RP 211-2000

SMPTE RECOMMENDED PRACTICE

Implementation of 24P, 25P and 30P Segmented Frames for 1920 × 1080 Production Format

Contents

1 Scope

This practice defines the changes to SMPTE 274M to implement various 1920 × 1080 progressive systems in their segmented frame format: 24sF, 25sF, and 30sF. Only the changes to the appropriate clauses of SMPTE 274M are contained herein. The same clause, table, and figure numbering system, as used in SMPTE 274M, is employed in this practice.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this practice are encouraged to investigate the possibility of applying the most recent edition of the standards listed below.

Same as in SMPTE 274M.

ITU-R BT.709-4, Parameter Values for the HDTV Standards for Production and International Programme Exchange

3 General

Same as in SMPTE 274M.

Additions to table 1 – Scanning systems

	System nomenclature	Samples per active line (S/AL)	Active lines per frame	Frame rate (Hz)	Scanning format	Interface sampling frequency fs (MHz)	Samples per total line (S/TL)	Total lines per frame
12	1920 × 1080/30 (sF)	1920	1080	30	Progressive (sF)	74.25	2200	1125
13	1920 × 1080/29.97 (sF)	1920	1080	$\frac{30}{1.001}$	Progressive (sF)	$\frac{74.25}{1.001}$	2200	1125
14	1920 × 1080/25 (sF)	1920	1080	25	Progressive (sF)	74.25	2640	1125
15	1920 × 1080/24 (sF)	1920	1080	24	Progressive (sF)	74.25	2750	1125
16	1920 × 1080/23.98 (sF)	1920	1080	$\frac{24}{1.001}$	Progressive (sF)	$\frac{74.25}{1.001}$	2750	1125

Approved September 29, 2000

4 Scanning

4.6 A segmented frame system shall scan a frame as a first field then as a second field, in which the scan lines of each field have twice the vertical spatial sampling pitch of the frame. Scanning lines in the second field shall be displaced vertically by the vertical sampling pitch, but the scanning time shall be the same temporally as that of scanning lines in the first field.

The first field shall convey 540 active picture lines, starting with the top picture line of the frame. The second field shall convey 540 active picture lines, ending with the bottom picture line of the frame.

5 System colorimetry

SAME as in SMPTE 274M.

6 Raster structure

NOTE ON INTERLACED AND SEGMENTED FRAME VERSIONS – All of the scanning systems defined in this practice and in SMPTE 274M use a total of 1125 lines per picture. In an analog-only system, this would normally imply that the interlaced versions would divide this total into two equal-length fields of 562½ lines each. However, because a digital interface must also be supported, only whole numbers of lines in each field are allowed, in order to permit unambiguous identification of lines by the digital timing reference sequences (see clause 8). Therefore, the interlaced and segmented frame versions define integer, and hence unequal, numbers of lines (563 and 562) in each of the two fields comprising one frame. Analog vertical sync sequences, however, must remain equally spaced in time and are therefore not fully aligned to the fields as defined for the digital interface. This results in the analog vertical sync for the second digital field beginning one half-line before the end of the first digital field.

6.1 For details of vertical timing, see figures 1 and 2.

6.4 According to this practice, in a segmented frame system, the assignment of lines within a frame shall be the same as that of an interlaced system. More specifically, the assignment of each even line of a progressive system shall correspond to lines 1 through 562 of a segmented frame system, and each odd line of a progressive system shall correspond to lines 563 through 1125 of a segmented frame system. In general, the relationship of line N of a progressive system and line M of a segmented frame system shall be shown as follows:

Line number of a progressive system:	N	2, 4., 6, ..., 1124	1,3,5, ..., 1125
Line number of a segmented frame system:	M	M = N/2	M = (N+1125)/2

For this reason, it is clear that the top active line of the progressive system, line 42, corresponds to the top active line of the segmented frame system, line 21. Also, according to the same relation above, line 1 of the progressive system corresponds to line 583 of the segmented frame system and line 2 of the progressive system corresponds to line 1 of the segmented frame system.

