



AS/ACIF S003:2005

AUSTRALIAN COMMUNICATIONS INDUSTRY FORUM

Australian Standard

**Customer Access Equipment for
connection to a Telecommunications
Network**

Adopted for
regulatory purposes



Australian Standard — *Customer Access Equipment for connection to a Telecommunications Network*

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FOREWORD

General

This Standard was originally prepared by the ACIF Working Committee CECRP/WC5 on *General Standards for Customer Equipment*. The Standard was subsequently revised by the ACIF Working Committee CECRP/WC17 on *Telephony Speech Performance*. It is one of a series of Telecommunication Standards developed under the Memorandum of Understanding between the Australian Communications Authority and the Australian Communications Industry Forum.

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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Details on current compliance arrangements can be obtained from the ACA website at <http://www.aca.gov.au> or by contacting the ACA below at:

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This Working Committee was chaired by Nick McKillop. Mike Johns and James Duck of ACIF provided project management support.

1 INTERPRETATIVE GUIDELINES

1.1 Categories of requirements

This Standard contains mandatory requirements as well as provisions that are recommendations only. Mandatory requirements are designated by the words 'shall' or 'shall not'.

Clauses referring to STS CE, identify requirements that are mandatory only for Customer Equipment (CE) used in conjunction with a Standard Telephone Service (STS) as defined by the *Telecommunications (Consumer Protection and Service Standards) Act 1999*.

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 under 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 [3].

2 SCOPE

- 2.1 This Standard specifies the technical requirements for Customer Access Equipment (CAE) that:
- (a) is designed with multiple ports (local or network) that provides or is intended to provide access (gateway functions) to a Telecommunications Network; and
 - (b) is capable of switching, storage, processing, conversion, integration, line isolation/coupling or multiplexing of analogue or digital voice or voice equivalent communication.
- 2.2 CE is not excluded from the Scope of this Standard by reason only that the CE is capable of performing functions additional to those described in this Standard.

3 REFERENCES

	Publication	Title
	ACA Technical Standard	
[1]	ACA TS 014:1997	General Requirements for Customer Equipment Connected to ISDN Primary Rate Access
	Australian Standards	
[3]	AS ISO 1000-1998	The International System of Units (SI) and its Application
[4]	AS/NZS 60950:2000	Safety of information technology equipment
	ACIF/Australian Standards	
[5]	AS/ACIF S002:2001	Analogue interworking and non-interference requirements for Customer Equipment for connection to the Public Switched Telephone Network
[6]	AS/ACIF S004:2001	Voice frequency performance requirements for Customer Equipment.
[7]	AS/ACIF S006:2001	Requirements for Customer Equipment, operating in the voiceband, for connection to the non-switched Telecommunications Network
[2]	AS/ACIF S016:2001	Requirements for Customer Equipment for connection to hierarchical digital interfaces
[8]	AS/ACIF S031:2001	Requirements for ISDN Basic Access Interface
[9]	AS/ACIF S038:2001	Requirements for ISDN Primary Rate Access Interface
[10]	AS/ACIF S043	Requirements for Customer Equipment for connection to a metallic local loop interface of a Telecommunications Network
	AS/ACIF S043.1:2003	General
	AS/ACIF S043.2:2003	Broadband
	AS/ACIF S043.3:2001	DC, low frequency AC and voiceband
	ACIF Publications	
[11]	ACIF G534:1999	Assessment of emergency service access and network interoperability items for the Standard Telephone Service for Standards
	ITU-T Recommendations	
[12]	G.101:1996	The transmission plan
[13]	G.223: 1988	Assumptions for the calculations of noise on hypothetical reference circuits for telephony
[14]	G.703: 1991	Physical/electrical characteristics of hierarchical digital interfaces

[15]	G.704: 1988	Synchronous frame structures used at primary and secondary hierarchical levels
[16]	G.711: 1988	Pulse code modulation (PCM) of voice frequencies
[17]	G.732: 1988	Characteristics of primary PCM Multiplex equipment operating at 2048 kbit/s
[18]	O.9: 1988	Measuring arrangements to access the degree of unbalance about earth
[19]	O.41: 1988	Psophometer for use on telephone type circuits
[20]	O.71: 1988	Impulsive noise measuring equipment for telephone-type circuits
[21]	O.81:1972	Group-delay measuring equipment for telephone-type circuits
[22]	Q.551: 1988	Transmission characteristics of digital exchanges

4 ACRONYMS, ABBREVIATIONS AND DEFINITIONS

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

4.1 Acronyms and abbreviations

AC	Alternating Current
ACA	Australian Communications Authority
ACD	Automatic Call Distribution
ACIF	Australian Communications Industry Forum
AGC	Automatic Gain Control
AS	Australian Standard
CAE	Customer Access Equipment
CAS	Channel Associated Signalling
CE	Customer Equipment
CSH	Call Still Held
CSS	Customer Switching System(s)
DC	Direct Current
DISA	Direct Inwards System Access
DTMF	Dual Tone Multifrequency
FE	Functional Earth
IAD	Integrated Access Device
ISDN	Integrated Services Digital Network
ISO	International Standardization Organization
LCL	Longitudinal Conversion Loss
LCTL	Longitudinal Conversion Transfer Loss
MFC	Multifrequency Code
NU	Number Unobtainable
NZS	New Zealand Standard
PCM	Pulse Code Modulation
PE	Protective Earth
PIN	Personal Identification Number
PSTN	Public Switched Telephone Network
REN	Ringer Equivalence Number
RVA	Recorded Voice Announcement
SA	Service Alarm
SIT	System Integral Telephone
STS	Standard Telephone Service
STS CE	Standard Telephone Service Customer Equipment
TAP	Test Access Point

TBRL	Terminal Balance Return Loss
TCL	Transverse Conversion Loss
TCTL	Transverse Conversion Transfer Loss
TPF	Test Point Frame
TRC	Telecommunications Reference Conductor
TTY	Teletype or Telephone Typewriter
VF	Voice Frequency

4.2 Definitions

4.2.1 Ancillary voice equipment

See Customer Access Equipment.

4.2.2 Answer signal

A signal which is sent in the backward direction to indicate that the called party has answered.

Note: This signal has a supervisory function.

4.2.3 Automatic Guard

A facility within the CE that prevents the seizure of faulty or incompletely released PSTN lines by the CE.

4.2.4 Blocking Signal (Back Busy)

A signal which is sent in the backward direction and causes a busy condition to be applied at the far end of the link.

4.2.5 Building Cabling Environment

Customer cabling contained within a single building.

4.2.6 Carriage Service Provider

Refer to the *Telecommunications Act 1997*.

4.2.7 Carrier

Refer to the *Telecommunications Act 1997*.

4.2.8 Channel Associated Signalling (CAS)

A signalling method in which the signals necessary for the traffic carried by a single channel are transmitted in the channel itself or in a signalling channel permanently dedicated to it.

4.2.9 Clear Back signal

A signal which is sent in the backward direction to indicate that the called party has cleared.

Note: This signal initiates circuit clearing and indicates that the incoming end has released.

4.2.10 Clear Forward signal

A signal which is sent in the forward direction to initiate the release of the connection.

4.2.11 Conference bridge

Equipment that provides a connection for calls involving more than two external lines (Local Ports (off-premises) or Network Ports).

- 4.2.12 **Customer Equipment (CE)**
Refer to the *Telecommunications Act 1997*.
- 4.2.13 **Customer Access Equipment (CAE)**
CE with multiple ports (local or network) that provides access (gateway functions) to a Telecommunications Network and is capable of switching, storage, processing, conversion, integration, line isolation/coupling or multiplexing of analogue or digital voice or voice equivalent communication.
Note: Examples of CAE include, but are not limited to, PABX or Key Systems, line isolators, ISDN terminal adapters, echo cancellers, interactive voice response systems, voice/packet gateway, IAD and voice messaging systems.
- 4.2.14 **Customer Switching System (CSS)**
See Customer Access Equipment
- 4.2.15 **Decadic signalling**
A system for transmitting address information by a succession of loop-disconnect, or earth referenced E & M, break pulses. The break pulses momentarily interrupt the established direct current in the circuit. The number of pulses transmitted for a digit corresponds to the numerical value of the digit, with 10 pulses being transmitted for the digit 0.
Note: Where 2 Mbit/s Channel Associated Signalling is used, Decadic Signalling is transferred by bit pattern toggling of the 'a' and 'b' bits in Timeslot 16 for the particular channel in use. See Appendix B for further information.
- 4.2.16 **Dialling**
In this Standard, the terms 'dials' and 'dialling' refer to the transmission of address information by a telephone-type rotary dial or push-button key-pad, and the transmission of the signals to line from such devices or from a storage device.
- 4.2.17 **Direct Inwards System Access (DISA)**
A method of providing direct caller access to CAE or private network equipment, after the Telecommunications Network call set up process has been completed. End to end address signalling is typically by use of in-band DTMF signals.
- 4.2.18 **Dual Tone Multifrequency Signalling (DTMF)**
A system for transmitting address and other information by superimposing a succession of voice frequency (VF) signals on a line.
Note: Each signal comprises two simultaneously transmitted tones of different frequency. Up to 16 different signals may be transmitted by standard DTMF signalling.
- 4.2.19 **E & M Signalling**
A signalling scheme by which DC line signals are transferred in each direction by application of an earth potential to an M lead, and reception of an Earth potential on the E lead. The E & M leads are separate from the voice path with which they are associated
- 4.2.20 **Exchange line**
See Network Port
- 4.2.21 **Extension line**
See Local Port (On Premises).

- 4.2.22 **External extension**
See Local Port (Off Premises).
- 4.2.23 **Functional Earth (FE)**
The earthing point in equipment or in a system which is necessary for a purpose other than safety.
A TRC is one form of a Functional Earth.
- 4.2.24 **Hold condition**
In relation to CE using loop-disconnect signalling, CE is considered to be in the Hold state at any time from application of loop until removal of loop provided that no other DC signalling activity is occurring.
- 4.2.25 **Indial Network Port**
A Network Port with the ability to accept address signals from the PSTN/ISDN.
- 4.2.26 **Integrated Access Devices (IAD)**
A device that aggregates multiple channels, (voice or voice equivalent), for transport to a telecommunications network via one or more transmission paths.
IADs may use DSL, ATM, optical or other means of connection.
- 4.2.27 **Local Port (On Premises)**
A port on a CAE that is capable of supporting terminating CE over a connecting link within a building-cabling environment.
A local port may be directly provided by a CAE or indirectly by system integral equipment.
- 4.2.28 **Local Port (Off Premises)**
A port on a CAE that is capable of supporting terminating CE over a connecting link outside a building cabling environment; a carrier or carriage service provider may provide part of the link or it may be wholly provided by the customer.
A local port may be directly provided by a CAE or indirectly by system integral equipment.
- 4.2.29 **Loop-in Network Port**
A unidirectional call set-up port (set-up from the PSTN to a CAE) that is seized by application of a DC loop at the PSTN exchange.
- 4.2.30 **Network Port**
A port on a CAE that is capable of connection to a Telecommunications Network Service.
- 4.2.31 **Non-switched Telecommunications Network**
That part of a Telecommunications Network used to provide dedicated circuit(s) by the carrier or carriage service provider between two or more locations.
- 4.2.32 **Point of zero relative level**
A particular place within a transmission path chosen for reference and calculation purposes (also called the '0 dBr point'). ITU-T Recommendation G.223 [13] defines a 0 dBr point as a point where the long term average speech level per subscriber in an individual VF channel is -15 dBm.

