturing and research applications where waveforms have to be calibrated or characterized accurately.

The 7612D's two independent digital time bases are crystal-controlled (accurate to 0.0035%) or can be driven from an external clock. You can vary the sampling rate for the internal clock from 5 ns to 1 s. The external clock input allows both channels of the 7612D to be slaved to a system clock. This external signal need not be periodic. The 7612D will take a sample every "N" external clock pulse ("N" being the divide ratio selectable from 1 to 200 x 10^6). Also, the external clock output can be used to drive other 7612Ds for synchronously sampling more channels of data.

Get the jump on unique waveform measurement problems.

With the 7612D, state-of-the-art microprocessor technology opens the door to a new world of measurement convenience and capability. You can capture the important components of difficult-to-examine signals. You can examine closely the signal components of interest and pay little attention to unimportant signal elements.

In avionics or computer testing, you can use the 7612D to precisely measure short rise or fall times as well as long pulse widths or time intervals. For making measurements in physics, chemistry, and mechanics, you can capture signals with a fast rise time and slow decay – all on a single record. In radar, lidar, sonar, ultrasonics, acoustics, and seismic research, the 7612D lets you easily capture multiple echoes (signals consisting of several echoes with long dead time between them) within the time window.

Variable sampling rates. The 7612D provides measurement versatility beyond the power of conventional oscilloscopes. You can vary the sampling rate up to 13 times within each record. Sample at a high rate during the rising and falling segments of a signal and then slowly during the plateau. You acquire and characterize an entire pulse in one step, as shown in figure 1.

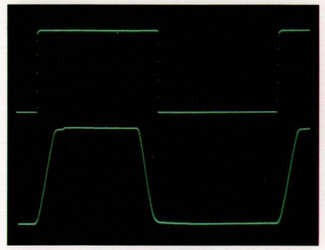


Figure 1. The complete period of a signal (top trace) is recorded at 200 ns; by changing the sample rate to 10 ns during rise and fall times and 800 ns during the plateau (bottom trace), you can measure rise time, fall time, pulse width and interval accurately on a single shot signal.

For signals with long decay, the 7612D also lets you sample fast during rise time, slow during decay. Even switch to a still slower sampling rate if the signals of interest have exceptionally long decay. With the touch of a few buttons, you can have the signals in memory ready for analysis (see figure 2).

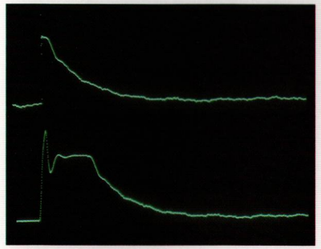


Figure 2. A decaying signal recorded at a 10 μs sampling rate (top trace); the same signal can be recorded at a 100 ns sampling rate during the initial portion and switched back to a 10 μs sampling rate (bottom trace), to capture all information on a single shot signal.

When you're dealing with echoes, sample rate switching is an invaluable capability. Capture the first echo at a high sampling rate. Switch to a slower rate after the echo and then back to the fast rate for the next echo. You can capture several echoes by switching sampling rates 13 times. The total equivalent time can be up to several seconds, while the useful portions of the echoes may amount to no more than a few hundred ns (see figure 3).

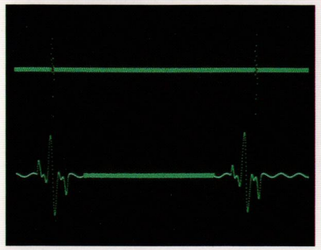


Figure 3. A signal with two echoes recorded at a uniform sampling rate (top trace); the same signal recorded at an increased sampling rate during each echo (bottom trace), to capture each echo with increased resolution.

In each of these cases, time measurements can be made with a high degree of accuracy (0.0035%) – even for long time intervals. This is possible because sampling intervals slower than 5 ns are changed coherently within records. So the last sample of a segment is the time origin of the following segment. With the internal clock, changes in the sampling rate within each segment can be selected independently from 5 ns to 1 s.

