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AUSTRALIAN STANDARD

AS/ACIF S041:2005

Requirements for DSL Customer Equipment for connection to the Public Switched Telephone Network

STANDARDS Australia

Adopted for regulatory purposes

Australian Standard – *Requirements for DSL Customer Equipment for connection to the Public Switched Telephone Network*

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FOREWORD

General

This Standard was prepared by the ACIF Working Committee CECRP/*WC15 Series Device Customer Equipment*. It is one of a series of Telecommunication Standards developed under the Memorandum of Understanding between the Australian Communications Authority (ACA) and the Australian Communications Industry Forum.

Note: On 1 July 2005 the Australian Communications Authority (ACA) became the Australian Communications and Media Authority (ACMA) and the Memorandum of Understanding continues in effect as if the reference to the ACA were a reference to ACMA.

This Standard is the result of a consensus among representatives on the ACIF Working Committee to produce it as an Australian Standard.

The requirements in this Standard are consistent with the aims of s376 of the *Telecommunications Act 1997*. Specifically these aims are—

(a) protecting the integrity of a telecommunications network or facility;

(b) protecting the health and safety of persons;

(c) ensuring access to emergency services; and

(d) ensuring interoperability with a standard telephone service.

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The Project Manager
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The Australian Communications Industry Forum
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Regulatory notice

This document has been made by ACMA as Telecommunications Technical Standard AS/ACIF S041 2005 under s376 of the *Telecommunications Act 1997*.

ACMA is a Commonwealth authority with statutory powers to impose requirements concerning telecommunications Customer Equipment and Customer Cabling.

ACMA requires Australian manufacturers and importers of specified items of Customer Equipment and Customer Cabling to establish compliance with Standards such as this. Items are required to be labelled to the applicable labelling notices.

Details on current compliance arrangements can be obtained from the ACMA website at http://www.acma.gov.au or by contacting ACMA below at:

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Introduction

This introduction for the AS/ACIF S041:2005 ***Requirements for DSL Customer Equipment for connection to the Public Switched Telephone Network*** Standard is not an authoritative section of this Standard and is only provided as guidance for the user of the Standard to outline its objectives, the factors that have been taken into account in its development.

The reader is directed to the clauses of this Standard for the specific requirements and to the Australian Communications and Media Authority (ACMA) for the applicable telecommunications labelling and compliance arrangements.

Note: Further information on the telecommunications labelling and compliance arrangements can be found in The Telecommunications Labelling (Customer Equipment and Customer Cabling) Notice (the TLN). The TLN can be obtained from the Australian Communications and Media Authority (ACMA) website at www.acma.gov.au

The objective of this Standard is to provide the technical requirements and test methods for Customer Equipment (CE) and in the case of Compound CE, the parts of Compound CE that are designed or intended for connection to a DSL service that shares the metallic local loop with an analogue PSTN two wire service in order to meet the regulatory arrangements for such equipment in Australia.

This Standard is based on Appendix F of AS/ACIF S0002:2001 Analogue interworking and non-interference requirements for Customer Equipment for connection to the Public Switched Telephone Network.

TABLE OF CONTENTS

FIGURES

TABLES

1 INTERPRETATIVE GUIDELINES

1.1 Categories of requirements

This Standard contains mandatory requirements as well as provisions that are recommendatory only. Mandatory requirements are designated by the words '**shall**' or '**shall not**'. All other provisions are voluntary.

1.2 Compliance statements

Compliance statements, in italics, suggest methodologies for demonstrating CE's compliance with the requirements.

1.3 Definitions, expressions and terms

If there is any conflict between the definitions used in this Standard and the definitions used in the *Telecommunications Act 1997*, the definitions in the Act take precedence.

1.4 Notes

Text denoted as 'Note' is for guidance in interpretation and is shown in smaller size type.

1.5 References

(a) Applicable editions (or versions) of other documents referred to in this Standard are specified in Section 3: REFERENCES.

(b) If a document refers to another document, the other document is a sub-referenced document.

(c) Where the edition (or version) of the sub-referenced document is uniquely identified in the reference document, then that edition (or version) applies.

(d) Where the edition (or version) of the sub-referenced document is not uniquely identified in the reference document, then the applicable edition (or version) is that which is current at the date the reference document is legislated under the applicable regulatory framework, or for a non- legislated document, the date upon which the document is published by the relevant standards organisation.

(e) A number in square brackets '[ ]' refers to a document listed in Section 3: REFERENCES.

1.6 Units and symbols

In this Standard the International System (SI) of units and symbols is used in accordance with Australian Standard AS ISO 1000 [1].

2 SCOPE

2.1 This Standard specifies the technical requirements for Customer Equipment (CE) and in the case of Compound CE, the parts of Compound CE that are designed or intended for connection to a DSL service that shares the metallic local loop with an analogue PSTN two-wire service.

2.2 This Standard does not apply to CE or the parts of Compound CE designed or intended for connection to an analogue PSTN two-wire service.

2.3 CE is not excluded from the scope of this Standard by reason only that it is capable of performing functions additional to those listed in this Standard.

Note 1: For the purposes of this scope ADSL modems and filters are examples of CE designed for connection to a DSL service operating over a shared metallic local loop with an analogue PSTN two-wire service.

Note 2: AS/ACIF S002 [3] specifies the technical requirements for connection to an analogue PSTN two-wire service.

3 REFERENCES

	Publication	Title
	Australian Standards	
[1]	AS ISO 1000-1998	The international System of Unit (SI) and its application.
[2]	AS/NZS 60950.1:2003	Information technology equipment - Safety - General requirements
	AS/ACIF Standards	
[3]	AS/ACIF S002:2005	Analogue interworking and non-interference requirements for Customer Equipment for connection to the Public Switched Telephone Network
	AS/ACIF S043:2005	Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network
[4]	AS/ACIF S043.2:2005	Part 2: Broadband
	ACIF Guidelines	
[5]	ACIF G534:2003	Assessment of Emergency Service Access and Network
	ETSI Standards and Reports	
[6]	TR 101 953-1-1 V1.1.1 (2002-11)	Access and Terminals (AT); Unified and Generic Testing Methods for European Specific DSL splitters; Part 1: ADSL splitters for European deployment; Sub-part 1: Specification of Testing methods for Low Pass part of ADSL/POTS splitters
[7]	ES 202 913 V1.1.1 (2003-01)	Access and Terminal (AT); POTS requirements applicable to ADSL modems when connected to an analogue presented PSTN line.
	ITU–T and CCITT Recommendations	
[8]	G.122 (03/93)	Influence of national systems on stability, talker echo, and listener echo in international connections
[9]	G.992.1 (07/99)	Asymmetric digital subscriber line (ADSL)

	Publication	Title
		transceivers
[10]	O.9 (03/99)	Measuring arrangements to assess the degree of unbalance about earth
[11]	O.41 (10/94)	Psophometer for use on telephone-type circuits
[12]	O.42 (11/88)	Equipment to measure non-linear distortion using the 4-tone method

4 ABBREVIATIONS AND DEFINITIONS

For the purposes of this Standard, the following abbreviations and definitions apply:

4.1 Abbreviations

ACA	Australian Communications Authority
ACIF	Australian Communications Industry Forum
ACMA	Australian Communications and Media Authority
ADSL	Asymmetric Digital Subscriber Line
AS	Australian Standard
CE	Customer Equipment
DC	Direct Current
DSL	Digital Subscriber Line
DUT	Device under test
ITU–T	International Telecommunications Union – Telecommunications
LCL	Longitudinal Conversion Loss
LCTL	Longitudinal Conversion Transfer Loss
NZS	New Zealand Standard
PE	Protective Earth
PSTN	Public Switched Telephone Network
SI	International System
TN12	Termination Network 12
TRC	Telecommunications Reference Conductor
VDSL	Very high speed Digital Subscriber Line
VF	Voice Frequency

4.2 Definitions

4.2.1 Carrier

Refer to the *Telecommunications Act 1997*.

4.2.2 Carriage Service Provider

Refer to the *Telecommunications Act 1997*.

4.2.3 Compound CE

For the purposes of this standard Compound CE means CE that is designed and intended for connection to—

(a) an analogue PSTN Ring-In/Loop Out two-wire service; and

(b) a DSL service that shares the metallic local loop with an analogue PSTN Ring-In/Loop Out two Wire service.

4.2.4 Customer Equipment

Refer to the *Telecommunications Act 1997*.

4.2.5 Facility

Refer to Section 374(2) of *the Telecommunications Act 1997*.

4.2.6 Line Port

A port on CE for connection to the PSTN.

4.2.7 Local Port

A port on series CE for connection of other CE.

4.2.8 Off-line

The state of the Line Terminating Equipment when it has an electrical configuration that causes the current in the basic network loop to be at its minimum steady-state value. Can also be described as 'on hook'.

4.2.9 Off-hook

See On-line.

4.2.10 On-line

The state of the Line Terminating Equipment when it has an electrical configuration that causes the current in the basic network loop to be at its maximum steady-state value. Can also be described as 'off-hook'.

4.2.11 On-hook

See Off-line

4.2.12 Public Switched Telephone Network (PSTN)

That part of the Telecommunications Network which enables any customer to establish a connection for voice frequency communication with any other customer either automatically or with operator assistance.

Note: The PSTN has a nominal transmission bandwidth of 3 kHz.

4.2.13 Ring-in/Loop-out PSTN line

A both-way call set-up line connection with the PSTN. Incoming signalling to CE is by the application of a ring signal at the PSTN exchange. Outgoing signalling from CE is by the application of a DC loop at the CE.

4.2.14 Series Equipment

Series Equipment is CE that is connected to the line in series with line terminating equipment.

4.2.15 Line Terminating Equipment

Line terminating equipment incorporates circuitry that applies an online condition to the PSTN line. CE incorporating this functionality may be associated with the line as—

(a) the only line terminating equipment connected to a line, to provide the sole termination of that line; or

(b) one or more parallel items of line terminating equipment, one or all of which can be used to terminate the line; or

(c) one of a number of items of line terminating equipment, which can be used alternatively to terminate the line, e.g. for alternative voice/data applications.

4.2.16 Standard Telephone Service

Refer to Section 6 of the *Telecommunications (Consumer Protection and Service Standards) Act 1999*.

Note: ACIF G534 [5] provides guidance on the application of the standard telephone service definition.

4.2.17 Telecommunications Network

Refer to Section 374(1) of the *Telecommunications Act 1997*.

