International Telecommunication Union

ITU-R

Radiocommunication Sector of ITU

Recommendation ITU-R BT.1847
(01/2009)

1 280 × 720, 16:9 progressively-captured image format for production and international programme exchange in the 50 Hz environment

BT Series

Broadcasting service (television)

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SM	Spectrum management
SNG	Satellite news gathering
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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.1847*

1 280 × 720, 16:9 progressively-captured image format for production and international programme exchange in the 50 Hz environment

(Question ITU-R 1/6)

(2008)

Scope

This Recommendation provides the parameters for a 1 280 × 720, 16:9 progressively scanned television format for the 50 Hz environment for production and programme exchange.

The ITU Radiocommunication Assembly,

considering

a) that the 720/P image format provides a resolution between Recommendations ITU-R BT.601 and ITU-R BT.709, which is an option for certain applications of acquisition, production and storage;

b) that digital content production will increasingly include a mixture of audio, video, data and interactive content;

c) that image format interoperability with computer applications is increasingly important, and the 720/P format is well matched to them because of the square pixels format;

d) that production-quality conversion between formats is facilitated by progressive image capture;

e) that a 720/P production format offers a resolution format that can be carried within the commonly used 1.5 Gbit/s production serial digital interface;

f) that Recommendation ITU-R BT.1543 gives the parameter values for a 720/P 60 Hz format;

g) that there is digital production equipment designed to operate with a variety of image formats including 1 280 × 720, 16:9, progressively-captured (720/P),

recognizing

a) that Recommendation ITU-R BT.709 is the recognized standard for high-definition television in the ITU;

b) that this Recommendation should have no impact on Recommendations (ITU-R BT.601 and ITU-R BT.709) referred to in *recommends* 1,

recommends

1 that, where there may be a requirement for a resolution between the video formats specified in Recommendations ITU-R BT.601 and ITU-R BT.709 for production and international programme exchange in the 50 Hz environment, the parameters in Annex 1 should be used.

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* Radiocommunication Study Group 6 made editorial amendments to this Recommendation in November 2009 in accordance with Resolution ITU-R 1.

Annex 1

1 280 × 720 progressive capture system at 50 Hz

1 Opto-electronic conversion[1]

Item	Parameter	Value	
1.1	Opto-electronic transfer characteristics before non-linear pre-correction	Assumed linear	
1.2	Overall opto-electronic transfer characteristics at source	$V = 1.099\ L^{0.45} - 0.099$ for $1 \geq L \geq 0.018$ $V = 4.500\ L$ for $0.018 > L \geq 0$ where: L : luminance of the image $0 \leq L \leq 1$ V : corresponding electrical signal	
1.3	Chromaticity coordinates (CIE, 1931)	X	y
	Primary: – Red (R) – Green (G) – Blue (B)	 0.640 0.300 0.150	 0.330 0.600 0.060
1.4	Assumed chromaticity for equal primary signals (reference white):	D_{65}	
		X	y
	– $E_R = E_G = E_B$	0.3127	0.3290

2 Picture characteristics

Item	Parameter	Value
2.1	Aspect ratio	16:9
2.2	Samples per active line	1 280
2.3	Sampling lattice	Orthogonal
2.4	Active lines per picture	720
2.5	Pixel aspect ratio	1:1 (square pixels)

[1] Opto-electronic conversion refers to the conversion of an optical signal (light stimulus) into an electrical signal, and vice versa. In the context of this Recommendation, the stimulus signal is produced by a digital imaging device.

