RECOMMENDATION ITU-R BT.1119-2*

WIDE-SCREEN SIGNALLING FOR BROADCASTING

(Signalling for wide-screen and other enhanced television parameters)

(Question ITU-R 42/11)

(1994-1995-1998)

The ITU Radiocommunication Assembly,

considering

a) that 16:9 wide-screen television receivers are increasingly being made available to the public in 525-line and 625-line countries. The advent of a wide-screen receiver market is leading programme producers to consider the production aspects of wide-screen programmes that will be shown on 4:3 displays as well as 16:9 displays;

b) that provision for a common system for optimizing the display of the original programme material on a suitably equipped 16:9 display device would be a valuable enhancement to the service provided, together with the means to make appropriate automatic arrangements for any subtitling;

c) that there would be benefits for multi-standard receivers and, recorders, and costs, if a unique signalling system were used for all television standards,

recommends

1 that for broadcasters wishing to broadcast a wide-screen signalling system, the system given in Annex 1 should be used for 625-line analogue broadcasts and the system in Annex 2 should be used for 525-line analogue broadcasts.

ANNEX 1

1 Scope

This specification is applicable to 625-line PAL and SECAM systems in use in cases where wide-screen signalling is to be provided by the broadcasters for use by new 16:9 television receivers.

It specifies the wide-screen signalling information, the coding and the way of incorporating the coded information into a 625-line system.

The wide-screen signalling information contains information on the aspect ratio range of the transmitted signal and its position as it would appear on a conventional 4:3 display and on the position of the subtitles and on the camera/film mode. Furthermore some bits are reserved for future EDTV signalling (e.g. PALplus, see Recommendation ITU-R BT.1197) as well as for future use.

This Annex specifies the transmitted signal. Appendix 1 gives the rules of operation for the minimum requirements for receiver display formats as well as for subtitling. Appendix 2 gives some recommended practices.

---

* This Recommendation should be brought to the attention of the European Broadcasting Union (EBU) and the European Telecommunications Standards Institute (ETSI).

2 Normative references

This Recommendation does not incorporate any normative reference.

3 Definitions

For the purpose of this Recommendation, the following definition applies:

Letterbox operation: the transmission of a picture format with an aspect ratio greater than 1.33, in such a way that empty (black) lines are added to conform to a 4:3 transmission format.

3.1 Symbols and abbreviations

a : aspect ratio

F_s : clock frequency

T_d : data bit period

T_s : sampling period

TXT : teletext.

4 Requirements

4.1 Line code

The following sections specify the line code of the wide-screen signalling.

4.1.1 Position

The signalling bits shall be transmitted as a data burst in the first part of line 23. The position of the beginning of the wide-screen signalling bits shall be 11.0 ± 0.25 µs from O_H of the horizontal sync, as indicated in Fig. 1.

In each frame the first part of line 23 shall be occupied with the wide-screen signalling.

4.1.2 Clock frequency

The clock frequency shall be: $F_s = 5$ MHz ($\pm 1 \times 10^{-4}$).

The period shall be: $T_s = 200$ ns.

4.1.3 Signal waveform

The signal waveform shall be approximately a sine squared pulse.

The half amplitude pulse duration shall be: 200 ± 10 ns.

4.1.4 Signal amplitude

The signal amplitude with respect to a maximum video signal amplitude of 700 mV shall be:

$$500 \text{ mV} \pm 5\%.$$

4.1.5 Modulation coding

Bi-phase coding shall be used in accordance with Fig. 2.

Duration of one data bit: T_d.

