CNT-104S
CNT-104R
CNT-104B
CNT-102
CNT-102B

pendulum

CNT-100 series

Multi-channel Frequency Analyzer

DATA SHEET

- **Two or four parallel, independent Frequency Counter/Analyzers in one box**
- Multi-channel 400 MHz Frequency Analyzer - plus optional RF-channel up to 24 GHz
- Gap-free zero-dead-time frequency / period / TIE measurements
- Very-high resolution:
  Time: down to 7 ps
  Frequency: up to 12-13 digits/s
- Very high measurement speed: up to 20M meas./s to internal memory
- Fast bus speed;
  170k meas./s in block mode
- Graphic touch screen display for settings and display of values, statistics (numeric and distribution graph), trend & modulation domain, and live ADEV
- The instrument can be controlled locally via touch screen or mouse, or remotely (from anywere in the world) - via web interface or VNC
- Intelligent and easy-to-use
- Rubidium timebase model; CNT-104R
- Affordable blind panel models for test systems: CNT-102B and CNT-104B

Pendulum CNT-100 series

The ***Pendulum CNT-100 series*** is a new family for super-performance ***multi-channel*** frequency and time-interval analysis in a bench-top unit. You can track parallel frequency, phase or time on 2 or 4 input channels simultaneously on the large graphic screen. These instruments feature gap-free measurements, and have a frequency resolution of up to 12-13 digits/s.

The base model, the 2-input **CNT-102**, with 14ps resolution and a speed of 1M Sa/s outperforms any competing Timer/Counter/Analyzer on the market at an attractive price.

For even higher performance, please check our **CNT-104S** and **CNT-104R**, 4-input Multi-channel Frequency Analyzers with 7ps resolution and a speed of up to 20M Sa/s. The CNT-104R has a built-in Rubidium atomic clock as timebase reference, that can be optionally GNSS-disciplined to totally eliminate oscillator ageing.

There are also two affordable blind panel models for test systems: **CNT-102B** and **CNT-104B**

Highest Performance for R&D and metrology

- The very-high resolution gives better insights in the design under test, faster results in phase comparisons between clocks, more accurate calibration, and allows capture of very small time/phase changes. Track and compare up to 4 signals in parallel with 7 ps resolution/timestamp, with 50 ns between samples in each channel.
- Gap-free, zero-dead-time counting provides back-to-back measurements without losing any cycle, even for very long measurements.
- The CNT-100 series are also high-performance Modulation Domain Analyzers (MDA). Thanks to the high measurement speed, very fast frequency or phase/time changes can be captured in real time on up to 4 parallel input signals.
- CNT-104 models have a unique parallel and independent 4-channel design, plus an optional RF input. All channels perform parallel, independent, and gap-free time-stamping of the input signals. This allows for new measurements that earlier required many instruments, like phase comparison of 4 atomic clocks to a common reference, without the need for a switch. Or replacing a stack of legacy counters for frequency comb testing in optical research
- In general R&D you can measure frequency, period and TIE simultaneously in 4 different test points, without moving any test cable or probe. And you can measure pulse parameters like pulse with, rise/fall time, slew rate simultaneously in 2 different test points.

Save money in production test

- CNT-102B & CNT-104B are 2 new models optimized for test systems with blind panel and rear inputs from start.
- The multi-channel design enables simultaneous frequency measurements in parallel. ***One CNT-102B can replace two existing frequency counters and one CNT-104B can replace four existing counters*** in a test system at a lower cost/counter.
- Using option 22/05 rackmount adapter, you get up to 8 parallel frequency counters in a 19", 2U high rack space. A huge space saving.
- Choose between Ethernet, WLAN*, USB** or GPIB*** as a communication interface to a PC/Laptop/Tablet, or to the test system controller.
- High bus speed reduces test time in ATE test systems. Perform individually triggered measurements, one-by-one, to 425 meas./s. And fast block measurements go up to 170k meas./s. Test time is reduced compared to existing solutions, and time is money.

** - With external Wi-Fi dongle*
*** - USB 2.0 RNDIS (Ethernet over USB)*
**** - Optional*

Easy-to-understand Numerical and Graphical Presentation

One of the great features of the CNT-100 series is the graphic display with its menu oriented settings. The non-expert can easily make correct settings, thanks to the guided instruction on most setting pages.

Valuable signal information, given in multi-parameter displays, removes the need for other instruments like DVM's and Scopes for quick signal verification.

Measured values are presented as both numerics and graphics. The graphical presentation of results (distribution, trends etc.) gives a 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. The same data set can be viewed in Numerical, Statistics, Distribution and Time-line views. It is very easy to capture and toggle between views of the same data set.

VALUES display mode: Compare 4 signals simultaneously on screen, with auxiliary parameters below. No need for a DVM, or oscilloscope, to check amplitude!

Graphical display view modes

The CNT-100 series feature innovative graphic display modes, that let you view the measurement data in various ways. These modes gives you more insight in the measurement and make interpretation easier.

The Timeline view shows variation over time and reveal long-term trends and short-term modulation and settling.

