
NATIONAL
INSTRUMENTS™

Building Video and Audio Test Systems

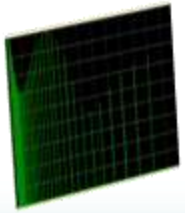
NI Technical Symposium

2008

Multimedia Device Testing Challenges

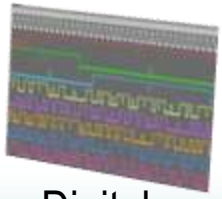
- Integrating wide range of measurement types
- Reducing test time while # of features increases
- Implementing newer digital video and audio tests

Video

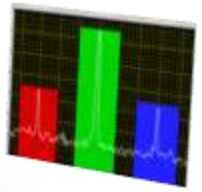


Audio

Voltage, Current, Power



Digital Interfaces



Wired & Wireless Communications

- vehicle telematics
- entertainment system
- multimedia semiconductor

- set-top box
- game console,
- mobile media player

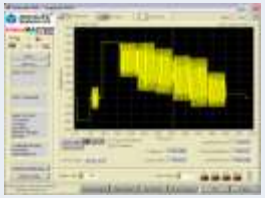
Agenda

- Starting with the Right Architecture
  - Make use of readily available technology (don't reinvent)
  - Use open, industry standard platforms and programming languages
  - Anticipate future expansion to meet new requirements
- Automating Video Measurements
  - Making video measurements
  - Tips to improve test times
- Automating Audio Measurements
  - Making audio measurements
  - Tips to ensure quality audio measurements

Start with the Right Architecture

Test Management Software

• Manages test execution, test limits & requirements, user interface, database interaction, reporting, etc



Test Software

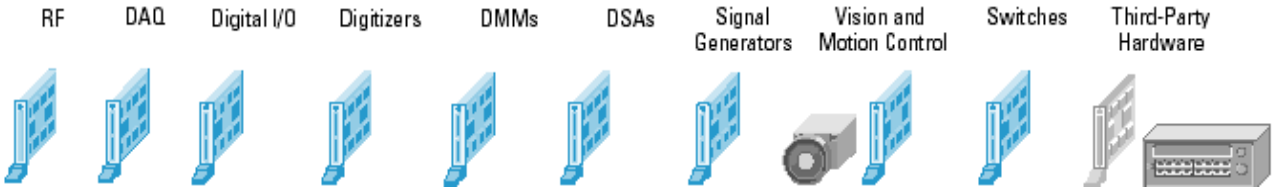
• Individual test code modules that configure the hardware, take the measurement, etc

Hardware Platform

• Platform for instrumentation
– PXI, GPIB, LAN, USB, etc

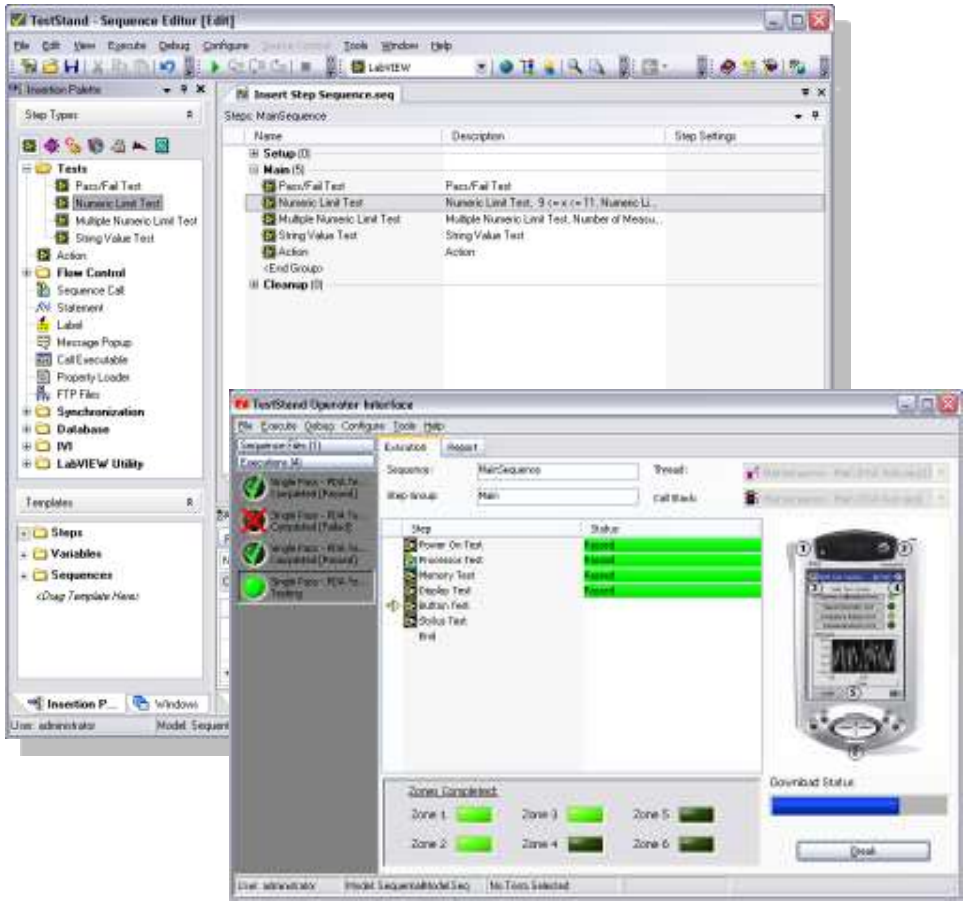
Services & Drivers

• Instrument Drivers, Configuration Mgrs, etc.



NI TestStand: Test Management Software

- Graphical sequence editor environment
- Sequence & automate tests written in any language
- Multithreaded sequence execution
- Report generation in ASCII, HTML/Web, XML, and ATML
- Database connectivity with Access, Oracle, SQL Server



Role of Test Management Software

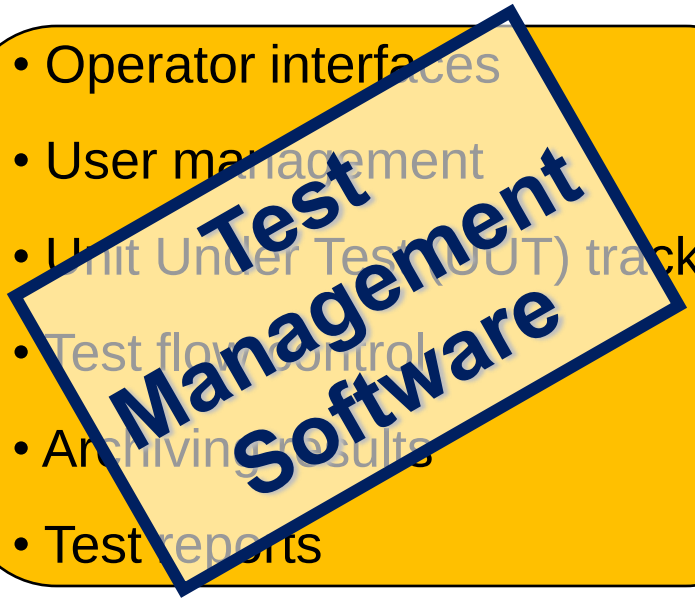
Common Automated Test System Components:

Operations different for each device tested:

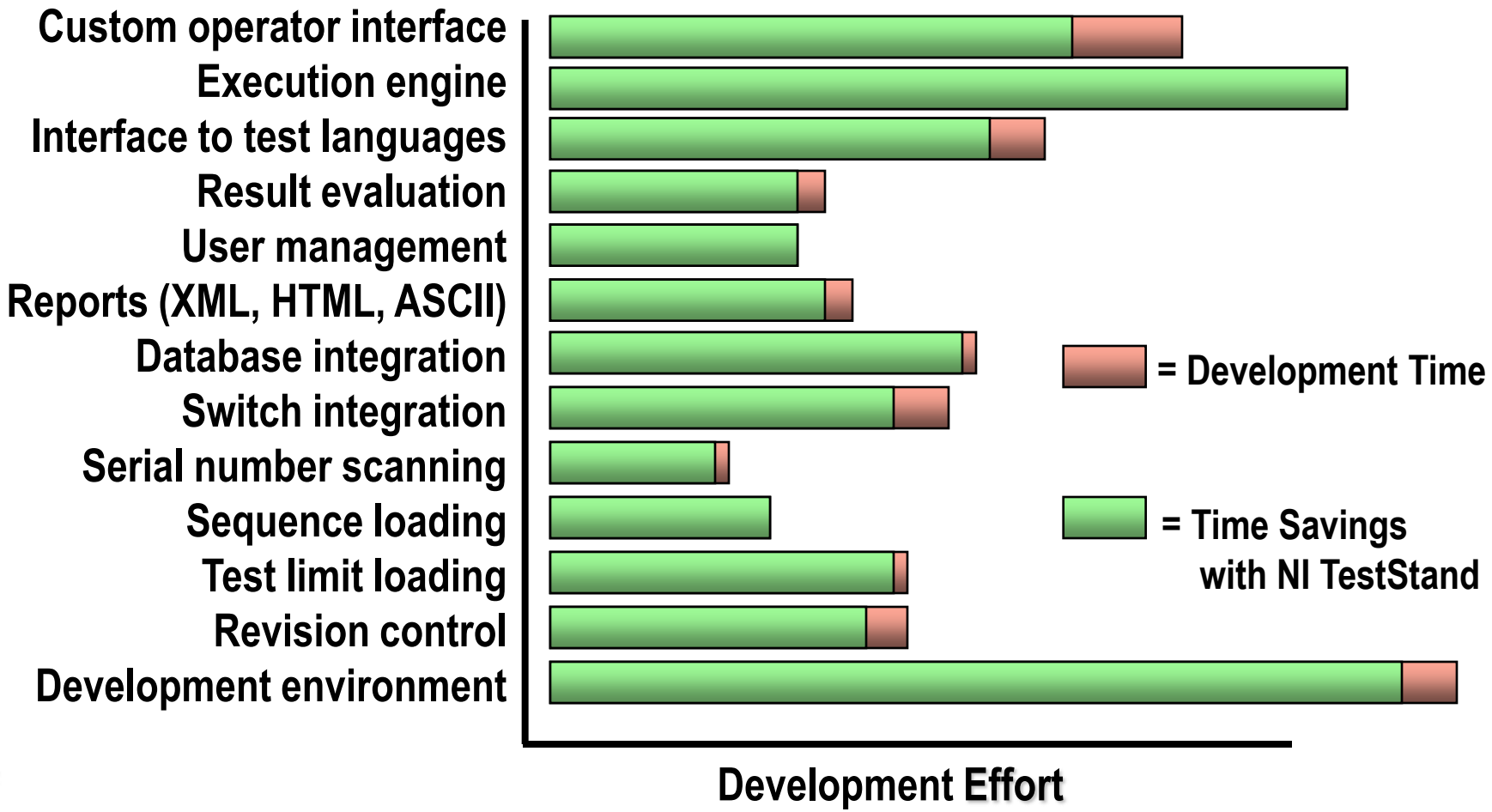
- Calibration
- Configuring instruments
- Data acquisition
- Measurements
- Analyzing results
- Test strategies

Operations repeated for each device tested:

- Operator interfaces
- User management
- Unit Under Test (UUT) tracking
- Test flow control
- Archiving results
- Test reports



Develop Automated Tests Faster



PXI Provides Open Hardware Platform

PXI controller
- OS Technology
- ADEs

Chassis

PXI backplane
- Bus Technology
- Timing
- Synchronization

Connectivity
- USB, LAN, GPIB, Serial
- 1553, ARINC, CAN, JTAG, MXI-2/3/4

Peripheral Slots
- Video, Audio, RF, DMM, Power Supply, etc
- Switching, Motion Control, DAQ, Vision, etc

PXI Provides Open Architecture for Expansion

Audio:
- Analog Audio Analyzer
- Digital Audio Analyzer

RF:
- RF Generator
- RF Signal Analyzer

Video:
- Analog Video Analyzer
- Analog Video Generator
- Digital Video Analyzer
- Digital Video Generator