NOTE – Clause 6.4 applies to 30, 29.97, 25, 24, and 23.98 systems only (systems 12 through 16 of table 1).

6.5 Ancillary signals may be conveyed in a progressive system during lines 7 through 41 inclusive, and in an interlaced and segmented frame system during lines 7 through 20 inclusive and lines 569 through 583 inclusive. The portion within each of these lines that may be used for ancillary data is defined in 9.3. Ancillary signals shall not convey picture information although they may be employed to convey other related or unrelated signals, coded similarly to picture information. Further specification of ancillary signals is outside the scope of this practice.

6.10 The center of the picture shall be located at the center of the clean aperture (and of the production aperture), midway between sample number 959 and 960, and midway between lines 581 and 582 in a progressive system, and midway between lines 291 and 853 in an interlaced and segmented frame system.

7 Digital representation

7.3 R′G′B′ signals and Y′ signals shall have bandwidth nominally 60 MHz for systems 1, 2, and 3 in table 1 and 30 MHz for systems 4 through 16 in table 1. C'_B C'_R signals shall have bandwidth nominally half that of the associated Y′ signal.

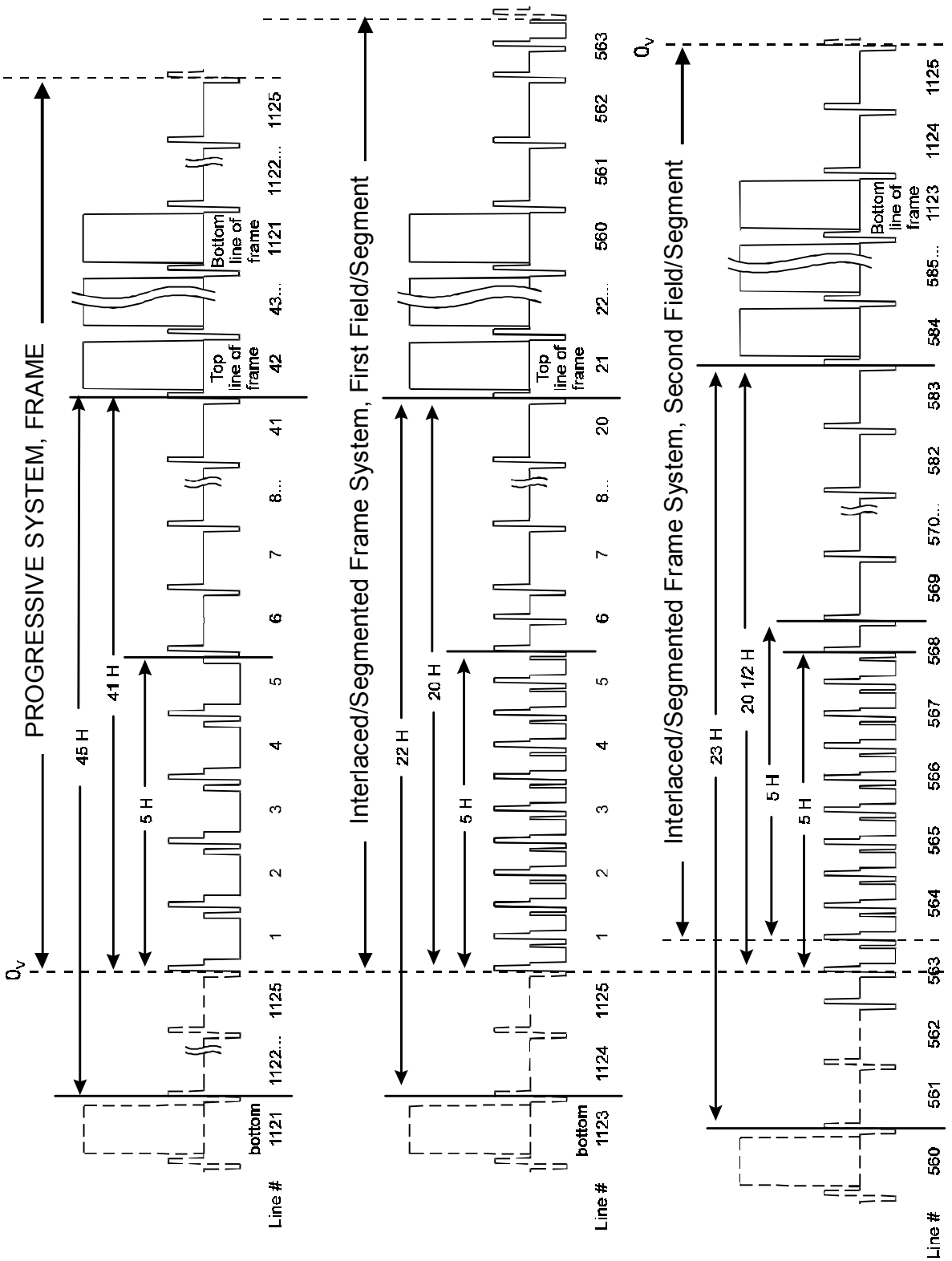


Figure 1 - Analog interface vertical timing details

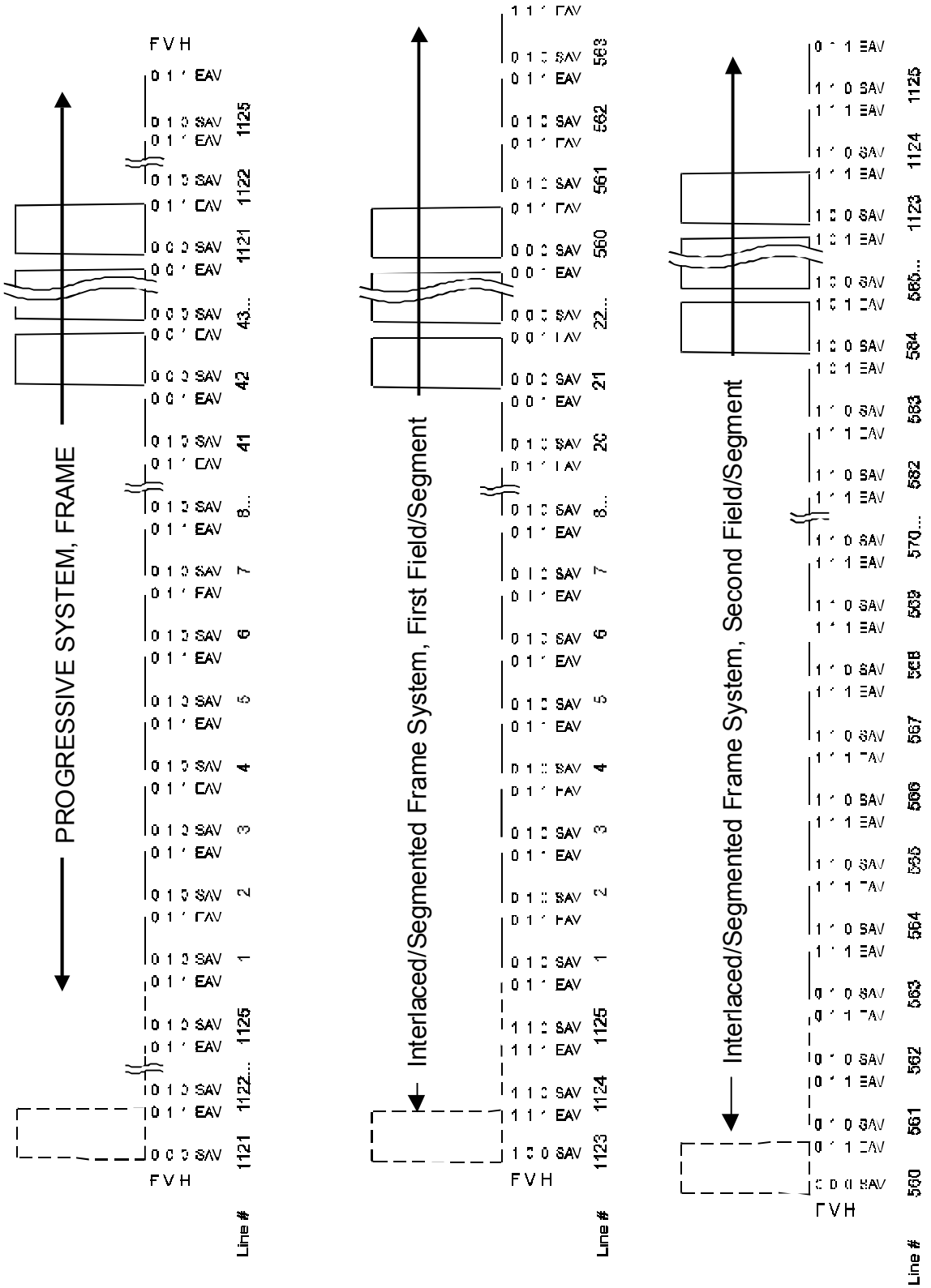
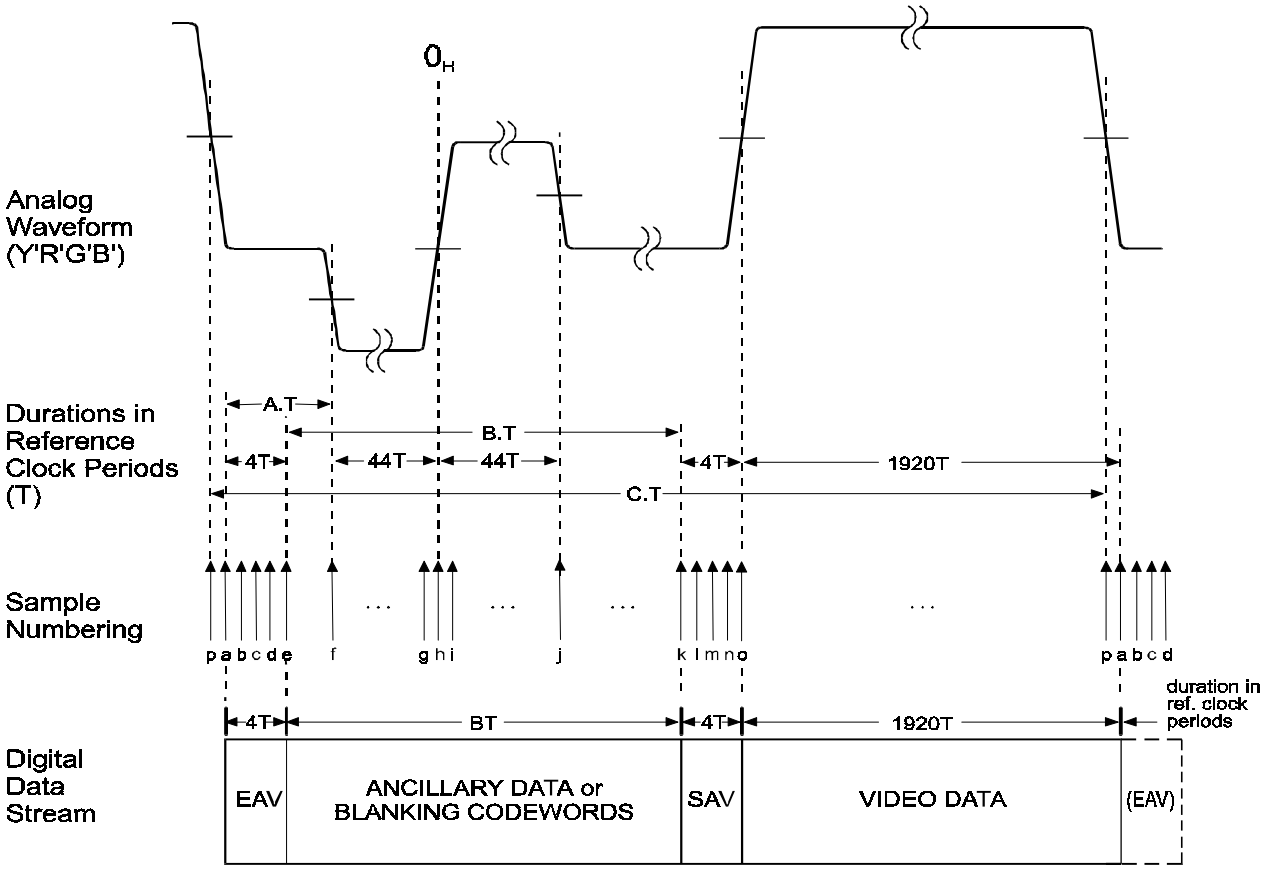


