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| *Title:* | **Coding-independent code points for video signal type identification (Draft 1 for 3rd edition)** | | |
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# Abstract

This document contains the draft text toward a 3rd edition of *Coding-independent code points for video signal type identification* (Rec. ITU-T H.273 | ISO/IEC 23091-2). Text modifications are provided for specification of code point identifiers for YCoCg-R colour representation with equal luma and chroma bit depths. The new code points are referred to as YCgCo-Re and YCgCo-Ro, where the number of bits added to a source RGB bit depth is 2 (i.e., even) and 1 (odd), respectively. Revision marking is provided to show modifications relative to the basis text (based on the 2021-07 edition of Rec. ITU-T H.273). Equation numbers and their cross-references that are maintained automatically have been updated without revision marking.

# Changes to the specification text in subclause 8.3

*Starting with the sentence that begins with* “The interpretation of matrix\_coefficients is specified as follows”*, replace the remainder of the subclause with the following:*

When MatrixCoefficients is equal to 0, 8, 15 or 16, the variables BitDepthRGB and MaxValRGB are derived using the following ordered steps:

a) The variable BitDepthRGB is derived as follows:

– If MatrixCoefficients is equal to 0 or 8, the following applies:

BitDepthRGB = BitDepthY (20)

– Otherwise, if MatrixCoefficients is equal to 15, the following applies:

BitDepthRGB = BitDepthY + 2 (21)

– Otherwise (MatrixCoefficients is equal to 16), the following applies:

BitDepthRGB = BitDepthY + 1 (22)

b) The variable MaxValRGB is derived as follows:

MaxValRGB = ( 1 << BitDepthRGB ) − 1 (23)

The interpretation of MatrixCoefficients is specified as follows:

– If VideoFullRangeFlag is equal to 0, the following applies:

– If MatrixCoefficients is equal to 0, 8, 15 or 16, equations 24 to 26 apply:

R = Clip3( 0, MaxValRGB, ( 1 << ( BitDepthRGB − 8 ) ) \* ( 219 \* E′R + 16 ) ) (24)

G = Clip3( 0, MaxValRGB, ( 1 << ( BitDepthRGB − 8 ) ) \* ( 219 \* E′G + 16 ) ) (25)

B = Clip3( 0, MaxValRGB, ( 1 << ( BitDepthRGB − 8 ) ) \* ( 219 \* E′B + 16 ) ) (26)

– Otherwise, if MatrixCoefficients is equal to 1, 4, 5, 6, 7, 9, 10, 11, 12, 13 or 14, equations 27 to 29 apply:

Y = Clip1Y( Round( ( 1 << ( BitDepthY − 8 ) ) \* ( 219 \* E′Y + 16 ) ) ) (27)

Cb = Clip1C( Round( ( 1 << ( BitDepthC − 8 ) ) \* ( 224 \* E′PB + 128 ) ) ) (28)

Cr = Clip1C( Round( ( 1 << ( BitDepthC − 8 ) ) \* ( 224 \* E′PR + 128 ) ) ) (29)

– Otherwise, if MatrixCoefficients is equal to 2, the interpretation of the MatrixCoefficients code point is unknown or is determined by the application.

– Otherwise (MatrixCoefficients is not equal to 0, 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 or 16), the interpretation of the MatrixCoefficients code point is reserved for future definition by ITU-T | ISO/IEC.

– Otherwise (VideoFullRangeFlag is equal to 1), the following equations apply:

– If MatrixCoefficients is equal to 0, 8, 15 or 16, equations 30 to 32 apply:

R = Clip3( 0, MaxValRGB, MaxValRGB \* E′R ) (30)

G = Clip3( 0, MaxValRGB, MaxValRGB \* E′G ) (31)

B = Clip3( 0, MaxValRGB, MaxValRGB \* E′B ) (32)

– Otherwise, if MatrixCoefficients is equal to 1, 4, 5, 6, 7, 9, 10, 11, 12, 13 or 14, equations 33 to 35 apply:

Y = Clip1Y( Round( ( ( 1 << BitDepthY ) − 1 ) \* E′Y ) ) (33)

Cb = Clip1C( Round( ( ( 1 << BitDepthC ) − 1 ) \* E′PB ) + ( 1 << ( BitDepthC − 1 ) ) ) (34)

Cr = Clip1C( Round( ( ( 1 << BitDepthC ) − 1 ) \* E′PR ) + ( 1 << ( BitDepthC − 1 ) ) ) (35)

– Otherwise, if MatrixCoefficients is equal to 2, the interpretation of the MatrixCoefficients code point is unknown or is determined by the application.

