INTERNATIONAL TELECOMMUNICATION UNION

ITU-T K.23

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

PROTECTION AGAINST INTERFERENCE

TYPES OF INDUCED NOISE AND DESCRIPTION OF NOISE VOLTAGE PARAMETERS FOR ISDN BASIC USER NETWORKS

ITU-T Recommendation K.23

(Extract from the *Blue Book*)

NOTES

1 ITU-T Recommendation K.23 was published in Volume IX 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.

Recommendation K.23

TYPES OF INDUCED NOISE AND DESCRIPTION OF NOISE VOLTAGE PARAMETERS FOR ISDN BASIC USER NETWORKS

(Melbourne, 1988)

1 Purpose of this Recommendation

This Recommendation has been produced by Study Group V to meet the urgent requirements of Administrations, manufacturers, and users who should evaluate equipment for its immunity to induced noise in order to design and use the ISDN.

The Recommendation identifies the types of induced noise that can cause degradation of transmission quality and malfunction of the equipment, and the noise voltage parameters that should be evaluated.

2 Scope

This Recommendation covers the degradation of equipment performance due to induced noise voltage on metallic pair cables (including residential inside wire), which is caused by an inducing source external to the cable or by another telecommunication system. However, this Recommendation does not cover interference caused by transmission characteristics of cables (for example, cross talk characteristics).

The Recommendation considers the characteristics of induced noise voltages at metallic-pair ISDN interfaces at subscriber's premises. Interface locations covered by this Recommendation are the S and T interfaces (see Recommendation I.430) as well as the 2-wire interface of the NT1.

The communication line constituting the S/T bus may be confined to a building or connect two separate buildings. The connecting telecommunications line may be either aerial or below-ground.

3 Types of induced noise affecting the ISDN

3.1 *Mode of voltage*

Two voltage modes should be considered: longitudinal voltage and transverse voltage. Figure 1/K.23 illustrates the definition of longitudinal voltage induced in telecommunication lines and the transverse voltage.

When longitudinal voltage is present at equipment interfaces, it may cause malfunction of the equipment. The transverse voltage is induced by conversion from the longitudinal voltage because of transmission line and input terminal equipment impedance unbalance, and by direct coupling with the inducing source. It may cause a degradation of transmission quality. Therefore, both the longitudinal voltage and the transverse voltage should be considered (Figure 2/K.23).

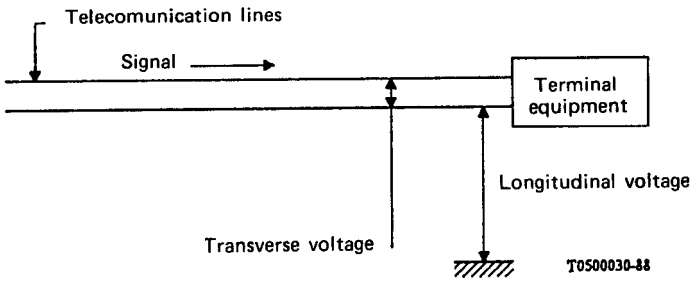


FIGURE 1/K.23

Mode of induced voltage

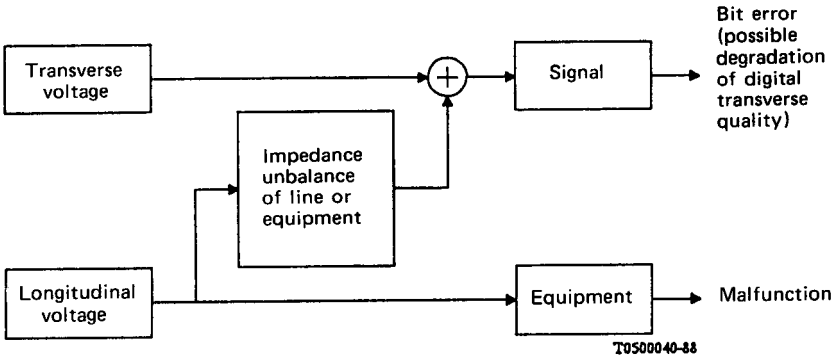


FIGURE 2/K.23

Influence of longitudinal voltage and transverse voltage on a digital transmission line

3.2 *Waveshape of induced noise voltage*

From a waveshape viewpoint, induced noise voltage can be categorized into continuous noise voltage (such as a broadcast wave) and transient noise voltage (such as a switching noise voltage).

The continuous noise waveshape can be reproduced from the components of the frequency spectrum. Continuous noise causes a degradation of the signal-to-noise ratio, which may cause an increase in the error rate.

On the other hand, the transient noise waveshape is composed of spark type waves. As the pulse width of one transient wave is much less than the duration time between two transient waves, each transient wave can be treated as an independent wave. Therefore, a knowledge of the total time of transient noise exceeding the decision voltage is important to the evaluation of digital transmission quality. To evaluate equipment malfunction, the above features of the noise waveshape should be considered.

3.3 *Equipment performance categories*

The induced noise described above may have a number of different functional effects on the performance of equipment and transmission quality. These fall into the following categories:

1) no loss of performance or function;

2) temporary loss of function or performance which is self-recoverable;

3) temporary loss of function or performance which requires operation intervention or system reset;

4) loss of function which is not recoverable due to damage of equipment (components), or due to the continuous nature of the interference.

