

# CNT-91 & CNT-90

## 50ps & 100ps Timer/Counter/Analyzers

### CNT-91

- **Continuous Data Streaming** over the bus during, *not after*, measuring
- **Zero-Dead-Time** frequency/period measurements
- **Fast GPIB/USB bus speed**  
2.6k meas/sec—talker only mode  
15k meas/sec—block mode
- **High resolution**  
50 ps-time; 12 digits/sec-freq
- **Unique graphic display**  
numerical statistics, histogram, trend, and modulation domain
- **250k meas/sec to internal memory**  
3.5M stored measurement results
- **Programmable Pulse Output**  
from 0.5 Hz to 50 MHz



The CNT-91 zero-dead-time counter features *continuous data streaming of measurements* over GPIB/USB during, not after, measuring; creating a *dynamic measurement/analysis system*, a first in the counter industry! The CNT-91 offers the highest performance ever achieved in a universal timer/counter, and provides faster measurements and higher resolution than the market leading CNT-90 timer/counter/analyzer.

### CNT-91

#### Leading World-Class Performance

- *High GPIB/USB bus speed* reduces test time in ATE test systems. Individual measurements up to 4k meas/sec in talker only mode. Fast Block measurements with continuous data streaming.
- *Zero-dead-time counting* provides period/frequency *back-to-back measurements* and the correct calculation of Allan Deviation.
- *High resolution* is critical for R&D and production testing. CNT-91's 50 ps single shot (time) or 12 digits/sec. (frequency) resolution allows capturing very small time and frequency changes, displayed to 14 digits.
- *Modulation Domain Analysis (MDA)*. With TimeView™ SW, the CNT-91 becomes a high-performance MDA. Thanks to the high measurement speed (250k meas/sec.) and large memory depth (3.5M) of these counters, very fast frequency changes in real time can be captured.
- *CNT-91's integrated programmable pulse output* offers 0.5 Hz to 50 MHz fast rise time signals as a reference frequency output, external pacing/trigger source, or general purpose pulse source.

### CNT-91 & CNT-90 Outstanding Performance/Price Ratio

The high performance CNT-90, and the ultra high performance CNT-91 timer/counter/analyzers out-perform every counter on the market, independent of measurement task.

- The *unique graphic presentation* of results – histogram, trend line, numerical statistics, modulation domain – provide a clearer understanding of random signal distribution and measurement changes over time – from slow drift to fast jitter, and modulation.
- 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.
- *Wide frequency range* – to 20 GHz – offers microwave CW frequency measurements and very short burst measurements down to 40 ns.
- *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.

The revolutionary CNT-90 and CNT-91 are the only tools you will ever need for time & frequency measurement, analysis, and calibration.

#### CNT-91 vs CNT-90 selection chart

Feature	CNT-91	CNT-90
Graphic display of trend, histogram, modulation domain	yes	yes
Freq. resolution	12 digits/sec	12 digits/sec
Time resolution (single shot)	50 ps	100 ps
Voltage resolution	1 mV	3 mV
Meas. speed to internal memory	250k meas/sec 3.5M results	250k meas/sec 750k results
Talker only output (GPIB/USB)	4k meas/sec	no
Individually triggered measurements	650/sec	500/sec
Block transfer speed	15k meas/sec	5k meas/sec
Freq/period, time, phase, volt, duty c, pulse w, rise time	yes	yes
Totalize, TIE	yes	no
Programmable pulse output	yes	no
Continuous measurements	yes	no

# Revolutionary Graphical Presentation

One of the unique features of the CNT-90/91 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 auxiliary measurement values such as  $V_{max}/V_{min}/V_{p-p}$  in frequency measurements, and frequency/attenuation/phase, eliminates the need for extra test instruments and provides 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.

# CNT-90 and CNT-91 Technical 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

**Mode:** Normal, Back-to-back (91 only)

#### 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 (normal)  
 11 digits in 1s measuring time (back-to-back)

**Aux. Parameters:** Vmax, Vmin, Vp-p

### Frequency Burst A, B, C (opt. 14/14B)

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)

#### Range:

*Input A, B, C:* See Frequency spec.

#### Minimum Burst Duration:

Down to 40 ns

#### 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 2 sec., 10 ns resolution

**Aux. Parameter:** PRF

### Period A, B, C

**Mode:** Single, Average,  
 Back-to-back (91 only)

#### Range:

*Input A, B:* 3.3 ns to 1000 sec. (single, average)  
 4 μs to 1000 sec. (back-to-back)

*Input C (option):* 10 ns down to 330, 125, 70 or 50 ps

#### Resolution:

CNT-90 100 ps (single); 12 digits/s (average)  
 CNT-91 50 ps (single); 12 digits/s (average)

**Aux. Parameters:** Vmax, Vmin, Vp-p

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

**Range:** (10<sup>-9</sup>) to 10<sup>11</sup>

#### 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:* 0 ns to +10<sup>6</sup> sec.  
*Smart Calculation:* -10<sup>6</sup> sec. to +10<sup>6</sup> sec.

