VideoQ VQMA

Software Suite for Video Quality Measurements

VideoQ, Inc

3283 Kifer Road

Santa Clara, CA 95051

www.videoq.com

Executive Summary

l VQMA – Video Quality Meter & Analyzer that measures the quality of captured video files and/or video signals

l Ideal tool for video development labs, software developers and high volume manufacturing

l Instantly revealing your video capture device or signal processing/transmission chain performance

l Benefits:

> l Unique technology for direct quality measurements of captured video data
>
> l Replaces and/or complements existing very expensive dedicated external video analyzers
>
> l Allows automated objective check of video capture device performance

VQMA Target Applications

- Pre-qualification objective video measurements of file-based environment in a full range of resolutions from HD to Portable Media Devices

- Accurate measurements on transcoded static images of any resolution by analysis of the standard VQMA test pattern

- Family of source test patterns of different resolutions, similar layout and the same coding format

- Programmable tolerance settings for pass/fail test

- Detailed PDF report documents can be printed off-line, if required

- Optional semi-custom Automated Testing Controller for full robotic usage

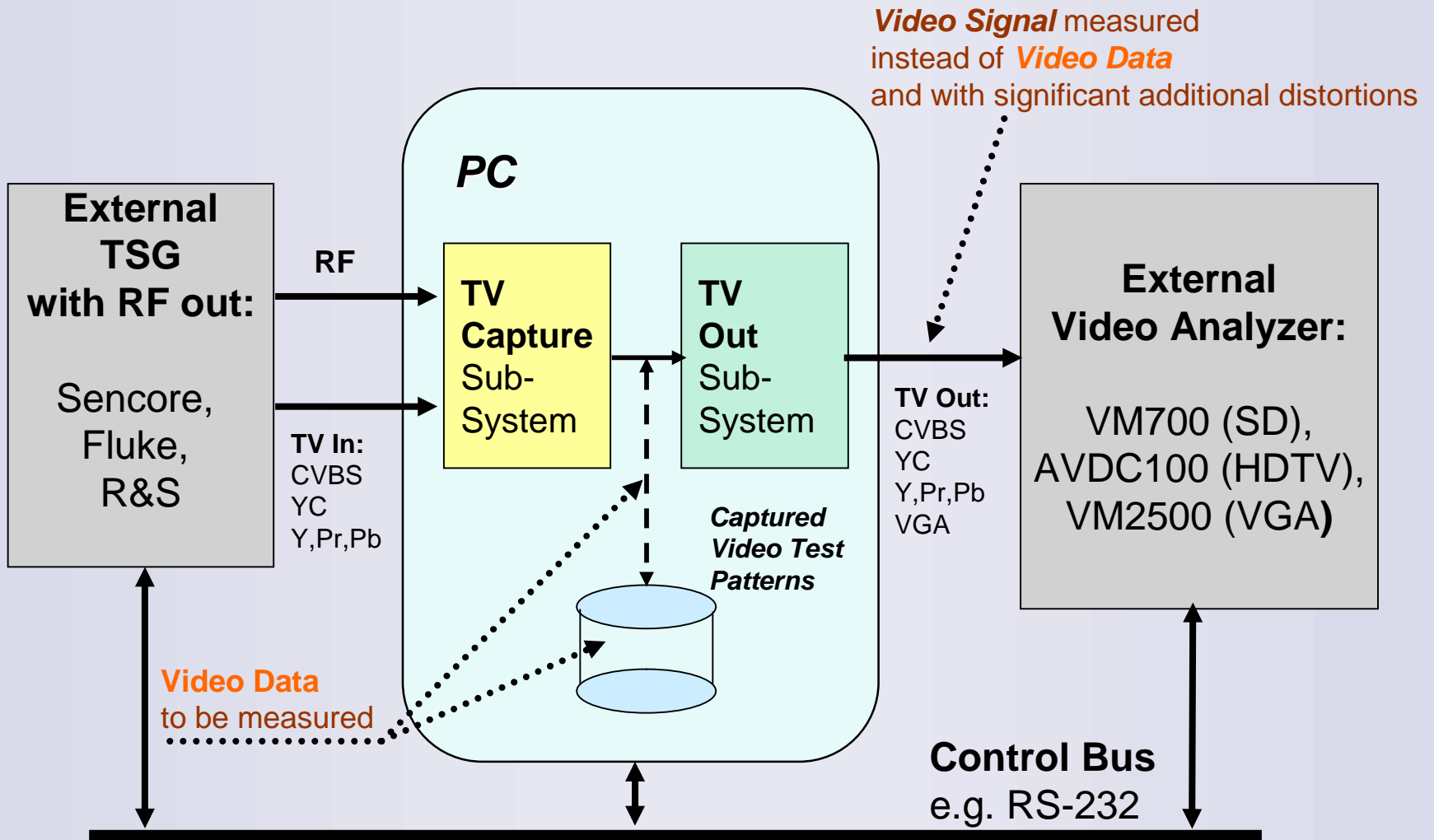# What about Video Quality on computers?

All main picture quality issues are more or less the same as for a traditional TV and video equipment, *but*!

l Captured (ingested, acquired, compressed, transcoded, etc.) video signals are going through unchartered waters of capture cards, software codecs and graphic cards *before* they can be accessed and evaluated for quality

l The most reliable solution is to measure the quality of *captured* pictures by software tools processing .AVI or .YUV *files* stored on a hard disk

l An alternative (in fact – complementary) approach is to provide self-contained PC-based unit combining hardware and software tools to measure the quality of analog or digital video *signals*

Prior Art: Testing with External TSG & Analyzer

Video Signal measured
instead of *Video Data*
and with significant additional distortions

PC

**External
TSG
with RF out:**

Sencore,
Fluke,
R&S

RF

TV In:
CVBS
YC
Y,Pr,Pb

**TV
Capture**
Sub-
System

**TV
Out**
Sub-
System

*Captured
Video Test
Patterns*

TV Out:
CVBS
YC
Y,Pr,Pb
VGA

**External
Video Analyzer:**

VM700 (SD),
AVDC100 (HDTV),
VM2500 (VGA**)**

Video Data
to be measured

Control Bus
e.g. RS-232

Prior Art: Testing with External TSG & Analyzer

- Pros:
    - Standard off-shelf products
    - Established and approved TV measurement methodology
- Cons:
    - PC-based TV capture can not be measured directly in a system memory
    - Additional conversions from capture into TV Out create multiple errors
    - Extremely high cost of the equipment ($50-100K per set)
    - TSG and Analyzer must be controlled and integrated into the system
- What is needed to overcome the problems of prior-art solutions:
    - Accurate SW analyzer to eliminate external analyzer
    - Library of test patterns to generate video and RF signals in all formats
    - Hardware player or PC card to provide accurate test signals from test patterns

VQMA - Auto-Matrix Test Pattern

All-In-One: Single pattern allows automatically measure multiple video signal parameters

