INTERNATIONAL TELECOMMUNICATION UNION

ITU-T G.989.3

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(03/2003)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Optical line systems for local and access networks

Phoneline networking transceivers – Isolation function

ITU-T Recommendation G.989.3

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ITU-T Recommendation G.989.3

Phoneline networking transceivers – Isolation function

Summary

This Recommendation specifies the characteristics and applications of an isolation function for use with phoneline networking transceiver devices in accordance with ITU-T Recs G.989.1 and G.989.2.

The Recommendation describes how the isolation function may apply in the system reference model for in-premises phoneline networking transceivers (PNT), provides examples of usage of the isolation function, and specifies the characteristics of an isolation function which performs spectral isolation by means of a filter.

Requirements for the implementation and deployment of G.989.3 devices are outside the scope of this Recommendation.

Source

ITU-T Recommendation G.989.3 was prepared by ITU-T Study Group 15 (2001-2004) and approved under the ITU-T Recommendation A.8 procedure on 16 March 2003.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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ITU-T Recommendation G.989.3

Phoneline networking transceivers – Isolation function

1 Scope

This Recommendation specifies the characteristics and applications of an isolation function for use with phoneline networking transceiver devices in accordance with ITU-T Recs G.989.1 and G.989.2.

Requirements for the implementation and deployment of G.989.3 devices are outside the scope of this Recommendation.

This Recommendation does not take into account the requirements of ITU-T Rec. G.992.5 (see Bibliography [3]); this item is for further study.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation

– ITU-T Recommendation G.989.1 (2001), *Phoneline networking transceivers – Foundation*.

– ITU-T Recommendation G.989.2 (2001), *Phoneline networking transceivers – Payload format and link layer requirements*.

3 Definitions

This Recommendation defines the following terms:

3.1 isolation function: A device which provides spectral isolation between the in-premises wiring and the access network, such as a filter, gateway etc.

3.2 station: A G.989.1 transceiver.

3.3 voiceband frequencies: Unless otherwise specified, for the purposes of this Recommendation, voiceband frequencies shall be considered as being 200 Hz to 4 kHz.

3.4 PNT frequencies: Unless otherwise specified, for the purposes of this Recommendation, PNT frequencies shall be considered as being 4 MHz to 30 MHz.

4 Abbreviations

This Recommendation uses the following abbreviations:

ADSL Asymmetrical Digital Subscriber Line (see ITU-T Recs G.992.1 [1] and G.992.2 [2])

AN Access Network

CPE Customer Premises Equipment

IF Isolation Function

ISDN Integrated Services Digital Network

MAC Media Access Control

PHY Physical Layer

PNT Phoneline Networking Transceiver

POTS Plain Old Telephone Service (one of the services using the voiceband; sometimes used as a descriptor for all voiceband services)

PSTN Public Switched Telephone Network

VDSL Very high speed Digital Subscriber Line (see ITU-T Rec. G.993.1 [4])

xDSL a collective term referring to any of the various types of DSL technologies

5 System reference model for phoneline networking transceivers

The system reference model for in-premises phoneline networking transceivers (PNT) is shown in Figure 1. The reference model includes physical layer (PHY) and media access control (MAC) functionality between the phoneline interface and a host interface. The primary interface is the wire-side electrical and logical interface (W1) between a PNT station and the phone wire. Typically the in-premises wiring is connected to the access network (AN). An Isolation Function (IF) separates the in-premises wiring from the access network.

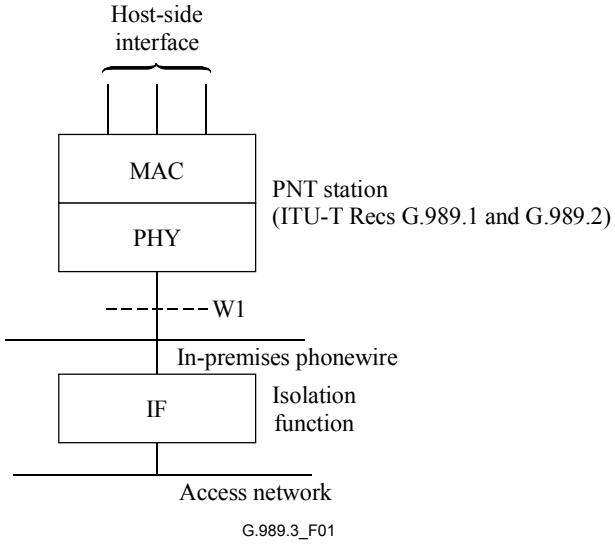

Figure 1/G.989.3 – Basic reference model

An Isolation Function (IF) shall be implemented, when necessary, to prevent interference between PNT devices operating on in-premises wiring and access network where technologies that use an overlapping frequency spectrum e.g., VDSL, are used.

