

**COMMUNICATIONS
ALLIANCE LTD**



AUSTRALIAN STANDARD

AS/CA S043.2:2016

**Requirements for Customer Equipment for
connection to a metallic local loop interface of a
Telecommunications Network —
Part 2: Broadband**

Draft Australian Standard — Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network — Part 2: Broadband

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FOREWORD

General

This Standard was prepared by Communications Alliance and most recently revised by the **VDSL2 and Vectoring** Working Committee (WC58). 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 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 the ACMA.

Communications Alliance was formed in 2006 and continues the functions previously fulfilled by ACIF.

This Standard is a revision of AS/ACIF S043.2:2015 **Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network — Part 2: Broadband**.

This Standard is the result of a consensus among representatives on the Communications Alliance 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.

It should be noted that some Customer Equipment (CE) may also need to comply with requirements in other Standards or other Parts of this Standard.

AS/CA S043 consists of the following parts under the general title **Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network**:

- Part 1: **General**
- Part 2: **Broadband**
- Part 3: **DC, low frequency AC and voiceband**

This Standard should be read in conjunction with AS/CA S043.1 [3].

Applicable electrical safety Standards and EMC Standards may apply under Commonwealth or State/Territory laws, or both.

Intellectual property rights

Equipment, which is manufactured to comply with this Standard, may require the use of technology, which is protected by patent rights in Australia. Questions about the availability of such technology, under licence or otherwise, should be

directed to the patent holder or Australian licensee (if known) or through enquiry at IP Australia which incorporates the Patent, Designs and Trade Marks Offices. Further information can be found at www.ipaustralia.gov.au.

Standards revision

Australian Standards (AS/ACIF and AS/CA Standards) developed by Communications Alliance are updated, according to the needs of the industry, by amendments or revision. Users of these Standards should make sure that they possess the latest amendments or editions. Representations concerning the need for a change to this AS/CA Standard should be addressed to:

The Project Manager
Customer Equipment and Cable Reference Panel
Communications Alliance
PO Box 444
Milsons Point NSW 1565

Regulatory notice

Upon publication, this technical standard has effect under the *Telecommunications (Customer Equipment and Customer Cabling) Notice 2015* made by the Australian Communications and Media Authority (ACMA).

For the purposes of the ACMA Standard, defined as *Telecommunications Technical Standard (Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network – AS/CA S043) 2015*, the transition period is 6 months.

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

The ACMA requires Australian manufacturers and importers, or their Australian agents, of specified items of Customer Equipment and Customer Cabling to establish compliance with Standards such as this. Items are required to be labelled in accordance with 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 the ACMA below at:

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PO Box 13112
Law Courts PO
Melbourne VIC 8010
Australia

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TTY: +61 3 9963 6948
Email: info@acma.gov.au

Introduction

This introduction for the AS/CA S043.2 ***Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network Part 2: Broadband*** Standard is not an authoritative section of this draft Standard and is only provided as guidance for the user of the draft Standard to outline its objectives, the factors that have been taken into account in its development and to list the principal differences between the new and the previous edition.

The reader is directed to the clauses of this Standard for the specific requirements and to the 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 ACMA website at www.acma.gov.au.

The objective of this Standard is to provide the requirements and test methods for customer equipment that is designed or intended for connection to a Telecommunications Network via a metallic local loop interface and has a broadband capability, in order to meet the regulatory arrangements for such equipment in Australia.

The objective of this revision is to update AS/CA S043.2 to add requirements for some CE to support Electrical Length Estimation.

The principal differences between this draft edition of AS/CA S043.2 and the previous edition are the addition of a requirement for VDSL2 modems to support:

- (i) Upstream Power Backoff in Equipment Class 10v, consistent with the existing requirement for Equipment Classes 10h and 10j to 10n; and
- (ii) Upstream Power Backoff Length Estimation Method (based on ITU-T Rec. G.993.2 [10]) in Equipment Classes 10h, 10j to 10n, and 10v.

Compliance with these added requirements should be by attestation by the supplier of the equipment.

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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

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

1.5.2 If a document refers to another document, the other document is a sub-referenced document.

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

1.5.4 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.

1.5.5 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].

1.7 Parts of Standards

CE scoped by this Standard is to comply with the applicable technology-specific Part(s) of this Standard.

