UHD World Association
世界超高清视频产业联盟

HDR Video Technology Part 3-2

Technical Requirements and Test Methods

-Mobile Display Device

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Contents

High Dynamic Range Video Technology Part 3-2:

Technical Requirements and Test Methods – Mobile Display Device

1 Scope

This Technical Specification stipulates the technical requirements and test methods for HDR display for battery-powered mobile display devices or systems (hereinafter referred to as "display devices") that support the HDR Vivid standard.

This Technical Specification applies to all types of battery-powered mobile display devices that support the HDR Vivid standard.

2 Normative References

The following documents are indispensable for the application of this Technical Specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendment) 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 systems for programme production and exchange

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

T/UWA 005.2-1-2022 High Dynamic Range (HDR) Video Technology Part 2-1: Application Guidelines - System Integration

3 Terms and Definitions

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

3.1 HDR Vivid

HDR Vivid refers to an HDR technical standard provided in T/UWA 005.1-2022. It is the generic term for derivative technologies of the kind.

3.2 HDR Vivid Playback Device

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

3.5 Curve Parameter Mode

The mode where the dynamic metadata also includes base curve parameters, refined curve parameters,

reference luminance, and cubic spline adjustment, in addition to the statistical information.

4 Abbreviations

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

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

5 Technical Requirements

5.1 Playback Software

The display device must have at least one type of video playback software that supports HDR Vivid.

5.2 Supported Signal Formats

The display 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	1920 × 1080
2	Frame rate	Hz	50 and 60
3	Scanning mode	-	Progressive
4	Precision of quantization	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 Decoding Function Requirements

The device can decode HDR Vivid streams of HEVC, AVS2 or other formats.

5.4 Function Requirements

Table 2 lists the function requirements for the display device.

Table 2 Function Requirements

No.	Function	Technical Requirements
1	Automatic switch to HDR Vivid display mode	By default, the display device automatically switches to the HDR Vivid display mode when it receives the HDR Vivid signals.
2	HDR Vivid visual identification*	A menu or other means are provided to check whether the received signal is HDR Vivid signal.
Note: *This requirement must be met by December 31, 2021.		

5.5 Display Performance Requirements

Table 3 lists the display performance requirements for the display device.

Table 3 Display Performance Requirements

No.	Parameter	Unit	Technical Requirement
1	Peak luminance (10% white window)	cd/m^2	≥ 450
2	Stable peak luminance	cd/m^2	≥ 450
3	Lowest black level	cd/m^2	≤ 0.5
4	Dynamic luminance range	%	≥ 30
5	Color gamut overlap (BT2020)	%	≥ 60
6	D65 white balance	-	Δu ≤ 0.01 Δv ≤ 0.01
7	Display quantization precision	Bit	≥ 8

5.6 Dynamic Metadata Processing Requirements

Table 4 lists the requirements for processing dynamic metadata.

Table 4 Dynamic Metadata Processing Requirements

No.	Item		Unit	Technical Requirement	
1	Statistics mode	Luminance deviation	%	Input luminance (L_0/nit) < 100	≤ 20%
				100 ≤ L0 < 1000	≤ 15%
				1000 ≤ L0 ≤ 4000	≤ 10%
2	Curve parameter mode	Luminance deviation	%	Input luminance (L_0/nit) < 100	≤ 20%
				100 ≤ L0 < 1000	≤ 15%
				1000 ≤ L0 ≤ 4000	≤ 10%
		Chroma deviation (Δu', Δv')	-	Skin color	≤ 0.02
				Sky color	≤ 0.02
				Floral color	≤ 0.02
3	Metadata synchronization test*		Frame	< 1	
Note: *This requirement must be met by December 31, 2021.					

As specified in T/UWA 005.1-2022, HDR Vivid dynamic metadata is processed in two modes, namely statistics mode and curve parameter mode. In statistics mode, metadata is formatted and transmitted as statistical information. After the terminal device receives the statistics, it generates tone mapping curves and processes the corresponding images in accordance with the method specified in T/UWA 005.1-2022. In curve parameter mode, metadata is formatted and transmitted as tone mapping curves. The statistics mode will be replaced by the curve parameter mode if curve parameters are included in the dynamic metadata. In other words, the curve parameter mode has higher priority.

6 Test Conditions

6.1 Environment

6.1.1 Atmospheric Conditions

The display device must be tested under standard atmospheric conditions as 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

Power is supplied by batteries. There should be no less than 50% power left in batteries.

6.1.3 Warming-up

Before the test starts, the display device is turned on and warmed up for 10 minutes under default settings to ensure stable device performance.

6.1.4 Test Conditions

The display performance should be tested in a dark room, where the stray light illuminance on the screen surface of the display device is equal to or less than 0.01 lx when the device is turned off.

6.2 Test Signal

The requirements in 5.2 apply to the test signal, and the decoding requirements in 5.3 apply to the test stream.