An Isolation Function (IF) may provide:

- spectral isolation with wide area network access technologies;
- known termination impedance;
- additional lightning and over-voltage suppression.

Requirements for the implementation and deployment of G.989.3 devices are outside the scope of this Recommendation.

6 Isolation function usage models

The following are examples of the use of an Isolation Function.

Figure 2 shows the simplest G.989.3 configuration. Spectral isolation between the access network and premises wiring is achieved by means of a filter, and POTS and ADSL signals pass through the filter largely unaffected. Signals above the ADSL band should be blocked. In this configuration, ADSL transceivers present in the premises may be connected to either side of the filter. VDSL transceivers that use downstream frequency bands which overlap with PNT frequencies are not expected to be connected to the in-premises side of the IF, and further, are not recommended to be connected to the access network side of the IF without additional filtering (e.g., using a splitter).

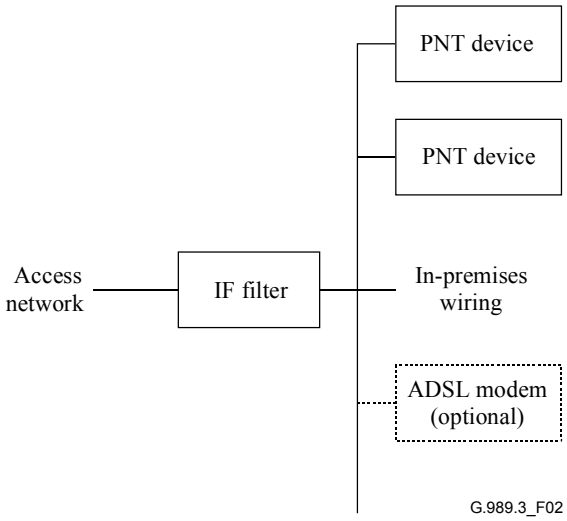

Figure 2/G.989.3 – Basic configuration

In Figure 3, an ADSL splitter is also present. Note, in many cases, the ADSL splitter itself will isolate signals above the ADSL band at the POTS port, in effect incorporating the functionality of a G.989.3 device.

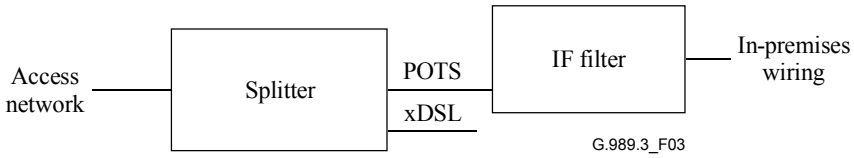

Figure 3/G.989.3 – Splittered configuration

In Figure 4, a Pass-through Gateway performs the IF function. If voice service is provided in-band over xDSL and POTS service is not supported, then the IF filter is not required and the xDSL to PNT Gateway itself performs the IF function.

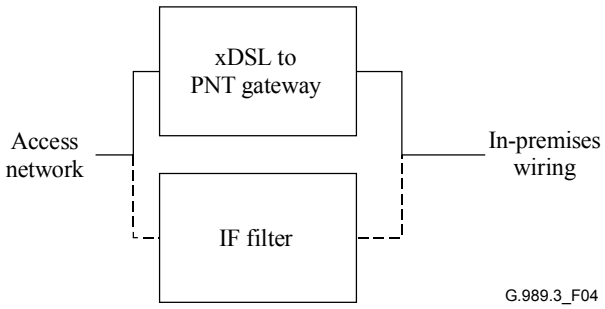

Figure 4/G.989.3 – Gateway

In Figure 5, a gateway along with an ADSL splitter is present. As was the case in Figure 3, in many cases, the ADSL splitter itself will isolate signals above the ADSL band at the POTS port, in effect incorporating the functionality of a G.989.3 device.

