VQCBA

VideoQ Color Bars Analyzer

Training Presentation

September 2025

VQCBA is one of **V**ideo**Q** **P**roductivity **T**ools modules

VQPT is a suite of software modules
for advanced video processing workflow

vqcba.html

videoq.com

All rights reserved. All trade marks and trade names are properties of their respective owners.

TOC ⟸ *Click on **TOC** n the upper-left corner of any slide for the **Table Of Contents***

Table of Contents

1. General

2. Overview

3. Supported Color Bars Test Patterns Types

4. Features 1

5. Features 2

6. Workflow Variants

7. CLI Usage Info

8. User-defined VQCBA.INI File Example

9. JSON Report Sections

10. VQCBA Report Test Results Explained

11. JSON Report Example

12. More Info & Support

13. About VideoQ

A1. Appendix A – Additional Color Bars Info

A2. Challenge and Solution

A3. Historical Background

A4. Color Spaces, Data Ranges, and Conversion Options

A5. Color Bars Related Standards

A6. VQCB HDR-PQ Test Composition

A7. VQCB HDR-HLG Test Composition

A8. VQCB SDR Test Composition

A9. VQCB Media File Timeline Segments

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

1. General

The following slides provide detailed description of VQCBA functions and its usage in the automated workflow checking scenarios suitable for most users.

Appendix A provides additional information for the advanced users and system architects about VQCB test patterns features, test sessions scenarios, and other VideoQ software tools usage examples.

VQCBA – **V**ideo**Q** **C**olor **B**ars **A**nalyzer program web-page

VQPT – **V**ideo**Q** **P**roductivity **T**ools suite web-page

VQCB – **V**ideo**Q** **C**olor **B**ars test patterns suite web-page

VQL – **V**ideo**Q** **L**ibrary of test patterns web-page

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

2. Overview

- **VQCBA auto-detects** and **process 5 different types** of color bars tests (*see next slide*)
- **Companion program** for **VQCB Wonder Bars™** Test Patterns Suite

- **CLI program** for **on premise** and **cloud** tasks, **Windows** and **Linux** versions
- **Applications**: Video production, post-production, transcoding, distribution

- **Software module** of **V**ideo**Q** **P**roductivity **T**ools suite
- **Video workflow verification** tool for the 8K / 4K / 2K, HDR / SDR environment

- **Automated tool**, instantly revealing your video device / system / workflow **performance**
- **VQCBA** compares **measured parameters** with user-defined **targets** and **tolerances**

- **VQCBA** generates detailed **JSON Report**, including **summary of pass/fail test results**
- **Frame sizes** from **480x270** to **8K UHD, HDR-PQ**, **HDR-HLG**, and **SDR**

- **Variety** of **color spaces**, **containers** and **encoding formats**, supported by **ffmpeg**

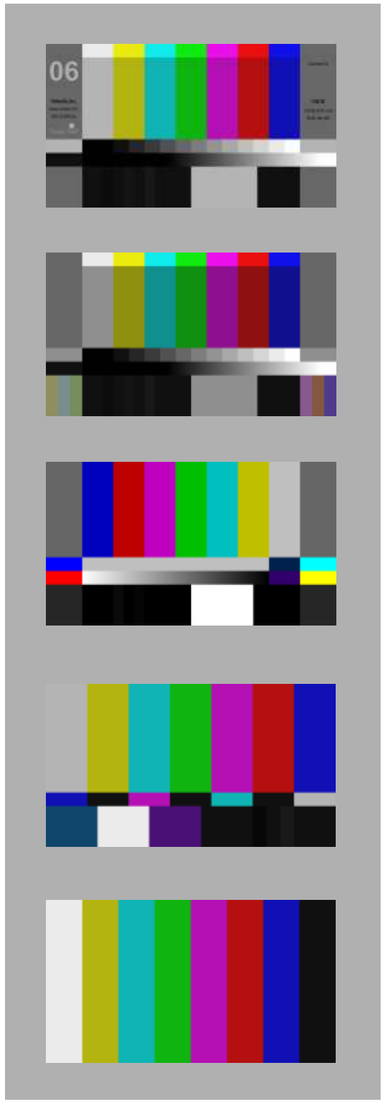
Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

3. Supported Color Bars Test Patterns Types

VQCBA supports 5 different color bars types (with optional audio components):

- **VideoQ VQCB** - dynamic **AV** test patterns: **HDR-PQ**, **HDR-HLG**, **SDR**
  - *recommended for the most comprehensive test results, ITU BT.2111 compliant*
- **ITU BT.2111 HDR-PQ** and **HDR-HLG** color bars test patterns
  - *fully specified, but not yet widely used test patterns, no SDR version*
- **SMPTE RP219**
  - *widely used SDR test pattern*
- **SMPTE EG1**
  - *legacy test pattern*
- **Full frame color bars**
  - *the most common video test pattern*



Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

4. Features 1

- VQCBA provides for automated cloud-based QA/QC, generating machine-readable JSON reports.

