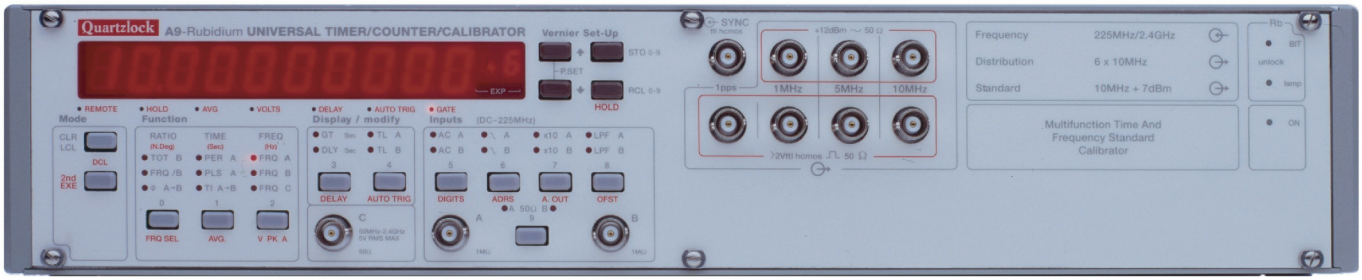
Universal Counter Timer Multifunction Calibrator

with rubidium timebase

250MHz → 2.5GHz → 10.24GHz ↔ 1pps → 1,5,10MHz



- 10 digit accuracy ($1x10^{-10}$)
- 10 digit resolution
- 10 storable front panel set-ups
- Auto-triggering, auto-attenuation for error free op
- 500 built in gate time intervals + external input
- Extended gate time range from 100µs to 1000s
- Complete GPIB programmability
- 100 ASCII-formatted readings in one second
- 13 measurement functions
- Resolves 9 digits in one second
- Complete input conditioning on both channels
- ▫ 9 x 10MHz outputs for referencing instruments
- ▫ 1MHz, 5MHz, 10MHz sine & square wave outputs
- Frequency range: 0 to 250MHz, both channels
- ▫ 2.5GHz input (2.7GHz typical)
- ▫ 10.24GHz output
- Dynamic range: ±50V with x10 attenuator
- Input impedance: 50Ω or 1MΩ, switchable
- Single shot time resolution: to 1ns
- Averaged time resolution: to 1ps
- Sensitivity: 25mV to 100MHz, 50mV to 250MHz
- Phase resolution: 0.01°
- V peak-peak resolution: 2 x three digits
- Trigger level range: from -50Vdc to +50Vdc
- ▫ 1pps sync input
- ▫ 1pps sync output

▫ = Options

Applications

- **Frequency & Time Measurements**
- **RF Measurements**
- **Microwave Measurements**
- **Communications**
- **High Speed Auto Test Systems**
- **Rackmount 'test solutions'**

Benefits

- **Versitility for most applications**
- **Multiple Measurement Parameters with One Instrument**
- **Simple, Fast Initial set up**
- **Phase/ Time/ Counter Applications**
- **Synchronise 6-10 Other Instruments**

Detailed Specification

Input Characteristics (Channels A & B)

RANGE
- DC coupled: 0 to 250 MHz (typically to 300 MHz).
- AC coupled: 1 MΩ, 30 Hz to 250 MHz; 50 Ω, 1 MHz to 250 MHz.

SENSITIVITY
25 mV rms sine wave to 100 MHz,
50 mV rms sine wave to 250 MHz,
75 mVp-p at minimum pulse width of 5 ns.

SIGNAL OPERATING RANGE
-5.00 Vdc to +5.00 Vdc (x attenuator).

DYNAMIC RANGE
75 mV to 5 Vp-p, to 100 MHz; 150 mV to 2.5 Vp-p, to 250 MHz.

IMPEDANCE
1 MΩ or 50Ω, selectable.

LOWPASS FILTER
100kHz NOMINAL, switchable.

TRIGGER LEVEL RANGE
- Manual (auto trigger off): Continuously adjustable over ± 5.00 V (x attenuator), displayed in 10 mV steps (x attenuator).
- Setting Accuracy: X1, ±(35 mV +2% of reading); X10, ±(350 mV + 2% of reading).

Auto Trigger

DC Coupled: 100 Hz to 150 MHz.

AC Coupled: 1 MΩ, 100 Hz to 150 MHz; 50Ω, 1 MHz to 150 MHz (typically to 225 MHz).

Auto Trigger Range: +/-280 mV to +/-50 Vp-p.

Trigger Slope: Independent selection of + or - slope.

Attenuator

Manual: X1 or X10 NOMINAL, selectable.