Variable pre-/post-trigger. The variable pre-/post-trigger allows you to observe waveforms before, after, or on both sides of a trigger event. You can select on each channel trigger parameters such as delay, level, slope, coupling, and source using the front panel or over the GPIB interface. Figure 4 describes triggering further.

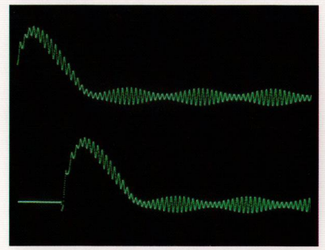


Figure 4. A transient response of a system at power-up recorded with no pre-trigger (top trace); by using the pre-trigger the complete response can be digitized (bottom trace).

The 7612D is two digitizers in one instrument. With dual channels and dual time bases, the 7612D can observe two signals with different triggers and at different sampling rates. You can also concatenate the two channels and double the record length. This method is ideal for applications where measurements must be made on extremely long or complex waveforms. The post-trigger delay lets you start channel B immediately after channel A has finished. So you record the first half of the signal on channel A and the second half on channel B – for a total record length of 4096 words with excellent horizontal resolution. Increase the sensitivity of channel B to analyze signals with long pulse tails. This provides the ability to examine signals over a wide dynamic range.

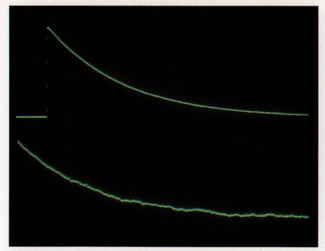


Figure 5. The initial portion of an exponential decay is recorded on Channel A (top trace); Channel B, set at a higher sensitivity and triggered to record after channel A has finished, captures the remaining pulse tail with increased vertical resolution (bottom trace).

Memory partitioning. When you're making measurements on regularly recurring events, sample rate switching lets you use memory effectively. When trying to capture successive randomly occurring signals, use the 7612D's memory partitioning capability.

With memory partitioning, you can divide each channel of local memory into 1 x 2048, 2 x 1024, 4 x 512, or 8 x 256 samples records – each able to store a waveform, and each with its specified trigger. With memory partitioning you can still vary the sampling rate within each record to accommodate the characteristics of the signals you are observing.

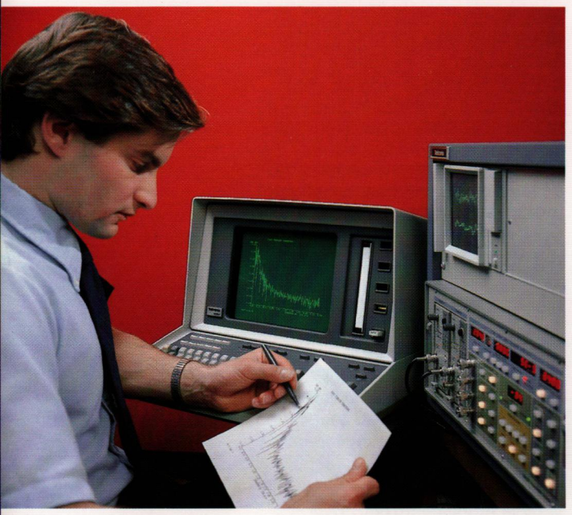
This feature is ideal in applications like lightning or breakdown analysis, or for making measurements on complex electronic circuitry, where signals occur at random with too little time between events to allow taking CRT photographs or sending data out of a digitizer having just one record.

Plug-in flexibility. The 7612D is made even more flexible because it accommodates 7000 Series Plug-In Vertical Amplifiers. They cover wide-ranging acquisition needs and let you tailor the 7612D for bandwidth, input impedance, differential or single-ended input, and input voltage range. In addition, the 7A16P Vertical Amplifier provides full programmability when used with the 7612D.

