Oscilloscopes for PDV: Getting More out of your Scope

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Amplifiers and attenuators scale the input signals amplitude to match the input range of the Analog to Digital Converter (ADC).

The ADC samples the analog signal and converts the voltage into a digital number.
Quantization Error

4x attenuation of signal produces 4x larger quantization steps = 2 bits less resolution!

Zooms of rising edges show quantization levels
**Enhanced Resolution**

**Description**
- ERES increases vertical resolution by filtering the waveform.
- Gain up to 3 bits of resolution in ½ bit steps.

**Usage**
- Suitable for single-shot and repetitive waveforms.
- Reduces noise.
- Increases precision.

**Disadvantages**
- Effective bandwidth decreased by 50% for every ½ bit gain.
12-bit High Definition Technology – Teledyne LeCroy HDO6000

- Combination of
  - High Sample Rate 12-bit ADCs
  - High signal-to-noise input amplifiers
  - Low noise system architecture
- 16 times more resolution than traditional 8-bit scope
- Capture high frequency signals with 1GHz bandwidth
- Benefits
  - Clean, Crisp Waveforms
  - More Signal Details
  - Precise Waveform Measurements
Introducing the Teledyne LeCroy HDO8000 Oscilloscope

**Further**
- 8 analog input channels
  - Ideal for high power and three-phase power electronics analysis
  - Very useful for deeply embedded electronic/mechatronic systems

**Finer**
- 12-bit HD4096 High Definition Technology
  - “16x closer to perfect”

**Faster**
- Up to 1 GHz
  - Bandwidth for today’s and tomorrow’s technologies

HD4096 12-bit technology is being deployed into 8 channels to meet the needs of fast growing applications
Traditional High Channel Count Setup:
Coherent Modulation Measurements, 2009-2010
LabMaster 10-100 Zi 100 GHz Real Time Bandwidth

✦ Starting at 25 GHz bandwidth
✦ The highest bandwidth: Up to 100 GHz
✦ The fastest sample rate: Up to 240 GS/s
✦ The highest channel count:
  ✦ Up to 80 channels @ 36 GHz
  ✦ Up to 40 channels @ 65 GHz
  ✦ Up to 20 channels @ 100 GHz
60 Channel 10Zi System at NY Factory
Track View

Histograms reveal statistical distribution of values, but they contain no timing information.

Track View plots the value of a measurement versus time.

Track waveform values are calculated cycle by cycle.

Track waveform is time coincident with source waveform.

Frequency is measured and plotted for each cycle.

Frequency of Track plot reveals FM modulation rate of 100 kHz.
Track of Frequency Reveals Shape of Velocity Curve
Custom parameters are selected from the measurement menu like any standard parameter. Supports MATLAB, C/C++, Visual Basic Script, VBA, MS Excel, and JavaScript.
User-Defined Custom Math

Custom math functions are selected from the math setup menu like any standard function. Script is entered in...
In-Line Custom Math and Measurements
MATLAB Spectrogram on Scope
Create Custom Math Functions with Excel

Measurements on Excel-generated trace

Acquired Trace

Trace generated in Excel

Measurements on Excel-generated trace
MATLAB Measurements

- Custom MATLAB parameter finds the half-life of the damped sine wave
- The value 3.149 is the number of cycles that have occurred when the signal reaches 50% of its peak amplitude