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PERFORMANCE AND SAFETY REQUIREMENTS
FOR
SUBSCRIPTION TELEVISION SYSTEM



TELECOMMUNICATIONS AUTHORITY
HONG KONG

FOREWORD

1. This specification sets out the performance and safety requirements of the subscription television system.
2. The Telecommunications Authority (TA) reserves the right to revise the contents of this specification without prior notice.
3. In case of any doubt about the interpretation of this specification and the methods of carrying out the tests, the decision of the TA shall be final.
4. The HKTA series specifications are issued by the TA. The documents can be downloaded directly through the OFTA's Internet Home Page at <http://www.ofta.gov.hk>.
5. The publications from the International Telecommunication Union (ITU) can be obtained from

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6. The publications from the European Committee for Electrotechnical Standardization (CENELEC) can be obtained from

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7. The publications from the International Electrotechnical Commission (IEC) can be obtained from

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1. GENERAL

1.1 SCOPE

1.1.1 This document specifies the performance requirements for downstream television signals and FM sound signals and the safety requirements of the subscription television.

1.1.2 Details of the characteristics of the television and sound signals referred to in this document are given in the following International Telecommunication Union - Radiocommunication (ITU-R) Recommendations:

- (a) ITU-R Recommendation **BT.470-6** "Conventional Television Systems" for 625-line, PAL System I Television System;
- (b) ITU-R Recommendation **BS.450-2** "Transmission Standards for FM Sound Broadcasting at VHF" for FM Sound Broadcasting System.

1.2 DEFINITION

For the purposes of this document, the following definitions shall apply.

1.2.1 ATTENUATION

The ratio of the input power to the output power, expressed in decibels.

1.2.2 CROSS-MODULATION

The undesired modulation of the carrier of a desired signal by the modulation of another signal as a result of system non-linearities.

1.2.3 DECRYPTER

An equipment for decryption of an encrypted signal.

1.2.4 ECHO RATING

The result of a system test with a 2T sine-squared pulse employing the boundary line on a specified graticule within which all parts of the received pulse fall. The 2T pulse is defined in ITU-T Recommendation **J.61** and as a field blanking insertion signal in ITU-T Recommendation **J.63**.

1.2.5 FEEDER

A transmission path forming part of a subscription television system. Such a path may consist of a metallic cable, optical fibre, waveguide, or any combination of them.

1.2.6 FREQUENCY RESPONSE

The gain or attenuation of a system plotted against frequency.

1.2.7 GAIN

The ratio of the output to the input power, expressed in decibels.

1.2.8 HEAD END

Equipment that is connected between receiving antennas or other signal sources and the remainder of the subscription television system to process the signals to be distributed.

1.2.9 INTERMODULATION

The process whereby non-linearity in equipment in a system produces spurious output signals (called intermodulation products) at frequencies which are linear combinations of those of the input.

1.2.10 LEVEL

The decibel ratio of a power P_1 , to the standard reference power P_o , expressed in decibels i. e.

$$10 \log_{10} (P_1 / P_o) \text{ dB}$$

1.2.11 MUTUAL ISOLATION

The attenuation between one system outlet and another at any frequency within the range of the system under investigation. It is always specified, for any particular installation, as the minimum value obtained within specified frequency limits.

1.2.12 SYSTEM OUTLET

A device for interconnecting a subscriber's feeder and a receiver lead.

1.3 GENERAL

- 1.3.1 The performance requirements are based on the assumption that the significant impairments are those produced by the multi-channel coaxial cable sub-system employing vestigial sideband transmission to carry signals having PAL-I characteristics.
- 1.3.2 The performance limits specified here will, with an unimpaired input, produce picture and sound signals where the impairment to any single parameter will not be worse than grade 4 on the ITU-R 5-grade impairment scale. It shall be obtained between the input(s) to the head end and any system outlet when the latter is terminated in a resistance equal to the nominal impedance of the system unless otherwise specified.
- 1.3.3 Where additional equipment (e.g. decrypter) is interposed between the system outlet and the subscriber's equipment, the performance limits shall also apply to the signals applied to the subscriber's equipment.
- 1.3.4 The subscription television system external to the subscriber's premises shall comply with the requirements of this document over the following conditions:
- (a) ambient temperature range external to the equipment cabinet of -10°C to $+45^{\circ}\text{C}$;
 - (b) relative humidity up to 100%;
 - (c) mains supply voltage variation of $\pm 10\%$ of the declared value of the supply;
 - (d) mains supply frequency variation of $\pm 5\%$ of the declared value of the supply.
- 1.3.5 The subscription television system shall be so designed and installed that it complies with the requirements of this document throughout the planned life of the installation.
- 1.3.6 The provisions of the latest edition of **EN 50083-7** "Cabled Distribution Systems for Television and Sound Signals, Part 7. System Performance" published by the European Committee for Electrotechnical Standardization (CENELEC) will apply for those methods of measurements not specifically given in this document.