2 SCOPE

- 2.1 This Standard applies to Customer Equipment (CE) that:
- (a) is designed or intended for connection to a Telecommunications Network via a metallic local loop interface; and
 - (b) has a broadband capability.
- 2.2 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.

3 REFERENCES

	Publication	Title
Australian Standards		
[1]	AS ISO 1000—1998	The International System of Units (SI) and its application
AS/CA Standards		
[2]	AS/CA S041:2014	Requirements for DSL Customer Equipment for connection to the Public Switched Telephone Network
	AS/CA S043	Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network
[3]	AS/CA S043.1:2015	Part 1: General
[4]	AS/CA S043.3:2015	Part 3: DC, low frequency AC and voiceband
International Telecommunications Union		
[5]	G.991.1 (10/1998)	High bit rate Digital Subscriber Line (HDSL) transceivers http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=7073
[6]	G.991.2 (12/2003)	Single-pair high-speed digital subscriber line (SHDSL) transceivers http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=4718
[7]	G.992.1 (07/1999)	Asymmetrical Digital Subscriber Line (ADSL) Transceivers http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=4719
[8]	G.992.3 (04/2009)	Asymmetric Digital Subscriber Line Transceivers-2 (ADSL2) http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=9652
[9]	G.992.5 (01/2009)	Asymmetrical Digital Subscriber Line (ADSL) Transceivers - Extended bandwidth ADSL2 (ADSL2+) http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=9653

[10]	G.993.2 (12/2011)	Very high speed Digital Subscriber Line transceivers 2 (VDSL2) http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=11415
[11]	G.993.5 (04/2010)	Self-FEXT cancellation (vectoring) for use with VDSL2 transceivers http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=10414
[12]	O.151 (10/1992)	Error performance measuring equipment operating at the primary rate and above http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=1679
[13]	O.152 (10/1992)	Error performance measuring equipment for bit rates of 64 kbit/s and N x 64 kbit/s http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=1681
[14]	O.153 (10/1992)	Basic parameters for the measurement of error performance at bit rates below the primary rate http://www.itu.int/ITU-T/recommendations/rec.aspx?rec=1683
European Telecommunications Standards Institute		
[15]	TS 102 080 V1.3.1 (1998-11)	Transmission and Multiplexing (TM); Integrated Services Digital Network (ISDN) basic rate access; Digital transmission system on metallic local lines

4 ABBREVIATIONS AND DEFINITIONS

For the purposes of this Standard, the following abbreviations and definitions and those of Part 1 apply:

4.1 Abbreviations

AC	Alternating Current
ACA	Australian Communications Authority
ACMA	Australian Communications and Media Authority
ACIF	Australian Communications Industry Forum
ADSL	Asymmetric Digital Subscriber Line
ADSL2	Asymmetric Digital Subscriber Line version 2
ADSL2+	Extended bandwidth ADSL2
AELE	Alternative Electrical Length Estimation
AS	Australian Standard
BR	Basic Rate
CE	Customer Equipment
CO-MIB	Central Office Management Information Base
DC	Direct Current
DSL	Digital Subscriber Line
EC	Echo Cancelling
ELE	Electrical Length Estimation
ELE-M0	Electrical Length Estimation Mode 0
ELE-M1	Electrical Length Estimation Mode 1
ESHDSL	Single-Pair High-Speed Digital Subscriber Line Extended rate
ETSI	European Telecommunications Standards Institute
FD	Frequency Division
FFS	For Further Study
HDSL	High bit rate Digital Subscriber Line
ISDN	Integrated Services Digital Network
PR	Payload Rate
PSD	Power Spectral Density
PSTN	Public Switched Telephone Network
RBW	Resolution BandWidth
ReADSL2	Reach extended ADSL2
SDSL	Symmetric Digital Subscriber Line
SHDSL	Single-Pair High Speed Digital Subscriber Line
TCPAM	Trellis Coded Pulse Amplitude Modulation
VDSL2	Very high speed Digital Subscriber Line

4.2 Definitions

4.2.1 Broadband capability

A means of transmission of signals that uses frequencies above 20 kHz.

4.2.2 Equipment Class

A classification of CE used in this Standard to identify applicable requirements for CE designed or intended for connection to a metallic local loop interface.