Auto: Attenuator is automatically enabled when in Auto Trigger Mode.

Auto Attenuator Sensitivity: Attenuator is switched when peak input signal exceeds 5.1 Vp-p.

Frequency A & Frequency B

Measurement Technique (automatically selected by the instrument)
- Reciprocal: below 120 MHz and in User Gate and Hold operating modes;
- Conventional: above 120 MHz.

Range: 0.1 Hz to 225 MHz (typically to 300 MHz).

LSD Displayed
- Reciprocal: 4 ns x frequency / gate time
- Conventional: 4 / gate time

Resolution: ±LSD ±(1.4 x Trig error) x Frequency / gate time

Accuracy: ±resolution ±Time Base Error x Frequency

Time Measurement - Single Shot

Period A, Pulse A, Time Interval A to B

Range
- Period A, Pulse A: 5 ns to 2000 s
- Time Interval A to B: 0 ns to 2000 s

LSD Displayed
- Below 20S: 1 ns
- Above 20S: 5x10E-10 x Time

Resolution
- Below 20 s: ±2 LSD ±Start trigger error ± Stop trig error
- Above 20 s: 1 LSD.

Accuracy: ±(Time Base error x Time) ±Trigger level timing error ±1 ns ± resolution.

Time Delay
- Internal: 500 internal pre-programmed delay intervals, ranging from 100 µs to 100 s, can be inserted between START and STOP of Time Interval A to B. Inputs during delay are ignored.
- External: User selectable delay intervals, ranging from 100 µs to 10E5 s, can be applied through rear panel BNC connector.

Time Measurement - Averaged

Period A
Range: 8 ns to 10 s

LSD Displayed: 4 ns x Period / gate time

Resolution: ±LSD ±(1.4 x Trig error) x Period / gate time

Accuracy: ±resolution ±Time Base error x Period

Number of Periods Averaged: N = gate time / Period

Pulse A, Time Interval A to B
Range
- Pulse A: 5 ns to 10 s.
- Time Interval A to B: -3 ns to 10 s.
- LSD Displayed: 4 ns / N
- Resolution: ±(1 LSD + 10 ps)
- Accuracy: ±(Time Base Error x Time) ±1ns ±(resolution ±Trig error)/ N
- Dead Time Stop to Start: 20 ns minimum.
- Number of Samples Averaged: N = gate time x Frequency A.

Phase A to B
Range: 0 to 360 degrees x (1 - 20 ns x Freq A).

Frequency Range: 0.1 Hz to 25 MHz.

LSD Displayed: 4 ns x 360 degrees x (1 + N) / gate time or 0.01 degrees, whichever is greater

Resolution: ±1 LSD.

Accuracy: ±resolution ±(1 ns x Freq A x 360 degrees) ±(Trigger error x Freq A x 360 degrees) / N

Number of Cycles Averaged: N = gate time x Frequency A

Min Amplitude: 100 mV rms sine wave.

Totalize B
Frequency Range: 0 to 120 MHz.

Totalling Range: 0 to 10^{16} - 1

Gate Modes
- Infinite: Totalling on B indefinitely.
- Gated by A: Totalling on B between a pair of two consecutive transitions of the opposite direction on A.
- Gated by AA: Totalling on B between a pair of two consecutive transitions of the same direction on A.

Gating Transition: Positive or Negative transitions, selectable.

Dead Time Stop to Start: 20 ns minimum.

LSD Displayed: 1 count of input signal.

Accuracy
- Infinite: Same as LSD.
- Gated by A, Gated by AA: ±pulse rep rate B x Trig error A / total counts B.

Ratio A/B, Ratio C/B
Frequency Range
- A: 0.1 Hz to 225 MHz;
- B: 0.1 Hz to 125 MHz;
- C: 50 MHz to 2.4 GHz (Channel C optional).

LSD displayed: 4 x Ratio / Freq B x gate time

Detailed Specification Continued

Resolution and Accuracy
C/B: ±LSD;
A/B: ±LSD ±Trigger error B x Ratio / gate time

V Peak A
Frequency Range: 40 Hz to 10 MHz.

Dynamic Range: 280 mVp-p to 51 Vp-p

Resolution: x1, 10 mV; x10, 100 mV. Attenuator is activated automatically

Accuracy: ±resolution ±0.1(Vpos pk - Vneg pk) ±35 mV

Gate Time
Internal: 500 pre-programmed gate time intervals, ranging from 100µs to 100s

External: User selectable gate time intervals, ranging from 100µs to 1000s

External Input: Positive true TTL levels

External Gate Delay: <10 us

External Arming (Trigger)
Function: Arms the instrument when set to HOLD

Trigger Delay: <50 µs

Minimum Pulse Width: 10 µs

External Input: Positive true TTL levels

Time Base
Frequency: 10 MHz

Aging Rate: 1 x 10E-7/month

Stability: 1 x 10E-6, 0 to 50 degree C

External Time Base Input: 10 MHz, TTL level.