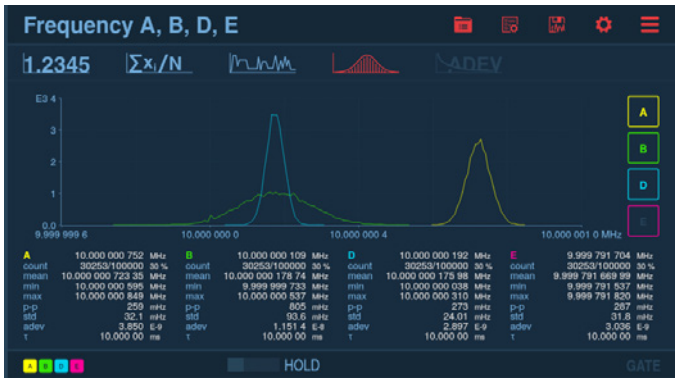
Beneath the graph you find additional statstics data.

The graphs could be turned off/on for viewing individually, allowing in-depth view of one graph at a time

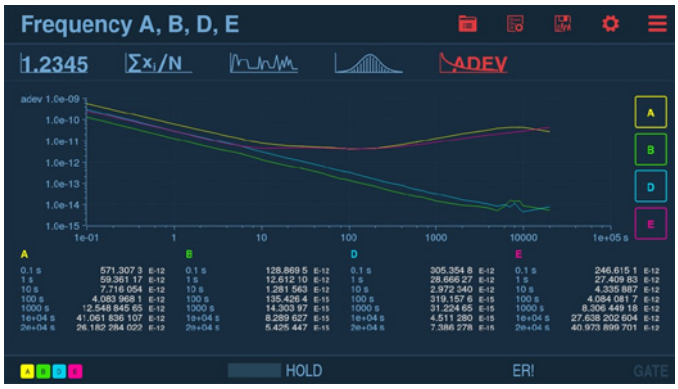
The graphs could be smoothed to eliminate noise and show underlying trends.

You could also pan and zoom in to an interesting part, and position cursors to read out actual values and the delta between values. This is a valuable feature for modulated, swept, or frequency agile input signals

The Distribution view shows the distribution of the measured values. The narrower graph, the less spread of values and higher resolution.



The optional Allan Deviation (ADEV) graph view shows the short-term stability of the input signals during measurement. Beneath the graph you have individual numeric tables for the input signals



Modulation Domain Analysis

The CNT-100 series features built-in modulation domain analysis, displaying frequency changes vs. time, on one or two input channels.

Thanks to the high resolution, and the high measurement speed of down to 50 ns between individual samples in each channel, you can follow and verify for example:

- FM, FSK, BPSK, PWM, PPM and other time, phase or frequency modulation schemes
- Frequency sweep
- Frequency transients
- Frequency settling in oscillators, VCOs and PLLs
- Synthesizer switching
- Frequency instability, incl. jitter
- Frequency hopping agile communication

View fast FM, or any time/phase/frequency modulation, on screen, on one or two channels. Here we see FM modulation with both sine and square wave shape

Full flexibility for remote control

The CNT-100 series comes as standard with a Gbit Ethernet interface for remote control and data transfer.

Using an external WiFi dongle in the front panel USB port, enables you to connect any CNT-100 model to your local wireless network.

You can access and control the instrument from your lab bench, or from anywhere in the world, using the integrated web interface.

USB 2.0 and optional GPIB interfaces are also available.

Very flexible configuration

The CNT-100 series can be configured as you like it to fit perfomance demands and/or budget.

- Add an optional extra channel C for RF frequency measurements. Choose either a 3 GHz or 10 GHz basic HW (the 10 GHz channel is SW license upgradable to 15, 20, or 24 GHz)
- Choose between 3 timebase oscillator options; the standard TCXO and 2x OCXO. Or the ultimate CNT-104R with built-in Rubidium timebase and optional GNSS disciplining capability (HW option). You can of course always use an external frequency reference, if available.
- Add an optional GPIB interface (HW option)
- Chose between measurement inputs on front or rear panel (HW option)
- Models CNT-102, CNT-102B, CNT-104B can upgrade resolution to 7ps and speed to 20 MSa/s (SW license key)
- Add optional 0.5 Hz to 100 MHz pulse generator (SW license key)
- Add optional ADEV graph display mode (SW license key)
- Add optional measurement functions, TIE and Frequency Offset (SW license key)

Frequency Offset Meter (option 152)

In ***Frequency Offset Meter mode***, tolerance limits are displayed and gives direct graphical feedback whether limits are passed or failed. In the example below, three 10 MHz and one 5 MHz oscillators are tested in parallel, with tolerance limit ±0.1 Hz or $1x10^{-8}$.

Oscillator A, B, D are inside limit range. Oscillator E is just outside range.

The time-line view reveals drift during the calibration

The limits can also be viewed in the frequency distribution display view mode. The information is the same but this graph gives additional info.

