MARKETING SALES RELEASE

FILE 7D11 PRB

DATE August 11, 1972

New 7000-Series Plug-in Expands Digital Family
7D11 Digital Delay Unit

Our new DIGITAL DELAY plug-in fulfills a long standing measurement requirement. It is now possible to achieve high accuracy and stability even when the measurement requires long time delays. A second mode -- Delay By Events -- makes it possible to start an oscilloscope sweep (or obtain an output pulse) after some number of chosen events have occurred in the world outside the test equipment. This mode can even be used for preset counting.

$1475 is a remarkably low price. The nearest competition is at $1900, and a technical comparison shows it really is not competitive. By the time you reach similar performance you find yourself with well over a $1000 price advantage. Said another way, the oscilloscope mainframe is practically free!

The 7D11 Digital Delay unit, even though it does not contain an oscilloscope time base, does retain a major feature of delaying sweep time bases -- the delay period is intensified.

There is an important generic distinction between our 7D11 and "competitive" digital delay generators. All of our delay accuracy and stability specifications apply to some signal in the outside world: Some signal that exists in the measurement situation. Digital delay generators are really double pulse generators. The delay specifications refer to the length of time between the two pulses. It's obviously much simpler to accurately and stably control the length of delay when you also control the start of things. The 7D11 effectively addresses itself to the more difficult situation where the start of things is some arbitrary event.

It hardly needs saying that this digital delay unit is a substantial extension of the 7000-Series measurement package concept.

Continued on back

7D11 Digital Delay Unit -- Major Sales Features and Customer Benefits

The 7D11 provides accurate and stable delayed triggers for low jitter and precision time delay measurements. It requires CRT READOUT and can be used in any compartment of a 7000-Series mainframe. The 7D11 operates in two modes and provides a variety of outputs.

- Delay-by-Time Mode: Provides a highly accurate delayed trigger and delay interval after reaching a preselected time. The delayed trigger and delay interval outputs are generated by counting precise increments of time (100 ns increments) from an internal crystal-controlled oscillator.

- Delay-by-Events Mode: The 7D11 counts selectable trigger events, periodic or aperiodic, and provides an output after reaching a preselected count. This mode is useful in disc memory, computer, radar or other timing work where it is desirable to initiate delay from a master sync or index pulse and then obtain a jitterless delayed trigger a given number of events later.

  Another example is in TV where a given line can be viewed from among any of the lines in a TV signal.

  Because it has the ability to distinguish between a start trigger pulse and event pulses being counted, the 7D11 greatly enhances complex digital measurements.

- Accuracy is 0.5 ppm ± 2 ns: The 7D11 is more accurate than a similarly priced competitive model, General Radio model #1399, whose accuracy is 1 ppm ± 100 ns. The more expensive competitive models are more accurate.

  By further contrast, the equivalent accuracy possible with our oscilloscope delaying sweep is about 10,000 ppm (typically specified as accuracy within 1% of the indicated delay).

- Delay Time is 100 ns to 1 s: The first 100 ns is calibrated and includes "insertion delay." This means that it will count from T_0 or from an external pulse; by contrast, competition (Berkeley Nucleonics Corp., model #7040 or Eldorado Model #650) measure delay from an initial pulse which follows a fixed insertion delay.

- Resolution is 1 ns: A front panel control permits analog fine time delay adjustments from 0 to 110 ns beyond any digital interval displayed by the CRT READOUT. This feature extends the benefits of the 7D11 over the General Radio model #1399.

Continued on next page

- Jitter is less than 2.2 ns: The competitive General Radio model #1399 jitter is 100 ns. Contrasted to analog delay jitter of an oscilloscope time base (such as a 7B70/7B71), the 7D11 is better beyond delays of 100 µs. At 50 µs, both the 7D11 and the oscilloscope time base are equal, and the oscilloscope time base wins 2-to-1 from 50 µs to 1 ns.

- Versatile Use: When installed in a vertical compartment, the 7D11 gives a delayed trigger and displays the delay time as a pedestal.

  The 7D11 can be used as a delay trigger source for the time base in the three-hole mainframes, provided that the 7D11 is triggered externally.

  In a horizontal compartment, the 7D11 will generate a blanking pulse for the duration of the delay interval. This provides a display similar to the "A Intensified By B" mode of conventional delayed sweep operation. When used in the A horizontal compartment, the 7D11 B Sweep delay mode controls will permit the B Sweep to either run or be triggerable after the delay generated by the 7D11; this delay interval is also available at the front panel for such uses as gated interval counter measurements and generating pulses of highly accurate width.

- Digital Delay Readout to 7 1/2 Digits: A competitor, the Eldorado model #650, has 4-digit readout with an 8-digit option for an additional $400. Another competitor, the Berkeley Nucleonics model #7040 has a 6-digit readout.

7D11 Sales Strategy

The 7D11 provides a time delay range that exceeds the performance of an analog delaying time base in terms of accuracy and jitter.

It provides an accurate event delay range. It also functions as a preset counter.

The 7D11 enables the owner of a 7000-Series oscilloscope to do all this at a substantially smaller investment when compared with our competition. This is another extension of the broad measurement capabilities of the growing 7000-Series.

Prices

7D11 DIGITAL DELAY UNIT $1475

Continued on back

Support Activities

Advertising

Public Announcement is August 14, 1972.

Public Relations and Editorials: New product announcement News Release will be sent to about 50 magazines such as CONTROL ENGINEERING, EDN, ELECTRONICS, ELECTRONIC DESIGN, ELECTRONIC ENGINEER, ELECTRONIC PRODUCTS, IEEE SPECTRUM, INDUSTRIAL RESEARCH, MICROWAVES, etc. The first editorial announcement of the 7D11 is in the August 14 issue of ELECTRONIC NEWS in a special feature on counters.