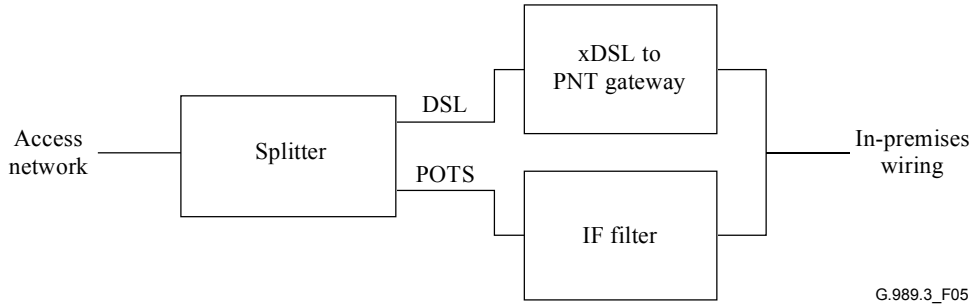

Figure 5/G.989.3 – Splitter plus gateway

Figure 6 shows an IF used with a Cable to PNT Gateway. The IF filter provides isolation between signals placed on the premises wiring by the Cable Gateway and signals on the Telephone Access Network. Optionally, if the output from the Cable Gateway contains energy in the ADSL or POTS band, then the POTS or ADSL devices (if any) would need to connect to the Telephone Access Network side of the IF.

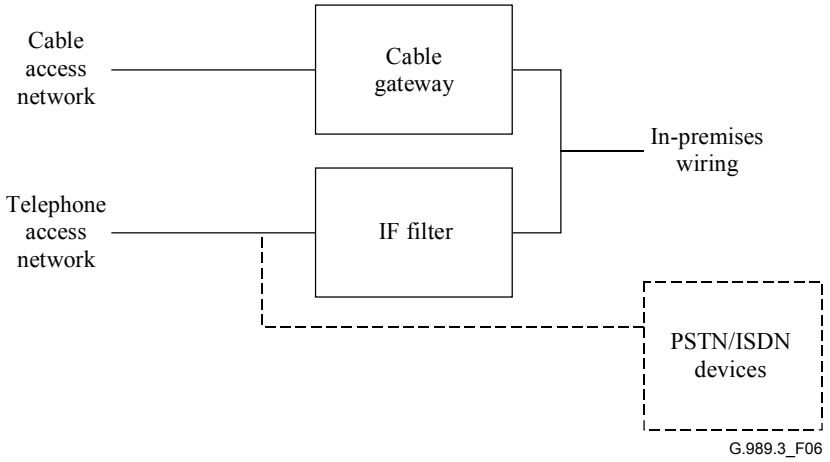

Figure 6/G.989.3 – IF in conjunction with cable gateway

7 Electrical characteristics of an IF filter

An Isolation Function which performs spectral isolation by means of a filter shall have the following characteristics.

7.1 Stress withstand

The following stress conditions should be applied at the access network port of the filter.

7.1.1 Voltage

The filter shall remain functional with the following applied:

- 100 V dc;
- 100 V ac rms 25-50 Hz.

7.1.2 Current

The filter shall remain functional with the following applied:

- 100 mA max continuous.

7.2 Isolation

7.2.1 Between wires

The isolation between wires should be greater than 5 MΩ at 100 V.

7.2.2 Wire-ground

The isolation between wire and ground shall be greater than 100 MΩ at 100 V.

7.3 DC resistance

The loop resistance should be less than 5 Ω.

NOTE – In a splitterless ADSL environment, the isolation filter will be in series with the individual in-line filters used to isolate each POTS device; therefore, the total DC resistance of the filter combination must be considered. Likewise, in a splittered ADSL environment, the use of Phoneline Networking Technology may also require the use of in-line filters to isolate POTS devices from PNT devices. In either situation, these in-line filters may be filters that allow a maximum DC resistance of 25 Ω. For example, see Bibliography [5] in Appendix II. These in-line filters will be in series with the isolation filter; therefore, to keep the total DC resistance of the residential environment under a 30-ohm limit, the DC resistance of the isolation filter must be less than 5 ohms.

7.4 Reference impedance

The nominal reference impedance for the filter design shall be Z_{ref}. Z_{ref} is 100 ohms.

7.5 Differential insertion loss

7.5.1 At voiceband frequencies

The differential insertion loss shall have the following characteristics:

- greater than 0;
- less than 0.5 dB in the band 200 Hz-4 kHz between 600-ohm loads;
- less than 0.5 dB in the band 200 Hz-4 kHz between loads of 150 nF // 750 ohms + 270 ohms, see Figure 7. (Bibliography [6].)