  This is especially useful when streaming in multiple formats or when converting between formats.

- VQCBA performs the following functions:
  - Reads media file **video and audio data**
  - Detects the relevant **segments** of video timeline
  - Auto-detects **test pattern type**
  - Calculates **video and audio content parameters**
  - Compares the results with **user-defined** VQCBA.INI file **tolerances**
  - Checks the **workflow distortions** and **conversion footprints**
  - Finally, produces machine-readable detailed **JSON Report,**

    including pass/fail **test summary result**

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

5. Features 2

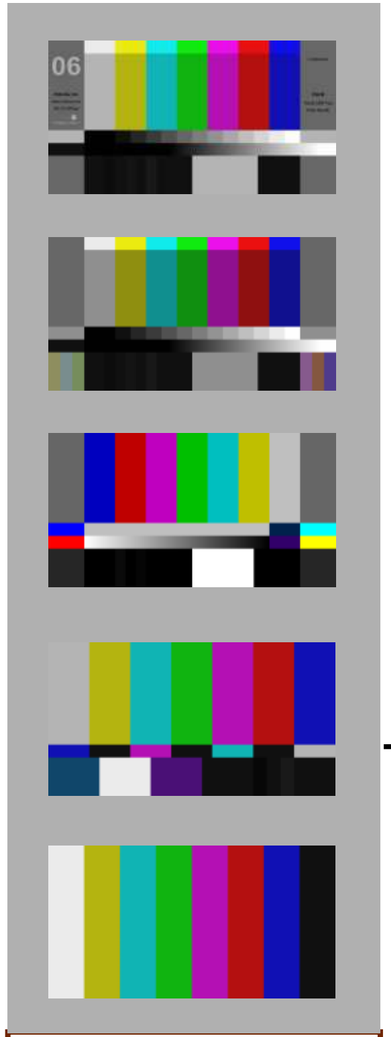
- If input file contains **continuous audio test tone**:
  - VQCBA detects this component and measures the **Audio Tone Level** in dBfs
  - Measured audio tone level is shown in Audio Test Results section of the Report

- In case of **VQCB test sequence,** containing **audio stream**:
  - VQCBA measures **Audio Tone Level**, throughput **Audio Gain** and **AV Sync Error**
  - Audio workflow measurement results are shown in Audio Test Results section of the Report

- In case of **VQCB test sequence**, containing **Text Box** with **QR code**:
  - VQCBA decodes the **VQCB QR code data**,
    decoded string data are shown in Original VQCB Parameters section of the Report
  - VQCBA compares **measured parameters** with the **original ones** (read from the QR code),
    comparison results are shown in Workflow Parameters Info section

Copyright VideoQ, Inc. – VQCBA Training Presentation

6. Workflow Variants



VQCBA Compatible Test File

Device Under Test

Reference Player

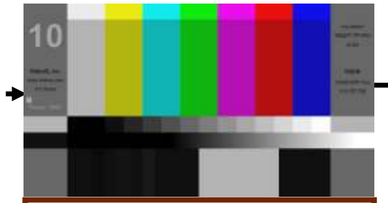
Video Player

Video Processor

Video Encoder

Data Capture

Reference Decoder



Captured AV Data

Media File/Stream: Y4M, MP4, MOV, etc.

VQCBA Analyzer

Report Files

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

7. CLI Usage Info

Usage (see more in ReadMe):

vqcba [-tm | -cd] [-nr | -fr] [-sdr | -pq | -hlg] **-i inFilePath** [-o] or [-o outFilePath]

Order of flags and parameters is mandatory and cannot be changed

[-tm | -cd] option flags are mutually exclusive, they enable special **Timeline Test Modes**

[-tm] option flag enables **Trailer Mode**, 20s long analyzed segment ends with the file end

In Trailer Mode input file duration must be >= 60s

[-cd] option flag enables **Captured Data Mode**; this flag is relevant only when capturing VQCB test video

In case of asynchronous capture of VQCB test, video file duration must be >= 22s

If [-tm | -cd] flags are not present, analysis starts at frame number 0 in **default Leader Mode**

