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VQGSG

VideoQ Geometry, Scaling & Gradations Test Pattern

Training Presentation

May 2023



www.videoq.com

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VideoQ Approach to Test Patterns Usage

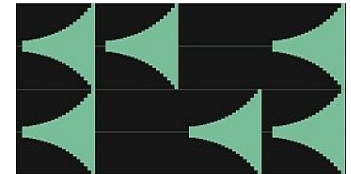


VideoQ approach combines “classic”, “digital” and “cloud” methodologies, sharing same test patterns and covering all 3 levels of video quality control:

Instant visual-aural quality estimation



Objective measurements of video and audio parameters



Fully automated Quality Control



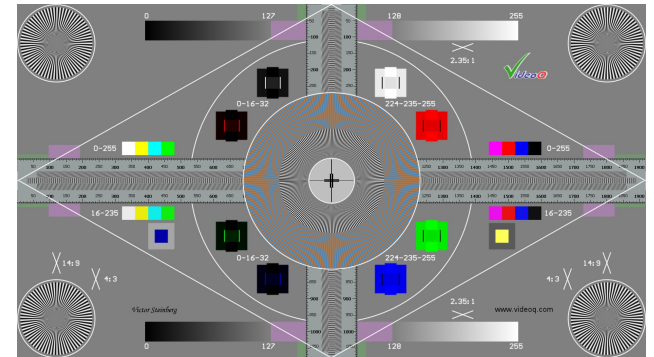
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> (0) "header": {} (11)
> (0) "generalFileInfo": {} (25)
> (0) "videoStream": {} (43)
> (0) "testConditions": {} (7)
> (0) "videoParameters": {} (19)
> (0) "activeImageFormats": {} (4)
v (0) "videoLevelsStatistics": {} (6)
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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

Learn more about VQL: www.videoq.com/vql.html

VQGSG (aka A1) – 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 and B channels
 - Color Saturation (Y vs. UV Gain)
- Frames continuity (skip/freeze frame sequence irregularities)



Geometry and Scaling Test Components

Corner Radial Plates x4
aimed at testing
Geometry & Sharpness

**Vertical Ruler,
Vertical Frequency Bursts**

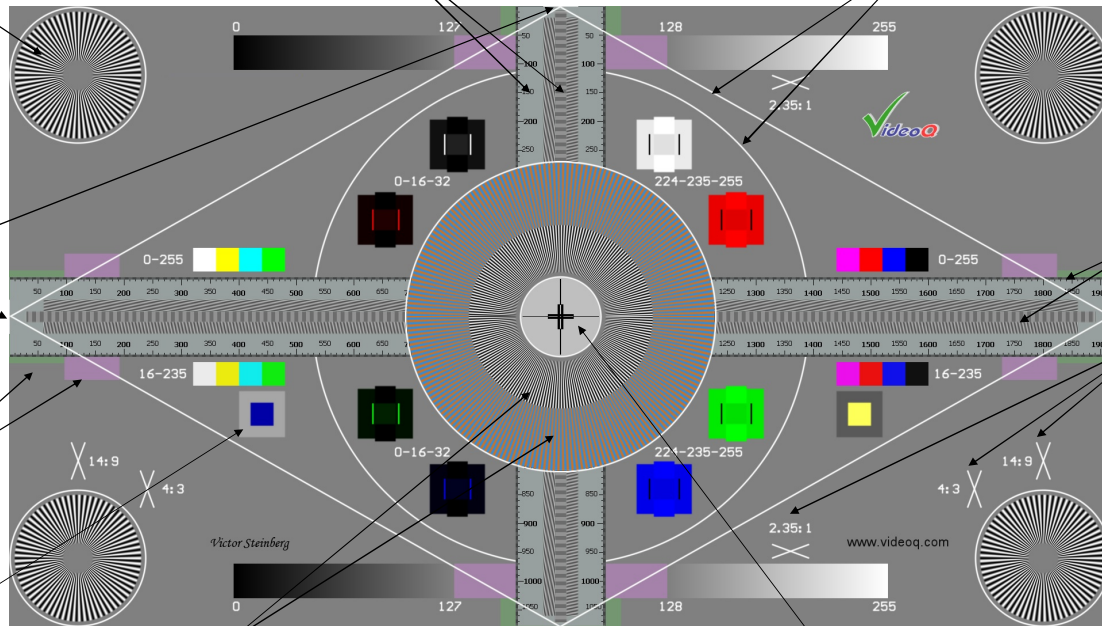
Large 0.8*H Circle and Diamond Lines
aimed at testing picture **Geometry**

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

Color Levels & Ranges Test Components

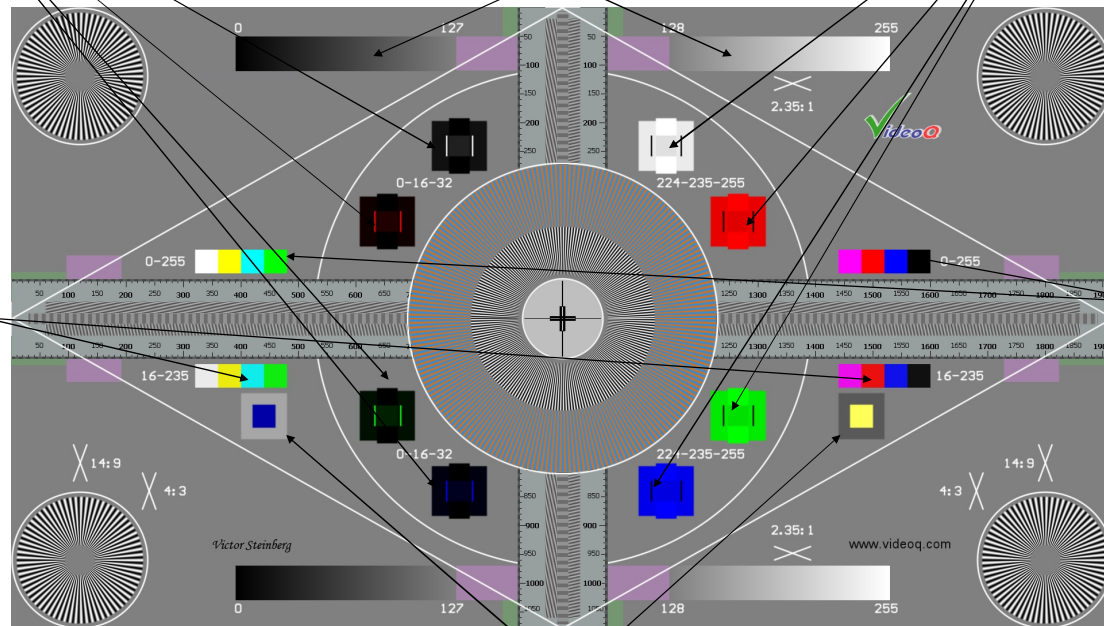
Four Tri-level
Black PLUGE boxes
aimed at testing
YRGB min levels

