TimeView

Modulation Domain Analysis

TimeView for CNT-90 & CNT-81

Ultimate Modulation Domain Analysis

- View dynamic frequency changes over time
- View up to 50 MHz FM on up to 20 GHz carriers
- Follow frequency changes every 4 µs in real time (every 10 ns with repetitive sampling)
- Analyze VCO settling, PLL responses and more
- Analyze frequency hopping, chirp radar, frequency droop up to 20 GHz
- Powerful analysis: Statistical distribution (histogram), FFT analysis, smoothing
- Zero dead-time measurements. Measure period back-to-back, detect phase jumps
- View Allan Dev and Modified Allan Dev vs τ

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 fig. 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)

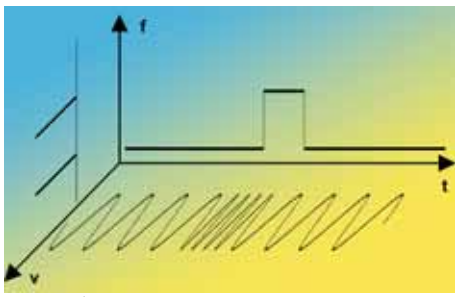

Figure 1.

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 (via USB or GPIB) and CNT-81 (via GPIB) and converts the Timer/Counter/Analyzer into a Modulation Domain Analyzer.

TimeView™ - an MDA solution

The Modulation Domain Analyzer TimeView from Pendulum consists of two parts:
- Fast sampling front-end (CNT-90 or CNT-81).
- Standard PC with USB or GPIB-interface running TimeView.

The signal to be characterized is connected to the front-end input (CNT-90 or CNT-81 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.

Cross-reference table CNT-90 vs CNT-81

Model:	CNT-90	CNT-81
Interface	USB/GPIB	GPIB
Speed- free run	250 kSa/s	8 kSa/s
Speed – repetitive sampling	100 MSa/s	10 MSa/s
Resolution time stamps	100 ps rms	125 ns p-p
Memory depth	375 k Samples	6k Samples
Cursor readouts	yes	yes
Histogram	yes	yes
FFT-analysis	yes	yes
Smoothing	yes	yes
Waveform capture	yes	yes

Modulation Domain Analysis Examples

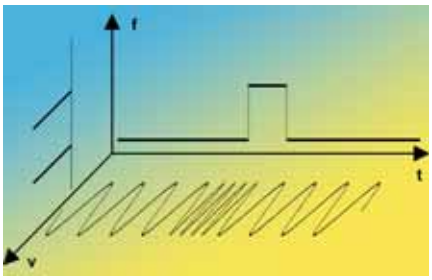

Figure 1: The modulation domain (f vs. t) complements the time (V vs. t) and the frequency (V vs. f) domains.

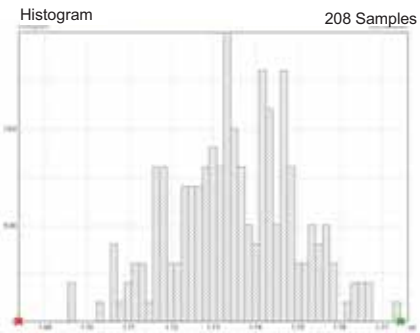

Figure 2: Jitter (rms and peak-peak) and noise is quantified in distribution histograms.

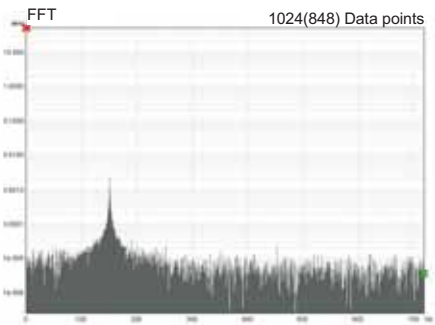

Figure 3: The FFT-diagram reveals the modulation frequency, whether intended or unwanted.

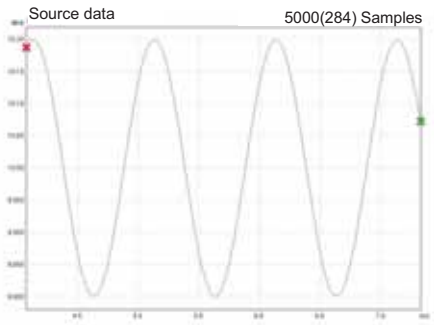

Figure 4: 10 MHz with 1 kHz FM – Modulation domain view.

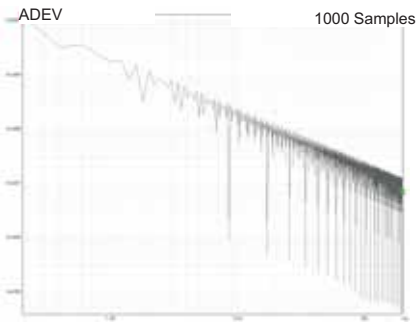

Figure 5: ADEV vs τ (Zero-dead-time measurement) reveals poor performance of a synthezised function genera-

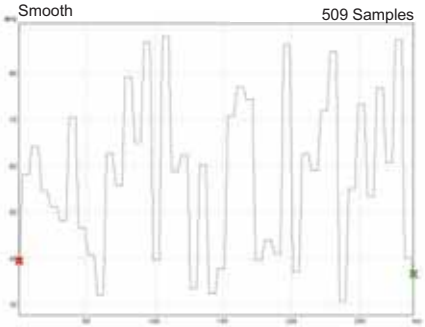

Figure 6: Frequency hopping in high quality military troop radio.

