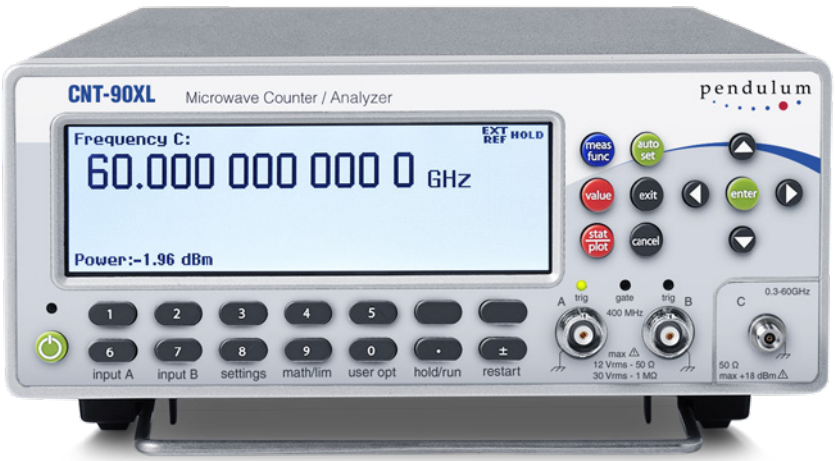
CNT-90XL

Pulsed RF Microwave Counter/Analyzer

DATA SHEET

- Pulsed RF measurements down to 30 ns
- Frequency, Power, CW or Burst to 27, 40, 46 or 60 GHz
- Speed: 250k measurements/s to internal memory
- Resolution: 14 digits display
- Statistical analysis including histogram, trend & modulation domain display
- Unique ease-of-use: Multiparameter display & graphical presentation of results
- USB & GPIB as standard
- 2 instruments in one - Microwave Counter/ Analyzer & 400 MHz general-purpose timer/ counter



The Pendulum CNT-90XL Microwave Counter/Analyzer is an excellent tool for measurement, analysis and calibration of Microwave Frequency, Power, and Pulsed RF time parameters like pulse width and PRI. Whether in test systems, on the R&D bench, in the calibration lab or out in the field, the high-resolution and ultra-fast CNT-90XL is the state-of-the-art Microwave Counter/Analyzer. The NEW option for pulsed RF makes CNT-90XL ideal for radar test and calibration. The CNT-90XL offers a unique ease-of-use with graphical display and improved control over measurement at an affordable price.

The Fastest Microwave Counter

The CNT-90XL Microwave Counter/Analyzer sets a new industry standard for microwave frequency analysis and outperforms any microwave Pulse or CW counter on the market regarding resolution, speed and acquisition time. The CNT-90XL is the worlds fastest Microwave counter and offers a measurement speed up to 250,000 frequency samples/s, for advanced statistical analysis, and for analysis of frequency or power transients.

The NEW Pulsed RF option enables measurements of pulses down to 30 ns width, plus PRI/PRF, frequency in burst and power in burst.

The multi-functional CNT-90XL also serves as a 400 MHz general purpose timer/counter, with unique ease-of-use with analysis capabilities to view variations in signal parameters both numerically and graphically.

Save money in production test

The CNT-90XL is intended for several applications, such as:

- Pulsed, Chirped, and Doppler Radar testing and calibration
- Microwave link carrier calibration
- Satellite communication equipment testing
- RF and microwave instrumentation calibration
- RF components and modules, including YIG and VCO testing
- Medical RF equipment testing

Product Features And Benefits

- Pulsed RF measurements (optional) includes Pulse Width to 30 ns, PRI/PRF, Frequency in Burst, Power in Burst
- Fast high-resolution frequency or power measurements, for modulation, doppler shifts, or transient analysis
- Very short acquisition time of 25 ms (Auto) or zero (Manual)
- High sensitivity (-33 dBm)
- Statistical processing and graphical histogram, trend and modulation display
- Affordable microwave frequency counting

Product Features And Benefits

- High resolution is vital for R&D and production testing. CNT-90XL meets this requirement with 100 ps single shot (time) or 12 digits/s (frequency). Obtained values are displayed with up to 14 digits.
- For calibration purposes, the CNT-90XL offers very high accuracy through stable internal OCXO time base, plus high resolution.
- Both USB and GPIB interfaces are standard. With USB you won't need to invest in a GPIB interface card for your PC. The GPIB operates in either SCPI/GPIB or 53131 emulation mode, for plug-and-play replacement in existing ATE systems.
- Menu-oriented settings reduce the risk of mistakes. Valuable signal information, given in multi-parameter displays, removes the need for other instruments like DVM's and Scopes.

