

# Frequency Counters

SR620 — Universal time interval and frequency counter

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## SR620 Time Interval & Frequency Counter

- **25 ps single-shot time resolution**
- **1.3 GHz frequency range**
- **11-digit frequency resolution (1 s)**
- **0.001° phase resolution**
- **Statistical analysis & Allan variance**
- **Graphical output to X-Y scopes**
- **Hardcopy to printers and plotters**
- **GPIB and RS-232 interfaces**
- **Optional ovenized timebase**

• **SR620 ... \$4950 (U.S. list)**

The SR620 Time Interval Counter performs virtually all of the time and frequency measurements required in a laboratory or ATE environment. The instrument's single-shot timing resolution and low jitter make it the counter of choice for almost any application.

### SR620 Measurements

The SR620 measures time interval, frequency, pulse-width, rise and fall time, period, phase and events. Time intervals are measured with 25 ps rms resolution, making the SR620 one of the highest resolution counters available. Frequency is measured from 0.001 Hz to 1.3 GHz, and a choice of gates ranging from 1 period to 500 seconds is provided. The SR620 delivers up to 11 digits of frequency resolution in one second, making it suitable for measurement applications ranging from short-term phase locked loop jitter, to the long-term drift of atomic clocks. All measurement modes are supported by a wide variety of flexible arming and triggering options.

### Histograms and Strip Charts

Unlike conventional counters that only have numeric displays, the SR620 provides live, graphical displays of measurement results. Graphical data is available in three formats: a histogram showing the distribution of values within a set of measurements, a strip chart of mean values from successive measurements, or a strip chart of jitter (standard deviation or Allan variance) values from successive measurements. Up to 250 strip-chart points or histogram bins can be displayed.



## SR620 Specifications

### Timebase

|                        | Standard   | Option 01                |
|------------------------|--|--------------------------|
| Frequency              | 10.000 MHz   | 10.000 MHz               |
| Type                   | TCVCXO   | Ovenized VCXO            |
| Aging                  | $1 \times 10^{-6}$ /yr.                                | $5 \times 10^{-10}$ /day |
| Allan variance (1 s)   | $3 \times 10^{-10}$ (typ.)                             | $< 5 \times 10^{-12}$    |
| Stability (0 to 50 °C) | 1 ppm  | $< 2 \times 10^{-9}$     |
| Settability            | 0.01 ppm   | 0.001 ppm                |
| External timebase      | User may supply 5 MHz or 10 MHz timebase (1 V nominal) |                          |

### Time Interval, Width, Rise and Fall Times

|                   |  |
|-------------------|--|
| Range             | -1000 s to +1000 s in $\pm$ TIME mode<br>-1 ns to +1000 s in all others modes  |
| Trigger rate      | 0 to 100 MHz   |
| Display LSD       | 4 ps single sample, 1 ps with avg.   |
| Resolution        |  |
| Standard timebase | $((25 \text{ ps typ. } [50 \text{ ps max.}]^2 + (0.2 \text{ ppb} \times \text{Interval})^2) / N)^{1/2}$ rms  |
| Option 01         | $((25 \text{ ps typ. } [50 \text{ ps max.}]^2 + (0.05 \text{ ppb} \times \text{Interval})^2) / N)^{1/2}$ rms, (N=sample size)  |
| Error             | $< \pm(500 \text{ ps typ. } [1 \text{ ns max.}] + \text{Timebase Error} \times \text{Interval} + \text{Trigger Error})$  |
| Relative error    | $< \pm(50 \text{ ps typ. } [100 \text{ ps max.}] + \text{Timebase Error} \times \text{Interval})$  |
| Arming modes      | +TIME (Stop is armed by Start)<br>+TIME EXT (Ext arms Start)<br>+TIME EXT HOFF (Leading EXT edge arms Start, trailing EXT edge arms Stop)<br>$\pm$ TIME (Armed by Start/Stop pair),<br>$\pm$ TIME CMPL (Armed by Stop/Start pair)<br>$\pm$ TIME EXT (Armed by EXT input edge)<br>EXT arming may be internally delayed or scanned with respect to the EXT input in variable steps. The step size may be set in a 1-2-5 sequence from 1 $\mu$ s to 10 ms. The maximum delay is 50,000 steps. |
| Display           | 16-digit fixed point with 1 ps LSD   |
| Sample rate       | $N \times (800 \mu\text{s} + \text{measured time interval}) + \text{calculation time}$ (N=sample size)<br>The calculation time occurs only after N measurements are completed and varies from zero (N=1, no graphics, binary) to 5 ms (N=1, no graphics) to 10 ms (display mean or standard dev.) to 60 ms (histogram).  |