4.2.18 Telecommunications Reference Conductor (TRC)

A conductor that can be used for signalling and other functional purposes which may include equipment reliability. Integral surge suppression devices within Customer Equipment may be connected to the TRC.

4.2.19 Voice Frequency (VF)

Those frequencies in the range of 300 Hz to 3.4 kHz.

4.2.20 Voiceband

Voiceband is a general term that may include frequencies from 200 Hz to 4.0 kHz.

4.2.21 Metallic local loop

Metallic twisted pair communications wire in a carrier's network that provides connectivity between a customer's premises and equipment in a Telecommunications Network.

5 REQUIREMENTS

5.1 General

Clause 5.1 lists the requirements that are common for all products within the scope of this standard while Clause 5.2 lists the additional requirements that are specific to ADSL filters. Similarly, Clause 5.3 covers additional requirements for ADSL modems.

Different requirements may apply to other DSL technologies when they are introduced.

5.1.1 Line polarity

CE operation **shall** be independent of line conductor polarity.

5.1.2 Transmitted voltages

Voltages transmitted to a Telecommunications Network from CE, in any line condition, are not to exceed the limits for Telecommunications Network Voltages (TNV), as specified in AS/NZS 60950.1 [2].

5.1.3 Insulation Resistance

CE **shall** provide an insulation resistance of not less than 10 MΩ between—

(a) the two line conductors;

(b) each line conductor and TRC terminal, if equipped; and

(c) each line conductor and PE terminal, if equipped

when tested with 250 V d.c. of either polarity, in series with a 600 kΩ resistance. Any protective devices internal to the CE **shall** remain connected for each test.

5.1.4 Ringing Impedance

CE **shall** have a modulus of impedance greater than 40 kΩ at 25 Hz when tested in the configuration of Figure 3.

Compliance with 5.1.4 can be verified by the procedure indicated in Clause 6.5.1.1.

5.1.5 DC during Ring

When a ring signal of 25 Hz sine wave at 95 V r.m.s. superimposed on 56 V d.c. (with a source impedance of 470 Ω) as shown in Figure 4 is applied to the line terminals of CE, the DC component of the current **shall not** exceed 600 μA.

5.2 ADSL filters

5.2.1 General

The following requirements apply to CE which is—

(a) an ADSL filter, or

(b) part of a CE that has an ADSL filter function for connection on a carrier access line to which both PSTN CE and ADSL modem equipment are connected.

A primary function of an ADSL over PSTN filter is to protect the Voiceband PSTN CE from interference from the ADSL signals. It also protects the ADSL transmission from signalling transients generated during ring, ring trip, dialling, etc. and also prevents interference to the ADSL service due to change in impedance and linearity that occur when Voiceband PSTN CE changes operational state (e.g. from off hook to on hook).

The transfer function between the LOCAL port and LINE port (and vice versa) of each filter is that of a low pass filter. Two types of low pass filter are addressed in Clauses 5.2.2 and 5.2.3. The differences between them are defined more by location of the filter than by function.

5.2.2 Distributed Filters ('in-line' filters or 'micro-filters')

Distributed Filters are typically two port devices. The ADSL signals are delivered over the entire premises wiring and Distributed Filters are placed individually in series with each item of Voiceband PSTN CE. Multiple filters will typically be used in a customer premise.

The Distributed Filters specified by the current document are only intended to be connected individually in series with the PSTN CE. Operation is not specified for stacking (i.e. connecting one Distributed Filter in series with another Filter).

Figure 17(a) shows how the distributed filter is used to isolate the DSL functions from the PSTN CE.

Distributed Filters are to comply with the requirements of this Standard in configurations of 1, 2 and 3 filters connected to line in parallel, where one filter is terminated in an on-line state, and the other filters are in an off-line state as shown in Figures 9 to 14. Each off line filter is terminated by a Z_{ON} network as shown in Figure 2(c).

In recognition of the increasing complexity of customer PSTN services, distributed filters should comply with the requirements of this Standard in configurations of up to five filters inclusive connected to line where one is in an on-line state and four of the filters are in the off-line state as described above.

Distributed filters are not intended to be used in parallel with centralised filters.

5.2.3 Centralised Filter (Master Splitters)

Centralised filters are typically three port devices, designed to be located and hard-wired at a central point in the customer premises (often the carrier demarcation point) from which all Voiceband PSTN CE cabling radiates. They provide separation of PSTN and ADSL signals at a single location.

Centralised filter are not intended to be used in parallel with Distributed filters.

Figure 17(b) shows how the Centralised filter is used to isolate the DSL functions from the PSTN CE.

5.2.4 Technical Requirements

5.2.4.1 Home networking

Where the filter is to be used with high frequency services such as home networking signals or VDSL, the requirements of this Standard should be met up to 32 MHz.

5.2.4.2 DC current range

On-line electrical requirements of ADSL filters **shall** be met with a DC line current over the range of 15 mA to 80 mA.

It is recommended that the ADSL filter On-line electrical requirement should be met with a loop current of up to 120 mA d.c.

5.2.4.3 Reference Impedance

Unless specified, the reference impedance **shall** be TN12 or Z_r. The European harmonized impedance Z_r is a close match to the Australian complex impedance TN12. Suppliers should nominate which reference impedance is to be used for compliance testing.

5.2.4.4 Test Impedances

Figure 2 illustrates the various impedance networks to be used for providing terminations in testing for compliance with this Standard.

Figure 2(a) illustrates the VF terminations that are used, these being:

(a) TN12 Australian complex impedance for Voiceband CE.

(b) Z_r European Harmonized impedance for Voiceband CE.

(c) Z_{sl} Short line impedance as would be encountered with a 600 Ω PSTN exchange.

Figure 2(b) illustrates the equivalent circuit of the ADSL modem CE (ATU-R).

Figure 2(c) illustrates the equivalent circuit of a single terminating CE (e.g. a line powered telephone) in the on hook state at VF and DSL signal amplitudes.

Figure 2(d) illustrates a wideband termination network that provides 120 Ω termination at high frequencies and a modified complex impedance at Voiceband frequencies.

5.2.4.5 DC series resistance

5.2.4.5.1 CE with linear electrical characteristics **shall** have a maximum total DC resistance of 50 Ω.

5.2.4.5.2 For distributed CE with non-linear electrical characteristics, the total DC voltage drop across the line connections **shall not** exceed—

(a) 3.0 V for line currents up to and equal to 30 mA; and

(b) 5.0 V for line currents greater than 30 mA.

5.2.4.5.3 For centralised CE with non-linear electrical characteristics, the total DC voltage drop across the line connections **shall not** exceed—

(a) 2.0 V for line currents up to and equal to 30 mA; and

(b) 4.0 V for line currents greater than 30 mA.

Compliance with Clause 5.2.4.5 should be checked by measuring the DC resistance and the DC voltage drop, as appropriate.

5.2.4.6 Ringing voltage drop

CE in the Off-line state **shall not** have a ringing voltage drop of more than 2 V r.m.s. over the frequency range 18 to 28 Hz.

Compliance with Clause 5.2.4.6 can be verified by the procedure indicated in Clause 6.5.1.2.

5.2.4.7 Return loss

(a) An ADSL filter CE **shall** have a Return Loss of greater than or equal to the limits specified in Table 1 when measured—

(i) using each termination as listed under Z_{ref} in Table 1;

(ii) both with and without Z_{DSL} connected;

(iii) when measured in each direction in turn; and

(iv) over the 15 mA to 80 mA on-line loop current range.

TABLE 1
ADSL filter return loss

Z_{ref}	Frequency band (Hz)	Limit (dB)
Z_{sl}	300 to 3400	12
Z_{sl}	3400 to 4000	8
TN12 or Z_r	300 to 3400	12
TN12 or Z_r	3400 to 4000	8

Note 1: The Z_{ref} terminations of TN12, Z_r and Z_{sl} are shown in Figure 2.

Note 2: The configuration for a distributed filter CE is given in Figure 9(a)

Note 3: The configuration for a centralised splitter filter CE is given in Figure 9(b)

(b) ADSL filter CE should have a return loss of greater than14 dB within the frequency band 300 to 3400 Hz and greater than 8 dB within the frequency band 3.4 kHz to 10 kHz inclusive.

Compliance with Clause 5.2.4.7 can be verified by the procedure indicated in Clause 6.5.2.

5.2.4.8 Unbalance about Earth

The balance of DSL filters measured as:

(a) A longitudinal conversion loss (LCL) at the line port, with S1 both open and closed, **shall** be no less than the LCL Limits shown in Table 2. See Figure 5(a).

(b) A longitudinal conversion transfer loss (LCTL) from the local port to the line port **shall** be no less than the LCTL Limits shown in Table 2. See Figure 5(b).

(c) A longitudinal conversion transfer loss (LCTL) from the local port to the line port should be no less than the LCL Limits shown in Table 2. See Figure 5(b).

(d) A longitudinal conversion loss (LCL) at the local port, with S1 both open and closed, should be no less than the LCL Limits shown in Table 2. See Figure 5(c).

Compliance with Clause 5.2.4.8 can be demonstrated by the method described in Clause 6.5.3.

TABLE 2
DSL filter impedance balance

R1 to R4 (Ω)	R5 (Ω)	Frequency band	LCL Limit (dB)	LCTL Limit (dB)
300	0	50 Hz to 600 Hz	46 dB	46 dB
300	0	600 Hz to 3400 Hz	53 dB	46 dB
300	0	3400 Hz to 4000 Hz	46 dB	46 dB
50	150	4.0 kHz to 30 kHz	40 dB	40 dB
50	150	30 kHz to 140 kHz	45 dB	40 dB
50	150	140 kHz to 2208 kHz	50 dB	40 dB
50	150	2208 kHz to 5.0 MHz	30 dB	30 dB

Note: The values for R1 to R5 refer to those shown in Figures 5(a), 5(b) and 5(c).

5.2.4.9 Group Delay Distortion

The increase of group delay (i.e. the Group Delay Distortion) of one splitter is determined relative to the lowest measured delay in the frequency range 300 Hz to 4 kHz. The Group Delay Distortion **shall** not exceed the limits in Table 3.

TABLE 3
Group delay distortion

Frequency band	Limit (μs)
200 Hz to 600 Hz	250
600 Hz to 3.2 kHz	200
3.2 kHz to 4.0 kHz	250

Compliance with Clause 5.2.4.9 should be checked in the configuration of Figure 10.

