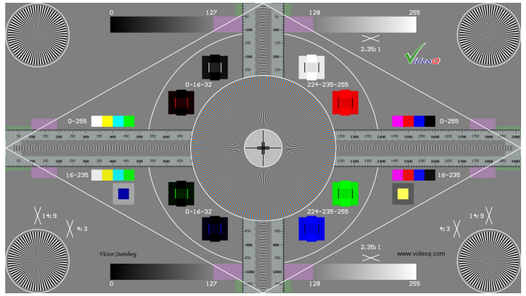

VQGSG

VideoQ Geometry, Scaling & Gradations Test Pattern

Training Presentation

December 2024

videoq.com/vqgsg.html

videoq.com

Table of Contents

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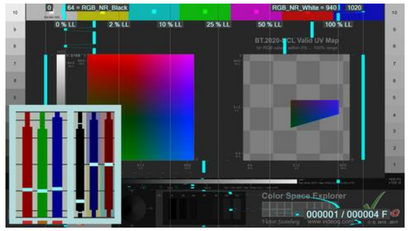
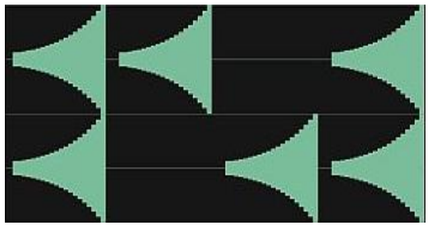
1. VideoQ Approach to Test Patterns Usage

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

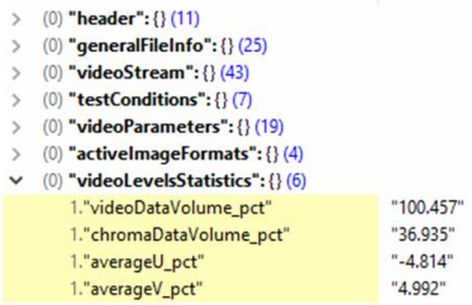
Instant visual-aural quality estimation

Objective measurements of video and audio parameters





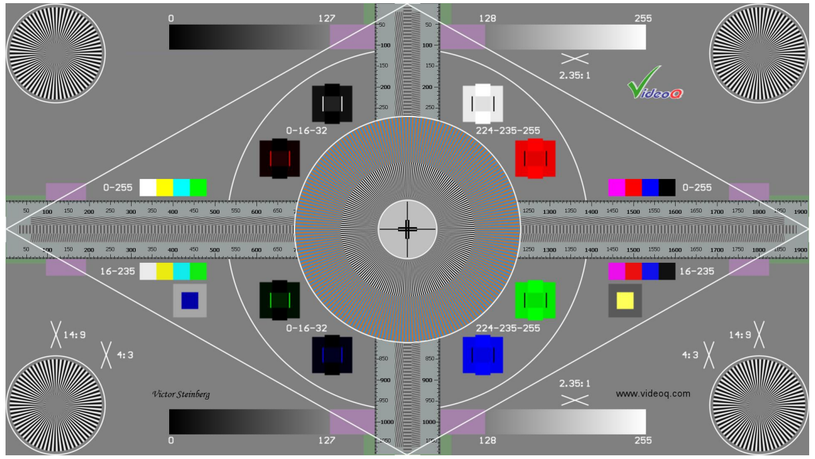
Fully automated Quality Control



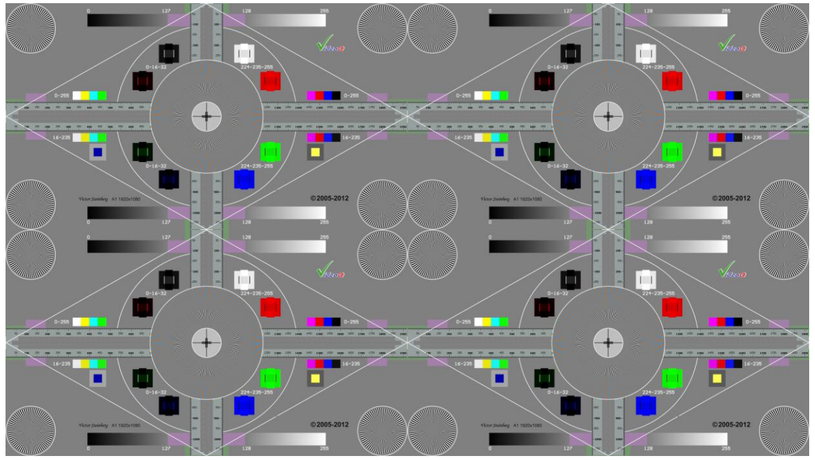
2. VQGSG – Dynamic Multi-purpose QA/QC Test

Parameters tested:

- Geometry:
  - Aspect Ratio
  - Scaling
  - Cropping
- Y and UV 2D Frequency Responses & Aliasing artefacts
- YUV & RGB levels:
- Non-linearity (“banding”), Black Crash and White Crash
- Dynamic Color Balance on Grayscales
- Color Bars levels vs. Reference levels
- Monitor Setup: Black and White in R, G an B channels
- Color Saturation (Y vs. UV Gain)
- Video frames continuity
- Video wall uniformity (display panels matching)



