

CNT-81 & CNT-81R

Timer/Counter/Calibrators

Ultimate Time and Frequency Calibration and Analysis

- Fast: 8000 measurements/s
- High resolution: 1ps (time)
11 digits/s (freq.), 0.001° (phase)
- Rubidium stability: 0.0001 ppm
- High trigger resolution: 1.25 mV
- Advanced arming/hold-off
- Modulation Domain Analysis SW
- EMC-immunity for noisy environments
- Ideal for fast test systems, R&D and calibration laboratories
- 8 GHz option for microwave & RF testing



NOW with
8 GHz option and
TimeView

With the CNT-81 series of counters and analyzers, Pendulum now offers the ultimate tools 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 (portable calibration). The series comprises 2 models; the ultra-high performance CNT-81 and the ultimate CNT-81R including a built-in Rubidium time-base reference.

Frequency calibration

The CNT-81 and CNT-81R can directly calibrate any application specific frequency up to 8 GHz. They are ideal for calibrating e.g. the timebase oscillator of other instruments, like frequency counters and synthesizers.

The Rubidium timebase of CNT-81R allows frequency calibration of even the highest possible specified oven oscillators. For a total uncertainty of 10^{-10} , just connect the unknown frequency to the counters input and wait for a second.

Each individual 1s-measurement has a 5×10^{-11} resolution. The built-in statistics averaging improves resolution further, and the std dev indicator gives added information about the stability of the unknown frequency.

Time Interval calibration

For the calibration of time-intervals the CNT-81 provides leading performance due to the fast 50 ps single shot time resolution (1 ps averaged) and the high trigger level resolution of 1.25 mV.

The systematic start-stop channel difference is only 500 ps, which can be further reduced by calibrating the input channel difference.

Phase calibration

With CNT-81 you can measure phase differences on signals of up to 160 MHz with a

Selection Chart

	CNT-81	CNT-81R
Frequency, burst, time interval, phase, Vp-p	yes	yes
Frequency range (standard)	300 MHz	300 MHz
Frequency resolution (1s gate time)	11 digits	11 digits
Time interval resolution (single/average)	50/1 ps	50/1 ps
Vp-p (and trigger level) resolution	1.25 mV	1.25 mV
Arming/Hold-off delay by time and events	yes	yes
Hold-off resolution	10 ns	10 ns
Best timebase stability/month	3×10^{-9}	5×10^{-11}
No. of 10 MHz +5 MHz reference outputs	1+0	6+1
Measurement speed: GPIB to internal memory	250/s	250/s
	8 k/s	8 k/s
Statistics calc.: mean, std, dev. and max/min	yes	yes
TimeView Documenting and Analysis SW	yes	yes
2.7 GHz HF-input	Option 10	Option 10
8 GHz RF-input	Option 13	Option 13

resolution better than 0.01° (below 30 MHz). This gives you outstanding resolution in measurements like laser positioning and calibration of phase meters. Calibration procedures exist that provide outstanding accuracy, with an uncertainty below 0.1° .

Ideal for fast test systems

In manufacturing test systems two things are important; EMC-immunity and speed. CNT-81 offers excellent EMC-shielding and the highest throughput for any commercially available counter. The speed is impressive

8000/s to internal memory, and 250/s for individually triggered measurements via GPIB. Up to 20 complex measurement set-ups can be locally stored in the counter's non-volatile set-up memory and instantly recalled via a short bus command. This enables new measurement tasks to be executed one after the other at a very-high rate. A complete cycle "setup-measure-transfer" takes less than 8 ms.

The two counters comply of course to SCPI, which facilitates easy updating of new test hardware without the penalty of time-consuming SW-rewriting.

Modulation Domain Analysis

The optional analysis PC-SW *TimeView* (option 29) converts the CNT-81/CNT-81R to a high performance modulation domain analyzer. In the modulation domain you can view rapid frequency changes vs. time, e.g. modulation, sweep, frequency setting, channel hopping etc.

