

Frequency Range up to 60 GHz

- Speed: 250k measurements/s to internal memory
- Frequency, power, CW or burst to 60 GHz
- Resolution: 14 digits display
- Statistical analysis including histogram, trend & modulation domain display
- Frequency range to 27, 40, 46 or 60 GHz
- Unique ease-of-use: Multi-parameter display & graphical presentation of results
- USB & GPIB as standard
- 2 instruments in one - Microwave Counter/Analyzer & 300 MHz general-purpose timer/counter



With the CNT-90XL Microwave Counter/Analyzer, Pendulum Instruments offers an excellent tool for measurement, analysis and calibration of **Microwave Frequency and Power**. Whether in test systems, on the R&D bench, in the calibration lab or out in the field, the CNT-90XL is the state-of-the-art Microwave Counter/Analyzer and outperforms any existing Microwave counter on the market. The CNT-90XL is the worlds fastest Microwave counter with integrated power meter and offers a unique ease-of-use with graphical display and improved control over measurement at an outstanding price.

The Fastest Microwave Counter

The CNT-90XL Microwave Counter/Analyzer has set new milestones for microwave frequency counting and outperforms any microwave counter on the market regarding resolution, speed and acquisition time. The CNT-90XL is the worlds fastest Microwave counter with integrated power meter and offers a unique ease-of-use with graphical display and improved control over measurement at an outstanding price. The measurement speed is up to 250 000 frequency samples/s, for advanced statistical analysis.

Except for being a Microwave Counter/Analyzer, the multi-functional CNT-90XL also serves as a 300 MHz general purpose timer/counter. Now, for the first time, the variations in signal power can be seen, collected, and analyzed in the same manner as frequency: both numerically and graphically.

Applications and Features

The CNT-90XL is intended for *several applications*, such as:

- Microwave link carrier calibration
- Satellite communication equipment testing
- YIG and VCO testing

- RF and microwave instrumentation calibration

- RF components and modules testing

Product features and benefits:

- Fast high-resolution frequency or power measurements, very short acquisition time of 25 ms (Auto) or zero (Manual)
- Burst measurements via Ext. arming
- High sensitivity (-33 dBm)
- Statistical processing and graphical histogram, trend and modulation display
- Affordable microwave frequency counting

Leading Performance

- *High resolution* is vital for R&D and production testing. CNT-90XL meets this requirement with 100 ps single shot (time) or 12 digits/s (frequency). Obtained values are displayed with up to 14 digits.

- For *calibration* purposes, the CNT-90XL offers very high accuracy through stable *internal OCXO time base*, low systematic time interval A-B error and high resolution.

- 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 emulation mode*, for plug-and-play replacement in existing ATE systems.

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.

- *Limit qualifying* a handy tool for making correct calculation of statistical parameters e.g. to verify the jitter of digital pulses that appear in discrete clusters (e.g. in CD-players or in HDB3-coded data). By setting limits you can isolate one cluster in the calculation.

Battery Option

The CNT-90XL has an optional battery pack with 90Wh capacity, capable of mains-free operation for at least 4.5 hours.

In stand-by mode the battery pack can keep an OCXO warm and running for over 24 hours. Battery operation of a frequency counter/analyzer is valuable in three different applications:

- Mains-free operation in the field
- Transportation of high-stability OCXO to maintain stability, which gives instant use at destination without any warm-up time
- Battery backup acting as a built in UPS (Uninterrupted Power Supply)

Excellent Graphical Presentation

One of the great features of the CNT-90XL 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 $V_{max}/V_{min}/V_{p-p}$ 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.

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

The graphical displays below shows frequency changes over time directly on-screen, e.g. fast power switching or FM. Built-in statistical processing presents numerical stability data and also frequency distribution histograms on-screen for analysis of frequency stability or modulation.