VQGSG-4 UHD variant
for 2x2 Video Wall

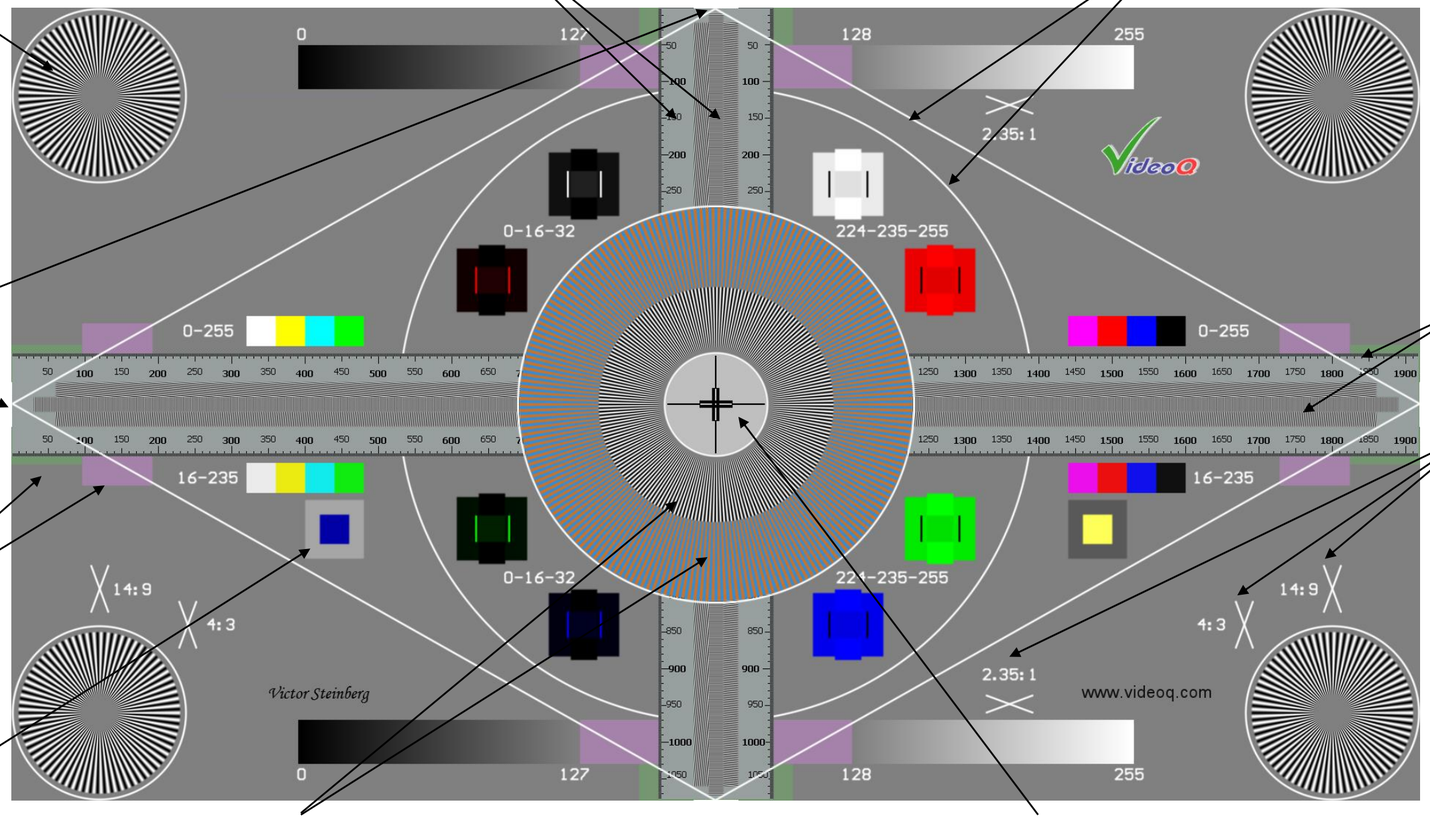


3. Geometry and Scaling Test Components

Corner Radial Plates x4
aimed at testing
Geometry & Sharpness

Vertical Ruler,
Vertical Frequency Bursts

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



Single white pixel
Edge Markers

Horizontal Ruler,
Horizontal Frequency Bursts

Aspect Ratio
Crop Markers

5% (Green),
10% (Magenta)
Crop Markers

Frames Continuity
Flashing Gray, Blue & Yellow
Tests x2

Large Radial Plate:
2D Sharpness Test
Central area: **Y**
Outer area: **UV**

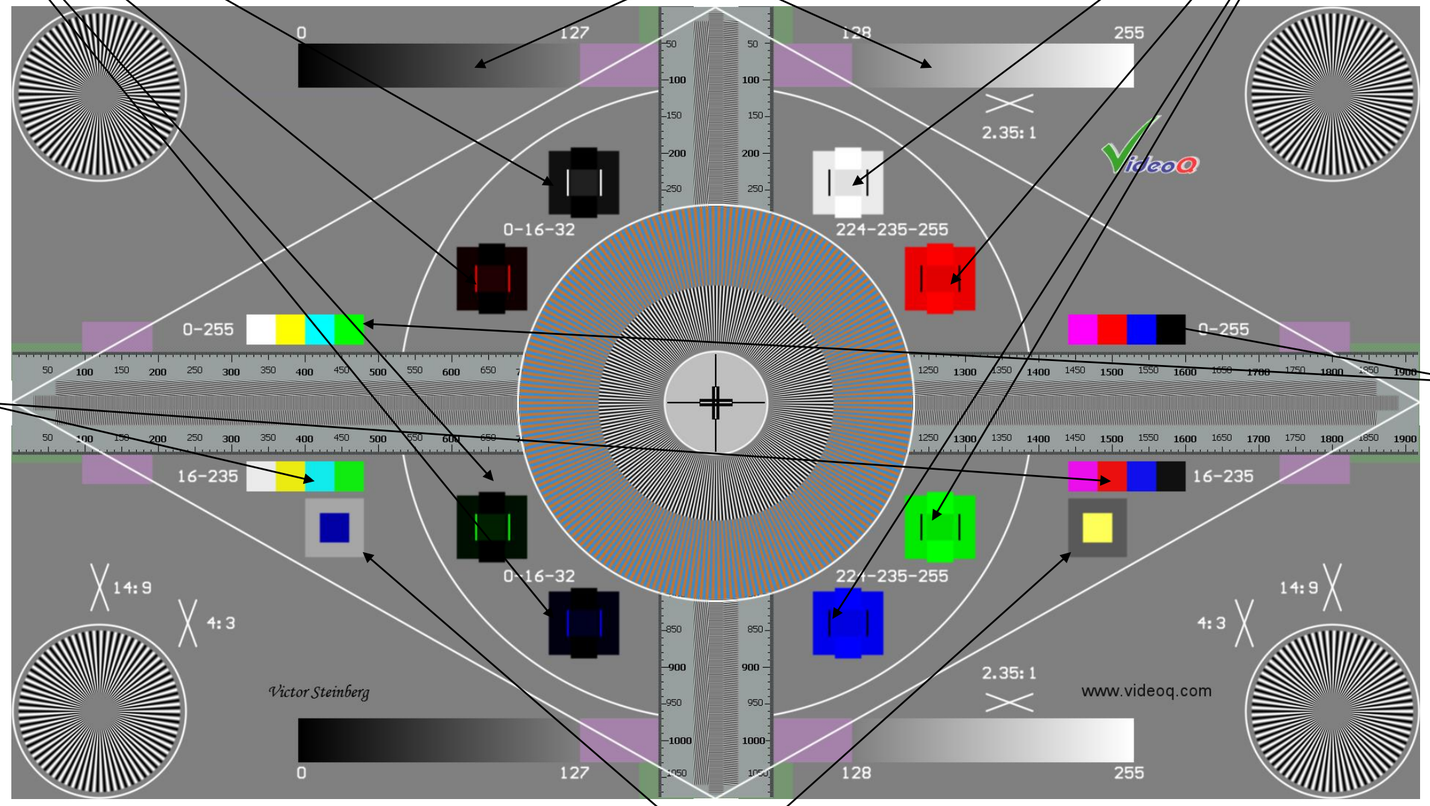
Digital Sharpness Test:
2 pixels wide Needles
and Central Cross

4. Color and Level Ranges Test Components

Four Tri-level **Black PLUGE** boxes aimed at testing **YRGB min levels**

Four Tri-level **White PLUGE** boxes aimed at testing **YRGB max levels**

Two full-range **Grayscale Ramps** aimed at testing **YRGB linearity**



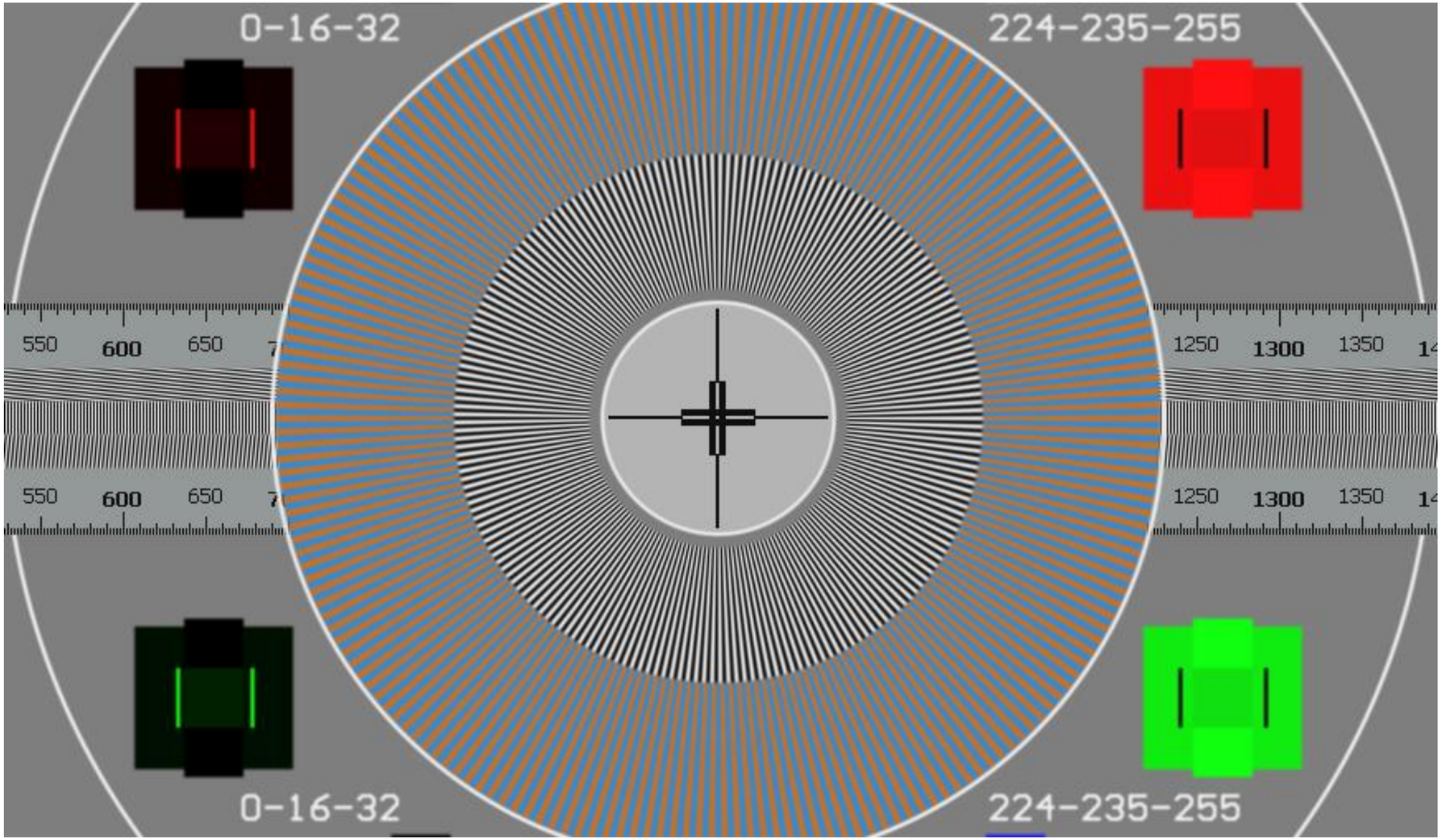
16-235 “Low RGB” Split **Color Bars**

0-255 “High RGB” Split **Color Bars**

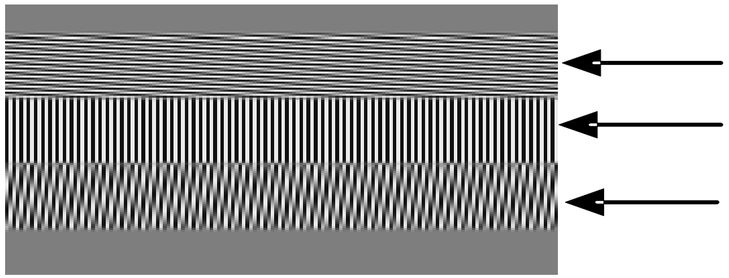
Two **Color Saturation Test** boxes used in “Blue Only” display mode (*flashing as **Frames Continuity Tests***)

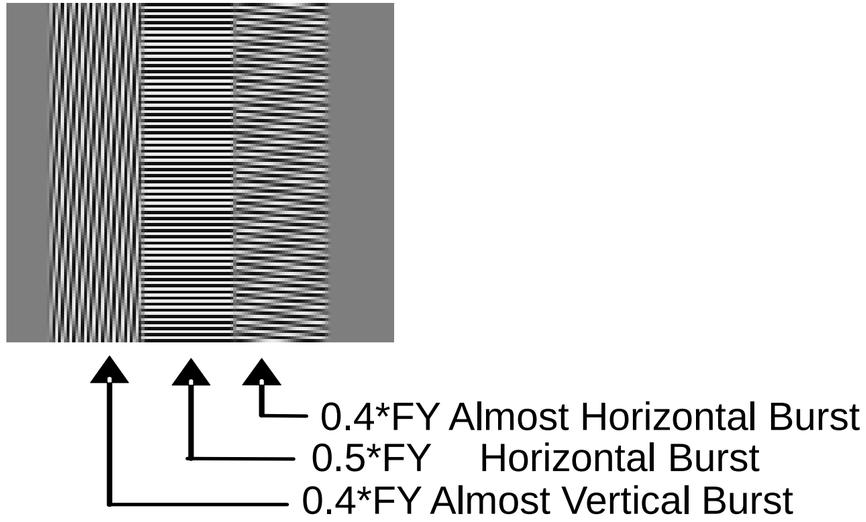
5. Central YUV Resolution and Y Sharpness Test

Use “100% zoom” (no scaling) mode to see **perfect reproduction** of all details.



6. Tri-band Combination Burst Patterns



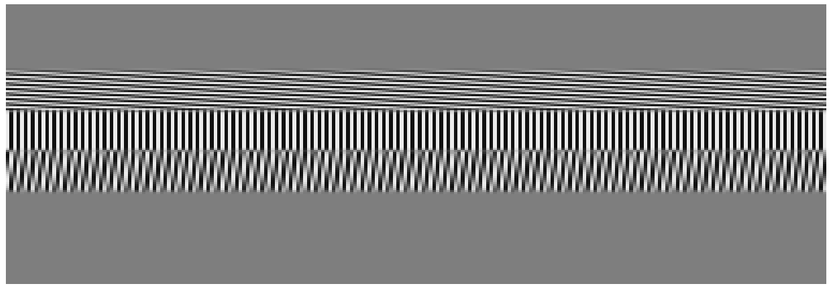


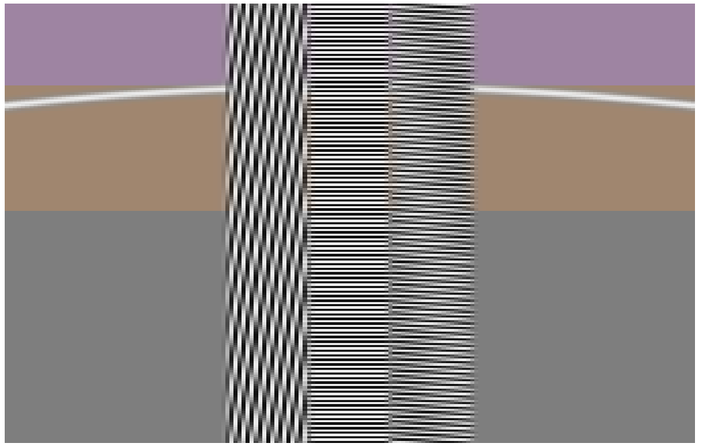
There are two groups of bursts with frequencies proportional to luminance pixels rate FY:
full length horizontal bursts band and **full height vertical** bursts band.
Maximum luminance frequency burst of exactly **0.5 FY** is in the middle of each band.
Two slightly oblique bands of 0.4 FY surrounds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

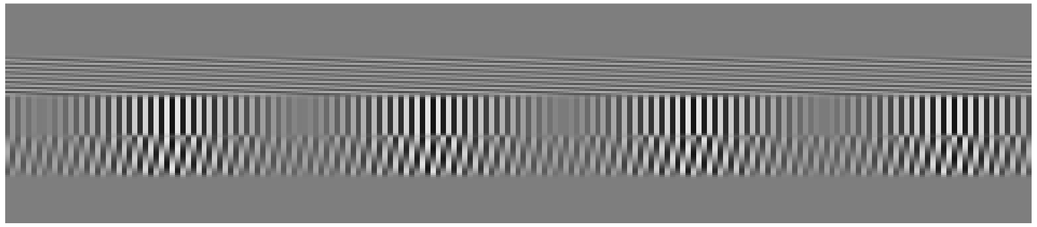
Within the burst vertical and almost **vertical lines** test **horizontal frequencies**,
whilst horizontal and almost **horizontal lines** test **vertical frequencies**.