Battery Option

The CNT-90XL has an optional battery pack with 90 Wh capacity, capable of mains-free operation for at least 4.5 hours. In stand-by mode the battery pack can keep an OCXO warm and running for over 24 hours. Battery operation of a frequency counter/analyzer is valuable in three different applications:

- Transportation of high-stability OCXO to maintain stability, which gives instant use at destination without any warm-up time
- Battery backup acting as a built in UPS (Uninterrupted Power Supply)

TimeView®, Modulat ion Domain Analysis SW

The optional Modulation Domain SW TimeView® is the ultimate tool to view and analyze dynamic frequency changes in real-time, utilizing the high-resolution PC screen, marker read-outs and processing, FFT calculation to find modulation frequencies, ADEV calculation of short-term stability and more.

Excellent Graphical Presentation

One of the great features of the CNT-90XL is the graphical display and the menu oriented settings. The non-expert can easily make correct settings without risking costly mistakes. The multi-parameter display shows auxiliary measurement values such as Power level in dBm in Frequency measurements.

Measurement values are presented both numerically and graphically. The graphical presentation of results (histograms, trends etc.) gives a much better understanding of the nature of signal jitter. It also provides you with a much better view of changes vs time, from long term trends like slow drift, to fast modulation and transients. Three statistical views of the same data set can be viewed: Numerical, Histogram and Modulation/Trend. It is very easy to capture and toggle between views of the same data.

When adjusting a frequency source to given limits, the Limit qualifying tool gives fast and accurate visual guidance. Tolerance limit markers are visually displayed and the actual frequency is graphically displayed inside or outside the limit markers. Passing the limits will cause an alarm indication.

The graphical display examples below show the frequency changes over time directly on-screen, for example Doppler frequency shift in speed radar sensors, fast power switching, FM or AM. Builtin statistical processing presents numerical stability data and also frequency distribution histograms on-screen for analysis of frequency stability or modulation.