Figure 2- Digital interface vertical timing details

8 Digital timing reference sequences (SAV, EAV)



NOTES

1 Horizontal axis not to scale.

2 0_H is the analog horizontal timing reference point and, in the analog domain, is regarded as the start of the line.

3 A line of digital video extends from the first word of EAV through the last word of video data.

4 The number of samples of video data (sample number o through p in figure 3) is 1920, that is, the letter o denotes sample number 0 and the letter p denotes sample number 1919. Analog 1/2 amplitude duration shall be 1920T – 12T/+0T as shown in table 6.

Figure 3 – Analog and digital timing relationship

Table 2 – Values for figures 3 and 4 for different scanning systems

System	Sample numbering															
	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
1, 2, 4, 5, 7, 8, 12, 13	1920	1921	1922	1923	1924	1964	2006	2008	2010	2052	2196	2197	2198	2199	0	1919
3, 6, 9, 14	1920	1921	1922	1923	1924	2404	2446	2448	2450	2492	2636	2637	2638	2639	0	1919
10, 11, 15, 16	1920	1921	1922	1923	1924	2514	2556	2558	2560	2602	2746	2747	2748	2749	0	1919

System	Durations in reference clock periods (T)		
	A	B	C
1, 2, 4, 5, 7, 8, 12, 13	44	272	2200
3, 6, 9, 14	484	712	2640
10, 11, 15, 16	594	822	2750

8.3 When digitized, every scan line shall include a four-sample EAV sequence commencing either 88 clocks prior to 0_H (scanning systems 1, 2, 4, 5, 7, 8, 12, and 13), or 528 clocks prior to 0_H (scanning systems 3, 6, 9, and 14), or 638 clocks prior to 0_H (scanning systems 10, 11, 15, and 16), and a four-sample SAV sequence commencing 188 clocks after 0_H. Digitized lines shall be numbered and the numbering shall change state prior to the horizontal timing point (0_H), as shown in figure 2. The EAV sequence immediately preceding the 0_H datum of line 1 shall be considered to be the start of the digital frame.

8.6 In a segmented frame system:

– The sequence of EAV and SAV shall be the same as that of an interlace system.

9 Ancillary data

Same as SMPTE 274M.

10 Bit-parallel electrical interface

10.1 This clause describes a bit-parallel electrical interface which is applicable to all the scanning systems specified in this standard. It is a point-to-point interface with one transmitter and one receiver. (The parallel signal is also the referenced source format for the serial interface which is specified in SMPTE 292M. The serial interface is applicable to scanning systems with nominal sampling frequency values near 74.25 MHz [systems 4-16] in this practice.) The parallel interface may be used to convey R′G′B′ components, $Y'C'_BC'_R$ components, or $Y'C'_BC'_R$ components augmented by an auxiliary component A coded similarly to video but otherwise outside the scope of this practice.

10.5 The signals on the interface shall be transmitted without equalization in systems 4-16 in table 1 for a distance of up to 20 m (65.6 ft), and in systems 1-3 in table 1 for a distance of up to 14 m (46.3 ft).

11 Electrical characteristics

NOTE – The transmitter and receiver parameters are ECL-compatible so as to permit, in systems 4-16 in table 1, the use of standard ECL (10KH series) devices.

12 Clock

Same as SMPTE 274M.

13 Bit-parallel mechanical interface

13.2 This standard applies to applications where the physical length of the cable is at most 20 m for systems 4-16 in table 1 and 14 m for systems 1-3 in table 1. Within this range, equalization of the cable characteristics is not required.

