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SMPTE STANDARD

for Television — 540 Mb/s Serial Digital Interface — Source Image Format Mapping

1 Scope

This standard specifies the mapping of various source image formats onto the 540 Mb/s serial digital interface. These formats include single link 4:4:4:4 component digital signals (525i/59.94 and 625i/50) as well as progressive scan 4:2:2 component digital signals (525p/59.94 and 625p/50). Additional source image formats may be added in future revisions of this standard.

2 Normative references

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

SMPTE 291M-1998, Television — Ancillary Data Packet and Space Formatting

SMPTE 352M-2001, Television — Video Payload Identification for Digital Television Interfaces

3 Source image format parameters

3.1 Source image format parameters are defined in table 1.

3.2 G, B, R, Y, C_B, C_R, and A components shall be prohibited from having the eight most significant bits all zeros or all ones. Any 10-bit G, B, R, Y, C_B, C_R, or A with values 000_h-003_h shall be remapped to 004_h and values $3FC_h$-$3FF_h$ shall be remapped to $3FB_h$.

Table 1 – Source image format parameters

	Nomenclature	Total lines per frame	Frame rate	Fields per frame	Active lines per frame	Samples per total line (each component)	Samples per active line (each component)	Reference standard
1	Single link 4:4:4:4 525i/59.94	525	30/1.001	2	483	858	720	SMPTE RP 174
2	Single link 4:4:4:4 625i/50	625	25	2	576	864	720	ITU-R BT.799
3	Single link 4:2:2P 525p/59.94	525	60/1.001	1	483	858	720	SMPTE 293M
4	Single link 4:2:2P 625p/50	625	50	1	576	864	720	ITU-R BT.1358
5	Dual link 4:2:2P 525p/59.94	525	60/1.001	1	483	858	720	SMPTE 294M
6	Dual link 4:2:2P 625p/50	625	50	1	576	864	720	ITU-R BT.1362

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4 54-MHz parallel data stream

G, B, R, and A or Y, C_B, C_R, and A components shall be mulitplexed into 54-MHz parallel data streams as shown in figures 1 (for system 1), 3 (for system 2), 5 (for system 3), 7 (for system 4), 9 (for system 5), and 11 (for system 6).

5 Timing references signals

5.1 EAV and SAV timing references shall be inserted into the parallel data streams on a line-by-line basis as shown in figures 1 (for system 1), 3 (for system 2), 5 (for system 3), 7 (for system 4), 9 (for system 5), and 11 (for system 6).

5.2 EAV sequences shall comprise four consecutive 10-bit code words: $3FF_h$, 000_h, 000_h, and XYZ.

5.3 XYZ words shall be encoded as defined in clauses 5.3.1 through 5.3.6.

5.3.1 XYZ words for system 1 (single link 4:4:4:4 – 525i/59.94)

Words 2883 and 3431 of the 54-MHz parallel data stream (refer to figure 1) shall be encoded as shown in tables 2 and 3. Refer to figure 2 for spatial representation of H, V, and F bits.

Table 2 – XYZ words for system 1 (single link 4:4:4:4 – 525i/59.94)

Bit	Words 2883 and 3431	Description
9	1	Fixed
8	F	F=0 during field 1 F=1 during field 2
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	S	S=0 for GBR signals S=1 for Y, C_b, C_r signals
4	P4	See table 3
3	P3	See table 3
2	P2	See table 3
1	P1	See table 3
0	P0	See table 3

Table 3 – Protection state bits for system 1 (single link 4:4:4:4 – 525i/59.94)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	S	P4	P3	P2	P1	P0
	1	0	0	0	0	0	0	0	0	0
	1	0	0	0	1	0	1	1	1	0
	1	0	0	1	0	1	0	1	1	0
	1	0	0	1	1	1	1	0	0	0
	1	0	1	0	0	1	1	1	0	0
	1	0	1	0	1	1	0	0	1	0
	1	0	1	1	0	0	1	0	1	0
	1	0	1	1	1	0	0	1	0	0
	1	1	0	0	0	1	1	0	1	0
	1	1	0	0	1	1	0	1	0	0
	1	1	0	1	0	0	1	1	0	0
	1	1	0	1	1	0	0	0	1	0
	1	1	1	0	0	0	0	1	1	0
	1	1	1	0	1	0	1	0	0	0
	1	1	1	1	0	1	0	0	0	0
	1	1	1	1	1	1	1	1	1	0

5.3.2 XYZ words for system 2 (single link 4:4:4:4 – 625i/50)

Words 2883 and 3455 of the 54-MHz parallel data stream (refer to figure 3) shall be encoded as shown in tables 4 and 5. Refer to figure 4 for spatial representation of H, V, and F bits.

Table 4 – XYZ words for system 2 (single link 4:4:4:4 – 625i/50)

Bit	Words 2883 and 3455	Description
9	1	Fixed
8	F	F=0 during field 1 F=1 during field 2
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	S	S=0 for GBR signals S=1 for Y, C_b, C_r signals
4	P4	See table 5
3	P3	See table 5
2	P2	See table 5
1	P1	See table 5
0	P0	See table 5

Table 5 – Protection state bits for system 2 (single link 4:4:4:4 – 625i/50)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	S	P4	P3	P2	P1	P0
	1	0	0	0	0	0	0	0	0	0
	1	0	0	0	1	0	1	1	1	0
	1	0	0	1	0	1	0	1	1	0
	1	0	0	1	1	1	1	0	0	0
	1	0	1	0	0	1	1	1	0	0
	1	0	1	0	1	1	0	0	1	0
	1	0	1	1	0	0	1	0	1	0
	1	0	1	1	1	0	0	1	0	0
	1	1	0	0	0	1	1	0	1	0
	1	1	0	0	1	1	0	1	0	0
	1	1	0	1	0	0	1	1	0	0
	1	1	0	1	1	0	0	0	1	0
	1	1	1	0	0	0	0	1	1	0
	1	1	1	0	1	0	1	0	0	0
	1	1	1	1	0	1	0	0	0	0
	1	1	1	1	1	1	1	1	1	0

5.3.3 XYZ words for system 3 (single link 4:2:2P – 525p/59.94)

Words 1443 and 1715 of the 54-MHz parallel data stream (refer to figure 5) shall be encoded as shown in tables 6 and 7. Refer to figure 6 for spatial representation of H, V, and F bits.

Table 6 – XYZ words for system 3 (single link 4:2:2P – 525p/59.94)

Bit	Words 1443 and 1715	Description
9	1	Fixed
8	F=0	F=0 always
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	P3	See table 7
4	P2	See table 7
3	P1	See table 7
2	P0	See table 7
1	0	Fixed
0	0	Fixed

Table 7 – Protection state bits for system 3 (single link 4:2:2P – 525p/59.94)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	P3	P2	P1	P0		
	1	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	1	0	1	0	0
	1	0	1	0	1	0	1	1	0	0
	1	0	1	1	0	1	1	0	0	0

5.3.4 XYZ words for system 4 (single link 4:2:2P – 625p/50)

Words 1443 and 1727 of the 54-MHz parallel data stream (refer to figure 7) shall be encoded as shown in tables 8 and 9. Refer to figure 8 for spatial representation of H, V, and F bits.