In Leader Mode the **analyzed segment size** may vary from **single frame** to **120s**

In case of **VQCB suite test patterns** analysis, input file duration must be **>= 20s**

[-nr | -fr] flags force analysis of Video Data in **Narrow Range Mode** or **Full Range Mode**

[-sdr | -pq | -hlg] flags force analysis of Video Data in the specified **Dynamic Range Mode**

[-o outFilePath] option specifies full **Path\FileName.Ext**

If [-o] is present but outFilePath omitted, **outFilePath = inFilePath.vqcba.json**

If [-o] is omitted, Report will be sent to console (no JSON file created)

If Path\FileName contains spaces or special characters use double quotes

All File names, Report and Log files are in multi-lingual **UTF-8** encoding format

Advanced Test Conditions Controls are stored in **VQCBA.INI** file co-sited with vqcba executable

If VQCBA.INI file is not found, then it will be **auto-created** with the default control values

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

8. User-defined VQCBA.INI File Example

```
;VideoQ VQCBA.INI file created 2022-06-24T00:53:27.779Z
;User can edit or replace this file as needed, add your notes below:
;User can modify only the string values after "=" symbol.
;
;The number of user comments lines is not limited.
;
[BlackLevelDelta_pct]
BlackLevelDelta_pct=0.5
[WhiteLevelDelta_pct]
WhiteLevelDelta_pct=0.75
[ColorBarsLevelsDelta_pct]
ColorBarsLevelsDelta_pct=0.75
[VideoGainDelta_pct]
VideoGainDelta_pct=1.0
[ColorBalanceDelta_pct]
ColorBalanceDelta_pct=1.0
[ColorSaturationDelta_pct]
ColorSaturationDelta_pct=2.5
[PLUGE_LevelsDelta_pct]
PLUGE_LevelsDelta_pct=0.5
[AudioTestToneRefLevel_dBFs]
AudioTestToneRefLevel_dBFs=-23.0
[AudioLevelsDelta_dB]
AudioLevelsDelta_dB=0.75
[AVSyncDelta_ms]
AVSyncDelta_ms=50.0
[VideoLevelProfilesReport]
VideoLevelProfilesReport=YES
[SingleFrameFileOut]
SingleFrameFileOut=NO
[ThumbNailFileOut]
ThumbNailFileOut=NO
[ConfiguredBy]
ConfiguredBy=Victor Steinberg, VideoQ Inc.
```

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

9. JSON Report Sections

- "header“: Program version and copyright info, license info, report timestamp, configuration file (VQCBA.INI), input and output file names
- "generalInputFileInfo“: Input video file name, its time tags, number of video streams, and number of optional audio streams
- “videoStreams“ and *optional* "audioStreams“ sections: Processed Media Info data for each stream
- “testConditions”: Configuration info, consists of processed CLI arguments and VQCBA.INI file data
- “testCaseInitParameters”: Complete set of the user-defined data, read from VQCBA.INI file
- “testResults” – This section contains two sub-sections:
  - “testSummary” **Main result:** “allTestsPassed” string = **Yes** (if all partial tests passed) or **No** (if at least one of partial tests failed)
  - “partialTestsPassed”: **13 partial tests pass/fail** boolean **values** in **Yes** / **No** string format
- “videoSegments”: Detected test sequence segments timeline positions and durations - in video frames, ms and TC1000 strings
- “testPatternComposition”: Detected layout, number of bands, color bars number and nomenclature, number of PLUGE bars, etc.
- “videoTestResults” and *optional* “audioTestResults”: Measured parameters values, including conversion/distortion footprints
- “qrCodeBasedInfo” – This section is present only if VQCB Test Sequence detected; it contains two sub-sections:
  - “originalTestPatternInfo”: Decoded QR Code data, in multi-string format
  - “workflowParametersInfo”: AV parameters comparison – measured vs. original - useful for workflow checks and debugging
- “videoLevelsProfiles”: Measured RGB/YUV values for each test pattern component and sample position – useful for advanced analysis

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

10. VQCBA Report Test Results Explained

Main result – VQCBA JSON Report 'testSummary >> allTestsPassed >> **Yes** / **No**' string:

Yes (*if **all** partial tests **passed***) or **No** (*if **at least one** of partial tests **failed***)

There are also 13 'testSummary >> partialTestsPassed >> **testName** >> **Yes** / **No**' strings.

