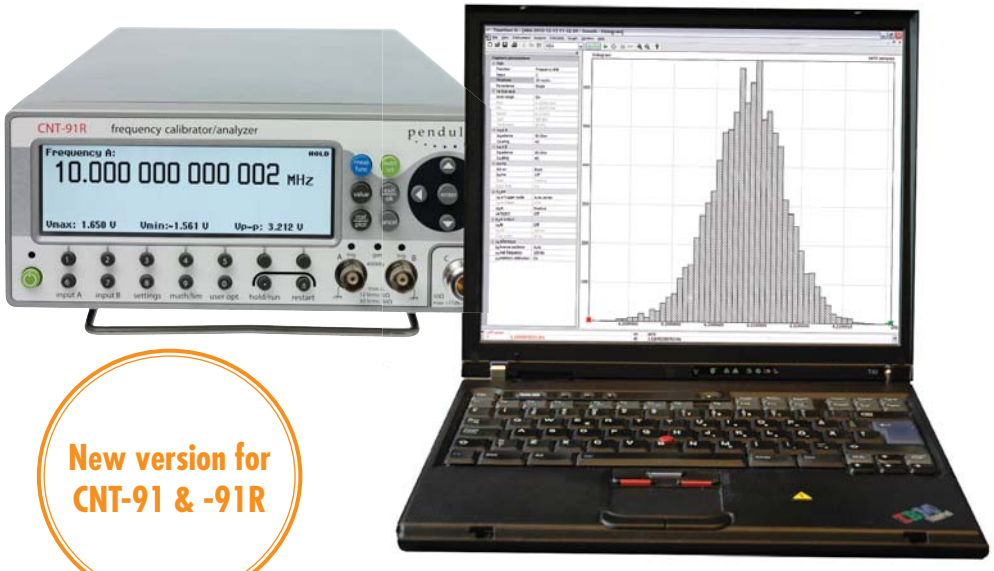
TimeView™ 3

Modulation Domain Analysis

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pendulum

- **View dynamic frequency changes over time**
- **Emulation of Agilent 53310A MDA**
- **Accurate FM analysis on carriers up to 20 GHz**
- **Sample frequency changes every 4μs in real time**
- **Analyze frequency in burst signals, hopping, chirp radar, frequency droop, etc**
- **Powerful analysis: Statistics (histogram), FFT, smoothing, ADEV and MADEV vs τ**
- **Zero dead-time measurements, detect phase jumps**



New version for CNT-91 & -91R

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™ 3 is a piece of SW that works with the Pendulum Timer/Counter/Analyzers CNT-91 and CNT-91R (via USB or GPIB) and converts the Timer/Counter/Analyzer into a Modulation Domain Analyzer.

TimeView™ - an MDA Solution

The Pendulum Modulation Domain Analyzer TimeView 3 consists of two parts:

- Fast sampling front-end CNT-91
- Standard PC with USB or GPIB-interface running TimeView 3

The signal to be characterized is connected to the front-end input (CNT-91 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.

TimeView 3 is a further refinement of the current TimeView 2 SW, with some extra functionality and a slightly different User Interface. To make use of the extra functionality, TimeView 3 requires the models CNT-91 or CNT-91R as front-ends. The TimeView 2 software can use any CNT-9x counter (CNT-90, CNT-90XL, CNT-91 or CNT-91R).

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

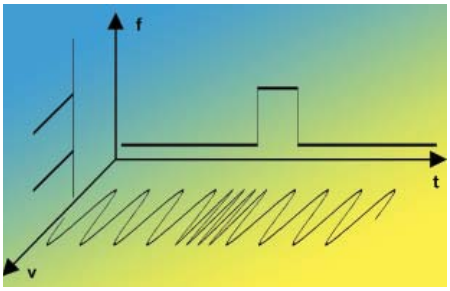


Figure 1: The modulation domain (f vs. t) complements the time (V vs. t) and the frequency (V vs. f) domains.

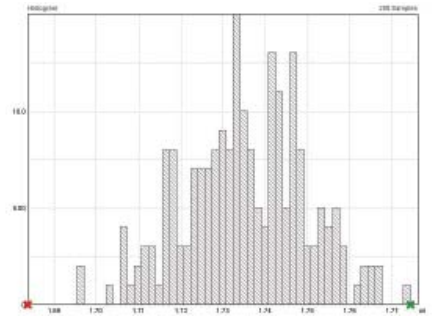


Figure 2: Jitter (rms and peak-peak) and noise is quantified in distribution histograms.

