

# INTERNATIONAL STANDARD



**Multimedia systems and equipment – Colour measurement and management –  
Part 12-2: Simple metadata format for identification of colour gamut**

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**Multimedia systems and equipment – Colour measurement and management –  
Part 12-2: Simple metadata format for identification of colour gamut**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

### MULTIMEDIA SYSTEMS AND EQUIPMENT – COLOUR MEASUREMENT AND MANAGEMENT –

#### Part 12-2: Simple metadata format for identification of colour gamut

#### FOREWORD

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**This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61966-12-2:2014. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.**

IEC 61966-12-2 has been prepared by technical area 2: Colour measurement and management, of IEC technical committee 100: Audio, video and multimedia systems and equipment. It is an International Standard.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the number of bits of metadata format has been extended in Clause 4;
- b) Annex C has been added for handling HDR content.

The text of this International Standard is based on the following documents:

| Draft        | Report on voting |
|--------------|------------------|
| 100/3847/CDV | 100/4109/RVC     |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

A list of all parts of the IEC 61966 series, published under the general title *Multimedia systems and equipment – Colour measurement and management*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

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- withdrawn, or
- revised.

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## INTRODUCTION

New technologies in capturing and displaying wide-gamut colour images enable a new market of wide-gamut video colour content creation. Recent video standards for wide gamut colour space encoding such as ITU-R BT.2100 (HDR), ITU-R BT.2020 (UHDTV) and IEC 61966-2-4 (xvYCC) were developed in order to be able to distribute content with a colour gamut that is extended with respect to classical colour gamuts such as those defined by standards ITU-R BT.601 (standard-definition television) and ITU-R BT.709 (high-definition television). With the increasing popularity of wide gamut and high dynamic range content and displays, the variety of colour gamuts of displays is expected to increase. This issue can be an obstacle to adoption of wide-gamut video colour content in professional content creation since the compatibility of the content to the employed displays, as well as the compatibility among different displays, is not ensured. The term "display" includes here any video colour reproduction equipment, such as direct view displays and projectors. Thanks to improvements in technology, the variety of colour gamuts and colour reproduction capacities of displays are increasing while the colour gamut and the colour encoding rules of existing colour space encoding standards are fixed.

To address this issue, IEC 61966-12-1 (*Metadata for identification of colour gamut (Gamut ID)*) specifies a colour gamut metadata scheme for video systems including information for colour reproduction. This metadata can apply to video content or displays. More specifically, improvements can be achieved if the wide-gamut colour content is created with the knowledge of the display colour gamut and if the colour reproduction in the display is done with the knowledge of the colour gamut of the pictorial content.

IEC 61966-12-1 has the capability to describe arbitrary 3D colour gamuts in a given colour space and include the full/medium profile for professional use and the simple profile for consumer use with easier product implementation. This approach is effective, but some ambiguities can occur in practical use, for example if typical CE devices are able to decode the simple profile only owing to CPU and software limitations.

In this case, even if a sender device and a receiver device are based on IEC 61966-12-1:

- a) the receiver device cannot handle the Gamut ID of incoming content, if the sender device sends only a full or a medium profile;
- b) the sender device should convert a full profile to a simple one for CE devices if the receiver can receive the simple profile only, but the conversion is not possible for all the cases.

Therefore, a simple Gamut ID profile standard based on this document has been developed to address this problem.

~~For published parts of this series of standards refer to the IEC website.~~

This second edition extends the number of bits of "back level ratio" in the metadata format to accommodate the wider dynamic range content and displays.

# MULTIMEDIA SYSTEMS AND EQUIPMENT – COLOUR MEASUREMENT AND MANAGEMENT –

## Part 12-2: Simple metadata format for identification of colour gamut

### 1 Scope

This part of IEC 61966-12 specifies the colour gamut metadata format for video systems intended for use in CE (consumer electronics) devices. The metadata specified in this part of IEC 61966-12 is limited to the gamut description ~~of additive three primary colours type displays~~ for display types comprising the three primary additive colours, whose white and black points have the same chromaticity. It is fundamentally based on the conventional VESA-EDID format.

When associated with content, the simple metadata format defines the gamut for which the content was created. It can be used by the display for controlled colour reproduction even if the display's colour gamut is different from that of the content.

When associated with a display, the simple metadata format defines the display colour gamut. It can be used during content creation to enable improved colour reproduction.

This document provides the simplest, but unambiguous solution for typical CE devices that are based on colour gamut information communication.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-845, *International Electrotechnical Vocabulary – Part 845: Lighting*

IEC 61966-12-1:2014, *Multimedia systems and equipment – Colour measurement and management – Part 12-1: Metadata for identification of colour gamut (Gamut ID)*

~~IEC 61966-2-4, Multimedia systems and equipment – Colour measurement and management – Part 2-4: Colour management – Extended gamut YCC colour space for video applications – xvYCC~~

ISO 15076-1:2005, *Image technology colour management – Architecture, profile format and data structure – Part 1: Based on ICC. 2004-10 2010*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-845 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

### 3.1 content

set of video signals in production, post-production or consumption

### 3.2 colour gamut

range of colours achievable on a given colour reproduction medium (or present in an image of that medium) under a given set of viewing conditions

Note 1 to entry: It is a volume in colour space.

### 3.3 gamut mapping

mapping of the colour-space coordinates of the elements of a source image to colour-space coordinates of the elements of a reproduction to compensate for differences in the source and output medium colour gamut capability

## 4 Simple description of gamut

**Additive** The three primary additive colours gamut can be specified by four combinations of CIE-xy chromaticity values of red, green, blue and white. The gamut is assumed to have the characteristic that combining equal amounts of the three primaries (red, green, blue) produces the chromaticity of white. These values can be encoded according to the gamut CIE-xy chromaticity values used in Vesa Enhanced Extended Display Identification Data Standard (Defines EDID Structure Version 1, Revision 4). The description includes eight values (CIE-xy chromaticity values for each red, green, blue and white) with 10-bit fixed point form in the range of 0,0 to 1,0. These display primary and the white point CIE-xy chromaticity values should be measured in such a way as to minimize the contribution from the display black. In addition to VESA-EDID format, the information of White Absolute Luminance (WAL) and Black Level Ratio (BLR) are included. WAL value is defined in  $\text{cd}/\text{m}^2$  and denoted as  $Y_W$ , and encoded into 16-bit unsigned integer form. BLR is defined as Equation (1), and encoded into 32-bit fixed point form in the range of 0,0 to 1,0.

$$\text{BLR} = (Y_K / Y_W) \quad (1)$$

where

$Y_K$  is the luminance of black shown in Figure 1;

$Y_W$  is the luminance of white shown in Figure 1.

Table 1 shows the total metadata which includes the VESA-EDID compatible CIE-xy chromaticity values of red, green, blue and white and BLR and WAL value. The total size of this format is 16 B.

Refer to Annex C for information about handling HDR content.

