product data

CNT-80 & CNT81/81R

Timer/Counter/Calibrators

Ultimate time & frequency calibration & analysis

- Fast: 8000 measurements/s
- High resolution: 1 ps (time), 11digits/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

With the CNT-80 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 3 models, the economy CNT-80, the ultra-high performance CNT-81 and the ultimate CNT-81R including a built-in Rubidium time-base reference.

Frequency calibration

The CNT-80/CNT-81/CNT-81R can directly calibrate any application specific frequency up to 2.7 GHz. They are ideal for calibrating e.g. the timebase oscillator of other instruments, like frequency counters and synthesisers. 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 $5x10^{-11}$ 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 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°.

Selection chart	CNT-80	CNT-81	CNT-81R
Frequency, burst, time interval, phase, Vp-p	●	●	●
Frequency range (standard)	225 MHz	300 MHz	300 MHz
Frequency resolution (1s gate time)	10 digits	11 digits	11 digits
Time interval resolution (single/average)	250 / 100ps	50 / 1 ps	50 / 1 ps
Vp-p (and trigger level) resolution	20 mV	1.25 mV	1.25 mV
Arming / hold-off delay by time and events	●	●	●
Hold-off resolution	100 ns	10 ns	10 ns
Best timebase stability/month	$3x10^{-9}$	$3x10^{-9}$	$5x10^{-11}$
No of 10 MHz + 5 MHz reference outputs	1 + 0	1 + 0	6 + 1
Measurement speed - GPIB	125/s	250/s	250/s
to internal memory	2k/s	8k/s	8k/s
Statistics calc.: mean, std. dev. and max/min	●	●	●
TimeView Documenting and Analysis SW		●	●
2.7 GHz HF-input	option 10	option 20	option 20

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.

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

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Modulation domain analysis

The analysis PC-SW *TimeView* converts the CNT-81 to a high performance modulation domain analyzer. In the modulation domain you can view rapid frequency changes vs. time, e.g. modulation, sweep, frequency settling, channel hopping etc.

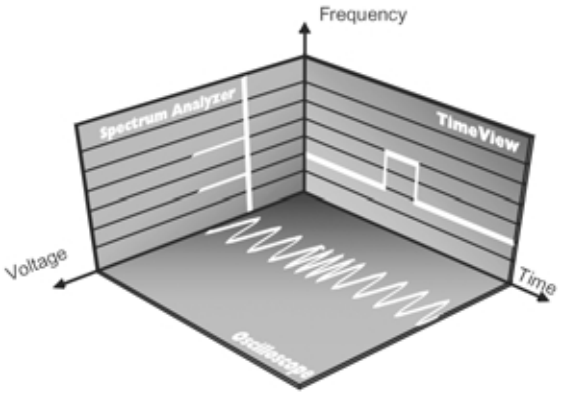
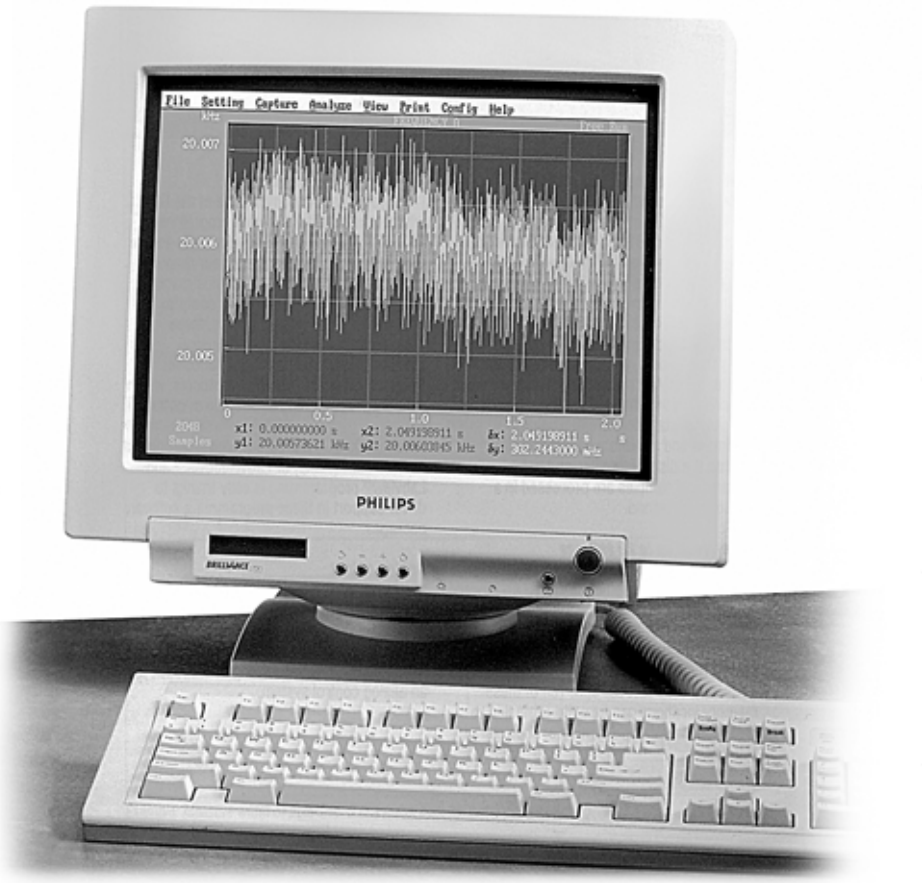