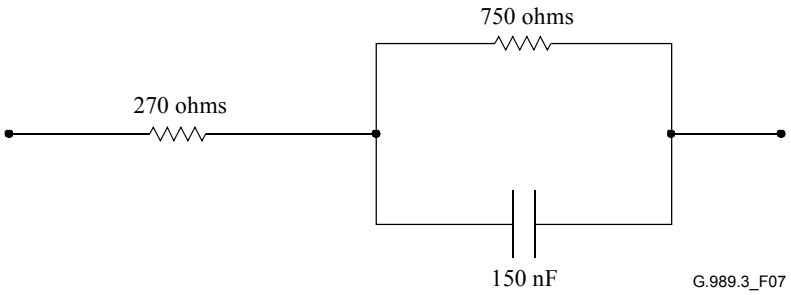

Figure 7/G.989.3 – Load impedance for insertion loss testing

7.5.2 Above voiceband up to 1104 kHz

The differential insertion loss shall have the following characteristics:

- greater than 0;
- less than 0.5 dB in the band 4 kHz-552 kHz between Z_{ref}-ohm loads;
- less than an amount increasing linearly with the logarithm of frequency from 0.5 dB at 552 kHz and 1 dB at 1104 kHz, as shown in Figure 8.

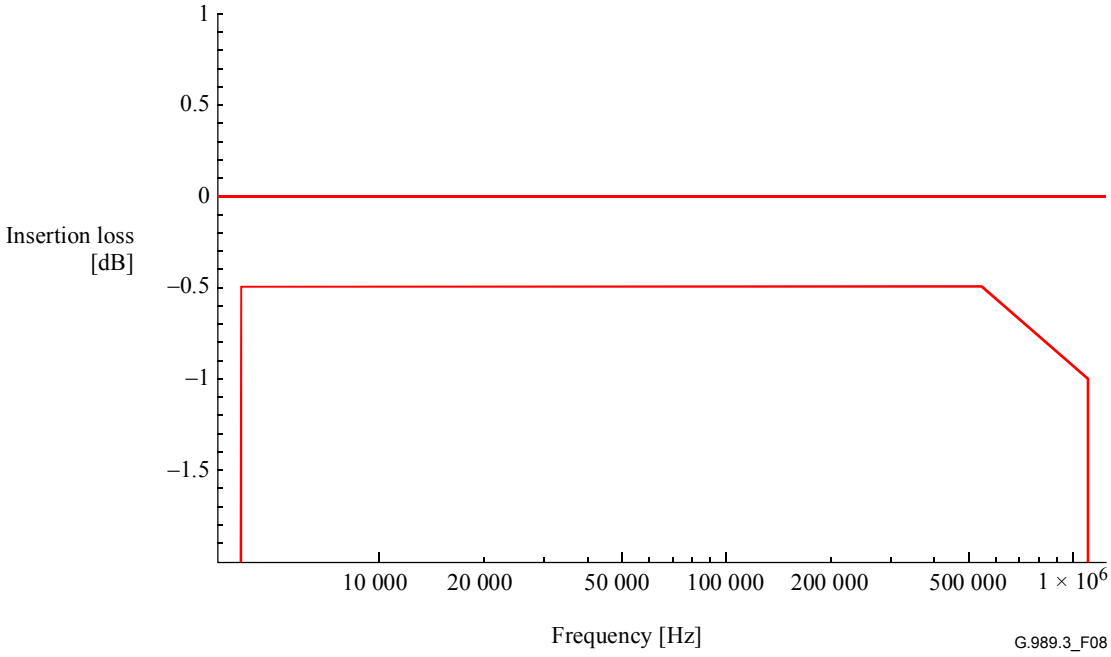

Figure 8/G.989.3 – Differential insertion loss

7.5.3 At PNT frequencies

The differential insertion loss shall be greater than 35 dB in the band 4-5.1 MHz, 41 dB in the band 5.1-8.5 MHz, 35 dB in the band 8.5-30 MHz, between Z_{ref}-ohm loads.

7.6 Common mode insertion loss

7.6.1 At PNT frequencies

The common mode insertion loss shall be greater than 20 dB in the band 4-30 MHz between 50-ohm loads, as shown in Figure 9.