Table 8 – XYZ words for system 4 (single link 4:2:2P – 625p/50)

Bit	Words 1443 and 1727	Description
9	1	Fixed
8	F=0	F=0 always
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	P3	See table 9
4	P2	See table 9
3	P1	See table 9
2	P0	See table 9
1	0	Fixed
0	0	Fixed

Table 9 – Protection state bits for system 4 (single link 4:2:2P – 625p/50)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	P3	P2	P1	P0		
	1	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	1	0	1	0	0
	1	0	1	0	1	0	1	1	0	0
	1	0	1	1	0	1	1	0	0	0

5.3.5 XYZ words for system 5 (dual link 4:2:2P – 525p/59.94)

Words 2883 and 3431 of the 54-MHz parallel data stream (refer to figure 9) shall be encoded as shown in tables 10 and 11. Refer to figure 10 for spatial representation of H, V, and F bits.

Table 10 – XYZ words for system 5 (dual link 4:2:2P – 525p/59.94)

Bit	Words 2883 and 3431	Description
9	1	Fixed
8	F	F=0 during field 1 F=1 during field 2
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	P3	See table 11
4	P2	See table 11
3	P1	See table 11
2	P0	See table 11
1	0	Fixed
0	0	Fixed

Table 11 – Protection state bits for system 5 (dual link 4:2:2P – 525p/59.94)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	P3	P2	P1	P0		
	1	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	1	0	1	0	0
	1	0	1	0	1	0	1	1	0	0
	1	0	1	1	0	1	1	0	0	0
	1	1	0	0	0	1	1	1	0	0
	1	1	0	1	1	0	1	0	0	0
	1	1	1	0	1	1	0	0	0	0
	1	1	1	1	0	0	0	1	0	0

5.3.6 XYZ words for system 6 (dual link 4:2:2P – 625p/50)

Words 2883 and 3455 of the 54-MHz parallel data stream (refer to figure 11) shall be encoded as shown in tables 12 and 13. Refer to figure 12 for spatial representation of H, V, and F bits.

Table 12 – XYZ words for system 6 (dual link 4:2:2P – 625p/50)

Bit	Words 2883 and 3455	Description
9	1	Fixed
8	F	F=0 during field 1 F=1 during field 2
7	V	V=0 during active video V=1 during vertical blanking
6	H	H=1 for EAV H=0 for SAV
5	P3	See table 13
4	P2	See table 13
3	P1	See table 13
2	P0	See table 13
1	0	Fixed
0	0	Fixed

Table 13 – Protection state bits for system 6 (dual link 4:2:2P – 625p/50)

Bit	9	8	7	6	5	4	3	2	1	0
		F	V	H	P3	P2	P1	P0		
	1	0	0	0	0	0	0	0	0	0
	1	0	0	1	1	1	0	1	0	0
	1	0	1	0	1	0	1	1	0	0
	1	0	1	1	0	1	1	0	0	0
	1	1	0	0	0	1	1	1	0	0
	1	1	0	1	1	0	1	0	0	0
	1	1	1	0	1	1	0	0	0	0
	1	1	1	1	0	0	0	1	0	0

6 Ancillary data

6.1 Ancillary data may be inserted in horizontal and vertical blanking intervals.

6.2 The ancillary data header shall consist of the three words 000_h, $3FF_h$, $3FF_h$ with formatting of the ancillary data packet defined in SMPTE 291M. Data values 000_h to 003_h and $3FC_h$ to $3FF_h$ are excluded from user ancillary data.

6.3 Ancillary data space is reserved for error detection and handling data formatted in accordance with SMPTE RP 165.

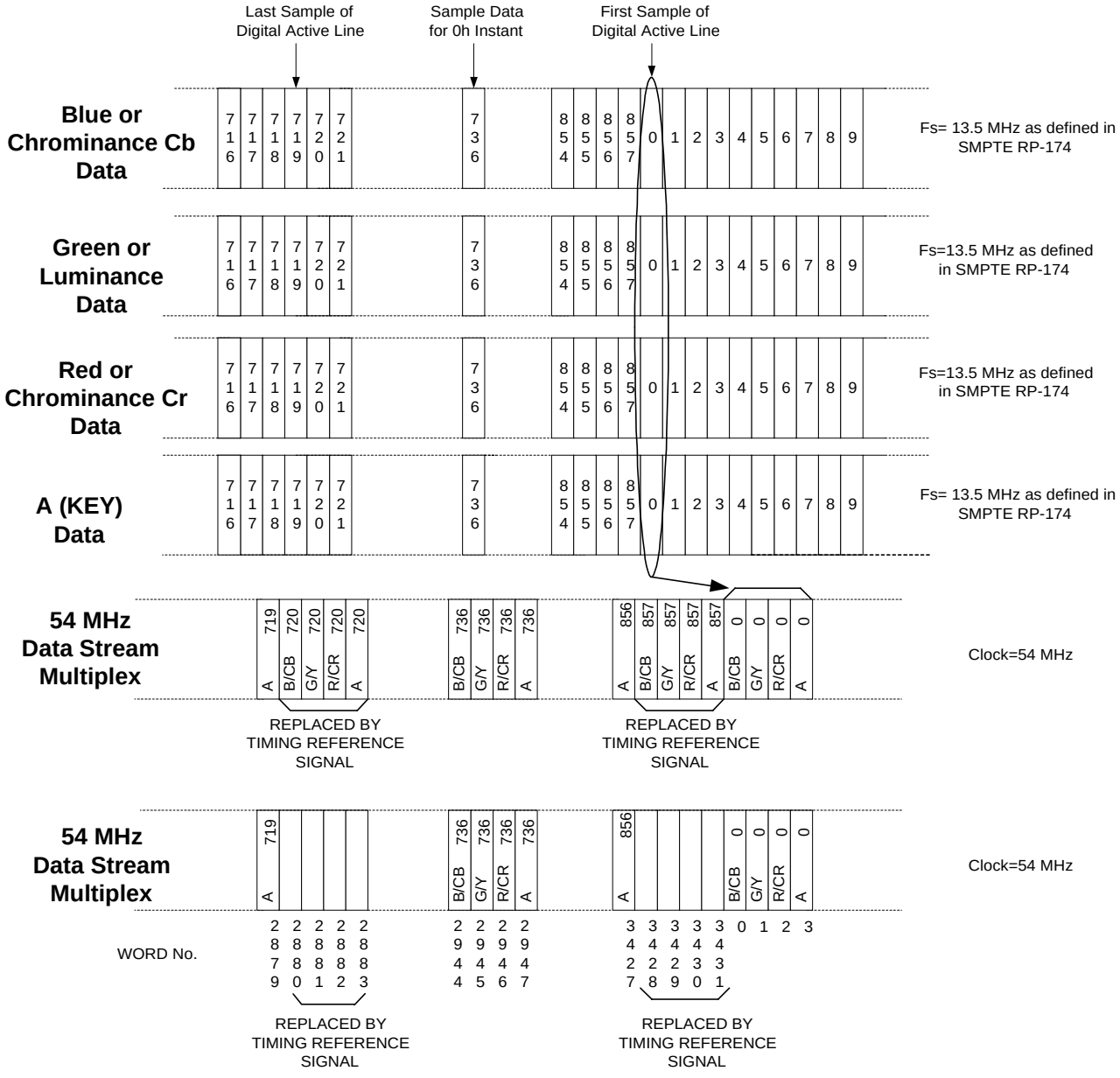

Figure 1 – Generation of 54-MHz parallel data stream for system 1 (single-link 4:4:4:4 — 525i/59.94)

