INSTRUCTION P2

Part 3

TEST WAVEFORMS

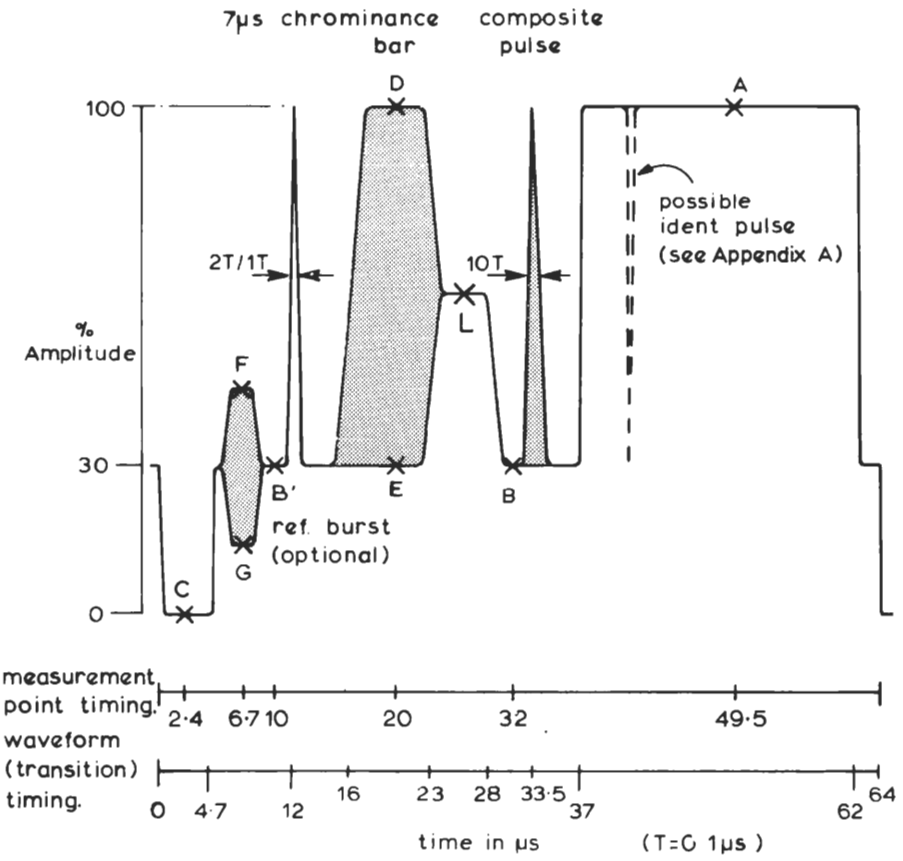
PART 3

VIDEO TEST WAVEFORMS

NOTES ON TEST SIGNALS FOR VIDEO MEASUREMENT

1. **Ordinary programme (picture) signals are unsuitable for most video measurements and should only be used in the absence of one of the recommended test signals.**

2. The most suitable signals for making measurements described in the Video Test Procedures (Part 1) are those illustrated by the idealised waveforms shown in this Part. Each waveform drawing is marked with a number of points chosen for certain measurements so as to minimise error resulting from signal distortion. Where appropriate, these points are referred to in the Test Procedures.

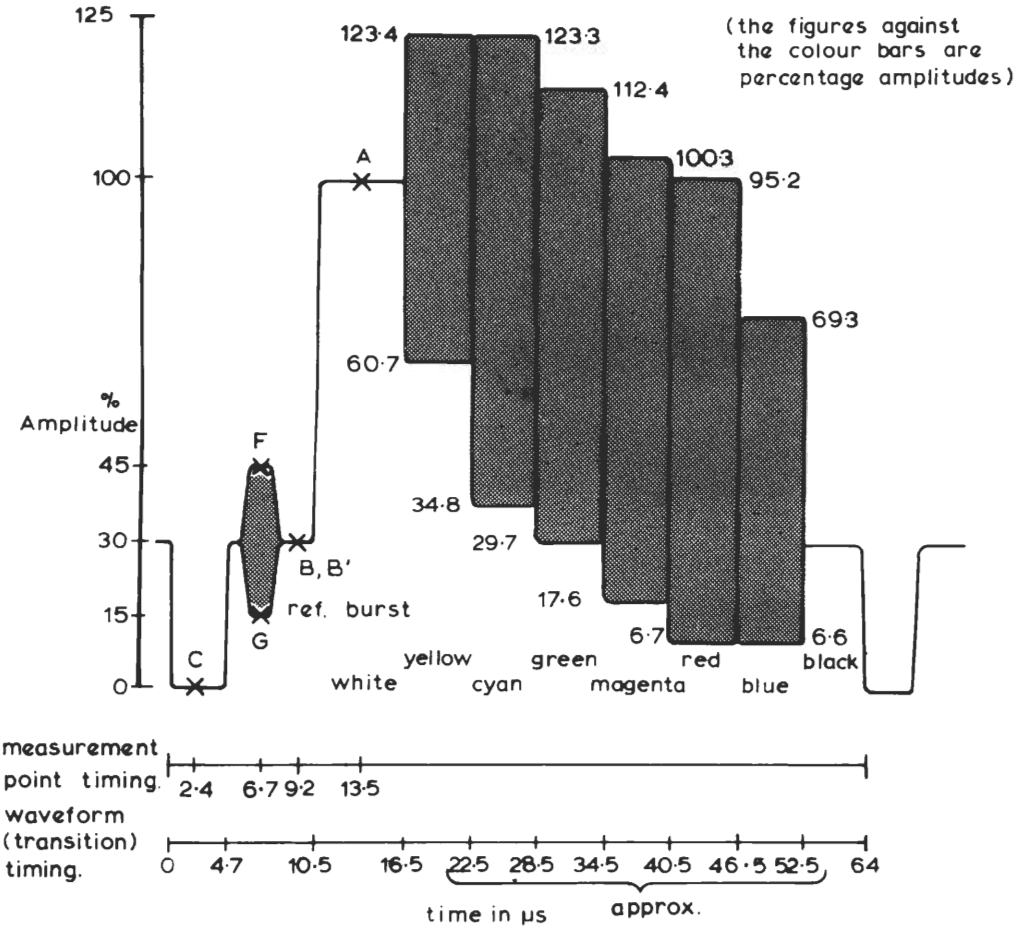


A negative-going sine-squared pulse between white and blanking levels and of either 2T or 1T duration may be included in the 25-μs luminance bar as shown. This is now used only for identification purposes. By blanking the pulse on particular groups of lines during each field, up to four vertical black 'dashes' are made to appear in the white (bar) stripe when the signal is displayed on a television screen. The number and spacing of these dashes is altered by changing the blanking sequence so that a code is formed which identifies the originating source of that signal. A list of these identifying patterns is held at switching centres and destinations in the UK distribution system.