5.2.4.10 Voiceband Filter Loss 'On-Line'

The filter loss of CE **shall** be in the range of 0 to 1 dB at 1 kHz in each direction for source and load reference impedance as specified in Clause 5.2.4.3.

Compliance with Clause 5.2.4.10 should be checked by measuring the filter loss as follows:

(a) For filter CE of the distributed type, by the method specified in Clause 6.5.4.

(b) For filter CE of the centralized type, by either—:

(i) the method specified in Clause 6.5.4; or

(ii) the method specified for measuring Insertion Loss in the Pass Band in ETSI TR 101 953-1-1 [6].

5.2.4.11 Voice Band Filter Loss distortion 'On-Line'

The absolute difference between the filter loss at any frequency in the range 200 Hz to 4000 Hz and the filter loss at 1 kHz **shall** be no greater than 1.5 dB in each direction and for source and load reference impedance specified in Clause 5.2.4.3.

Compliance with Clause 5.2.4.11 should be checked by measuring the filter loss distortion as follows:

(a) For filter CE of the distributed type, by the method specified in clause 6.5.4.

(b) For filter CE of the centralized type, by either—

(i) the method specified in clause 6.5.4; or

(ii) the method specified for measuring Insertion Loss Distortion in the Pass Band in ETSI TR 101 953-1-1 [6].

5.2.4.12 Voiceband Filter Loss 'Off-line'

The voltage loss of CE should be within the range –4 dB to +4 dB over the range 200 to 2800 Hz, for 600 Ω source and 10 kΩ load impedances.

Testing is to be performed using a –4 dBV test signal level.

Compliance with Clause 5.2.4.12 should be checked by measuring the Filter loss in the configuration of Figures 12(a) or 12(b), as appropriate.

5.2.4.13 Intermodulation distortion

Using reference impedance specified in Subclause 5.2.4.3 and the 4-tone method detailed in ITU-T Rec. O.42 [13], at a level of –9 dBm, the second and third order Harmonic distortion product **shall** be at least 57 dB and 60 dB, respectively below the received signal level.

The second and third order harmonics of the 4-tone signal are measured at the Local port.

Compliance with Clause 5.2.4.13 should be checked in the configuration of Figures 13(a) or 13(b), as appropriate.

5.2.4.14 ADSL band filter loss On-line state

5.2.4.14.1 An individual filter in the On-line state **shall** comply with either of the loss requirements under the conditions set out in Table 4.

TABLE 4

Loss requirements in the On-line state

Frequency	Loss	Source & Load	DC Loop
32 kHz ≤ f ≤ 2208 kHz	> 55dB	120 Ω	15mA ≤ I ≤ 80mA
32 kHz ≤ f ≤ 2208 kHz	> 55dB	Z_{RHF}	15mA ≤ I ≤ 80mA

5.2.14.4.2 An individual filter in the On-line state should comply with either of the loss requirements under the conditions set out in Table 5.

TABLE 5

Recommended loss in the On-line state

Frequency	Loss	Source & Load	DC Loop
32 kHz ≤ f ≤ 2208 kHz	> 55dB	120 Ω	80mA ≤ I ≤ 120mA
32 kHz ≤ f ≤ 2208 kHz	> 55dB	Z_{RHF}	80mA ≤ I ≤ 120mA

5.2.14.4.3 Filter loss is defined as 20 log (V_1/V_2) where V_1 is the voltage at the Line port of the CE and V_2 is the voltage at the load at the local port.

While Figure 14 provides the configuration for this test, ETSI TR 101 953-1-1 [6] offers a different test configuration for centralised filters. For ADSL band filter loss (isolation), either method can be used to verify compliance.

Compliance with Clause 5.2.4.14 should be checked in the configuration of Figures 14(a) or 14(b), as appropriate.

5.2.4.15 ADSL band filter loss Off-line state

An individual filter in the Off-line state **shall** comply with the loss requirements under the conditions set out in either Table 6 or Table 7.

TABLE 6

Loss in the Off-line state with a 120 Ω Source

Frequency	Loss	Source	Load
32 kHz ≤ f≤ 350 kHz	> 34 dB	120 Ω	Z_{ON}
350 kHz ≤ f ≤ 2208 kHz	> 55 dB	120 Ω	Z_{ON}

TABLE 7

Loss in the Off-line state with a Z_{RHF} Source

Frequency	Loss	Source	Load
32 kHz ≤ f ≤ 350 kHz	> 34 dB	Z_{RHF}	Z_{ON}
350 kHz ≤ f ≤ 2208 kHz	> 55 dB	Z_{RHF}	Z_{ON}

Testing is to be performed using a –6 dBV test signal level.

Filter loss is defined as 20 log (V_1/V_2) where V_1 is the voltage at the Line port of the CE and V_2 is the voltage at the load at the local port.

Compliance with Clause 5.2.4.15 should be checked in the configuration of Figures 14(a) or 14(b), with the DC loop replaced by Z_{ON} termination.

5.2.4.16 LINE Port impedance Offline state

The low pass filter CE in the Offline state should present a modulus of impedance to the Line port of at least 1 kΩ for the frequency range 32 kHz to 2208 kHz.

This requirement applies with the Local port terminated in either 120Ω or Z_{RHF}.

5.2.4.17 Noise in Voiceband

Mean noise power **shall not** exceed:

(a) –75 dBmp using a 600 Ω impedance and a testing device compliance with ITU-T Rec. O.41 [11].

(b) –50 dBm (unweighted), measured using a device with a uniform frequency response over the range 30 Hz to 20 kHz.

(c) –60 dBm at any single frequency over the range 30 Hz to 20 kHz, measured selectively with a 30 Hz bandwidth.

(d) –62 dBmp measured across a 600Ω termination and using a testing device compliant to ITU-T Rec. O.41 [11] where the CE is used in conjunction with an ADSL modem and the ADSL modem—

(i) is compliant with—

(1) ITU-T Rec. G.992.1 [9];

(2) the group B requirements of Equipment Class 6a of AS/ACIF S043.2 [4]; and

(3) clause 5.3 of this Standard; and

(ii) is—

(1) in an active state excluding transient start up or initialisation phases, and

(2) transmitting in the R-MEDLEY state for a sufficient period of time that will allow a stable psophometer measurement to be performed.

Note: R-MEDLEY state is a minimum power of +12.5dBm as defined in G.992.1 [9].

Compliance with Clause 5.2.4.17 may be verified using the configuration of Figures 6 and 7.

5.2.4.18 Noise in ADSL band

The noise in the frequency range 26 kHz to 2208 kHz measured at the line port of filter CE **shall** be less than –140 dBm/Hz in a bandwidth of 10 kHz.

Compliance with Clause 5.2.4.18 may be verified using the configuration of Figure 15.

5.2.4.19 PSTN transient effects

Transient effects measured at the Line port of the filter should be less than 2 V peak-to-peak and the main lobe of the Fourier Transform of the transient has its peak at a frequency less than 15 kHz when step loads are applied in either direction at the Local port.

Compliance with Clause 5.2.4.19 may be verified as described in Clause 6.5.8.

5.2.4.20 Parallel operation

To ensure that the DC characteristics of distributed filter CE will allow for handover between parallel connected CE, the filter should not block DC loop currents to the local port for a voltage ≥ 6 V dc at the line port.

Compliance with Clause 5.2.4.20 may be verified as described in Clause 6.5.9.

5.3 Modems

The following requirements apply to CE which is an ADSL modem, or part of a CE performing the function of an ADSL modem.

5.3.1 ADSL Line Impedance

The impedance that ADSL CE presents to the line **shall** have a modulus of impedance greater than or equal to the impedance limits defined in the Table 8 and Figure 1.

Note: Clause 5.3.1 is based on the requirements in ETSI ES 202 913 [7] with the limits from ITU-T Rec. G.992.1 [9].

TABLE 8
Impedance limits

Frequency (Hz)	Impedance (Ω)
200	10 000
440	10 000
4000	1100

Compliance with Clause 5.3.1 should be checked by using the method described in Clause 6.5.7

5.3.2 Impedance Balance

With the modem powered up and in a quiet state, the impedance balance about earth of the CE **shall** be greater than 46 dB over the frequency range 50 Hz to 3.4 kHz. This test is to be applied with respect to the TRC terminal and protective earth termination, separately and connected together when either or both of these terminations are provided.

Compliance with Clause 5.3.2 should be checked by using the method described in Clause 6.5.3.

5.3.3 Noise Performance

When the ADSL modem is in an active state and transmitting maximum power, excluding transient start up or initialisation phases, the mean noise power **shall not** exceed –62 dBmp when measured across a 600 Ω termination and using a device compliant with ITU–T Rec. O.41 [11].

Compliance with Clause 5.3.3 should be checked by using the method described in Clause 6.5.5

6 TESTING

6.1 Verification of compliance with requirements

Compliance with all mandatory requirements in this AS/ACIF Standard is to be verified. This may be done by direct measurement, modelling and analysis, operation or inspection.

Methods for demonstrating compliance of CE with the requirements clauses specified in this Standard are described in Clauses 6.2 to 6.5.

Alternative methods of demonstrating compliance to those described may be used if the risk of passing non-compliant CE is not increased because of increased measurement uncertainty.

6.2 Standard test conditions

6.2.1 Unless this Standard provides otherwise, testing for compliance with this Standard should be conducted at the nominal supply voltage of the CE and within the following ranges of atmospheric conditions:

(a) An ambient temperature in the range of 15°C to 25°C inclusive.

(b) A relative humidity in the range of 30% to 75% inclusive.

(c) An air pressure in the range of 86 kPa to 106 kPa inclusive.

6.2.2 Where elements in a test configuration are variable, the test should be carried out over the indicated range for that element.

6.2.3 Unless indicated elsewhere within this Standard—

(a) the accuracy level of all measurements should be better than ± 2% for voltage and current, ± 0.25% for frequency and ± 0.5% for time; and

(b) the tolerance of the nominal 48 V d.c. test source should be ± 0.5 V.

6.2.4 Unless indicated elsewhere within this Standard for an individual test, all component values in the test configuration should have a tolerance of—

(a) ± 1% for resistance;

(b) ± 1% for capacitance; and

(c) – 0%, + 25% for inductors.

6.2.5 D.C. excitation

6.2.5.1 Figures 9 to 15 show provision for DC feed, and DC loop connections. The components for these circuits, and the associated coupling capacitors, are to be chosen to ensure that negligible impact on Voiceband and DSL band measurement results are caused by these connections.