3 Signal format

Item	Parameter	Value
3.1	Conceptual non-linear pre-correction of primary signals	$\gamma = 0.45$ (See Item 1.2)
3.2	Derivation of luminance signal E'_Y	$E'_Y = 0.2126\ E'_R + 0.7152\ E'_G + 0.0722\ E'_B$
3.3	Derivation of colour-difference signal (analogue coding)	$E'_{CB} = \frac{E'_B - E'_Y}{1.8556}$ $= \frac{-0.2126\ E'_R - 0.7152\ E'_G + 0.9278\ E'_B}{1.8556}$ $E'_{CR} = \frac{E'_R - E'_Y}{1.5748}$ $= \frac{0.7874\ E'_R - 0.7152\ E'_G - 0.0722\ E'_B}{1.5748}$
3.4	Quantization of *RGB*, luminance and colour-difference signals[1, 2]	$D'_R = \mathrm{INT}\left[(219\ E'_R + 16)\cdot 2^{n-8}\right]$ $D'_G = \mathrm{INT}\left[(219\ E'_G + 16)\cdot 2^{n-8}\right]$ $D'_B = \mathrm{INT}\left[(219\ E'_B + 16)\cdot 2^{n-8}\right]$ $D'_Y = \mathrm{INT}\left[(219\ E'_Y + 16)\cdot 2^{n-8}\right]$ $D'_{CB} = \mathrm{INT}\left[(224\ E'_{CB} + 128)\cdot 2^{n-8}\right]$ $D'_{CR} = \mathrm{INT}\left[(224\ E'_{CR} + 128)\cdot 2^{n-8}\right]$
3.5	Derivation of luminance and colour-difference signals via quantized *RGB* signals	$D'_Y = \mathrm{INT}\left[\ 0.2126\ D'_R + 0.7152\ D'_G + 0.0722\ D'_B\ \right]$ $D'_{CB} = \mathrm{INT}\left[\left(-\frac{0.2126}{1.8556}D'_R - \frac{0.7152}{1.8556}D'_G + \frac{0.9278}{1.8556}D'_B\right)\cdot\frac{224}{219} + 2^{n-1}\right]$ $D'_{CR} = \mathrm{INT}\left[\left(\frac{0.7874}{1.5748}D'_R - \frac{0.7152}{1.5748}D'_G - \frac{0.0722}{1.5748}D'_B\right)\cdot\frac{224}{219} + 2^{n-1}\right]$

(1) "n" denotes the number of the bit length of the quantized signal.

(2) The operator INT returns the value of 0 for fractional parts in the range of 0 to 0.4999 ... and +1 for fractional parts in the range of 0.5 to 0.9999 ..., i.e. it rounds up fractions above 0.5.

4 Digital representation

Item	Parameter	Value	
4.1	Coded signal	R, G, B or Y, C_B, C_R	
4.2	Sampling lattice: – R, G, B, Y	Orthogonal, line and picture repetitive	
4.3	Sampling lattice: – C_B, C_R	Orthogonal, line and picture repetitive co-sited with each other and with alternate(1) Y samples	
4.4	Number of active samples per line: – R, G, B, Y – C_B, C_R	1 280 640	
4.5	Coding format	Linear 8 or 10 bits/component	
4.6	Quantization levels:	8-bit coding	10-bit coding
	– Black level: – R, G, B, Y	16	64
	– Achromatic: – C_B, C_R	128	512
	– Nominal peak: – R, G, B, Y – C_B, C_R	235 16 and 240	940 64 and 960
4.7	Quantization level assignment:	8-bit coding	10-bit coding
	– Video data – Timing references	1 through 254 0 and 255	4 through 1 019 0-3 and 1 020-1 023
4.8	Filter characteristics(2): – R, G, B, Y – C_B, C_R	See Fig. 4a See Fig. 4b	

