VideoQ VQB

Video Quality Benchmarking

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VQB Target Applications

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

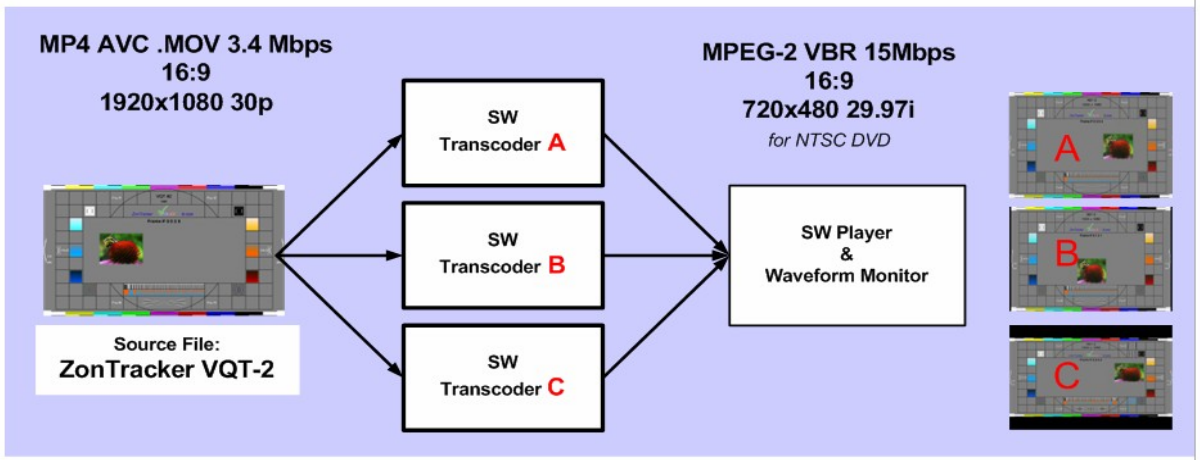
- Industry analysts
- Computers, video servers and related hardware manufacturers
- GPU and CPU suppliers
- Software developers
- System integrators
- PC-based home theatre installers and customers
- PC users interested in getting top video performance

VQB Methodology

All parameters critical for video quality of professional, semi-professional and consumer devices can be sub-divided into two classes:

1. **Classical** (deterministic) video processors parameters:
   - Picture Size, Aspect Ratio and Position, Black Bands (Letterbox/Pillar-box)
   - Y and UV Gain and Offset
   - Frequency Response, including its off-band part, i.e. Aliasing
   - Pulse Response (K-rating)
   - Inter-frame Random Noise and Periodic Interferences
   - Differential Phase and Differential Gain (affected by YUV=>RGB conversion)
2. **Digital Compression** (pseudo-random) artifacts:
   - Blockiness and Mosquito Noise (aka Digital Noise)
   - Video Frames Drop/Freeze and related AV sync problems

VQB Methodology Example



TRANSCODER	A	B	C
Geometry:			
- Scaling	✓	✗	✗
- Cropping	✓	✓	✓
Levels:			
- Luma	✓	✓	✓
- Chroma	✓	✓	✓
Sharpness/Moire:			
- H in-band	✗	✓	✗
- H off-band	✗	✓	✗
- V in-band	✗	✓	✗
- V off-band	✗	✓	✗

Software transcoders **A**, **B** and **C** performed the same task: down-converting HD source file to SD DVD NTSC video files. All three files were played by the same player.

Summary of Transcoders Benchmarking:

VQL methodology allows direct benchmarking without any extra tools involved with unambiguous results - easy to interpret.

VQT-2 clearly demonstrates significant image quality differences between transcoders.

Overall transcoder **B** performance is drastically superior to **A** and **C**, except for narrow vertical black bars, i.e. small horizontal scaling error.

Quality Metrics – ‘Classical’ vs. ‘Digital’

- Two classes of video quality parameters are not only heavily interdependent, but ‘classical’ video parameters often affect video quality much more than ‘modern’ digital artifacts
- Moreover without thorough alignment of all classical parameter there is no point even to start digital parameters evaluation
- Therefore classical parameters ***must*** be measured during ***pre-qualification*** stage (***prior*** to any measurement of digital parameters) and taken into account for final quality verdict
- Skipping classical parameters verification creates misleading situation, when formally better digital parameters are demonstrated whilst paying high price of gravely deteriorated picture quality

VideoQ Approach To Quality Metrics – Pitfalls & Solutions

- Digital noise can be significantly reduced, if frequency response of MPEG pre- and/or post-processor is sacrificed in favor of good PSNR. All attempts to fix codec poor frequency response preserving given bitrate usually result in much worse PSNR values
- Accurate scaling purposed to get correct picture size requires either sophisticated (expensive and slow) multi-tap filters with good frequency response or ‘cheap, cheerful and fast’ filters with inadequate frequency response, which means bad blurred and/or aliased images
- Optimal compromise can be found by combining both ‘classical’ and ‘digital’ parameters in a reasonably balanced weighted sum; since each system has its own specifics, the benchmarking solution should be semi-custom for each case