14 Analog sync (60Hz/59.94Hz/50Hz/30sF/29.97sF/25sF/24 sF/23.98sF systems only)

NOTE – This clause, including table 6, applies to 60 Hz, 59.94 Hz, 50 Hz, 30sF, 29.97sF, 25sF, 24sF, and 23.98sF scanning systems only (table 1, systems 1-6 and 12-16), because direct analog interconnection is not recommended for use with slow-rate systems (30-Hz progressive and below).

14.1 Details of analog sync timing are shown in figures 1, 3, and 11, and are summarized in table 6. The parameter ϕ not shown in these figures is the duration of the rising edge of the horizontal sync pulse.

14.6 In addition to the trilevel sync pulse that defines 0_H, an interlaced and segmented frame system's vertical sync line may include a midline trilevel sync pulse whose elements are delayed from 0_H by one-half the line duration. Certain vertical sync lines may, therefore, contain a broad pulse during the first half line, and may contain a broad pulse during the second half line, in the manner described in 14.8 and 14.9, or a broad pulse within the whole line as described in 14.7. The leading 50% point of a broad pulse shall be 132T after the preceding trilevel zero-crossing; its duration shall be 880T in interlaced or segmented frame systems and1920T in progressive systems (see figure 11).

14.8 The first field of an interlaced/segmented frame system shall commence with five vertical sync lines (see figure 1):

– five lines having broad pulses in both the first and second half lines; plus

– a sixth line having only a midpoint trilevel pulse.

14.9 The second field of an interlaced/segmented frame system shall commence as shown in figure 1. The vertical sync associated with the second field shall be contained within six lines comprising:

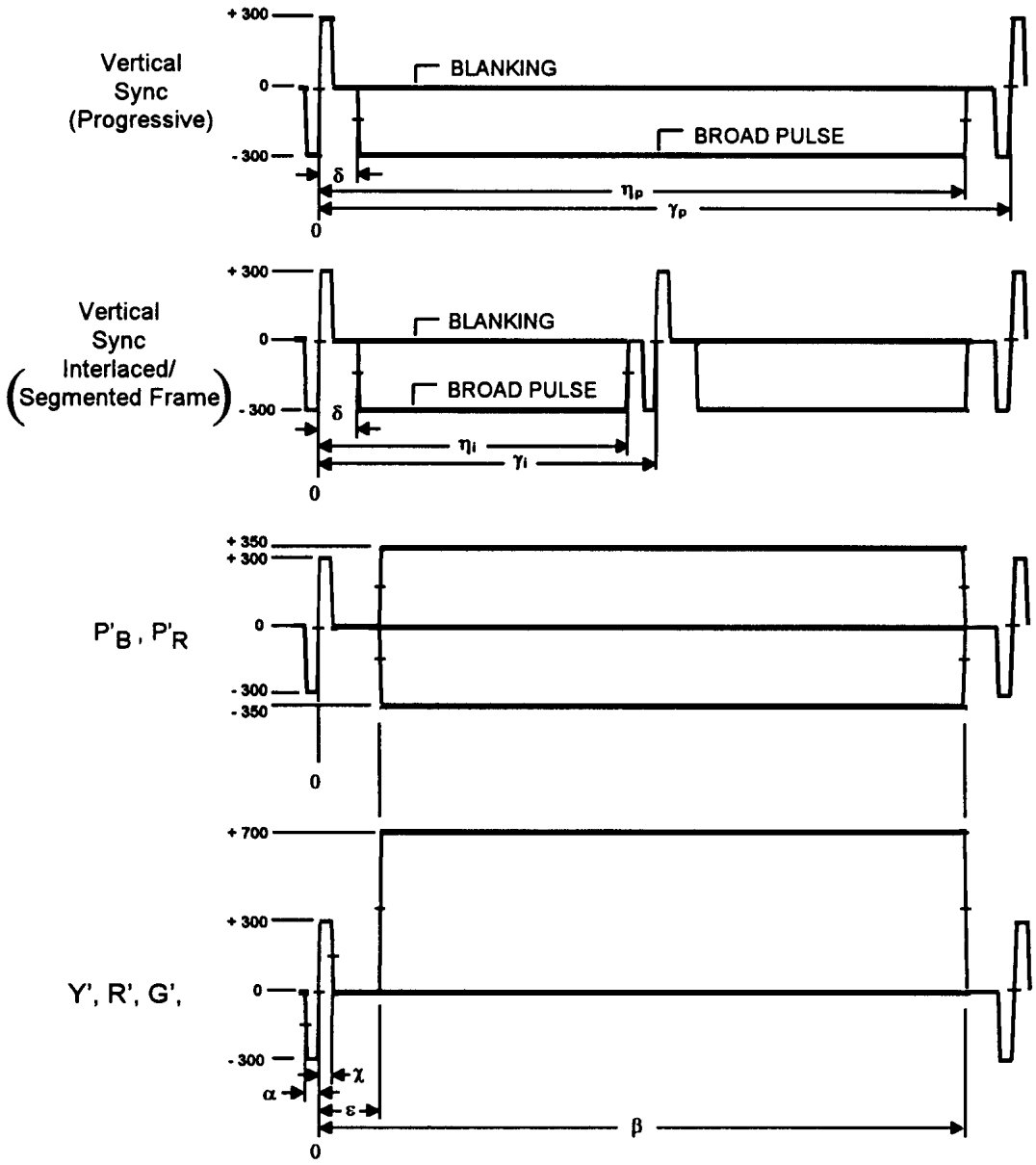
– the second half of a line having blanking in the first half line, a midline trilevel pulse, and a broad pulse in the second half line;