6.3 Test Instruments

6.3.1 Luminance Meter and Colorimeter

The luminance meter is used to test the brightness of a small area on the screen, and its test range should be from 0.001 cd/m^2 to 2,000 cd/m^2 with a precision rate of ±xx%.
The colorimeter should be able to test the chromaticity coordinates (x, y) or (u', v') of a small area on the screen, when the luminance is lower than 2 cd/m^2. Spectrocolorimeter is recommended for testing.

6.4 Playback Software Testing

The Default audio playback software is used for testing. If other types of software are used, they should be explained in test conditions.

6.5 Adjustment of Working Status

Unless otherwise specified, the working status of the display device is adjusted in following steps:

6.5.1 Initialize the Status

Reset image settings of the display device to default mode.
If default mode is not available, set the image mode to standard, and set other menus the same as the original settings when the device is powered on.
Disable auto illuminance adjustment function if there is any and adjust the backlight or brightness to the highest value.

6.5.2 Adjust the Working Status

The display device is tested in HDR Vivid display mode and full-screen mode (not necessarily filling the whole screen).

6.5.3 Disable Automatic Environment Adjustment

Before the test, manually disable the automatic environment adjustment functions so that they would not affect test result accuracy. These functions include but are not limited to ambient light adaptation (automatic screen brightness adjustment based on the ambient brightness) and ambient color temperature adaptation (automatic adjustment of the screen color temperature based on the ambient color temperature).

6.6 Position of Test Instruments

The optical axis of the optical test instrument should be perpendicular to the center of the display screen. If spectral light meter and spectrocolorimeter are used, the test distance should be 50 cm, as is shown in Figure 1.

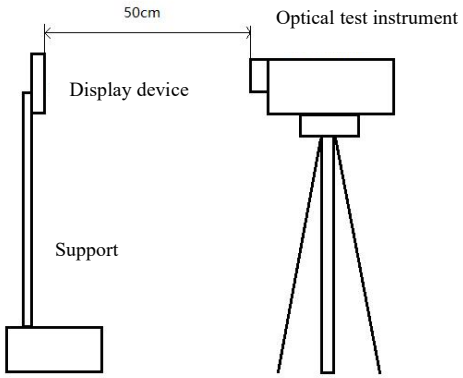

Figure 1 Position of Test Instrument

7 Test Methods

7.1 Video Playback Software

7.1.1 Overview

The section is to test whether playback software in the display device supports HDR Vivid.

7.1.2 Test Conditions

Test signal: HDR Vivid color bar test stream specified in 5.3.

7.1.3 Test Steps

a) Adjust the display device to the working status as specified in 6.5.
b) Play back HDR Vivid color bar test stream using the playback software specified in 6.4.
c) Check if the display device functions properly.

7.1.4 Result

The test result is Supported or Not Supported.

7.2 Supported Signal Format Testing

7.2.1 Overview

This section is to test signal formats supported by the display device.

7.2.2 Test Conditions

Test signal: Video test stream specified in 5.3.

7.2.3 Test Steps

a) Adjust the display device to the working status as specified in 6.5.
b) Play back the color bar test signal specified in 5.2 using the playback software specified in 6.4.
c) Check if the display device functions properly.

7.2.4 Result

The test result is Supported or Not Supported.

7.3 Decoding Function Test

7.3.1 Overview

This section is to test the HDR stream decoding performance of the display device.

7.3.2 Test Conditions

Video test signal: video streams specified in 5.3.

7.3.3 Test Steps

a) Adjust the display device to the working status as specified in 6.5.
b) Play back the video stream in sequence using the playback software specified in 6.4.
c) Check whether the display device can play the stream and decode to display it.

7.3.4 Result

The test result is Supported or Not Supported.

7.4 Function Requirement Test

7.4.1 Automatic Switch to HDR Vivid Display Mode

7.4.1.1 Overview

This section is to test whether the display device can automatically switch to HDR Vivid display mode upon receiving HDR Vivid signal.

7.4.1.2 Test Conditions

Video test signal: HDR Vivid color bar test stream specified in 5.3.

7.4.1.3 Test steps.

a) Adjust the display device to the working status as specified in 6.5
b) Play back HDR Vivid test stream using the playback software specified in 6.4.
c) Check whether the display device under assessment can automatically switch to HDR Vivid mode.

7.4.1.4 Result

The test result is Supported or Not Supported.

7.4.2 Test of HDR Vivid Visual Identification

7.4.2.1 Overview

This section is to test whether the display device supports visual identification when it receives HDR Vivid signal.

7.4.2.2 Test Conditions

Video test signal: HDR Vivid test stream specified in 5.3.

7.4.2.3 Test Steps

a) Adjust the display device to the working status as specified in 6.5;
b) Enable automatic switch to HDR Vivid display;
c) Play back HDR Vivid test stream;
d) Check whether the device under testing shows a menu indicating that current signal format is HDR Vivid.

7.4.2.4 Result

The test result is Supported or Not Supported.

7.5 Display Performance Test

7.5.1 Peak Luminance

7.5.1.1 Overview

This section is test the luminance limit of the display device.