**Table 1 – Simple metadata format for identification of colour gamut**

| Byte#<br>hex | Size<br>B | Colour<br>characteristic  | Description |       |       |       |       |       |       |       |
|--------------|-----------|---|-------------|-------|-------|-------|-------|-------|-------|-------|
|              |           |   | 7           | 6     | 5     | 4     | 3     | 2     | 1     | 0     |
| 00           | 1         | Red_x, Red_y,<br>Green_x,<br>Green_y<br>Bits1 & bits0                       | Rx1         | Rx0   | Ry1   | Ry0   | Gx1   | Gx0   | Gy1   | Gy0   |
| 01           | 1         | Blue_x, Blue_y,<br>White_x, White_y<br>bits1 & bits0                        | Bx1         | Bx0   | By1   | By0   | Wx1   | Wx0   | Wy1   | Wy0   |
| 02           | 1         | Red_x bit9 – bit2   | Rx9         | Rx8   | Rx7   | Rx6   | Rx5   | Rx4   | Rx3   | Rx2   |
| 03           | 1         | Red_y bit9 – bit2   | Ry9         | Ry8   | Ry7   | Ry6   | Ry5   | Ry4   | Ry3   | Ry2   |
| 04           | 1         | Green_x bit9 – bit2   | Gx9         | Gx8   | Gx7   | Gx6   | Gx5   | Gx4   | Gx3   | Gx2   |
| 05           | 1         | Green_y bit9 – bit2   | Gy9         | Gy8   | Gy7   | Gy6   | Gy5   | Gy4   | Gy3   | Gy2   |
| 06           | 1         | Blue_x bit9 – bit2  | Bx9         | Bx8   | Bx7   | Bx6   | Bx5   | Bx4   | Bx3   | Bx2   |
| 07           | 1         | Blue_y bit9 – bit2  | By9         | By8   | By7   | By6   | By5   | By4   | By3   | By2   |
| 08           | 1         | White_x bit9 – bit2   | Wx9         | Wx8   | Wx7   | Wx6   | Wx5   | Wx4   | Wx3   | Wx2   |
| 09           | 1         | White_y bit9 – bit2   | Wy9         | Wy8   | Wy7   | Wy6   | Wy5   | Wy4   | Wy3   | Wy2   |
| 0A           | 1         | White absolute<br>luminance<br>Bit15 – bit8<br>(16 bit unsigned<br>Integer) | WAL15       | WAL14 | WAL13 | WAL12 | WAL11 | WAL10 | WAL9  | WAL8  |
| 0B           | 1         | White absolute<br>luminance<br>Bit7 – bit0<br>(16 bit unsigned<br>Integer)  | WAL7        | WAL6  | WAL5  | WAL4  | WAL3  | WAL2  | WAL1  | WAL0  |
| 0C           | 4         | Black level ratio<br>bit15 – bit8 (16-bit<br>fixed point)                   | BLR15       | BLR14 | BLR13 | BLR12 | BLR11 | BLR10 | BLR9  | BLR8  |
| 0D           | 4         | Black level ratio<br>bit7 – bit0 (16-bit<br>fixed point)                    | BLR7        | BLR6  | BLR5  | BLR4  | BLR3  | BLR2  | BLR1  | BLR0  |
| 0C           | 1         | Black level ratio<br>Bit31 – bit24 (32-<br>bit fixed point)                 | BLR31       | BLR30 | BLR29 | BLR28 | BLR27 | BLR26 | BLR25 | BLR24 |
| 0D           | 1         | Black level ratio<br>Bit23 – bit16 (32-<br>bit fixed point)                 | BLR23       | BLR22 | BLR21 | BLR20 | BLR19 | BLR18 | BLR17 | BLR16 |
| 0E           | 1         | Black level ratio<br>Bit15 – bit8<br>(32-bit fixed<br>point)                | BLR15       | BLR14 | BLR13 | BLR12 | BLR11 | BLR10 | BLR9  | BLR8  |
| 0F           | 1         | Black level ratio<br>Bit7 – bit0 (32-bit<br>fixed point)                    | BLR7        | BLR6  | BLR5  | BLR4  | BLR3  | BLR2  | BLR1  | BLR0  |

NOTE The metadata format in this document has backward compatibility with IEC 61966-12-2:2014 because addresses "0C" and "0D" indicate same bits.

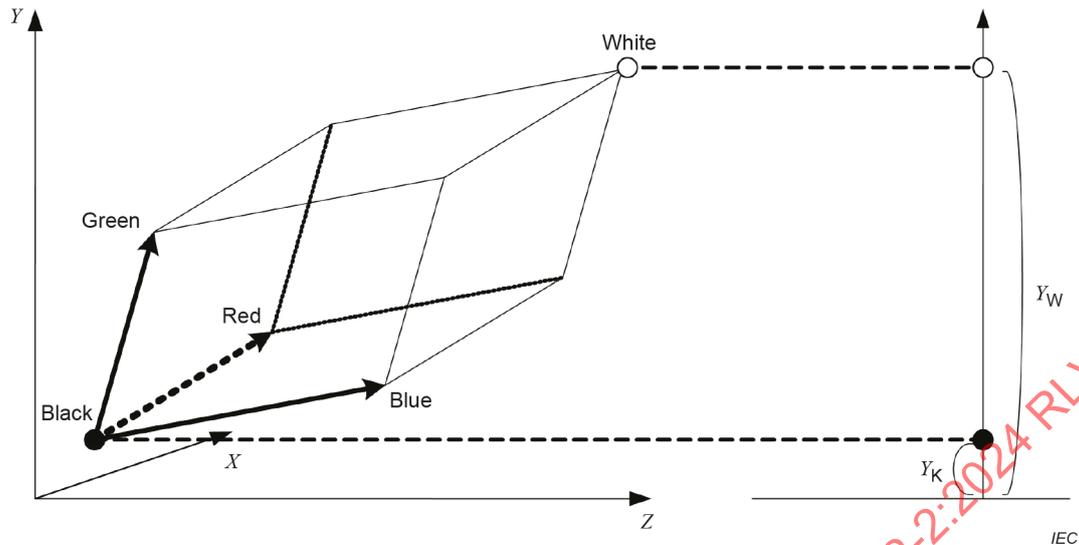


Figure 1 – The colour gamut of additive three primary colours type display for display types comprising three primary additive colours

## 5 Relationship with IEC 61966-12-1

A content gamut is usually smaller than a colour encoding gamut of today's extended-gamut colour space, such as IEC 61966-2-4 xvYCC. If there is no description of an actual colour gamut for some content, it is possible that gamut mapping will use the colour encoding gamut as the content gamut, which can cause some problems. IEC 61966-12-1 solves this problem by associating an explicit description of an actual content gamut to content. IEC 61966-12-1 has a full, medium and simple profile.

The full profile and the medium profile have high flexibility for describing 3D-shapes of complicated content gamuts in a colour space as shown in Figure 2. Consequently, IEC 61966-12-1 full and medium profiles are well suited for some professional-use applications, such as content production. In addition, IEC 61966-12-1 provides simple profile formats that are limited to three primary type colour gamuts, as shown in Figure 3.

However, the IEC 61966-12-1 simple profile is 77 B and still large for CE devices. This document is therefore limited to the CIE-xy chromaticity values of additive the three primary additive colour gamuts and has a reduced size of 1416 B.

Refer to Annex A for more details about the conversion from IEC 61966-12-2 to the IEC 61966-12-1 simple profile. Refer to Annex B for an example of simple metadata format and conversion to the IEC 61966-12-1 simple profile.

