UHD World Association
世界超高清视频产业联盟

HDR Video Technology Part 3-3

Technical Requirements and Test Methods

-Player Device

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Contents

High Dynamic Range Video Technology

Part 3-3: Technical Requirements and Test Methods – Player Device

1 Scope

This document stipulates technical requirements for HDR adaptation and processing of player devices or systems (hereinafter referred to as "player devices") that support HDR Vivid standard, and methods for testing processing performance.

It applies to player devices that support HDR Vivid adaptation technologies and send a signal to an external display via an output port.

2 Normative References

The following documents are indispensable for the application of this technical specification due to normative references. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

SJ/T 11324 Terminology of Digital Television Receiving Equipment

GY/T 307-2017 Parameter values for ultra-high definition television systems for programme production and exchange

GY/T 315-2018 Image parameter values for high dynamic range television for programme production and exchange

T/UWA 005.1-2022 High Dynamic Range (HDR) Video Technology Part 1: Metadata and Tone Mapping

ISO/CIE 11664-6:2014 Colorimetry – Part 6: CIEDE2000 Colour-difference formula

3 Terms and Definitions

For the purpose of this document, the terms and definitions below and those provided in SJ/T 11324 apply.

3.1 HDR Vivid

An HDR technical standard provided in T/UWA 005.1-2022. It is the generic term for derivative technologies of the same.

3.2 HDR Vivid Player Device

A device that decodes video, processes metadata and images in accordance with T/UWA 005.1-2022, and exports the result through a digital visual interface.

3.3 HDR Vivid Display Device

A device that processes metadata and images in accordance with T/UWA 005.1-2022 and displays the images.

3.4 Statistics Mode

The mode where the dynamic metadata only includes statistics.

3.5 Curve Parameter Mode

The mode where the dynamic metadata includes base curve parameters, refined curve parameters, reference brightness, and cubic spline adjustment, in addition to statistics.

3.6 Perceptual Quantizer (PQ) Curve

A new gamma curve based on human perception. According to its creator, ambient light is converted into display light used for display. The reference standards are SMPTE ST 2084 or ITU-R BT.2100.

4 Abbreviations

For the purpose of this document, the abbreviations below apply.

EOTF Electro-Optical Transfer Function
HDR High Dynamic Range
HLG Hybrid Log-Gamma
OETF Opto-Electrical Transfer Function
PQ Perceptual Quantizer

5 Technical Requirements

5.1 Interfaces

The player device must have at least one of video stream input interface, video file input interface, or video media interface.

5.2 Supported Signal Formats

The player device must support at least signal formats specified in Table 1.

Table 1 Supported Signal Formats and Technical Requirements

No.	Format	Unit	Technical Requirement
1	Resolution	Pixel	3840×2160/7680×4320
2	Frame rate	Hz	50 and 60
3	Scanning mode	-	Progressive
4	Quantization accuracy	Bit	10
5	Color gamut	-	Complies with the specification in 3.3 of GY/T 307-2017
6	Transfer functions	-	Complies with the specification in 4.4 of GY/T 315-2018
7	Metadata	-	Complies with T/UWA 005.1-2022

5.3 Function and Performance Level Requirements

HDR Vivid player devices are classified into three profiles, based on the functions and performance of the player devices. From lowest to highest, the profiles are: compatible, basic and standard. Basic profile devices shall meet all requirements for compatible profile devices, and standard profile devices shall meet all requirements for basic profile devices.

5.3.1 Technical Requirements for Compatible Profile

See Table 2 for details on the technical requirements for compatible profile.

Table 2 Technical Requirements for Compatible Profile

Profile	Functional Requirement	Technical Requirements
Compatible profile	Compatibility requirements on input format	The player device is compatible with HEVC or AVS2 or AVS3, and support HDR Vivid dynamic metadata stream decoding and playback. 1) When playing video streams with HDR Vivid dynamic metadata, the image output by the player device remains normal. 2) When switching between video streams with HDR Vivid dynamic metadata and HDR video content that is not of HDR Vivid format, the image output by the player device remains stable, and there are no obvious abnormalities such as flickering or black screen.

5.3.2 Technical Requirements for Basic Profile

See Table 3 for details on the technical requirements for basic profile.

Table 3 Technical Requirements for Basic Profile

Profile	Functional Requirement	Technical Requirements
Basic profile	Basic output format requirements	The player device supports SDR Adaptation Mode, i.e. it meets the following requirements. 1) The device correctly decodes and processes video images and dynamic metadata; and the video image matches the dynamic metadata frame by frame. 2) The output signal is SDR compliant.
		The player device supports HDR10 Optimization Mode and meets the following requirements. 1) The device correctly decodes and processes video images and dynamic metadata; and the video image matches the dynamic metadata frame by frame. 2) The output signal is HDR10 compliant.
	Basic output control requirements	When the input signal of the player device is an HDR Vivid signal, apart from automatically setting output format, the player device shall also provide a user interface menu with options for users to set the format and parameters of the output signal. 1) The options shall include the following three: HDR10 Optimization, SDR Adaptation, and Automatic. In Automatic Mode, the optimal output format is selected automatically based on negotiation with the display device. 2) In SDR Adaptation Mode, users can set the maximum luminance that a display can adapt to. Maximum luminance is defined from a set of values – 100 nits by default, or 200, 300, 400 nits. The minimum luminance is 0.1 nit. The output gamut using SDR Adaptation Mode is

		BT.709, and the transmission curve is Gamma 2.2. 3) In HDR10 Optimization Mode, users can set the maximum luminance that a display can adapt to. Maximum luminance is defined from a set of values – 1,000 nits by default, or 500, 800, 1,200 nits. The minimum luminance is 0.05 nit. The output gamut under HDR10 Optimization Mode is BT.2020, and the transmission curve is PQ curve. 4) The image output by the player device has no display image distortion or other anomalies when the output mode is set manually.
	Processing precision requirements	The error range between output signals in HDR10 Optimization or SDR Adaptation and the reference value in HDR Vivid standard processing shall be calculated according to CIE DE2000, and the error deviation does not exceed 5.