FIGURE 1

Position of status bit signalling in line 23

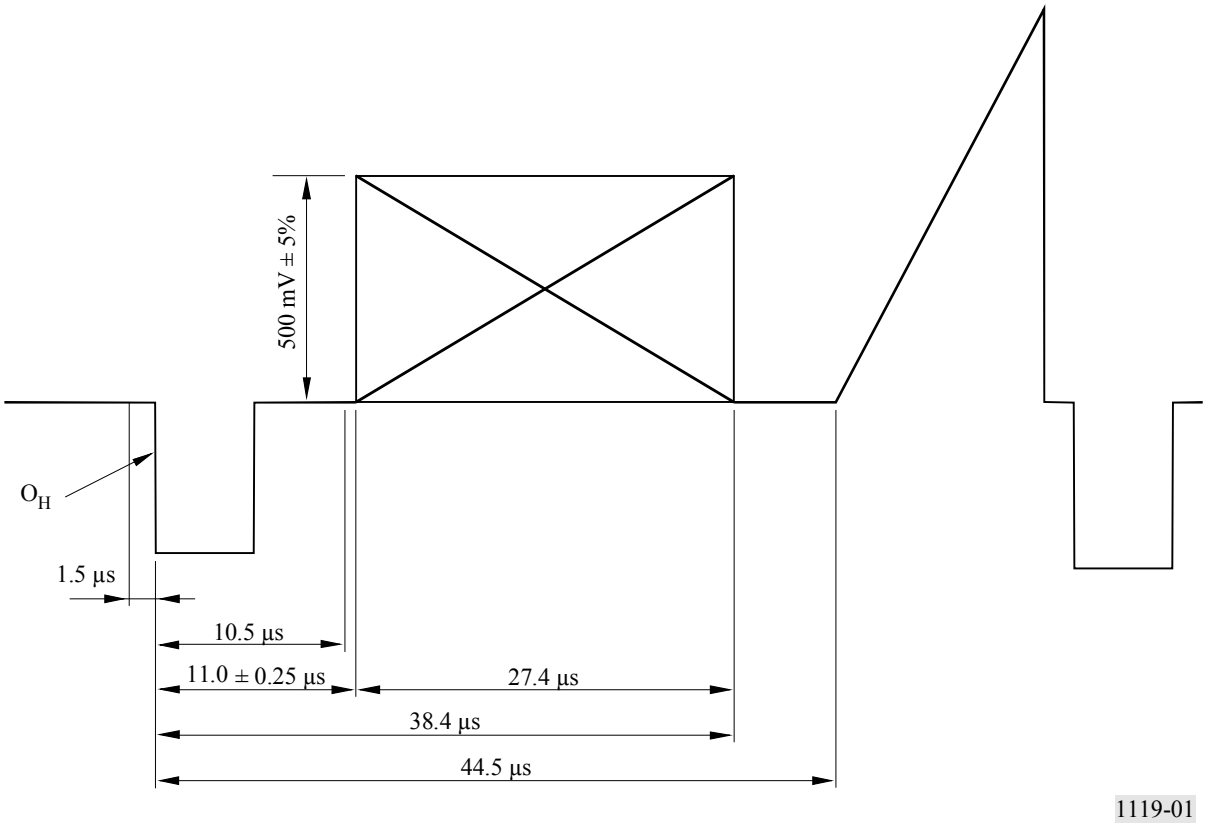
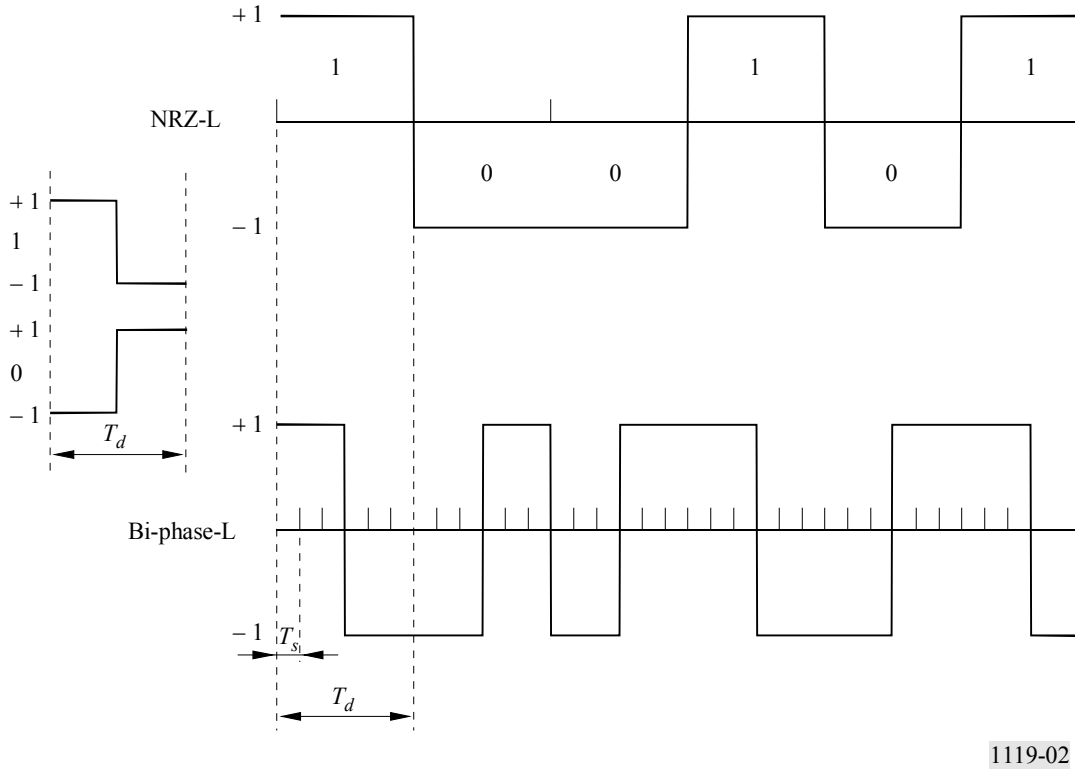


FIGURE 2

Example of bi-phase-L coding



The data bits shall be inserted in NRZ-L at the input of the (bi-phase-L) code modulator. The code modulator will produce on line 23, the data in bi-phase-L code, in which one data bit period equals 2×3 clock periods, whereby:

$$T_d = 6\ T_s$$

4.1.6 Preamble

The preamble contains a run-in and a start code. The preamble shall be in accordance with Table 1.