### Frequency

|       |  |
|-------|--|
| Range | 0.001 Hz to 300 MHz via comparator inputs. 40 MHz to 1.3 GHz via |
|-------|--|

|         |   |
|---------|---|
| Error   | internal UHF prescalers.<br>RATIO A/B range: $10^{-9}$ to $10^3$<br>$< \pm((100 \text{ ps typ. } [350 \text{ ps max.}]) / \text{Gate} + \text{Timebase Error}) \times \text{Frequency}$                                 |
| Gates   | External, 1 period, 1 $\mu$ s to 500 s in 1-2-5 sequence. Gates may be externally triggered with no delay. Gates may be delayed relative to an EXT trigger. The delay from trigger is set from 1 to 50,000 gate widths. |
| Display | 16-digit fixed point with<br>LSD = Freq. $\times$ 4 ps / Gate. 1 $\mu$ Hz maximum resolution (1 nHz with $\times$ 1000 for frequencies $<$ 1 MHz)   |

### Period

|         |  |
|---------|--|
| Range   | 0 to 1000 s  |
| Error   | RATIO A/B range: $10^{-9}$ to $10^3$<br>$< \pm((100 \text{ ps typ. } [350 \text{ ps max.}]) / \text{Gate} + \text{Timebase Error}) \times \text{Period}$ |
| Gates   | Same as frequency  |
| Display | 16-digit fixed point, LSD = 1 ps (1 fs with $\times$ 1000 for periods $<$ 1 s)   |

### Phase

|            |   |
|------------|---|
| Definition | Phase = $360 \times (T_b - T_a) / \text{Period A}$  |
| Range      | -180 to +180 degrees, 0 to 100 MHz  |
| Resolution | $(25 \text{ ps} \times \text{Freq.} \times 360 + 0.001)^\circ$  |
| Gate       | 0.01 seconds (1 period min.) for period measurement and 1 sample for time interval measurement. Period may also be measured using externally triggered internal gates as in frequency mode. |
| Error      | $< \pm(1 \text{ ns} \times \text{Freq.} \times 360 + 0.001)^\circ$  |

### Counts

|            |  |
|------------|--|
| Range      | $10^{12}$ , RATIO A/B range: $10^{-9}$ to $10^3$ |
| Count rate | 0 to 300 MHz                                     |
| Gates      | Same as frequency                                |
| Display    | 12 digits  |

### Inputs

|             |  |
|-------------|--|
| Bandwidth   | 300 MHz (1.2 ns rise time)   |
| Threshold   | -5.00 to +5.00 VDC<br>(10 mV resolution)   |
| Accuracy    | 15 mV + 0.5 % of setting   |
| Sensitivity | see graph next page  |
| Auto level  | Threshold set between peak input excursions.<br>( $f >$ 10 Hz, duty cycle $>$ $10^{-6}$ )            |
| Slope       | Rising or falling edge   |
| Impedance   | (1 M $\Omega$ + 30 pF) or 50 $\Omega$<br>50 $\Omega$ termination has SWR $<$ 2.5:1 from 0 to 1.3 GHz |
| Coupling    | AC or DC<br>(Ext is always DC coupled)   |

Input noise 350  $\mu$ Vrms (typ.)  
 Prescaler see graph  
 Protection 100 V, 50  $\Omega$  terminator is released if input exceeds  $\pm 5$  Vp

**REF Output**

Frequency 1.00 kHz (accuracy same as timebase)  
 Rise/fall time 2 ns  
 Amplitude TTL: 0 to 4 V (2 V into 50  $\Omega$ )  
 ECL: -1.8 to -0.8 V into 50  $\Omega$