5.3.3 Technical Requirements for Standard Profile

See Table 4 for details on the technical requirements for standard profile.

Table 4 Technical Requirements for Standard Profile

Profile	Functional Requirement	Technical Requirements
Standard profile	Standard output format requirements	The player device supports HDR Vivid Receiver Mode, i.e. it meets the following requirements. 1) The device correctly decodes and transmits video images and dynamic metadata. 2) The video image output by the player device matches the dynamic metadata frame by frame. 3) The output signal contains the correct dynamic metadata.
		The player device supports HDR Vivid Monitor Mode, i.e. it meets the following requirements. 1) The device correctly and transmits video images and dynamic metadata. 2) The video image output by the player device matches dynamic metadata frame by frame. 3) The output signal contains the correct static metadata.
	Standard output control requirements	The user interface menu provides options for users to set the format and parameters of output signal. 1) In addition to the basic output control requirements, the following two output options are included: HDR Vivid Receiver Mode, and HDR Vivid Monitor Mode. 2) In HDR Vivid Monitor Mode, users can set the maximum luminance that a display can adapt to. Maximum luminance is defined from a set of values – 1,000 nits by

		default, or 500, 800, 1,200 nits. The minimum luminance is 0.05 nit.
	Processing precision requirements	The error range between the output signals of the player device in HDR Vivid Receiver, HDR Vivid Monitor, SDR Adaptation or HDR10 Optimization Mode and the reference value in HDR Vivid standard processing shall be calculated according to CIE DE2000, and the error deviation does not exceed 5.

During CIE $L^*a^*b^*$ color space conversion, use the following parameters.

1) If the output signal of device under test is in SDR Adaptation Mode, 100% luminance of the output signal is the output peak brightness set in test, such as 100/200/300/400 nits.
2) If the output signal of device under test is in HDR Vivid Receiver Mode, and if the transmission curve of output signal is an HLG curve, 100% luminance of the output signal is 1,000 nits.
3) If the output signal of device under test is in HDR Vivid Monitor or HDR10 Optimization Mode, and if the transmission curve of output signal is a PQ curve, luminance is determined by the absolute luminance mapped to the PQ curve in BT.2100.

To calculate CIE DE2000, use the following parameters: $k_L=1$, $k_C=1$, $k_H=1$.

6 Test Conditions

6.1 Environment

6.1.1 Atmospheric Conditions

The player device must be tested under atmospheric conditions that meet the standard specified below.

—— Temperature: 15°C to 35°C, preferably 20°C

—— Relative humidity: 25% to 75%

—— Atmospheric pressure: 86 kPa to 106 kPa

6.1.2 Power Supply

The device must be tested under the rated supply voltage, and fluctuation of the supply voltage during the test shall not exceed ±2%. When using an AC mains power supply, fluctuation of the power supply frequency shall not exceed ±2%.

6.1.3 Warming-up

To ensure stable device performance, the player device is turned on before the test starts, and given 15 minutes to warm up, with the settings at the default values.

6.2 Test Signal

The test signal should meet the requirements specified in section 5.2 and 5.3.

6.3 Test Instruments

6.3.1 Digital Visual Interface Analyzer

The digital visual interface analyzer is used for the following:

1) Editing the EDID information in accordance with the test requirements.
2) Displaying images in real time.

3) Receiving and recording digital visual interface data.

6.3.2 Display Device

Display devices include SDR and HDR devices, and HDR Vivid devices that support Receiver Mode.

6.4 Test Signal Input Interface

The test stream is sent to the player device as a video file or video stream.

6.5 Adjustment of Working Status

6.5.1 Initialize the Status

Reset the player device settings to factory setting. If a reset is not possible, manually set the parameters to their standard configuration, and set other menus the same as the original settings when the device is powered on.

6.5.2 Adjust the Working Status

Put the device in HDR Vivid mode.

6.5.3 Basic Format of Output Signals

—— Resolution: 3840 x 2160
—— Frame rate: 50
—— Quantization precision: 10 bits
—— Chroma downsampling: YCbCr420

6.6 Position of Test Instruments

The player device receives and processes HDR Vivid test videos, and then outputs the videos to the HDR Vivid display device or digital visual interface analyzer through the digital visual interface. The HDR Vivid display device is used for partial functional testing. The digital visual interface analyzer is used to capture the output image and related metadata of the player device.

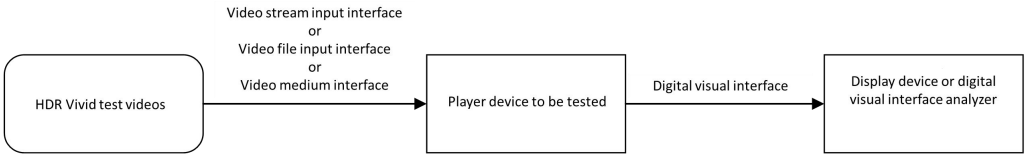


Figure 1: Networking Diagram of the Test Instruments

7 Compatible Profile Test Methods

7.1 Decoding Test of HDR Vivid Format

7.1.1 Overview

The purpose of this test item is to ascertain whether the player device is capable of decoding and playing HDR Vivid video content.

Test signal input interface: Video stream input interface or file input interface.

7.1.2 Test Conditions

Test signal: Test signal #1 in Table B.1 of Appendix B

Output signal: Set to the format specified in Section 6.5.4. The mode is selected automatically by the player device.

7.1.3 Test Procedure

The test procedure is as follows:

a) Adjust the player device as specified in 6.5, and connect it to the SDR and HDR display devices respectively.
b) Input test signals through interfaces specified in 5.1.
c) If the output signals from the player device are normal on the display devices and there is no obvious abnormality such as black screen or flickering, the player device is deemed to have passed the test.

7.1.4 Result

The two possible test results are Compatible with HDR Vivid Signal and Not Compatible with HDR Vivid Signal.