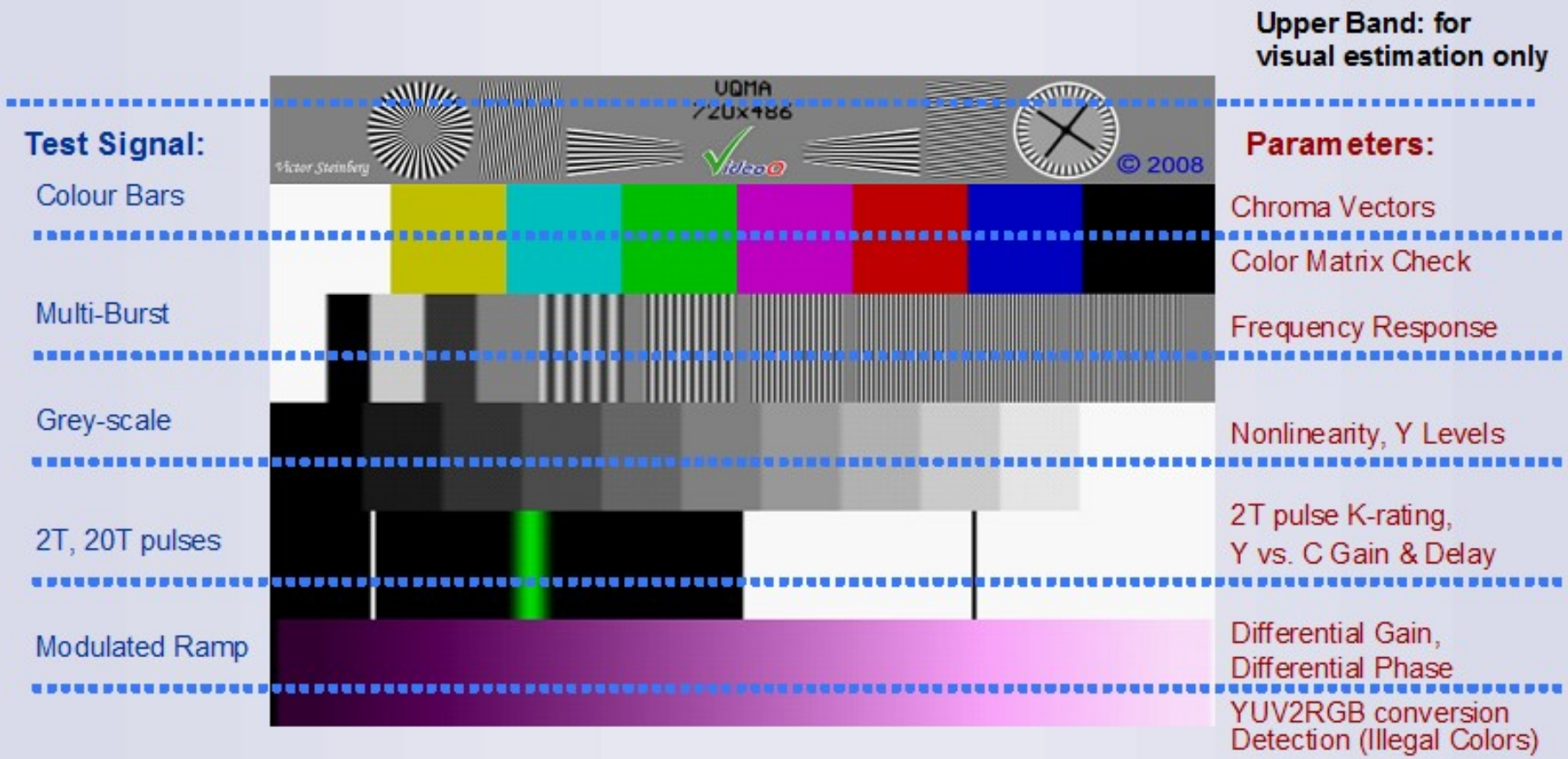
VideoQ VQB Test Environment Set-up Example

This example (few following pages) demonstrates the usage of VideoQ products and technologies for end-to-end objective video quality measurement and subjective visual quality assessment

- Device under the test:
  - '**TiVo Series2 dual channel DVR**' – widely accepted consumer product
- VideoQ products used in this set-up:
  - **VQTS-100** – Test Pattern Generator & Analyzer
  - **VQMA** – Software Analyzer
  - **VQL** – Library of Test Patterns (VQMA, DS, ST and SC patterns used)
- Tool Kit – VideoQ & 3rd party Coders, Decoders, Scalers/Converters