Figure 1. The modulation domain (f vs. t) complements the time (V vs. t) and the frequency (V vs. f) domains



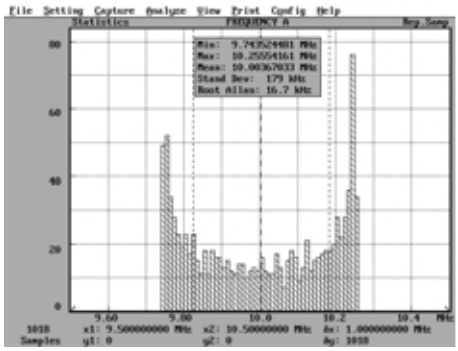


Figure 2. Jitter (rms and peak-peak) and noise is quantified in distribution histograms

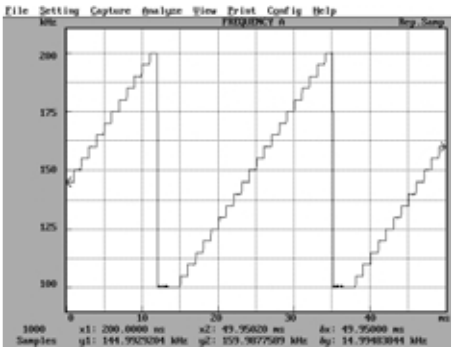


Figure 4. Linearity of frequency sweep can be verified in the modulation domain (frequency vs. time)

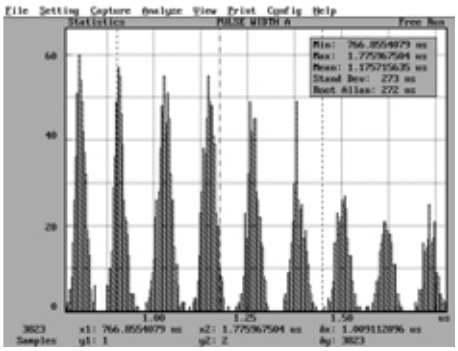


Figure 6. The 9 different pulse width clusters, corresponding to the 9 different pit lengths (T3-T11) in a CD-recording

