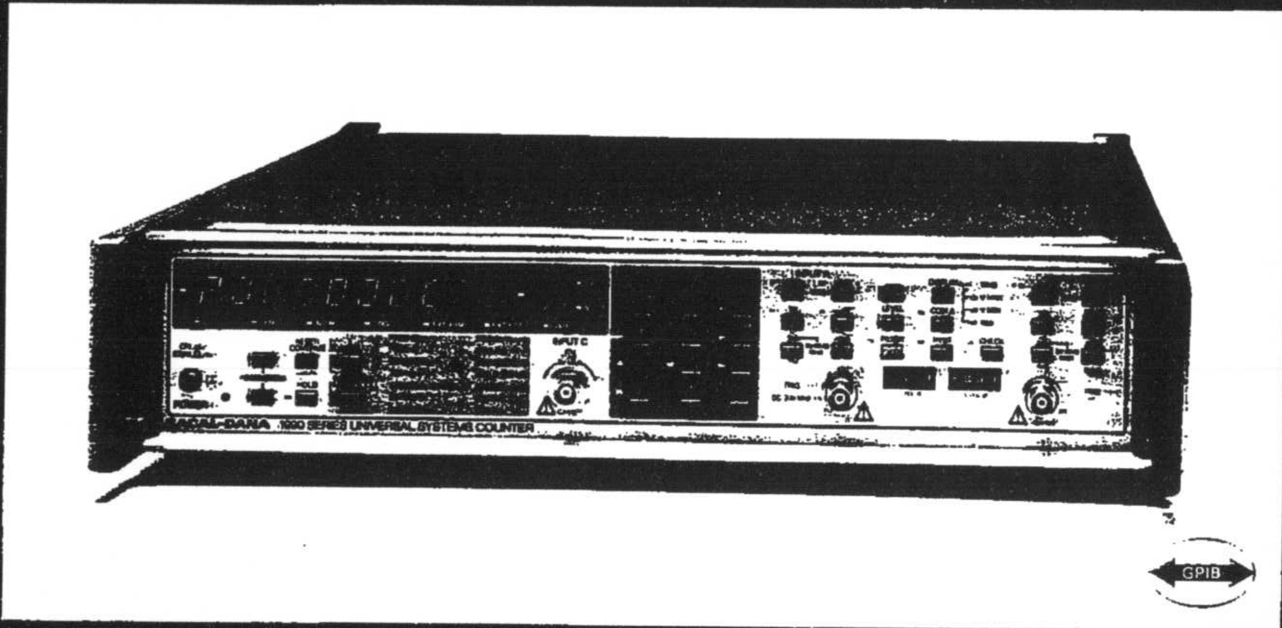
Universal Counters Models 1995 and 1996



Features

- 1 nSec single-shot time interval resolution
- 9-digit resolution in 1 second
- Comprehensive external arming
- Pulse parameter measurements
- Peak signal amplitude measurement
- Auto trigger over a ±250 volt range
- Phase, Slew and Duty Cycle measurement
- Complete digital control
- Full GPIB programmability
- Optional MATE interface

A Total Solution

Racal-Dana Models 1995 and 1996 bring the most current technology to universal counter timers. With a powerful 16-bit microprocessor, full programmability and a wide range of sophisticated measurement functions, these counters meet the stringent frequency and time measurement criteria necessary for the most demanding requirements in research and development or automatic test systems.

Racal-Dana's emphasis on reliability and maintainability, together with the versatility to interface with high-level languages, makes the 1995 and 1996 excellent choices for defense applications.

Models 1995/6 Provide Fast, Accurate Measurements.

Resolution is selectable up to ten digits, with 9-digit resolution in one second over the entire frequency range. Gate time can be as short as 200 nanoseconds, or one cycle of the signal at the measurement gate. This is ideal for burst measurements or frequency profiling.

Rubidium Standard

With 10-digit resolution plus overflow, the 1995/6 are able to resolve frequencies to 1 part in 10^{10}. Normal reference time bases are not precise enough to guarantee the accuracy of this reading. Racal-Dana now offers a Rubidium standard, Option 04R, which provides 1 part in 10^{11} stability.

16-bit Processing Power Improves Speed and Performance.

The 1995 and 1996 use the powerful 16-bit 68000 microprocessor, selected for its high-speed performance. Now measurement functions such as phase, duty cycle, slew rate and statistical analysis may be performed quickly and easily. The processor is also able to output fully processed data at rates up to 150 readings per second.

Custom VLSI, custom hybrids and surface-mounted components increase reliability while significantly improving performance. In addition, several specialized circuits enhance the comprehensive measurement ability of the 1995/6.