2. PERFORMANCE REQUIREMENTS FOR TELEVISION SIGNAL

2.1 R.F. CHARACTERISTICS

2.1.1 *Impedance*

The nominal impedance of the system including all coaxial feeder cables and system outlets shall be 75 Ω .

2.1.2 *Signal level at outlet*

The r.m.s. voltage of each vision carrier at the peak of the modulation envelope when measured at the system outlet across a non-inductive 75 ohm resistor (or referred to 75 Ω) shall be:

Frequency range and service	Maximum level (dB μ V)	Minimum level (dB μ V)
30 MHz to 300 MHz television	80	60
300 MHz to 1 GHz television	80	63

The maximum level is based upon an internationally recommended upper limit for receivers. Too high a level may cause picture cross-talk between channels in the receiver. The received signal has also to exceed the minimum level so that the final picture is not unduly degraded by the noise generated in the receiver.

The levels of the sound carriers relative to the vision carrier shall be within +3 dB, -6 dB of the specified nominal values.

2.1.3 *Permissible difference in level of TV signals*

The difference in carrier levels when both carriers are either in the VHF range or the UHF range shall not exceed the values given in the following table:

Frequency range	Interval	Maximum level difference (dB)
30 MHz to 300 MHz	Entire range	12
	60 MHz range	8
	Adjacent channel	3
300 MHz to 1 GHz	Entire range	15
	100 MHz range	9
	Adjacent channel	3

The difference in carrier levels when one carrier is in the VHF range and one is in the UHF range shall not exceed 15 dB.

If FM sound signals are present at the system outlet intended for television signals, the level of any FM carrier shall be at least 3 dB lower than the lowest television signal level at the outlet.

2.1.4 *Level variation*

Subject to the limits specified in Section 2.1.2, the variation of level of the picture carrier in each channel shall not vary by more than 2 dB from the mean level.

2.1.5 *Frequency response*

The amplitude response as a function of frequency at every subscriber outlet shall be within ± 2 dB over the entire frequency range of each channel conveying picture information, and the variation in amplitude within any frequency range of 0.5 MHz shall not exceed by more than 0.5 dB.

2.1.6 *Frequency stability of distributed carrier*

The mean distributed vision carrier frequency shall be within ± 50 kHz of the declared nominal and the variation from that mean shall not exceed ± 12.5 kHz. These limits shall also apply to the frequencies of locally generated vision carrier signals and in this case the difference between the vision and sound carriers of any one channel shall be maintained within ± 5 kHz of the nominal. The limits specified here do not include the frequency variations due to any broadcast transmitter or those resulting from any equipment provided in the subscriber's premises (see Section 5.3).

Where adjacent channels of 8 MHz bandwidth are employed the total variation in frequency of each vision carrier shall not exceed ± 20 kHz of the declared nominal.

2.2 UNWANTED SIGNALS

2.2.1 *Minimum signal to noise ratio*

The signal to noise ratio of any signal at any system outlet shall be equal to or greater than that given in the following table, with the test signal applied to the system input at a level equal to that normally available at that point.

The signal to noise ratio in decibels is given by

$$20 \log_{10} (\text{signal voltage} / \text{noise voltage})$$

where the signal voltage is the r.m.s. value of the vision carrier at the peak of the modulation envelope, or the r.m.s. value of the sound carrier and the noise voltage is the r.m.s. value of the random noise within the specified bandwidth.

Service	System	Minimum signal/noise ratio (dB)	Noise bandwidth (MHz)
Television	625 line system I	43	5.08

2.2.2 *Generation of spurious signals*

Frequency converters shall comply with the following limits in respect of R.F. voltages at their signal terminals:

- (a) local oscillator fundamentals : 60 dB μ V maximum;
- (b) local oscillator harmonics and sub-multiples : 50 dB μ V maximum.