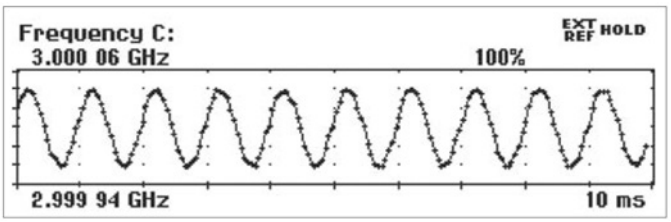


Figure 1: 1kHz FM with 12 ppm modulation depth

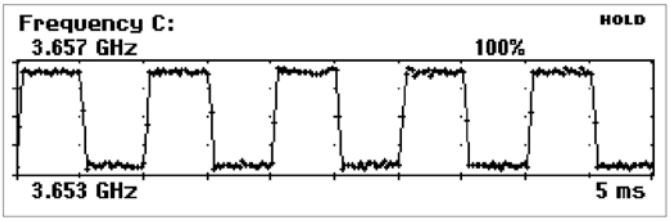


Figure 2: Pulse modulated frequency or FSK

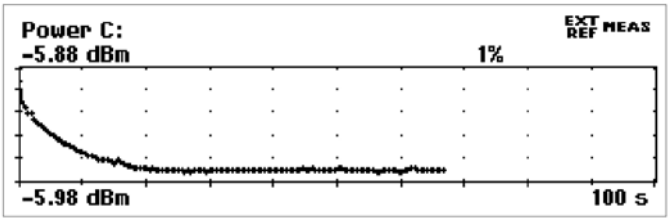


Figure 3: Generator start-up power settling

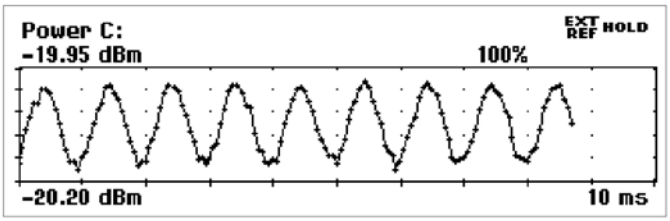


Figure 4: Very small AM on carrier is visualized

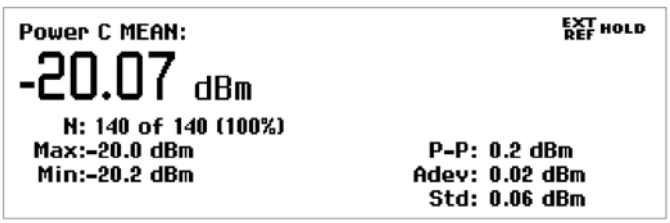


Figure 5: Numeric statistics screen of the previous AM signal

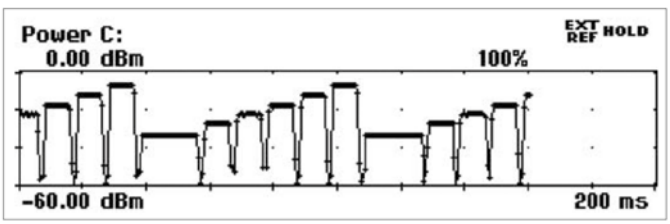


Figure 6: Power step from generator (-30 to -5dBm in 5dBm steps)
NOTE: output is turned off shortly betw. power steps

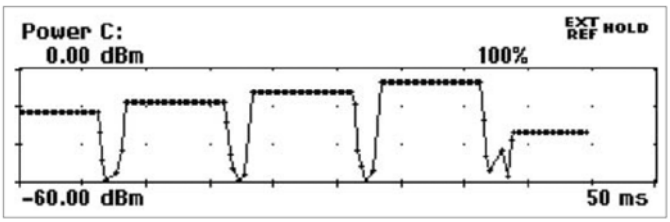


Figure 7: Power step (close up)

Measuring Functions

Frequency A, B, C

Range:
Input A, B: 0.002 Hz to 400 MHz
Input C: 300 MHz to 27, 40, 46 or 60 GHz
Resolution: 12 digits in 1s measuring time
Acquisition C: Auto or Manual
Acquisition time: 25 ms in Auto (typ.)

**Note: Some frequencies may not be acquired correctly with Auto Acquisition. If so, switch to Manual Acquisition instead*

Aux. Parameters:
Input A, B: Vmax, Vmin, Vp-p
Input C: Power C in dBm or W

Frequency Burst A, B

Range:
Input A, B: 0.002 Hz to 400 MHz
Input C: Requires option 28 - see "Pulsed RF" specs
Minimum Burst Duration: Down to 40 ns
Minimum Pulses in Burst:
Input A or B: 3 (6 above 160 MHz)
PRF Range: 0.5 Hz to 1MHz
Start Delay: 10 ns to 2sec., 10 ns resolution
Aux. Parameter: PRF

Period A, B (single or average), C (average)

Mode: Single, Average
Range:
Input A, B: 2.5 ns to 1000 s
Input C: 3.3 ns down to 37, 25, 22 or 17 ps
Resolution: 100 ps (single); 12 digits/s (avg)
Acquisition C: Auto or Manual
Acquisition time: 25 ms in Auto (typ.)
Aux. Parameters: See Freq. A, B, or C measurements

Ratio A/B, B/A, C/A, C/B

Range: (10^{-9}) to 10^{11}
Input Frequency:
Input A, B: 0.1 Hz to 300 MHz
Input C: 300 MHz to 27, 40, 46 or 60 GHz
Aux Parameters: Freq 1, Freq 2

Time Interval A to B, B to A, A to A, B to B

Range:
Normal Calculation: 0ns to +106 sec.
Smart Calculation: -106 sec. to +106 sec.
Resolution: 100 ps
Min. Pulse Width: 1.6 ns
Smart Calculation: Smart Time Interval to determine sign (A before B or A after B)

Positive and Negative Pulse Width A, B

Range: 2.3 ns to 106 sec.
Min. Pulse Width: 2.3 ns
Aux. Parameters: Vmax,Vmin, Vp-p

Rise and Fall Time A, B

Range: 1.5 ns to 106 sec.
Trigger Levels: 10% and 90% of signal Vp-p
Min. Pulse Width: 1.6 ns
Aux. Parameters: Slew rate, Vmax, Vmin

Positive and Negative Duty Factor A, B

Range: 0.000001 to 0.999999
Freq. Range: 0.1 Hz to 300 MHz
Aux. parameters: Period, pulse width

Phase A Relative B, B Relative A

Range: -180° to +360°
Resolution: Single-cycle: 0.001° to 10 kHz, decreasing to 1° >10 MHz. Resolution can be improved via averaging (statistics)
Freq. Range: up to 160 MHz
Aux. Parameters: Freq (A), Va/Vb (in dB)