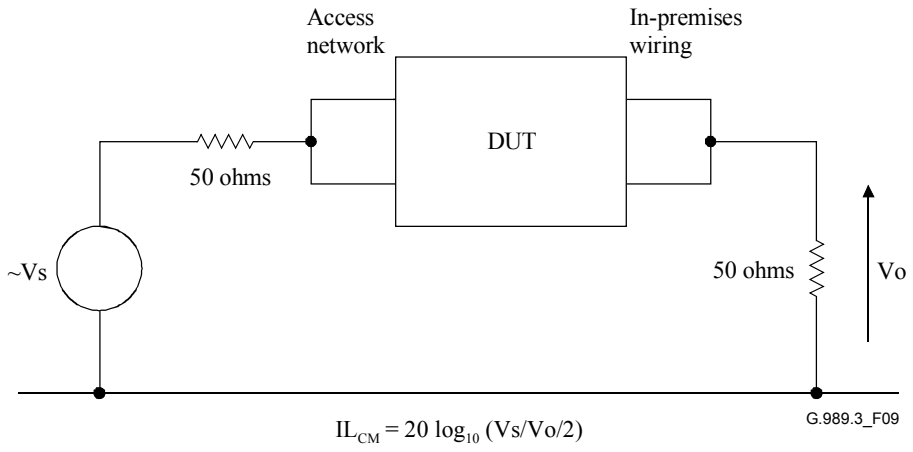

Figure 9/G.989.3 – Common mode insertion loss measurement

7.7 Differential mode return loss

Differential mode return loss requirements applies to both ports of the filter, see Figure 10.

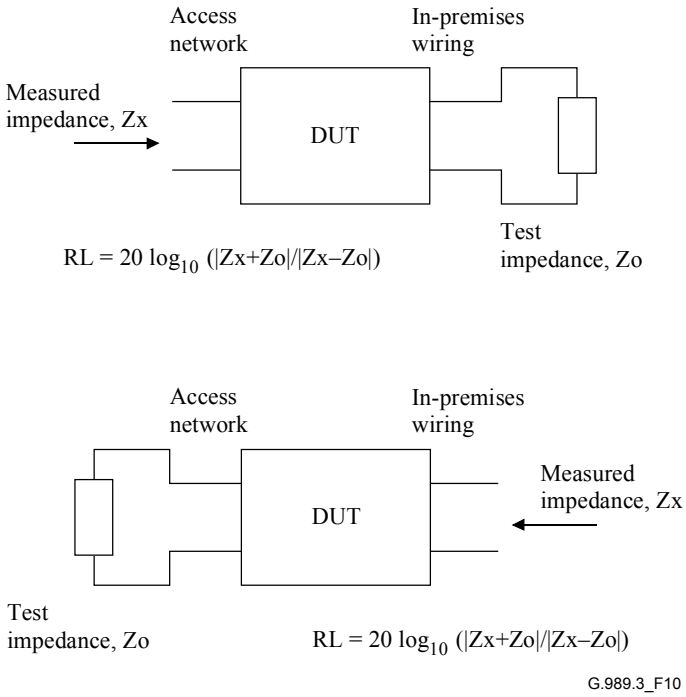

Figure 10/G.989.3 – Differential mode return loss measurements

7.7.1 At POTS frequencies

The differential mode return loss shall have the following characteristics:

- greater than 18 dB in the band 200 Hz-4 kHz between 600-ohm loads;
- greater than 18 dB in the band 200 Hz-4 kHz between loads of 150 nF // 750 ohms + 270 ohms (Bibliography [6]).

7.7.2 Above voiceband up to 1104 kHz

The differential mode return loss shall have the following characteristics:

- greater than 18 dB in the band 10 kHz-552 kHz between Z_{ref}-ohm loads;
- greater than 6 dB at 1104 kHz between Z_{ref}-ohm loads;
- as shown in Figure 11.

