

VQMPC

VideoQ Multi-Purpose Chart

VQL – VideoQ Test Patterns Library

Training Presentation

December 2024



videoq.com/vqmpc.html

videoq.com

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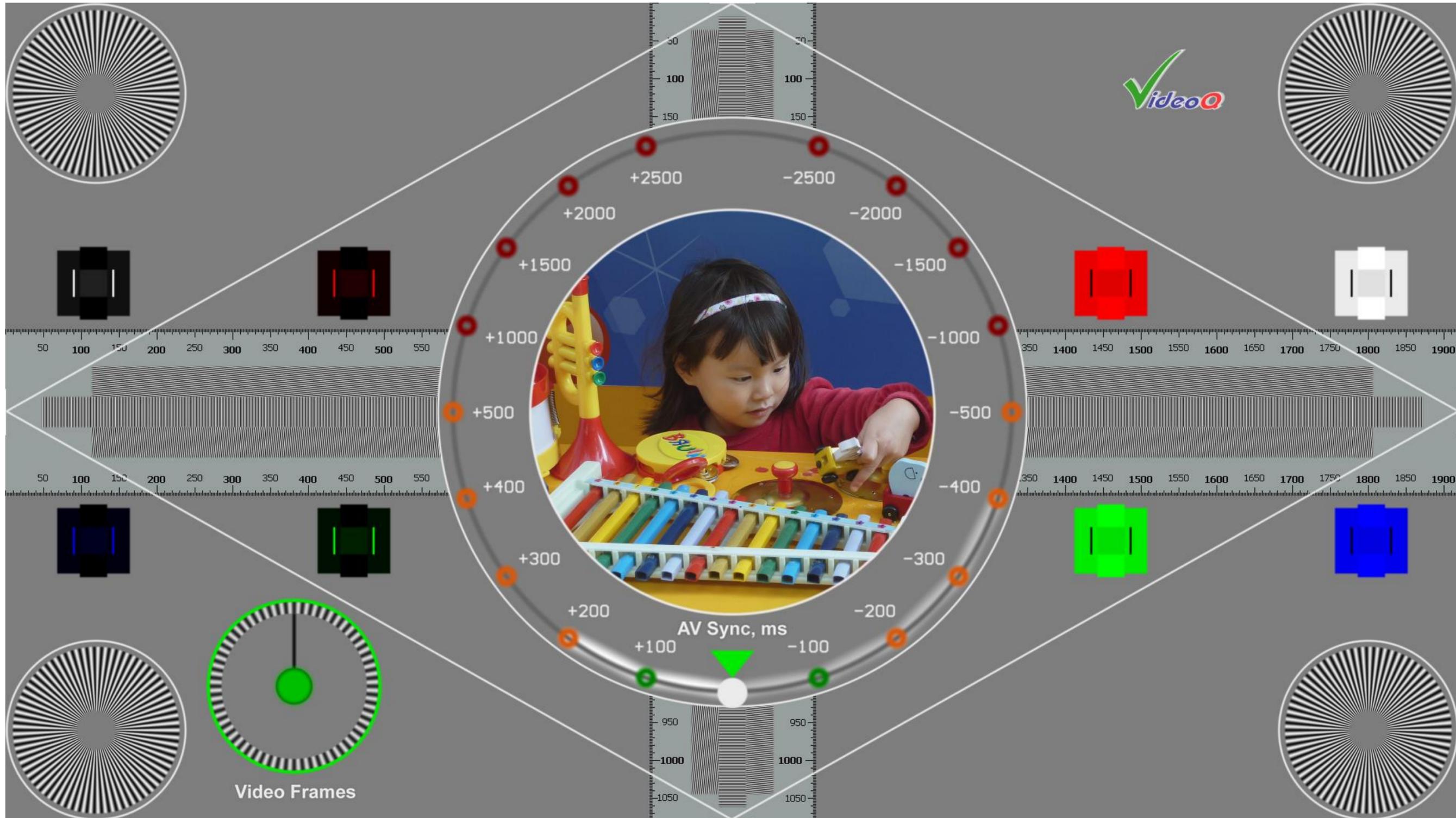
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1. General Info

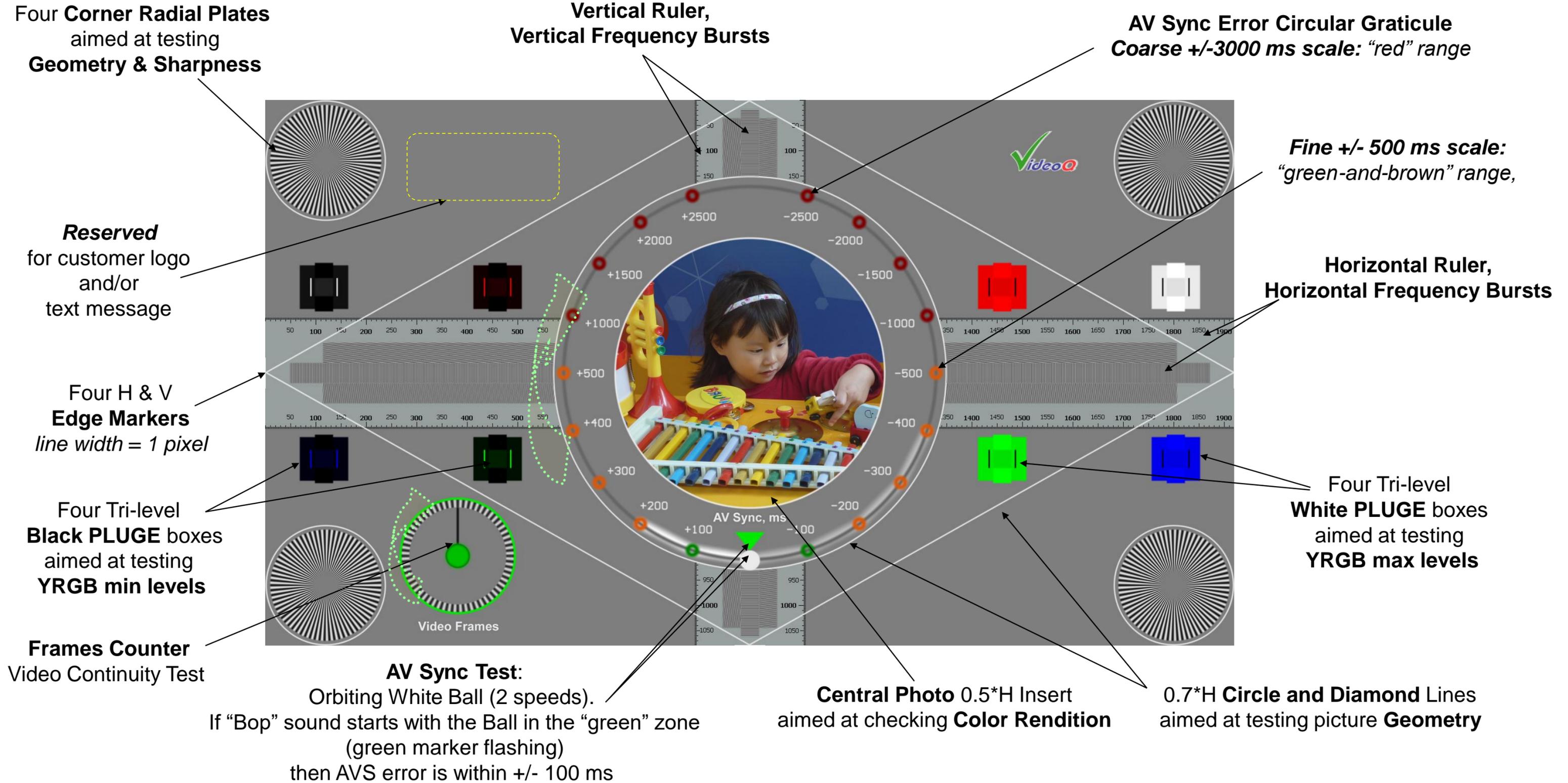
The **most popular** VideoQ test pattern used by the renown industry leaders:

- Major **R&D labs** uses SDR and HDR versions of this test for processing chain **performance validation** and **product verification**
- The **most valuable US media company** uses dynamic VQMPC test for instant **CDN/OTT quality estimation**
- **VQMPC UHD version** was used at **Olympic Games 2018** for international broadcast **system setup & configuration spot checks**

2. VQMPC – Dynamic Test with AV Sync Components



3. VQ MPC Test Composition



4. Features

Multi-purpose, multi-resolution, multi-format test pattern to check at glance:

- **Geometry:** Aspect Ratio, Overscan and "Ultra-wide Mode" effects of the display
- **Scaling Quality** or proof of no-scaling, especially in case of DHCP/DRM conflict in STB/OTT
- **Colors:** PLUGEs x8 for display setup and Photo Insert for general quality evaluation
- **Dynamic Range Modes:** SDR, HDR-PQ and HDR-HLG versions
(see separate Presentation for HDR Test Patterns suite)
- **2D Frequency Response** and **Sharpness Correction** settings
- **Frames Continuity**, e.g. codec freeze-skip, 3:2 pull-down, frame rate conversion
- **De-interlacing Performance:** artifacts are especially noticeable on moving white circle component
- **AV Sync Errors** (6000/6006 ms loop): coarse range +/-3000 ms and fine range +/-500 ms
- **Option of automatic Audio Gain & AV Sync Errors measurement**
via VideoQ software tools

5. Applications

Picture quality control and calibration tool for general public, video installers, hardware and software developers, video development labs, production, post-production and content distribution facilities in the fields of:

- Broadcast HD & UDH TV
- Consumer Electronics
- Video Transcoding
- Video Data Compression
- Digital Cinema
- Mobile TV
- IPTV, CDN, Cloud video processing and transcoding

VQMPC test patterns are equally suitable as QA/QC tool for:

- Direct audio-visual quality estimation by eyes and ears
- Semi-automatic and fully automated AV levels and AV sync measurement using VideoQ software tools

6. Formats

Set of test pattern video and audio files:

- Raw formats: .YUV, planar 4:4:4, 10 bit, .WAV: 2.0 LR or 5.1 surround sound, 48 kHz, 24 bit
- Encoded format: .MP4, 4:2:2 or 4:2:0, 8, 10 or 12 bit, fixed GOP size = 1s, medium to high bitrate
- 6 frame sizes, various frame rates and interlace formats:

720x480p (SD 4:3), 23.976, 24.0, 29.97, 30.0, 59.94, and 60.0 fps

720x480i (SD 4:3), 29.97 fps (i29.97 aka 59.94i)

720x576p (SD 4:3), 25, 50 fps

720x576i (SD 4:3), 25 fps (i25 aka 50i)

1280x720p (Sub-HD 16:9), 50, 59.94 and 60.0 fps

1920x1080p (HD 16:9), **Special** “consumer camera” YUVJ levels and fps: 47.952, 48.0 fps

1920x1080p (HD 16:9), 23.976, 24.0, 25.0, 29.97, 30.0, 50.0, 59.94, and 60.0 fps

1920x1080i (HD 16:9), 25.0 fps (i25 aka 50i), 29.97 fps (i29.97 aka 59.94i),

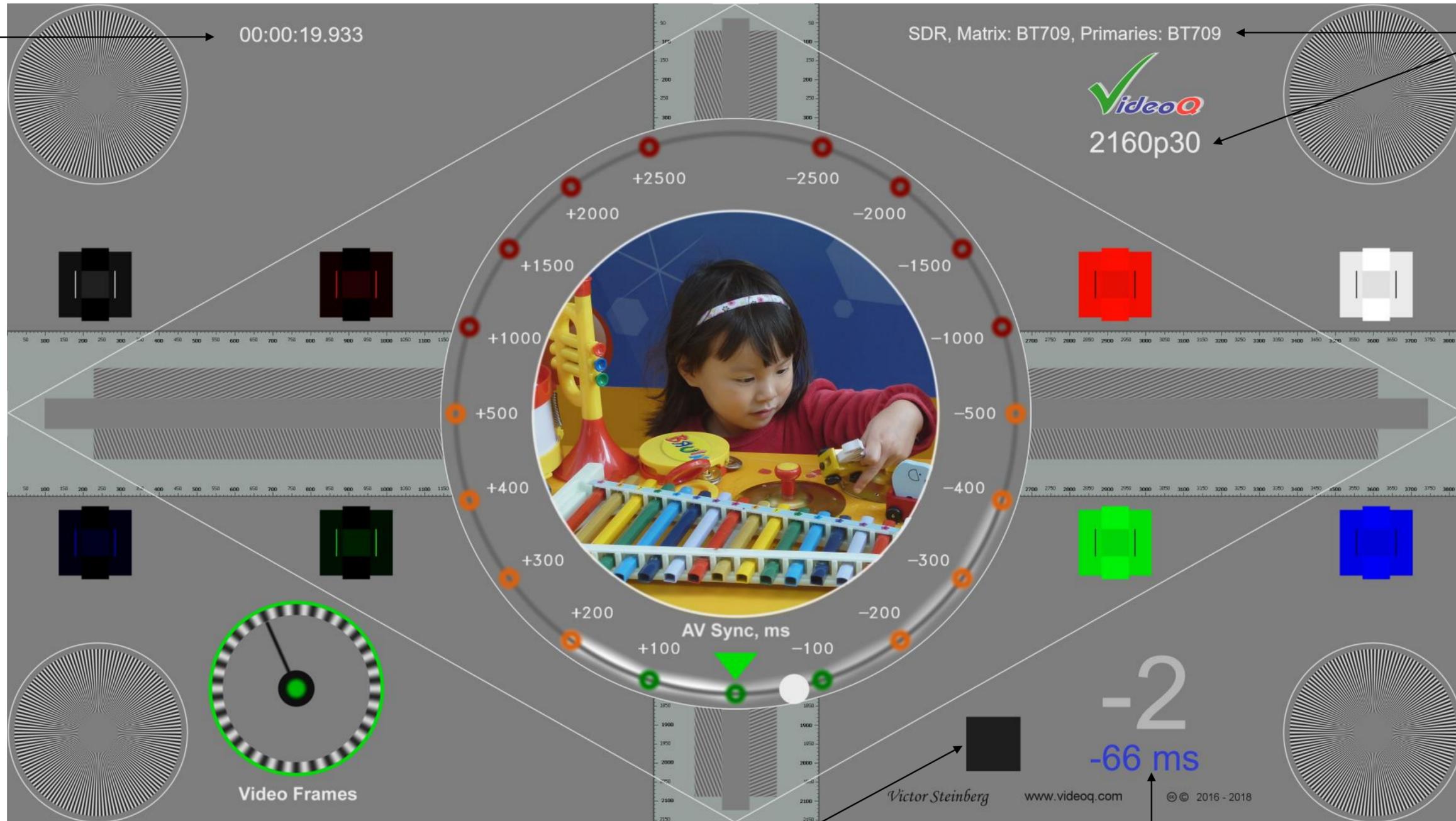
3840x2160p (4K UHD 16:9), 23.976, 24.0, 25.0, 29.97, 30.0, 50.0, 59.94, and 60.0 fps

7680x4320p (8K UHD 16:9), 23.976, 24.0, 25.0, 29.97, 30.0, 50.0, 59.94, and 60.0 fps

