IEC 61966-2-2

Edition 1.0 2003-01

INTERNATIONAL STANDARD

Multimedia systems and equipment – Colour measurement and management – Part 2-2: Colour management – Extended RGB colour space – scRGB

IEC 61966-2-2:2003-01(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and definitions clause of IEC publications issued between 2002 and 2015. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC 61966-2-2

Edition 1.0 2003-01

INTERNATIONAL STANDARD

Multimedia systems and equipment – Colour measurement and management – Part 2-2: Colour management – Extended RGB colour space – scRGB

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 33.160.60; 37.080

ISBN 978-2-8322-0631-7

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MULTIMEDIA SYSTEMS AND EQUIPMENT – COLOUR MEASUREMENT AND MANAGEMENT –

Part 2-2: Colour management – Extended RGB colour space – scRGB

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning encoding of colour management given in Clause 4.

The IEC takes no position concerning the evidence, validity and scope of this patent right.

The holder of this patent right has assured the IEC that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with IEC. Information may be obtained from:

Eastman Kodak Company

343 State Street

Rochester

New York 14650

USA

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61966 has been prepared by Technical Area 2: Colour measurement and management, of IEC technical committee 100: Audio, video and multimedia systems and equipment and ISO TC 42: Photography.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/556A/FDIS	100/626/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 61966 consists of the following parts, under the general title *Multimedia systems and equipment – Colour measurement and management*:

Part 2-1: Colour management – Default RGB colour space – sRGB

Part 2-2: Colour management – Extended RGB colour space – scRGB

Part 3: Equipment using cathode ray tubes

Part 4: Equipment using liquid crystal display panels

Part 5: Equipment using plasma display panels

Part 7-1. Colour printers – Reflective prints – RGB inputs

Part 8: Multimedia colour scanners

Part 9: Digital cameras

It is published as a double logo standard.

In the ISO the Standard has been approved by 9 P-members out of 10 having cast the vote.

The committee has decided that the contents of this publication will remain unchanged until 2007. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

The contents of the corrigendum of August 2003 have been included in this copy.

INTRODUCTION

The IEC 61966 standards are a series of methods and parameters for colour measurements and management for use in multimedia systems and equipment applicable to the assessment of colour reproduction.

The method of digitization in this part is designed to provide high bit precision, large colour gamut and extended dynamic range that is linear with respect to scene radiance. Based on IEC 61966-2-1 (sRGB), this colour space is well suited to meet the needs of the multimedia, gaming and computer graphics applications. This standard provides a robust solution to these needs. The white point and colour primaries of the scRGB solution are directly inherited from the IEC 61966-2-1 (sRGB) standard. The encoding transformations provide all of the necessary information to encode an image.

MULTIMEDIA SYSTEMS AND EQUIPMENT – COLOUR MEASUREMENT AND MANAGEMENT –

Part 2-2: Colour management – Extended RGB colour space – scRGB

1 Scope

This part of IEC 61966 is applicable to the encoding, editing and communication of relative scene radiance, wide dynamic range, extended colour gamut, and extended bit precision RGB colours as a colour space used in computer systems and similar applications by defining encoding transformations. Primaries and white point values of the colour space defined in this standard are identical to CIE chromaticities for ITU-R BT.709-5 reference primaries and CIE standard illuminant D65 as its white point. The scRGB colour space is an extension of sRGB and it is considered compatible with sRGB.

Additional transformations, such as white point adaptation methods, are beyond the scope of this standard. The appropriate CIE recommendations should be referred to for guidelines in this area.

2 Normative references

The following referenced documents are indispensable for the application 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):1987, *International Electrotechnical Vocabulary (IEV) – Chapter 845: Lighting*

3 Definitions

For the purposes of this document, the following definitions apply. Definitions of illuminance, radiance, tristimulus, and other relating lighting terms are defined in IEC 60050(845).

3.1
output referred colour space
a colour space that represents the colorimetry of an output device with specified viewing conditions

3.2
wide dynamic range colour space
a colour space whose encoding encompasses values below black and above white

3.3
luma
luminance signal as defined by SMPTE/EG28: 1993

NOTE Video systems approximate the lightness response of vision by computing a luma component Y′ as a weighted sum of nonlinear R′G′B′ primary components: Each RGB signal is, comparable to the 1/3 power function with an offset defined by L*. Luma is often incorrectly referred to as luminance.

4 Encoding characteristics

4.1 General

The encoding transformations provide unambiguous methods to transform between CIE 1931 XYZ tristimulus values and 16-bit values for each channel of scRGB. The CIE 1931 XYZ values are scaled so that the sRGB black point to white point luminance is 0,0 to 1,0, not 0,0 to 100,0. Y-tristimulus values less than 0,0 in CIE 1931 XYZ space represent values below black. Y-tristimulus values greater than 1,0 represent values brighter than relative white.

The scRGB components that range from 0 to 16 384 encompass all visible surface colours (from –0,5 to 1,5). The range from 12 288 to 65 535 is used to encode an extended specular range of colours (from larger than 1,0 to 7,4999).