Over 1500 Products from More than 70 Different Vendors

Making Video Measurements

Analog and Digital Video Applications

Portable Electronics

Home Theater

Mil-Avionics

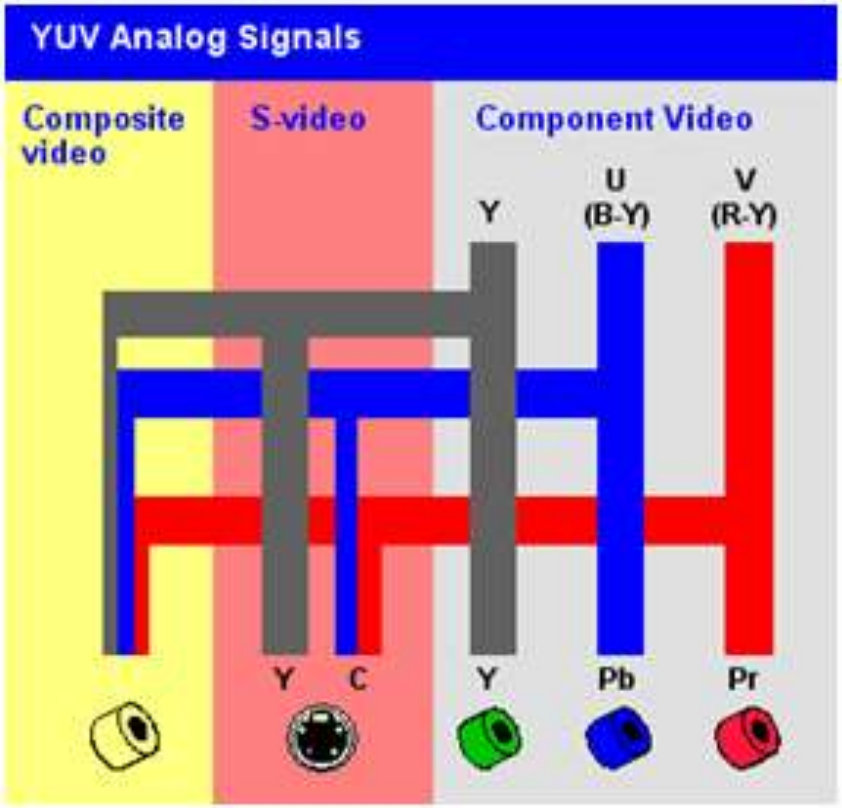
Cameras

Video (& Audio) Applications

Automotive

Set-Top Boxes & TVs

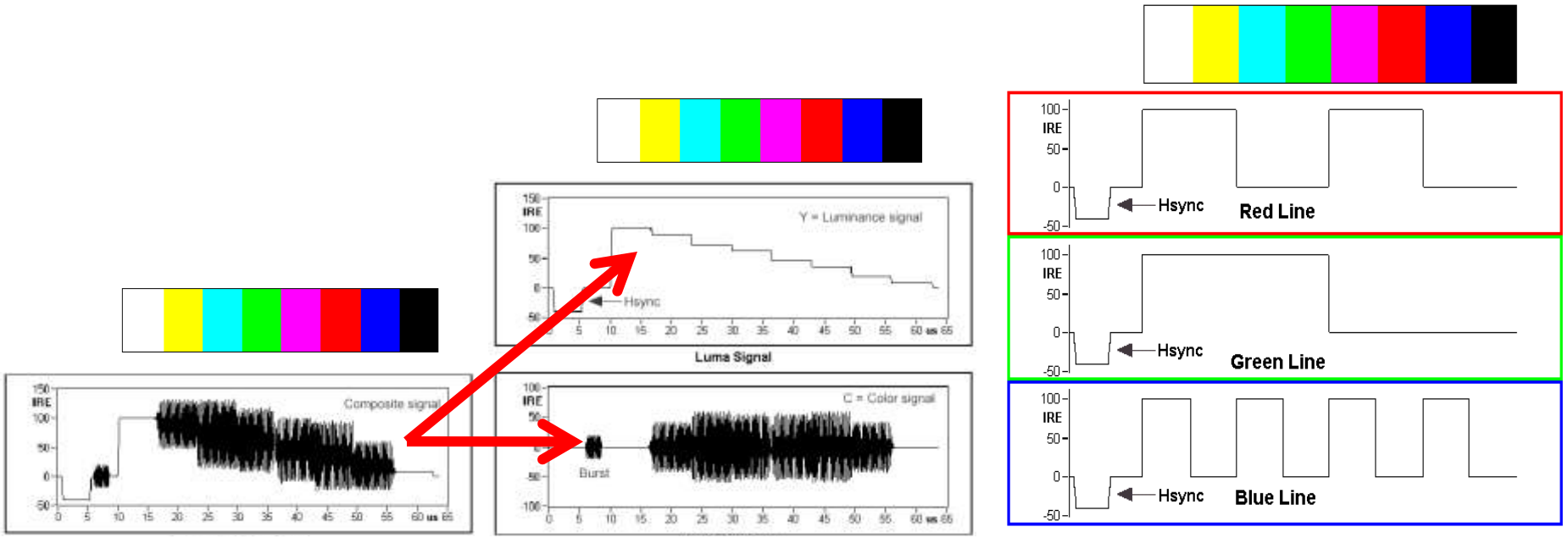
Analog Video: Composite, S-Video & Component



Analog video uses 1, 2, or 3 channels:

- Composite video (CVBS) 1 Ch
- S-Video 2 Ch
- Component video (CAV)
  - RGB 3 Ch
  - YPbPr (YUV) 3 Ch

Analog Video: Composite, S-Video & Component



Composite video (CVBS)