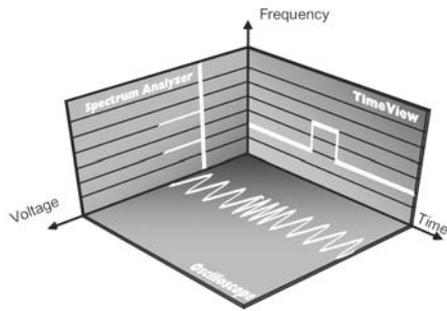


Figure 1: The modulation domain (f vs. t) complements the time (V vs. t) and the frequency (V vs. f) domains

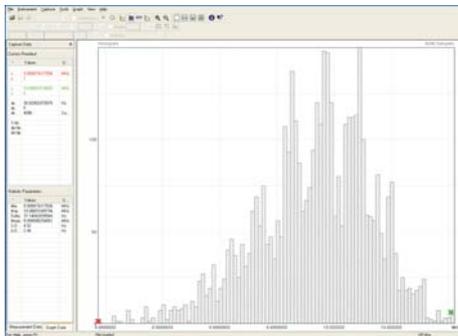


Figure 2: Jitter (rms and peak-peak) and noise is quantified in distribution histograms.

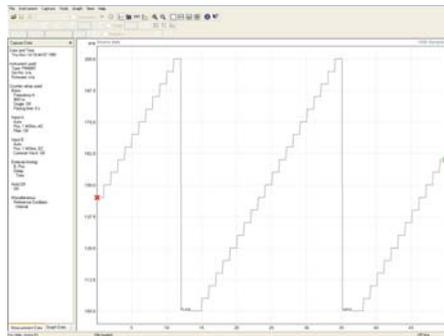


Figure 4: Linearity of frequency sweep can be verified in the modulation domain (frequency vs. time).

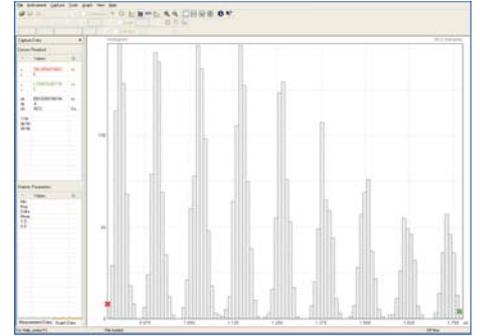


Figure 6: The 9 different pulse width clusters, corresponding to the 9 different pit lengths (T3-T11) in a CD-recording.

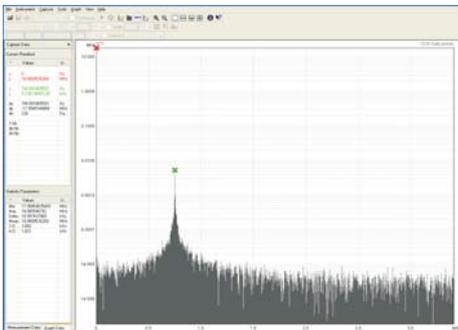


Figure 3: The FFT-diagram reveals the modulation frequency, whether intended or unwanted.

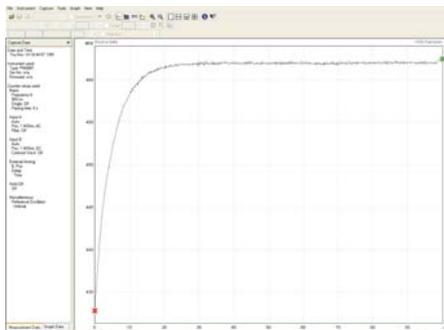


Figure 5: Repetitive samplings gives an effective sampling rate of 10 Msa/s. This VCO has a frequency switching time of approx. 10.7 us.