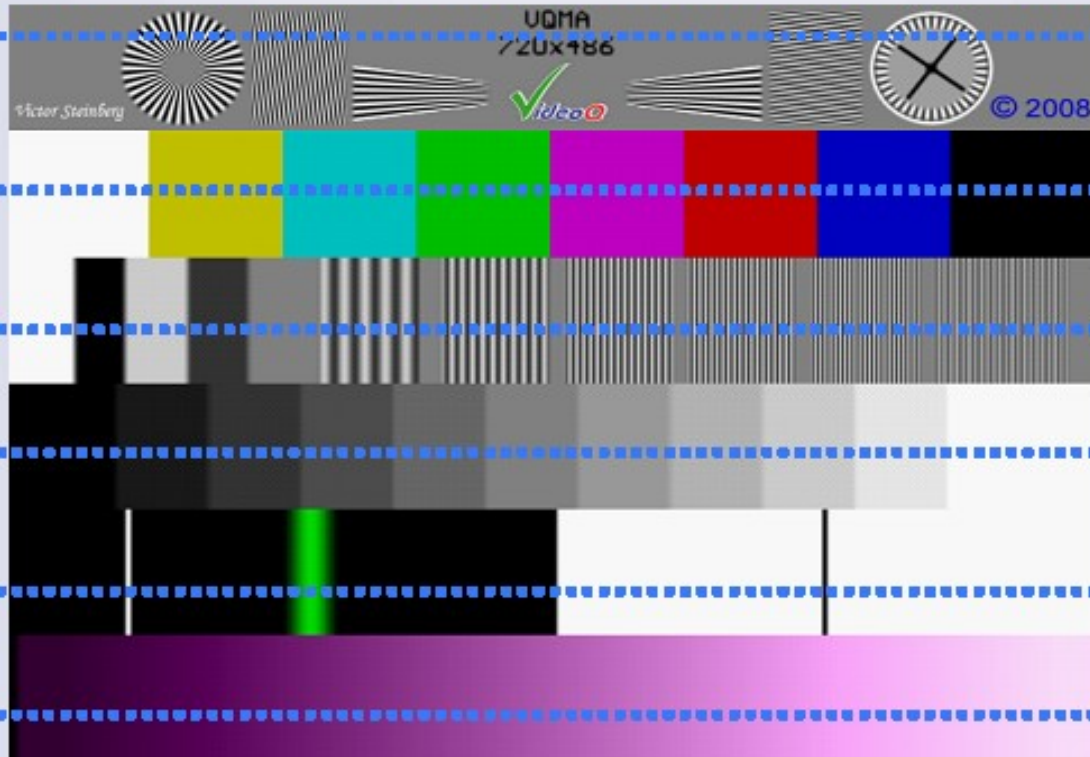**Upper Band: for visual estimation only**

Test Signal:
- Colour Bars
- Multi-Burst
- Grey-scale
- 2T, 20T pulses
- Modulated Ramp

Parameters:
- Chroma Vectors
- Color Matrix Check
- Frequency Response
- Nonlinearity, Y Levels
- 2T pulse K-rating, Y vs. C Gain & Delay
- Differential Gain, Differential Phase
- YUV2RGB conversion Detection (Illegal Colors)

Noise & Interferences accurately measured on any static image by analysis of frame differences

Key Video Measurements

Parameter	Unit	*VQMA Test Matrix Component*
Black & White Levels	%	*Black & White Bars*
Nonlinearity, Y levels	%	*Gray-scale*
K-rating	%	*2T Pulse*
C vs. Y Gain & Delay	dB, ns	*20T Pulses*
Frequency Response	dB vs. MHz	*Multi-Burst*
Differential Phase & Gain	deg, %	*Modulated Ramp*
UV Vector Errors	%, deg	*Color Bars*
SNR & Noise Spectrum	dB, dB vs. MHz	*VQMA pattern (all bands)*
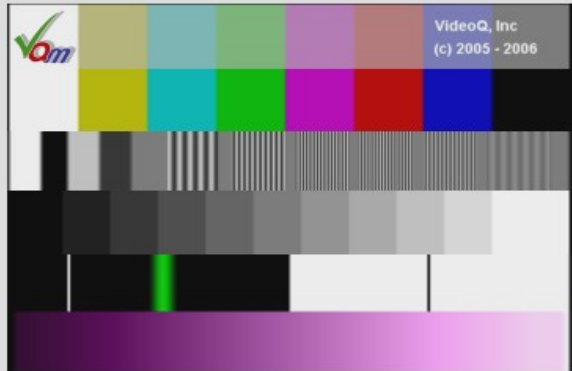
VQMA Summary Page Screenshot

C:\vq\NTSC Tuner 1mV.avi - VQM
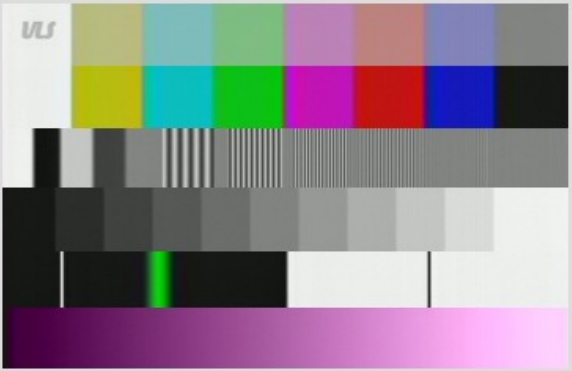
File   BitStream   View   Aperture   Help

VQM Test Failed *Fri Mar 31 12:12:20 2006* ✕ **Video Quality Test Summary** *Averaged of 50 x 32 lines of 32 frames*

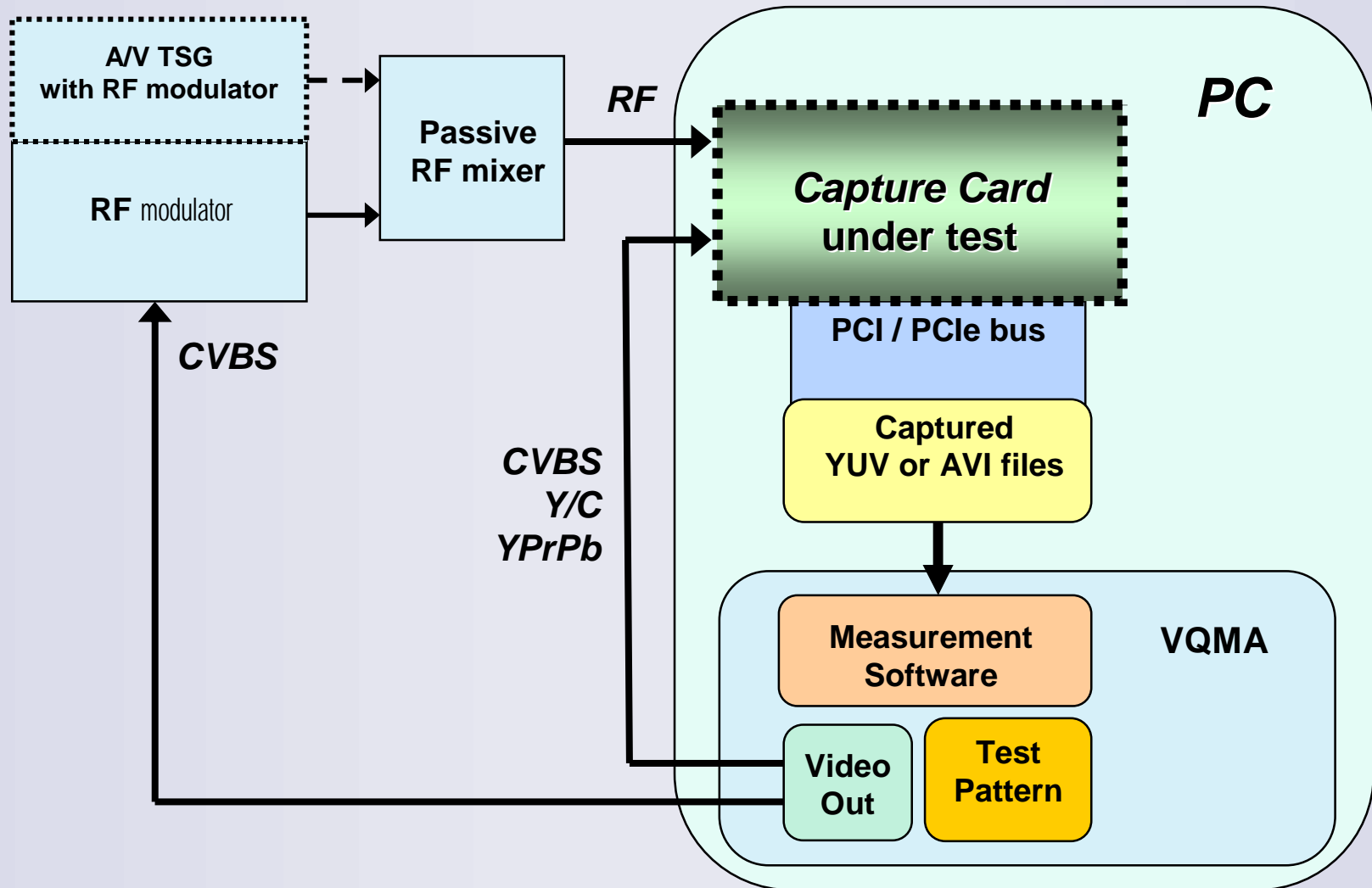| Parameter	Measurement	Unit	Target	Pass
Black Level	3.5 %, (23.6)	%, (8 bits)	-5.0 -- +5.0 %	✓
White Level	101.6 %, (238.5)	%, (8 bits)	95.0 -- 105.0 %	✓
Unfiltered Y SNR	35.79	dB	> 40 dB	✕
K Rating on 2T Pulse	1.47	%	< 3 %	✓
Chroma vs Luma Gain	1.58	dB	0.0 -- +0.0 dB	✕
Chroma vs Luma Delay	287	ns	-40 -- +40 ns	✕
Differential Gain	5.76	%	< 5 %	✕
Differential Phase	1.1	degree	< 5 degree	✓
Freq. Response @ 1.00 MHz	-0.04	dB	-1.0 -- +1.0 dB	✓
Freq. Response @ 2.00 MHz	-1.11	dB	-1.0 -- +1.0 dB	✕
Freq. Response @ 3.00 MHz	-3.06	dB	-3.0 -- +1.0 dB	✕
Freq. Response @ 3.58 MHz	-7.41	dB	-4.0 -- +1.0 dB	✕
Freq. Response @ 4.20 MHz	-26.16	dB	-6.0 -- +1.0 dB	✕
Freq. Response @ 5.80 MHz	-31.43	dB	-20.0 -- +1.0 dB	✕

