CNT-90XL
Microwave Counter/Analyzer

pendulum

- **Frequency range to 27, 40, 46 or 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**
- **Unique ease-of-use: Multiparameter display & graphical presentation of results**
- **USB & GPIB as standard**
- **2 instruments in one - Microwave Counter/Analyzer & 400 MHz general-purpose timer/counter**

The Pendulum CNT-90XL Microwave Counter/Analyzer is 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/Analyzers has set new milestones for microwave frequency counting and outperforms any microwave counter on the market regarding resolution, speed and acquistion 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.

In addition to being a Microwave Counter/Analyzer, the multi-functional CNT-90XL also serves as a 400 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 is 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 90 Wh 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 Vmax/Vmin/Vp-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. Doppler frequency shift in speed radar sensors, 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.
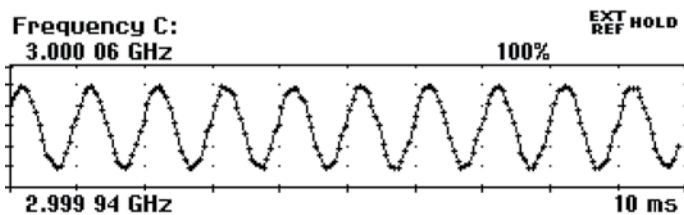
Figure 1: 1kHz FM with 12 ppm modulation depth
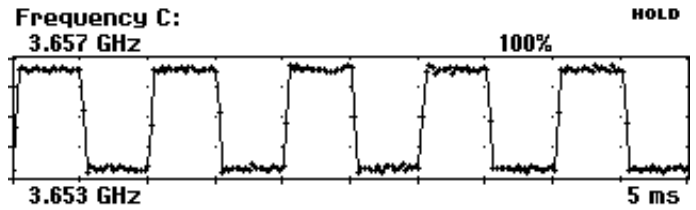

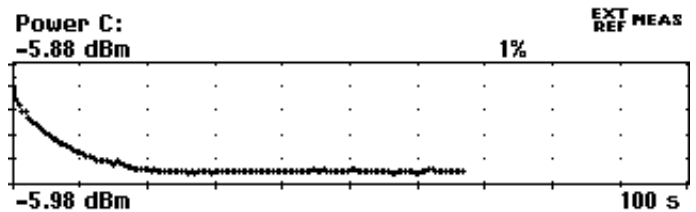**Figure 2:** Pulse modulated frequency

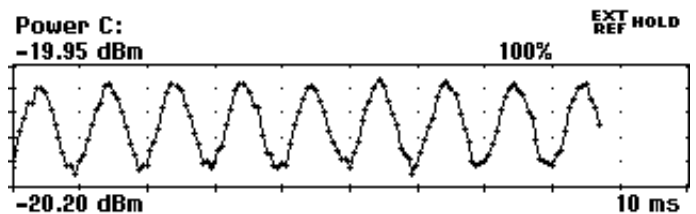**Figure 3:** Generator start-up power settling

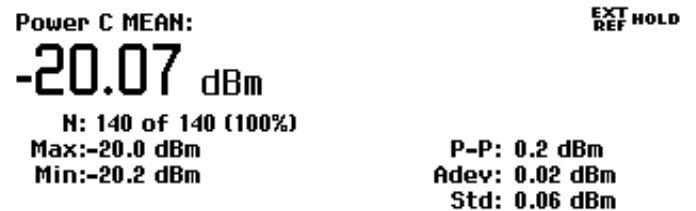**Figure 4:** Very small AM on carrier is visualized

Figure 5: Numeric statistics screen of the previous AM signal
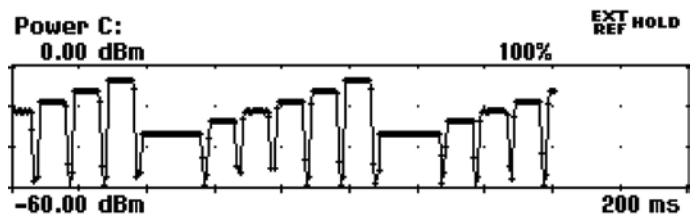