7.2 Multi-format HDR Content Switchover Test

7.2.1 Overview

The purpose of this test item is to test the visual effect when switching from PQ-HDR and HLG-HDR video content to HDR Vivid video content.

Test signal input interface: Video stream input interface or file input interface

7.2.2 Test Conditions

Test signal: Test signal #2 in Table B.1 of Appendix B

Output signal: Set to the format specified in Section 6.5.4. The mode is automatically selected by the player device.

7.2.3 Test Procedure

The test procedure is as follows:

a) Adjust the player device as specified in 6.5, and connect it to the HDR display device.
b) Input test signals through interfaces specified in 5.1.
c) If the player device is able to play the test signal and images are stable on the HDR display device without obvious abnormalities such as black screen and flickering throughout the entire testing process, the device passes the test.

7.2.4 Result

The two possible test results are Pass and Fail.

8 Basic Profile Test Methods

8.1 SDR Adaptation Mode Test

8.1.1 Overview

The purpose of this test item is to ascertain whether the player device parses and processes HDR Vivid dynamic metadata according to T/UWA 005.1-2022, and is capable of SDR Adaptation Mode.

HDR Vivid uses dynamic metadata, which can change in every frame. On the player device to be tested,

ensure that the dynamic metadata of each frame is used accurately.

Use a video of natural scenery (test stream #1 in Table B.1) to view the image effect on the corresponding display device according to the maximum luminance set.

8.1.2 Test Conditions

Test signal: Test signal #1, #3, and #4 in Table B.1 of Appendix B.

Output signal: Set to the format specified in Section 6.5.4.

8.1.3 Test Procedure

The test procedure is as follows:

a) Adjust the player device as specified in 6.5, and connect it to the SDR display device.
b) Set the player to SDR mode and set the maximum luminance to 400 nits.
c) Input test signals through the interfaces specified in 5.1 in turn, and visually check whether there is obvious abnormality on the screen.
d) If there is any obvious abnormality on the display screen, the device is deemed to have failed the SDR Adaptation Mode function test. If there is no obvious abnormality, repeat step c) with the maximum luminance of the device set to 300 nits, then 200 nits, and finally 100 nits.
e) Set the maximum luminance of the player device to be tested to 100 nits, and input test signals #3 and #4 in turn through the interfaces specified in 5.1.
f) If the window luminance at the center of the display screen is stable without visible flickering, the player device passes the SDR Adaptation Mode function test.

8.1.4 Result

The two possible test results are Pass and Fail.

8.2 HDR10 Optimization Mode Test

8.2.1 Overview

The purpose of this test item is to ascertain whether the player device implements HDR Vivid dynamic metadata parsing and processing according to T/UWA 005.1-2022 and supports HDR10 Optimization Mode output.

HDR Vivid uses dynamic metadata, which can change in every frame. On the player device to be tested, ensure that the dynamic metadata of each frame is used accurately.

Use a video of natural scenery and test stream for synchronization test to view the image effect on the corresponding display device according to the maximum luminance set.

8.2.2 Test Conditions

Test signal: Test signal #1, #3, and #4 in Table B.1 of Appendix B.

Output signal: Set to the format specified in Section 6.5.4.

8.2.3 Test Procedure

The test procedure is as follows:

a) Adjust the player device as specified in 6.5, and connect it to the HDR display device.

b) Enable the HDR10 Optimization Mode of the player device, connect it to the digital visual interface analyzer, and set the maximum luminance to 1200 nits.
c) Input test signal #1 through the interface specified in 5.1, and visually check whether there is obvious abnormality on the screen.
d) If there is any obvious abnormality, the device is deemed to have failed the HDR10 Optimization Mode test. If there is no obvious abnormality, repeat step c) with the maximum luminance of the device set to 1000 nits, then 800 nits, and finally 500 nits.
e) Set the maximum luminance of the player device to 500 nits, and input test signals #3 and #4 in turn through the interfaces specified in 5.1.
f) If the window luminance at the center of the display screen is stable without visible flickering, the player device is deemed to have passed the HDR10 Optimization Mode test.

8.2.4 Result

The two possible test results are Pass and Fail.

8.3 Processing Precision Test

8.3.1 Overview

The purpose of this test item is to ascertain whether the player device correctly processes HDR Vivid signals in HDR10 Optimization and SDR Adaptation modes in the basic profile.

8.3.2 Test Conditions

Test signal: Test signal #5 to #17 in Table B.1 of Appendix B.

Output signal: Set to the format specified in Section 6.5.4.

8.3.3 Test Procedure for SDR Adaptation Mode

The test procedure is as follows:

a) Adjust the player device as specified in 6.5 and set it to SDR mode. Connect the device to the digital visual interface analyzer and set the maximum luminance to 100 nits.
b) Input test signal #5 to the player device, capture a frame using the digital visual interface analyzer, and read the YCbCr code values PCV1 to PCV12 in the center of each test color block in sequence.
c) Separately calculate the DE2000 mean errors PDE1 to PDE12 between PCV1 to PCV12 and the corresponding reference data PR1 to PR12. If PDEs 1 through 12 meet the processing precision requirements specified in section 5.3.3, the device is deemed to have passed the SDR mode processing precision test for test stream #5.
d) Repeat steps b) and c) using test signal #6, and then test signal #7, and record the test results each time.
e) Input test signal #11 to the player device, capture a frame using the digital visual interface analyzer, and read the YCbCr code values HCV1 to HCV11 in the center of each test color block in sequence.
f) Separately calculate the DE2000 mean errors HDE1 to HDE11 between HCV1 to HCV11 and the corresponding reference data HR1 to HR11. If HDEs 1 through 11 meet the processing precision requirements specified in section 5.3.3, the device is deemed to have passed the SDR mode processing precision test for test stream #11.
g) Repeat steps f) and g) using test signals #12, and then test signal #14, and record the test results each

time.

h) If the device passes the SDR mode processing precision tests for all the above-mentioned test streams, the device is deemed to have passed the overall processing precision test.