Shows: First show is WESCON; others pending. Papers will be presented at a WESCON seminar sponsored by ELECTRONIC PRODUCTS magazine.

Media Advertising: Starting in September, advertising will appear in general electronics magazines, such as ELECTRONICS, ELECTRONIC DESIGN, ELECTRONIC NEWS, ELECTRONIC PRODUCTS, and EDN.

Tekscope: The 7D11 is planned for the November/December issue.

Sales Literature: The 7D11 is in the 1973 general catalog (available early September).

PPRB: 7D11 articles offer applications and operating details.

Preliminary Copy of 1973 General Catalog Pages for Digital Family: We are enclosing a preliminary copy of the 1973 General Catalog pages for the Digital Family. This is to provide you with immediate information until you receive the catalog in early September.

Service

Training Tapes: A 7D11 introduction tape will be shipped to each Field Office; the tape will arrive coincident with the arrival of demo's.

Continued on next page

Manuals

Description	Availability
Operators Manual	now
Electrical Parts List, schematic, and calibration procedure (interim package)	mid-August
Service Manual	planned for late October

Product Availability

7D11 Demos: Demos and customer orders will be mixed; demos will be shipped starting the week of August 14.

7D11 Customers: Initial PAL quote will be six weeks from public announcement.

Marshall Pryor
Bob LeBrun
Bernie Floersch

#153

MARKETING SALES RELEASE

FILE | PRB 7D15

DATE | August 11, 1972

New 7D15 Universal Counter/Timer
Complements the 7D14 Digital Counter

Loud and clear, since the early days of the 7D14, we have heard your message about the utility and sales appeal that a time interval counter plug-in would have. Of the customer requests you have relayed to us, it outweighed the sum of all others by a factor of three. It's with an unusual degree of confidence that I share with you my feeling that the 7D15 Universal Counter/Timer will substantially outsell both of our previous digital plug-ins.

The features and benefits described below are very real ones. The 7D15's performance as a universal counter is among the best existing. In several respects it is best. The addition of our "see what you're counting" capability is even more valuable here than in the 7D14.

7D15 Universal Counter/Timer -- Major Sales Features and Benefits

The 7D15 provides all the measurement capabilities being made today.

- Oscilloscope-controlled Time and Frequency Measurements: This feature allows the user to make selective measurements on complex waveforms.

- 10 ns "Single-shot" Time Interval Measurement Resolution: This feature is not found in similarly priced competitive models such as the H-P model #5326A and H-P model #5327A which have 100 ns.

- Time Interval Averaging: This feature is not normally found in similarly priced competitive models.

- Waveform Display of Counting Interval and Schmitt Trigger Signal: Some competitive counters have an output for displaying trigger levels on an oscilloscope. The 7D15, however, simultaneously displays the counting interval as well as the actual signal being measured -- thereby providing a more meaningful measurement.

- 10 Picosecond Period Averaging Resolution: This feature is made possible with a 10 ns clock -- this tops most competitive models by a factor of 10.

Continued on back

- Signal Conditioning via Mainframe Trigger Source: Exclusive with TEKTRONIX 7000 Series, the different types of vertical plug-in units can provide signal conditioning. Because the signal from a vertical plug-in is routed to the horizontal compartment, the vertical plug-in can be used for signal conditioning such as with a differential amplifier, a high gain amplifier, a current probe amplifier, etc.

- Frequency Measurements Directly to 225 MHz: This is a much higher frequency than competitive models such as H-P model #5326A and H-P model #5327A (which count directly to 50 MHz) and Systron Donner model #6150 series (which counts directly to 200 MHz).

- Accurate "Time Mark" Outputs: Useful for calibrating oscilloscopes, etc. (10 ns, 100 ns, 1 µs, 10 µs, and 1 ms).

7D15 Sales Strategy

The 7D15 extends the 7000-Series measurement capabilities. It combines the waveform display advantages of the oscilloscope with the accuracy of a digital counter. The 7D15 is not intended to replace the 7D14, but rather, to permit more digital measurements.

Prices

7D15 UNIVERSAL COUNTER/TIMER $1475

Support Activities

Advertising

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Continued on next page

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Manuals

Description	Availability
Operators Manual	late September
Electrical Parts List, schematic, and calibration procedure (interim package)	late September
Service Manual	planned for mid-October

Product Availability

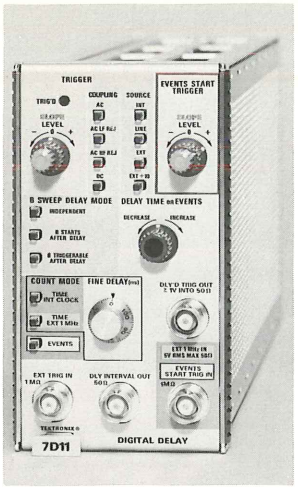
7D15 Demos: A few demos will be shipped at public announcement; for the remainder, a few demos will be shipped each week on a sustaining basis.

7D15 Customers: Initial PAL quote will be six weeks from public announcement.

Marshall Pryor
Bob LeBrun
Bernie Floersch

#157

- DIGITAL DELAY READOUT TO 7½ DIGITS
- DELAY BY TIME OR EVENTS
- 100 ns to 1 s DELAY TIME
- 1 ns RESOLUTION
- LESS THAN 2.2 ns JITTER
- 0.5 ppm (±2 ns) ACCURACY
- DELAY INTERVAL CRT DISPLAY



The 7D11 Digital Delay plug-in provides a means of accurate and stable delayed triggers for measurements requiring low jitter and precision time delays. With the capability of being used in any compartment of a 7000-Series mainframe equipped with CRT READOUT, the 7D11 provides a variety of outputs. Upon the receipt of a trigger, the 7D11, in the Delay By Time mode, counts a highly accurate clock and at the selected delay time, delivers a delayed trigger to its front panel connector and to the mainframe in which it is installed. (See Fig 1.)

