

RECOMMENDATION ITU-R BT.1124-3

Reference signals for ghost cancelling in analogue television systems

(Question ITU-R 55/11)

(1994-1995-1998-2001)

The ITU Radiocommunication Assembly,

considering

- a) that a ghost cancelling system using a ghost cancelling reference (GCR) signal is one of the most effective countermeasures for ghost images in individual and collective antenna reception of television signals;
- b) that the system should be effective for cancelling multiple and long delayed ghost images as well as short delayed ghost images and it should be also effective for leading ghosts and waveform equalization of video signals;
- c) that the GCR signals can be inserted into the lines in the vertical blanking intervals;
- d) that for each television system an appropriate GCR signal can be defined;
- e) that for each country the appropriate GCR signal can be used to suit the various propagation conditions and the types of transmission media;
- f) that the ghost canceller using the GCR signals can be manufactured at a reasonable cost;
- g) that the cost of ghost cancellers may be lower if there is widespread use of a common GCR signal,

recommends

- 1 that the GCR signal should be a dedicated reference signal optimized for ghost cancelling;
- 2 that the GCR signal should allow the rapid determination of the channel response even under poor signal-to-noise conditions;
- 3 that the GCR signal must be able to provide a flat amplitude and flat group delay response versus frequency over the entire passband of each system;
- 4 that the GCR signal should make efficient use of the vertical interval resources;
- 5 that for NTSC, PAL and SECAM television systems, a broadcaster wishing to integrate a GCR signal should use a GCR signal complying with the specifications given in Annex 1 for:
 - GCR signal A,
 - GCR signal B,
 - GCR signal C;
- 6 that for new GCR applications for NTSC, PAL or SECAM, GCR signal C should preferably be used;

7 that for advanced analogue television systems, a broadcaster wishing to integrate a GCR signal should use a GCR signal complying with the specifications given in Annex 2 for a MUSE system.

ANNEX 1

GCR signal specifications for conventional TV systems

1 Introduction

GCR Signal A for use with the NTSC system, was recommended by ITU-R in 1994 and has been used extensively in Japan since 1989.

GCR Signal B was recommended by ITU-R in 1994 and has been used extensively with the NTSC system in Korea since 1993.

GCR Signal C for use with NTSC, PAL, and SECAM system is being adopted by broadcasters in many countries now introducing GCR signals.

1.1 GCR Signal A

Requirements for the GCR signal relevant to the NTSC system are specified in Tables 1 to 4 and Figs. 1 to 3.

TABLE 1
Specification of GCR waveform

	Value	Remarks
Amplitude	70 ± 2 IRE units	Difference between setup level and the centre point level of the GCR waveform
Setup	0 ± 2 IRE units	Difference between blanking level and pedestal level of the active line. Difference between line A and line B should be 0.5 IRE or less
Width	160 ± 1.0 sc ⁽¹⁾ (44.7 ± 0.28 μ s)	Measured at 50% value of the GCR amplitude
Start of GCR	60 ± 1.5 sc ⁽²⁾ (16.76 ± 0.42 μ s)	GCR rising edge timing (50% point) with respect to leading edge of line sync
Rising edge	Integrated $\sin(x)/x$	See equation (1)
Trailing edge	0.25 ± 0.05 μ s (2T bar)	Interval between 10% point and 90% point of the GCR amplitude

⁽¹⁾ sc – Subcarrier cycles (one colour subcarrier cycle: $1/3.579545$ μ s).

⁽²⁾ Specified at the output point of the GCR signal generator. Not specified at the output point of the GCR inserter unless necessary.

$$f(t) = \frac{1}{A} \int_{-\infty}^t \frac{\sin(\omega x)}{\omega x} h(x) dx \quad (1)$$

where A is a normalizing factor ($A = f(\infty)$), $\omega = 2\pi \times 4.177447 \times 10^6$, and $h(x)$ is a window function to give the signal spectrum as shown in Fig. 4, such as raised cosine having the half amplitude width of 10.5 μs .

