Signal Processing Systems

The Next Step in Measurement Technology!

If you need to . . .

Make measurements faster

Increase accuracy and repeatability

Perform a variety of analyses . . . from simple to sophisticated

Automate testing

Capture high-speed signals

Tektronix Signal Processing Systems (SPS) have the capabilities you're looking for.

SPS offers a variety of waveform digitizers for capturing and digitizing signals ranging from hertz to gigahertz. Once digitized, the signal can be transferred to a variety of controllers for processing. To meet different processing needs, Tektronix offers Signal Processing Systems based on the Tektronix CP4165 controller and controllers from the TEKTRONIX 4050 Series of Graphic Computing Systems and Digital Equipment Corporation's PDP*-11 family of minicomputers. Systems based on various digitizer-controller combinations are listed in the table below. They are all available with IEEE 488 (GPIB) interfacing and special Tektronix-designed signal-processing software (4050 BASIC with Signal Processing ROM Packs for 4050 Series controllers and TEK SPS BASIC for PDP-11 controllers and the CP-4165).

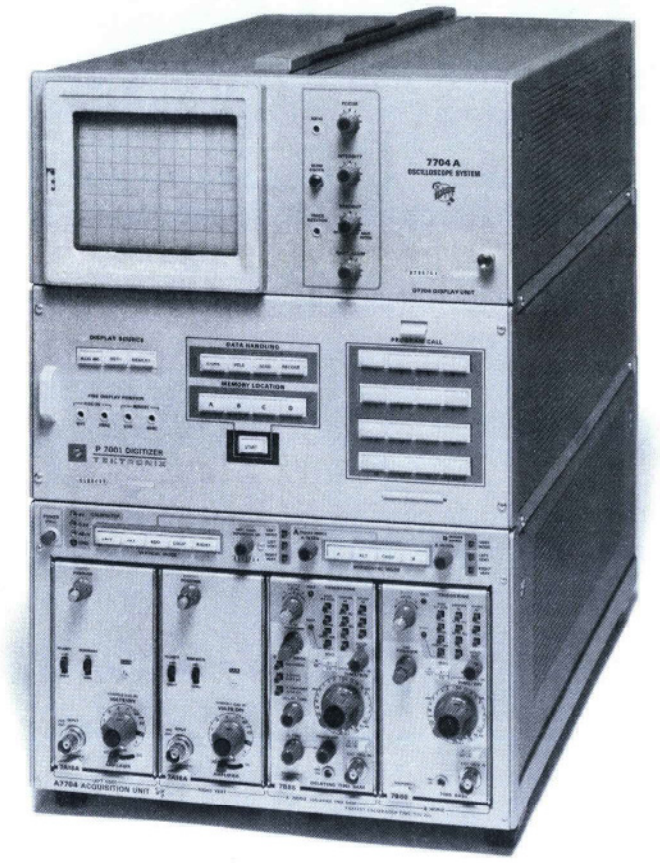
To select your complete SPS package, refer to the table below and the waveform digitizer specifications on the following pages. For more information on these systems ask your local Tektronix Field Engineer to direct you to the nearest SPS specialist.

Tektronix offers training classes in TEK SPS BASIC Software and the operation of typical signal acquisition and processing systems. For further training information, contact your local Field Office or request a copy of the Tektronix Customer Training Catalog on the return card at the back of this catalog.

SIGNAL PROCESSING SYSTEMS

	4050 Series Controller	PDP-11 Controller CP4165 Controller
DPO	WP1110	WP1200
7912AD	WP2050	WP2250

*PDP-11 is a registered trademark of Digital Equipment Corporation.



DPO
DIGITAL PROCESSING OSCILLOSCOPE
GPIB Product

Dc-175 MHz Bandwidth

Waveform Digitizing to 10 Bit Vertical and 9 Bit Horizontal Resolution

Internal Waveform Storage (4K MOS Memory)

IEEE 488 and Other Interfaces Available

The DPO (Digital Processing Oscilloscope) offers both enhancement and extension of standard oscilloscope measurements. This is accomplished by adding a digitizing, storage, and interfacing unit (the P7001 Digitizer) to a TEKTRONIX 7704A General Purpose Oscilloscope System.