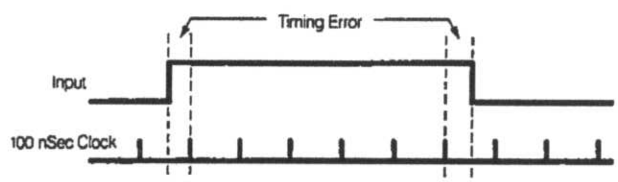
RACAL-DANA

Timing Capability Equivalent to a 1 GHz Clock

Racal-Dana's time error correction (TEC) circuit significantly improves measurement resolution over that of normal reciprocatic counters, and up to one hundred times that of most other counters.

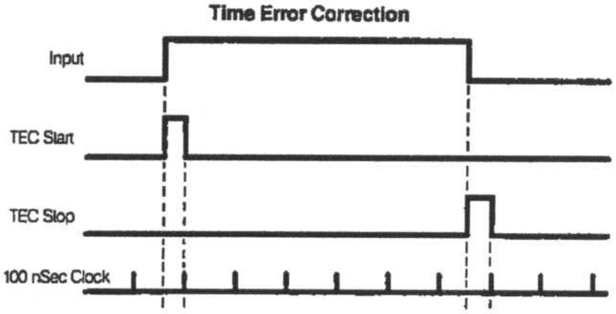
By using time error correction in combination with traditional recipromatic techniques, long gate times may be eliminated. For instance, a 1 MHz signal may be resolved to 0.1 Hz in just 10 mSec. The TEC technique permits single-shot time interval measurements to be made with one nanosecond resolution. Pulse parameters (rise/fall time and pulse width) may be determined accurately on pulses as narrow as five nanoseconds. This capability allows measurement of propagation delay and pulse shape integrity through integrated circuits. Difficult measurements such as computer memory access times can be examined quickly and easily.

Standard Measurement

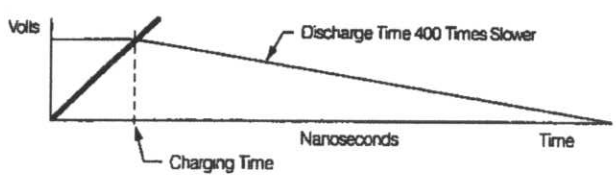


When a time interval measurement is performed by a normal counter, the clock signal is counted while the pulse is present. This results in measurement errors between the clock pulse and the start and stop edges of the input signal.

Time Error Correction



TEC improves resolution by initiating a pulse at precisely the same time as the START edge, and a second pulse precisely at the STOP edge. The pulse width of these error signals is set by the next clock pulse. Even pulses with durations smaller than the internal clock can be evaluated using this method. The action is similar to that shown in the chart above.



The pulse-measuring technique is similar to that of a dual-slope integrating digital voltmeter. A capacitor is charged from a constant current source so that the stored charge is fixed by the width of the TEC pulse. This stored charge is proportional to the time required to completely discharge the capacitor with a constant current source of opposite polarity. The charge and discharge currents determine the transfer characteristic of the TEC circuit. This allows the error time to be increased by a constant factor. The 100 nSec clock can then be used to measure the error. The transfer characteristic is calculated before each measurement cycle by measuring a precise clock pulse. This characteristic is typically 1/400: plenty of margin to guarantee one nanosecond resolution.

Outstanding Resolution

The 1995/6 feature frequency and period resolution of nine digits in one second. This exceptional resolution permits evaluation of precision frequency standards: 1 Hz resolution at 1 GHz and 10 nHz resolution at 10 Hz are obtainable in just one second.

In addition, frequency profiling may be performed using minimum gate times and external arming. When faster measurement is desirable, resolution may be decreased to allow gate times of 200 nSec. Use of a zero gate time permits the input signal period to gate the counter and further optimize measurements.

Fully variable readings from four to ten digits allow noisy or unstable signals to be displayed with meaningful resolution.

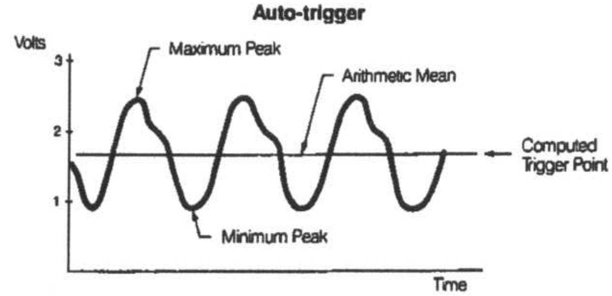
Automatic and Manual Trigger

Triggering and its effect on measurement accuracy can be crucial to counter users. The sophisticated circuitry of the 1995/6 permits automatic as well as manual control of triggering. Fast, fully-automatic trigger control guarantees triggering at 50 percent, the optimum point for true pulse width measurements.

Racal-Dana's sophisticated continuous auto trigger takes less than one second, even on DC and frequencies as low as 30 Hz. The mean, positive peak, negative peak and peak-to-peak voltages of the input signal are determined. Separate displays provide independent readings for channels A and B, allowing the trigger or voltage measurements to be viewed independent of the main counter reading.

Continuous auto-trigger can decrease read rates. For applications where fast read rates and optimum triggering is required, single-shot auto trigger, selected via a special function, provides the ideal solution.