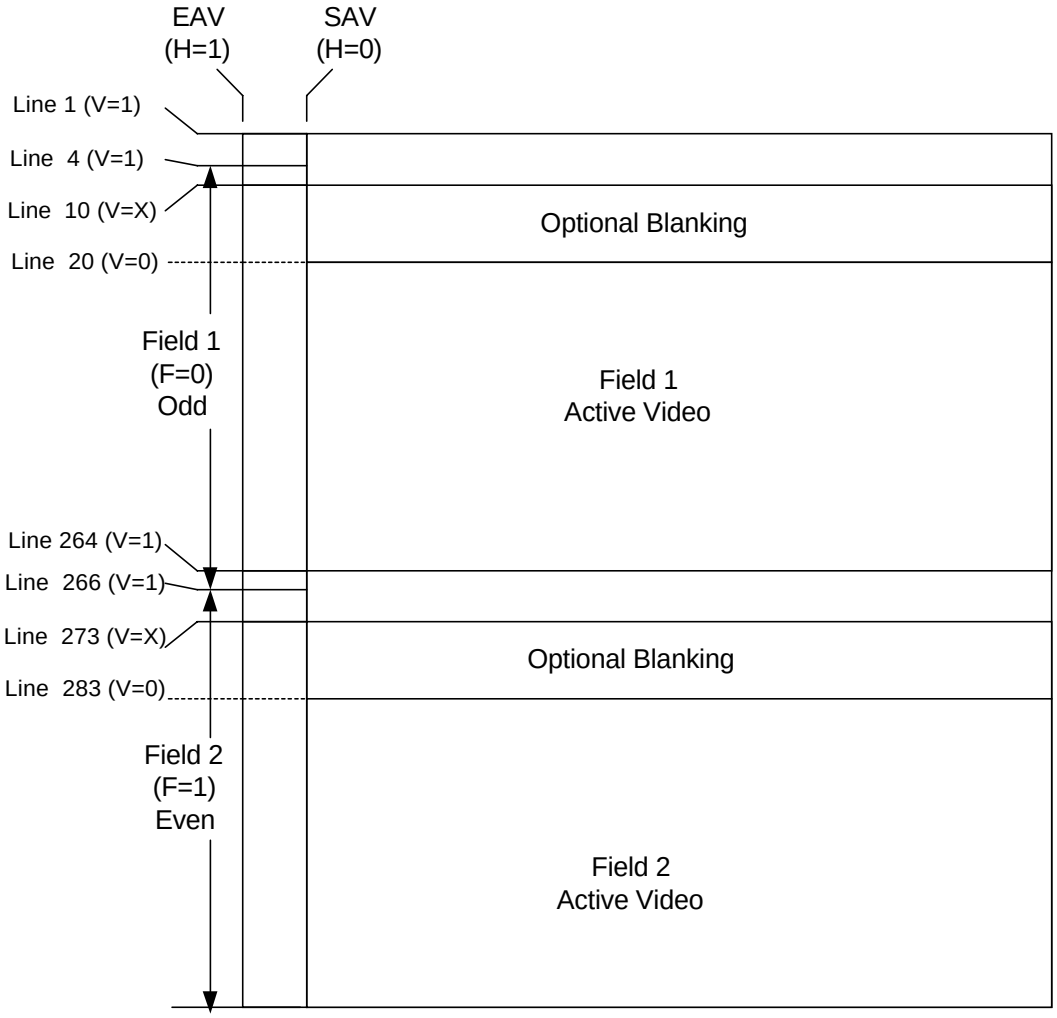

Figure 2 – Spatial representation of timing reference signals during video frame for system 1 (single-link 4:4:4:4 – 525i/59.94)

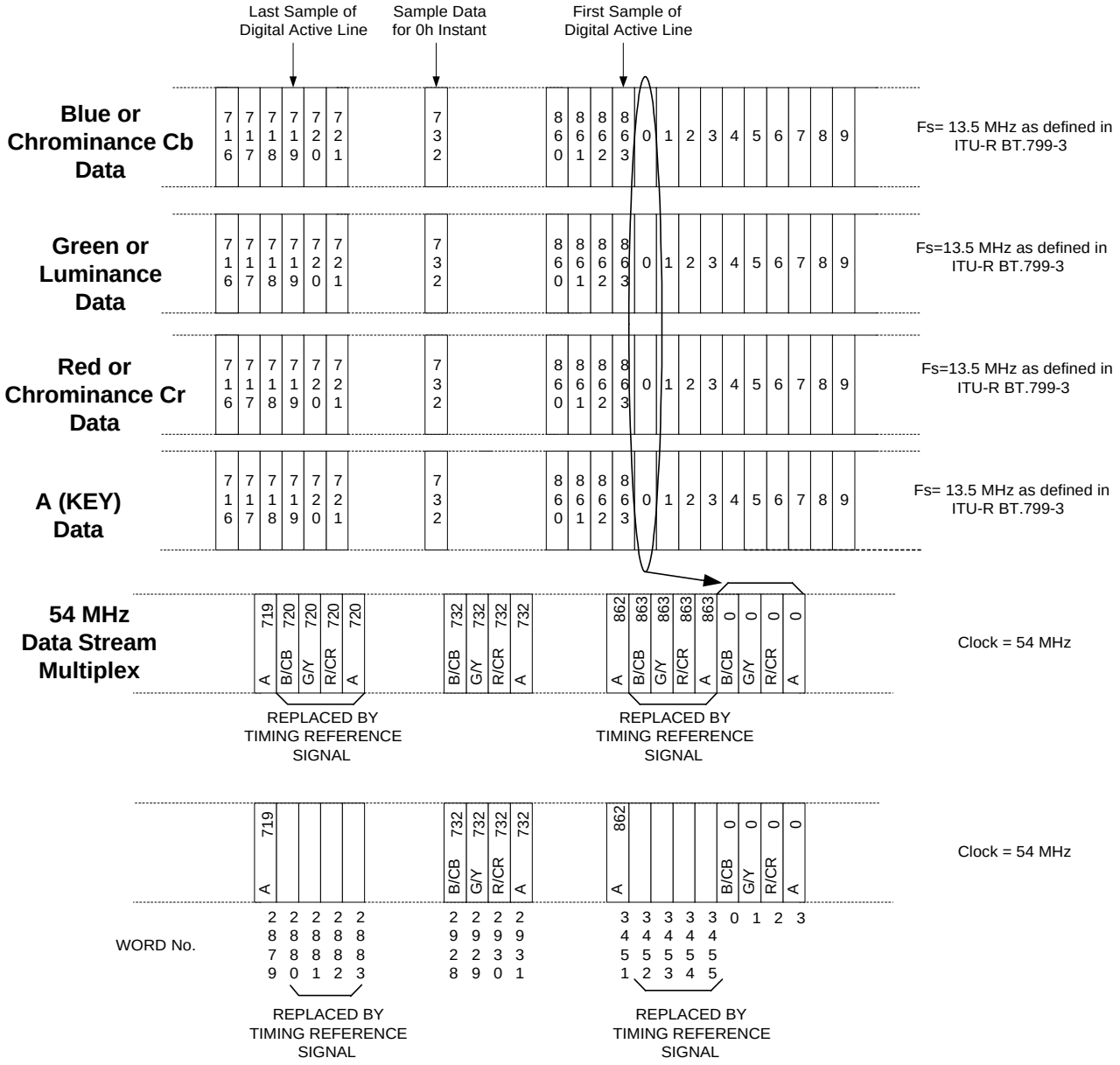

Figure 3 – Generation of 54-MHz parallel data stream for system 2 (single-link 4:4:4:4 – 625i/50)