In the Delay By Events mode, the 7D11 will count arbitrary trigger events, periodic or aperiodic, and will deliver an output after the preselected count has been reached. In both modes, the delay time or the number of events to be counted is selected by a single front panel control.

The 7D11 generates signals which are applied to the vertical channel and Z-axis to aid in obtaining the proper delay. Installed in a vertical compartment, the CRT will display a waveform that lasts for the duration of the delay interval. This waveform can be displayed together with the signal waveform on which the 7D11 is triggered. From a vertical compartment, the 7D11 can trigger a timebase, such as a 7B70, 7B53A or another 7D11, through the internal mainframe trigger path.

In any horizontal compartment, the 7D11 will generate a blanking pulse for the duration of the delay interval. This provides a display similar to the "A Intensified By B" mode of conventional delayed sweep operation. (See Fig 2.) When used in the A Horizontal compartment, the 7D11 B Sweep delay mode controls will permit the B Sweep to either run or be triggerable after the delay generated by the 7D11. This delay interval is also available at the front panel for such uses as gated interval counter measurements and generating pulses of highly accurate width.

In the Delay By Events operation, an external pulse (Events Start Trigger) may be used to enable counting of the events. In such applications as a line selector on a video monitor, the vertical sync pulse is the Events Start Trigger. Then the 7D11 counts "n" number of horizontal sync pulses (Events) into the field or frame (See Fig 3). In a similar manner, the origin pulse of a disc memory can be used as the Events Start Trigger, and the disc clock pulses become the events that are counted.

For timing measurements requiring a higher degree of accuracy than the 0.5 PPM source available in the 7D11, the Delay By Time clock may be referenced to an external 1-MHz timing standard through the EXT 1-MHz input.

Time delay resolution up to 1 ns can be obtained by using the front panel Fine Delay control.

By setting an internal switch, the indicated delay time is half the actual delay time. In such applications as TDR, radar timing, etc., the CRT READOUT would display the "one-way-trip" time.

The 7D11 Digital Delay Unit is very helpful in making measurements under complex timing conditions such as those encountered in troubleshooting modern digital circuitry.

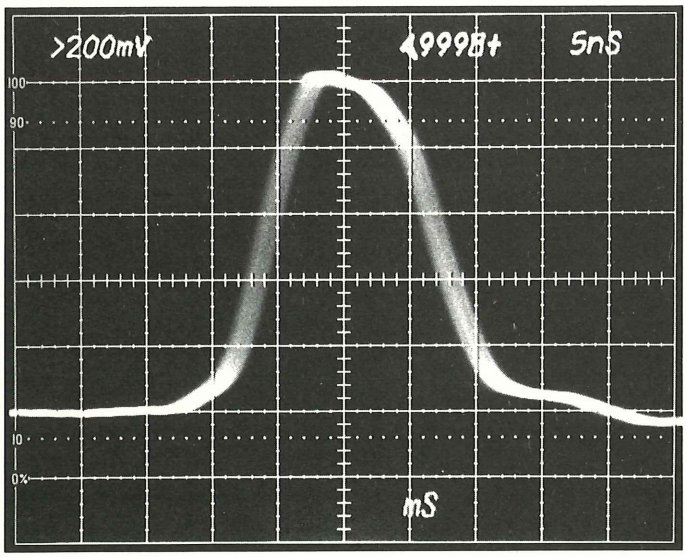


Fig. 1: 0.2 μs time marker delayed 4.9998 ms by the 7D11 and displayed at 5 ns/div.

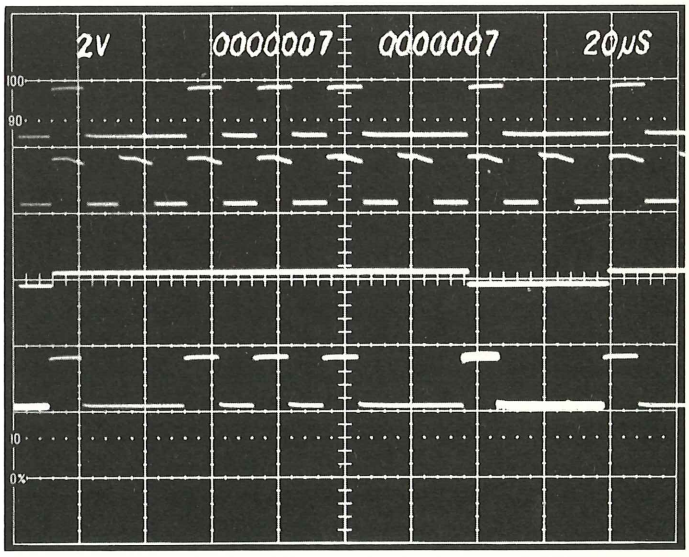


Fig. 2: Events Delay Mode (delay equals seven events). The top trace is a digital wavetrain and the second waveform is its clock. The third waveform represents the delay interval generated by the 7D11 in a vertical compartment; this began on the 1st clock pulse and ended on the 7th. The lower trace shows the display obtained with a 7D11 in a horizontal compartment (double exposure).