7.5.1.2 Test Conditions

Video test signal: 10% white window image with window luminance at 3,987.99 cd/m^2 (code values: 923/923/923) and background luminance at 0 cd/m^2 (code values: 0/0/0).
Dynamic metadata setting: Set according to metadata parameters described in Appendix A.3.

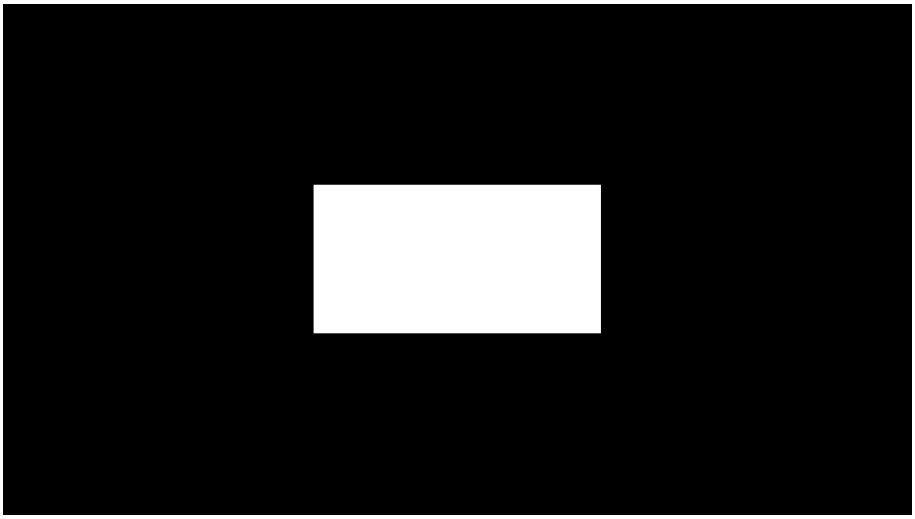

Figure 2 10% White Window Signal

7.5.1.3 Test Steps

The test steps are as follows:

a) Adjust the display device to the working status as specified in 6.5.
b) Play back the black field test image and keep displaying for more than 30s to check the display stability.
c) Switch to the 10% white window image and measure the luminance at the center point of the screen 5, 25 and 45 seconds after the switchover.
d) Take the highest value out of the 3 results as peak luminance.

7.5.1.4 Result

The test result is measured in Candela per square meter (cd/m^2).

7.5.2 Stable Peak Luminance

7.5.2.1 Overview

This section is to test the luminance of the display device when in stable operation.

7.5.2.2 Test Conditions

Video test signal: 1) 10% white window image with window luminance at 3,987.99 cd/m^2 (code values: 923/923/923) and background luminance at 0 cd/m^2 (code values: 0/0/0); 2) 5% white window image with window luminance at 3,987.99 cd/m^2 (code values: 923/923/923) and background luminance at 0 cd/m^2 (code values: 0/0/0); 20% white window image with window luminance at 3,987.99 cd/m^2 (923/923/923) and background luminance at 0 cd/m^2 (code values: 0/0/0).
Dynamic metadata settings: Set dynamic metadata parameters according to Appendix A.3.

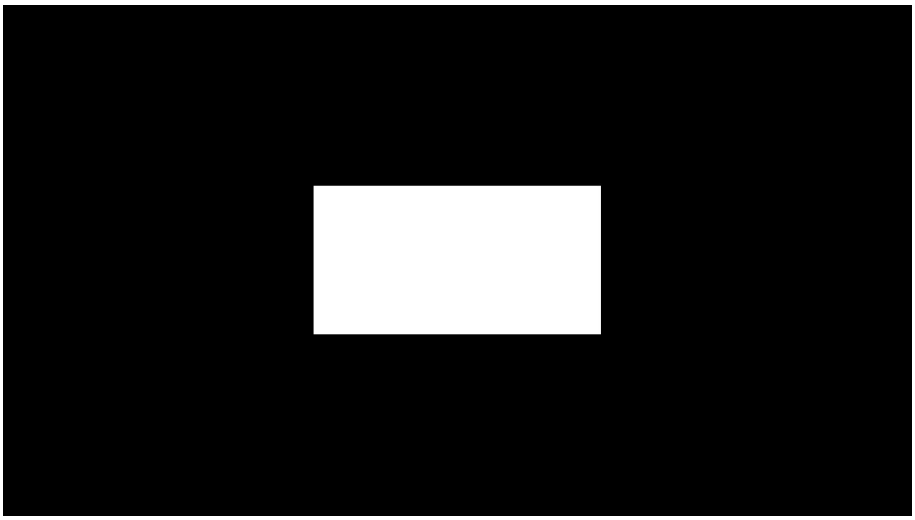

Figure 3 10% White Window Signal

7.5.2.3 Test Steps

The test steps are as follows:

a) Adjust the display device to the working status as specified in 6.5.
b) Feed in 5%, 10% and 20% white window test images one by one with each image staying for 30 seconds,

and do it four times.

c) Test luminance at the center point of the screen every time when the 10% white window image is displayed. Specifically, measure the luminance 5 and 25 seconds after the switchover.

d) Take the lowest value of the 8 measurement results as the stable peak luminance.