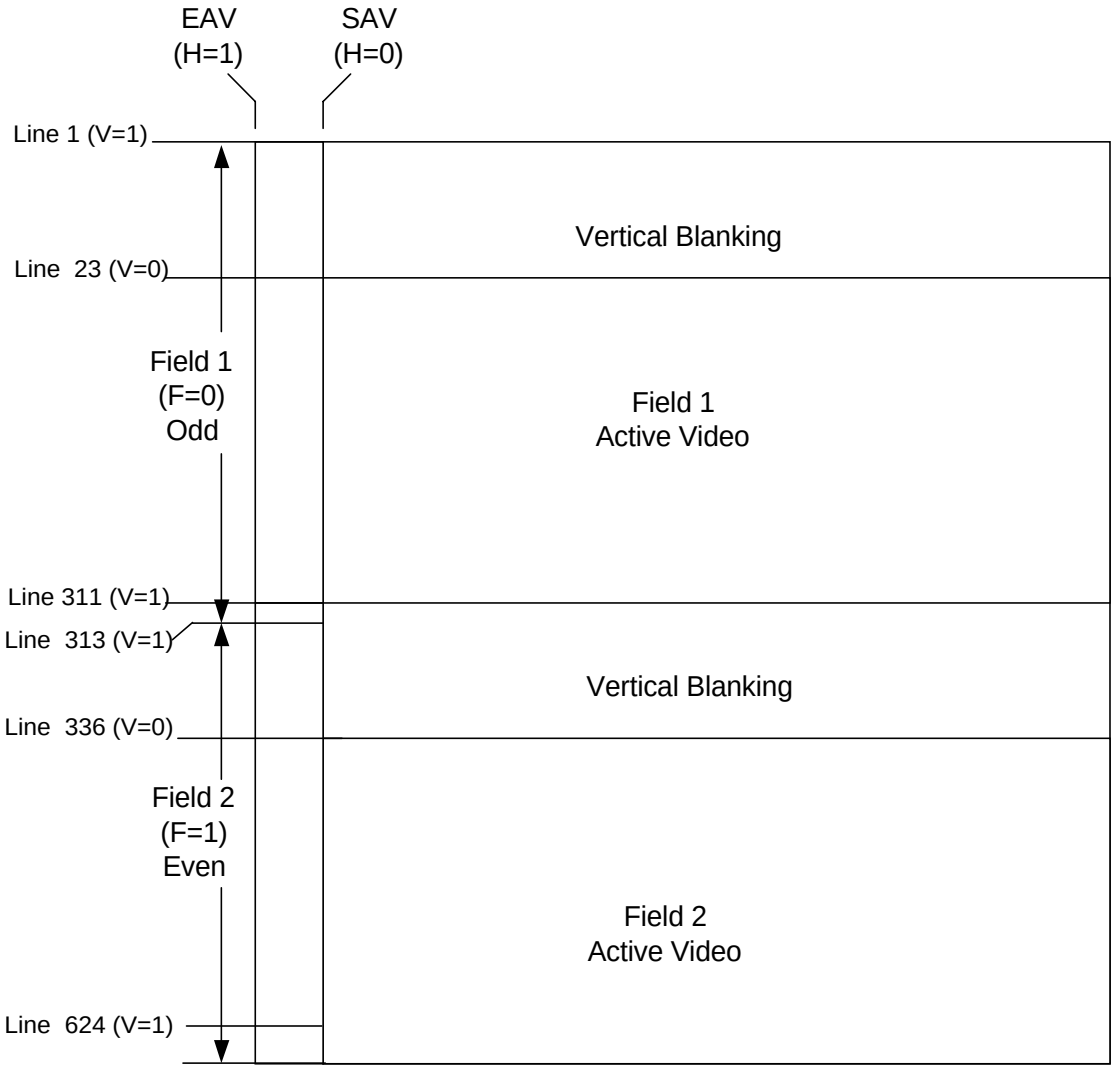

Figure 4 – Spatial representation of timing reference signals during video frame for system 2 (single-link 4:4:4:4 – 625i/50)

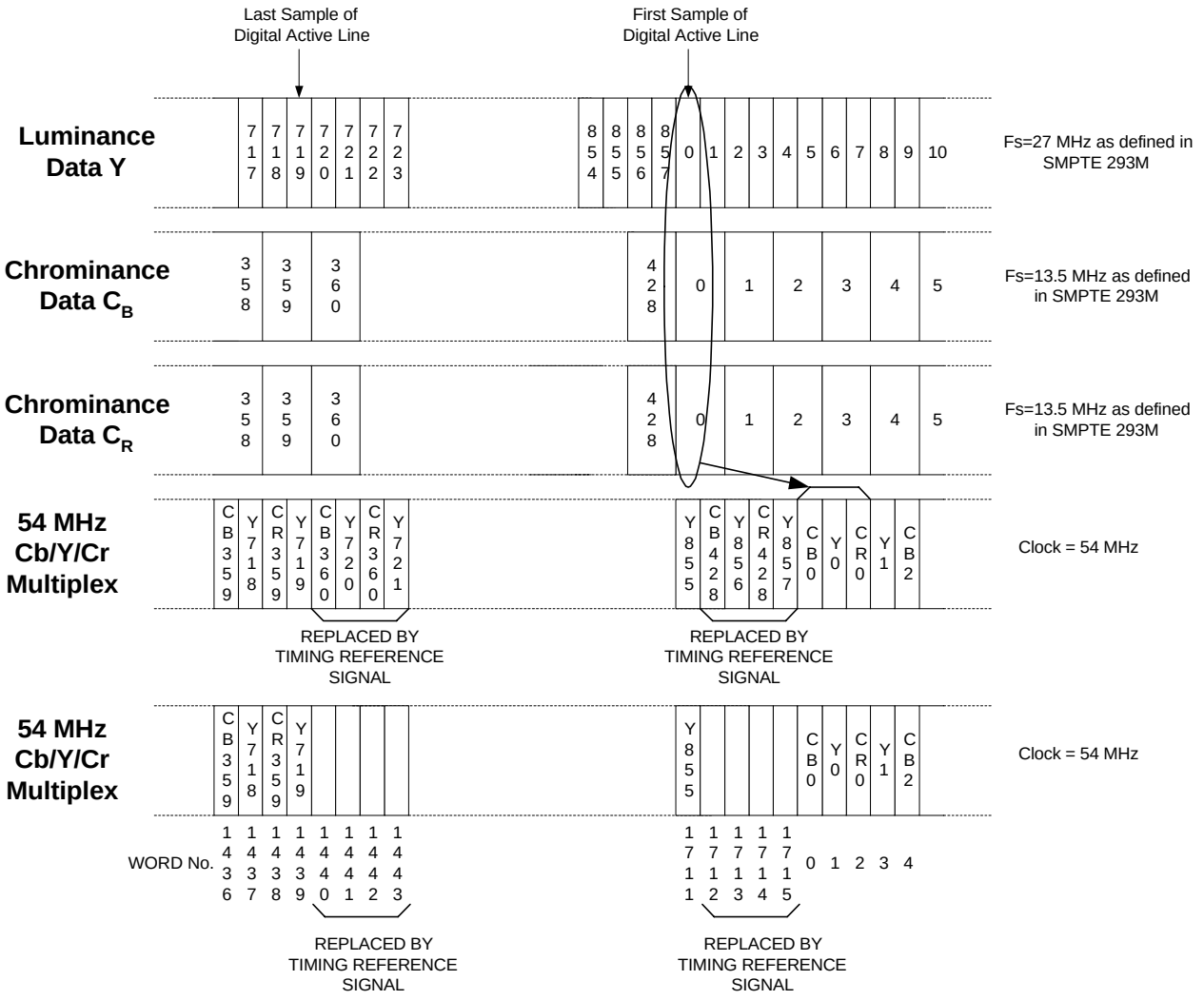

Figure 5 – Generation of 54-MHz parallel data stream for system 3 (single-link 4:2:2p – 525p/59.94)