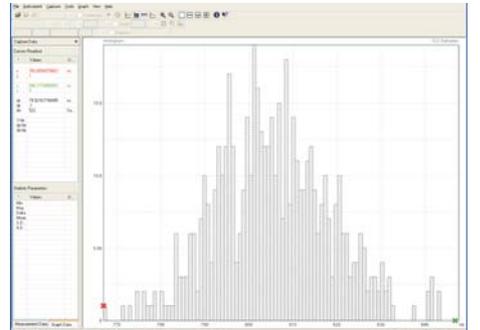


Figure 7: Zoom in on T3-cluster displays an rms-jitter of 13 ns, which is OK for an audio CD.

CNT-81 & CNT-81R Specifications

Measuring Modes

Inputs A and B can be swapped internally in all modes except Rise and Fall Time.

Frequency A, B, C

Range:

Input A:	up to 300 MHz
Input B:	up to 100 MHz
Input C (option 20):	100 MHz to 2,7 GHz
Input C (option 13):	300 MHz to 8 GHz

Resolution: 11 digits in 1s measuring time

Frequency Burst A, B, C

Frequency and PRF of burst signals down to 1 μ s (CH. A and B) or 50 μ s (Ch. C) can be measured without external control signals.

Period A

Range: 3.3 ns to 10¹⁰s

Resolution: 11 digits in 1s measuring time

Frequency Ratio A/B, C/B

Range: 10⁻⁹ to 10¹⁵

Time Interval A to B

Range: 0 ns to 10¹⁰ s

Resolution:

Single shot: 50 ps (1 ps average)

Pulse Width A

Range: 3 ns to 10¹⁰ s

Rise and Fall Time A

Range: 3 ns to 10¹⁰s

Phase A Relative B

Range: -180 to +360°

Resolution: 0,01°

Duty Factor:

Range: 0.000001 to 1.000000

Totalize A, B

Range: 0 to 10¹⁷, 0 to 10¹⁰ in A-B modes

Modes:
A Gated by B
A Start/Stop by B
Manual gating A minus B
Time gating A minus B

V max, V min, Vp-p A, B

Range: -50V to +50V

Frequency Range: up to 100 MHz

Resolution: 1.25 mV

Inputs and Outputs

Inputs A and B

Coupling: AC or DC

Impedance: 1 M Ω /15 pF or 50 Ω /(VSWR \leq 2:1)

Max. Channel Timing Difference: 500 ps

Max. Sensitivity: 20 mV rms, <100 MHz

Attenuation: x1 or x10

Var. Hysteresis A: 30 mVp-p to 10Vp-p hup to 120 MHz

Triggerpegel: read-out on display

Range:
(x1): -5V to +5V
(x10): -50V to +50V

Resolution (x1): 1.25 mV

AUTO-Trigger Level: Trigger level is automatically set to 50% point of input signal (10% and 90% for Rise/Fall Time, 75% and 25% for variable hysteresis A)

Min. Frequency: Settable from 1 Hz and upwards. Default=100 Hz

Low Pass Filter A: 100 kHz

Digital LP Filter: 1 Hz to 10 MHz using trigger Hold-Off

Input C (Option 20)

Frequency Range: 100 MHz to 2.7 GHz

Operating Input Voltage Range:

0.1 to 0.3 GHz: 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

Impedance: 50 Ω nominal, (VSWR<2.5:1)

Max Voltage Without Damage: 12V rms during 60s, PIN-diode protected

Connector: N-type, female

Input C (Option 13)

Operating input voltage range:

0.3 to 0.5 GHz -21 to +30 dBm (20 mV rms to 7V rms)

0.5 to 3.0 GHz -27 to +30 dBm (10 mV rms to 7V rms)

3.0 to 4.5 GHz -21 to +30 dBm (20 mV rms to 7V rms)

4.5 to 6.0 GHz -15 to +30 dBm (40 mV rms to 7V rms)

6.0 to 8.0 GHz - 9 to +30 dBm (80 mV rms to 7V rms)

Impedance: 50 Ω nom, VSWR<2:1

Connector: N-type, female

Rear Panel Inputs and Outputs

Reference Input: 1, 2, 5 or 10 MHz>200mV rms

Reference Output:

CNT-81: 1x10 MHz>0.5V rms sinewave into 50 Ω load

CNT-81R: 6x10 MHz; 1x5 MHz>0.6V rms sinewave into 50 Ω load

Arming Input: Most measuring functions can be performed using arming

Gate Output: Gate open/gate closed signal

Trigger Level Outputs: Outputs for channel A and B trigger levels

Probe Comp. Outputs: Outputs for channel A and B to adjust for best pulse response when using probes for counter inputs

Analog Output: 0 to 4.98V in 20 mV steps; proportional to 3 selected display digits

Auxiliary Functions

Trigger Hold Off

Time Delay Range: 60 ns to 1.34s, 10 ns resolution

Event Delay Range B: 2 to 2²⁴-1, max. 100 MHz

External Arming

Time Delay Range B, E: 200 ns to 1.6s, 100 ns resolution

Event Delay Range B: 2 to 2²⁴-1, max. 20 MHz

Statistics

Functions: Maximum, Minimum, Mean and Standard Deviation

Sample Size: 1 to 2x10⁹ samples

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_o) or as value from preceding measurement (X_{n-1}).

Other Functions

Measure Time: Single cycle, 80, 160, 320, 640, 1280 ns and 20 μ s to 20s (to 400s for some functions)

Display Hold: Freezes measuring result, until a new measurement is initiated via Restart.

Set-ups: 20 instrument setups can be saved and recalled from internal non-volatile memory. 10 can be user protected.

Display: 10-digit LCD with high-luminance back-light

CNT-81 & CNT-81R Specifications

GPIB Interface

Max Measurement Rate*	
Via GPIB:	250 readings/s
To Internal Memory:	8k readings/s
Time Stamping:	125 ns resolution
Back-to-back-Period:	Up to 40k readings/s (100 ns resolution)
Internal Memory Size*:	Up to 6100 readings
Data Output:	ASCII, IEEE double precision floating point

TimeView™ Time & Frequency Analyse Software

TimeView is supported on both CNT-81 and CNT-81R models.

Windows (32 bit) version: Optional accessory (option 29)

Data Capture Modes and Measurement Rate*

Free-run sampling:	8k readings/s
Repetitive Sampling:	Up to 10 MSA/s
Back-to-back-Period:	Up to 40k readings/s

Waveform Capture: Yes (vertical sampling)

Instrument Control: All front panel functions and some AUX MENU functions

Data Analysis: Measurement data vs time
FFT Graph
Root Allan Variance
Smoothing function
Zoom function
Cursor measurements
Distribution Histogram

File Storage: Setup and Measurement data

* Depending on measurement function and internal data format.

Time Base Options

Model:	CNT-81	CNT-81	CNT-81	CNT-81R
Option:	Standard	Option 30	Option 40	-
Stability:	UCXO	OCXO	OCXO	Rubidium
Ageing:				
per month	<5x10 ⁻⁷	<1x10 ⁻⁸	<3x10 ⁻⁹	<5x10 ⁻¹¹ *
per year	<5x10 ⁻⁶	<7.5x10 ⁻⁸	<2x10 ⁻⁸	<2x10 ⁻¹⁰
per 10 years	n.s.	n.s.	n.s.	<1x10 ⁻⁹
vs. temp:				
0°C-50°C	<1x10 ⁻⁵	<5x10 ⁻⁹	<2.5x10 ⁻⁹	<3x10 ⁻¹⁰
20°C-26°C (typ.)	<3x10 ⁻⁶	<6x10 ⁻¹⁰	<4x10 ⁻¹⁰	<2x10 ⁻¹¹
Short Term:				
τ=1s(Allan Dev.)	n.s.	1x10 ⁻¹¹	5x10 ⁻¹²	5x10 ⁻¹¹
Warm-up Stability:				
after warm-up time of:	n.s.	<1x10 ⁻⁸	<5x10 ⁻⁹	<4x10 ⁻¹⁰
	30 min.	10 min.	10 min.	10 min.
Total Uncertainty (2σ):				
(20°C -26°C)				
1 year after calibration	<7x10 ⁻⁶	<1x10 ⁻⁷	<2.5x10 ⁻⁸	<2.5x10 ⁻¹⁰
2 years after calibration	<1.2x10 ⁻⁵	<2x10 ⁻⁷	<5x10 ⁻⁸	<5x10 ⁻¹⁰

* After 1 month of continuous operation.