7. Optional Video Format and AV Sync Text Messages



Original Time Code



AV Sync Reference Marker,
Flashing White @ 0 ms for 200 ms

Timeline distance wrt
AV Sync Reference Position,
In video frames & milliseconds

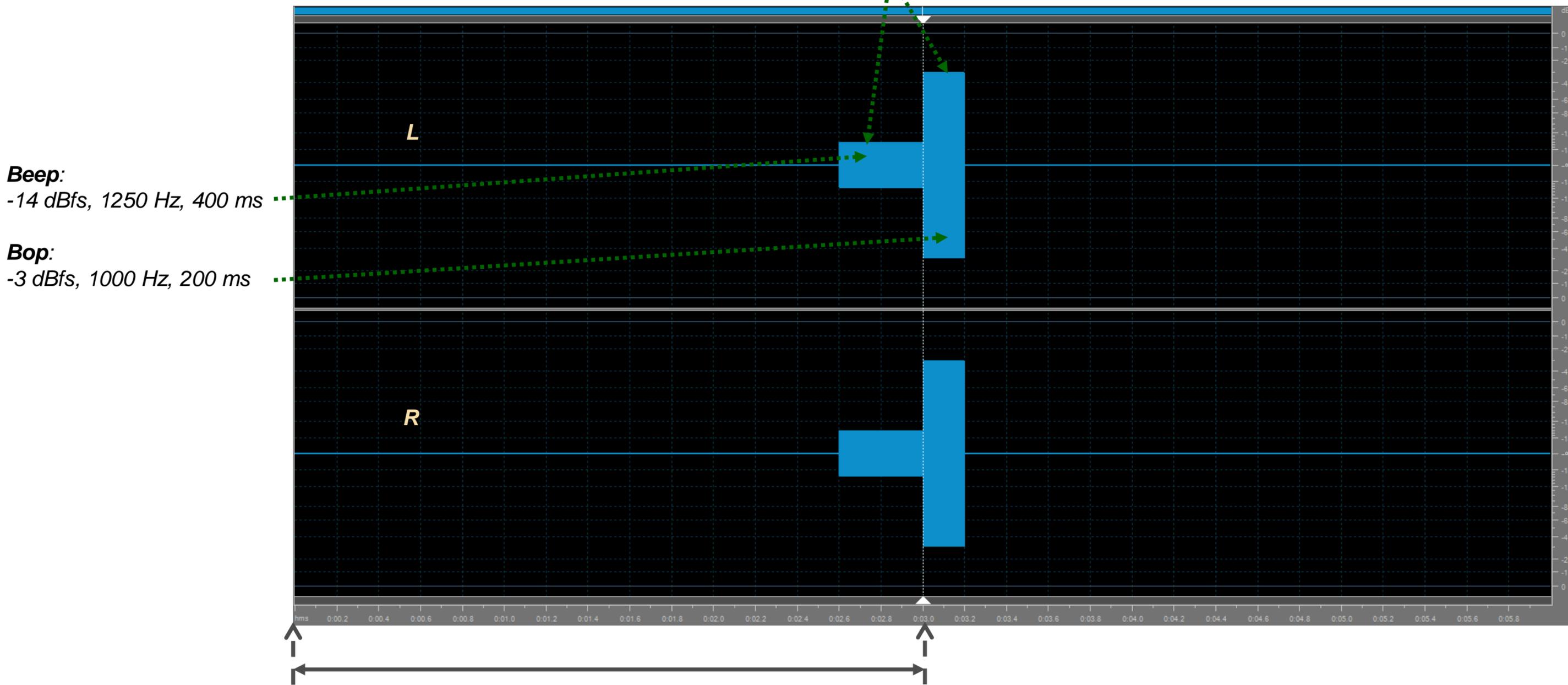


8. AV Sync Test Audio Component Time-line

Loop duration: 6,000 ms (6,006 ms for 23.976, 29.97 and 59.94 fps)

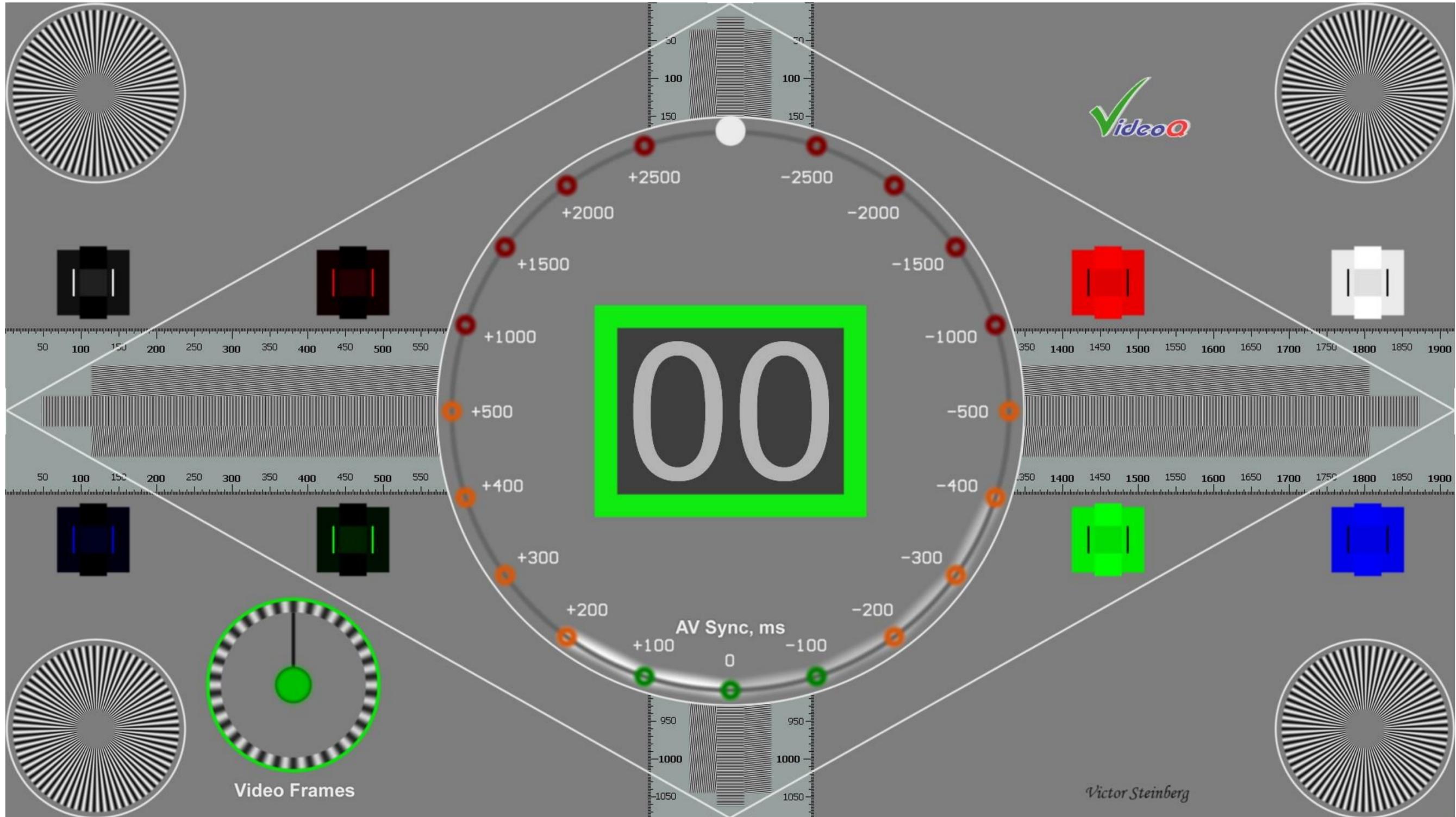


AV Sync Reference: "Beep-bop" burst



AV Sync Reference Position = 3000 ms (3003 ms for 23.976, 29.97 and 59.94 fps)

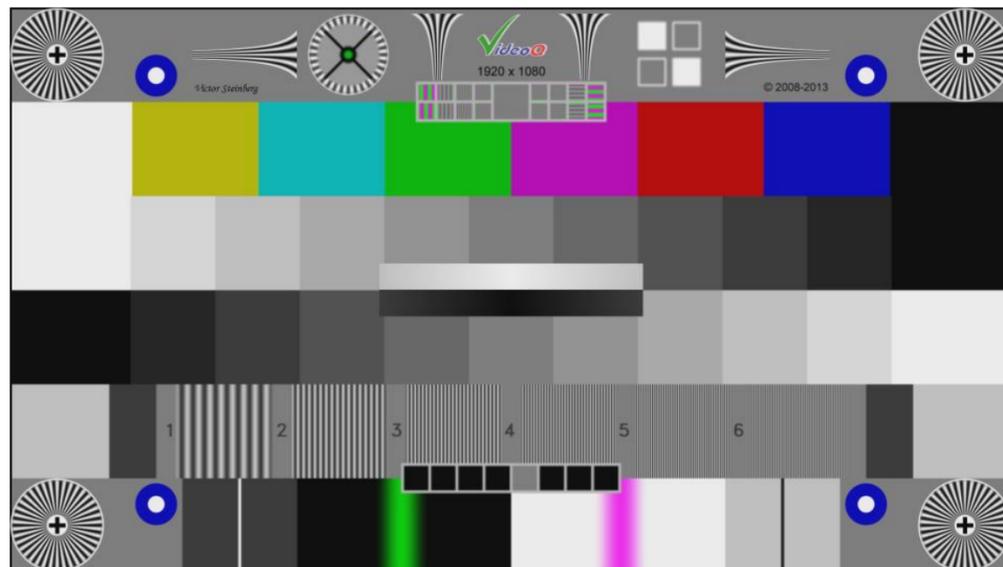
9. VQ MPC-C – Variant with Frames Counter Component



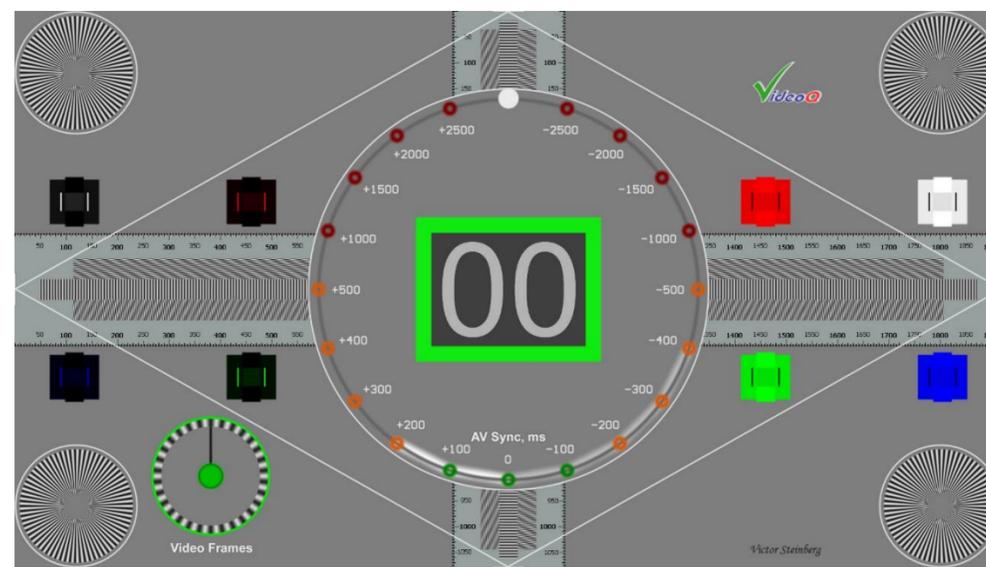
10. VQMPC-E Variant

Enhanced 8s long dynamic test, more suitable for repetitive lab testing, especially if transcoding is involved. Test patterns sequence consists of three segments:

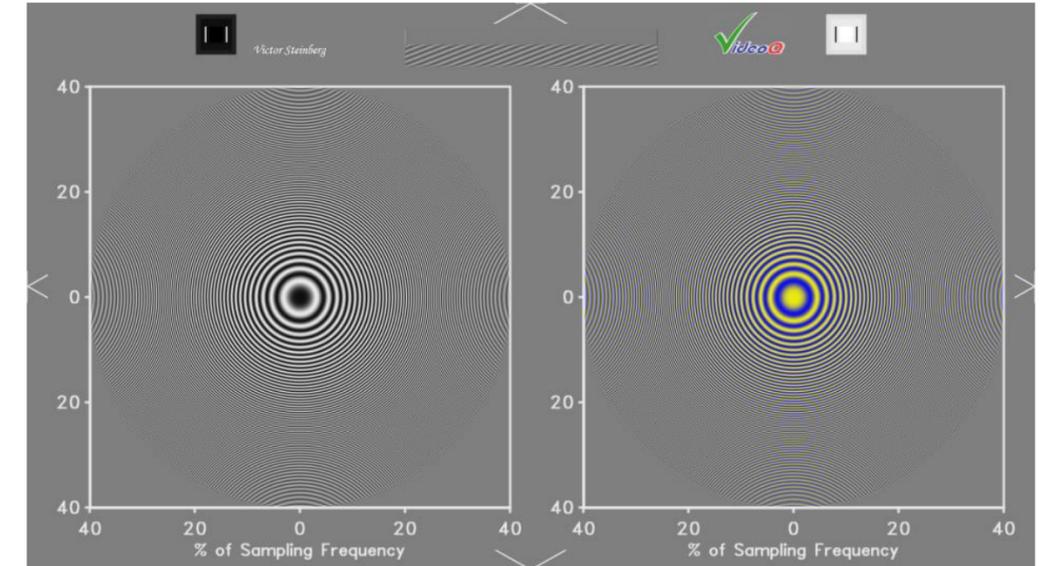
- 1s long **VQMA4** matrix test at the beginning, for **fully automated video image quality analysis**, VideoQ **VQMA** Software Analyzer recommended,
- then 6s long regular **VQMPC-C** test, for **audio-visual estimation**,
- then 1s long **FZP** (Large Flashing Zone Plates) test, revealing **scaling & compression artifacts**, VideoQ **VQV** Software Viewer/Analyzer recommended.



0s ... 1s: VQMA4



1s ... 7s: VQMPC-C



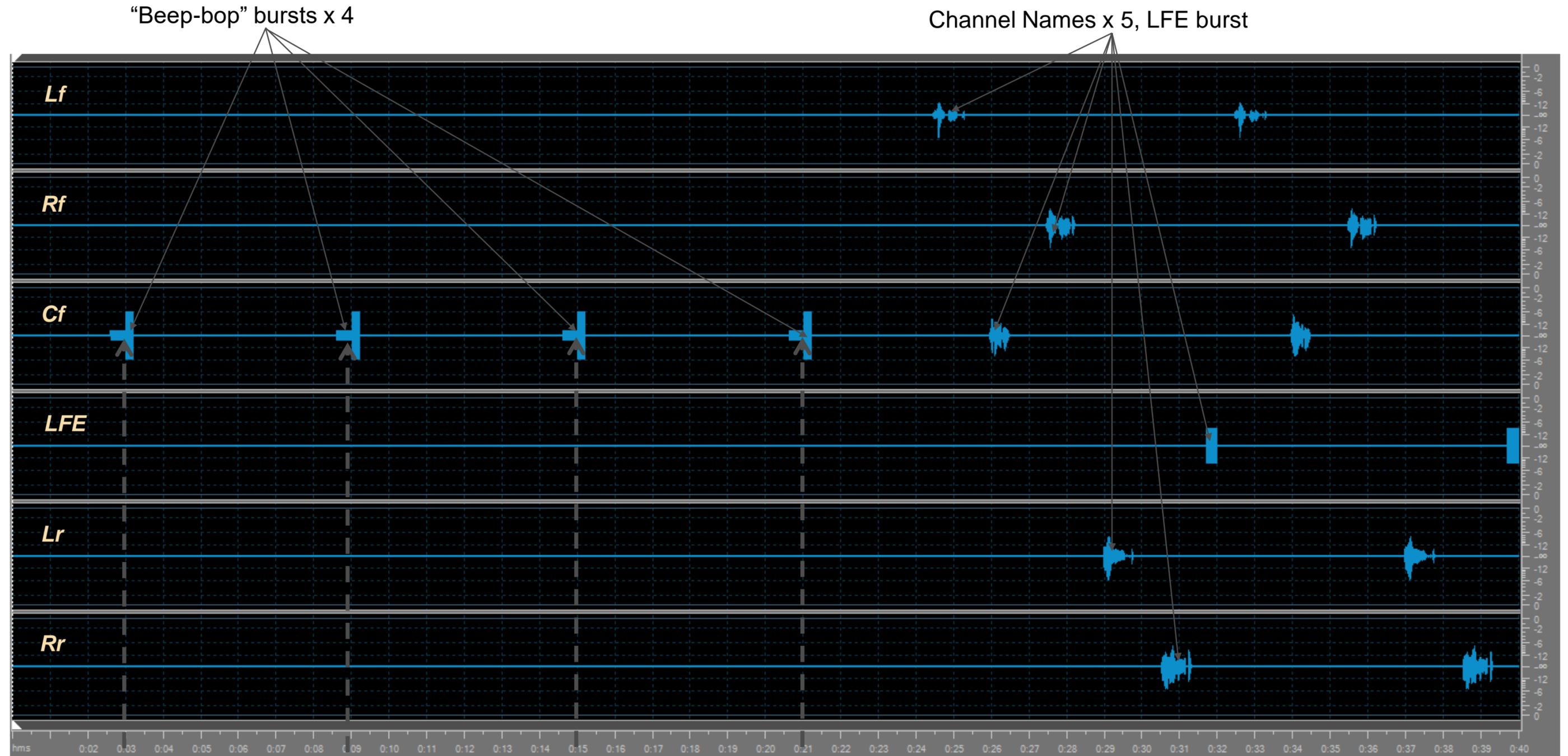
7s ... 8s: FZP



11. Optional 5.1 Combination Test (Time-line Parts 1 & 2)

Part 1: 24 s = 4 x 6000 ms (6006 ms for 23.976, 29.97 and 59.94 fps)

Part 2: 18 s = 3 x 6000 ms



1250 Hz, 400 ms,
1000 Hz, 200 ms

110 Hz,
300 ms

AV Sync Ref Position = 3000 ms (3003 ms for 23.976, 29.97 and 59.94 fps). Period = 6000 ms (or 6006 ms)

12. VQMPC-PQ – HDR Test, PQ version



The slide displays a comprehensive test pattern suite for VQMPC-PQ HDR testing. It includes:

- Resolution and Aspect Ratio:** 10b, 4:2:2, 4:4:4, 4:2:0, FALL: 80nt, CLL: 10knt.
- Color and Contrast:** Multi-Purpose Chart Test with color bars (200 nt, Ref. White, 58% 572) and grayscale bars (100 nt, 250 nt, 500 nt, 750 nt, 1000 nt, 2000 nt, 4000 nt).
- Encoding and Frame Info:** UHD HDR10 24fps, 10b VP9 420, Frame # 0.
- Visual Elements:** A central circular image of a child playing with toys, surrounded by various geometric patterns and scales.

13. VQMPC-HLG – HDR Test, HLG version



The slide displays a comprehensive set of test patterns for VQMPC-HLG HDR testing. At the top center, three square patterns are labeled SDR, HLG, and PQ. Below them is a horizontal scale from 9 to 9, with a central '0' and '64 Ref. Black' marker, and a 'ms x100' label. To the right, a color bar chart shows seven color patches with their respective nits: 203 nt (Ref. White, 75% 721), 179 nt (Diffuse White), 100 nt, 200 nt, 400 nt, 600 nt, 800 nt, and 1000 nt. A central circular inset shows a young girl playing with colorful toys. Below this, a horizontal scale from 50 to 3800 is visible. At the bottom left, a circular pattern is shown next to a scale from 64 to -128 to 64. At the bottom right, a box contains the text: 'UHD HLG 24fps', '10b VP9 420', 'Frame # 0', 'Multi-Purpose Chart Test', 'VQMPC', 'Victor Steinberg', 'www.videoq.com', and '© 2015 - 2019' with the VideoQ logo.

