



## COURSE OF TECHNICAL INSTRUCTION

Engineering Training Section, Headquarters, Postmaster-General's Department, Melbourne C.2.

# STANDARDS OF THE AUSTRALIAN TELEVISION SERVICE.

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### 1. INTRODUCTION.

1.1 The Australian Broadcast Control Board is responsible for prescribing standards for the Australian Television Service. This paper sets out the details of these standards.

### 2. TELEVISION CHANNEL.

2.1 Channel Width. The width of the standard television channel is 7 megacycles per second.

2.2 Location of the Carriers within the Channel. The unmodulated sound carrier is 0.25 megacycles per second below the upper frequency limit of the channel and the picture carrier 1.25 megacycles per second above the lower limit, so that the carriers are spaced 5.5 megacycles per second apart.

2.3 Picture Transmission Amplitude Characteristic. Vestigial sideband transmission is used, and the maximum amplitude versus frequency characteristic of the radiated picture signal is as shown in Fig. 2.

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3. SCANNING SPECIFICATIONS.

- 3.1 Number of Lines and Interlacing. The standard number of scanning lines per picture is 625 interlaced two to one. The radiated signal is monochrome.
- 3.2 Picture and Field Frequencies. The picture frequency of the radiated signal is 25 per second and the field frequency is 50 per second non-synchronous with the power mains supply, and held to the appropriate sub-multiple of the line frequency (625 and 312.5 respectively).
- 3.3 Aspect Ratio. The standard aspect ratio of the transmitted television picture is four units horizontally to three units vertically.
- 3.4 Scanning Order. During active scanning intervals, the scene is scanned from left to right horizontally and from top to bottom vertically at uniform velocities.