4.1.7 Data bits

There shall be 14 bits in total. One of these 14 bits shall be allocated to the error detection code. There shall be 13 data bits available for transmission of information. The data bits shall be grouped in four data groups (see Table 1).

4.1.8 Odd parity bit

For error detection, an odd parity bit has been introduced. The odd parity bit shall belong to the first three data bits only (see Table 1).

TABLE 1

Status bits transmission scheme

Status bits transmission
Insertion: first half of line 23
Coding: bi-phase modulation coding
Clock: 5 MHz (T_s = 200 ns)

Run-in	Start code	Group 1 Aspect ratio	Group 2 Enhanced services	Group 3 Subtitles	Group 4 Reserved
29 elements based on 5 MHz	24 elements based on 5 MHz	24 elements based on 5 MHz	24 elements based on 5 MHz	18 elements based on 5 MHz	18 elements based on 5 MHz
		Bit numbering 0 1 2 3 LSB MSB per info bit(1) "0" = 000 111 "1" = 111 000	Bit numbering 4 5 6 7 LSB MSB per info bit(1) "0" = 000 111 "1" = 111 000	Bit numbering 8 9 10 LSB MSB per info bit(1) "0" = 000 111 "1" = 111 000	Bit numbering 11 12 13 LSB MSB per info bit(1) "0" = 000 111 "1" = 111 000
0 × 1F1C 71C7 1 1111 0001 1100 0111 0001 1100 0111	0 × 1E 3C1F 0001 1110 0011 1100 0001 1111	3 2 1 0 bit number 1000 full format 4:3 0001 box 14:9 centre 0010 box 14:9 top 1011 box 16:9 centre 0100 box 16:9 top 1101 box > 16:9 centre 1110 full format 14:9 centre shoot and protect 14:9 0111 full format 16:9 anamorphic b_3 = odd parity bit	b_4 film bit 0 camera mode 1 film mode b_5 = colour coding bit 0 conventional coding 1 Motion Adaptative Colour Plus b_6 = helper bit 0 no helper 1 modulated helper b_7 = Reserved. Should be set to "0" until otherwise defined	8 bit number 0 no subtitles within teletext 1 subtitles within teletext 10 9 bit number 00 no open subtitles 01 subtitles in active image area 10 subtitles out of active image area 11 reserved	Reserved. Should all be set to "0" until otherwise defined

(1) 1 info bit consists of 6 elements based on 5 MHz clock.

4.2 Information content of data bits

The 13 data bits shall be grouped in four groups.

Group 1 shall contain 4 bits in which the first 3 bits carry data and the last bit shall denote the odd parity bit of the first three data bits. Group 2 shall contain 4 data bits, Group 3 shall contain 3 data bits and Group 4 shall contain 3 data bits.

The data bits shall be labelled b_0 up to and including b_2 combined with b_4 up to and including b_{13},b_3 shall be the odd parity bit as is shown in Tables 1 and 2. The index also indicates the order of transmission: b_0 shall be the first transmitted bit.

4.2.1 Data group 1

4.2.1.1 Aspect ratio

b_0, b_1, b_2 : shall denote the aspect ratio label, the letterbox format and position according to Table 2.

Diagrams illustrating the way that pictures will be displayed on: 16:9 displays equipped to make use of wide-screen signalling information; and on conventional 4:3 displays (not equipped to decode wide-screen signalling information) are given in Figure 3.

b_3 : shall denote the odd parity of b_0, b_1, b_2, b_3 according to Table 2.

TABLE 2

Aspect ratio label, letterbox and position code

b_3	$b_2b_1b_0$	Aspect ratio label	Full format or letterbox	Position (when shown on a conventional 4:3 display)	No. of active lines[1]
1	000	4:3	Full format	Not applicable	576
0	001	14:9	Letterbox	Centre	504
0	010	14:9	Letterbox	Top	504
1	011	16:9	Letterbox	Centre	430
0	100	16:9	Letterbox	Top	430
1	101	>16:9	Letterbox	Centre	Not defined
1	110	14:9	Full format[2]	Centre	576
0	111	16:9	Full format (anamorphic)	Not applicable	576

(1) The number of active lines is only an indication for the exact aspect ratio $a = 1.33$, $a = 1.57$ and $a = 1.78$.

(2) The actual transmitted aspect ratio is 4:3, but within this 4:3 area a 14:9 window is protected so that it contains all the relevant picture content to encourage a wide-screen display on a 16:9 television set.

