A Video Quality Test & Measurements Collection

Version 4.1s, May 2009

*Sub-set for VideoQ **VQS-200***

VideoQ, Inc.

VideoQ is a California-based company, focused on video test & measurement and video enhancement technologies, products and services.

More than 50 man-years of award-winning experience in the field of Broadcast, Consumer Electronics, Transcoding and Video Data Compression.

Critical Picture Quality Technologies for Broadcast, Consumer Electronics, Transcoding, Video Data Compression, SDTV, HDTV, Digital Cinema, Mobile TV, IPTV.
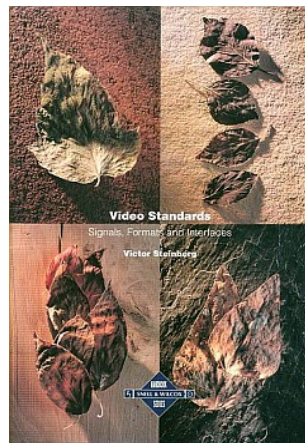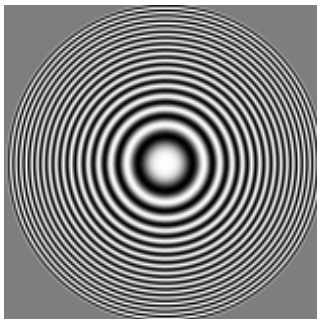
VQS-200 – Reference HDMI/SPDIF Source

- **Ultra-compact AV Test Source**

- **SD and HD playback, user selectable HDMI output format:**
  - 480p@60, 576p@50, 720p@50, 720p@60
  - 1080i@50, 1080i@60, 1080p@24, 1080p50, 1080p@60

- **Slide-show with adjustable speed:**
  BMP images, including Static Test Patterns

- **HDMI 1.3 output:** 16-235 and 0-255 level schemes switchable by test file selection

- **Flexible pixels mapping and scaling:**
  - No scaling (dot-by-dot), if file resolution matches HDMI resolution
  - Up- and down- scaling to match the HDMI resolution, if AutoScaling=On

- **Easy expansion with any external USB storage device**
  (live clips, user content, etc.)

- **Codecs & Formats:** MP2, MP4, H264/AVC; AVI, MP4, VOB, TS, M2TS

- **Easy Navigation:** thru straight forward folders and files with Remote Control

- **SPDIF 5.1. and Analog Audio (L+R) out, AC3 & MP3**

- **Auxiliary CVBS output (NTSC/PAL)**

VQS-200 Library Structure

1. Static Basic Tests

Aimed at testing YUV/RGB levels and YUV/RGB frequency response

2. Static Advanced Tests

Aimed at checking display gamma, color space conversion (matrixing) and gradations linearity

3. Visual ScalTracker Test

Dynamic test aimed at testing cascaded scalers, aspect ratio convertors, and frame rate convertors

4. ZonTracker Test

Multi-purpose universal dynamic test to check overall video performance thru scalers, codecs, etc.

5. Dynamic Contrast Tests

Allows at glance assessment of luminance gradations rendition - static and dynamic, global and local

6. Color Space Explorer Test

Visualize color space transformations - smoothly going thru all 16 millions colors in 8 bit YUV space

7. Audio Tests

1. Static Basic Test Patterns

Resolutions: 720x480, 720x576, 1280x720, and 1920x1080

1.1. Color Bars 100/0/100/0

1.2. Color Bars 100/0/75/0

1.3. SMPTE Bars

1.4. Grayscale, 10steps with PLUGE

1.5. Y Ramp with PLUGE

1.6. Pulses and Bars

1.7. Y Sweep

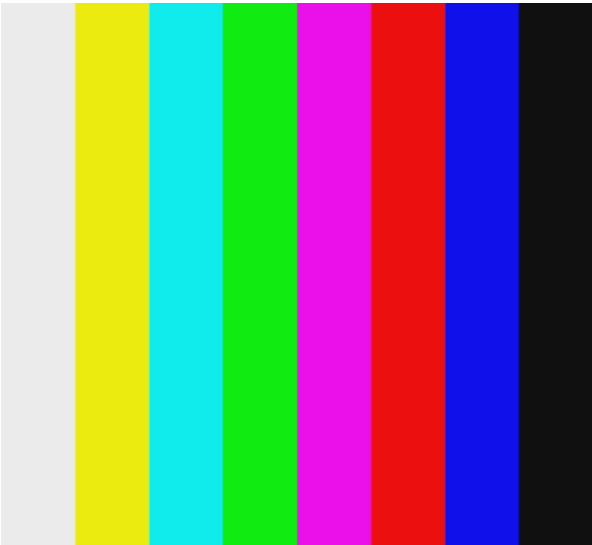1.8. Y Multiburst Digital

1.9. Blue-Yellow Sweep

1.10. UV Sweep
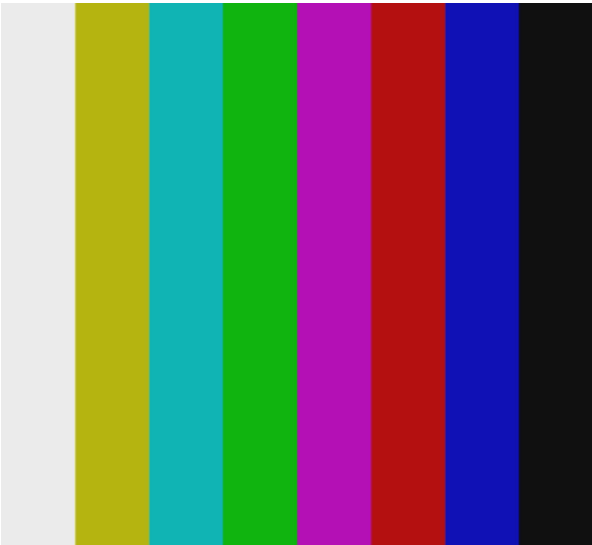
1.11. UV Multiburst Digital

1.12. Valid Ramps

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Static Basic Test Patterns (1)

**1.1. Color Bars
100/0/100/0**

**1.2. Color Bars
100/0/75/0**

1.3 SMPTE Bars

RGB range: 16-235

RGB range: 16-235

RGB range: 16-235

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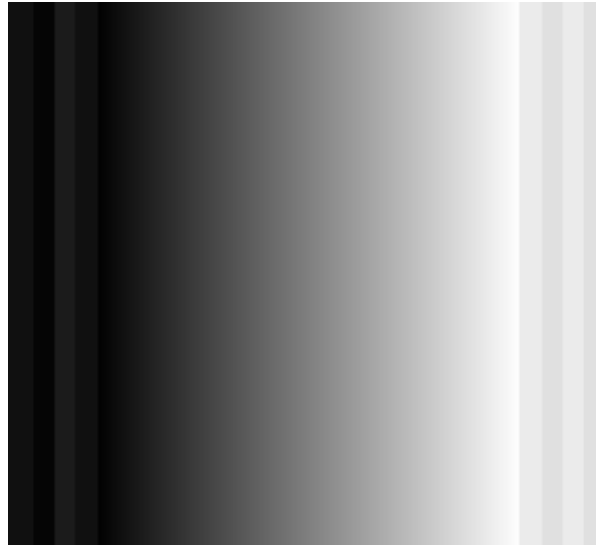# Static Basic Test Patterns (2)

**1.4. Grayscale-10
with PLUGE**
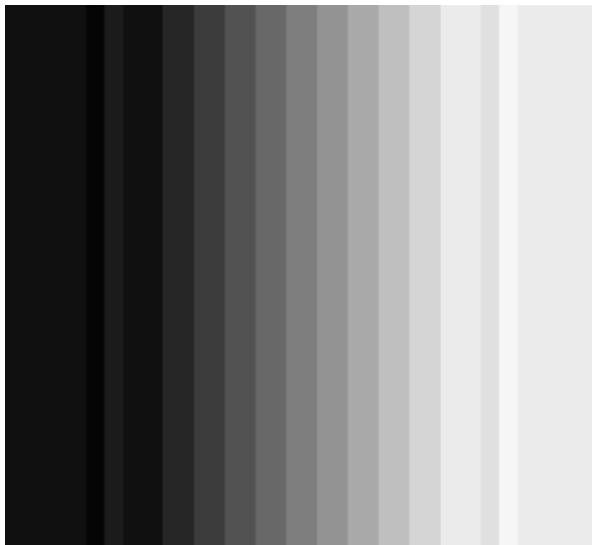
**1.5. Y Ramp
with PLUGE**

1.6. Pulses and Bars

Y range: 16-235
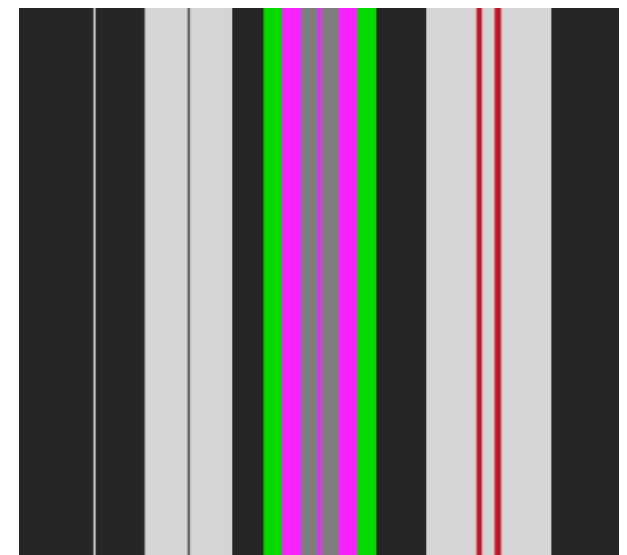
Y range: 16-235

Y range: 16-235

Static Basic Test Patterns (3)