Full programmability with micro processor control makes automatic measurements fast, easy, and repeatable.

Whether you need to make repetitive measurements accurately and consistently or analyze several channels simultaneously, the 7612D with microprocessor control and GPIB compatibility can help you get the results you need.

Automating your measurements can simplify data collection and reduction, and reduce hours of testing and documenting into minutes, saving you time and money. Such capabiltities let you



perform measurements that would otherwise not be feasible. System automation minimizes the chances of human error by reducing the need for manual operation and high skill levels.

At the core of the 7612D's performance lies a powerful microprocessor – the instrument's master controller. It controls programmable operations between the 7612D, its plug-ins, and your external controller. That all adds up to performance you can readily build into almost any GPIB automated system.

The microprocessor performs a complete power-up test of the 7612D. When you turn on the instrument, it automatically goes to local operation. The microprocessor monitors the front panel buttons – where instrument control, time base, and triggering functions are located in separate color-coded areas – and controls the display.

The front panel also indicates to the operator incorrect settings (see figure 6). For instance, when certain signal parameters are being selected, the microprocessor allows selection of only those values that are correct for the current state of the instrument. And when the 7612D is armed, the microprocessor goes even further: it verifies the validity of the settings and reports any errors on the front panel or over the GPIB.

The REMOTE LOCKOUT feature of the 7612D ensures that no unauthorized front panel entry will interrupt costly testing sequences or critical research measurements. When the 7612D is operating in the remote state, only front panel controls *not* affecting the state of the instrument or its data memory can be enabled.

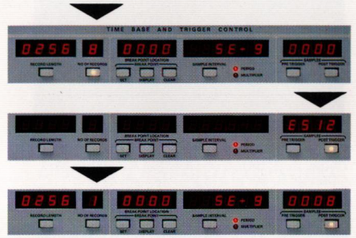


Figure 6. Error detected and correction in setting the trigger mode and number records.

Full GPIB programmability and compatibility, conforming to the IEEE 488-1978 standard, mean you can easily integrate the 7612D with your specialized instruments to set up a fully automated waveform measurement system. Simple, high-level mnemonics (sent in ASCII) make it easy to communicate with the 7612D over the bus. (See table 1.) These remote control messages for setting and reading the 7612D's operating modes conform to the Tektronix Codes and Formats Standard – a Tektronix standard defined to enhance compatibility between GPIB instruments and controllers. The 7612D and its programmable plug-ins take only one address on the bus through the use of the secondary addressing capability of the IEEE 488 standard. With a single command the controller has access to all the settings of the 7612D or a specified plug-in. The "learn mode" method of operation allows all instrument settings to be easily accessed by a controller and sent back later …returning the instrument to the "learned" operating condition.

Table 1

Example of Commands	Description
TMBS A	Specify the channel to be programmed
ARM A, B	Arm time base A and B
READ A	Read data from channel A
REP n, A, B	Repeat ARM/READ sequence for A then B n times
ALT n	Repeat the ARM A, READ A, ARM B, READ B sequence n times
SET ?	Returns all settings to the controller ("LEARN mode")
MODE PRE, n	Set to pretrigger by n samples

Table 1 shows a sample of the 7612D's instruction set.

Build the 7612D into your system…

You can easily use the 7612D in your system to characterize devices or phenomena, and fully automate testing procedures – boosting efficiency while cutting time and costs.

Use the 7612D to set up a waveform processing system for research and development applications to measure or analyze laser induced phenomena, radar signals, lightning strikes, video signals, ultrasonic echoes, or other electronic phenomena.

With its standard GPIB connector, timing and transfer protocols, and ease of programming, the 7612D is ideal for use in ATE systems. By using the 7612D with your specialized GPIB-compatible instruments, you can boost the performance of your total automated testing system. At times you can even remove other pieces of equipment and let the 7612D do their tasks. Just link the 7612D to your GPIB controller. You can set the front panel buttons for proper signal acquisition, then let software "learn" the settings for future acquisitions, or you can control the settings entirely through software.

