**CNT-91 & CNT-91R**

Timer/Counter/Analyzer & Calibrator

- Continuous Data Streaming over the bus during, not after, measuring
- Zero-dead-time frequency/period measurements
- Fast GPIB/USB bus speed; 4k meas/sec in talker only mode
  15k meas/sec in block mode
- High resolution 50 ps-time; 12 digits/sec-frequency
- Graphic display; numerical statistics, histogram, trend & modulation domain
- 250k meas/sec to internal memory 3.75M stored measurement results
- Programmable Pulse Output from 0.5 Hz to 50 MHz
- Integrated Rubidium atomic clock (model CNT-91R)

**Highest Performance Ever**

- 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. 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 (3.75M) of these, very fast frequency changes in real time can be captured.
- CNT-91's integrated programmable pulse output offers 0.5Hz to 50 MHz fast rise time signals as a reference frequency output, external pacing/trigger source, or general purpose pulse source.

**Outstanding Measurement Tool**

The CNT-91 timer/counter/analyzer outperforms every counter on the market, independent of measurement task.

- The 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 53131/53132 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 high-performance CNT-91 is the only tool you need for time & frequency measurement, analysis, and calibration.
**CNT-91R Frequency Calibrator/Analyzer**

The CNT-91R Frequency Calibrator/Analyzer is an all-inclusive high performance calibrator of frequency sources, that combines the high resolution measurements and advanced analysis of CNT-91, with a built-in ultra-stable Rubidium atomic reference clock. Its compact format, and its short warm-up time, makes the CNT-91R an ideal transportable one-box frequency calibrator/analyzer.

**Excellent Graphical Presentation**

One of the great features of the CNT-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 Vmax/Vmin/Vp-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 figure 4, 5 & 6).

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

**CNT-91/91R vs CNT-90**

<table>
<thead>
<tr>
<th>Feature</th>
<th>CNT-91/91R</th>
<th>CNT-90</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphic display of trend, histogram, domain</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Frequency resolution</td>
<td>12 digits/sec</td>
<td>12 digits/sec</td>
</tr>
<tr>
<td>Time resolution (single shot)</td>
<td>50 ps</td>
<td>100 ps</td>
</tr>
<tr>
<td>Voltage resolution</td>
<td>1mV</td>
<td>2.5mV</td>
</tr>
<tr>
<td>Measurement speed to internal memory</td>
<td>250k meas/sec</td>
<td>3.75M results</td>
</tr>
<tr>
<td>Talker only output (GPIB/USB)</td>
<td>4k meas/sec</td>
<td>no</td>
</tr>
<tr>
<td>Individually triggered measurements</td>
<td>650/sec</td>
<td>500/sec</td>
</tr>
<tr>
<td>Block transfer speed</td>
<td>15k meas/sec</td>
<td>5k meas/sec</td>
</tr>
<tr>
<td>Freq. period, time, phase, volt, duty c, pulse w, rise time</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Totalize, TIE</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Programmable pulse output</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Continuous measurements</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Timebase CNT-91</td>
<td>OCXO (opt)</td>
<td>OCXO (opt)</td>
</tr>
<tr>
<td>Timebase CNT-91R</td>
<td>Rubidium</td>
<td>OCXO (opt)</td>
</tr>
</tbody>
</table>

**Figure 1:** Display showing phase value, frequency, attenuation Va/Vb, and auxiliary parameters.

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

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

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

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

**Figure 6:** The same result as in Figure 5, now displayed as a histogram.
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
- **Ranges**: Input A, B: 0.002 Hz to 400 MHz
  - Input C (option): Up to 3, 8, 15 or 20 GHz
- **Resolution**: 12 digits in 1 ms or time (normal) 11 digits in 1 ms or time (back-to-back)
- **Aux. Parameters**: Freq (A), 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)
- **Ranges**: Input A, B, C: See Frequency spec.
- **Minimum Pulse Duration**: Down to 40 ns
- **Minimum Pulses in Burst**: Input A or B: 3 (6 above 160 MHz)
  - Input C: 3 × prescaler factor
- **PRF Range**: 0.1 Hz to 300 MHz
- **Start Delay**: 10 ns to 2 sec., 10 ns resolution
- **Aux. Parameter (A, B)**: Vmax, Vmin, Vp-p

**Period A, B, C**

- **Mode**: Single, avg., back-to-back
- **Range**: Input A, B: 2.5 ns to 1000 sec. (single, avg.)
  - 4 μs to 1000 sec. (back-to-back)
- **Input C (option)**: 10 ns down to 330, 125, 70 or 50 ps
- **Resolution**: 50 ps (single); 12 digits/s (avg)
- **Aux. Parameter (A, B)**: Vmax, Vmin, Vp-p

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

- **Range**: 10⁻¹ to 10¹¹
- **Input Frequency**: Input A, B: 0.1 Hz to 400 MHz
  - Input C (option): Up to 3, 8, 15 or 20 GHz
- **Aux. Parameters**: Freq 1, Freq 2

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

- **Normal Calculation**: Ons + to +° sec.
  - Smart Calculation: -10° sec. to + 10° sec.
- **Resolution**: 50 ps (single)
- **Min. Pulse Widths**: 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° sec.
- **Min. Pulse Widths**: 2.3 ns
- **Aux. Parameters**: Vmax, Vmin, Vp-p

