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Radiocommunication Sector

# Recommendation ITU-R BT.2166-0

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BT Series: Broadcasting service (television)

# Viewing conditions for high dynamic range and standard dynamic range monitoring in close proximity within a single-master high dynamic range production environment

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### Series of ITU-R Recommendations

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| **SM** | Spectrum management |
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| **V** | Vocabulary and related subjects |

***Note***: *This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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Geneva, 2025

RECOMMENDATION ITU-R BT.2166-0

# Viewing conditions for high dynamic range and standard dynamic range monitoring in close proximity within a single-master high dynamic range production[1] environment

(2025)

**Scope**

This Recommendation specifies recommended viewing conditions that are appropriate for use in single-master high dynamic range (HDR) productions where standard dynamic range (SDR) and HDR images are in close proximity.

**Keywords**

Single-master, standard dynamic range (SDR), high dynamic range (HDR), HDR television (HDR-TV), television production, international programme exchange, perceptual quantization (PQ), hybrid log-gamma (HLG), viewing environment

The ITU Radiocommunication Assembly,

*considering*

*a)* that a single-master HDR production, where the core production is in HDR and SDR is derived from down-mapping, is often used for reasons of efficiency;

*b)* that in single-master HDR productions, close proximity viewing of both HDR and SDR is often unavoidable;

*c)* that HDR images are significantly brighter than SDR images in their respective reference viewing environments;

*d)* that close proximity viewing will cause eye adaptation issues unless a unified white level is established between displayed HDR and SDR images;

*e)* that a unified white level can be achieved by either raising SDR luminance or lowering HDR luminance away from their respective reference levels;

*f)* that when monitoring in close proximity, the same surround environment for SDR and HDR will be present;

*g)* that SDR production suites generally employ surround luminance levels similar to those of Recommendation ITU-R BT.2100 which differ from the levels specified in Recommendation ITU-R BT.2035,

*recognizing*

*a)* that Recommendation ITU-R BT.2035 specifies an SDR reference white of 100 cd/m$^2$;

*b)* that Recommendation ITU-R BT.2100 specifies a peak luminance level of $\geq$ 1 000 cd/m$^2$ for a reference monitor and critical viewing of HDR;

[1] A “single-master HDR production” is a production approach that uses a single (master) HDR video format within the vision mixer (video switcher). The output of a “single-master HDR production” simultaneously includes a down-mapped SDR output in addition to the native HDR output.

*c)* that Report ITU-R BT.2408 describes an HDR reference white of 203 cd/m$^2$ for a Perceptual Quantization (PQ) reference monitor, which for HLG corresponds to a Hybrid Log-Gamma (HLG) display with a peak luminance of 1 000 cd/m$^2$;

*d)* that Recommendation ITU-R BT.2100 has specified a monitoring surround luminance level of 5 cd/m$^2$,

*recommends*

that for single-master HDR productions where SDR and HDR programme monitors must be in close proximity, the recommended viewing conditions described in Annex 1 should be used.

# Annex 1

## Recommended viewing conditions for monitoring HDR and SDR images in close proximity

### Overview

The intent of this Recommendation is to specify viewing conditions for close proximity HDR and SDR image monitoring within a single-master HDR production where either the HDR or SDR display uses a nominal peak reference luminance level. Some common examples for close proximity viewing of HDR and SDR include side-by-side HDR/SDR shading, when using multiview monitors (one monitor containing multiple images of different formats in close proximity), or for basic quality assessments by the vision assist. Section 1 contains a set of common recommended viewing environment specifications which relate to ambient light surround conditions and viewing distance. Section 2 contains monitor setup parameters for HDR and SDR imagery.

### 1 Recommended viewing environment

The recommended viewing environment is based in part on the reference viewing environment described in Table 3 of Recommendation ITU-R BT.2100. The parameters used are listed in Table 1.