Standard 7000 Series plug-ins offer versatile performance from dc to 175 MHz. **Additional capabilities are available to 14 GHz** in the time domain via a sampling plug-in and 60 GHz via a spectrum analyzer plug-in. With dual-channel plug-ins, up to four waveforms can be displayed in real time on the DPO crt. Also, up to four waveforms with scale factor information can be stored—simultaneously or individually—in the internal MOS memory.

Waveform storage is in digital format. Amplitude samples of the waveform are taken at 512 equally spaced horizontal locations. Each amplitude sample is digitized to 10 bits (1024 distinct levels possible for each sensitivity setting) and stored in the DPO memory.

Any of the four stored waveforms can be accessed at any time by push button for re-display on the DPO crt. Or, because they are in digital format, any or all of the stored waveforms can be transferred from the DPO to an interfaced controller. Processed waveforms can also be transferred back to the DPO for display of results.

This latter capability, the transfer of digitized waveforms to and from a computer or controller, is a DPO feature of great significance. Not only does it allow making oscilloscope measurements at computer speeds and computer resolutions, but it extends your measurement capabilities to include complete waveform analysis under program control.

Extracting information from high-speed repetitive signals is a typical application of Digital Processing Oscilloscope Systems.

VERTICAL SYSTEM

Channels — Two left-hand plug-in compartments accept all 7000 Series plug-ins; function and bandwidth determined by the 7000 Series plug-ins used; 7D01 plug-in not recommended for use in the digitizing mode.

Bandwidth — 175 MHz with 7A19 plug-in amplifier.

Modes of Operation — LEFT, ALT, ADD, CHOP, RIGHT during real-time displays and LEFT, ALT, or RIGHT during digitizing and storage.

Delay Line — Permits viewing leading edge of waveform.

HORIZONTAL SYSTEMS

Channels — Two right-hand plug-in compartments compatible with all 7000 Series plug-ins; 7T11 not recommended for use in digitizing mode.

Modes of Operation — A, ALT, CHOP, B for real-time displays. A, ALT, B for digitizing and storage with some restrictions in combinations of plug-in and mainframe vertical and horizontal switching modes.

CRT

Refer to 7704A crt characteristics, described on page 64.

OUTPUTS/INPUTS

Refer to 7704A Outputs/Input characteristics, described on page 65.

CALIBRATOR

Refer to 7704A Calibrator characteristics, described on page 65.

DIGITIZING AND STORAGE

Method — Pseudo-random every 6.5 microseconds with a maximum of 512 samples per waveform. Any transient longer than five milliseconds or any repetitive signals that can be displayed on the crt can be stored in internal memory along with its scale factors and redisplayed on the crt.

Resolution — 10 bits (1024 levels).

Memory — Type: MOS. Size: 1024 10-bit words per waveform, total of 4K words. Record Length: 512 samples per waveform plus scale factors and areas for computer-generated messages.

PROGRAMMABLE FUNCTIONS

The P7001 Data Handling mode, Display Source, and Memory Locations can be selected by an external controller, and the Program Call Buttons generate interrupts which can be processed by an external controller. Also, an external controller can be used to read the status of the time-base single sweep and to arm the sweep for transient acquisition.

INTERFACING

And IEEE 488 compatible interface is available for general purpose use. Also, a 16 bit parallel interface (CP Bus Interface) is available for fast data transfer to 16 bit controllers. Complete interfacing to PDP*-11 series minicomputers available on request.

*PDP is a registered trademark of Digital Equipment Corporation.

POWER REQUIREMENTS

Range — 90 to 132 V ac. Option 09, 180 to 264 V ac.

Line Frequency — 48 to 440 Hz.

Power Consumption — 300 watts maximum at 115 V, 60 Hz.

PHYSICAL CHARACTERISTICS

Dimensions — Height, 18.9 in (47.5 cm). Width, 12 in (30.6 cm). Length, 22.7 in (57.7 cm).

Weight — 48 lbs. (21.8 kg).

STANDARD ACCESSORIES

One pin-to-BNC cable.

One each Operator and Service manuals.