– Otherwise (MatrixCoefficients is not equal to 0, 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 or 16), the interpretation of the MatrixCoefficients code point is reserved for future definition by ITU-T | ISO/IEC.

When MatrixCoefficients is equal to 1, 4, 5, 6, 7, 9, 10, 11, 12 or 13, the constants KB and KR are specified as follows:

– If MatrixCoefficients is not equal to 12 or 13, the constants KB and KR are specified in Table 4.

– Otherwise (MatrixCoefficients is equal to 12 or 13), the constants KR and KB are computed as follows, using the chromaticity coordinates (xR, yR), (xG, yG), (xB, yB) and (xW, yW) specified in Table 2 for the ColourPrimaries code point for the red, green, blue and white colour primaries, respectively:

KR =  (36)

KB =  (37)

where the values of zR, zG, zB and zW, are given by:

zR = 1 − ( xR + yR ) (38)

zG = 1 − ( xG + yG ) (39)

zB = 1 − ( xB + yB ) (40)

zW = 1 − ( xW + yW ) (41)

The variables E′Y, E′PB and E′PR (for MatrixCoefficients not equal to 0, 8, 15 or 16) or Y, Cb and Cr (for MatrixCoefficients equal to 0, 8, 15 or 16) are specified as follows.

– If MatrixCoefficients is not equal to 0, 8, 10, 11, 13, 14, 15 or 16, equations 42 to 44 apply:

E′Y = KR \* E′R + ( 1 − KR − KB ) \* E′G + KB \* E′B (42)

E′PB = 0.5 \* ( E′B − E′Y ) ÷ ( 1 − KB ) (43)

E′PR = 0.5 \* ( E′R − E′Y ) ÷ ( 1 − KR ) (44)

NOTE 1 – E′Y is a real number with the value 0 associated with nominal black and the value 1 associated with nominal white. E′PB and E′PR are real numbers with the value 0 associated with both nominal black and nominal white. When TransferCharacteristics is not equal to 11 or 12, E′Y is a real number with values in the range of 0 to 1. When TransferCharacteristics is not equal to 11 or 12, E′PB and E′PR are real numbers with values in the range of −0.5 to 0.5. When TransferCharacteristics is equal to 11 (IEC 61966-2-4) or 12 (Rec. ITU‑R BT.1361-0 extended colour gamut system), E′Y, E′PB and E′PR are real numbers with a larger range not specified in this Specification.

– Otherwise, if MatrixCoefficients is equal to 0, equations 45 to 47 apply:

Y = Round( G ) (45)

Cb = Round( B ) (46)

Cr = Round( R ) (47)

– Otherwise, if MatrixCoefficients is equal to 8 and BitDepthC is equal to BitDepthY, equations 48 to 50 apply:

Y = Round( 0.5 \* G + 0.25 \* ( R + B ) ) (48)

Cb = Round( 0.5 \* G − 0.25 \* ( R + B ) ) + ( 1 << ( BitDepthC − 1 ) ) (49)

Cr = Round( 0.5 \* (R − B ) ) + ( 1 << ( BitDepthC − 1 ) ) (50)

NOTE 2 – For purposes of the YCgCo nomenclature used in Table 4, Cb and Cr of equations 49 and 50 may be referred to as Cg and Co, respectively. The inverse conversion for equations 48 to 50 should be computed as:

t = Y − ( Cb − ( 1 << ( BitDepthC − 1 ) ) ) (51)

G = Clip1Y( Y + ( Cb − ( 1 << ( BitDepthC − 1 ) ) ) ) (52)

B = Clip1Y( t − ( Cr − ( 1 << ( BitDepthC − 1 ) ) ) ) (53)

R = Clip1Y( t + ( Cr − ( 1 << ( BitDepthC − 1 ) ) ) ) (54)