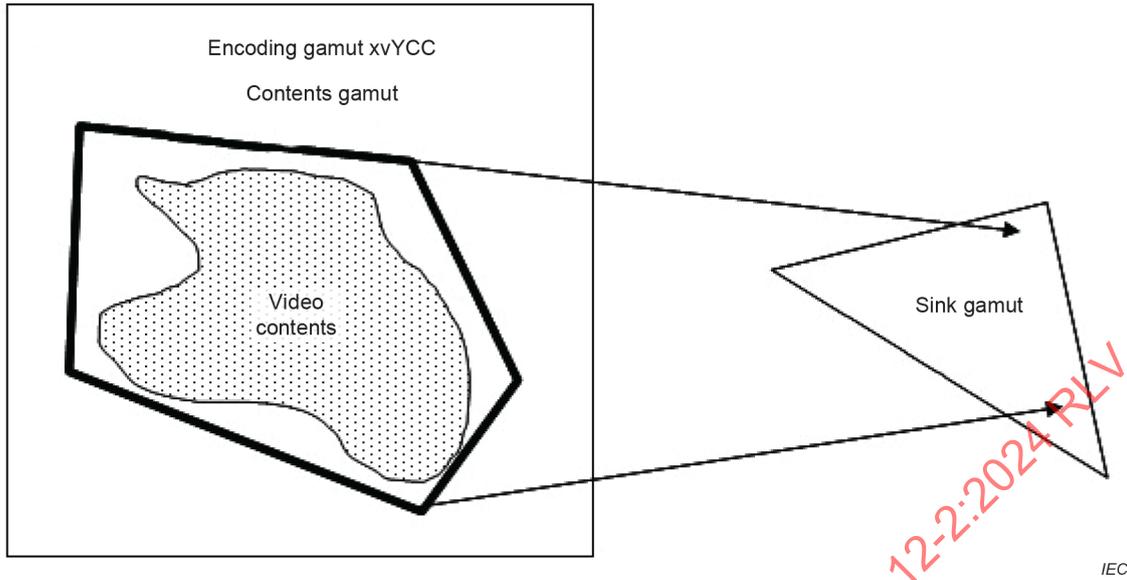


Figure 2 – IEC 61966-12-1 full and medium profiles

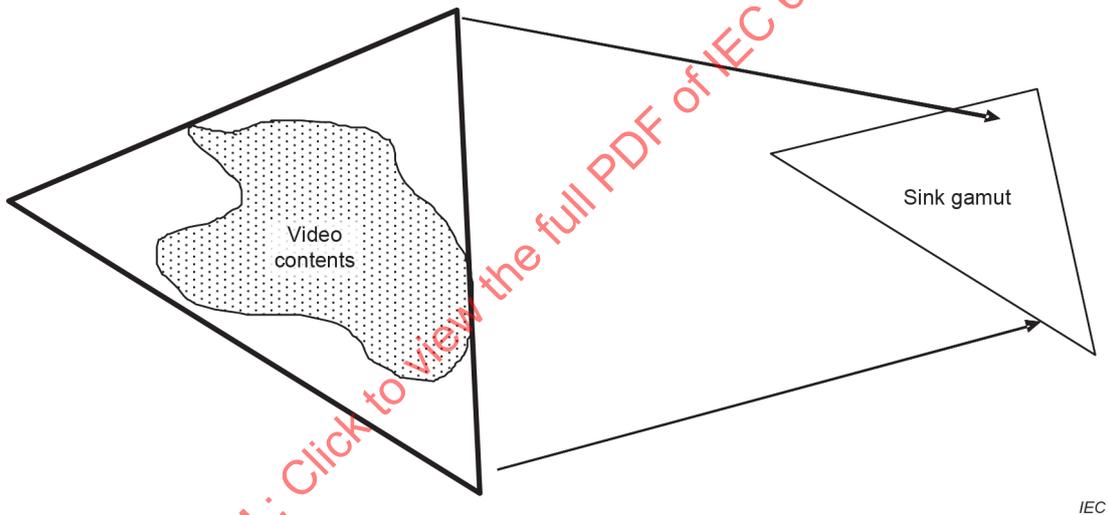


Figure 3 – IEC 61966-12-1 simple profile and IEC 61966-12-2

Table 2 – Differences of IEC 61966-12-1 simple profile and IEC 61966-12-2

|                     | IEC 61966-12-1 simple profile   | IEC 61966-12-2  |
|---------------------|---|---|
| Size                | 77 B (Header: 17 B<br>+ Gamut description: 60 B)  | <del>44</del> 16 B<br>(Gamut description only)  |
| Coordinate's format | <ul style="list-style-type: none"> <li>- CIE-XYZ tristimulus values of 5 colours (red, green, blue, white, black)</li> <li>- s15Fixed16Number (see ICC profiles in ISO 15076-1:2005)</li> </ul> | <ul style="list-style-type: none"> <li>- CIE-xy chromaticity values of four colours (red, green, blue, white)</li> <li>- VESA-EDID compatible</li> <li>- 16-bit unsigned integer form</li> <li>- <del>16</del>32-bit fixed point form in the range of 0,0 to 1,0</li> </ul> |

## Annex A (informative)

### Conversion from IEC 61966-12-2 to IEC 61966-12-1 simple profile

IEC 61966-12-2 can be converted to the IEC 61966-12-1 simple profile. This annex shows an example of the conversion method. The conversion equations calculate five CIE-XYZ tristimulus values of red, green, blue, white and black colour vertices from four CIE-xy chromaticity values of the red, green, blue and white colour vertices, WAL and BLR values. ~~It should be noted that~~ The inverse conversion cannot be uniquely defined when the additivity rule of the three primary colours mixture is not guaranteed.

$x_i$  and  $y_i$  are  $x,y$  coordinates of colours described in IEC 61966-12-2.  $X_i$ ,  $Y_i$  and  $Z_i$  are  $X,Y,Z$  coordinates of IEC 61966-12-1 simple profile. In both coordinate systems,  $i = R,G,B,W$ , or  $K$ , which denotes red, green, blue, white or black colour vertices.

The conversion process has the following four steps:

- a) In the first step,  $X,Y,Z$  values for white colour are calculated. Here, absolute  $Y_W$  value information from IEC 61966-12-2 should be used. We can calculate  $X,Y,Z$  values using  $Y_W$  value and  $x,y$  chromaticity coordinates for white colour as Equation (A.1).

$$\begin{bmatrix} X_W \\ Y_W \\ Z_W \end{bmatrix} = Y_W \begin{bmatrix} \frac{x_W}{y_W} \\ 1 \\ \frac{1-x_W-y_W}{y_W} \end{bmatrix} \quad (\text{A.1})$$

- b) In the second step,  $X,Y,Z$  values for black colour are calculated. First,  $Y_K$  can be obtained from  $Y_W$  and BLR values in Equation (A.2).

$$Y_K = BLR \times Y_W \quad (\text{A.2})$$

Then,  $X,Y,Z$  values for black can be  $Y_K$  and  $x,y$  chromaticity coordinates can be calculated as Equation (A.3) for we assume black has the same chromaticity as white.

$$\begin{bmatrix} X_K \\ Y_K \\ Z_K \end{bmatrix} = Y_K \begin{bmatrix} \frac{x_W}{y_W} \\ 1 \\ \frac{1-x_W-y_W}{y_W} \end{bmatrix} \quad (\text{A.3})$$

- c) Then in the third step, assuming ~~additive~~ three primary **additive** colours,  $Y$  values for red, green and blue colours without the offset value by black are estimated using the calculated value of white and black colours as Equation (A.4). Here,  $-1$  denotes the inverse of the  $3 \times 3$  matrix.

$$\begin{bmatrix} Y_R - Y_K \\ Y_G - Y_K \\ Y_B - Y_K \end{bmatrix} = \begin{bmatrix} \frac{x_R}{y_R} & \frac{x_G}{y_G} & \frac{x_B}{y_B} \\ 1 & 1 & 1 \\ \frac{1-x_R-y_R}{y_R} & \frac{1-x_G-y_G}{y_G} & \frac{1-x_B-y_B}{y_B} \end{bmatrix}^{-1} \begin{bmatrix} X_W - X_K \\ Y_W - Y_K \\ Z_W - Z_K \end{bmatrix} \quad (\text{A.4})$$

- d) In the last step,  $X, Y, Z$  values of red, green and blue colours are calculated using the estimated luminance of each colour in step two, and then black offset values are added as shown in Equations (A.5), (A.6) and (A.7).

$$\begin{bmatrix} X_R \\ Y_R \\ Z_R \end{bmatrix} = \begin{bmatrix} \frac{x_R}{y_R} \\ 1 \\ \frac{1-x_R-y_R}{y_R} \end{bmatrix} (Y_R - Y_K) + \begin{bmatrix} X_K \\ Y_K \\ Z_K \end{bmatrix} \quad (\text{A.5})$$

$$\begin{bmatrix} X_G \\ Y_G \\ Z_G \end{bmatrix} = \begin{bmatrix} \frac{x_G}{y_G} \\ 1 \\ \frac{1-x_G-y_G}{y_G} \end{bmatrix} (Y_G - Y_K) + \begin{bmatrix} X_K \\ Y_K \\ Z_K \end{bmatrix} \quad (\text{A.6})$$

$$\begin{bmatrix} X_B \\ Y_B \\ Z_B \end{bmatrix} = \begin{bmatrix} \frac{x_B}{y_B} \\ 1 \\ \frac{1-x_B-y_B}{y_B} \end{bmatrix} (Y_B - Y_K) + \begin{bmatrix} X_K \\ Y_K \\ Z_K \end{bmatrix} \quad (\text{A.7})$$

At this step, all five CIE-XYZ tristimulus values of red, green, blue, white and black colour vertices which are needed in the IEC 61966-12-1 simple profile are defined. Each  $X, Y, Z$  value should be encoded in the s15Fixed16Number format.