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

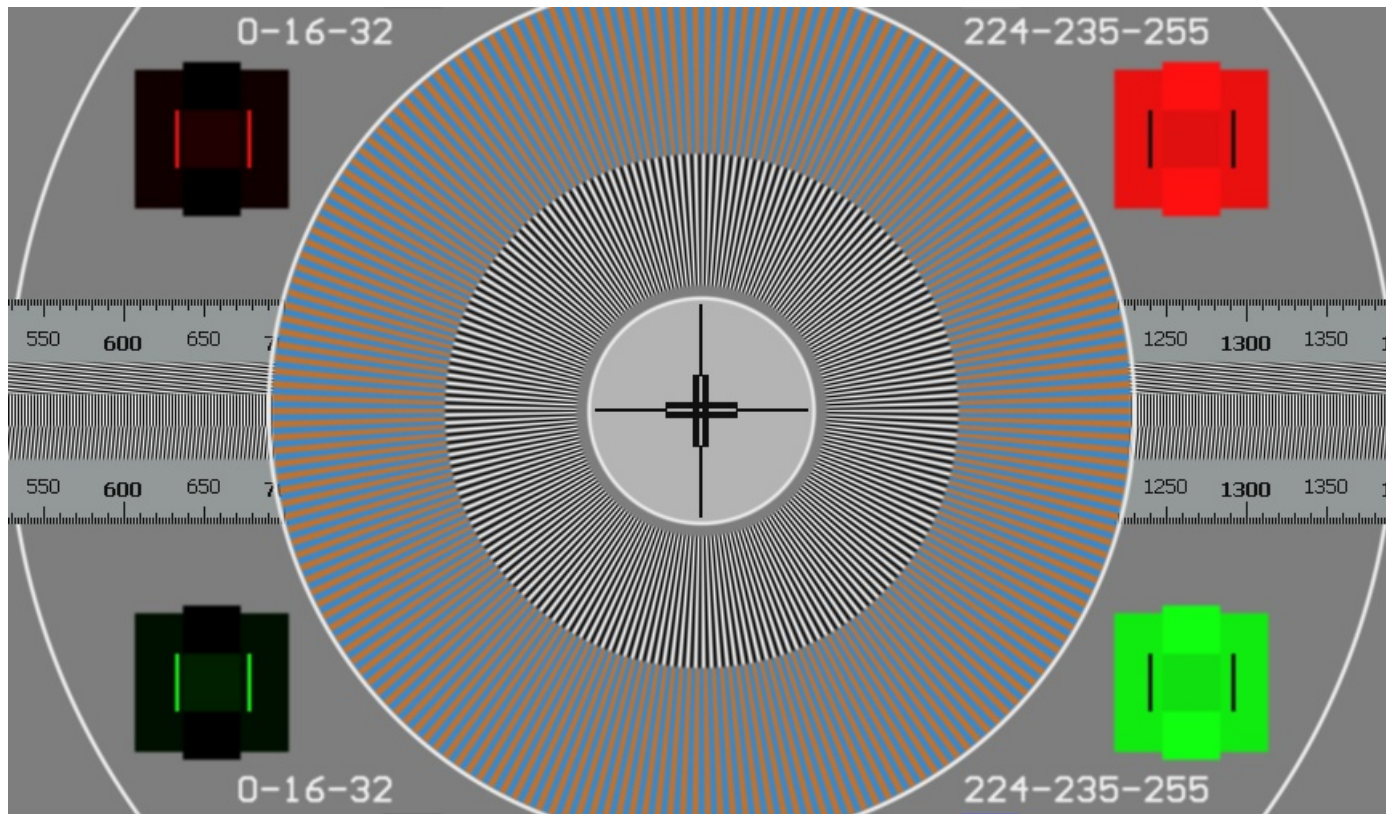


Two **Color Saturation Test** boxes
used in "Blue Only" display mode
(flashing as **Frames Continuity Tests**)

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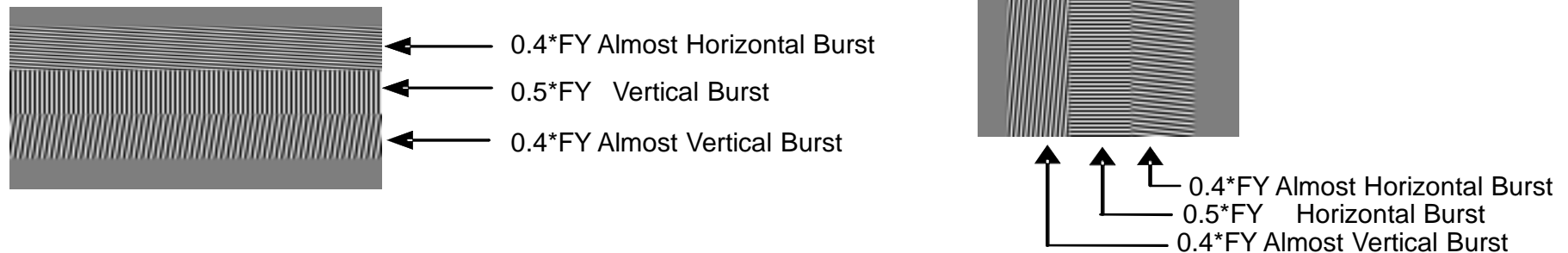
Central Fragment – YUV Resolution & Y Sharpness Test

Use your MS Power Point in “Slide Show” (Full Screen) mode to see **perfect reproduction** of all details.