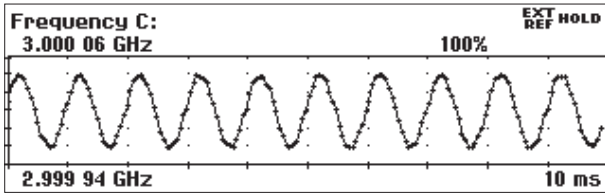


Fig. 1: 1 kHz FM with 12 ppm modulation depth

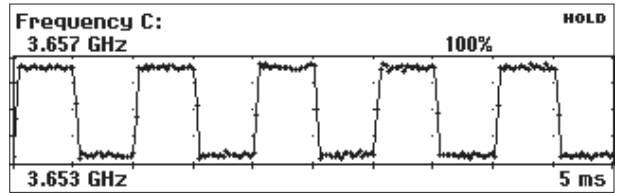


Fig. 2: Pulse modulated frequency

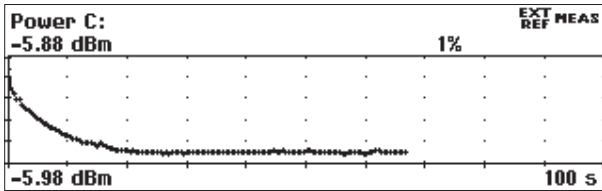


Fig. 3: Generator start-up power settling

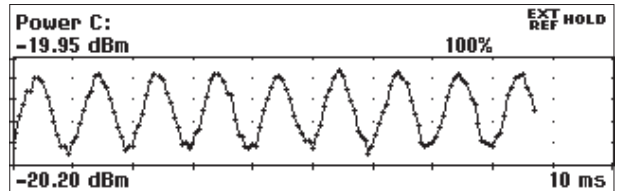


Fig. 4: Very small AM on carrier is visualized

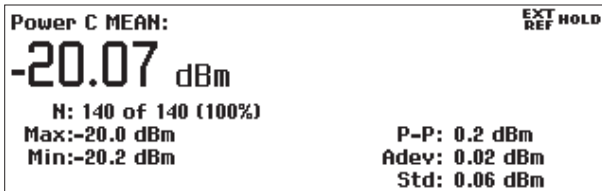


Fig. 5: Numeric statistics screen of the previous AM signal

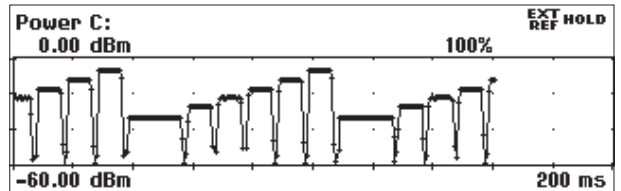


Fig. 6: Power step from generator (-30 to -5 dBm in 5 dBm steps)
NOTE: output is turned off shortly betw. power steps

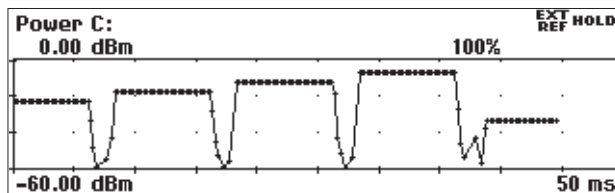


Figure 7: Power step (close up)

CNT-90XL Technical Specifications

Measuring Functions

Frequency A, B, C

Range:

Input A, B: 0.002 Hz to 300 MHz
Input C: 300 MHz to 27, 40, 46 or 60 GHz
Resolution: 12 digits in 1s measuring time
Acquisition C: Auto or Manual
Acquisition time: 25 ms in Auto (typ.)

Aux. Parameters:

Input A, B: Vmax, Vmin, Vp-p
Input C: Power C in dBm or W

Frequency burst A, B, C

Range:

Input A, B: 0.001 Hz to 300 MHz
Input C: 300 MHz to 27, 40, 46 or 60 GHz
Acquisition C: Manual
Minimum Burst Duration:
Down to 40 ns

Minimum Pulses in Burst:

Input A or B: 3 (6 above 160 MHz)
Input C: 3 x prescaler factor
PRF Range: 0.5 Hz to 1 MHz
Start Delay: 10 ns to 2 sec., 10 ns resolution