## Annex B (informative)

### Example of simple metadata format and conversion to IEC 61966-12-1 simple profile

This annex provides an example of the simple metadata format. This example describes the theoretical gamut of IEC 61966-2-5 opRGB and the encoded data. Table B.1 shows the CIE-xy chromaticity coordinates for four colour vertices: white, red, green, blue of opRGB colour space.

**Table B.1 – Colour gamut for IEC 61966-2-5 opRGB**

|       | CIE-x   | CIE-y   |
|-------|---------|---------|
| White | 0,312 7 | 0,329 0 |
| Red   | 0,640 0 | 0,330 0 |
| Green | 0,210 0 | 0,710 0 |
| Blue  | 0,150 0 | 0,060 0 |

White absolute luminance values of white and black level are 160 cd/m<sup>2</sup> and 0,4 cd/m<sup>2</sup>.

The simple metadata format calculated from the chromaticity values CIE-xy coordinates for the above four colour vertices is shown in Table B.2. The  $x,y$  chromaticity values for red, green, blue and white colour vertices are encoded into fixed 10-bit values. The white absolute luminance is encoded into a 16-bit unsigned integer form and the black level ratio is encoded into a 16-bit fixed point form in the range of 0,0 to 1,0.

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**Table B.2 – Encoded simple metadata format**

| Byte#<br>hex | Size B | Colour characteristic   | Description |   |   |   |   |   |   |   |
|--------------|--------|---|-------------|---|---|---|---|---|---|---|
|              |        |   | 7           | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| 00           | 1      | Red/Green bits1 and bits0                                       | 1           | 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 01           | 1      | Blue/White bits1 and bits0                                      | 1           | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 02           | 1      | Red_x bit9 to bit2  | 1           | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 03           | 1      | Red_y bit9 to bit2  | 0           | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| 04           | 1      | Green_x bit9 to bit2  | 0           | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| 05           | 1      | Green_y bit9 to bit2  | 1           | 0 | 1 | 1 | 0 | 1 | 0 | 1 |
| 06           | 1      | Blue_x bit9 to bit2   | 0           | 0 | 1 | 0 | 0 | 1 | 1 | 0 |
| 07           | 1      | Blue_y bit9 to bit2   | 0           | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 08           | 1      | White_x bit9 to bit2  | 0           | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| 09           | 1      | White_y bit9 to bit2  | 0           | 1 | 0 | 1 | 0 | 1 | 0 | 0 |
| 0A           | 1      | White absolute luminance bit15 – bit8 (16-bit unsigned integer) | 0           | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0B           | 1      | White absolute luminance bit7 – bit0 (16-bit unsigned integer)  | 1           | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| 0C           | 4      | Black level ratio bit15 – bit8 (16-bit fixed point)             | 0           | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0D           | 4      | Black level ratio bit7 – bit0 (16-bit fixed point)              | 1           | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| 0C           | 1      | Black level ratio bit31 – bit24 (32-bit fixed point)            | 0           | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0D           | 1      | Black level ratio bit23 – bit16 (32-bit fixed point)            | 1           | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 0E           | 1      | Black level ratio bit15 – bit8 (32-bit fixed point)             | 1           | 1 | 0 | 1 | 0 | 1 | 1 | 1 |
| 0F           | 1      | Black level ratio bit7 – bit0 (32-bit fixed point)              | 0           | 0 | 0 | 0 | 1 | 0 | 1 | 0 |

The XYZ tristimulus values for five colour vertices: white, black, red, green, blue of the opRGB colour space can be decoded in accordance with Annex A (see Table B.3).

**Table B.3 – Conversion result to CIE-XYZ values for five colour vertices**

|       | CIE-X       | CIE-Y       | CIE-Z       |
|-------|-------------|-------------|-------------|
| White | 151,928 783 | 160,000 000 | 174,243 323 |
| Black | 0,380 193   | 0,400 391   | 0,436 034   |
| Red   | 92,156 976  | 47,760 013  | 4,779 668   |
| Green | 30,047 025  | 100,715 680 | 11,750 826  |
| Blue  | 30,485 168  | 12,325 089  | 158,584 898 |

The resultant converted Gamut ID metadata in the simple profile of IEC 61966-12-1 format is shown below. This format includes three headers described in Table B.4, Table B.5, and

Table B.6 and CIE XYZ tristimulus values of five colours in Table B.7. These XYZ values are basically the same values as in Table B.3, and encoded in the s15Fixed 16Number format.

**Table B.4 – Example for the header**

| Byte #<br>hex | Size<br>B | Symbols | Description   |            |              |              |   |   |   |   | Values |
|---------------|-----------|---------|---|------------|--------------|--------------|---|---|---|---|--------|
|               |           |         | 7   | 6          | 5            | 4            | 3 | 2 | 1 | 0 |        |
| 00            | 1         | N, P    | 0   | 1          | 0            | 0            | 0 | 0 | 1 | 1 |        |
|               |           |         | R   | ID_PROFILE | ID_PRECISION | ID_GBD_SPACE |   |   |   |   |        |
| 01            | 1         | ID_G    | Byte # of start of the description of gamut geometry      |            |              |              |   |   |   |   | 0h00   |
| 02            | 1         |         |   |            |              |              |   |   |   |   | 0h09   |
| 03            | 1         | ID_E    | Byte # of start of the description of colour reproduction |            |              |              |   |   |   |   | 0h00   |
| 04            | 1         |         |   |            |              |              |   |   |   |   | 0h00   |
| 05            | 1         |         | Reserved. Shall be zero.                                  |            |              |              |   |   |   |   | 0h00   |
| 06            | 1         |         | Reserved. Shall be zero.                                  |            |              |              |   |   |   |   | 0h00   |
| 07            | 1         |         | Reserved. Shall be zero.                                  |            |              |              |   |   |   |   | 0h00   |
| 08            | 1         |         | Reserved. Shall be zero.                                  |            |              |              |   |   |   |   | 0h00   |

**Table B.5 – Example for the header of description of gamut geometry**

| Byte #<br>hex | Size<br>B | Symbol | Description                 | Values |
|---------------|-----------|--------|-----------------------------|--------|
| 09            | 1         | ID_V   | Byte # of start of vertices | 0h00   |
| 0A            | 1         |        |                             | 0h0D   |
| 0B            | 1         |        | Reserved                    | 0h00   |
| 0C            | 1         |        | Reserved                    | 0h00   |

**Table B.6 – Example of definition of vertices**

| Byte #<br>hex | Size<br>B                 | Symbol | Description   | Values                                 |
|---------------|---------------------------|--------|---|--|
| 0D            | 1                         | V      | Total number of vertices                                | 0h00                                   |
| 0E            | 1                         |        |   | 0h05                                   |
| 0F            | 1                         | R      | Shall be zero   | 0h00                                   |
| 10            | 1                         |        |   | 0h00                                   |
| 11            | $\lceil 3V/8 \rceil = 60$ |        | 3V encoded colour space coordinates defining V vertices | See Table D.5 of IEC 61966-1:2014/2020 |

**Table B.7 – Example of encoded colour space coordinates for vertices**

| Byte # hex | Value hex | Description |
|------------|-----------|-------------|
| 11         | 00        | White X     |
| 12         | 97        |             |
| 13         | ED        |             |
| 14         | C4        |             |
| 15         | 00        | White Y     |
| 16         | A0        |             |
| 17         | 00        |             |
| 18         | 00        |             |
| 19         | 00        | White Z     |
| 1A         | AE        |             |
| 1B         | 3E        |             |
| 1C         | 4A        |             |
| 1D         | 00        | Black X     |
| 1E         | 00        |             |
| 1F         | 61        |             |
| 20         | 54        |             |
| 21         | 00        | Black Y     |
| 22         | 00        |             |
| 23         | 66        |             |
| 24         | 80        |             |
| 25         | 00        | Black Z     |
| 26         | 00        |             |
| 27         | 6F        |             |
| 28         | 9F        |             |
| 29         | 00        | Red X       |
| 2A         | 5C        |             |
| 2B         | 28        |             |
| 2C         | 2F        |             |
| 2D         | 00        | Red Y       |
| 2E         | 2F        |             |
| 2F         | C2        |             |
| 30         | 90        |             |
| 31         | 00        | Red Z       |
| 32         | 04        |             |
| 33         | C7        |             |
| 34         | 98        |             |
| 35         | 00        | Green X     |
| 36         | 1E        |             |
| 37         | 0C        |             |
| 38         | 09        |             |
| 39         | 00        | Green Y     |
| 3A         | 64        |             |
| 3B         | B7        |             |
| 3C         | 36        |             |
| 3D         | 00        | Green Z     |
| 3E         | 0B        |             |
| 3F         | C0        |             |
| 40         | 36        |             |