8.3.4 Procedure for Testing the Processing Precision of the HDR10 Optimization Mode

The test procedure is as follows:

a) Adjust the player device as specified in section 6.5, set the device to HDR mode, connect the digital interface analyzer, and set the maximum display brightness to 500 nits.

b) Input test signal #6 to the player device, capture a frame of image and corresponding static HDR metadata information frame by using the digital interface analyzer, and read YCbCr elementary values PCV1 to PCV12 in the central area of each test color block in turn.

c) If the signal transmission characteristic of the received static HDR metadata information frame is a PQ curve, continue with step d) check the accuracy of the image data. If it is not a PQ curve, the player device is deemed to have failed the compatible HDR display device adaptation mode processing precision test, and the test is terminated.

d) Calculate the DE2000 mean errors PDE1 to PDE12 between PCV1 to PCV12 and the corresponding reference data PR1 to PR12, respectively. If PDE1 to PDE12 all meet the processing precision requirements specified in section 5.3.3 of this specification, the HDR display device adaptation mode of the player device is deemed to have passed the test on the processing precision of elementary stream #6. If any of the PDEs do not meet the specified requirements, the HDR display device adaptation mode of the player device is deemed to have failed the test.

e) Input test signal #13 to the device, capture a frame using the digital interface analyzer, and read the YCbCr elementary values HCV1 to HCV11 in the center of each test color block in sequence.

f) Calculate the DE2000 mean errors HDE1 to HDE11 between HCV1 to HCV11 and the corresponding reference data HR1 to HR11, respectively. If HDE1 to HDE11 all meet the processing precision requirements specified in section 5.3.3 of this specification, the HDR display device adaptation mode of the player device is deemed to have passed the processing precision test on the processing precision of elementary stream #13. If any of the HDEs do not meet the specified requirements, the HDR display device adaptation mode of the player device is deemed to have failed the test.

g) Upon passing the processing precision tests of all the elementary streams to be tested, the HDR display device adaptation mode of the player device is deemed to have passed the processing precision test.

8.3.5 Result Indication

If the processing precision tests of the HDR10 optimization and SDR adaptation functions in this section are passed, the processing precision of the player device is deemed to have met the criteria of the base profile of the HDR Vivid standard.

The two possible test results are Pass and Fail. If the processing precision of a player device meets the base profile criteria of the HDR Vivid standard it is deemed to have passed.

9 Standard profile test method

9.1 HDR Vivid Receiver Test

9.1.1 Overview

This purpose of this test item is to test the capability of the player device to transmit video images and dynamic metadata in receiver adaptation mode.

9.1.2 Test Conditions

Video test signal: test signals #2, #3, and #4 in Table B.1 of Appendix B.
Output signal: Set to the format specified in section 6.5.4.

9.1.3 Test Procedure

The test procedure is as follows:

a) Adjust the settings on the player device as specified in section 6.5, put the device in receiver adaptation mode, and connect an HDR Vivid display device that supports the receiver adaptation function;
b) Input test signal #2 (provided in Table B.1) to the player device through the input port specified in section 5.1.
c) Observe whether the HDR Vivid display device flickers visibly during the entire process of playing test signal #2. If there is no visible flicker, the player device meets the multi-format switching effect requirement in receiver adaptation mode.
d) Input test signal #3, and then test signal #4, to the player device, and visually check whether the luminance of the signal in the window is stable. If the luminance of the signal in the central display window is stable and there is no visible flicker, the player device is deemed to have passed the synchronizing image and metadata information in receiver adaptation mode test.

e) Put the player device in receiver adaptation mode, connect the digital interface analyzer, and then input test signal #3, and capture 6 consecutive VS-EMDS information frames. If the dynamic metadata information transmitted in the captured VS-EMDS information frames is consistent with the dynamic metadata information defined in Appendix A.3, and the requirements in the two previous steps have also been met, the player device is deemed to have passed the receiver adaptation mode function test.

9.1.4 Result Indication

The two possible test results are Pass and Fail. If the player device passes the above tests, it is deemed to have met the receiver adaptation mode criteria of the standard profile of the HDR Vivid standard.

9.2 HDR Vivid Monitor Mode Test

9.2.1 Overview

The purpose of this test item is to ascertain whether the player device can process video images and dynamic metadata in monitor adaptation mode.

9.2.2 Test Conditions

Video test signals: Test signals #3 and #4 (provided in Table B.1 in Appendix B).
Output signal: Set to the format specified in section 6.5.4.

9.2.3 Test Procedure

The test procedure is as follows:

a) Adjust the settings on the player device as specified in section 6.5, put the player device in monitor adaptation mode, connect the digital interface analyzer, and set the maximum display brightness to 500 nits;
b) Input test signal #3, and then #4, to the player device, capture one VS-IF information frame for each test signal, and visually check whether the luminance of the signal in the window is stable. If the VS-IF information frames for both elementary stream #3 and elementary stream #4 are correct, and the signal luminance in the central window of the display screen is stable, and there is no visible flicker, the player device is deemed to have passed the monitor adaptation mode test.

9.2.4 Result Indication

The two possible test results are Pass and Fail. If the player device passes the above test, it is deemed to have met the monitor adaptation mode criteria of the standard profile of the HDR Vivid standard.

9.3 Processing Precision Test

9.3.1 Overview

The purpose of this test item is to ascertain whether the player device can accurately process HDR Vivid signal in all four adaptation modes (Receiver, Monitor, HDR10 Optimization, and SDR Adaptation).

9.3.2 Test Conditions

Test signals: 13 test signals from #5 to #17 in Table B.1 of Appendix B are used for this section.

Output signal: Set to the format specified in section 6.5.4.

