

20 GHz Timer/Counter/Analyzer**A REVOLUTION IN TIME & FREQUENCY ANALYSIS**

- Fastest: 250k measurements/s to internal memory and 2k/s via GPIB
- Highest resolution: 12 digits/s (freq.), 100 ps (time), 0.001° (phase)
- 14 digits display
- Frequency range: 300 MHz standard; 3, 8, 14 and 20 GHz optional
- Unique ease-of-use: Multi-parameter display and graphical presentation of results
- USB and GPIB as standard
- Outstanding performance/price ratio



With the new CNT-90 timer/counter/analyzer, Pendulum Instruments now offers **The Ultimate Tool** for measurement, analysis and calibration of Frequency, Time Interval or Phase. Whether in test systems, on the R&D bench, in the calibration lab or out in the field, the CNT-90 is the state-of-the-art timer/counter/analyzer and outperforms any existing counter on the market. The CNT-90 is the worlds fastest timer/counter/analyzer which offers a unique ease-of-use with graphical display and improved control over measurement at an outstanding price.

Outstanding Performance/Price ratio

The CNT-90 timer/counter/analyzer outperforms any counter on the market, independent of measurement task. The CNT-90 offers ultimate and unique control of measurement and is the choice for all needs and budgets - giving you outstanding performance at the price of a standard counter.

Leading World-Class Performance

The basic performance of the CNT-90 is World-leading compared to competition:

- With *2k measurement results transferred per second via GPIB/USB*, the CNT-90 can save you up to 90% testing time (and thus money) in test systems by increased throughput.

- *High resolution* is vital for R&D and production testing. CNT-90 meets this requirement with 100 ps single shot (time) or 12 digits/s (frequency), thus following very small time and frequency changes. That is 2 more digits than other interpolating counters. Obtained values are displayed with up to 14 digits.

- *Modulation Domain Analysis* is performed by capturing very fast frequency changes in real time, thanks to the high 250k measurement speed and the large memory depth of 750k readings.

- For *calibration* purposes, results are quickly obtained. The CNT-90 offers very high accuracy through very stable *internal OCXO time base*, very low systematic time interval A-B error and of course very high resolution.

- *Wide frequency range* to 20 GHz covers most CW and burst microwave frequency measurement needs. There's no need to invest in a separate microwave counter.

Ease-of-Use

The *menu-oriented settings* reduce the risk of mistakes. Valuable signal information given as numerical results with *multi-parameter display* removes the need for other instruments like DVM's and Scopes.

The *graphical presentation* of results (histograms, trends, modulation domain etc) gives a much better understanding of random signal distribution and measurement changes vs time, from slow drift to fast jitter and modulation.

The intelligent *Auto-trigger* automatically sets optimum trigger level and hysteresis, adapted to the actual input signal.

Excellent Connectivity to Computers

The CNT-90 is delivered with both USB- and GPIB high-speed interfaces as standard. This eliminates the need to invest in an

extra GPIB interface for your PC since USB is present everywhere.

Plug-and-Play in Existing Test Systems

The GPIB interface comes in two modes: SCPI/1999 plus a 53131A emulation mode for easy implementation in test systems originally designed for other brands.

This instant "plug-and-play" feature facilitates the exchange of the timer/counter/analyzer and reduces the need to re-program existing system commands.

Improved Control over Measurement Start/Stop

CNT-90 takes the art of measurement to the top with features such as arming, adjustable arming delay, trigger hold-off and limit qualifying.

Arming enables full control of both start and stop of the measurement of time or frequency in complex signals. Frequency burst parameters are automatically detected due to the adjustable arming delay and trigger hold-off, both with 10 ns resolution. The feature limit qualifying skips unwanted parameter values.

The state-of-art CNT-90 is the revolution - it is the only tool for time & frequency measurement, analysis and calibration you will ever need.

Revolutionary Graphical Presentation

One of the unique features of the CNT-90 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 with additional auxiliary measurement values such as $V_{\max}/V_{\min}/V_{p-p}$ in frequency measurements, and frequency/attenuation/phase measurements, eliminates the

need for extra test instruments and provides you direct answers to frequently asked questions, like “What is the attenuation and phase shift of this filter?”

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 jitter. It also provides you with a much better view

of changes vs time, from slow drift to fast modulation (trend plot). Three statistical views of the same data set can be viewed: Numerical, Histogram and Trend. It is very easy to capture and toggle between views of the same data (see fig.4, 5 & 6).

When adjusting a frequency source to given limits, the graphic display gives fast and accurate visual calibration guidance.



Figure 1: Display showing phase value, frequency, attenuation V_A/V_B , and auxiliary parameters.