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| Byte # hex | Value hex | Description |
|------------|-----------|-------------|
| 41         | 00        | Blue X      |
| 42         | 1E        |             |
| 43         | 7C        |             |
| 44         | 33        |             |
| 45         | 00        | Blue Y      |
| 46         | 0C        |             |
| 47         | 53        |             |
| 48         | 39        |             |
| 49         | 00        | Blue Z      |
| 4A         | 9E        |             |
| 4B         | 95        |             |
| 4C         | BB        |             |

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**Annex C**  
(informative)

**Handling HDR content**

**C.1 General**

Recently, WCG (wide colour gamut) colour encoding standards, such as ITU-R BT.2020, and HDR (high dynamic range) colour encoding standards, such as ITU-R BT.2100, are widely used to provide WCG/HDR content, whose colour ranges exceed the provisions of traditional colour encoding standards, such as ITU-R BT.709.

However, since the wide colour gamut defined by ITU-R BT.2020 is based on single-wavelength primaries, it is technically difficult to manufacture reasonably priced displays that can fully express the ITU-R BT.2020 colour gamut. Therefore, in the current market, displays with DCI-P3 colour gamut (defined by SMPTE ST 2113) are widely used as WCG displays.

This annex shows an example of metadata when using content which has these wide gamut colour spaces.

**C.2 Relationship with other HDR related standards**

SMPTE ST.2086 defines Mastering Display Colour Volume (MDCV), which could be added to video content as metadata. This MDCV standard defines the colour gamut of the mastering display that was used to edit/verify the WCG video content. The metadata defined in SMPTE ST. 2086 consists of display primaries, chromaticity of white point, maximum display mastering luminance and minimum display mastering luminance.

This document would be suitable for describing MDCV, since its simple structure is necessary and sufficient to express MDCV. On the other hand, IEC 61966-12-1 would be more appropriate for describing complex video content colour volume (CCV), since its description flexibility is much higher than that of this document.

Table C.1 indicates P3D65x1000n0005 in ITU-R H Supl.19 (Clause 7.3) which is defined as the HDR mastering display colour volume description. Table C.2 indicates an example for the MDCV description in the format outlined by this document.

**Table C.1 – P3D65x1000n0005 in ITU-R H Supl.19**

|                 |       | Value    |          |
|-----------------|-------|----------|----------|
|                 |       | <i>x</i> | <i>y</i> |
| Colour          | White | 0,312 7  | 0,329 0  |
|                 | Red   | 0,680 0  | 0,320 0  |
|                 | Green | 0,265 0  | 0,690 0  |
|                 | Blue  | 0,150 0  | 0,060 0  |
| White luminance |       | 1 000    |          |
| Black luminance |       | 0,000 5  |          |

**Table C.2 – Metadata example when distributing content whose colour gamut is DCI-P3**

| Byte#<br>Hex | Colour<br>Characteristic                              | Description |       |       |       |       |       |       |       |
|--------------|---|-------------|-------|-------|-------|-------|-------|-------|-------|
|              |   | 7           | 6     | 5     | 4     | 3     | 2     | 1     | 0     |
| 00           | Red_x, Red_y,<br>Green_x, Green_y,<br>bits1 & bits0   | Rx1         | Rx0   | Ry1   | Ry0   | Gx1   | Gx0   | Gy1   | Gy0   |
|              |   | 0           | 0     | 1     | 1     | 1     | 1     | 1     | 0     |
| 01           | Blue_x, Blue_y,<br>White_x, White_y,<br>bits1 & bits0 | Bx1         | Bx0   | By1   | By0   | Wx1   | Wx0   | Wy1   | Wy0   |
|              |   | 0           | 1     | 0     | 1     | 0     | 0     | 0     | 0     |
| 02           | Red_x bit9 – bit2                                     | Rx9         | Rx8   | Rx7   | Rx6   | Rx5   | Rx4   | Rx3   | Rx2   |
|              |   | 1           | 0     | 1     | 0     | 1     | 1     | 1     | 0     |
| 03           | Red_y bit9 – bit2                                     | Ry9         | Ry8   | Ry7   | Ry6   | Ry5   | Ry4   | Ry3   | Ry2   |
|              |   | 0           | 1     | 0     | 1     | 0     | 0     | 0     | 1     |
| 04           | Green_x bit9 – bit2                                   | Gx9         | Gx8   | Gx7   | Gx6   | Gx5   | Gx4   | Gx3   | Gx2   |
|              |   | 0           | 1     | 0     | 0     | 0     | 0     | 1     | 1     |
| 05           | Green_y bit9 – bit2                                   | Gy9         | Gy8   | Gy7   | Gy6   | Gy5   | Gy4   | Gy3   | Gy2   |
|              |   | 1           | 0     | 1     | 1     | 0     | 0     | 0     | 0     |
| 06           | Blue_x bit9 – bit2                                    | Bx9         | Bx8   | Bx7   | Bx6   | Bx5   | Bx4   | Bx3   | Bx2   |
|              |   | 0           | 0     | 1     | 0     | 0     | 1     | 1     | 0     |
| 07           | Blue_y bit9 – bit2                                    | By9         | By8   | By7   | By6   | By5   | By4   | By3   | By2   |
|              |   | 0           | 0     | 0     | 0     | 1     | 1     | 1     | 1     |
| 08           | White_x bit9 – bit2                                   | Wx9         | Wx8   | Wx7   | Wx6   | Wx5   | Wx4   | Wx3   | Wx2   |
|              |   | 0           | 0     | 0     | 1     | 0     | 0     | 0     | 0     |
| 09           | White_y bit9 – bit2                                   | Wy9         | Wy8   | Wy7   | Wy6   | Wy5   | Wy4   | Wy3   | Wy2   |
|              |   | 0           | 1     | 0     | 1     | 0     | 1     | 0     | 1     |
| 0A           | White Absolute<br>Luminance<br>bit15 – bit8           | WAL15       | WAL14 | WAL13 | WAL12 | WAL11 | WAL10 | WAL9  | WAL8  |
|              |   | 0           | 0     | 0     | 0     | 0     | 0     | 1     | 1     |
| 0B           | White Absolute<br>Luminance<br>bit7 – bit0            | WAL7        | WAL6  | WAL5  | WAL4  | WAL3  | WAL2  | WAL1  | WAL0  |
|              |   | 1           | 1     | 1     | 0     | 1     | 0     | 0     | 0     |
| 0C           | Black Level Ratio<br>Bit31 – bit24                    | BLR31       | BLR30 | BLR29 | BLR28 | BLR27 | BLR26 | BLR25 | BLR24 |
|              |   | 0           | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| 0D           | Black Level Ratio<br>Bit23 – bit16                    | BLR23       | BLR22 | BLR21 | BLR20 | BLR19 | BLR18 | BLR17 | BLR16 |
|              |   | 0           | 0     | 0     | 0     | 0     | 0     | 0     | 0     |
| 0C           | Black Level Ratio<br>bit15 – bit8                     | BLR15       | BLR14 | BLR13 | BLR12 | BLR11 | BLR10 | BLR9  | BLR8  |
|              |   | 0           | 0     | 0     | 0     | 1     | 0     | 0     | 0     |
| 0D           | Black Level Ratio<br>bit7 – bit0                      | BLR7        | BLR6  | BLR5  | BLR4  | BLR3  | BLR2  | BLR1  | BLR0  |
|              |   | 0           | 1     | 1     | 0     | 0     | 0     | 1     | 1     |

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VESA ENHANCED EXTENDED DISPLAY IDENTIFICATION DATA STANDARD (Defines EDID Structure Version 1, Revision 4)

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# INTERNATIONAL STANDARD

**Multimedia systems and equipment – Colour measurement and management –  
Part 12-2: Simple metadata format for identification of colour gamut**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MULTIMEDIA SYSTEMS AND EQUIPMENT –  
COLOUR MEASUREMENT AND MANAGEMENT –****Part 12-2: Simple metadata format for identification of colour gamut**

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This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the number of bits of metadata format has been extended in Clause 4;
- b) Annex C has been added for handling HDR content.