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7000-SERIES OSCILLOSCOPES

NEW 7D11 *Digital Delay Unit*

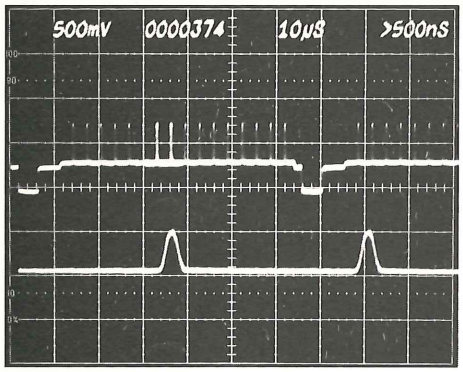

Fig. 3: Digital Delay Analog-Delay operation. The 7D11 triggers Time Base A at the beginning of the 374th line (upper trace). The 7th and 8th vertical bars are intensified by Time Base B set by the 7B71 delay time multiplier. The lower trace shows video information on the B delayed sweep.

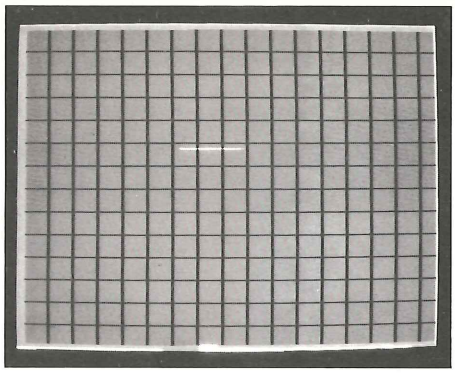

Fig. 4: The cross hatch signal seen on a Video Monitor. The B sweep gate of Fig. 3 applied to the monitor shows the 7th and 8th vertical bars unblanked at the 374th line.

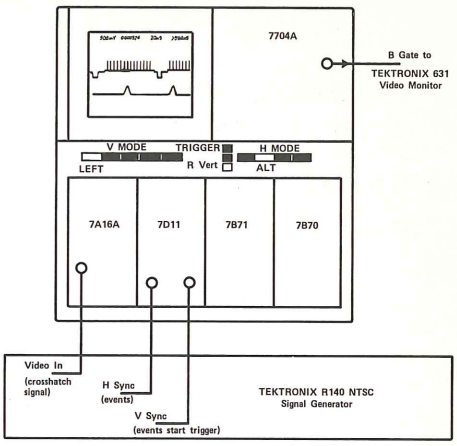

Fig. 5: Equipment set up for figures 3 and 4.

EVENTS DELAY

Events Delay Range—One to 10^7 events.

Delay Increment—One event.

Insertion Delay— 35 ns ±5 ns.

Recycle Time—Less than 500 ns.

Maximum Event Frequency—At least 50 MHz.

TRIGGERING

EXTERNAL TRIGGER				
SOURCE	Int, Line, Ext, Ext ÷ 10			
COUPLING	DC, AC, AC LF Rej, AC HF Rej			
MAX INPUT VOLTAGE	150 V DC + Peak AC			
LEVEL RANGE	±3.5 V in Ext ±35 V in Ext ÷ 10			
INPUT R and C	1 MΩ ±5%, 20 pF ±2 pF			
SENSITIVITY	COUPLING	FREQUENCY RANGE	MIN SIGNAL REQUIRED	
			INT	EXT
	AC	30 kHz - 10 MHz 10 MHz - 50 MHz	0.3 div 1.0 div	150 mV 750 mV
	AC LF REJ*	30 kHz - 10 MHz 150 kHz - 10 MHz 10 MHz - 50 MHz	0.3 div — 1.0 div	— 150 mV 750 mV
	AC HF REJ	30 Hz - 50 kHz	0.3 div	150 mV
	DC	DC - 10 MHz 10 MHz - 50 MHz	0.3 div 1.0 div	150 mV 750 mV

*Will not trigger on sinewaves of 3 div or less INT or 1.5 V EXT below 120 Hz.

EVENTS START TRIGGER	
SOURCE	External Only
COUPLING	DC Only
MAX INPUT VOLTAGE	150 V DC + Peak AC
LEVEL RANGE	±3 V
INPUT R and C	1 MΩ within 5%, 20 pF ± 2 pF
SENSITIVITY	40 mV minimum, 30 Hz to 4 MHz; increasing to 100 mV, 4 MHz to 20 MHz; increasing to 250 mV, 20 MHz to 50 MHz.

TIME DELAY

Digital Delay Range—Normal Mode: 100 ns to 1 s in 100 ns increments. Echo Mode: 200 ns to 2 s in 200 ns increments.

Analog Delay—Continuously variable from 0 to at least 100 ns, accuracy within 2 ns of indicated delay.

Jitter With Internal Clock—2.2 ns or (delay time X 10^{-7}) whichever is greater.

Insertion Delay—Zero within 2 ns.

Recycle Time—Less than 575 ns.

Time Base— 500 MHz oscillator phase locked to internal or external clock.

Internal Clock— 5 MHz Crystal oscillator. Accuracy is 0.5 ppm.

External Clock— 1 MHz within 2%, AC coupled, 50 Ω.

OUTPUTS

Delayed Trigger Out—Amplitude: 2 V or greater into open circuit, 1 V or greater into 50 Ω. Risetime into 50 Ω Load: 2 ns or less. Falltime into 50 Ω Load: 5 ns or less. Pulse width: 200 to 250 ns.

Delay Interval Out—Amplitude: 2 V or greater into open circuit, 1 V or greater into 50 Ω. Risetime and Falltime: 5 ns or less. Accuracy: Equal to Delay Interval less 20 to 30 ns.

READOUT

Display— 7½ digit with leading zero suppression. ms legend in Time Delay Mode. Plus (+) symbol reminds the operator to add on the FINE DELAY (ns) setting.