SYSTEMS

The DPO is also available in WP100 Series Signal Processing Systems. These semiautomatic systems are desgined, assembled, tested, and documented to satisfy the demand for speed, accuracy, and repeatability in characterizing devices or phenomena which give rise to repetitive waveforms in the millisecond to picosecond range. For more information on these systems, contact your local Tektronix Field Engineer.

ORDERING INFORMATION

DPO $10,765

DPO OPTIONS

03 Add EMI shielding ..... Add $185

09 Change line voltage (230 V/50 Hz) ... No Charge

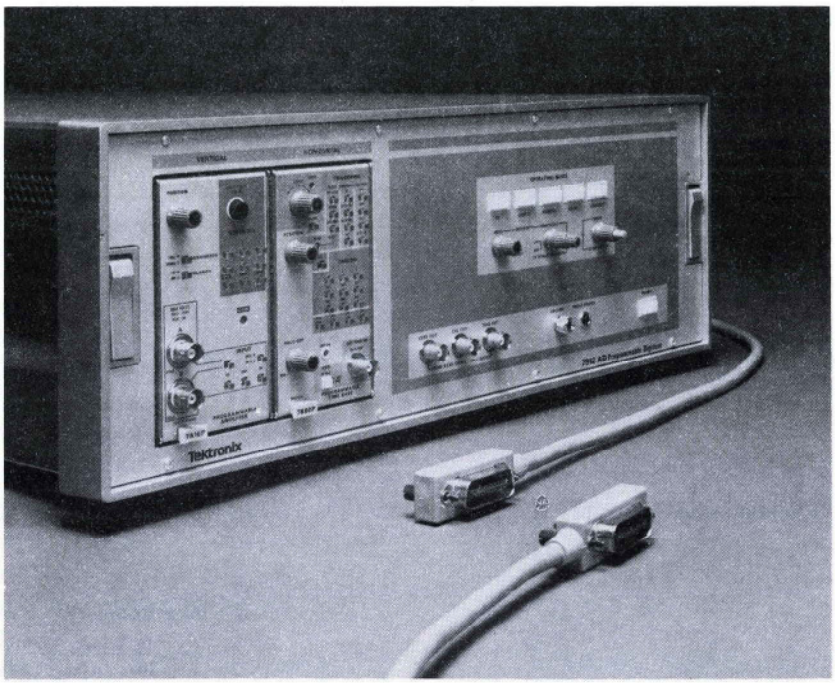
18 Change to 1K MOS memory ..... Sub $1045

19 Change to 2K MOS memory ..... Sub $760

20 Change to 4K core memory ..... Add $315

31 Add IEEE 488 Bus Interface (021-0206-00); order cable separately (012-0432-00) .. Add $2000

32 Add CP Bus Interface (021-0116-03); order cable separately (012-0432-00) ..... Add $475



7912AD
PROGRAMMABLE DIGITIZER
GPIB Product

Digitize and Store Single-Shot or Repetitive Signals from Millisecond to Subnanosecond duration

500 MHz Bandwidth at 10 mV/div, 1 GHz Direct Access at 4 V/div

500 ps/div Fastest Calibrated Sweep Rate

Waveform Digitizing to 9-Bit Vertical and 9-Bit Horizontal Resolution

Built-In Signal Averaging Capability

Fully Programmable over IEEE 488 Bus For System Oriented Operation

Capturing high-speed waveforms is the 7912AD's forte. Each waveform can be sampled up to 512 times within selectable time window ranging from ten milliseconds to five nanoseconds (50 kHz to 100 GHz equivalent sampling rate).

This performance is accomplished by a Tektronix scan converter which writes the signal onto a silicon-diode target array. In TV Mode, the signal information is read from the target and converted to composite video for a bright display on a television monitor. However, in the Digital Mode the waveform data is read into an internal memory. From this memory, the digitized waveform can be transferred via the IEEE 488 bus to an external controller for processing.

The 7912AD Mainframe is programmable over the same IEEE 488 bus. When the programable plug-ins (one 7A16P Programmable Amplifier and one 7B90P Programmable Time Base) are used, the 7912AD becomes a fully programmable digitizer with a bandwidth of 200 MHz. This is a significant step toward fully automated test and measurement in disciplines such as laser and energy-related research, component or subassembly testing, and other areas requiring information extraction from high-speed waveforms.

