INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.622

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

TRANSMISSION MEDIA CHARACTERISTICS

CHARACTERISTICS OF 1.2/4.4 mm COAXIAL CABLE PAIRS

ITU-T Recommendation G.622

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation G.622 was published in Fascicle III.3 of the *Blue Book*. This file is an extract from the *Blue Book.* While the presentation and layout of the text might be slightly different from the *Blue Book* version, the contents of the file are identical to the *Blue Book* version and copyright conditions remain unchanged (see below).

2 In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

© ITU 1988, 1993

All rights reserved. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the ITU.

Recommendation G.622

CHARACTERISTICS OF 1.2/4.4 mm COAXIAL CABLE PAIRS

(former Recommendation G.342; further amended)

The following Recommendation describes the 1.2/4.4 mm coaxial pair recommended by the CCITT for the international service. The use of this pair is defined in Tables 1 and 2 given in the introduction to Subsection 6.2. When the possibility of television or digital transmission has been envisaged, it is expressly mentioned in each provision.

1 Characteristics of the pair

1.1 *Electrical characteristics of the coaxial pair*

1.1.1 *Characteristic impedance*

The nominal real part of the characteristic impedance is 75 Ω at 1 MHz.

The tolerance is ± 1.5 Ω for telephony or ± 1 Ω for pairs that may be used for television transmissions.

For information, the impedance values in Table 1/G.622 were obtained at various frequencies on coaxial pairs manufactured by different processes.

TABLE 1/G.622

Means real part of the characteristic impedance measured at various frequencies

Frequency (MHz)	0.06	0.1	0.2	0.5	1	1.3	4.5	12	18
Impedance (Ω)	79.8	78.9	77.4	75.8	75	74.8	74	73.6	73.5

1.1.2 *Attenuation coefficient*

The nominal value of the attenuation coefficient of the pair, at 12 MHz and at 10°C, is 18.0 ± 0.4 dB/km.

Table 2/G.622 shows the general trend of the variation of the attenuation coefficient as a function of frequency for all pairs which conform to the present Recommendation.

TABLE 2/G.622

Nominal values of the attenuation coefficient at various frequencies

Frequency (MHz)	0.06	0.1	0.3	0.5	1	1.3	4.5	12	18
Attenuation coefficient (dB/km)	1.5	1.8	2.9	3.7	5.3	6.0	11	18	22

The following equation, in which α is expressed in dB/km and f in MHz, gives an approximation of the attenuation coefficient from 2 MHz onwards:

$$\alpha = 0.07 + 5.15\sqrt{f} + 0.005 f .$$

Note - By way of information, Annex A shows the values measured or specified in various countries, with the corresponding deviations or tolerances. In any case, amplifier design must be based on the values measured on the type of cable which will actually be used.

1.1.3 *Attenuation distortion*

The attenuation distortion required in particular for digital transmission is checked by calculating the ratio

$\frac{\alpha_{f1}}{\alpha_{f2}}$ between attenuation values α_{f1} and α_{f2} measured at two frequencies f_1 and f_2.

One of the following three limits should be observed:[1)]

$$\frac{\alpha_{16\ \text{MHz}}}{\alpha_{4\ \text{MHz}}} \leqslant 2.005$$

$$\frac{\alpha_{24\ \text{MHz}}}{\alpha_{6\ \text{MHz}}} \leqslant 2.009$$

$$\frac{\alpha_{48\ \text{MHz}}}{\alpha_{12\ \text{MHz}}} \leqslant 2.016$$

The attenuation distortion is checked in the factory on a small percentage of factory lengths.

1.2 *Mechanical construction of the coaxial pair*

The nominal dimensions are the following:

- diameter of solid copper centre conductor: 1.2 mm;
- inner diameter of outer conductor: 4.4 mm.

The cylindrical outer conductor is obtained using a copper tape with a thickness of 0.15 or 0.18 mm.

2 Cable specification

2.1 *Characteristic impedance*

To check that the value given in § 1.1.1 above is met, pulse measurements can be made. The real part of impedance at 1 MHz is to be taken as meaning the resistive component of the impedance at 1 MHz of the network with the best balance against the coaxial pair measured.

2.2 *Impedance regularity*

Routine control measurements of impedance regularity are carried out by means of pulse echometers from one or both ends of the factory lengths. The echo curve should be plotted with correction in amplitude and if possible in amplitude and phase. If the equivalent resistance error is measured, it must be corrected. However, for routine measurements, correction may be dispensed with if the test length is so short that the correction is small.

Table 3/G.622 shows the various values to be obtained according to the purpose for which the cable is intended.

1) These three conditions are equivalent. Accordingly, only one of them is to be used for checking attenuation distortion.