9.3.3 Procedure for Testing the Processing Precision in Receiver Mode

The test procedure is as follows:

a) Adjust the settings on the player device as specified in section 6.5, put the player device in receiver adaptation mode, and connect the digital interface analyzer.
b) Input test signal #6 to the player device, use the digital interface analyzer to capture a frame, and read the YCbCr elementary values PCV1 to PCV12 in the center of each test color block.
c) Calculate the DE2000 mean errors PDE1 to PDE12 between PCV1 to PCV12 and the corresponding reference data PR1 to PR12. When PDE1 to PDE12 all meet the processing precision requirements specified in section 5.3.3 of this specification, the receiver adaptation mode of the player device to be tested passes the test on the processing precision of elementary stream #6.
d) Input test signal #13 to the player device, use the digital interface analyzer to capture a frame, and read the YCbCr elementary values HCV1 to HCV11 in the center of each test color block in order.
e) Calculate the DE2000 mean errors HDE1 to HDE11 between HCV1 to HCV11 and the corresponding reference data HR1 to HR11, respectively. If HDE1 to HDE11 all meet the processing precision

requirements specified in section 5.3.3 of this specification, the player device is deemed to have passed the test of processing precision of elementary stream #13 in receiver adaptation mode.

f) If the processing precision tests of elementary stream #6 and elementary stream #13 are passed, the processing precision of the player device in receiver adaptation mode is deemed to meet the criteria of the standard profile of the HDR Vivid standard.

9.3.4 Procedure for Testing the Processing Precision in Monitor Mode

The test procedure is as follows:

a) Adjust the settings on the player device as specified in section 6.5, put the player device in monitor adaptation mode, connect the digital interface analyzer, and set the maximum display brightness to 500 nits.

b) Input test signal #5 to the player device, and read YCbCr elementary values PCV1 to PCV12 in the center area of each test color block in order.

c) Calculate the DE2000 mean errors PDE1 to PDE12 between PCV1 to PCV12 and the corresponding reference data PR1 to PR12. When PDE1 to PDE12 all meet the processing precision requirements specified in section 5.3.3 of this specification, the player device is deemed to have passed the test of the processing precision of elementary stream #5 in monitor adaptation mode.

d) Repeat the test using test signals #6 to #10, in ascending order, repeat steps b) to d), and record whether the requirements are met in each case.

e) Input test signal #12 to the player device, capture a frame using the digital interface analyzer, and read the YCbCr elementary values HCV1 to HCV11 in the center area of each test color block in sequence.

f) Calculate the DE2000 mean errors HDE1 to HDE11 between HCV1 to HCV11 and the corresponding reference data HR1 to HR11, respectively. When HDE1 to HDE11 all meet the processing precision requirements specified in section 5.3.3 of this specification, the player device is deemed to have passed the test of the processing precision of elementary stream #12 in monitor adaptation mode.

g) Replace the input test elementary stream with test signals #13 to #17, repeat steps f to g, and record whether the requirements are met in each case.

h) If the player device passes the processing precision tests of elementary streams #6 to #10 and #12 to #17, the processing precision of the player device in monitor adaptation mode is deemed to meet the criteria of the standard profile of the HDR Vivid standard.

9.3.5 Procedure for Testing Processing Precision in HDR10 Optimization Mode

The test procedure is as follows:

a) Adjust the player device as specified in 6.5, set it to HDR mode. Connect the device to the digital interface analyzer, and set the maximum luminance to 500 nits.

b) Input test signal #6 to the player device, capture a frame of image and the corresponding static HDR metadata information frame using the digital interface analyzer, and read YCbCr code values PCV1 to PCV12 in the center area of each tested color block.

c) If the signal transmission characteristic of the received static HDR metadata information frame is a PQ curve, proceed to step d) to check the precision of the image data. Otherwise, the device is deemed to have failed the processing precision test, and the test is terminated.

d) Calculate the DE2000 mean errors PDE1 to PDE12 between PCV1 to PCV12 and the corresponding reference data PR1 to PR12. If PDEs 1 through 12 all meet the processing precision requirements specified in section 5.3.3, the adaptation of the HDR-compatible display device of the player device

is deemed to have passed the HDR mode processing precision test for elementary stream #6.

e) Input test signal #13 to the player device, capture a frame using the digital interface analyzer, and read the YCbCr code values HCV1 to HCV11 in the center area of each tested color block.
f) Calculate the DE2000 mean errors HDE1 to HDE11 between HCV1 to HCV11 and the corresponding reference data HR1 to HR11. If HDE1 to HDE11 all meet the processing precision requirements specified in section 5.3.3 of this specification, the adaptation of the HDR-compatible display device of the player device is deemed to have passed the processing precision test for elementary stream #13.
g) If the adaptation of the HDR-compatible display device of the player device passes the processing precision tests for all the above-mentioned elementary streams, it is deemed to have passed the HDR transcoding processing precision test.

9.3.6 Procedure for Testing the Processing Precision of SDR Adaptation Mode

The test procedure is as follows:

a) djust the player device as specified in 6.5, and set it to SDR mode. Connect the device to the digital interface analyzer, and set the maximum luminance to 100 nits.
b) Input test signal #5 to the player device, capture a frame using the digital interface analyzer, and read the YCbCr code values PCV1 to PCV12 in the center area of each tested color block.
c) Calculate the DE2000 mean errors PDE1 to PDE12 between PCV1 to PCV12 and the corresponding reference data PR1 to PR12. When PDE1 to PDE12 all meet the processing precision requirements specified in section 5.3.3 of this specification, the adaptation of the SDR-compatible display device of the player device is deemed to have passed the processing precision test for elementary stream #5.
d) Repeat steps b) to c), first with test signal #6, and then with test signal #7. Each time, record whether the test is passed.
e) Input test signal #11 to the player device, capture a frame using the digital interface analyzer, and read the YCbCr code values HCV1 to HCV11 in the center of each tested color block.
f) Calculate the DE2000 mean errors HDE1 to HDE11 between HCV1 to HCV11 and the corresponding reference data HR1 to HR11. If HDE1 to HDE11 all meet the processing precision requirements specified in section 5.3.3, the the adaptation of the SDR-compatible display device of the player device is deemed to have passed processing precision test for elementary stream #11.
g) Repeat steps f) to g) with test signals #12 to #14. Each time, record whether the test is passed.
h) If the processing precision tests of all the above-mentioned elementary streams are passed, the adaptation of the SDR-compatible display device of the player device is deemed to have passed the processing precision test.