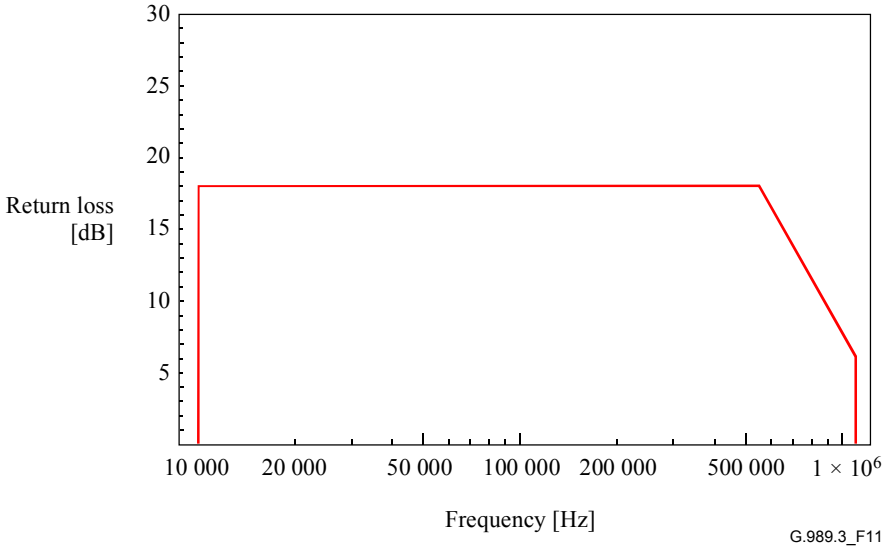

Figure 11/G.989.3 – Differential mode return loss

7.8 Differential mode impedance

7.8.1 At PNT frequencies

The differential mode impedance at the in premises wiring side of the IF shall be greater than 160 ohms in the band 4 MHz-30 MHz.

7.9 Balance

7.9.1 At voiceband frequencies

The filter shall have the following balance characteristics:

- greater than 40 dB in the band 15-50 Hz when terminated with 600 ohms;
- greater than 46 dB in the band 50-600 Hz when terminated with 600 ohms;
- greater than 52 dB in the band 600-3400 Hz when terminated with 600 ohms.

7.9.2 Above voiceband up to 1104 kHz

At the access side, the filter shall have the following balance characteristics:

- greater than 46 dB in the band 10-552 kHz when terminated with Z_{ref}-ohm centre tap grounded at the in premises wiring side;
- greater than 40 dB in the band 552-1104 kHz when terminated with Z_{ref}-ohm centre tap grounded at the in premises wiring side.

7.9.3 At PNT frequencies

At the line side, the filter shall have the following balance characteristics:

- greater than 35 dB in the band 4-30 MHz when terminated with Z_{ref}-ohm differential, and 100 ohms from one leg to ground at in premises wiring side. (i.e., deliberately unbalanced load).

7.10 Noise

Noise levels shall be measured at the AN port of the filter.

7.10.1 At POTS frequencies

Noise levels shall be less than –80 dBVp total into 600 ohms in the band 200 Hz-3.4 kHz.

7.10.2 Between voiceband and PNT frequencies

Noise levels shall be less than –80 dBm total into Z_{ref} ohms in the band 10 kHz-1104 kHz.

7.10.3 At PNT frequencies

Noise levels shall be less than –66 dBm total into Z_{ref} ohms in the band 4 MHz-30 MHz.

7.11 Group delay distortion

7.11.1 Between voiceband and PNT frequencies

For further study.

7.12 Distortion

7.12.1 Between voiceband and PNT frequencies

With a wideband test signal covering the band 160 kHz-1104 kHz with of level +20 dBm, and a power spectral density of –40 dBm/Hz, applied from a Z_{ref}-ohm source at the line side of the filter, the total noise and intermodulation measured in the band 25 kHz to 138 kHz in a 100-ohm load on the in premises wiring side shall not exceed –140 dBm/Hz.

With a wideband test signal covering the band 25 kHz-138 kHz with of level +12.5 dBm, and a power spectral density of –38 dBm/Hz, applied from a Z_{ref}-ohm source at the in premises wiring side of the filter, the total noise and intermodulation measured in the band 160 kHz to 1104 kHz in a 100-ohm load at the line side shall not exceed –140 dBm/Hz.

7.13 Physical properties

Physical properties of the filter are not defined in this Recommendation.

Appendix I

Example of basic filter design

A schematic of a filter which could meet the requirements of clause 7, where Z_{ref} is 100 ohms, is shown in Figure I.1 below.