- *1 Ch*
- *Luma (Y) & Chroma (C) combined*

S-Video

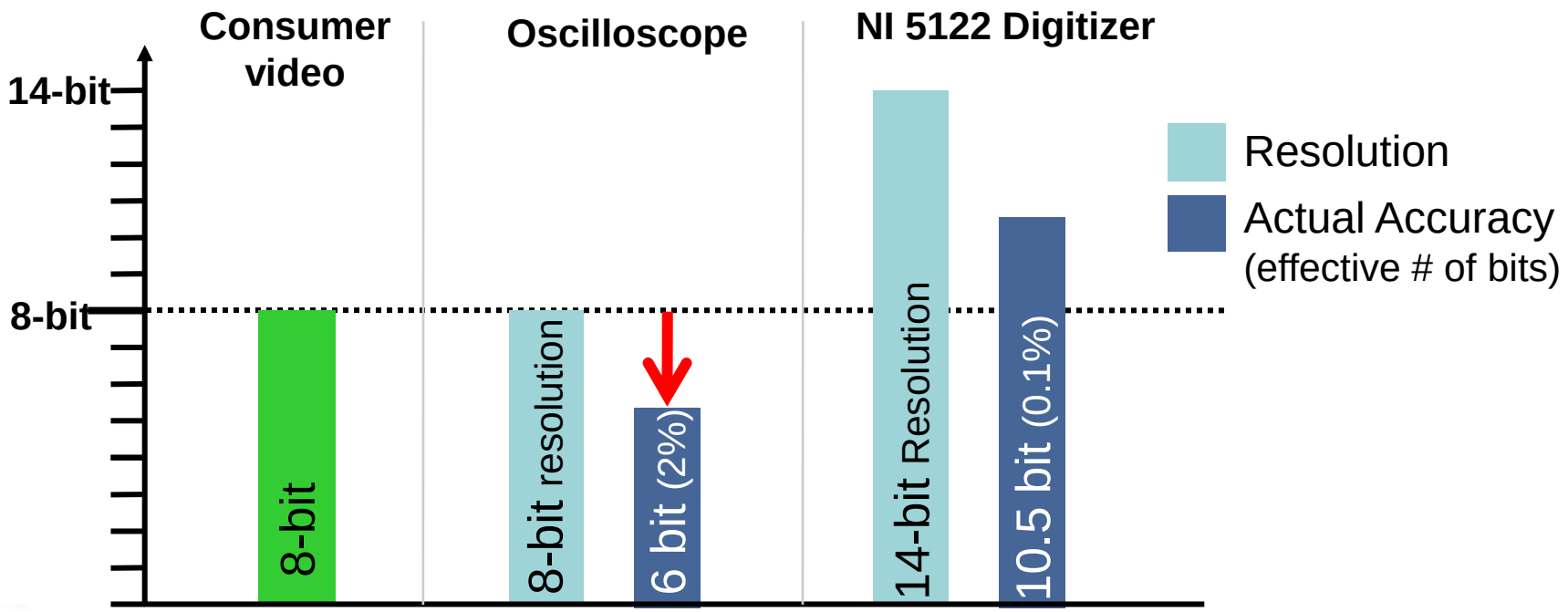
- *2 Ch,*
- *Luma (Y) & Chroma (C)*

Component

- *3 Ch*
- *RGB or YPbPr (YUV)*
- *Typically highest quality*

Analog Video: Digitizer Performance Is Important

- Typical oscilloscopes are not well suited for analog video measurements

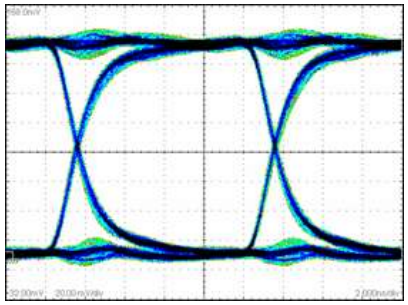


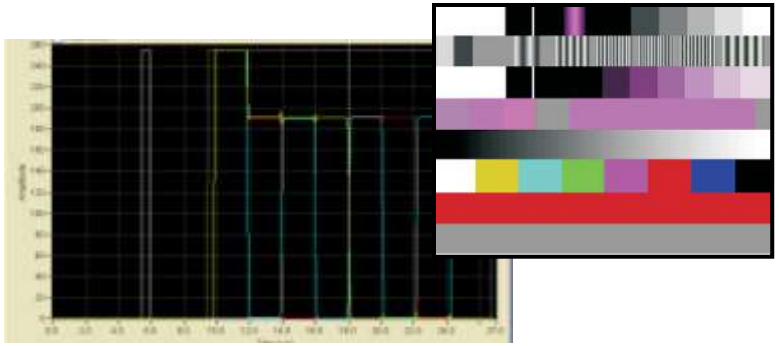
Digital Video

Digital Video Brings New Requirements to Address:

- Different interfaces – HDMI, DVI, HD-SDI/SDI, etc
- Content Protection – HDCP, DTCP, CGMS etc
- Pixel Encoding – 4:4:4, 4:2:2, 4:1:1, etc
- Color Standards – sRGB, studio RGB, etc (SD & HD formats)
- Detection of Artifacts – Blocking, Stuck Frame, Dropped Frame, etc

Digital Video: Physical Layer vs. Function Tests





Physical Layer:

Common in design & validation

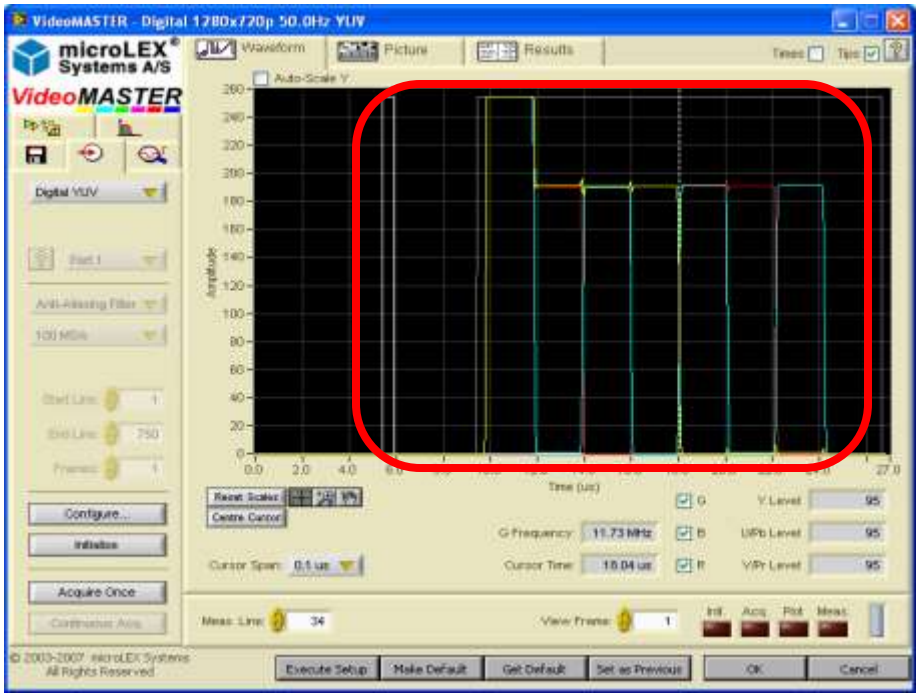
- *Eye Diagrams*
- *Rise & Fall Times*
- *Jitter*
- *Impedance*
- *Common-Mode Rejection*

Functional Test:

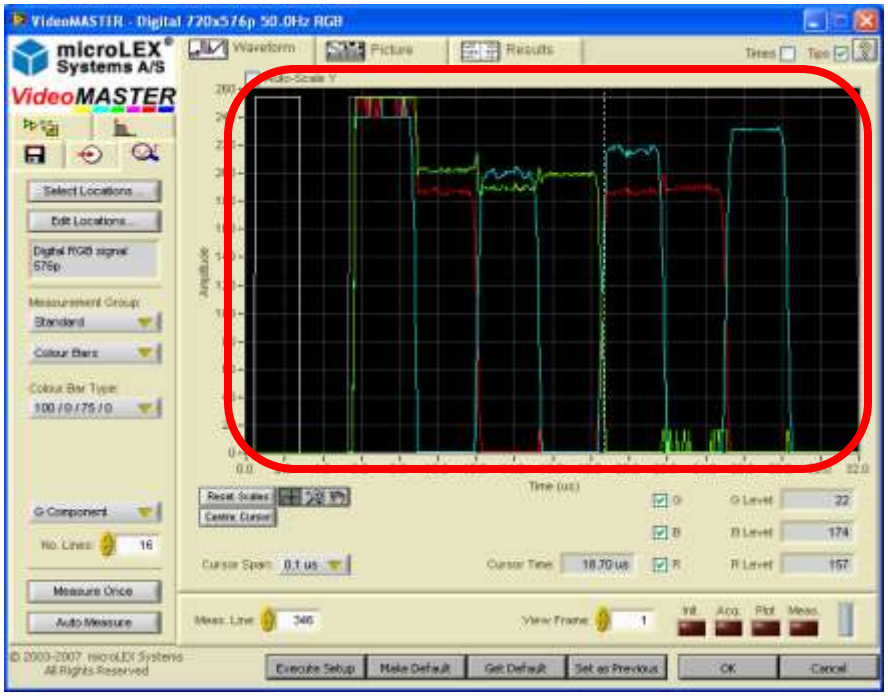
Common in validation & production

- *Image quality*
  - *Color Bar, Linearity, Multiburst, Noise*
- *Internal signal processing*
  - *Up and Down Scaling*
  - *Format Scaling*
  - *Picture improvement processing*