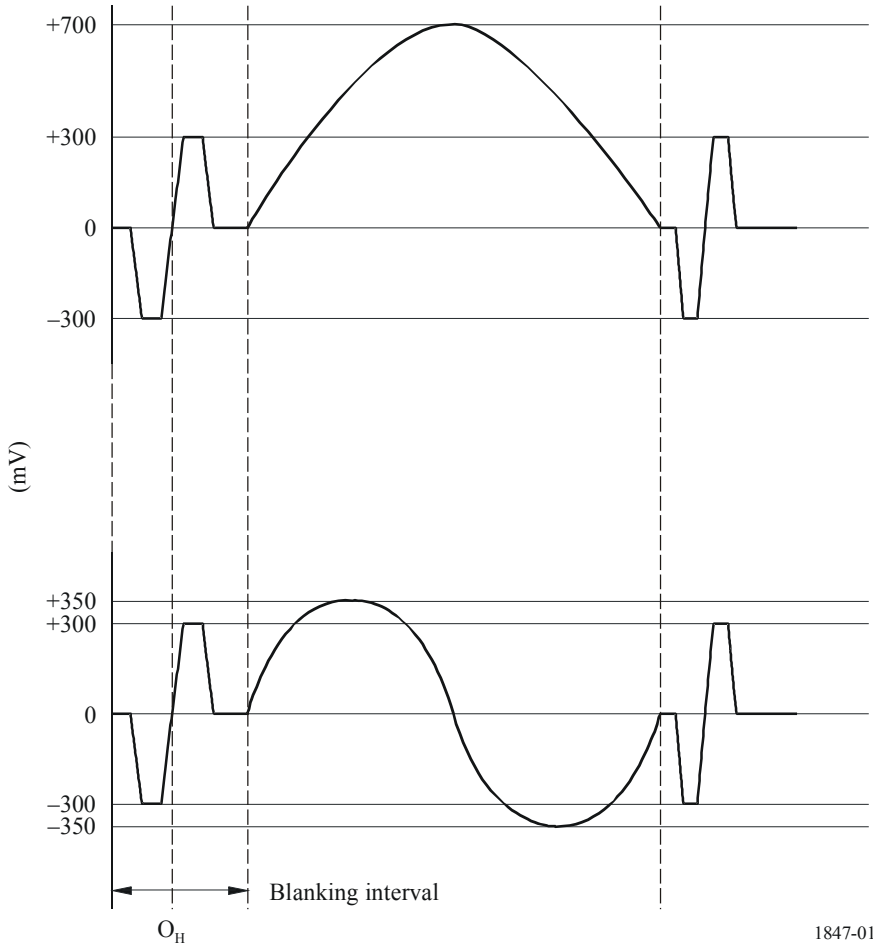
(1) The first active colour-difference samples being co-sited with the first active luminance sample.
(2) These filter templates are defined as guidelines.

5 Analogue representation

Item	Parameter	Value
5.1	Nominal level (mV): – E'_R, E'_G, E'_B, E'_Y	Reference black: 0 Reference white: 700 (See Fig. 1)
5.2	Nominal level (mV): – E'_{C_B}, E'_{C_R}	±350 (See Fig. 1)
5.3	Form of synchronizing signal	Tri-level bipolar (See Fig. 3)
5.4	Line sync timing reference	O_H (See Fig. 3)
5.5	Sync level (mV)	±300 ±2%
5.6	Sync signal timing	Sync on all components (See Table 1, Figs 2 and 3)
5.7	Inter-component timing accuracy	Not applicable
5.8	Blanking interval	(See Table 2 and Fig. 2)
5.9	Total lines	750

FIGURE 1

Analogue levels and O_H timing reference



6 Picture capture characteristics

Item	Parameter	Value
6.1	Order of sample presentation in a scanned system	Left to right, top to bottom
6.2	Frame frequency (Hz)	50
6.3	Picture rate (Hz)	50
6.4	Line frequency (Hz)	37 500
6.5	Samples per full line: – *R*, *G*, *B*, *Y* – C_B, C_r	 1 980 990
6.6	Nominal channel bandwidths (MHz)	(For *R*, *G*, *B*, *Y* components) 30
6.7	Sampling frequency (MHz): – *R*, *G*, *B*, *Y*	 74.25
6.8	Sampling frequency[1] (MHz): – C_B, C_R	 37.125

[1] C_B, C_R sampling frequency is half of luminance sampling frequency.