General Specifications

Environmental Data

Operating Temp:	0°C to 50°C
Storage Temp:	-40°C to 70°C
Safety:	CSA 22.2 Nr. 231, EN 61010-1, Cat. II pollution degree 2, CE
EMC:	EN 5501 1 ISM Group 1, Class B; EN 50082-2; FCC Part 15J Class A, CE

Power Line Requirements (at 25°C)

AC Voltage:	
CNT-81:	90 to 265V rms, 45 to 440 Hz
CNT-81R:	90 to 265V rms, 45 to 440 Hz

Power Rating:	
CNT-81:	Max. 35W
CNT-81R:	Max. 100W (6 min. warm-up); Max. 47W (cont. operation)

Mechanical Data

WxHxD:	315x86x395 mm (12.4x3.4x15.6 in)
Weight:	
CNT-81:	Net 4 kg (8.5 lb) Shipping 7 kg (15 lb)
CNT-81R:	Net 4.8 kg (10.5 lb) Shipping 7.8 kg (16.8 lb)

Ordering Information

Basic models

CNT-81	Timer/Counter/Analyzer 300 MHz/50 ps, incl. Standard timebase (5x10 ⁻⁷ /Month)
CNT-81R	Timer/Counter/Calibrator 300 MHz/50 ps, incl. Rubidium timebase (5x10 ⁻¹¹ /Month)

Included with Instrument Power line cord
Users documentation on CD-rom
Certificate of Calibration

RF Input Frequency Options (CNT-81/81R)*

Option 13:	8.0 GHz Input C (CNT-81/81R)
Option 20:	2.7 GHz Input C (CNT-81/81R)

Time Base Options (CNT-81)*

Option 30:	Very-high stability Oven Time Base (1x10 ⁻⁸ /Month)
Option 40:	Ultra-high stability Oven Time Base (5x10 ⁻⁹ /Month)

Optional Accessories*

Option 11:	Rear Panel Inputs
Option 22:	Rack-Mount Kit
Option 27:	Carrying Case
Option 27H:	Heavy Duty Hard Transport Case
Option 29:	TimeView for Windows 98/2000/XP/NT
OM-81:	Operators Manual (printed) for CNT-81/81R
PM-81:	Programmers Manual (printed) for CNT-81/81R
SM-81:	Service Manual (printed) for CNT-81/81R
NI 778416-01:	GPIB-USB interface from National Instruments
NI 778034-0:	PCMCIA-GPIB interface from National Instruments
NI 778209-0:	GPIB-ENET interface from National Instruments
NI 763061-01:	GPIB cable type X2 (1m) from National Instruments
NI 763061-02:	GPIB cable type X2 (2m) from National Instruments
NI 763061-03:	GPIB cable type X2 (3m) from National Instruments

Warranty

Standard	18 months
Option 95/03	Extended to 3 years
Option 95/05	Extended to 5 years

*Options are factory installed upon order and can not be customer retrofitted.

Specifications subject to change without notice

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US: Pendulum Instruments Inc

5811 Racine Street
Oakland, CA 94609-1519, USA
Voice:(510)-428-9488 Fax: (510)-428-9469

International: Pendulum Instruments AB

PO Box 20020, SE-16102 Bromma, Sweden
Voice: +46 8 598 51057 Fax:+46 8 598 51040

www.pendulum-instruments.com

- Experts in time & frequency calibration, measurement and analysis

Pendulum Instruments is a company of the Orolia Group