Reference

Test
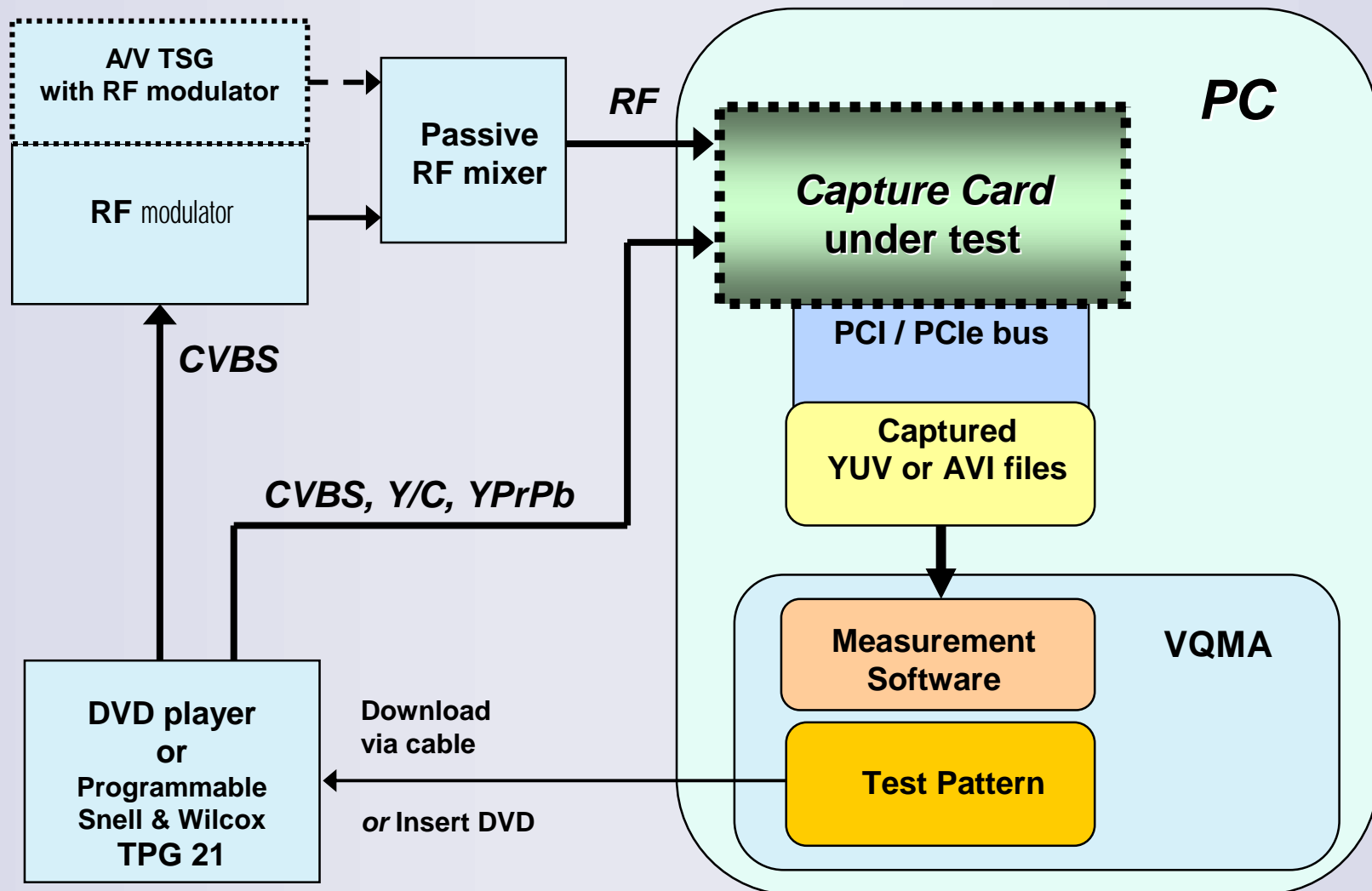
C:\vq\NTSC Tuner 1mV.avi

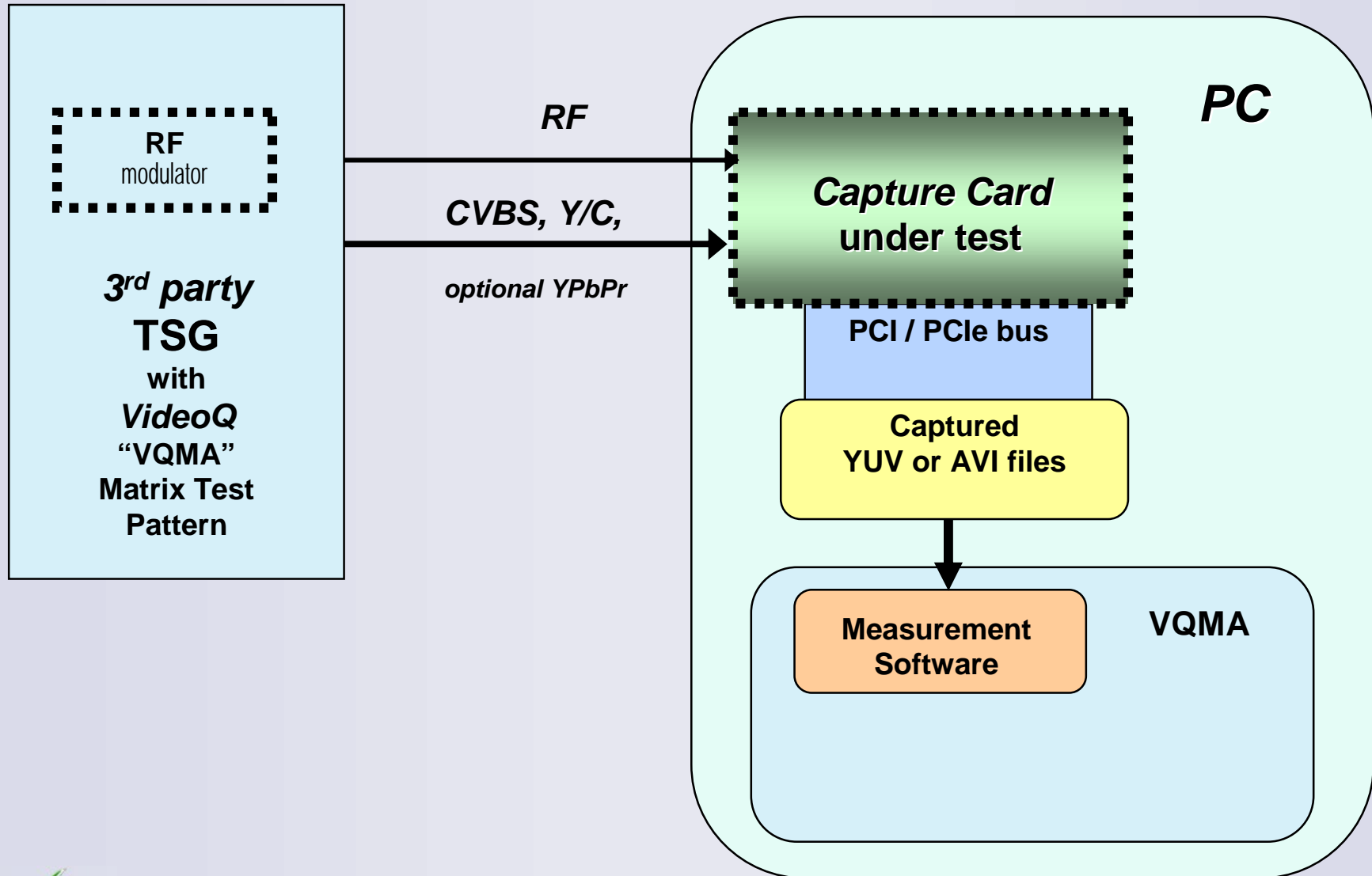# Capture Card Testing with High Quality Video Output Card

Capture Card Testing with DVD player or Conventional TSG

A/V TSG with RF modulator

RF modulator

Passive RF mixer

RF

PC

Capture Card under test

PCI / PCle bus

Captured YUV or AVI files

CVBS

CVBS, Y/C, YPrPb

Measurement Software

VQMA

DVD player or Programmable Snell & Wilcox TPG 21

Download via cable

or **Insert DVD**

Test Pattern

VQMA Testing with Factory Loaded Test Pattern

RF modulator

3rd party TSG with *VideoQ* "VQMA" Matrix Test Pattern

RF

CVBS, Y/C,

optional YPbPr

PC

Capture Card **under test**

PCI / PCIe bus

Captured YUV or AVI files

Measurement Software

VQMA

VQMA Software Analyzer Features

l   Software executable running under Windows

l   Unique Matrix Test Pattern to check ALL parameters in one process

l   Detailed and sophisticated analysis of video data using spatial and temporal filtering

l   Highly accurate and consistent results due to sophisticated processing algorithms

l   0.1 dB accuracy of SNR and frequency response meters

l   0.1 dB and 0.1 degree accuracy of differential gain and differential phase

l   Built-in spectrum analyzer with industry standard weighting filters

l   NTSC and PAL standards supported

l   User-friendly intuitive GUI for off-line analysis

l   Unattended ('robotic') mode provides machine-readable log file

VQMA Modes of Operation

VQMA software can be launched in two ways:

- Windows GUI mode – aimed for a video design and verification environment. It provides a detailed multi-page printable report file with all test results in both numerical and graphic representation

- Unattended mode provides machine readable log file with numerical representation of test results for automated production environment or automated software drivers verification, e.g. for inclusion in higher level automated QA systems

Either mode allows customization of the tolerance values by direct editing of the .INI files to match the performance of particular board types/models.

VQMA program checks the captured video data against the tolerance values contained within the customizable .INI file.