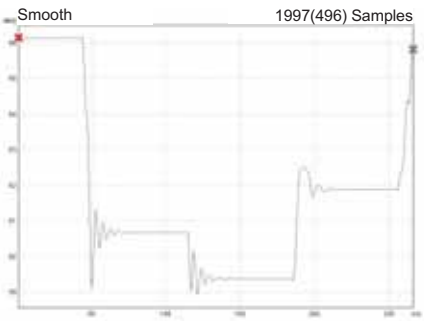

Figure 7: Frequency hopping in low cost commercial radio channel scanner.

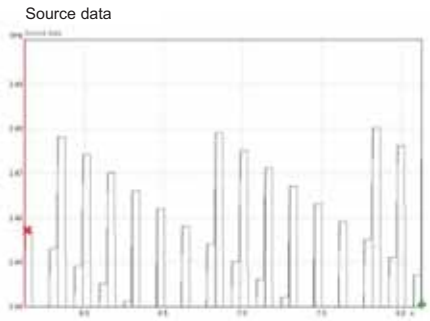

Figure 8: Frequency hopping in 2.4 GHz WLAN (FHSS).

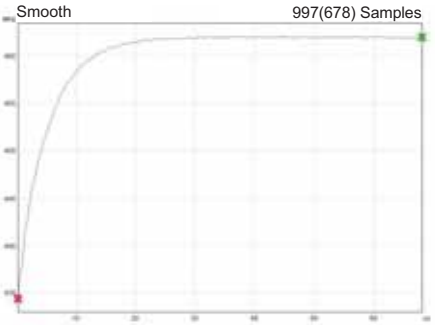

Figure 9: Frequency settling of VCO after step change of input voltage.

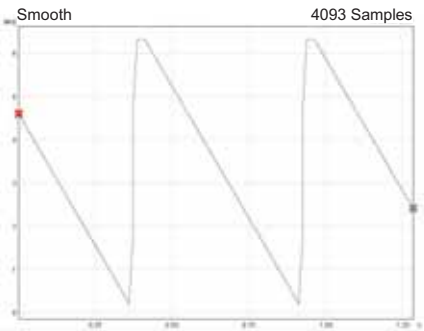

Figure 10: Frequency sweep of an analog sweep generator.

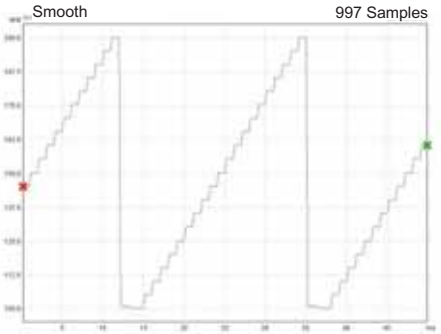

Figure 11: Frequency sweep of a digital low-cost sweep generator.

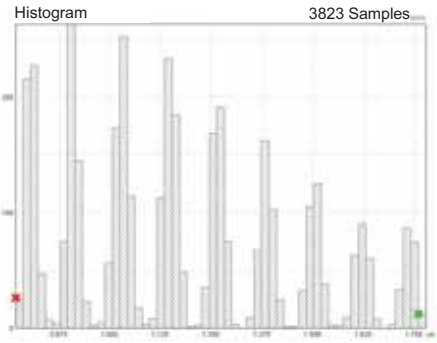

Figure 12: Jitter of optical CD-pulses T3 through T11 in CD player.

Time View Specifications

HW and SW Requirements

Measurement HW:

Pendulum CNT-81 or CNT-90

Operating System:

MS Windows NT, 2000 or XP

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

Measurement & Speed

Measurement Functions

	CNT-90	CNT-81
Frequency	X	X
Period	X	X
Time interval	X	X
Phase	X	X
Duty factor	X	X
Frequency ratio	X	X
Voltage max/min/p-p	X	
Pulse width	X	X
Rise/fall time	X	X
Time stamping	X	
Totalize		X

Speed

Sample speed to internal memory

CNT-90 up to 250 000 samples/s
CNT-81 up to 8 000 samples/s

Transfer speed to PC

CNT-90 10 000 samples/s
CNT-81 1 000 samples/s

Result memory

CNT-90 375k results (result plus timestamps)
CNT-81 6k results

Timestamp resolution

CNT-90 70 ps rms
CNT-81 125 ns p-p

Capture Modes

Free-running measurements

Measurements are captured as quickly as possible and stored in internal memory

CNT-90 <4 µs dead-time between measurements
CNT-81 <125 µs dead-time between measurements

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 down to 10ns delay between measurements (effective 100 MSa/s)
CNT-81 down to 100ns delay between measurements (effective 10 MSa/s)

Waveform Measurements

This capture mode requires a repetitive signal

CNT-90 Voltage resolution is 2.5 mV
CNT-81 Voltage resolution is 1.25 mV

Zero-dead-time Timestamping Capture (*CNT-90 only*)

Freq. range: DC to 250 kHz (capture and timestamp ALL trigger events)
DC to 160 MHz (count all trigger events, timestamp with set pacing interval)
Pacing: 4 µs to 500s

Display Modes

Modulation domain (frequency vs time)
Any measured parameter 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 (*CNT-90 only*)

- ADEV vs τ
- MADEV vs τ
- Period back-to-back (DC to 250 kHz)

Ordering Information

Option 29	TimeView for CNT-81. Software for PC. One license per user. The program will be delivered on a CD-ROM.
Option 29/90	TimeView for CNT-90. Software for PC. One license per user. The program will be delivered on a CD-ROM.

Specifications subject to change without prior notice

4031 600 29101 - rev. 2 August 2006

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- Experts in time & frequency calibration, measurement and analysis