FIGURE 3

Diagrams showing the appearance of various display modes when displayed on 16:9 and 4:3 displays

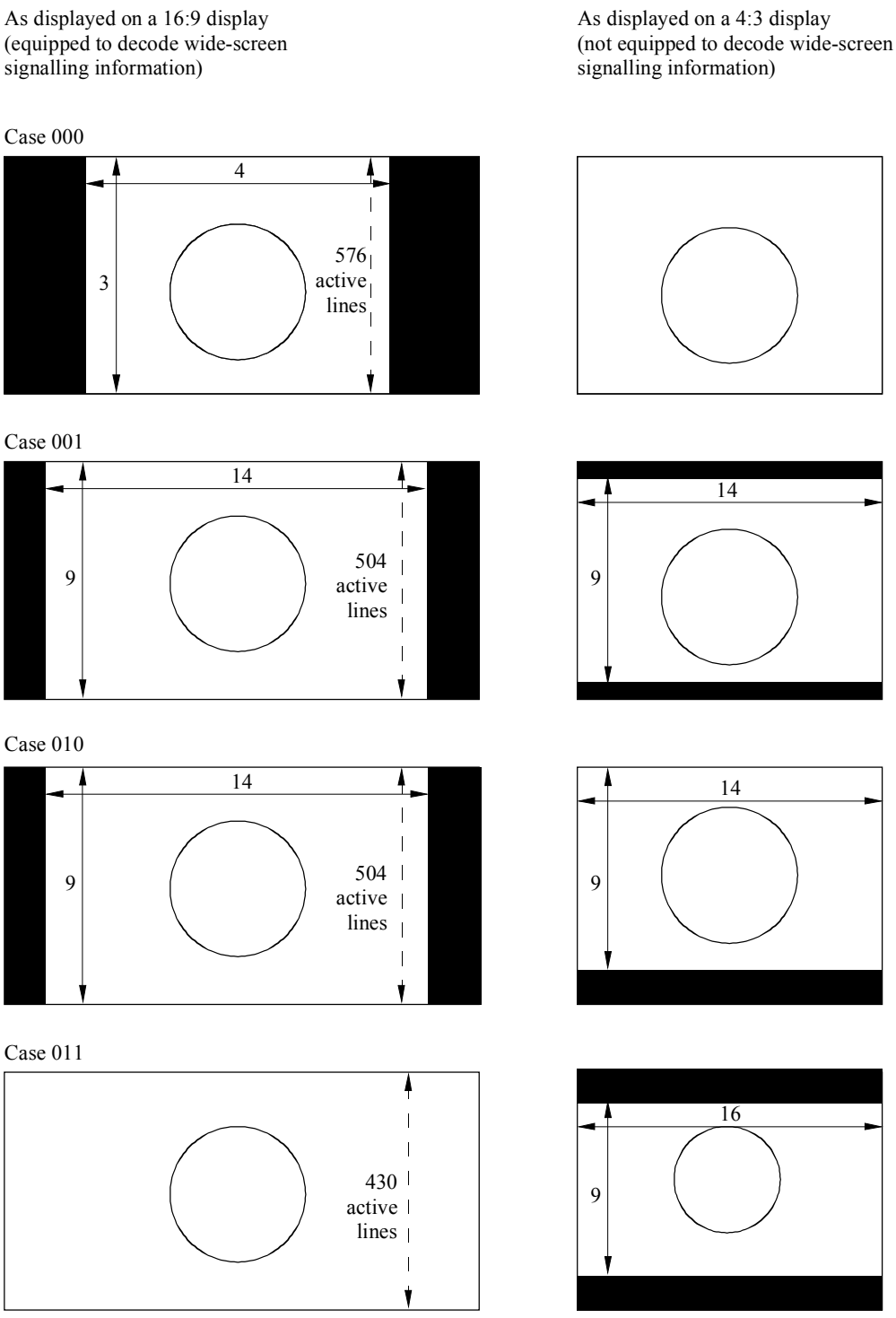
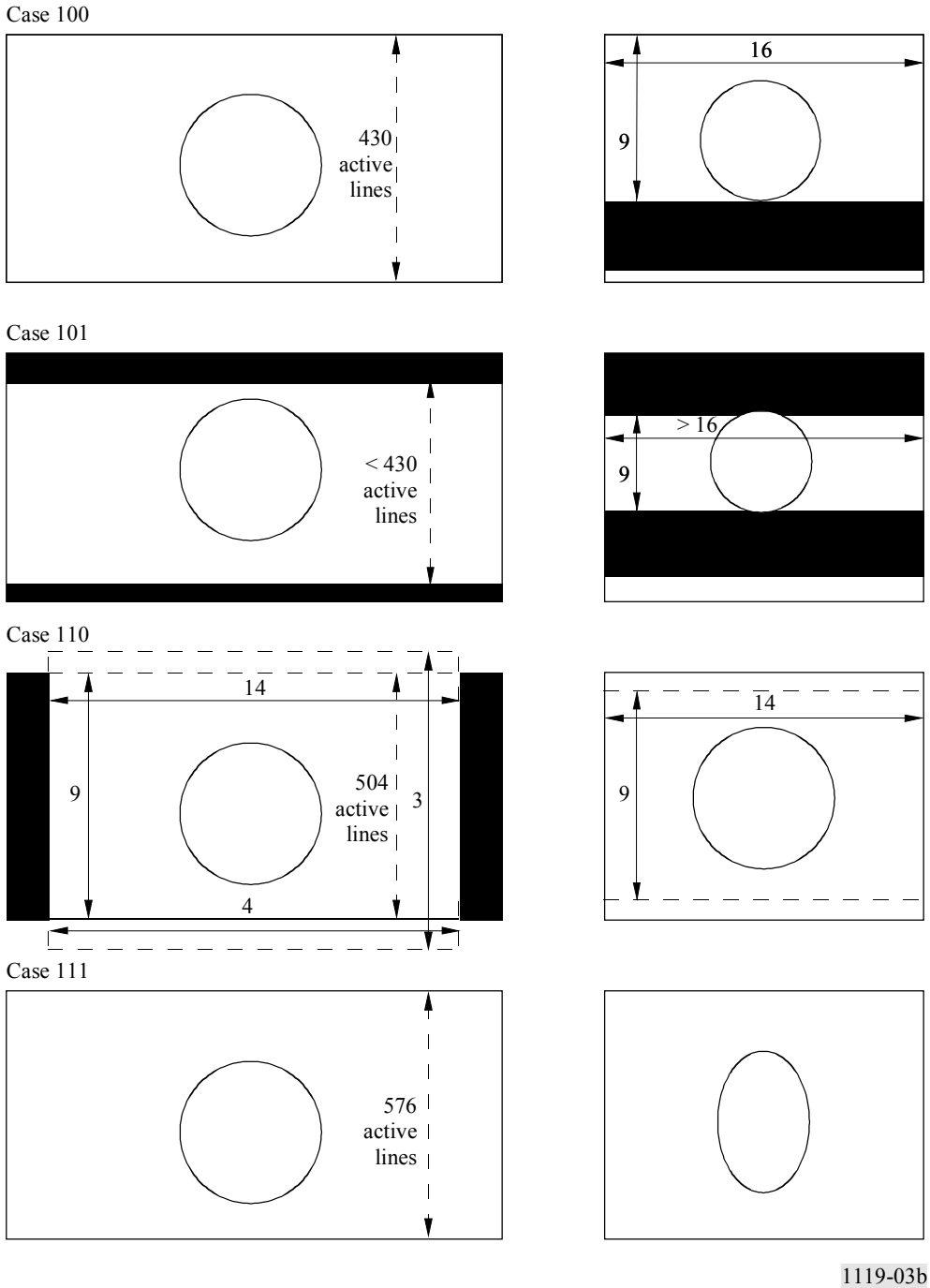


