

SMPTE STANDARD

for Television —

System M/NTSC Composite Video Signals — Bit-Parallel Digital Interface



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1 Scope

1.1 This standard describes a bit-parallel composite video digital interface for systems operating according to the 525-line, 59.94-Hz NTSC standard, as described by SMPTE 170M, sampled at four times color subcarrier frequency. Sampling parameters for the digital representation of encoded video signals, the relationship between sampling phase and color subcarrier, and the digital levels of the video signal are defined.

1.2 This standard has application for use with shielded twisted 12-pair cable of conventional design over distances up to 50 m, without transmission equalization or any special equalization of the receiver. Longer cable lengths may be used, but with rapidly increasing requirement for care in the cable selection and possible receiver equalization or the use of active repeaters or both.

1.3 Digital composite video signals, as defined by this standard, are the signals conveyed by the composite implementation of the serial digital interface. It should be noted that additional information to that described by this standard is also carried by the serial digital interface.

The serial digital interface is the preferred method for the interconnection of composite digital equipments when cable lengths exceed 50 m.

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 170M-1999, Television — Composite Analog Video Signal — NTSC for Studio Applications

ISO 2110:1989, Information Technology — Data Communication — 25-Pole DTE/DCE Interface Connector and Contact Number Assignments

ITU-R BT.471-1 (07/86), Nomenclature and Description of Colour Bar Signals

3 General specifications

3.1 The analog signal shall be sampled at a rate of four times the color subcarrier frequency along the I and Q axes. The phase reference for the sample clock shall be color subcarrier (f_{sc}). Many systems will derive this phase reference from the burst of the analog signal.

3.2 Color subcarrier phase to horizontal sync timing (SC/H) in the digital domain shall be zero.

3.3 The quantization scale shall be uniformly quantized PCM at 10 bits per sample. Eight bits per sample video data may be carried across the interface by using the eight most significant bits and setting the two least significant bits to zero.

3.4 The bits of the digital words that describe the video signal are transmitted in a parallel arrangement using 10 conductor pairs. An eleventh conductor pair carries a clock signal at $4f_{sc}$ (14.31818 MHz).

3.5 The interface consists of one transmitter and one receiver in a point-to-point connection.

4 Sampling structure and quantization specifications

4.1 Sampling structure

Figure 1 depicts the line and field structure of the NTSC signal during the vertical blanking interval. Burst locked sinewave, shown in figure 1, is defined as a continuous sinewave at subcarrier frequency, with the same phase as burst.

4.1.1 There are 910 samples in a horizontal line period; 768 samples constitute the digital active video portion of each line. The remaining 142 samples comprise the digital horizontal blanking interval.

Each of the four samples during a color subcarrier period is described by the chrominance signal axis that it falls on. Figure 2 shows the derivation of the sample sequence.

Figure 3 depicts the sample numbering for a nominal NTSC signal. The half-amplitude point of the leading (falling) edge of the analog horizontal sync signal falls between samples 784 and 785.

The first of the 910 samples represents the first sample of the digital active line and is designated sample 0 for the purpose of reference. The 910 samples per line are, therefore, numbered 0 through 909. Samples 0 through 767 inclusive contain the digital active line video data.

4.1.2 The sample at sample 0, line 10, field 1, color frame A is an I axis (+123°) sample. (See figure 4.)

4.2 Quantization specifications

4.2.1 The digital video signal shall be quantized according to table 1.

Table 1 – Signal quantization

	8-bit system	10-bit system
White level	C8h	320h
Blanking level	3Ch	0F0h
Sync tip level	04h	010h
NOTE – The “h” suffix indicates a hexadecimal value		

4.2.2 The amplitude relationship between the digital signal and an equivalent analog signal is shown in figure 5. The signal illustrated is a representation of 100% level, 7.5% setup (100/7.5/100/7.5) color bars.

4.2.3 The characteristics of the data word are based on the assumption that the location of any required $(\sin x)/x$ correction is at the point where the digital signal is converted to an analog form.

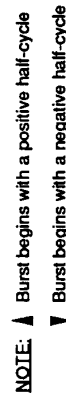
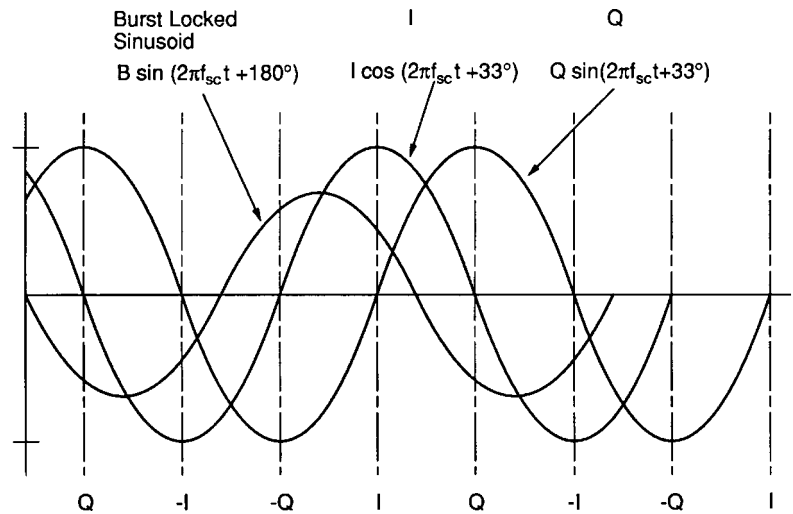


Figure 1 – Vertical blanking interval structure



NOTE – The equation for the chrominance signal is $E = I \cos(2\pi f_{sc} t + 33^\circ) + Q \sin(2\pi f_{sc} t + 33^\circ)$.
The equation for the burst locked sinusoid is $E = B \sin(2\pi f_{sc} t + 180^\circ)$.