7.5.2.4 Result

The test result is measured with Candela per square meter (cd/m^2).

7.5.3 Lowest Black Level

7.5.3.1 Overview

This section is to test the black level limit of the display device.

7.5.3.2 Test Conditions

Video test signal: 2.5% corner window image with window luminance at 603.75 cd/m^2 (code values: 713/713/713) and background luminance at 0 cd/m^2 (code values: 0/0/0). The size of each box at the corner is 2.5% of that of the whole 16:9 window, and each box is 50 pixels away from neighboring boxes.
Dynamic metadata settings: curve parameter mode. See Appendix A.3.

Figure 4 2.5% Corner Window Signal

7.5.3.3 Test Steps

The test steps are as follows:

a) Adjust the display device to the working status as specified in6.5.

b) Feed in the 2.5% corner window signal and measure the luminance at the center point of the screen by shielding the four corners of the screen with light proof non-glare material.

7.5.3.4 Result

The test result is measured in Candela per square meter (cd/m^2).

7.5.4 Color Gamut Overlap

7.5.4.1 Overview

The color gamut overlap is the ratio of the overlapped area between the RGB (red/green/blue) gamut triangle and the ITU-R BT.2020 gamut triangle to the ITU-R BT.2020 gamut triangle.

7.5.4.2 Test Conditions

Video test signal: red image (923/0/0)
green image (0/923/0)
blue image (0/0/923)
Dynamic metadata settings: Set to direct mapping curve. See A.3 in Appendix A for relevant parameters.

7.5.4.3 Test Steps

The test steps are as follows:
a) Adjust the display device to the working status as specified in 6.5.

b) Display red, green, and blue images respectively and measure the chromaticity coordinates ($(u_r^{'},v_r^{'})$, $(u_g^{'},v_g^{'})$, and $(u_b^{'},v_b^{'})$) at the center point with a colorimeter. Then, calculate the overlap area $S_{coincide}$.

c) Calculate the color gamut overlap $G_{coincide}$ with the following formula:

$$G_{coincide}=\frac{S_{coincide}}{0.1118}\times 100\% \quad \text{..... (4)}$$

7.5.4.4 Result

The test result is expressed in percentage (%).

7.5.5 Dynamic Luminance Range

7.5.5.1 Overview

This section specifies the test of dynamic luminance range of the display device.

7.5.5.2 Test Conditions

The same as specified in 7.5.1 and 7.5.3.

7.5.5.3 Test Steps

The test steps are as follows:
a) Measure the peak luminance in accordance with steps in 7.5.1 and the lowest black level in accordance with steps in 7.5.3.
b) Calculate the dynamic luminance range with formula (7):

$$\mathrm{HDR_{coverage}}=\frac{\mathrm{lgL_W}-\mathrm{lgL_B}}{\mathrm{lgL_{Wr}}-\mathrm{lgL_{Br}}}\times 100\% \quad \text{.....(7)}$$

In this formula:
L_W — Peak luminance

L_B — Lowest black level
L_{Wr} — 10,000 cd/m^2 (SMPTE ST.2084)
L_{Br} — 0.000001 cd/m^2 (SMPTE ST.2084)

7.5.5.4 Result

The test result is expressed in percentage (%).

7.5.6 D65 White Balance

7.5.6.1 Overview

This section specifies the test of white balance performance of the display device.

7.5.6.2 Test Conditions

Video test signal: 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 changes as indicated in Table 5.

Table 5 Luminance Test Signal (Nonlinear Full Range PQ RGB Signal)

Luminance Test Signal		RGB Code in PQ Gamut (10-bit, BT.2020 Gamut)		
No. [k]	Input Luminance (cd/m^2)	R Signal	G Signal	B Signal
1	100.2301	520	520	520
2	199.1536	592	592	592
3	401.5059	668	668	668
4	998.9344	769	769	769

Dynamic metadata settings: Set to direct mapping curve. See A.3 in Appendix A for relevant parameters.

7.5.6.3 Test Steps

The test steps are as follows:

a) Adjust the display device to the working status as specified in6.5.

b) Input the test code streams, maintain for 30s for each luminance level, and measure the chromaticity coordinates (u', v') at the 5th second. The measured chromaticity value is recorded as M[k, j] {k = 1,...,5; j = 1,2}. The values of j represent component u' and v', respectively.

c) Calculate the respective absolute difference Δu' and Δv' between the chromaticity coordinates at each luminance level and the standard D65 coordinates (0.1978, 0.4683).

7.5.6.4 Result

The test results are the maximum values of Δu' and Δv'.

7.5.7 Display Quantization Accuracy

7.5.7.1 Overview

This section specifies the test of the quantization accuracy of the display device, in order to check if the display device produces serious banding artifacts within the range of peak luminance.

