spectracom

TimeView™

Modulation Domain Analysis

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pendulum

- **View dynamic frequency changes over time**
- **View residual FM and AM on up to 60 GHz carriers (CNT-90XL)**
- **Follow frequency changes every 4µs in real time (every 10 ns with repetitive sampling)**
- **Analyze VCO settling, PLL responses and more**
- **Analyze frequency hopping, chirp radar, frequency droop to 20 GHz**
- **Powerful analysis: Statistics (histogram), FFT, smoothing, ADEV and MADEV vs τ**
- **Zero dead-time measurements, detect phase jumps**

Background – What's a Modulation Domain Analyzer?

An MDA (Modulation Domain Analyzer) could be thought of as a frequency sampler analogous to a digital oscilloscope that is a voltage sampler. An MDA displays frequency vs time, just like an oscilloscope displays voltage vs time. You could think of a Modulation Domain Analyzer as a "Frequencyscope". For example for an FM signal, the MDA would show the modulation frequency (f vs t), whereas an oscilloscope would show the carrier frequency (V vs t).

Dynamic Signal Analysis of Amplitude and Frequency

Amplitude and frequency contents are the two most important signal properties of any signal. Oscilloscopes are used to analyze changes in amplitude but not changes in frequencies. The traditional tool for analyzing the frequency contents of a signal is the Spectrum Analyzer. This can find static frequency components or give an averaged view of dynamic (changing) frequencies. To view also changing frequencies a third type of tool is needed; the Modulation Domain Analyzer (MDA).

To analyze all dynamic properties of a signal, three basic tools are needed, see figure 1:

- Oscilloscope (Voltage vs. time - the time domain)
- Spectrum or FFT-analyzer (Voltage vs. frequency - the frequency domain)
- Modulation Domain Analyzer (Frequency vs. time - the modulation domain)

The modulation domain is the "missing domain" that complements the time and frequency domains. TimeView™ is a piece of SW that works with the Pendulum Timer/Counter/Analyzers CNT-90, CNT-91 and CNT-90XL (via USB or GPIB) and converts the Timer/Counter/ Analyzer into a Modulation Domain Analyzer.

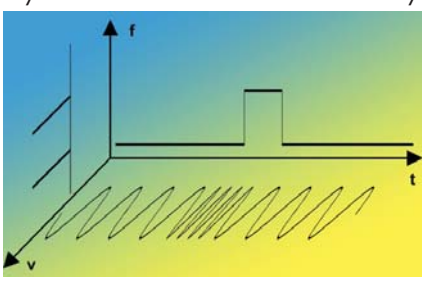

Figure 1: The modulation domain (f vs. t) complements the time (V vs. t) and the frequency (V vs. f) domains.

TimeView™ - an MDA Solution

The Pendulum Modulation Domain Analyzer TimeView consists of two parts:

- Fast sampling front-end, CNT-90, CNT-90XL and CNT-91
- Standard PC with USB or GPIB-interface running TimeView

The signal to be characterized is connected to the front-end input (CNT-90-family Timer/Counter/Analyzer), which samples the frequency (or time, or phase, or voltage if selected). The data is transferred to the PC and post-processed. All setting controls are made from the PC. Graphs can be printed on the PC-printer and settings and results are stored as ASCII-files, that are easily imported in various programs, e.g. MS-Excel for further analysis.

USA | 1565 Jefferson Road, Suite 460 | Rochester, NY 14623 | +1.585.321.5800 | sales@spectracomcorp.com
FRANCE | 3 Avenue du Canada | 91974 Les Ulis, Cedex | +33 (0)1 64 53 39 80 | sales@spectracom.fr
UK | 6A Beechwood | Chineham Park | Basingstoke, Hants, RG24 8WA | +44 (0)1256 303630 | info@spectracom.co.uk

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Modulation Domain Analysis Examples

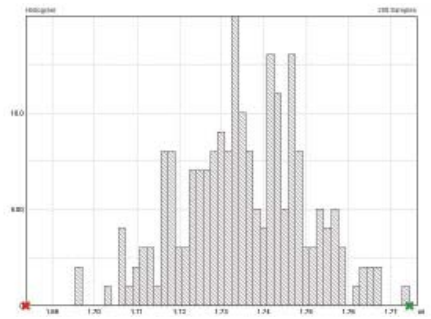

Figure 2: Jitter (rms and peak-peak) and noise is quantified in distribution histograms.