GPIB Interface
Programmable Controls: All front panel controls except POWER switch.

Interface Functions: SH1, AH1, T6, TE0, L4, LE0, SR1, RL1, PP0, DC1, DT1, C0, E1

Data Output
Single Shot: One reading processed after trigger
Normal Mode: Four readings/second, formatted
Fast Mode: Up to 100 reading/second, formatted
Address Selection: Front panel programming

General
Arming: Each channel is armed by it's own signal

Reset: Clears display and re-cycles measurement

Trigger Level Outputs: DC Outputs via rear panel terminals, not adjusted for attenuators

Displayed Digits: Selectable from 3 to 9 digits

Stored Set-ups: Stores ten front panel set-ups

Operating Temp: 0 to 50 degree C

Power: 115/230 Vac, 50-60 Hz, 25 W

Internal Rubidium

Output
Frequency: 10MHz

Voltage (into 50Ω): 0.5-1.0Vrms

Accuracy at Shipment
± 5E-11

Aging
1 month: 1E-10
1 year: 5E-10

Warm Up Time to 1E-9
5 mins

Phase Noise, dBc/Hz
10 Hz: -100
100 Hz: -125

Distortion, dBc
Harmonic: -40
Non-harmonic: -80
1 kHz: 135
10 kHz: 145

Frequency Stability
1 s: 3E-11
10 s: 1E-11
100 s: 3E-12

Temperature
Operating (Ambient): -10°C - +55°C

Storage: -40°C - +85°C

Frequency offset over operating temperature range: ± 5E-10

Frequency Converter and Distribution Amplifier

Frequency standard outputs
1MHz, 5MHz, 10MHz sine wave @ 12dBm

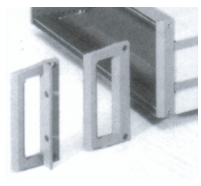
1MHz, 5MHz, 10MHz square wave @ >2V ttl hcmos 50Ω

Distribution amplifier outputs
6 x 10MHz @ 12dBm, 50Ω

Time sync output
1pps

Timing input sync
1pps

19" Rackmount Version



Description

The Model A9 is a ten-digit, three-channel Universal Counter/Timer. It is microprocessor based, fully programmable, and has a rubidium oscillator timebase. The instrument measures with a very high resolution and precision the following parameters: frequency A, Frequency B, Frequency C, Period A, Pulse-width, Time interval A to B, Total counts B, Ratio A/B, Ratio C/B, Phase A to B and Amplitude peaks. An averaging function is available for improved resolution in time measurement, giving resolution intervals of Pico seconds. Various repetitive tests, no matter how complex, are greatly simplified by utilizing any of the 10 pre-programmed front panel set-ups. Set-ups are stored in a non-volatile memory and can be recalled by a simple keystroke.

The A9 utilises a combination of two measurement techniques in order to always achieve maximum display resolution. Some functions, such as Frequency measurement function, can be displayed with up to ten digits. Resolution can be gained from frequencies as low as 0.01 Hz to more than 300 MHz. The reciprocal technique is being used in low frequency measurements, up to exactly 120 MHz, where the measurement technique is changed to the conventional measurement technique. Model A9 measures frequencies of input signals with minimum resolution of nine digits in one second of gate time.

In the A9, the traditionally featured decade steps of gate times, are replaced by a more flexible variable gate time. This feature permits a choice from 500 internally pre-selected gate intervals, or any external gate interval which is applied to a rear panel BNC connector. Internal gate times range from 100µs to 100s. The external gate expands this range to 1000s. Trigger level may be selected manually or left to be automatically adjusted, by the instrument, to the optimum level, eliminating false triggering on unknown signals.

Options

There are several options available with Model A9:

Option 1 - Multi frequency outputs 1, 5 & 10MHz Sine & Square Wave (14 outputs total). 1pps sync input and 1pps sync output. 7 x 10MHz outputs
Option 2 - 2.4 GHz C Channel input (typically 2.7GHz)
Option 3 - Analog output
Option 4 - Microwave calibration output: 1.28GHz, 10.24GHz - +10dBm +/-1dB @ 20-25°C. Level calib to 0.1dB. Low phase noise -100dB.

Options may be ordered with new instruments from the factory, or separately for future installation. There are no software upgrades necessary when installing the options. The instrument automatically senses the presence of the new option and allows access to parameters that are associated with the newly installed option.

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