FIGURE 3 *(continued)*



The aspect ratio label indicates a range of possible aspect ratio. All aspect ratios falling in these ranges shall be labelled by the same code. Table 3 indicates the aspect ratio ranges.

TABLE 3

Aspect ratio ranges

Aspect ratio label	Aspect ratio range
4:3	$a \leq 1.46$
14:9	$1.46 < a \leq 1.66$
16:9	$1.66 < a \leq 1.90$
>16:9	$a > 1.90$

4.2.2 Data group 2, enhanced services

4.2.2.1 Film bit

b_4 : shall denote the film bit in accordance with Table 4.

TABLE 4

Film bit

b_4	Film bit
0	Camera mode
1	Film mode(1)

(1) The field dominance shall conform to Recommendation ITU-R BR.469 and EBU Recommendation R62-1990.

4.2.2.2 Colour coding bit

b_5: shall denote the colour coding bit in accordance with Table 5.

TABLE 5

Colour coding bit

b_5	Colour coding bit
0	Conventional coding
1	Motion adaptive colour plus coding

4.2.2.3 Helper bit

b_6: shall denote the helper bit in accordance with Table 6.

4.2.2.4 Bit b_7

b_7: reserved, this bit should be set to "0" until otherwise defined.

TABLE 6

Helper bit

b_6	Helper bit
0	No helper
1	Modulated helper

4.2.3 Data group 3, subtitles

4.2.3.1 Subtitles within teletext bit

b_8 : shall denote the subtitles within teletext in accordance with Table 7.

TABLE 7

Subtitles within teletext bit

b_8	Subtitles within teletext bit
0	No subtitles within teletext
1	Subtitles within teletext

4.2.3.2 Subtitling mode

b_9, b_{10} : shall denote the mode of subtitling in accordance with Table 8.

TABLE 8

Subtitling mode

b_{10}, b_9	Subtitles in/out of active image area
00	No open subtitles
01	Subtitles in active image area
10	Subtitles out of active image area
11	Reserved

NOTE 1 – The "out of active image area" subtitling, which extends into the active image area shall be treated as "out of active image area".

Figure 4 indicates the meaning of the terms "in active image area" and "out of active image area".