6.2.5.2 On-line DC conditions are a loop current adjustable over a 15 mA to 80 mA range.

6.2.5.3 For CE that senses an unlooped state, the Off-line DC condition is an applied voltage of 36 ± 0.5 V dc.

6.2.6 For DSL band loss, measurements can be made with either 120 Ω or Z_{RHF} source and load terminations.

6.3 Levels

Unless otherwise specified, tests should be carried out with a send level of –10 dBV for VF signals.

6.4 Test frequencies

Test frequencies should be in the range of 300 Hz to 4 kHz unless otherwise specified in the relevant requirement clauses of this Standard. Sufficient measurements should be carried out around all nodal points of relevant masks, where applicable.

6.5 Parameters to be tested

6.5.1 Ringing characteristics

6.5.1.1 Impedance

The impedance of DSL products that are interfaced to a PSTN subscriber line should be measured in the configuration of Figure 3 with switch S1 operated and the impedance calculated from the voltage dropped across the 1.2 kΩ resistor.

6.5.1.2 Insertion Loss

Ringing Voltage drop of DSL filters, should be measured in the configuration of Figure 3 with the appropriate load for the type of filter connected across M1. The insertion loss is the difference in the readings at M1 with both S_1 and S_2 as shown, and with both S_1 and S_2 operated.

6.5.1.3 DC during Ring

The DC component of the current flowing during application of ring should be measured using the test configuration shown in Figure 4. The milliammeter used should be a moving-coil DC responding instrument.

6.5.2 Return loss

The return loss, as defined in Annex B of ITU–T Rec. G.122 [8], should be measured by a suitable bridge circuit or a vector impedance meter as shown in Figure 9 using a test level of 10 dBm.

6.5.3 Impedance balance

Impedance balance is defined as the ratio U/V measured as shown in Figure 5. The test should be carried out by injecting a signal of 3 V r.m.s. between the earth and the midpoint of two resistors

connected in series, in accordance with ITU–T Rec. O.9 [10]. Earth should be either TRC or protective earth termination, or both.

A twoport device (i.e. filter) is tested with a pair of resistors on each port, the port not being measured having provision to connect the midpoint to earth.

Note that the source and measuring device are always connected to the same port of a twoport device.

Measurements are to be performed during both the offline and online states in conjunction with the DC conditions specified in Clause 5.2.

CE without an earth connection should be placed on an earthed metal plate of sufficient size.

Note: Impedance balance = 20 log (U/V) dB.

6.5.4 Filter loss

Filter loss should be measured as shown in the test circuit of Figure 11 or Figure 12 as appropriate.

Testing should be performed using a –10 dBm test signal level and Complex Impedance (TN12)/Z_r source and load.

The filter loss is given by

Filter loss = 20 log (V_1/V_2) dB.

Where V_1 = Voltage at source

V_2 = Voltage at load.

6.5.5 Noise performance

6.5.5.1 The following types of noise should be measured—

(a) Psophometric;

(b) Unweighted; and

(c) Single frequency.

6.5.5.2 Depending on the type of noise, appropriate noise measurement equipment should be used as shown in the test circuit of Figure 6 or Figure 7.

6.5.6 Signal levels and frequencies

Signal levels and frequencies should be measured as shown in Figure 7 using a selective level meter or spectrum analyser with appropriate input dynamic range and frequency range. When used to measure the levels of individual frequency components, bandwidths of 3 Hz, 10 Hz, 30 Hz and 100 Hz may be used as appropriate.

6.5.7 Test for ADSL Line Impedance

This measurement should be performed by connecting a Vector Impedance meter or VF Level Tracer to the ADSL modem Line port while the modem is in the powered up quiet state.

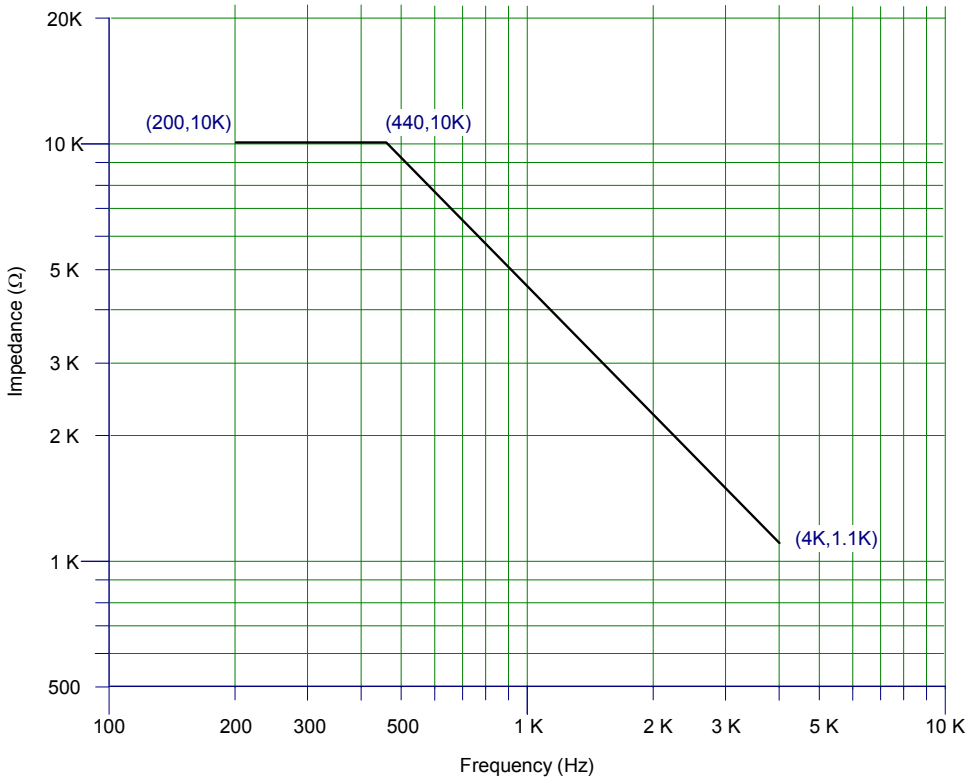
Note: Equipment suppliers should provide details of a method for placing the CE in the On-line condition with no signal being applied to line for a period of not less than 10 minutes.

6.5.8 Test for POTS Transient effects

The test configuration is shown in Figure 8. The switch is operated and released in turn, the resultant signals being observed on the FFT. The recommended requirements of Clause 5.2.4.19 should be satisfied.

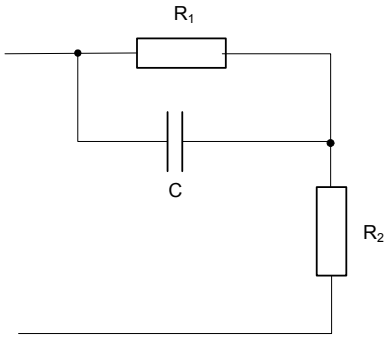
6.5.9 Parallel Handover

Parallel Handover can be verified by a current of ≥10 mA flowing in the configuration of Figure 16.



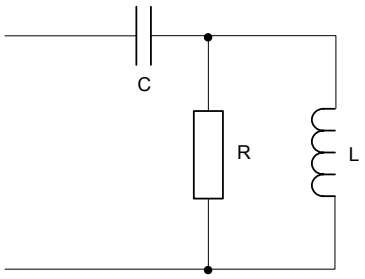
Note: Between 440 Hz and 4 KHz the log of the impedance decreases linearly with the log of the frequency.

FIGURE 1
Minimum impedances in the Voiceband



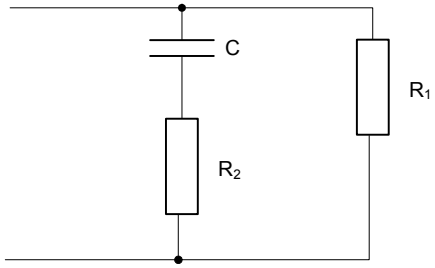
Load	Component Values
TN12	R_1 = 820 Ω ± 0.1% R_2 = 220 Ω ± 0.1% C = 115 nF or 120 nF ± 0.1%
Z_r	R_1 = 750 Ω ± 0.1% R_2 = 270 Ω ± 0.1% C = 150 nF ± 0.1%
Z_{sl}	R_1 = 600 Ω ± 0.1% R_2 = 82 Ω ± 0.1% C = 68 nF ± 0.1%

Voice frequency networks
Figure 2(a)



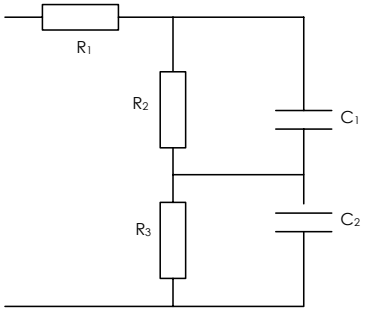
Load	Component Values
Z_{DSL}	R = 100 Ω ± 1% C = 27 nF ± 1% L = 470 µH ± 1%

DSL frequency network
Figure 2(b)



Load	Component Values
Z_{ON}	R_1 = 1 MΩ ± 1% R_2 = 10 kΩ ± 1% C = 1 µF ± 1%

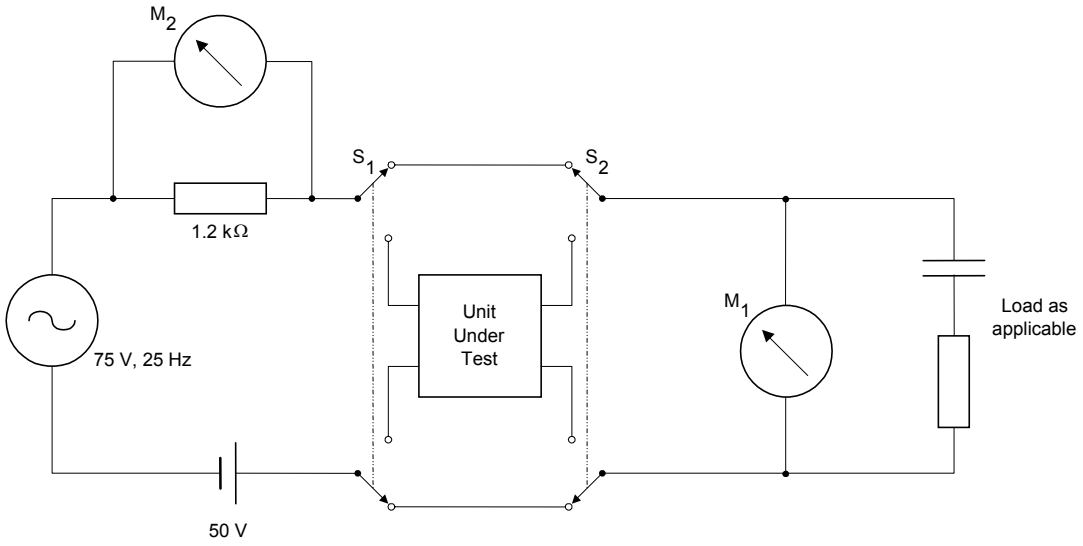
On-hook termination network
Figure 2(c)