TABLE 3/G.622

Echometric measurement of factory lengths

Type of system			Analogue		Digital	
Frequency range or bit rate			0.06-6 MHz	0.3-20 MHz	Medium bit rate (6-34 Mbit/s)	High bit rate (140 Mbit/s)
Maximum pulse duration			100 ns	50 ns	50 ns	10 ns
General provisions	Maximum peak	100%	45 dB	48 dB	48 dB	48 dB
		95%	50 dB	50dB	50dB	49dB
Additional optional provisions[a)]	A	Mean of 3 maximum peaks	48dB	51dB	51dB	47 dB
	B	Equivalent resistance error	1.2 Ω	1.6 Ω	1.6 Ω	2.5 Ω

[a)] It is enough to check that one of the two conditions A or B is fulfilled.

Note 1 - For 0.06-1.3 MHz analogue systems, the provisions are the same as for 0.06-6 MHz analogue systems.

Note 2 - To detect systematic irregularities, return wave attenuation measurements should be carried out on a small proportion of factory lengths. The limits to be observed are set out in Table 4/G.622.

Note 3 - The percentage figures given in the table relate to all the pairs of a batch of cables submitted for control or delivered at the same time.

TABLE 4/G.622

Return wave attenuation on irregularities

Type of system		Digital	
Frequency range or bit rate		Medium bit rate (6-34 Mbit/s)	High bit rate (140 Mbit/s)
Percentage of lengths concerned		about 5%	about 5%
Frequency band explored		1-40 MHz	20-100 MHz
Minimum measured value	100%	20 dB	20 dB
	95%	23 dB	23 dB

2.3 *Attenuation coefficient*

The attenuation of pairs should be such as to allow compliance with the provision of § 3.3 below[2)].

If reference is made to the length measured along a generatrix of the cable sheath, the attenuation coefficient should be multiplied by the take-up factor, the values of which for different numbers of pairs contained in the cable are given as an indication in Table 5/G.622.

TABLE 5/G.622

Take-up factor values

Number of pairs in cable	Take-up factor last layer	Weighted take-up factor, entire cable
4 or 6		1.002
8		1.003
12-18	1.004	1.003
24	1.005	1.004
48	1.008	1.006

2.4 *Crosstalk*

The crosstalk between pairs should be such as to allow compliance with the provisions of § 3.4 below[2)].

2) At this stage of manufacture, attenuation and crosstalk measurements are merely prototype measurements.

2.5 *Dielectric strength*

The pair should withstand an a.c. voltage of 1000 V r.m.s. at 50 Hz (or a d.c. voltage of 1500 V) applied for at least one minute between the centre and outer conductors.

If, in normal use, the outer conductors of the coaxial pair are not earthed, a dielectric strength test is made between the outer conductors and the earthed metallic sheath. The conductors of the auxiliary quads or pairs are connected to the outer conductors of the coaxial pairs or to the sheath, according to the kind of system used for these quads or pairs. Under these conditions, an a.c. voltage of 2000 V r.m.s. or more at 50 Hz will be applied for at least one minute (or a d.c. voltage of 3000 V or more).

Note - The test voltages recommended take account of the normal safety margins applied in the various countries. Polythene insulation, however, might reasonably withstand considerably higher test voltages. In any case, some other dielectric might conceivably be used in the future.

2.6 *Insulation resistance*

The insulation resistance between the centre and outer conductors of the coaxial pair, measured with a perfectly steady voltage of between 100 and 500 V, should not be less than 5000 MΩ-km after electrification for one minute, at a temperature not lower than 15 °C. The measurement of the insulation resistance should be made after the dielectric strength test. This measurement should be made on each factory length.

3 Elementary cable section specification

3.1 *End impedance*

The conditions described in §§ 1.1.1 and 2.1 above are applicable.

3.2 *Impedance regularity*

Impedance regularity measurements are carried out from each end of the elementary cable section. Reference should be made to one of the columns in Table 6/G.622, according to the purpose for which the cable is intended.

3.3 *Attenuation coefficient*

At 1 MHz, the real attenuation coefficient must not differ from the nominal figure by more than ± 0.2 dB.

Attenuation measured on a cable at an average temperature of *t*°C is referred to 10 °C by the formula:

$$\alpha_{10} = \alpha_t \frac{1}{1 + k_\alpha (t - 10)}$$

The coefficient k_α , of the variation in attenuation with temperature is about 2 x 10^{-3} per °C at frequencies of 500 kHz or more. It increases slightly at lower frequencies (about 2.8 x 10^{-3} per °C at 60 kHz).

3.4 *Crosstalk*

The far-end crosstalk ratio between two coaxial pairs in a cable transmitting in the same direction at any frequency in the band actually transmitted must be not less than the values given in Table 7/G.622.