4. PICTURE SIGNAL MODULATION.

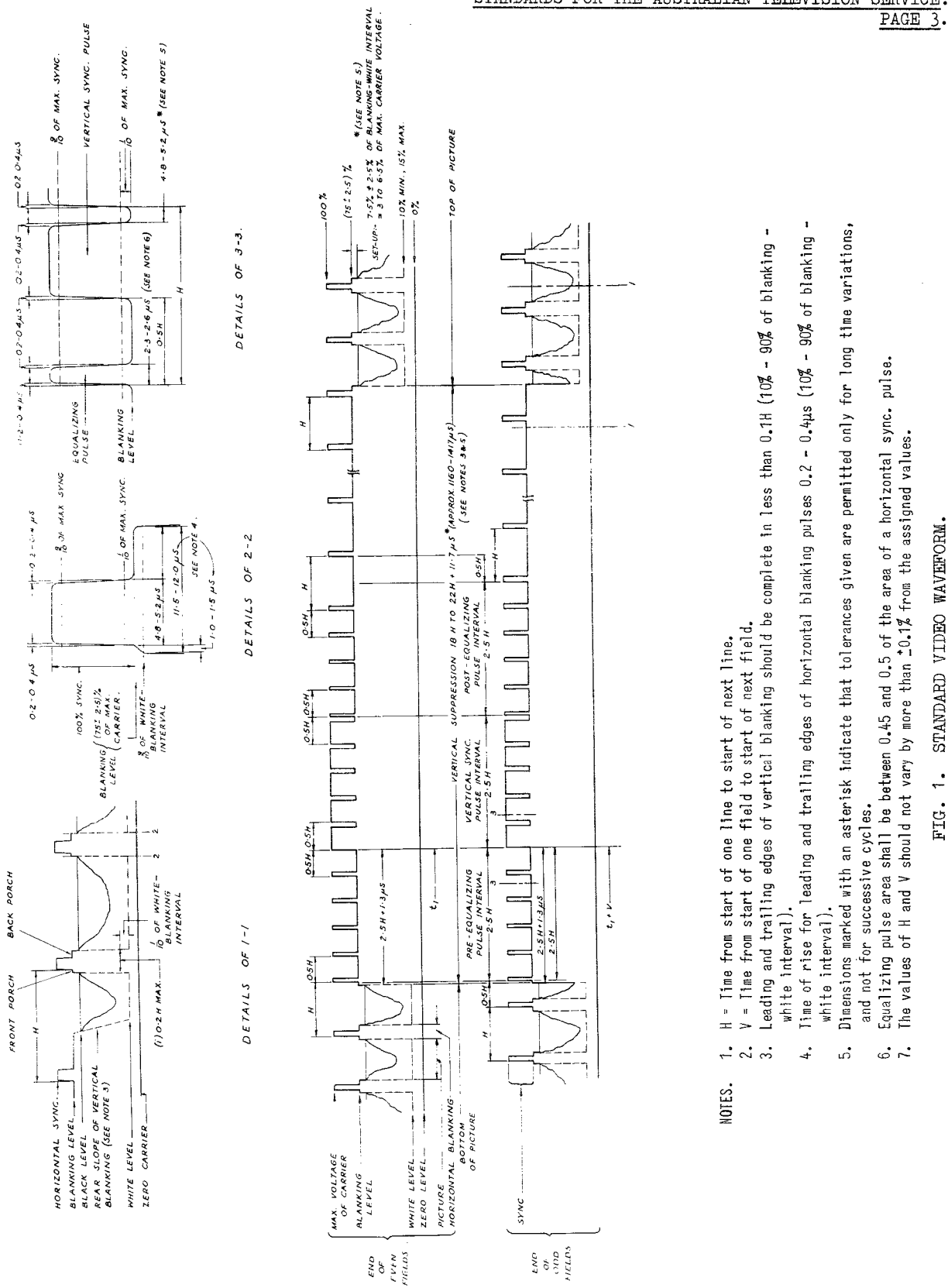
- 4.1 Type of Modulation. The carrier within a single television channel with both picture and synchronizing signals is amplitude modulated, the synchronizing and picture modulation occurring alternatively on a time division basis as shown in Fig. 1. The waveform shown represents the output from a standard monitor (preserving zero carrier level) connected to the transmitter output after the vestigial sideband filter. The standard monitor has an amplitude characteristic flat to 5Mc/s, and a phase characteristic which has a constant group delay at low and medium video frequencies, and an increased delay at high video frequencies equal to that of a single section all pass network having a maximum delay at 5.5Mc/s and a group delay increase at 4.5Mc/s of 120 nano-seconds.
- 4.2 Polarity of Modulation. Negative modulation is employed; that is, a decrease in initial light intensity causes an increase in radiated power.
- 4.3 Brightness Characteristic. The black level is represented by a definite carrier level independent of light and shade in the picture.

The transmitter output varies in the opposite sense to the brightness of the subject, substantially in accordance with a power law of less than unity, and with an approximate gamma 0.5.

- 4.4 Percentage Modulation of Blanking and Black Levels. Transmitters transmit the blanking level at 75 per cent. of the peak carrier amplitude, with a tolerance of 2.5 per cent. of the peak carrier amplitude.
- The black level is separated from the blanking level by the set-up interval of 7.5 per cent.  $\pm$  2.5 per cent. of the picture signal range from blanking to white level, corresponding to an interval of 3 to 6.5 per cent. of peak carrier amplitude.
- 4.5 Line Frequency. The line frequency is maintained at 15,625 cycles per second  $\pm$  0.1 per cent.
- 4.6 White Level. In the modulation of the picture transmitter, the radio frequency signal amplitude for the maximum white is not more than 15 per cent., nor less than 10 per cent. of the maximum carrier amplitude.

5. SOUND SIGNAL MODULATION.

- 5.1 Type of Modulation. Frequency modulation is used for the television sound transmission
- 5.2 Modulation Band and Pre-Emphasis Characteristic. Transmitters are capable of operating with modulation frequencies between 30 cycles per second and 15,000 cycles per second.