14. Order Options

Choice of:

- Standard 6s long **VQMPC** (aka VQMPC-P – P = photo insert)
- Standard 6s long **VQMPC-C** (C = frame counter)
- Enhanced 8s long **VQMPC-E**
with VQMA matrix test pattern during the first second and flashing Zone Plates during the last second
- Alternative video formats (e.g. raw planar .YUV, .Y4M with header, wrapped .AVI or .MP4), alternative frame sizes and/or frame rates – *available on request*
- Insertion of customer logo and/or special text messages
- Central photo insert is customizable, i.e. it can be replaced by:
 - Alternative static picture (customer choice)
 - Radial plate test component
 - Large frame counter digital display

15. About VideoQ



Customers & Partners



Company History



- Founded in 2005
- Formed by an Engineering Awards winning team sharing between them decades of global video technology.
- VideoQ is a renown player in calibration and benchmarking of Video Processors, Transcoders and Displays, providing tools and technologies instantly revealing artifacts, problems and deficiencies, thus raising the bar in productivity and video quality experience.
- VideoQ products and services cover all aspects of video processing and quality assurance - from visual picture quality estimation and quality control to fully automated processing, utilizing advanced VideoQ algorithms and robotic video quality analyzers, including latest UHD and HDR developments.

Operations

- Headquarters in CA, USA
- Software developers in Silicon Valley and worldwide
- Distributors and partners in several countries
- Sales & support offices in USA, UK

A1. Appendix: VQMPC Advanced Analysis Examples



This section provides more details about VQMPC test sessions scenarios, VideoQ software tools usage examples and test patterns features.

The screenshots and measurement results shown in this section are taken from VideoQ **VQV** – Media Files Viewer-Analyzer and **VQMP** – Media Files Player-Analyzer:

<https://videoq.com/vqv.html>

<https://videoq.com/vqmp.html>

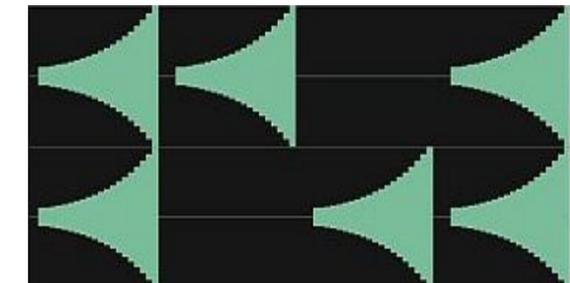
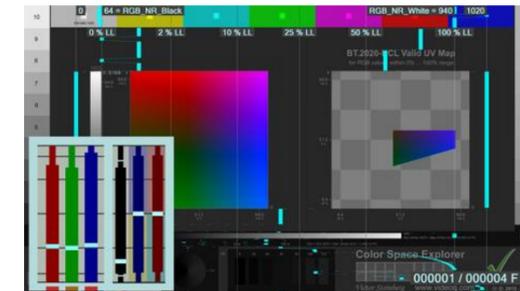
A2. VideoQ Approach to Test Patterns Usage

VideoQ approach combines “classic”, “digital” and “cloud” methodologies, sharing same test patterns and covering all 3 levels of video quality control:

Instant visual-aural quality estimation



Objective measurements of video and audio parameters

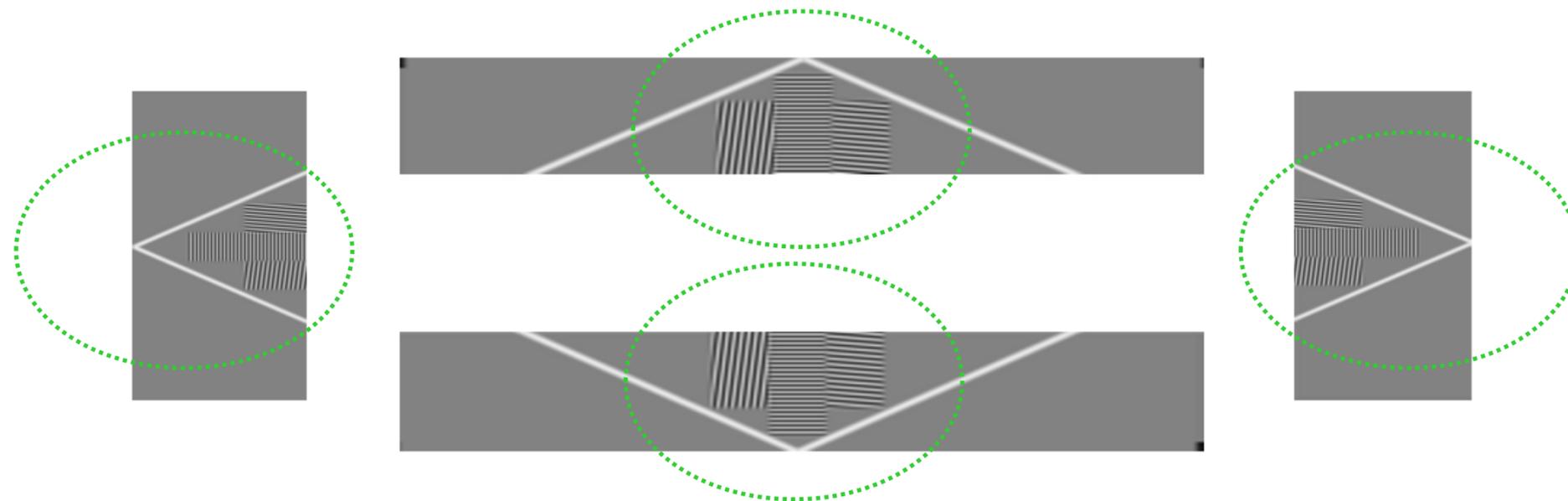


Fully automated Quality Control



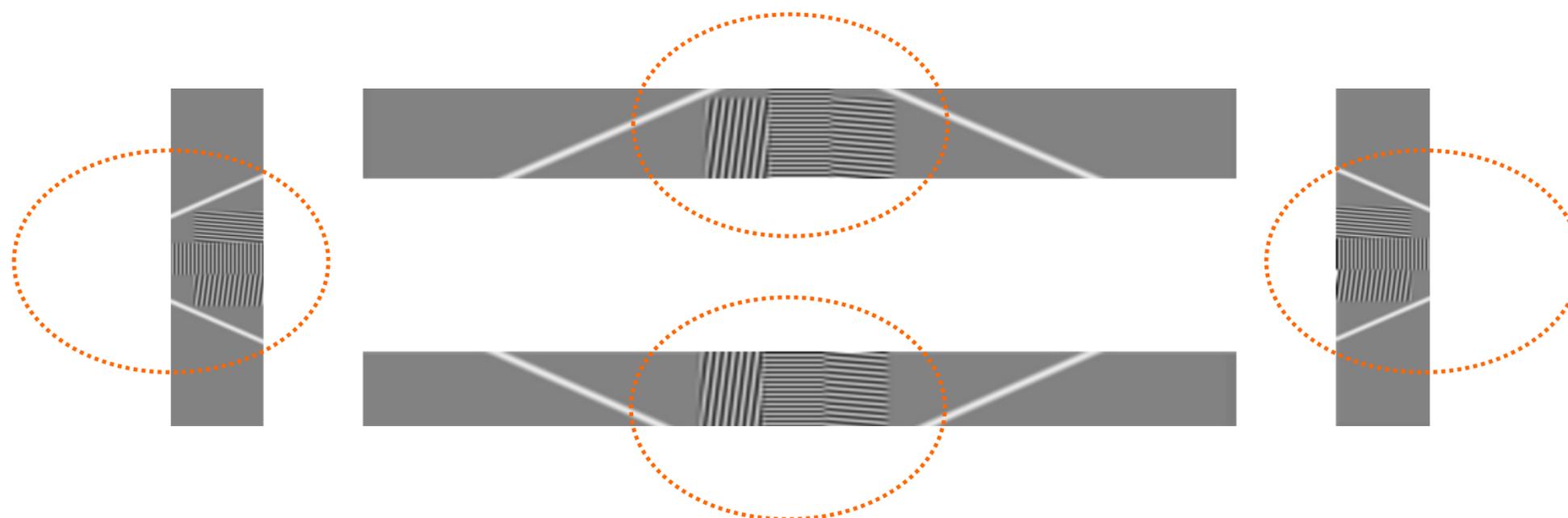
```
> (0) "header": {} (11)
> (0) "generalFileInfo": {} (25)
> (0) "videoStream": {} (43)
> (0) "testConditions": {} (7)
> (0) "videoParameters": {} (19)
> (0) "activeImageFormats": {} (4)
v (0) "videoLevelsStatistics": {} (6)
  1."videoDataVolume_pct" "100.457"
  1."chromaDataVolume_pct" "36.935"
  1."averageU_pct" "-4.814"
  1."averageV_pct" "4.992"
```