Vmax, Vmin, Vp-p A, B

Range: -50 V to +50 V, -5V to +5V
Range is limited by the specifi cation for maxinput voltage without damage (see input A, B)
Freq. Range: DC, 1Hz to 300 MHz
Mode: Vmax, Vmin, Vp-p
Resolution: 2.5 mV
Uncertainty (5V range, typical):
DC, 1Hz to 1kHz: 1% +15 mV
1kHz to 20 MHz: 3% +15 mV
20 to 100 MHz: 10% +15 mV
100 to 300 MHz: 30% +15 mV
Aux parameters: Vmin, Vmax, Vp-p

Time Stamping A, B, C

Raw time stamp data together with pulse counts on inputs A, B or C, accessible via GPIB or USB only.
Max Sample Speed: See GPIB specifications
Max Frequency: 160 MHz
Timestamp Resolution: 70 ps

Power C

Range:
Power: -35 dBm to +10 dBm
Frequency: 300 MHz to 27, 40, 46 or 60 GHz
Display units: dBm (default) or W
Resolution: 0.01 dBm @100 ms measuring time
Accuracy (typ.): <1dBm to 27 GHz;
<2dBm to 40 GHz; <3dBm to 60 GHz
Acquisition:
Auto or Manual (within ±40 MHz)
Acquisition time: 20 to 30 ms in Auto (typ.)
Aux.Parameters: Frequency C

Pulsed RF parameters (Option 28)

Pulse ON voltage range:
0.4 to 40 GHz: -15 dBm to +13 dBm
(-20 dBm typ. to +13 dBm)
40 to 46 GHz: -10 dBm (typ.) to +13 dBm
46 to 60 GHz: 0 dBm (typ.) to +10 dBm
Min ON/OFF ratio: 15 dB

Pulse Width

Range: 30 ns to 1 sec.
Resolution: 200 ps rms
Accuracy: <10 ns+TBE*P_width

PRI (pulse repetition interval)

Range: 60 ns to 1 sec.
Resolution: 200 ps rms
Accuracy: <2 ns +TBE*PRI*

PRF (pulse repetition frequency)

Range: 1 Hz to 16.7 MHz (20 MHz typ.)
Resolution: (200ps/Meas_time)*PRF Hz

Frequency in Burst

Range: 400 MHz to 60 GHz
Pulse width: down to 100 ns
Resolution: (50ps/ √N/Gate_time)*FREQ Hz*
Acquisition: Manual

Peak Power in Burst

Range: - 20dBm to +10 dBm
Pulse width: down to 50 us
Acquisition: Manual
Resolution: 0.1 dBm < 1ms pulse
0.01 dBm>1ms pulse

** N = number of RF pulses during total measurement*
** TBE=number of RF pulses during total measurement (e.g. 6E-8)*
**Gate=meas. time inside each RF pulse*

Input and Output Specifications

Inputs A and B

Frequency Range:
DC-Coupled: DC to 400 MHz
AC-Coupled: 10 Hz to 400 MHz
Impedance: 1MΩ // 20 pF or 50 Ω (VSWR ≤2:1)
Trigger Slope: Positive or negative
Max. Channel Timing Difference: 500 ps
Sensitivity:
DC-200 MHz: 15 mVrms
200-300 MHz: 25 mVrms
300-400 MHz: 35 mVrms
Attenuation: x1, x10
Dynamic Range (x1):
30 mVp-p to 10 Vp-p within ±5V window
Trigger Level: Read-Out on display
Resolution: 3mV
Uncertainty (x1): ±(15 mV + 1% of trigger level)
AUTO Trigger Level: Automatically set to 50% point of input signal (10% and 90% for Rise Fall Time)
AUTO Hysteresis:
Freq. range: 1Hz to 300 MHz
Time: Min hysteresis window (hysteresis compensation)
Frequency: 40% of input signal amplitude (typ.)
Analog LP Filter: Nominal 100 kHz, RC-type.
Digital LP Filter: 1Hz to 50 MHz cut-off frequency
Max Voltage Without Damage:
1M: 350 V (DC + AC pk) to 440 Hz, falling to 12 Vrms at 1MHz; 50Ω : 12 Vrms
Connector: BNC