9.3.7 Result

If all four modes ((Receiver, Monitor, HDR10 Optimization, and SDR Adaptation), the player device passes the processing precision tests, then it is deemed to have passed the HDR Vivid processing precision test.

If the device passes the test, it is deemed to meet the requirements of the standard profile of the HDR Vivid standard.

Appendix A
(Normative)
Dynamic Metadata Configuration Parameters

A.1 Configuration 1 – Statistics Mode

The dynamic metadata contains only statistical information, which is used for testing the HDR Vivid processing accuracy of a player device. For specific parameters, see Appendix A.1 of T/UWA 005.3-1-2022 *High Dynamic Range Video Technology Part 3-1 Technical Requirements and Test Methods – Display Device*.

A.2 Configuration 2 – Curve Parameter Mode

The dynamic metadata contains curve parameter information (base curve parameters, refined curve parameters, reference luminance, and adjustment information of cubic spline), which are used for testing the HDR Vivid processing accuracy of a player device. For specific parameters, see Appendix A.2 of T/UWA 005.3-1-2022 *High Dynamic Range Video Technology Part 3-1 Technical Requirements and Test Methods – Display Device*.

A.3 Configuration 3 – Curve Parameters for Synchronization Test

The elementary stream used for metadata synchronization test is shown in Figure A 1. The stream is composed of two 10% window signals with different luminance, i.e. input image 1 and 2. By using different dynamic metadata, they can output windows with the same luminance. When the processing of dynamic metadata does not synchronize with that of the image, the window is displayed with unstable luminance, and there is visible flickering.

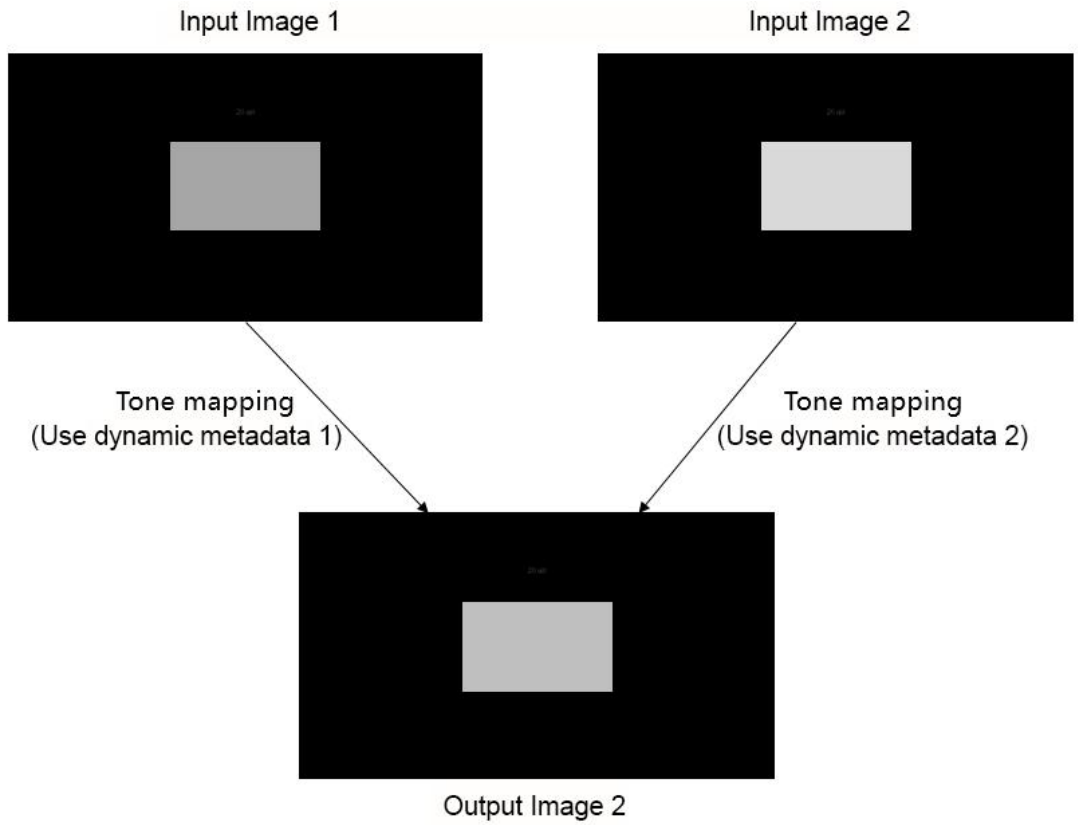


Figure A 1 Synchronization Test Signals

The video content of the metadata synchronization test of PQ curve is 10% window signal with the background luminance at 0 cd/m^2 (corresponding code value for the nonlinear full range PQ RGB signal is 0/0/0). The input value for each component of the window signal (10-bit BT.2020 color gamut) changes repeatedly according to the signals of test image 1 and test image 2 indicated in Table A 1.

Table A 1 Full Range PQ Curve Synchronization Test Signal

	RGB Code in Full Range PQ			YUV Code in HLG Limit Range		
No. [k]	R Signal	G Signal	B Signal	Y Signal	Cb Signal	Cr Signal
Test image 1	683	683	683	649	512	512
Test image 2	765	765	765	719	512	512

The video content of the metadata synchronization test of HLG curve is 10% window signal with the background luminance at 0 (corresponding code value for the nonlinear full range PQ RGB signal is 0/0/0). The input value for each component of the window signal (10-bit BT.2020 color gamut) changes repeatedly according to the signals of test image 1 and test image 2 indicated in Table A 2.