Figure 4: Display showing different statistical parameters viewed at the same time.



Figure 2: Measure function selection menu, shown with measured results.



Figure 5: Display showing the trend (signal over time) of sampled data.



Figure 3: Input parameter setting menu shown with measured result.



Figure 6: The same result as in figure 5, now displayed as a histogram.

Additional Technical Features

CNT-90 not only offers leading World-Class performance, it is the ultimate tool for more specialized measurement. Some more unique features of the CNT-90 are:

- *Zero dead-time technique* and continuous time-stamping of trigger events. Fast time-stamping of trigger events enables capture of ALL individual periods, back-to-back without dead-time, up to 250k measurements/s. This feature allows theoretically correct measurements of Allan Deviation and is very valuable in mechanical (e.g. rotational encoder testing) and medical (e.g. nerve impulse/respiratory cycles) measurements where every single cycle must be measured.

- *SMART Time Interval measurements through single-pass technique.* Unlike traditional methods where you needed to define the start and stop channel beforehand (e.g. Time A-B), you can now let CNT-90 detect start and stop automatically. No more false results due to the stop signal occurring before the start signal.

- *TRUE Phase and Duty Cycle measurements through single-pass technique.* Traditional methods calculate Phase as $(\text{Time Interval A-B})/\text{Period} \times 360^\circ$ and Duty Cycle as $(\text{Pulse width})/\text{Period}$ where Time Interval A-B, Pulse Width and Period were measured separately, and not simultaneously. The single-pass phase and duty cycle measurement in CNT-90 enables TRUE phase measurements between signals with a varying frequency. This feature is very valuable to verify the relative phase between quadrature output pulses (90°) from rotational encoders, where rotation speed may vary during the measurement.

- *Limit qualifying* lets the user accept or reject measurement values inside or outside set limits. This is a very handy tool for making correct calculation of statistical parameters e.g. to verify the rms jitter of digital pulses that appear in discrete clusters (e.g. in CD-players or in HDB3-coded data). By setting limits you can isolate one cluster in the calculation.

- *Measurement pacing* sets an accurate sample rate for the measurement, ensuring that samples are taken at exact and equal-distant intervals. Setting e.g. the pacing time to 600s (one measurement every 10 minutes) for a 24 hr monitoring period, reduces the amount of data to 144 measurement samples equally spread over the day.

- *Hysteresis compensation* in Time Interval measurements reduces trigger level error from the typical 15-20 mV found in most counters on the market today, down to typ. 2.5 mV. This means 6-8 times improved trigger precision in critical time interval measurements.

If CNT-90 can't make the measurement, no other counter can!

CNT-90 Specifications

Measuring Functions

All measurements are displayed with a large *main parameter* value and smaller *auxiliary parameter* values (with less resolution). Some measurements are only available as auxiliary parameters.

Frequency A, B, C

Range:

Input A, B: 0.001 Hz to 300 MHz

Input C (option): Up to 3, 8, 14 or 20 GHz

Resolution: 12 digits in 1s measuring time

Aux. Parameters: Vmax, Vmin, Vp-p

Frequency Burst A, B, C

Frequency and PRF of repetitive burst signals can be measured without external control signal and with selectable start arming delay.

Functions: Frequency in burst (in Hz)
PRF (in Hz)
Number of cycles in burst

Range:

Input A, B, C: See Frequency spec.

Minimum Burst Duration (Ch A and B):

40ns

Minimum Pulses in Burst:

Input A or B: 3 (6 above 160 MHz)

Input C: 3 x prescaler factor

PRF Range: 0.5 Hz to 1 MHz

Start Delay: 10 ns to 2s, 10 ns resolution

Aux. Parameters: PRF, number of cycles in burst

Period A, B, C Average

Range:

Input A, B: 3.3 ns to 1000s

Input C (option): down to 330, 125, 70 or 50 ps

Resolution: 100 ps (single); 12 digits/s (average)

Aux. Parameters: Vmax, Vmin, Vp-p

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 (option): Up to 3, 8, 14 or 20 GHz

Aux Parameters: Freq 1, Freq 2

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

Range:

Normal Calculation: -5 ns to $+10^6$ s

Smart Calculation: -10^6 s to $+10^6$ s

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 10^6 s

Min. Pulse Width: 2.3 ns

Aux. Parameters: Vmax, Vmin, Vp-p

Rise and Fall Time A, B

Range: 700 ps to 1000s

Trigger Levels: 10% and 90% of signal amplitude

Min. Pulse Width: 1.6 ns

Aux. Parameters: Slew rate, Vmax, Vmin

Phase A Relative B, B relative A

Range: -180° to $+360^\circ$

Resolution: 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)

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

Vmax, Vmin, Vp-p A, B

Range: -50V to +50V, -5V to +5V

Range is limited by the specification for max input voltage without damage (see input A, B)

Freq. Range: DC, 1 Hz to 300 MHz

Mode: Vmax, Vmin, Vp-p

Resolution: 2.5mV

Uncertainty (5V range):

DC, 1Hz to 1kHz: 1% +15 mV

1 kHz 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

Raw time stamp data together with pulse counts on input A or B, accessible via GPIB or USB only.