Load	Component Values
Z_{RHF}	R1= 120 Ω +/- 0.1% R2= 150 Ω +/- 0.1% R3= 750 Ω +/- 0.1% C1= 47nF +/–0.1% C2= 150nF +/–0.1%

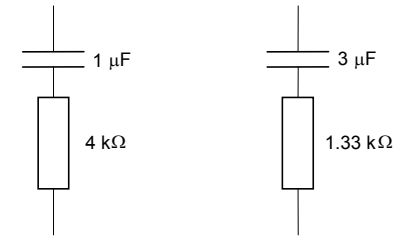
Wideband termination network
Figure 2(d)

FIGURE 2
Reference impedances



Test method 1 Ring insertion loss
Note reading at meter M_1
Operate both switches S_1 and S_2
Note second reading at meter M_1
Subtract second reading from the first

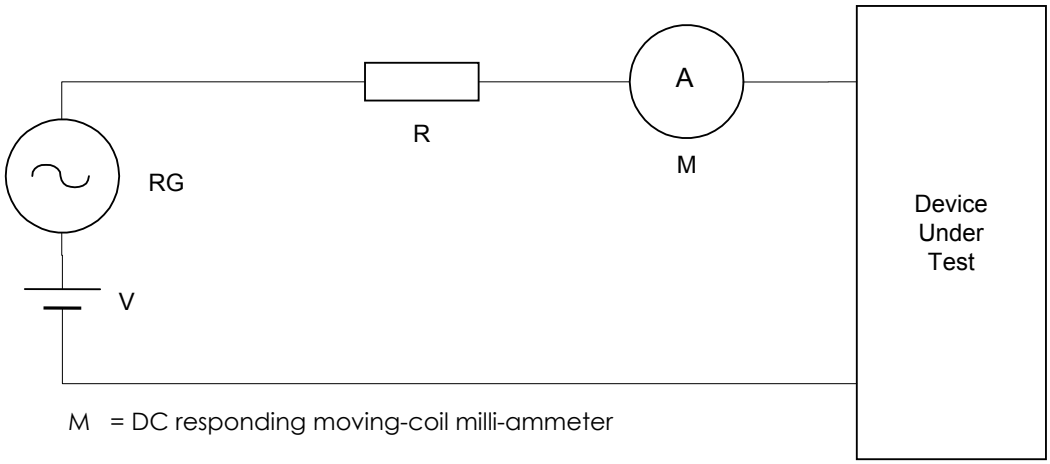
Test method 2 Ring Impedance
Operate switch S_1
Measure volts droped at M_2
Calculate current in 1.2 k Ω
Calculate resistance of Unit Under Test



Applicable Load

FIGURE 3

Test circuit for ring characteristics of xDSL filters



M = DC responding moving-coil milli-ammeter

R = 470 Ω ± 1%

RG = 95 ± 1 Vr.m.s., 25 ± 1 Hz

FIGURE 4
Test circuit for DC flowing during ring

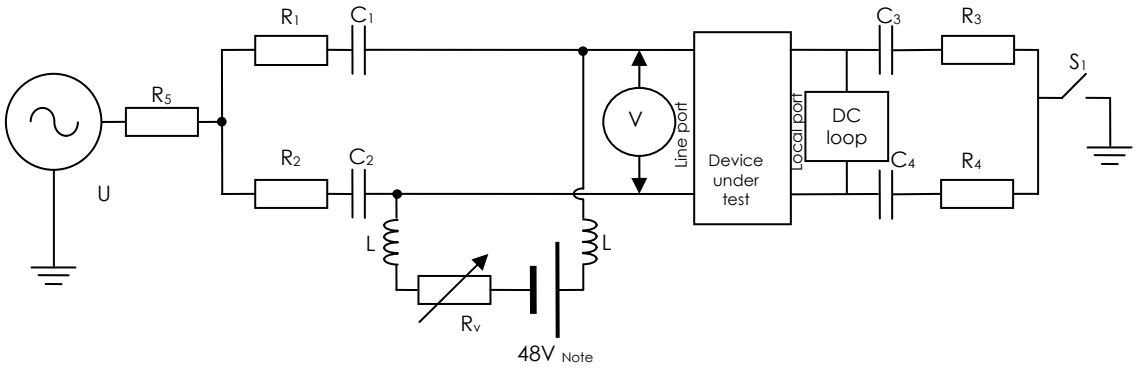


Figure 5(a): Test for xDSL filter balance about earth at the line port

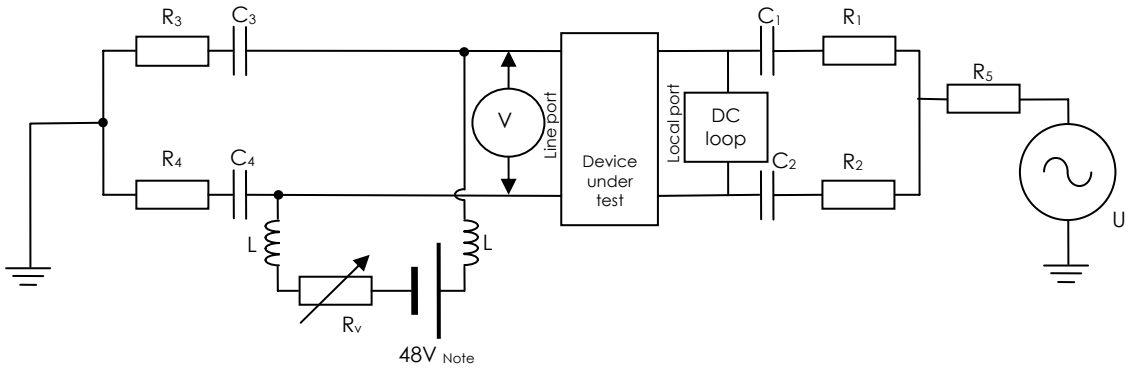


Figure 5(b): Test for xDSL filter balance about earth from the local port to the line port

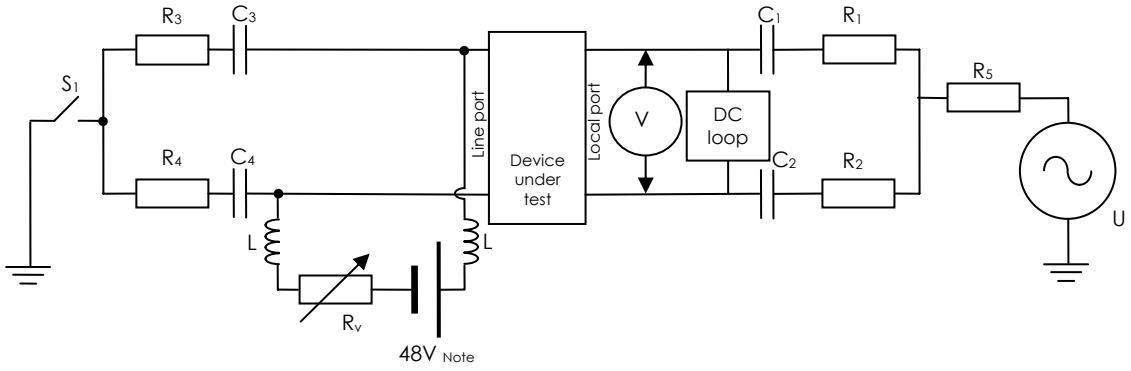
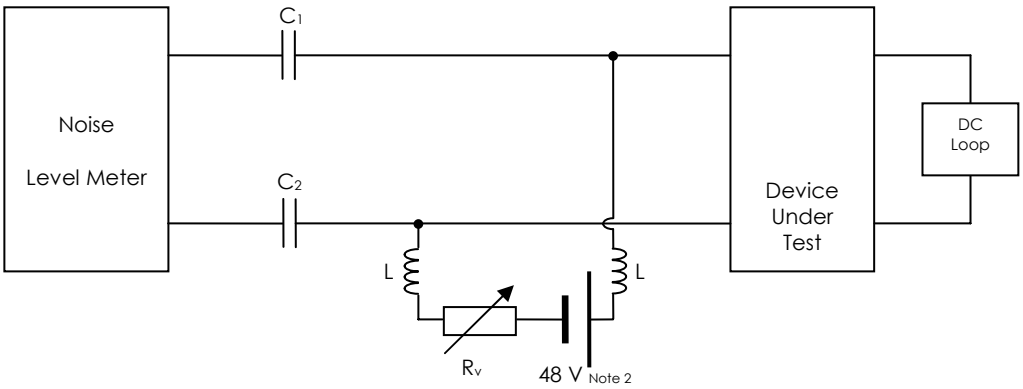


Figure 5(c): Test for xDSL filter balance about earth at the local port

Note 1:	All measurements to accuracy better than: +/- 2% Voltage and current +/- 0.5% time +/- 0.25% frequency +/- 0.2dB power level	L ≥ 10 H for up to 125 mA d.c. over the range 100 Hz to 4000 Hz. For frequencies above 4000 Hz, a high frequency feedbridge will be required that has a loading effect ≤ 0.1 dB. Feedbridge LCL **shall** be at least 20 dB better than the values in Table 2. C_1 > 100 µF C_3 > 100 µF C_2 > 100 µF C_4 > 100 µF $C_1 - C_2$ < +/- 0.01 C_1 $C_3 - C_4$ < +/- 0.01 C_3 R_1, R_2, R_3 and R_4 = 300 (or 50) Ω R_1 to R_4 - +/- 0.1 Ω R_5 = 0 or 150 Ω (includes the source impedance of U) R_V = 400 to 2300 Ω (includes resistance of 2 L)
Note 2:	The battery should be replaced by a shorting link if DUT does not draw loop current from the line.	
Note 3:	C_3, R_3, C_4, R_4 and the DC loop are required for a two port device.	