Order 7D11 DIGITAL DELAY UNIT $1475

U.S. Sales Prices FOB Beaverton, Oregon

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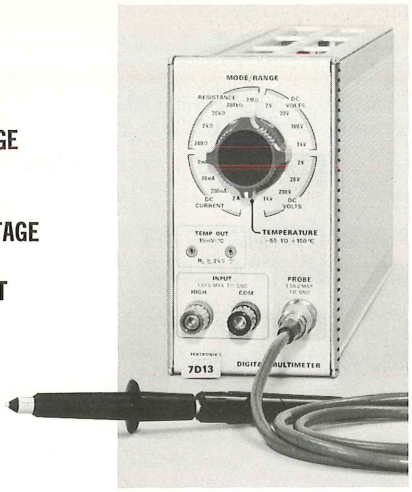
- TEMPERATURE MODE
- 1.5 kV MAXIMUM COMMON MODE VOLTAGE
- PROBE MEASURES TEMPERATURE OR VOLTAGE
- 3½-DIGIT CRT READOUT



The 7D13 is a Digital Multimeter plug-in designed for use in all 7000-Series Oscilloscopes mainframes except those without CRT READOUT. The 7D13 will function in any plug-in compartment.

In addition to measuring DC volts, DC current and resistance, temperature measuring capability is also featured in the 7D13, provided by a temperature sensor on the tip of the P6058 voltage/temperature probe. The temperature probe functions regardless of 7D13 mode or range setting and provides a front-panel analog signal output of 10 mV/°C (0°C = 0 volts), thus, temperature may be measured simultaneously with any other function. Most any NPN transistor can be used as a separate sensor to make small space, "free air," measurements.

When the 7D13 is used, the character generator traces out a 3½-digit display on the face of the CRT, along with a legend for units like kΩ, mA, C (temperature).

DC Voltage Range— 0 to 1000 V in four ranges. 3 1/2-digit presentation of 1.999 V, 19.99 V, 199.9 V, and 1000 V full scale. Accuracy is ±0.1% of reading ±1 count from +15°C to +40°C, ±0.2% of reading ±2 counts from 0°C to +50°C. Input impedance is 10 megohms on all ranges. Maximum safe input is 1.5 kV Peak between either contact and ground, 1.0 kV Peak between voltage contacts.

DC Current Range— 0 to 2 A in four ranges. 3 1/2-digit presentation of 1.999 mA, 19.99 mA, 199.9 mA and 1999 mA full scale. Accuracy is ±0.5% of reading ±2 counts from +15°C to +40°C, ±0.7% of reading ±4 counts from 0°C to +50°C. Maximum input is 3A (fuse protected). Input impedance is 0.2 V/full scale current +0.3 Ω.

Resistance Range— 0 to 2 megohms in five ranges. 3 1/2-digit presentation 199.9 Ω, 1999 Ω, 19.99 kΩ, 199.9 kΩ, and 1999 kΩ full scale. Accuracy is ±0.5% of reading ±1 count from +15°C to +40°C, ±0.8% of reading ±2 counts from 0°C to +50°C. Input is fuse protected.

Temperature Measurement Range— −55°C to +150°C in one range. 3 1/2-digit presentation to +150°C. Accuracy (+15°C to +40°C ambient) is ±1°C from −55°C to +125°C, ±2°C above +125°C. Accuracy (0°C to +50°C ambient) is ±2°C from −55°C to +125°C, ±3°C above +125°C.

Settling Time— 1.5 s or less (voltage, current, and resistance modes).

Polarity—Automatic indication.

Maximum Common-Mode Voltage— 1.5 kV Peak between two terminals and ground.

Normal-Mode Rejection Ratio—At least 30 dB at 60 Hz increasing at 20 dB/decade.

Common-Mode Rejection Ratio—With a 1-kΩ imbalance it is at least 100 dB at DC; 80 dB at 60 Hz.

Overrange Indication—When overrange occurs, the readout goes into a "blinking" mode with the most significant digit displaying a 2.

Recycle Time— 5 measurements per second.

Temperature Out— 10 mV/°C into a load of at least 2 kΩ.

Included Accessories—P6058 Voltage/Temperature probe package (010-0260-00); pair of test leads (003-0120-00).

Order 7D13 DIGITAL MULTIMETER **$560**

7D13 OPTION

Order Option 2 without P6058 Probe ..... **Sub $65**

P6058 PROBE

The P6058 Probe is a combination 1X DC voltage and temperature measuring device. The temperature sensing element consists of a transistor installed in the nose tip that plugs into the end of the probe body. For voltage measurements, a twelve inch and a five inch "common" (low) strap is provided, and is attached by threading into a hole in the side of the probe body. There is no external ground on the P6058 body, "ground" or the low potential point of the circuit under test is obtained via the common strap or connector, which is a floating common that has no tie to chassis ground. This lead may be floated at up to 1500 VDC away from chassis ground. The retractable hook-tip must be used on the probe when voltage measurements are made.

Temperature is measured by applying the flat surface of the probe tip to the device to be measured.

DC Voltage Range— 0 to 1000 V. Accuracy is ±0.1% of reading ±1 count.

Maximum Safe Input— 1500 V peak between either voltage contact and chassis ground. 1000 V peak between voltage contacts.

Temperature Range—See the 7D13 for the accuracy of a P6058/7D13 combination.

Cable— 46 inches including probe body. Output connector is four-pin locking type for attaching the P6058 to the 7D13. Supplies power to the probe sensor transistor and signal to the digital multimeter.

Net Weight—Approximately 5 ounces.

P6058 VOLTAGE/TEMPERATURE PROBE, Order 010-0260-00 ... **$65**
Includes: P6058 Probe (010-0259-00); probe retractable hook tip (013-0121-00); 5-inch ground lead (screw-in, 175-0848-01); 12-inch ground lead (screw-in, 175-0848-02); two miniature alligator clips (344-0046-00).