**DVM Inputs**

Full scale  $\pm 1.999$  VDC or  $\pm 19.99$  VDC  
 Type Sample & hold with successive approximation converter  
 Impedance 1 M $\Omega$   
 Accuracy 0.3 % of full scale  
 Speed Approximately 5 ms

**D/A Outputs**

Full scale  $\pm 10.00$  VDC  
 Resolution 5 mV  
 Impedance <1  $\Omega$   
 Default Voltage proportional to mean and deviation  
 Accuracy 0.3 % of full scale

**Graphics**

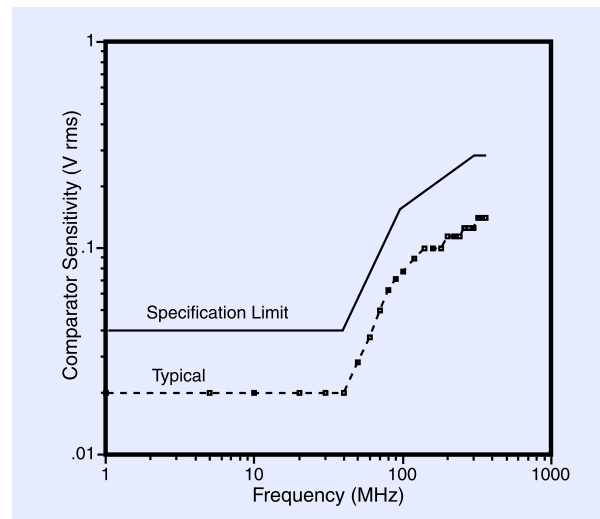
Scope Two rear-panel outputs to drive x-y analog oscilloscope  
 Displays Histograms and strip charts of mean and jitter  
 X-axis -5 V to +5 V for 10 division deflection  
 Y-axis -4 V to +4 V for 8 division deflection  
 Resolution 250 (H)  $\times$  200 (V) pixels  
 Hardcopy Centronics port for dot-matrix printers. RS-232, IEEE-488.2 for HP-GL compatible plotters.

**Interfaces**

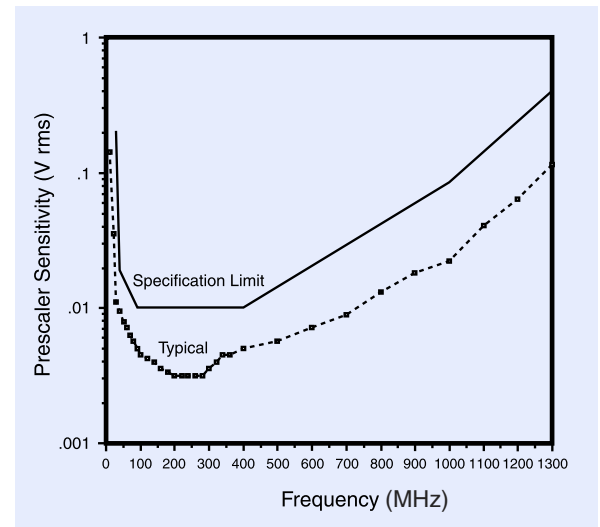
RS-232 300 baud to 19.2 kbaud. All instrument functions may be controlled.  
 GPIB IEEE-488.2 interface. All instrument functions may be controlled.  
 Speed Approximately 150 ASCII formatted responses per second, 1400 binary responses per second.

**General**

Operating 0  $^{\circ}$ C to 50  $^{\circ}$ C  
 Power 70 W, 100/120/220/240 VAC, 50/60 Hz  
 Weight, dimensions 11 lbs., 14"  $\times$  3.5"  $\times$  14" (WHD)  
 Warranty One year parts and labor on defects in materials and workmanship



*Input sensitivity*



*Prescaler sensitivity*

**Ordering Information**

|           |   |        |
|-----------|---|--------|
| SR620     | Time interval & frequency counter (with rack mount kit) | \$4950 |
| Option 01 | 2 ppb OCXO timebase                                     | \$950  |