- 4.2.33 Port**
An interface to equipment for the purpose of supplying an output signal and/or accepting an input signal.
- 4.2.34 Protective Earth (PE)**
A connection to the Protective Earthing Conductor. Refer to AS/NZS 60950.
- 4.2.35 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.
- 4.2.36 Recall Backward signal**
A signal which is sent in the backward direction after answer.
Note: This signal can only be used with the agreement of the parties providing the equipment at both ends of the circuit.
- 4.2.37 Recall Forward signal**
A signal which is sent in the forward direction after the completion of information signalling.
Note: This signal can only be used with the agreement of the parties providing the equipment at both ends of the circuit.
- 4.2.38 Release Guard signal**
A signal which is sent in the backward direction in response to the clear forward signal, and indicates that release of the equipment is in progress at the far end.
- 4.2.39 Reversal on Seizure**
Reversal on Seizure is a facility available to some PSTN Network Ports that indicates the PSTN line state. It consists of a polarity reversal applied:
(a) in response to an applied loop for outgoing calls
(b) immediately prior to application of Ring for an incoming call.
- 4.2.40 Reversal-On-Answer (ROA)**
Reversal-On-Answer is a facility available to some PSTN Network Ports that indicates the B-Party state. It consists of a polarity reversal applied by the PSTN exchange to the A party line when the B-Party answers.
- 4.2.41 Ring-in/Loop-out Network Port**
A bothway call set-up port. Incoming signalling to CE is by application of a ring signal at the PSTN exchange. Outgoing signalling from CE is by application of a DC loop at the CE.
- 4.2.42 Ringer Equivalence Number (REN)**
An approximate value of loading presented to the line during ringing state, and is based on the capacitance applied to the line when the CE is Off-line.
- 4.2.43 Seize Acknowledge signal (Proceed to Send)**
A signal which is sent in the backward direction following the receipt of a seize signal and indicates that the equipment is ready to receive information signals.
Note: The signal can only be used with the agreement of the parties providing the equipment at both ends of the circuit.

- 4.2.44 Seize signal**
 A signal which is sent in the forward direction at the beginning of a call and prepares the equipment at the far end of the circuit to accept subsequent information and supervisory signals.
- 4.2.45 Standard telephone instrument**
 CE, or part thereof, for analogue two-wire voice communication to which the requirements of AS/ACIF S002 [5] and AS/ACIF S004 [6] apply where both initiation and termination of the call is under user control.
 Note: Address signalling is provided by either loop-disconnect decadic signalling or by dual-tone multifrequency (DTMF) signalling, under direct user control or by user initiation of stored numbers.
- 4.2.46 Standard Telephone Service (STS)**
 Refer to the *Telecommunications Act 1997*.
 Note: ACIF G534 [11] provides guidance on the application of the standard telephone service definition.
- 4.2.47 Standard Telephone Service Customer Equipment (STS CE)**
 Customer Equipment designed or intended for use in conjunction with a Standard Telephone Service.
- 4.2.48 Switchblock/transmission path**
 The transmission path through the CE, inclusive of ports, local or network.
 Note: On connections to two-wire lines the switchblock/transmission path boundary is the TPF, while on connections to four-wire lines the switchblock/transmission path boundary is the TAP.
- 4.2.49 System integral equipment**
 Analogue or digital equipment which is intended to operate in association with a CAE and functions as part of the CAE via a local port.
 Note: This definition includes both wired and wireless interfaces using proprietary or standards based signalling.
- 4.2.50 Telecommunications Network**
 Refer to Section 374(1) of the *Telecommunications Act 1997*.
- 4.2.51 Telecommunications Reference Conductor (TRC)**
 A conductor that can be used for signalling and other functional purposes including, but not limited to, equipment reliability.
 Note: Integral surge suppression devices within Customer Equipment may be connected to the TRC.
- 4.2.52 Telephone Typewriter (TTY)**
 Customer Equipment primarily used by the hearing impaired to communicate using text. Also known as a TTY, or as a text telephone.
- 4.2.53 Test Access Point (TAP)**
 Break access test points in the transmission path through the CAE equipment.
- 4.2.54 Test Point Frame (TPF)**
 The distribution frame to which the CAE cables are connected.
- 4.2.55 Tie Line Port**
 A Network Port for the interconnection of CAE.

4.2.56 Voice Frequency (VF)

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

4.2.57 Voice multiplexing equipment

Multiplexing equipment used on the customer side of the boundary of a Telecommunications Network that is able to multiplex voice channels onto a higher rate transmission channel.

5 REQUIREMENTS

5.1 General

5.1.1 Power failure

In the event of power failure, such as caused by mains failure or discharge of back-up batteries, then the following apply:

- (a) For Ring-in/Loop-out PSTN Network Ports—
 - (i) the CE **shall not** seize the line to cause blocking; and
 - (ii) if a line is transferred to a standard telephone instrument, on restoration of power, the CE should not release any connection established during the power fail period.
- (b) For loop-in PSTN Network Ports the battery feed **shall** be removed so that incoming traffic is not offered to the CE.
- (c) For E & M signalling PSTN Network Ports the CE **shall not** seize the line to cause blocking.

Note: The PSTN will not be able to offer traffic to the CE as the M lead Wink will not be returned by the CE.

Compliance should be checked by inspection or operation as appropriate.

5.1.2 Network Port calls

For STS CE, an incoming call from the telecommunication network (including those switched via a private network) **shall** only be lost if—

- (a) the call is unanswered by the called party or the operator and then abandoned by the calling party;
- (b) the call is forcibly released by the operation of a key at the operator's position; or
- (c) the call is force released by the PSTN or ISDN.

5.1.3 Functional Earth connection and Protective Earth connection

5.1.3.1 If Customer Equipment has;

- (i) a DC earth dependent signalling component; or
- (ii) a requirement for a low noise earth

then a FE should take the form of;

- (i) a TRC;
- (ii) an ELV DC power source that complies with AS/NZS 3015; or
- (iii) a DC positive return circuit.

5.1.3.2 The following requirements apply for the connection of CE to the FE:

- (a) Where CE has 50 Hz longitudinal metering capability, the Cailho earth return path of the signal receiver **shall** be connected to the FE.

Note: 50 Hz longitudinal metering is described in AS/ACIF S002 [5].

- (b) Where CE has Loop-in PSTN ports, the positive pole of the power supply providing the battery feed potential for loop-in PSTN lines **shall** be connected to the FE.

Note: Loop-in PSTN line is described in AS/ACIF S002 [5].

- (c) Where CE has E &M signalling capability, the positive pole of the power supply providing the signalling source **shall** be connected to the FE.

Note: E & M signalling is described in Clause 5.6 and Appendix A.

- 5.1.3.3 For Local Port (Off Premises) as described in Clause 5.3.4, the CE should have the FE connected to the positive pole of the power supply providing the battery feed potential.

Note: This is to minimise noise and facilitate carrier or carriage service provider operations and maintenance activities.

- 5.1.3.4 Where a hard-wired PE is connected to the CE, the optional linking of PE and FE terminals within the CE is allowed. The following requirements apply:

- (a) Where the linking of PE and FE terminals is factory fitted or intended to be performed by installation personnel, the installation manual/instructions or other supporting documentation **shall** indicate—

- (i) the methods by which installation personnel are to install and/or remove the link;
- (ii) the methods by which installation personnel are to connect the PE and/or FE to the CE;
- (iii) that a FE conductor cannot be connected if the link is installed between PE and FE terminals within the CE; and
- (iv) that the link between PE and FE terminals must not be installed within the CE if a FE conductor is connected.

- (b) Where an intrinsic bond exists between PE and FE within the CE, the installation manual/instructions or other supporting documentation **shall** indicate—

- (i) the methods by which installation personnel are to connect the PE to the CE; and
- (ii) that a FE conductor must not be connected to the CE.

Compliance to Clause 5.1.3.4 should be checked by inspection of the relevant installation documentation.

- 5.1.3.5 The requirements of AS/NZS 60950 [4] are to apply to the isolation between the FE and PE terminals within a CE with any links as described in Clause 5.1.3.4 removed.

Compliance to Clause 5.1.3.5 should be checked in accordance with the requirements of AS/NZS 60950 [4].

- 5.1.4 **Indial requirements for CE**

The following requirements apply to CE with PSTN or ISDN indial capability, or both:

- (a) Indial PSTN port

For CE that has a PSTN indial capability, the requirements of AS/ACIF S002 [5] apply for both loop-in PSTN interface and 2048 kbit/s interface - CAS protocol.

- (b) Indial ISDN port

For CE that has an ISDN indial capability, the following Call Control requirements apply, as detailed in AS/ACIF S031 [8] or AS/ACIF S038 [9], as appropriate to the interface type used.

- (i) If the addressed user is classified as denied, unallotted or unequipped, the CE **shall** return Cause Code 1 (Unallocated /Unassigned Number) as part of a clearing message where the call is not diverted to an operator or a RVA.
- (ii) If the addressed user is diverted to an operator or RVA, any through connection of the speech path **shall** be preceded by a Connect message.
- (iii) If the addressed user is free, for a 3.1 kHz Audio Bearer Service or Speech call, the CE **shall**—
 - (a) return an Alerting message; or
 - (b) return a Progress message, if the Telecommunications Network supports the option to through switch the transmission path prior to call acceptance.

Note 1: An Alerting message will enable the Telecommunications Network to apply Ring Tone to the caller where applicable.

Note 2: A CE should not return a clearing message after this Alerting Message unless it is either preceded by a clearing message from the Telecommunications Network or as a consequence of error procedures detailed in ACA Technical Standard 014 [1] and AS/ACIF S031 [8] and AS/ACIF S038 [9].

- (iv) If the addressed user is busy, the CE **shall** return Cause Code 17 (User Busy) as part of a clearing message where the call is not diverted to an operator or RVA.

5.2 Ring-in / Loop-out Network Ports

5.2.1 General

5.2.1.1 Section 5.2 specifies the requirements for analogue two-wire Ring-in/Loop-out Network Ports. The requirements for four-wire network ports using E & M Signalling are specified in Appendix A. The requirements for two-wire Loop-in (Indial) Network Ports are specified in AS/ACIF S002 [5].

5.2.1.2 The CE is to comply with the analogue interworking and non-interference requirements of AS/ACIF S002 [5] unless stated otherwise in this Standard.

5.2.1.3 While the Network Port is in the idle state, an incoming call **shall not** be blocked.

5.2.2 Common requirements

The following requirements apply to each ring-in/loop-out Network Port of the CE.

5.2.2.1 Line polarity

The operation of the Network Port **shall** be independent of line conductor polarity except where polarity dependent line signals need to be detected. If the CE is polarity dependent because it needs to detect line signals (those associated with incoming and outgoing calls), then the CE should incorporate long term polarity independence while still being able to detect the short term signals present during calls.

Note 1: The polarity of a line may not be guaranteed by carriers or carriage service providers.

Note 2: Polarity dependent line signals include reversal-on-seizure and reversal-on-answer signals.

Compliance with Clause 5.2.2.1 should be checked by application of polarity reversals.

5.2.2.2 Release blocking

For STS CE, the Network Port **shall** be blocked to further outgoing calls for not less than 800 ms after the release of an outgoing call.

Compliance with Clause 5.2.2.2 should be checked by using the test set up as indicated in Clause 6.6.3.