The text of this International Standard is based on the following documents:

| Draft        | Report on voting |
|--------------|------------------|
| 100/3847/CDV | 100/4109/RVC     |

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at [www.iec.ch/members\\_experts/refdocs](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

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## INTRODUCTION

New technologies in capturing and displaying wide-gamut colour images enable a new market of wide-gamut video colour content creation. Recent video standards for wide gamut colour space encoding such as ITU-R BT.2100 (HDR), ITU-R BT.2020 (UHDTV) and IEC 61966-2-4 (xvYCC) were developed in order to be able to distribute content with a colour gamut that is extended with respect to classical colour gamuts such as those defined by standards ITU-R BT.601 (standard-definition television) and ITU-R BT.709 (high-definition television). With the increasing popularity of wide gamut and high dynamic range content and displays, the variety of colour gamuts of displays is expected to increase. This issue can be an obstacle to adoption of wide-gamut video colour content in professional content creation since the compatibility of the content to the employed displays, as well as the compatibility among different displays, is not ensured. The term "display" includes here any video colour reproduction equipment, such as direct view displays and projectors. Thanks to improvements in technology, the variety of colour gamuts and colour reproduction capacities of displays are increasing while the colour gamut and the colour encoding rules of existing colour space encoding standards are fixed.

To address this issue, IEC 61966-12-1 (*Metadata for identification of colour gamut (Gamut ID)*) specifies a colour gamut metadata scheme for video systems including information for colour reproduction. This metadata can apply to video content or displays. More specifically, improvements can be achieved if the wide-gamut colour content is created with the knowledge of the display colour gamut and if the colour reproduction in the display is done with the knowledge of the colour gamut of the pictorial content.

IEC 61966-12-1 has the capability to describe arbitrary 3D colour gamuts in a given colour space and include the full/medium profile for professional use and the simple profile for consumer use with easier product implementation. This approach is effective, but some ambiguities can occur in practical use, for example if typical CE devices are able to decode the simple profile only owing to CPU and software limitations.

In this case, even if a sender device and a receiver device are based on IEC 61966-12-1:

- a) the receiver device cannot handle the Gamut ID of incoming content, if the sender device sends only a full or a medium profile;
- b) the sender device should convert a full profile to a simple one for CE devices if the receiver can receive the simple profile only, but the conversion is not possible for all the cases.

Therefore, a simple Gamut ID profile standard based on this document has been developed to address this problem.

This second edition extends the number of bits of "back level ratio" in the metadata format to accommodate the wider dynamic range content and displays.

# MULTIMEDIA SYSTEMS AND EQUIPMENT – COLOUR MEASUREMENT AND MANAGEMENT –

## Part 12-2: Simple metadata format for identification of colour gamut

### 1 Scope

This part of IEC 61966-12 specifies the colour gamut metadata format for video systems intended for use in CE (consumer electronics) devices. The metadata specified in this part of IEC 61966-12 is limited to the gamut description for display types comprising the three primary additive colours, whose white and black points have the same chromaticity. It is fundamentally based on the conventional VESA-EDID format.

When associated with content, the simple metadata format defines the gamut for which the content was created. It can be used by the display for controlled colour reproduction even if the display's colour gamut is different from that of the content.

When associated with a display, the simple metadata format defines the display colour gamut. It can be used during content creation to enable improved colour reproduction.

This document provides the simplest, but unambiguous solution for typical CE devices that are based on colour gamut information communication.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-845, *International Electrotechnical Vocabulary – Part 845: Lighting*

IEC 61966-12-1, *Multimedia systems and equipment – Colour measurement and management – Part 12-1: Metadata for identification of colour gamut (Gamut ID)*

ISO 15076-1, *Image technology colour management – Architecture, profile format and data structure – Part 1: Based on ICC.2010*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-845 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

#### 3.1 content

set of video signals in production, post-production or consumption

### 3.2 colour gamut

range of colours achievable on a given colour reproduction medium (or present in an image of that medium) under a given set of viewing conditions

Note 1 to entry: It is a volume in colour space.

### 3.3 gamut mapping

mapping of the colour-space coordinates of the elements of a source image to colour-space coordinates of the elements of a reproduction to compensate for differences in the source and output medium colour gamut capability

## 4 Simple description of gamut

The three primary additive colours gamut can be specified by four combinations of CIE-xy chromaticity values of red, green, blue and white. The gamut is assumed to have the characteristic that combining equal amounts of the three primaries (red, green, blue) produces the chromaticity of white. These values can be encoded according to the gamut CIE-xy chromaticity values used in Vesa Enhanced Extended Display Identification Data Standard (Defines EDID Structure Version 1, Revision 4). The description includes eight values (CIE-xy chromaticity values for each red, green, blue and white) with 10-bit fixed point form in the range of 0,0 to 1,0. These display primary and the white point CIE-xy chromaticity values should be measured in such a way as to minimize the contribution from the display black. In addition to VESA-EDID format, the information of White Absolute Luminance (WAL) and Black Level Ratio (BLR) are included. WAL value is defined in  $\text{cd}/\text{m}^2$  and denoted as  $Y_W$ , and encoded into 16-bit unsigned integer form. BLR is defined as Equation (1), and encoded into 32-bit fixed point form in the range of 0,0 to 1,0.

$$\text{BLR} = (Y_K / Y_W) \quad (1)$$

where

$Y_K$  is the luminance of black shown in Figure 1;

$Y_W$  is the luminance of white shown in Figure 1.

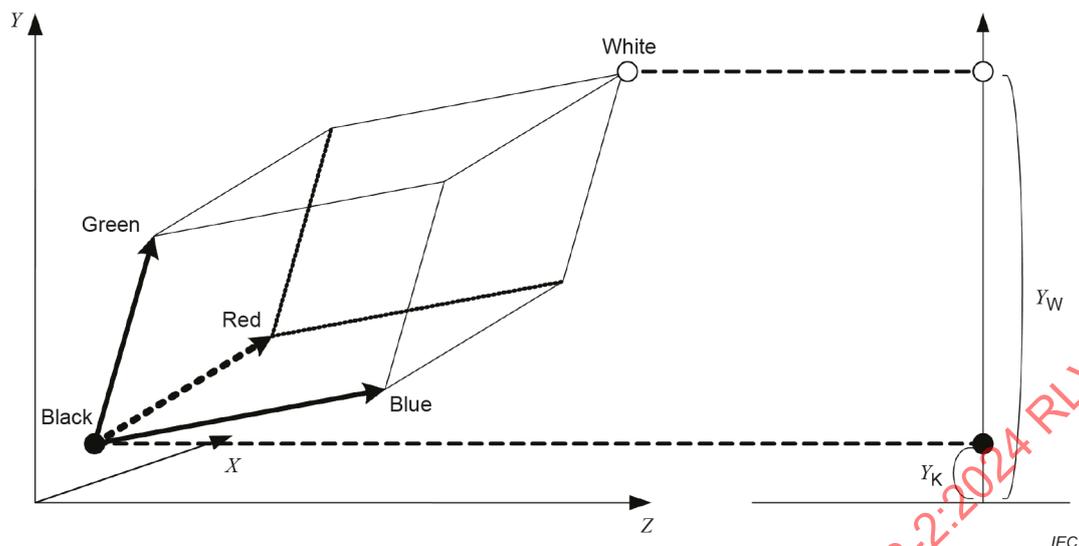
Table 1 shows the total metadata which includes the VESA-EDID compatible CIE-xy chromaticity values of red, green, blue and white and BLR and WAL value. The total size of this format is 16 B.

Refer to Annex C for information about handling HDR content.