Staircase Display
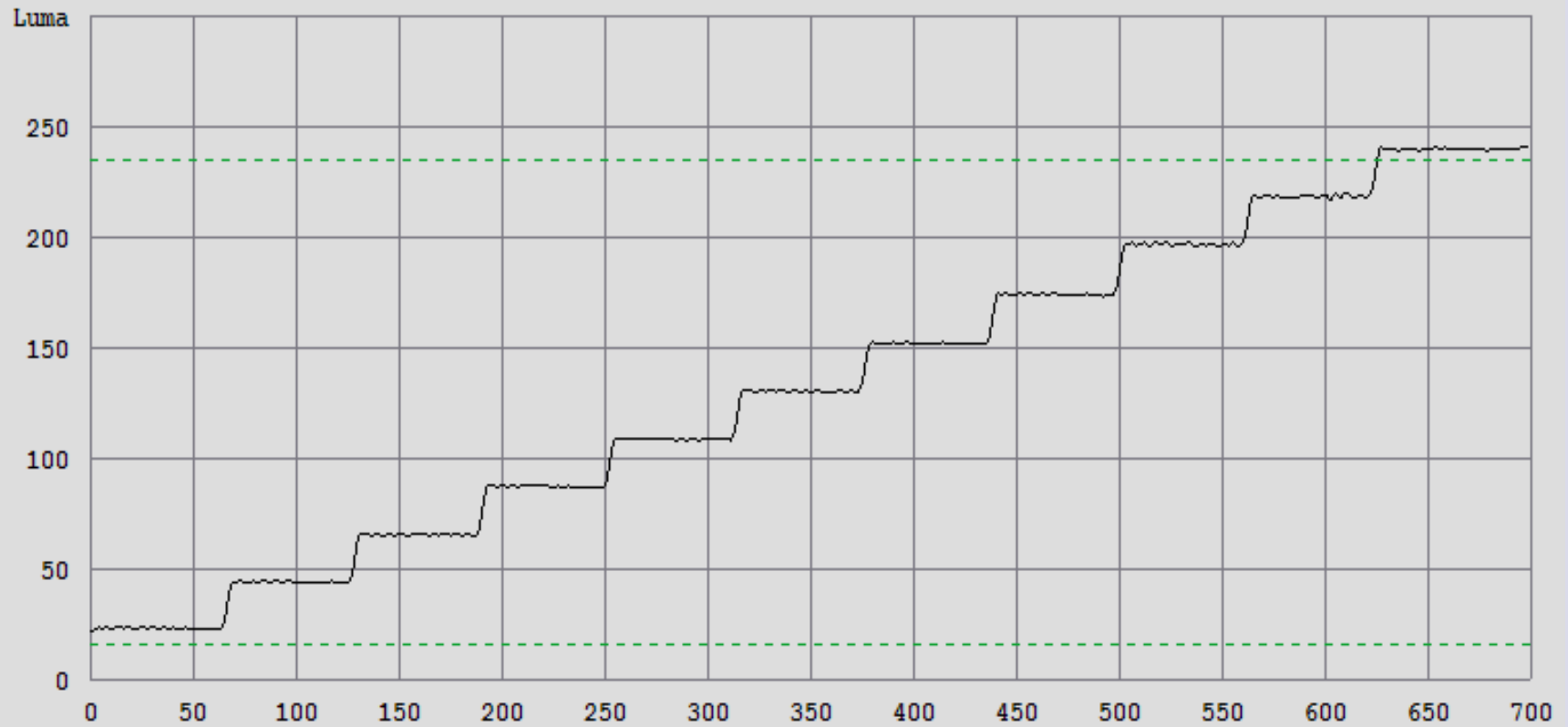
K-Rating & C vs. Y

Chroma vs Luma Gain   1.58 dB   Blue: U
Chroma vs Luma Delay   287 ns   Red: V
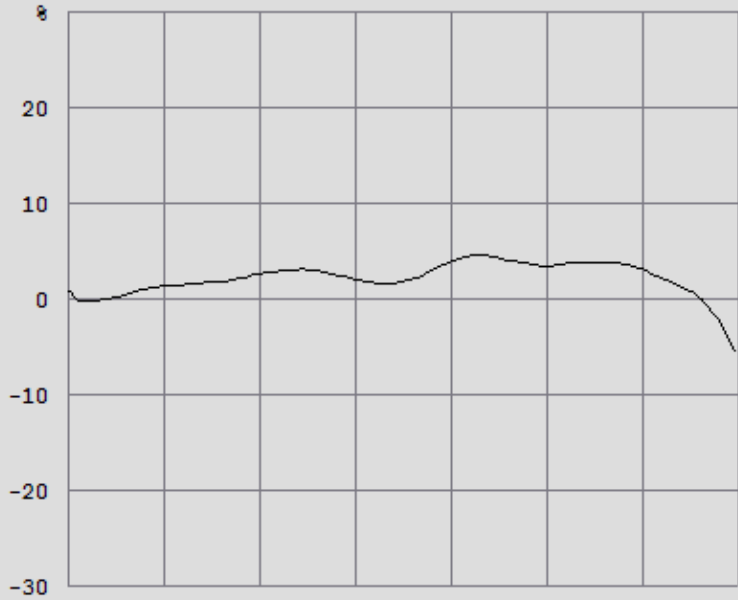K Rating on 2T Pulse   1.47 %   Black: Y
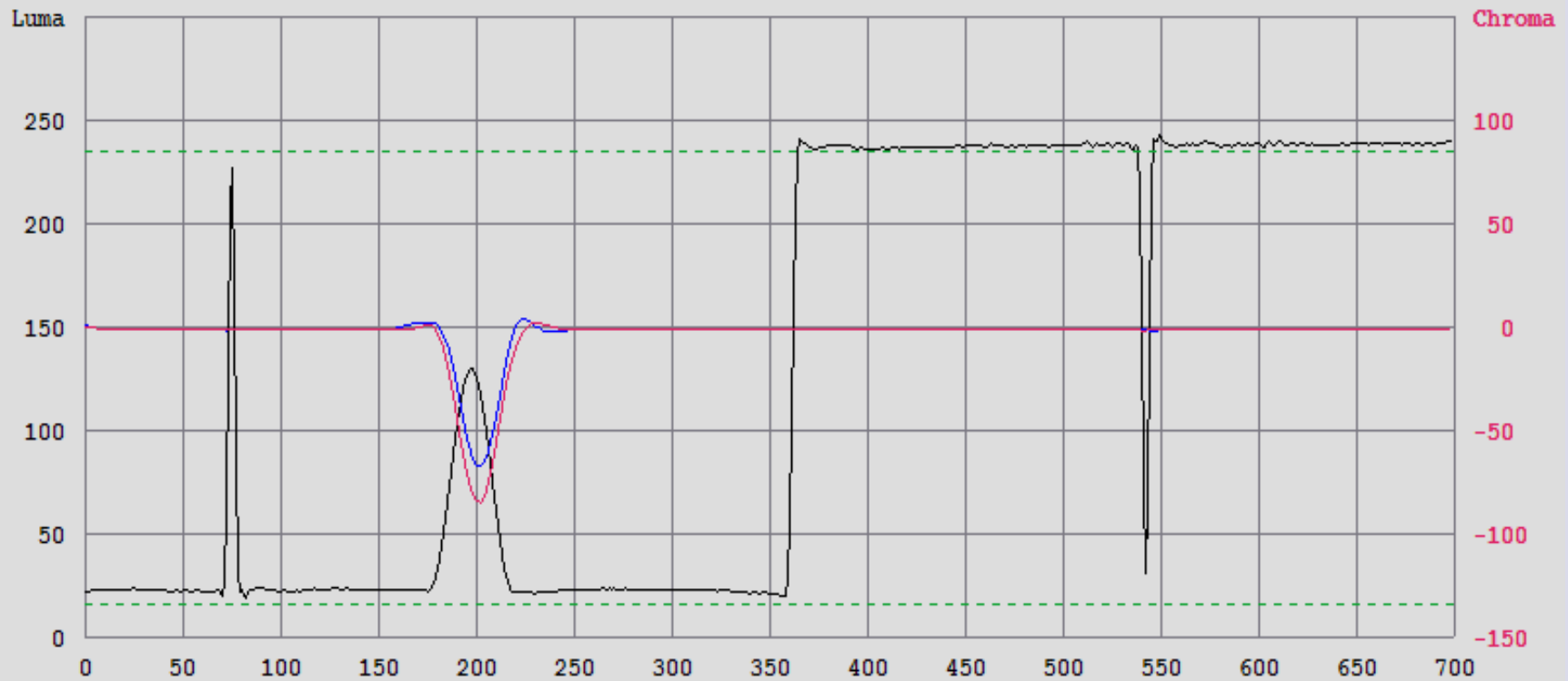
Frequency Response