TABLE 1

Level and line timing specification
(see Figs 2 and 3)

Symbol	Parameter	System values
T	Reference clock interval (μs)	1/74.25
a	Negative line sync width (*T*)[1]	40 ± 3
b	End of active video[2] (*T*)	+6 440 –0
c	Positive line sync width (*T*)	40 ± 3
d	Clamp period (*T*)	110 ± 3
e	Start of active video (*T*)	+6 260 –0
f	Rise/fall time (*T*)	4 ± 1.5
$t_2 - t_1$	Symmetry of rising edge	Symmetric about T_r
–	Active line interval (*T*)	+0 1 280 –12
S_m	Amplitude of negative pulse (mV)	300 ± 6
S_p	Amplitude of positive pulse (mV)	300 ± 6
V	Amplitude of video signal (mV)	700

(1) *T* denotes the duration of a reference clock or the reciprocal of the clock frequency.

(2) A line starts at line sync timing reference O_H (inclusive) and ends just before the subsequent O_H (exclusive).

TABLE 2

Frame timing specification
(see Figs 2 and 3)

Symbol	Parameter	System values
H[1]	Total line interval (*T*)[2]	1 980
H	Vertical sync width (*T*)	1 280 ± 3
LT	Top line of picture	No. 26
LB	Bottom line of picture	No. 745
WBL	Frame blanking interval	30 *H*
	Start of frame	No. 1
	End of frame	No. 750

(1) *H* denotes the duration of a line or the reciprocal of the line frequency (see § 6). A line starts at line sync timing reference O_H (inclusive) and ends at just before the subsequent O_H (exclusive).

(2) *T* denotes the duration of a reference clock or the reciprocal of the clock frequency (see Table 1).