Input C

Freq. Range: 0.3 to 27, 40, 46, 60 GHz depending on model
Operating input voltage range:
0.3 to 18 GHz: -33 to +13 dBm
18 to 20 GHz: -29 to +13 dBm
20 to 27 GHz: -27 to +13 dBm
27 to 40 GHz: -23 to +13 dBm
40 to 46 GHz: -17 to +13 dBm
46 to 60 GHz: -15 to +10 dBm
Impedance: 50Ω nominal, AC coupled
VSWR:
0.3 to 27 GHz: <2.0:1 (typ.)
27 to 46 GHz: <2.5:1 (typ.)
46 to 60 GHz: <3.0:1 (typ.)
FM tolerance:
Manual acq.: 50 MHz p-p; freq C >3.5 GHz
30 MHz p-p; freq C <3.5 GHz
Auto acq.: 20 MHz p-p; for any freq C and modulation frequency > 0.1 MHz
AM tolerance:
Any modulation index (minimum signal must be within sensitivity range)
Automatic Amplitude Discrimination:
10 dB separation between 2 signals within 30 MHz, 20 dB otherwise
Max Voltage Without Damage: +25 dBm
Overload indication:
ON when input C power >+10 dBm
Connector:
27 and 40 GHz: 2.92 mm sparkplug female
46 and 60 GHz: 1.85 mm sparkplug female
(all connectors are field replaceable)

Rear Panel Inputs and Outputs

Reference Input: 1, 5, or 10 MHz; 0.1 to 5Vrms sine; impedance ≥ 1kΩ
Reference Output:
10 MHz; >1Vrms sine into 50Ω
Arming Input:
Arming of all measuring functions
Impedance: Approx. 1kΩ
Freq. Range: DC to 80 MHz
Connector: BNC

Measuring Functions

Trigger Hold-Off
Time Delay Range: 20 ns to 2sec., 10 ns resolution

External Start and Stop Arming
Modes: Start and Stop Arming
Input Channels: A, B or E (Ext. Arming input)
Max Rep. Rate for Arming Signal:
Channel A, B: 160 MHz
Channel E: 80 MHz
Start Time Delay Range:
20 ns to 2sec., 10 ns resolution

Statistics
Functions: Maximum, Minimum, ΔMax-Min, Mean, Standard Deviation and Allan Deviation
Display: Numeric, histograms or trend plots
Sample Size: 2 to 2 x 10^9 samples
Limit Qualifier: OFF or Capture values above/below/inside or outside limits
Measurement Pacing: 4s to 500 sec.

Mathematics
Functions: (K*X+L)/M, (K/X+L)/M or X/M-1. X is current reading and K, L and M are constants; set via keyboard or as frozen reference value (X_0)

Other Functions
Measuring Time: 20 ns to 1000 s for Frequency, Burst, PRF, Period Average and Power. Single cycle for other measuring functions
Timebase Reference:
Internal, External or Automatic
Display Hold: Freezes result, until a new measurement is initiated via Restart
Limit Alarm: Graphical indication on front panel and/or SRQ via GPIB
Limit Values: Lower limit, Upper limit
Settings: OFF or Alarm if value is above/below/inside or outside limits
On Alarm: STOP or CONTINUE
Display: Numeric + Graphic
Stored Instrument Set-ups: 20 instrument setups can be saved/recalled from internal nonvolatile memory. 10 can be user protected.
Result Storage: Up to 8 measurements of max 32k samples can be stored in local memory for later downloading.
Display: Backlit LCD Graphics screen for menu control, numerical read-out and status information
Number of Digits: 14 digits in numerical mode
Resolution: 320*97 pixels

GPIB Interface
Compatibility: IEEE 488.2-1987, SCPI 1999 or 53131A/53132A compatibility mode
Interface Functions:
SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2
Max. Measurement Rate:
GPIB: 5k readings/s (block mode) 500 readings/s (individual GET trig'ed)
To Internal Memory: 250k readings/s
Internal Memory Size: Up to 750k readings.