TABLE 1

**Recommended viewing environment for critical monitoring of HDR and SDR images in close proximity**

| Parameter | Values |
|---|---|
| Surround and periphery (1) | Neutral grey at D65 |
| Luminance of surround | 5 cd/m$^2$ |
| Luminance of periphery | ≤ 5 cd/m$^2$ |
| Ambient lighting | Avoid light falling on the screen |
| Viewing distance (2) | For 1 920 × 1 080 format or lower: 3.2 picture heights<br>For 3 840 × 2 160 format: 1.6 to 3.2 picture heights<br>For 7 680 × 4 320 format: 0.8 to 3.2 picture heights |

(1) "Surround" is the area surrounding a display that can affect the adaptation of the eye, typically the wall or curtain behind the display; "periphery" is the remaining environment outside of the surround.

(2) When picture evaluation involves resolution, the lower value of viewing distance should be used. When resolution is not being evaluated, any viewing distance in the indicated range may be used.

## 2 Recommended SDR and HDR display parameters

The display settings and characteristics for close proximity HDR and SDR image monitoring within a single-master HDR production are contained in this section. To avoid SDR display eye adaptation issues where HDR and SDR displays are in close proximity, HDR and SDR displays should have a unified white level. There are two approaches to achieve this result. Use cases of each approach are shown in informative Annex 2. The order for the approaches described below and in Annex 2 should not be taken to indicate a preferred method. Background information on each approach is available in the informative reference of Annex 3.

- Approach A (§ 2.1) uses images viewed on an SDR monitor with nominal reference peak luminance levels defined in Recommendation ITU-R BT.2035 and an HLG HDR monitor with adjusted luminance levels (described in Table 2) for optimal comparability. This approach applies only to HLG and SDR images in close proximity.
- Approach B (§ 2.2) uses images viewed on an HDR monitor with nominal reference peak luminance levels defined in Recommendation ITU-R BT.2100 for either PQ or HLG and an SDR monitor with adjusted luminance levels (described in Table 3) for optimal comparability.

### 2.1 Approach A: unified white levels achieved by using an SDR display with reference peak luminance and an HLG display with adjusted peak luminance levels

This method employs an SDR monitor per Recommendation ITU-R BT.1886 with a screen luminance for white ($L_W$) of 100 cd/m$^2$ per Recommendation ITU-R BT.2035, and an HLG display with a lower peak luminance level and system gamma adjusted according to Note 5f of Table 5 in Recommendation ITU-R BT.2100.

As shown in Table 2, the HLG display nominal peak luminance is adjusted such that it is in the range of 300-600 cd/m$^2$ with appropriately adjusted system gamma, as defined in Recommendation ITU-R

BT.2100. This results in luminance levels for HDR reference white (nominal signal level 75% HLG) that more closely match the peak luminance of the SDR display, whilst providing HDR images of sufficient brightness for a typical production.

TABLE 2

**Parameters for the HLG display**

| Adjustment parameter | Value |
|---|---|
| Nominal peak luminance of HLG display | 300-600 cd/m$^2$ |
| Luminance for 75% HLG signal level | 79-138 cd/m$^2$ |
| System Gamma | 1.00-1.11 |

### 2.2 Approach B: unified white levels achieved by using an HDR display with reference peak luminance and an SDR display with adjusted peak luminance levels

This approach employs an HDR reference display, as specified in Recommendation ITU-R BT.2100 and an SDR display with adjusted luminance levels as shown in Table 3. In the case of HLG specifically, the nominal peak luminance level should be 1 000 cd/m$^2$.

TABLE 3

**Parameters for the SDR display**

| Adjustment parameter | Value |
|---|---|
| Peak luminance of SDR display ($L_w$ adjustment described in Rec. ITU-R BT.1886) | HDR reference white [1] |

[1] The SDR display luminance should be adjusted to match the HDR reference white luminance level of the production, noting that Report ITU-R BT.2408 describes a nominal HDR reference white of 203 cd/m$^2$.

# Annex 2
# (informative)

# Use cases for each approach

Approach A is used for side-by-side vision supervision, multiviews, or where the control room HDR and SDR images are in close proximity.

Approach B is used for side-by-side video shading, vision supervision, multiviews or where the control room HDR and SDR images are in close proximity.

# Annex 3
# (informative)

## Informative reference

[1] Report ITU-R BT.2408-8 Suggested guidance for operational practices in HDR Television Production (*Section 7 and Annexes 9, 10, 11*).