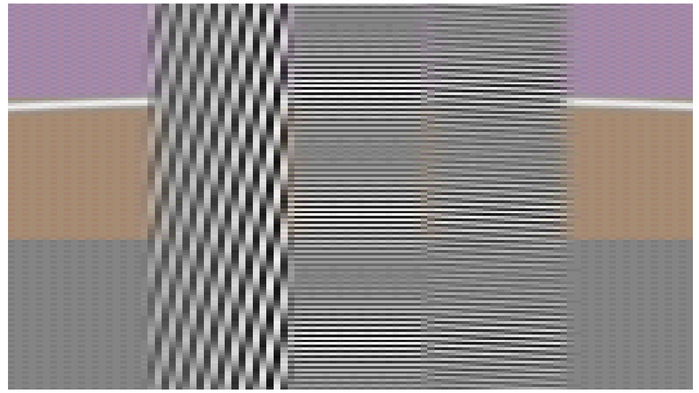
7. Tri-band Combination Burst Pattern Usage





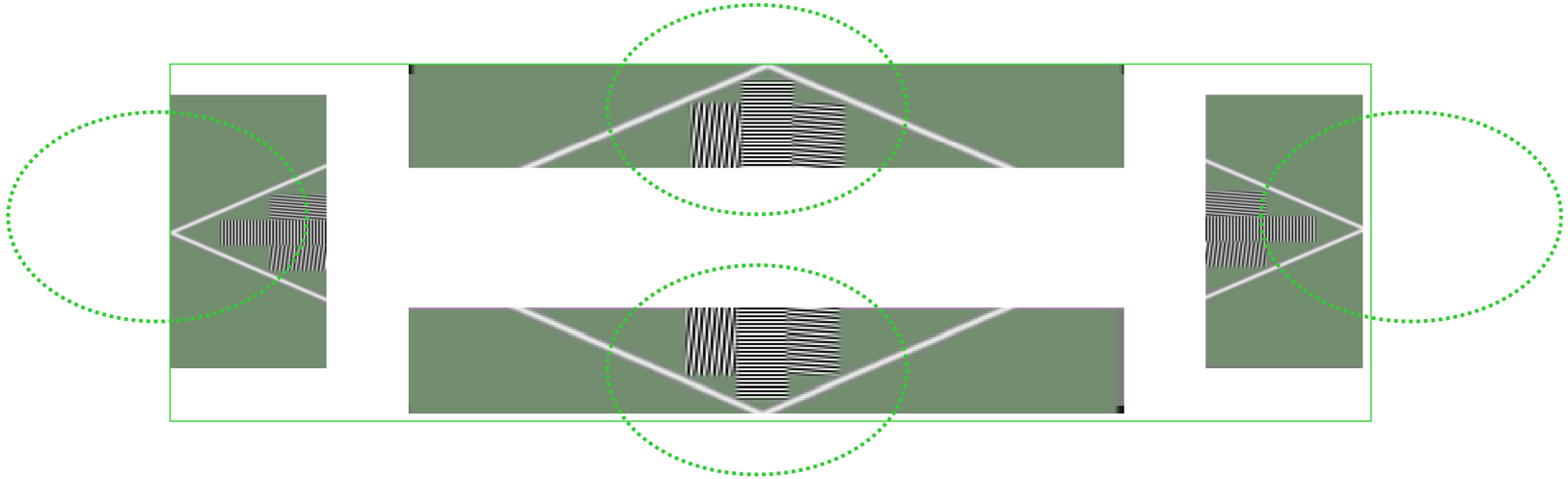
Example of correct settings (no scaling):
There are no visible beat waves on both horizontal and vertical Tri-band Patterns



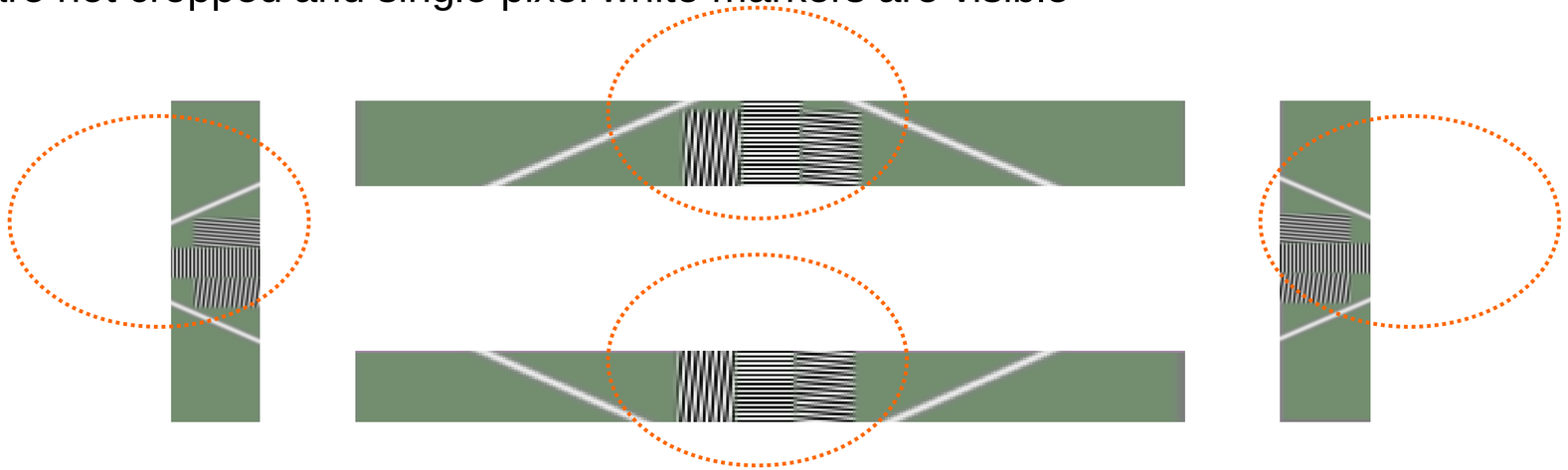


Example of incorrect settings (with scaling):
Scaling causes beat waves on both horizontal and vertical Tri-band Patterns

8. Diamond Pattern and Crop Markers Usage



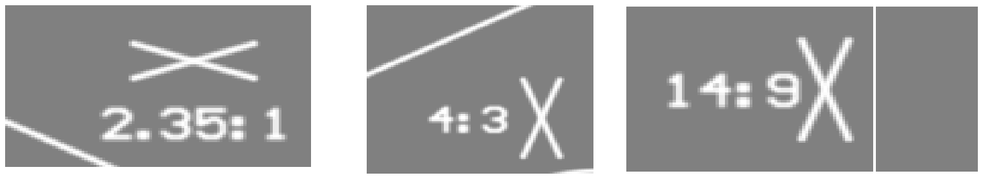
Example of correct settings (no cropping):
All picture edges are not cropped and single pixel white markers are visible



Example of incorrect settings (with cropping):
Picture edges are cropped

9. Active Image Aspect Ratio Markers

Crop Markers



Correct 4:3 Crop

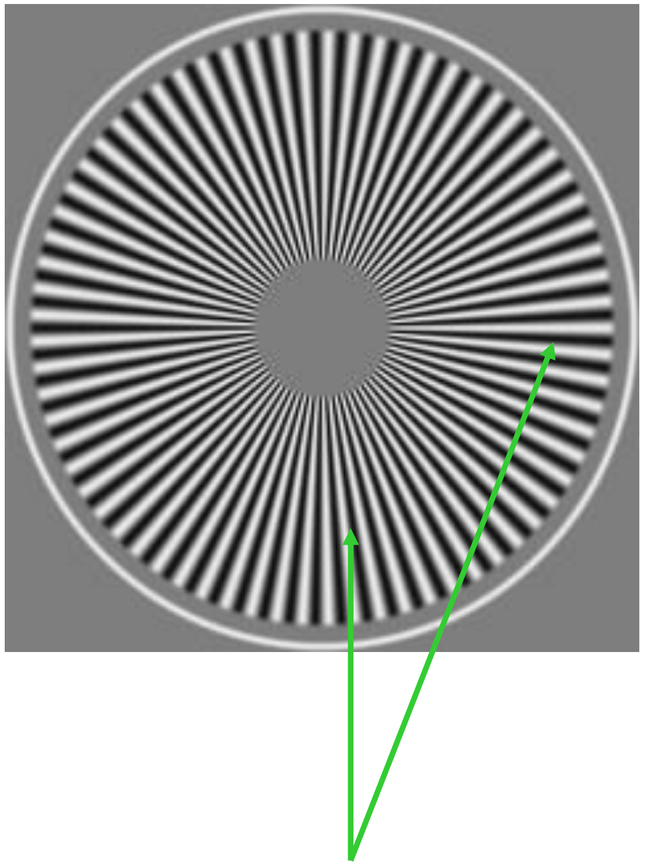
Wrong 4:3 Crop

The VQGSG pattern is suitable for measurement in the default **16:9** format, but it can be also used to check **4:3**, **14:9** and **2.35:1** active image formats. Cross-shaped Frame Format Markers indicate precise area boundaries for each active frame format.