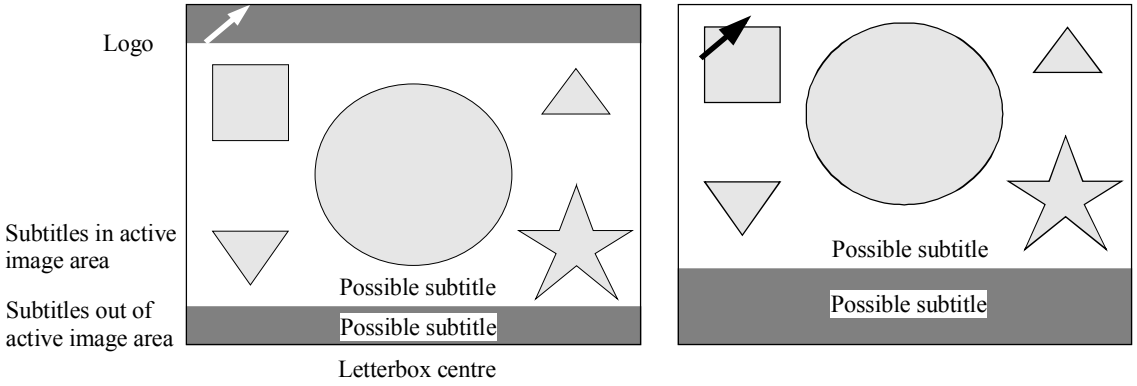
NOTE – In the case of "out of active image area", subtitling the helper bit, b_6, must be set to "0".

4.2.4 Data group 4, reserved

b_{11}, b_{12}, b_{13} : reserved these should be set to "0" until otherwise defined.

FIGURE 4

Examples of letterbox signals with logos and subtitling



APPENDIX 1

TO ANNEX 1

Rules of operation

1 Receiver display formats

To ensure automatic selection of the most appropriate display mode, the receiver with a 16:9 display should comply with the following minimum requirements.

TABLE 9

Aspect ratio minimum requirements

$b_2b_1b_0$	Aspect ratio label	Minimum requirements
000	4:3	Case 1
001	14:9	Case 2
010	14:9	Case 2
$b_2b_1b_0$	Aspect ratio label	Minimum requirements
011	16:9	Case 3
100	16:9	Case 3
101	>16:9	Case 4

Case 1: 4:3 full format: The 4:3 aspect ratio picture should be displayed centred with black bars at the left and right hand side of the display.

Case 2: letterbox signalled as 14:9. The 14:9 aspect ratio picture should be displayed using one of the following two methods:

- the 14:9 aspect ratio picture should be displayed centred with small bars at the left and right hand sides of the display.
- the 14:9 picture may be displayed filling the full width of the visible screen by incorporating a small horizontal geometrical error – typically 8%.

Case 3: letterbox signalled as 16:9. The 16:9 aspect ratio picture should be displayed using the full width of the screen.

Case 4: letterbox signalled as >16:9. The >16:9 aspect ratio picture should be displayed using one of the following two methods:

– as under Case 3;

It should be noted that the viewer should be free to override the automatically selected display condition. The speed of the automatic change of aspect ratio is limited mainly by the response time of the deflection circuits.

2 Subtitling

When the subtitling of letterboxed pictures is in, or partly in, the "out of active image area", the new 16:9 receivers will lose this information, unless they display the picture in the 4:3 mode. This would mean that on the 16:9 receiver black bars would be present all around the active image content, and this should be avoided.

To serve both the interests of the existing 4:3 and the new 16:9 viewers, it is of great importance that:

– wide-screen programmes should always have the subtitling (whether "in active image area" or "out of active image area") conveyed as well by means of the teletext service;

– new 16:9 receivers, complying with this standard, should be equipped with a teletext decoder and always have the possibility of detecting the teletext presence bit b_8.

3 Procedure in absence of signalling

In the absence of signalling bits, the receiver should go to a default mode.

APPENDIX 2

TO ANNEX 1

Recommended practices

1 Low pass pre-filtering

It is recommended that the received status bit is low pass filtered before decoding.

This low pass filter should preserve the main spectral energy of the status bits signal, which resides in the spectral domain of 0 up to 1.67 MHz.

2 Response time on a change in the received signalling information

The maximum response time on a change in the received status bits signalling information is recommended to be 120 ms.

ANNEX 2

1 Scope

The specification is applicable to the 525-line NTSC system in cases where wide-screen signalling is to be provided by the broadcasters for use by new television receivers.

It specifies wide-screen signalling information, the coding and the method of incorporating the coded information into a 525-line system.

The wide-screen signalling information contains information on the aspect ratio of the transmitted signals and various information required for the EDTV-II enhanced television system, such as the incorporation of various picture quality helper signals and on the designation field/frame types. Furthermore, some bits are reserved for future use.

This Annex specifies the transmitted signal.