- NOTES.
1. H = Time from start of one line to start of next line.
  2. V = Time from start of one field to start of next field.
  3. Leading and trailing edges of vertical blanking should be complete in less than 0.1H (10% - 90% of blanking - white interval).
  4. Time of rise for leading and trailing edges of horizontal blanking pulses 0.2 - 0.4μs (10% - 90% of blanking - white interval).
  5. Dimensions marked with an asterisk indicate that tolerances given are permitted only for long time variations, and not for successive cycles.
  6. Equalizing pulse area shall be between 0.45 and 0.5 of the area of a horizontal sync. pulse.
  7. The values of H and V should not vary by more than ±0.1% from the assigned values.

FIG. 1. STANDARD VIDEO WAVEFORM.

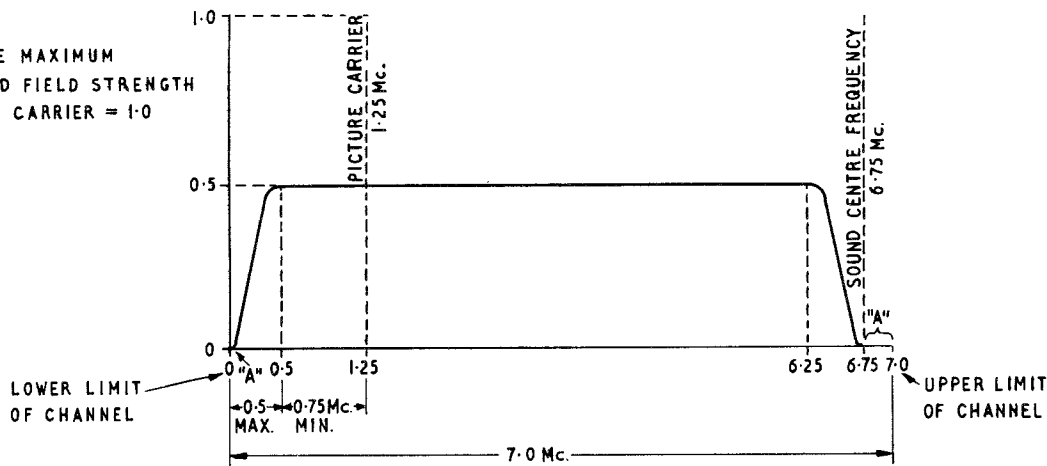
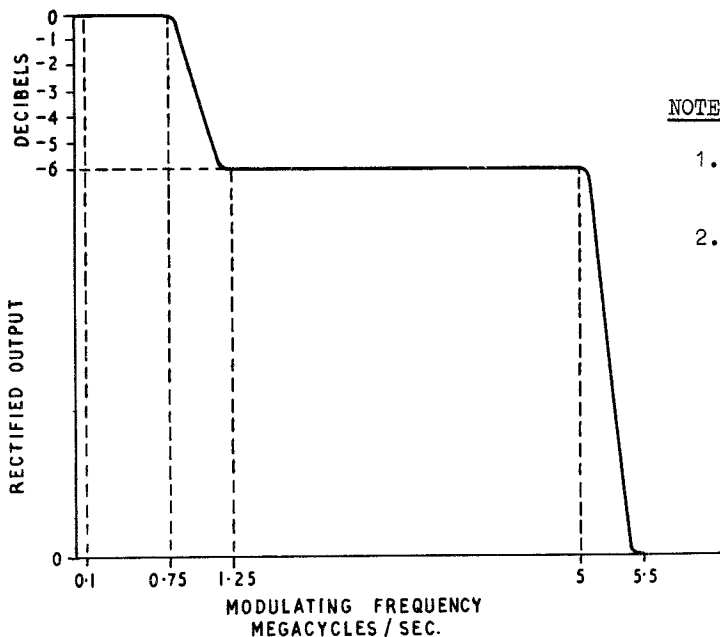


FIG. 2. PICTURE TRANSMISSION AMPLITUDE CHARACTERISTIC.

NOTES:

1. Sideband attenuation at frequencies "A" is at least 20db. greater than the attenuation at frequency 1.15Mc.
2. All frequencies given are added to the lower limit of the channel.



NOTES:

1. This is the rectified output from an ideal double sideband receiver.
2. Tolerances are given below, relative to 0db, which is the case for 100% double sideband modulation rectified without loss.