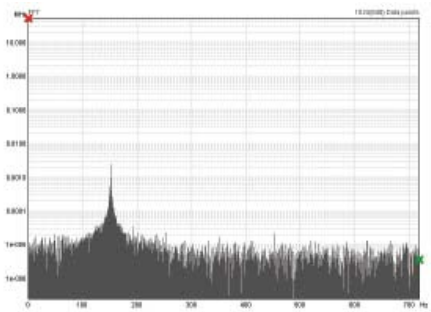

Figure 3: The FFT-diagram reveals the modulation frequency, whether intended or unwanted.

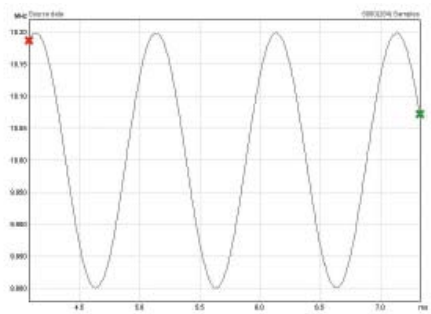

Figure 4: 10 MHz with 1kHz FM –Modulation domain view.

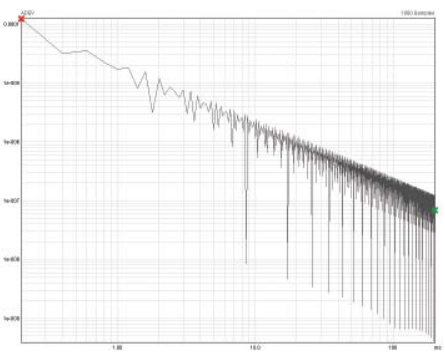

Figure 5: ADEV vs τ (Zero-dead-time measurement) reveals poor performance of a synthezised function generator.

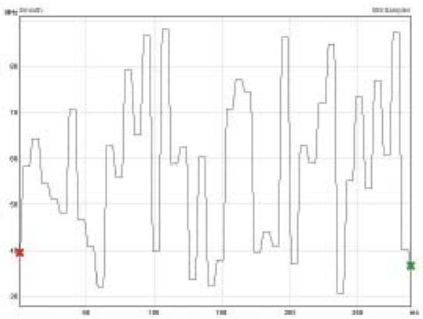

Figure 6: Frequency hopping in high quality military troop radio.

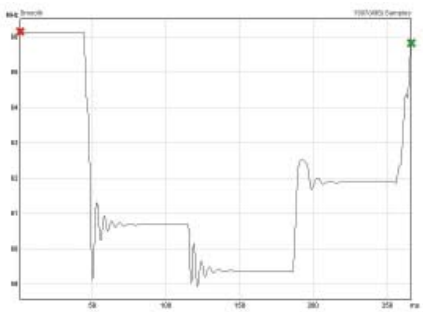

Figure 7: Frequency hopping in low cost commercial radio channel scanner.

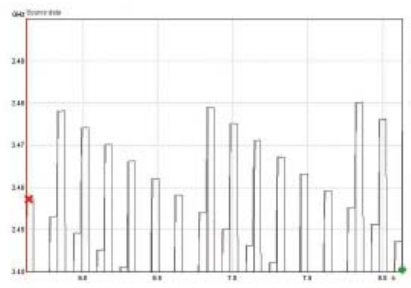

Figure 8: Frequency hopping in 2.4 GHz WLAN (FHSS).

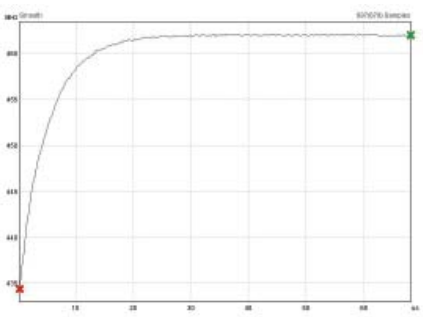

Figure 9: Frequency settling of VCO after step change of input voltage.

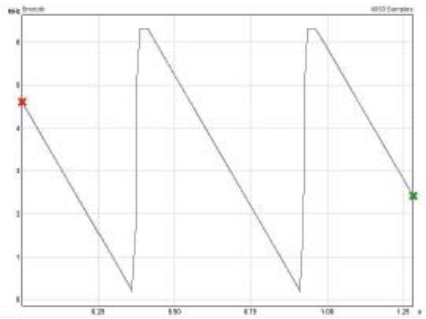

Figure 10: Frequency sweep of an analog sweep generator.