FIGURE 1
GCR waveform for line A

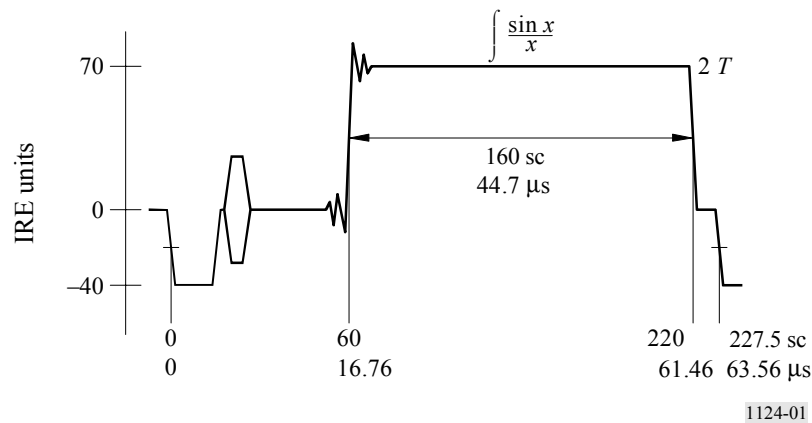
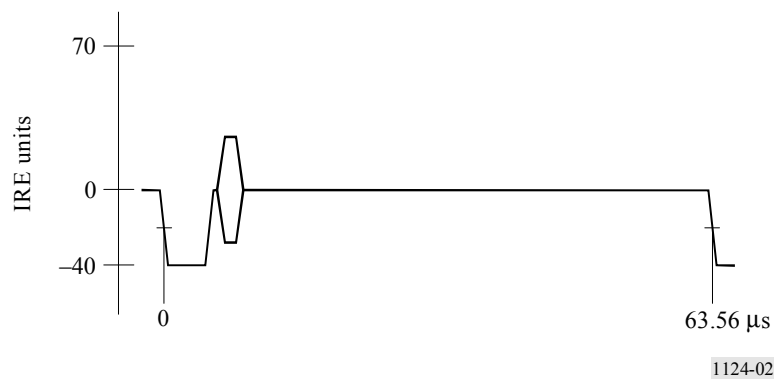
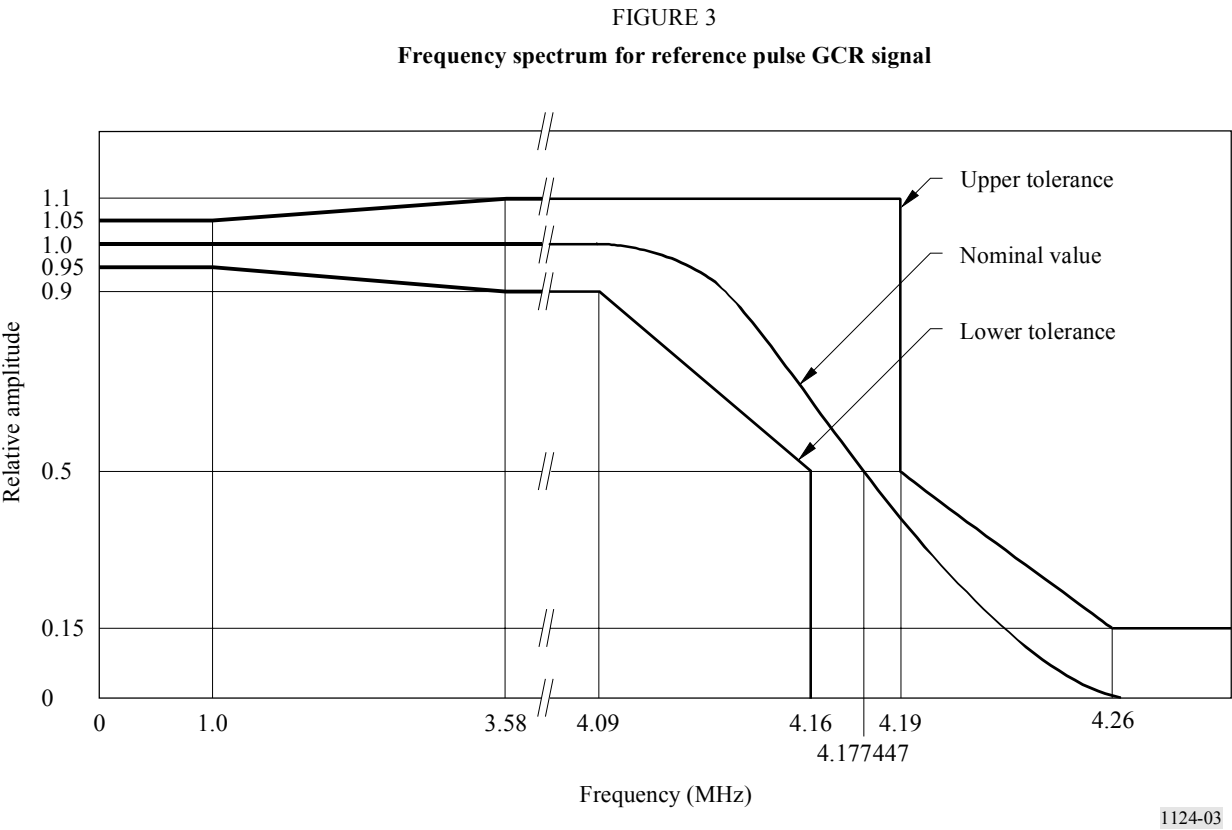