Auto-trigger



In the auto-trigger mode, the counter measures the input signal's maximum and minimum peak voltages. The microprocessor sets the trigger levels at the computed mean. With continuous auto-trigger, the mean is recomputed upon any change in signal amplitude or offset. The attenuator is selected automatically to permit measurement of any input waveform within the instrument's full ±250 V operating range.

Manual trigger level control is provided through the keyboard. The level can be varied by entering the desired trigger voltage or by using the "Up" and "Down" slew controls.

The slew controls may be used in a manner similar to that of a potentiometer. However, the digital slew keys eliminate the inherent reliability problems associated with analog controls.

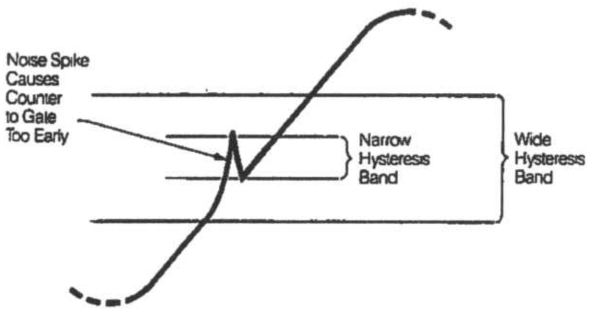
Accurate Peak Signal Amplitide Measurement

As mentioned earlier, automatic triggering circuits are used to establish the peak voltages for setting trigger points. The simple addition of a digital peak voltmeter as a standard feature expands system performance at no additional cost to the user.

Enhanced Hysteresis Performance for Systems Flexibility

To inhibit false triggering on noisy signals, all counters employ hysteresis. In the past, tradeoffs were made between hysteresis and trigger level timing error. (This error is due to the difference between the displayed and actual trigger points.) A narrow hysteresis band minimizes trigger level timing error, but may cause false triggering on noisy signals. However, a wide hysteresis band increases trigger level timing error.

Switchable Hysteresis



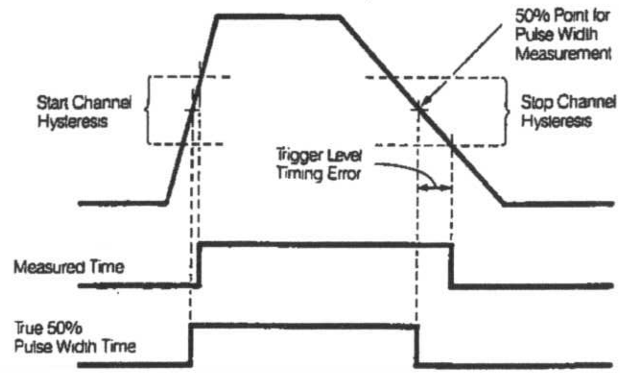
To overcome hysteresis limitations, Racal-Dana offers two bands: a narrow one to reduce trigger level timing errors on noise-free signals, and a wide one which may be used on extremely noisy signals. The standard hysteresis band is 25 mV; the high-level band is 100 mV.

The 1995/6 reduce noise interference by providing separate low pass filters on channels A and B. These filters eliminate miscounting caused by high frequency noise imposed on low frequency signals.

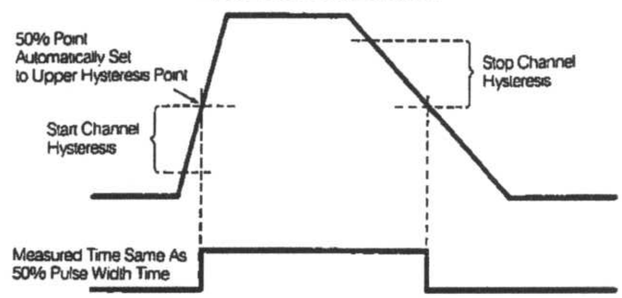
Automatic Hysteresis Compensation Improves Time Interval Accuracy

The 1995/6 further reduce trigger level timing errors caused by hysteresis. The trigger level is effectively lowered on positive slopes and raised on negative slopes by an amount equal to half the hysteresis band. With this capability, even wide hysteresis bands produce more accurate pulse width measurements by reducing trigger level timing error.

Normal Counter Operation

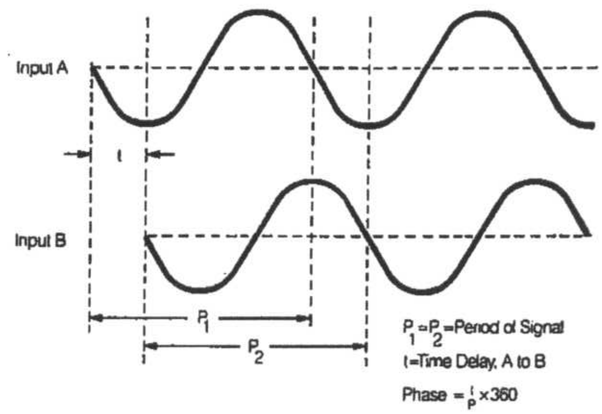


Hysteresis Compensation



Phase Measurement

The processing power of the 1995/6 permits the inclusion of phase measurement. This is particularly useful with the increasing application of electronic control systems and for evaluating phase continuity in phase-coherent synthesizers. The entire process is performed automatically when initiated by a single-key command. Phase measurements on non-repetitive signals may be obtained by the combined use of the Time Interval and Math functions.