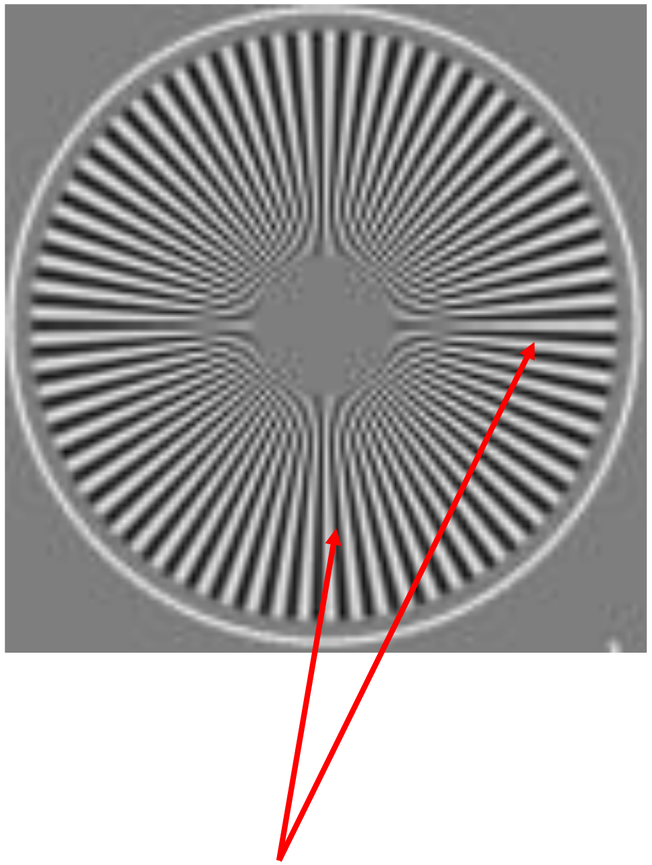
These are several most popular scale and crop modes:

- *4:3 crop is used to display 16:9 content on legacy standard definition TV sets,*
- *14:9 is a compromise (non-letterboxed) mode used in simulcast broadcasting to present 16:9 content on 4:3 and 16:9 screens,*
- *2.35:1 is used to show letterboxed “cinemascope” movies on 16:9 screens.*

10. Radial Plates Usage

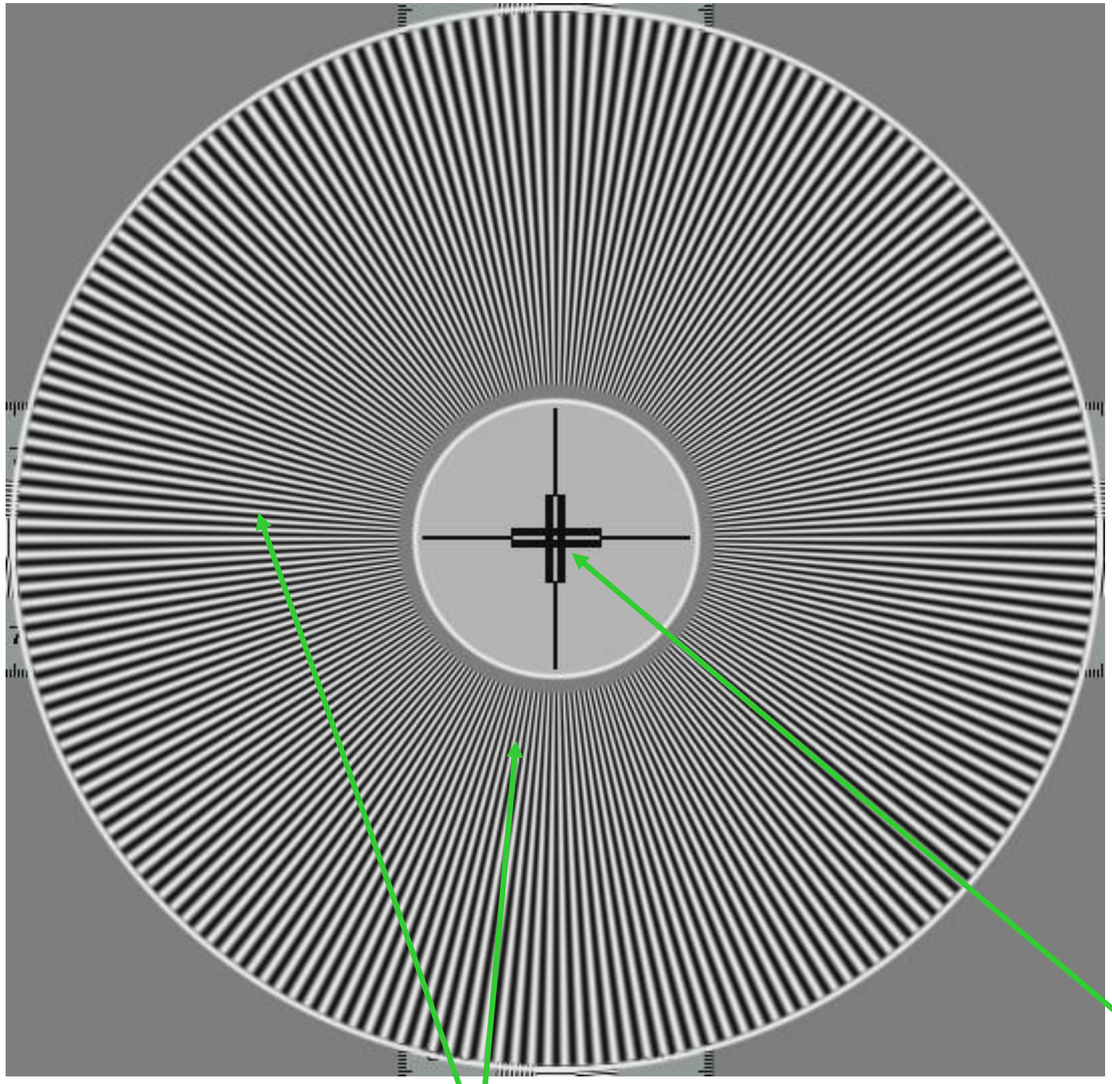


Original Size – dot-by-dot:
Full contrast of **fine details** in all directions



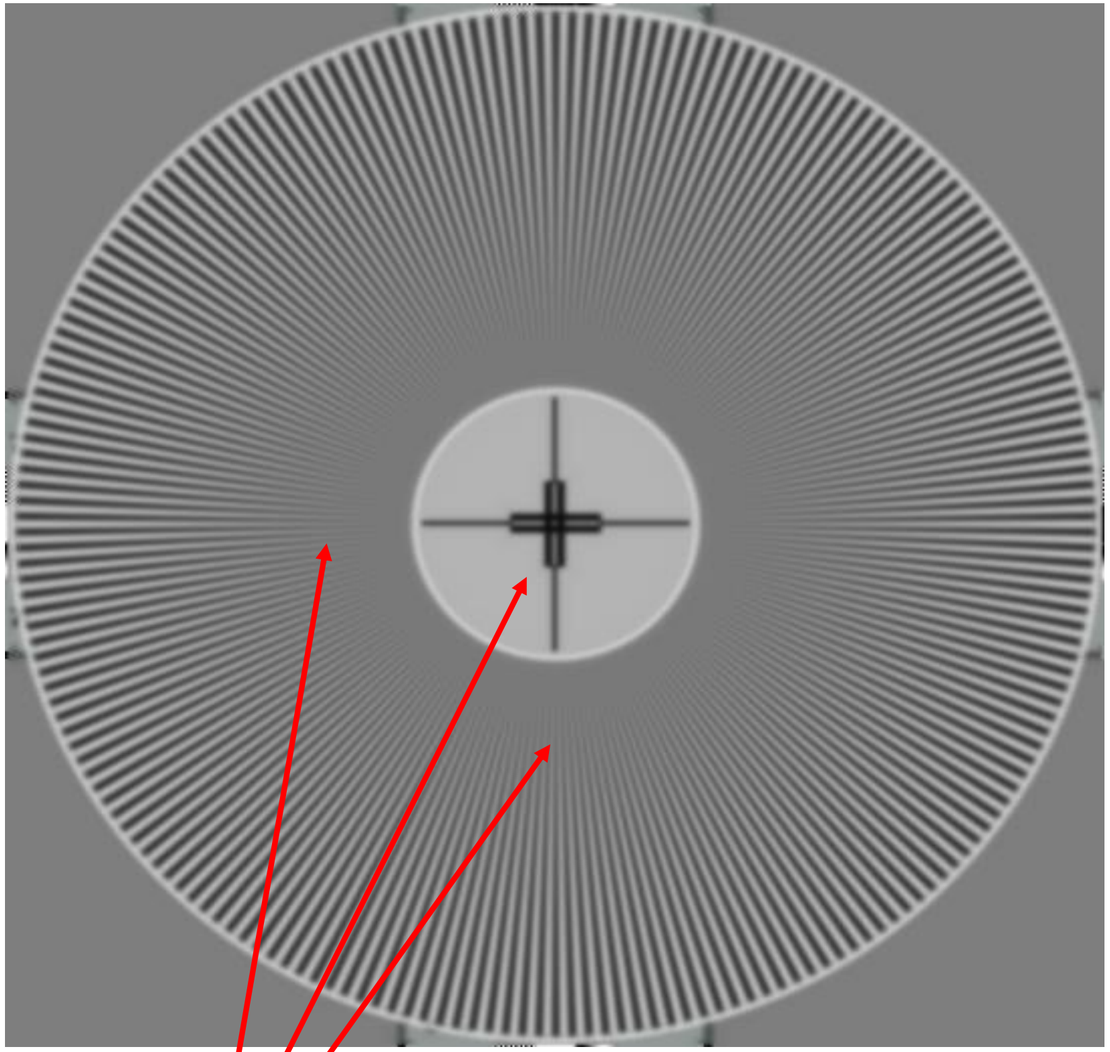
Scaled (Up or Down) Picture:
Loss and/or distortion of **fine details**

11. Sharpness Test Usage 1



Optimal Sharpness Control Settings:
Full contrast of fine details in all directions, perfect digital sharpness, no blur, no ghost images