5.2.2.3 Idle resistance

The following requirements are applicable to the CE in the off-line state:

- (a) The insulation resistance **shall not** be less than 1 M Ω between—
 - (i) the two line conductors;
 - (ii) each line conductor and FE terminal if equipped; and
 - (iii) each line conductor and PE terminal, if equipped

when tested with 250 V d.c. of either polarity, in series with a 600 k Ω resistor. Any internal protective devices remain connected during this test.
- (b) The idle insulation resistance of the Network Port **shall not** be less than 200 k Ω at 100 V d.c. when one or both of the following facilities are provided:
 - (i) Reversal-on-Seizure detection, as described in Clause 5.2.2.5.
 - (ii) Automatic Guard, as described in Clause 5.2.2.6.

5.2.2.4 Line leakage resistance

A CE Network Port **shall** continue to operate with a 50 k Ω resistance across the line or from either leg to ground.

Compliance with Clause 5.2.2.4 should be checked by using the test set up as indicated in Clause 6.6.5.

5.2.2.5 Reversal-on-Seizure

For CE, Reversal-on-Seizure may be used to indicate the release of a PSTN line at cessation of an incoming or an outgoing call. Its availability is subject to negotiation with the carrier or carriage service provider concerned. Incorporation of this facility is optional, but where it is incorporated the CE Network Port **shall**—

- (a) recognise a polarity reversal for a duration of 200 ms and greater as a seizure condition; and
- (b) recognise application of normal polarity for a duration of 200 ms and greater as an idle or line-lockout condition.

Note 1: Reversal-on-Seizure is achieved by the PSTN exchange applying a normal polarity to the line wires during the idle and line-lockout states. When an outgoing (loop) or incoming (ring) seizure occurs, the line polarity is reversed. Table 1 details the line wire conditions.

Note 2: For Reversal-on-Seizure, the only Proceed to Send indication for outgoing calls from the CE is receipt of PSTN dial tone. The application

by the PSTN exchange of a polarity reversed, after application by the CE of an outgoing Loop, does not constitute a Proceed to Send indication.

Compliance with Clause 5.2.2.5 should be checked by using the test set up indicated in Clause 6.6.2.

TABLE 1

Line Polarity for Reversal-on-Seizure

State	Normal Bothway line		Bothway line with Reversal-on-Seizure	
	L +	L –	L +	L –
Idle	+ve	–ve	+ve	–ve
Outgoing Loop	+ve	–ve	–ve	+ve
Incoming Ring	+ve	–ve	–ve	+ve
Line-Lockout	+ve	–ve	+ve	–ve

5.2.2.6 Automatic Guard

The following requirements apply to CE that provides Automatic Guard:

- (a) CE **shall** detect one or more of the following:
- (i) The absence of exchange service tones, as specified in Appendix B of AS/ACIF S002 [5] at outgoing seizure.
 - (ii) An open circuit on one or both legs.
 - (iii) An idle line voltage of less than 40 V d.c.

On detection of any of the above, the CE **shall** block the port to outgoing traffic. This blocking is to be effective only during the period of the fault condition, and should operate a suitable indicator or alarm.

Note: In the case of Clause 5.2.2.6(a)(iii), it should be possible to disable this feature, if implemented, on a per Network Port basis.

- (b) CE may be able to automatically detect that a fault on a PSTN line has been corrected. Where a CE provides this capability through the automatic seizure of PSTN lines, such automatic seizures should not be repeated at intervals of less than 60 s on any individual line.

If a CE detects that a PSTN line has been returned to service, the CE **shall** unblock the Network Port.

Note: The CE may detect that the line has been restored to service by a successful seizure, or an incoming call, or the detection of feed restoration utilising Clauses 5.2.2.6(a)(ii) and/or 5.2.2.6(a)(iii).

Compliance with Clause 5.2.2.6 should be checked by using the test set up as indicated in Clause 6.6.4.

5.2.2.7 Emergency services access

When each of the following emergency services access numbers is dialled, all CE **shall** provide a full duplex speech path within 1 s of the last digit being forwarded to a Telecommunications Network:

- (a) 000 (three digits).

(b) 106 (three digits).

5.2.2.7.1 CE should not support access barring of emergency service numbers.

5.2.2.7.2 Mains-powered CE should continue to support the dialling of emergency service numbers for at least 30 minutes following the loss of mains power.

Note: CE that does not continue to support emergency dialling after loss of mains power, should include in the accompanying documentation a warning notice. A suggested wording for such a warning notice is as follows:

Warning
This equipment will be inoperable when mains power fails

Compliance with Clause 5.2.2.7 should be checked by inspection.

5.2.2.8 Security of dialled information

5.2.2.8.1 To assist in safeguarding the security of dialled information stored or processed within a CE or output to any subsequent call detail processing system, CE which incorporates the facility for recording or outputting of digits dialled on outgoing Public Network calls should provide the capability to truncate the digit information. Where a truncation capability is provided, the extent of truncation should be configurable within a CE.

Note 1: The following is a possible example of achieving this:

- (a) All Local Telecommunications Network codes – not more than six leading digits to be available.
- (b) All National Telecommunications Network codes – not more than eight leading digits to be available.
- (c) All International Telecommunications Network codes – not more than sixteen leading digits to be available.

Note 2: Local telecommunications network codes may be determined from the ACA numbering plan.

Note 3: ‘Leading’ digits exclude the Telecommunications Network exchange access codes used by the CE, e.g. ‘0’.

5.2.2.9 Security of incoming automatically answered calls

5.2.2.9.1 Where a CE provides for DISA facility and it is used to access other Network Ports and/or private network features, it is strongly recommended that an authorisation procedure be invoked (e.g. Personal Identification Number (PIN) with a suitable number of digits) to enable access.

5.2.2.9.2 The CE user documentation should include information warning that the DISA facility could be subject to fraudulent use if adequate security measures are not in place.

Compliance with Clause 5.2.2.9.2 should be checked by inspection.

5.2.2.10 Proceed-to-send – Wink Start (Loop-out calls)

When a CE has the capability to receive a Wink Start, it **shall** recognise a Line Polarity Wink (fleeting reversal) in the range 135 ms to 165 ms inclusive occurring 90 ms and later after the CE has applied a loop.

Note: The availability of this proceed-to-send signal, in lieu of dial tone, is subject to negotiation with the carrier or carriage service provider concerned.

5.2.2.11 Reversal-On-Answer (ROA)

Where Reversal-On-Answer (ROA) detection capability is provided, the CE **shall** be ready to receive the ROA within 90 ms of the transmission of the last digit.

TABLE 2

Line Polarity for Reversal-on-Answer

State	Normal Bothway Line		Bothway Line with Reversal on Answer	
	L+	L-	L+	L-
Idle	+ve	-ve	+ve	-ve
Outgoing Loop	+ve	-ve	+ve	-ve
B-party Answer	+ve	-ve	-ve	+ve
Incoming Ring	+ve	-ve	+ve	-ve
Incoming Answer	+ve	-ve	+ve	-ve
LineLockout	+ve	-ve	+ve	-ve

Note 1: This facility may not be available for all types of outgoing lines provided by carriers or carriage service providers.

Note 2: The line polarity is restored to the pre-answer state, depending on the particular carriage service provider line being directly interfaced to the CE, by any of the following:

- (a) On clearing by the A-party.
- (b) On clearing by the B-party.
- (c) By PSTN timeout after B-party clearing,

5.2.3 Automatic bothway operation

5.2.3.1 General

Clauses 5.2.3.2 and 5.2.3.3 apply, in addition to the requirements for incoming or outgoing operation, to bothway operation of CE that—

- (a) access the PSTN by automatic selection of a Network Port from a group of two or more ports for the purposes of making an outgoing call; and
- (b) do not provide, within 2 s of PSTN line seizure, a full duplex speech path between a Local Port making an outgoing call and the selected Network Port.

5.2.3.2 Call collision – outgoing

CE is to prevent the connection of an automatically selected outgoing call to a Network Port that is held by an earlier incoming call by use of one of the following methods:

- (a) Both of the following:
 - (i) Blocking Network Ports to outgoing calls after the release of an incoming call at the CE end. The blocking period **shall** normally be set at 10 s and should be adjustable from 5 to 16 s.
 - (ii) If a Call Still Held (CSH) situation arises (i.e. when the incoming call is held by the originating party for longer than the blocking period described in item (i)), the CE should block the port to outgoing calls for a period of not less than 140 s. Incoming ring during this CSH period **shall** be detected and the CSH period terminated. The detection of a busy tone may also be used to terminate the CSH period.

Note: The PSTN will force release the incoming call within 140 s of the CE clear back signal being detected but will restart its supervision period if a seizure signal is detected.

- (b) The use of the Reversal-on-Seizure facility, as specified in Clause 5.2.2.5, that is available at some PSTN exchanges.
- (c) A method other than those specified in Items (a) to (b) such that the number of outgoing calls lost **shall not** be more than 1 in every 1000.

Compliance with Clause 5.2.3.2(a) should be checked by using the test set up as indicated in Clause 6.6.3.

Compliance with Clause 5.2.3.2(c) may need to be supported by the results from statistical analysis, simulation and/or in-service trial.

5.2.3.3 Early Guard – incoming

5.2.3.3.1 The following signals are applied by the PSTN as incoming line seizure:

- (a) Ring as specified in AS/ACIF S002 [5].
- (b) Reversal of line polarity for duration of 200 ms and greater.

5.2.3.3.2 Except where provided for in Clause 5.2.3.3.3, the CAE Network Port **shall** be blocked to outgoing calls within 200 ms of commencement of the incoming line seizure signal (ring or polarity reversal) from the exchange.

5.2.3.3.3 In the event of the detection of the seizure signal from the Telecommunications Network exchange simultaneously with the seizure of the port by an outgoing call from the CAE, the incoming call **shall** take precedence and be processed in the normal manner.

Note 1: If the seizure signal is indicated by reversal, the CAE may unblock the port to outgoing calls if feed polarity is restored before the incidence of ring signal.

Note 2: If the seizure signal is not followed by a ring signal for a period longer than the maximum silent period of ring signal cadence, the CAE may unblock the port for outgoing calls.

Compliance with Clause 5.2.3.3 should be checked by using the test set up as indicated in Clause 6.6.2.

5.3 Standard analogue telephone Local Port (On Premises and Off Premises)

5.3.1 General

If the CE has provision for the connection of other STS CE (Ring-in/Loop-out), then the signalling requirements of Clause 5.3 are to apply.

A Local Port that is not compliant with the requirements of Clause 5.3 may be considered to be proprietary (i.e. for the connection of system integral equipment). This port will be unsuitable for connection of CE that is compliant with the requirements of AS/ACIF S002 [5]. Where this is the case, the user documentation **shall** clearly describe this limitation.

5.3.2 Line signals

5.3.2.1 Ring signal

The following requirements apply for the Ring Signal:

- (a) The frequency **shall** be in the range of 16 Hz to 55 Hz.

Note: The recommended frequency is 25 Hz.

- (b) The harmonic content **shall not** exceed 774 mV psophometric for all loadings of the ring signal source.

Note: The harmonic content requirement does not apply where building cabling and/or the Telecommunications Network is not intended to be used for the distribution of Local Ports..

- (c) The level **shall** be sufficient to produce a minimum ring voltage of 50 V r.m.s. across the line termination of 1 μ F in series with a 4 k Ω resistor for;

- (i) Local Port (On Premises), in the configuration of Figure 17 (a);
- (ii) Local Port (Off Premises) in the configuration of Figure 17 (b).