The 1995 and 1996 automatically measure the phase differential between two signals. Phase measurement involves three automatic measurements: Ratio, to assure that A and B are at the same frequency; the Time Interval between the two signals; and Period.

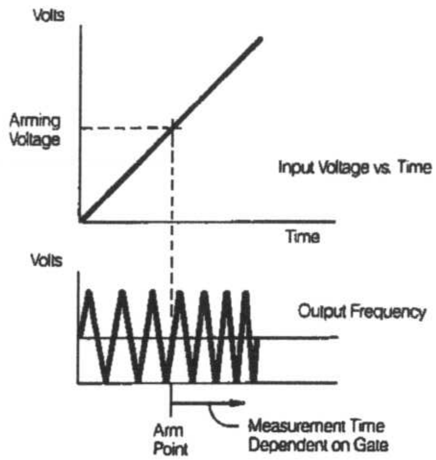
Additional Measurement Control

The 1995/6 provide several additional trigger control functions through use of the Special Functions. This permits use of sophisticated capabilities while maintaining ease of system operation.

Universal Counters Models 1995 and 1996

External arming and gating provides more comprehensive control of measurement points. This is ideal for such applications as measuring time intervals in complex bit patterns or for RF bursts having variable pulse widths. Three levels of arm control are available to offer maximum flexibility: Zero crossing, TTL and programmable voltage levels.

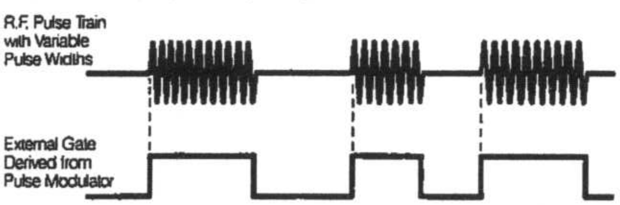
Voltage Controlled Oscillator Measurements Using Arming



Voltage-controlled oscillators can be dynamically tested by measuring frequency at given voltage points. The sample time can be made as small as two periods of the incoming signal. Resolution then can be increased by averaging a number of measurements.

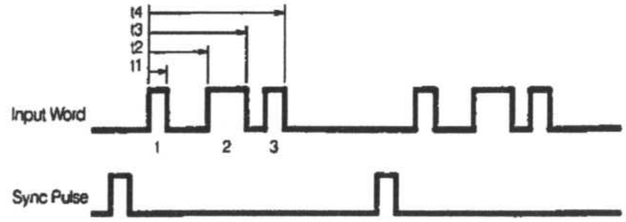
The external arming signal may be used to define the START point of a measurement. This allows individual pulses or bursts to be selected from a complex waveform. Radar or pulse code modulated signals may be fully evaluated by use of this technique. In addition, arming may be combined with the "Stop Delay" function for further characterization capability.

External Gating Optimizing Complex RF Pulse Train Measurements



In the example above, since the widths are continuously changing, a fixed gate time cannot be optimized for every pulse. By using an external gate, a measurement can be made with optimum resolution.

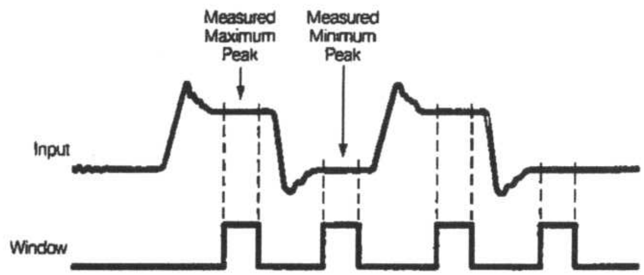
The stop delay function utilizes an internal timing delay generator to inhibit stop signals until a programmed period has elapsed. A stop delay time, set to be greater than the last transition, may be entered via the keyboard or GPIB. This inhibits stop signals until after the stop delay time, and provides a convenient way to characterize a repetitive word, or avoid mistriggering on 'ringing' input signals.



Where
t1 is a simple pulse width measurement
t2 uses time interval with a delay equal to t1 and trigger edge control + to +
t3 uses time interval with a delay equal to t2 and trigger edge control + to −
t4 uses time interval with a delay equal to t3 and trigger edge control + to −

The example shows how simple it is to measure the time between pulses, even from complex digital words. Arming, used to define the start of every measurement, is taken from the digital word's sync pulse. Stop delay is then used progressively to establish the time to each pulse.