Table 1/K.23 lists various noise sources that cause induced voltage on transmission lines. It also lists the categories 1) to 4) above of degradation of equipment performance and transmission quality, and the interfaces to be considered for each noise source.

TABLE 1/K.23

Categorization of induced noise source, waveshape to be evaluated, interference to be evaluated and line interfaces involved

Induced noise source (Note 1)			Wave shape to be evaluated		Category of equipment performance (See § 3.3)				Interface to be considered	
			Continuous noise	Transient noise	1	2	3	4	2-wire NT	S and T
External induced noise	Coupling into telecommunication lines from radiating source	① Radio broadcast	X		X			X	X	X
		② Mobil transceiver	X		X	X	X		X	X
		③ Power line (outdoors)	X	X	X	X	X	X	X	
		④ Electric railway	X	X	X	X	X	X	X	
		⑤ lightning		X	X	X	X	X	X	X
		⑥ Automotive engine ignition		X	X	X	X		X	X
		⑦ Electrostatic discharge		X	X	X	X	X	(Note 2)	(Note 2)
	Coupling into telecommunication lines a.c. power mains within building	⑧ Continuous operation of electrical apparatus	X		X			X	X (Note 3)	X (Note 3)
		⑨ Switching		X	X	X	X		X (Note 3)	X (Note 3)
Induced noise source in telecommunication system	⑩ Impulsive noise from analogue telecommunication circuit			X	X	X	X		X	X
	⑪ Contact noise (e.g. at splices)			X	X	X	X		X	X

Note 1 – Some of these noise sources are being studied under other questions in Study Group V.

Note 2 – Equipment test, not interface.

Note 3 – Test mains input to NT and TE.

4 Induced noise voltage parameters that should be evaluated

Evaluation of transmission quality and malfunction of the equipment using raw data from various induced noise voltage waves is too inefficient. Therefore, it is useful to describe waveshapes using several parameters, which are found by analyzing waveshape features, and to establish a standardized measurement method and a standardized test procedure. This will enable an efficient evaluation of the effect which induced noise voltage has on the digital transmission quality and the malfunction of equipment.

Continuous noise voltage should be evaluated using the amplitudes of the frequency spectrum as a basic parameter since from these amplitudes the waveshapes can be reproduced. Transient noise voltage should be evaluated using amplitude probability distributions, and frequency spectrum as well as waveshape parameters in the time domain (for example, peak value, periodic time, decay time, duration time of burst, etc.). These basic parameters can be used to design a transient noise simulator.

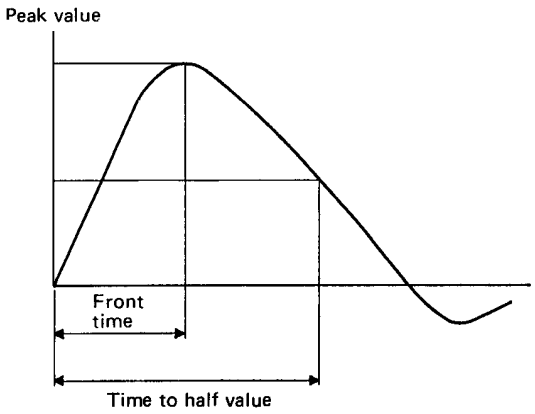
Table 2/K.23 lists some induced noise voltage parameters that should be evaluated.

TABLE 2/K.23

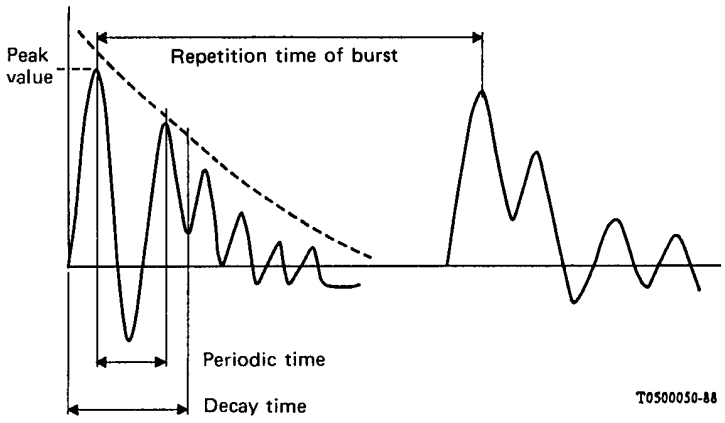
Induced noise voltage parameters that should be evaluated

Type of induced noise waveform (Note)		Frequency domain		Time domain						
		Amplitude	Frequency	Peak value	Front time	Time to half value	Periodic time	Decay time	Duration time of burst	Amplitude probability distribution
Continuous noise voltage	Narrow band ①, ②	X	X							
	Broad band ③, ④	X	X							
Impulsive noise voltage	Type I ⑤, ⑦	X	X	X	X	X				X
	Type II ⑤, ⑥, ⑧ ⑨, ⑩, ⑪	X	X	X	X	X	X	X	X	X

Note – The encircled numbers give the induced noise source from Table 1/K.23.



Type I – High energy transient noise



Type II – Repetitive fast transient noise