This waveform may or may not contain field group synchronising pulses

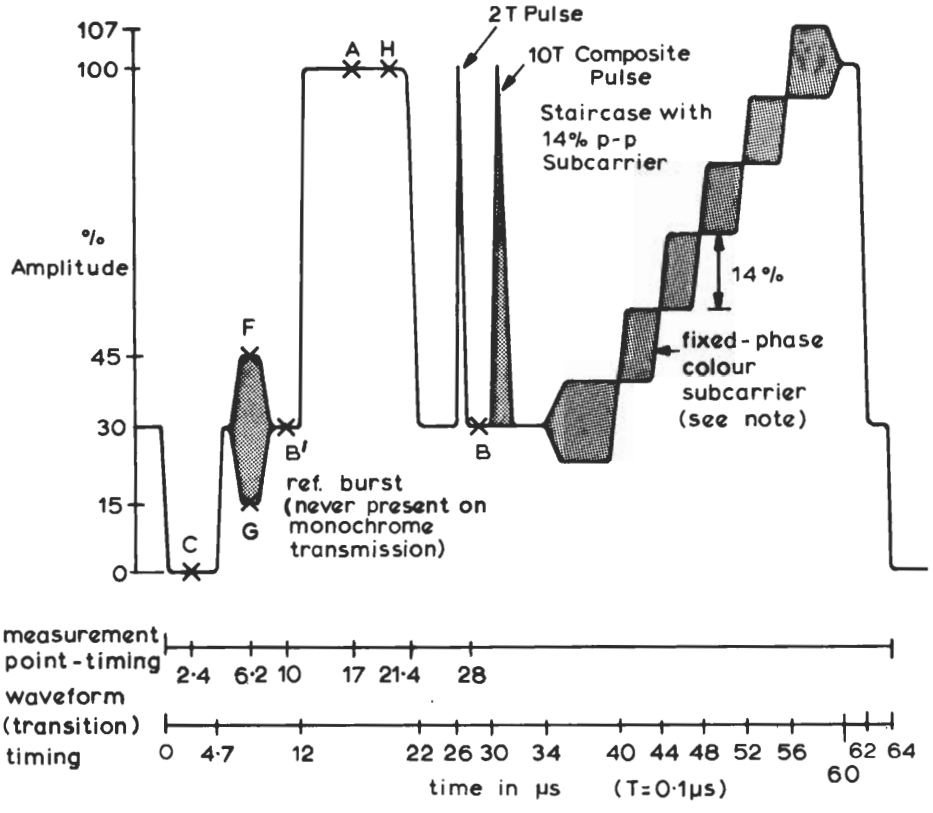
Note – the 7μs chrominance bar is sometimes known as the chrominance minibar.

Line Repetitive Chrominance-Luminance Pulse-and-Bar Test Signal



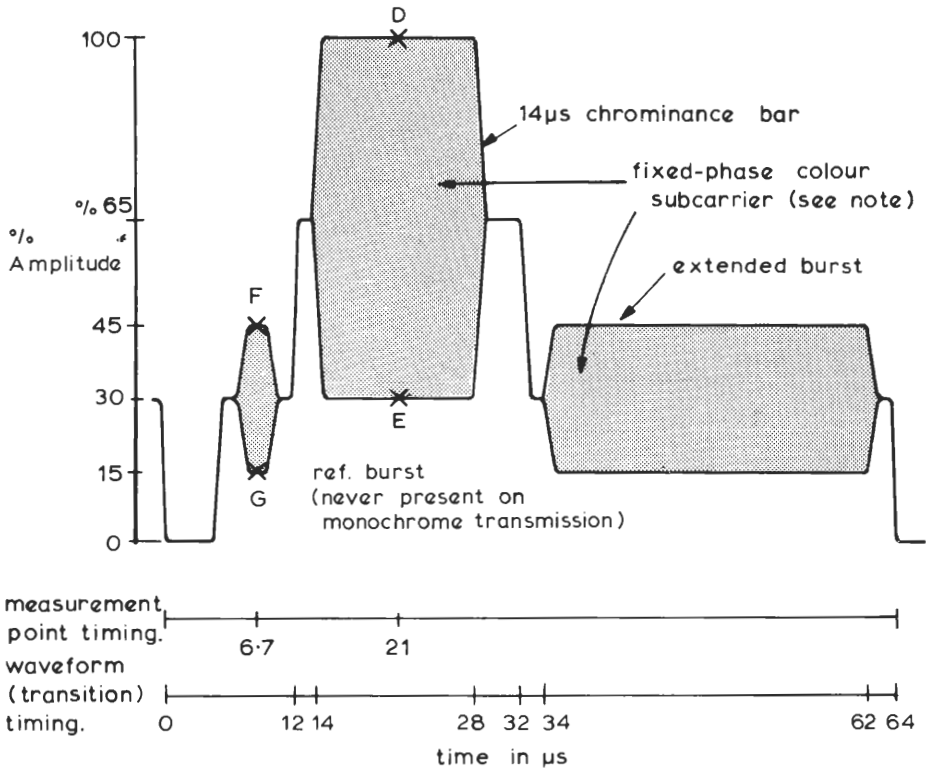
Note – Other colour bars are sometimes used. These are all listed in Instruction P.8.

100% (100.0.100.0) Colour Bar Test Signal



The subcarrier phase in these blocks lies along an axis inclined 60 degrees counter-clockwise to the +U-axis