Synchronous Window Auto Trigger (S.W.A.T.)

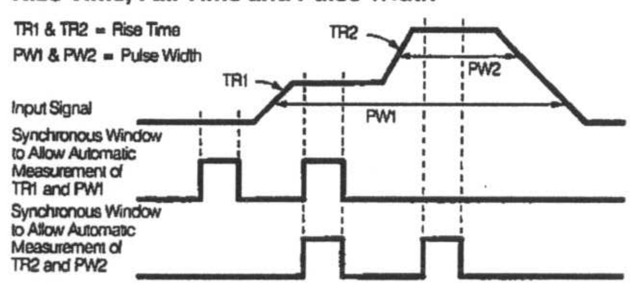


An additional arming capability, Synchronous Window Auto-Trigger, allows auto-trigger to operate only within a specified "window". This window can be set, for example, between possible ringing on both the rising and falling edges of the signal. Measurements are then performed during this window, resulting in far more accurate measurements than would otherwise be obtained.

Full Pulse Characterization

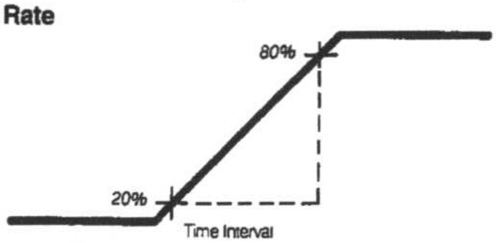
The 1995/6 provides full pulse characterization. Rise and fall time, slew rate, duty cycle and pulse width measurement functions may be implemented with a single keystroke, or by a single command over the GPIB.

Rise Time, Fall Time and Pulse Width



Automatic rise time and pulse width measurements on complex pulses can now be made. In conjunction with Synchronous Window Auto Trigger, the above waveform can be fully evaluated. This type of signal is often found in Electronic Warfare systems—in video log amplifiers, for example.

Slew Rate



Slew Rate is the effective slope, expressed in volts-per-second, between the 20% and 80% points of a rising or falling waveform. The 1995/6 measures the true slew rate and is not calculated from the 10%/90% rise time measurement. Now slew rates on operational amplifiers can be measured with a single keystroke.

Math and Statistics Capability

The versatile math capability, [(Measurement−X)Y/Z], permits offset, normalize and scale functions to be performed on all timing and counting functions. The display units can be made relevant to the application, such as feet-per-second, gallons-per-hour, parts-per-million or any exponent format.

For further measurement analysis, the 1995/6 includes statistical computation of a sample from 2 to 9,999 readings. Mean, Standard Deviation, and Low and High Values may be displayed. By using the mean function, measurements can be averaged to obtain 100 picosecond resolution. Averaging can be combined with arming to increase the resolution when measuring short bursts of signal.

Computer Interfaces

Full GPIB Control (IEEE-STD-488 [1978] and IEEE-STD-728 [1982])

Full GPIB programmability allows remote system control of all front panel signal conditioning, measurement function and data entry operations. Up to 150 fully processed readings per second are available via the General Purpose Interface Bus.

MATE Interface

The −02M option meets the U.S. Air Force-defined mechanical and electrical parameters for MATE, including the MATE/CIIL* interface as standard. This includes the important relay-controlled isolation capability. The Test Module Adapter is internal, reducing the space requirements compared to counters with an external add-on box. The interface may be used to control all measurement operations in accordance with MATE specifications 2806763.

Reliability

The use of hybrid circuitry, large scale integration and microprocessor-based logic has improved the reliability parts count prediction for Models 1995 and 1996 to over 5000 hours (MIL-HDBK-217D)—about five times that of conventional counters. Typically this relates to actual field experience of well over 10,000 hours.

When problems do occur, an extensive self-test permits verification of all basic counting and timing functions.

Measurement logic tests are performed using a 5 MHz signal derived from the reference. The test signal is introduced via isolation relays which block out external signals. Number of events per time, time between start/stop events, and mismatch in time between start/stop channels are all evaluated.

*Acronym for Control Intermediate Interface Language.

Specifications

(25°C nominal unless otherwise specified.)

Input Characteristics

Inputs A and B

Start/stop channels for each input provide independent, matched measurements for Input A and Input B.

Frequency Range

DC Coupled: DC to 200 MHz

AC Coupled: 20 Hz to 200 MHz

Sensitivity

Sinewave: 25 mV rms to 100 MHz
50 mV rms to 200 MHz

Pulse: 75 mV p−p at 5 nSec

Hysteresis[1]

Normal: 25 mV p−p

High: 100 mV p−p

Filter[1]**:** 100 kHz nominal; independently selectable Input A and Input B.