– Otherwise, if MatrixCoefficients is equal to 8, 15 or 16, equations 55 to 58 apply:

Cr = Round( R ) − Round( B ) + ( 1 << ( BitDepthC − 1 ) ) (55)

t = Round( B ) + ( ( Cr − ( 1 << ( BitDepthC − 1 ) ) ) >> 1 ) (56)

Cb = Round( G ) − t + ( 1 << ( BitDepthC − 1 ) ) (57)

Y = t + ( ( Cb − ( 1 << ( BitDepthC − 1 ) ) ) >> 1 ) (58)

NOTE 3 – For purposes of the YCgCo nomenclature used in Table 4, Cb and Cr of equations 57 and 55 may be referred to as Cg and Co, respectively. The inverse conversion for equations 55 to 58 should be computed as:

t = Y − ( ( Cb − ( 1 << ( BitDepthC − 1 ) ) ) >> 1 ) (59)

G = Clip3( 0, MaxValRGB, t + ( Cb − ( 1 << ( BitDepthC − 1 ) ) ) ) (60)

B = Clip3( 0, MaxValRGB, t − ( ( Cr − ( 1 << ( BitDepthC − 1 ) ) ) >> 1 ) ) (61)

R = Clip3( 0, MaxValRGB, B + ( Cr − ( 1 << ( BitDepthC − 1 ) ) ) ) (62)

– Otherwise, if MatrixCoefficients is equal to 10 or 13, the signal E′Y is determined by application of the transfer characteristics function as follows and equations 65 to 72 apply for specification of the signals E′PB and E′PR:

EY = KR \* ER + ( 1 − KR − KB ) \* EG + KB \* EB (63)

E′Y = ( EY )′ (64)

NOTE 4 – In this case, EY is defined from the "linear-domain" signals for ER, EG and EB, prior to application of the transfer characteristics function, which is then applied to produce the signal E′Y. EY and E′Y are real values with the value 0 associated with nominal black and the value 1 associated with nominal white.

E′PB = ( E′B − E′Y ) ÷ ( 2 \* NB ) for −NB <= E′B − E′Y <= 0 (65)

E′PB = ( E′B − E′Y ) ÷ ( 2 \* PB ) for 0 < E′B − E′Y <= PB (66)

E′PR = ( E′R − E′Y ) ÷ ( 2 \* NR ) for −NR <= E′R − E′Y <= 0 (67)

E′PR = ( E′R − E′Y ) ÷ ( 2 \* PR ) for 0 < E′R − E′Y <= PR (68)

where the constants NB, PB, NR and PR are determined by application of the transfer characteristics function to expressions involving the constants KB and KR as follows:

NB = ( 1 − KB )′ (69)

PB = 1 − ( KB )′ (70)

NR = ( 1 − KR )′ (71)

PR = 1 − ( KR )′ (72)

– Otherwise, if MatrixCoefficients is equal to 11, equations 73 to 75 apply:

E′Y = E′G (73)

E′PB = ( 0.986566 \* E′B − E′Y ) ÷ 2.0 (74)

E′PR = ( E′R − 0.991902 \* E′Y ) ÷ 2.0 (75)

NOTE 5 – In this case, for purposes of the Y′D′ZD′X nomenclature used in Table 4, E′PB may be referred to as D′Z and E′PR may be referred to as D′X.

– Otherwise (MatrixCoefficients is equal to 14), the following applies:

– If TransferCharacteristics is not equal to 18, equations 76 to 78 apply:

E′Y = 0.5 \* ( E′L + E′M ) (76)

E′PB = ( 6610 \* E′L − 13613 \* E′M + 7003 \* E′S ) ÷ 4096 (77)

E′PR = ( 17933 \* E′L − 17390 \* E′M − 543 \* E′S ) ÷ 4096 (78)

– If TransferCharacteristics is not equal to 18, equations 79 to 81 apply:

E′Y = 0.5 \* ( E′L + E′M ) (79)

E′PB = ( 3625 \* E′L − 7465 \* E′M + 3840 \* E′S ) ÷ 4096 (80)

E′PR = ( 9500 \* E′L − 9212 \* E′M − 288 \* E′S ) ÷ 4096 (81)