The Frequency distribution view reveals the spread (stability) of the oscillators

Outstanding ease-of-use

The big color touch screen with its intuitive menus lets you make your settings via a simple finger touch. Alternatively you can connect a wireless mouse to the front USB host port, and make your settings via mouse clicks on screen instead. Or you can use the web interface to control your instrument from a large PC-screen.

The intelligent AUTO SET will help you to make best settings for each measurement function.

You do not even need to be close to your instrument. The web server functionality lets you connect to any CNT-100 series model over Ethernet, view the front panel, and control the measurements and read results via a few mouse clicks.

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

You can pan and zoom in graphs to view individual samples with cursor read-outs.

Any measured signal can be smoothed, to reveal underlying trends in the presence of excessive noise.

The CNT-102/102B Multi-channel Frequency Analyzers outperform every existing benchtop frequency counter/analyzer on the market, except “big brothers” CNT-104R/104S/104B, independent of measurement task.

The high-performance CNT-100 series is the optimal tool you need for affordable, high-performance, time & frequency measurement, analysis, and calibration.

SELECTION CHART	CNT-104R	CNT-104S	CNT-104B	CNT-102	CNT-102B
No. of 400 MHz channels	4	4	4	2	2
No. of parallel measurements	4	4	4	2	2
Resolution/timestamp	7 ps	7 ps	14 ps (7 ps optional)	14 ps (7 ps optional)	14 ps (7 ps optional)
Speed to internal memory	20 M meas./s	20 M meas./s	1 M meas./s (20 M opt.)	1 M meas./s (20 M opt.)	1 M meas./s (20 M opt.)
Std. Timebase	Rubidium	TCXO	TCXO	TCXO	TCXO
Optional timebase	n/a	2x OCXO	2x OCXO	2x OCXO	2x OCXO
GNSS disciplining	option 55	n/a	n/a	n/a	n/a
Visual Display	front, web UI	front, web UI	web UI only	front, web UI	web UI only
Meas. inputs position	front	front	rear	front	rear

THE MODELS

The CNT-100 series consists of 5 different models, targeted for different applications:

CNT-102, all-round, general purpose
CNT-102B/104B, test system optimized
CNT-104S, high-performance R&D
CNT-104R, ultimate metrology incl. Rubidium freq. reference

CNT-102 the basic model

CNT-102 is the entry level model with 2 parallel inputs for all measurements. CNT-102 can replace 2 legacy counters in one box. The resolution of 14 ps and measurement speed of 1M values/sec. makes CNT-102 outerform any traditional timer/counter on the market.

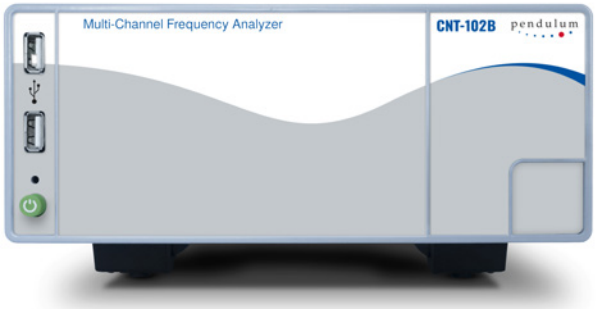
CNT-102B and CNT-104B, the test system models

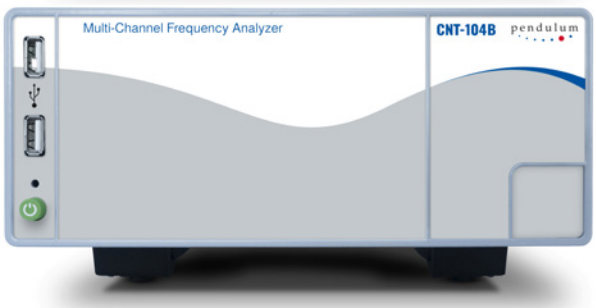
CNT-102B and CNT-104B are two models designed for test systems. They have blind panels without display, and all measurement inputs are found on the rear panel from the beginning. The normal control of the units are SCPI programming via Ethernet, USB or GPIB (optional).

It is possible to control the unit via the web interface as well, from a PC, laptop or tablet, where you can view all graphs, as you would on a normal display.

Without a display, you improve reliability with a 10k+ hours longer MTBF, and achieve a safe operation, with no accidental front panel touch interfering with the running test SW. Military users may appreciate that accidental show of classified frequencies is not possible.

The basic units have 2 (CNT-102B), or 4 (CNT-104B) inputs, 14ps resolution and a speed of 1 M values/sec.





CNT-104S the high performance model for R&D

CNT-104S has 4 input channels and an outstanding resolution of 7 ps and a speed to internal memory of 20M values/sec as standard.

The high resolution and measurement speed makes the CNT-104S especially suitable for advanced R&D, in e.g. defense electronics, quantum electronics, optical clocks, oscillator manufacturing, sync networks, and physical research. One CNT-104S can e.g. replace a stack of legacy counters for frequency comb testing, and two CNT-104s can e.g. replace an 8-channel phase comparator in network sync node monitoring.