1.7. Y Sweep

1.8. Y Multiburst Digital

1.9 Blue-Yellow Sweep
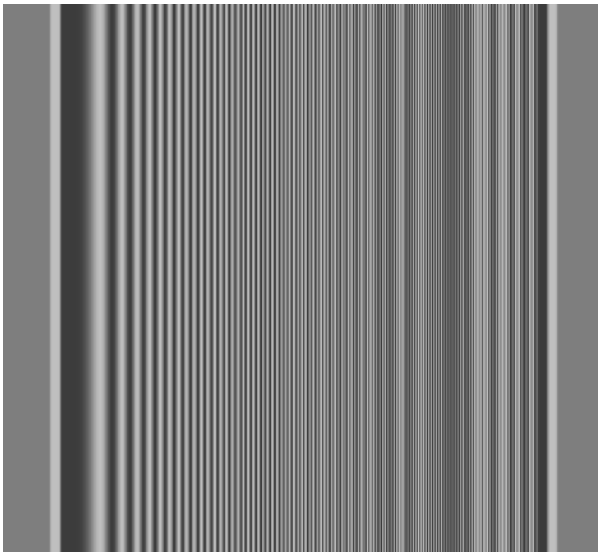
Min Period: 2.5 Y pixels
(Max Frequency 0.4*FY)
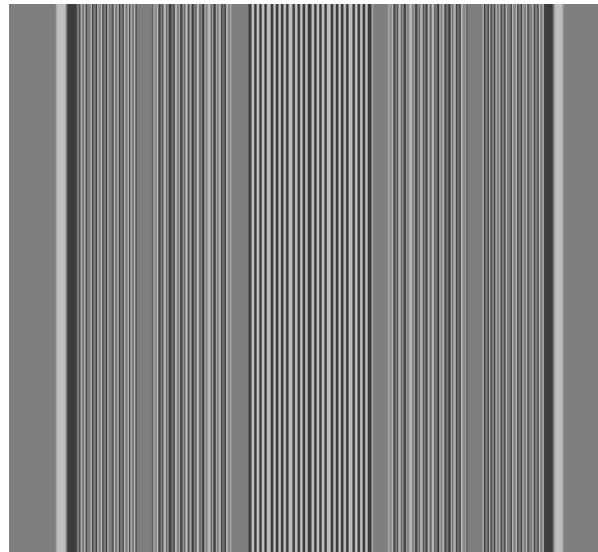
Periods: 2, 2.5, 4 Y pixels
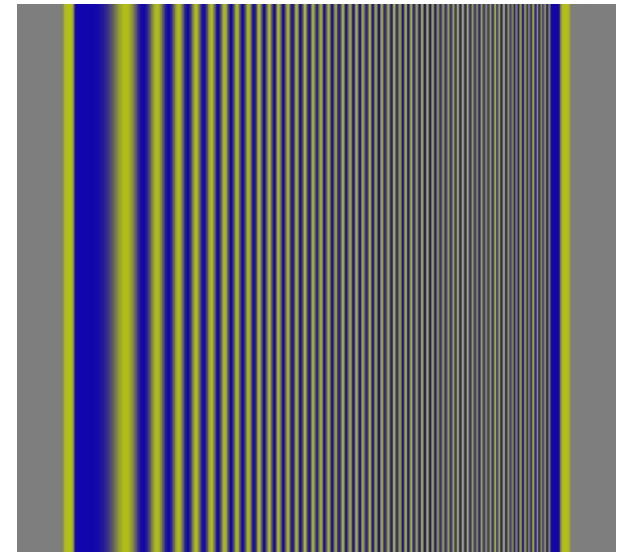
Min Period: 5 Y pixels
(Max Frequency 0.2*FY)

Static Basic Test Patterns (4)

1.10. UV Sweep
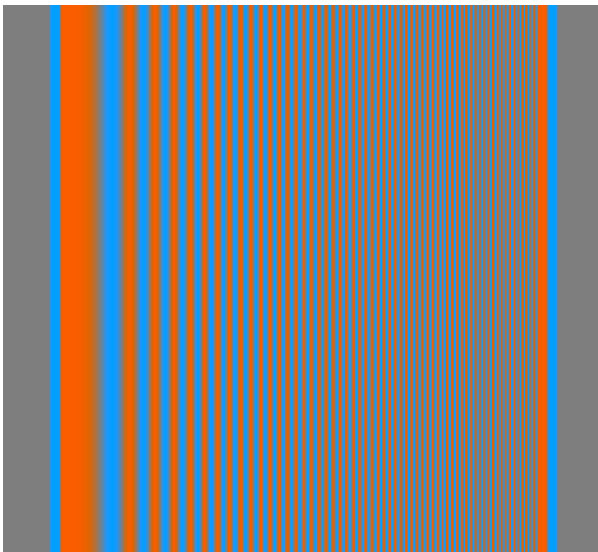
1.11. UV Multiburst Digital

1.12. Valid Ramps

Min Period: 5 Y pixels
*(Max Frequency 0.2*FY)*
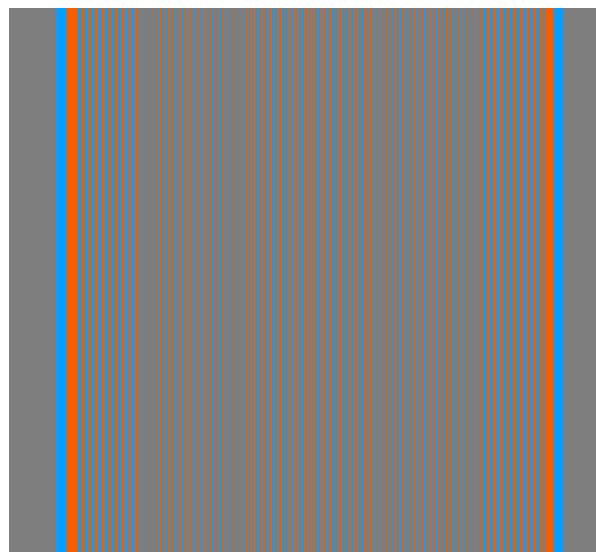
Periods: 4, 5, 8 Y pixels

RGB range: 16-235

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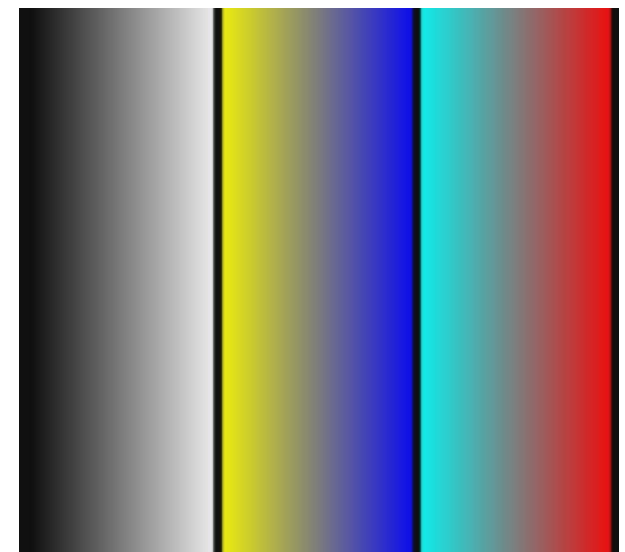
2. Static Advanced Tests

Resolution 1920x1080:

2.1. Split Color Bars, 4 Bands

RGB-to-YUV Matrices 709 and 601, levels schemes 16-235 and 0-255

2.2 Display Gamma Test

Visual Check Test, Gamma Range: 1 to 3.8, Y ranges: 0-50% and 0-75%

2.3 Luminance Linearity Test

Visual check of clipping & banding in three ranges: 215-255, 0-255 and 0-32

2.4 YRGB Gradations Test

Visual check of clipping & banding, separately for Y, R, G, and B

2.1. Split Color Bars 75/0/75/0, 4 Bands

Band #1: 709to709 0-255

Band #2: 709to709 16-235

Band #3: 709to601 0-255

Band #4: 709to601 16-235
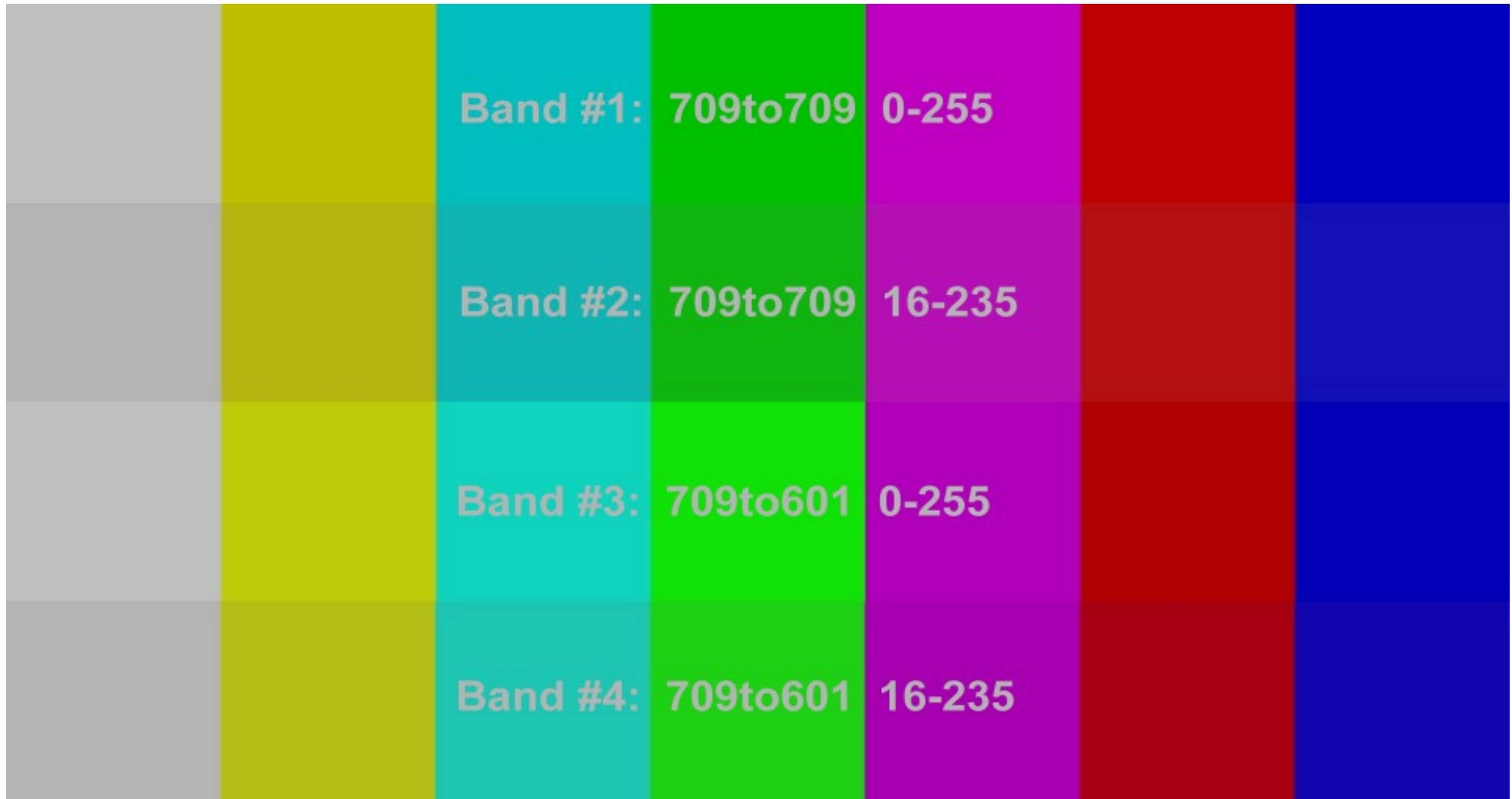
RGB-to-YUV Matrices 709 & 601, levels schemes 16-235 and 0-255

2.2. DG – Display Gamma Test
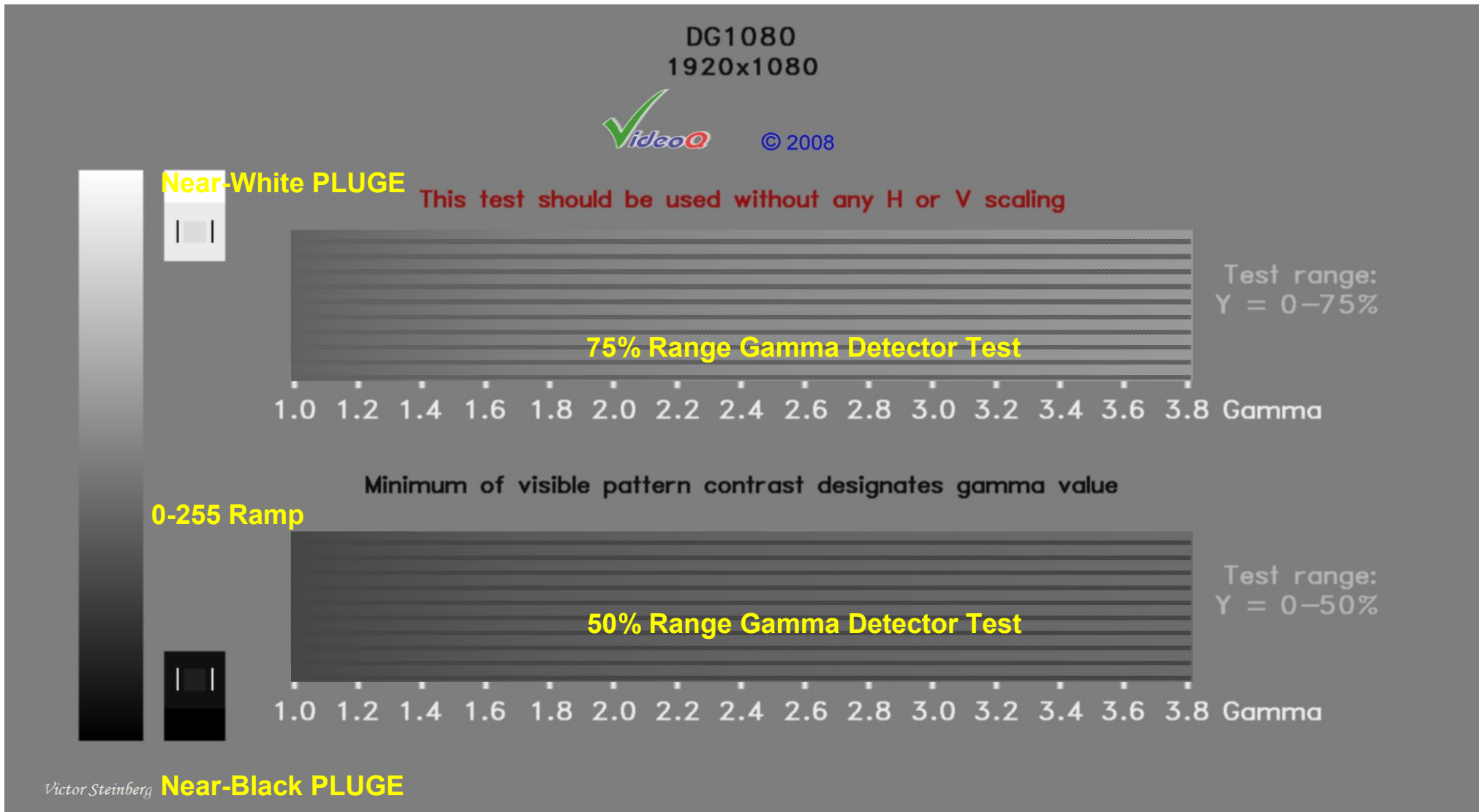
- *Two multi-strip textured bands allow visual assessment of picture display gamma. These bands test gamma values for two corresponding critical sub-ranges of screen brightness: 0%-75% and 0%-50%*

- *Black and white PLUGE components and vertical luminance ramp facilitate proper display set-up prior to actual gamma assessment.*

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2.3. LIN – Luminance Linearity Test

Luminance Linearity
1920x1080

Near-White Shallow Ramp

215   220   225   230   235   240   245   250   255

16

Full Range Ramp with PLUGE

235

8 24 0   25   50   75   100   125   150   175   200   225   250   227
255   255   243