Mod. Freq.	Max. Response	Min. Response
0.5 Mc/s	0db	-2 db
1.25Mc/s	-5db	-8 db
2.5 Mc/s	-5db	-8 db
4.0 Mc/s	-5db	-10db
5.0 Mc/s	-6db	-11db

FIG. 3. FREQUENCY RESPONSE OF PICTURE TRANSMITTER.

Pre-emphasis is employed in the sound transmitter in accordance with the impedance-frequency characteristic of a series inductance resistance network having a time constant of 50 microseconds.

- 5.3 Frequency Deviation. In the sound transmitter, the deviation for full modulation is  $\pm 50$  kilocycles per second.

## 6. TRANSMITTER CHARACTERISTICS.

- 6.1 Polarization of Radiated Signal. The radiated signals from both sound and picture transmitters are horizontally polarized, except in special cases.
- 6.2 Power Output. The ratio of peak power output of the picture transmitter to mean power output of the sound transmitter is five to one.
- 6.3 Frequency Response of Picture Transmitter. The overall frequency response of the picture transmitter is within the limits of the demodulated output specified in Fig. 3, from the transmitter input to the output of the vestigial sideband filter.
- 6.4 Frequency Response of Sound Transmitter. The frequency response of the sound system from microphone output to sound transmitter output shall be within the limits set out in Fig. 4.
- 6.5 Phase Modulation of Picture Transmitter. The picture transmitter is suitable for use with the intercarrier type of receiver. The phase modulation of the transmitted picture carrier, for modulating frequencies in the range 30 to 15,000 cycles per second, is such that the noise due to this modulation, that is present at the sound output of an ideal intercarrier receiver with de-emphasis, is at least 46db below the level which would be present if the picture carrier was deviated  $\pm 50$  kilocycles per second at 1,000 cycles per second.

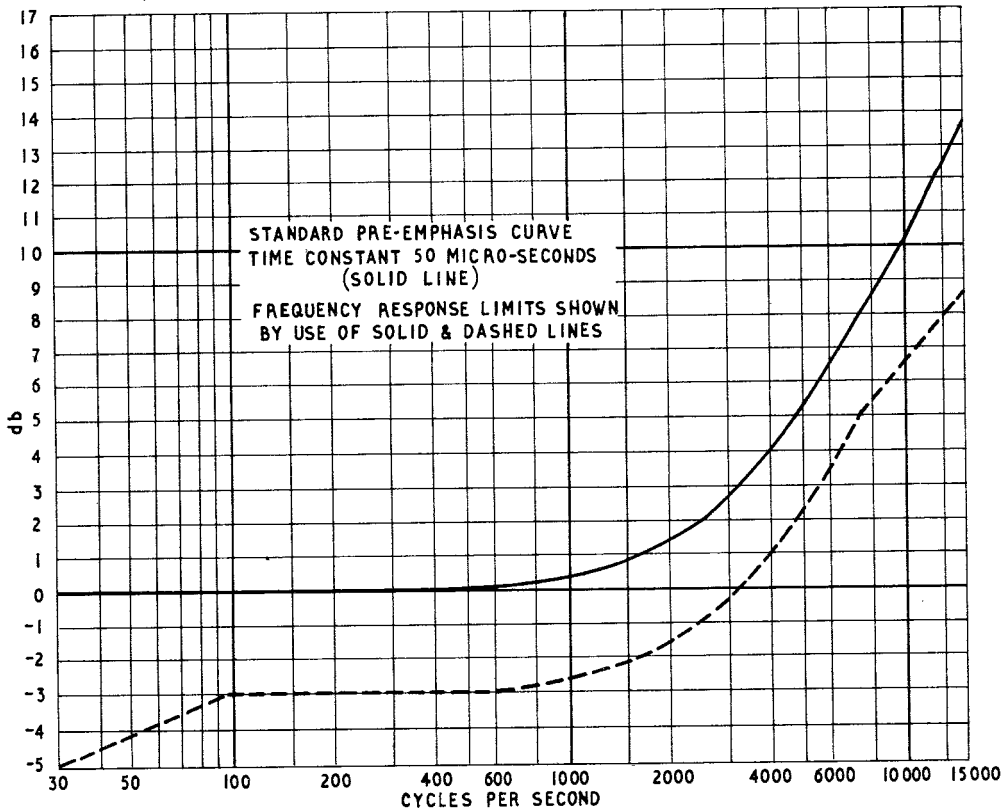


FIG. 4. FREQUENCY RESPONSE OF SOUND TRANSMITTER.