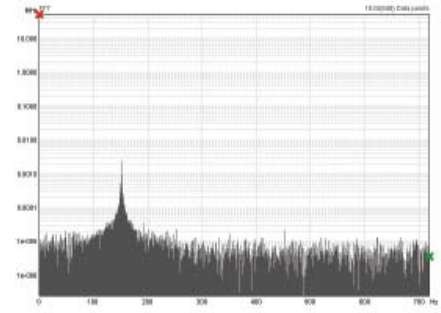


Figure 3: The FFT-diagram reveals the modulation frequency, whether intended or unwanted.

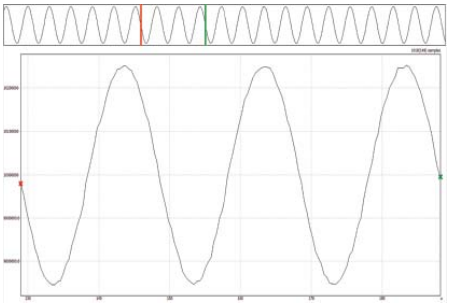


Figure 4: 10 MHz with 1kHz FM –Modulation domain view with panorama view.

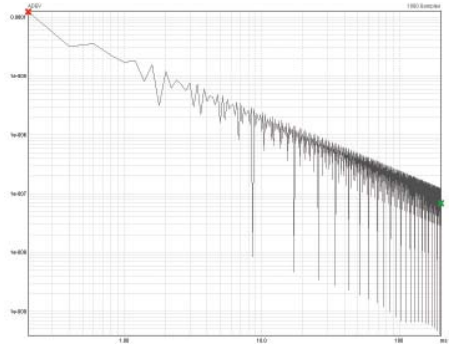


Figure 5: ADEV vs τ (Zero-dead-time measurement) reveals poor performance of a synthesized function generator.

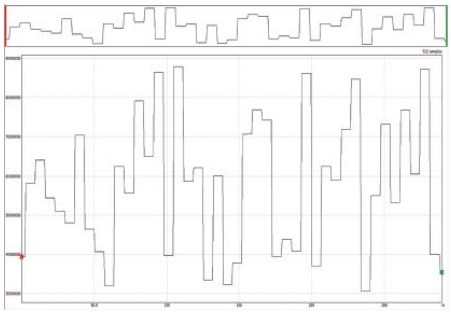


Figure 6: Frequency hopping in high quality military troop radio with panorama view.

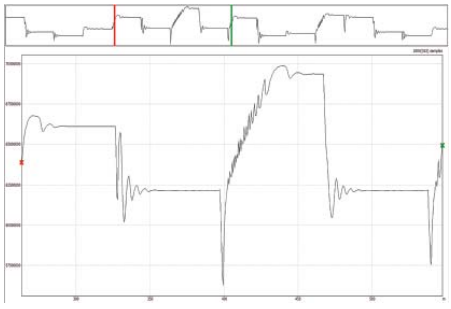


Figure 7: Frequency hopping in low cost commercial radio channel scanner with panorama view.

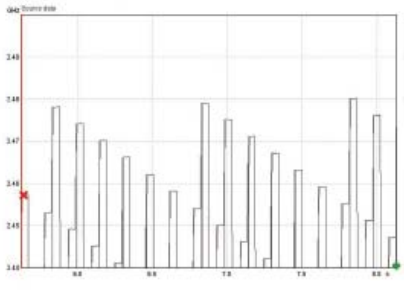


Figure 8: Frequency hopping in 2.4 GHz WLAN (FHSS).

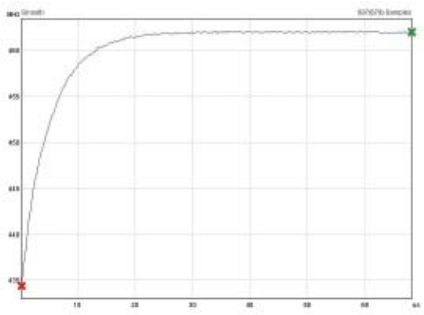


Figure 9: Frequency settling of VCO after step change of input voltage.

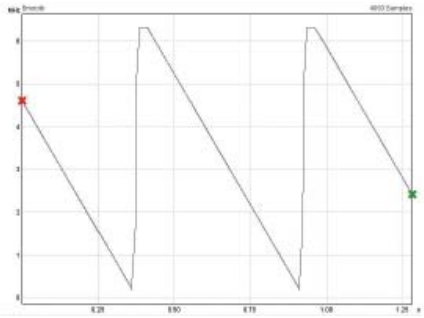


Figure 10: Frequency sweep of an analog sweep generator.

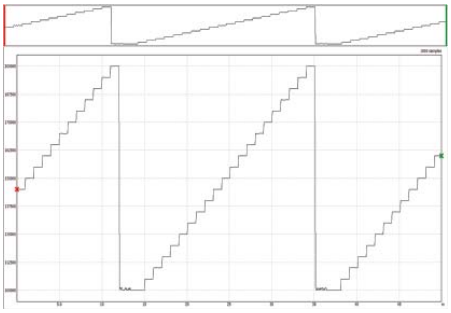


Figure 11: Frequency sweep of a digital low-cost sweep generator with panorama view.