VERTICAL SYSTEM

Channels — Single plug-in compartment accepts any 7000 Series amplifier plug-in. Fully programmable when 7A16P is used.

Bandwidth — Determined by amplifier plug-in. 7A16P: 200 MHz. 7A19: 500 MHz. 7A21N Direct Access: 1 GHz.

Delay Line — Permits viewing of digitized leading edge of acquired waveform.

HORIZONTAL SYSTEM

Channels — Single plug-in compartment accepts any 7000 Series time base. Fully programmable with 7B90P.

Fastest Calibrated Sweep Rate — 500 ps/div with the 7B90P or 7B92A Time Bases.

Slowest Recommended Sweep Rate — 1 ms/div in digital mode, possible loss of data below this limit.

DIGITIZING AND STORAGE

Method — Scan conversion.

Resolution — 9 bits. In the Digital Mode, the target is scanned in a 512 x 512 point matrix offering at least 400 discrete horizontal elements, each with a range of at least 320 discrete vertical values. In the TV Mode, the target is scanned in a standard TV format with a resolution of at least 400 lines at 50% response.

Writing Rate (+10°C to +40°C) — TV Mode: writes an 8-div sine wave of at least 500 MHz in a single sweep. Digital Mode: Stores a single 8-div pulse with a rise time of 1 ns or less. Option 04, increase TV Mode writing rate by factor of 2 and Digital Mode writing rate by 2.5.

Target Defects — No more than six points digitized other than those written by input waveform. Built-in firmware allows for defect removal by an external controller.

Memory — Type: semiconductor. Size: 4096 10-bit words for data from target and two 512 16-bit word areas for internally processed and reduced data. Record Length: 512 samples per waveform maximum.

ELECTRONIC GRATICULE

8 x 10 division dot matrix written onto the scan-converter target immediately after waveform acquisition. Can be displayed simultaneously with the input signal on the TV monitor or digitized and stored. Cannot be used when 7A21N Direct Access plug-in is used.

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 K Ω or greater; adjustable from 0.75 V to 1.3 V. Z level is 0 to 1 V (full white) into 100 K Ω or greater.

COMPOSITE VIDEO OUTPUT — Only available in TV mode. Used to drive a TV monitor for displaying signal written on scan-converter target as an aid to setting intensity for complete digitizing. Linear Output: Replica of the signal read from the target with sync added. Binary Output: Two-level output derived from the linear composite video output. Used to indicate on the TV monitor how well a waveform will be digitized. Scale factor readout included in both linear and binary.

Sync Output — At least 4 V into 75 Ω. Conforms to EIA RS-170.

Sync Loop — Allows TV Mode to be synchronized with external EIA RS-170 sync waveform.

+Gate Output — Provides a positive pulse with a duration equal to and coincident with the time-base sweep.

Z Axis Input — ±1 V input modulates the writing gun intensity over its full range.

Vert. In, Cal. In, Trig. In — Three internal 50 Ω coaxial cables connect signals from the rear panel to the front panel to ease system configuration in rack mounts.

Probe Power — Provides power for Tektronix active probes.

Digital Interface — Conforms to IEEE Standard 488-1975.

ENVIRONMENTAL

Temperature Range — Operating: 0-40°C. Nonoperating: −55°C to +75°C.

Altitude — Operating: Up to 15,000 ft (4 570 m). Nonoperating: Up to 50,000 ft (15 200 m).

EMI (plug-ins inserted) — Meets MIL-STD-461A and 462 radiated and conducted interference from 30 Hz to 1 GHz.

POWER REQUIREMENTS

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

Line Frequency — 48-440 Hz.

Power Consumption (including plug-ins) — 360 watts maximum.

Remote Control — Remote power ON/OFF capabilities provided.

PHYSICAL CHARACTERISTICS

Size — Fits 19 in rack. Height: 7 in (17.7 cm). Width: 19 in (48.3 cm). Length: 26.8 in (67.9 cm).
Weight — 54.6 lbs (24.7 kg).

