product data

CNT-81 & CNT-81R

Timer/Counter/Calibrators

Ultimate Time & Frequency calibration & 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 laboratoires
- 8 GHz option for microwave IRF testing

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 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-81*	*CNT-81R*
Frequency, burst, time interval, phase, Vp-p	•	•
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	•	•
Hold-off resolution	10 ns	10 ns
Best timebase stability/month	$3x10^{-9}$	$5x10^{-11}$
No. of 10 MHz +5 MHz reference outputs	1+0	6+1
Measurement speed: GPIB	250/s	250/s
to internal memory	8 k/s	8 k/s
Statistics calc.: mean, std, dev. and max/min	•	•
TimeView Documenting and Analysis SW	•	•
2.7 GHz HF-input	Option 10	Option 10
8 GHz RF-input	Option 13	Option 13

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.

pendulum

Incorporating XL Microwave

Modulation Domain Analysis

The analysis PC-SW *TimeView* 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, freqiency setting, channel hopping etc.

The 16-bit DOS program is standardly included with all CNT-81/81R.

The 32-bit Windows program is an optional accessory (option 29).

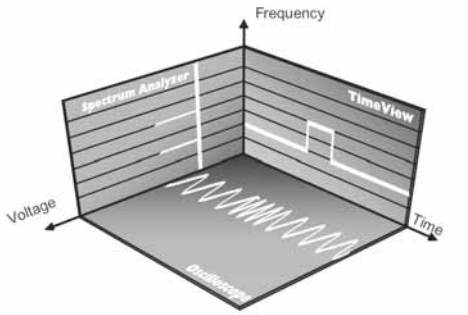

Figure 1: The modulation domain (f vs. t) complements the time (V vs. t) and the frequency (V vs. f) domains

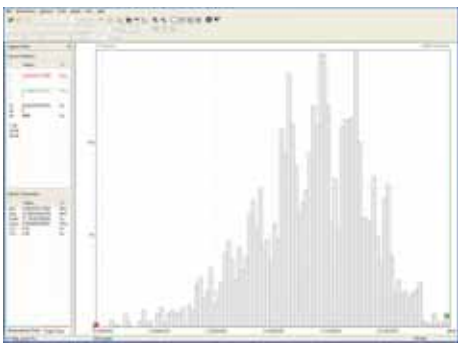

Figure 2: Jitter (rms and peak-peak) and noise is quantified in distribution histograms.

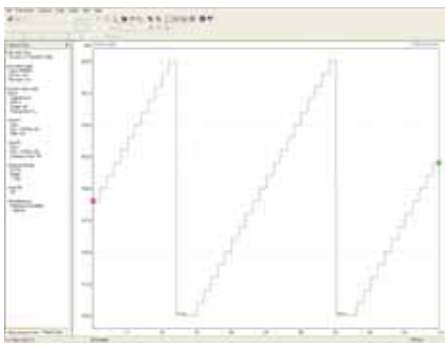

Figure 4: Linearity of frequency sweep can be verified in the modulation domain (frequency vs. time).

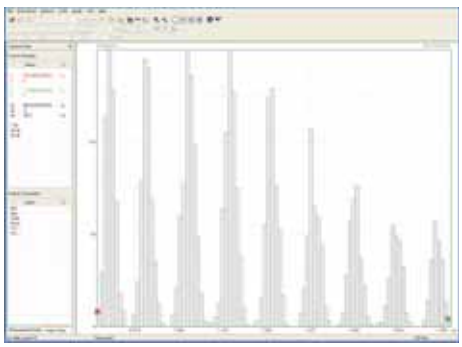

Figure 6: The 9 different pulse width clusters, corresponding to the 9 different pit lenghts (T3-T11) in a CD-recording.

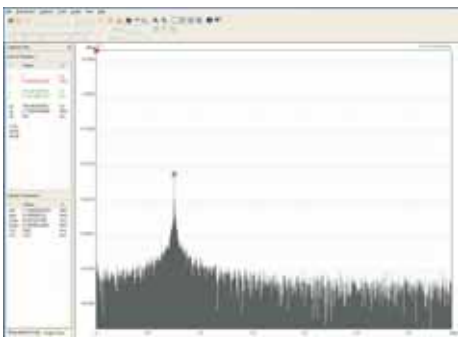

Figure 3: The FFT-diagram reveals the modulation frequency, whether intended or unwanted.

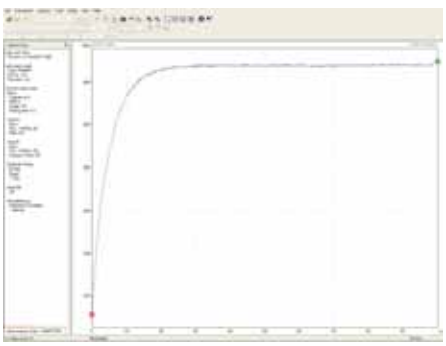

Figure 5: Repetitive samplings gives an effective sampling rate of 10 Msa/s. This VCO has a frequency switching time of approx. 10.7 us.

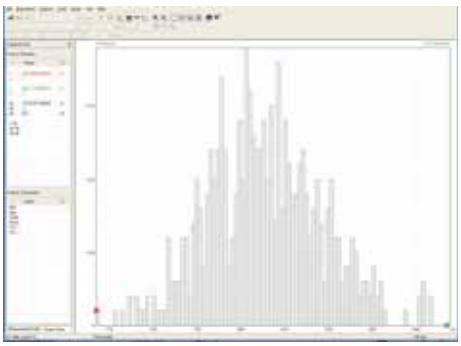

Figure 7: Zoom in on T3-cluster displays an rms-jitter of 13 ns, which is OK for an audio CD.

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 1µs (CH. A and B) or 50 µs (Ch. C) can be measured without external control signals.

Period A

Range:	3.3 ns to 10^{10}s
Resolution:	11 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:	50 ps (1 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:

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 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 MΩ/15 pF or 50Ω/(VSWR≤2:1)
Max. Channel Timing Difference:	500 ps
Max. Sensitivity:	20 mV rms, <100 MHz
Attenuation:	x1or 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:	50Ω 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:	50Ω 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 50Ω load
CNT-81R:	6x10 MHz; 1x5 MHz>0.6V rms sinewave into 50Ω load
Arming Input:	Most mesuring 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 2^{24}-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 2^{24}-1, max. 20 MHz

Statistics

Functions:	Maximum, Minimum, Mean and Standard Deviation
Sample Size:	1 to 2x10^{-9} samples

Mathematics

Functions:	(K*X+L)/M and (K/X+L)/M, X is urrent 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 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.
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.

Versions:	
DOS-version:	Standardly supported
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	OXCO	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:	n.s.	$<1x10^{-8}$	$<5x10^{-9}$	$<4x10^{-10}$
after warm-up time of:	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	$<1.2x10^{-5}$	$<2x10^{-7}$	$<5x10^{-8}$	$<5x10^{-10}$

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) and Time&Frequency Software TimeView for DOS
CNT-81R	Timer/Counter/Calibrator 300 MHz/50 ps, incl. Rubidium timebase ($5x10^{-11}$/Month) and Time&Frequency Software TimeView for DOS
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 ($1x10^{-8}$/Monat)
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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