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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.

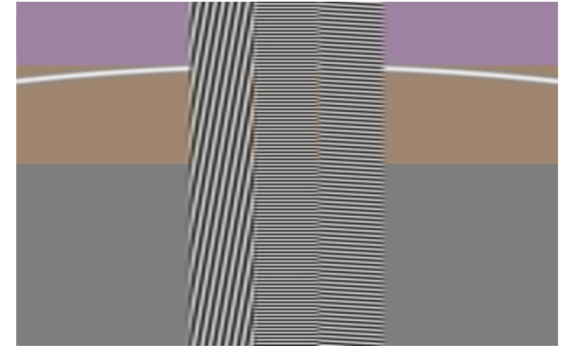
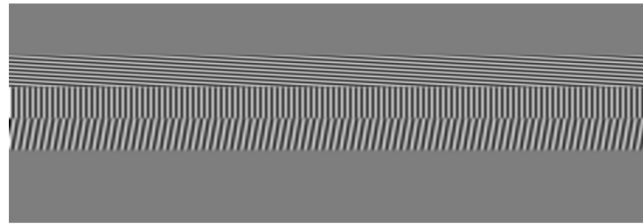
Two slightly oblique bands of 0.4 FY surrounds the middle burst.

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.

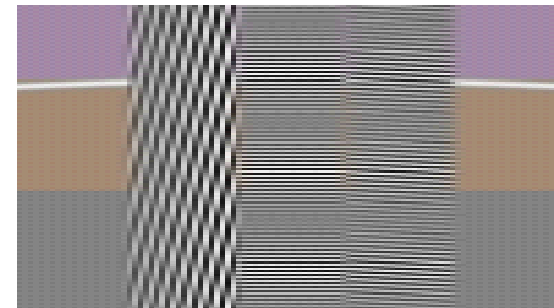
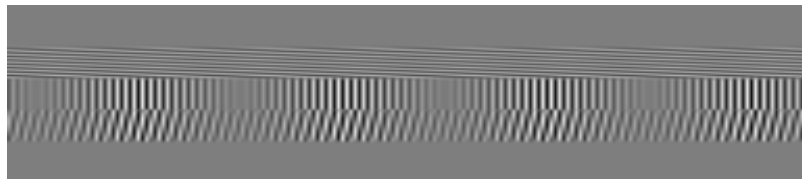
Within the burst vertical and almost **vertical lines** test **horizontal frequencies**, whilst horizontal and almost **horizontal lines** test **vertical frequencies**.

Tri-band Combination Burst Pattern Usage



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

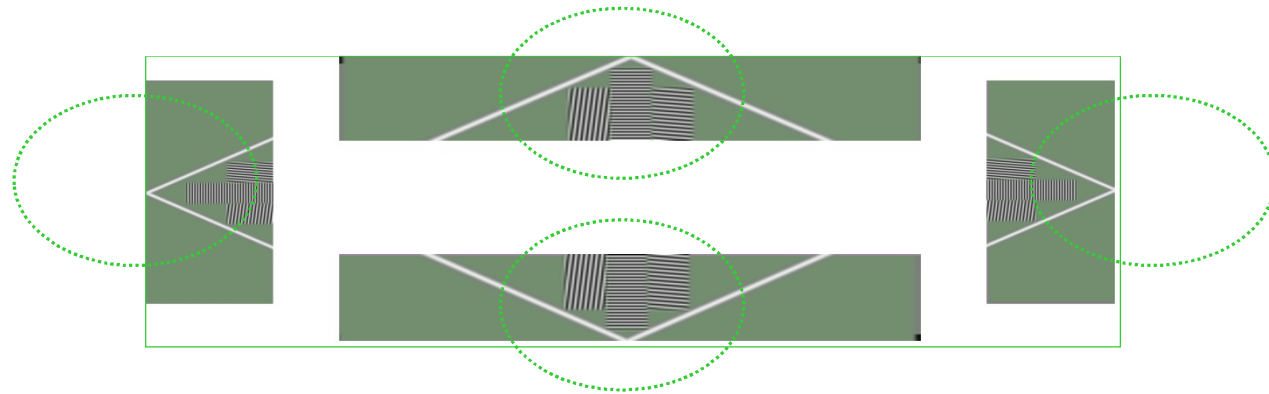
There are no visible beat waves on both horizontal and vertical Tri-band Patterns



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

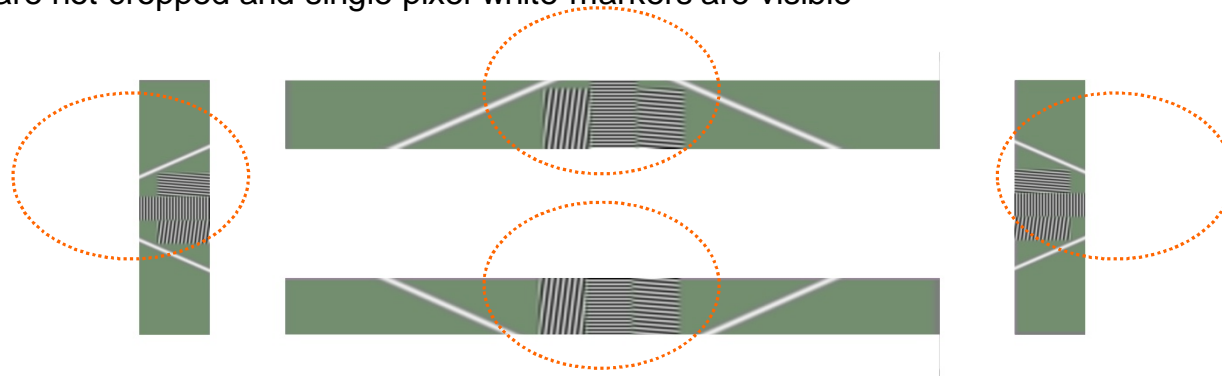
Scaling causes beat waves on both horizontal and vertical Tri-band Patterns

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

2.35:1, 4:3, 14:9 Frame Aspect Ratio Markers

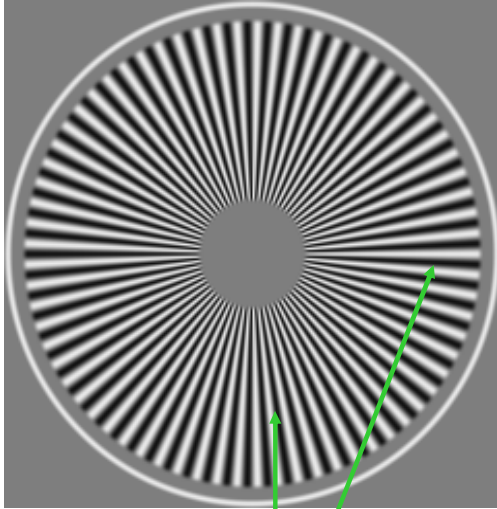


A1 pattern is designed for measurement in 16:9 format, as well as in 4:3, 14:9 and 2.35:1 frame formats. Cross-shaped Frame Format Markers indicates precise area for each corresponding frame format.