In these cases, for purposes of the ICTCP nomenclature used in Table 4, E′Y, E′PB and E′PR of equations 76, 77 and 78 or equations 79, 80 and 81 may be referred to as I, CT and CP, respectively. Equations 76, 77 and 78 were designed specifically for use with TransferCharacteristics equal to 16 (PQ), and equations 79, 80 and 81 were designed specifically for use with TransferCharacteristics equal to 18 (HLG).

| **Table 4 – Interpretation of matrix coefficients (MatrixCoefficients) value** | | |
| --- | --- | --- |
| **Value** | **Matrix coefficients** | **Informative remarks** |
| 0 | Identity | The identity matrix.  Typically used for GBR (often referred to as RGB); however, may also be used for YZX (often referred to as XYZ);  IEC 61966-2-1 sRGB  SMPTE ST 428-1 (2019)  See equations 45 to 47 |
| 1 | KR = 0.2126; KB = 0.0722 | Rec. ITU-R BT.709-6  Rec. ITU-R BT.1361-0 conventional colour gamut system and extended colour gamut system (historical)  IEC 61966-2-4 xvYCC709  SMPTE RP 177 (1993) Annex B  See equations 42 to 44 |
| 2 | Unspecified | Image characteristics are unknown or are determined by the application |
| 3 | Reserved | For future use by ITU-T | ISO/IEC |
| 4 | KR = 0.30; KB = 0.11 | United States Federal Communications Commission (2003) *Title 47 Code of Federal Regulations* 73.682 (a) (20)  See equations 42 to 44 |
| 5 | KR = 0.299; KB = 0.114 | Rec. ITU-R BT.470-6 System B, G (historical)  Rec. ITU-R BT.601-7 625  Rec. ITU-R BT.1358-0 625 (historical)  Rec. ITU-R BT.1700-0 625 PAL and 625 SECAM  IEC 61966-2-1 sYCC  IEC 61966-2-4 xvYCC601  (functionally the same as the value 6)  See equations 42 to 44 |
| 6 | KR = 0.299; KB = 0.114 | Rec. ITU-R BT.601-7 525  Rec. ITU-R BT.1358-1 525 or 625 (historical)  Rec. ITU-R BT.1700-0 NTSC  SMPTE ST 170 (2004)  (functionally the same as the value 5)  See equations 42 to 44 |
| 7 | KR = 0.212; KB = 0.087 | SMPTE ST 240 (1999)  See equations 42 to 44 |
| 8 | YCgCo or YCgCo-R | See equations 48 to 54 for YCgCo (when BitDepthC is equal to BitDepthY)  See equations 55 to 62 for YCgCo-R (when BitDepthC is equal to BitDepthC equal to BitDepthY + 1) |
| 9 | KR = 0.2627; KB = 0.0593 | Rec. ITU-R BT.2020-2 (non-constant luminance)  Rec. ITU-R BT.2100-2 Y′CbCr  See equations 42 to 44 |
| 10 | KR = 0.2627; KB = 0.0593 | Rec. ITU-R BT.2020-2 (constant luminance)  See equations 63 to 72 |
| 11 | Y′D′ZD′X | SMPTE ST 2085 (2015)  See equations 73 to 75 |
| 12 | See equations 36 to 41 | Chromaticity-derived non-constant luminance system  See equations 42 to 44 |
| 13 | See equations 36 to 41 | Chromaticity-derived constant luminance system  See equations 63 to 72 |
| 14 | ICTCP | Rec. ITU-R BT.2100-2 ICTCP  See equations 76 to 78 for TransferCharacteristics value 16 (PQ)  See equations 79 to 81 for TransferCharacteristics value 18 (HLG) |
| 15 | YCgCo-Re | See equations 55 to 62 |
| 16 | YCgCo-Ro | See equations 55 to 62 |
| 17–255 | Reserved | For future use by ITU-T | ISO/IEC |

NOTE 6 – In a previous version of this Specification, the IEC 61966-2-1 sYCC representation was identified as corresponding to MatrixCoefficients equal to 1. Closer study later determined that this representation should correspond to MatrixCoefficients equal to 5 instead (which is functionally the same as the value 6). This Specification was therefore revised to correct the error.