Aux. Parameter: PRF

Period A, B (single or average), C (average)

Mode: Single, Average

Range:

Input A, B: 3.3 ns to 1000s
Input C: 3.3 ns down to 37, 25, 22 or 17 ps
Resolution: 100 ps (single); 12 digits/s (average)
Acquisition C: Auto or Manual (within ± 40 MHz)
Acquisition time: 25 ms in Auto (typ.)
Aux. Parameters: See Freq. A, B, or C measurements

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

Range: (10^{-9}) to 10^{11}

Input Frequency:

Input A, B: 0.1 Hz to 300 MHz
Input C: 300 MHz to 27, 40, 46 or 60 GHz
Aux Parameters: Freq 1, Freq 2

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

Range:

Normal Calculation: 0 ns to 10^{+6} sec.
Smart Calculation: -10^6 sec. to 10^{+6} sec.
Resolution: 100 ps
Min. Pulse Width: 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 10^6 sec.

Min. Pulse Width: 2.3 ns

Aux. Parameters: Vmax, Vmin, Vp-p

Rise and Fall Time A, B

Range: 1.5 ns to 10^6 sec.

Trigger Levels: 10% and 90% of signal amplitude
Min. Pulse Width: 1.6 ns

Aux. Parameters: Slew rate, Vmax, Vmin

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 B, B relative A

Range: -180° to $+360^\circ$

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), Va/Vb (in dB)

Vmax, Vmin, Vp-p A, B

Range: -50V to +50V, -5V to +5V

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: 3 mV

Uncertainty (5V range, typical):

DC, 1Hz to 1kHz: 1% +15 mV
1 kHz to 20 MHz: 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

Raw time stamp data together with pulse counts on inputs A, B accessible via GPIB or USB only.

Max Sample Speed: See GPIB specifications

Max Frequency: 160 MHz

Timestamp Resolution: 100 ps

Power C

Range:

Power: -35 dBm to +10 dBm
Frequency: 300 MHz to 27, 40, 46 or 60 GHz
Display units: dBm (default) or W
Resolution: 0.01 dBm @100ms measuring time
Accuracy (typ.): <1 dBm to 27 GHz;
<2 dBm to 40 GHz;
<3 dBm to 60 GHz

Acquisition: Auto or Manual (within ± 40 MHz)

Acquisition time: 20 to 30 ms in Auto (typ.)

Aux. Parameters: Frequency C

Input and Output Specifications

Inputs A and B

Frequency Range:

DC-Coupled: DC to 300 MHz
AC-Coupled: 10 Hz to 300 MHz
Impedance: 1 M Ω // 20 pF or 50 Ω (VSWR $\leq 2:1$)
Trigger Slope: Positive or negative
Max. Channel Timing Difference: 500 ps
Sensitivity: 15mVrms (DC to 200MHz)
25mVrms (200 to 300MHz)

Attenuation: x1, x10

Dynamic Range (x1): 30 mV p-p to 10V p-p within $\pm 5V$ window

Trigger Level: Read-Out on display

Resolution: 3 mV

Uncertainty (x1): $\pm(15$ mV + 1% of trigger level)

AUTO Trigger Level: Trigger level is automatically set to 50% point of input signal (10% and 90% for Rise/Fall Time)

AUTO Hysteresis:

Time: Min hysteresis window (hysteresis compensation)

Frequency: One third of input signal amplitude

Analog LP Filter: Nominal 100 kHz, RC-type.

Digital LP Filter: 1 Hz to 50 MHz cut-off frequency

Impedance: 1 M Ω // 20 pF or 50 Ω (VSWR $\leq 2:1$)

Max Voltage Without Damage:

1 M Ω : 350V (DC + AC pk) to 440 Hz, falling to 12Vrms (x1) at 1 MHz

50 Ω : 12Vrms

Connector: BNC

Input C

Freq. Range: 0.3 to 27, 40, 46, 60 GHz depending on model

Operating input voltage range :

0.3 to 18 GHz: -33 to +13 dBm
18 to 20 GHz: -29 to +13 dBm
20 to 27 GHz: -27 to +13 dBm
27 to 40 GHz: -23 to +13 dBm

40 to 46 GHz: -17 to +13 dBm

46 to 60 GHz: -15 to +10 dBm

Impedance: 50 Ω nominal, AC coupled

VSWR:

0.3 to 27 GHz: <2.0:1 (typ.)