13 testName strings of 13 partial tests are shown below:

- blackLevel,
- blackClip,
- whiteLevel,
- whiteClip,
- videoGain,
- colorBalance,
- colorSaturation,
- colorBarsLevels,
- videoDataRangeMetadata,
- colorMatrixMetadata,
- plugeLevels,
- audioLevels,
- avSync.

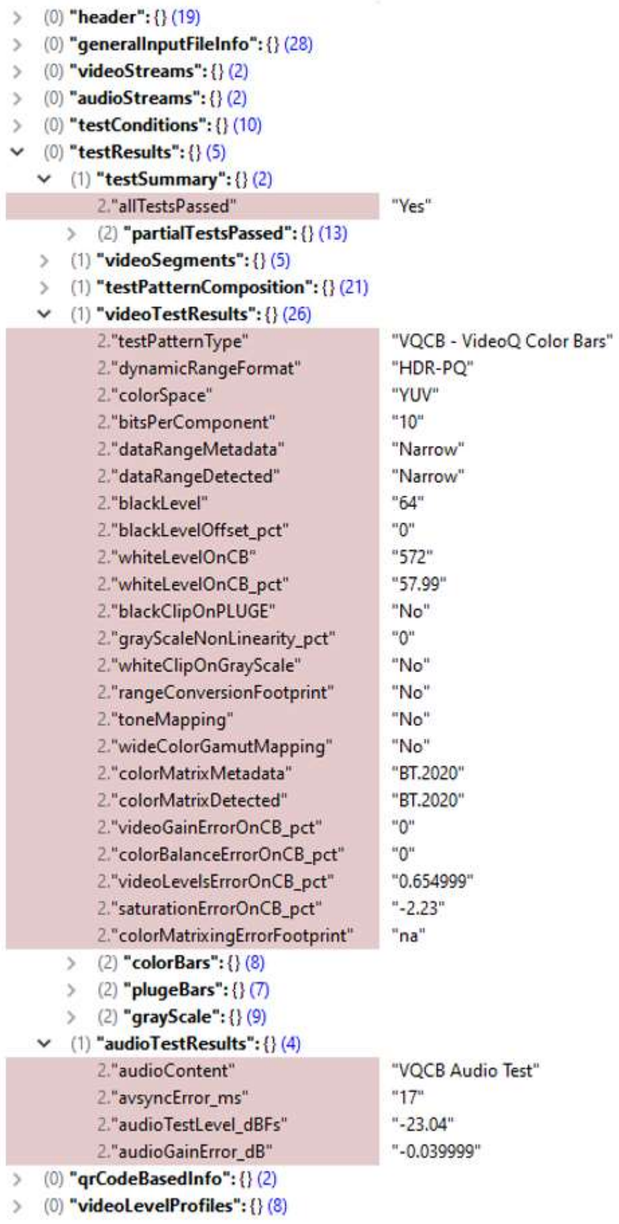
All partial tests nominal (target) values are set automatically. Only 'AudioTestToneRefLevel_dBFs' target value can be modified by the user via editing the **VQCBA.INI** file; default: ***AudioTestToneRefLevel_dBFs=-23*** (EBU standard).

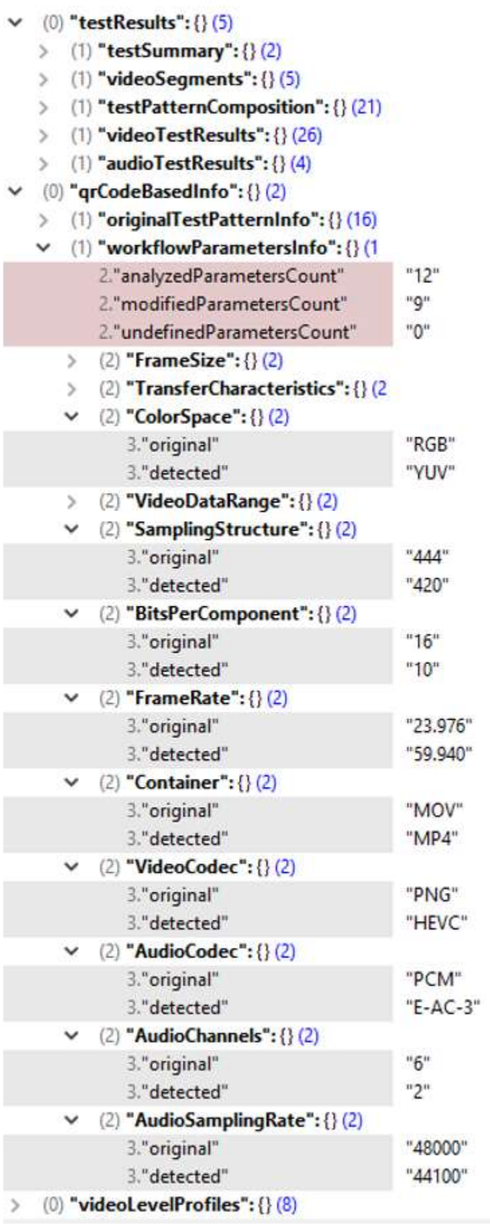
Nearly all pass/fail tolerances (allowed delta values) can be modified by the user via editing the **VQCBA.INI** file,
e.g. ***AVSyncDelta_ms=50.0*** line means that if measured abs(AVSyncError) < 50ms,
then avSync partial test result = **pass**, otherwise this partial test result = **fail**.