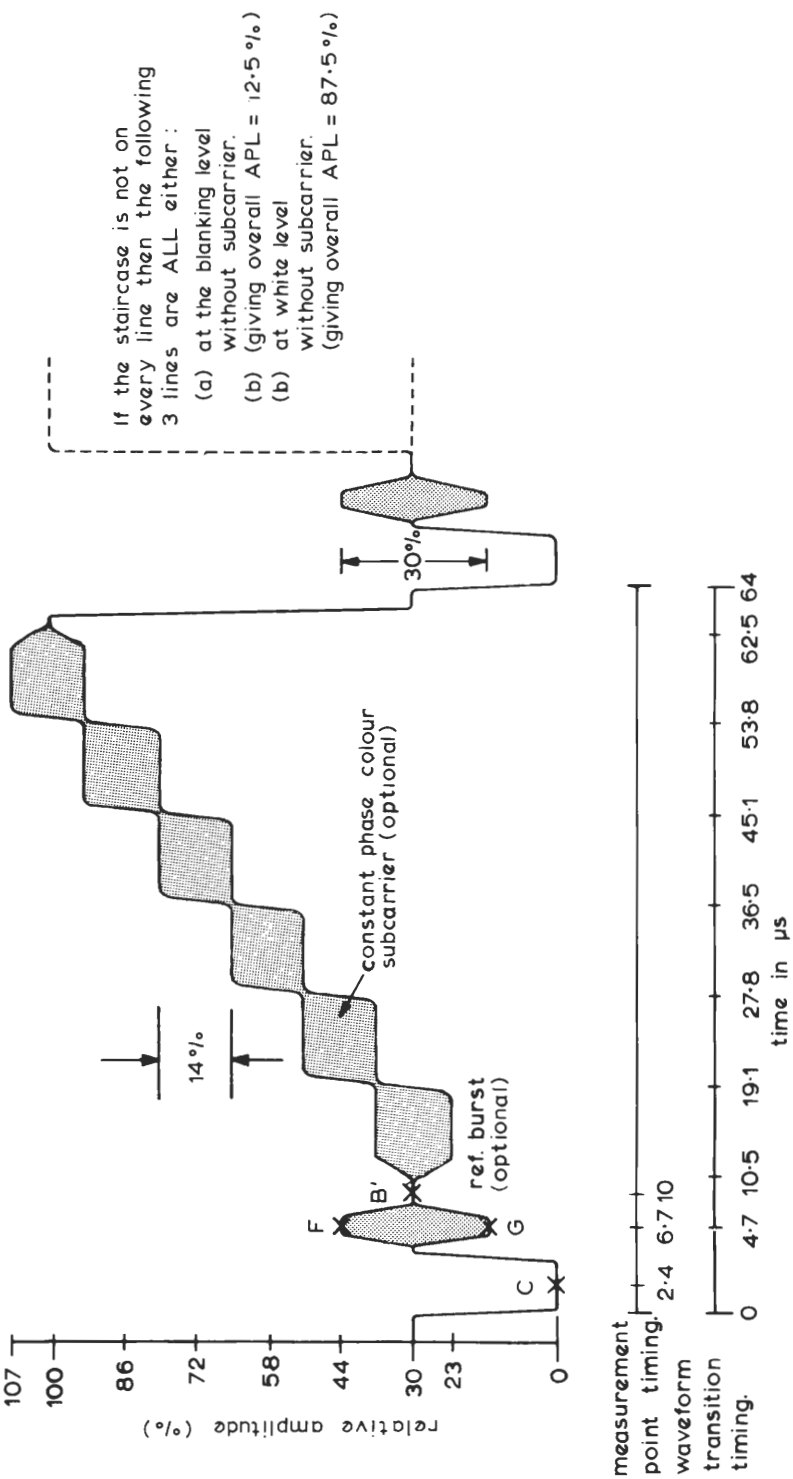
National Insertion Test Signal (A) (lines 19 and 332)



The subcarrier phase in these blocks lies along an axis inclined 60 degrees counter-clockwise to the +U-axis

Note – the period shown as being occupied by the extended burst may instead contain other test waveforms.

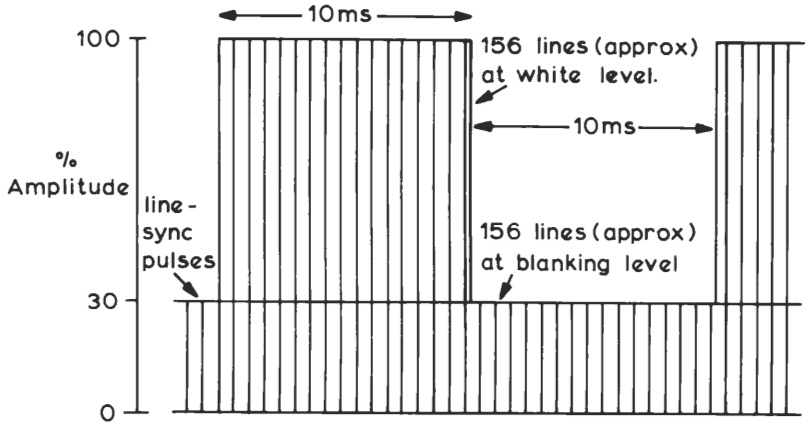
National Insertion Test Signal (B) (lines 20 and 333)



This signal may be repeated on every line OR on every fourth line with intermediate lines as shown.

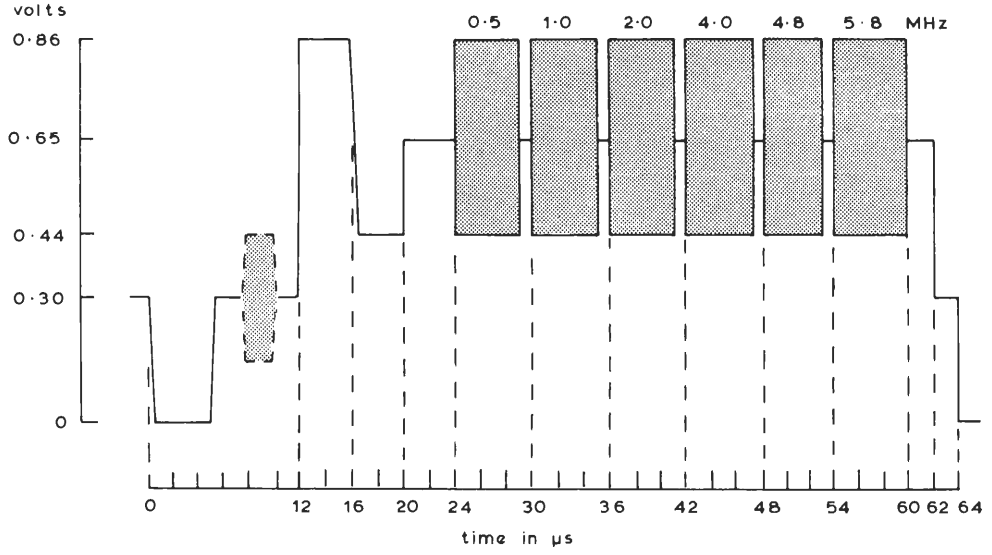
The waveform may or may not contain field group synchronising pulses.

Line Repetitive Staircase Test Signal



(This waveform may or may not contain field-group synchronising pulses.)

50 Hz Squarewave Test Signal



Note – the Multiburst signal is inserted on line 18 only on international distribution circuits. In the U.K. lines 17 and 18 are used for CEEFAX.