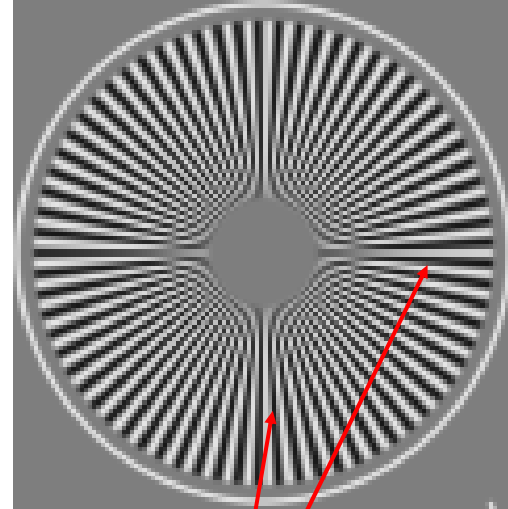
These are several most popular scale and crop modes:

- | 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.

Radial Plates Usage

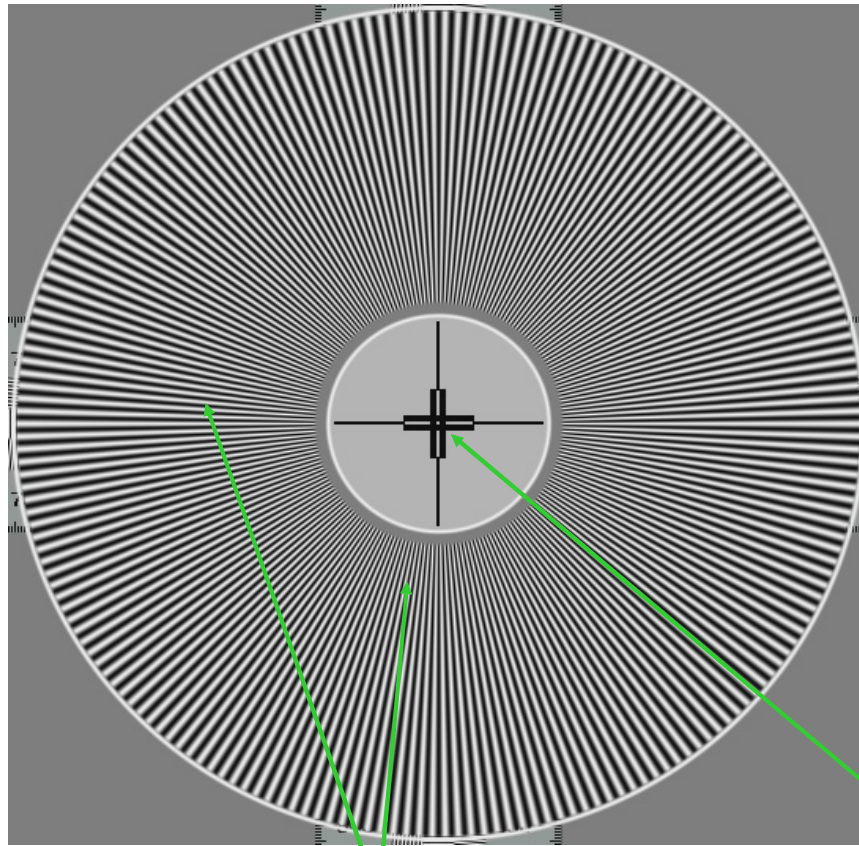


Original Size – dot-by-dot:
Full contrast of fine details in all directions



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

Sharpness Test Usage : Example #1

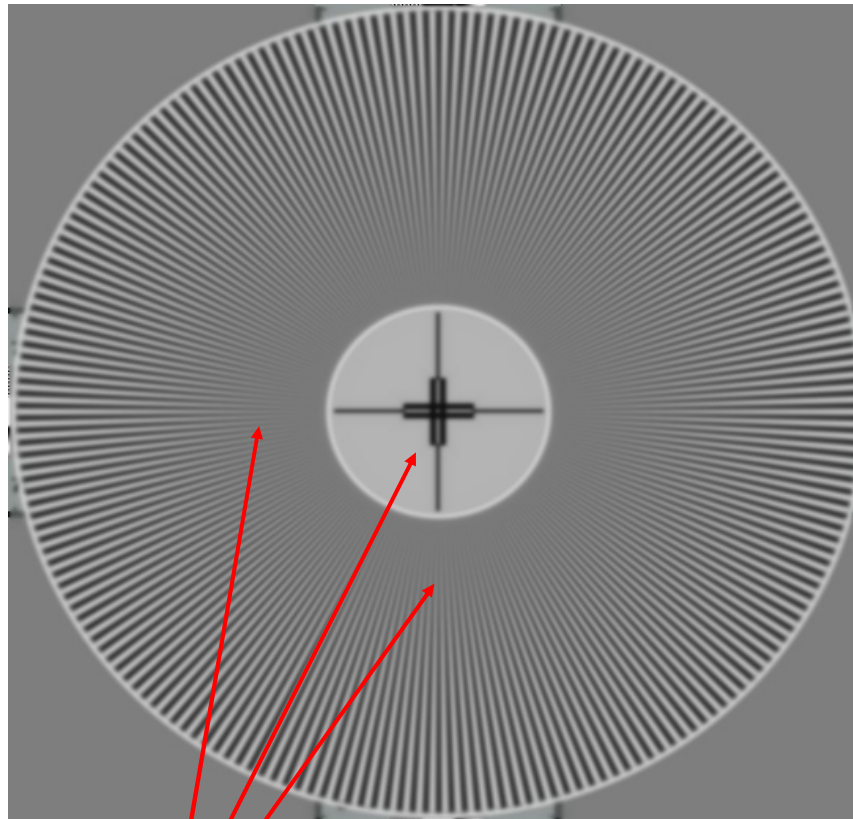


Optimal Sharpness Control Settings:

Full contrast of fine details in all directions, perfect digital sharpness, no blur, no ghost images

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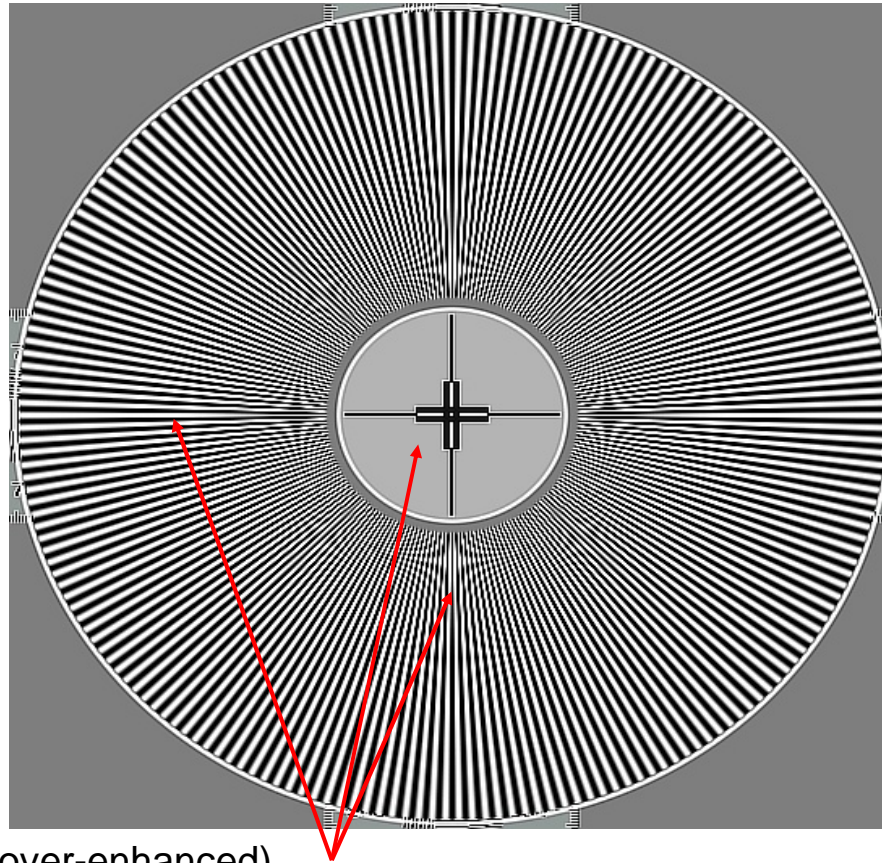
Sharpness Test Usage: Example #2



Not enough sharpness:

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

Sharpness Test Usage: Example #3



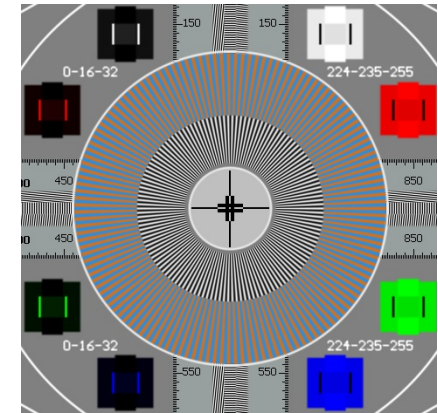
Too much sharpness:

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

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 \leftrightarrow 0-255, YUV \leftrightarrow RGB and/or 601 (SD) \leftrightarrow 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



Black PLUGE & 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 A1 Pattern do not contain fine tuning SPLUGE components

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**

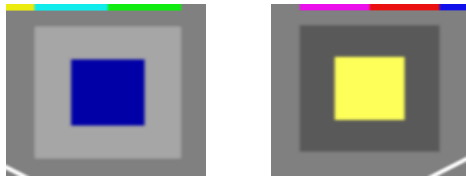


Conical grayscale is clipped exactly half-circle (180 degrees), no shades of gray on the left half

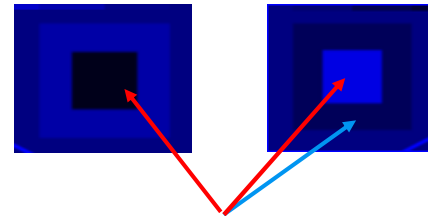
Note that some versions of A1 Pattern do not contain fine tuning SPLUGE components

Color Saturation Test Usage

Normal View
Correct Color Saturation

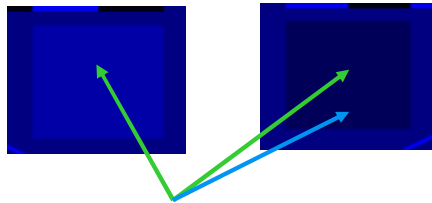


Blue Only Display Mode
Low Color Saturation



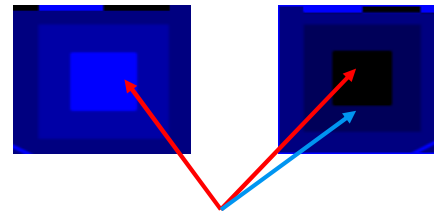
Blue component intensity on **colored** areas **differs** from **gray** areas