VideoQ VQMA - Auto-Matrix Test Pattern

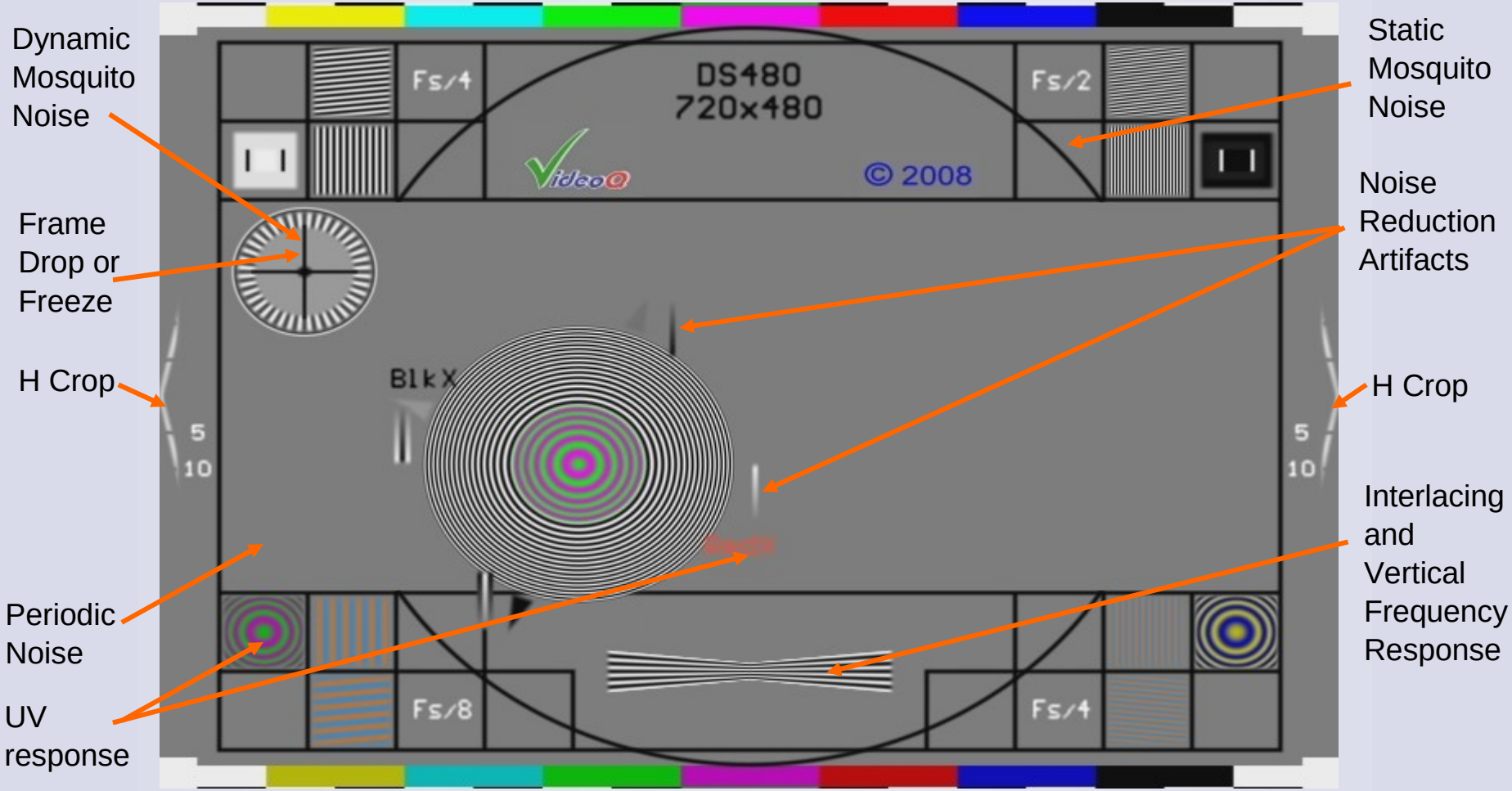
All-In-One: Single pattern allows automatically measure multiple video signal parameters