Near-Black Shallow Ramp

0   5   10   15   20   25   30   32
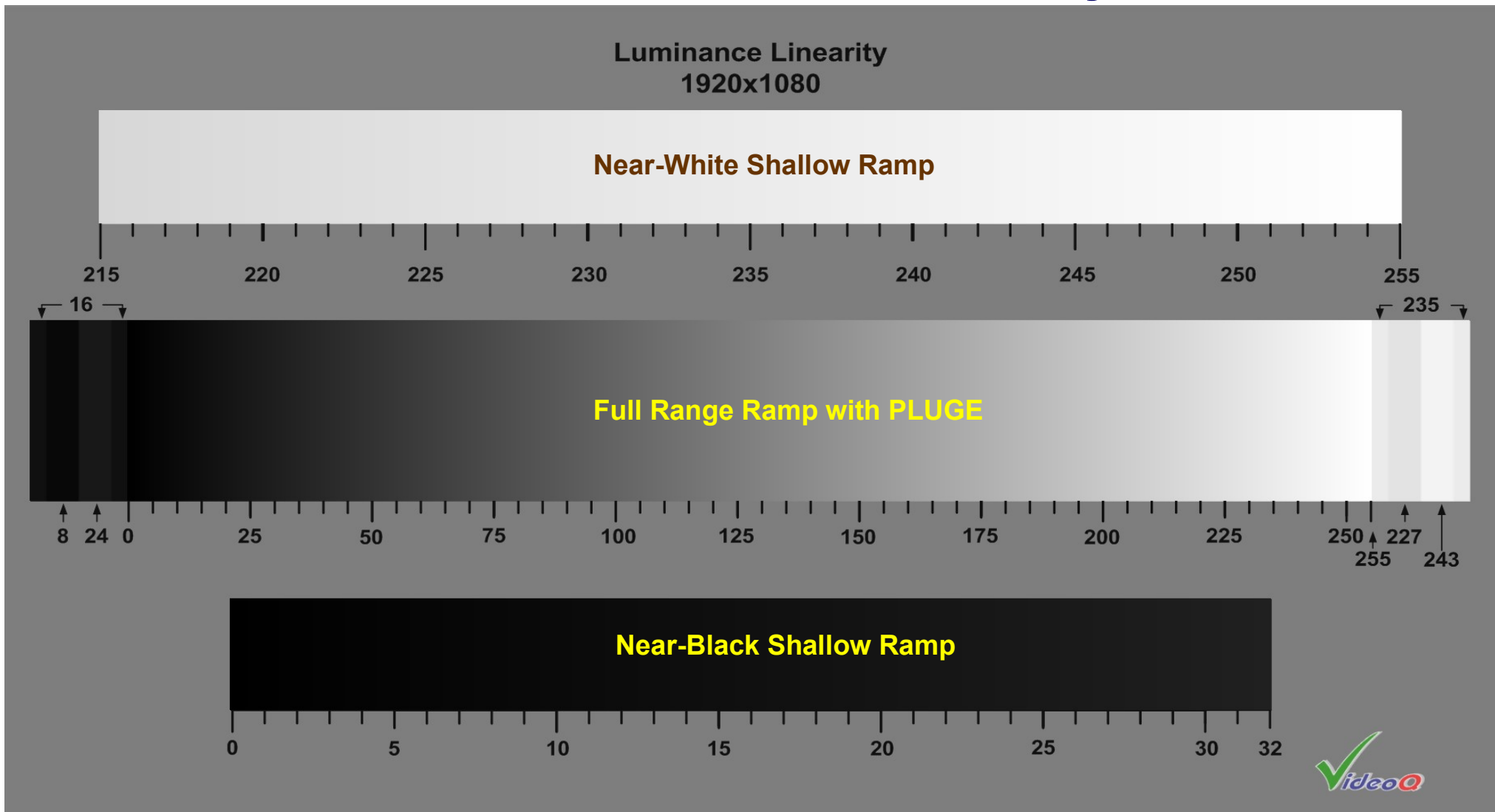
Ÿ *HD static pattern suitable for Luminance Levels and Linearity Accuracy assessment.*

Ÿ *Featuring full luminance range (0-255) ramp and shallow luminance ramps for two sub-ranges near nominal black (16) and nominal white (235) video levels*

LIN - Details Of Full Range Ramp with PLUGEs
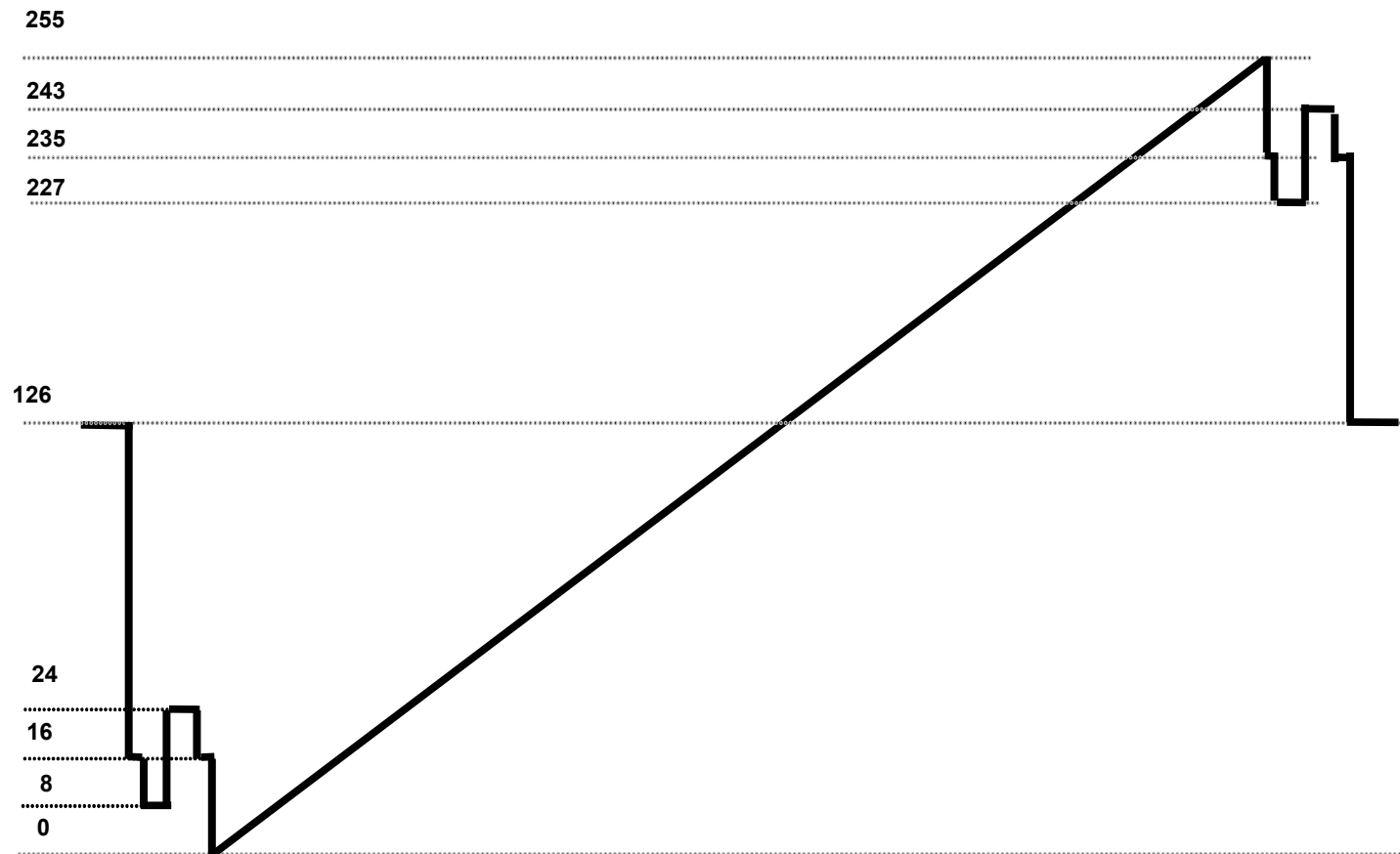
LIN - Details Of Shallow Luminance Ramps