Max Sample Speed: See GPIB specifications

Max Frequency: 160 MHz

Time Stamp Resolution: 100 ps

Input and Output Specifications

Inputs A and B

Frequency Range:

DC-Coupled: DC to 300 MHz

AC-Coupled: 10 Hz to 300 MHz

Impedance: 1 M Ω // 20 pF or 50 Ω (VSWR \leq 2:1)

Trigger Slope: Positive or negative

Max. Channel Timing Difference: 500 ps

Sensitivity:

DC-200 MHz: 15 mV rms

200-300 MHz: 25 mV rms

Attenuation: x1, x10

Dynamic Range (x1): 30 mV p-p to 10V p-p within \pm 5V window

Trigger Level: Read-Out on display

Resolution: 2.5 mV

Uncertainty (x1): \pm (15 mV + 1% of trigger level)

AUTO Trigger Level: Trigger level is automatically set to 50% point of input signal (10% and 90% for Rise/Fall Time)

AUTO Hysteresis:

Time: Min hysteresis window (hysteresis compensation)

Frequency: One third of input signal amplitude

Analog Noise Reduction Filter: Nominal 100 kHz, RC-type.

Digital Low Pass Filter:

1 Hz to 50 MHz cut-off frequency

Max Voltage Without Damage:

1 M Ω : 350V (DC + AC pk) to 440 Hz, falling to 12V rms (x1) at 1 MHz

50 Ω : 12V rms

Connector: BNC

Input C (Option 10)

Operating Input Voltage Range:

100 to 300 MHz: 20 mV rms to 12V rms

0.3 to 2.5 GHz: 10 mV rms to 12V rms

2.5 to 2.7 GHz: 20 mV rms to 12V rms

2.7 to 3.0 GHz: 40 mV rms to 12V rms

Prescaler Factor: 16

Impedance: 50 Ω nominal, VSWR <2.5:1

Max Voltage without Damage:

12V rms, pin-diode protected

Connector: Type N Female

Input C (Option 13)

Operating Input Voltage Range:

200 to 300 MHz: 40 mV rms to 7 V rms (typ.)

300 to 500 MHz: 20 mV rms to 7 V rms

0.5 to 3.0 GHz: 10 mV rms to 7 V rms

3.0 to 4.5 GHz: 20 mV rms to 7 V rms

4.5 to 6.0 GHz: 40 mV rms to 7 V rms

6.0 to 8 GHz: 80 mV rms to 7 V rms

Prescaler Factor: 256

Impedance: 50 Ω nominal, VSWR <2.5:1

Max Voltage Without Damage: 7V rms

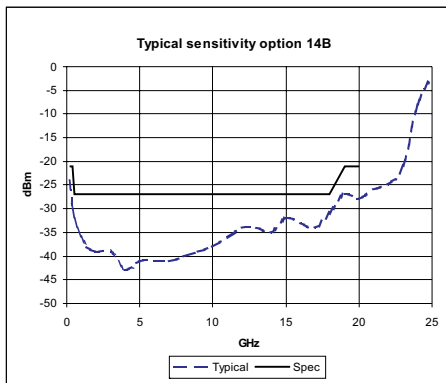
Connector: Type N Female

Input C (Option 14 and 14B)

Freq. Range: 0.2 to 14 GHz (opt. 14)
0.2 to 20 GHz (opt. 14B)

Operating input voltage range :

200 to 500 MHz: -21 to +27dBm
0.5 to 14 GHz: -27 to +27dBm
14 to 18 GHz: -27 to +27dBm (Option 14B only)
18 to 20 GHz: -21 to +27dBm (Option 14B only)



Prescaler Factor: 128

Impedance: 50Ω nominal, VSWR <2.0:1

AM tolerance: > 90% within sensitivity range

Max Voltage Without Damage: +27dBm

Connector: Type precision N Female

Rear Panel Inputs and Outputs

Reference Input: 1, 5, or 10 MHz; 0.1 to 5V rms sine; impedance ≥1 kΩ

Reference Output: 10 MHz; >1 Vrms sine into 50Ω

Arming Input: Arming of all measuring functions

Impedance: Approx. 1 kΩ

Freq. Range: DC to 80 MHz

Rear Panel Measurement Inputs: A, B, C (option)