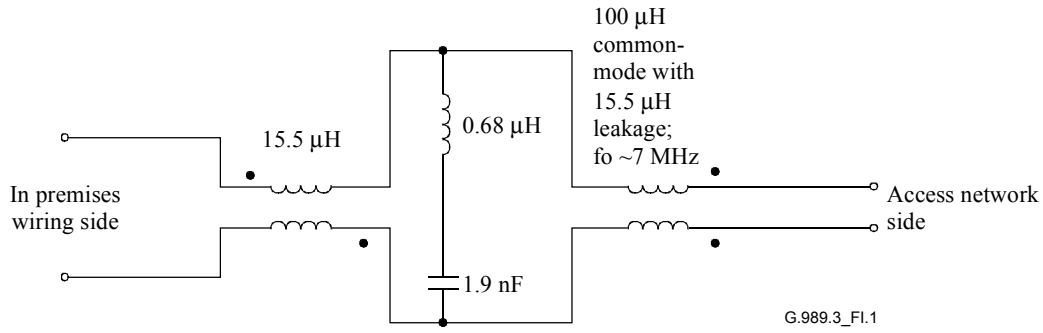

Figure I.1/G.989.3 – Example filter schematic

For example, the 100-ohm differential insertion loss would be as shown in Figure I.2.

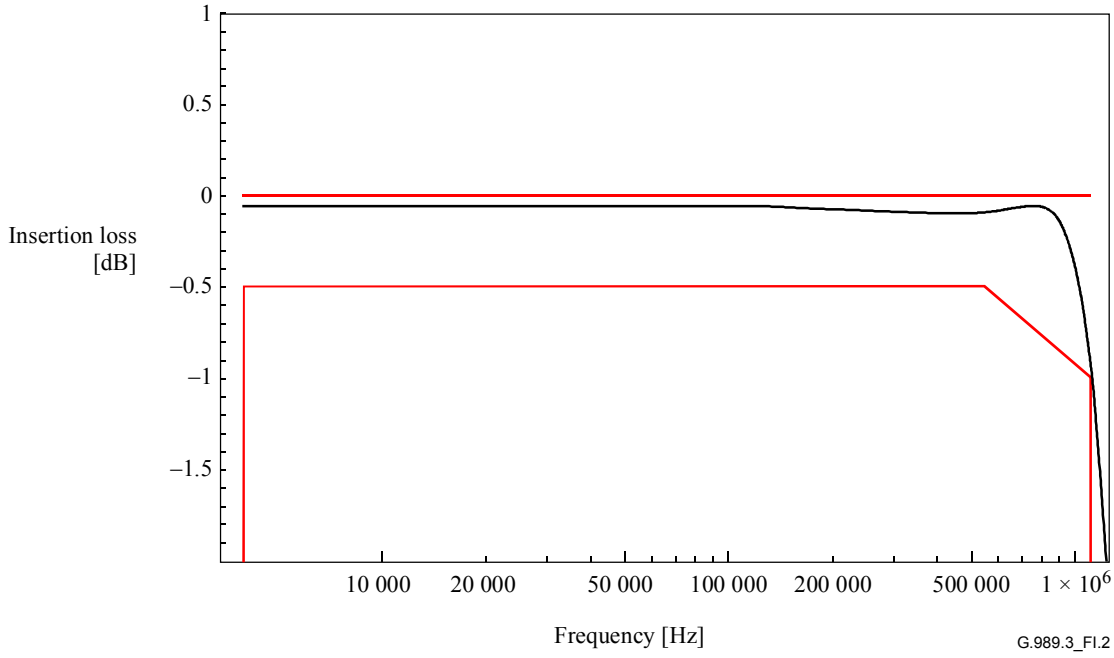

Figure I.2/G.989.3 – Example filter differential insertion loss

The stop-band attenuation would be as shown in Figure I.3.