Digital Video Functional Test



Product with **high quality** video content and internal video signal processing

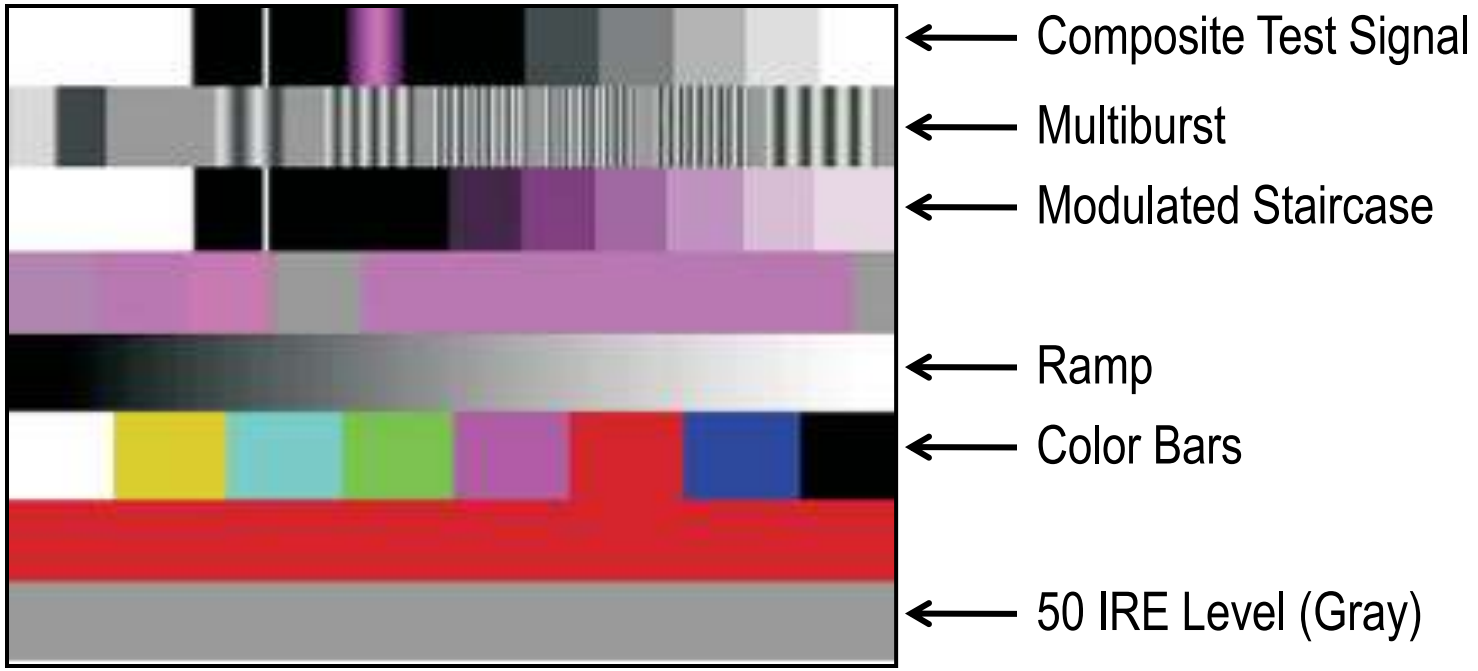


Product with **sub-optimal** video content or video signal processing

Tips to Improving Video Measurement Time

1. **Initialize your instrumentation once at start of test system setup, and not once per DUT**
   - Avoid redundant hardware initialization
2. **Use a matrix video test pattern**
   - Eliminate setup time for DUT to generate each pattern and time to acquire each pattern for each measurement
3. **Acquire the entire image at one time, then perform individual video measurements**
   - Eliminate additional video acquisition setup time
4. **Use the latest Instrument and CPU technology**
   - Upgrading to newer processors can lead to shorter measurements time.

Use a Matrix Video Test Pattern



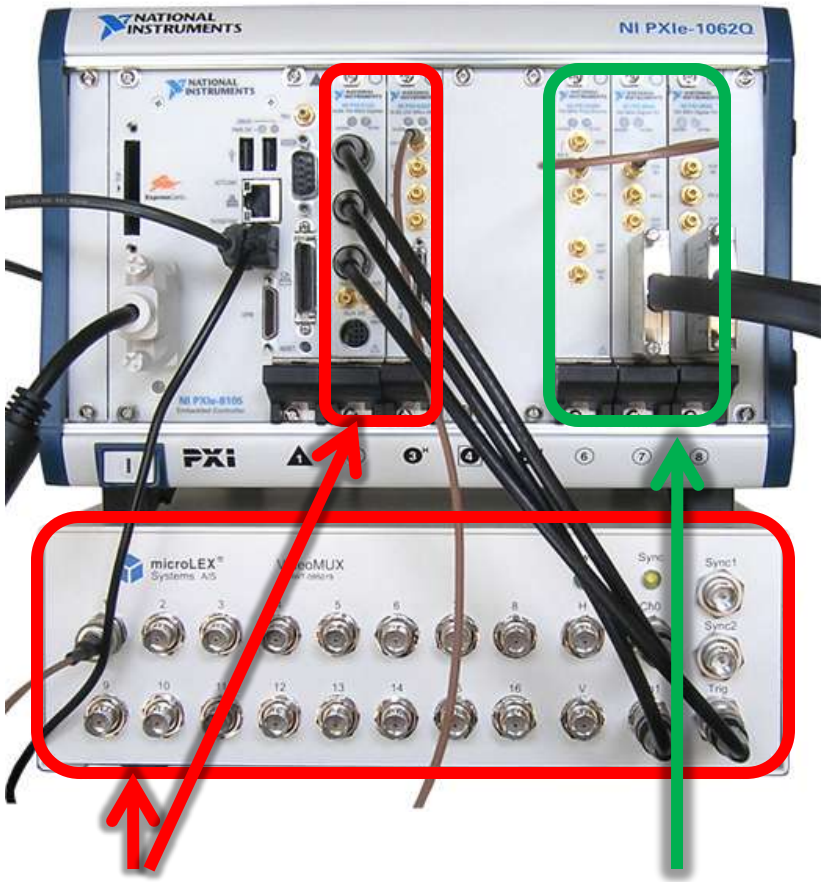
1. **Acquire entire test image at one time**
   - Eliminate additional overhead in acquisition setup each time
2. **Perform various measurements on appropriate video line using same acquired image**