-0.04 dB @ 1.0 MHz	-7.41 dB @ 3.58 MHz
-1.11 dB @ 2.0 MHz	-26.16 dB @ 4.2 MHz
-3.06 dB @ 3.0 MHz	-31.43 dB @ 5.8 MHz
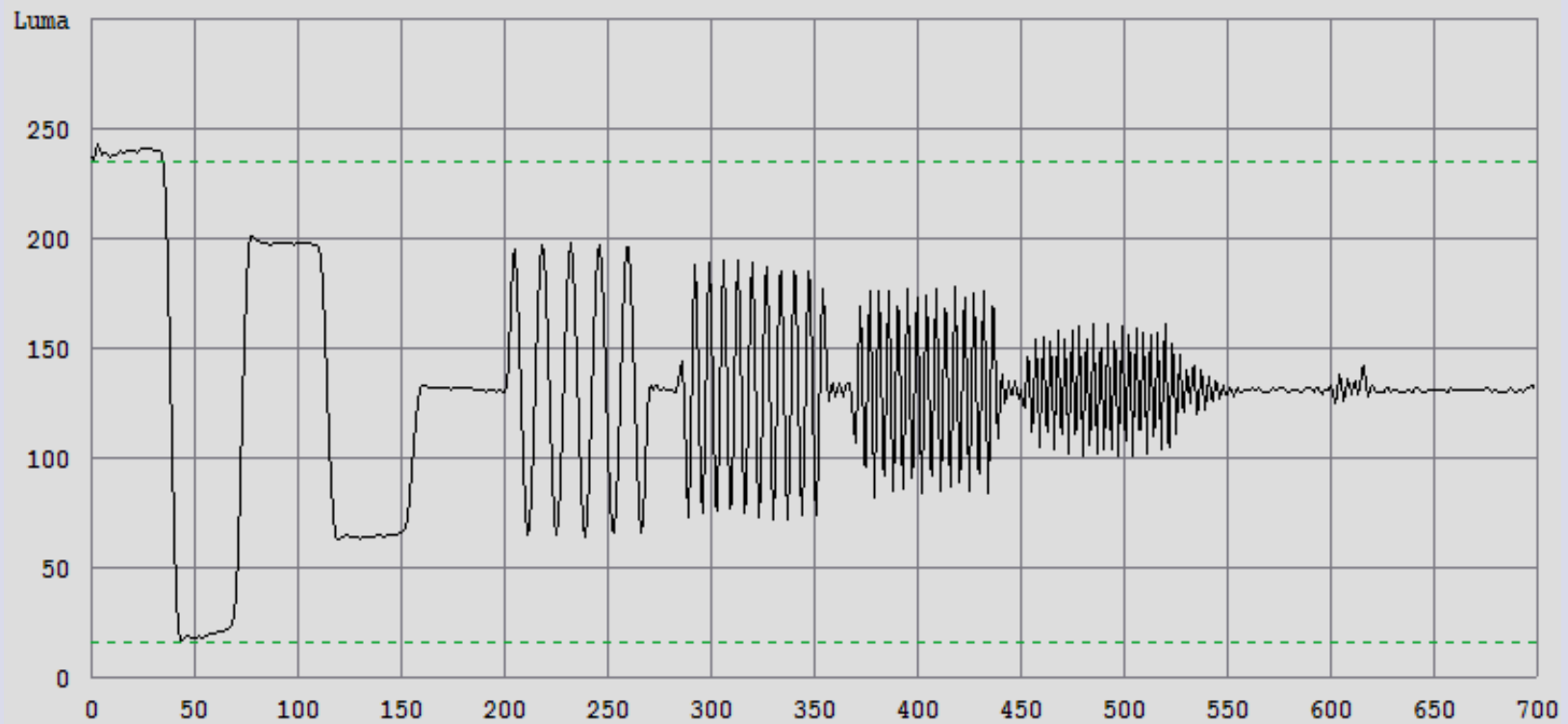
Differential Gain & Differential Phase

Chroma Vectors

Chroma(Cb, Cr) Vectors in Percent of full D1 Range
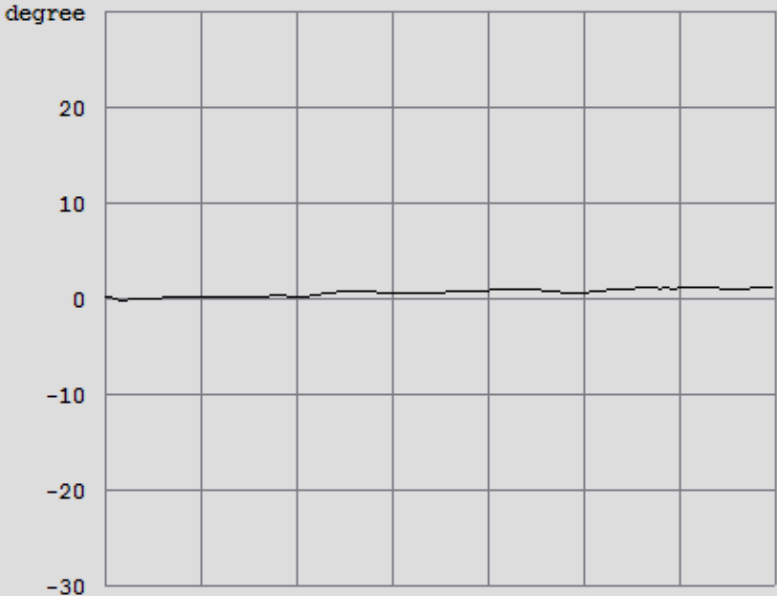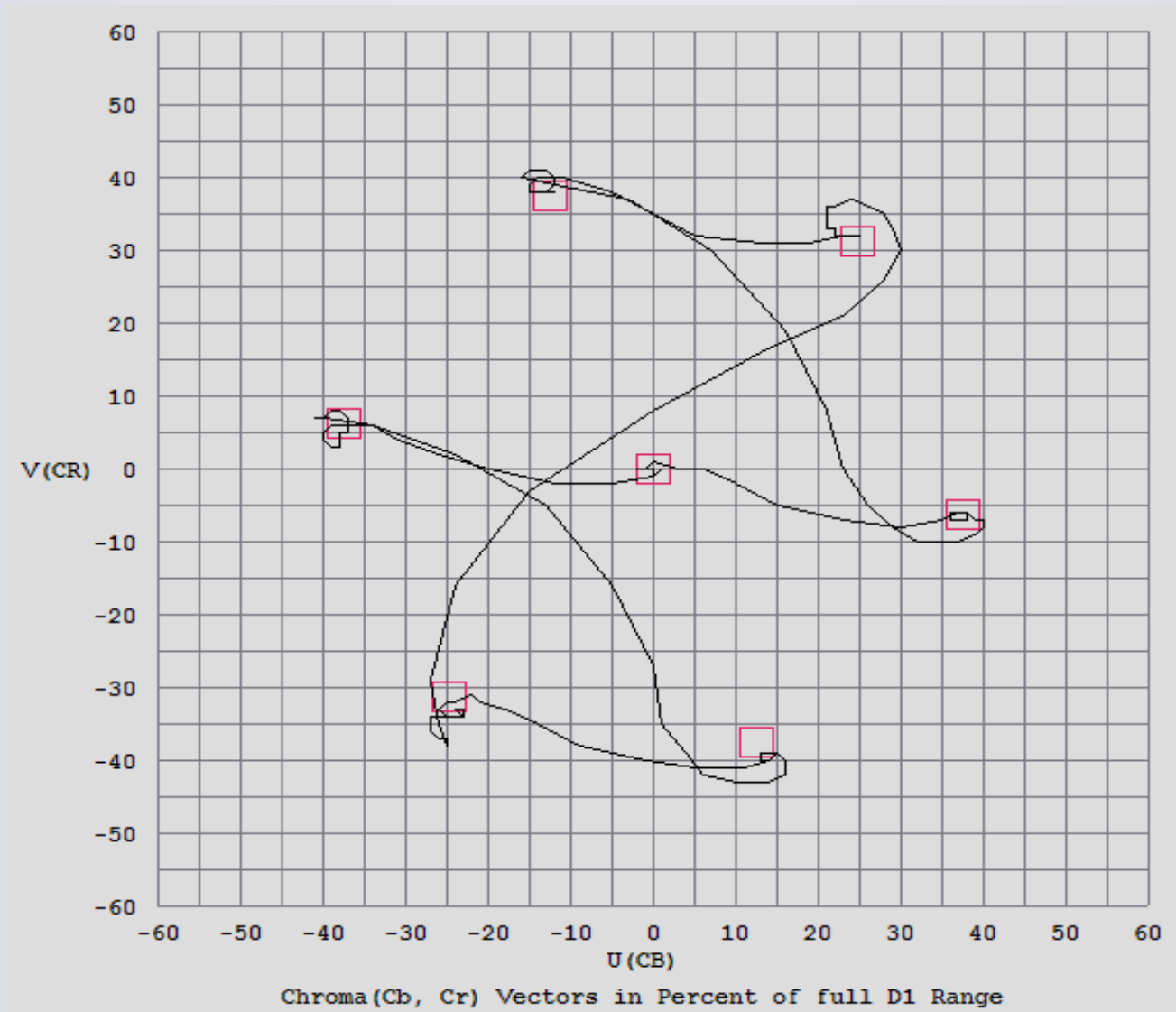