FIGURE 5

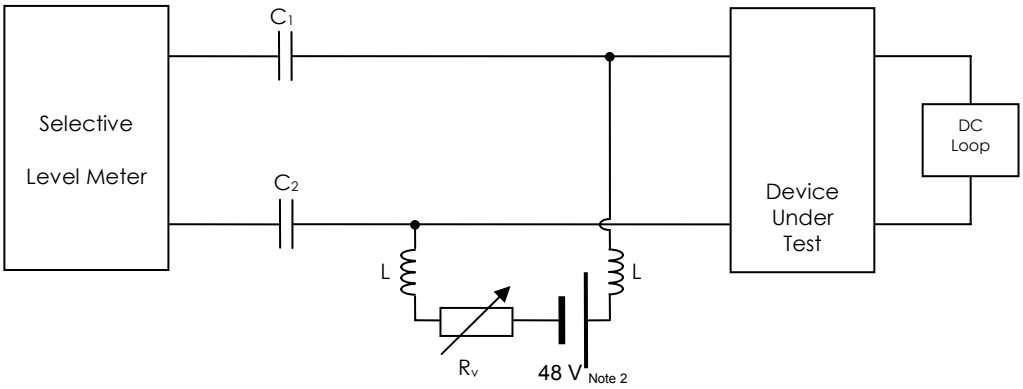
Test for xDSL filter balance about earth



Note 1:	All measurements to accuracy better than: +/- 2% Voltage and current +/- 0.5% time +/- 0.25% frequency +/- 0.2dB power level	L ≥ 10 H for up to 125 mA d.c. over the range 100 Hz to 4000 Hz C_1 > 100 µF C_2 > 100 µF R_V = 400 to 2300 Ω (includes resistance of 2 L)
Note 2:	The battery should be replaced by a shorting link if DUT does not draw loop current from the line.	

FIGURE 6

Noise measurements psophometric and unweighted



Note 1:	All measurements to accuracy better than: +/- 2% Voltage and current +/- 0.5% time +/- 0.25% frequency +/- 0.2dB power level	L ≥ 10 H for up to 125 mA d.c. over the range 100 Hz to 4000 Hz C_1 > 100 µF C_2 > 100 µF R_V = 400 to 2300 Ω (includes resistance of 2 L)
Note 2:	The battery should be replaced by a shorting link if DUT does not draw loop current from the line.	
Note 3:	The selective level meter should have a bandwidth of 10 Hz +/- 30% at its 3 dB points	

FIGURE 7

Noise measurements single frequency

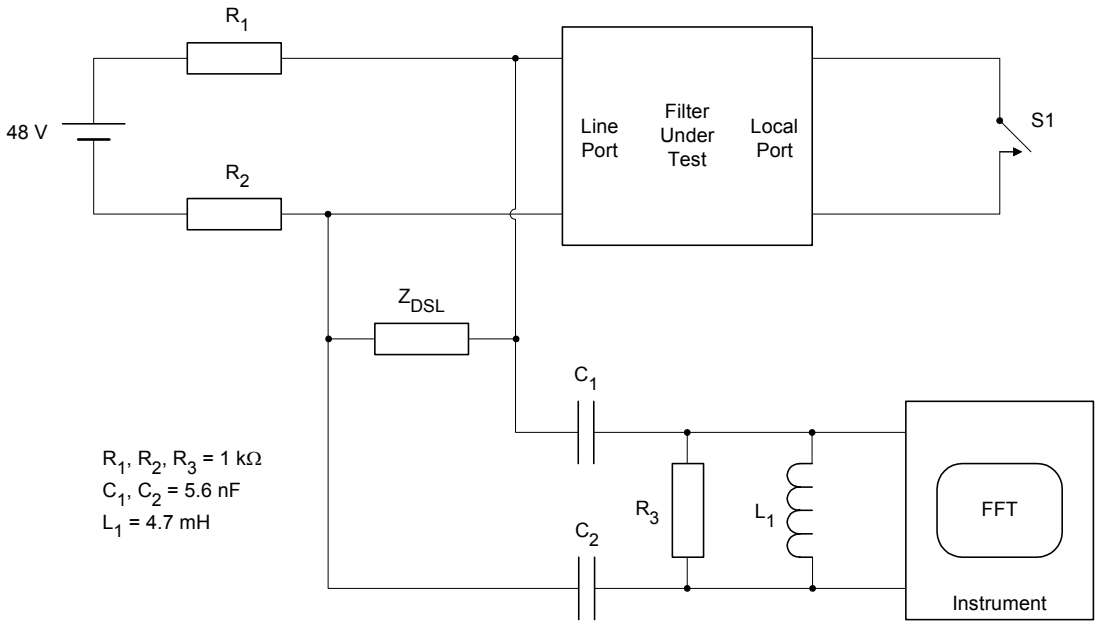
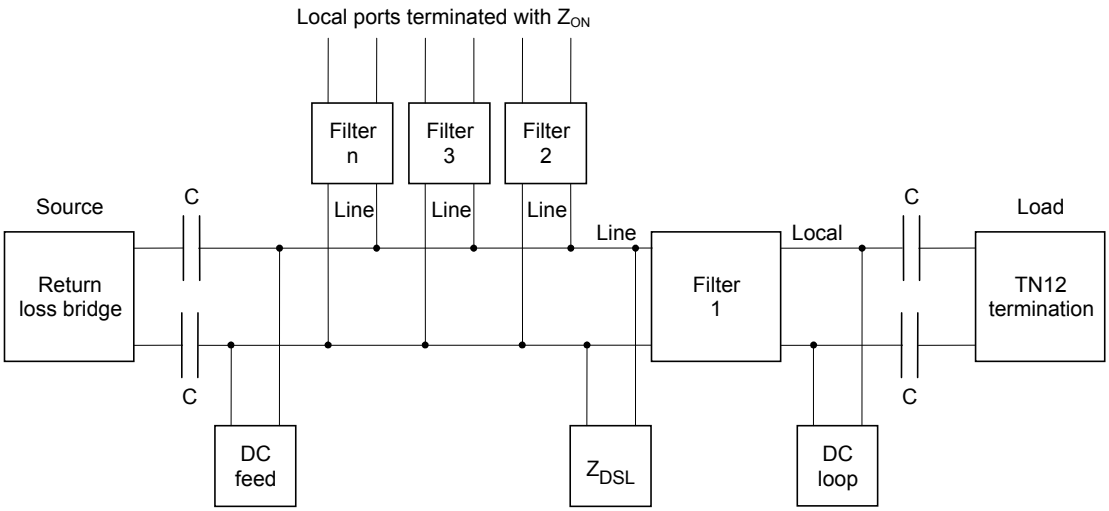
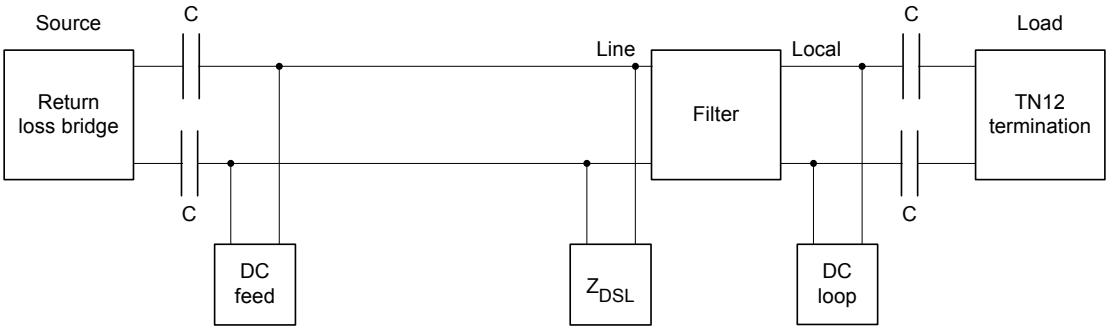


FIGURE 8
Test for PSTN transient effects

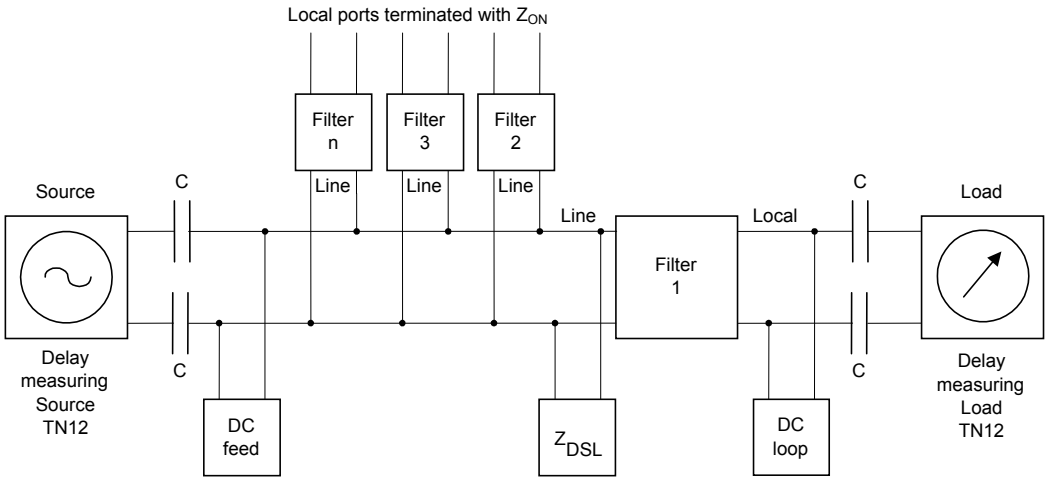


Distributed filter
Figure 9(a)

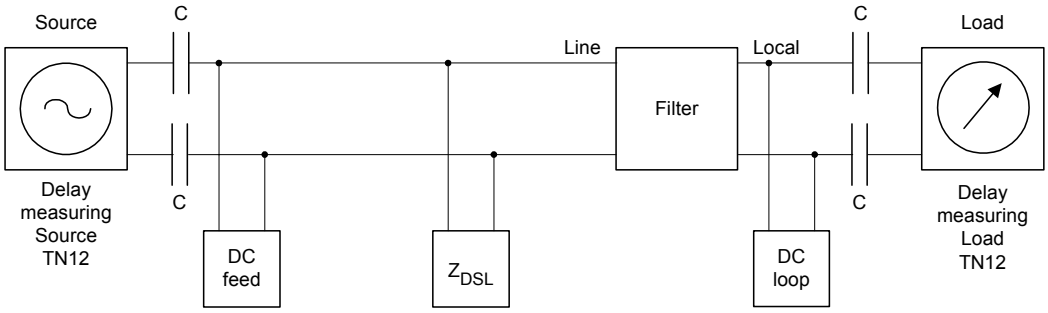


Centralised filter
Figure 9(b)