2.2.3 *Intermediate frequency interference*

At any system outlet, the level of any signal in the intermediate frequency (IF) range of the television receivers (33 MHz to 41 MHz) shall be more than 10 dB lower than the lowest VHF television signal level and not higher than the lowest UHF television signal level.

2.2.4 *Single-frequency interference*

At any system outlet the level of any unwanted signal generated within the system shall be such that the lowest carrier to interference ratio within a wanted television channel shall be equal to or greater than 57 dB, where this ratio is expressed as:

$$20 \log_{10} (\text{r.m.s. vision carrier signal voltage/r.m.s. interference voltage})$$

where the voltages have those values which occur at the peaks of modulation envelopes.

However, where a frequency assignment taking into account of known future off-air and distributed channel is adopted so that interference signals fall only in less sensitive areas of the television channel spectrum, the limits given in Figure 1 applies.

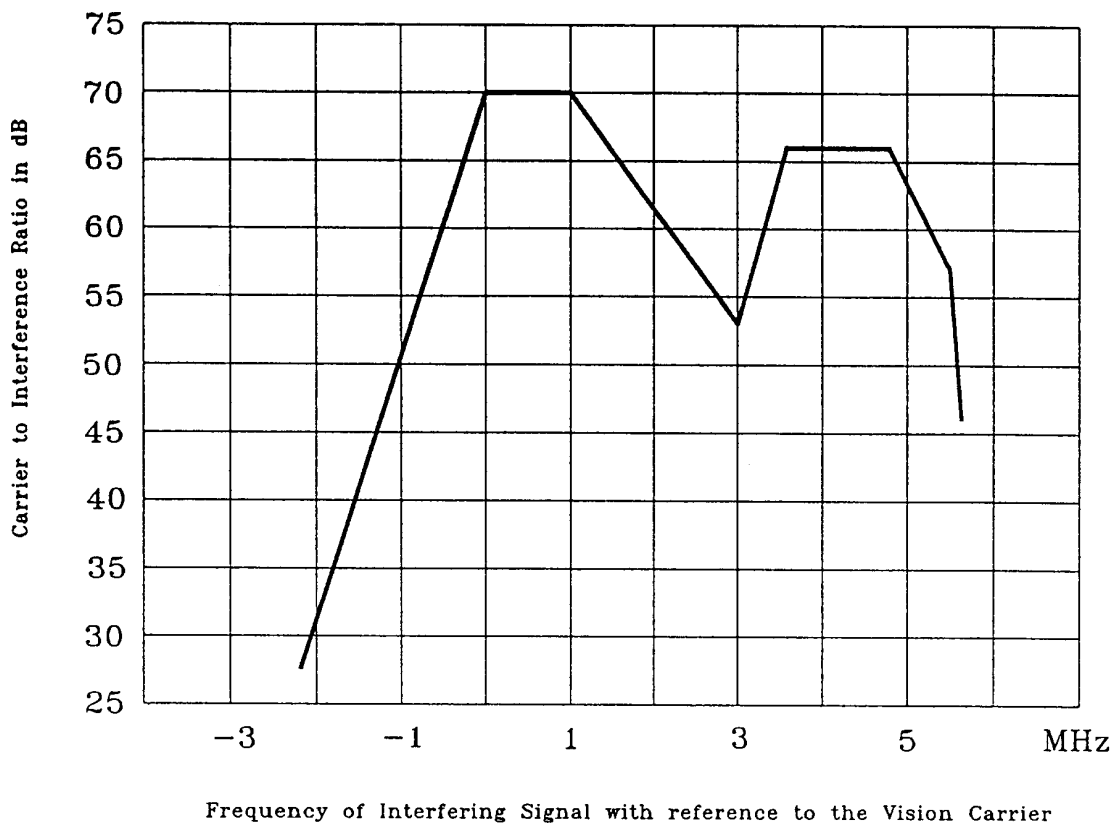


Figure 1 Carrier to single-frequency interference protection ratio for 625-line PAL system I C.W. interference with no special control

2.2.5 Cross-modulation

At any system outlet the level of modulation of one signal by the modulation of another signal, the cross-modulation shall be such that the signal to cross-modulation ratio, in dB, shall be equal to or greater than $46 + 10 \log_{10} (N-1)$ where this ratio is defined as

$$20 \log_{10} \left(\frac{\text{Peak-to-peak wanted modulation on the wanted carrier}}{\text{Peak-to-peak transferred modulation on the wanted carrier}} \right)$$

and N is the total number of television channels for which the system is designed.

