

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R BT.2087-0 (10/2015)

Colour conversion from Recommendation ITU-R BT.709 to Recommendation ITU-R BT.2020

BT Series
Broadcasting service
(television)



Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

Policy on Intellectual Property Right (IPR)

ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <http://www.itu.int/ITU-R/go/patents/en> where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

Series of ITU-R Recommendations

(Also available online at <http://www.itu.int/publ/R-REC/en>)

Series	Title
BO	Satellite delivery
BR	Recording for production, archival and play-out; film for television
BS	Broadcasting service (sound)
BT	Broadcasting service (television)
F	Fixed service
M	Mobile, radiodetermination, amateur and related satellite services
P	Radiowave propagation
RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
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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RECOMMENDATION ITU-R BT.2087-0

**Colour conversion from Recommendation ITU-R BT.709 to
Recommendation ITU-R BT.2020**

(2015)

Scope

This Recommendation addresses a method of colour conversion from Recommendation ITU-R BT.709 to Recommendation ITU-R BT.2020 for use when HDTV programme content is included within UHDTV programmes. Two sets of conversion equations are specified. One set is based on an opto-electronic transfer function (OETF) and its inverse. The other set is based on an electro-optical transfer function (EOTF) and its inverse.

Keywords

UHDTV, colour conversion

The ITU Radiocommunication Assembly,

considering

- a) that Recommendation ITU-R BT.2020 – Parameter values for ultra-high definition television systems for production and international programme exchange, specifies the parameter values for the UHDTV image systems, and one of the features of UHDTV is its colour gamut wider than that of HDTV as specified in Recommendation ITU-R BT.709;
- b) that an increasing number of television broadcasters and programme makers around the world are starting to produce UHDTV programmes;
- c) that HDTV programmes may well be used for making UHDTV programmes, which necessitates colour conversion from Recommendation ITU-R BT.709 to Recommendation ITU-R BT.2020;
- d) that it is required that colours of Recommendation ITU-R BT.709 content should be unchanged by the colour conversion to Recommendation ITU-R BT.2020 and that the conversion method should be mathematically definable,

recommends

- 1** that when colour conversion from Recommendation ITU-R BT.709 to Recommendation ITU-R BT.2020 is required for UHDTV programme production and international exchange, the method described in Annex 1 should be used.

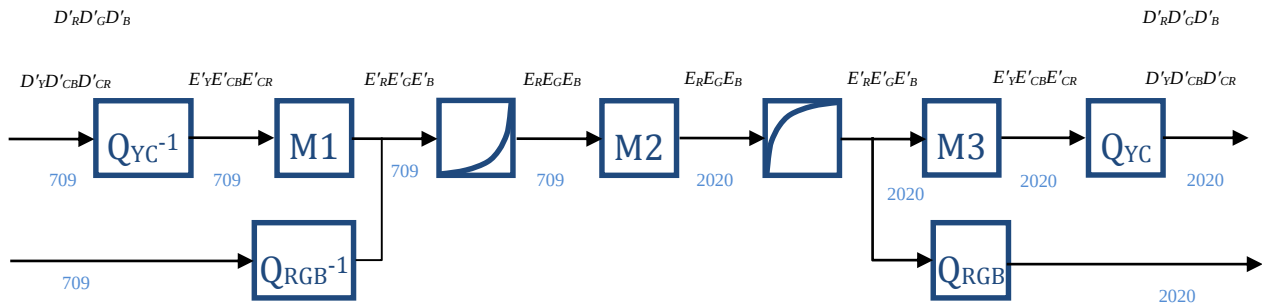
Annex 1

Method for colour conversion from Recommendation ITU-R BT.709 to Recommendation ITU-R BT.2020

Figure 1 shows a block diagram of the colour conversion from Recommendation ITU-R BT.709 (Rec. 709) to the non-constant luminance signal format in Table 4 of Recommendation ITU-R BT.2020 (Rec. 2020). The input and output of this diagram are digitally represented $Y'C'_B C'_R$ signals or $R'G'B'$ signals.

FIGURE 1

Block diagram of colour conversion from Rec. 709 $Y'C'_B C'_R$ or $R'G'B'$ to Rec. 2020 $Y'C'_B C'_R$ or $R'G'B'$ for the non-constant luminance signal format in Recommendation ITU-R BT.2020



The functions and equations of each block in Fig. 1 are as follows:

$$Q_{YC}^{-1}$$

Inverse-quantisation of digitally represented luminance and colour-difference signals $D'_Y D'_CB D'_CR$ (Rec. 709) in the bit-depth of N_{709} bits to normalized luminance and colour-difference signals $E'_Y E'_CB E'_CR$ (Rec. 709):

$$\begin{aligned} E'_Y &= (D'_Y / 2^{N_{709}-8} - 16) / 219 \\ E'_{CB} &= (D'_{CB} / 2^{N_{709}-8} - 128) / 224 \\ E'_{CR} &= (D'_{CR} / 2^{N_{709}-8} - 128) / 224 \end{aligned}$$

$$Q_{RGB}^{-1}$$

Inverse-quantisation of digitally represented colour signals $D'_R D'_G D'_B$ (Rec. 709) in the bit-depth of N_{709} bits to normalized colour signals $E'_R E'_G E'_B$ (Rec. 709):

$$\begin{aligned} E'_R &= (D'_R / 2^{N_{709}-8} - 16) / 219 \\ E'_G &= (D'_G / 2^{N_{709}-8} - 16) / 219 \\ E'_B &= (D'_B / 2^{N_{709}-8} - 16) / 219 \end{aligned}$$