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

11. JSON Report Example





Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

12. More Info & Support

To learn more about VQCB, VQMP, VQV, other VideoQ Test Patterns and Analyzers see the corresponding **Training Presentations.**

Learn more on VideoQ site:

Contact VideoQ team: info@videoq.com, support@videoq.com

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

13. 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

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

A1. Appendix A – Additional Color Bars Info

This section provides additional information for the advanced users and system architects.

Learn more about the role of Color Bars test patterns in the long history of TV broadcast industry, the related color space issues, format conversion issues, and international standards.

VideoQ VQCB is the picture quality control, calibration and verification tool for general public, video installers, hardware and software developers, video development labs, production, post-production and content distribution facilities.

VQCB tests are useful when broadcasting in multiple formats or when converting between formats.

They can simplify test procedures and reduce the opportunity for misinterpretation of signal parameters and misalignment of systems.

They are also useful for establishing that a video circuit is active, and associated audio is available.

Copyright VideoQ, Inc. – VQCBA Training Presentation

A2. Challenge and Solution

Nowadays, moving color images are encountered nearly everywhere, not only in broadcast TV.

With the massive increase of volumes of hardware items and video related software, the strict rules established for the broadcast TV are not always recognized.

The major effort in capturing, delivering, and rendering of high-quality moving images demands the guidance and commonly accepted rules.

This affects camera manufacturers, display manufactures, cloud transcoding, telecom, video conference services providers, content originators, digital cinema systems, even the old movies de-archiving.

The solution is in establishing easy-to-use and straightforward rules and matching tools, such as further derivatives of the ubiquitous **Color Bars Test Pattern**.

The long history of broadcast TV demonstrates the path from the usage of physical reflectance test charts to the extremely successful practice of using color bars test patterns to check, calibrate and ensure reliable exchange of video images on a global scale.

VideoQ has been active in standards and test patterns creation, so we published and released the calibrated **V**ideo**Q** **C**olor **B**ars (**VQCB**) test tools suite that meet this challenge. *The best way to reliable QA is via reliable QC!*

Copyright VideoQ, Inc. – VQCBA Training Presentation

A3. Historical Background

Color Bars is the most used **Test Pattern** known for more than 70 years.

It can be used in classic full screen variant and it is also an important component of many other tests.

There are many standard and non-standard variants of this test.

The simplest and oldest color bars variant is a sequence of eight vertical bars of 100% (maximum intensity) colors.

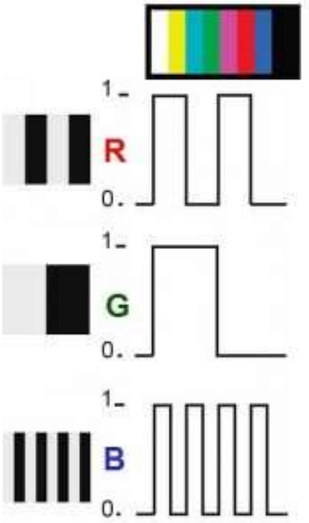
This sequence can be produced in RGB format by a simple 3-bit counter.

The standard color bar sequence is White, Yellow, Cyan, Green, Magenta, Red, Blue, Black.

Six colored bars show 3 Primary Colors – Red, Green, Blue

and 3 Complementary Colors – Cyan, Magenta, Yellow

White and Black bars provide for **Reference White** & **Reference Black** Signal Levels.



The arrival of new **HDR** and **WCG** technologies added new twist to the history of this test. Now we should test not only **RGB** and **YUV** Signal Levels, but also the **Light Levels** (**LL**) of the media files content and rendered images.