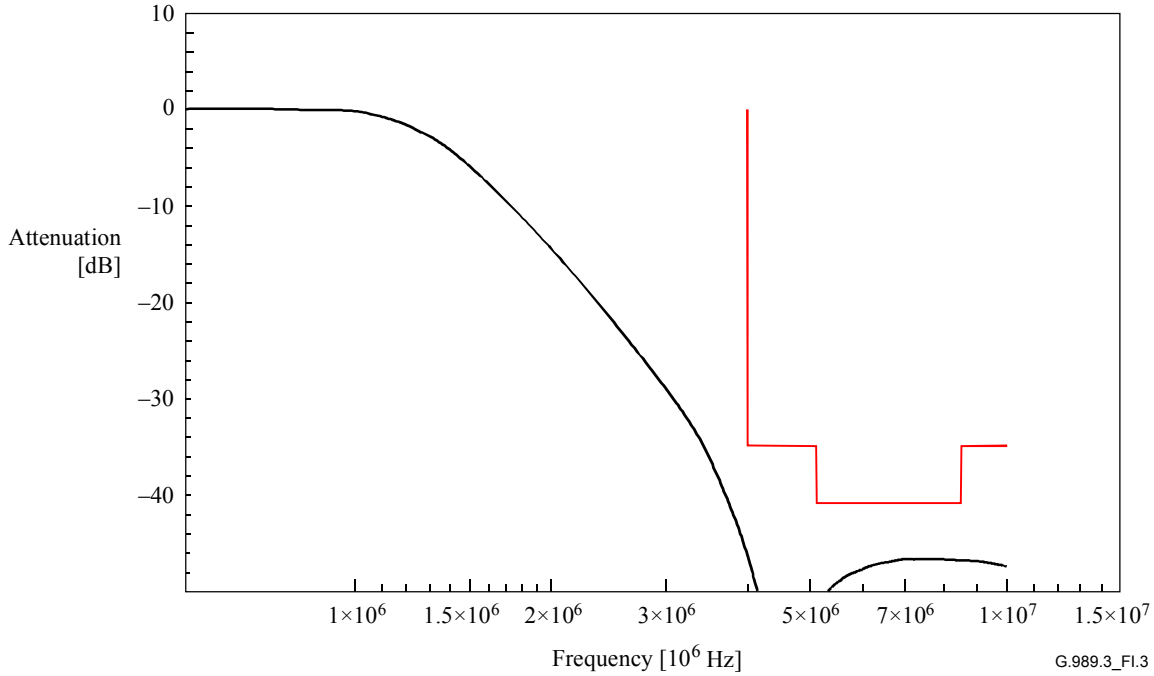

Figure I.3/G.989.3 – Example filter stop-band attenuation

The 100-ohm return loss (at either port) would be as shown in Figure I.4.

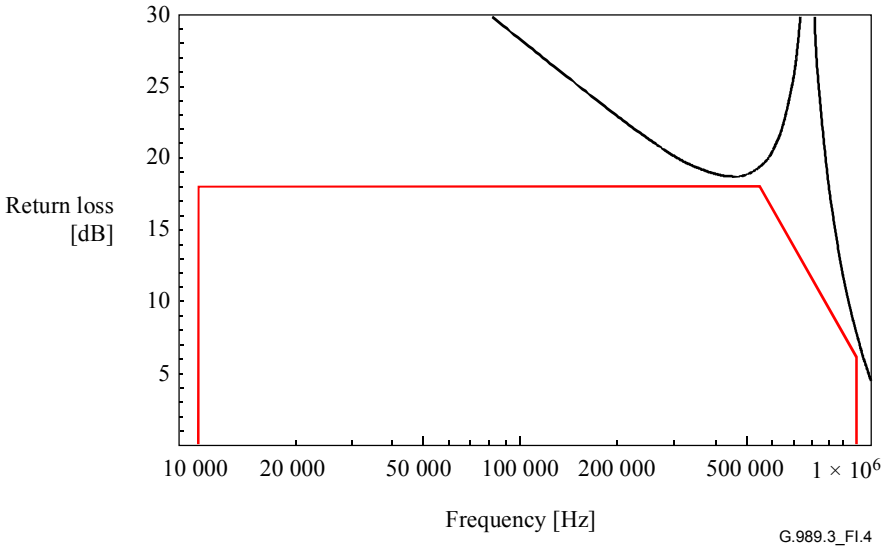

Figure I.4/G.989.3 – Example filter return loss

Appendix II

Bibliography

The following references are intended for background information (i.e., they are informative not normative).

[1] ITU-T Recommendation G.992.1 (1999), *Asymmetrical digital subscriber line (ADSL) transceivers*.

[2] ITU-T Recommendation G.992.2 (1999), *Splitterless asymmetric digital subscriber line (ADSL) transceivers*.

[3] ITU-T Recommendation G.992.5 (2003), *Asymmetric Digital Subscriber Line (ADSL) Transceivers – Extended Bandwidth ADSL2 (ADSL2+)*.

[4] ITU-T Recommendation G.993.1 (2001), *Very high speed digital subscriber line foundation*.

[5] Committee T1 T1.421-2001, *In-line Filter for Use with Voiceband Terminal Equipment Operating on the Same Wire Pair with High Frequency (up to 12 MHz) Devices*.

[6] ETSI TBR 021, *Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling*.

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Printed in Switzerland
Geneva, 2003