FIGURE 9
Return loss measurements

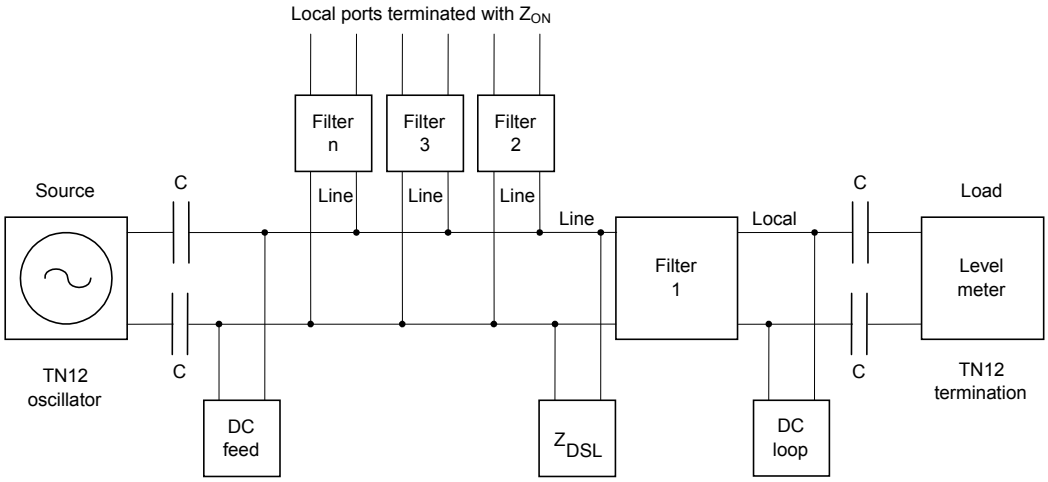


Distributed filter
Figure 10(a)

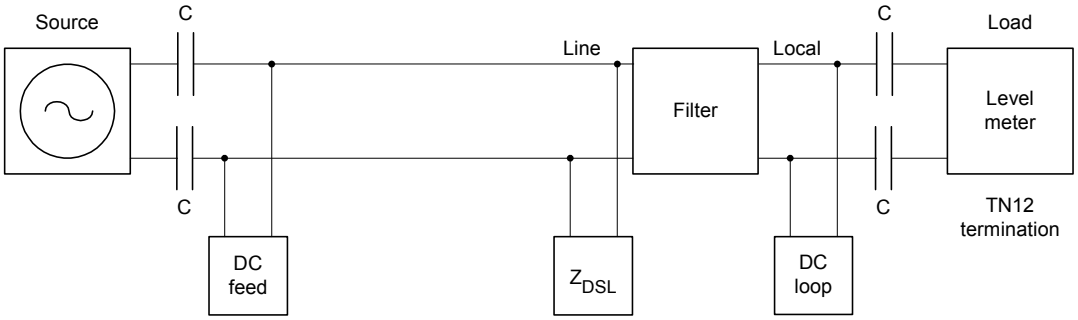


Centralised filter
Figure 10(b)

FIGURE 10
Group delay measurements

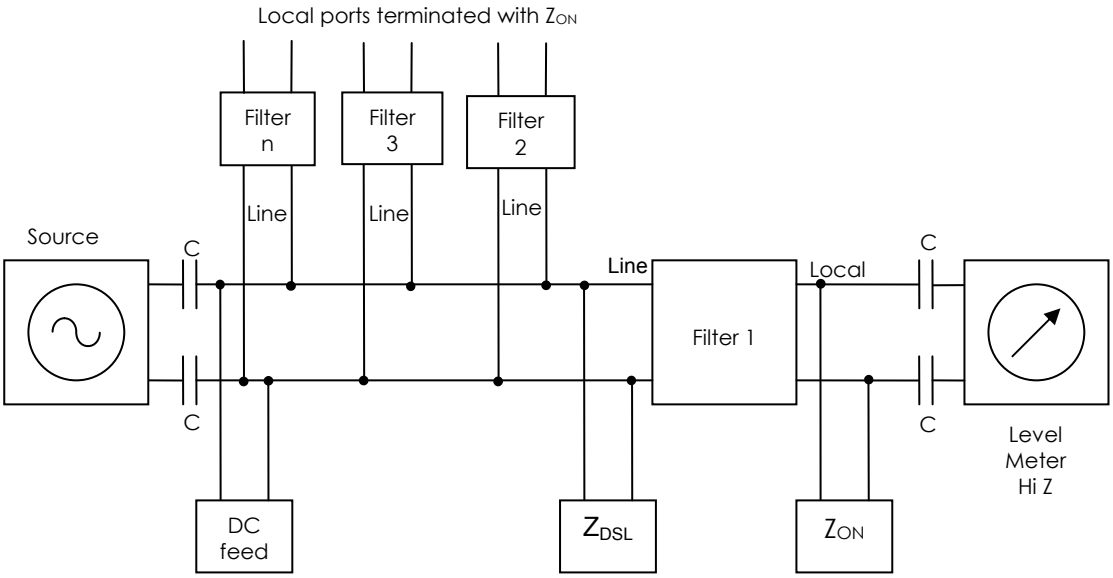


Distributed filter
Figure 11(a)

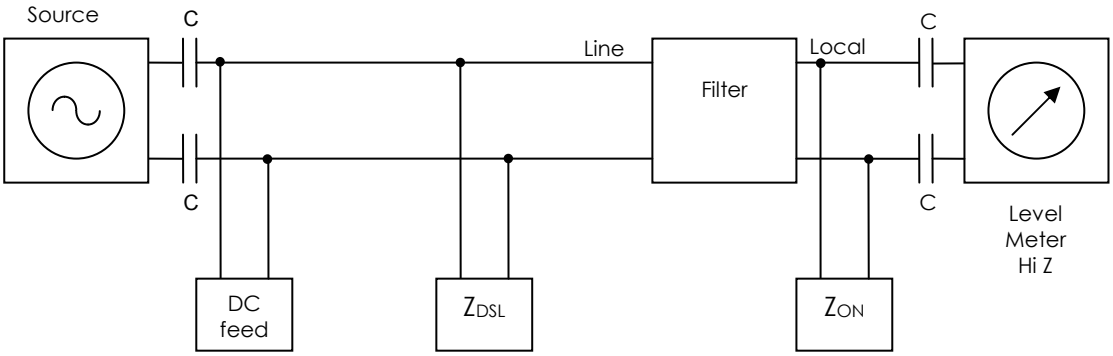


Centralised filter
Figure 11(b)

FIGURE 11
Voiceband filter loss (on-line) / distortion measurements

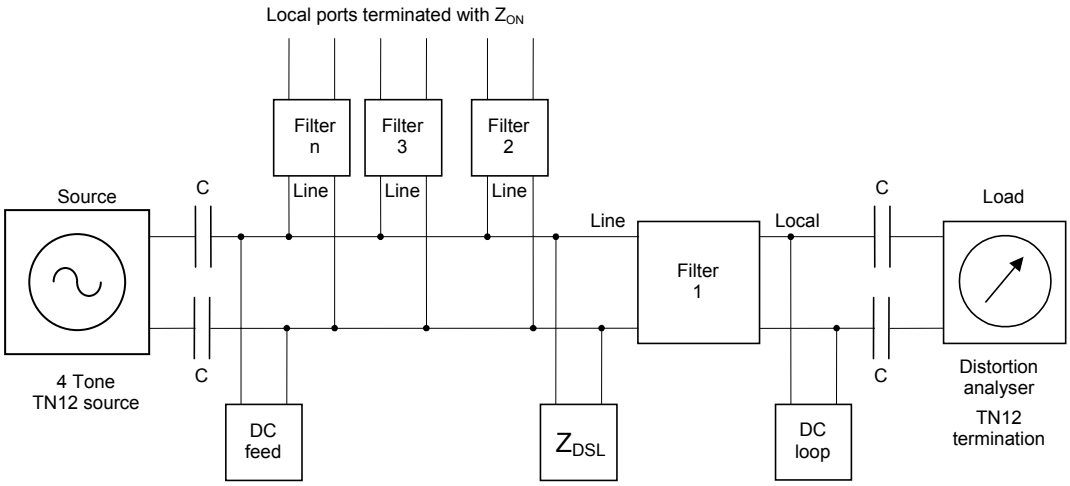


Distributed filter
Figure 12(a)

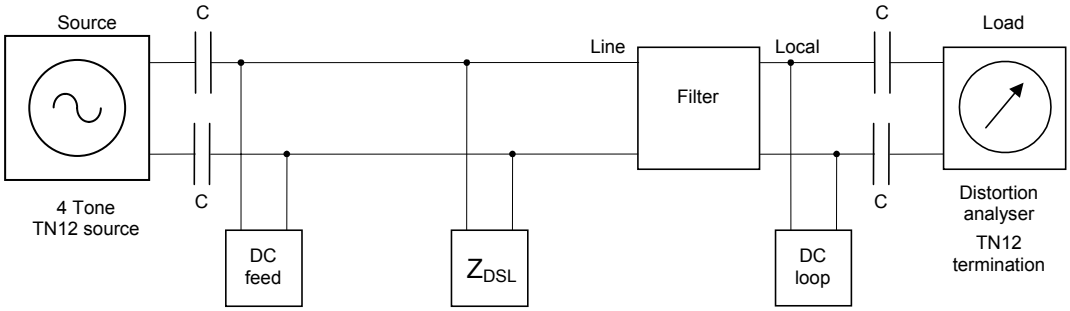


Centralised filter
Figure 12(b)