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



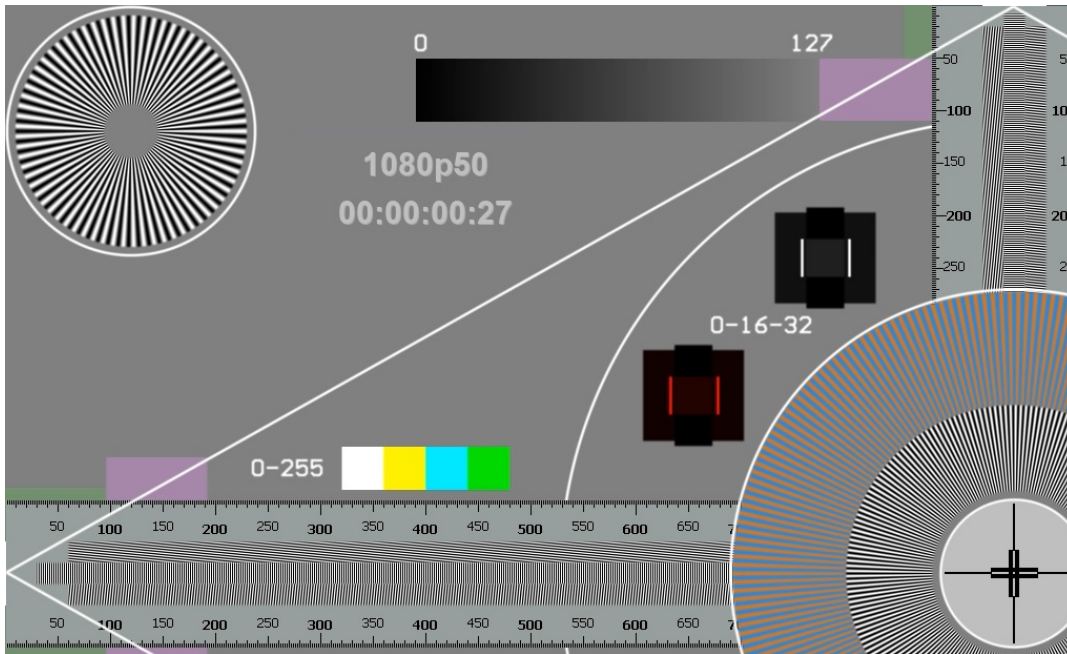
Blue component intensity on **colored** areas **differs** from **gray** areas

Consumer Player Scaling Quality Test Results: Example #1

VQSG Test Pattern Size: 1920x1080. Display Screen Size: 1920x1080.

Player works in Full Screen Mode. No scaling, zoom: 1:1

Use your MS Power Point in "Slide Show" (Full Screen) mode to see **perfect reproduction** of all details.

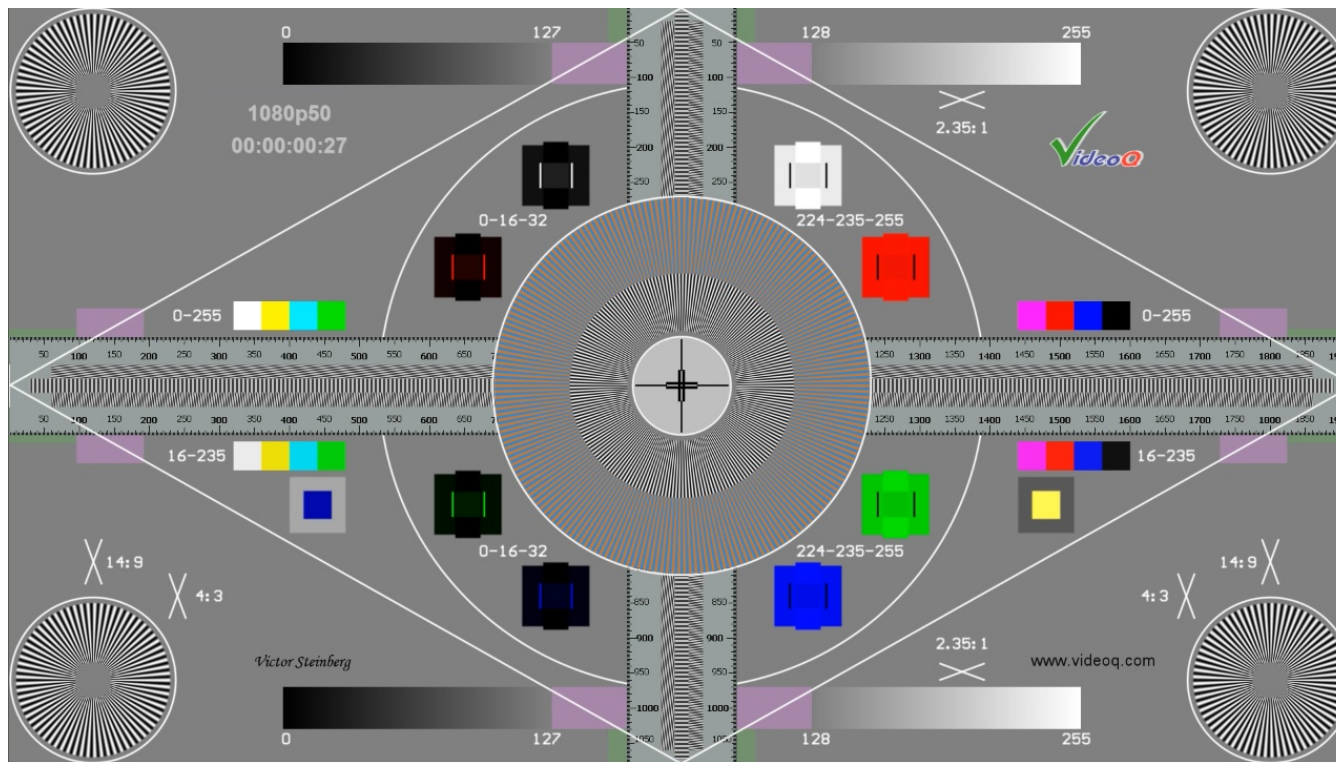


Consumer Player Scaling Quality Test Results: Example #2

VQGSG Test Pattern Size: 1920x1080. Display Screen Size: 1920x1080.

Player's active area size: 1280x720. Player "fast, sharp and dirty mode" scaler's zoom: 1:1.5

Use your MS Power Point in "Slide Show" (Full Screen) mode to see significant **scaling distortions**.