Multiburst

405 - line Monochrome Waveform

405-line Monochrome Waveform

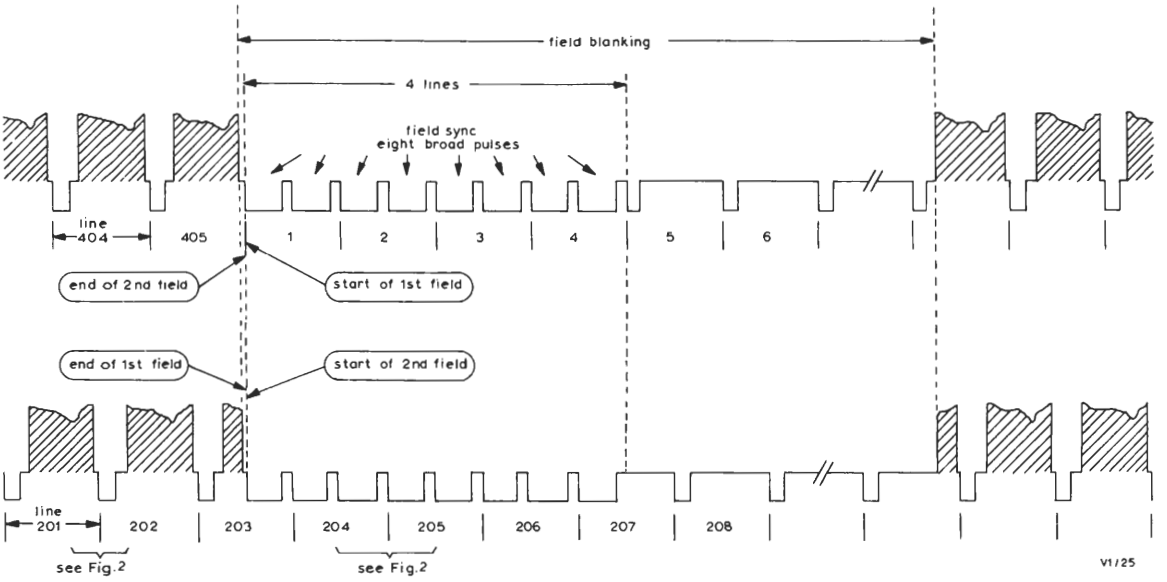


Fig. 1 405-line waveform: start of first and second fields in each picture

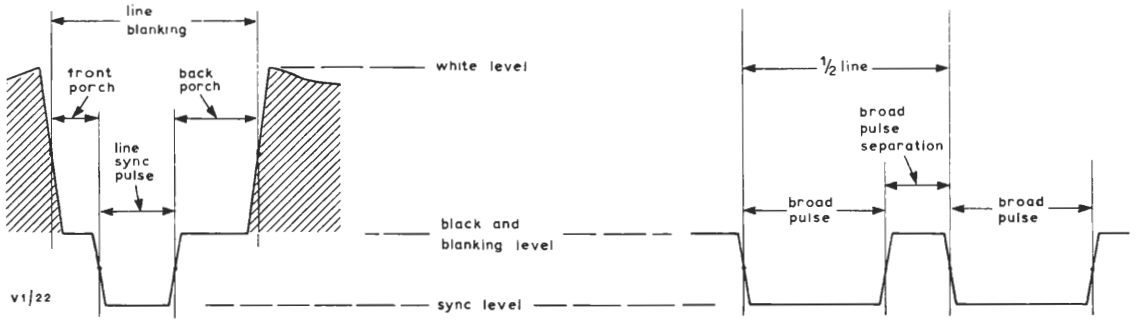


Fig. 2 405-line waveform: line sync interval (left) and field sync broad pulse (right)

405-line Monochrome Waveform

Waveform Durations (between half-amplitude points)

Line period	98.8 μs nominal
Line blanking	17.5-19.0 μs
Front porch	1.5-2.0 μs
Line sync pulse	8.0-10.0 μs
Line sync pulse + back porch	16.0-17.0 μs
Field period	20 ms
Field blanking	13-15½ lines + 18.25 μs (See Note 2)
Separation between field sync broad pulses	7.4-11.4 μs

Times of Rise and Fall (10-90% full amplitude)

Line sync pulse	0.25 μs max
Field sync broad pulse	0.25 μs max
Line blanking	0.25-0.5 μs
Field blanking	0.25-0.5 μs

Amplitudes, Relative to Blanking Level

White level	+0.7 V
Sync level	–0.3 V

Line and Field Frequencies

Line frequency	10,125 Hz
Field frequency	50 Hz

Signals in Field Blanking

At present, lines 13 and 215 may contain tests signals.

Notes

1. The preceding data giving waveform durations and times of rise and fall correspond to the values given for the 405-line system in C.C.I.R. Report 308-1 (Oslo 1966).
2. In a 405-line waveform that comes from an electronic standards converter, one or two lines before and after the true field blanking period may contain only low-level spurious signals.

525-line Monochrome and NTSC Colour Waveforms

525-line Monochrome and NTSC Colour Waveforms

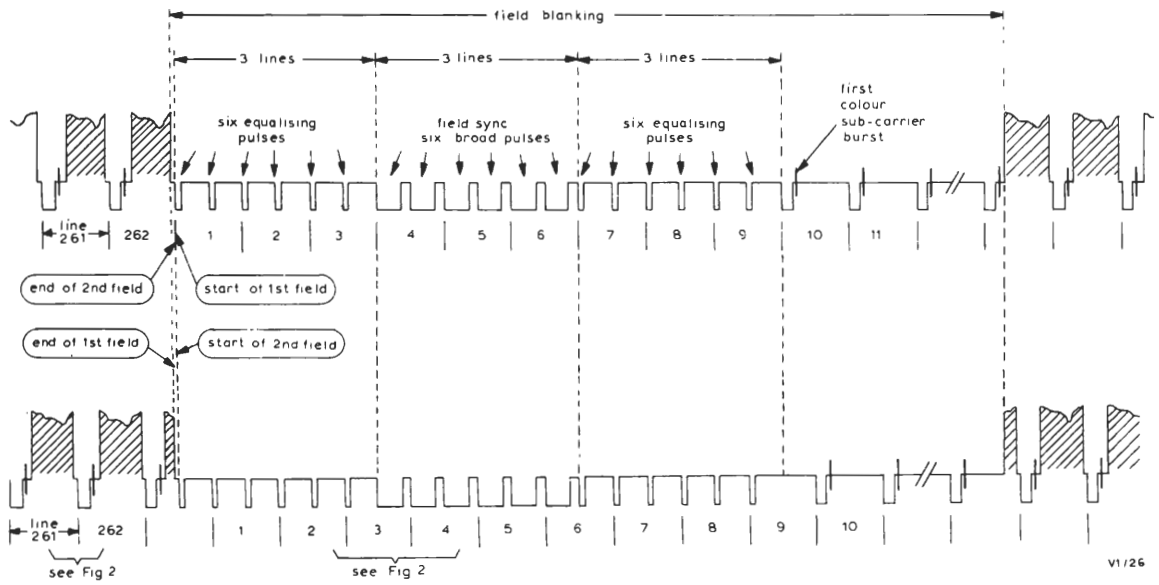


Fig. 1 525-line waveform: start of first and second fields in each picture
(Bursts are not present in a monochrome signal. Fields and lines are numbered as in the U.S.A.; line 1 starts with the second equalizing pulse.)