TABLE 6/G.622

Echometric measurement of elementary cable sections[a)]

Type of system				Analogue		Digital	
Frequency range or bit rate				0.06-6 MHz	0.3-20 MHz	Medium bit rate (6-34 Mbit/s)	High bit rate (140 Mbit/s)
Maximum pulse duration				200 ns	100 ns	100 ns	50 ns
General provisions	Maximum peak	100%		42 dB	42 dB	42 dB	40 dB
		95%		46 dB	46 dB	46 dB	44 dB
Additional optional provisions[a)]		A	Mean of 3 maximum peaks. Uncorreted maximum	45 dB 48 dB	45 dB 48 dB	45 dB 48 dB	43 dB 46 dB
	Equivalent resistance error	B	Energy corrected ($\Omega \cdot km^{-1/2}$)	2	2.5	2.5	3.5
		C	Uncorrected (Ω)	1.8	2.0	2.0	2.5

[a)] It is enough to check that one of the three conditions A, B or C is fulfilled.

Note 1 - Notes 1 and 2 to Table 3/G.622 still hold good. However, for 0.06 to 1.3 MHz analogue systems, the provisions of column 0.06 to 6 MHz apply, but the pulse duration may attain 400 ns for elementary cable sections longer than 4 km.

Note 2 - Measurements using sine-wave signals on elementary cable sections are unnecessary unless there are serious grounds for believing that systematic irregularities may have been introduced during the laying or installation of the cable. In such cases, the measurement results should not be less than 20 dB.

TABLE 7/G.622

Minimum far-end crosstalk ratio between two 1.2/4.4 mm coaxial pairs

Length of the section (km)	Far-end crosstalk ratio (dB)	
	Without phase inversion	With phase inversion at repeaters
8	87	-
6	89	80
4	93	-
3	95	83
2	99	-

There is no need to specify a near-end crosstalk ratio when the former limits are chosen for the far-end crosstalk ratio.

When phase inversion is used, the near-end crosstalk ratio for pairs transmitting in opposite directions must be at least 84 dB for a section about 6 km long, and 87 dB for a section about 3 km long.

Note - These limits enable a far-end crosstalk ratio of 65 dB to be obtained on the worst homogenous 280-km section, assuming that for the frequencies in question only far-end crosstalk due to the cable is to be considered[3)]. It is assumed that the variation in the minimum far-end crosstalk ratio as a function of the distance approximately follows a 20 dB/decade law for distances below a limit distance L_1 and a 10 dB/decade law for distances above L_1. The values depend on a number of factors, mainly the system used, the type of cable and the considered frequency. A value of 30 km appears suitable in most cases, although values of L_1 ranging from a few kilometers to 30 kilometers have been observed in practice, ensuring the consistency of the limits in Table 7/G.622 with the 65 dB limit on a 280 km section.

3.5 *Dielectric strength*

The pair must withstand a d.c. voltage of at least 1000 V applied during at least one minute between the inner and the outer conductors.

In addition, a test of dielectric strength between the coaxial pair and earth shall be made as described in § 2.5, using a d.c. voltage of at least 2000 V applied for one minute.

Note - The recommended test voltages take account of the normal safety margins applied in the various countries. Polythene insulation, however, might reasonably withstand considerably higher test voltages. In any case, some other dielectric might conceivably be used in the future.

3.6 *Insulation resistance*

The insulation resistance between the centre and outer conductors of the coaxial pair, measured with a perfectly steady voltage of between 100 and 500 V, should not be less than 5000 MΩ-km after electrification for one minute. The measurement of the insulation resistance should be made after the dielectric strength test. This measurement should be made on every elementary cable section.

---

3) In practice it is possible to forget the influence of line equipment on intelligible crosstalk, but this is only true for low frequencies of the band (less than 300 kHz).

ANNEX A

(to Recommendation G.622)

Examples of attenuation coefficient measured or specified in some countries

(Values given as an indication)

TABLE A-1/G.622

Values measured on a type of pair whose outer conductor is 0.15 mm thick

Frequency (MHz)	0.060	0.1	0.3	0.5	1	4	12	18	52
Attenuation (dB/km)	1.54	1.85	2.89	3.67	5.21	10.4	18.0	22.0	37.5
Tolerance (dB/km)	± 0.1	± 0.1	± 0.1	± 0.1	± 0.1	± 0.1	± 0.2	± 0.2	± 0.5
Temperature coefficient	0.0028	0.0026	0.0024	0.00225	0.0020	0.0020	0.0020	0.0020	0.0020

TABLE A-2/G.622

Values specified in certain countries for a type of pair whose outer conductor is 0.18 mm thick

Frequency (MHz)	60	100	200	300	500	700	1000	1300	4500
Specific attenuation (dB/km)	1.49	1.80	2.42	2.91	3.73	4.43	5.30	6.05	11.2
Tolerance (dB/km)	± 0.1	± 0.1	a)	a)	a)	a)	± 0.2	± 0.2	± 0.2

a) Not specified.