7.5.7.2 Test Conditions

Video test signal: gray scale stripe signals. The first signal is a 32-level gray scale signal stepping from (0/0/0) to (1023/1023/1023). The second signal is a 16-level gray scale signal stepping from 660/660/660 to 675/675/675 with a step of 1. The third signal is a 64-level gray scale signal stepping from (1023/1023/1023) to (0/0/0), and the fourth signal is a 4-level gray scale signal stepping from 660/660/660 to 672/672/672 with a step of 4.

Dynamic metadata settings: Set to direct mapping curve. See A.3 in Appendix A for relevant parameters.

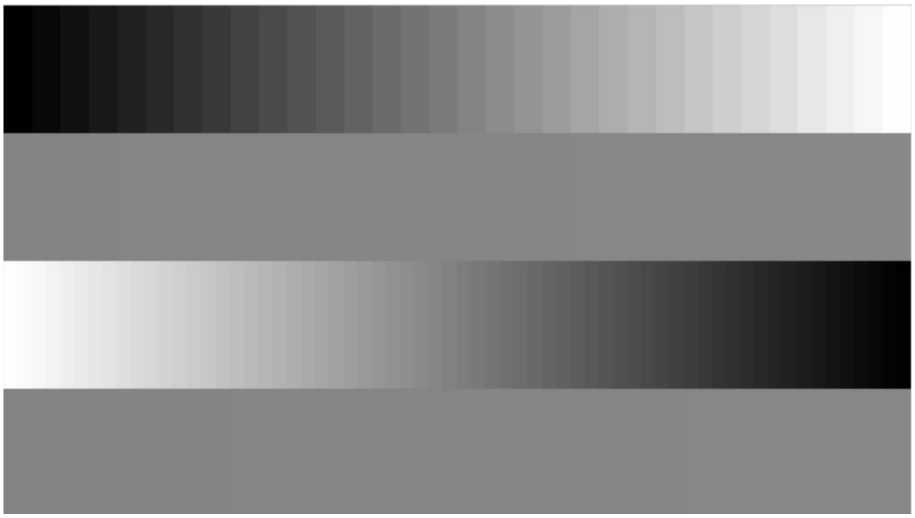

Figure 5 Display Quantization Accuracy

7.5.7.3 Test Steps

The test steps are as follows:

1) Adjust the display device to the working status as specified in 6.5.
2) Input the gray scale stripe signals and display for 30s.
3) Observe the third stripe on the screen and count the number of visible gray scales.
4) In case of more than 50% of the gray scales are clear and distinguishable, the accuracy is greater than or equal to 6 bits; otherwise, the accuracy is less than 6 bits.
5) Continue to observe the fourth stripe on the screen and count the number of visible gray scales.
6) If it does not show four distinguishable gray scales, then the accuracy is 6 bits;
7) If it shows four distinguishable gray scales, then the accuracy is greater than or equal to 8 bits;
8) Continue to observe the second stripe on the screen and count the number of visible gray scales;
9) In case of smooth gradient with no visible gray scales or more than 4 gray scales, the accuracy is 10 bits, otherwise it is 8 bits.

7.5.7.4 Result

The test result is expressed in bit number.

7.6 Test of Dynamic Metadata Processing

7.6.1 Statistics Mode

7.6.1.1 Overview

This section specifies the test of consistency of the tone mapping process defined by HDR Vivid in statistics mode of the display device when the dynamic metadata contains data statistics.

7.6.1.2 Luminance Test Conditions

Video test signal: 10% window signal with the background luminance at 0 cd/m^2 (code value: 0/0/0). The input value for each component of the window signal changes as indicated in Table 6.

Table 6 Luminance Test Signal (Nonlinear Full Range PQ RGB Signal)

Luminance Test Signal		RGB Code in PQ Gamut (10-bit, BT.2020 Gamut)		
No. [k]	Input Luminance (cd/m^2)	R Signal	G Signal	B Signal
1	49.7907	450	450	450
2	100.2301	520	520	520
3	199.1536	592	592	592
4	401.5059	668	668	668
5	998.9344	769	769	769
6	3,987.9926	923	923	923

Dynamic metadata configuration: Three sets of dynamic metadata are applied in the test.

- Scenario 1
- Scenario 2
- Scenario 3

For details about dynamic metadata in each scenario, see Appendix A.1.

Figure 6 is the sample test image.