Use the Latest Instrumentation & CPU Technology

- GPIB controlled instruments typically take minutes (1-3 min) to perform common set of video measurements

- A PXI-based system typically takes < 10 seconds
  - ***Composite video*** (**CVBS**) can be done in **2.5-3 sec**. (incl. Color Bar, Bar Line Time, Horizontal timing, Dif. Gain & Diff. Phase, K-Factor, Multiburst and Noise Spectrum).
  - ***Component video*** (**CAV**) can be done in **4-6 sec**. (incl. Color Bar, Horizontal timing, K-Factor, Multiburst and Noise Spectrum).
  - **CVBS & CAV and HDMI** (digital) for features like above, can be done completely in about **6-8 sec.**

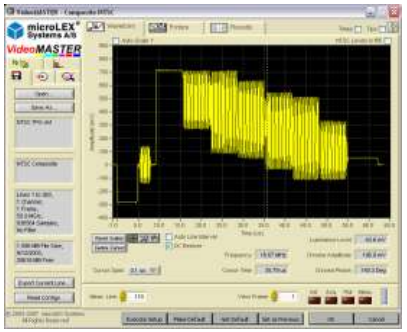
VideoMASTER: Interactive, Configuration Based Programming



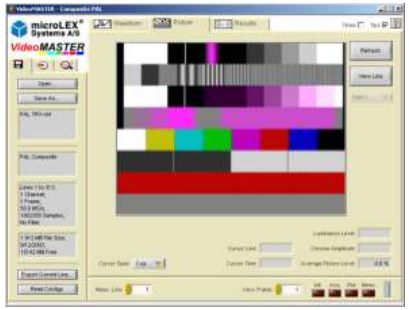
Analog Video

Digital Video

Video Waveform



Measurement Results



Video Image

Vector Scope Display

Demo

Solutions for Video Analysis and Generation

NI VideoMASTER solutions:

- **Analog video analysis:**
  - Composite video & S-Video(NTSC & PAL)
  - Component Video (YPbPr & RGB)
- **Analog video generation:**
  - Composite video (NTSC, PAL & SECAM)
  - Component video (Coming in Q4 2008)
  - NATO STANAG 3350 (875, 625 & 525 lines), etc.
- **Digital video analysis**
  - DVI & HDMI w/o HDCP up to 720p/60 Hz, 1080i & 1080p/60 Hz
- **Digital video generation:**
  - DVI up to 720p/60 Hz, 1080i/60 Hz & 1080p/30 Hz

Making Audio Measurements

Making Various Audio Measurements

Acoustical

- Hearing aids

Electro Acoustical

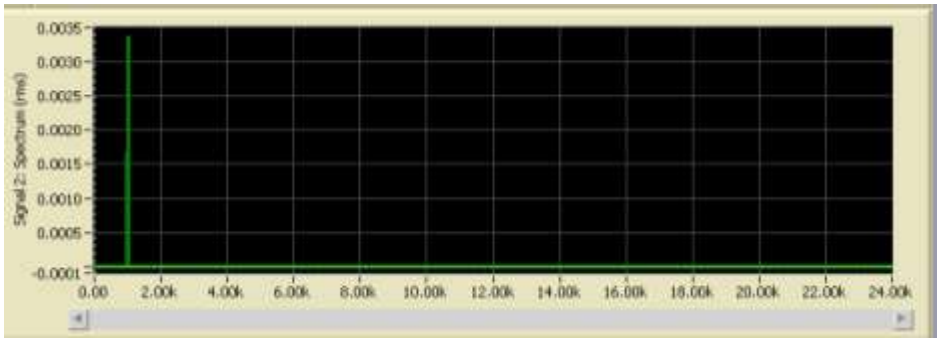
- Phone, loudspeaker, microphone

Electrical

- Amplifier, filter, DVD player, set-top box, video distribution equipment

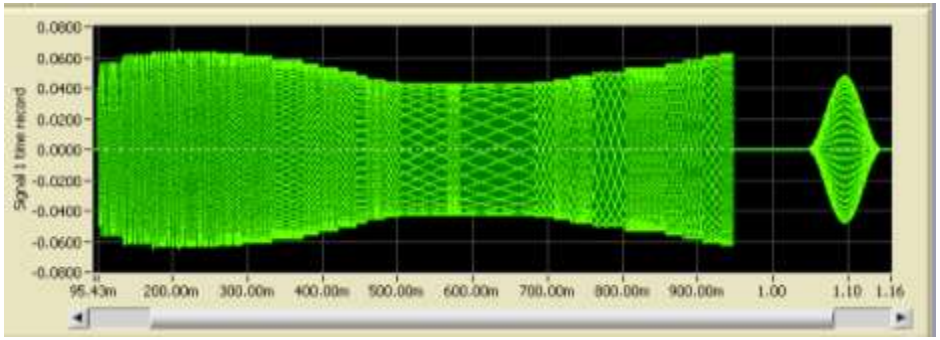
Common Types of Excitation/Stimulus Signals

- Single Tone **(simplest source)**



Common Types of Excitation/Stimulus Signals

- Single Tone **(simplest source)**
- Amplitude Sweep **(sweep amplitude at constant frequency)**
- Coherent Sweep & Chirp **(continuous frequency sweep at constant amplitude)**



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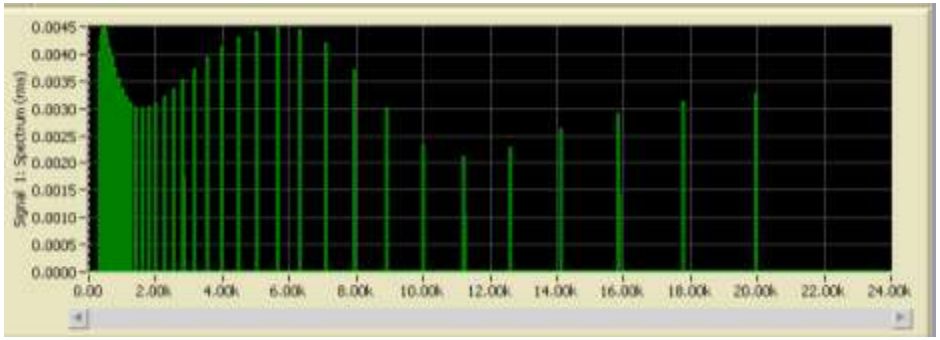
- Multiple Pure Tones, or Stepped Frequency **(discrete frequency excitation steps)**
- Multi-tone **(two or more simultaneously generated sinusoidal signals)**