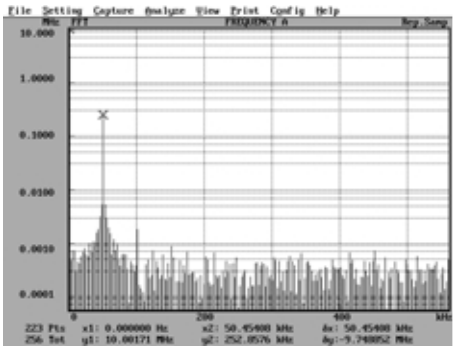


Figure 3. The FFT-diagram reveals the modulation frequency, whether intended or unwanted

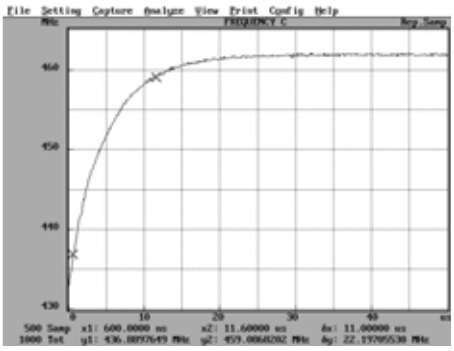


Figure 5. Repetitive sampling gives an effective sampling rate of 10 Msa/s. This VCO has a frequency switching time of approx. 10.7 ms.

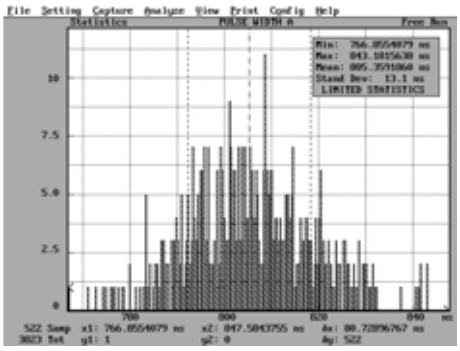


Figure 7. Zoom in on T3-cluster displays an rms-jitter of 13 ns, which is OK for an audio CD.

CNT-80, 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 (CNT-81): up to 300 MHz
- Input A (CNT-80): up to 225 MHz
- Input B: up to 100 MHz
- Input C (option): 140 MHz to 2.7 GHz

Resolution (CNT-81): 11 digits in 1s measuring time
Resolution (CNT-80): 10 digits in 1s measuring time

Frequency Burst A, B, C

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

Period A

Range (CNT-81): 3.3 ns to 10^{10}s
Range (CNT-80): 6 ns to 10^{10}s
Resolution (CNT-81): 11 digits in 1s measuring time
Resolution (CNT-80): 10 digits in 1s measuring time

Frequency Ratio A/B, C/B

Range: 10^{-9} to 10^{15}

Time Interval A to B

Range: 0 ns to 10^{10}s
Resolution:
- Single shot (CNT-81): 50 ps (1 ps average)
- (CNT-80): 250 ps (100 ps average)

Pulse Width A

Range: 3 ns to 10^{10}s

Rise and Fall Time A

Range: 3 ns to 10^{10}s

Phase A Relative B

Range: -180° to +360°
Resolution: 0.01°

Duty Factor A

Range: 0.000001 to 1.000000

Totalize A, B

Range: 0 to 10^{17}, 0 to 10^{10} in A-B modes
Modes: A Gated by B
A Start/Stop by B
Manual gating A minus B
Timed gating A minus B

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

Range: -50V to +50V
Frequency Range: up to 100 MHz
Resolution (CNT-81): 1.25 mV
Resolution (CNT-80): 20 mV

Inputs and Outputs

Inputs A and B (CNT-81)

Coupling: AC or DC
Impedance: 1 MΩ//15 pF or 50Ω (VSWR ≤2:1)
Max. channel timing difference: 500 ps
Max. sensitivity: 20 mV rms, <100 MHz
Attenuation: x1 or x10
Var. hysteresis A: 30 mV p-p to 10V p-p up to 120 MHz
Trigger Level: 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