Copyright VideoQ, Inc. – VQCBA Training Presentation

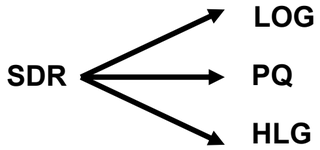
TOC A4. Color Spaces, Data Ranges, and Conversion Options

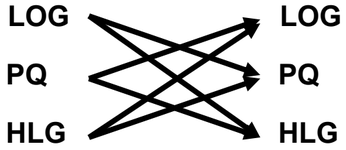
International Telecommunication Union (**ITU**) Recommendation BT.2020 defines various aspects of ultra-high-definition television (**UHDTV**) with standard dynamic range (**SDR**) and wide color gamut (**WCG**).
It mandates the use of RGB ⇔ YUV Color Space Conversion **BT.2020 Matrices** for the frame sizes greater than HD.
Note that RGB ⇔ YUV conversion in ubiquitous **HD** format relies on significantly different BT.709 **Matrices**.

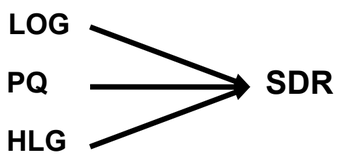
Since the introduction of **BT.601** standard YUV data are generated in **Narrow Range** format (abbreviated as **NR**).
Main advantage of the NR format is the availability of extra levels below **Reference Black** and above **Reference White**.

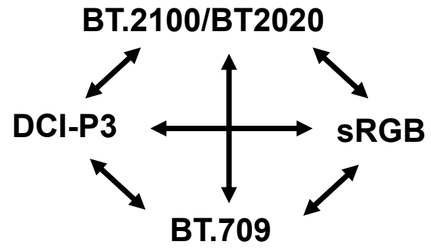
However, the RGB data traditionally used in production and post-production are defined in two formats – **Full Range** format (**FR RGB**, without reserved levels) and **Narrow Range** format (**NR RGB**, similar to NR YUV).
Thus, generic RGB ⇔ YUV conversion workflows should handle FR/NR RGB, NR YUV and BT.2020/BT.709 Matrices.

The **HDR/SDR** conversion processes are even more complicated, note the Unified Reference White concept:









Copyright VideoQ, Inc. – VQCBA Training Presentation

A5. Color Bars Related Standards

Years ago, ITU-R (United Nations agency division) issued Recommendation **BT.471** “Nomenclature and Description of Color Bar Signals”; it covers only **Full Frame Bars** and does not address modern **UHD**, **HDR** and **WCG** issues.

Widely used in several countries multi-band **SMPTE RP219 Bars** (derived from the legacy **SMPTE EG1** Bars) are suitable *only* for **Standard Dynamic Range** (**SDR**) **YUV** formats.

The HDR and WCG issues are mostly covered by Recommendation **BT.2111** “Specification of colour bar test pattern for high dynamic range television systems”.

However, the Recommendation BT.2111 specifies the reference test patterns *only* for the **High Dynamic Range** (**HDR**) television systems specified in **BT.2100**.
This means that currently there is no *officially recommended* Color Bars Test Patterns matching BT.2111 and suitable for widely used **Standard Dynamic Range** workflows in mixed RGB/YUV, UHD/HD and WCG formats.

VideoQ has filled this gap by developing the suite of Color Bars Test Patterns, which includes all **BT.2111 HDR** variants ***as well as*** the newly developed **SDR** variants for the **BT.2020** Color Space ***and*** traditional **BT.709** Color Space.
NB: By some obscure reasons the BT.709 color space was labeled by marketing people as “Narrow Color Gamut”.

The layout, data levels and appearance of the SDR variants of **VQCB** test pattern suite are similar to the HDR variants, which makes much easier the usage of the whole VQCB suite in modern mixed formats environments.

Copyright VideoQ, Inc. – VQCBA Training Presentation

A6. VQCB HDR-PQ Test Composition

Peak White
100%, 10,000 nit

100% Bars

58% Bars
for Color Calibration

40% Gray Side Panels may contain text messages about video and audio parameters plus customizable info

Reference White
58%, 200 nit

Grayscale

Full Range Ramp

BT.709 Bars mapped to BT.2020

BT.709 Bars mapped to BT.2020

0% -2% +2% +4% 0%
NR PLUGE
or
0% 0% +2% +4% 0%
FR PLUGE

Reference White
58%, 200 nit

Reference Black
0%, 0 nit

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

A7. VQCB HDR-HLG Test Composition

Peak White
1,000 nit, 100% LL

100% Bars

75% Bars
for Color Calibration

40% Gray Side Panels
may contain text
messages about video
and audio parameters
plus customizable info