U.S. Sales Prices FOB Beaverton, Oregon

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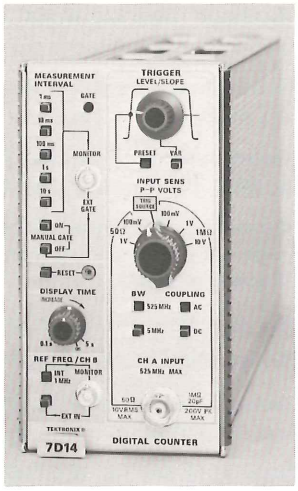
7000-SERIES OSCILLOSCOPES
7D14 *Digital Counter*

- **FREQUENCY MEASUREMENTS DIRECTLY TO 525 MHz**
- **TRIGGER INDICATOR DISPLAY**
- **NO-WARM-UP OSCILLATOR**
- **50-Ω and 1-MΩ INPUTS**
- **10 μV SENSITIVITY AT 1 MHz WITH 7A22**
- **FULL SIGNAL CONDITIONING TO 525 MHz**



The 7D14 is a directly gated digital counter plug-in unit designed for use in all 7000-Series Oscilloscope mainframes except those without CRT READOUT. It will function in any plug-in compartment. The 7D14 has three modes of operation: Frequency—0 to 525 MHz, Frequency Ratio (A/B)—0 to 10^5:1, and Totalize—0 to 10^8.

The 7D14 counts directly to 525 MHz. The gated approach makes possible "single event" counting which is frequently very desirable in rapid burst measurements. The resolution and accuracy can be improved by increasing the measurement interval.

Measurements which were previously impossible can now be made with an oscilloscope having a digital counter plug-in. By locating the counter in one of the vertical compartments of the oscilloscope and operating the scope in the delaying time-base mode, the B sweep (delayed sweep) can drive the counter gate. By doing this, signals can be displayed on the screen with the ones being counted intensified.

With the 7D14 in a vertical compartment, the output of its trigger circuit can be displayed directly on the CRT. This provides an indication of the actual triggering point, thus, many signals that were difficult to trigger on in the past can now be measured with much greater reliability. Not only is general-purpose triggering made easier, selective triggering is now possible.

When the 7D14 is used in a horizontal plug-in compartment, a signal connected to a vertical plug-in can be internally routed to it by the trigger source switches. All the 7000-Series vertical plug-ins are available as signal conditioners for the counter. Another advantage is the reduction of circuit loading. One connection to the oscilloscope deflects the vertical and provides the input for the counter.

FREQUENCY MEASUREMENTS

Input—Channel A, 0 to 525 MHz. Upper bandwidth can be restricted to 5 MHz to filter incoming high frequency noise.

Measurement Interval (Time Base)—1 ms to 10 s in five decade steps. Up to 0.1 Hz resolution can be obtained.

Accuracy—Within $\pm \frac{1}{\text{total count}} \pm$ time base.

Time Base Stability—Within ±0.00005%, 0°C to +50°C ambient temperature.

Long Term Drift—1 part or less in 10^7/month.

Input Characteristics

	CHANNEL A		CHANNEL B	INTERNAL TRIGGER SOURCE
	50 Ω	1 MΩ		
DC COUPLED	DC to 525 MHz	DC to 525 MHz	AC Coupling only	AC Coupling only
AC COUPLED	200 kHz to 525 MHz	5 Hz to 525 MHz	10 Hz to 2 MHz	5 Hz to 525 MHz*
SENSITIVITY	100 mV P-P (35 mV RMS)	100 mV P-P (35 mV RMS)	800 mV P-P	1.5 graticule div*
INPUT R & C	50 Ω	1 MΩ ≈20 pF	10 kΩ ≈30 pF	Depends on amplifier plug-in used
MAX VOLTAGE	10 V RMS	200 V (DC + Peak AC) to 5 MHz 50 V DC + Peak AC) 5 MHz to 525 MHz	15 V (DC + Peak AC) to 2 MHz	Depends on amplifier plug-in used

*Bandwidth and sensitivity limited by mainframe, sensitivity derated above 150 MHz.

FREQUENCY RATIO

Range—Channel A: 0 to 525 MHz.
Channel B: 10 Hz to 2 MHz.

TOTALIZE

Range—0 to 10^8.

Gating—Manual or with an electrical gate. The external gate input is compatible with the Sweep Gate from the oscilloscope mainframe. Reset and external gate signals compatible with TTL logic.

MONITORS

Monitor/Ext Gate—Provides crystal-based time markers of +5 V, the width is determined by the measurement interval.

REF FREQ/CH B Monitor—Provides a crystal-based, 1-MHz, +5 V output pulse. This connector functions as CH B input in the EXT IN mode.

READOUT

Display—8 digits with leading zero suppression, positioned decimal, MHz or kHz legend.

Display Time—0.1 to 5 s, also a preset position for infinite display time.

TRIGGERING

Level/Slope Range—+ and −0.5 V with INPUT at 100 mV.

Displayed Trigger Indicator—Displayed amplitude of Schmitt trigger output is approximately 0.2 div.

Included Accessories—BSM male to BNC female adapter (103-0036-00).