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

VideoQ VQL DS480 Test Pattern

Parameters Tested and Test Pattern Components

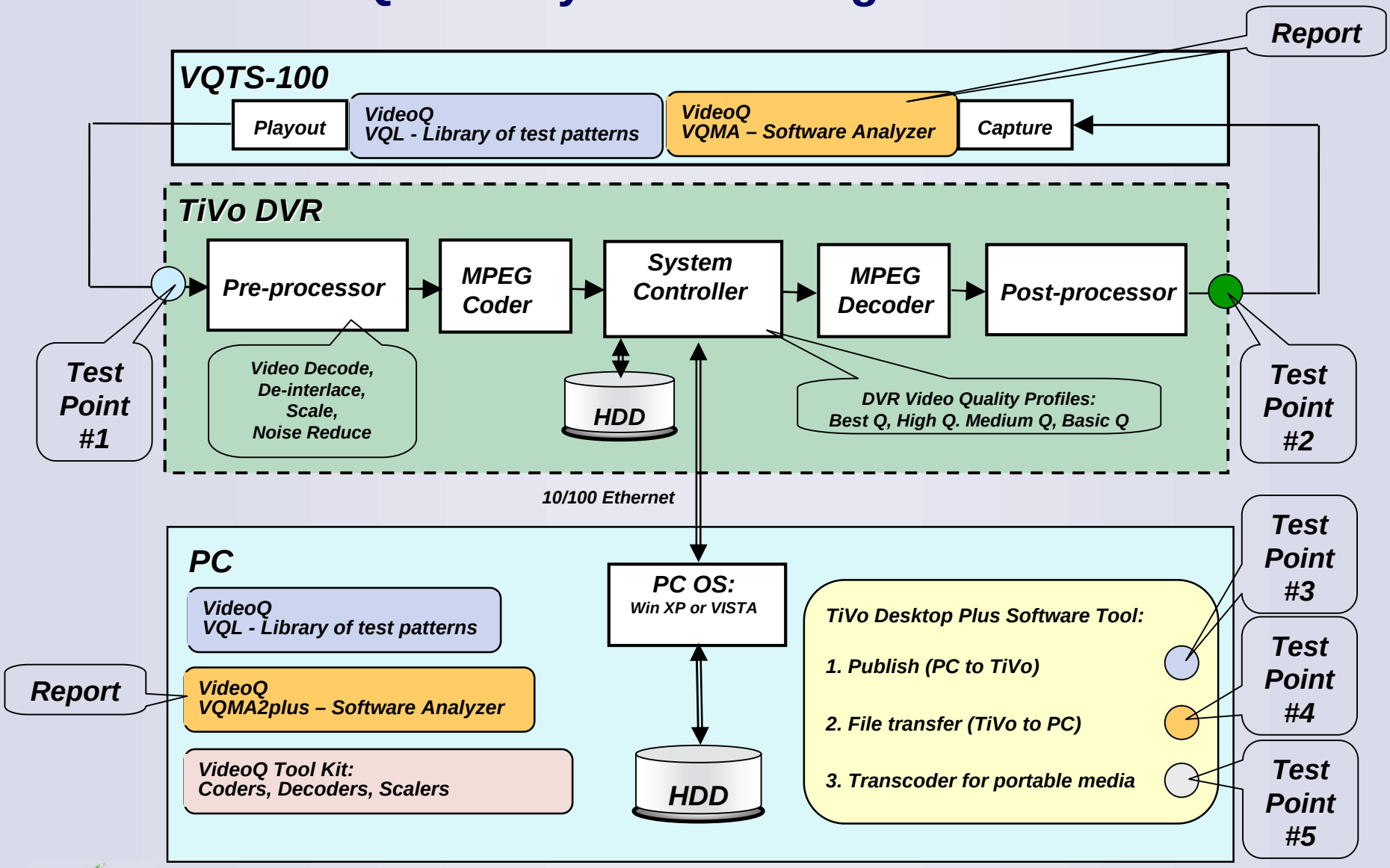


AVC MPEG-TS Pristine Source Quality Screenshot

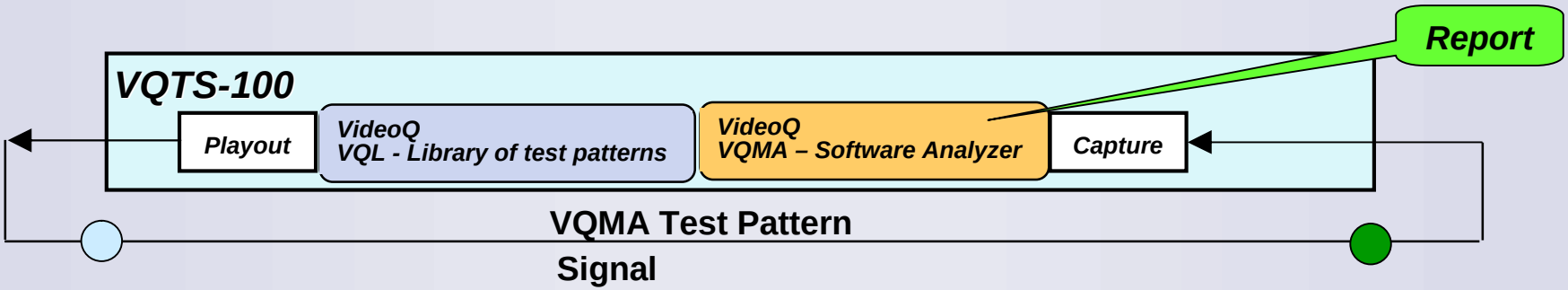
Why TiVo was selected

- TiVo is a popular and a mature high-volume family of consumer products for DVR, IPTV, VOD and other home media applications
- ‘TiVo DVR Series2’ contains key components affecting the perceived video quality:
  - MPEG coder with common video input interfaces
  - MPEG decoder with common video output interfaces
  - Support of PC-based media network with software transcoding
- TiVo DVR is easy-to-get and easy to set-up device
- TiVo DVR comes with ‘TiVo Desktop Plus’ downloadable software transcoder, allowing down-conversion to portable devices formats

VideoQ TiVo System Testing Environment



VideoQ VQTS-100 Self-check Results



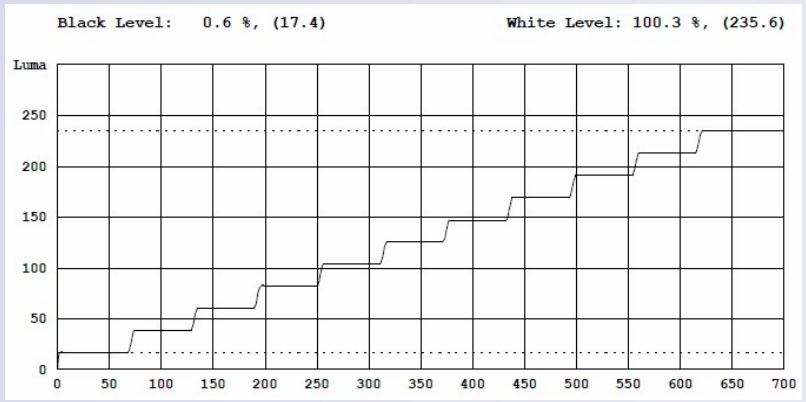
No problem detected. Test results of all parameters: "Pass"

Parameter	Measurement	Unit	Target	Pass
Black Level	0.6 %, (17.4)	%, (8 bits)	-5.0 -- +5.0 %	Yes
White Level	100.3 %, (235.6)	%, (8 bits)	95.0 -- 105.0 %	Yes
Unfiltered Y SNR	55.46	dB	> 40 dB	Yes
K Rating on 2T Pulse	0.25	%	< 3 %	Yes
Chroma vs Luma Gain	0.04	dB	-1.00 -- +1.00 dB	Yes
Chroma vs Luma Delay	1	ns	-40 -- +40 ns	Yes
Differential Gain	0.58	%	< 5 %	Yes
Differential Phase	0.6	degree	< 5 degree	Yes
Freq. Response @ 1.00 MHz	0.04	dB	-1.0 -- +1.0 dB	Yes
Freq. Response @ 2.00 MHz	0.08	dB	-1.0 -- +1.0 dB	Yes
Freq. Response @ 3.00 MHz	-0.03	dB	-1.0 -- +1.0 dB	Yes
Freq. Response @ 3.58 MHz	-0.55	dB	-1.0 -- +1.0 dB	Yes
Freq. Response @ 4.20 MHz	-1.08	dB	-1.2 -- +1.2 dB	Yes
Freq. Response @ 5.80 MHz	-3.39	dB	-3.5 -- +1.0 dB	Yes