2.2.7 *Differential gain and phase*

The differential gain in any television channel at any system outlet shall not exceed 10% and differential phase shall not exceed 12°.

2.2.8 *Echo rating*

The echo rating at any system outlet shall not exceed 6%.

2.2.9 *Hum modulation of carriers*

This is visible as horizontal bands which may move slowly up or down the picture.

At any system outlet, the depth of amplitude modulation of any vision carrier due to hum at the frequency of the supply mains and harmonics shall not be greater than 0.5% i.e. 46 dB below 100%.

2.2.10 *Chrominance/luminance delay and gain inequalities*

At any system outlet on any television channel the difference in transmission delay between luminance and chrominance information shall not exceed 100 ns and the difference in gain shall not exceed 2 dB.

2.2.11 *Single-channel intermodulation interference*

The ratio of the reference level to the interference signal shall be equal to or greater than 54 dB.

2.2.12 *Multiple-frequency intermodulation interference*

At any system outlet the level of multiple-frequency intermodulation in any channel shall be such that the carrier to interference ratio shall be equal to or greater than 54 dB, where this ratio is expressed as:

$$20 \log_{10} (\text{vision carrier voltage} / \text{interference voltage})$$

where the vision carrier voltage is the r.m.s. value of that carrier at peak of the modulation envelope and the interference voltage is the r.m.s. value of the effective sum of the weighted interference voltages. A lower figure may apply when special techniques such as harmonically-related or incrementally-related vision carriers are in use.

2.2.13 *Mutual isolation between systems outlets*

Isolation is necessary because the local oscillator energy from one receiver may cause interference with other receivers on the same coaxial cable sub-system.

The mutual isolation between outlets connected separately to a spur feeder shall be equal to or greater than 33 dB. Greater isolation will be necessary where local oscillator interference cannot be avoided.

3. **PERFORMANCE REQUIREMENTS FOR SOUND SIGNAL**

3.1 **R.F. CHARACTERISTICS**

3.1.1 *Signal level at outlet*

The r.m.s. voltage of each carrier when measured at the system outlet across a non-inductive 75 ohm resistor (or referred to 75 Ω) shall be:

Frequency range and service	Maximum level (dB μ V)	Minimum level (dB μ V)
VHF band II		
FM sound (mono)	74	40
FM sound (stereo)	74	54

3.1.2 *Level variation*

Subject to the limits given in Section 3.1.1, the variation of the carrier levels in each channel shall not exceed the values given in the following table:

Range	Maximum level difference (dB)
Entire band of 87-108 MHz	8
Adjacent channel	6

3.1.3 *Frequency stability of distributed carriers*

The frequency of the unmodulated carrier of any distributed FM sound signal shall not vary by more than ± 5 kHz from the declared nominal.

3.1.4 *Signal-to-noise ratio*

Within any programme channel bandwidth, the minimum signal-to-noise ratio measured at any system outlet, with a substantially noise-free test signal applied to the input of the system and with signal levels specified in Section 3.1.1, shall be 25 dB and 45 dB for mono and stereo sound respectively. The noise bandwidth is taken to be 180 kHz.

3.1.5 *Adjacent channel spacing*

The minimum spacing between adjacent unmodulated carriers shall be equal to or greater than 400 kHz.

3.2 **AUDIO CHARACTERISTICS**

Distortions introduced by the system shall not cause the demodulated signal parameters to exceed the following limits:

3.2.1 *Gain stability* ± 0.5 dB

3.2.2 *Harmonic distortion*

i)	1 kHz	0 dBm	0.5%
ii)	80 Hz	0 dBm	1.0%
iii)	1 kHz	+8 dBm	1.0%
iv)	80 Hz	+8 dBm	2.0%
v)	1 kHz	+14 dBm	5.0%
vi)	80 Hz	+14 dBm	5.0%