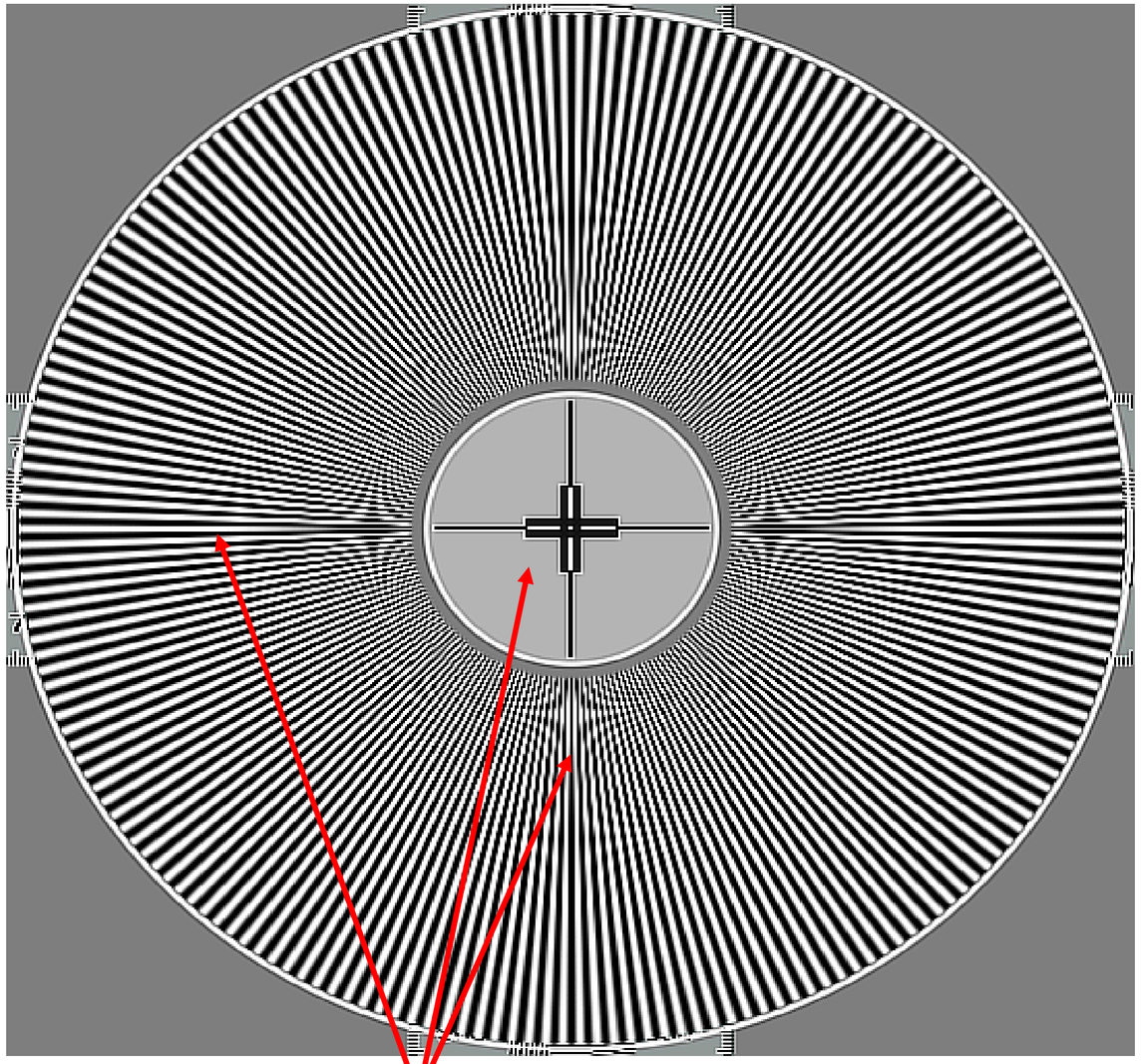
12. Sharpness Test Usage 2



Not enough sharpness:

1. Fine details contrast reduced,
2. Central cross blurred

13. Sharpness Test Usage 3

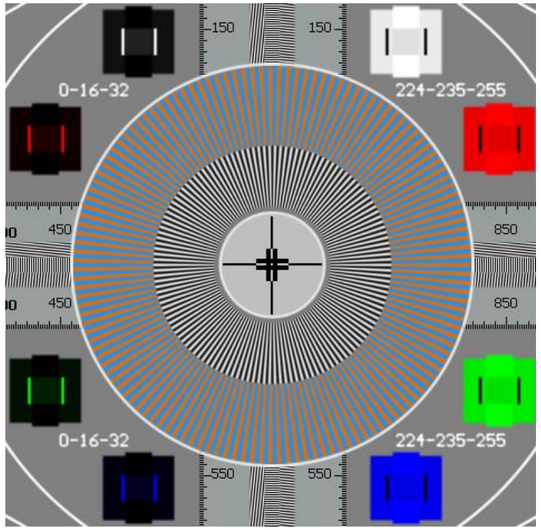


Too much sharpness:

1. Fine details distorted (over-enhanced),
2. Visible ghost images next to central cross

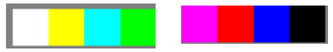
14. YRGB PLUGE Boxes and other Color Tests Usage

1. YRGB Range Check:



- By observing YRGB levels in VideoQ VQV Viewer/Analyzer or similar software tool.
  Note that Color Space Conversion, such as 16-235 ⇔ 0-255, YUV ⇔ RGB and/or 601 (SD) ⇔ 709 (HD) matrices, may cause significant YRGB (YUV) level errors
- By checking the appearance of black and white PLUGE and SPLUGE components:
  see next slides for details.

2. Color Saturation Check:



- By observing **Color Bars RGB levels** in VideoQ VQV Viewer/Analyzer or similar software tool:
  If color saturation is preserved (correct mode of operation) reconstructed YRGB min and max levels must be **equal on all bars**

- By checking the appearance of Color Saturation Test boxes in “Blue only mode”:
  If color saturation is preserved (correct mode of operation) there should be no visible on-screen differences between shades of blue on colored and gray areas

15. Black PLUGE and SPLUGE Usage

Fine Tuning (SPLUGE)
optional component

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

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

Coarse Tuning (PLUGE)

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

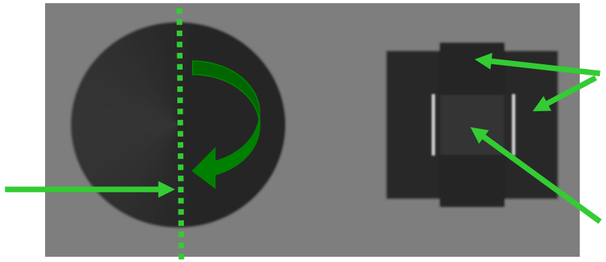
Brightness is **too high**

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

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

Brightness is **correct**

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



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

Central small square is clearly visible

Note that some versions of the VQGSG Test Pattern do not contain fine tuning SPLUGE components

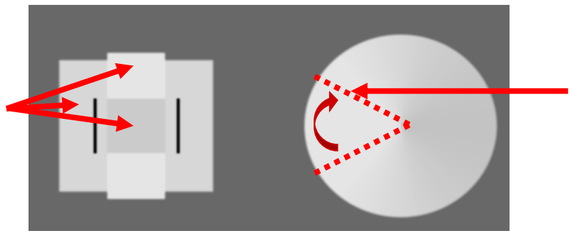
16. White PLUGE and SPLUGE Usage

Coarse Tuning (PLUGE)

Fine Tuning (SPLUGE)
optional component

Contrast (Gain) is **too low**

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



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

Contrast is **too high**

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

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

Contrast is **correct**

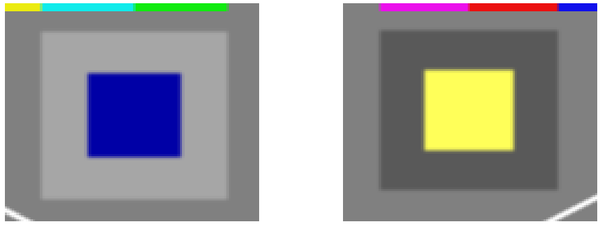
The super-white vertical band is almost the same brightness as big white square.
Central small square is clearly visible

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

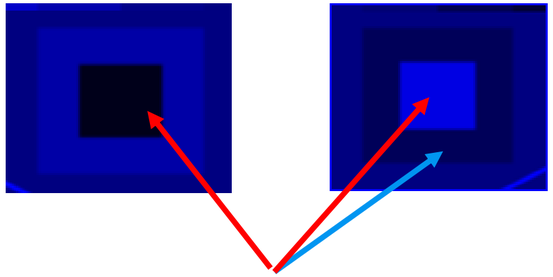
Note that some versions of the VQGSG Test Pattern do not contain fine tuning SPLUGE components

17. Color Saturation Test Usage

Normal View
Correct Color Saturation

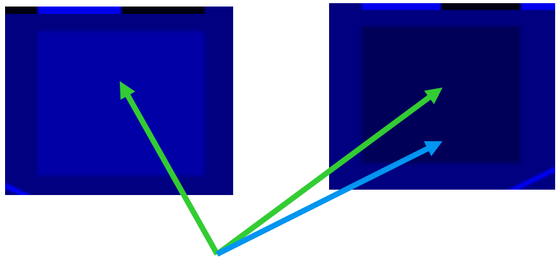


Blue Only Display Mode
Low Color Saturation



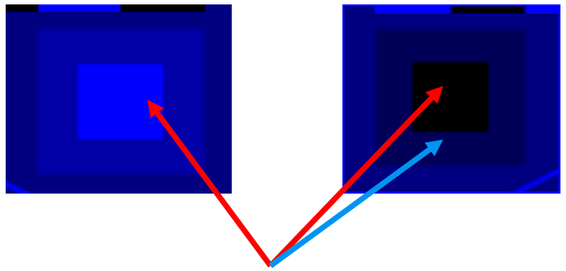
Blue component intensity on **colored** areas **differs** from **gray** areas

Blue Only Display Mode
Correct Color Saturation



Equal blue component intensity on **gray** and **colored areas**, inner squares **are not visible**

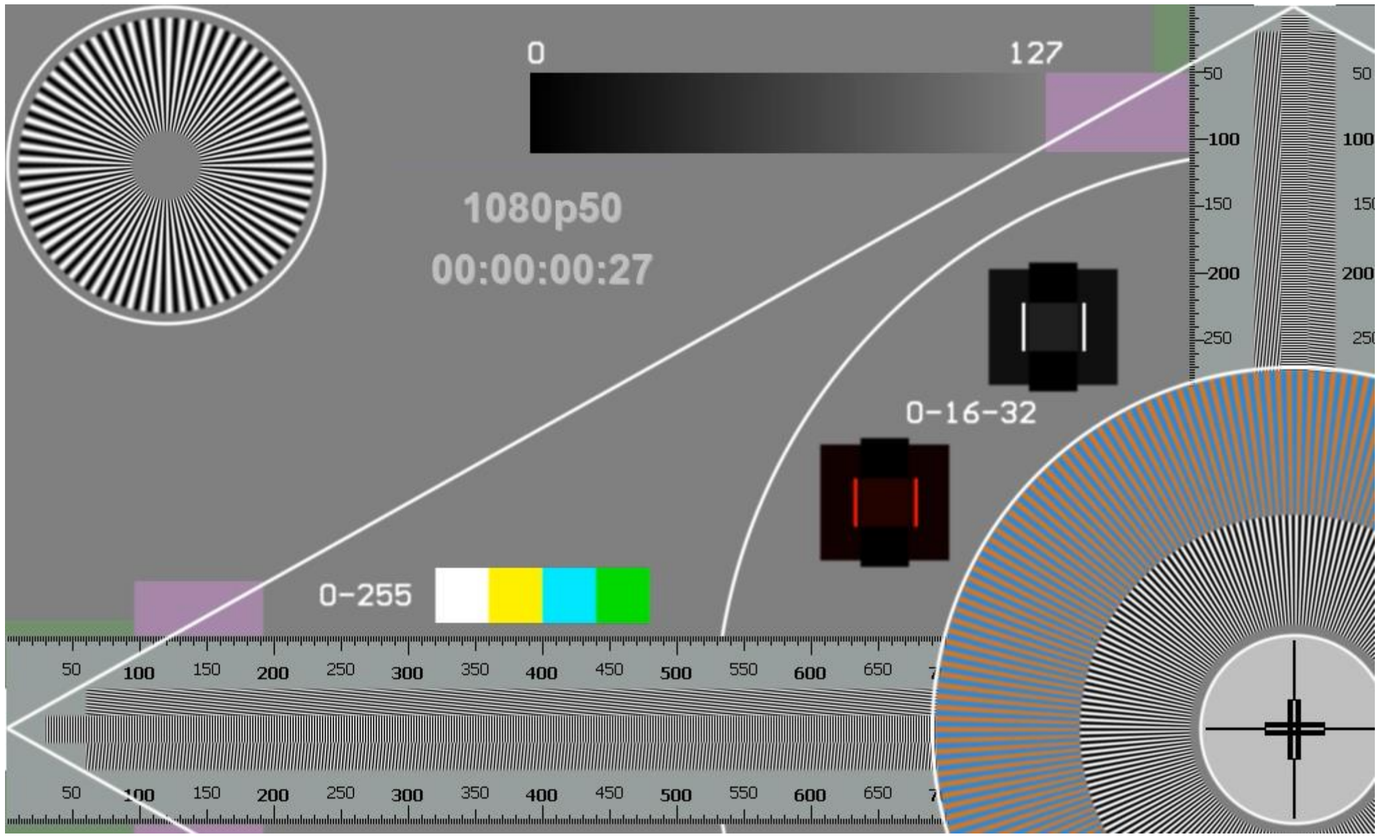
Blue Only Display Mode
Excessive Color Saturation