#### Resolution:

CNT-90 100 ps  
 CNT-91 50 ps (single)

**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<sup>6</sup> sec.

**Min. Pulse Width:** 2.3 ns

**Aux. Parameters:** Vmax, Vmin, Vp-p

### Rise and Fall Time A, B

**Range:** 1.5 ns to 10<sup>6</sup> sec.

**Trigger Levels:** 10% and 90% of signal amplitude

**Min. Pulse Width:** 1.6 ns

**Aux. Parameters:** Slew rate, Vmax, Vmin

### Time Interval Error (TIE) A, B (CNT-91 only)

Normalized Period Back-to-back measurements, calculated as  $TIE(k) = k \cdot T_{REF} - \Sigma T_i$ , when  $T_i$  = Individual period back-to-back and  $T_{REF}$  = Reference period value

### 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)

### Totalize A, B (CNT-91 only)

**Mode:** Tot A, Tot B, Tot A+B, Tot A-B, Tot A/B

**Range:** 1-10<sup>10</sup> counts

**Freq range:** up to 160 MHz

**Start control:** Manual, start arming

**Stop control:** Manual, stop arming, timed

**Aux. Parameters:** Other Tot functions

### 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:

CNT-90 3 mV  
 CNT-91 1 mV

#### Uncertainty (5V range, typical):

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, 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:

CNT-90 100 ps  
 CNT-91 50 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 MΩ // 20 pF or 50Ω (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

**Attenuation:** x1, x10

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

**Trigger Level:** Read-Out on display

*Resolution:* 3 mV (CNT-90), 1 mV (CNT-91)  
*Uncertainty (x1):* ±(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 LP Filter:** Nominal 100 kHz, RC-type.

**Digital LP Filter:** 1 Hz to 50 MHz cut-off frequency

#### Max Voltage Without Damage:

1 MΩ: 350V (DC + AC pk) to 440 Hz, falling to 12Vrms (x1) at 1 MHz

50Ω: 12Vrms

**Connector:** BNC

### Input C (Option 10)

#### Operating Input Voltage Range:

100 to 300 MHz: 20 mVrms to 12Vrms  
 0.3 to 2.5 GHz: 10 mVrms to 12Vrms  
 2.5 to 2.7 GHz: 20 mVrms to 12Vrms  
 2.7 to 3.0 GHz: 40 mVrms to 12Vrms

**Prescaler Factor:** 16

**Impedance:** 50Ω nominal, VSWR < 2.5:1

#### Max Voltage without Damage:

12Vrms, pin-diode protected

**Connector:** Type N Female

### Input C (Option 13)

#### Operating Input Voltage Range:

200 to 300 MHz: 40 mVrms to 7 Vrms (typ.)  
 300 to 500 MHz: 20 mVrms to 7 Vrms  
 0.5 to 3.0 GHz: 10 mVrms to 7 Vrms  
 3.0 to 4.5 GHz: 20 mVrms to 7 Vrms  
 4.5 to 6.0 GHz: 40 mVrms to 7 Vrms  
 6.0 to 8 GHz: 80 mVrms to 7 Vrms

**Prescaler Factor:** 256

**Impedance:** 50Ω nominal, VSWR < 2.5:1

**Max Voltage Without Damage:** 7V rms

**Connector:** Type N Female

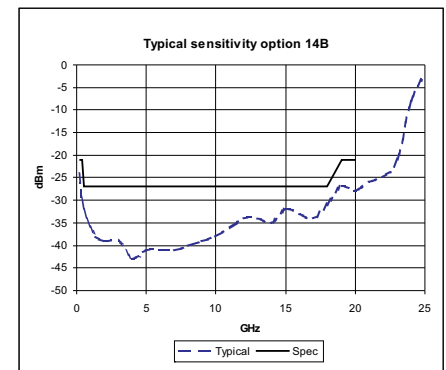
### Input C (Option 14 and 14B)

**Freq. Range:** 0.2 to 14 GHz (opt. 14)

0.25 to 20 GHz (opt. 14B)

#### Operating input voltage range:

250 to 500 MHz: -21 to +27 dBm  
 0.5 to 14 GHz: -27 to +27 dBm  
 14 to 18 GHz: -27 to +27 dBm (Option 14B only)  
 18 to 20 GHz: -21 to +27 dBm (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 5Vrms 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