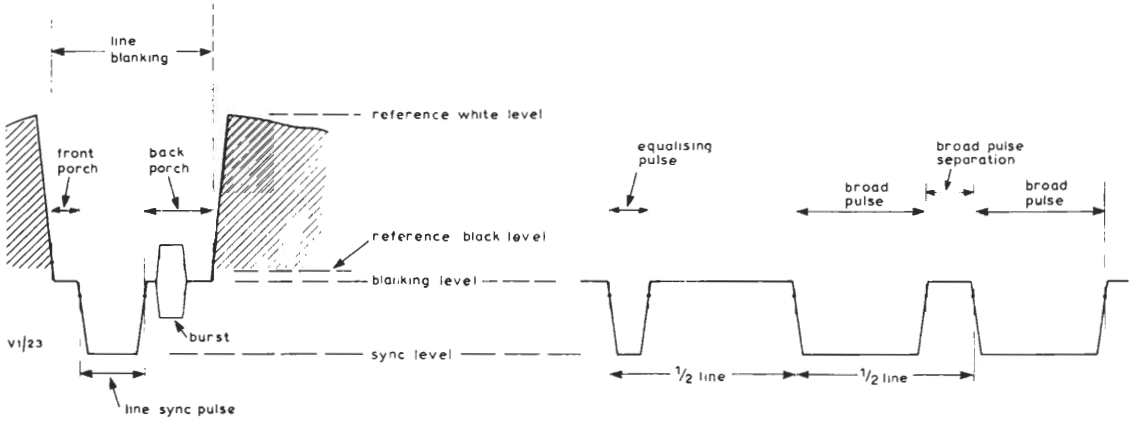


Fig.2 525-line waveform: line synce interval (left), equalising pulse and field-sync broad pulse (right)

525-line Monochrome and NTSC Colour Waveforms

Waveform Durations (See Note 2)

	Monochrome	*Colour*
Line period	63.5 μs	63.556 μs
Line blanking	10.2-11.4 μs	10.5-11.4 μs
Front porch	1.27-2.54 μs	1.27 μs min.
Line sync pulse	4.2-5.7 μs	4.2-5.7 μs
Line sync pulse + back porch	8.9-10.2 μs	8.06-10.2 μs (See Note 3)
Field period	16.667 ms	16.683 ms
Field blanking	19-21 lines + 10.7 μs	1,168-1,335 μs (approx. 18-21 lines)
Equalising pulse	2.29-2.54 μs	2.29-2.54 μs (See Note 4)
Separation between field sync broad pulses	3.8-5.6 μs	3.8-5.6 μs

Times of Rise and Fall (10-90 % full amplitude)

Line sync pulse	0.25 μs max.	0.25 μs max.
Field sync broad pulse	0.25 μs max.	0.25 μs max.
Line blanking	0.64 μs max.	0.48 μs max.
Field blanking	6.35 μs max.	6.36 μs max.

Amplitudes, Relative to Blanking Level (See Note 5)

Reference white	+100 ±4 units	+100 ±4 units
Reference black (set up)	+7.5 ±2.5 units	+7.5 ±2.5 units
Sync level	−40 ±4 units	−40 ±4 units

Line and Field Frequencies

Line (f_L)	15,750 Hz	15,734.264 Hz
Field (f_F)	60 Hz	$\frac{2}{525} \times f_L$ (approx. 59.94-Hz

Burst Parameters (Colour Waveform)

Waveform — At least 8 cycles of colour subcarrier at 3.579545 MHz ±10 Hz.

Start — At least 0.38 μs after the trailing edge of the line sync pulse. The phase of the subcarrier wave has no specified relation ship with the line sync pulse.

Finish — Not more than 7.94 μs after the leading edge of the line sync pulse.

Amplitude — 0.9 to 1.1 times the blanking to sync-level amplitude, p-p

Burst Blanking (Colour Waveform)

Bursts are omitted during the 9-line interval occupied by equalising pulses and field sync broad pulses.

Phase Reference (Colour Waveform)

Phase of burst plus 180 degrees.

Colour Signal Phase Angle (Colour Waveform)

The phase angles of signals representing primary and complementary colours, relative to phase reference, are the same as those tabulated for odd lines of the first and second fields in the 625-line PAL system.

Notes

1. Figs. 1 and 2, and the associated data for monochrome or colour, conform to monchrome system M or the U.S.A. colour system as detailed in C.C.I.R. Reports 308-1 and 407 (Oslo 1966), except where any of the following notes specify otherwise.
2. The durations quoted for 525-line waveforms usually refer, in accordance with U.S.A. practice, to intervals between points where leading and trailing edges have reached 10 % of their final amplitude relative to blanking level.
3. Some U.S.A. and Canadian sources specify 9.22 μs minimum for line sync pulse plus back porch.
4. C.C.I.R. Report 407 only gives the single value 2.29 μs for the equalising pulse duration in the colour waveform. Other sources specify up to 2.54 μs.
5. The amplitudes are specified in units on a scale originated by the I.E.E.E. (U.S.A.) and are derived from a number of U.S.A. and Canadian sources. In a particular system, the relationship of units to voltage may be defined: e.g., where the composite signal is 1 volt p-p, 100 units (reference white level) is 0.71 volt.

625-line Monochrome and PAL Colour Waveforms

625-line Monochrome and PAL Colour Waveforms

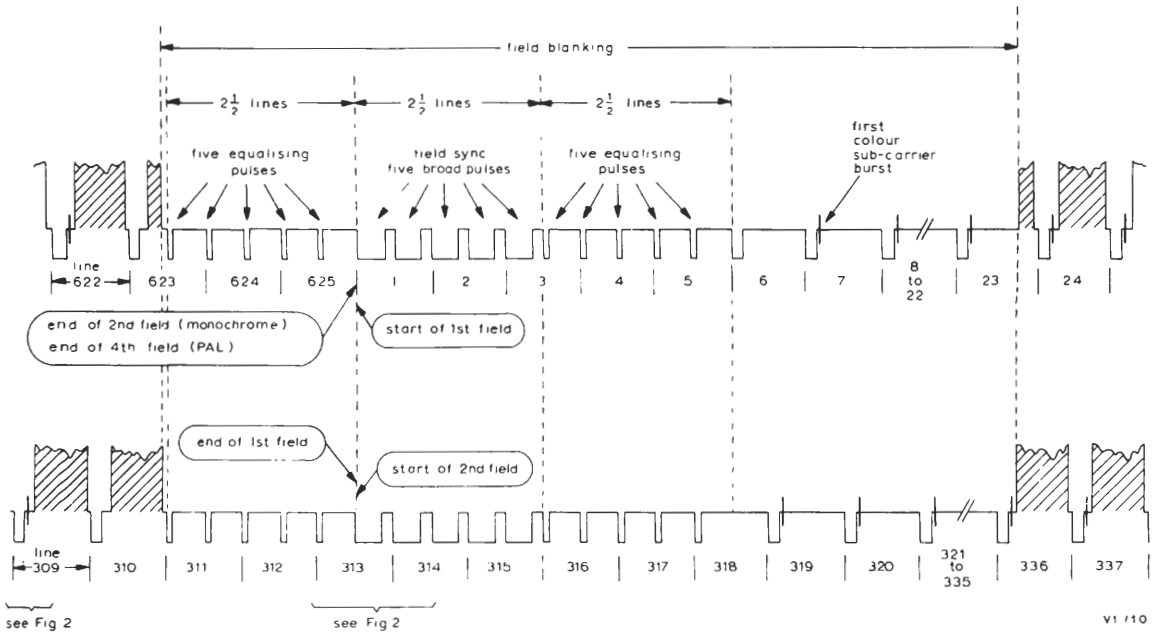


Fig. 1 625-line waveform: start of first and second fields
(The timing of bursts is repetitive over a series of four fields.)