27 to 46 GHz: <2.5:1 (typ.)

46 to 60 GHz: <3.0:1 (typ.)

FM tolerance:

Manual acq.: 50 MHz p-p; freq C >3.5 GHz
30 MHz p-p; freq C <3.5 GHz

Auto acq.: 20 MHz p-p; for any freq C and modulation frequency > 0.1 MHz

AM tolerance: Any modulation index (minimum signal must be within sensitivity range)

Automatic Amplitude Discrimination:

10 dB separation between 2 signals within 30 MHz, 20 dB otherwise

Max Voltage Without Damage:

+27dBm (27, 40, 46 GHz models)
+25dBm (60 GHz model)

Overload indication:

ON when input C power >+10dBm

Connector:

27 GHz: SMA

40 and 46 GHz: 2.92 mm sparkplug female

60 GHz: 2.4 mm sparkplug female (all connectors are field replaceable)

Rear Panel Inputs and Outputs

Reference Input: 1, 5, or 10 MHz; 0.1 to 5Vrms sine; impedance ≥ 1 k Ω

Reference Output: 10 MHz; >1 Vrms sine into 50 Ω

Arming Input: Arming of all measuring functions

Impedance: Approx. 1 k Ω

Freq. Range: DC to 80 MHz

Connectors: SMA female for rear input C
BNC for all other inputs/outputs

Auxiliary Functions

Trigger Hold-Off

Time Delay Range: 20 ns to 2 sec., 10 ns resolution

External Start and Stop Arming

Arming can be used to synchronize the frequency and power measurements with the start of a burst signal. Minimum burst length must exceed 100 μ s.

Modes: Start and Stop Arming

Input Channels: A, B or E (Ext. Arming input)

Max Rep. Rate for Arming Signal:

Channel A,B: 160 MHz

Channel E: 80 MHz

Start Time Delay Range:

20 ns to 2 sec., 10 ns resolution

Statistics

Functions: Maximum, Minimum, Mean, Δ max-Min, Standard Deviation and Allan Deviation

Display: Numeric, histograms or trend plots

Sample Size: 2 to 2 x 10⁹ samples

Limit Qualifier: OFF or Capture values above/below/inside or outside limits

Measurement Pacing:

Pacing Time Range: 4 μ s to 500 sec.

Mathematics

Functions: (K*X+L)/M, (K/X+L)/M or X/M-1. X is current reading and K, L and M are constants; set via keyboard or as frozen reference value (X₀)

Other Functions

Measuring Time: 20 ns to 1000s 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
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/re-called from internal non-volatile memory.
 10 can be user protected.
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 199953131A compatibility mode

Interface Functions:
 SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2

Max. Measurement Rate

GPIB: 5k readings/s (block mode)
 500 readings/s (individual GET trig'ed)

To Internal Memory:
 250k readings/s

Internal Memory Size:
 CNT-90XL Up to 750k readings.

USB Interface

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

Calibration

Mode: Closed case, menu controlled
Cal. 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
Storage Temp: -40°C to +71°C
Humidity: 5%-95% (10°C-30°C)
 5%-75% (30°C-40°C)
 5%-45% (40°C-50°C)
Altitude: 4 600m
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, pollution degree 2, meas cat I, CSA C22.2 No 1010-1, CE

EMC: EN 61326 (1997); A1 (1998), increased test levels according to EN 50082-2, Group 1, Class B, CE

Mains power: 90 to 265V rms, 45 to 440 Hz, <40W

Dimensions and Weight

Width x Height x Depth:
 210x90x395 mm (8.25x3.6x15.6 in)
Weight: Net 2.7 kg (5.8 lb),
 Shipping app. 3.5 kg (app. 7.5 lb)