Luminance Linearity
1920 x 1080
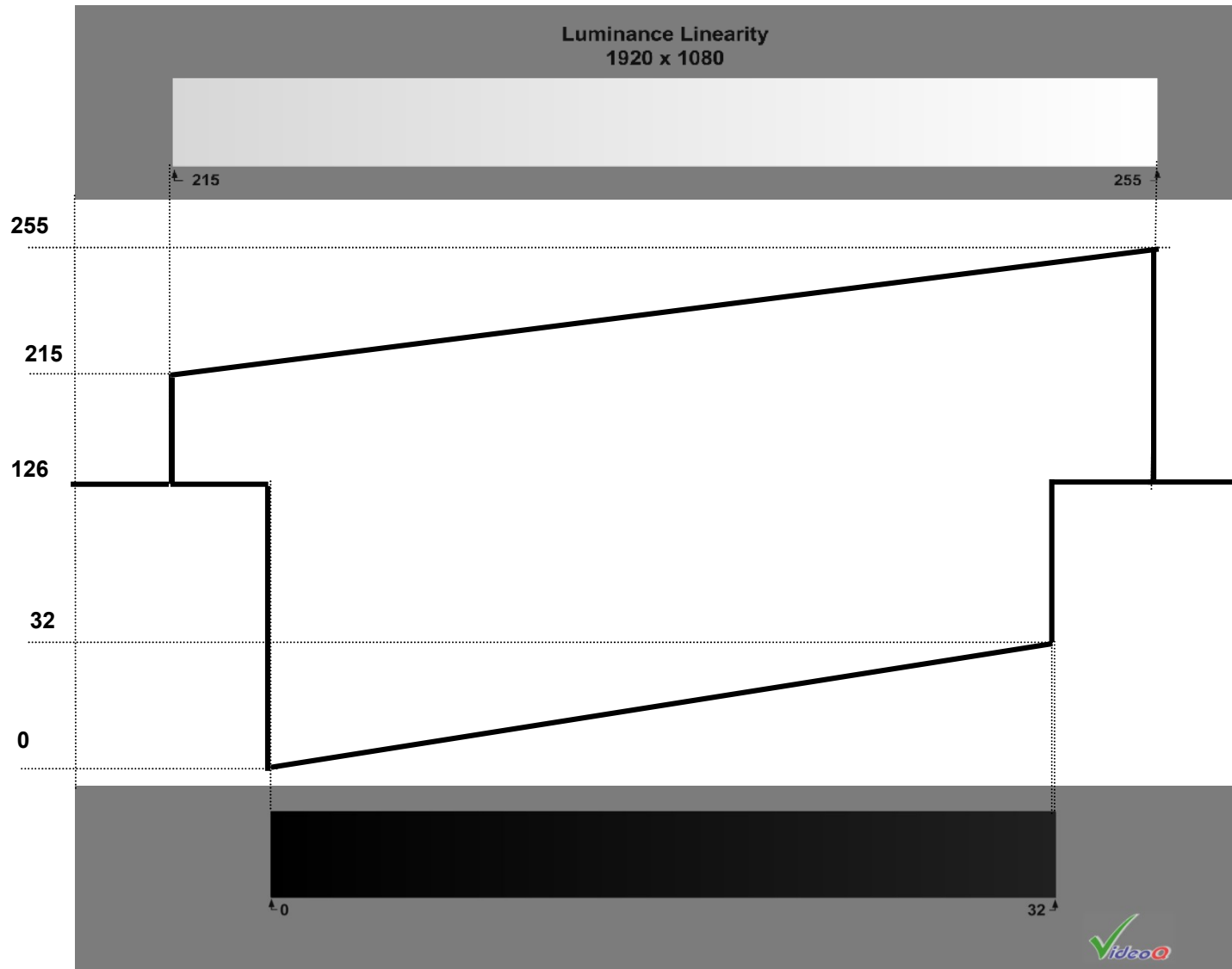
2.4. LINYRGB – 4 Channels Gradation Test
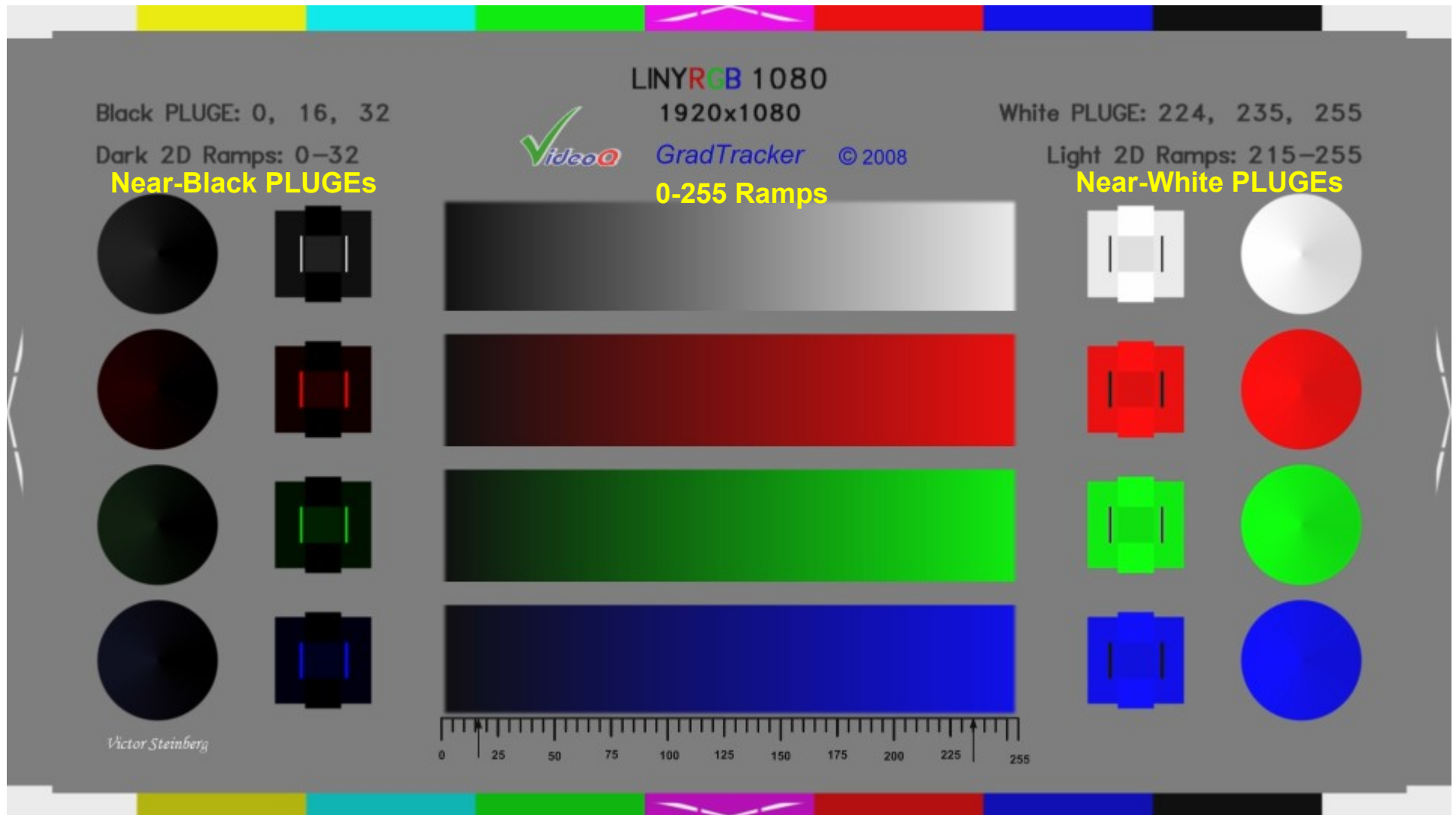
- Ÿ *HD static pattern suitable for Y, R, G and B Levels and Linearity Accuracy assessment*
- Ÿ *Featuring 4 full range (0-255) ramps, 2x4 PLUGES and 2x4 2D (conical) shallow ramps*

3. VST – Visual ScalTracker

VST – *Visual ScalTracker*: Scaling, Cropping, De-interlacing Test

480i60, 480p60,

576i50, 576p50,

720p50, 720p60,

1080p24, 1080p30, 1080i50, 1080i60, 1080p50, 1080p60

Family of HD and SD, 16:9 and 4:3 dynamic patterns suitable for visual picture quality assessment; sub-patterns revealing critical image scaling problems at glance:

- H & V Pixel Mapping
- Pixel Phase
- Centering & Cropping
- Motion Adaptive De-interlacing artifacts
- Linear and Non-Linear Aspect Ratio Conversion
- Frame Rate Conversion artifacts
- Static and Dynamic Y Sharpness and 2D Frequency Response

VST Test Pattern Composition

Radial Plates, Y & UV

Vertical Frequency Bursts Area

Large 0.8*H Circle and Diamond Lines aimed at testing picture geometry

Single white pixel Edge Markers on top of 5 % Safe Area Markers (dark gray rectangles)

Horizontal Frequency Bursts Area

5 % Safe Area Border Lines

Aspect Ratio

Crop Markers

Moving Sprite with Radial Plate and Central Star

VST720 50p
1280x720

ScalTracker

Visual

2.35:1

VideoQ

5%

5%

14:9

4:3

14:9

4:3

2.35:1

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VST Functional Components' Example
Tri-band Frequency Burst Patterns

0.4*FY Almost Horizontal Burst
0.5*FY Vertical Burst
0.4*FY Almost Vertical Burst

0.4*FY Almost Horizontal Burst
0.5*FY Horizontal Burst
0.4*FY Almost Vertical Burst
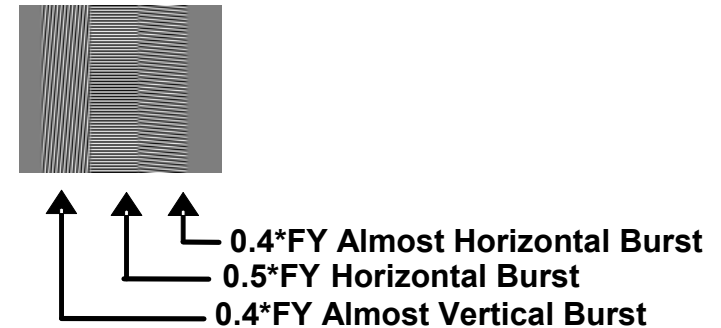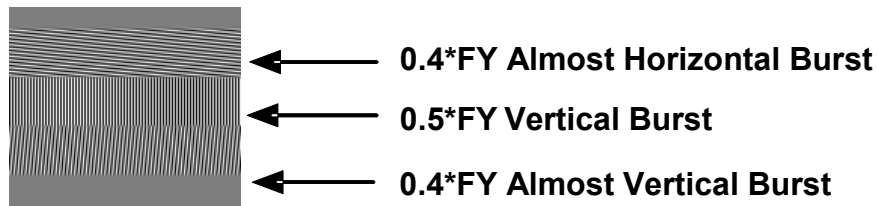
Tri-band Frequency Burst Patterns consist of **two groups of bursts** with frequencies proportional to luma pixels rate FY: **full width horizontal** and **full height vertical** bursts bands, each consisting of maximum luminance frequency of 0.5 FY in the middle with slightly oblique bands of 0.4 FY surrounding the middle burst.