Table A 2 Full Range HLG Curve Synchronization Test Signal

	RGB Code in PQ Full Range			YUV Code in HLG Limit Range		
No. [k]	R Signal	G Signal	B Signal	Y Signal	Cb Signal	Cr Signal
Test image 1	901	901	901	836	512	512
Test image 2	1017	1017	1017	935	512	512

The dynamic metadata of the elementary stream contains curve parameter information (base curve parameters, reference luminance, refined curve parameters, and adjustment information of cubic spline), which are used to check the time synchronization between metadata and image content in HDR Vivid image processing of a player device. Relevant settings are listed in Table A 3.

Table A 3 Dynamic Metadata Parameters for the Synchronization Test of a Player Device

Dynamic Metadata	Test Image 1	Test Image 2
system_start_code	1	1
minimum_maxrgb_pq	0	0
average_maxrgb_pq	3046	3046
variance_maxrgb_pq	1535	1535
maximum_maxrgb_pq	4095	4095
tone_mapping_enable_mode	1	1
tone_mapping_param_enable_num	0	0
targeted_system_display_maximum_luminance_pq[0]	2770	2770
base_enable_flag[0]	1	1
base_param_m_p[0]	5734	5734
base_param_m_m[0]	24	24
base_param_m_a[0]	563	510
base_param_m_b[0]	0	0
base_param_m_n[0]	10	10

Table A.3 (continued)

Dynamic Metadata	Test Image 1	Test Image 2
base_param_K1[0]	1	1
base_param_K2[0]	1	1
base_param_K3[0]	1	1
base_param_Delta_enable_mode[0]	0	0
base_param_enable_Delta[0]	0	0
3Spline_enable_flag[0]	1	1
3Spline_enable_num[0]	0	0
3Spline_TH_enable_mode[0][0]	0	0
3Spline_TH_enable_MB[0][0]	224	224
3Spline_TH_enable [0][0]	0	0
3Spline_TH_enable_Delta1[0][0]	511	511
3Spline_TH_enable_Delta2[0][0]	511	511
3Spline_enable_Strength[0][0]	127	127
targeted_system_display_maximum_luminance_pq[1]	2080	2080
base_enable_flag[1]	1	1
base_param_m_p[1]	5734	5734
base_param_m_m[1]	24	24
base_param_m_a[1]	563	510
base_param_m_b[1]	0	0
base_param_m_n[1]	10	10
base_param_K1[1]	1	1
base_param_K2[1]	1	1
base_param_K3[1]	1	1
base_param_Delta_enable_mode[1]	0	0
base_param_enable_Delta[1]	0	0
3Spline_enable_flag[1]	1	1
3Spline_enable_num[1]	0	0
3Spline_TH_enable_mode[0][1]	0	0
3Spline_TH_enable_MB[0][1]	224	224
3Spline_TH_enable[0][1]	0	0
3Spline_TH_enable_Delta1[0][1]	511	511
3Spline_TH_enable_Delta2[0][1]	511	511
3Spline_enable_Strength[0][1]	127	127
color_saturation_mapping_flag	1	1
color_saturation_num	2	2
color_saturation_gain[0]	38	38
color_saturation_gain[1]	25	25

Appendix B
(Normative)
Elementary stream

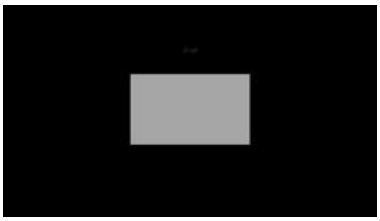
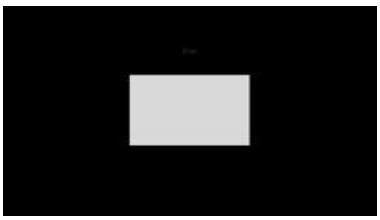
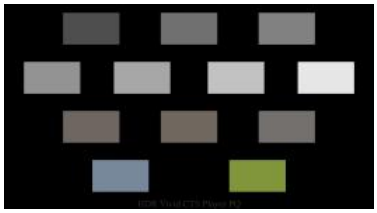
B.1 Elementary Stream

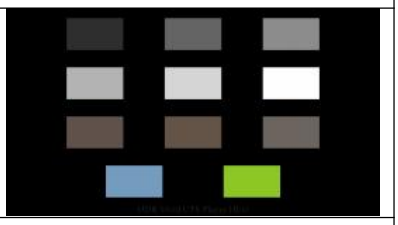
Table B 1 lists the characteristics of the elementary streams used for the test.

Table B 1 Elementary Stream List

No.	Sequence Name	Description	Sequence Thumbnail
1-1	Subjective elementary stream #1	The first 45 seconds is a video of multiple PQ-encoded natural scenes, and the last 45 seconds is a video of the same natural scenes superimposed with BT.2110 PQ narrow signals by 10% window. The dynamic metadata used by the elementary stream includes the HDR and SDR tone mapping curves.	
1-2	Subjective elementary stream #2	The first 45 seconds is a video of multiple PQ-encoded natural scenes, and the last 45 seconds is a video of the same natural scenes superimposed with BT.2110 PQ narrow signals by 10% window. The dynamic metadata used by the elementary stream only contains HDR Vivid statistical information.	Same as above
1-3	Subjective elementary stream #3	The first 45 seconds is a video of multiple HLG-encoded natural scenes, and the last 45 seconds is a video of the same natural scenes superimposed with BT.2110 HLG narrow signal by 10% window. The dynamic metadata used by the elementary stream includes the HDR and SDR tone mapping curves.	