Note 1: This termination represents a load impedance which has a nominal REN of 1.

Note 2: The cadence of the ring signal should be such that the silent period of the ring is less than 2.5 s. This is because AS/ACIF S002 compliant automatic answering CE may interpret the call as abandoned if the silent period exceeds this duration.

Note 3: Ring signals of frequencies greater than 28 Hz may not be supported by a carrier or carriage service provider for Local Port (Off Premises).

Compliance with Clause 5.3.2.1 should be checked by using the test set up as indicated in Clause 6.6.6.

5.3.2.2 Answer/Seizure/Hold signals

The Local Port(**shall**—

- (a) For Local Port (On Premises):
 - (i) recognise within 300 ms as an answer/seizure/hold signal, the application of a resistive termination of: up to 600 Ω (recommended up to 1200 Ω),
 - (ii) provide a minimum battery feed current of 18 mA over the entire range of hold signals.
- (b) For Local Port (Off Premises):
 - (i) recognise within 300 ms as an answer/seizure/hold signal, the application of a resistive termination of: up to 1800 Ω
 - (ii) provide a minimum battery feed current of 18 mA over the entire range of hold signals.
- (c) The provision of an Off Premises Local Port capability shall not rely on equipment being located on the carrier or carriage service provider side of the network boundary, for example remote ring generators, signalling loop extenders.

Note 1: The loop resistance of 600 Ω and 1800 Ω comprises the sum of telephone and associated cabling resistance.

Note 2: CE may provide a local port covering both On Premises and Off Premises requirements which must recognise terminations from 600 Ω to 1800 Ω

Note 3: If CE has both On Premises and Off Premises Local Ports, together the two Local Ports shall cover the whole range of loop conditions up to 1800 Ω .

Note 4: An open circuit voltage of 42 V d.c. minimum is recommended for Off Premises Local Ports. Any voltage less than 42 V d.c. may not be supported by the carrier or carriage service provider.

Compliance with Clause 5.3.2.2 should be checked by using the test set up as indicated in Clause 6.6.7 and 6.6.11.

5.3.2.3 Idle/Release signals

The Local Port **shall** recognise a resistive termination of 10 k Ω and greater as an idle/release signal.

Compliance with Clause 5.3.2.3 should be checked by using the test set up as indicated in Clause 6.6.8.

5.3.2.4 Recall signal

If the CE is to recognise timed loop break signals as specified in AS/ACIF S002 [5], then the receive limits should be 40 ms to 140 ms.

Compliance with Clause 5.3.2.4 should be checked by using the test set up as indicated in Clause 6.6.12.

5.3.3 Address signals

5.3.3.1 Decadic signals

If decadic (loop disconnect) signal detection is provided, the following requirements are to apply:

- (a) Break and Make signals that are within the following limits **shall** be recognised:
 - Break pulse: 50 ms to 76 ms
 - Make pulse: 28 ms to 46 ms
- (b) A make period of 350 ms and greater **shall** be recognised as an interdigital pause.
- (c) Make and Break pulses of 5 ms or less should be rejected.

Compliance with Clause 5.3.3.1 should be checked by using the test set up as indicated in Clause 6.6.9.

5.3.3.2 DTMF signals

If DTMF signal detection is provided, the following requirements are to apply:

- (a) DTMF signals that are within the following limits **shall** be recognised:
 - (i) Frequency tolerances of $\pm (1.5\% + 2 \text{ Hz})$ from the nominal frequency as specified in AS/ACIF S002 [5].
 - (ii) A total RMS power level between 0 dBm and -20 dBm with a maximum difference between the high frequency tone and the low frequency tone power of +4 dB to -4 dB relative to that of the low frequency tone.
 - (iii) A break between tone signals of 70 ms and greater, as an interdigital pause.
 - (iv) A valid tone signal of 40 ms duration and greater.
- (b) The following DTMF signals **shall** be rejected:
 - (i) A tone signal of 20 ms duration and less.

- (ii) A tone signal of -40 dBm and less.
- (iii) A tone signal with a deviation of either frequency of greater than or equal to $\pm 3.5\%$ from the nominal frequency as specified in AS/ACIF S002 [5].
- (iv) A break between two consecutive and identical tone signals of less than 15 ms as an interdigital pause.

Compliance with Clause 5.3.3.2 should be checked by using the test set up as indicated in Clause 6.6.10.

5.4 System integral equipment

The following requirements apply to CAE which provide the capability to connect system integral equipment (such as System Integral Telephones and operator console instruments) for the purpose of voice telephony with the Telecommunications Network.

The combined CAE with the SIT is regarded as a 'STS CE' for purposes of testing voice telephony.

5.4.1 Loudness ratings

5.4.1.1 Analogue exchange port

Combined CAE with system integral equipment, is to comply with the loudness rating requirements of AS/ACIF S004 [6].

5.4.1.2 Digital exchange port

Combined CAE with system integral equipment, is to comply with the loudness rating requirements of AS/ACIF S004 [6].

Note: The loudness ratings of a connection involving system integral equipment and a digital port is defined with respect to the analogue port of a test codec or a digital equivalent, complying with ITU-T Recommendation G.711[16] A-law at the digital access point.

5.4.2 Signal levels

The signal levels are recommended to comply with the relevant requirements AS/ACIF S043 [10], unless they are restricted to pairs of screened cable or coaxial cable or a separate dedicated cable.

5.4.3 Balance about earth

The analogue Network Ports of a CE **shall** have an impedance balance as specified in Clauses 5.5.3.15(a) when a connection is established through the CE to system integral equipment.

5.4.4 Return loss

The analogue Network Ports of a CE **shall** have return loss values as specified in Clause 5.5.3.13 when a call connection is established through the CE to system integral equipment.

5.5 Transmission requirements

5.5.1 General

5.5.1.1 The requirements of Clause 5.5 apply to each direction of the full duplex transmission paths for CE which has provision for one or more of the following:

- (a) The connection of other STS CE (Ring-in/Loop out).
- (b) The transit switching of telephone calls in any call connection combinations shown in Table 5.

Note 1: Transmission parameters for internal analogue extension port to internal analogue extension port are recommendations only and need not be tested.

Note 2: Transmission parameters for an analogue extension port that is considered to be proprietary (i.e. for the connection of analogue system integral equipment only), that is not compliant with the requirements of Clause 5.3 (and therefore not suitable for the connection of STS CE that is compliant with the requirements of AS/ACIF S002 [5]) are recommendations only and need not be tested.

Compliance with Clause 5.5.1.1 should be checked using the test set-up as indicated in Clause 6.6.13.

- 5.5.1.2 The test tone frequency unless otherwise stated in this Standard, is nominally 1000 Hz (1004 Hz to 1020 Hz).
- 5.5.1.3 The test tone level unless otherwise stated in this Standard is -10 dBm0.
- 5.5.1.4 For all analogue ports, the DC current for testing purposes **shall** be determined by the range of terminations shown in Table 3.

TABLE 3

DC terminations

Analogue port type	External resistance (Ω)	External voltage (V)
Local Port (On Premises)	300 to 600 (Note)	Not applicable
Local Port (Off Premises)	300 to 1800 (Note)	Not applicable
Network Port (Ring-in/Loop-out)	400 to 2300	44 to 56
Network Port (Loop-in)	300 to 2500	Not applicable
Network Port (Four-wire)	300 to 2500	44 to 56

Note: Local Ports are to comply with the requirements of Clause 5.3.

- 5.5.1.5 For all analogue ports, the nominal impedance of the transmission test access points and their associated balance networks in a four-wire CE or a two-wire CE incorporating four-wire amplified loops, is to be according to Figure 1 and Table 4. The actual impedances of the CE ports are to comply with the return loss requirements of Clause 5.5.3.13. It is preferable that the nominal impedance be maintained at the extension port during call set-up and clearing. However, if a break in the DC loop is required then a reactive impedance corresponding to at least 68 nF **shall** be maintained.

TABLE 4

Port and balance network impedances

Port type	Input impedance [Z_{in}]	Balance impedance [Z_B]
Local Port (On Premises) or (Off Premises)	$Z_1 = 220 \Omega + (820 \Omega // 120 \text{ nF})$ = 600 Ω (Note)	$Z_2 = 220 \Omega + (820 \Omega // 120 \text{ nF})$ = 600 Ω (Note)
Two-wire Network Port	$Z_3 = 220 \Omega + (820 \Omega // 120 \text{ nF})$ = 600 Ω (Note)	$Z_4 = 220 \Omega + (820 \Omega // 120 \text{ nF})$ = 600 Ω (Note)
Four-wire Network Port	= 600 Ω	Not applicable

Note: Complex impedances (i.e. 220 Ω in series with 820 $\Omega // 120 \text{ nF}$) are mandatory on Local and 2 wire Network ports, however, a complex impedance [Z] using 115 nF may be used, providing all relevant requirements of Clause 5.5.3 are satisfied. To improve matching and the four-wire loop loss when the ports are connected to a 600 Ω device/service, a 600 Ω impedance is recommended as a strappable/switchable option.

- 5.5.1.6 For analogue ports, the measurement of the power into a complex impedance is to be in accordance ITU-T Recommendation G.101 [12].
- 5.5.1.7 For digital ports, the equivalent power levels are to be defined with respect to the analogue port of a test codec, or a digital equivalent, complying with ITU-T Recommendation G.711 [16] A-law at a digital access point.
- 5.5.2 Test Access Points (TAPs)
- 5.5.2.1 Provision of TAPs assist in laboratory testing of the switchblock/transmission paths and more importantly, provide standard test points for initial line-up and testing of local and network ports.
- 5.5.2.2 Figure 2 depicts the arrangement of switchblock/transmission paths and TAPs in a CE.
- 5.5.3 Switchblock/Transmission path performance
- 5.5.3.1 General
- 5.5.3.1.1 The Relative Levels assigned by public network carriers/carriage service providers for CE connected to analogue 2-wire PSTN are +3 dBr Sending, and -9 dBr Receiving. These Relative Levels take account of the fixed 6 dB inter-exchange loss and the nominal 3 dB (average) customer access network loss.
- 5.5.3.1.2 For design and transmission testing purposes, the Send Relative Level for Analogue Local and Analogue PSTN Network Ports has been set at 0 dBr; similarly the Receive Relative Level for Analogue Local and Analogue PSTN Network Ports has been set at -6 dBr. This will provide a nominal 0 dB loss between these two port types. These Relative Level values have been chosen in conformity with those used in a number of standards internationally.

5.5.3.1.3 Nominal Relative Levels are assigned as shown in Table 5. These levels **shall** be used as the reference for all transmission measurements.

Note: These levels are used to relate specifications expressed in units of dBm0 and measured values expressed in units of dBm. The relationship between dBr, dBm0 and dBm is $\text{dBm} = \text{dBm0} + \text{dBr}$.

Compliance with Clause 5.5.3.1 should be checked by using the test set up as indicated by Clause 6.6.13.