Ordering Information

Basic Models

CNT-90XL-27G 27 GHz Microwave Counter/Analyzer
CNT-90XL-40G 40 GHz Microwave Counter/Analyzer
CNT-90XL-46G 46 GHz Microwave Counter/Analyzer
CNT-90XL-60G 60 GHz Microwave Counter/Analyzer

Time Base: Option 19/90, Medium Stability Time Base; 0.06 ppm/month as standard

Included with Instrument: 18 months product warranty, line cord, user documentation on CD, and Certificate of Calibration

Time Base Options

Option 30/90 Very High Stability Oven Time Base; 0.01 ppm/month
Option 40/90 Ultra High Stability Oven Time Base; 0.003 ppm/month

Option 23/90 Battery Unit

Battery Type: Lilon, 90Wh

External DC input:

10 to 18V dc; max 6 A

Operating temp. range:

-20 to 40 degrees C

Storage: -20 to +60 degrees C

1 month

-20 to +45 degrees C

3 months

-20 to +20 degrees C

1 year

Battery operating time (at 25 degrees C):

ON: >4.5 hours

Stand-by: >24 hours

Charging: Automatically when AC or ext DC is connected

Battery status indicator:

On-screen with Low battery warning

Weight: 2.3 kgs

Optional Accessories

Option 22/90 Rack-Mount Kit

Option 27 Carrying Case - soft
Option 27H Heavy-duty Hard Transport Case
Option 29/90 TimeView Modulation domain Analysis SW for CNT-90XL
Option 90/01 Calibration Certificate with Protocol; Standard oscillator
Option 90/06 Cal. Cert.; Oven oscillator
Option 90/00 Cal. Cert. Frequency ageing/week
Option 95/05 3 years extended warranty
Option 95/05 5 years extended warranty
OM-90 Users Manual English (printed)
PM-90 Programmers Manual English (printed)
SM-90 Service Manual English
GS-90-EN Getting Started English
GS-90-FR Getting Started French
GS-90-DE Getting Started German

Time Base Options - CNT-90XL

Option model:	Standard	30/90	40/90
Time base type:	OCXO	OCXO	OCXO
Uncertainty due to:			
-Ageing. per 24h	<5x10 ⁻⁹ (1)	<5x10 ⁻¹⁰ (1)	<3x10 ⁻¹⁰ (1)
per month	<6x10 ⁻⁸	<1x10 ⁻⁸	<3x10 ⁻⁹
per year	<2x10 ⁻⁷	<5x10 ⁻⁸	<1.5x10 ⁻⁸
-Temperature variation: 0°C-50°C	<5x10 ⁻⁸	<5x10 ⁻⁹	<2.5x10 ⁻⁹
20°C-26°C (typ. values)	<2x10 ⁻⁸	<1x10 ⁻⁹	<4x10 ⁻¹⁰
Short term stability: τ = 1s	<1x10 ⁻¹⁰	<1x10 ⁻¹¹	<5x10 ⁻¹²
(root Allan Variance) τ = 10s	<1x10 ⁻¹⁰	<1x10 ⁻¹¹	<5x10 ⁻¹²
Power-on stability			
-Deviation vs final value after 24h on time, after a warm-up time of:			
30 min	<1x10 ⁻⁷	<1x10 ⁻⁸	<5x10 ⁻⁹
10 min			10 min
Typical total uncertainty, for operating temperature 20°C to 26°C, at 2σ (95%) confidence interval:			
- 1 year after calibration	<2.4x10 ⁻⁷	<0.6x10 ⁻⁷	<1.8x10 ⁻⁸
- 2 years after calibration	<4.6x10 ⁻⁷	<1.2x10 ⁻⁷	<3.5x10 ⁻⁸

1) After 1 month of continuous operation

Specifications subject to change without prior 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 8 598 510 00 Fax:+46 8 598 510 40

www.pendulum-instruments.com

- Experts in time & frequency calibration, measurement and analysis

Pendulum Instruments is a company of the Orolia Group