7. TELEVISION CHANNEL FREQUENCIES.

7.1 Thirteen channels in the very high frequency (V.H.F.) band are allocated for television stations in the Commonwealth. These channels are:-

Channel	0	45 - 52Mc/s
	1	56 - 63Mc/s
	2	63 - 70Mc/s
	3	85 - 92Mc/s
	4	94 - 101Mc/s
	5	101 - 108Mc/s
	5A	137 - 144Mc/s
	6	174 - 181Mc/s
	7	181 - 188Mc/s
	8	188 - 195Mc/s
	9	195 - 202Mc/s
	10	208 - 215Mc/s
	11	215 - 222Mc/s

8. TELEVISION STATION CHANNEL ALLOCATIONS.

- 8.1 The allocation of channels for television stations and the construction of these stations has proceeded in phases, gradually extending the service by both National and Commercial stations from the initial service in the densely populated areas to the country and provincial areas.
- 8.2 To reduce the possibility of interference between stations in different areas that share the same frequencies and to make most effective use of the numbers of channels available for television purposes, the transmissions from some stations are vertically polarized.
- 8.3 The allocated channels and the areas served in phases 1 to 4 of the development of the television service are listed in Table 1, along with the polarization of the radiated signal in each of the areas.

9. TELEVISION RECEIVER INTERMEDIATE FREQUENCIES.

- 9.1 Standard intermediate frequencies for vision and sound are required for all receivers used in the Commonwealth, so that frequency allocations can be made for television stations in specific locations in such a manner as to avoid mutual interference between television and other services arising from image responses, intermediate frequency difference responses and beat oscillator radiation. If a multiplicity of intermediate frequencies is used for receivers, it would be impracticable to ensure maximum protection from interference.

The following alternative standard intermediate frequencies are used in television receivers in Australia:-

Sound carrier	..	..	30.5Mc/s	31.375Mc/s.
Vision carrier	..	..	36 Mc/s	or 36.875Mc/s.

These frequencies should be adhered to within  $\pm 0.25\text{Mc/s}$ . The oscillator frequency should be above the channel frequency.

- 9.2 The arrangements have been made for frequency assignments in the band encompassing the above intermediate frequencies to ensure protection of television services from interference.