Blue component intensity on **colored** areas **differs** from **gray** areas

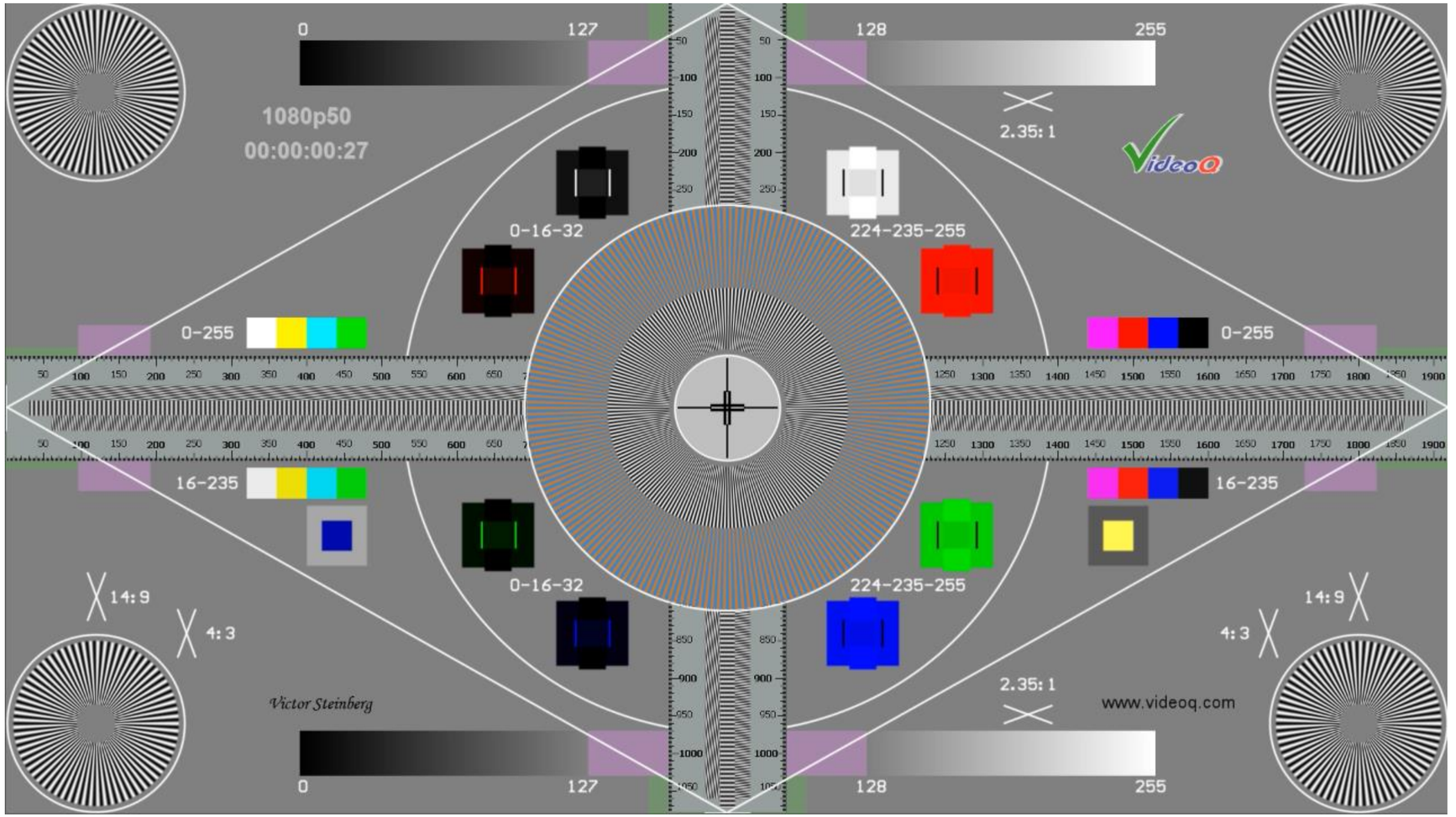
18. Checking Consumer Player Scaling Quality 1

VQGSG Test Pattern Size: **1920x1080**. **Display Screen** Size: **1920x1080**.
Player works in **Full Screen Mode**, pixel-by-pixel matching the test pattern. No scaling, zoom: **1:1**
Use this mode as a **reference**, note nearly **perfect reproduction** of all fine details.



19. Checking Consumer Player Scaling Quality 2

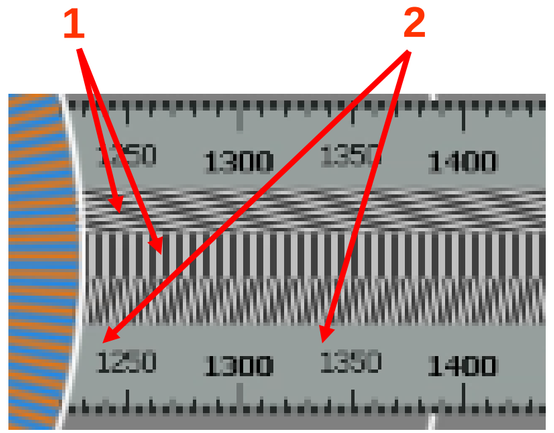
VQGSG Test Pattern Size: **1920x1080**. **Display Screen** Size: **1920x1080**.
Player's active area size: **1280x720**, zoom: **1:1.5**. It looks like scaler works in "*fast, sharp and dirty mode*".
In this mode we see significant **scaling distortions**.



Strong aliasing effects:

1. Ideally, after such scaling all high frequency **bursts should look** as solid **Gray** areas, but they exhibit high contrast of low frequency **beating components.**

2. Due to the **aliasing** effect **some characters** of the Ruler text labels looks much worse that **the others**. In case of any motion, it means **quite annoying flicker effect**.



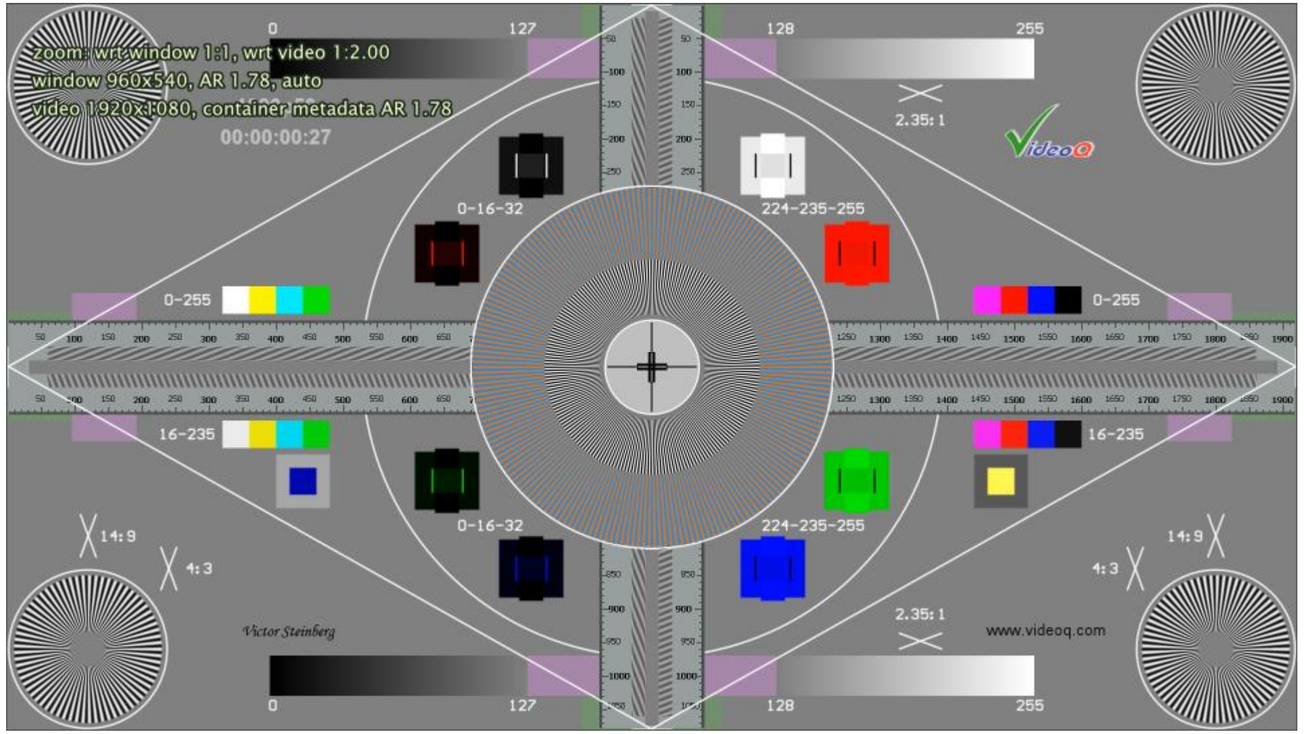
20. Checking Consumer Player Scaling Quality 3

VQGSG Test Pattern Size: **1920x1080**. **Display Screen** Size: **1920x1080**.
Player's active area size: **960x540**. Its scaler delivers "*fast, sharp and dirty*" zoom: **1:2.0**
In this mode we see noticeable, but not so strong, **scaling distortions**.

Central cross is significantly **blurred**, as it should be with the applied zoom ratio **1:2**.

Y channel large and small **radial plates** exhibit **medium** level of **aliasing** components.