A3. Diamond Pattern and Crop Markers Usage



Example of **correct** settings (no cropping):

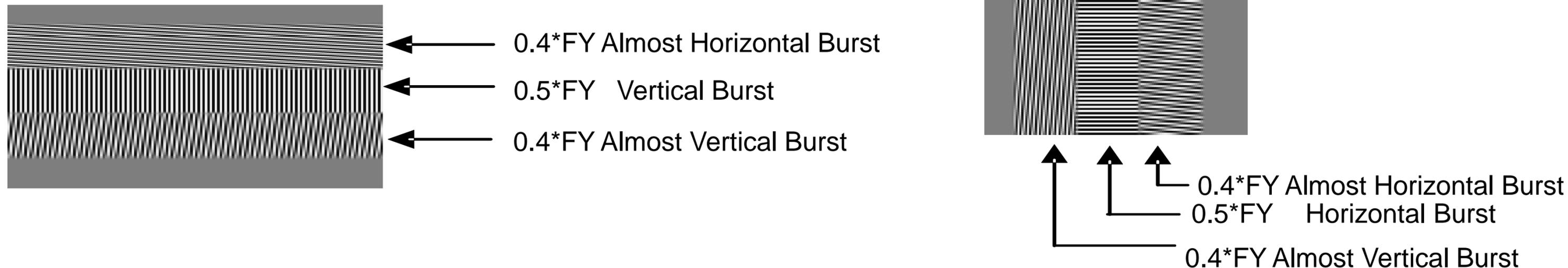
All picture edges are not cropped and single pixel white markers are visible



Example of **incorrect** settings (with cropping):

Picture edges are cropped

A4. Tri-band Combination Burst Patterns



There are two groups of bursts with frequencies proportional to luma pixels rate FY : **full length horizontal** bursts band and **full height vertical** bursts band. Maximum luminance frequency burst of exactly **0.5 FY** is in the middle of each band. Two slightly oblique bands of $0.4\ FY$ surrounds the middle burst.

Two **central 0.5 FY sub-bands** are especially sensitive to any errors in **pixel clock, mapping** or **scaling**.

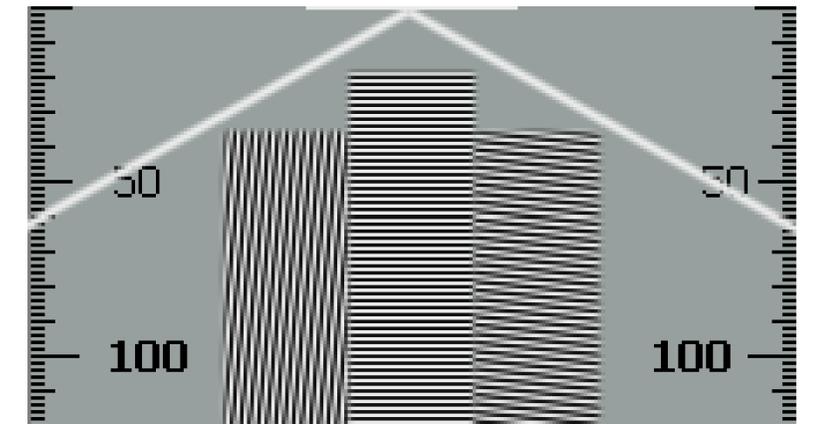
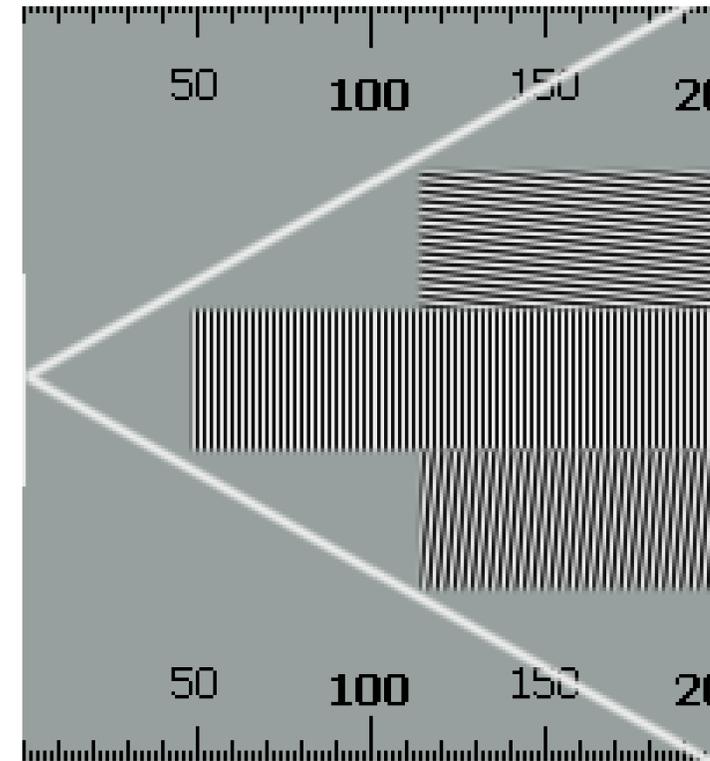
Four other sub-bands allow differentiation between horizontal and vertical distortions thru the whole picture area – from left picture edge to the right picture edge and from top to bottom.

Within the burst group **vertical** and **almost vertical** lines test **horizontal frequencies**, whilst **horizontal** and **almost horizontal** lines test **vertical frequencies**.

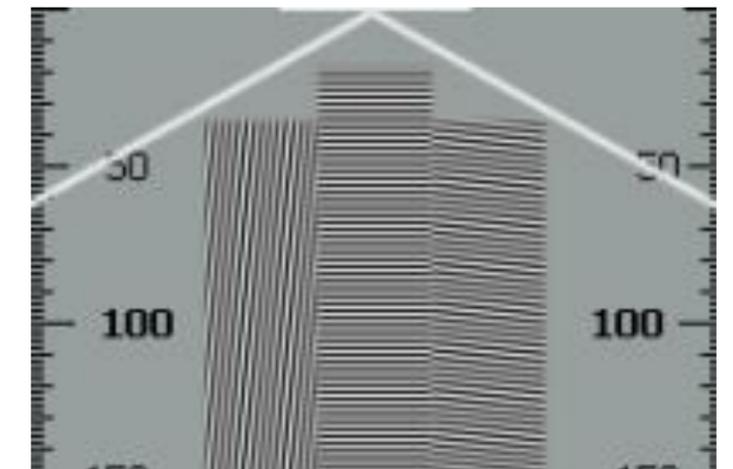
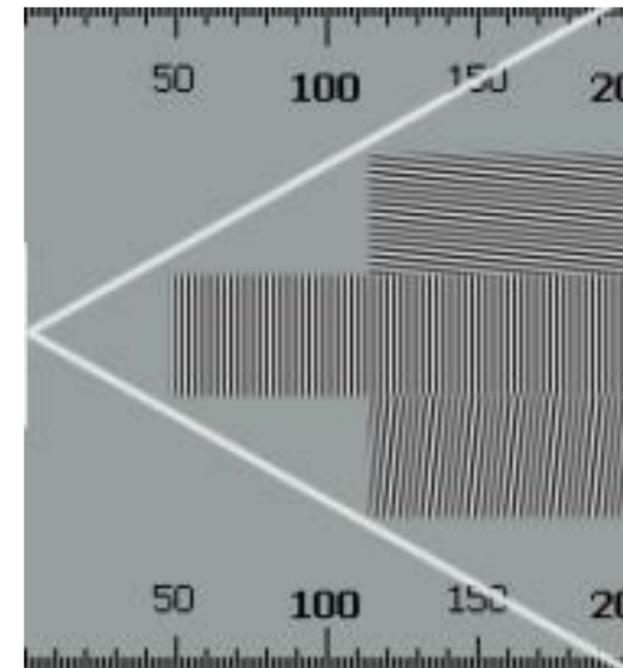
A5. Tri-band Combination Burst Pattern Usage