Reference White:
75%, 200 nit, 20% LL

Grayscale

Full Range Ramp

BT/709 Bars
mapped to
BT.2020

BT.709 Bars
mapped to
BT.2020

0% -2% +2% +4% 0%
NR PLUGE

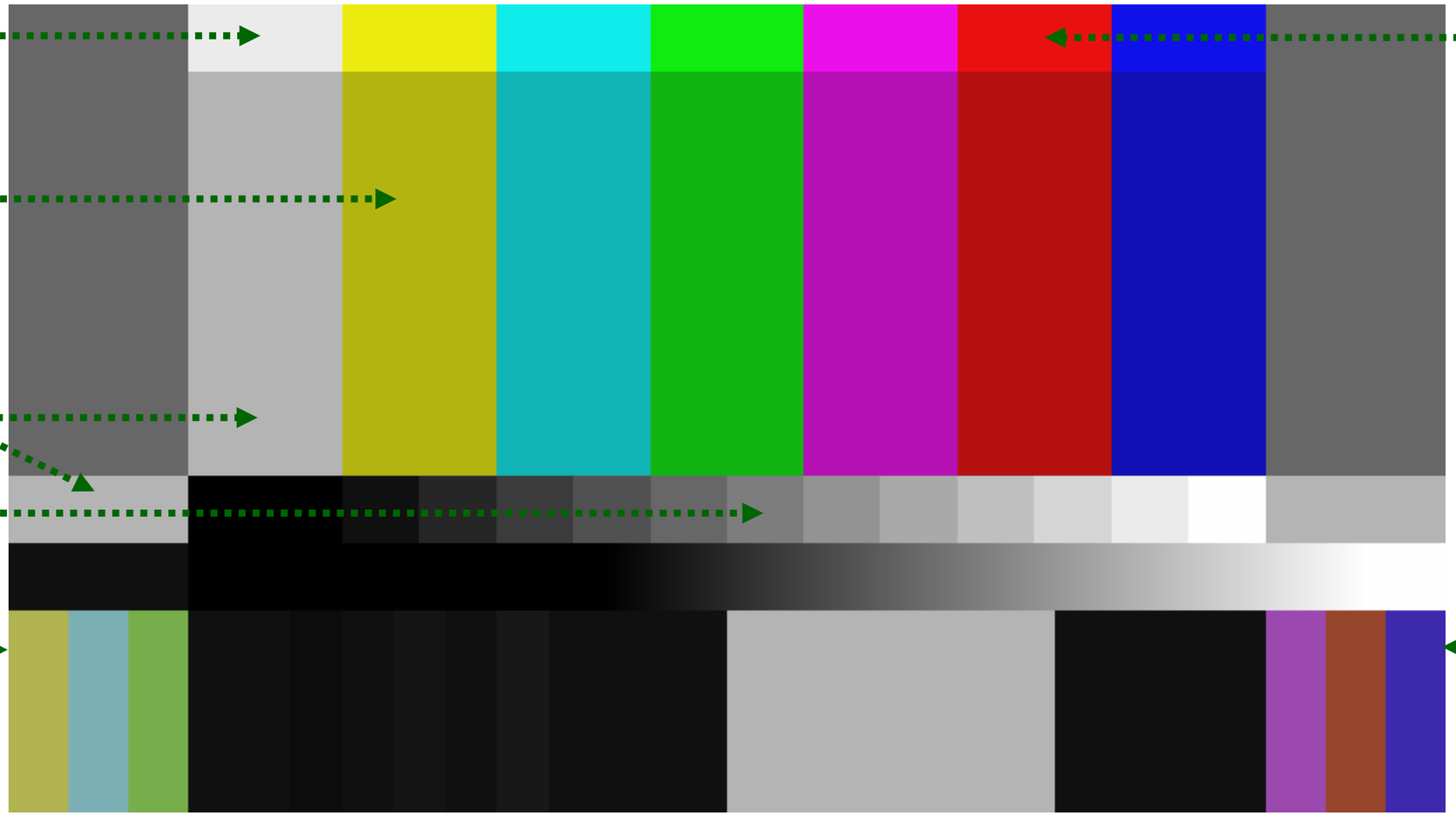
Reference White:
75%, 200 nit, 20% LL

Reference Black
0% LL

Copyright VideoQ, Inc. – VQCBA Training Presentation

TOC

A8. VQCB SDR Test Composition



Reference White
100%, 100% LL

100% Bars

75% Bars
for Color Calibration

40% Gray Side Panels may contain text messages about video and audio parameters plus customizable info