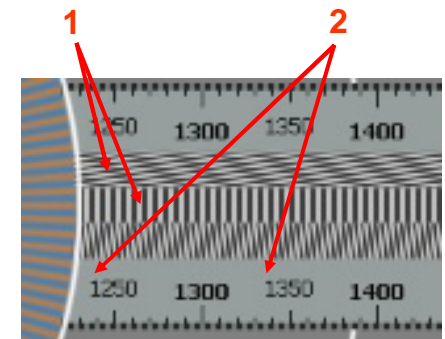


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Strong **aliasing** effects:

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 than **the others**. In case of any motion, it means **quite annoying flicker effect**.



Consumer Player Scaling Quality Test Results: Example #3

VQSG Test Pattern Size: 1920x1080. Display Screen Size: 1920x1080.

Player's active area size: 960x540. Player "fast, sharp and dirty mode" scaler's zoom: 1:2.0

Use your MS Power Point in "Slide Show" (Full Screen) mode to see noticeable **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.

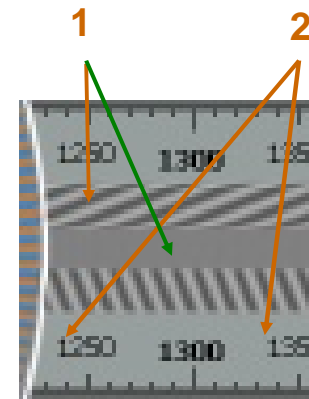
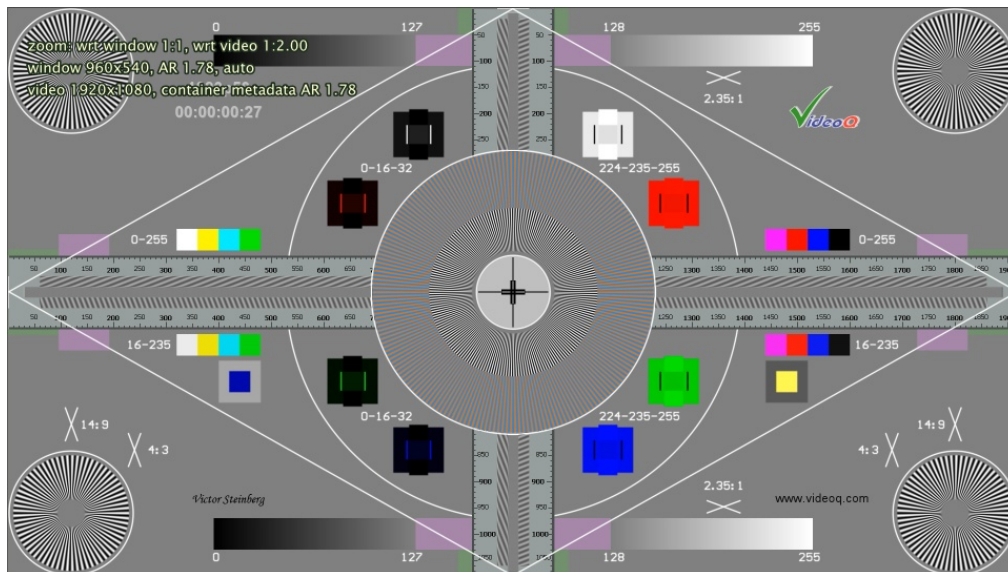
UV large radial plate shows some **loss** of contrast on the **highest frequencies**, but there are no serious problems

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**, but **not annoying flicker effect**.



Consumer Player Scaling Quality Test Results: Example #4

VQSG Test Pattern Size: 1920x1080. Display Screen Size: 1920x1080.

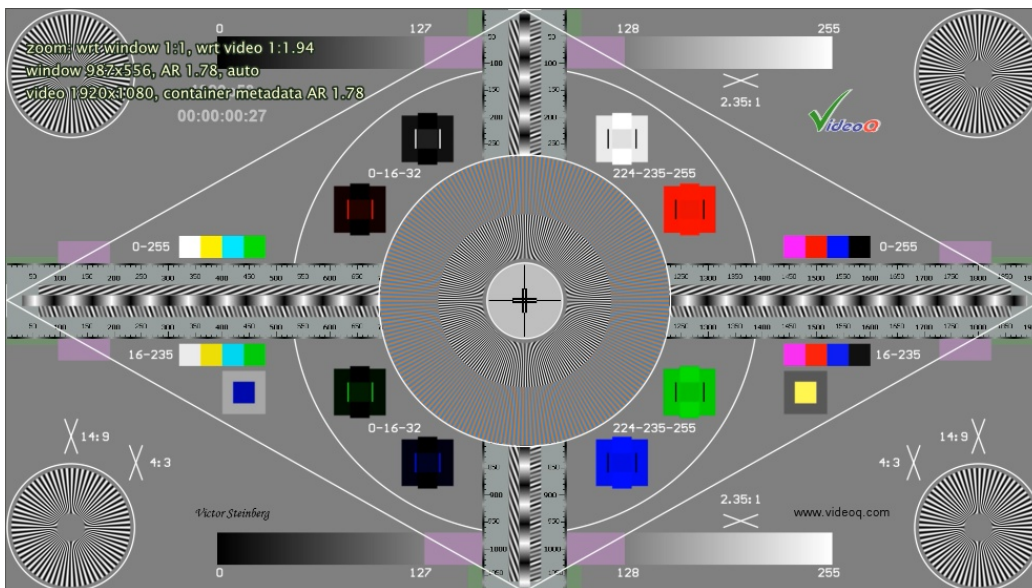
Player's active area size: 987x556. Player scaler's zoom: 1:1.94 – *this is the worst case!*

Use your MS Power Point in "Slide Show" (Full Screen) mode to see **very strong scaling distortions**.

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

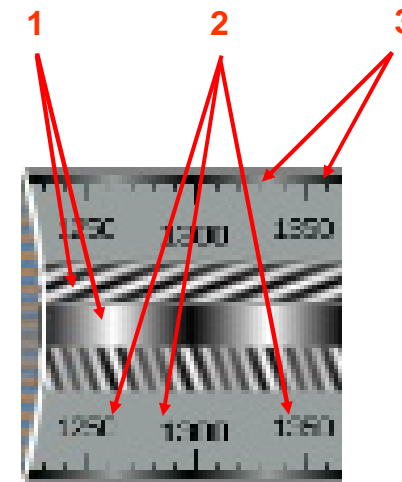
In case of any slow panorama motion it means **very strong flicker effect**.