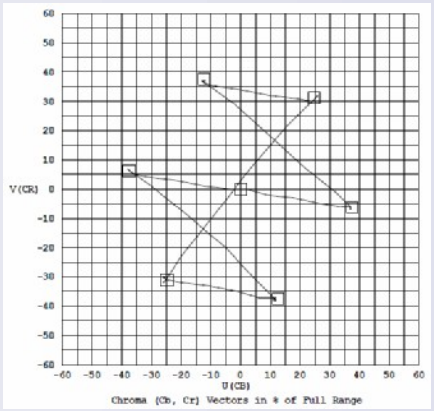
VideoQ VQTS-100 Self-check Results, continued

No problem detected. Test results of all parameters: "Pass"

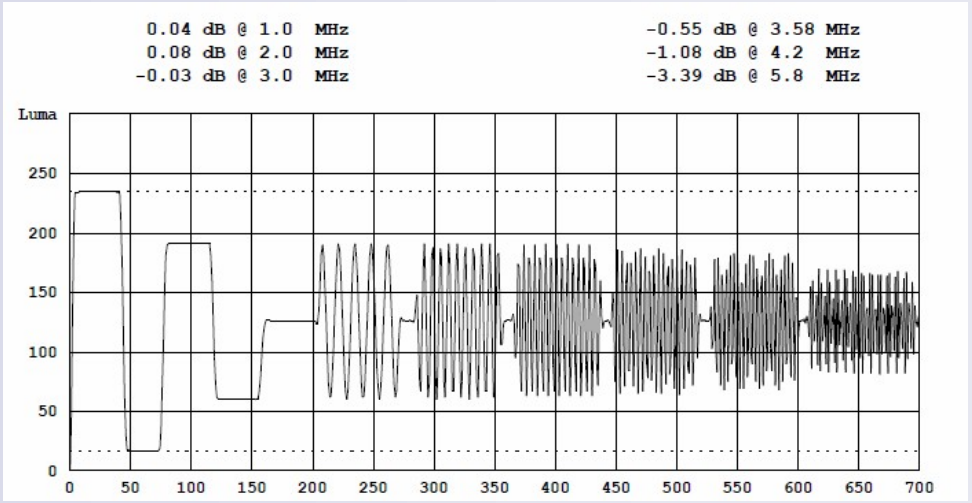
Y Levels: correct



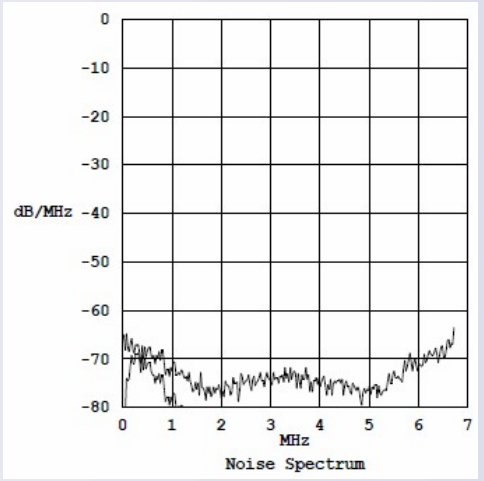
UV Levels: correct



Frequency response: correct

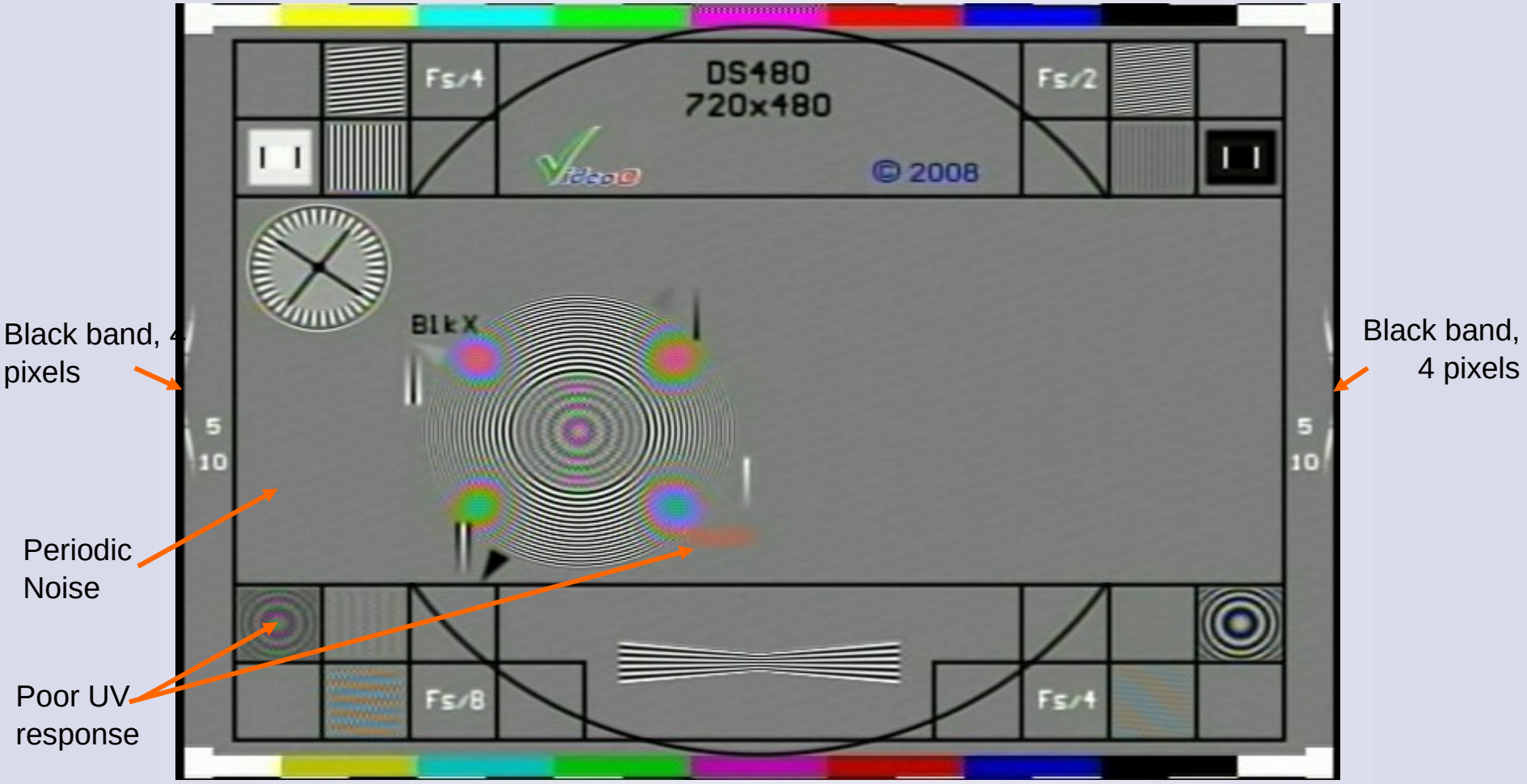


Noise and Interferences: low



Test Results Example #1: TP1=>TP2 ‘DVR - Best Quality’