CNT-104R the ultimate one-box calibrator for metrology

CNT-104R is the ultimate model for metrology. It includes all functions of CNT-104S, and has an atomic clock (Rubidium) as internal timebase oscillator, resulting in an extremely low ageing of below 1 ppb per year. And an optional GNSS disciplining, that totally eliminates the ageing of the oscillator.

The Rubidium oscillator makes CNT-104R an extremely accurate frequency reference for a lab, a department or a site. The combination of the ultra-stable frequency reference and the ultra-high performance frequency counter/analyzer, makes CNT-104R a one-box frequency calibrator for parallel calibration of 4 test objects, with simultaneous supply of a 10 MHz reference frequency to the lab.

The CNT-104R is ideal for portable field calibration, since you have just one instrument to carry vs. the traditional two instruments, one frequency reference and one timer/counter.

Technical Data

Multi-channel

CNT-104R/104S/104B: Measure up to 4 input signals in parallel
CNT-102/102B: Measure up to 2 input signals in parallel

Resolution

CNT-102/102B/104B: Resolution is 14 ps per timestamp, that can be upgraded to 7 ps, via SW license (option 121).
CNT-104R/104S: Resolution is 7 ps per timestamp

Smart Frequency/Period avg. calculation mode

Statistics resolution enhancement algorithm (*smart mode*) gives up to one extra result digit depending on input signal and measurement setting.

Display modes

Values/Statistics: Numeric display of Measurement values or Statistics parameters with large digits. Values mode also display auxiliary parameter values.
Time-line/Distribution: All measurements are displayed graphically. Multi-channel graphs are color-coded. Statistics values are displayed beneath the graphs.

ADEV display mode: A, B, (D, E) and C:

Calculation of Allan Deviation in real time and display
Floor @1s:

- $1x10^{-11}$ (7 ps resolution models)
- $2x10^{-11}$ (14 ps resolution models)

Floor @1000s:

- $1x10^{-14}$ (7 ps resolution models)
- $2.2x10^{-14}$ (14 ps resolution models)

Measuring Functions

Notation: ***CNT-104*** means CNT-104R, CNT-104S, or CNT-104B
Accessible inputs:

- CNT-102/102B: A, B, and C (opt.)
- CNT-104: A, B, D, E, and C (opt.)

Frequency A, B, C (, D, E)

Mode: Parallel measurements on 2 (4) inputs. Back-to-back, with or without smart calculation
Range A, B (, D, E): 0.001 Hz to 400 MHz
Range C: See input C
Aux. Parameter:

- Ch. A, B (, D, E): Vmax, Vmin, Vp-p
- Ch. C: Period C

Frequency Offset A, B, C (, D, E) (SW option 152)

Mode: Parallel measurements on 2 (4) inputs. Back-to-back, with or without smart calculation
Intended for easy-to-use high-performance frequency calibration. The user sets tolerance limits for the DUT, e.g. $\pm1x10^{-9}$, and all other background settings are auto-set.
The display shows graphical frequency limits, and alerts if the values are outside tolerance

Frequency Ratio (A,B,D,E or C) / (A,B,D,E or C)

Mode: ***Parallel measurements*** on 2 (4) inputs plus division.
Number of values: 1 or 2 (Freq1/Freq2, Freq3/Freq4)
Range: $4x10^{-14}$ to $2.4x10^{13}$
Input Frequency: See inputs A, B, D, E and C
Aux Parameters: Freq 1, Freq 2

Period A, B, C (, D, E) average

Mode: ***Parallel measurements*** on 2 (4) inputs Back-to-back, with or without smart calculation
Range: See the inverse of Frequency specifications
Aux. Parameter:

- Ch. A, B (, D, E): Vmax, Vmin, Vp-p
- Ch. C: Frequency C

TIE A, B, C (, D, E) (Option 151)

TIE = Time Interval Error, calculated as: *Accumulated period - Expected ("ideal") accumulated period*
Mode: ***Parallel measurements*** on 2 (4) inputs. Back-to-back.
Freq range: See Frequency specifications
Aux. Parameter: Reference Frequency

Period A, B (, D, E) single

Mode: ***Parallel measurements*** on 2 inputs
Range: 2.5 ns to 1000 sec.
Aux. Parameter: Vmax, Vmin, Vp-p

Time Interval A, B (, D, E)

Mode: Parallel timestamping of trigger events on 2 (4) inputs on continuous or single-shot signals.
Start and stop channel(s): any of A, B (, D, E)
Note: each input can produce 1 or 2 trigger events with individual trigger level and slope
Multi-stop Time Interval (CNT104 only): E.g. start on channel A and stop on channels B, D, E
Dual Time Intervals (CNT-104 only): Measure e.g. channel A to B, and channel D to E, independtly in parallel
Accumulated Time Interval: ON or OFF (adding or subtracting one start channel period to the Time Interval, when required, provided that the input signals have the same nominal repetition rate)
Range: -1000 s to +1000 s
Repetition rate: up to 300 MHz or single-shot events
Min. Pulse width: 1.5 ns

Positive and Negative Pulse Width A, B (, D, E)

Mode: ***Parallel measurements*** on 2 inputs
Range: 1.5 ns to 1000 s
Repetition rate: up to 300 MHz or single-shot events