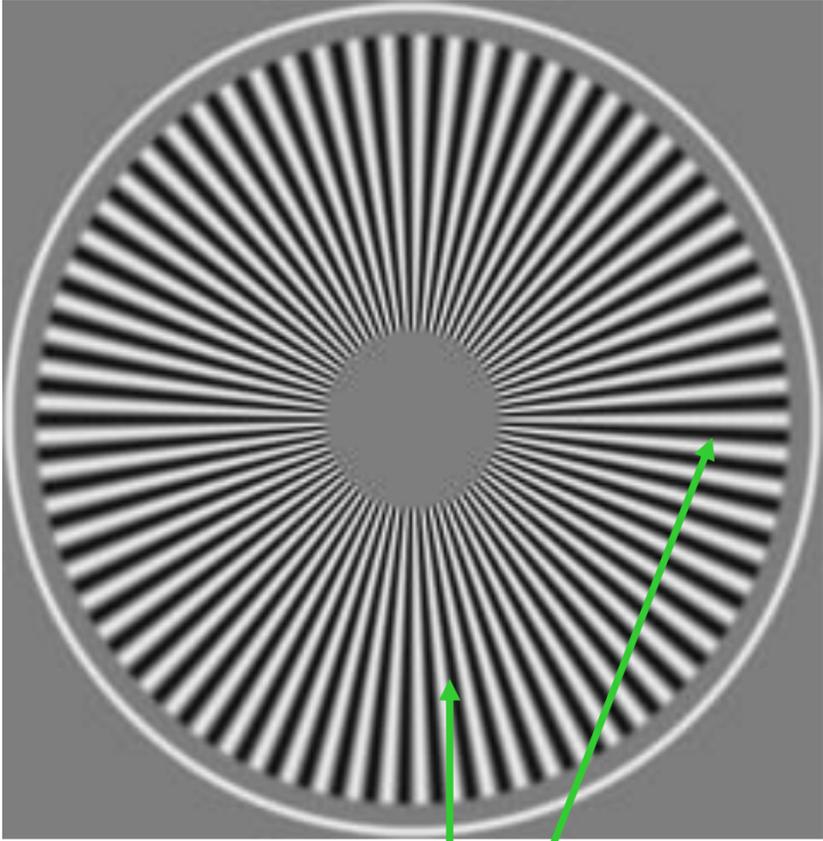
Example of correct settings (no scaling):
There are no visible beat waves on both horizontal and vertical Tri-band Patterns



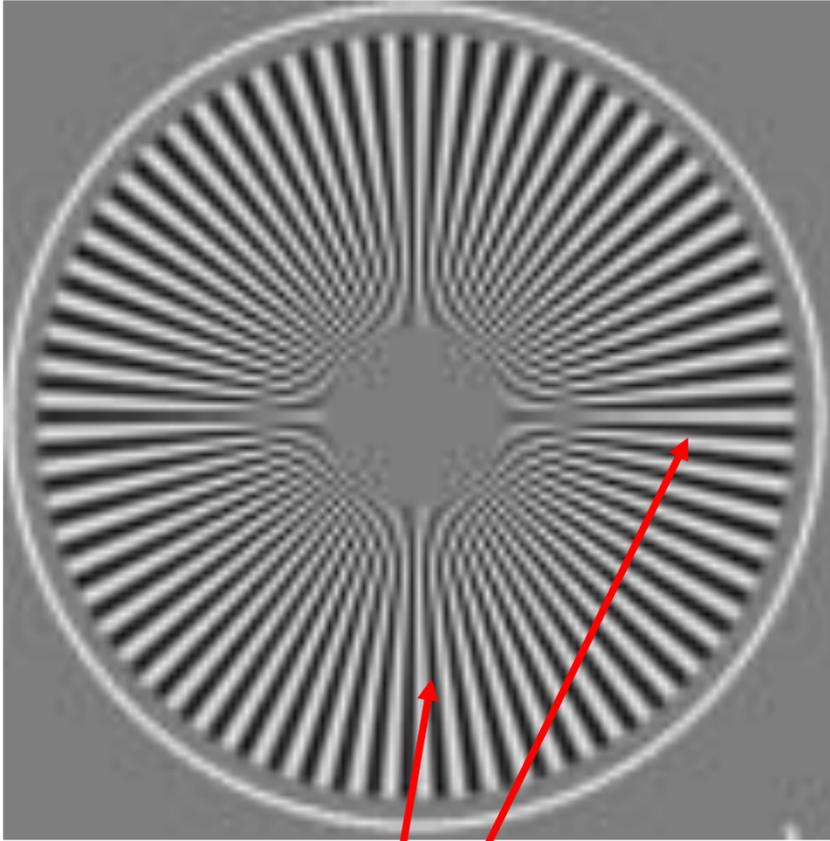
Example of scaling artifacts:
Scaling causes beat waves on both horizontal and vertical Tri-band Patterns



A6. Radial Plates Usage



Original Size – dot-by-dot:
Full contrast of fine details in all directions



Scaled (Up or Down) Picture:
Loss and/or distortion of fine details

A7. Black PLUGE & SPLUGE Usage

Fine Tuning (SPLUGE) *optional component*

Clipped sector (with no shades of gray) is much more than 180 degrees

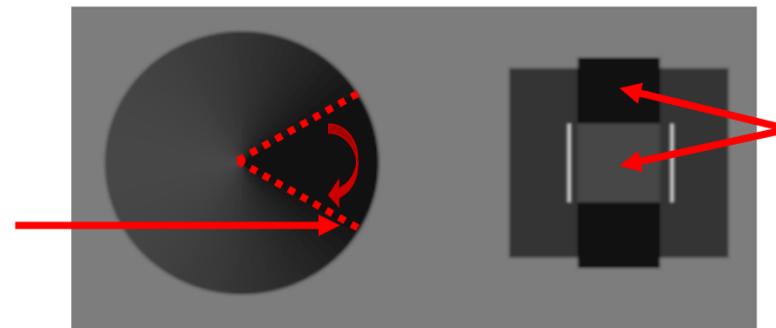
Clipped sector (with no shades of gray) is much less than 180 degrees

Conical grayscale is clipped exactly half-circle (180 degrees), no shades of gray on the right half

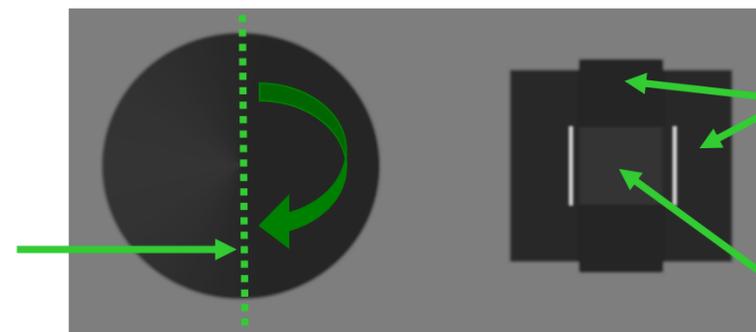
Brightness (Y Offset) is **too low**



Brightness is **too high**



Brightness is **correct**



Coarse Tuning (PLUGE)

Both central super-black vertical band and central small square are almost the same brightness as big black square

Both central super-black vertical band and central small square are clearly visible

The super-black vertical band is almost the same brightness as big black square

Central small square is clearly visible

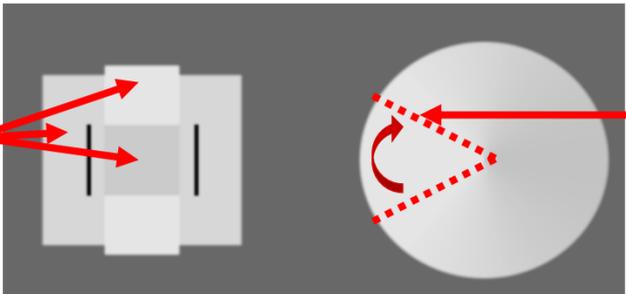
Note that some versions do not contain fine tuning SPLUGE components

A8. White PLUGE & SPLUGE Usage

Coarse Tuning (PLUGE)

Both central super-white vertical band and central small square are clearly visible

Contrast (Gain) is **too low**



Fine Tuning (SPLUGE) *optional component*

Clipped sector (with no shades of gray) is much less than 180 degrees

Both central super-white vertical band and central small square are almost the same brightness as big white square

Contrast is **too high**



Clipped sector (with no shades of gray) is much more than 180 degrees

The super-white vertical band is almost the same brightness as big white square. Central small square is clearly visible

Contrast is **correct**



Conical grayscale is clipped exactly half-circle (180 degrees), no shades of gray on the left half

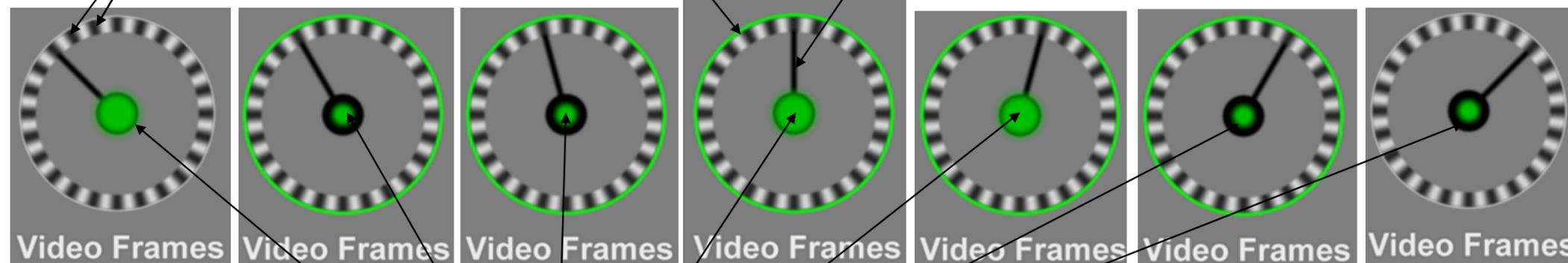
Note that some versions do not contain fine tuning SPLUGE components

A9. Frame Counter Features

Green Circle flashes for ~ +/- 100 ms with 1s periodicity:
@ 0 ms, 1000 ms, 2000 ms, etc.