– four lines having broad pulses in both the first and second half lines and a midline trilevel pulse between them; then

– the first half of one line having a broad pulse in the first half line and a midline trilevel pulse.

Table 6 – Analog sync timing (60 Hz/59.94 Hz/50 Hz/30sF/29.97sF/25sF/24sF/23.98sF)

			Duration (T)			
			60/59.94 Hz 30sF 29.97sF	50 Hz 25sF	24sF 23.98sF	Tolerance (T)
α	See figure 11		44	44	44	± 3
β	See figure 11		2112	2112	2112	– 6 + 0
χ	See figure 11		44	44	44	± 3
δ	See figure 11		132	132	132	± 3
ε	See figure 11		192	192	192	– 0 + 6
ϕ	Sync rise time		4	4	4	± 1.5
γi	See figure 11	(Interlaced/segmented frame)	1100	1320	1375	—
γp		(Progressive)	2200	2640	—	—
ηi	See figure 11	(Interlaced/segmented frame)	1012	1012	1012	± 3
ηp		(Progressive)	2112	2112	—	± 3
	Total line		2200	2640	2750	—
	Active line		1920	1920	1920	– 12 + 0



NOTES
1 Values for α, β, χ, δ, ε, γ, and η are given in table 6.
2 Sync rise time, ϕ, is not shown here.
3 See also figure 3.
4 Amplitudes are expressed in millivolts.

Figure 11 – Analog interface horizontal timing details (valid for 60-, 59.94-, and 50-Hz and 30, 29.97, 25, 24, and 23.98sF systems only; see table 6 and note in clause 14)

15 Analog interface

NOTE - This clause applies to 60-Hz, 59.94-Hz, 50-Hz, 30sF, 29.97sF, 25sF, 24sF, and 23.98sF scanning systems only (table 1, systems 1-6 and 12-16) because direct analog interconnection is not recommended for use with slow-rate systems (30-Hz progressive and below).

15.2 R′G′B′ signals and Y′ signals shall have bandwidth nominally 60 MHz for systems 1-3 in table 1 and 30 MHz for systems 4-16 in table 1.

Annex A (informative)

Same as SMPTE 274M.

Annex B (informative)

B.2 The passband frequency of the component Y′, R′, G′, and B′ signals is nominally 60 MHz for systems 1-3 and 30 MHz for systems 4-16.

Annex C (informative)

Same as SMPTE 274M.

Annex D (informative)

Same as SMPTE 274M.