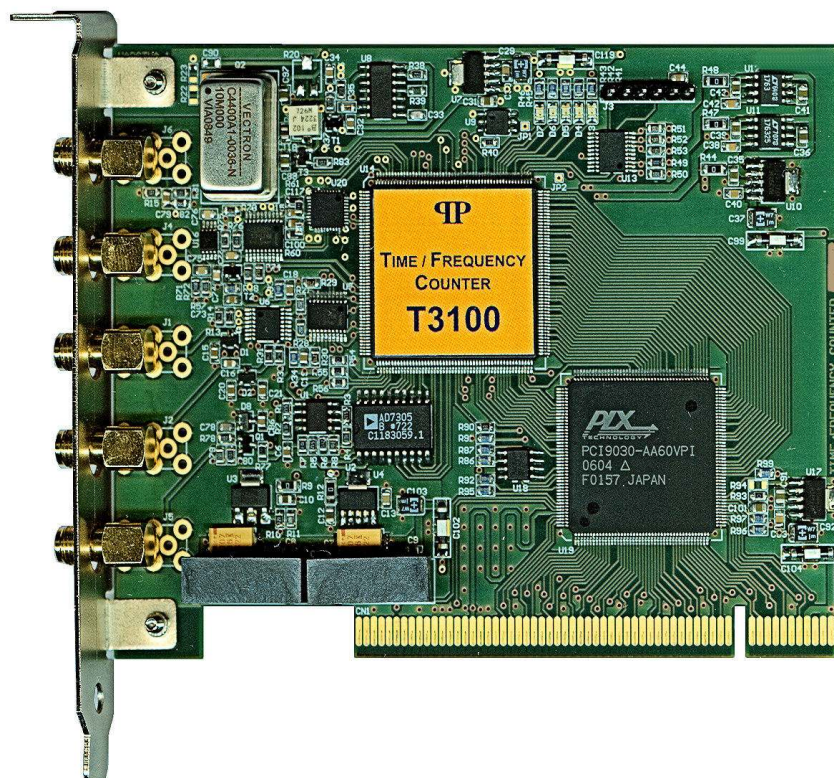# Time/Frequency Counter Model T3100(S)

High Performance Instrumentation

- Single PCI board for PC
- Time interval measurement range:
  0 – 4400 seconds
- Precision (standard deviation) **< 35 ps** at time interval measured from 0 to 50 ms
- Frequency range up to **3.5 GHz**
- **Frequency sampling** up to **2 MSa/s**
- Measurement of **Allan Deviation** (ADEV)
- Measurement of **Time Interval Error** (TIE, MTIE), TDEV
- Totalize mode

- Built-in automatic calibrator
- Selectable pulse edge and polarity
- Selectable input threshold level or automatic threshold search
- Comprehensive statistical data processing
- User-friendly software for Windows and DLL file for user's applications
- Export of data files for processing in other programs (*Stable32*, *MS Excel*)
- TCXO (T3100), **OCXO (T3100S)**

The T3100(S) Time/Frequency Counter occupies a single PCI slot in a PC and combines the picosecond precision of measurement with affordable cost and reliability for thorough industrial and scientific applications. The supplied software creates a user-friendly graphic interface and provides many useful functions for accurate control, diagnostics and statistical processing of the measurement data.

The heart of the instrument is a newly developed FPGA counter device, which contains a complete interpolation time counter with two precision two-stage Time-to-Digital Converters, a FIFO memory which allows for very high measurement rate, and a dedicated microcontroller. The counter T3100 has on-board a *Temperature-Compensated Crystal Oscillator* (TCXO), while the model T3100S contains an *Oven-Controlled Crystal Oscillator* (OCXO) which provides still higher accuracy and stability at reasonable cost.

PIK TIME SYSTEMS®
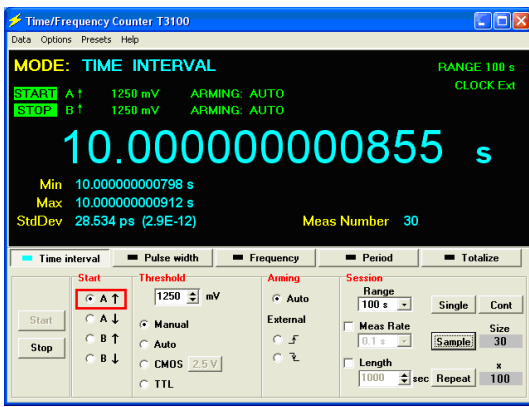
Display in Time Interval mode
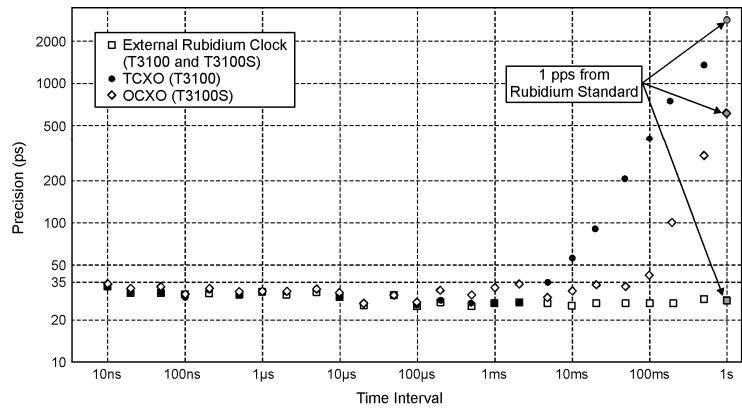
Precision (Standard Deviation of TI measurements)