Rise/Fall Time, and Slew Rate A, B (, D, E)

Mode 1: ***Parallel measurements*** on 2 inputs of Rise OR Fall time, or
Mode 2: ***Single*** input measurement of simultaneous Rise AND Fall time on the same pulse, or
Mode 3: ***Parallel measurements*** on 2 inputs of Pos OR Neg Slew Rate (80% of Vp-p) / (Rise or Fall Time)
Range: 1.5 ns to 1000 s
Min pulse width (between 10% and 90% trigger points)**:** 1.5 ns
Aux. Parameters: Slew rate or Rise/Fall, Vmax, Vmin

Positive and Negative Duty Cycle A, B (, D, E)

Mode: ***Single*** input meaurement
Range: 0.000001 to 0.999999
Repetition rate: up to 300 MHz
Min pulse width: 1,5 ns
Aux. parameters: Period, Pulse width

Phase Ch. 1 Relative Ch. 2

Inputs: any of A, B (, D, E)
Mode: Intended for phase shift or delay measurements of two signals with identical frequency
Accumulated Phase: OFF or ON (adding or subtracting 360° to the Phase, when required)
Range: -180° to +180° (Acc. Phase is OFF)
Resolution: 0.00003° to 100 kHz, decreasing to 0.03° >100 MHz. (10k sample statistics averaging)
Freq. Range: up to 300 MHz
Aux. Parameters: Freq (ch. 1), V(ch. 1)/V(ch.2) in dB

Totalize A, B (, D, E)

Basic mode: Tot (event counts) on A, B (, D, E)
Processed mode: Tot X+Y; X-Y; X/Y;
X and Y are the event counts on any of inputs A, B, D, E; 2 simultaneous values (CNT-104S only)
Range: 1 to 10^{15} counts
Freq range: up to 400 MHz
Start control: Manual, start arming
Stop control: Manual, stop arming, timed

Vmax, Vmin, Vp-p A, B (, D, E)

Range: -5 V to +5 V, -50 V to +50 V
Freq. Range: DC, 1 Hz to 200 MHz
Coupling: Sine (AC>100 Hz or DC), Square (DC only)
Resolution: 1 mV (5V range), 10 mV (50 V range)
Uncertainty (5V range):

- DC, 1Hz to 1kHz: <1% +15 mV
- 1kHz to 20 MHz sine: 3% +15 mV (typ.)
- 20 to 100 MHz sine: 10% +15 mV (typ.)
- 100 to 200 MHz sine: 30% +15 mV (typ.)

(For square waves add 10% to Vmax,/min & 20% to Vp-p)
(For 50 V range, add 2% + 150 mV)
Aux parameters: Vmin, Vmax, Vp-p

Input Specifications

Inputs A, B, D, E

Position:

- Front panel: CNT-102, CNT-104R, CNT-104S
- Rear panel: CNT-102B, CNT-104B

Frequency Range:

- DC-Coupled: DC to 400 MHz
- AC-Coupled: 10 Hz to 400 MHz

Impedance: 1M Ω // 40 pF or 50 Ω (VSWR ≤2:1 typ.)
Trigger Slope: Positive or negative
Channel-channel skew: 25 ps rms (after calibration)
Sensitivity (typical):

- DC-400 MHz: <70 mVrms (PreAmp=OFF)
- DC-100 MHz: 15 mVrms (PreAmp=ON)
- 100-200 MHz: 25 mVrms (PreAmp=ON)
- 200-350 MHz: 35 mVrms (PreAmp=ON)
- 350-400 MHz: 50 mVrms (PreAmp=ON)

Hysteresis window: approx. 20 mV (PreAmp=OFF)
Attenuation: x1, x10
Dynamic Range (x1):
PreAmp = OFF: 0.2 to 10 Vp-p within ±5 V window
PreAmp = ON: 0.01 to 2 V p-p within ±1 V window
Trigger Level: Read-out in menu

- Resolution: 1 mV
- Uncertainty (x1): ±(15 mV + 1% of trigger level)

Trigger Level modes: Manual, Relative (to Vp-p), Auto
Auto Trigger Level is set to:

- 50% point of input signal's Vp-p, combined with a wide hysteresis between the 40% and 60% points, for frequency, period average, TIE
- 10% and 90% points, for Rise/Fall Time, Slew rate, combined with minimum hysteresis
- 50% point with minimum hysteresis for all other functions
- Min. voltage 200 mVp-p

Analog LP Filter: Nominal 10 kHz, 100 kHz selectable
Max Voltage Without Damage:

- 1M Ω: 350 V (DC + AC pk) to 440 Hz, falling to 12 Vrms at 1 MHz.
- 50 Ω: 12 Vrms

Connector: BNC

Input C (Option 10)

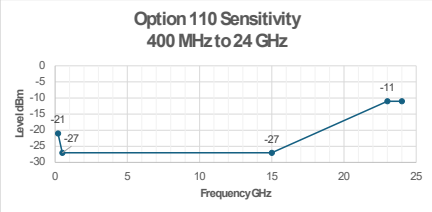
Operating Input Power Range opt. 10:

- 100 to 300 MHz: -21 dBm to +35 dBm
- 0.3 to 2.5 GHz: -27 dBm to +35 dBm
- 2.5 to 2.7 GHz: -21 dBm to +35 dBm
- 2.7 to 3.0 GHz: -15 dBm to +35 dBm

Prescaler Factor: 16
Impedance: 50 Ω nominal, VSWR <2.5:1 typ.
Max Power without Damage: +35 dBm
Connector: Type N, Female

Input C (Option 110)

Freq. Range: 0.4 to 24 GHz; As standard SW limited by 10 GHz. Upgradable by SW license to 15, 20 or 24 GHz



Max Operating Input Power Level: +20 dBm
Prescaler Factor: 64
Impedance: 50 Ω nominal, VSWR <2.0:1 typ.
AM tolerance: > 90% within sensitivity range
Max Power Without Damage: +27 dBm
Connector: 2.92 mm, SMA compatible, Female

Rear Panel Inputs and Outputs

Reference Input

Frequency: 5 or 10 MHz; 0.1 to 5Vrms sine (typ.)
1 MHz; 0.2 to 5 Vrms sine (typ.)
Impedance: 50 Ω (nom.)
Connector: BNC

Reference Output

Source: External input if used, otherwise internal
Frequency: External ref freq., or 10 MHz (internal)
Output impedance: 50 Ω
Amplitude: 1Vrms sine into 50 Ω (nom.)
Connector: BNC

Arming Input

Arming of all measuring functions

- **Impedance:** Approx. 1k Ω
- **Freq. Range:** DC to 160 MHz
- **Trigger level:** approx. 1.5 V fixed
- **Trigger slope:** Pos. or neg. selectable

Connector: BNC

External Disciplining Input (CNT-104R only)

Frequency: 1 pps (from external source)
Input levels: TTL levels in 50 Ω
Connector: SMA

Multi-GNSS antenna input (CNT-104R-opt.55)

Supported Systems and Frequencies:

- GPS: L1 C/A, L5
- Gallileo: E1 B/C, E5a
- GLONASS: L1OF
- BeiDou: B1I, B2a
- QZSS: L1 C/A, L5

System/frequency bands can be individually enabled/disabled
Supported active antenna parameters:
Gain: 17 to 50 dB, <+10 dBm at receiver input
DC feed on center pin: +5 V, 100 mA max.
Connector: SMA

Programmable Pulse Output (Option 132)

Pulse mode: Pulse generator, Gate open, Alarm
Period range: 10 ns-2 s in 2 ns steps
Pos. Pulse width range: 4 ns-2 s in 2 ns steps
Min negative pulse width : 6 ns
Rise time: 2.5 ns (nom.)
Output impedance: 50 Ω (nom.)
Output level: Low <0.4 V; High: 4.5-5.25 V (open output); 2.0-2.5 V (50 Ω load).
Connector: BNC

Auxiliary Functions

Trigger Hold-Off

Time Delay Range: 20 ns to 2 s in 10 ns steps

External Start and Stop Arming

Modes:

- Start Arming
- Stop Arming
- Ext. Gate (combined Start and Stop Arming)

Arming channels: A, B, (D, E) or rear panel ARM
Arming delay to first trigger ready: <5 ns
Start/Stop Time Delay Range: 20 ns to 2 s in 10 ns steps

Statistics

Functions: Maximum, Minimum, Mean, Δmax-min, Standard Deviation and Allan Deviation
Display: Numeric or frequency distribution graph
Sample Size: 2 to $16x10^6$ samples
Max. sample rate:

- up to 140 kSa/s calculated
- up to 1 MSa/s captured (CNT-102 / 102B / 104B)
- up to 20 MSa/s captured (CNT-102 / 102B / 104B & option 122)
- up to 20 MSa/s captured (CNT-104R / 104S)

Limit alarm

Graphical indication of limits with Pass/Fail message on front panel, SNMP notifications and/or level shift on optional Pulse Output
Limit Qualifier: OFF or Capture values above, below, inside or outside limits

Sample Interval (Gate time)

The Sample Interval sets the measuring time (gate) in Frequency/Period modes, the timing gate in Totalized timed measurements, and the time between measurements/samples in all other modes except Voltage mode (fixed interval) and Frequency Offset mode (preset gate time, depending on set required accuracy).
Range:

- OFF or 1 µs to 10000 s (CNT-102 / 102B / 104B)
- OFF or 50 ns to 10000 s (CNT-102 / 102B / 104B & option 122)
- OFF or 50 ns to 10000 s (CNT-104R / 104S)

Mathematics

Functions: OFF, (K*X-L)/M, (K/X-L)/M, X/M-1
X is current reading, and K (Scale factor), L (Nulling value) and M (Reference value) are constants

Other Functions

Timebase Reference: Internal, External or Auto-selected
Restart: Aborts current measurement and starts a new
Run/Hold: Switch between RUN (continuous measurements) and HOLD (Freezes result, until a new measurement is initiated via Restart)