The central 0.5 FY bands are especially sensitive to any errors in pixel clock, mapping or scaling. Two other bands allow differentiation between horizontal and vertical distortions thru the whole picture area – from left picture edge to the right picture edge and from top to bottom.

Vertical and almost vertical burst lines test horizontal frequencies, whilst horizontal and almost horizontal lines test vertical frequencies.

These large bursts are also used as background for moving sprite, thus allowing "at glance" detection of adaptive de-interlacing static and dynamic artifacts.

VST Components Showing Scaling Problems

Highly noticeable Beating Artifacts shows the slightest V scaling, e.g. 5% overscan

Missing Edge Markers reveal side cropping

Highly noticeable Beating Artifacts shows the slightest H scaling, e.g. 5% overscan

Radial Plates show Y & UV 2D Frequency Response

Full Width and Full Height Tri-band Frequency Bursts allows local scaling detection
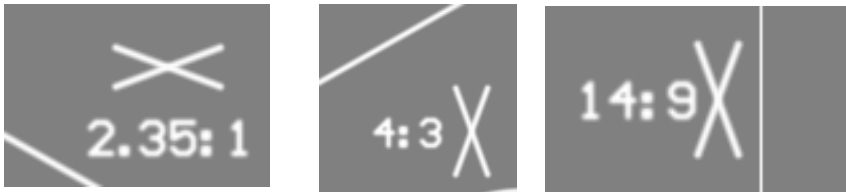
Moving Sprite jerkiness reveals Frame Rate Conversion problems

VST Frame Format Markers
2.35:1 height crop, 4:3 or 14:9 width crop

Crop Markers

Examples of 4:3 Crop:
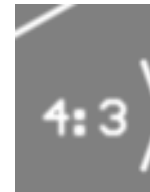
Correct 4:3 Crop   Wrong 4:3 Crop

VST 720 and VST 1080 patterns are designed for measurement in16:9 frame format, as well as in 4:3, 14:9 and 2.35:1 frame formats. Cross-shaped Frame Format Markers indicates precise area for each corresponding Aspect Ratio.

These are the most popular scale and crop modes:

l *4:3 crop is used to display 16:9 content on legacy standard definition TV sets,*

l *14:9 is a compromise (non-letterboxed) mode used in simulcast broadcasting to present 16:9 content on 4:3 and 16:9 screens,*

l *2.35:1 is used to show letterboxed "cinemascope" movies on 16:9 screens.*

4. ZT – ZonTracker

ZT – *ZonTracker*: Universal Multi-purpose Test

720p50, 720p60,
1080p24, 1080p30, 1080i50, 1080i60, 1080p50, 1080p60

Family of HD 16:9 dynamic patterns, featuring moving multi-colored sprite with Y and UV zone plates, suitable for visual picture quality assessment; sub-patterns revealing critical image spatial and temporal scaling problems at glance:

- Static and Dynamic Y and UV Sharpness and 2D Frequency Response
- Frame Rate Conversion artifacts
- Timeline problems
- Y and UV Motion Adaptive De-interlacing artifacts
- Y Levels Conversion artifacts (Banding)
- Black & White Clipping
- Color Space Conversion (Matrixing) errors
- H & V Cropping
- Analog and Digital Noise and Interferences

ZT Test Pattern Composition

Tri-band White PLUGE

100% Color Bars

Vertical & Horizontal Frequency Luminance Bursts, fractions of Y rate

V Crop Markers

Tri-band Black PLUGE

0-255 Grayscale

Timing Indicator

H Frequency Wedge, Markers in equivalent H sizes

Green-Magenta Zone Plate

H Crop Markers, in pixels

Blue-Yellow Zone Plate

Moving Sprite with Y & UV Zone Plates, Noise Reducer Tests Y & UV Texts (BlackX & RedX)

Interlace Wedge

0.9 H Circle

75% Color Bars

Horizontal & Vertical Frequency Chrominance Bursts, fractions of Y rate

1280

1/4

ZT720
1280x720   50p

1/2

VideoQ   ZonTracker   © 2008

BlkX

RedX

1280

720

640

320

8
16

8
16

255

225

200

175

150

125

100

75

50

25

0

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1/8   1/2   1/4

ZT Test Pattern Components

1. **Background** – 50% Gray (126d) with black 16:9 Grid Pattern, central area allocated for Moving Sprite

2. **Moving Sprite** – Luminance / Green-Magenta Zone Plate with variable contrast wedges, triangles, luminance and chrominance letters:

 - Estimates Y and UV 2D static and dynamic frequency response

 - Circular motion, two speeds with pauses

3. **Large Circle** – 0.9 Height Diameter in the center - Geometry and smoothness of curved lines indicator

4. **Timing Indicator** – clockwise handle rotation indicates frame rate:

 - One small increment (black to white strip) equals to 1 frame

 - Green flashes indicate one second increments.

5. **Crop Markers** on vertical & horizontal edges - estimation in pixels of horizontal and vertical cropping

6. **Color Bars** – 100% and 75% saturated strips at the top and bottom - Correct color indicators

7. **Tri-band PLUGE(s)** – Black (0, 16, 31) and White (224, 235, 255) levels clipping estimation

8. **Colored Zone Plates** – Green-Magenta and Yellow-Blue - 4:2:0 detection and Y/UV discrepancies

9. **Horizontal & Vertical Frequency Luminance Bursts** - Luminance H and V frequency response

11. **Horizontal & Vertical Frequency Chrominance Bursts** - Chrominance H and V frequency response

12. **Interlace Wedge** - Interlace and vertical scaling problems indications
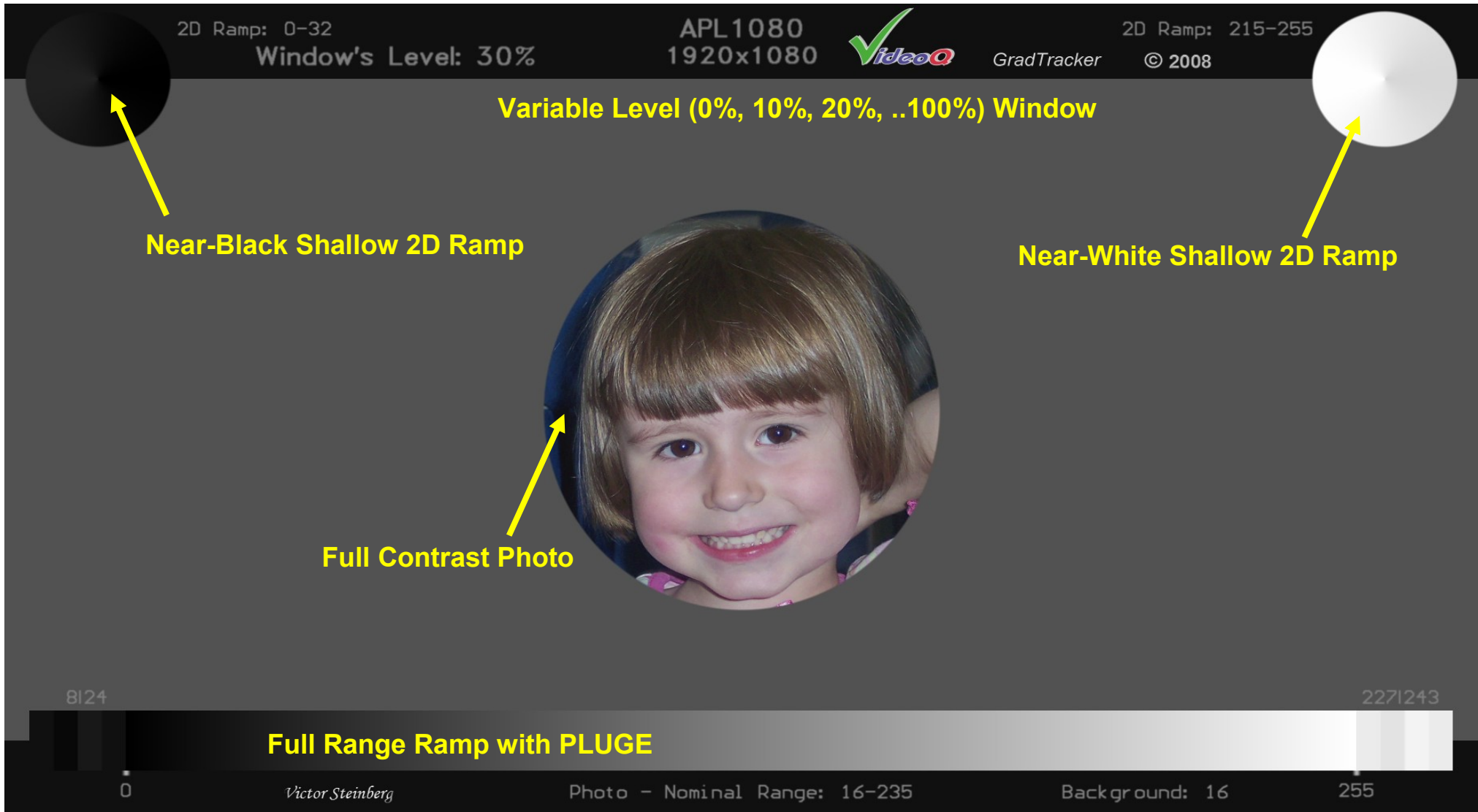
5. Dynamic Contrast Tests