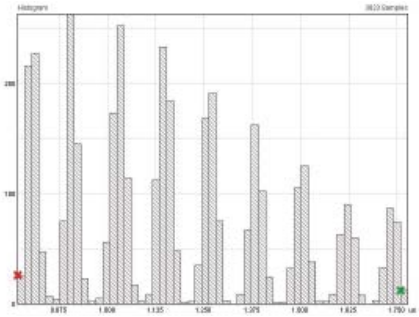


Figure 12: Jitter of optical CD-pulses T3 through T11 in CD player.

Cross-reference table TimeView 3 versus TimeView 2

Version:	TimeView 3	TimeView 2
Front-end hardware	CNT-91, CNT-91R	CNT-90, CNT-90XL, CNT-91, CNT-91R
Agilent 53310A emulation mode	yes	no
Special FM modulation calibration mode	yes	no
Burst frequency vs time view	enhanced	basic
MTIE, TDEV, MRTIE calculation	yes	no
Interface	USB/GPIB	USB/GPIB
Sampling speed- free run	250 kSa/s	250 kSa/s
Sampling speed – repetitive sampling	100 MSa/s	100 MSa/s
Resolution time stamps	35 ps rms	35 ps rms (CNT-91, CNT-91R) 70 ps rms (CNT-90, CNT-90XL)
Memory depth	1.9M Samples	375k Samples (CNT-90, CNT-90XL) 1.9M Samples (CNT-91, CNT-91R)
Input frequency range max	20 GHz	20 GHz (CNT-90, CNT-91, CNT-91R) 60 GHz (CNT-90XL)
Max frequency p-p deviation	20 GHz	20 GHz (CNT-90, CNT-91, CNT-91R) 50 MHz (CNT-90XL)
View all frequency and time related parameters vs time	yes	yes
View totalize functions	no	yes
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-91 or CNT-91R

Operating System
MS Windows 2000, XP, Vista or Windows 7

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

Measurement & Speed

Measurement Functions
Frequency (normal, BtB, burst, PRF, ratio)
Period (average, BtB, single shot)
Time interval
Phase
Duty factor
Frequency ratio
Voltage max/min/p-p, ratio
Pulse width
Rise/fall time
Slew rate
TIE

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

Result memory
1.9M results (result plus timestamps)

Timestamp resolution
35 ps rms

Capture Modes

Presentation modes summary
MDA: Emulating the behavior of 53310A, including for example value trigger and panorama view.

TIE: Short term stability and Wander meas.

Single shot: Any measurement function vs time

Repetitive sampling: Measurement function vs time – repetitive with start arming

Waveform:
Display draft signal waveform over time

Burst: Display pulsed RF signals

FM: Accurate FM modulation calibrator

MDA
Frequency Back-to-Back values are sampled and displayed in a similar way as an oscilloscope. Horizontal and Vertical axis are set via timebase and limit controls. The display trace is triggered using "value trigger", a given frequency value, just as an oscilloscope is triggered on a certain voltage level. The presentation mode is very similar to an Agilent 53310A MDA (Modulation Domain Analyzer).
Sample interval: 4µs to 500 s
Value trigger: Manual value (positive or negative slope), or auto triggered (50% between peak deviations).

TIE
TIE (or phase back-to-back values) are sampled and displayed. Various post-processing alternatives gives ADEV, MADEV for short-term stability measurements and MTIE, MRTIE, TDEV for Wander analysis
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)
Sample interval: 4µs to 500 s

Single-shot 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
Equivalent sample time: down to 10ns delay between measurements (effective 100 MSa/s)

Waveform Measurements
This capture mode requires a repetitive signal. Voltage resolution is 1.0 mV

Burst
This capture mode shows frequency vs time for pulsed RF signals

FM
This capture mode measures accurately all FM parameters
- Carrier frequency up to 20 GHz[1)]
- Modulation frequency up to 125 kHz
- Frequency deviation up to 10 GHz[1)]

[1)]*limited by measurement range*

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 dy/dx

FFT analysis (detect modulation frequencies)

Window functions: Hamming, Hanning, rectangular

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

TIE analysis: ADEV vs τ, MADEV vs τ, MTIE vs τ, MRTIE vs τ, TDEV vs τ

Ordering Information
Option 29/91: TimeView 3 for CNT-91 or CNT-91R. Software for PC. One license per user. The program will be delivered on a CD-ROM.

May 3, 2012 - 4031 600 29911 - rev. 02
Specifications subject to change or improvement without notice.
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