Figure 6 Sample Image with Input Luminance at 49.7907 cd/m^2

7.6.1.3 Luminance Test Steps

The test steps are as follows:

1) Adjust the display device to the working status as specified in 6.5.
2) Input the test code streams, maintain for 10s for each luminance level, and measure the luminance within 5s. Then, record the measured luminance values.
3) Record the actual test values corresponding to the six input brightness in Table 5 respectively as M[k]; {k=1, ..., 6}. The test results are expressed as cd/m2.
4) Take the metadata corresponding to the test code streams, nominal maximum and minimum luminance of the display device, and 6 input luminance values as the input data. Then, calculate the expected luminance P[k] {k = 1,...,6} corresponding to each input luminance, in accordance with the image processing method specified in Chapters 9 and 10 of T/UWA 005.1-2022. The unit for the result is expressed in Candela per square meter (cd/m^2).
5) Based on the nominal maximum luminance of the display device and the peak luminance measured as per 7.5.2, calculate the screen luminance adjustment coefficient S with the following formula:

$$S = \frac{Pm}{Ps}$$

6) Calculate the relative error A[k] between the expected and measured luminance values:

$$A[k] = \frac{\left| P[k] - \frac{M[k]}{S} \right|}{P[k]} \times 100\%$$

7.6.1.4 Luminance Test Result

Take the largest A[k] in each luminance range as the result of that range in the scenario.
Take the largest A[k] in all scenarios in statistics mode as the final result of the luminance range, and check whether the value is in the error range specified in Table 4.

7.6.2 Curve Parameter Mode

7.6.2.1 Overview

This section specifies the consistency test of the tone mapping process defined by HDR Vivid in curve parameter mode of the display device when the dynamic metadata contains curve parameter information (base curve parameters, reference luminance, corrected curve parameters, and cubic spline adjustment).
Three sets of dynamic metadata are applied in curve parameter mode for the test, namely:

- Scenario 4
- Scenario 5
- Scenario 6

See Appendix A.2 for the dynamic metadata in the scenarios.

7.6.2.2 Luminance Deviation Test Conditions

Luminance test conditions in curve parameter mode are the same as those in statistics mode. For more details, see 7.6.1.2

7.6.2.3 Luminance Deviation Test Steps

Luminance test steps in curve parameter mode are the same as those in statistics mode. For more details, see

7.6.1.3.

7.6.2.4 Luminance Deviation Test Result

The result of luminance test in curve parameter mode is indicated in the same way as that in statistics mode. For more details, see 7.6.1.4.

7.6.2.5 Chromaticity Deviation Test Conditions

Video test signal: 10% window signal with the background luminance at 0 cd/m^2 (the 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 changes as indicated in Table 7.

Table 7 Chromaticity Test Signal (Nonlinear Full Range PQ RBG Signal)

Color Test Signal		RGB Code in PQ Gamut (10-bits, BT.2020 Gamut）			Reference Chromaticity Coordinates	
No. [k]	Type	R Signal	G Signal	B Signal	u’	v’
1	Skin color 1#	441	409	389	0.2320	0.4867
2	Skin color 2#	449	413	381	0.2377	0.4946
3	Skin color 3#	465	449	437	0.2137	0.4790
4	Sky color	477	550	622	0.1503	0.3960
5	Floral color	518	602	233	0.1385	0.5726

The dynamic metadata configuration in this test is the same as that in the luminance test. See Appendix A.2.

Figure 7 Input Chromaticity of Skin Color 2#

7.6.2.6 Chromaticity Deviation Test Steps

The test steps are as follows:

1) Adjust the display device to the working status as specified in 6.5.
2) Input the test code streams, maintain for 30 seconds for each color, and measure and record the chromaticity coordinates (u', v') at the 25th second.
3) Record the five measured chromaticity values as M[k, j]; {k=1,…,5; j=1,2}. The values of j represent component u' and v', respectively.
4) Take the metadata corresponding to the test code streams, nominal maximum luminance of the

display device, and five input chromaticity values as the input data. Then, calculate the expected chromaticity output values corresponding to each chromaticity input values, in accordance with the image processing method specified in Chapters 9 and 10 of T/UWA 005.1-2022. The chromaticity output values are represented as RGB components which are then converted to u' and v' components. The results are recorded as P[k, j]; {k=1,…,K; j=1,2}. The values of j represent components u' and v', respectively.

5) Calculate the absolute error A[k] between the expected and measured chromaticity output values:
A[k]=max (|P[k,1] - M[k,1]|, |P[k,2] - M[k,2]|), k=1,…,5

7.6.2.7 Chromaticity Deviation Test Result

For skin colors, take the largest value among A[1], A[2], and A[3] as the result in the scenario. For the sky color sequence, take A[4] as the result in the scenario. For the floral color, take A[5] as the result in the scenario.

Take the largest one among values in all scenarios in curve parameter mode as the final test result, and check whether the value is within the deviation range specified in Table 4.

7.6.3 Metadata Synchronization Test

7.6.3.1 Overview

This section specifies the test of synchronization between the video image and the dynamic metadata.

HDR Vivid uses dynamic metadata which may change from one frame to another. On a terminal device, it is necessary to ensure that each frame of image accurately uses the corresponding dynamic metadata.

The code stream used in this test is specially constructed. As shown in Figure 8, the stream is composed of two 10% window signals with different luminance, i.e. input image 1 and 2. Despite the difference in luminance, 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 instable luminance, showing obvious flickering.