FIGURE 2
Zero-pedestal waveform for line B





The characteristics are applied to the differential or one-sample difference of the GCR signal.

TABLE 2
GCR insertion line

Insertion line numbers	18 and 281
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TABLE 3
Signal on the line immediately preceding the GCR line

Field numbers							
1	2	3	4	5	6	7	8
x ₁	x ₂	x ₃	x ₄	x ₁	x ₂	x ₃	x ₄

x₁, x₂, x₃ and x₄ should not contain time varying information.

TABLE 4

GCR transmission sequence

Field number	1	2	3	4	5	6	7	8
Waveform	Line A	Line B	Line A	Line B	Line B	Line A	Line B	Line A

1.2 GCR signal B

Requirements for the GRC signal relevant to the 525-line NTSC and 625-line PAL systems are specified in Tables 5 to 8 and Figs. 4 and 5.

TABLE 5

Ternary sequence of length 366

1	0	1	0	1	0	1	0	1	0	1	0	1	0	-1
0	-1	0	1	0	0	0	-1	0	-1	0	1	0	1	0
-1	0	1	0	1	0	1	0	-1	0	-1	0	-1	0	-1
0	1	0	1	0	1	0	1	0	-1	0	1	0	-1	0
1	0	-1	0	-1	0	0	0	1	0	1	0	-1	0	-1
0	1	0	1	0	-1	0	-1	0	1	0	0	0	1	0
-1	0	1	0	-1	0	-1	0	1	0	-1	0	1	0	1
0	1	0	-1	0	-1	0	1	0	1	0	-1	0	1	0
-1	0	0	0	-1	0	0	0	-1	0	1	0	-1	0	1
0	-1	0	-1	0	-1	0	-1	0	-1	0	1	0	-1	0
-1	0	1	0	-1	0	1	0	1	0	0	0	1	0	1
0	1	0	-1	0	-1	0	-1	0	0	0	1	0	1	0
-1	0	-1	0	-1	0	1	0	1	0	-1	0	1	0	1
0	-1	0	1	0	-1	0	-1	0	-1	0	-1	0	-1	0
-1	0	1	0	-1	0	1	0	0	0	-1	0	1	0	1
0	1	0	1	0	-1	0	1	0	1	0	-1	0	1	0
1	0	0	0	0	0	1	0	1	0	0	0	-1	0	1
0	1	0	1	0	0	0	1	0	-1	0	1	0	-1	0
1	0	0	0	-1	0	1	0	1	0	1	0	1	0	1
0	-1	0	1	0	-1	0	-1	0	1	0	1	0	-1	0
1	0	1	0	-1	0	-1	0	-1	0	1	0	-1	0	1
0	-1	0	-1	0	1	0	0	0	1	0	1	0	1	0
-1	0	-1	0	-1	0	-1	0	1	0	1	0	-1	0	-1
0	1	0	-1	0	1	0	-1	0	-1	0	-1	0	1	0
1	0	1	0	1	0									