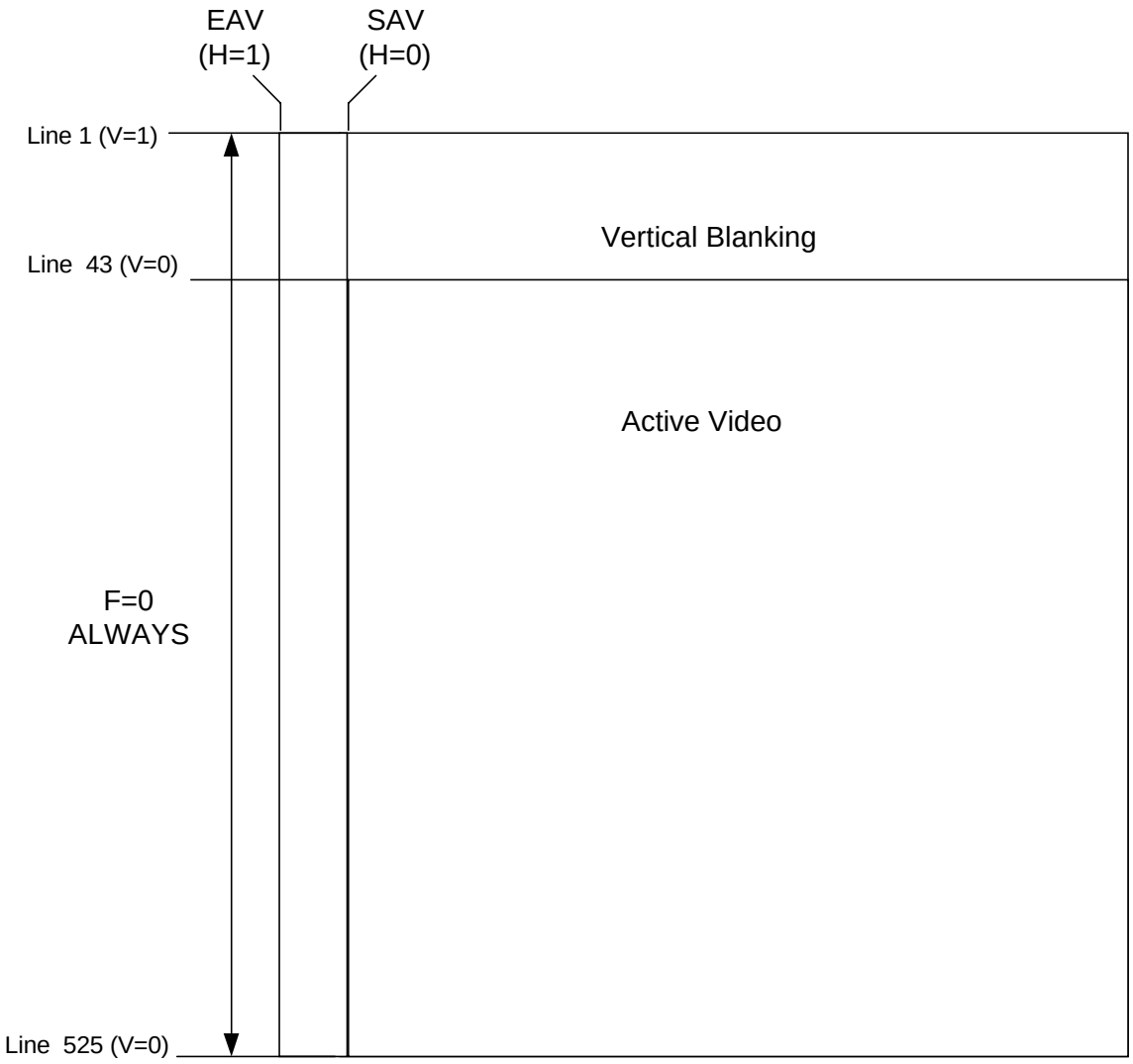

Figure 6 – Spatial representation of timing reference signals during video frame for system 3 (single-link 4:2:2p – 525p/59.94)