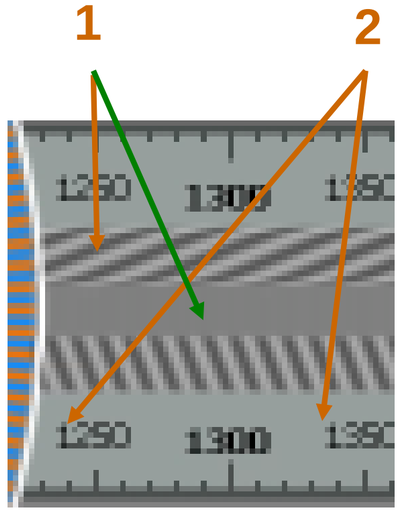
UV large radial plate shows some **loss** of contrast on the **highest frequencies**, but there are no serious problems



Not so strong aliasing effects:

1. The highest frequency **bursts now look good –** as solid **Gray** areas, but the **oblique bursts** still exhibit medium contrast low frequency **beating components.**

2. Due to the **aliasing** effect **some characters** of the Ruler text labels looks a bit different from **the others**.
In case of any motion, it means **noticeable, and slightly annoying, flicker effect.**



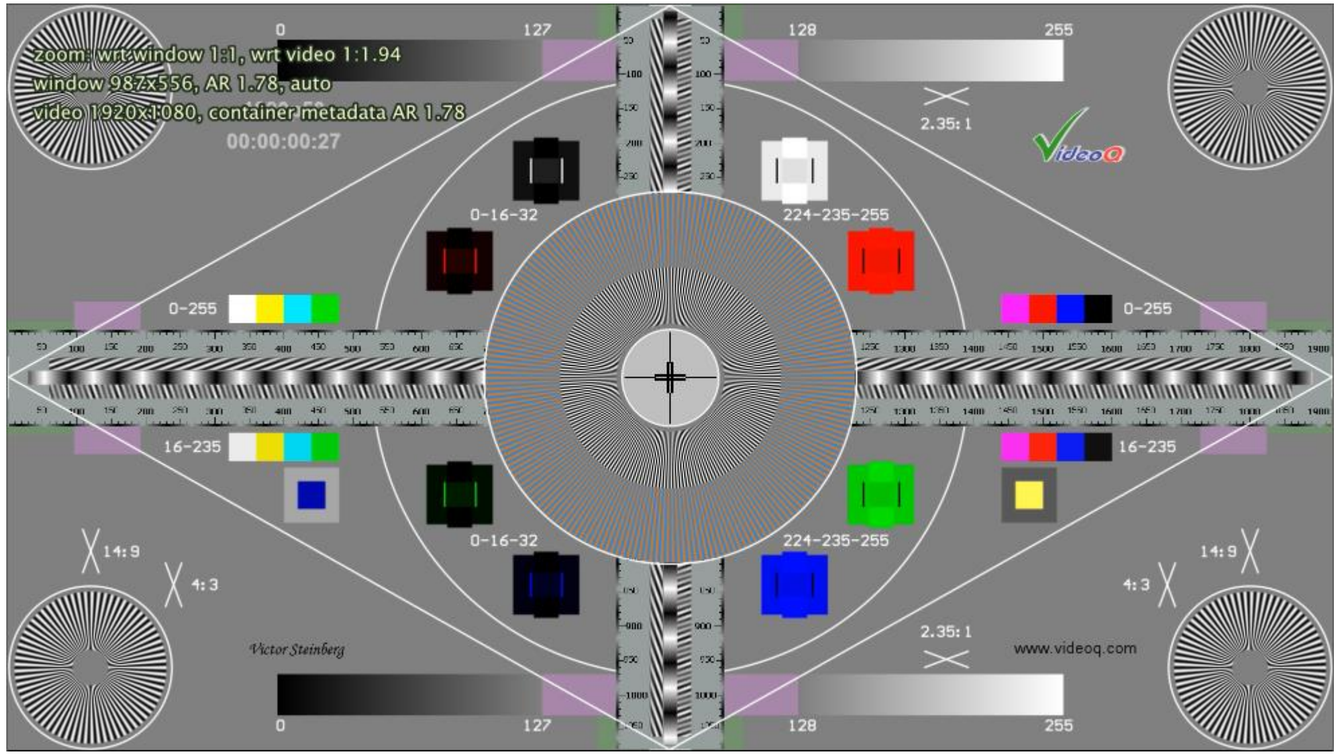
21. Checking Consumer Player Scaling Quality 4

VQGSG Test Pattern Size: **1920x1080**. **Display Screen** Size: **1920x1080**.
Player's active area size: **987x556**. Player scaler's zoom: **1:1.94 – *this is the worst case!***
In this mode we see **very strong** **scaling distortions**.

Central cross is **not blurred**, as it should be with the applied zoom ratio **1:1.94**.

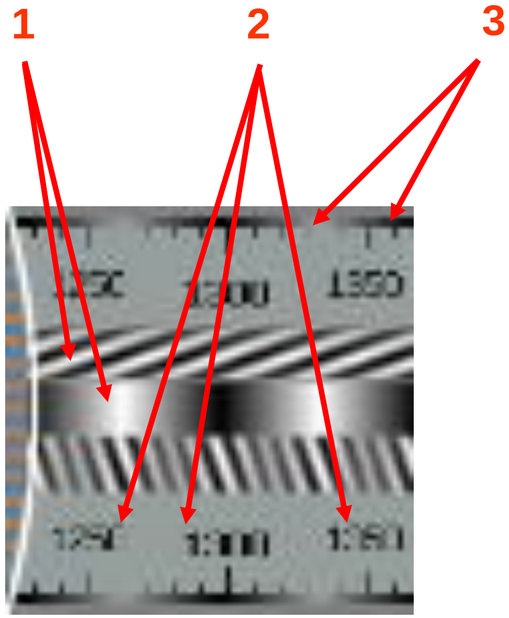
In case of any slow panorama motion it means **very strong** **flicker effect**.

Both **vertical** and **horizontal** max frequency **bursts** show **very annoying high contrast** of highly noticeable **very low frequency beating** components.



Very strong aliasing effects:

1. **All** high frequency **bursts** exhibit very high contrast of low frequency **beating components.**
2. **Some characters** of Ruler text labels completely **disappeared**, but some others are still visible
3. **Some Ruler division markers** completely **disappeared**, but some others are still visible



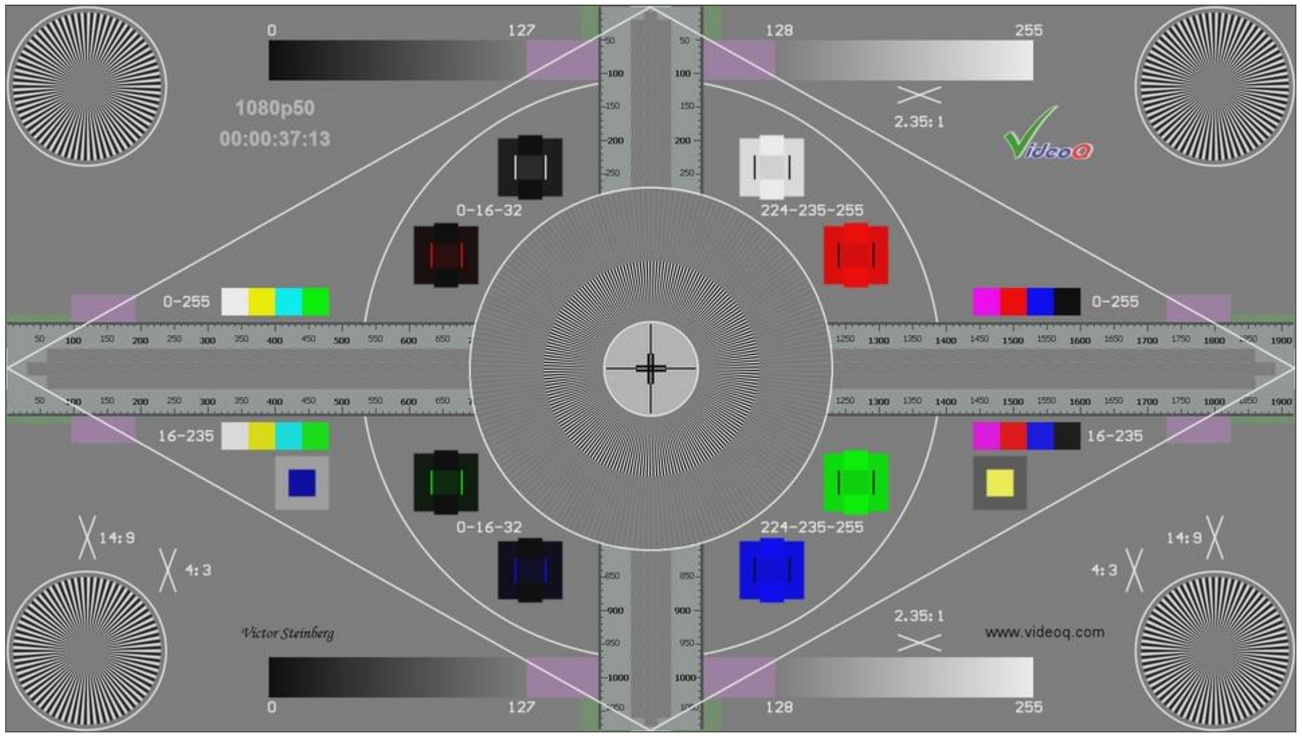
22. Checking FFPlay Lanczos Filter Scaler 1

VQGSG Test Pattern Size: **1920x1080**. **Display Screen** Size: **1920x1080**.
Player's active area size: **960x540**, *i.e. exactly 50%*, linear 3-taps filter scaler's zoom: **1:2.0**
In this mode FFPlay exhibits **different** (*vs. "Consumer Player"*) **type** of **scaling distortions**.

Central cross is **moderately blurred**, as it should be with the applied zoom ratio **1:2**.

Y channel large and small **radial plates** exhibit **low** level of **aliasing** components.

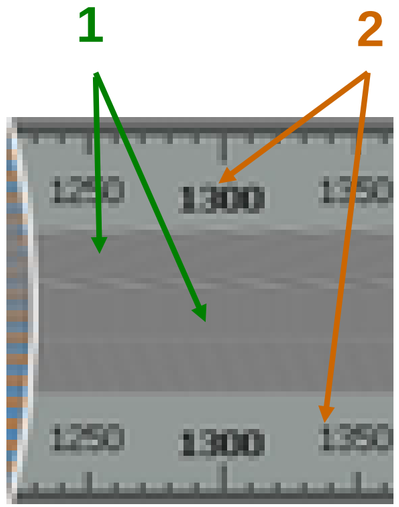
Y and **UV** large **radial plates**, as well as **4 corner plates**, show **significant loss** of contrast on **medium** and **high frequencies**, and this a **problem**



1. The highest frequency **bursts** and the **oblique bursts look good – they look** as solid **Gray** areas.

There are **no strong aliasing** effects, but there are two important issues – **ringing** artefacts and **fine details contrast loss**.