3.2.3 *Frequency attenuation characteristics*

(Amplitude/Frequency Response w.r.t. 1 kHz)

i)	40 Hz to 125 Hz	< +1.0 dB and > -2.0 dB
ii)	125 Hz to 10 kHz	< +0.5 dB and > -1.0 dB
iii)	10 kHz to 15 kHz	< +1.0 dB and > -2.0 dB

3.2.4	<i>Interchannel crosstalk</i>	-55 dB
3.2.5	<i>Level difference between Left and Right channels</i>	
	40 Hz to 125 Hz	1.5 dB
	125 Hz to 10 kHz	1.0 dB
	10 kHz to 15 kHz	1.5 dB
3.2.6	<i>Crosstalk between Left and Right channels</i>	
	40 Hz to 15 kHz	-50 dB

4. PREVENTION OF INTERFERENCE

- 4.1 The subscription television system shall at all times be operated and maintained in such a manner that it does not cause interference with any other authorised telecommunications services including the reception of off-air broadcast sound and television signals.
- 4.2 The level of radiation emitted from the subscription television system shall not exceed the limits as specified in the latest edition of HKTA 1102.
- 4.3 The immunity of the subscription television system shall be such that at any system outlet, or any distribution channel, the ratio of carrier to an external interfering signal shall be equal to or greater than the limits for single frequency interference as specified in Section 2.2.4. A list of the maximum effective radiated power of authorised radiocommunication services in Hong Kong and the neighbouring territories is given in the latest edition of HKTA 1105.

5. PERFORMANCE REQUIREMENTS FOR EQUIPMENT IN THE SUBSCRIBER'S PREMISES

5.1 INTRODUCTION

The performance of equipment provided as part of the subscription television system but installed in the subscriber's premises (set-top converter, decrypter, etc.) is in general taken to be included in the overall performance requirements for that system. However, certain aspects need to be controlled separately and these are specified in this section. For any parameter not included here, the limits specified in Sections 1 - 4 shall apply to the whole system including the equipment provided in the subscriber's premises.

5.2 GENERAL

5.2.1 The equipment in the subscriber's premises shall comply with the relevant requirements of this specification over the following external conditions:

- (a) external ambient temperature range of +5°C to +40°C;
- (b) external relative humidity up to 95%;
- (c) mains supply voltage variation of $\pm 10\%$ of the declared value;
- (d) mains supply frequency variation of $\pm 5\%$ of the declared value.

5.2.2 The equipment shall be so designed and installed that it complies with the requirements of this document throughout its planned life.

5.3 STABILITY OF LOCAL OSCILLATORS

The stability of local oscillators employed in any frequency conversion shall be such that, given an input signal the frequency of which does not vary, the variation of output frequency does not exceed ± 50 kHz after a 15 seconds warm up period.

5.4 ACCURACY OF OUTPUT FREQUENCY

The accuracy of setting of any local oscillator(s) shall be such that the mean frequency of the output signal shall be within ± 150 kHz of the declared nominal, and this mean frequency shall not vary by more than ± 50 kHz over the full tuning range of the equipment.

6. SAFETY REQUIREMENTS

6.1 GENERAL

Equipment or apparatus comprising the subscription television system shall comply with the latest editions of the following specifications and regulation:-

- (a) **IEC 950**, "Safety of Information Technology Equipment, Including Electrical Business Equipment" published by International Electrotechnical Commission (IEC)

or

EN 60950, “Safety of Information Technology Equipment, Including Electrical Business Equipment” published by European Committee for Electrotechnical Standardization (CENELEC)

or

UL 1950, “Safety of Information Technology Equipment, Including Electrical Business Equipment” published by Underwriters’ Laboratories, Inc.

and

(b) **EN 60065**, “Safety Requirements for Mains Operated Electronic and Related Apparatus for Household and Similar General Use”, published by CENELEC

and

(c) Electrical Products (Safety) Regulation of the Electricity Ordinance (Cap. 406), Hong Kong Law

6.2 PROTECTION AGAINST NON-IONIZING RADIATION HAZARDS

If microwave channels are employed for transmission and distribution purposes, adequate protection shall be provided to the personnel working on or externally inspecting the system and members of the general public against non-ionizing radiation hazards. The latest edition of the “Code of Practice for the Protection of Workers and Members of Public Against Non-Ionizing Radiation Hazards from Radio Transmitting Equipment” published by OFTA shall be observed in the design, installation and maintenance of the subscription television system.