…Or let Tektronix provide you with a complete signal processing system.

For maximum measurement and processing power, you can use the 7612D in complete signal processing systems based on one of two powerful controllers from Tektronix.

Desktop Computer-Based Systems. The Tektronix 4052 is one of the fastest and most powerful desktop computers available today. Its graphic display lets you graph acquired and processed waveforms in seconds. Specially designed ROM Packs simplify waveform processing from pulse parameters to Fast Fourier Transforms. And, the 4052 will easily interface with other GPIB instruments for configuring bench-top systems.

Minicomputer-Based Systems. The Tektronix series of PDP11* compatible controllers provide access to the power and flexibility of a modern minicomputer. This performance is strongly enhanced by a powerful, simple-to-use language – TEK SPS BASIC.

Ready-to-use software gives you complete control over all instrument and measurement functions. This modular and comprehensive software is interactive and specially developed for complete waveform array processing. Standard operators include high-level commands as simple as waveform multiplication and division, or as complex as Fast Fourier Transform.

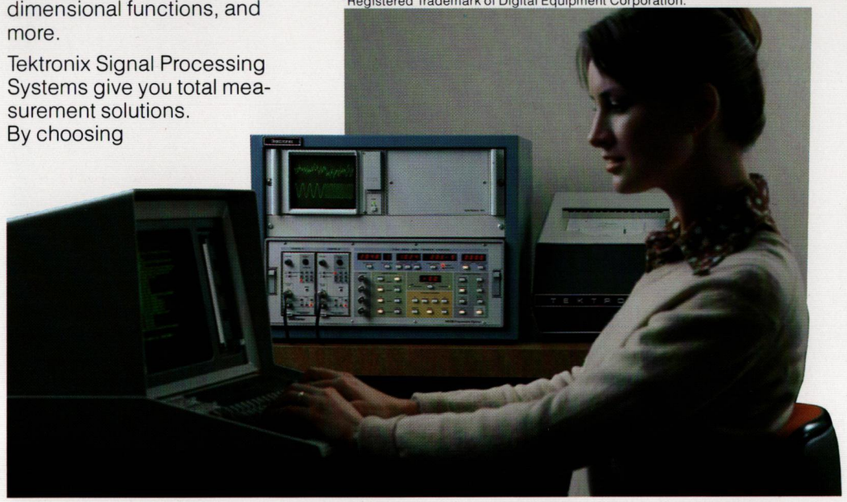
You get unlimited display capabilities with Tektronix System Software. It lets you document and present measurement solutions in alphanumerics, graphs, bar charts, three-dimensional functions, and more.

Tektronix Signal Processing Systems give you total measurement solutions. By choosing a complete system from Tektronix, you're guaranteed the best in system performance, service, and long term value.

The 7612D, used with Tektronix PDP11* compatible controller, provides flexible processing power with the comprehensive TEK SPS BASIC Software.

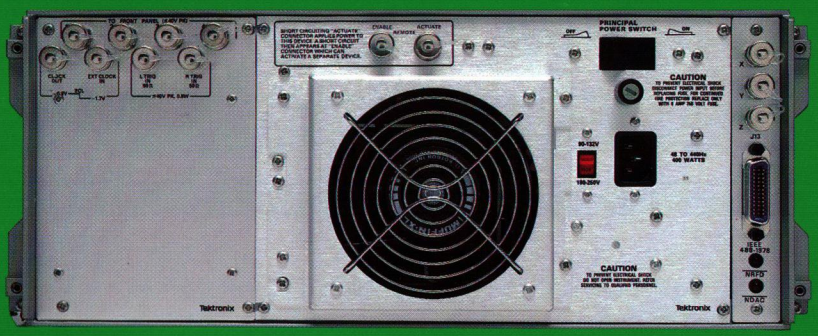
Whether you choose a waveform digitizer, or a total signal processing system, Tektronix Signal Processing Systems Specialists will help you select the best system components for your specific applications. And, Tektronix will even provide training support to help you get the most out of your Tektronix system.