Clock Handle in upward position:
@ 0 ms, 1000 ms, 2000 ms, etc.

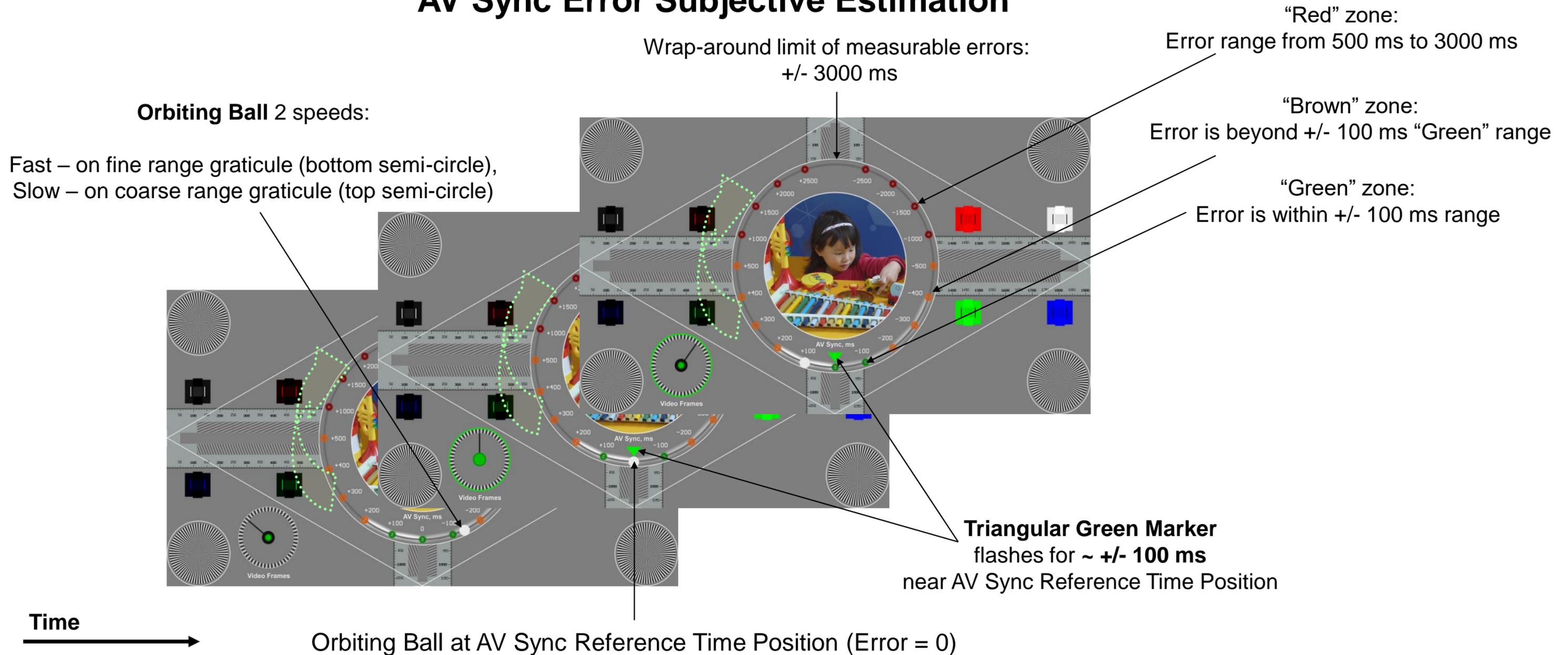
One Division = 1 Video Frame



Green “LED” flashes for 2 frames every 4 frames (2/4 periodic pattern)
revealing any video frames cadence discontinuities,
3:2 pull-down and other frame rate conversion cases

A10. AV Sync Test Features 1

AV Sync Error Subjective Estimation



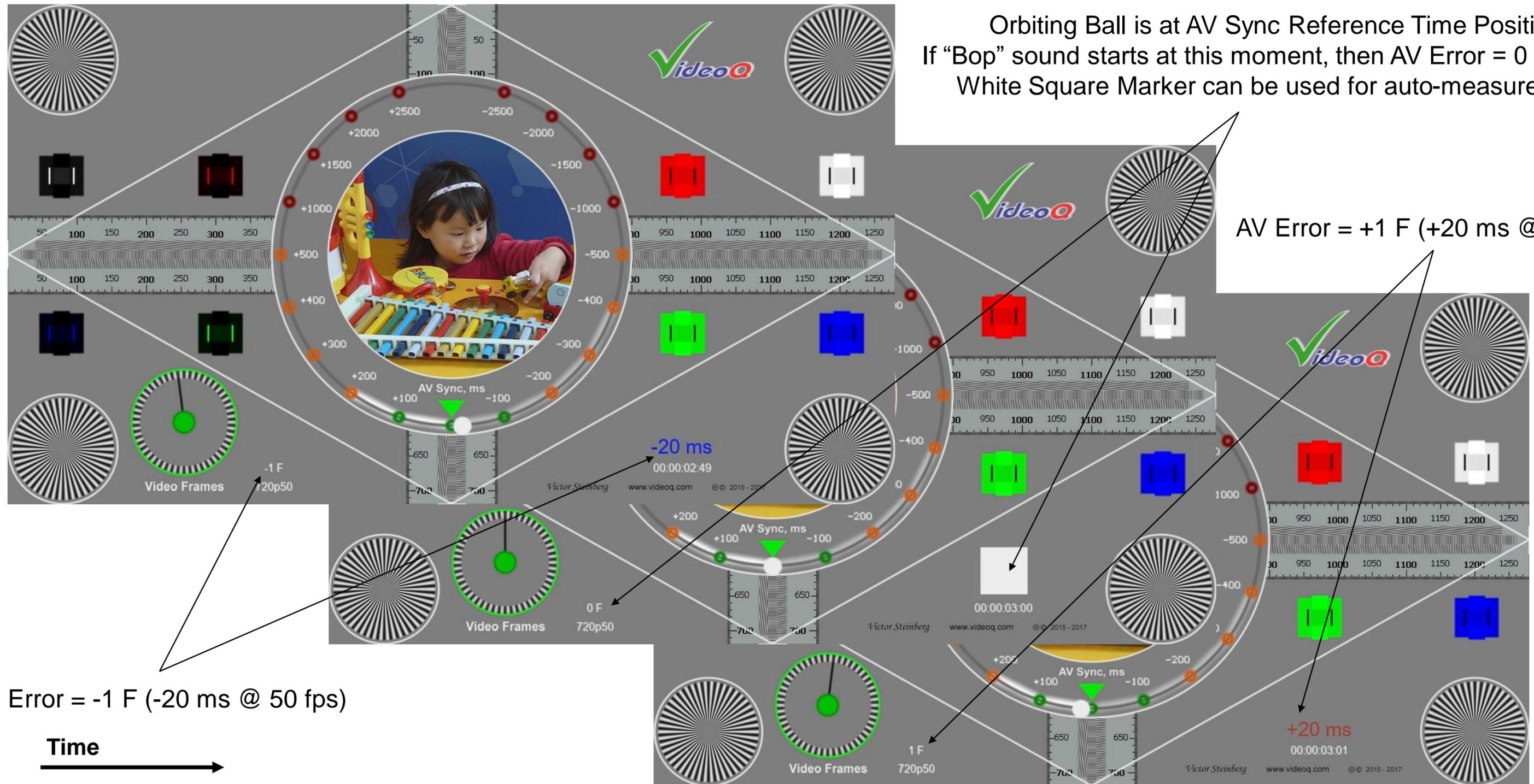
User can estimate the AV Sync Error value by the ball position at the moment of “bop” sounds start.

Green triangular marker flashes for about +/- 100 ms wrt AV Sync Reference, thus indicating the boundaries of acceptable errors (“green” range).

A11. AV Sync Test Features 2

Numerical Readout and Automated Measurement

Orbiting Ball is at AV Sync Reference Time Position.
 If "Bop" sound starts at this moment, then AV Error = 0 F (0 ms).
 White Square Marker can be used for auto-measurement.



AV Error = -1 F (-20 ms @ 50 fps)

AV Error = +1 F (+20 ms @ 50 fps)

Time →