**Table 1 – Simple metadata format for identification of colour gamut**

| Byte#<br>hex | Size<br>B | Colour<br>characteristic  | Description |       |       |       |       |       |       |       |
|--------------|-----------|---|-------------|-------|-------|-------|-------|-------|-------|-------|
|              |           |   | 7           | 6     | 5     | 4     | 3     | 2     | 1     | 0     |
| 00           | 1         | Red_x, Red_y,<br>Green_x,<br>Green_y<br>Bits1 & bits0                       | Rx1         | Rx0   | Ry1   | Ry0   | Gx1   | Gx0   | Gy1   | Gy0   |
| 01           | 1         | Blue_x, Blue_y,<br>White_x,<br>White_y bits1 &<br>bits0                     | Bx1         | Bx0   | By1   | By0   | Wx1   | Wx0   | Wy1   | Wy0   |
| 02           | 1         | Red_x bit9 –<br>bit2  | Rx9         | Rx8   | Rx7   | Rx6   | Rx5   | Rx4   | Rx3   | Rx2   |
| 03           | 1         | Red_y bit9 –<br>bit2  | Ry9         | Ry8   | Ry7   | Ry6   | Ry5   | Ry4   | Ry3   | Ry2   |
| 04           | 1         | Green_x bit9 –<br>bit2  | Gx9         | Gx8   | Gx7   | Gx6   | Gx5   | Gx4   | Gx3   | Gx2   |
| 05           | 1         | Green_y bit9 –<br>bit2  | Gy9         | Gy8   | Gy7   | Gy6   | Gy5   | Gy4   | Gy3   | Gy2   |
| 06           | 1         | Blue_x bit9 –<br>bit2   | Bx9         | Bx8   | Bx7   | Bx6   | Bx5   | Bx4   | Bx3   | Bx2   |
| 07           | 1         | Blue_y bit9 –<br>bit2   | By9         | By8   | By7   | By6   | By5   | By4   | By3   | By2   |
| 08           | 1         | White_x bit9 –<br>bit2  | Wx9         | Wx8   | Wx7   | Wx6   | Wx5   | Wx4   | Wx3   | Wx2   |
| 09           | 1         | White_y bit9 –<br>bit2  | Wy9         | Wy8   | Wy7   | Wy6   | Wy5   | Wy4   | Wy3   | Wy2   |
| 0A           | 1         | White absolute<br>luminance<br>Bit15 – bit8<br>(16 bit unsigned<br>Integer) | WAL15       | WAL14 | WAL13 | WAL12 | WAL11 | WAL10 | WAL9  | WAL8  |
| 0B           | 1         | White absolute<br>luminance<br>Bit7 – bit0<br>(16 bit unsigned<br>Integer)  | WAL7        | WAL6  | WAL5  | WAL4  | WAL3  | WAL2  | WAL1  | WAL0  |
| 0C           | 1         | Black level ratio<br>Bit31 – bit24<br>(32-bit fixed<br>point)               | BLR31       | BLR30 | BLR29 | BLR28 | BLR27 | BLR26 | BLR25 | BLR24 |
| 0D           | 1         | Black level ratio<br>Bit23 – bit16<br>(32-bit fixed<br>point)               | BLR23       | BLR22 | BLR21 | BLR20 | BLR19 | BLR18 | BLR17 | BLR16 |
| 0E           | 1         | Black level ratio<br>Bit15 – bit8<br>(32-bit fixed<br>point)                | BLR15       | BLR14 | BLR13 | BLR12 | BLR11 | BLR10 | BLR9  | BLR8  |
| 0F           | 1         | Black level ratio<br>Bit7 – bit0 (32-<br>bit fixed point)                   | BLR7        | BLR6  | BLR5  | BLR4  | BLR3  | BLR2  | BLR1  | BLR0  |

NOTE The metadata format in this document has backward compatibility with IEC 61966-12-2:2014 because addresses "0C" and "0D" indicate same bits.



**Figure 1 – The colour gamut for display types comprising three primary additive colours**

## 5 Relationship with IEC 61966-12-1

A content gamut is usually smaller than a colour encoding gamut of today's extended-gamut colour space, such as IEC 61966-2-4 xvYCC. If there is no description of an actual colour gamut for some content, it is possible that gamut mapping will use the colour encoding gamut as the content gamut, which can cause some problems. IEC 61966-12-1 solves this problem by associating an explicit description of an actual content gamut to content. IEC 61966-12-1 has a full, medium and simple profile.

The full profile and the medium profile have high flexibility for describing 3D-shapes of complicated content gamuts in a colour space as shown in Figure 2. Consequently, IEC 61966-12-1 full and medium profiles are well suited for some professional applications, such as content production. In addition, IEC 61966-12-1 provides simple profile formats that are limited to three primary type colour gamuts, as shown in Figure 3.

However, the IEC 61966-12-1 simple profile is 77 B and still large for CE devices. This document is therefore limited to the CIE-xy chromaticity values of the three primary additive colour gamuts and has a reduced size of 16 B.

Refer to Annex A for more details about the conversion from IEC 61966-12-2 to the IEC 61966-12-1 simple profile. Refer to Annex B for an example of simple metadata format and conversion to the IEC 61966-12-1 simple profile.