4.2 Transformation from CIE 1931 XYZ values to 16-bit scRGB values ($R_{\text{scRGB}(16)}$, $G_{\text{scRGB}(16)}$, $B_{\text{scRGB}(16)}$)

The relationship is defined as follows:

$$\begin{bmatrix} R_{\text{scRGB}} \\ G_{\text{scRGB}} \\ B_{\text{scRGB}} \end{bmatrix} = \begin{bmatrix} 3{,}240\,625 & -1{,}537\,208 & -0{,}498\,629 \\ -0{,}968\,931 & 1{,}875\,756 & 0{,}041\,518 \\ 0{,}055\,710 & -0{,}204\,021 & 1{,}056\,996 \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix} \quad (1)$$

and:

$$\begin{aligned} R_{\text{scRGB}(16)} &= \text{round}\left[\left(R_{\text{scRGB}} \times 8192{,}0\right) + 4096\right] \\ G_{\text{scRGB}(16)} &= \text{round}\left[\left(G_{\text{scRGB}} \times 8192{,}0\right) + 4096\right] \\ B_{\text{scRGB}(16)} &= \text{round}\left[\left(B_{\text{scRGB}} \times 8192{,}0\right) + 4096\right] \end{aligned} \quad (2)$$

4.3 Transformation from 16-bit scRGB values ($R_{\text{scRGB}(16)}$, $G_{\text{scRGB}(16)}$, $B_{\text{scRGB}(16)}$) to CIE 1931 XYZ values

The relationship is defined as follows:

$$\begin{aligned} R_{\text{scRGB}} &= \left(R_{\text{scRGB}(16)} \div 8192{,}0\right) - 0{,}5 \\ G_{\text{scRGB}} &= \left(G_{\text{scRGB}(16)} \div 8192{,}0\right) - 0{,}5 \\ B_{\text{scRGB}} &= \left(B_{\text{scRGB}(16)} \div 8192{,}0\right) - 0{,}5 \end{aligned} \quad (3)$$

and

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix} = \begin{bmatrix} 0{,}412\,4 & 0{,}357\,6 & 0{,}180\,5 \\ 0{,}212\,6 & 0{,}715\,2 & 0{,}072\,2 \\ 0{,}019\,3 & 0{,}119\,2 & 0{,}950\,5 \end{bmatrix} \begin{bmatrix} R_{\text{scRGB}} \\ G_{\text{scRGB}} \\ B_{\text{scRGB}} \end{bmatrix} \quad (4)$$

Annex A
(informative)

Simple transformation between 8-bit sRGB and 16-bit scRGB values

A.1 General

This annex describes a simple transformation between 8-bit sRGB and 16-bit scRGB. While more complicated and intelligent tonal rendering should be applied for the scRGB images to obtain the most preferred images, this transformation is targeted to real-time display transformations for quick and easy previewing. Other transformations that focus on other requirements are possible. If such other transformations are intended to exchange with other devices or applications, these transformations should be described within the application documentation or file format as appropriate.

A.2 Transformation from 16-bit scRGB values ($R_{\text{scRGB}_{(16)}}$, $G_{\text{scRGB}_{(16)}}$, $B_{\text{scRGB}_{(16)}}$) to 8-bit sRGB values ($R_{\text{sRGB}_{(8)}}$, $G_{\text{sRGB}_{(8)}}$, $B_{\text{sRGB}_{(8)}}$)

The relationship is defined as follows:

$$\begin{aligned} R_{\text{scRGB}} &= \left(R_{\text{scRGB}_{(16)}} \div 8192\right) - 0{,}5 \\ G_{\text{scRGB}} &= \left(G_{\text{scRGB}_{(16)}} \div 8192\right) - 0{,}5 \\ B_{\text{scRGB}} &= \left(B_{\text{scRGB}_{(16)}} \div 8192\right) - 0{,}5 \end{aligned} \qquad \text{(A.1)}$$

If $R_{\text{scRGB}}, G_{\text{scRGB}}, B_{\text{scRGB}} < 0 \quad \left(R_{\text{scRGB}_{(16)}}, G_{\text{scRGB}_{(16)}}, B_{\text{scRGB}_{(16)}} \le 4095\right)$

$$\begin{aligned} R_{\text{sRGB}_{(8)}} &= 0 \\ G_{\text{sRGB}_{(8)}} &= 0 \\ B_{\text{sRGB}_{(8)}} &= 0 \end{aligned} \qquad \text{(A.2)}$$

else if

$$0 \le R_{\text{scRGB}}, G_{\text{scRGB}}, B_{\text{scRGB}} < 0{,}018 \quad \left(4096 \le R_{\text{scRGB}_{(16)}}, G_{\text{scRGB}_{(16)}}, B_{\text{scRGB}_{(16)}} \le 4243\right)$$

$$\begin{aligned} R_{\text{sRGB}_{(8)}} &= \text{round}\left[\left(4{,}500 \times R_{\text{scRGB}}\right) \times 255\right] \\ G_{\text{sRGB}_{(8)}} &= \text{round}\left[\left(4{,}500 \times G_{\text{scRGB}}\right) \times 255\right] \\ B_{\text{sRGB}_{(8)}} &= \text{round}\left[\left(4{,}500 \times B_{\text{scRGB}}\right) \times 255\right] \end{aligned} \qquad \text{(A.3)}$$

else if

$$0{,}018 \le R_{\text{scRGB}}, G_{\text{scRGB}}, B_{\text{scRGB}} \le 1{,}0 \quad \left(4244 \le R_{\text{scRGB}_{(16)}}, G_{\text{scRGB}_{(16)}}, B_{\text{scRGB}_{(16)}} \le 12288\right)$$