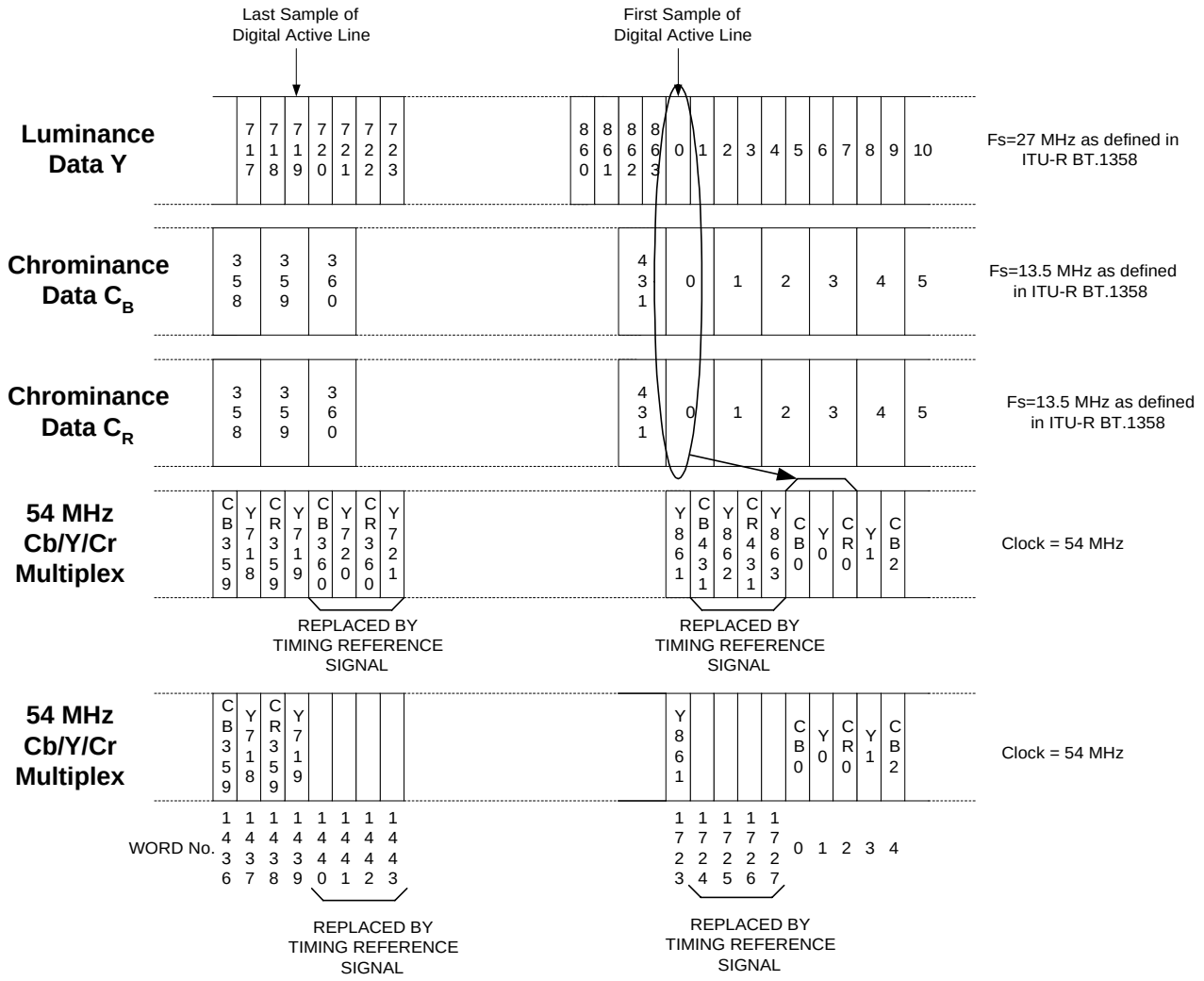

Figure 7 – Generation of 54-MHz parallel data stream for system 4 (single-link 4:2:2p – 625p/50)

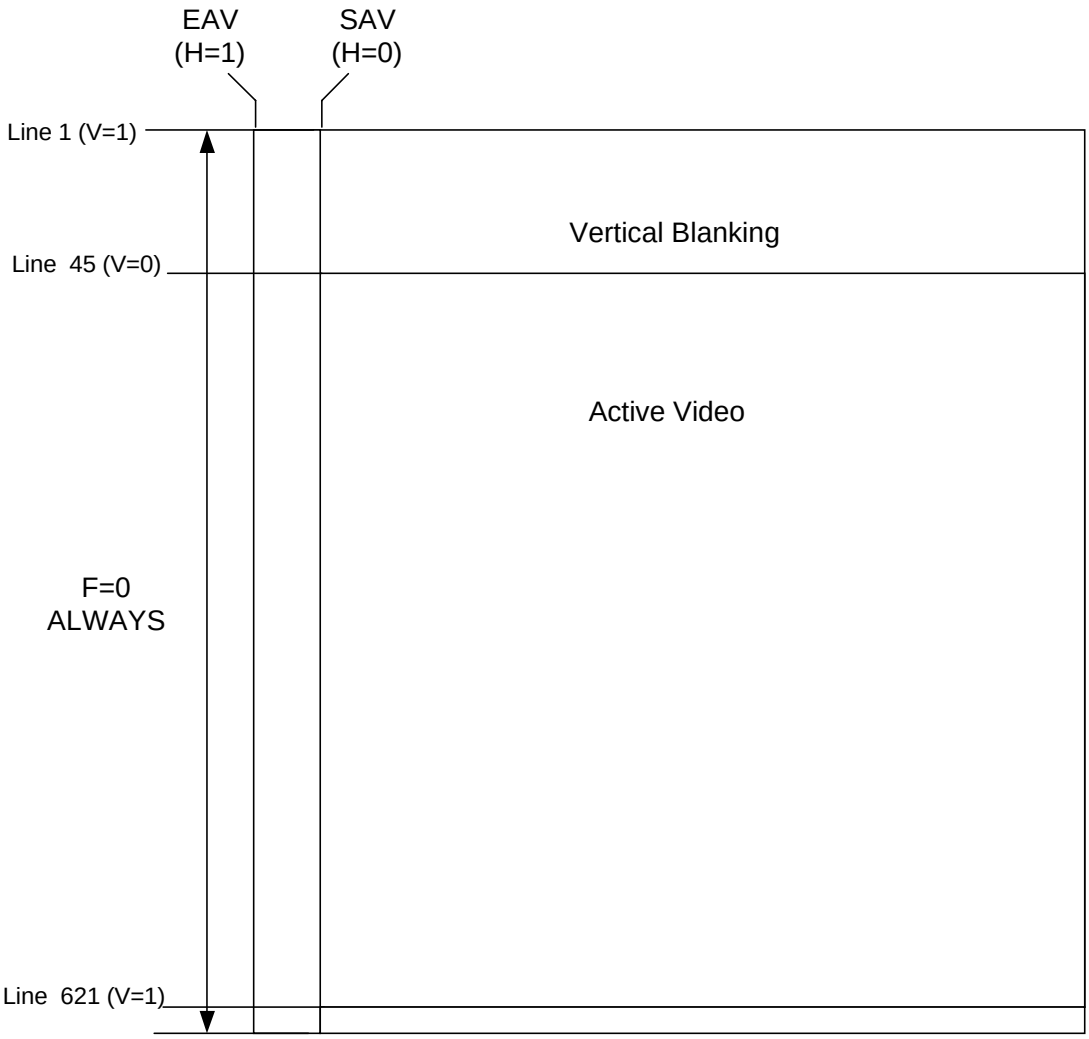

Figure 8 – Spatial representation of timing reference signals during video frame for system 4 (single-link 4:2:2p – 625p/50)