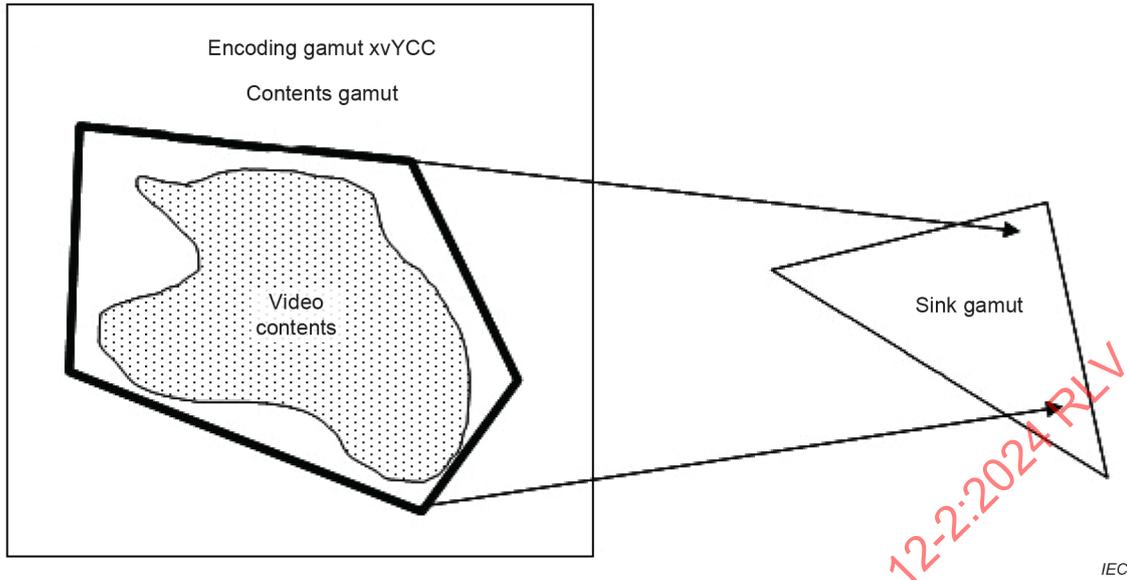


Figure 2 – IEC 61966-12-1 full and medium profiles

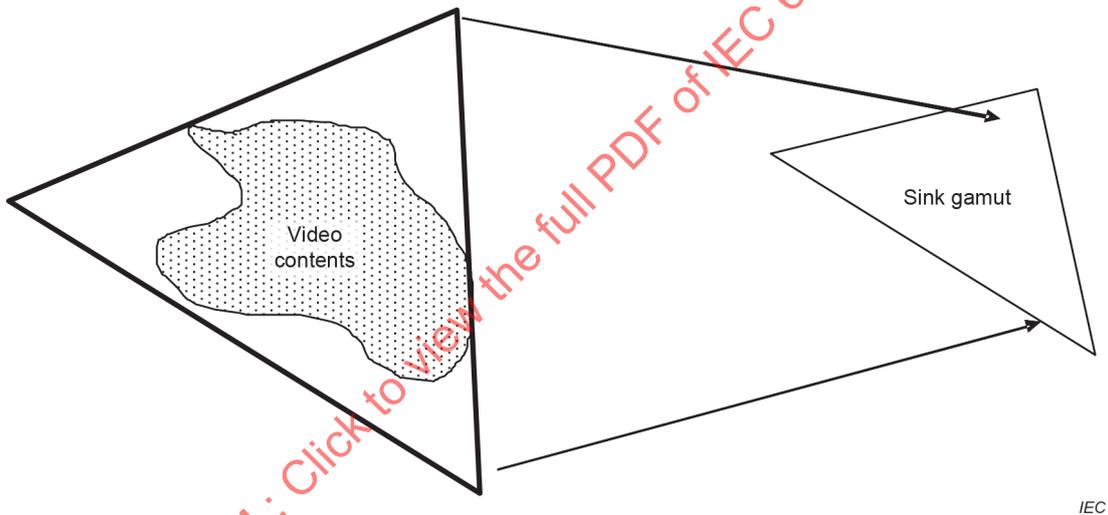


Figure 3 – IEC 61966-12-1 simple profile and IEC 61966-12-2

Table 2 – Differences of IEC 61966-12-1 simple profile and IEC 61966-12-2

|                     | IEC 61966-12-1 simple profile  | IEC 61966-12-2   |
|---------------------|--|--|
| Size                | 77 B (Header: 17 B<br>+ Gamut description: 60 B)   | 16 B<br>(Gamut description only)   |
| Coordinate's format | <ul style="list-style-type: none"> <li>- CIE-XYZ tristimulus values of 5 colours (red, green, blue, white, black)</li> <li>- s15Fixed16Number (see ICC profiles in ISO 15076-1)</li> </ul> | <ul style="list-style-type: none"> <li>- CIE-xy chromaticity values of four colours (red, green, blue, white)</li> <li>- VESA-EDID compatible</li> <li>- 16-bit unsigned integer form</li> <li>- 32-bit fixed point form in the range of 0,0 to 1,0</li> </ul> |

## Annex A (informative)

### Conversion from IEC 61966-12-2 to IEC 61966-12-1 simple profile

IEC 61966-12-2 can be converted to the IEC 61966-12-1 simple profile. This annex shows an example of the conversion method. The conversion equations calculate five CIE-XYZ tristimulus values of red, green, blue, white and black colour vertices from four CIE-xy chromaticity values of the red, green, blue and white colour vertices, WAL and BLR values. The inverse conversion cannot be uniquely defined when the additivity rule of the three primary colours mixture is not guaranteed.

$x_i$  and  $y_i$  are  $x,y$  coordinates of colours described in IEC 61966-12-2.  $X_i$ ,  $Y_i$  and  $Z_i$  are  $X,Y,Z$  coordinates of IEC 61966-12-1 simple profile. In both coordinate systems,  $i = R,G,B,W$ , or  $K$ , which denotes red, green, blue, white or black colour vertices.

The conversion process has the following four steps:

- a) In the first step,  $X,Y,Z$  values for white colour are calculated. Here, absolute  $Y_W$  value information from IEC 61966-12-2 should be used. We can calculate  $X,Y,Z$  values using  $Y_W$  value and  $x,y$  chromaticity coordinates for white colour as Equation (A.1).

$$\begin{bmatrix} X_W \\ Y_W \\ Z_W \end{bmatrix} = Y_W \begin{bmatrix} \frac{x_W}{y_W} \\ 1 \\ \frac{1-x_W-y_W}{y_W} \end{bmatrix} \quad (\text{A.1})$$

- b) In the second step,  $X,Y,Z$  values for black colour are calculated. First,  $Y_K$  can be obtained from  $Y_W$  and BLR values in Equation (A.2).

$$Y_K = BLR \times Y_W \quad (\text{A.2})$$

Then,  $X,Y,Z$  values for black can be  $Y_K$  and  $x,y$  chromaticity coordinates can be calculated as Equation (A.3) for we assume black has the same chromaticity as white.

$$\begin{bmatrix} X_K \\ Y_K \\ Z_K \end{bmatrix} = Y_K \begin{bmatrix} \frac{x_W}{y_W} \\ 1 \\ \frac{1-x_W-y_W}{y_W} \end{bmatrix} \quad (\text{A.3})$$

- c) Then in the third step, assuming three primary additive colours,  $Y$  values for red, green and blue colours without the offset value by black are estimated using the calculated value of white and black colours as Equation (A.4). Here,  $-1$  denotes the inverse of the  $3 \times 3$  matrix.

$$\begin{bmatrix} Y_R - Y_K \\ Y_G - Y_K \\ Y_B - Y_K \end{bmatrix} = \begin{bmatrix} \frac{x_R}{y_R} & \frac{x_G}{y_G} & \frac{x_B}{y_B} \\ 1 & 1 & 1 \\ \frac{1-x_R-y_R}{y_R} & \frac{1-x_G-y_G}{y_G} & \frac{1-x_B-y_B}{y_B} \end{bmatrix}^{-1} \begin{bmatrix} X_W - X_K \\ Y_W - Y_K \\ Z_W - Z_K \end{bmatrix} \quad (\text{A.4})$$

- d) In the last step,  $X, Y, Z$  values of red, green and blue colours are calculated using the estimated luminance of each colour in step two, and then black offset values are added as shown in Equations (A.5), (A.6) and (A.7).

$$\begin{bmatrix} X_R \\ Y_R \\ Z_R \end{bmatrix} = \begin{bmatrix} \frac{x_R}{y_R} \\ 1 \\ \frac{1-x_R-y_R}{y_R} \end{bmatrix} (Y_R - Y_K) + \begin{bmatrix} X_K \\ Y_K \\ Z_K \end{bmatrix} \quad (\text{A.5})$$

$$\begin{bmatrix} X_G \\ Y_G \\ Z_G \end{bmatrix} = \begin{bmatrix} \frac{x_G}{y_G} \\ 1 \\ \frac{1-x_G-y_G}{y_G} \end{bmatrix} (Y_G - Y_K) + \begin{bmatrix} X_K \\ Y_K \\ Z_K \end{bmatrix} \quad (\text{A.6})$$

$$\begin{bmatrix} X_B \\ Y_B \\ Z_B \end{bmatrix} = \begin{bmatrix} \frac{x_B}{y_B} \\ 1 \\ \frac{1-x_B-y_B}{y_B} \end{bmatrix} (Y_B - Y_K) + \begin{bmatrix} X_K \\ Y_K \\ Z_K \end{bmatrix} \quad (\text{A.7})$$

At this step, all five CIE-XYZ tristimulus values of red, green, blue, white and black colour vertices which are needed in the IEC 61966-12-1 simple profile are defined. Each  $X, Y, Z$  value should be encoded in the s15Fixed16Number format.

## Annex B (informative)

### Example of simple metadata format and conversion to IEC 61966-12-1 simple profile

This annex provides an example of the simple metadata format. This example describes the theoretical gamut of IEC 61966-2-5 opRGB and the encoded data. Table B.1 shows the CIE-xy chromaticity coordinates for four colour vertices: white, red, green, blue of opRGB colour space.

**Table B.1 – Colour gamut for IEC 61966-2-5 opRGB**

|       | CIE-x   | CIE-y   |
|-------|---------|---------|
| White | 0,312 7 | 0,329 0 |
| Red   | 0,640 0 | 0,330 0 |
| Green | 0,210 0 | 0,710 0 |
| Blue  | 0,150 0 | 0,060 0 |

White absolute luminance values of white and black level are 160 cd/m<sup>2</sup> and 0,4 cd/m<sup>2</sup>.

The simple metadata format calculated from the chromaticity values CIE-xy coordinates for the above four colour vertices is shown in Table B.2. The  $x,y$  chromaticity values for red, green, blue and white colour vertices are encoded into fixed 10-bit values. The white absolute luminance is encoded into a 16-bit unsigned integer form and the black level ratio is encoded into a 32-bit fixed point form in the range of 0,0 to 1,0.

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