TABLE 5

Relative levels (dBr) and nominal composite loss (dB)

		B			
		Standard analogue Local Port	Analogue Network Port two-wire (Note 1)	Analogue/Digital Network Ports four-wire (Note 2)	Analogue/Digital Network Port four-wire (Note 2)
	Input relative levels (dBr)	(0) (Note 3)	(-6) (Note 3)	(0) (Note 3)	(0) (Note 3)
A	Standard analogue Local Port	6 to 12	0 to 1.2 (Note 3)	0 to 6 / 6 to 12 (Note 4)	0 to 6 / 6 to 12 (Notes 3, 4)
	Analogue Network Port two-wire (Note 1)	0 to 1.2 (Note 3)	(Note 5)	-6 / 0 (Notes 4, 6, 7)	-6 / 0 (Notes 4, 6, 7)
	Analogue/Digital Network Ports four-wire (Note 2)	6 to 12 / 0 to 6 (Note 4)	0 / -6 (Notes 4, 6, 7)	0	0
	Analogue/Digital Network Port four-wire (Note 2)	6 to 12 / 0 to 6 (Notes 3, 4)	0 / -6 (Notes 4, 6, 7)	0	0

Note 1: Where the CAE is installed on long analogue two wire lines, a gain of up to 3 dB may be provided in the CE or private network (see Clause 5.5.3.2(b) for further information).

Note 2: The nominal relative level of a 2048 kbit/s ITU-T Recommendation G.703 [14] interface is 0 dBr.

Note 3: The shaded areas indicate the mandatory Relative Levels and Composite Loss values. All other entries are recommended design values.

Note 4: Composite loss A to B/Composite loss B to A.

Note 5: Exchange to exchange gain/loss is to comply with the requirements of AS/ACIF S002 [5] for Automatic Call Transfer Equipment (ACTE). It may not always be possible to obtain satisfactory end-to-end transmission performance using two-wire analogue interfaces. In such cases, the use of digital switched Telecommunications Network access will provide an improved performance.

Note 6: Within the Table, nominal composite gain values are shown with a negative sign (-).

Note 7: Loop stability is to be maintained for all transit call connections.

5.5.3.2 Composite loss

For CE that can be used to support an STS path, composite loss **shall** comply with the mandatory values in Table 5.

- (a) Conference and Operator Intrusion: for conference calls involving more than two external lines (Local Ports [Off Premises] or Network Ports) the requirements in Clause 5.10 apply. For all other conference calls, loss additional to the upper limits specified in Table 5, is permitted as follows:
 - (i) When the operator enters a call connection, an extra loss of up to—
 - (A) 0.3 dB when the operator listens only; or
 - (B) 3.5 dB when the operator speaks.
 - (ii) For any call connection in a conference configuration, an extra loss of up to 9 dB is allowed.
- (b) Use of amplification to offset insertion loss is subject to the following conditions:
 - (i) The call connection **shall** be unconditionally stable with all ports terminated with the appropriate impedances given in Table 4, i.e. balance network as well as with open and short circuit terminations.
 - (ii) For CE that can be used to support an STS path, the use of voice switching techniques shall not be permitted, except during voice conferencing and diversion.

Note 1: The return path of the four-wire connection may be opened or inhibited during tests for composite loss. Also applicable to Clause 5.5.3.13.

Note 2: The definition of composite loss is given in ITU-T Recommendation Q.551 [22].

Compliance with Clause 5.5.3.2 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.3 Attenuation/Frequency distortion

For CE that can be used to support an STS path, attenuation/Frequency Distortion with respect to the loss at 1000 Hz (nominal) **shall** be within the limits of Figure 3.

Compliance with Clause 5.5.3.3 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.4 Non-linear distortion (variation of gain with input level)

For CE that can be used to support an STS path, the gain for a sine-wave signal in the frequency range 700 to 1100 Hz applied to the input port of a call connection at a level between -55 and $+3$ dBm₀, relative to the gain at an input level of -10 dBm₀, **shall** be within the limits of Figure 4.

Compliance with Clause 5.5.3.4 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.5 Absolute delay and group delay distortion

5.5.3.5.1 For CE that can be used to support an STS path, the absolute group delay **shall not** exceed 1950 μ s.

Note: Absolute group delay refers to the minimum group delay measured in the frequency band 500 Hz to 2800 Hz in one transmission direction.

Absolute group delay is identical to the One-way Propagation Time. For switching systems the One-way Propagation Time includes times due to electronic devices such as frame aligners and time stages of the switching matrix but does not include times due to ancillary functions such as echo suppression or echo cancellation.

- 5.5.3.5.2 For CE that can be used to support an STS path, taking as the reference the minimum group delay, in the frequency range between 500 Hz and 2800 Hz, the group delay distortion of the call connection **shall** lie within the limits shown in the template of Figure 18. Group delay distortion is measured in accordance with -ITU-T-Recommendation O.81 [21].

Compliance with Clause 5.5.3.5 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.6 **Signal-to-total-distortion limits**

- 5.5.3.6.1 For CE that can be used to support an STS path, the psophometrically weighted signal-to-total-distortion ratio (including harmonic distortion and quantising distortion), **shall** comply with the requirements of Figure 5 when using a 1000 Hz (nominal) test signal with levels in the range -45 to 0 dBm0,.

- 5.5.3.6.2 For CE that can be used to support an STS path, the signal-to-total-distortion ratio as defined above **shall** be greater than 26 dB when using a 400 Hz, 0 dBm0 test signal.

Compliance with Clause 5.5.3.6 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.7 **Intermodulation products**

CE that can be used to support an STS path **shall not** produce any $2f_1 - f_2$ (or $2f_2 - f_1$) intermodulation product having a level greater than 35 dB below the lower power level of either output signal when measured using two superimposed sine-wave signals (denoted as the fundamental frequencies f_1 and f_2) each in the range 450 Hz to 2050 Hz (but not harmonically related), and of equal level in the range -21 dBm0 to -4 dBm0.

Compliance with Clause 5.5.3.7 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.8 **Crosstalk**

For CE that can be used to support an STS path, the level measured at the TAP of any one call connection **shall not** be greater than -67 dBm0 when a 0 dBm0, 1000 Hz signal is applied at the TAP of any other call connection.

Compliance with Clause 5.5.3.8 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.9 **Crosstalk via service tone connections**

- 5.5.3.9.1 For STS CE, for any two test connections connected to a common service or intrusion tone generator, the signal-to-crosstalk ratio, measured with disturbing and disturbed circuits terminated **shall** be greater than 65 dB for tones transmitted during conversation periods (e.g. Intrusion Tone, Offer Tone) and 55 dB for other tones.

Note 1: A service or intrusion tone test connection may or may not involve a through call connection within the CE. In cases where a through call connection exists, the distant ends are to be terminated in the relevant impedances specified in Table 4, i.e. the balance impedance at the distant end.

Note 2: Measurements of return loss and crosstalk may be made with the tone generator turned on, using a selective level meter, provided adequate rejection of the service tone signal is achieved (to allow reliable readings at the measurement frequency).

Compliance with Clause 5.5.3.9 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.10 Noise performance

For STS CE, the following requirements apply to any test call connection, terminated at the input port with terminating impedance as specified in Table 4 and terminated at the output port in 600 Ω :

(a) *Mean noise power*

The mean noise power **shall not** exceed—

- (i) -65 dBm0p, measured using a psophometer weighted in accordance with ITU-T Recommendation O.41 [19]; and
- (ii) -40 dBm0 unweighted, measured using a device with a uniform frequency response over the range 30 Hz to 20 kHz.

(b) *Single frequency noise power*

Any single frequency (in particular the sampling frequency and its submultiples where appropriate) over the range 30 Hz to 20 kHz, measured selectively, **shall not** exceed -50 dBm0.

(c) *Impulsive Noise*

The number of noise counts above a threshold level of -35 dBm0 **shall not** exceed five counts in 5 mins, measured using an impulsive noise counter compliant with ITU-T Recommendation O.71 [20], using the 600 Hz to 3 kHz filter described in § 3.5 therein.

Compliance with Clause 5.5.3.10 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.11 Spurious in-band signals

For STS CE, the output level at any frequency, other than the frequency of the applied signal, **shall** be less than -40 dBm0, when measured selectively (maximum 40 Hz bandwidth) in the range 300 Hz to 3400 Hz, with a sinusoidal signal in the frequency range 700 Hz to 1100 Hz, and at a level of 0 dBm0 applied to the input port of a test call connection.

Compliance with Clause 5.5.3.11 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.12 Spurious out-of-band signals

For STS CE, the level of spurious out-of-band image signals **shall** be less than -25 dBm0, when measured selectively (maximum 40 Hz bandwidth) at the output port, with a sinusoidal signal in the frequency range 300 Hz to 3300 Hz at a level of 0 dBm0 applied to the input port of a test call connection.

Compliance with Clause 5.5.3.12 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.13 Return loss

The return loss against the relevant impedances specified in Table 4 at any test point of any test call connection **shall not** be less than—

- (a) 10 dB for $300 \leq \text{Frequency} < 600$ Hz; and

- (b) 15 dB for $600 \leq \text{Frequency} \leq 3400$ Hz.

Compliance with Clause 5.5.3.13 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.14 Terminal Balance Return Loss (TBRL) for two-wire ports in four-wire CE

For two-wire Ports in four-wire CE, the balance impedance in the hybrid balance network is to be such that the TBRL **shall** comply with the requirements of Fig. 6.

Compliance with Clause 5.5.3.14 should be checked by using the test set up as indicated in Clause 6.6.13.

5.5.3.15 Balance about earth

The following measurements are to be made in conformance with ITU-T Recommendation O.9 [18] to assess the degree of unbalance about earth.

- (a) Longitudinal Conversion Loss (LCL)

The LCL **shall** be greater than 46 dB for both two-wire and four-wire ports. LCL is defined as the ratio of the input transverse voltage arising from a balanced input longitudinal voltage of 3.0 V r.m.s, in the frequency range 50 Hz to 3400 Hz, applied between earth and the midpoint of two 300 Ω resistors connected in series across the input terminals of the test point, to the input longitudinal voltage.

- (b) Longitudinal Conversion Transfer Loss (LCTL)

The LCTL **shall** be greater than 46 dB for both two-wire and four-wire ports. LCTL is defined as the ratio of the output transverse voltage arising from a balanced input longitudinal voltage of 3.0 V r.m.s., in the frequency range 50 Hz to 3400 Hz, applied between earth and the midpoint of two 300 Ω resistors connected in series across the input terminals of the test point, to the input longitudinal voltage.

- (c) Transverse Conversion Loss (TCL)

The TCL should be greater than 46 dB for both two-wire and four-wire ports. TCL is defined as the ratio of the input longitudinal voltage arising from a balanced input transverse voltage of -10 dBm₀, in the frequency range 50 Hz to 3400 Hz, applied across the input terminals of the test point, to the input transverse voltage.

- (d) Transverse Conversion Transfer Loss (TCTL)

The TCTL should be greater than 46 dB for both two-wire and four-wire ports. TCTL is defined as the ratio of the output longitudinal voltage arising from a balanced input transverse voltage of -10 dBm₀, in the frequency range 50 Hz to 3400 Hz, applied across the input terminals of the test point, to the input transverse voltage.

Compliance with Clause 5.5.3.15 should be checked by using the test set up as indicated in Clause 6.6.13.

5.6 Analogue Tie Line Network Ports

5.6.1 C2 Series signals

C2 Series E & M Lead Signals are intended for use with four-wire voice services utilising separate E & M connections. Earth-off-idle signalling is the recommended method. Figure 7 shows the line signalling protocol. If

the CE provides C2 Series signalling capability then the following requirements apply.

Note 1: The transfer of information by means other than DC, such as VF signals, may be used where there is agreement between the parties providing the CE at each end of the Tie Line.