Impedance: 1 MΩ/50 pF or 50Ω (VSWR ≤ 2:1)

Connectors: Type N female for rear input C
BNC for all other inputs/outputs

Auxiliary Functions

Trigger Hold-Off

Time Delay Range: 20 ns to 2s, 10 ns resolution

External Start and Stop Arming

Modes: Start, Stop, Start and Stop Arming

Input Channels: A, B or E

Max Rep. Rate for Arming Signal:

Channel A,B: 160 MHz

Channel E: 80 MHz

Start Time Delay Range: 20 ns to 2s, 10 ns resolution

Time Base Options

Option model:	std	30/90	40/90
Time base type:	Standard	OCXO	OCXO
Uncertainty due to:			
-Ageing.	per 24h per month per year	n.a. <5x10 ⁻⁷ <5x10 ⁻⁶	<5x10 ⁻¹⁰ (1) <1x10 ⁻⁸ <1.5x10 ⁻⁸
-Temperature variation: 0°C-50°C 20°C-26°C (typ. values)	<1x10 ⁻⁵ <3x10 ⁻⁶	<5x10 ⁻⁹ <1x10 ⁻⁹	<2.5x10 ⁻⁹ <4x10 ⁻¹⁰
Short term stability:	τ = 1 s	not specified	<1x10 ⁻¹¹
(root Allan Variance)	τ = 10s	<1x10 ⁻¹¹	<5x10 ⁻¹²
Power-on stability			
-Deviation vs final value after 24h on time, after a warm-up time of:	n.a. 30 min	<1x10 ⁻⁸ 10 min	<5x10 ⁻⁹ 10 min
Typical total uncertainty, for operating temperature 20°C to 26°C, at 2σ (95%) confidence interval:			
- 1 year after calibration	<7x10 ⁻⁶	<0.6x10 ⁻⁷	<1.8x10 ⁻⁸
- 2 years after calibration	<1.2x10 ⁻⁵	<1.2x10 ⁻⁷	<3.5x10 ⁻⁸

1) After 1 month of continuous operation

Statistics

Functions: Maximum, Minimum, Mean, Amax-Min, Standard Deviation and Allan Deviation

Display: Numeric, histograms or trend plots

Sample Size: 2 to 2 x 10⁹ samples

Limit Qualifier: OFF or Capture values above/below/inside or outside limits

Measurement Pacing

Pacing Time Range: 2 us to 1000s

Mathematics

Functions: (K*X+L)/M and (K/X+L)/M. X is current reading and K, L and M are constants; set via keyboard or as frozen reference value (X₀)

Other Functions

Measuring Time: 20 ns to 1000s for Frequency, Burst and Period Average. 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 non-volatile memory. 10 can be user protected.

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 53131A compatibility mode

Interface Functions: SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2

Max. Measurement Rate

Via GPIB: 2k readings/s (block)
500 readings/s (individual)

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

Operating Temp: 0°C to +50°C

Storage Temp: -40°C to +71°C

Humidity: 5%-95% (10°C-30°C)
5%-75% (30°C-40°C)
5%-45% (40°C-50°C)

Altitude: 4 600m

Vibration: Random and sinusoidal according to MIL-PRF-28800F, Class 3

Shock: Half-sine 30G per MIL-PRF-28800F Bench handling

Transit drop test: Heavy-duty transport case and soft carrying case tested according to MIL-PRF-28800F

Reliability: MTBF 30 000h (calculated)

Safety: EN 61010-1, pollution degree 2, meas cat I, CSA C22.2 No 1010-1, CE

EMC: EN 61326 (1997); A1 (1998), increased test levels according to EN 50082-2, Group 1, Class B, CE

Power Requirements

Basic Version: 90 to 265V rms, 45 to 440 Hz, <40W

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 Model

CNT-90 300 MHz, 100 ps Timer/Counter including Standard Time Base

Included with Instrument: 18 months product warranty, line cord, user documentation on CD, and Certificate of Calibration

Input Frequency Options

Option 10 3 GHz Input C
Option 13 8 GHz Input C
Option 14 14 GHz Input C
Option 14B 20 GHz Input C

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

Optional Accessories

Option 11/90 Rear Panel Inputs
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-90
Option 90/01 Calibration Certificate with Protocol; Standard oscillator
Option 90/06 Calibration Certificate with Protocol; Oven oscillator
Option 90/00 Calibration Certificate with Protocol; Hold-over frequency ageing/week
Option 95/03 3 years extended warranty
Option 95/05 5 years extended warranty

Specifications subject to change without prior notice

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Pendulum Instruments AB

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- Experts in time & frequency calibration,

pendulum