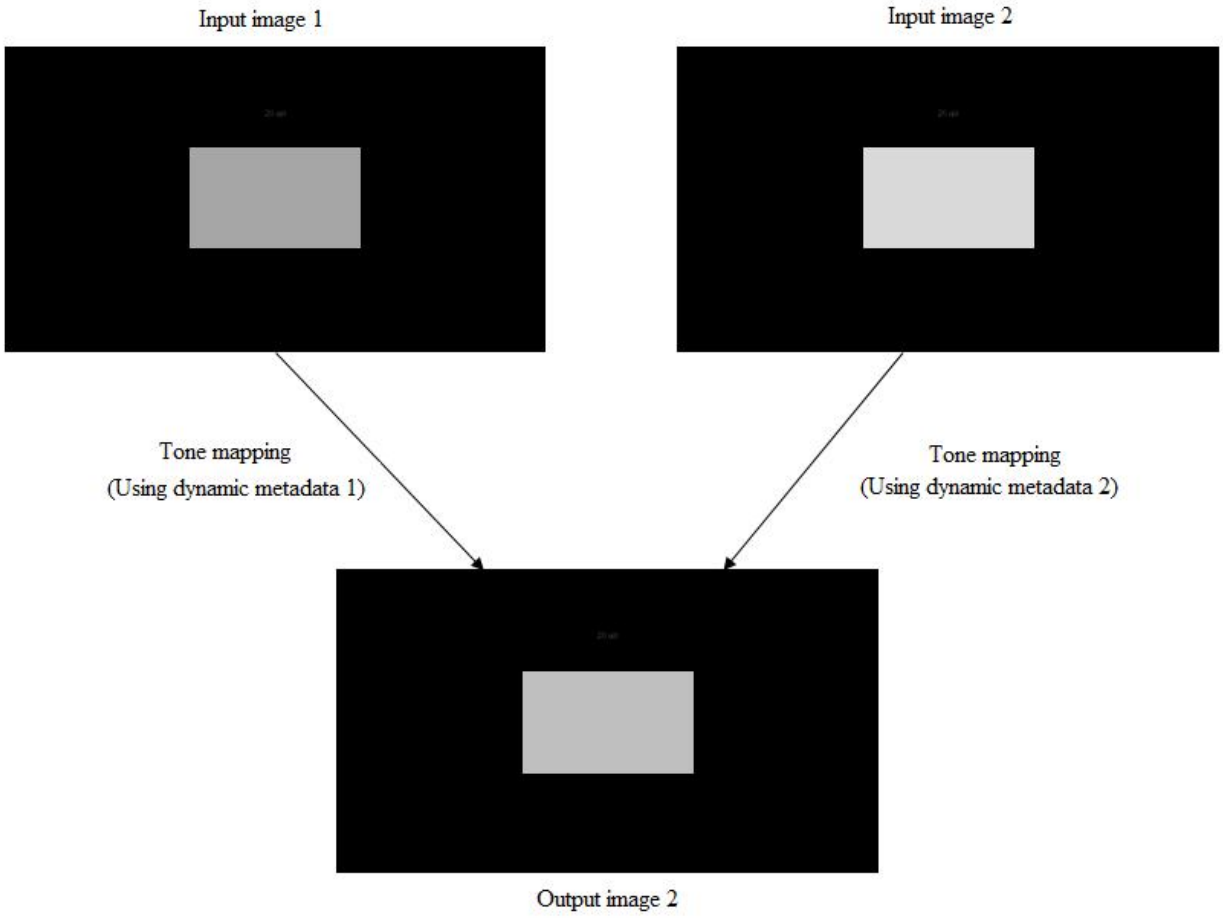

Figure 8 Metadata Synchronization Test

7.6.3.2 Test Conditions

Video test signal: 10% window signal with the background luminance at 0 cd/m^2 (the 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 changes as indicated in Table 8.

Table 8 Synchronization Test Signal (Nonlinear Full Range PQ RGB Signal)

RGB Code in PQ Gamut (10-bit, BT.2020 Gamut)			
No. [k]	R Signal	G Signal	B Signal
Test image 1	683	683	683
Test image 2	765	765	765

See A.4 in Appendix A for the dynamic metadata configurations of the test.

7.6.3.3 Synchronization Test Steps

The test steps are as follows:

1) Adjust the display device to the optimal working status as specified in 6.5.

2) Input the metadata synchronization test code stream and visually check whether the luminance of the window signal is stable.
3) If the window luminance at the center of the display screen is stable without visible flickering, the display device passes the metadata synchronization test. Otherwise, it fails the test.