TABLE 6

Specifications of GCR waveform

Television system	525-line	625-line	
		B, G	D, K
GCR signal frequency limit	4.18 MHz	5.0 MHz	6.0 MHz ⁽¹⁾
Pedestal height	30 IRE units	300 mV	
Start of pedestal ⁽²⁾	8.75 µs	10.5 µs	
Finish of pedestal ⁽²⁾	61.9 µs	62.5 µs	
Start of GCR ⁽²⁾	11.5 µs	12.2 µs	
Duration of GCR	25.6 µs	20.6 µs	
Lowest level of GCR	−10 IRE units	0 mV	
Highest level of GCR	+70 IRE units	600 mV	
Clock frequency ⁽³⁾	4 × 3.58 MHz	4 × 4.43 MHz	

(1) The 6 MHz option is not compatible with transmission of NICAM digital sound using a 5.85 MHz carrier.

(2) The start and finish times are defined at the half-amplitude points.

(3) This refers to the use of a clock at four times the colour subcarrier frequency of NTSC or PAL, as appropriate.

TABLE 7a

Transmission sequence of NTSC GCR signal

Field number	1	2	3	4
GCR signal polarity	+	−	+	−

TABLE 7b

Transmission sequence of PAL GCR signal*

Field number	2	4	6	8
GCR signal polarity	+	−	+	−

* There is no absolute relationship between the polarity of the GCR transmission sequence and the eight-field sequence of PAL.

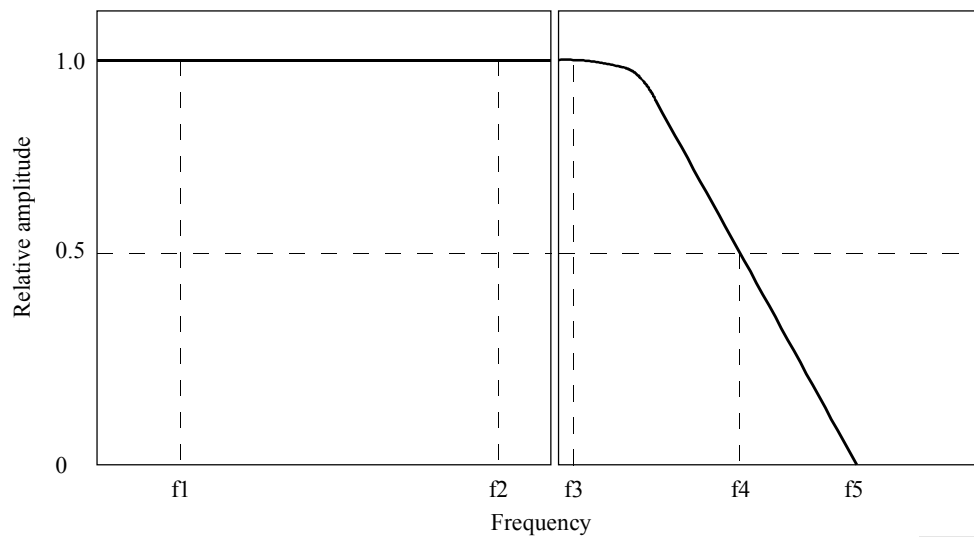
TABLE 8

The frequency values in Fig. 4

TV system frequency	525-line	625-line	
		B, G	D, K
f1 (MHz)	1.00	1.00	1.00
f2 (MHz)	3.58	4.43	4.43
f3 (MHz)	4.09	4.80	5.80
f4 (MHz)	4.18	5.00	6.00
f5 (MHz)	4.25	5.20	6.20

FIGURE 4

Frequency characteristic of the lowpass filter



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