STANDARD ACCESSORIES

Power cord, set of rack slides, IEEE 488 bus cable, Operator and Service manuals.

SYSTEMS

The 7912AD is also available in WP2000 Series Signal Processing Systems. These fully automatic systems are designed, assembled, tested, and documented to satisfy the demand for speed, automation, accuracy, and repeatability in characterizing devices or phenomena which give rise to waveforms in the millisecond to nanosecond range. For more information on these systems contact your local Tektronix Field Engineer.

ORDERING INFORMATION

It is recommended that 7912ADs not be purchased or operated without an accompanying TEKTRONIX 634 Raster Scan Display Monitor with Option 01.

7912AD Programmable Digitizer . . . $21,200

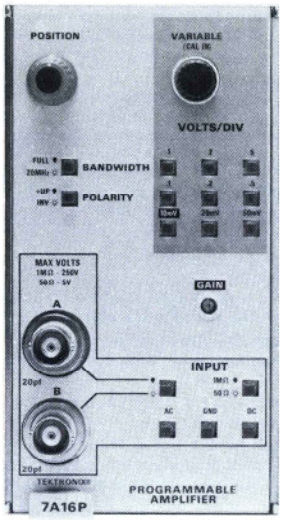
OPTIONS

04 Change to Fast Digitize (changes scanning matrix to 256 x 256 points, changes electronic graticule to mark only every other division, increases writing rate) . . . . . NC

09 Change Line Voltage (220 V/50 Hz) . . . . . NC

13 Change TV scan to 625 lines at 50 Hz . . . . . NC

30 Delete IEEE bus cable . . . . . Sub $90



7A16P
PROGRAMMABLE AMPLIFIER

GPIB Product

Fully Programmable in 7912AD or 7612D Digitizers

10 mV/div to 5 V/div Calibrated Deflection Factors

225 MHz Bandwidth

The 7A16P is designed for use in TEKTRONIX 7000 Series Programmable Digitizers. All of the normal operational features of a high-quality, wide-band 7000 Series plug-in amplifier are provided in the 7A16P. These are available at the front panel for manual selection, or they can be set under program control via a programmable mainframe and the IEEE 488 bus. Whether operated manually or under program control, the front-panel push buttons light to indicate plug-in status. Plug-in status can also be read over the IEEE 488 bus by an external controler for input to instrument set-up and control routines.

Two switchable input connectors are also provided for selecting input signal source.

CHARACTERISTICS

Bandwidth — 225 MHz, plug-in only. 200 MHz in the 7912AD. Bandwidth may be limited to 20 MHz ±3 MHz by bandwidth limit switch.

Ac Coupled Lower Bandwidth — 10 Hz or less.

Step Response — 1.6 ns rise time, plug-in only.

Deflection Factor — 10 mV/div to 5 V/div, 9 steps in a 1-2-5 sequence. Accuracy is ±2% of indicated deflection factor with GAIN adjusted at 10 mV/div.

Uncalibrated VARIABLE is continuous between steps and extends selected deflection factor to at least 2.5 times the calibrated value.

Input R and C — Selectable: 1 MΩ within 2% and ≈20 pF or 50 Ω ±1 Ω with VSWR ≤1.5:1 at 200 MHz or less.

Inputs — Selectable A or B signal input connectors.

Max Input Voltage — 1 MΩ, dc coupled: 250 V (dc + peak ac), ac component 500 V p-p max, 1 kHz or less. 1 MΩ, ac coupled: 500 V (dc + peak ac), ac component 500 V p-p max, 1 kHz or less. 50 Ω: 0.5 watts max.

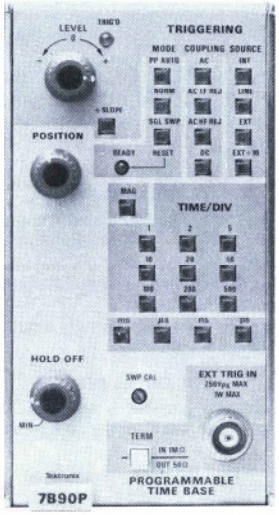
Overdrive Recovery — ≤100 μs to recover to within 1 div of baseline after removal of overdrive signal. Overdrive occurs when the following peak amplitudes are exceeded.