Appendix A

Dynamic Metadata Configuration Parameters

A.1 Configurations under the Statistics Mode

The dynamic metadata only contains statistical information which is used for the consistency test of terminal devices. Relevant settings are as follows:

Dynamic Metadata	Scenario 1	Scenario 2	Scenario 3
system_start_code	1	1	1
minimum_maxrgb_pq	0	0	0
average_maxrgb_pq	1893	2309	3047
variance_maxrgb_pq	4055	3583	2103
maximum_maxrgb_pq	4094	4094	4094
tone_mapping_enable_mode	0	0	0
color_saturation_mapping_flag	1	1	1
color_saturation_num	2	2	2
color_saturation_gain[0]	38	38	38
color_saturation_gain[1]	25	25	25

A.2 Configurations under the Curve Parameter Mode

The dynamic metadata contains curve parameter information (base curve parameters, reference luminance, corrected curve parameters, and cubic spline adjustment) which is used for the conformity test of terminal devices in the curve parameter mode. Relevant settings are as follows:

Dynamic Metadata	Scenario 4	Scenario 5	Scenario 6
system_start_code	1	1	1
minimum_maxrgb_pq	0	0	0
average_maxrgb_pq	1893	2309	3047
variance_maxrgb_pq	4055	3583	2103
maximum_maxrgb_pq	4094	4094	4094
tone_mapping_enable_mode	1	1	1
tone_mapping_param_enable_num	1	1	0
targeted_system_display_maximum_luminance_pq[0]	2770	2770	2770
base_enable_flag[0]	1	1	1
base_param_m_p[0]	9241	8871	8217
base_param_m_m[0]	24	24	24
base_param_m_a[0]	750	723	707
base_param_m_b[0]	0	0	0
base_param_m_n[0]	10	10	10

Dynamic Metadata	Scenario 4	Scenario 5	Scenario 6
base_param_K1[0]	1	1	1
base_param_K2[0]	1	1	1
base_param_K3[0]	1	1	1
base_param_Delta_enable_mode[0]	1	1	1
base_param_enable_Delta[0]	16	8	0
3Spline_enable_flag[0]	1	1	1
3Spline_enable_num[0]	1	1	1
3Spline_TH_enable_mode[0][0]	0	0	0
3Spline_TH_enable_MB[0][0]	224	204	176
3Spline_TH_enable[0][0][0]	368	599	1007
3Spline_TH_enable_Delta1[0][0]	267	271	139
3Spline_TH_enable_Delta2[0][0]	534	391	279
3Spline_enable_Strength[0][0]	127	127	114
3Spline_TH_enable_mode[1][0]	1	1	1
3Spline_TH_enable[1][0]	2715	2855	3499
3Spline_TH_enable_Delta1[1][0]	613	613	291
3Spline_TH_enable_Delta2[1][0]	613	613	291
3Spline_enable_Strength[1][0]	165	165	165
targeted_system_display_maximum_luminance_pq[1]	2080	2080	NA
base_enable_flag[1]	0	0	NA
3Spline_enable_flag[1]	1	1	NA
3Spline_enable_num[1]	0	0	NA
3Spline_TH_enable_mode[0][1]	1	1	NA
3Spline_TH_enable[0][1]	1973	2783	NA
3Spline_TH_enable_Delta1[0][1]	794	819	NA
3Spline_TH_enable_Delta2[0][1]	1023	491	NA
3Spline_enable_Strength[0][1]	127	127	NA
color_saturation_mapping_flag	1	1	1
color_saturation_num	2	2	2
color_saturation_gain[0]	38	38	38
color_saturation_gain[1]	25	25	25

A.3 Configurations of Direct Mapping Curve

With the direct mapping curve, the display device directly maps the video content if its luminance is lower than the nominal maximum luminance, and truncate the content if otherwise. Display performance, maximum luminance, color gamut, and other display performance can be tested in this mode. Relevant settings are as follows:

Dynamic Metadata	Direct Mapping Curve
system_start_code	1
minimum_maxrgb_pq	0
average_maxrgb_pq	1024

Dynamic Metadata	Direct Mapping Curve
variance_maxrgb_pq	1024
maximum_maxrgb_pq	2048
tone_mapping_enable_mode	1
tone_mapping_param_enable_num	0
targeted_system_display_maximum_luminance_pq[0]	2674
base_enable_flag[0]	1
base_param_m_p[0]	5734
base_param_m_m[0]	24
base_param_m_a[0]	920
base_param_m_b[0]	0
base_param_m_n[0]	10
base_param_K1[0]	1
base_param_K2[0]	1
base_param_K3[0]	1
base_param_Delta_enable_mode[0]	0
base_param_enable_Delta[0]	0
3Spline_enable_flag[0]	0
color_saturation_mapping_flag	0

A.4 Curve Parameter Configurations for Synchronization Test

The dynamic metadata contains curve parameter information (base curve parameters, reference luminance, corrected curve parameters, and cubic spline adjustment) which is used in the curve parameter mode of the terminal device. Relevant settings are as follows:

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
base_param_K1[0]	1	1
base_param_K2[0]	1	1
base_param_K3[0]	1	1

Dynamic Metadata	Test Image 1	Test Image 2
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
color_saturation_mapping_flag	1	1
color_saturation_num	2	2
color_saturation_gain[0]	38	38
color_saturation_gain[1]	25	25