Specifications

Functions	Time Interval (between two pulses at two inputs or pulses appearing consecutively at a single, common input), Period, Pulse Width, Frequency, Frequency Sampling, Allan Deviation, Time Interval Error (TIE), Maximum TIE (MTIE), Time Deviation (TDEV), Totalize
Statistics	Mean, Min and Max Values, Standard Deviation, Allan Deviation (frequency)
Graphics	Tables and plots of statistical distributions, display of frequency sampling in time domain to show possible frequency variation (Sampling mode)

Time Interval & Period

Range	0 – 4400 seconds (Inputs **A** and **B**)
Resolution (LSB)	25 ps in single-shot measurements, may be reduced to 1 ps by averaging
Precision (*Standard Deviation*)	< 35 ps at time interval measured from 0 to 2 ms (TCXO – T3100)
	< 35 ps at time interval measured from 0 to 50 ms (OCXO – T3100S)
	< 35 ps at 1 second (when an atomic clock is used as external reference clock)
	$< 35/\sqrt{Sample\_Size}$ ps with averaging
Systematic Error	$< \pm$ (1 ns max + (Timebase Error x Interval) + Trigger Level Timing Error)
Range Limit (*Overflow*)	presettable: 1 s, 10 s, 100 s, 4400 s
Start Enable	internal (software) or external pulse (+1… +3 V) into 50 Ω (input **EN**)
Stop Disable	referred to Start, programmable over the range (1…999)·20 units, where the unit is selected as ns, µs, and ms
Dead Time	200 ns
Measurement Rate	$5 \cdot 10^6$ measurements per second maximum (when measuring zero time interval and storing data in internal FIFO memory), up to $4 \cdot 10^5$ measurements per second stored to memory in PC

Frequency & Period

Range	Inputs **A** and **B**: 0.1 Hz to 200 MHz
	        Sensitivity < 75 mV RMS typ. (0.01 to 250 MHz)
	        Minimum slew rate: 10 V/µs
	Input **F**: 100 MHz to 3.5 GHz
	        Sensitivity < -12 dBm (< 55 mV RMS) from 400 MHz to 3 GHz
	        Sensitivity < - 3 dBm (< 160 mV RMS) from 100 MHz to 3.5 GHz

Gate Time	selected from 1 µs to 10 s (reciprocal method)
Measurement Rate	up to $8 \cdot 10^5$ measurements/sec (when measuring frequency in 1 µs gate and storing data in internal FIFO memory), up to $2.5 \cdot 10^5$ measurements/sec stored to memory in PC

Frequency Sampling

Range	Inputs **A** and **B**: 1 to 200 MHz Input **F**: 100 MHz to 3.5 GHz
Sampling Rate	0.1, 0.2, 0.5, 1.0, 2.0 MSa/s

Totalize

Range	0 to 10^{12} counts
Input frequency	max. 200 MHz
Gate Time	Internal: from 1 µs to 10 s, External arming (**EN**), Manual Start-Stop

Inputs A and B	Impedance:	50 Ω, DC coupled; SMA sockets
	Amplitude:	within ± 4 V
	Pulse edge:	selectable, rising or falling
	Threshold:	manually adjustable from -4 V to +4 V with 40 mV resolution, or set automatically

Input EN	Impedance:	50 Ω, DC coupled; SMA socket
	Input pulses:	standard TTL or min. +1 V referred to ground

Internal Clock Generator	**T3100:** 10 MHz TCXO, stability 0.5 ppm (- 40 to +85 °C), ageing 1×10^{-6}/year
	T3100S: 10 MHz OCXO, stability 0.1 ppm (-20 to +70 °C), ageing 1×10^{-8}/day*

External Clock Generator	10 MHz, sine or pulse, min. 100 mV on 50 Ω input impedance; SMA socket
Capacity of FIFO Memory	4 K measurements of time interval, 2.7 K measurements of frequency
Supplied Software	for *Windows*® XP/Vista/7, DLL file for other applications

*after 30 days of operation