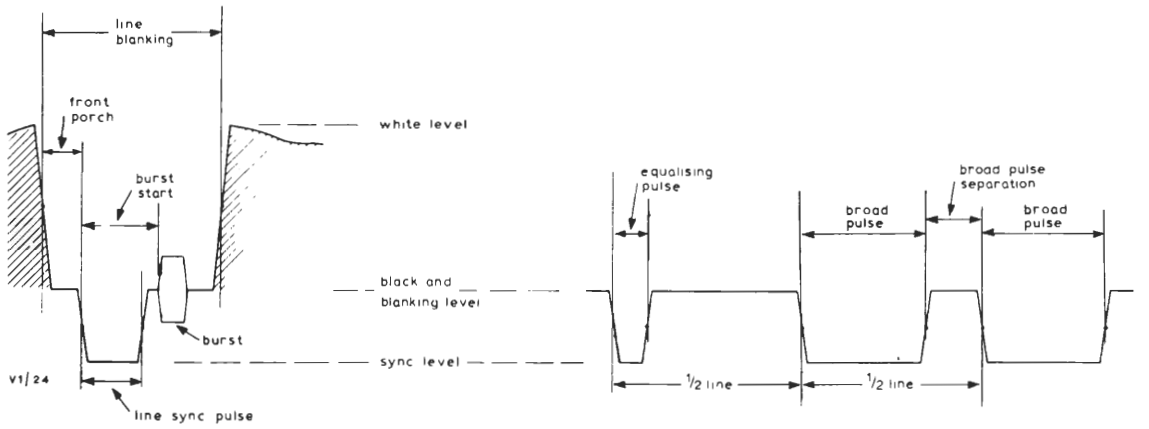


Fig. 2 625-line waveform: line sync interval (left); equalizing pulse and field sync pulses (right)

625-line Monochrome and PAL Colour Waveforms

Waveform Durations (between half-amplitude points)

Line period	64 μs nominal
Line blanking	12.05 ± 0.25 μs
Front porch	1.55 ± 0.25 μs (See Note 7)
Line sync pulse	4.7 ± 0.1 μs (See Note 2)
Field period	20 ms
Field blanking	25 lines + 12.05 μs (See Note 3)
Equalising pulse	2.35 ± 0.1 μs (See Note 3)
Separation between field sync broad pulses	4.7 ± 0.1 μs (See Note 2)

Times of Rise and Fall (10-90 % full amplitude)

Line sync pulse	0.25 ± 0.05 μs (See Note 4)
Equalising pulse	0.25 ± 0.05 μs (See Note 4)
Field sync broad pulse	0.25 ± 0.05 μs (See Note 4)
Line blanking	0.3 ± 0.1 μs
Field blanking	0.3 ± 0.1 μs (See Note 3)

Amplitudes, Relative to Blanking Level

White level	+0.7 V ± 0.25 dB.
Sync level	−0.3 V ± 0.25 dB

Frequencies

Colour subcarrier (f_{SC})	4,433,618.75 ± 1 Hz. (See Note 5)
Line (f_L)	$f_{SC} \div (\frac{567}{2} + \frac{1}{4} + \frac{1}{625})$ = 15,625 Hz. (See Note 6)
Field (f_F)	$2 f_L \div 625 = 50$ Hz.

Burst Parameters (Colour Waveform)

Waveform	10 ± 1 cycles of colour subcarrier
Start	5.6 ± 0.1 μs after the leading edge of the line sync pulse. (See Notes 4 and 8). The phase of the subcarrier wave has no specified relationship with the line sync pulse.
Amplitude	0.3 V p-p ± 0.25 dB. (See Note 2).

Burst Blanking and Burst Phase Sequence (Colour Waveform)

Bursts are omitted from nine-line periods commencing in advance of or coincident with field blanking, and are introduced in successive series of four fields as follows:

First field:	on lines 7 to 309
Second field:	on lines 319 to 621
Third field:	on lines 6 to 310
Fourth field:	on lines 320 to 622

The first burst waveform in each field is at 135 degrees relative to phase reference, and following bursts are alternately at 225 (i.e. −135) degrees and 135 degrees.

The bursts are also specified as being at 45 ± 0.5 degrees, each side of a 'burst mean phase axis' which is at 180 ±2 degrees relative to phase reference. (See Note 4).

Phase Reference (Colour Waveform)

B–Y axis. (Corresponds in position to the U axis in the PAL system).

Bandwidth (Colour Waveform)

Luminance	D.C. to 5.5 MHz; flat except if modified at f_{SC} by a notch filter.
Chrominance	Less than 3 dB down at 1.3 MHz, more than 20 dB down at 4 MHz relative to low frequencies. (See Note 4)

Signals in Field Blanking

Lines 16 and 329 may contain international identification and control signals.

Lines 17, 18, 330, 331 may contain international test signals.

Lines 19, 20, 332 and 333 may contain national test signals.

Colour Signal Phase Angle, after Coder

Signal	*Angles of Burst and of Signals Representing Primary and Complementary Colours, Relative to Phase Reference*	
	On Odd Lines of 1st and 2nd Fields *On Even Lines of 3rd and 4th Fields*	*On Even Lines of 1st and 2nd Fields* *On Odd lines of 3rd and 4th Fields*
Burst	135°	225°
Yellow	167.2°	192.8°
Cyan	283.5°	76.5°
Green	240.7°	119.3°
Magenta	60.7°	299.3°
Red	103.5°	256.5°
Blue	347.2°	12.8°

This table is based on information in Designs Department Technical Memorandum No. 8.222(66).

See notes overleaf

Notes

1. Figs. 1 and 2, and the associated data, conform to monochrome system I and the PAL system in C.C.I.R. Reports 308-1 and 407 (Oslo 1966) except where any of the following notes specify otherwise.
2. The tolerance is that adopted in the BBC. See Designs Dept. Technical Memorandum 8.258(68).
3. The field-blanking and equalising-pulse durations and the field blanking times of rise and fall, conform to C.C.I.R. Report 310-1 (Oslo 1966).
4. Values adopted in the BBC. See Designs Dept. Technical Memorandum 8.258(68).
5. f_{SC} may have a tolerance of ±5 Hz in a PAL signal originating outside the U.K.
6. The relationship of f_L to f_{SC} may not be exact while a signal is (a) in the process of synchronisation or (b) derived by standards conversion. At these times f_L = 15,625 Hz ± 0.01 %.
7. A front porch of 1.65 ± 0.1 μs has been found necessary for optimum operation of video tape machines.
8. The burst may be at 5.5 ± 0.2 μs in a PAL signal originating outside the BBC.