2 Definitions, symbols and abbreviations

2.1 Definitions

Letterbox operation: the use of a picture format to transmit 16:9 aspect ratio pictures, in such a way that upper and lower black areas are added to conform to a 4:3 transmission format.

Full format operation: the use of all active picture lines to carry a 4:3 transmission format.

2.2 Symbols and abbreviations

SC: duration of one cycle of chrominance signal subcarrier (SC = 1/3.579545 μs)

D: delay element of one data bit period

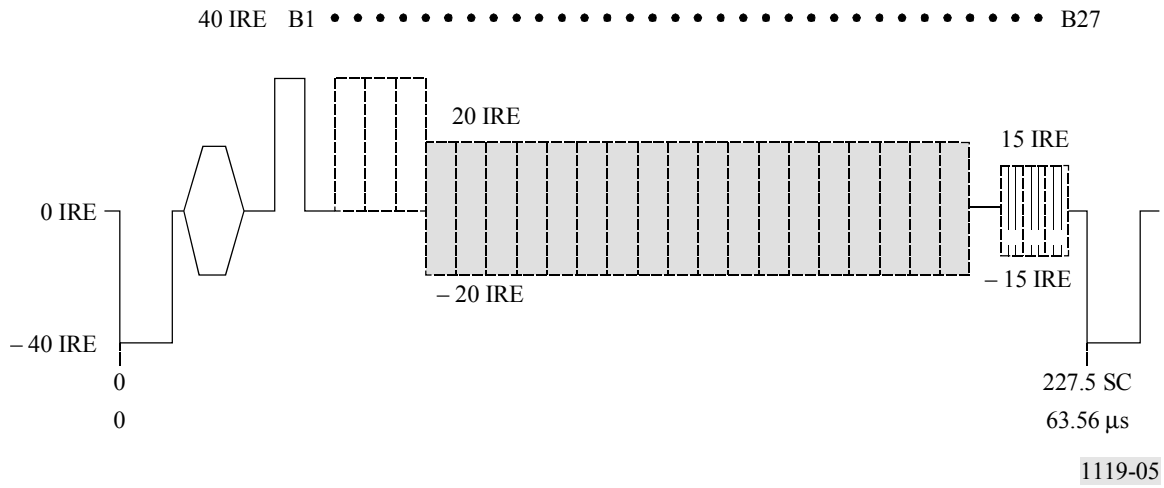
IRE: unit picture signal level when pedestal level is zero and the picture signal white level is 100

F_S: clock frequency

T_S: sampling period

FIGURE 5

Information bit location of wide-screen signalling in line 22 and 285



3 Requirements

The following subclauses specify the line code for wide-screen signalling.

3.1.1 Position

Wide-screen signalling is inserted into line 22 and line 285, as indicated in Figure 5.

The position of the beginning of the signalling bits is defined relative to T1. T1 is defined as the 50% amplitude point of the falling edge of the first data bit B1, with respect to 0_h, the 50% amplitude point of the falling edge of the horizontal synchronizing signal. T1 shall be nominally 40 SC.

Furthermore, T1 shall accord with the zero crossing point of the colour subcarrier which has the same phase as the colour burst.

3.1.2 Clock frequency

The clock frequency shall be: $F_S = 4/SC$ MHz

The sample period shall be: $T_S = SC/4$ μs.

The clock frequency of four times the colour subcarrier frequency shall be synchronized to a colour subcarrier with a phase of 57 degrees delayed with respect to the colour burst. The sampling period just after the 50% amplitude point at the falling edge of B1 shown in Figure 5 shall be the 35th pixel. This pixel numbering system conforms to that of SMPTE 244M, where pixels are separated by period T_S.

3.1.3 Data bits

There shall be 27 data bit periods. Each data bit period has a duration of nominally 7 SC.

Each data bit period is indicated as Bn (n is an integer from 1 to 27). Six of these bits shall be allocated to an error correction code and a further bit shall be a parity bit. In addition, three data bits shall be reference signals, three data bit periods shall be used for a confirmation signal, and three bits are user bits for broadcasters. There shall be 11 data bits available for transmission of information.

Relative to T1, the start and end positions of Bn shall be (7n-14)SC and (7n-7)SC respectively.

3.1.4 Signal waveform

3.1.4.1 B1 to B5, and B24

B1 to B5, and B24 shall be binary NRZ pulses with a setup level of 0 IRE and amplitude of 40 IRE. The rising and falling edges shall be a sine squared pulse. The nominal rise and fall times between the 10% and 90% amplitude points shall be 145 ns.

3.1.4.2 B6 to B23

B6 to B23 shall each be formed from a sine wave with the same frequency as that of the colour subcarrier with the setup level of 0 IRE and the amplitude of ±20 IRE.

The phase shall be the same as that of the colour burst when the information of wide-screen signalling is “0”, and the opposite phase when it is “1”.