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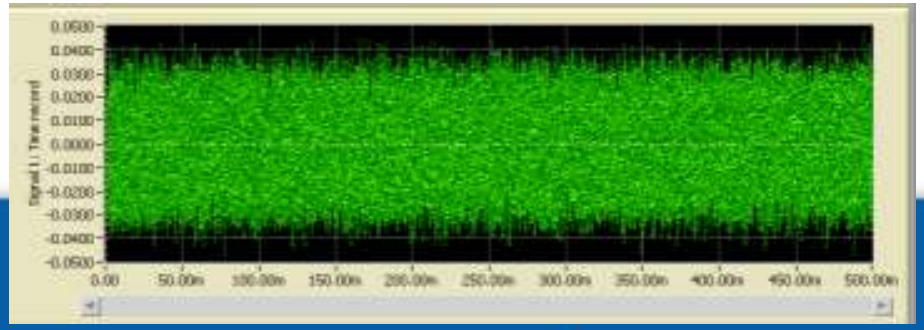
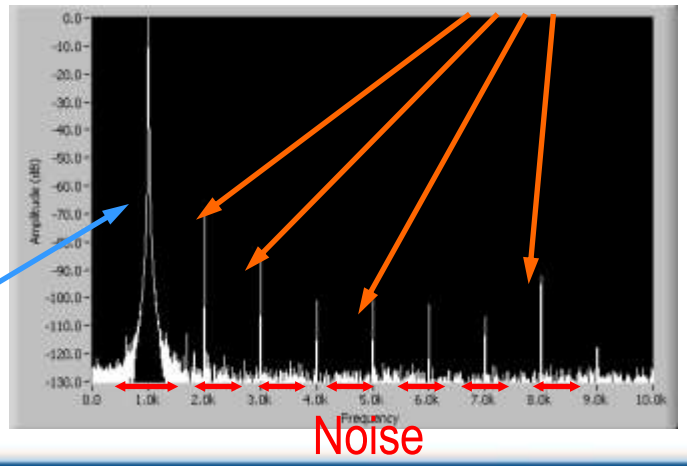
- Multiple Pure Tones, or Stepped Frequency **(discrete frequency excitation steps)**
- Multi-tone **(two or more simultaneously generated sinusoidal signals)**
- Step Response **(step between high and low amplitude at same frequency)**
- White Noise **(equal energy at all frequencies)**



Common Audio Measurements

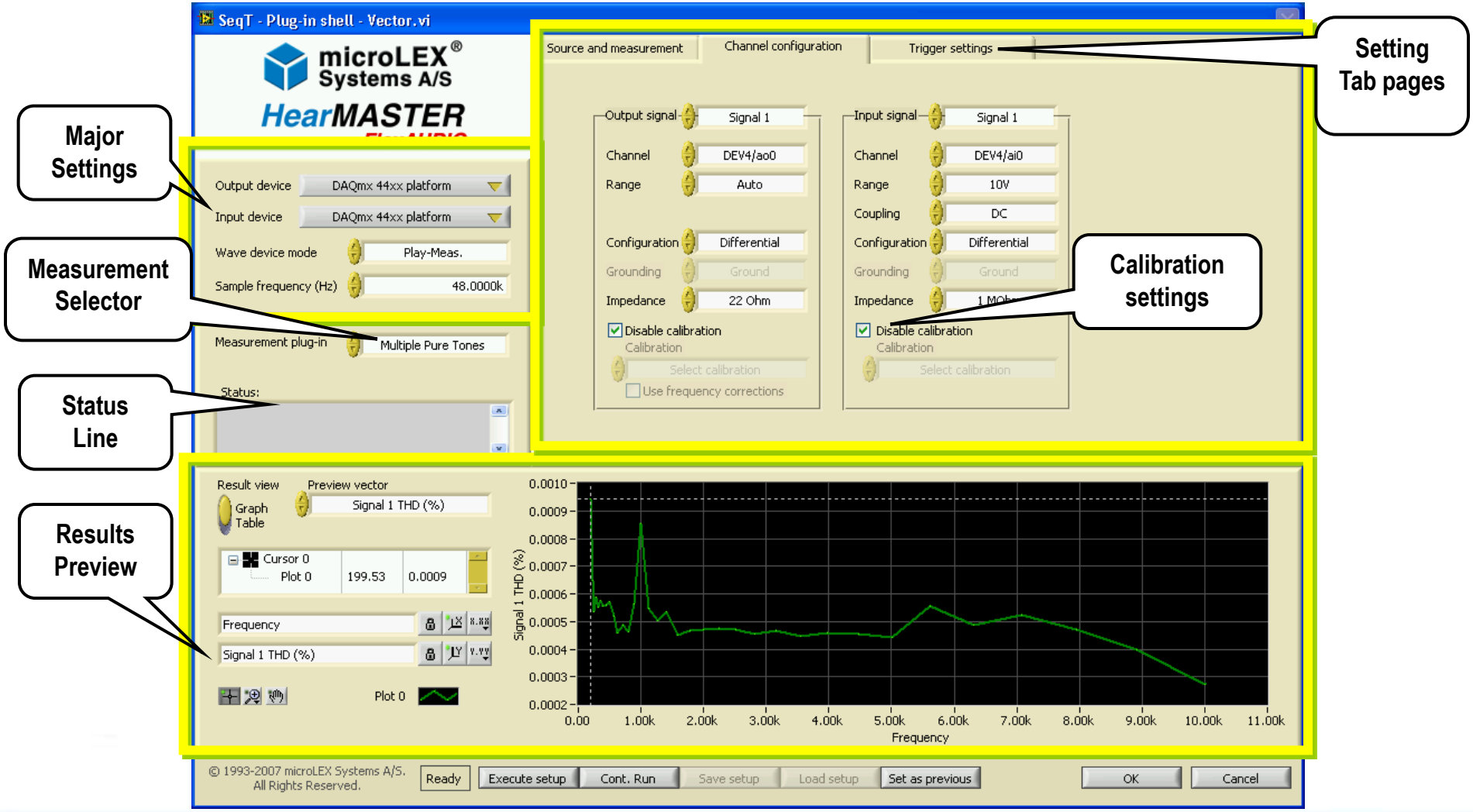
- Frequency response
  - Discrete tone excitation (swept sine)
  - Broadband excitation
- Noise and Distortion
  - Total Harmonic Distortion (THD, THD +N)
  - Signal In Noise And Distortion (SINAD)
  - Signal to Noise Ratio (SNR)
  - Inter-modulation Distortion (IMD)
  - Dynamic Range
  - Channel Balance
  - Cross Talk