Note: Table 1 lists the Equipment Classes and test criteria used in this Standard. Each Equipment Class has a related Appendix which lists the requirements for the class. The Equipment Class and test criteria do not relate to the class types of any other regime or country.

4.2.3 Power Spectral Density (PSD)

The power level and frequency content of a transmitted signal.

4.2.4 Public Switched Telephone (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.

4.2.5 Referenced Documents

Those documents set out in the column titled 'Group B' in the tables in the Appendices.

4.2.6 Vectoring

The coordinated transmission and/or coordinated reception of signals of multiple DSL transceivers using techniques to mitigate the adverse effects of crosstalk to improve performance.

5 REQUIREMENTS

5.1 General

5.1.1 Applicable requirements

CE **shall** comply with the requirements of an Equipment Class as specified in Clauses 5.2 to 5.6. The Appendix detailing the test criteria and Referenced Documents for each Equipment Class is specified in Table 1.

5.1.2 Multiple Equipment Classes

Where more than one Equipment Class applies to the CE, the CE **shall** comply with each Equipment Class requirement.

5.1.3 Group A and Group B requirements

CE **shall** comply with all the requirements of either:

- (a) Group A which specifies the parameter values and testing requirements; or
- (b) Group B which specifies either the test criteria or the requirements in the Referenced Documents

for the applicable Equipment Class.

Where the CE does not support all line code options in an Equipment Class (e.g. where there are multiple types of coding), the CE **shall** comply with each requirement that has been implemented of the applicable Equipment Class.

Note 1: It is expected that most equipment which complies with international standards will comply under the relevant Group B requirements in this Standard. Group A requirements, which correspond to tighter (i.e. lower) PSD masks than the Group B requirements, are available as an alternative path for compliance of systems which cannot comply with the line code aspect of the Group B requirements.

Note 2: For Equipment Class 10v, there is no option to comply with Group A requirements, because the line code and vectoring operation need to be consistent across all Class 10v services in the cables.

5.1.4 Non-compliant line code

CE that does not comply with a line code specified in Group B for the applicable Equipment Class, except Equipment Class 10v, **shall** use the Group A requirements.

5.2 Total average power

The total average power transmitted by CE **shall not** exceed the total average power limit over the specified frequency range, measured when the CE is transmitting maximum power, excluding any transient startup or initialisation phases.

5.3 Total average power in Voiceband

For each equipment class, the total average transmitted power in the voiceband **shall** be less than or equal to -10dBm measured in 0 to 4 kHz, with 600 Ω measuring impedance.

Note: This requirement is intended to limit pair to pair crosstalk into voice services to acceptable levels. For systems such as ADSL that coexist with voice services on the same line, tighter requirements exist. Refer to AS/CA S041 [2].

Compliance with Clause 5.2 should be demonstrated using the methodology specified in Clause 6.4.1.

5.4 Power Spectral Density (PSD)

The PSD transmitted by CE **shall not** exceed the PSD mask, at any frequency, measured when the CE is transmitting maximum power, excluding any transient startup or initialisation phases.

Compliance with Clause 5.3 should be demonstrated using the methodology specified in Clause 6.4.2.

5.5 Line code

Where Group B requirements are used, the CE **shall** comply with the requirements for line code.

Compliance with Clause 5.4 should be by attestation by the supplier of the equipment.

5.6 Longitudinal balance

The longitudinal balance of the CE **shall** be greater than or equal to the longitudinal balance limit over the specified frequency range, when the longitudinal termination is 1/4 of the termination impedance for the Equipment Class.

Longitudinal balance is defined as:

$$\text{Longitudinal balance(dB)} = 20 \times \log_{10} \left(\frac{V_l}{V_m} \right)$$

where: V_l is the longitudinal or common mode voltage

V_m is the metallic or differential voltage

Compliance with Clause 5.5 should be demonstrated using the methodology specified in Clause 6.4.3.

5.7 Longitudinal output voltage

The longitudinal output voltage **shall not** exceed the longitudinal output voltage limit over the specified frequency range, when measured across a load (consisting of 100 Ω in series with 0.15 μF)

when CE is transmitting maximum power. Any transient startup or initialisation phases should be excluded.

Compliance with Clause 5.6 should be demonstrated using the methodology specified in Clause 6.4.4.