Reference Gray
75%, 50% LL

Grayscale

Full Range Ramp

BT.709 Bars mapped to BT.2020
present only in BT.2020 versions

BT.709 Bars mapped to BT.2020
present only in BT.2020 versions

0% -2% +2% +4% 0%
NR PLUGE
or
0% 0% +2% +4% 0%
FR PLUGE

Reference Gray
75%, 50% LL

Reference Black
0%, 0% LL

Copyright VideoQ, Inc. – VQCBA Training Presentation

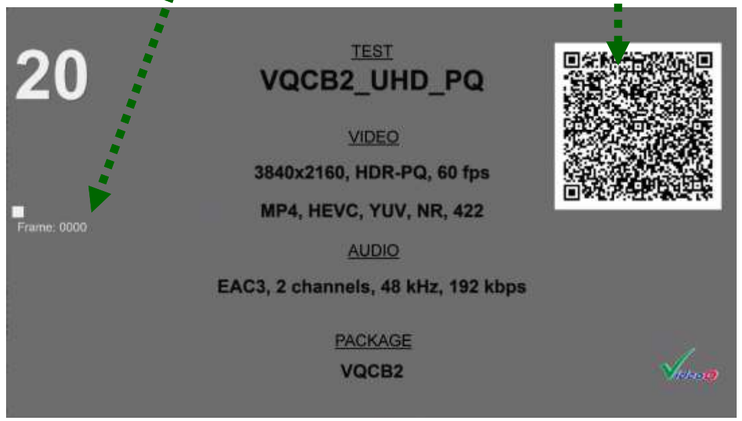
TOC

A9. VQCB Media File Timeline Segments

VQCB sequence is suitable for automated repetitive lab testing. The sequence consists of three segments:

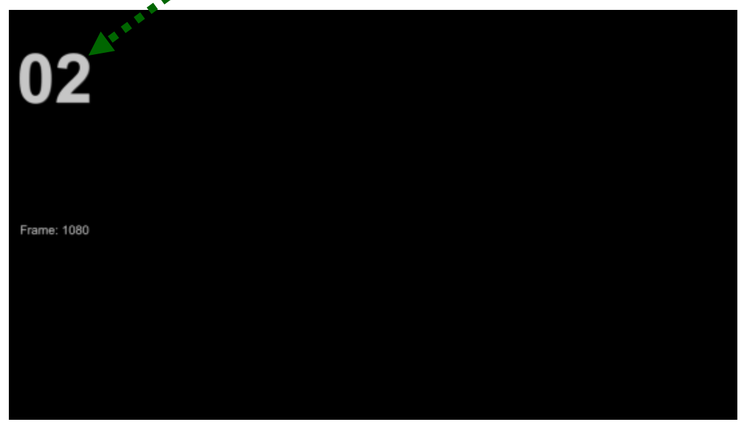
- 0s~10s: **Text Box** containing all test pattern details and machine-readable **QR Code**,
- 10s~18s: **Color Bars** test pattern,
- 18s~20s: **Black**.

Frames Counter **QR Code**



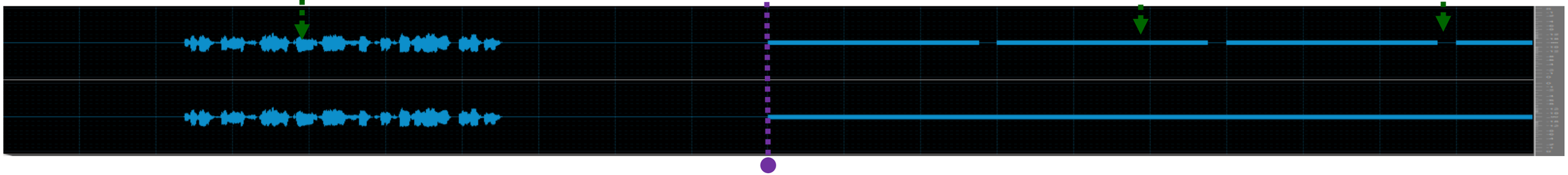
Placeholder for License Info

20s Count-down



Optional audio stream composition (LR stereo, 48kHz, PCM 24b or AC3 192kbps):

0s~10s: Voice tag **AV Sync: 0ms** **10s~20s: 1kHz tone, -23dBfs, L channel marked by 0.25s gaps**



Copyright VideoQ, Inc. – VQCBA Training Presentation