Important Analog Audio Measurement Tips

- Frequency response measurements require a known stimulus to excite UUT/DUT, so measure both stimulus and response
- Phase measurements require simultaneous sampling
- Most applications require hardware with anti-alias filters to avoid broadband noise
- Often requires analog triggering on the stimulus channel
- System calibration can help eliminate system non-linearities from microphones, speakers, chambers, etc when taking acoustical or electro-acoustical measurements

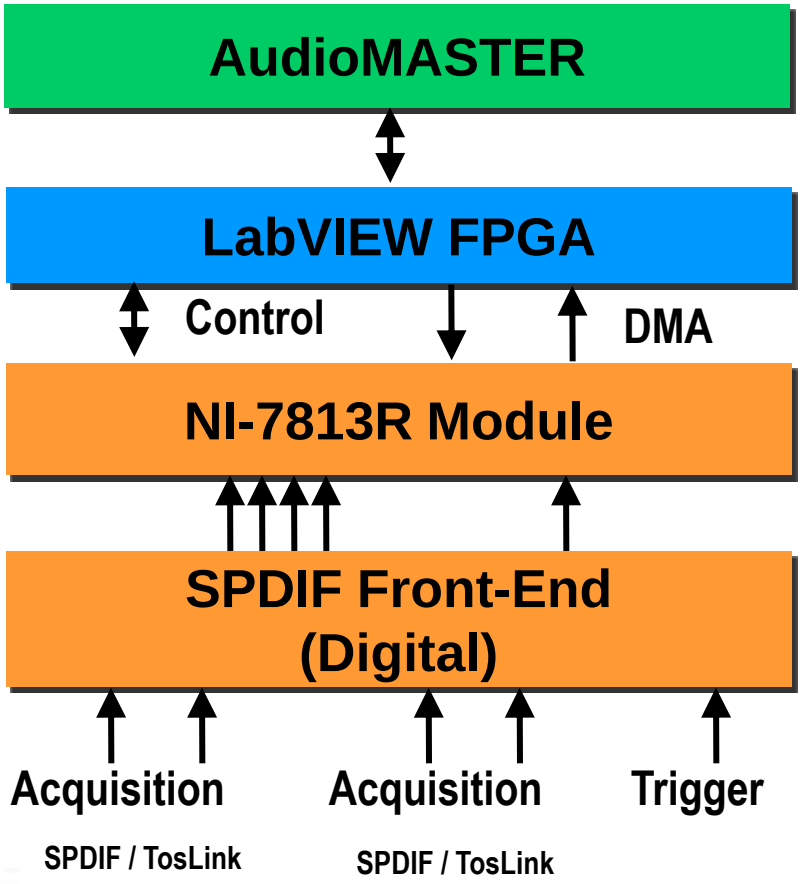
AudioMASTER: Interactive, Configuration Based Programming



AudioMASTER Features

- Interactive, configuration based programming for analog and digital audio measurements
- Acquire, Generate, or Both (Stimulus/Response)
- Provides several types of excitation signals for swept audio measurements
- Evaluate scalar or vector measurement results
- System calibration for microphones, speakers, chambers, etc.

AudioMASTER for Digital Audio



Acquire S/PDIF

NI Solutions for Audio Analysis and Generation

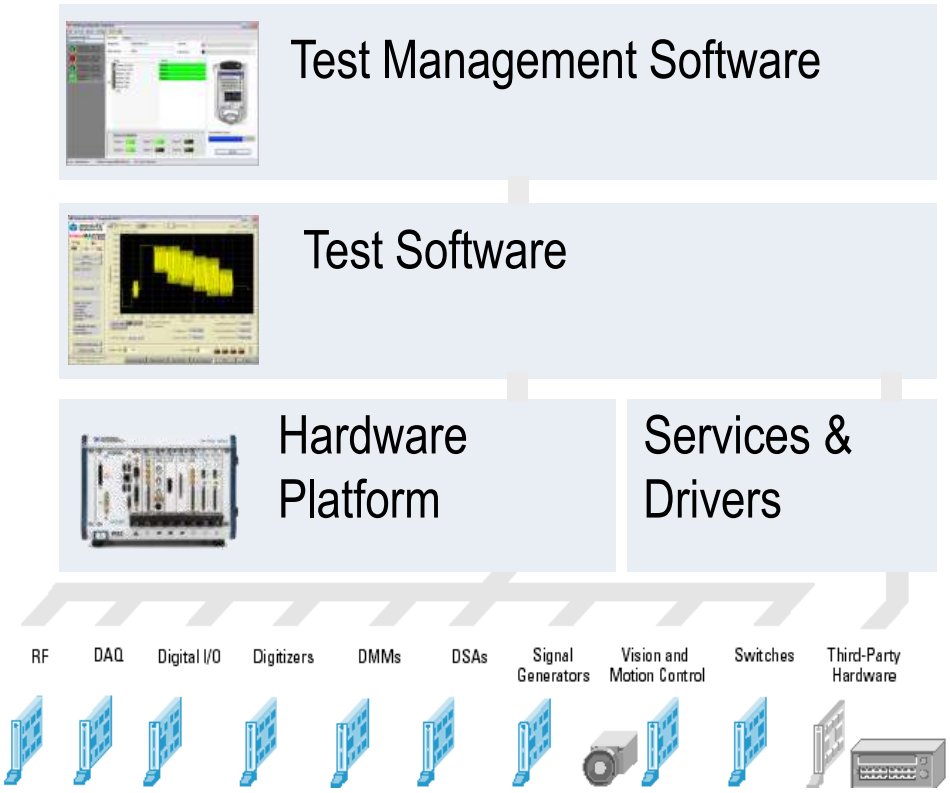
Analog Audio Analysis and Generation:

- NI 4461/4462 DSA with NI AudioMASTER (TestStand) or NI Sound & Vibration (LabVIEW, Signal Express)
  - Analog audio stimulus/response with various measurements

Digital Audio Analysis

- NI 7813R R-Series module and NI SPDIF accessory with NI AudioMASTER for Digital Audio
  - Digital audio stimulus/response with various measurements
  - SPDIF input available today, SPDIF output coming soon…

Building Video and Audio Test Systems



Thank you.
Any Questions?