**Rise and Fall Time A, B**

- **Range**: 1.5 ns to 10° sec.
  - Trigger Levels: 10% and 90% of signal Vp-p
- **Min. Pulse Widths**: 1.6 ns
- **Aux. Parameters**: Slow rate, Vmax, Vmin

**Time Interval Error (TIE) A, B**

Normalized period back-to-back measurements, calculated as TIE[k] = kTREFERENCE ± 2TREFERENCE, where:

- TREFERENCE = individual period back-to-back and
- TREFERENCE = 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 to 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), Vp-p

**Totalize A, B**

- **Mode**: Tot A, Tot B, Tot A/B, Tot A/B
- **Range**: 1 to 10¹⁰ counts
- **Freq. Range**: up to 160 MHz
- **Start control**: Manual, start arming
- **Aux. Parameters**: Other Tot functions

**Vmax, Vmin, Vp-p, A, B**

- **Range**: -50 V to +50 V, -5 V to +5 V 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**: 1 mV
  - **Uncertainty**: (5V range, typical)
  - **DC**: 1% + 15 mV
  - **Hz**: 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**

- **Input Frequency**: (10⁻⁹) to 10¹¹
  - **Input C (option)**: 0.5 Hz to 3.0 GHz
  - **Input C (option 13)**: 0.5 Hz to 3.0 GHz
  - **Input C (option 10)**: 0.5 Hz to 3.0 GHz

**Operating Input Voltage Range**

<table>
<thead>
<tr>
<th>Input Voltage Range</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 mV to 7 V RMS</td>
<td>For typical operation</td>
</tr>
<tr>
<td>200 mV to 7 V RMS</td>
<td>For high resolution</td>
</tr>
<tr>
<td>300 mV to 7 V RMS</td>
<td>For ultra-high resolution</td>
</tr>
</tbody>
</table>

**Input and Output Specifications**

**Inputs A and B**

- **Frequency Range**: DC-Coupled: DC to 400 MHz
- **AC-Coupled**: 10 Hz to 400 MHz

**Impedance**

- **1 MΩ** / 20 pF or 50 Ω (VSWR <2.5:1)

**Trigger Slope**

Positive or negative

**Max. Channel Timing Difference**

- **500 ps**

**Input C**

- **Freq. Range**: 0.25 to 15 GHz (opt. 14B)
- **Operating input range**: 250 to 300 MHz: ±21 to ±27 dBm
- **Max Sample Speed**: Accessible via GPIB or USB only.
- **Max Voltage Without Damage**: >90% within sensitivity range
- **Connector**: Type N Female

**Digital LP Filter**

- **Nominal 100 kHz, RC-type**

**Analog LP Filter**

- **Frequency Range**: 1 MHz to 20 MHz
- **Resolution**: 3% +15 mV

**Reference Input**

- **Frequency**: 1, 5, or 10 MHz;
- **Impedance**: ≥ 1 MΩ

**Reference Output**

- **Frequency**: 10 MHz; >1 Vrms sine into 50 Ω
- **Impedance**: 50 Ω nominal, VSWR <2.0:1
- **Amplitude Tolerance**: >90% within sensitivity range
- **Max Voltage Without Damage**: +27 dBm
- **Connecting**: Type precision N Female

**Rear Panel Inputs and Outputs**

- **Reference Input**: 1, 5, or 10 MHz;
  - **Impedance**: ≥ 1 MΩ
  - **Reference Output**: 10 MHz; >1 Vrms sine into 50 Ω
- **Impedance**: 50 Ω nominal, VSWR <2.0:1
- **Amplitude Tolerance**: >90% within sensitivity range
- **Max Voltage Without Damage**: +27 dBm
- **Connecting**: Type precision N Female

**Pulse Output**

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 50 Ω, rise time 2 ns

**Typical Sensitivity Option 14B**

**Technical Specifications**: CNT-91 & CNT-91R
Technical Specifications: CNT-91 & CNT-91R

Auxiliary Functions

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

Statistics

Functions: Maximum, Minimum, Mean, 8max-Min, Standard Deviation and Allan Deviation
Display: Numeric, histograms or trend plots
Sample Sizes: 2 to 2 x 10^10 samples
Limit Qualifier: OFF or Capture values above/below/inside or outside limits

Mathematics

Functions: (K^n+M)/L and (K^4+L)/M. X is current reading and K, L and M are constants; set via keyboard or as frozen reference value [K]

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
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.

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, 53131A/53132A compatibility mode
Interface Functions:
- SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2
Max. Measurement Rate:
- GPIB: 15 readings/s (block mode)
- 4k readings/s (talker only mode)
- 650 readings/s (individual GET triggered)
To Internal Memory: 250k readings/s
Internal Memory Size: Up to 3.75M readings.

USB Interface

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

Calibration

Mode: Closed case, menu controlled
Calibration 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 (CNT-91)
- 0°C to +45°C (CNT-91R)
Storage Temp: -40°C to +71°C
Humidity: 10% - 80% (40°C to 50°C)
- 5% - 75% (30°C to 40°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]

Specifications subject to change or improvement without notice.

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