FIGURE 2

Frame synchronizing signal waveform

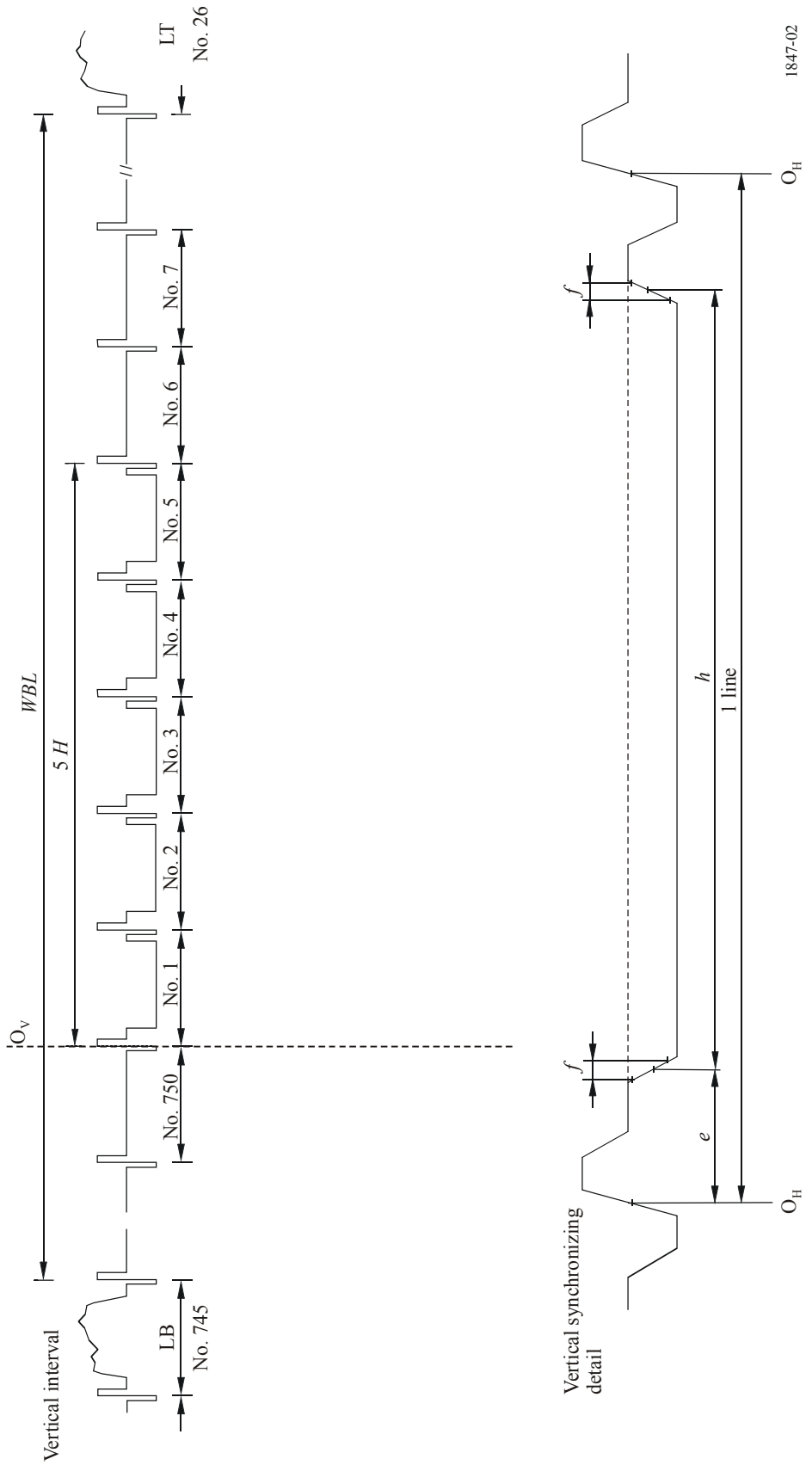
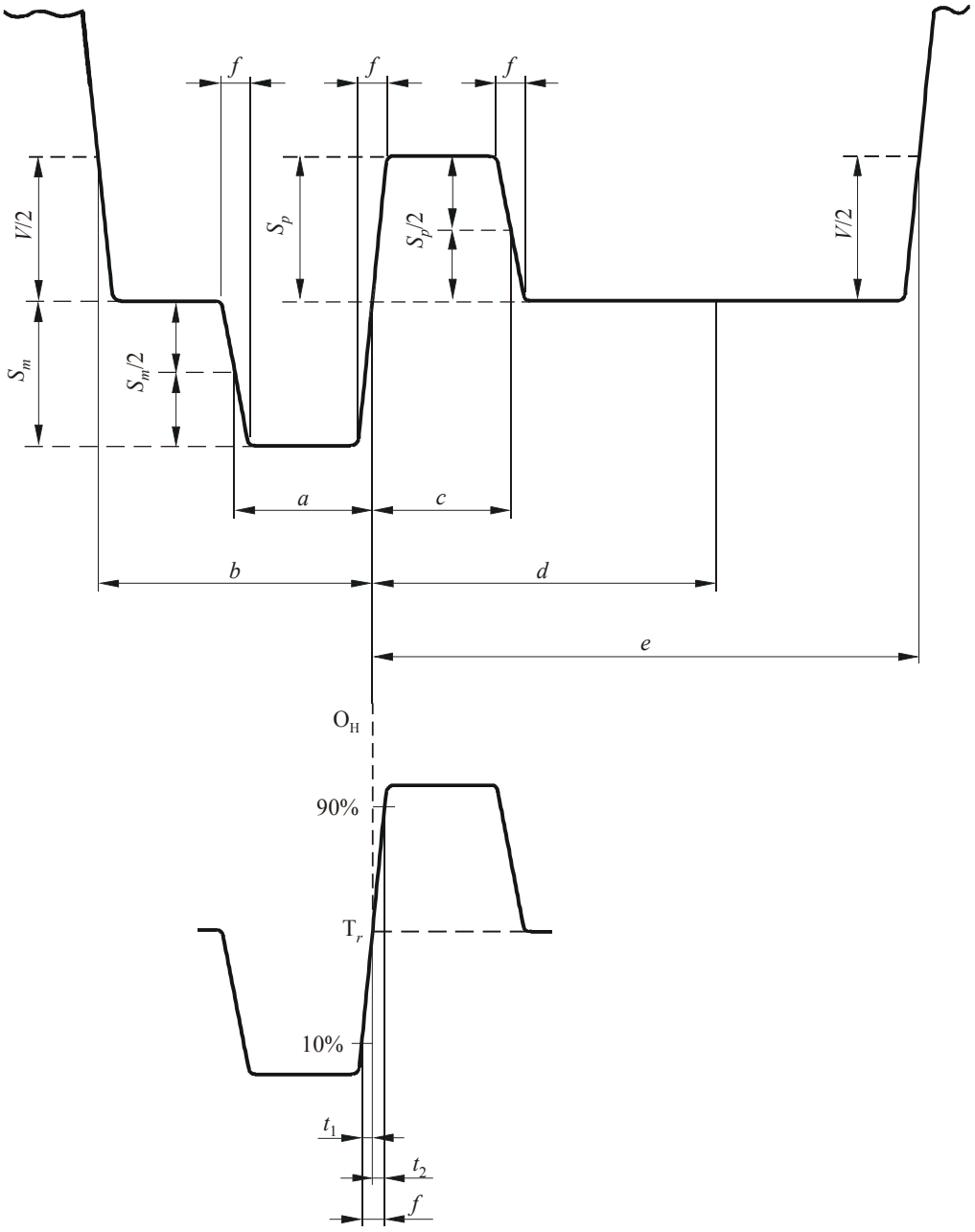