Note 2: Carriers may not support Earth-on Idle signalling

5.6.1.1 Electrical interface

CE is to comply with the electrical interface requirements of Appendix A

5.6.1.2 Signalling codes (Earth-on-Idle)

Table 6 specifies the C2 Series signalling codes (Earth-on-Idle).

TABLE 6

C2 Series signalling codes (Earth-on-Idle)

Signal/State	Direction	Code
Idle	Forward	Earth applied
	Backward	Earth applied
Seize	Forward	Removal of earth
Seize Acknowledge (optional)	Backward	Removal of earth (timed)
Answer	Backward	Removal of earth
Clear Back	Backward	Restoration of earth
Recall Forward (optional)	Forward	Restoration of earth (timed)
Recall Backward (optional)	Backward	Restoration of earth (timed)
Decadic Pulsing	Forward	Restoration of earth (pulsed)
Clear Forward	Forward	Restoration of earth
Release Guard	Backward	Restoration of earth
Blocking (optional)	Backward	Removal of earth (timed or continuous)

5.6.1.3 Signalling codes (Earth-off-Idle)

Table 7 specifies the C2 Series signalling codes (Earth-off-Idle).

TABLE 7

C2 Series signalling codes (Earth-off-Idle)

Signal/State	Direction	Code
Idle	Forward	Earth removed
	Backward	Earth removed
Seize	Forward	Application of earth
Seize Acknowledge (optional)	Backward	Application of earth (timed)
Answer	Backward	Application of earth
Clear Back	Backward	Removal of earth
Recall Forward (optional)	Forward	Removal of earth (timed)
Recall Backward (optional)	Backward	Removal of earth (timed)
Decadic Pulsing	Forward	Removal of earth (pulsed)
Clear Forward	Forward	Removal of earth
Release Guard	Backward	Removal of earth
Blocking (optional)	Backward	Restoration of earth (timed or continuous)

5.6.2 Line signalling tolerances

The following requirements apply to C2 Series signals, as described in Clause 5.6.1.

5.6.2.1 Signal sending

The line signal duration **shall** be within the ranges specified in Table 8.

TABLE 8

Sending tolerances

Signal	Duration (ms)	Remarks
Seize Acknowledge	110 to 130	Optional
Clear Back	110 and greater	
Answer	110 and greater	
Recall	60 to 80	Optional
Clear Forward	480 and greater	
Blocking	110 to 130	Optional
Decadic Make	30 to 40	
Decadic Break	60 to 70	

5.6.2.2 Signal recognition

5.6.2.2.1 The Tie Line ports should recognise signals with the timings specified in Table 9.

TABLE 9

Receiving tolerances

Signal	Duration (ms)	Remarks
Seize	150 and greater	
Seize Acknowledge	100 to 140	Optional
Answer	40 and greater	
Clear Back	100 and greater	
Clear Forward	240 and greater	
Blocking	100 to 140	Optional
Recall	50 to 90	
Decadic Make	20 to 70	
Decadic Break	28 to 90	

5.6.2.2.2 Interruptions of less than 10 ms to any signal should be ignored. Interruptions of more than 20 ms should cause the timing of the signal recognition to restart except in the case of Decadic Make and Break signals.

5.6.2.3 Repetition of Line Signals

Where it is necessary for a CE to repeat line signals, the outgoing signal should be corrected to conform to the sending limits above.

5.7 Digital Tie Line Ports

5.7.1 General

This section specifies the requirements for digital Tie Line Ports at the CE. CE intended for connection to a 2048 kbit/s telecommunications service is to comply with the applicable requirements AS/ACIF S016 [2].

5.7.2 $n \times 64$ kbit/s service

The CE may interface to the 2048 kbit/s telecommunications service using n times 64 kbit/s timeslots, for $1 \leq n \leq 30$. Where this service is used, the CE interface is to comply with the following requirements:

- (a) The interface **shall** conform to the framing format specified in ITU-T Recommendation G.704 [15] § 5.1.
- (b) Channel Associated Signalling (CAS), conforming to ITU-T Recommendation G.704 [15], § 5.1.3.2, may be used. Where CAS is used, the signalling sense **shall** be positive (this means when the M-Lead is grounded, the corresponding bit is set to zero).
- (c) The CE may use the carrier or carriage service provider to process encoded voice frequency signals (0.3 to 3.4 kHz). Where processing is performed, such signals **shall** be A-law PCM encoded to ITU-T Recommendation G.711 [16].

Note: An example of processing is the provision of echo cancelling facilities by the carrier or carriage service provider.

5.8 Digital PSTN Network Ports

5.8.1 General

This section specifies the requirements for digital PSTN Network Ports at the CE. CE intended for connection to a 2048 kbit/s telecommunications service is to comply with the applicable requirements of AS/ACIF S016 [2].

Note: The 2048 kbit/s service allows the replacement of up to 30 analogue ports between an exchange and the Customer Equipment with a single digital link. The exchange service is the replacement of n analogue ports with a digital link of $n \times 64$ kbit/s channels, thus providing a complete digital path from the exchange to the Customer Equipment. The normal analogue in-band features are available with the line signalling transmitted using CAS.

5.8.2 $n \times 64$ kbit/s service

5.8.2.1 Where this service is used, the CE is to comply with the following requirements:

- (a) The interface **shall** conform to the framing format specified in ITU-T Recommendation G.704 [15] § 5.1.
- (b) The multiframe format as specified in ITU-T Recommendation G.704 [15] § 5.1.3.2. The signalling sense **shall** be positive (this means that when the M-Lead is grounded, the corresponding bit is set to zero).
- (c) Voice frequency signals (0.3 to 3.4 kHz) **shall** be A-Law PCM encoded as specified in ITU-T Recommendation G.711 [16].

5.8.2.2 The signalling requirements for the CAS scheme are to comply with Appendix B.

5.8.3 Emergency services access

The CE **shall** comply with the requirements of Clause 5.2.2.7.

Compliance with Clause 5.8.3 should be checked by inspection.

5.8.4 Security of dialled information

The CE should comply with the requirements of Clause 5.2.2.8.

5.8.5 Security of incoming automatically answered calls

The CE should comply with the requirements of Clause 5.2.2.9.

5.8.6 Automatic bothway operation

The CAE **shall** comply with the requirements as detailed in Clauses 5.2.3.2(a) and (b).

5.8.7 Automatic answering of incoming calls

- (a) The CE is to comply with the requirements of AS/ACIF S002 [5] for Automatic Answering of incoming calls.
- (b) The delay to answer **shall** comply with the requirements of AS/ACIF S002 [5] for a Loop-in PSTN line.

5.9 ISDN Network Ports

Where provided, the CE is to comply with the requirements for connection to ISDN Basic Access as specified in AS/ACIF S031 [8] and ISDN Primary Rate Access as specified in ACA Technical Standard 014 [1] and AS/ACIF S038 [9].

5.10 Conference bridges

5.10.1 Conference supervision

5.10.1.1 The call connection between a participant and the bridge should be released when the party goes off-line, (either automatically or under control of the conference supervisor). Automatic release may be achieved by the detection of service tones (i.e. Busy, Congestion, Dial or Number Unobtainable (NU) tone) at that port.

5.10.1.2 When using tone detection, automatic disconnection from the bridge should be achieved within four cycles of Busy tone, two cycles of Congestion tone or three seconds of Dial tone or NU tone being received.

Compliance with Clause 5.10.1 should be checked by operation and inspection.

5.10.2 Nominal impedance

The requirements for nominal impedance as specified in Clause 5.5.1.5 apply.

5.10.3 Impedance unbalance to earth

The requirements for impedance unbalanced as specified in Clause 5.5.3.15 apply.

5.10.4 Relative levels

The requirements for relative levels as specified in Clause 5.5.3 apply.

5.10.5 Threshold level

It is recommended that the threshold level be adaptable between -46 dBm and -30 dBm in 1 dB steps.

5.10.6 Gain/Loss/Automatic Gain Control (AGC)

5.10.6.1 The gain/loss characteristics of the call connections are at the discretion of the manufacturer. The following characteristics are suggestions only:

(a) For input less than -21 dBm₀, the amplifiers in the bridge should be designed to incorporate the following characteristics:

Output = input + gain of 18 dB \pm 1 dB.

(b) For input equal to -21 dBm₀ or greater:

Output = -3 dBm₀ (i.e. under AGC) \pm 1 dB.

5.10.6.2 If the equipment design uses voice switching techniques, for the conditions specified in Clause 5.10.6.1, the reverse direction through the device should experience an inverse loss equal to the forward gain (i.e. up to 18 dB) for the time during which the signal in the forward direction has 'captured' the speech detector.

5.10.6.3 Clause 5.10.6.1 describes peak power levels for speech. For performance testing, a sinusoidal signal 3 dB below these levels should be used to avoid the effects of AGC attack and decay.

Note: Test tones of levels -21 dBm and -23 dBm are used to detect the point at which AGC is activated.

5.10.7 Automatic gain control attack and decay times

The attack and decay times are at the discretion of the manufacturer. To cause negligible subjective impairment to speech the following times are suggested:

(a) Attack

When in the quiescent state, each bridge port should assume the active state within 5 ms of detecting a signal level which exceeds the input threshold.

(b) Decay

Each bridge port should revert to the quiescent state from the active state when the signal level appearing at the port is less than the input threshold for durations longer than 100 ms.

5.10.8 Attenuation/Frequency distortion

The requirements for attenuation/frequency distortion as specified in Clause 5.5.3.3 apply.

5.10.9 Stability

The conference bridge **shall** be unconditionally stable for all input levels and with all input/output ports terminated in any impedance of any phase angle.

5.10.10 Group delay distortion

The requirements for group delay distortion as specified in Clause 5.5.3.5 apply.

5.10.11 Total distortion

The requirements for total distortion as specified in Clause 5.5.3.6 apply.

5.10.12 Intermodulation distortion

The requirements for intermodulation distortion as specified in Clause 5.5.3.7 apply.

5.10.13 Noise performance

The requirements for noise performance of any test call connection through the bridge, with all ports active and terminated in 600 Ω and strapped for maximum gain, **shall** be as specified in Clause 5.5.3.10 but relaxed by a value of 3 dB.

5.10.14 Crosstalk

Between separately established conferences, the requirements for crosstalk performance as specified in Clauses 5.5.3.8 and 5.5.3.9, apply.

6 TESTING

6.1 General

- 6.1.1 Compliance with all mandatory requirements applicable to the CE as specified in the requirements Clauses is to be verified. This verification may be through direct measurement, modelling and analysis, or inspection.
- 6.1.2 Methods for demonstrating compliance of CE with requirement Clauses specified in this Standard are described in Clauses 6.2 to 6.6. 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 Unless this Standard provides otherwise, testing for compliance with this Standard is to 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 The prevailing conditions should be recorded for each test.

6.3 Test configurations

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 are to accompany test reports.

Note: Some tests for which no specific test configuration is provided in this Standard may be performed by inspection, as indicated in the appropriate requirements Clauses of this Standard.

6.4 Test level

Unless otherwise specified, transmission tests should be carried out with a send level of -10 dBm₀ (i.e. -10 dBm at 0 dBr point).

6.5 Test frequencies

Test frequencies should be in the range of 300 Hz to 4000 Hz 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.

Note: Where the test frequencies are sub-multiples of the PCM sampling rate of 8000 Hz, an offset of 3 Hz to 20 Hz should be used to reduce errors in level measurements.