Inputs A and B (CNT-80)

Coupling: AC or DC
Impedance: 1 MΩ//30 pF or 50Ω (VSWR ≤2:1)
Max. channel timing difference: 1 ns
Max. sensitivity: 20 mV rms, <100 MHz
Attenuation: x1 or x10
Var. hysteresis A: 60 mV p-p to 10V p-p up to 120 MHz
Trigger Level: Read-Out on display
- Range: (x1): -5.1V to +5.1V
  (x10): -51V to +51V
- Resolution (x1): 20 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)
- Frequency: >100 Hz
- Amplitude: >150 mV p-p

Low Pass Filter A: 100 kHz
Digital LP Filter: 1 Hz to 5 MHz using trigger Hold-Off

Input C (option 10/20)

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: 50Ω nominal, VSWR<2.5:1
Max Voltage Without Damage:
12V rms during 60s, pin-diode protected
Connector: N-type, female

Rear Panel Inputs and Outputs

Reference input:
- CNT-81/81R: 1, 2, 5 or 10 MHz >200mV rms
- CNT-80: 10 MHz >500 mV rms signal

Reference output:
- CNT-80, CNT-81: 1x10 MHz >0.5V rms sinewave into 50Ω load
- CNT-81R: 6x10 MHz; 1x5MHz >0.6V rms sinewave into 50Ω 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 input
Analog output: 0 to 4.98V in 20 mV steps; proportional to 3 selected display digits

Auxiliary Functions

Trigger Hold-Off

Time Delay Range: CNT-81/81R: 60 ns to 1.34s, 10 ns resol.
Time Delay Range: CNT-80: 200 ns to 1.6s, 100 ns resol.
Event Delay Range B: CNT-81/81R: 2 to 2^{24}-1, max. 100 MHz
CNT-80: 2 to 2^{24}-1, max. 20 MHz

External Arming

Time Delay Range B, E: 200 ns to 1.6s, 100 ns resolution
Event Delay Range B: 2 to 2^{24}-1, max. 20 MHz

Statistics

Functions: Maximum, Minimum, Mean and Standard Deviation
Sample Size (CNT-81): 1 to 2 x 10^{-9} samples
Sample Size (CNT-80): 1 to 65535 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_0) or as value from preceding measurement (X_{n-1})

Other Functions

Measure Time (CNT-81): Single cycle, 80, 160, 320, 640, 1280 ns and 20 µs to 20s (to 400s for some functions)
Measure Time (CNT-80): Single cycle, 0.8, 1.6, 3.2, 6.4, 12.8 µs and 50 µs 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.
Auxiliary Menu: Gives access to additional functions
Display: 10-digit LCD with high-luminance back-light

CNT-80, CNT-81, CNT-81R Specifications

GPIB Interface

Max measurement rate*
Via GPIB
CNT-81/81R: 250 readings/s
CNT-80: 125 readings/s
To Internal Memory:
CNT-81/81R: 8k readings/s
CNT-80: 2k readings/s
Time stamping:
CNT-81/81R: 125 ns resolution
Back-to-back-Period:
CNT-81/81R: Up to 40k readings/s (100 ns resolution)
Internal Memory Size:
CNT-81/81R* Up to 6100 readings
CNT-80* Up to 2600 readings
Data Output: ASCII, IEEE double precision floating point

TimeView™ Time & Frequency Analysis Software

TimeView runs on any PC with VGA/EGA monitor.
TimeView is supported on CNT-81 and CNT-81R models.