5.1. APL – Average Picture Level Test**:** Y Levels, Black & White Clipping
1080p30

5.2. DP – Dynamic 2D PLUGE & APL Test: Dynamic Y Levels Consistency
1080p24

5.3. DBL – Dynamic Backlight Test: Local & Global Luminance Uniformity
1080p24

5.1. APL – Average Picture Level Test

2D Ramp: 0-32
Window's Level: 30%

APL1080
1920x1080

VideoQ

GradTracker © 2008

2D Ramp: 215-255

Variable Level (0%, 10%, 20%, ..100%) Window

Near-Black Shallow 2D Ramp

Near-White Shallow 2D Ramp

Full Contrast Photo

8|24

227|243

Full Range Ramp with PLUGE

0

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Photo - Nominal Range: 16-235

Background: 16

255

5.2. DP – Dynamic PLUGE Test

DP1080CG
1920x1080

GradTracker

Dynamic PLUGE (DP) Pattern View at Start Moment

Variable & Flashing APL Background

Range: 0d – 255d

Range: 0d – 255d

Large Near-Black 2D Ramp

Moving Full Range 2D Ramp

Moving Full Range 2D Ramp

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Background: 25d = +4%

Range: 16d – 34d = 0 – 8%

DP Pattern View at 50% APL Segment

Full Range 2D Ramps – moved out of screen

←

Large Near-Black 2D Ramp

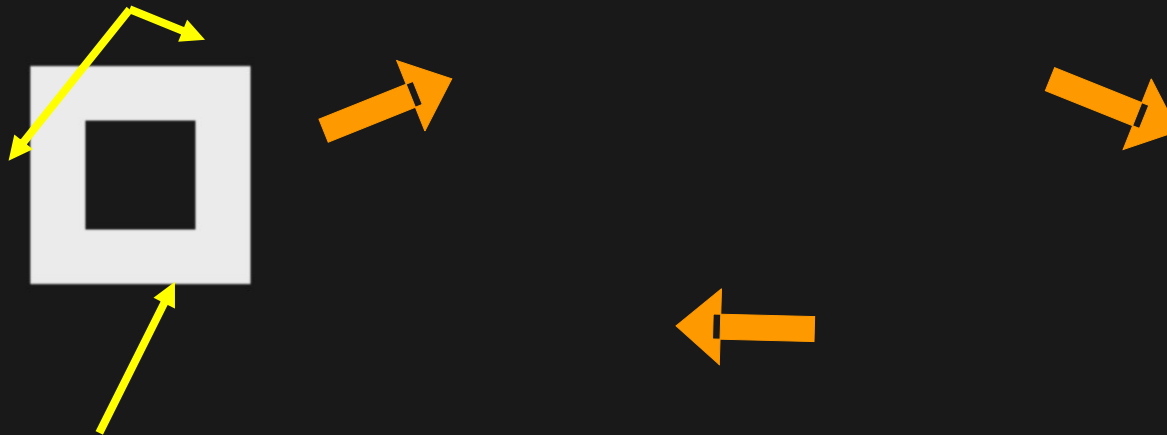*Full Range 2D Ramps – moved out of screen*

→

APL = 50%
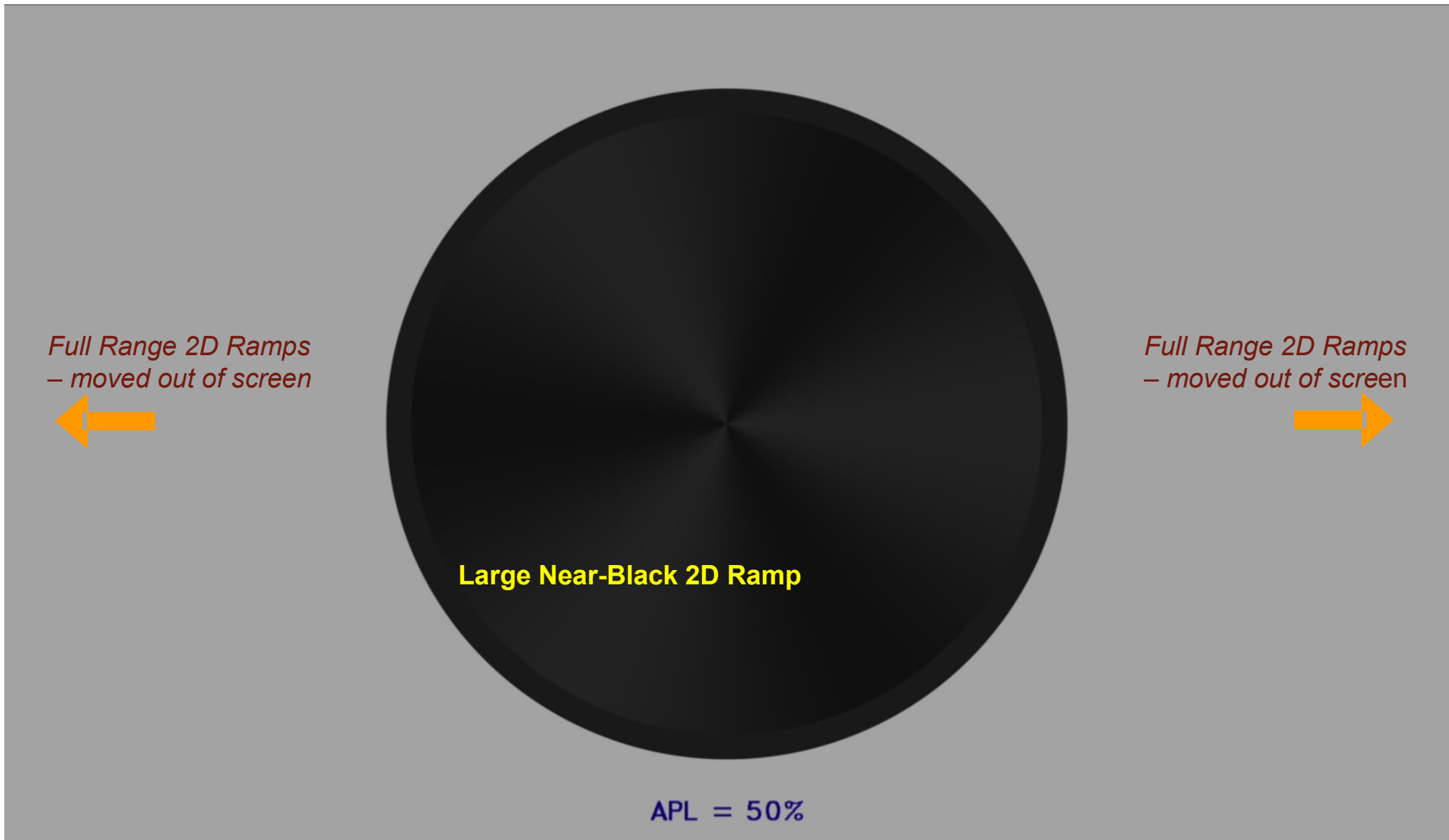
5.3. DBL – Dynamic Backlight Test

DBL1080
920x1080

GradTracker

Dark Gray / White Background

Possible Halo Artifacts Areas – near the sprite

Moving Sprite changing colors:
White on Black,
Black on White,
White on Black with Black in the center

Square Sprite: 235 or 25

Background: 25 or 235

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6. CSX – Color Space Explorer

**CSX** – Unique test aimed at visualization of color space conversion artifacts
1080i60

In 20 seconds this test going three times thru all 256x256x256 = 16 millions colors with accurate digital read-out of Y, U and V Levels.

Featuring large dynamic YUV palette and current Y level indicator.

Four-quadrant dynamic indication of RGB legal space boundaries for two level schemes (16-235 and 0-255) and two color matrixing schemes (601 and 709)

Black and white PLUGE components and vertical luminance ramp allow to check set-up prior to actual test.