Figure 2 – Derivation of sample sequence

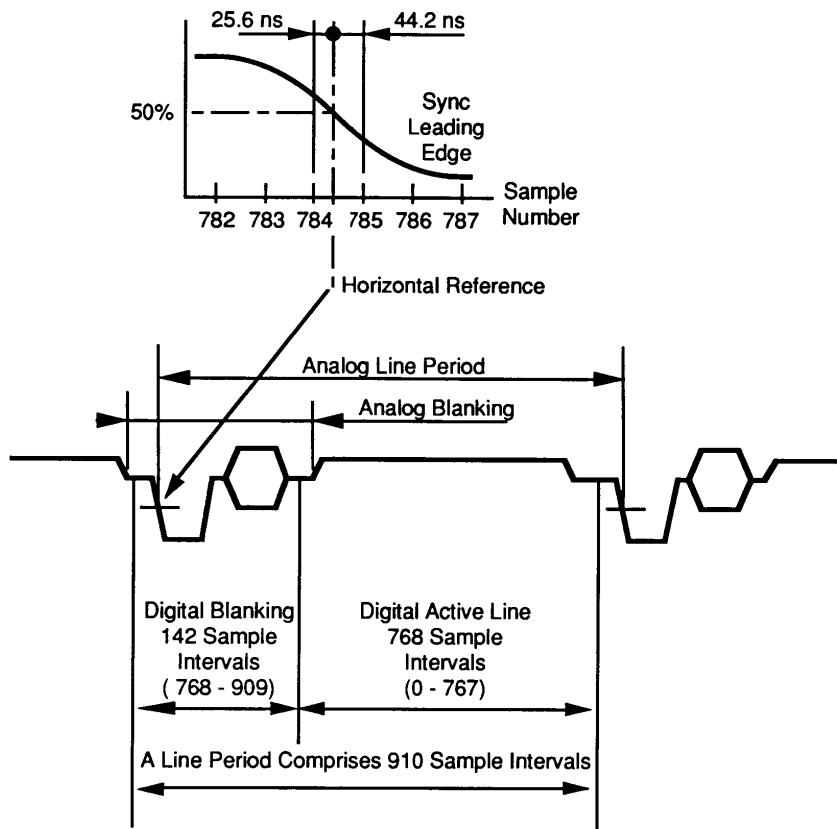


Figure 3 – Sample numbering for horizontal line period of nominal NTSC signal



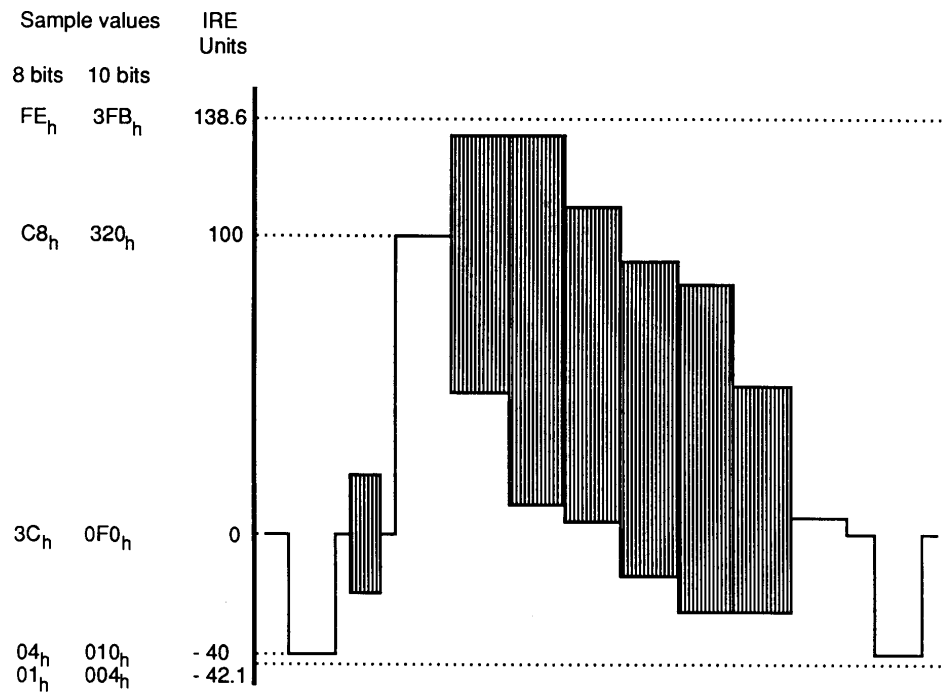


Figure 5 – Relationship between analog signal levels (IRE units) and digital sample values

4.2.4 Data is represented in 8- or 10-bit words.

In an 8-bit system, 254 of the 256 levels (01 through FE) are used to express a quantized value. In a 10-bit system, 1016 of the 1024 levels (004 through 3FB) are used to express a quantized value.

In an 8-bit system, levels 00 and FF are protected and are not permitted in the data stream. In a 10-bit system, levels 000, 001, 002, 003 and 3FC, 3FD, 3FE, and 3FF are protected and are not permitted in the data stream.

The protected and permitted data levels are shown in table 2.

Table 2 – Permitted and protected values

8 bits		10 bits
		000
		001
00	Protected	002
		003
		004
01		—
—	Permitted	3FB
FE		3FC
		3FD
FF	Protected	3FE
		3FF