Save and Recall Settings and Measurements

Instrument Set-ups can be saved/recalled.
Setups saved to internal memory can be user protected.
Measurement results (RAM) can be accessed by connected PC, and/or saved in internal non-volatile memory, and moved to USB stick.
Max. Measurement Speed and Storage size (RAM): 20 MSa/s (1 to 4 inputs): 16k samples total 12.5 to 3.125 MSa/s (1 to 4 inputs): 32M samples total

Display (except for CNT-102B, CNT-104B)

Displayed data: Graphic screen for menu control, numerical read-out, status information, plus distribution, trend, time-line, and ADEV graphs
Resolution: 1280x720 pixels
Type: Color Touch 5" TFT LCD display with backlight
Accessible tools: Graph smoothing, pan and zoom, cursor read-out, max-min detection

Remote interfaces

Remote operation

Programmable Functions: All front panel accessible functions
Data Output format: ASCII, IEEE double precision floating point, or packed

USB interface

USB version: 2.0
Connectors:
Rear panel: 1x Type B; (Device) used for remote communication and data transfer both ways
Protocol: RNDIS (Ethernet over USB)
Front panel: 2x Type A; (Host) 5 V (nom.) max. 0.5 A. Used for FW updates, mouse/keyboard connection, external result storage, WiFi dongle.

LAN & WLAN interface

Speed: 10/100/1000 Mbps
Capabilities:
- Web server
- SCPI over HiSLIP protocol, compatibility with VISA

Max. measurement rate (depending on input signal and measurement settings)**:**
Block mode: up to 170k readings/s
Individual results: up to 425 readings/s
Supported WiFi USB-dongles:
TP-Link TL-WN321G, TP-LINK Archer T4U v.2, TP-LINK Archer T4U v.3

GPIB interface (Option 26)

Compatibility: IEEE 488.2-1987, SCPI 1999
Interface functions: SH1, AH1, T6, L4, SR1, RL1, E2, DC1
Max. measurement rate (depending on input signal and measurement settings)**:**
Block mode: up to 7.3k readings/s
Individual results: up to 220 readings/s

Calibration of Timebase Oscillator

Mode: Closed case, electronic calibration, menu controlled. Calibration menu is password protected.
Ref. Cal. Frequencies: 1, 5, 10, 1.544 or 2.048 MHz

General Specifications

Environmental Data

Class: MIL-PRF-28800F, Class 3
Installation category: II
Operating Temp:
0°C to +50°C / 5 to 75% RH, bench-top,
0°C to +40°C / 5 to 75% RH, rack-mount
Storage Temp: -40°C to +71°C
Max altitude: 4600 m[1]
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 61010-1:2011, pollution degree 2, installation/over voltage category II, measurement category I, CE, indoor use only
CSA C22.2 No 61010-1-12
EMC: EN 61326-1:2013-06, increased test levels according to EN 61000-6-2:2008, Group 1, Class B, CE
1: Safety approved 2000 m.

Power Requirements
Mains Voltage: 100 to 240 V_{AC} (nom.)
Mains Frequency: 50 to 60 Hz (nom.); 400 Hz[2] (nom.)
Power: <70 W; max. configuration
2: Safety approved for 50/60 Hz (nom.)

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 3 kg (6.6 lb)

Ordering Information

Basic models
CNT-102: 2-channel 400 MHz Frequency Analyzer, 14 ps resolution, 1 MSa/s, TCXO 1 ppm/year
CNT-102B: 2-channel 400 MHz Frequency Analyzer, 14 ps resolution, 1 MSa/s, TCXO 1 ppm/year, blind front panel, rear panel inputs
CNT-104B: 4-channel 400 MHz Frequency Analyzer, 14 ps resolution, 1 MSa/s, TCXO 1 ppm/year, blind front panel, rear panel inputs
CNT-104S: 4-channel 400 MHz Frequency Analyzer, 7 ps resolution, 20 MSa/s, TCXO 1 ppm/year
CNT-104R: 4-channel 400 MHz Frequency Analyzer, 7 ps resolution, 20 MSa/s, Rubidium 0.1 ppb/year

Included with Instrument:
- 2 year product warranty[3]
- Line cord (*dependent on destination country*)
- Link to User documentation (PDF)
- Certificate of Calibration
- Important information document

3: Warranty period is extended to 3 years, at no cost, by registering the product within 1 year from delivery.

Input C Frequency Options
Option 10: 3 GHz Input C (HW-Factory installed)
Option 110: 10 GHz Input C (HW-Factory installed)
Option 110/15: SW upgrade from 10 to 15 GHz
Option 110/20: SW upgrade from 15 to 20 GHz
Option 110/24: SW upgrade from 20 to 24 GHz

Timebase Oscillator Options (HW-Factory installed)
Option 30: Very High Stability, OCXO 50 ppb/year
Option 40: Ultra High Stability, OCXO 15 ppb/year
Option 55: GNSS disciplining of Rubidium timebase in CNT-104R, zero ageing

GPIB Option (HW-Factory installed)
Option 26: GPIB interface

Rear Panel Input Options (HW-Factory installed)
for CNT-102, CNT-104S, CNT-104R
Option 11A: Rear panel A, B (,D, E) inputs (replace front inputs), BNC connectors[5]
Option 11C: Rear panel C input (replace front input), input connector type depends on particular installed Input C option
5: SMA connectors instead of BNC are possible on demand. Contact sales for availability, pricing and lead time.