Dynamic Range (X1): 75 mV to 10 V p−p to 25 MHz; 42 dB
75 mV to 5 V p−p to 100 MHz; 36 dB
150 mV to 2.5 V p−p to 200 MHz; 24 dB

Signal Operating Range: −5 VDC to +5 VDC

Crosstalk at 100 MHz[2]**:** 500 mV rms

Coupling: AC or DC, independently selectable

Impedance

High: 1 megohm shunted by 40 pF (nominal) (Separate or Common)

50 Ohms: 50 ohms nominal

Attenuator: X1, X10 or X50, switchable

Damage Level

1 megohm

(X1): DC to 2 kHz: 260 V (DC + AC rms)
2 kHz to 100 kHz: (5X10⁵/f) V rms
100 kHz to 200 MHz: 5 V rms

(X10, X50): DC to 20 kHz: 260 V (DC + AC rms)
20 kHz to 100 kHz: (5X10⁶/f) V rms
100 kHz to 200 MHz: 50 V rms

50 ohms: 5 V rms (DC to 200 MHz)

Input C (Model 1996)

Frequency Range: 40 MHz to 1.3 GHz

Sensitivity, Sine: 10 mV rms to 1.0 GHz
50 mV rms to 1.3 GHz

Dynamic Range: 40 dB to 1 GHz

Impedence: 50 ohms nominal, AC-coupled

VSWR: 2:1 at 1 GHz

Maximum Operating Input: 1 V rms

Damage Level: 7 V rms (fuse protected)

[1]NOTE: Filter and hysteresis functions may be combined to increase noise immunity.

[2]Sine wave into either input will not trigger the other input.

Universal Counters Models 1995 and 1996

Input D (Gate Control Input)

Sensitivity, Pulse: 300 mV p–p, 50 nSec minimum pulse width

Impedance: 10 kilohm

Damage Level: ±20 V (DC + AC peak)

Trigger Level: TTL or zero-crossing, selectable via Special Function

Trigger Slope: Positive or negative, selectable via Special Function

Triggering

Trigger Level

Range (X1): ±5 V in 10 mV steps

(X10): ±50 V in 100 mV steps

(X50): ±250 V in 500 mV steps

Accuracy

(X1): ±1% of trigger level ±10 mV

Slope: Selectable, positive or negative; with automatic hysteresis compensation

Auto-trigger[3]

Set to 50% point; requires repetitive signal

Frequency Range: DC, 30 Hz to 100 MHz (AC or DC coupled), usable to 200 MHz

Minimum Amplitide: 150 mV p–p

Response Time: 650 mSec typical; 1 Sec maximum

Accuracy: ±2% of peak-to-peak voltage ±20 mV for pulses >20 nSec wide and rise time ≥5 nSec

Measurement Functions

Frequency A & B

Range: DC to 200 MHz

LSD: (1 nSec/Gate Time) × FREQ. (i.e., 9 digits in 1 Sec)

Resolution: ±(LSD) ±(Trigger Error/Gate Time) × FREQ.

Accuracy: ±Resolution ±(Time Base Uncertainty) × FREQ.

Frequency C (Model 1996)

Range: 40 MHz to 1.3 GHz

LSD: (1 nSec/Gate Time) × FREQ.

Resolution: LSD

Accuracy: ±(Resolution) ±(Time Base Uncertainty) × FREQ.

Period

Range: 5 nSec to 1.0 × 10^7 Sec

LSD: (1 nSec/Gate Time) × PER. (i.e., 9 digits in 1 Sec)

Resolution: ±(LSD) ±(Trigger Error/Gate Time) × PER.

Accuracy: ±(Resolution) ±(Time Base Uncertainty) × PER.

Time Interval

Input Configuration

Separate: Input A start/Input B stop
Input B start/Input A stop (Selectable through Special Function)

Common: Input A or Input B start and stop

Range[4]**:** –3 nSec to 1.0 × 10^7 Sec

LSD: 1 nSec (100 pSec using Average mode)

Resolution: ±(LSD) ±(Start Trigger Error) ±(Stop Trigger Error)

Accuracy: ±(Resolution) ±(Time Base Uncertainty) × TIME INT ±(Trigger Level Timing Error) ±2 nSec

Delay

Time Interval Delay: Programmable 200 nSec to 100 Sec

Delay Resolution: ≥1 mSec = 0.10%, <1 mSec = 0.1 μSec

Delay Accuracy: ≥1 mSec = 0.10% <1 mSec = 0.1 μSec

Totalize A by B

(Totalize B by A is available through Special Function)

Range: 0 to 100 MHz; 0 to (10^9)–1 events

Start/Stop: Input B or manually (via Special Function)

LSD: 1 count

Resolution: LSD

Accuracy: LSD

Frequency Ratio

Ratio A/B—software

(Ratio B/A is available via Special Function)

Range, A and B: 0 to 200 MHz

Accuracy: $\pm\frac{(\text{Accuracy of } F_A)}{F_A} \pm \frac{(\text{Accuracy of } F_B)}{F_B}$,

Where F_A and F_B are the frequencies of input signals A and B, respectively

Ratio A/B—hardware

(Available over GPIB)