The rising and falling edges of each data bit is shaped in the form of a sine squared pulse. The nominal rise and fall times between the 10% and 90% amplitude points of the envelope shall be 290 ns.

3.1.4.3 B25 to B27

The entire period of B25 to B27 shall consist of a sine wave with four-seventh of the frequency of the colour subcarrier with the setup level of 0 IRE and the amplitude of ±15 IRE. The first rising sine wave shall cross zero at the 680th pixel.

The rising and falling edges of the envelope are shaped in the form of a sine squared pulse, and its nominal rise and fall times between the 10% and 90% amplitude points shall be 290 ns.

3.1.5 Tolerances

The amplitude tolerance of each data bit shall be ±2 IRE.

The position of the 50% amplitude point of the falling edge of B1 shall be maintained to better than ±710 ns of its nominal value T1.

The tolerance of the setup level of the wide-screen signalling waveform shall be ±2 IRE.

3.1.6 Reference signals

B1, B2 and B24 shall be reference signals. B1 shall be set to "1", B2 shall be set to "0" and B24 shall be set to "0".

3.1.7 Confirmation signal

B25 to B27 shall be used as a confirmation signal to distinguish between wide-screen signalling and picture signals.

3.1.8 Even parity bit

An even parity bit is introduced for error detection. B4 shall be the even parity bit for B3 to B5.

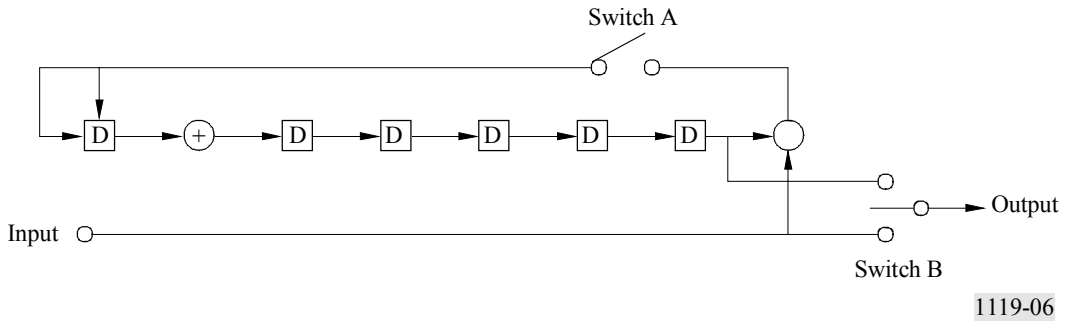
3.1.9 Error correction code

A 6-bit error correction code is allotted to the information bits B3 to B17 to allow the detection or correction of bit errors.

B18 to B23 shall be the error correction codes, and they are binary code series obtained by entering B3 to B17 into the circuit shown in Figure 6.

FIGURE 6

Error correction code generation circuit



NOTE 1 - ⊕ is an exclusive operand.

NOTE 2 - When entering the B3 code, all one-bit delay elements shall be set to "1".

NOTE 3 - When entering from B3 to B17, switch A shall be turned "on", and switch B shall be connected to the lower contact. After the entry, switch A shall be turned "off", and switch B shall be connected to the upper contact.

3.2 Information content of data bits

3.2.1 B3, and B6 to B11

The contents of B3, and B6 to B11 shall be as shown in Table 8.

3.2.2 B5, and B15 to B17

B5, and B15 to B17 are reserved and shall be set to "0".

3.2.3 B12 and B13

B12 and B13 are assigned for use in TV broadcasting stations.

3.2.4 B14

B14 is assigned for use in TV broadcasting stations. On transmission, this shall be set to "0".

TABLE 8

The content of wide-screen signalling information

No.	Items	Output	
		0	1
B1	Reference signal	-	1
B2	Reference signal	0	-
B3	Aspect ratio (Note 1)	4:3 full format	16:9 letterbox
B4	Even parity for B3 ~ B5		
B5	Reserved	0	-
B6	Field type (Note 2)	First field	Next field
B7	Frame type	Reference frame	Other frame
B8	Vertical temporal helper	No	Yes
B9	Vertical high resolution helper	No	Yes
B10	Horizontal helper	No	Yes
B11	Horizontal helper pre-combing	No	Yes
B12 ~ B13	Assigned for use in TV broadcasting stations		
B14	Assigned for use TV broadcasting stations (Should be set to "0" for output)	0	-
B15 ~ B17	Reserved	0	-
B18 ~ B23	Error correction codes for B3 ~ B17 (Note 3)		
B24	Reference signal	0	-
B25 ~ B27	Confirmation signal (sine wave)		

NOTE 1 – If any of B8 to B10 are "Yes", B3 shall be set to "1".

NOTE 2 – B6 may not be required to indicate field type. In this case, the output shall be set to "0".

NOTE 3 – These 6 data bits shall be CRC (Cyclic Redundancy Check) codes belonging to B3 to B17.

The generator polynomial G(X) shall be: $G(X) = X^6 + X + 1$.