625-line System L Monochrome and SECAM III Colour Waveforms

625-line System L Monochrome and SECAM III Colour Waveforms

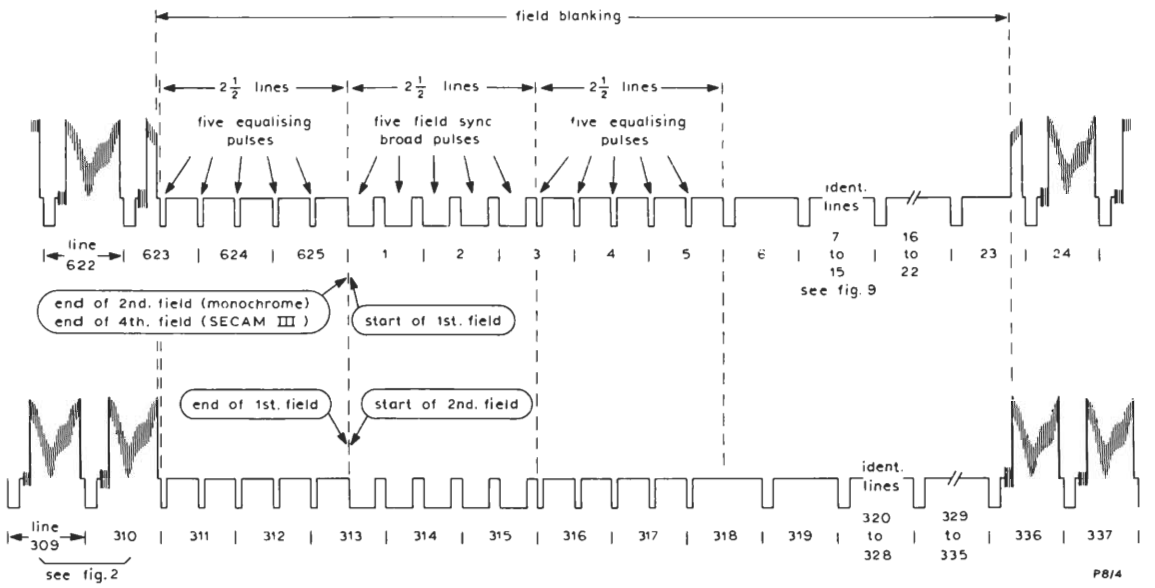


Fig.1 625-line system L and SECAM III waveforms: start of first and second fields
(The waveforms shown recur in each pair of fields which make a picture, except that the alternation of subcarrier frequency and amplitude creates a cycle of four fields and the reversal of subcarrier phase a cycle of 12 fields.)

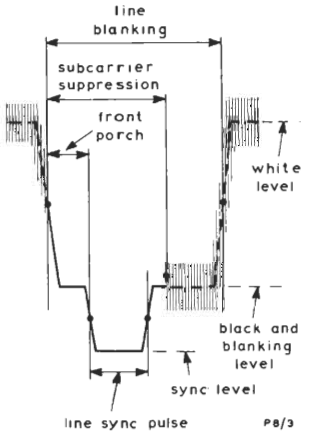


Fig. 2 SECAM III line sync interval

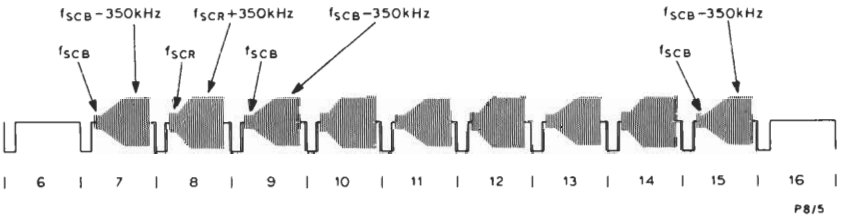


Fig. 3 A sequence of SECAM III ident lines

625-line System L Monochrome and SECAM III Colour Waveforms

Waveform Durations (between half-amplitude points)

Line period	64 μs nominal
Line blanking	12.0 ± 0.3 μs
Front porch	1.5 ± 0.3 μs
Line sync pulse	4.7 ± 0.2 μs
Field period	20 ms nominal
Field blanking	25 lines + 12.0 μs
Equalising pulse	2.35 ± 0.1 μs
Separation between field sync broad pulses	4.7 ± 0.2 μs

Amplitude, Relative to Blanking Level

White level (luminance signal)	0.7 V
Black level (luminance signal)	At, or close to, blanking level
Sync level	−0.3 V

Line and Field Frequencies

Line (f_L)	15,625 Hz
Field (f_F)	$f_L \div 625 = 50$ Hz (independent of mains frequency)

Times of Rise and Fall (10-90 % full amplitude)

Line sync pulse	0.15 ± 0.05 μs (See Note 2)
Equalising pulse	0.15 ± 0.05 μs
Field sync broad pulse	0.15 ± 0.05 μs
Line blanking	0.3 ± 0.1 μs (See Notes 2 and 3)
Field blanking	0.3 ± 0.1 μs (See Note 2)

Chrominance Subcarrier

Frequencies — On successive lines the unmodulated subcarrier is alternately at

$f_{SCR} = 282f_L = 4.40625$ MHz

$f_{SCB} = 272f_L = 4.25000$ MHz

within ±2 kHz of reference signals of $282f_L$ and $272f_L$, respectively, to which the subcarrier is initially locked during line blanking.

Phase — The subcarrier is locked in phase, or 180 degrees out of phase, with the reference signals. Pairs of lines in which the subcarrier is locked in one mode alternate with single lines in which the subcarrier is locked in the other mode. The sequence is reversed in each field and is also staggered in successive fields so that a complete cycle of subcarrier frequency and phase changes occupies 12 fields.

Ident lines — The sequence of f_{SCR} and f_{SCB} is established in each field blanking period by nine alternate ident lines, i.e. lines 7 to 15 and 320 to 328 in each picture.

In f_{SCR} ident lines the subcarrier deviates linearly, in 15 ±5 μs, from f_{SCR} (206 mV p-p) to f_{SCR} + 350 kHz (535 mV p-p), at which the subcarrier remains for the remainder of the line.

In f_{SCB} ident lines the subcarrier deviates linearly, in 20 ± 10 μs, from f_{SCB} (166 mV p-p) to f_{SCB} −350 kHz (501 mV p-p), at which the subcarrier remains.

In ident lines the luminance signal is zero.

Subcarrier suppression — Beginning with line blanking, for 6.7 to 7.8 μs (See Note 4.)

Throughout field blanking, except in the ident lines.

Subcarrier Modulation

Two modulating signals are formed by subjecting the gamma-corrected red and blue colour difference signals $(E_R - E_Y)$ and $(E_B - E_Y)$ to individual weighting factors and to video-frequency pre-emphasis with bandwidth limitations. (See Note 5.). These two signals linearly frequency modulate the subcarrier when it is f_{SCR} and f_{SCB} respectively, on alternate lines.