2. Due to the Lanczos Filter aperture **ringing** effect **all characters** of the Ruler text labels looks significantly different from **the original**, and this is a **problem**.

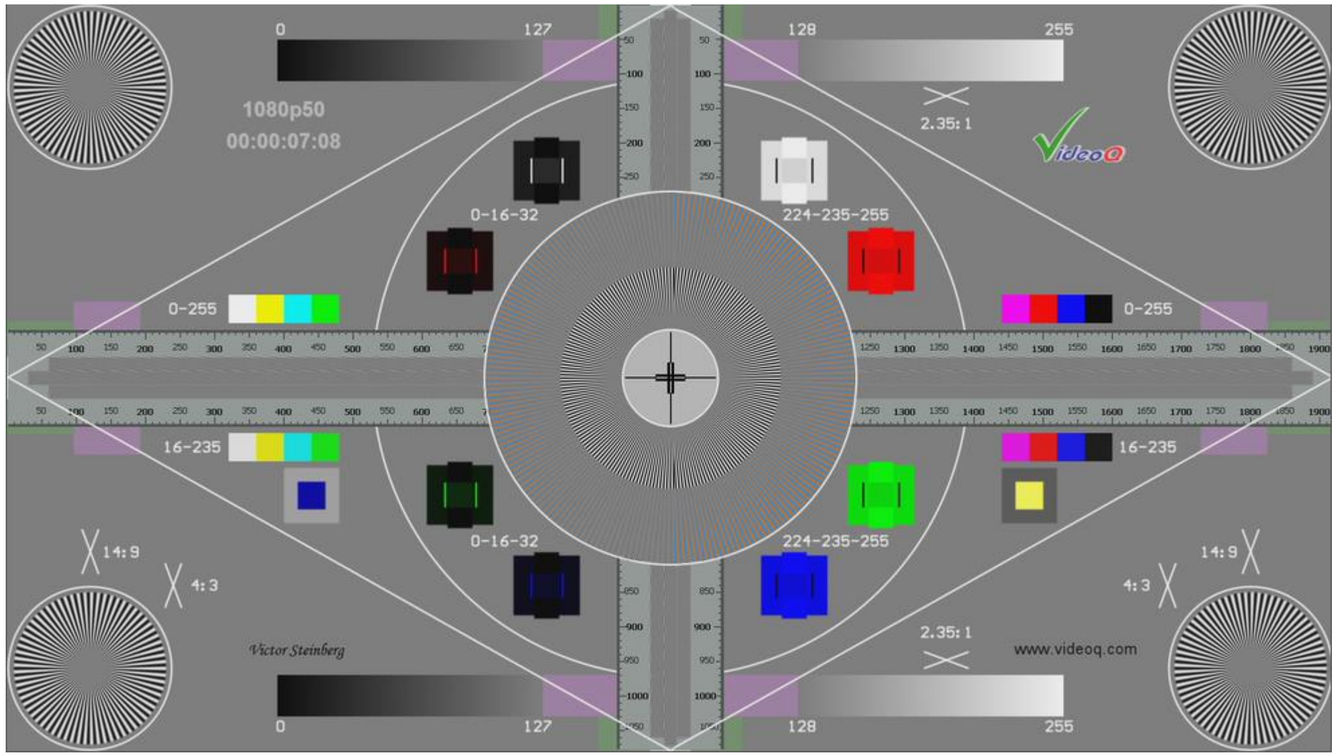


23. Checking FFPlay Lanczos Filter Scaler 2

VQGSG Test Pattern Size: **1920x1080**. **Display Screen** Size: **1920x1080**.
Player's active area size: **987x556**, *slightly more than 50%*. Linear 3-taps filter scaler's zoom: **1:1.94**
In this "worst case" mode we estimate **scaling distortions** strength as "medium".

Good thing about these two FFPlay images is that for zoom ratios **1:2.0** and **1:1.94** they are **not much different**. Important rule for any video player: "***consistency is more important than performance***".

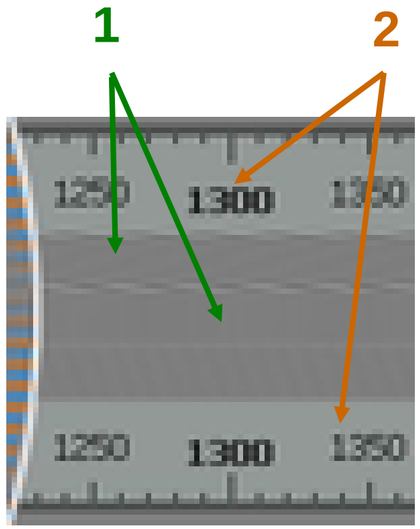
Among other advantages, consistency also means **low level** of **flicker** artifacts.



1. The highest frequency **bursts** and the **oblique bursts look good – they still look** as solid **Gray** areas.

There are **no strong aliasing** effects, but there are two important issues – **ringing** artefacts and **fine details contrast loss**.

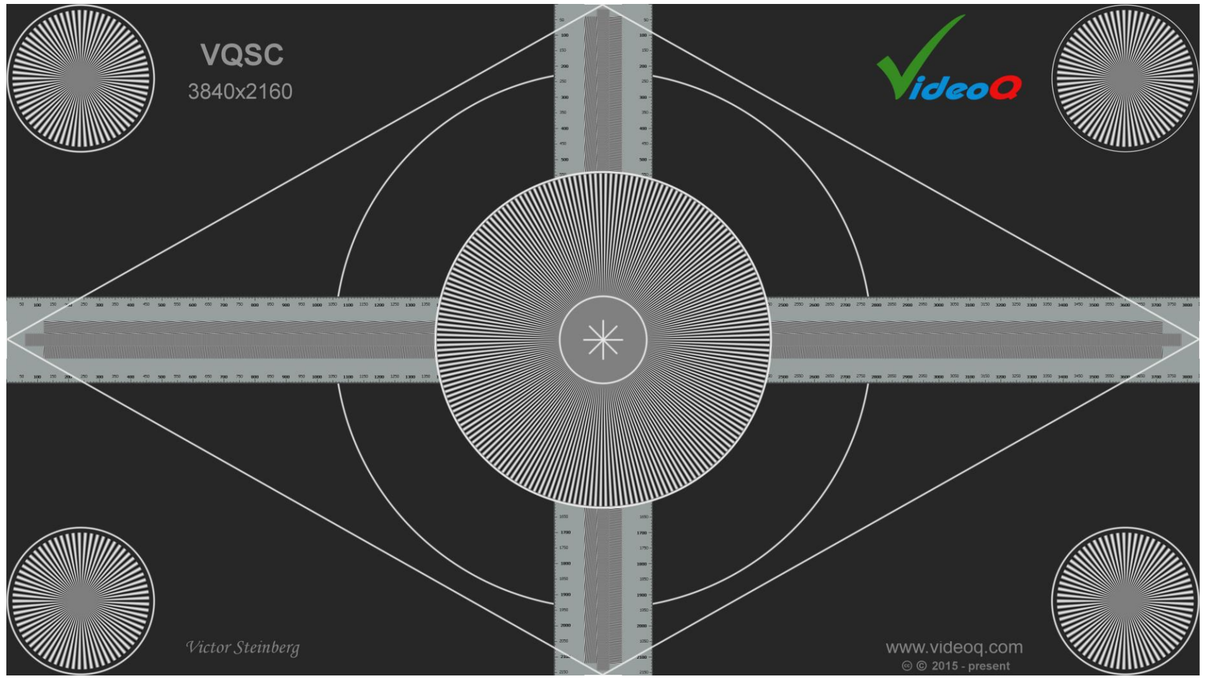
2. Due to the Lanczos Filter aperture **ringing** effect **all characters** of the Ruler text labels looks significantly different from **the original**, and this is a **problem**.

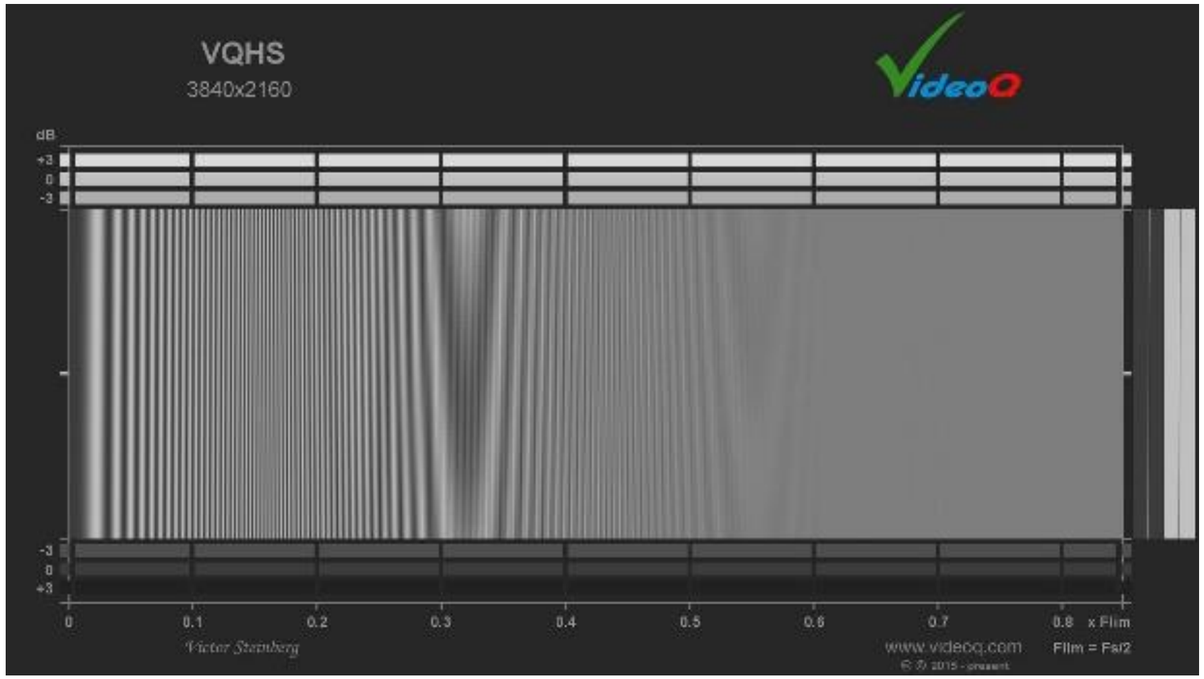


24. Companion Tests – VQSC and VQHS

Sophisticated VideoQ **VQSC** and **VQHS** UHD and HD test patterns contain full bandwidth and half-bandwidth test components. The tests are specially designed to check the **advanced GPU adaptive scaling** algorithms:

1. **VQSC** – containing one large and 4 smaller radial mires and 2 rulers including VideoQ proprietary “tri-band” test components
2. **VQHS** – containing 19 large horizontal frequencies sweep bands of 18 different phases: from -180 to +180 degrees, 20 degrees steps





25. 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