Front Panel Input Options (HW)
for CNT-102B, CNT-104B
Option 12A: Front panel A, B (,D, E) inputs (replace rear inputs), BNC connectors
Option 12C: Front panel C input (replace rear input), input connector type depends on particular installed Input C option

Other options (SW license enabled)[6]
Option 121: Resolution upgrade from 14 to 7 ps
Option 122: Speed upgrade from 1M to 20 MSa/s
Option 132: Programmable pulse output; 0.5 Hz to 100 MHz
Option 151: TIE measurement function
Option 152: Frequency offset function
Option 161: ADEV graph display mode
6: these options can be installed at any time by the user

Calibration and warranty extension services
Option 90/03: Calibration Certificate with Protocol; Standard TCXO oscillator
Option 90/06: Calibration Certificate with Protocol; Oven oscillator
Option 90/06A: Accredited ISO17025 Calibration; Oven oscillator
Option 90/07: Calibration Certificate with Protocol; Rubidium oscillator
Option 90/07A: Accredited ISO17025 Calibration; Rubidium oscillator
Option 95/05: Extended warranty 2 extra years

Optional Accessories; CNT-104R only
Option 01/200: Multi-GNSS L1 & L5 antenna, 40 dB gain, N-female connector, incl. mounting kit
Option 02/20T: Antenna cable, N to TNC, 20m
Option 02/50T: Antenna cable, N to TNC, 50m
Option 02/130T: Antenna cable, N to TNC, 130m
Option 02/A: Antenna cable adapter SMA to TNC

Optional Accessories; all models
Option 22/90: Rack-Mount Kit - 1 unit
Option 22/04: Rack-Mount Kit - 1 CNT-10x unit plus a half-19", 2U unit, side by side
Option 22/05: Rack-Mount Kit - 2 units
Option 27: Carrying Case - soft
Option 27H: Heavy-duty Hard Transport Case
OM-100: User's Manual English (printed)[7]
PM-100: Programmer's Manual English (printed)[7]
7: Always available as download from the Pendulum website

Time Base Options

Option model	STD	30	40	CNT-104R	CNT-104R, opt 55
Time base type:	TCXO	OCXO	OCXO	Rubidium	Rb+GNSS control
Uncertainty due to:					
-Aging per 24 h	n/a	$<5x10^{-10}$ (4)	$<3x10^{-10}$ (4)	$<5x10^{-12}$ (4)	$<1x10^{-12}$ (4)
per month	$<2x10^{-7}$ (typ.)	$<1x10^{-8}$	$<3x10^{-9}$	$<5x10^{-11}$	$<1x10^{-12}$
per year	$<1x10^{-6}$	$<5x10^{-8}$	$<1.5x10^{-8}$	$<5x10^{-10}$	$<1x10^{-12}$
-Temperature variations: 0°C to 50°C	$<5x10^{-7}$	$<5x10^{-9}$	$<2.5x10^{-9}$	$<3x10^{-10}$	
20°C to 26°C (typ. values)	not specified	$<1x10^{-9}$	$<4x10^{-10}$	$<3x10^{-11}$	
Short-term stability: τ =1 s	$<1x10^{-9}$ (typ.)	$<1x10^{-11}$	$<1x10^{-12}$	$<5x10^{-11}$	$<5x10^{-11}$
(Allan Deviation) τ =10 s		$<1x10^{-11}$	$<1x10^{-12}$	$<2x10^{-11}$	$<2x10^{-11}$
Phase noise 10 Hz offset	n/a	<-120 dBc/Hz	<-125 dBc/Hz	<-95 dBc/Hz	<-95 dBc/Hz
10 kHz offset		<-150 dBc/Hz	<-155 dBc/Hz	<-140 dBc/Hz	<-140 dBc/Hz
Power-on stability at room temperature 20-26°C:					
Deviation vs. final value,	$<1x10^{-6}$	$<1x10^{-8}$	$<5x10^{-9}$	$<5x10^{-10}$	$<5x10^{-9}$
after a warm-up time of:	5 min	10 min	10 min	7 min	7 min
Time to lock (Rubidium):	n/a	n/a	n/a	6 min	6 min
Typical total uncertainty for 24 h average, at operating temperature 20°C to 26°C, at 2σ (95%) confidence interval:					
-1 year after calibration	$<1.2x10^{-6}$	$<6x10^{-8}$	$<1.8x10^{-8}$	$<6x10^{-10}$	$<2x10^{-12}$
-2 years after calibration	$<2.4x10^{-6}$	$<1.2x10^{-7}$	$<3.5x10^{-8}$	$<1.2x10^{-9}$	$<2x10^{-12}$

4: After 1 month of continuous operation

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Specifications subject to change or improvements without notice.

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