Ratio C/B—software

(Ratio C/A is available through Special Function)

Range

Input C: 40 MHz to 1.3 GHz

Input B: 0 to 200 MHz

Accuracy: $\pm\frac{(\text{Accuracy of } F_C)}{F_C} \pm \frac{(\text{Accuracy of } F_B)}{F_B}$

Where F_B and F_C are the frequencies of input signals B and C

Ratio C/B—hardware

(Available over GPIB)

Rise/Fall Time

Range: 5 nSec to 25 mSec

Minimum Pulse Height: 250 mV p–p

Minimum Pulse Width: 15 nSec at signal peaks

LSD: 1 nSec (100 pSec using Average mode)

Resolution: ±(LSD) ±(Start Trigger Error) ±(Stop Trigger Error)

Accuracy: ±(Resolution) ±(Time Base Uncertainty) × TIME INT ±(Trigger Level Timing Error) ±2 nSec
(Trigger Level Timing Error computed at 10% and 90% trigger points)

[3] The Auto-trigger function is independent of the input signal duty cycle.
[4] When B STOP occurs before A START, the display will indicate a negative value.

Pulse Width

Range: 5 nSec to 33 mSec (10^7 Sec when trigger level set manually)

LSD: 1 nSec (100 pSec using Average mode)

Resolution: ±(LSD) ±(Start Trigger Error) ±(Stop Trigger Error)

Accuracy: ±(Resolution) ±(Time Base Uncertainty) × TIME INT ±(Trigger Level Timing Error) ±2 nSec (Trigger Level Timing Error computed at 50% trigger points)

Phase A Relative B

(Phase B relative to A is available through Special Function)

Range: 0 to 360°

Minimum Signal: 150 mV p–p with Auto Trigger
25 mV rms with Manual Trigger

LSD: 0.1° to 1 MHz
1° to 10 MHz
10° to 100 MHz

Resolution: $\pm LSD \pm \frac{(\text{Time Interval Resolution} \times 360°)}{\text{Period A}}$

Accuracy: $\pm LSD \pm \frac{(\text{Time Interval Accuracy} \times 360°)}{\text{Period A}}$

Duty Cycle[5]

Range: 0.01% to 99.99%

Frequency Range: 30 Hz to 100 MHz (to DC for manually set trigger levels)

LSD: 0.01% or (1 nSec/period) × 100% (whichever is greater)

Resolution: $\frac{\text{Pulse Width Resolution}}{\text{Period}} \times 100\%$

Accuracy: $\pm LSD \pm \frac{\text{Pulse Width Accuracy}}{\text{Period}} \times 100\%$

Slew Rate

Range: 10 V/Sec to 2×10^9 V/Sec

Transition Time Range: 5 nSec to 30 mSec

Minimum Pulse Height: 250 mV p–p

LSD: $\frac{1 \text{ nSec} \times \text{Slew Rate (to 3 digits)}}{\text{Transition Time}}$

Resolution:

$$\pm \left[\frac{(\text{Stop Trigger Level} - \text{Start Trigger Level}) + 10 \text{ mV}}{0.9 \times (\text{Transition Time} - \text{Transition Time Resolution})} - \text{Slew} \right]$$

Accuracy:

$$\pm \left[\frac{(\text{Stop Trigger Level} - \text{Start Trigger Level}) + 20 \text{ mV}}{0.9 \times (\text{Transition Time} - \text{Transition Time Accuracy})} - \text{Slew} \right]$$

External Arming

Positive or negative edge, selectable via Special Function. Allows counter to start measurement cycle.

Input: A, B or D; selectable through Special Function

External Gating: As arming, but with a selectable stop edge.

Minimum Time: 50 nSec start-to-stop

Synchronous Window Auto Trigger

Input: A, B or D; selectable via Special Function

Start/Stop Edges: Positive or negative, selectable via Special Function.

Peak Signal Measurement

Indicates the peak maximum, peak minimum, peak-to-peak and DC (mean) values of the measurement signal applied to Inputs A or B.

Frequency Range: DC, 30 Hz to 25 MHz useable to 200 MHz

Display: Individual 3-digit display for A and B

Dynamic Range (X1): 150 mV to 10 V p–p, 36 dB

Resolution (X1): 10 mV

Accuracy

Sine: ±5% of peak-to-peak voltage ±20 mV

Pulse and Rise Time: ±2% of peak-to-peak voltage ±20 mV for pulses >20 nSec wide and rise time ≥5 nSec

Statistics

Sample Size: n = 2 to 9999

Standard Deviation: Standard Deviation of sample size (n)

Average: Average (mean) value of sample size (n)

Highest Value: Highest value in sample size (n) is displayed via Special Function

Lowest Value: Lowest value in sample size (n) is displayed via Special Function

Math[6]

Applies to all counting/timing measurement functions except Trigger Level and Gate Time.