*Registered Trademark of Digital Equipment Corporation.



The 7612D interfaced to a Tektronix 4052 desk-top computer provides a powerful bench-top system.

7612D Specifications:



7612D rear-panel: the GPIB connector and outputs for an X-Y-Z monitor (right); clock input/output, trigger inputs, and BNC connectors to feed signals to the front panel (left); remote power ON/OFF is also provided through the two central BNC connectors.

VERTICAL SYSTEM

Channels—Two plug-in compartments compatible with all 7000-Series amplifier plug-ins (dual channel plug-ins can be used in single channel mode only). Fully programmable when 7A16P plug-ins are used.

Bandwidth—80 MHz with 7A16P plug-in.

Modes of Operation—One time-base per channel.

TIME-BASE A AND B

Type—Two built-in digital time bases with a common crystal-controlled clock.

Clock—Internal: 200 MHz ±0.0035%; stability: 10 ppm/year. External: from signal source less than or equal to 200 MHz.

Sample Interval—With internal clock: Selectable from 5 ns to 1 s in a 1, 2, 3, . . . 9 sequence (excluding 6, 7, 8 and 9 ns). With external clock: Selectable from 1 to 200 × 10^6 times the external clock period in a 1, 2, 4, 6, . . . 20 sequence.

Interval Switching—Sample interval can be changed up to 13 times per waveform record.

Time Measurement Accuracy—0.0035% (stability 10 ppm/year).

Modes of Operation—Time Base A with left channel and Time Base B with right channel. Independent or B triggerable after A completes its acquisition.

TRIGGERING A AND B

Source—Internal: Ch A, Ch B; external; manual.

Mode—Single sweep.

Coupling—AC, DC, AC HF REJ, DC HF REJ.

Slope—Positive or negative.

Level Range—Internal: at least ±128 LSB in 256 steps. External: at least ±1.28 V in 256 steps.

Trigger Jitter (Internal)—0.1 ns or less, dc to 100 MHz.

Triggering Error—±1 sample ambiguity in recognizing the trigger. 1 sample maximum recognition error between channels (using same trigger channel for both time bases).

Trigger Sensitivity—

Coupling	Triggering Frequency Range	Minimum Signal Required	
		Internal	Ext
AC	40 Hz to 50 MHz	20 LSB	100 mV
	50 MHz to 100 MHz	44 LSB	100 mV
AC HF REJ	40 Hz to 50 kHz	20 LSB	100 mV
DC	dc to 50 MHz	20 LSB	100 mV
	50 MHz to 100 MHz	44 LSB	100 mV
DC HF REJ	dc to 50 kHz	20 LSB	100 mV

ARMING A AND B

Push button or computer control.

DIGITIZING AND STORAGE

Method—Continuous, sequential digitizing of the input signals with storage of samples selected by instrument settings.

Resolution—8 bits.

Dynamic Accuracy—Signal to noise ratio and effective bits performance at 25°C for a half scale sine-wave input signal (an ideal 8 bit digitizer would give a S/N ratio of 43.8 dB).

Signal Freq.	S/N Ratio	Effective Bits
300 kHz	42.0	7.8
20 MHz	32.0	6.0
80 MHz	20.0	4.0

Internal Memory—Type: ECL. Size: 2048 8-bit words per channel, total of 4096 8-bit words.

Record Length, A or B—256, 512, 1024, or 2048 samples. Number of stored records: up to eight 256-word, four 512-word, two 1024-word, or one 2048-word records per channel, each requires a trigger. Trigger(s) will automatically rearm after each record acquisition until the number of records specified is completed.