Noise Measurement Results

```
Y Noise Level RMS    3.56 (8 bit level)
Y SNR unfiltered     35.79 dB                    UV SNR 1.5 MHz   43.36 dB
Y SNR 4.2 MHz        36.13 dB       Y SNR 4.2 MHz weighted   42.08 dB
Y SNR 6.0 MHz        36.10 dB       Y SNR 6.0 MHz weighted   42.07 dB
```
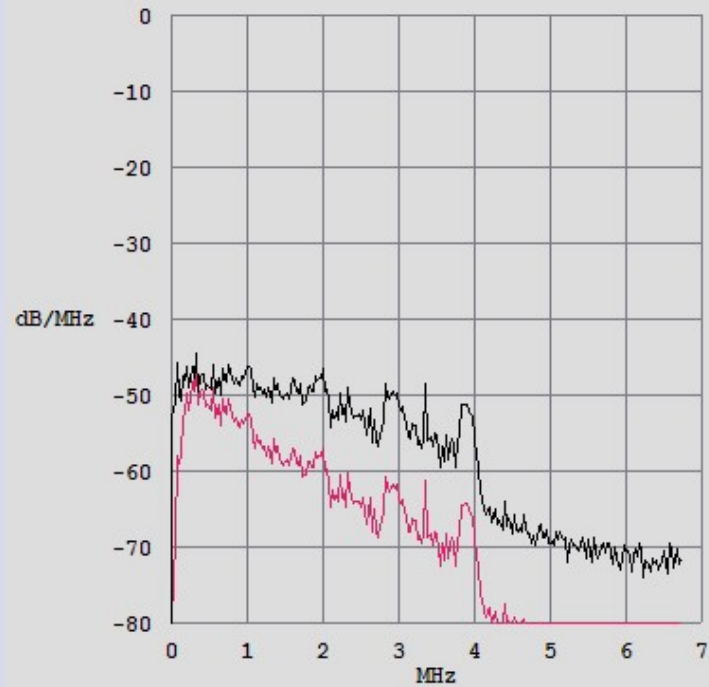