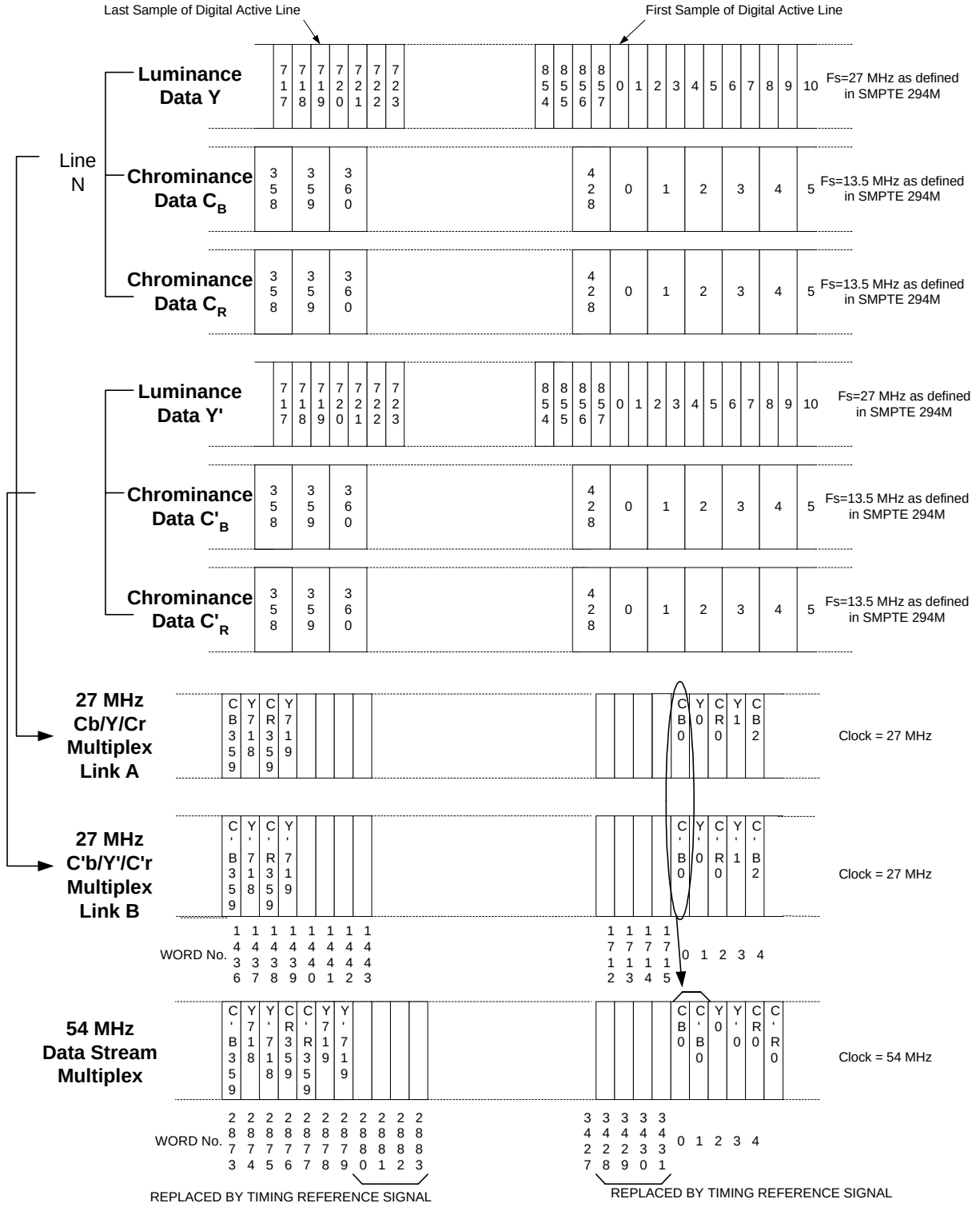

Figure 9 – Generation of 54-MHz parallel data stream for system 5 (dual-link 4:2:2p – 525p/59.94)

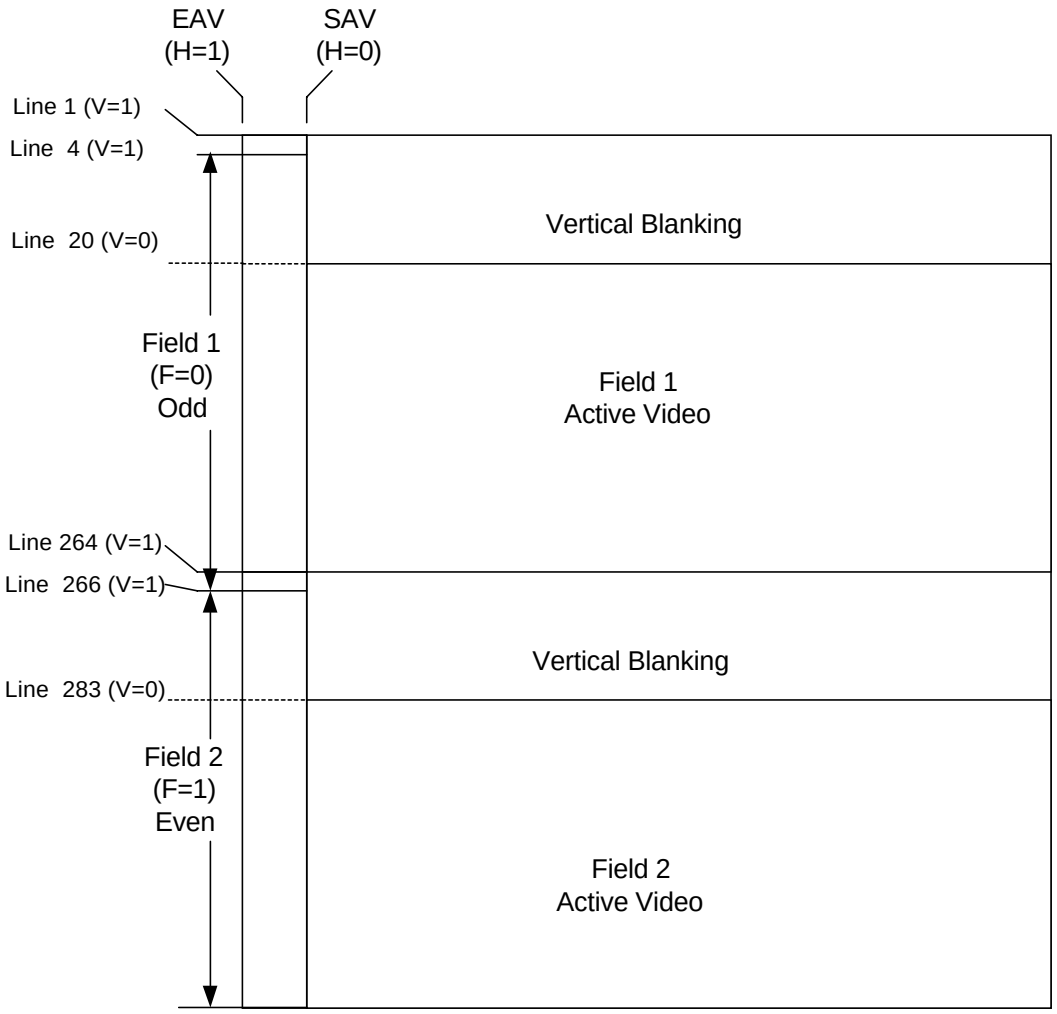

Figure 10 – Spatial representation of timing reference signals during video frame for system 5 (single-link 4:2:2p – 525p/59.94)