Problems detected: Horizontal Size, Black Curtains, UV Response, Noise



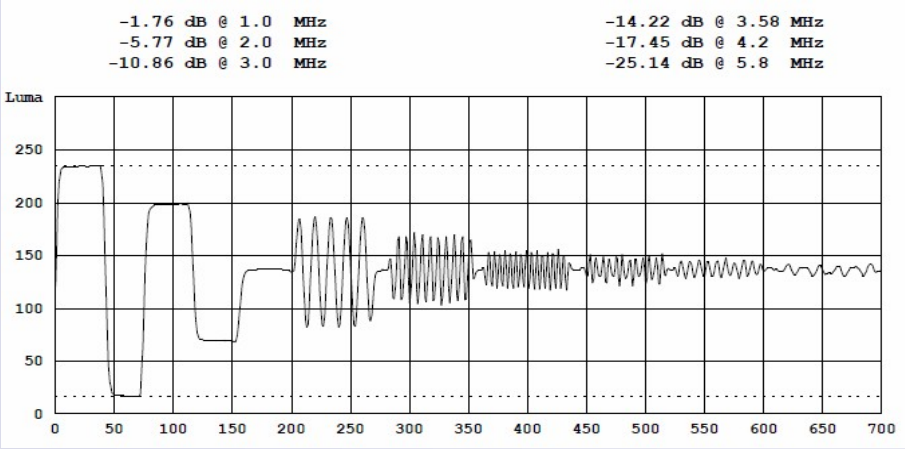
Test Results Example #2: TP4=>TP5 'iPod'

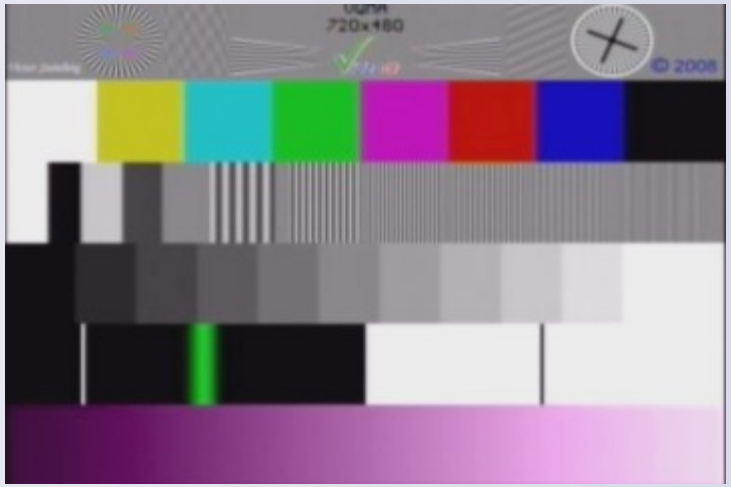
Serious problems detected: vertical and horizontal scaling

Frequency response drop of **6dB** @2MHz (vs. **2dB** in 'DVR Best Quality' mode) is caused by multi-stage vertical and horizontal scaling from 720x480 to 544x480, then 544x480 to 320x240 (iPod), and optionally from 320x240 to 720x480.