Noise Spectrum

Noise weighted in red

8 x Noise

Noise Spectrum Display

Low Level
Interference
Signal
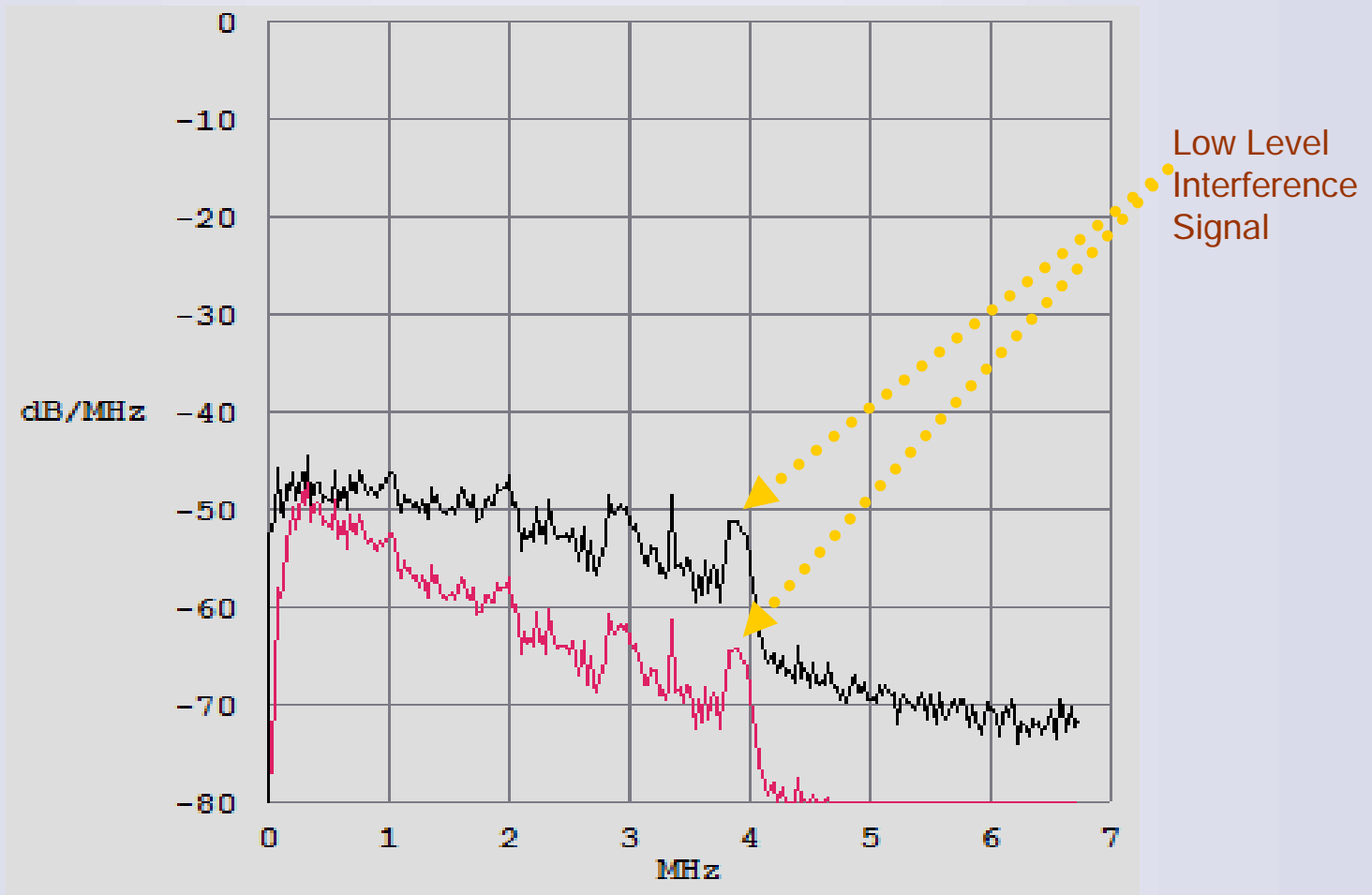
Noise Pattern View – contrast magnified

In this example: both additive noise & sync jitter are visible

Adjusting TV Capture Card - VQMA Application Example

With VQM it takes few minutes – not many hours as before

Process and results are fully documented in the report file .PDF

Automated Mode – Fragment of VQMA Log File

VideoQ Inc. Copyright [c] 2005-2008

V2.4.1, 03/31/08 12:13:14 PM

BL, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 2.8, %, Success

WL, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 99.3, %, Success

SNR, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 52.23, dB, Success

KR, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 0.94, %, Success

CYG, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 1.51, dB, Failure

CYD, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 2, ns, Success

DG, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 1.21, %, Success

DP, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 0.8, degree, Success

FR1, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, 0.12, dB, Success

FR2, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, -0.77, dB, Success

FR3, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, -1.35, dB, Failure

FR36, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, -1.88, dB, Failure

FR42, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, -3.05, dB, Failure

FR58, 10/19/05 2:13:14 PM, 10/19/05 2:13:14 PM, Success, -4.38, dB, Failure

Customizable VQMA Target Values – Fragment of .INI File

```
VQNTSC.ini - VideoQ inc. Copyright [c] 2005 - 2008
; [BL]
; BLUNIT=%
; BLMIN=-5.00
; BLMAX=5.00
; [WL]
; WLUNIT=%
; WLMIN=95.00
; WLMAX=105.00
………
.........
; [SNR]
; SNRUNIT=dB
; SNRMIN=40.00
; [KR]
; KRUNIT=%
; KRMAX=3.00
; FR36MAX=1.00
; [FR42]
; FR42UNIT=dB
; FR42MIN=-1.00
; FR42MAX=1.00
; [FR58]
; FR58UNIT=dB
; FR58MIN=-1.00
; FR58MAX=1.00
```