Table B 1 (continued)

No.	Sequence Name	Description	Sequence Thumbnail
1-4	Subjective elementary stream #4	The first 45 seconds is a video of multiple HLG-encoded natural scenes, and the last 45 seconds is a video of the same natural scenes superimposed with BT.2110 HLG narrow signals by 10% window. The dynamic metadata used by the elementary stream only contains HDR Vivid statistical information.	Same as above
2	Elementary stream for multi-format switching	Multiple formats, such as HDR Vivid, PQ HDR BT2020, and HLG BT2020, are compiled into the same elementary stream file to implement format switching.	
3	Elementary stream for PQ synchronization	PQ-coded Two-level gray scale alternation (the RGB code value of gray scale signal is determined by Table A.1) Use the two sets of dynamic metadata in A.4.	
4	Elementary stream for HLG synchronization	HLG-coded Two-level gray scale alternation (the RGB code value of gray scale signal is determined by Table A.2) Use the two sets of dynamic metadata in A.4.	
5	Dynamic metadata sequence for PQ set 1	PQ-coded 7 color cards for gray scale test 5 color cards for color test Use the metadata of set 1 in A.1.	
6	Dynamic metadata sequence for PQ set 2	Use the metadata of set 2 in A.1.	Same as above
7	Dynamic metadata sequence for PQ set 3	Use the metadata of set 3 in A.1.	Same as above
8	Dynamic metadata sequence	Use the metadata of set 4 in	Same as above

	for PQ set 4	A.2.	
9	Dynamic metadata sequence for PQ set 5	Use the metadata of set 5 in A.2.	Same as above
10	Dynamic metadata sequence for PQ set 6	Use the metadata of set 6 in A.2.	Same as above
11	HLG static metadata sequence	HLG-coded 6 color cards for gray scale test; 5 color cards for color test; CTA861.3 static metadata.	
12	Dynamic metadata sequence for HLG set 1	Use the metadata of set 1 in A.1.	Same as above
13	Dynamic metadata sequence for HLG set 2	Use the metadata of set 2 in A.1.	Same as above
14	Dynamic metadata sequence for HLG set 3	Use the metadata of set 2 in A.1.	Same as above
15	Dynamic metadata sequence for HLG set 4	Use the metadata of set 4 in A.2.	Same as above
16	Dynamic metadata sequence for HLG set 5	Use the metadata of set 5 in A.2.	Same as above
17	Dynamic metadata sequence for HLG set 6	Use the metadata of set 6 in A.2.	Same as above

B.2 Test Signal

B.2.1 PQ Test Signal

No. 5 to No. 10 in Table B.1 are PQ test signals. The RGB code values of the PQ gamut of each color block in the test signal are shown in Table B 2.

Table B 2 Test Code Values of Dynamic Metadata under HDR Vivid PQ

No. [k]	Test Signal	RGB Code Value in PQ Gamut (10-bit, BT.2020 color gamut, full range)		
		R Signal	G Signal	B Signal
1	Gray scale No. 1	307	307	307
2	Gray scale No. 2	450	450	450
3	Gray scale No. 3	520	520	520
4	Gray scale No. 4	592	592	592
5	Gray scale No. 5	668	668	668
6	Gray scale No. 6	769	769	769
7	Gray scale No. 7	923	923	923
8	Skin color No. 1	441	409	389
9	Skin color No. 2	449	413	381
10	Skin color No. 3	465	449	437
11	Sky color	477	550	622
12	Floral color	518	602	233

Figure B 1 shows the corresponding test signals.

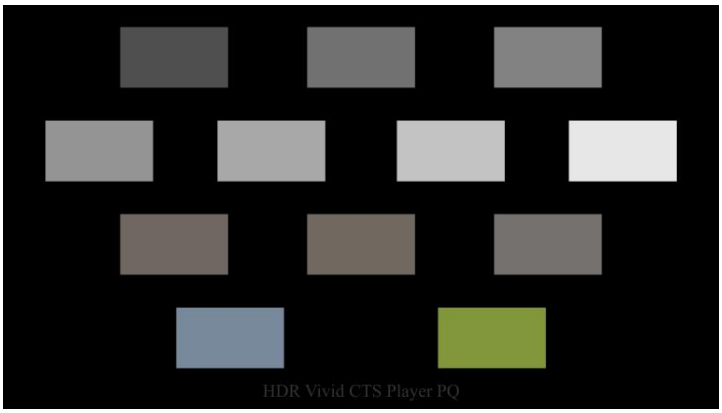


Figure B 1 HDR Vivid PQ Dynamic Metadata Test Diagram

B.2.2 B.2.2 HLG Test Signal

No. 11 to No. 17 are HLG test signals. The RGB code values of HLG gamut of each color block in the test signal are shown in Table B 3.

Table B 3 HDR Vivid HLG Static Mapping and Dynamic Metadata Test Code Values

No. [k]	Test Signal	RGB Code Value in HLG Gamut (10-bit, BT.2020 color gamut, full range)		
		R Signal	G Signal	B Signal
1	Gray scale No. 1	178	178	178
2	Gray scale No. 2	395	395	395
3	Gray scale No. 3	557	557	557
4	Gray scale No. 5	709	709	709
5	Gray scale No. 5	849	849	849
6	Gray scale No. 6	1023	1023	1023
7	Skin color No. 1	377	319	286
8	Skin color No. 2	393	326	274
9	Skin color No. 3	427	393	370
10	Sky color	454	624	766
11	Floral color	552	728	108

Figure B 2 shows the corresponding test signals.

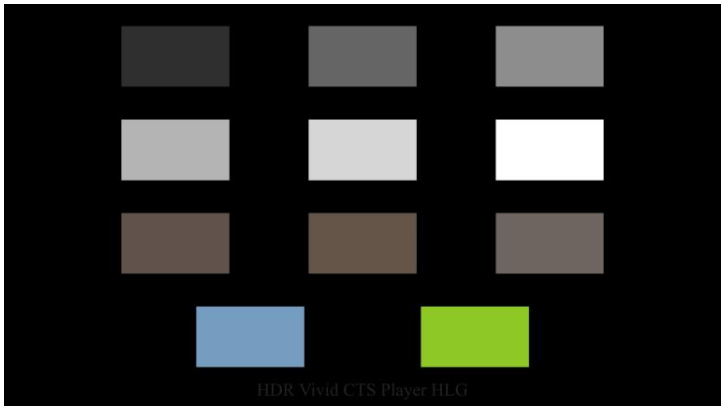


Figure B 2 HDR Vivid HLG Static Mapping and Dynamic Metadata Test Diagram