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



FFPlay Linear 3-taps Lanczos Filter Scaler Results: Example #1

VQSG Test Pattern Size: 1920x1080. Display Screen Size: 1920x1080.

Player's active area size: 960x540. Player scaler's zoom: 1:2.0

Use your MS Power Point in "Slide Show" (Full Screen) mode to see **different type of scaling distortions**.

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

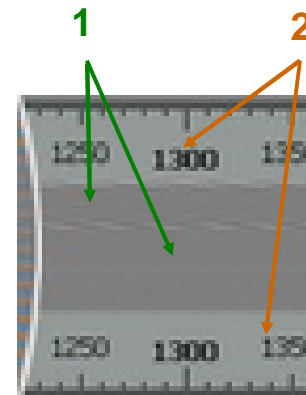
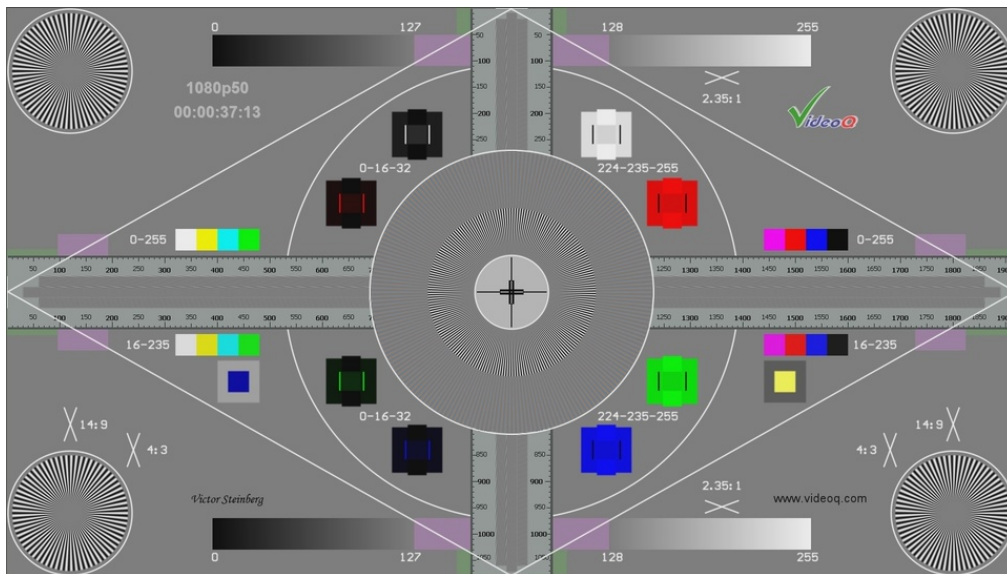
Y channel large and small **radial plates** exhibit **low** level of **aliasing** components.

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 **serious problem**

1. The highest frequency **bursts** and the **oblique bursts** look **good** – 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 **ringing** effect **all characters** of the Ruler text labels looks significantly different from the **original**, and this is a **serious problem**.



FFPlay Linear 3-taps Lanczos Filter Scaler Results: Example #2

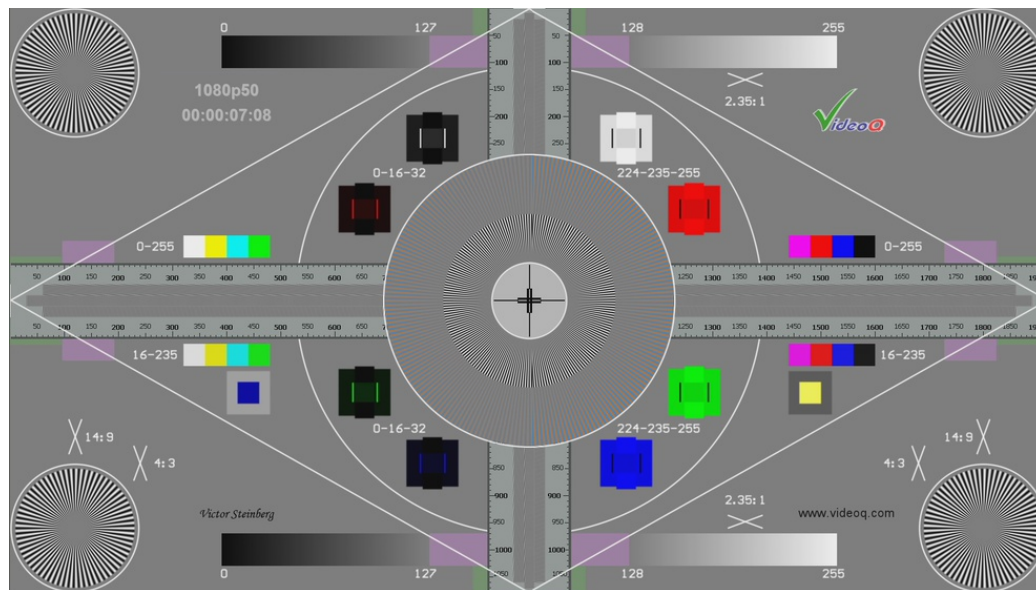
VQSG Test Pattern Size: 1920x1080. Display Screen Size: 1920x1080.

Player's active area size: 960x540. Player scaler's zoom: 1:2.0

Use your MS Power Point in "Slide Show" (Full Screen) mode to see **scaling distortions**.

Good thing about these 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**".

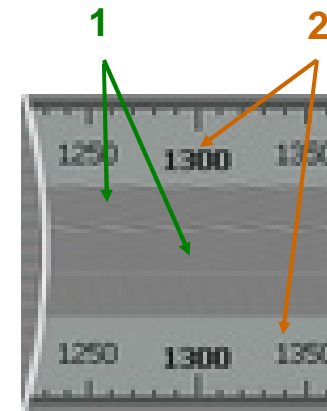
Among other advantages, consistency also means **low level** of **flicker** artifacts.



1. The highest frequency **bursts** and the **oblique bursts look good** – 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 **ringing** effect **all characters** of the Ruler text labels looks significantly different from the **original**, and this is a **serious problem**.



About VideoQ



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