Phase	Area	Polarization	Call Sign and Channel	
			National	Commercial
	<u>AUSTRALIAN CAPITAL TERRITORY</u>			
3	Canberra	Vertical	ABC-3	CTC-7
	<u>NEW SOUTH WALES</u>			
1	Sydney	Horizontal	ABN-2	ATN-7 TCN-9 TEN-10
-				
3	Central Tablelands	Vertical	ABCN-1	CBN-8
3	Newcastle-Hunter River	Horizontal	ABHN-5	NBN-3
3	Illawarra	Horizontal	ABWN-5A	WIN-4
3	Richmond-Tweed Heads	Horizontal	ABRN-6	RTN-8
4	South Western Slopes-Eastern Riverina (Wagga)	Horizontal	ABMN-0	RVN-2
4	Upper Namoi (Tamworth)	Horizontal	ABUN-7	NEN-9
4	Murrumbidgee Irrigation (Griffith)	Horizontal	ABGN-7	MTN-9
4	Manning River (Taree)	Vertical	ABTN-1	ECN-8
4	Grafton/Kempsey	Horizontal	ABDN-2	NRN-10
4	Broken Hill	Vertical	ABLN-2	BHN-7
4	Bega/Cooma	Vertical	ABSN-8	
4	Central Western Slopes (Dubbo)	Vertical	ABQN-3	CWN-6
	<u>VICTORIA</u>			
1	Melbourne	Horizontal	ABV-2	HSV-7 GTV-9 ATV-0
-				
3	Bendigo	Vertical	ABEV-1	BCV-8
3	Ballarat	Horizontal	ABRV-3	BTV-6
3	Goulburn Valley	Vertical	ABGV-3	GMV-6
3	Lalor Valley	Horizontal	ABLV-4	GLV-10
4	Upper Murray (Albury)	Horizontal	ABAV-1	AMV-4
4	Murray Valley (Swan Hill)	Vertical	ABMV-2	-
4	Sunraysia (Mildura)	Horizontal	ABSV-4	STV-8
	<u>QUEENSLAND</u>			
2	Brisbane	Horizontal	ABQ-2	BTQ-7 QTQ-9 TVQ-0
-				
3	Darling Downs	Horizontal	ABDQ-3	DDQ-10
3	Rockhampton	Horizontal	ABRQ-3	RTQ-7
3	Townsville	Horizontal	ABTQ-3	TNQ-7
4	Southern Downs (Warwick)	Horizontal	ABSQ-1	SDQ-4
4	Wide Bay (Maryborough)	Vertical	ABMQ-6	WBQ-8
4	Mackay	Horizontal	ABAQ-4	-Q-6
4	Cairns	Horizontal	ABNQ-9	FNQ-10
	<u>SOUTH AUSTRALIA</u>			
2	Adelaide	Horizontal	ABS-2	ADS-7 NWS-9 SAS-10
4	South East (Mt. Gambier)	Horizontal	ABGS-1	SES-8
4	Spencer Gulf North (Port Pirie)	Vertical	ABNS-1	
	<u>WESTERN AUSTRALIA</u>			
2	Perth	Horizontal	ABW-2	TVW-7 STW-9 BTW-3
4	Bunbury	Horizontal	ABSW-5	
4	Central Agricultural (Northam)	Vertical	ABCW-4	-
4	Southern Agricultural (Albany)	Vertical	ABAW-2	-
	<u>TASMANIA</u>			
3	Hobart	Horizontal	ABT-2	TVT-6
3	North Eastern Tasmania	Horizontal	ABNT-3	TNT-9

TABLE 1. LIST OF TELEVISION STATIONS.

## 10. SUMMARY OF AUSTRALIAN TELEVISION STANDARDS.

Number of Lines	625 per picture.
Horizontal or Line Frequency	15,625 cycles per second $\pm$ 0.1%
Horizontal or Line Period	64 microseconds (including blanking time).
Equalizing Pulse Frequency	31,250 cycles per second.
Vertical or Field Frequency	50 cycles per second $\pm$ 0.1%
Vertical or Field Period	20,000 microseconds.
Picture Frequency (Frame)	25 cycles per second.
Aspect Ratio	4 units horizontally, 3 units vertically.
Scanning During Active Periods	Left to right. Top to bottom.
System Operation	Independent of mains frequency.
Horizontal or Line Blanking	11.5 to 12.0 microseconds.
Vertical or Field Blanking	1,160 to 1,417 microseconds.
Number of Equalizing Pulses	5 before (pre-equalizing) and 5 after (post-equalizing) the vertical synchronizing pulse.
Equalizing Pulse Duration	2.3 to 2.6 microseconds.
Horizontal Synchronizing Pulse Duration	4.8 to 5.2 microseconds.
Vertical Synchronizing Pulse Duration	2.5 lines including vertical synchronizing pulse serrations.
Vertical Synchronizing Pulse Serration	4.8 to 5.2 microseconds.
Front Porch Duration	1.0 to 1.5 microseconds.
Back Porch Duration	Not directly specified.
Video Bandwidth	5 megacycles per second.
Blanking Level	75% $\pm$ 2.5% of maximum carrier amplitude.
White Level	10% to 15% of maximum carrier amplitude.
Black Level	70% approx. of maximum carrier amplitude.
Set-up	7.5% $\pm$ 2.5% of blanking-white interval. 3 to 6.5% of maximum carrier amplitude.