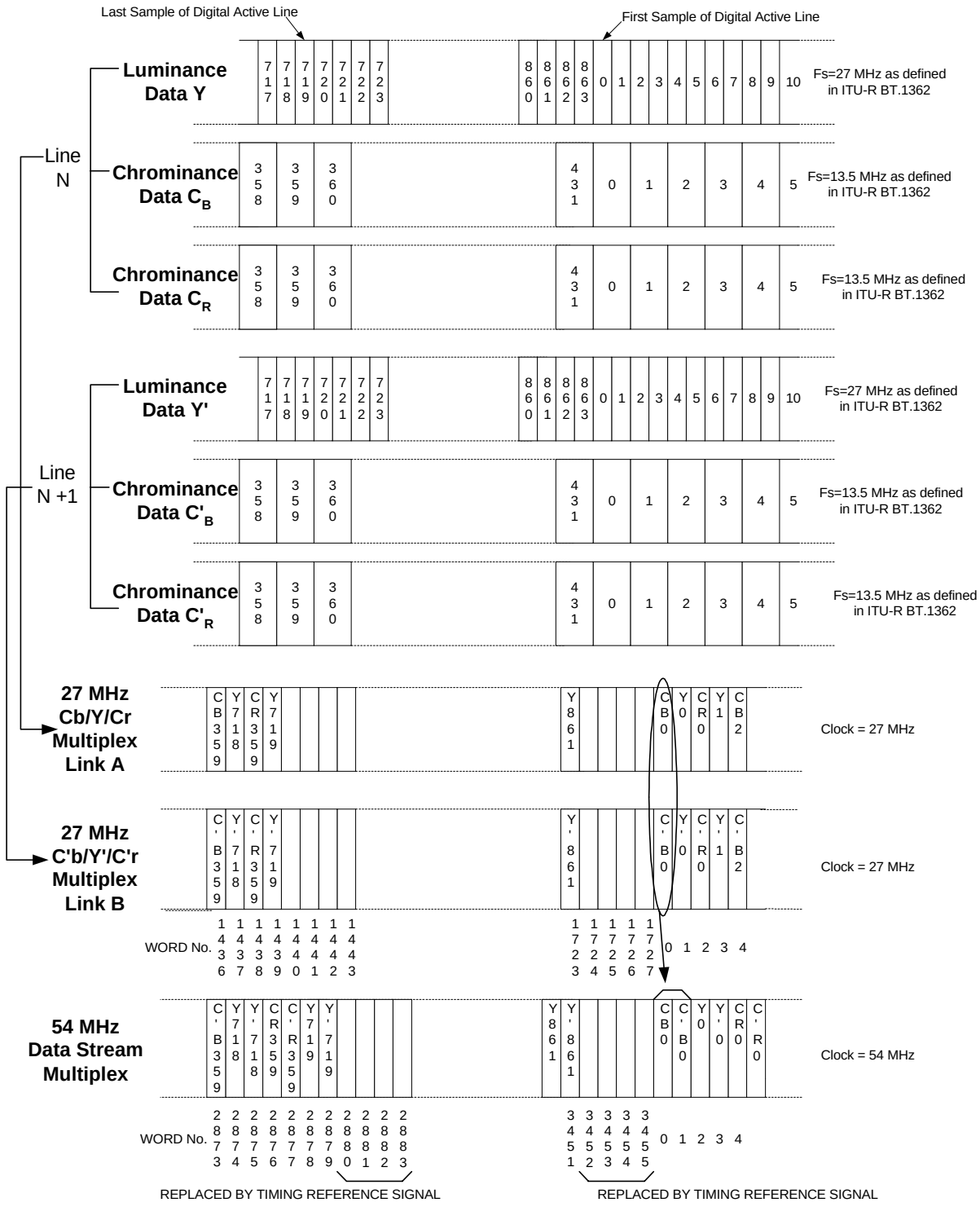

Figure 11 – Generation of 54-MHz parallel data stream for system 6 (dual-link 4:2:2p – 625p/50)

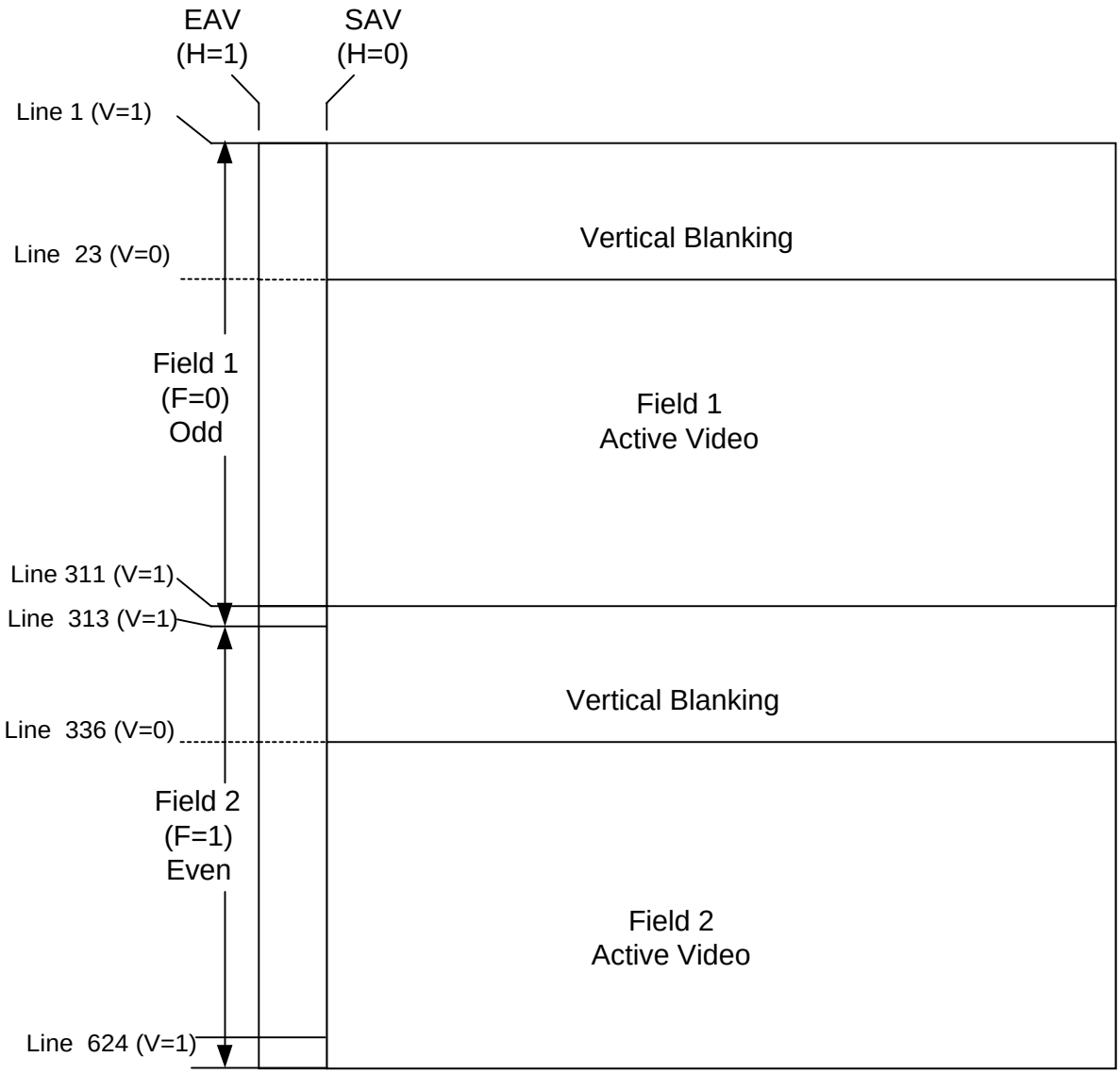

Figure 12 – Spatial representation of timing reference signals during video frame for system 6 (dual link 4:2:2p – 625p/50)

7 Format identifier

7.1 A format identifier shall be inserted into the relevant 54-MHz parallel data stream in accordance with SMPTE 352M.

7.2 As defined by SMPTE 352M, the format identifier shall have the structure in table 14.

7.3 The four SDI payload label words for systems 1, 2, 3, 4, 5, and 6 shall be as defined in SMPTE 352M.

Table 14 – Format identifier structure

Name	Acronym	Value
Ancillary data flag (10-bit word)	ADF	000_h, $3FF_h$, $3FF_h$
Data identification	DID	41_h
Secondary data identification	SDID	01_h
Data count	DC	04_h
SDI payload label	4 words	See 7.3
Checksum	CS	—

Annex A (informative)
Bibliography

ANSI/SMPTE 293M-1996, Television — 720 × 483 Active Line at 59.94-Hz Progressive Scan Production — Digital Representation

ANSI/SMPTE 294M-1997, Television — 720 × 483 Active Line at 59.94-Hz Progressive Scan Production — Bit-Serial Interfaces

SMPTE 344M-2000, Television — 540 Mb/s Serial Digital Interface

SMPTE RP 165-1994, Error Detection Checkwords and Status Flags for Use in Bit-Serial Digital Interfaces for Television

SMPTE RP 174-1993, Bit-Parallel Digital Interface for 4:4:4:4 Component Video Signal (Single Link)

ITU-R BT.799-3 (02/98), Interfaces for Digital Component Video Signals in 525-Line and 625-Line Television Systems Operating at the 4:4:4 Level of Recommendation ITU-R BT.601 (Part A)

ITU-R BT.1358 (02/98), Studio Parameters of 625 and 525 Line Progressive Scan Television Systems

ITU-R BT.1362 (02/98), Interfaces for Digital Component Video Signals in 525- and 625-Line Progressive Scan Television Systems