Display: $\frac{(\text{Reading} - X)Y}{Z}$

Where X, Y and Z are constants entered and stored via the keyboard

Constant Range: ±0.000000001 (10^{-9}) to ±9999999999 (10^9)

General

Time Base

Frequency: 10 MHz

Aging: $<1 \times 10^{-6}$ per month
$<2 \times 10^{-6}$ for first year

Temperature Stability 0 to 50°C: $< \pm 1 \times 10^{-5}$ referenced to 25° C

External Standard Input

Frequency: 10, 5 or 1 MHz

Level: 500 mV rms minimum; 5 V rms maximum

Impedance: 1 kilohm

Internal Standard Output

Frequency: 10 MHz

Level: 500 mV into 50 ohms

Gate Time

Range: 200 nSec to 100 Sec or 1 period of input signal at measurement gate.

LSD: 0.1 μSec or 3 digits

Non-Volatile Memory: Up to 10 complete front-panel settings may be stored for subsequent recall

Gate Out: A TTL-compatible signal is provided from a rear-panel BNC connector coincident with the measurement gate. Not included on 02M.

Trigger Level Outputs (Calibration Only): Start and stop calibration levels are available on the rear panel from BNC connectors

Display: 10 digit LED display plus exponent

Character Size: 0.43", including exponent

[5]Constant duty cycle required during measurement.
[6]Math Function is applied prior to Statistics Function.

Universal Counters Models 1995 and 1996

Environmental

Temperature

Operating: 0° C to 50° C

Storage: −40° C to 75° C

Models 1995 and 1996 are designed to meet requirements of MIL-T-28800, Type III, Class 5, Style E.

Power: 100, 115, 220, 240 VAC ±10%
45 to 450 Hz
80 VA

Weight: 22 lbs (10 kg)

Dimensions: 3.5H × 16.8W × 18.7D inches
(88.9H × 427W × 475D mm)

Computer Interfaces

GPIB Interface

Standard: IEEE-STD-488 (1978); IEEE-STD-728 (1982)

Programmable Controls: All front panel signal conditioning, measurement function and data entry operations

Data Output Rate: 150 readings/second

Subsets: SH1, AH1, T5, L4, SR0, RL1, PP0, DC1, DT1

MATE Interface (Models 1995/1996–02M)

Hardware Interface: IEEE-STD-488 (1978)

High-Level Language: CIIL as defined by MATE Specification 2806763

DFI (Discrete Fault Indicator)

Relay closure is provided from a rear-panel connector, indicating fan or power supply failure, or loss of CPU control

Options

Option 04E High-Stability Precision Frequency Standard

Proportionally controlled ovenized internal frequency standard

Frequency: 10 MHz

Aging: $<5 \times 10^{-10}$ day

Temperature Stability: $<7 \times 10^{-9}$ averaged over range 0° C to 50° C

Option 04R Rubidium Precision Frequency Standard

Frequency: 10 MHz

Aging Rate: 5×10^{-11}/month after one month continuous operation

Temperature Stability: $\leq 3 \times 10^{-10}$ averaged over range 0° C to 50° C

Ordering information

	Part Number
1995 200 MHz Universal Counter	404335
1995-02M Model 1995 with Internal TMA MATE Interface (Includes rear inputs, rack mounts and handles)	404335-02M
1996 1.3 GHz Universal Counter	404336
1996-02M Model 1996 with Internal TMA MATE Interface (Includes rear inputs, rack mounts and handles)	404336-02M
Options and Accessories	
Option 04 50 Hz operation	404131
Option 71 220/240 V operation	404387
Option 01 Rear Inputs	404378
Option 04E Precision Frequency Standard ($<5\times10^{-10}$/day)	404384
Option 04R Rubidium Frequency Standard ($<5\times10^{-11}$/month)	404469
Option 60 Rack Mounts	404180
Option 65 Rack Mounts/Slides	404183
Option 65M MATE slides	
Aluminum	404468
Steel	404467
Extra Instruction Manual (1995/1996)	980599
Extra Instruction Manual (1995-02M/1996-02M)	980607

Definitions

LSD: Least significant digit. (May be rounded to the nearest whole decade.)

Trigger Error (rms)

$$\text{Trigger error} = \sqrt{\frac{(e_{ix}^2+e_{nx}^2)}{S_x^2} + \frac{(e_{iy}^2+e_{ny}^2)}{S_y^2}}$$

Where e_i = input amplifier rms noise (typically 150 μV rms)
e_n = input signal rms noise in measurement bandwidth
S= Slew rate at trigger point V/Sec
Subscript x denotes START edge
Subscript y denotes STOP edge

Trigger Level Timing Error

$$\text{Trigger Level Timing Error (seconds)} = Z\left(\frac{1}{S_x} - \frac{1}{S_y}\right)$$

Where Z=0.012, typically 0.006
S_x =Slew rate on START edge V/Sec
S_y =Slew rate on STOP edge V/Sec

RACAL-DANA

RACAL

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