Modulation of f_{SCR} due to $(E_R - E_Y)$ signal	Unit modulating signal (corresponding to the steady level for red and cyan in EBU colour bars) produces 280 kHz deviation. down or up for positive or negative values of $(E_R - E_Y)$ respectively. See Table of Signal Values.
Modulation of f_{SCB} due to $(E_B - E_Y)$	Unit modulating signal (corresponding to the steady level for blue and yellow in EBU colour bars) produces 230 kHz deviation, up or down for positive or negative values of $(E_B - E_Y)$ respectively. See Table of Signal Values.
Deviation limits (See Note 5).	f_{SCB} +350 kHz and −500 kHz, f_{SCB} +500 kHz and −350 kHz, i.e., on both f_{SCR} and f_{SCB} lines the subcarrier deviation is limited at about 4.75 MHz and 3.90 MHz.
Modulated subcarrier pre-emphasis (See Note 5).	Before addition to the luminance signal, the modulated subcarrier is subject to the transmission factor. $\frac{1 + j16F}{1 + j1.26F}$ where $F = \frac{f}{fo} - \frac{fo}{f}$ and $fo = 4.28600$ MHz

Bandwidth

Luminance	D.C. to 6.0 MHz
Chrominance	From 2.8 to 5.8 MHz approximately

Signals in Field Blanking

Lines 7 to 15 and 320 to 328 are subcarrier frequency ident lines.

Lines 16 to 22 and 329 are reserved for test and control signals.

625-line System L Monochrome and SECAM III Colour Waveforms

Table of Signal Values

Steady-state values (after transients due to pre-emphasis) of the subcarrier modulating signal and modulated subcarrier for EBU colour bars (100 % amplitude white bar, 75 % amplitude primary and secondary colour bars), and for levels reached in ident lines.

Colour	*Colour Signals* Relative Amplitudes			*Luminance Signal*	*Modulating Signal* Relative Amplitudes		*Subcarrier Deviation* (kHz)		*Subcarrier Amplitude* (mV**p-p)	
	Red	Green	Blue							
	E'_R	E'_R	E'_B	E'_Y	f_{SCR} lines	f_{SCB} lines	f_{SCR} lines	f_{SCB} lines	f_{SCR} lines	f_{SCB} lines
White	1.00	1:0	1.00	1.00	0	0	0	0	206	166
Yellow	0.75	0.75	0	0.66	–0.16	–1.00	–45	–230	184	350
Cyan	0	0:75	0.75	0.53	+1.00	+0.34	+280	+78	457	170
Green	0	0.75	0	0.44	+0.84	–0.66	+235	–152	418	270
Magenta	0.75	0	0.75	0.31	–0.84	+0.66	–235	+152	206	204
Red	0.75	0	0	0.23	–1.00	–0.34	–280	–78	242	206
Blue	0	0	0.75	0.09	+0.16	+1.00	+45	+230	245	266
Black	0	0	0	0	0	0	0	0	206	166
Ident				0	+1.25	–1.52	+350	–350	535	501

*$E_Y = 0.30E_R + 0.59E_G + 0.11E_B$

**Corresponding to a black-to-white luminance amplitude of 700 mV

Notes

1. Figs. 1, 2 and 3, and the following data, conform to the C.C.I.R. monochrome system L and the optimised SECAM III colour system, as detailed in Designs Department Technical Memorandum 11.38(67), translated from ORTF specification SN 043A (January 1967), except where any of the further notes specify otherwise.

2. Maximum overshoot allowable is 5 %.

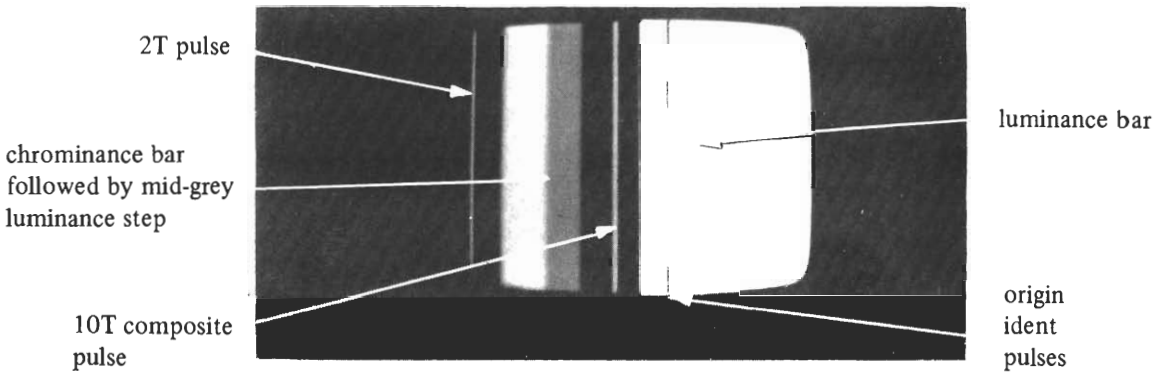
3. Measured with a signal at white level at the end and beginning of lines.

4. From a C.C.I.R. draft report, September 1969. The earlier value in D.D.T.M. 11.38(67) for the end of subcarrier suppression was 5.7 ±0.3 μs after the leading edge of line sync.

5. The video-frequency pre-emphasis and the subcarrier pre-emphasis are also known as the low-frequency and high-frequency pre-emphasis, correction, or pre-correction. The first can cause overshoots in the modulating signal at transitions of level in the colour difference signals and, for increases of level, may cause the frequency modulation to reach, and be curtailed at, the deviation limits. The subcarrier pre-emphasis results in an increase in subcarrier amplitude as it deviates away from 4.286 MHz, and the chrominance signal may include overshoots or rounded edges on its envelope at colour signal transitions, as may be evident on the waveform for colour bars.

APPENDIX VTW.B
STATION IDENTIFICATION PATTERNS

The line-repetitive chrominance-luminance pulse-and-bar test signal (see VTW.1) may include a negative-going sine-squared pulse within the period of the 25 μs luminance bar. This pulse can be blanked so that a vertical column of one to four black bars is visible when the waveform is viewed on a television monitor. The pattern of bars is used to identify the station originating the signal. The table below shows the codes in use at the time of writing (February 1977).



Birmingham	Bangor	Edinburgh	Bristol	Manchester	Glasgow	Belfast	
BM	BG	EH	BS	MR	GW	BE	
I				I	I	I	
	I			I	I	I	
		I			I	I	
			I			I	

Aberdeen	London	Southampton	Plymouth	Cardiff	Leeds	Norwich	Newcastle
AB	LO	SO	PY	CF	LS	NC	NT
I	I				I	I	
		I	I		I		I
I		I		I		I	I
	I		I	I	I	I	I