FIGURE 3

Line synchronizing signal waveform



(The waveform exhibits symmetry with respect to point T_r)

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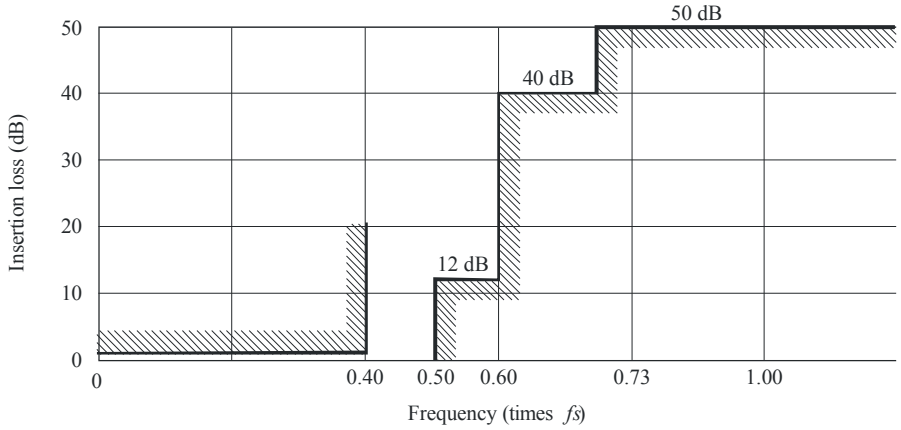
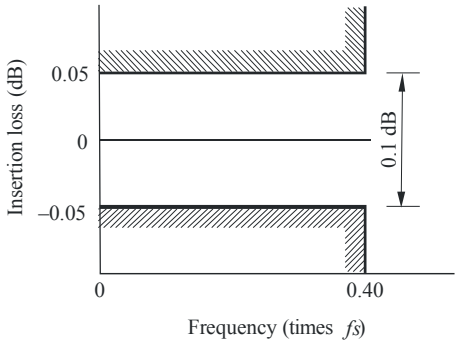
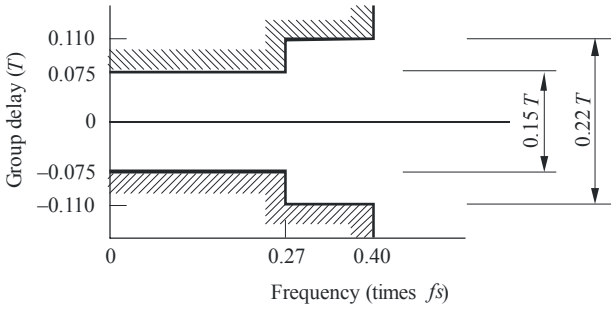
FIGURE 4a
Filter characteristics for *R*, *G*, *B* and *Y* signals



a) Template for insertion loss



b) Passband ripple tolerance



c) Passband group-delay

Note 1 – fs denotes luminance sampling frequency, the value of which is given in Item 6.7.
Note 2 – Ripple and group delay are specified relative to their values at 100 kHz.