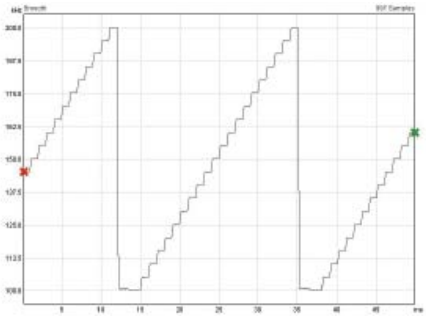

Figure 11: Frequency sweep of a digital low-cost sweep generator.

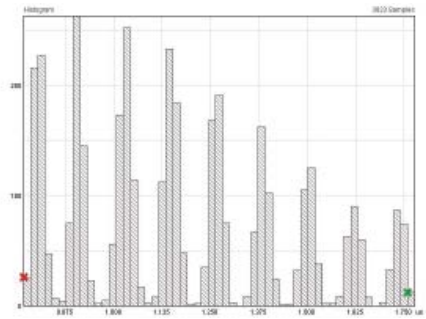

Figure 12: Jitter of optical CD-pulses T3 through T11 in CD player.

Cross-reference table CNT-90/90XL, CNT-91

Model:	CNT-91	CNT-90/90XL
Interface	USB/GPIB	USB/GPIB
Speed- free run	250 kSa/s	250 kSa/s
Speed – repetitive sampling	100 MSa/s	100 MSa/s
Resolution time stamps	50 ps rms	100 ps rms
Memory depth	1.9M Samples	375k Samples
Input frequency range max	20 GHz	20 GHz (CNT-90) 60 GHz (90XL)
Max frequency p-p deviation	20 GHz	20 GHz (CNT-90) 50 MHz (90XL)
Cursor readouts	yes	yes
Histogram	yes	yes
FFT-analysis	yes	yes
Smoothing	yes	yes
Waveform capture	yes	yes

HW and SW Requirements

Measurement HW
Pendulum CNT-90, CNT-90XL or CNT-91

Operating System
MS Windows 2000, XP or Vista

PC interfaces
USB (CNT-90-family only)
GPIB (National Instruments)
GPIB (Agilent)
GPIB (Keithley/CEC)

Measurement & Speed

Measurement Functions

	CNT-91	CNT-90 CNT-90XL
Frequency	X	X
Period	X	X
Frequency and Period Back-to-Back	X	
Time interval	X	X
Phase	X	X
Duty factor	X	X
Frequency ratio	X	X
Voltage max/min/p-p	X	X
Pulse width	X	X
Rise/fall time	X	X
Time stamping	X	X
Totalize	X	
TIE	X	

Speed
Sample speed to internal memory:
Up to 250 000 samples/s

Result memory
CNT-91: 1.9M results (result plus timestamps)
CNT-90/90XL: 375k results (result plus timestamps)

Timestamp resolution
CNT-91: 35 ps rms
CNT-90: 70 ps rms

Capture Modes

Free-running measurements
Measurements are captured as quickly as possible and stored in internal memory
Zero dead-time:
Frequency and Period BtB, TIE
4µs dead-time:
All other functions, except voltage

Repetitive Sampling
Measurements are repeated with a delayed start that is incremented for each new measurement. The results are combined into a resulting graph (similar to repetitive sampling DSO:s). This capture mode requires a repetitive signal
CNT-90-family: down to 10ns delay between measurements (effective 100 MSa/s)

Waveform Measurements
This capture mode requires a repetitive signal
CNT-90/90XL: Voltage resolution is 2.5 mV
CNT-91: Voltage resolution is 1.0 mV

Zero-Dead-Time Timestamping

Frequency range
Input A, B: DC to 250 kHz (capture and timestamp ALL trigger events);
DC to 160 MHz (count all trigger events, timestamp events with set pacing interval)
Input C: Full input C freq. range (see specification for actual input used)
Pacing: 4µs to 500 s

Display Modes
Modulation domain (frequency vs time);
Any measured parameter vs time;
Continuous Timestamp (trigger events vs time);
Time domain - Waveform (voltage vs time for repetitive signals)

Analysis Modes
Statistical distribution (histogram)

Statistical numerical analysis
- max value
- min value
- mean value
- standard deviation
- Allan deviation

Dual cursor readout in graphs with calculation of dx, dy and 1/dx

FFT analysis (detect modulation frequencies)

Window functions: Hamming, Hanning, rectangular

Smoothing (digital LP-filter via a moving average of data points)

Timestamp data analysis
- ADEV vs τ
- MADEV vs τ

Ordering Information
Option 29/90: TimeView for CNT-90-family. Software for PC. One license per user. The program will be delivered on a CD-ROM.

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