Order 7D14 DIGITAL COUNTER $1400

U.S. Sales Price FOB Beaverton, Oregon

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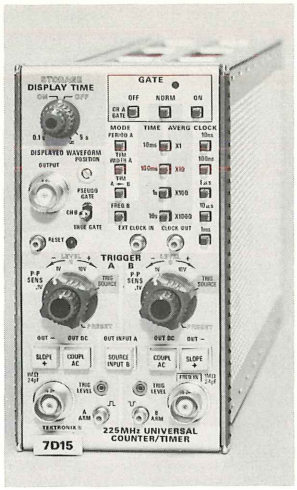
- OSCILLOSCOPE CONTROLLED TIME and FREQUENCY MEASUREMENTS
- 10 ns "SINGLE SHOT" TIME INTERVAL MEASUREMENT RESOLUTION
- TIME INTERVAL AVERAGING
- CRT DISPLAY OF COUNTING INTERVAL AND SCHMITT TRIGGER SIGNAL
- 10 PICO SECOND PERIOD AVERAGING RESOLUTION
- SIGNAL CONDITIONING VIA MAINFRAME TRIGGER SOURCE
- FREQUENCY MEASUREMENTS DIRECTLY TO 225 MHz
- ACCURATE "TIME MARK" OUTPUTS



The 7D15 is a Universal Counter/Timer Plug-In unit designed for use in all 7000-Series Oscilloscope mainframes except those without CRT READOUT.

The 7D15 offers all of the measurement capabilities known to the Counter/Timer world such as time interval, period, frequency, frequency ratio, totalize, and manual stop watch.

The performance of the 7D15 is further enhanced by its ability to display the count interval or the output of the Channel B Schmitt trigger shaper on the CRT. By utilizing the 7000-Series mainframe Vertical Mode switching, these outputs from the 7D15 can be displayed simultaneously with the actual signal being measured. The Pseudo Gate, which is a high rep-rate replica of the actual gate (True Gate), is independent of the Display Time control and therefore a more useful display. Three displays, the Pseudo Gate, Ch B Schmitt Trigger Output and True Gate are obtainable from a 7D15 front panel switch and are also available at a front panel connector.

Another 7D15 feature useful in complex timing or burst related measurements is its ability to be completely controlled by the oscilloscope's delayed or B Gate. "Arming" inputs are provided for each channel. By using the delayed B Gate to control the start and stop count points, "visually selective" measurements can be made at any desired point on the CRT display. See Fig. 1.

Two identical high speed trigger circuits provide complete signal processing. Identical trigger circuits also allow "single shot" time interval measurements to be made with 10 ns resolution. With repetitive signals, time interval averaging will increase the accuracy of a measurement by a factor of ten or more.

The high resolution capabilities of the 7D15 are made possible by a 10-ns clock, one of five clock positions obtainable from the front panel. A front panel Clock Out connector makes the selected clock signal available at a front panel connector. This provides a "time mark" function that is TTL compatible, which will also drive a 50 Ω load.

The Ext Clock In connector allows an external 1-MHz timing standard to be used for measurements requiring a higher degree of accuracy than that provided by the internal time base.

The 7D15 is compatible in vertical or horizontal compartments of 7000-Series mainframes. It provides a full 8 digit CRT display with leading zero suppression, and positioned decimal. Legend and averaging information appear at the bottom of the CRT display.

The measurement versatility, high degree of accuracy and resolution, that the 7D15 introduces to the 7000-Series Oscilloscopes, will contribute significantly to the higher performance measurement requirements of today's expanding technologies.

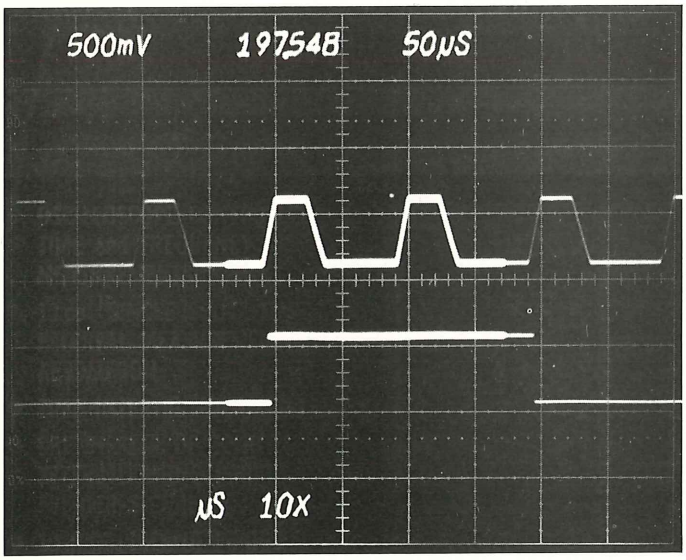


Fig 1: Oscilloscope controlled digital measurements using the delayed B Gate as the arming input logic allows user to make precise time measurement from third to fifth pulse on CRT display. Counter Ch A is "armed" with leading edge of B Gate while Ch B is "armed" with falling edge of B Gate. Lower trace is Pseudo Gate of 7D15.

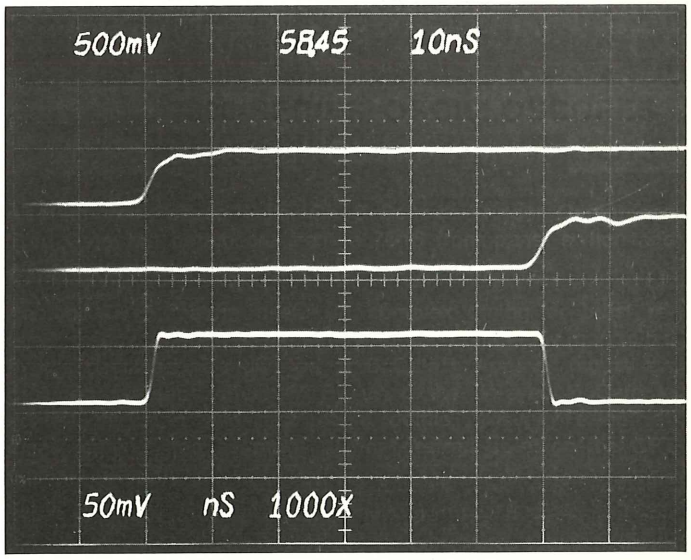


Fig 2: The delay time between the input of a delay line (upper trace) and the output of the delay line (middle trace) is measured digitally. Lower trace is 7D15 Pseudo Gate display.