FIGURE 12
Voiceband filter loss (off-line) measurements

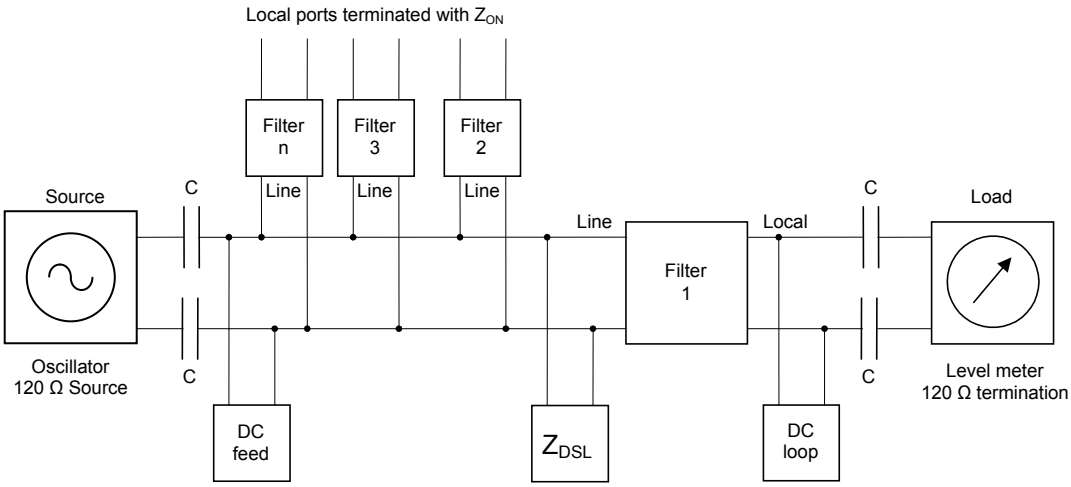


Distributed filter
Figure 13(a)

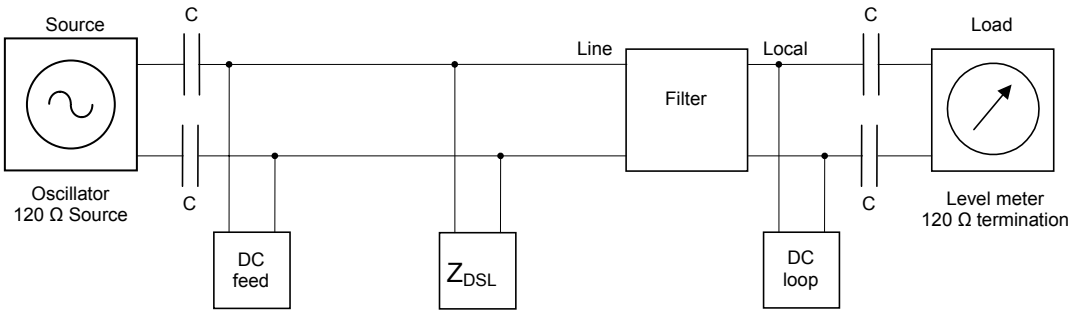


Centralised filter
Figure 13(b)

FIGURE 13
Intermodulation measurements



Distributed filter
Figure 14(a)



Centralised filter
Figure 14(b)

FIGURE 14
DSL band loss measurements

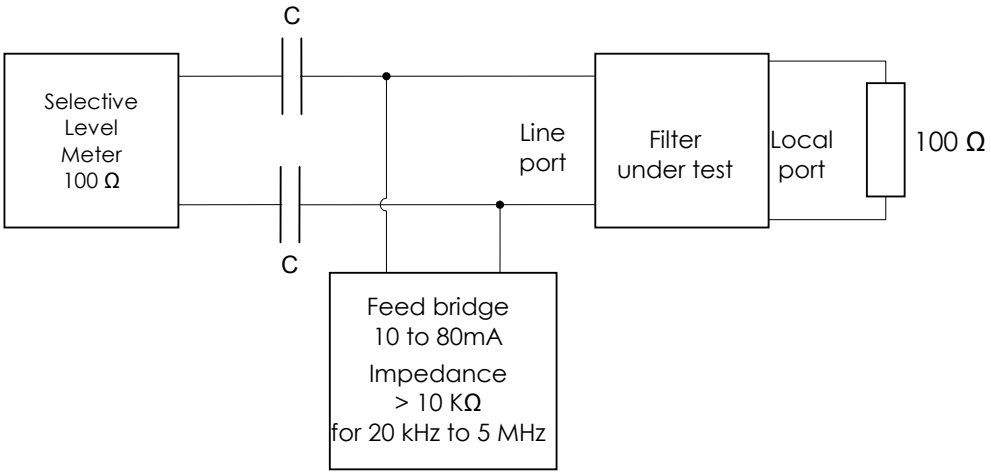


FIGURE 15
ADSL band noise measurements

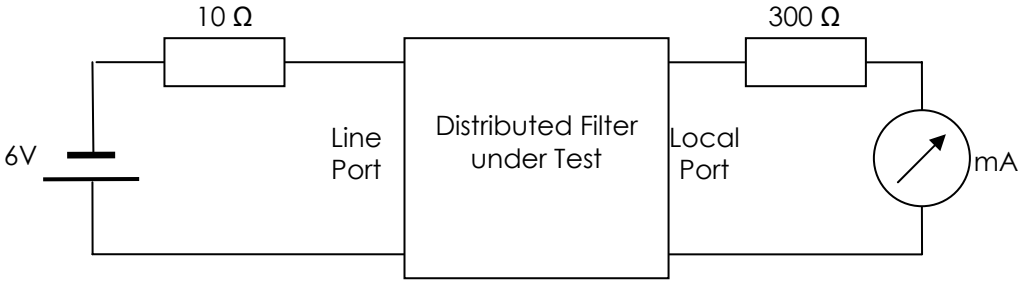
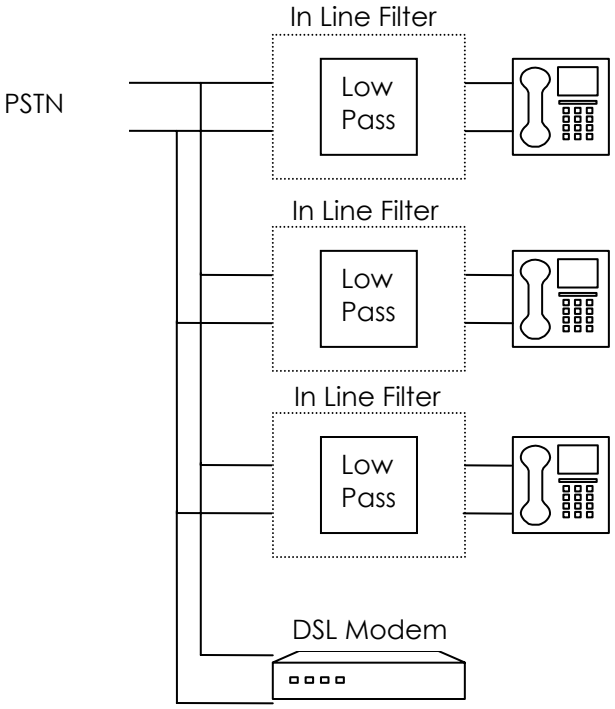
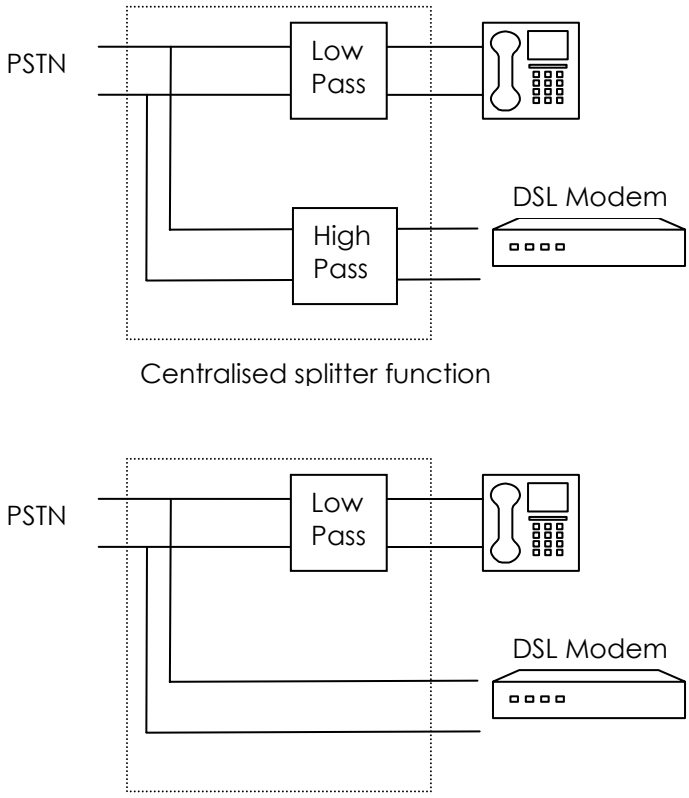


FIGURE 16
Test circuit for parallel handover



Distributed Filter Configuration
Figure 17(a)



Centralised Filter Configurations
Figure 17(b)

FIGURE 17
Filter use for isolation of DSL functions from PSTN CE

PARTICIPANTS

The Working Committee that developed this Standard consisted of the following organisations:

Organisation	Membership
Austest Laboratories	Voting
Cisco Systems	Voting
Comtest Laboratories	Voting
NEC Australia	Voting
Optus	Voting
Primus Telecommunications	Voting
Telephone Equipment	Voting
Thomson Telecom Australia	Voting
Australian Communications and Media Authority	Non-voting
Australian Communications Industry Forum	Non-voting

The Working Committee was chaired by Laurie Collier. Mike Johns and James Duck of ACIF provided project management support.

NOTES

The policy objective of the greatest practicable use of industry self-regulation without imposing undue financial and administrative burdens on industry is central to the regulatory scheme of the *Telecommunications Act 1997*.

ACIF was established to implement the policy of industry self-regulation. It is a company limited by guarantee and is a not-for-profit membership-based organisation. Its membership comprises carriers/carriage service providers, business and residential consumer groups, industry associations and individual companies.

ACIF's mission is to develop collaborative industry outcomes that foster the effective and safe operation of competitive networks, the provision of innovative services and the protection of consumer interests. In the development of Industry Codes and Technical Standards as part of its mission, ACIF's processes are based upon its principles of openness, transparency, consensus, representation and consultation. Procedures have been designed to ensure that all sectors of Australian society are reasonably able to influence the development of Standards and Codes. Representative participation in the work of developing a Code or Standard is encouraged from relevant and interested parties. All draft Codes and Standards are also released for public comment prior to publication to ensure outputs reflect the needs and concerns of all stakeholders.

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