5.8 Customer Equipment for connection to the PSTN

AS/CA S041 [2] contains separate requirements for CE that is designed or intended for connection to a DSL service that shares the metallic local loop with an analogue PSTN Ring-In / Loop-Out two-wire service.

Table 1
Equipment classes and test criteria

Equipment Class (Note 1)	Appendix specifying the test criteria and Referenced Documents	Typical technology (informative) (Notes 2, 3, 5, 6)
1a	Not used in this Standard	–
1b	Not used in this Standard	–
2a	Not used in this Standard	–
3a	Not used in this Standard See also AS/CA S043.3 [4] (Note 4)	Low Band (DC to 3.4 kHz)
3b	Not used in this Standard See also AS/CA S043.3 [4] (Note 4)	Low Band (DC to 20 kHz)
4a	Appendix A	ISDN BR 2B1Q
5a	Appendix B	–
5b	Appendix C	–
6a, 6d, 6e, 6f	Appendix D	ADSL FD, ADSL EC or ADSL2 EC
6b	Not used in this Standard	ADSL Lite
6c	Appendix E	ADSL over ISDN or ADSL2 over ISDN
6g	Appendix F	Reach Extended ADSL2 non-overlapped spectrum with mask 1
6h	Appendix G	ADSL2 non-overlapped spectrum or ADSL2+ non-overlapped spectrum
6i	Appendix H	All Digital Mode ADSL2 non-overlapped spectrum or All Digital Mode ADSL2+ non overlapped spectrum
6j	Appendix I	ADSL2 or ADSL2+ with extended upstream bandwidth (Annex M) Mask EU-40
6k	Appendix I	ADSL2 or ADSL2+ with extended upstream bandwidth (Annex M) Mask EU-52
6l	Appendix I	ADSL2 or ADSL2+ with extended upstream bandwidth (Annex M) Mask EU-56

Equipment Class (Note 1)	Appendix specifying the test criteria and Referenced Documents	Typical technology (informative) (Notes 2, 3, 5, 6)
6m	Appendix I	ADSL2 or ADSL2+ with extended upstream bandwidth (Annex M) Mask EU-60
6n	Appendix I	ADSL2 or ADSL2+ with extended upstream bandwidth (Annex M) Mask EU-64
7a to 7j	Not used in this Standard	SDSL
8a	Not used in this Standard	HDSL 2B1Q (768 kbit/s)
8b	Appendix J	HDSL 2B1Q (1168 kbit/s)
8c, 8d	Not used in this Standard	HDSL 2B1Q (2320 kbit/s)
9a	Appendix K	SHDSL (up to 576 kbit/s)
9b, 9c	Appendix K	SHDSL (up to 776 kbit/s)
9d	Appendix K	SHDSL (up to 1160 kbit/s)
9e	Appendix K	SHDSL (up to 1544 kbit/s)
9h	Appendix K	SHDSL (up to 1800 kbit/s)
9f	Appendix K	SHDSL (up to 2056 kbit/s)
9g	Appendix K	SHDSL (up to 2312 kbit/s)
9i	Appendix L	ESHD SL (up to 2624(C-16) or 3496(C-32) kbit/s)
9j	Appendix L	ESHD SL (up to 2880(C-16) or 3840(C-32) kbit/s)
9k	Appendix L	ESHD SL (up to 3072(C-16) or 4096(C-32) kbit/s)
9l	Appendix L	ESHD SL (up to 3264(C-16) or 4352(C-32) kbit/s)
9m	Appendix L	ESHD SL (up to 3456(C-16) or 4608(C-32) kbit/s)
9n	Appendix L	ESHD SL (up to 3648(C-16) or 4864(C-32) kbit/s)
9o	Appendix L	ESHD SL (up to 3840(C-16) or 5120(C-32) kbit/s)
9p	Appendix L	ESHD SL (up to 5376(C-32) kbit/s)
9q	Appendix L	ESHD SL (up to 5696(C-32) kbit/s)
9r	Appendix L	ESHD SL (up to 6096(C-32) or 7624(C-64) or 9152(C-128) kbit/s)
9s	Appendix L	ESHD SL (up to 8104(C 32) or 10136(C-64) or 12160(C-128) kbit/s)