What's In The Box

VQMA Software CD

NTSC Test Patterns DVD

PAL Test Patterns DVD

**Copy Protection
USB Dongle**
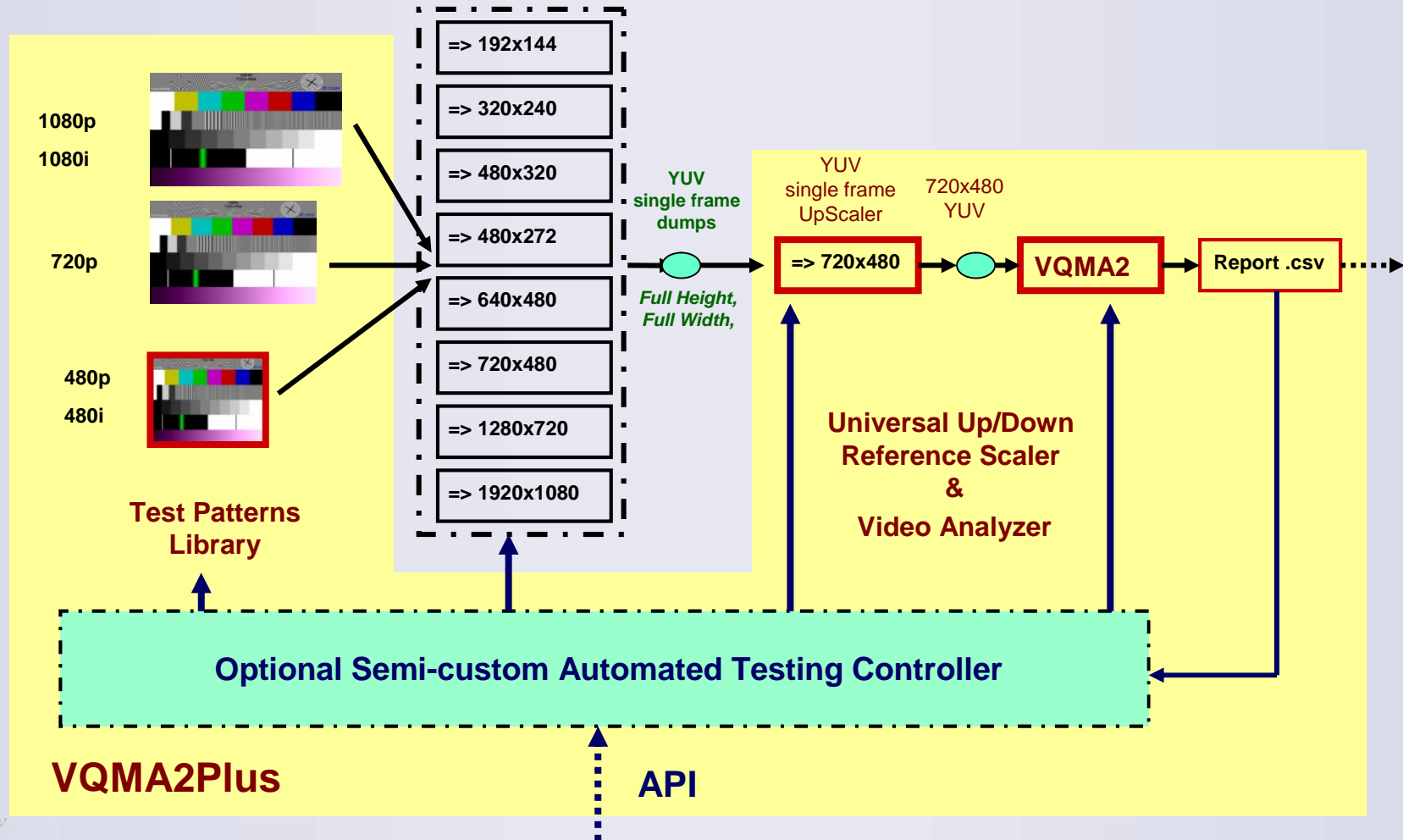
Other VQMA-related VideoQ Products

VQL/VQMA for Multi-Resolution Applications

Input test files,
e.g. MP2 TS

Devices
under test

Batch Processor (.bat):
one device & one source/target set per run

1080p
1080i

720p

480p
480i

**Test Patterns
Library**

=> 192x144
=> 320x240
=> 480x320
=> 480x272
=> 640x480
=> 720x480
=> 1280x720
=> 1920x1080

YUV
single frame
dumps

*Full Height,
Full Width,*

YUV
single frame
UpScaler

720x480
YUV

=> 720x480

VQMA2

Report .csv

**Universal Up/Down
Reference Scaler
&
Video Analyzer**

Optional Semi-custom Automated Testing Controller

VQMA2Plus

API

VQL – Library of Test Files

ScalTracker

ZonTracker

ZonTracker

SD Digital & Analog

Color Gamut Palettes

Line-based Tests

Audio Tests
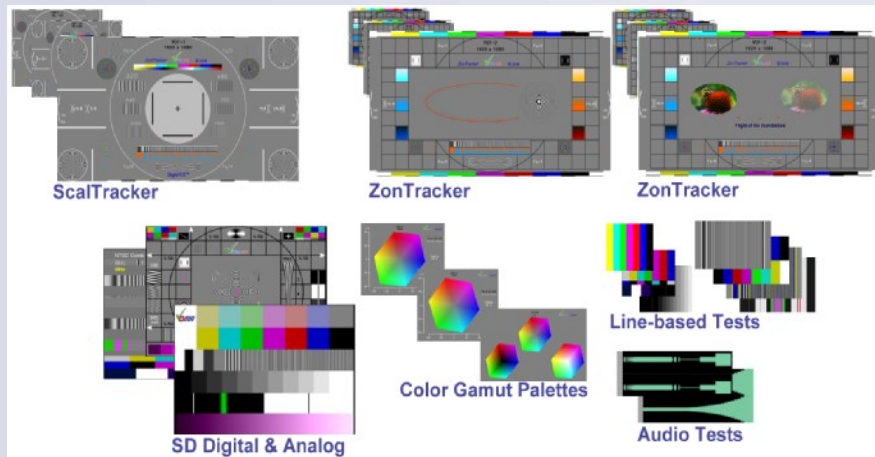
Software Coders, Transcoders, Players, Analyzers

VQL Compatible Hardware Players/Generators

3Genie by NuMedia

Rackmount & Pedestal

VQTS by VideoQ

Other (3rd party) players

VQTS – PC-based Generator-Analyzers

- **Target Applications:**
  - R&D Labs Development, Verification & QA
  - Factory Automation & QA/QC
- **Modular architecture, containing:**
  - VQL Test Files Library
  - VQMA Family of SW Analyzers
- **Multi-standard, multi-format VQL test library playout:**
  - HDMI/DVI, VGA, YPrPb, CVBS
  - HDSDI - option
- **Multi-standard, multi-format video capture:**
  - HDMI/DVI, VGA, YPrPb, CVBS
  - HDSDI - option
- **Full Custom SW Automation Shell**

VQB – Video Quality Benchmarking Tool

VQB is a sophisticated video benchmarking tool for multiple segments of IPTV, PC and CE industries. It is targeted at:

l   Industry analysts

l   Computers, video servers and related hardware manufacturers

l   GPU and CPU suppliers

l   Software developers

l   System integrators

l   PC-based home theatre installers and customers

l   PC users interested in getting top video performance