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-80/81	CNT-80/81	CNT-80/81	CNT-81R
Option:	Standard	Option 30	Option 40	
Stability : Time base type:	UCXO	OCXO	OCXO	Rubidium
Ageing: per month	$< 5 \times 10^{-7}$	$< 1 \times 10^{-8}$	$< 3 \times 10^{-9}$	$< 5 \times 10^{-11}$
per year	$< 5 \times 10^{-6}$	$< 7.5 \times 10^{-8}$	$< 2 \times 10^{-8}$	$< 2 \times 10^{-10}$
vs. temp: 0°C -50°C,	$< 1 \times 10^{-5}$	$< 5 \times 10^{-9}$	$< 2.5 \times 10^{-9}$	$< 3 \times 10^{-10}$
20°C -26°C (typ.)	$< 3 \times 10^{-6}$	$< 6 \times 10^{-10}$	$< 4 \times 10^{-10}$	$< 2 \times 10^{-11}$
Short term: $\tau = 1$ s (Allan dev.)	n. s.	1×10^{-11}	1×10^{-11}	5×10^{-11}
Warm-up stability:	n. s.	$< 5 \times 10^{-8}$	$< 5 \times 10^{-9}$	$< 4 \times 10^{-10}$
after a warm-up time of:	30 min	10 min	10 min	10 min
Total uncertainty (2σ):				
1 year after calibration	$< 7 \times 10^{-6}$	$< 1 \times 10^{-7}$	$< 2{,}5 \times 10^{-8}$	$< 2{,}5 \times 10^{-10}$
2 years after calibration	$< 1{,}2 \times 10^{-5}$	$< 2 \times 10^{-7}$	$< 5 \times 10^{-8}$	$< 5 \times 10^{-10}$
(20°C -26°C operating temperature)				

General Specifications

Environmental Data

Operating Temp: 0°C to +50°C
Storage Temp : -40°C to +70°C
Safety: CSA 22.2 No. 231, EN 61010-1, Cat II, pollution degree 2, CE
EMC: EN 55011 ISM Group 1, Class B; EN 50082-2; FCC Part 15J Class A, CE

Power Line Requirements (at 25ºC)

AC voltage:
CNT-80,CNT-81 90 to 265V rms, 45 to 440 Hz
CNT-81R 90 to 265V rms, 45 to 440 Hz
Power rating:
CNT-80,CNT-81 max 35 W
CNT-81R max 100 W (6 min. warm-up)
max 47 W (cont. operation)

Mechanical Data

WxHxD: 315x86x395 mm (12.4x3.4x15.6 in)
Weight :
CNT-80, 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-80 Timer/Counter 225 MHz / 250 ps, incl. Standard time base (5×10^{-7}/month) and GPIB-interface
CNT-81 Timer/Counter/Analyzer 300 MHz / 50 ps, incl. Standard timebase (5×10^{-7}/month), GPIB-interface and Time & Frequency Software TimeView
CNT-81R Timer/Counter/Calibrator 300 MHz / 50 ps, incl. Rubidium timebase (5×10^{-11}/month), GPIB-interface and Time & Frequency Software TimeView

Included with Instrument
Power line cord
Users manual
Programming manual
Certificate of Calibration

RF Input Frequency Options (CNT-80/81/81R)*
Option 10 2.7 GHz Input C (CNT-80)
Option 20 2.7 GHz Input C (CNT-81/81R)

Time Base Options (CNT-80, CNT-81)*
Option 30 Very-high stability Oven Time Base (1×10^{-8}/month)
Option 40 Ultra-high stability Oven Time Base (3×10^{-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

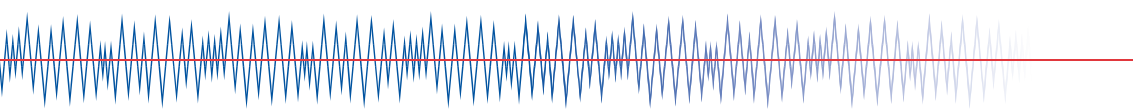
**) Options are factory installed upon order and can not be customer retrofitted.*

Specifications subject to change without notice

4031 600 80101- rev. 02 January 2001

Pendulum Instruments AB
www.pendulum.se

– experts in Time & Frequency Calibration, Measurement and Analysis



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