Pretrigger Range—Selectable in multiples of 8 samples. Without sample interval switching: 0 to 16 samples less than the record length. With sample interval switching: 0 to 16 samples less than the position of the first sample interval change.

Posttrigger Range—Selectable in multiples of 8 samples from 8 to the record length (allows only one record).

OUTPUTS/INPUTS

X, Y, Z Analog Output—Provides for analog display of data in memory. X and Y level is 1 V p-p into 100 kΩ or greater, adjustable from 0.75 V to 1.3 V.

Z level is 0 to 1 V (full white) into 100 kΩ or greater.

Clock Out—Provides internal clock signal at ECL level.

External Clock In—ECL levels. Less than or equal to 1 ns rise and fall time. 2.5 ns minimum pulse width and less than or equal to 200 MHz.

L and R TRIG IN.—Provide external trigger input to the left and right trigger channels (50 Ω terminated).

1, 2, 3, 4—Four feed-through connections to the front panel.

IEEE-488 INTERFACE

Standard—Conforms to IEEE-488-1975 standard.

Interface Functions Subset Implemented: SH 1—Complete source handshake.

AH1—Complete acceptor handshake
TE6—Extended talker function
LE4—Extended listener function
SR1—Complete service request capability
RL1—Complete remote/local function
PP0—No parallel poll
DC1—Complete device clear capability
CO—No controller function
DTO—No device trigger capability

Response to Interface Control Messages—The 7612D responds to the following interface control messages:

GLT—To to local
LLO—Local lockout
SDC-DCL—Selected device clear and device clear
SPE-SPD—Serial poll enable and disable
IFC—Interface clear

IEEE-488 Bus Addresses—Mainframe and programmable plug-ins share a common primary address and are differentiated through the use of secondary addresses.

Programmable Functions—All instrument settings and operating modes are programmable.

Format—Commands in ASCII, waveform data in binary (range 0 to 377_8).

Transfer Rate—710 K bytes/second maximum.

Waveform Transfer Time—To an infinitely fast controller: 8.35 ms for one 2048 points record. Actual transfer time depends on controller and software speed.

ENVIRONMENTAL

Temperature Range—Operating: 0-40°C. Nonoperating: −62°C to +85°C.

Altitude—Operating: −250 to +15,000 feet (−76 to +4570 meters).

Nonoperating: −250 to +50,000 feet (−76 to +15,200 meters).

POWER REQUIREMENTS

Line Voltage Range—90 V to 132 V ac and 180 V to 250 V ac.

Line Frequency—48 to 440 Hz.

Power Consumption (including plug-ins)—Maximum 400 watts, 5 A at 115 V 60 Hz.

Remote Control—Remote power ON/OFF capability is provided.

PHYSICAL CHARACTERISTICS

Size—Fits 19 in. rack. Height: 7 in. (17.8 cm). Width: 19 in. (48.3 cm). Length: 26.75 in. (67.9 cm).

Weight—55 lbs. (25 kg).

STANDARD ACCESSORIES

Operators and Service Manuals, set of rack slides, power cord, IEEE-488 bus cable.

ORDERING INFORMATION

7612D Programmable Digitizer.

For further information, contact:

U.S.A., Asia, Australia, Central & South America, Japan
Tektronix, Inc.
P.O. Box 1700
Beaverton, OR 97075
For additional literature, or the address and phone number of the Tektronix Sales Office nearest you, contact:
Phone: 800/547-1512
Oregon only: 800/452-1877
TWX: 910-467-8708
TLX: 15-1754
Cable: TEKTRONIX

Europe, Africa, Middle East
Tektronix Europe B.V.
European Headquarters
Postbox 827
1180 AV Amstelveen
The Netherlands
Phone: (20) 471146
Telex: 18312-18328

Canada
Tektronix Canada Inc.
P.O. Box 6500
Barrie, Ontario L4M 4V3
Phone: 705/737-2700

Tektronix®
COMMITTED TO EXCELLENCE