Figure 6: Power step from generator (-30 to -5dBm in 5dBm steps)
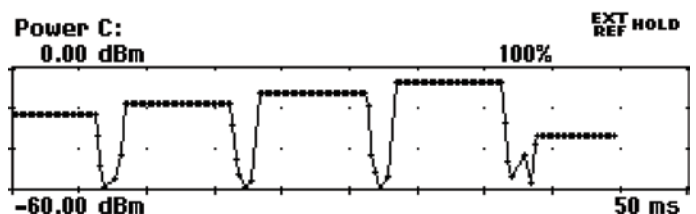NOTE: output is turned off shortly betw. power steps

Figure 7: Power step (close up)

Measuring Functions

Frequency A, B, C
Range:

Input A, B: 0.002 Hz to 400 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 400 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 1MHz

Start Delay: 10 ns to 2sec., 10 ns resolution

Aux. Parameter: PRF

Period A, B (single or average), C (average)
Mode: Single, Average

Range:

Input A, B: 2.5 ns to 1000 s

Input C: 3.3 ns down to 37, 25, 22 or 17 ps

Resolution: 100 ps (single); 12 digits/s (avg)

Acquisition C: Auto or Manual

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: 0ns 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 Vp-p

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°

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: -50 V to +50 V, -5V to +5V
Range is limited by the specification for max input voltage without damage (see input A, B)

Freq. Range: DC, 1Hz to 300 MHz

Mode: Vmax, Vmin, Vp-p

Resolution: 2.5 mV

Uncertainty (5V range, typical):

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

1kHz 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, C
Raw time stamp data together with pulse counts on inputs A, B or C, accessible via GPIB or USB only.

Max Sample Speed: See GPIB specifications

Max Frequency: 160 MHz

Timestamp Resolution: 70 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 @100 ms measuring time

Accuracy (typ.): <1dBm to 27 GHz; <2dBm to 40 GHz; <3dBm 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 400 MHz

AC-Coupled: 10 Hz to 400 MHz

Impedance:
1MΩ // 20 pF or 50 Ω (VSWR ≤2:1)

Trigger Slope: Positive or negative

Max. Channel Timing Difference: 500 ps

Sensitivity:

DC-200 MHz: 15 mVrms

200-300 MHz: 25 mVrms

300-400 MHz: 100 mVrms

Attenuation: x1, x10

Dynamic Range (x1):
30 mVp-p to 10 Vp-p within ±5V window

Trigger Level: Read-Out on display

Resolution: 3mV

Uncertainty (x1): ±(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:

Freq. range: 1Hz to 300 MHz

Time: Min hysteresis window (hysteresis compensation)

Frequency: One third of input signal amplitude

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

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

Max Voltage Without Damage:

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

50 Ω: 12 Vrms

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

Overload indication:
ON when input C power >+10 dBm

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 ≥1kΩ

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

Arming Input:
Arming of all measuring functions

Impedance: Approx. 1kΩ

Freq. Range: DC to 80 MHz

Connectors: BNC

Auxiliary Functions

Trigger Hold-Off
Time Delay Range:
20 ns to 2sec., 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 μs.

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 2sec., 10 ns resolution

Statistics
Functions: Maximum, Minimum, Mean, ∆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: 4µs 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 (X_0)

Other Functions
Measuring Time: 20 ns to 1000 s 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/recalled from internal non-volatile memory. 10 can be user protected.
Result Storage: Up to 8 measurements of max 32k samples can be stored in local memory for later downloading.
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 1999 or 53131A 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: 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 to 30°C)
5%-75% (30°C to 40°C)
5%-45% (40°C to 50°C)
Altitude: 4 600 m
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 265 Vrms, 45 to 440 Hz, <40 W, <60 W if battery option

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: Medium Stability Time Base; 0.06 ppm/month as standard

Included with Instrument: 3 years 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: LiIon, 90 Wh
External DC input: 10 to 18 Vdc; max 6A
Operating temp. range: 0°C to 40°C
Storage: -20°C to +60°C, 1 month
-20°C to +45°C, 3 months
-20°C to +20°C, 1 year
Battery operating time (at 25°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 aging/week
Option 95/05: Extended warranty from 3 to 5 years
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

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

[1]After 1 month of continuous operation