USB Interface
USB Version: 2.0 Full speed (11 Mbits/s)

Calibration
Mode: Closed case, menu controlled
Cal. Frequencies: 0.1, 1, 5, 10, 1.544 and 2.048 MHz

General Specifications

Environmental Data
Class: MIL-PRF-28800F, Class 3
Installation category: II
Operating Temp: 0 °C to +50 °C bench top; 0 °C to +40 °C rack mounted
Storage Temp: -40 °C to +71 °C
Humidity: 5%-95% (10 °C to 30 °C)
5%-75% (30 °C to 40 °C)
5%-45% (40 °C to 50 °C)
Altitude: 4 600 m
Vibration: Random and sinusoidal according to MIL-PRF-28800F, Class 3
Shock: Half-sine 30G per MIL-PRF-28800F
Bench handling
Transit drop test: According to MIL-PRF-28800F
Safety: EN 61010-1, pollution degree 2, meas cat I, CSA C22.2 No 1010-1, CE. Indoor use only
EMC: EN 61326 (1997); A1 (1998), increased test levels according to EN 50082-2, Group 1, Class B, CE
Mains power: 100-240 Vac, 50-400 Hz (Nom.), <40 W, <60 W if battery option

Dimensions and Weight
Width x Height x Depth:
210x90x395 mm (8.25x3.6x15.6 in)
Weight: Net 2.7 kg (5.8 lb),
Shipping app. 3.5 kg (app. 7.5 lb)

Ordering Information
Basic Models
CNT-90XL-27G:
27 GHz Microwave Counter/Analyzer
CNT-90XL-40G:
40 GHz Microwave Counter/Analyzer
CNT-90XL-46G:
46 GHz Microwave Counter/Analyzer
CNT-90XL-60G:
60 GHz Microwave Counter/Analyzer
Time Base: Medium Stability Oven Time Base; 0.06 ppm/month as standard
Included with Instrument: 3 years product warranty[1], line cord, user documentation on CD, and Certificate of Calibration

[1]*The warranty period may be dependent on country.*

Pulsed RF Option
Option 28: Pulsed RF measurements

Time Base Options
Option 30/90: Very High Stability Oven Time Base; 0.01 ppm/month
Option 40/90: Ultra High Stability Oven Time Base; 0.003 ppm/month

Option 23/90 Battery Unit
Battery Type: Li-Ion, 90 Wh
External DC input: 10 to 18 Vdc; max 6A
Operating temp. range: 0 °C to 40 °C
Storage: -20 °C to +60 °C, 1 month
-20 °C to +45 °C, 3 months
-20 °C to +20 °C, 1 year
Battery operating time (at 25°C):
ON: >4.5 hours
Stand-by: >24 hours
Charging:
Automatically when AC or ext DC is connected
Battery status indicator:
On-screen with Low battery warning
Weight: 2.3 kg (4.9 lb)

Optional Accessories
Option 22/90: Rack-Mount Kit
Option 27: Carrying Case - soft
Option 27H: Heavy-duty Hard Transport Case
Option 29/90: TimeView Modulation Domain Analysis SW for CNT-90XL
Option 90/06: Calibration Certificate with Protocol; Oven oscillator
Option 90/00: Calibration Certificate with Protocol; Frequency aging/week
Option 95/05: Extended warranty from 3 to 5 years
OM-90: Users Manual English (printed)
PM-90: Programmers Manual English (printed)
SM-90: Service Manual English
GS-90-EN: Getting Started English
GS-90-FR: Getting Started French
GS-90-DE: Getting Started German

Time Base Options

Option model	Standard:	30/90	40/90
Time base type:	OCXO	OCXO	OCXO
Uncertainty due to: -Aging per 24h per month per year -Temperature variations: 0˚C to 50˚C 20˚C to 26˚C (typ. values)	 <5x10$^{-9(1)}$ <6x10^{-8} <2x10^{-7} <5x10^{-8} <2x10^{-8}	 <5x10$^{-10(1)}$ <1x10^{-8} <5x10^{-8} <5x10^{-9} <1x10^{-9}	 <3x10$^{-10(1)}$ <3x10^{-9} <1.5x10^{-8} <2.5x10^{-9} <4x10^{-10}
Short-term stability: τ =1s (root Allan Variance) τ =10s	<1x10^{-10} <1x10^{-10}	<1x10^{-11} <1x10^{-11}	<5x10^{-12} <5x10^{-12}
Power-on stability: Deviation vs. fi nal value after 24 h on time, after a warm-up time of:	<1x10^{-7} 30 min	<1x10^{-8} 10 min	<5x10^{-9} 10 min
Typical total uncertainty, for operating temperature 20˚C to 26˚C, at 2σ (95%) confi dence interval: -1 year after calibration -2 years after calibration	 <2.4x10^{-7} <4.6x10^{-7}	 <0.6x10^{-7} <1.2x10^{-7}	 <1.8x10^{-8} <3.5x10^{-8}

[1] After 1 month of continuous operation

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Specifications subject to change or improvements without notice.

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