Equipment Class (Note 1)	Appendix specifying the test criteria and Referenced Documents	Typical technology (informative) (Notes 2, 3, 5, 6)
9t	Appendix L	ESHDSL (up to 10192(C-32) or 12744(C 64) or 15296(C-128) kbit/s)
10a to 10g	Not used in this Standard	-
10h	Appendix M	VDSL2 non-overlapped spectrum
10i	Not used in this Standard	-
10j	Appendix N	VDSL2 with extended upstream ADSL2 bandwidth (Annex M) Mask EU-40 below 1104 kHz
10k	Appendix N	VDSL2 with extended upstream ADSL2 bandwidth (Annex M) Mask EU-52 below 1104 kHz
10l	Appendix N	VDSL2 with extended upstream ADSL2 bandwidth (Annex M) Mask EU-56 below 1104 kHz
10m	Appendix N	VDSL2 with extended upstream ADSL2 bandwidth (Annex M) Mask EU-60 below 1104 kHz
10n	Appendix N	VDSL2 with extended upstream ADSL2 bandwidth (Annex M) Mask EU-64 below 1104 kHz
10v	Appendix O	Vectored VDSL2 for FTTN deployment

Note 1: Some CE may have more than one Equipment Class.

Note 2: The individual technologies listed in this column are examples only.

Note 3: The bit rate upper limits under the column titled 'Typical technology' represent line rates (total payload plus overhead bits carried), except for SHDSL and ESHDSL where they represent payload rates only, without the 8 kbps line overhead. For Classes 9a to 9h the SHDSL system maximum payload rates shown are based on 3 bits per symbol (C-16 line-code) as per the default in G.991.2 [6]. For these Classes systems that operate at the same symbol rates using the alternative option of 4 bits per symbol (C-32) have maximum payload rates corresponding to the 32-TCPAM column of Table K2. Classes 9i to 9o are for ESHDSL systems for which G.991.2 [6] specifies two line-code options (C-16 or C-32). Maximum payload rates are shown for both options for these Classes. Classes 9p and 9q show maximum payload rates for the C-32 line-code only, because G.991.2 [6] specifies no C-16 alternatives for these cases.

Note 4: Subject to other Standards or Parts of this Standard.

Note 5: SHDSL and ESHDSL system Equipment Class is determined by the Symbol Rate – which may correspond to different system bit-rates depending on whether 16-TCPAM (3 bits per symbol) or 32-TCPAM (4 bits/symbol) coding is being used, as defined in G.991.2 Annex K [6]. Example payload bitrates are denoted with a suffix (C-16) for 16-TCPAM (3 bits/symbol) values, and (C-32) for 32-TCPAM (4 bits/symbol) values. Refer to Appendix K for details on SHDSL and Appendix L for details on ESHDSL.

Note 6: The Equipment Classes (with corresponding ‘Typical technology’) listed below were in earlier version(s) of this Standard but have been removed as options for deployment of a new service in the future because:

- (i) doing so will improve the overall performance of services on an access network by reducing the risk of interference between services; and
- (ii) the number of existing services for the Equipment Classes listed below are zero in most examples or few enough to be managed on a case-by-case basis:
 - (a) 1a and 1b (E1 HDB3) – redeployment of existing E1 services and pair rearrangement might still occur.
 - (b) 2a (listed in the original planning of Equipment Classes but never used in publication).
 - (c) 6b (ADSL Lite).
 - (d) 7a to 7j (SDSL at various data rates).
 - (e) 8a, 8c and 8d (HDSL at 784 kbps and 2320 kbps).

6 TESTING

6.1 General

6.1.1 Compliance verification

Compliance with all requirements applicable to the CE as specified in Clause 5 is to be verified. This verification may be through direct measurement, modelling and analysis, or inspection.

6.1.2 Compliance demonstration methods

Methods for demonstrating compliance of CE with requirement Clauses specified in this Standard are described in Clauses 6.2 to 6.4. Other methods 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 Conditions

Unless this Standard provides otherwise, testing for compliance with this Standard should be conducted at the nominal supply voltage of the equipment 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 Record keeping

The prevailing conditions should be recorded for each test including measurement uncertainty. The environmental conditions at the time of test should be recorded.

6.3 Test configurations

6.3.1 General

Test configurations used should be outlined for each individual test. Test circuits other than those indicated in this Standard may be used but details of the circuits should accompany test reports.

Note: CE under test should be placed in and maintain a normal operational state.