6.6 Parameters to be tested

All requirements specified in this Standard, applicable to the particular CE, should be verified by testing or inspection, as appropriate.

- 6.6.1 This Clause intentionally left blank
- 6.6.2 Early Guard – Incoming/Reversal-on-Seizure

For Early Guard – Incoming, refer to Clause 5.2.3.3. Figure 8 is the circuit to be used for sending the seizure signal in the form of a polarity reversal

for early guard testing and a polarity reversal for reversal on seizure testing. Figure 9 is the circuit to be used for sending a seizure signal in the form of a ring signal. This test can be performed by blocking all Network Ports except one and making simultaneous 'early guard' and attempted outgoing seizure of the network port.

For Reversal-on-Seizure, refer to Clause 5.2.2.5.

6.6.3 Release blocking

Refer to Clause 5.2.2.2. This test can be performed using a similar test circuit to Figure 8 (without operation of switch SW1). Repeated call attempts should be made and the outgoing line monitored between clear down and re-seizure.

6.6.4 Automatic Guard

Refer to Clause 5.2.2.6. For open circuit voltages of less than 40 V d.c., the total series resistance is 2300 Ω as shown in Figure 10. Where Automatic Guard by absence of service tones is incorporated, the test configuration of Figure 11 should be used with the CE service tone detectors active.

6.6.5 Line leakage resistance

Refer to Clause 5.2.2.4. For a 50 k Ω resistance either across the line or from either leg to ground, the test should be performed using the circuit shown in Figure 11.

6.6.6 Measurement of ring signal characteristics

Refer to Clause 5.3.2.1.

- (a) The minimum value of the ring voltage should be measured using the test circuit shown in Figure 17.
- (b) The frequency of the ring signal should be measured using the test circuit shown in Figure 17.
- (c) The harmonic content of the ring signal should be measured using a psophometer (with characteristics in accordance with ITU-T Recommendation O.41 [19]) set to the weighted mode, bridged measurement configuration. The procedure should use the test circuit shown in Figure 12 whilst the following steps are performed:

Step 1: Connect a psophometer across Port 0 as shown. Apply ring signal to Port 0 and note the reading at Port 0.

Step 2: Connect standard load (REN ~ 1) across Port 1. Apply ring signal simultaneously to both ports and note the reading at Port 0.

Step 3: Connect standard loads (REN ~ 1) across half of the maximum number of ports that may be simultaneously served with Ringing current from the ring generator. Alternatively load the ring generator with an equivalent load. Apply ring signal simultaneously to all of these ports and note the reading at Port 0.

Where the maximum number of ports (less Port 0), that can be simultaneously served by a ring signal source is an odd number, for the purpose of this test the next lowest whole number of ports will be sufficient.

Step 4: Repeat Step 3 for the maximum number of ports that may be simultaneously served by the ring generator and note the reading at Port 0.

- 6.6.7 Answer/Seizure/Hold signals**
Refer to Clause 5.3.2.2. These signals should be tested using the test circuit shown in Figure 13 with switches SW2 open and SW1 closed. This test should be performed with R set to 300 Ω and 600 Ω in turn.
- 6.6.8 Idle/Release signals**
Refer to Clause 5.3.2.3. These signals should be tested using the test circuit shown in Figure 13. The CE should detect both—
- the idle signal if switches SW2 and SW1 are initially open and then switch SW2 is closed; and
 - the release signal if switches SW2 and SW1 are initially closed and then switch SW1 is opened with R set to 300 Ω and 600 Ω in turn.
- 6.6.9 Decadic signals**
- 6.6.9.1** Decadic signals should be measured over the range of make and break periods specified in Clause 5.3.3.1 and should use the test circuit shown in Figure 14 with R set to 600 Ω for Local Ports (On Premises) and 1800 Ω for Local Ports (Off Premises).
- 6.6.9.2** The test circuit should present a break termination of 50 k Ω and the impulse source should have a maximum contact bounce of 0.5 ms. The recording device should have accuracy greater than 1 ms. The test should include trains of the digit 0 or 9.
- 6.6.10 DTMF signals**
- 6.6.10.1** DTMF signals should be measured over the range of conditions specified in Clause 5.3.3.2 and should use the test circuit shown in Figure 15.
- 6.6.10.2** Switch SW applies a seizure loop to the Local Port (On Premises). DTMF signalling can then take place.
- Note: The DTMF source may be implemented as two low-distortion oscillators connected through a terminating network.
- 6.6.10.3** For measurement of CE generated DTMF signals at a digital port, the use of a test codec or digital equivalent complying with ITU-T Recommendation G.711 [16] A-law is required at the digital access point.
- 6.6.11 Local Port (Off Premises)**
Refer to Clause 5.3.3. For answer/seizure/hold testing of this port refer to Clause 6.6.7 with R set to 600 Ω , 1200 Ω and 1800 Ω in turn.
- 6.6.12 Recall signal**
Refer to Clause 5.3.2.4. For testing of this signal refer to Clause 6.6.7 with R set to 600 Ω for Local Ports (On Premises) and 1800 Ω for Local Ports (Off Premises). For this test, the CE should not be in a state where a Facility Signal can be confused with decadic digit '1'.
- 6.6.13 Transmission measurements**
- 6.6.13.1** Refer to Clauses 5.5 and 5.6. The transmission requirements of these Clauses should be measured between representative samples of all available port types. Transmission tests should be performed using the circuit of Figure 16 as a guide. The values of V_{-} , $R_{NETWORK}$ and R_{LOCAL} should be the minimum, maximum, and mid-range values selected from Table 3.

- 6.6.13.2 When performing return loss measurements, the return path of the four-wire circuit in the call connection should be opened. To enable testing, instructions should be provided with the CE equipment to indicate the method of opening this return path. If the return path is not readily accessible then the far end of the test call connection should be terminated with the appropriate impedance given in Table 3, i.e. far end balance network, to achieve maximum semi-loop loss.

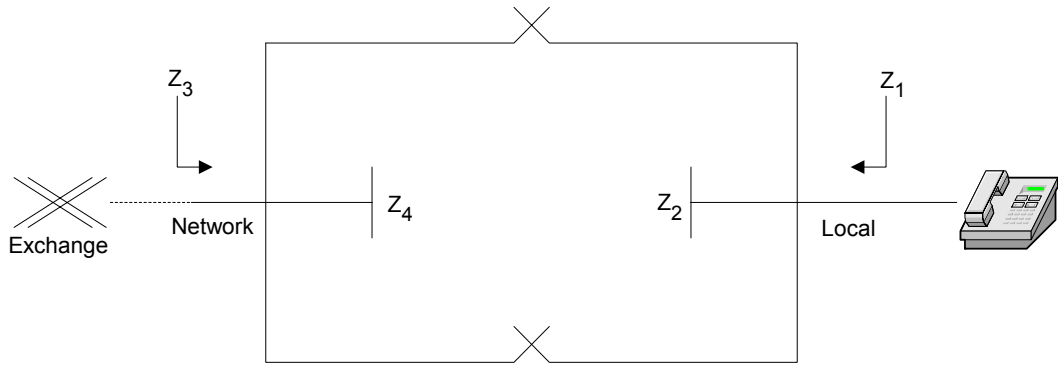
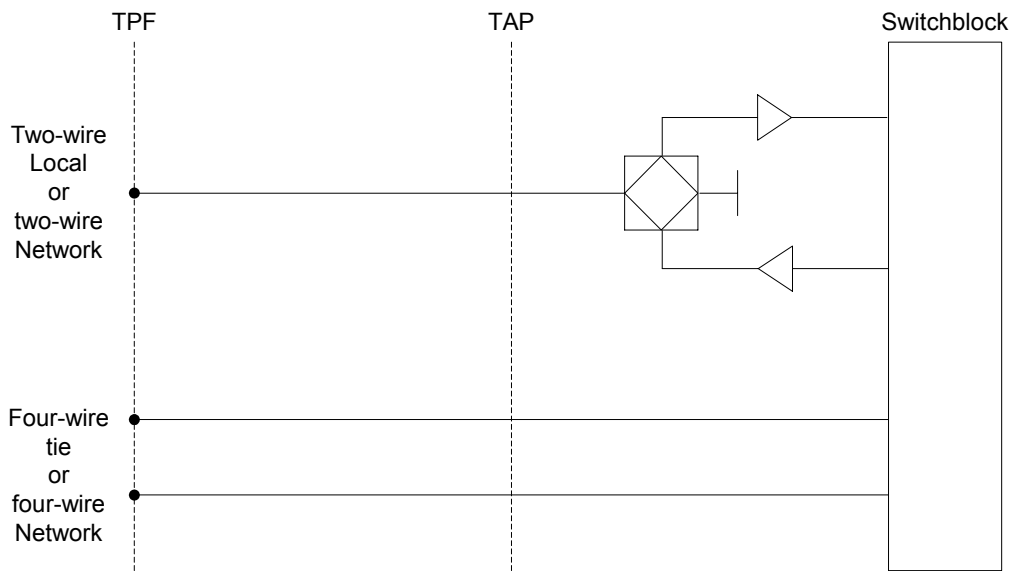


FIGURE 1

Designation of port impedance



TPF Test Point Frame
 TAP Test Access Point

FIGURE 2

CE Test Access Points TAPs

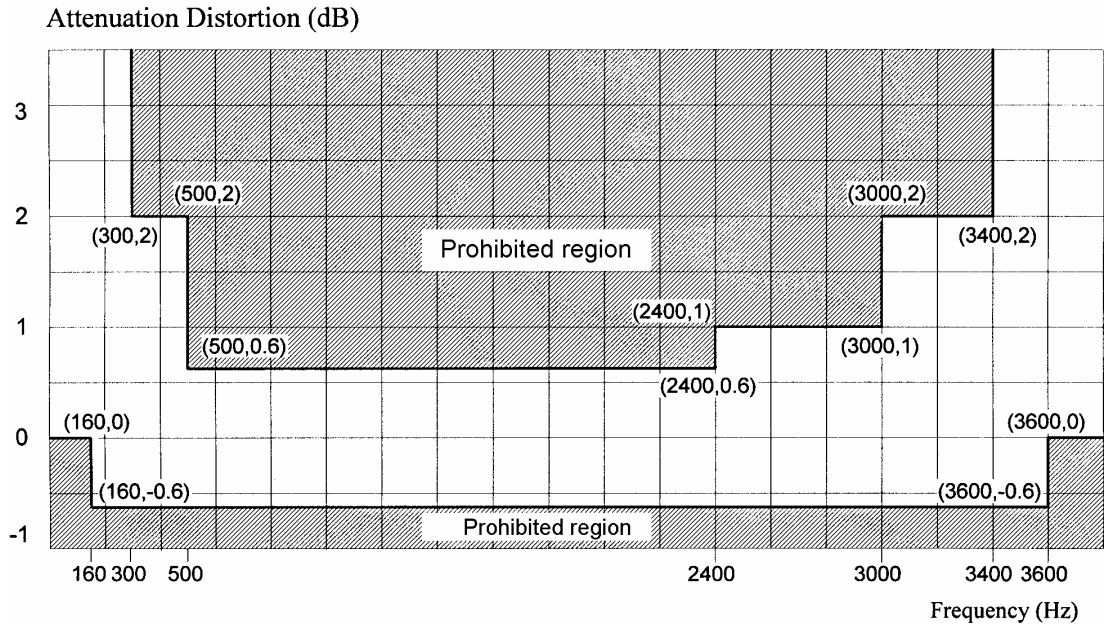


FIGURE 3

Attenuation/Frequency distortion

Gain/Loss Variation (dB)