4 V on 10-50 mV range
40 V on 100-500 mV range
70 V on 1-5 V range

Displayed Noise — At 10 mV/div: ≤0.1 div at full bandwidth measured tangentially.

Programmable Functions — All functions except VARIABLE, GAIN, and IDENTIFY are programmable.

7A16P Programmable Amplifier $1640



7B90P
PROGRAMMABLE TIME BASE

GPIB Product

500 ps/div to 500 ms/div Calibrated Time Base

Fully Programmable in 7912 AD Digitizer

400 MHz Trigger Bandwidth

Single-Sweep Operation

The programmable 7B90P is designed for use with a TEKTRONIX 7912AD Programmable Digitizer. Its operating functions can be manually selected at the front panel or selected under program control via the IEEE 488 bus. The only nonprogrammable functions are the Sweep Calibration adjustment and the External Trigger Input Terminator Switch.

CHARACTERISTICS

Sweep Rates — 500 ms/div to 10 ns/div in 24 steps. Magnifier extends fastest calibrated sweep rate to 500 ps/div.

Sweep Accuracy — Measured over center 8 div, +15°C to +35°C, with any 7000 Series programmable mainframe. Derate accuracies by additional 1% each for 0°C to +50°C.

Time/Div	Unmagnified	Magnified
500 ms/div to 100 ns/div	2%	3%
50 ns/div to 10 ns/div	3%	4%
500 ps/div	—	5%

Trigger Holdoff — Programmable in 62 steps between minimum and maximum.

Time/Div	Min (ccw)	Max (cw)
500 ps/div to 2 μs/div	≤3.5 μs	≥90 μs
5 μs/div to 20 μs/div	≤35 μs	≥900 μs
50 μs/div to 200 μs/div	≤350 μs	≥9 ms
500 μs/div to 2 ms/div	≤3.5 ms	≥90 ms
5 ms/div to 500 ms/div	≤35 ms	≥900 ms

Triggering Sensitivity —

P-P AUTO MODE

Triggering Frequency Range	Min Signal Required	
	INT	EXT
At least 50 Hz	2.0 div	500 mV
200 Hz to 50 MHz	0.5 div	125 mV
50 MHz to 400 MHz	1.5 div	375 mV

NORM Mode

Coupling	Triggering Frequency Range	Min Signal Required	
		INT	EXT*
AC	30 Hz to 50 MHz	0.3 div	100 mV
	50 MHz to 400 MHz	1.5 div	250 mV
AC LF REJ[1]	30 kHz to 50 MHz	0.3 div	100 mV
	50 MHz to 400 MHz	1.5 div	250 mV
AC HF REJ[2]	30 Hz to 50 kHz	0.3 div	100 mV
DC	Dc to 50 MHz	0.3 div	100 mV
	50 MHz to 400 MHz	1.5 div	250 mV

*EXT ÷ 10 operation attenuates external signal 10 times.

[1] Will not trigger on sine waves of less than 8 div, INT, or 3 V, EXT, at or below 60 Hz.

[2] Will not trigger on 50 MHz sine waves 1.5 div or less, INT, or 0.15 V or less, EXT.

Single-Sweep Mode — Same as NORM mode.

Trigger Level — Programmable in 0.05 div steps.

Horizontal Position — Programmable in 0.0125 div step unmagnified, 0.125 div step magnified.

Internal Trigger Jitter — 0.1 ns or less at 400 MHz.

External Trigger Input — Selectable: 1 MΩ ±5%, 20 pF ±10% or 50 Ω ±5% with 1.22 max VSWR at 400 MHz. Maximum input is 250 V (dc + peak ac) for 1 MΩ or 1 watt for 50 Ω. The level range (excluding p-p AUTO) for a 1 kHz sine wave input is at least ±3 V in EXT and at least ±30 V in EXT ÷ 10.

7B90P Programmable Time Base $1915

Tektronix offers maintenance training classes on waveform digitizing instruments and systems. For further training information, contact your local Field Office or request a copy of the Tektronix Customer Training Catalog on the return card at the back of this catalog.