CSX Pattern View Example: Y=36d
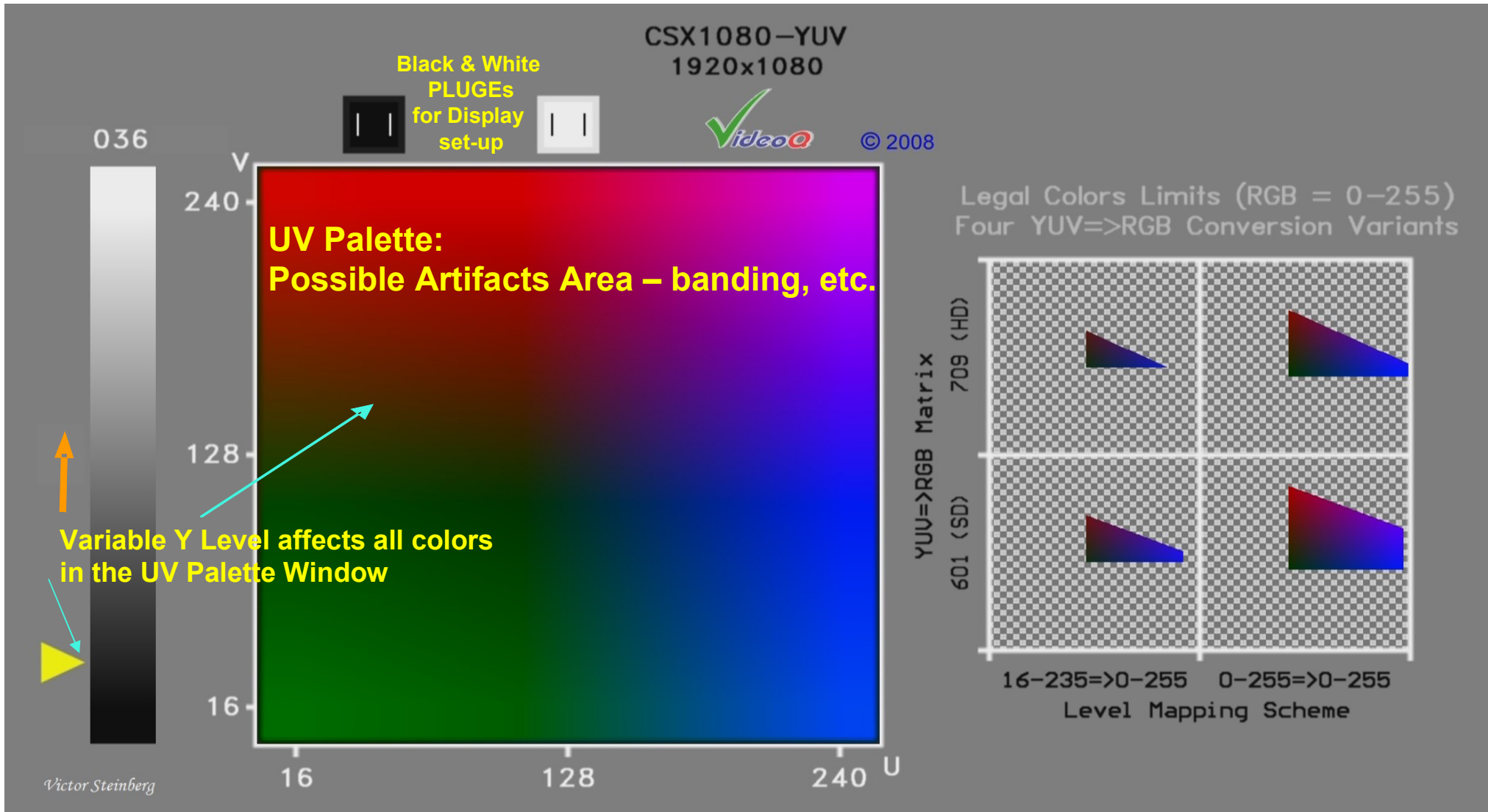
7. Audio Tests

7.1. AUD1 Combination Test: WAV, MP3, L+R Stereo

7.2. AUD2 Combination Test: WAV, MP3, L+R Stereo

7.3. Surround Sound 5.1 Channel Names: AAC-ADTS, AC3,

Multi-channel WAV

7.4. Blank Audio: MP3, L+R Stereo

7.5. White Noise: 0 dBFs, WAV (not filtered) and MP3 (20-20000 bandpass)

7.6 Pink Noise: 0 dBFs, WAV (not filtered) and MP3 (20-20000 bandpass)

7.7. Brown Noise: 0 dBFs, WAV (not filtered) and MP3 (20-20000 bandpass)

7.1. AUD1 Sound Test

LR Stereo Test for Level Calibration, Frequency Response Measurement,
Pulse Response Measurement, Dolby Low Level Noise & Distortion Check
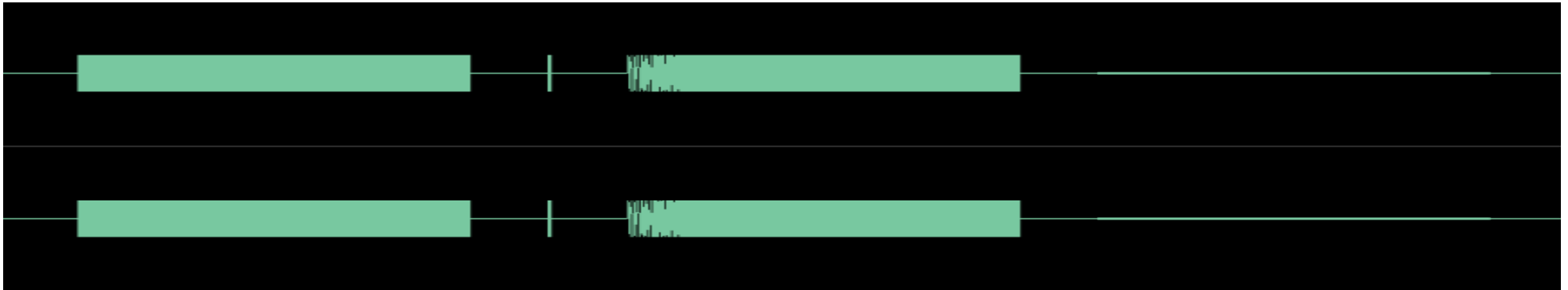
AUD1 Test Components Sequence (total length = 20 sec):

- 1 sec mute
- 5 sec of 1,000 Hz, -12 dBFs Tone
- 1 sec mute
- 0.02 sec of 1,000 Hz, -12 dBFs (Modulated Pulse = 1 TV frame in 50p)
- 1 sec mute
- 5 sec of Logarithmic Sweep: 2 octaves/sec, 10 octaves, 20-20,000 Hz, -12 dBFs
- 1 sec mute
- 5 sec 1kHz, -40 dBFs Tone
- 1 sec mute

7.2. AUD2 Sound Test

LR Stereo Test for Level Calibration, Channel Swap Check, Channel Polarity Check, Overload and Dynamic Range Test, including L-R difference channel
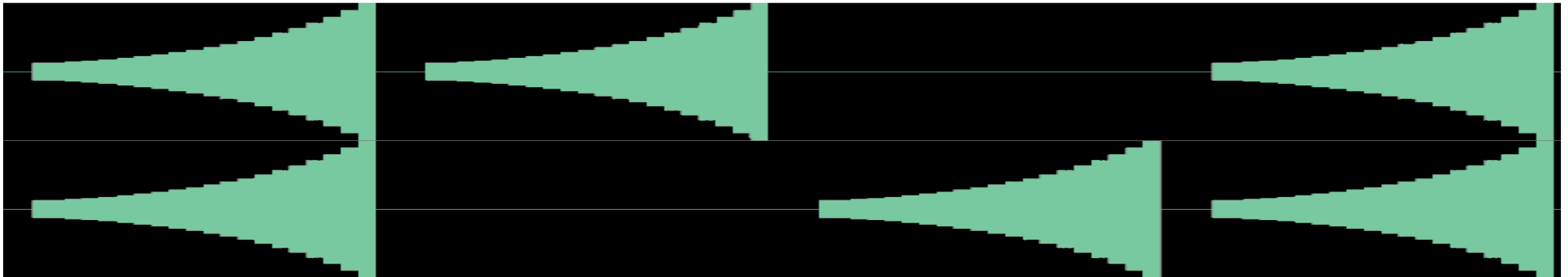
AUD2 Test Components Sequence (total length = 20 sec):

- 0.4 sec mute
- 4 sec of L & R 1,000 Hz, 18 steps Raiser from -18 dBFs to 0 dBFs
- 0.6 sec mute
- 4.4 sec of L only (R=mute) 1,000 Hz, 18 steps Raiser from -18 dBFs to 0 dBFs:
- 0.6 sec mute
- 4.4 sec of R only (L=mute) 1,000 Hz, 18 steps Raiser from -18 dBFs to 0 dBFs:
- 0.6 sec mute
- 4.4 sec of Inverted L & R 1,000 Hz, 18 steps Raiser from -18 dBFs to 0 dBFs
- 0.13 sec mute

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