### Pulse Output (CNT-91):

Programmable via front/GPIB/USB  
**Mode:** Pulse out, Gate open, Alarm out  
**Period:** 20 ns – 2 sec., in 10 ns increments  
**Pulse width:** 10 ns – 2 sec., in 10 ns increments  
**Output:** TTL-levels in 50Ω, rise time 2ns

### Rear Panel Measurement Inputs: A, B, C (opt. 11/90)

**Impedance:** 1 MΩ/50 pF or 50Ω (VSWR ≤ 2:1)  
**Connectors:** SMA female for rear input C  
 BNC for all other inputs/outputs

## Auxiliary Functions

### Trigger Hold-Off

**Time Delay Range:** 20 ns to 2 sec., 10 ns resolution

### External Start and Stop Arming

**Modes:** Start, Stop, Start and Stop Arming

**Input Channels:** A, B or E-rear panel

### Max Rep. Rate for Arming Signal:

**Channel A,B:** 160 MHz  
**Channel E:** 80 MHz

**Start Time Delay Range:** 20 ns to 2 sec., 10 ns resolution

### Statistics

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

**Display:** Numeric, histograms or trend plots

**Sample Size:** 2 to 2 x 10<sup>9</sup> samples

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

### Measurement Pacing

**Pacing Time Range:** 4 μs to 500 sec.

### 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 (X<sub>0</sub>)

### Other Functions

**Measuring Time:** 20 ns to 1000 sec. 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, plus pulse output connector (CNT-91)

**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 199953131A compatibility mode

### Interface Functions:

SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2

### Max. Measurement Rate

**GPIB (CNT-91):** 15k readings/s (block mode)  
 4k readings/s (talker only mode)  
 650 readings/s (individual GET trig'ed)

**GPIB (CNT-90):** 5k readings/s (block mode)  
 500 readings/s (individual GET trig'ed)

**To Internal Memory:** 250k readings/s

### Internal Memory Size:

**CNT-91** Up to 3.5M readings.  
**CNT-90** 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:** 4,600 meters

**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 30,000 hours (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:**  
 210 x 90 x 395 mm  
 (8.25 x 3.6 x 15.6 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

**CNT-91** 300 MHz, 50 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 19/90** Medium Stability Oven Time Base; 0.06 ppm/month

**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** Extended warranty from 18 months to 3 years

**Option 95/05** Extended warranty from 18 months to 5 years

## Time Base Options

Option model:	std	19/90	30/90	40/90
Time base type:	Standard	OXCXO	OXCXO	OXCXO
Uncertainty due to:	n.a.	<5x10 <sup>-9</sup> (1)	<5x10 <sup>-10</sup> (1)	<3x10 <sup>-10</sup> (1)
-Ageing, per 24h	<5x10 <sup>-7</sup>	<6x10 <sup>-8</sup>	<1x10 <sup>-8</sup>	<3x10 <sup>-9</sup>
per month	<5x10 <sup>-6</sup>	<2x10 <sup>-7</sup>	<5x10 <sup>-8</sup>	<1.5x10 <sup>-8</sup>
per year	<1x10 <sup>-5</sup>	<5x10 <sup>-8</sup>	<5x10 <sup>-9</sup>	<2.5x10 <sup>-9</sup>
-Temperature variation: 0°C-50°C	<3x10 <sup>-6</sup>	<2x10 <sup>-8</sup>	<1x10 <sup>-9</sup>	<4x10 <sup>-10</sup>
20°C-26°C (typ. values)	not specified	<1x10 <sup>-10</sup>	<1x10 <sup>-11</sup>	<5x10 <sup>-12</sup>
Short term stability: τ = 1s		<1x10 <sup>-10</sup>	<1x10 <sup>-11</sup>	<5x10 <sup>-12</sup>
(root Allan Variance) τ = 10s		<1x10 <sup>-10</sup>	<1x10 <sup>-11</sup>	<5x10 <sup>-12</sup>
Power-on stability	n.a.	<1x10 <sup>-7</sup>	<1x10 <sup>-8</sup>	<5x10 <sup>-9</sup>
-Deviation vs final value after 24h on time, after a warm-up time of:	30 min	30 min	10 min	10 min
Typical total uncertainty, for operating temperature 20°C to 26°C, at 2σ (95%) confidence interval:				
- 1 year after calibration	<7x10 <sup>-6</sup>	<2.4x10 <sup>-7</sup>	<0.6x10 <sup>-7</sup>	<1.8x10 <sup>-8</sup>
- 2 years after calibration	<1.2x10 <sup>-5</sup>	<4.6x10 <sup>-7</sup>	<1.2x10 <sup>-7</sup>	<3.5x10 <sup>-8</sup>

1) After 1 month of continuous operation

*Specifications subject to change without prior notice*

4031 600 91101 - rev. 06 May 2008

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- Experts in time & frequency calibration, measurement and analysis

Pendulum Instruments is a company of the Orolia Group