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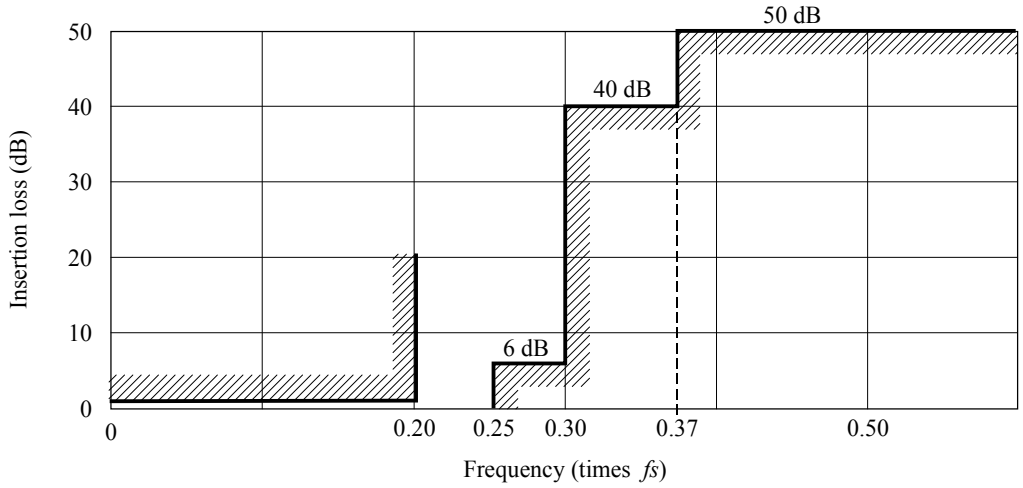
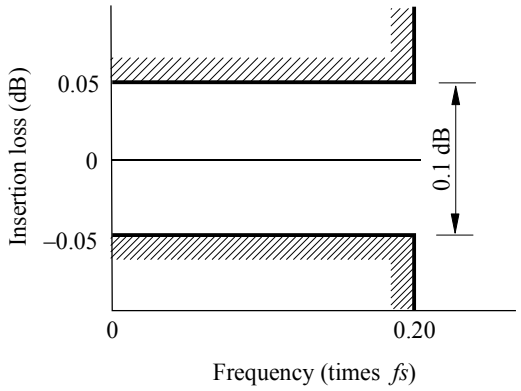
FIGURE 4b

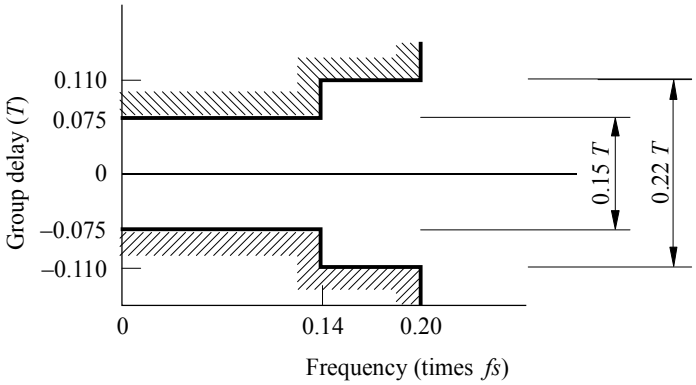
Filter characteristics for C_B and C_R signals



a) Template for insertion loss



b) Passband ripple tolerance



c) Passband group-delay

Note 1 – fs denotes luminance sampling frequency, the value of which is given in Item 6.7.
Note 2 – Ripple and group delay are specified relative to their values at 100 kHz.

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