Resulting picture looks very soft even in native iPod resolution**.**

Parameter	Measurement	Unit	Target	Pass
Black Level	0.9 %, (18.0)	%, (8 bits)	-5.0 -- +5.0 %	Yes
White Level	100.0 %, (235.0)	%, (8 bits)	95.0 -- 105.0 %	Yes
Unfiltered Y SNR	51.09	dB	> 40 dB	Yes
K Rating on 2T Pulse	8.35	%	< 3 %	No
Chroma vs Luma Gain	-1.04	dB	-1.00 -- +1.00 dB	No
Chroma vs Luma Delay	-1	ns	-40 -- +40 ns	Yes
Differential Gain	54.79	%	< 5 %	No
Differential Phase	2.0	degree	< 5 degree	Yes
Freq. Response @ 1.00 MHz	-1.76	dB	-1.0 -- +1.0 dB	No
Freq. Response @ 2.00 MHz	-5.77	dB	-1.0 -- +1.0 dB	No
Freq. Response @ 3.00 MHz	-10.86	dB	-1.0 -- +1.0 dB	No
Freq. Response @ 3.58 MHz	-14.22	dB	-1.0 -- +1.0 dB	No
Freq. Response @ 4.20 MHz	-17.45	dB	-1.0 -- +1.0 dB	No
Freq. Response @ 5.80 MHz	-25.14	dB	-3.0 -- +1.0 dB	No





TiVo Test Results – Overall Summary

Full VideoQ TiVo Test Report is available on request

Video Gain and Level Offset:

- Y – Correct
- UV – Good

Scaling:

- V size – Correct
- H size – Slightly wrong, black bands, left and right, up to 12 pixels wide
- Down-conversion (portable devices scaler) – Bad, both H & V Frequency Responses

Frequency Response and Pulse Response:

- Horizontal Y – Poor, Vertical Y – Poor
- Horizontal UV – Bad, Vertical UV – Bad

Random Noise & Interferences:

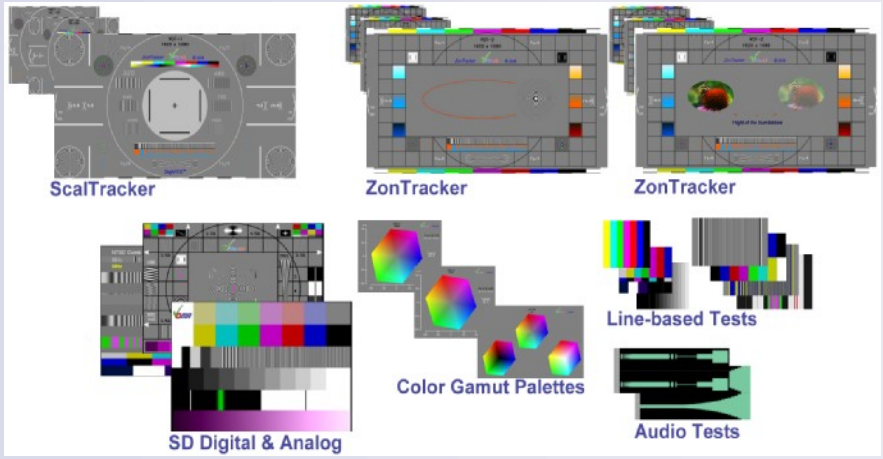
- Y and UV Random Noise – Good, no noticeable artifacts due to Noise Reduction
- Interference – Bad, noticeable periodic interference in 'Best Quality' mode

Digital Compression Artifacts:

- Blockiness – Medium
- Mosquito Noise – Poor, noticeable in all DVR modes

Other VQB-related VideoQ Products

VQL – Library of Test Files



Software Coders, Transcoders, Players, Analyzers

VQL Compatible Hardware Players/Generators

3Genie by NuMedia

VQTS by VideoQ

Other (3rd party) players

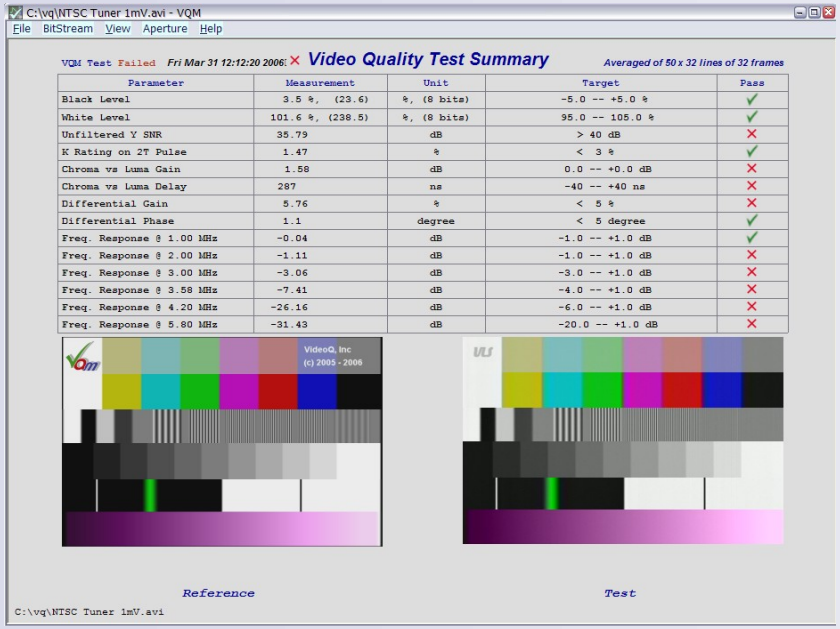
VQTS – PC-based Generator-Analyzers

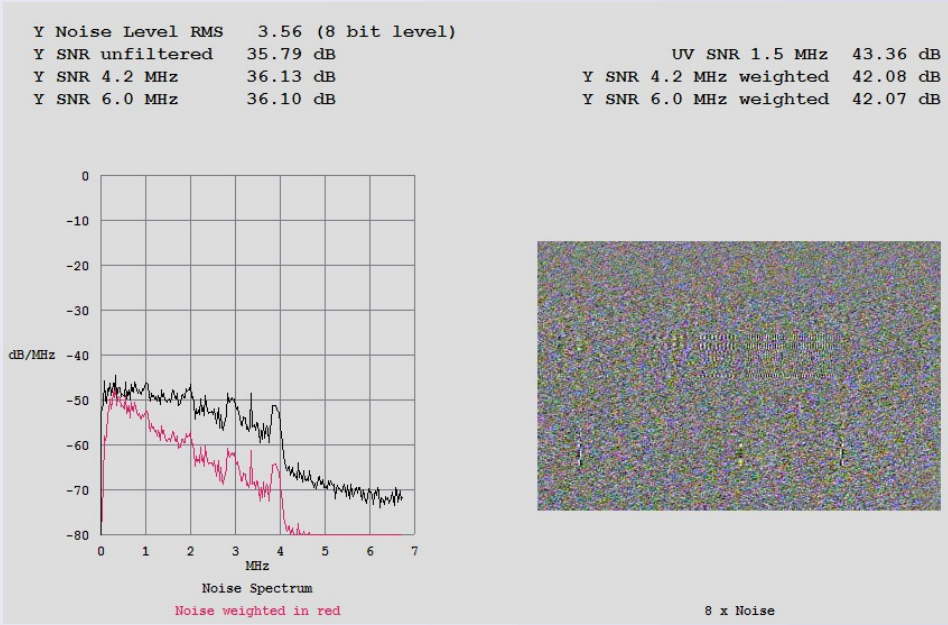
- **Target Applications:**
  - R&D Labs Development, Verification & QA
  - Factory Automation & QA/QC
- **Modular architecture, containing:**
  - VQL Test Files Library
  - VQMA Family of SW Analyzers
- **Multi-standard, multi-format VQL test library playout:**
  - HDMI/DVI, VGA, YPrPb, CVBS
  - HDSDI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

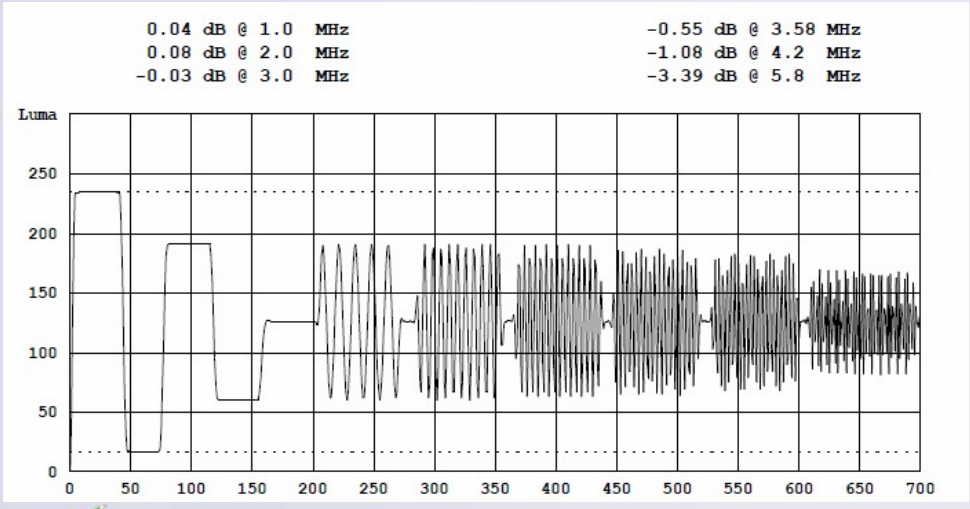
VQMA – Software Suite for Video Quality Measurements

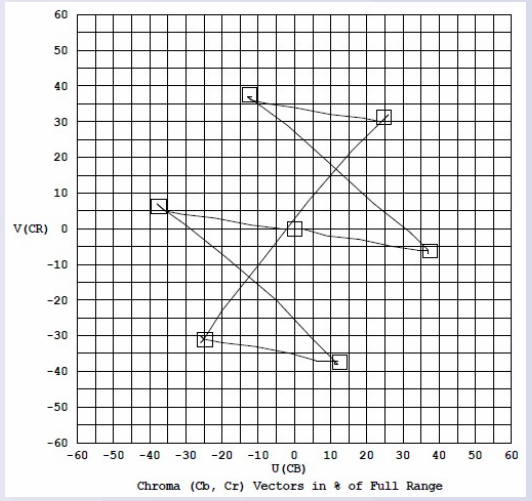
- Pre-qualification objective video measurements of file-based environment in a full range of resolutions from HD to Portable Media Devices
- Accurate measurements on transcoded static images of any resolution by analysis of the standard VQMA test pattern
- Library of source test patterns of different resolutions, similar layout and the same coding format
- Programmable tolerance settings for pass/fail test
- Optional semi-custom Automated Testing Controller for full robotic usage
- Detailed PDF report documents can be printed off-line, if required

VQMA Screenshots









VQL/VQMA in Multi-Resolution Applications