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NEW 7D15 *Universal Counter/Timer*

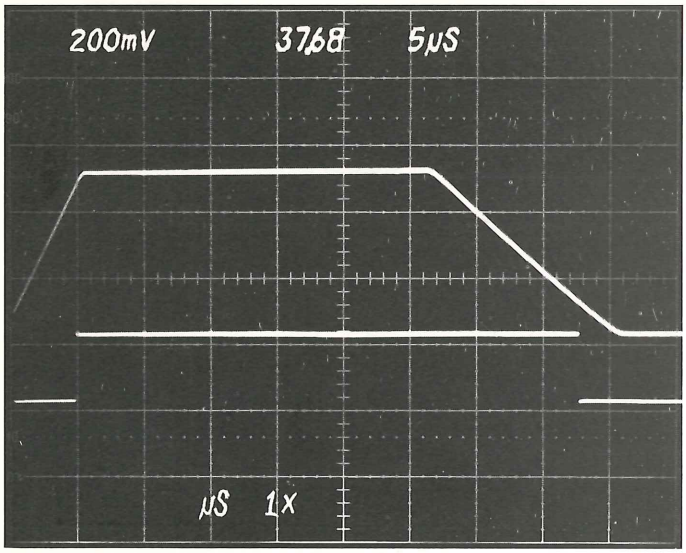

Fig 3: Independent Slope and Level control allows the user to select precise points on the waveform where the counter starts and stops.

MODES OF OPERATION		
FREQUENCY MODE	RANGE	DC to 225 MHz
	ACCURACY	Resolution = 0.1 Hz minimum $\epsilon_{freq(Hz)} = \pm TB \cdot f_{in} \pm \frac{1}{T} \pm 10^{-9} \cdot f_{in}$
PERIOD and MULTI-PERIOD MODE	RANGE	10 ns to 10^5 seconds with averaging times of X1 to X1000 in decade steps. Resolution: 10 picoseconds
	ACCURACY	$\epsilon_{period(s)} = \pm TB \cdot P_{in} \pm \frac{10^{-9}}{M} \pm \frac{2E_{npk}}{\frac{dv}{dt} \cdot M} \pm \frac{P_{ck}}{M}$
TIME INTERVAL (TI) and TI AVERAGE MODE	RANGE	6 ns to 10^5 seconds with averaging times of X1 to X1000. 0.1 ns resolution (usable)
	ACCURACY (NOMINAL)	$\epsilon_{TI(s)} = \pm TB \cdot P_{in} \pm \frac{P_{ck}}{\sqrt{M}} \pm 10^{-9} \pm \frac{2E_{npk}}{\frac{dv}{dt}}$
FREQUENCY RATIO, CH B/ EXT CLOCK	RANGE	10^{-7} to 10^4
MANUAL STOP WATCH	RANGE	0 to 10^5 seconds
TOTALIZE, CH B	RANGE	0 to 10^8 counts

NOTE: Formulas given where ϵ is the error; TB (dec %) is the time base accuracy; P_{in} is the period or time interval of unknown signal; M is the number of averages given; P_{ck} is the measurement clock period; T is the gate time; f_{in} is the frequency of the unknown signal; E_{npk} equals peak noise pulse amplitude as presented to Schmitt trigger circuit; dv/dt equals signal slope at input to Schmitt trigger (volts/second).

INTERNAL TIME BASE

Crystal Oscillator—Accuracy: Within 0.5 ppm (0°C to +50°C ambient.) Long term drift: 1 part or less in 10^7 per month. Oscillator is temperature compensated, no warm up is required.

OUTPUT SIGNALS

Clock Out—Logical "1" $\geq$ +0.5 V into 50 Ω. Logical "0" $\leq$ 0 V into 50 Ω. TTL compatible without 50 Ω Load (1.6 mA current capacity).

A and B Trigger Level—$Z_{out} \approx 1$ kΩ, $V_{out} = \pm 0.5$ V into 1 MΩ.

Displayed Waveform (internally connected)—Front panel switch selects either: "True Gate," "Pseudo Gate," or "Channel 'B'" signal out. Position: controlled by front panel screwdriver control.

External Display—Located on front panel, same as internal except position control has no effect.

Display Mode Switch—Front panel switch allows selection of readout "follow or store."

Display Time—0.1 to 5 s, also a preset position for infinite display time.

Readout—Eight digit display, the four most significant have zero suppression. Overflow indicated by ">" arrow.

INPUT SIGNALS CH A & B

Frequency Range (CH B only)—DC coupled: DC to 225 MHz, AC coupled: 5 Hz to 225 MHz.

Sensitivity—Ch A and B Inputs: 100 mV P-P. Trigger Source: 0.5 divisions of vertical deflection.

Input R and C—1 MΩ and 22 pF.

Triggering—Preset Position: Automatically triggers at 0 volts.

Level Control Range (CH A and B Inputs)—100 mV Range: ±500 mV; 1 V Range: ±5 Volts; 10 V Range: ±50 Volts.

Arming Inputs—Input R and C: 10 kΩ and 20 pF. Sensitivity Arm "A": Logical "1" $\geq$ +0.5 V, Logical "0" $\leq$ +0.2 V. Sensitivity Arm "B": Logical "1" $\leq$ +0.2 V, Logical '0" $\geq$ +0.5 V.

External Clock In—20 Hz to 5 MHz.

Reset Front Panel—Reset initiates the instrument, all counters are affected, including averaging circuits.

Includes Accessories—Two Cables RF 42" (012-0403-00), (Sealectro to BNC connector).

Order 7D15 UNIVERSAL COUNTER/TIMER **$1475**

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