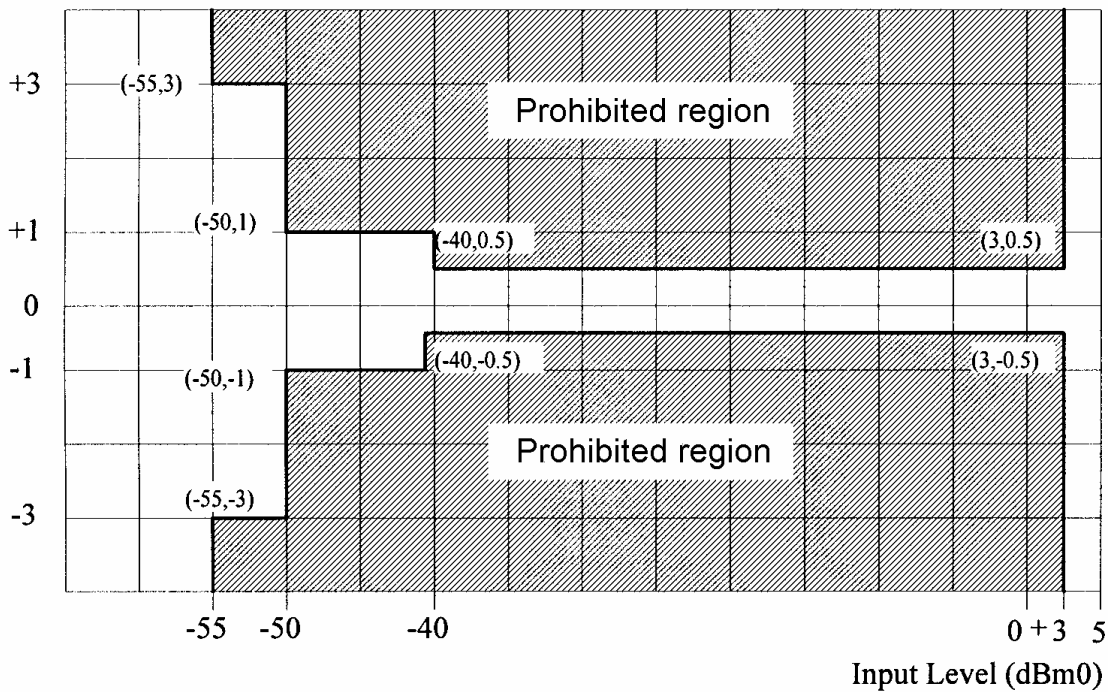


FIGURE 4

Variation of gain with level

Signal to Total Distortion (dB)

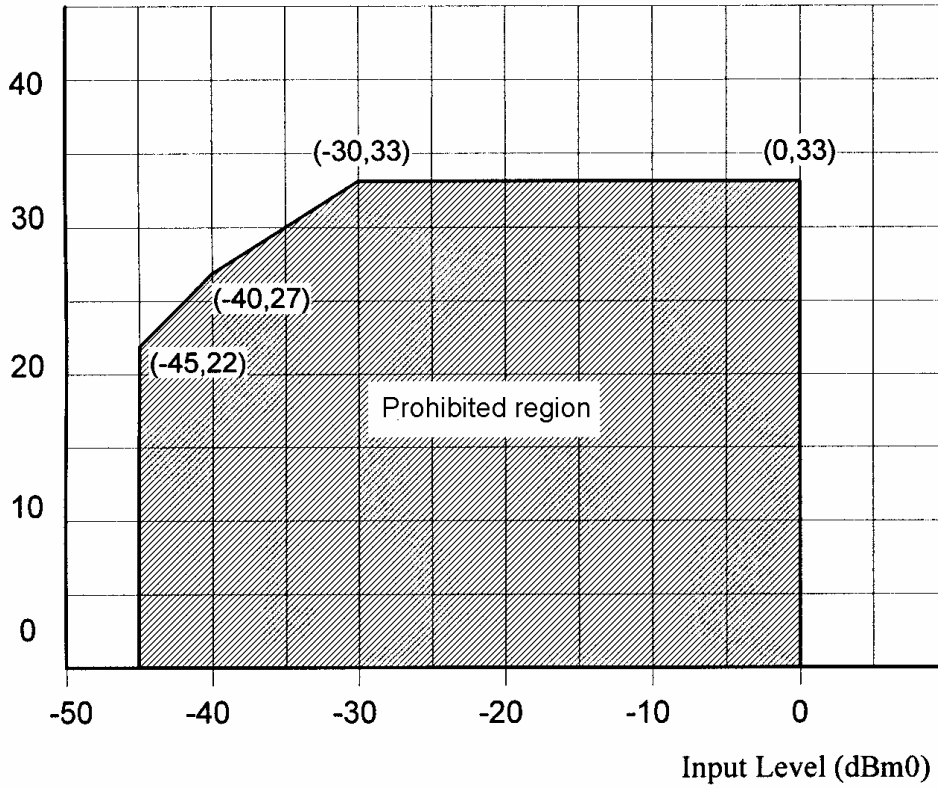


FIGURE 5

Signal to total distortion limits

TBRL (dB)

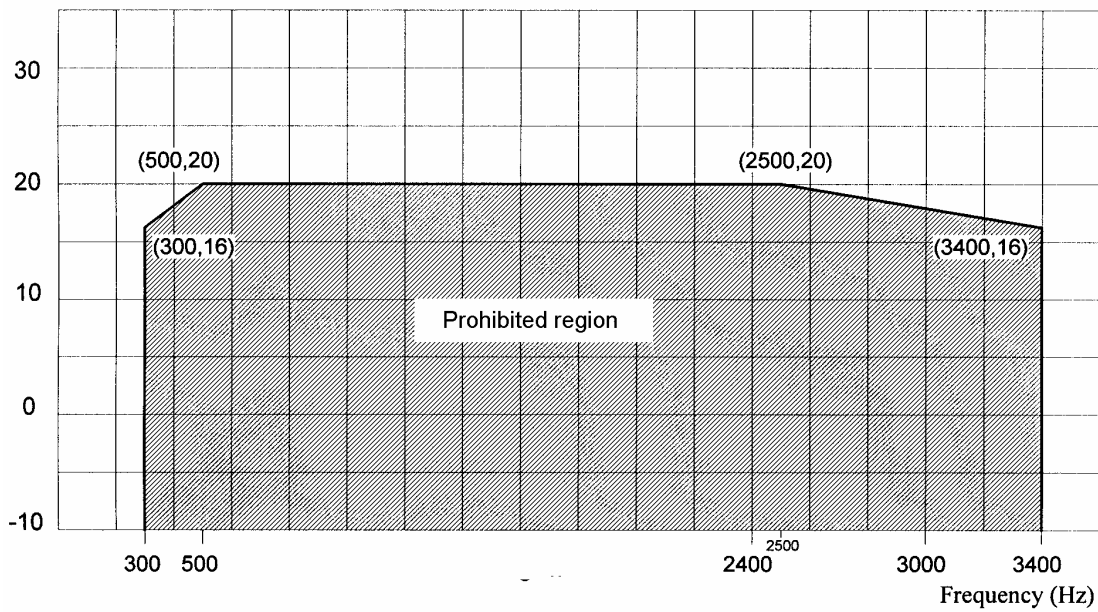
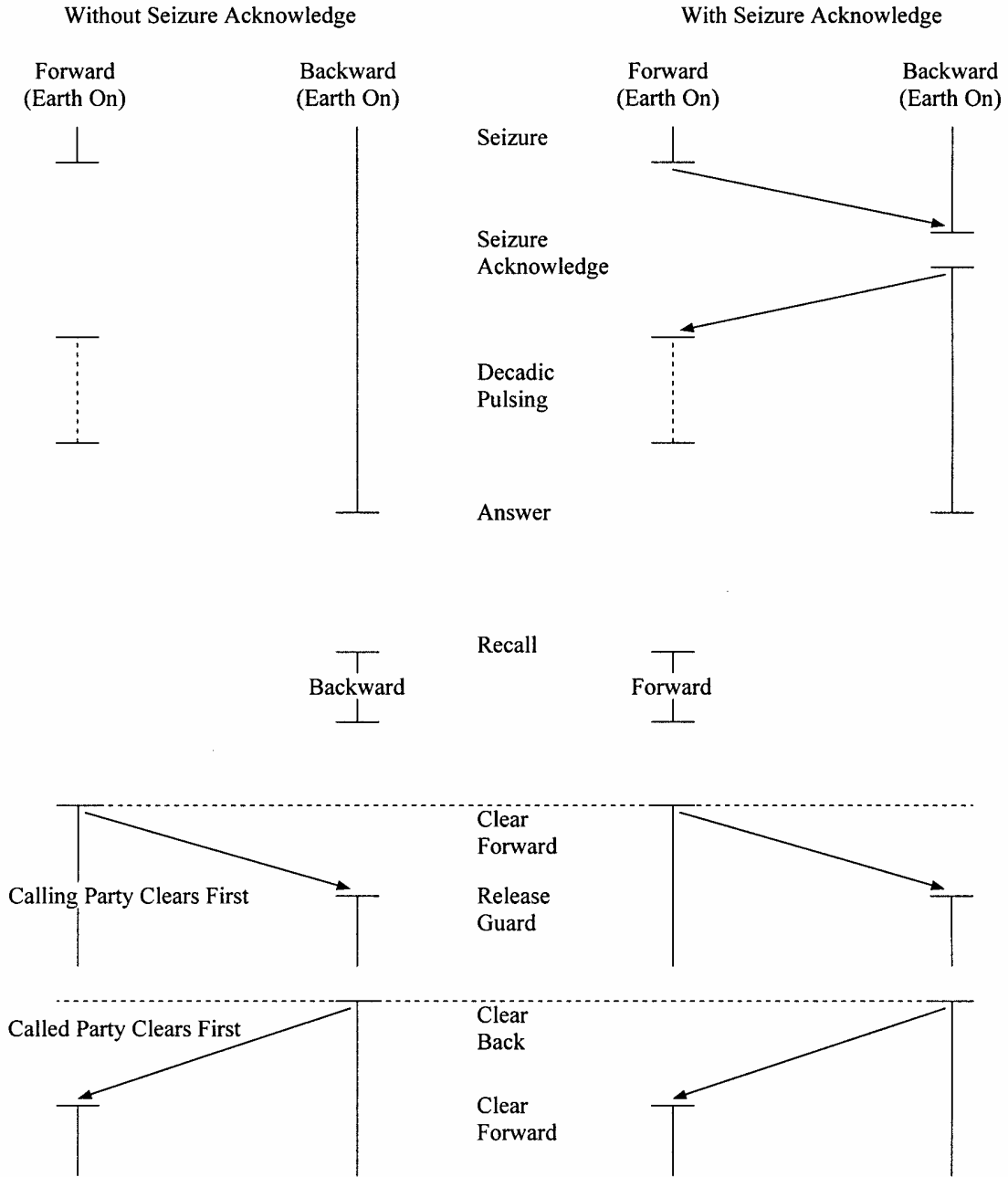


FIGURE 6

Terminal balance return loss



Note: This diagram represents the signalling for "Earth-on-Idle".
 Signalling for "Earth-off-Idle" is the inverse.

FIGURE 7

C2 Series signalling

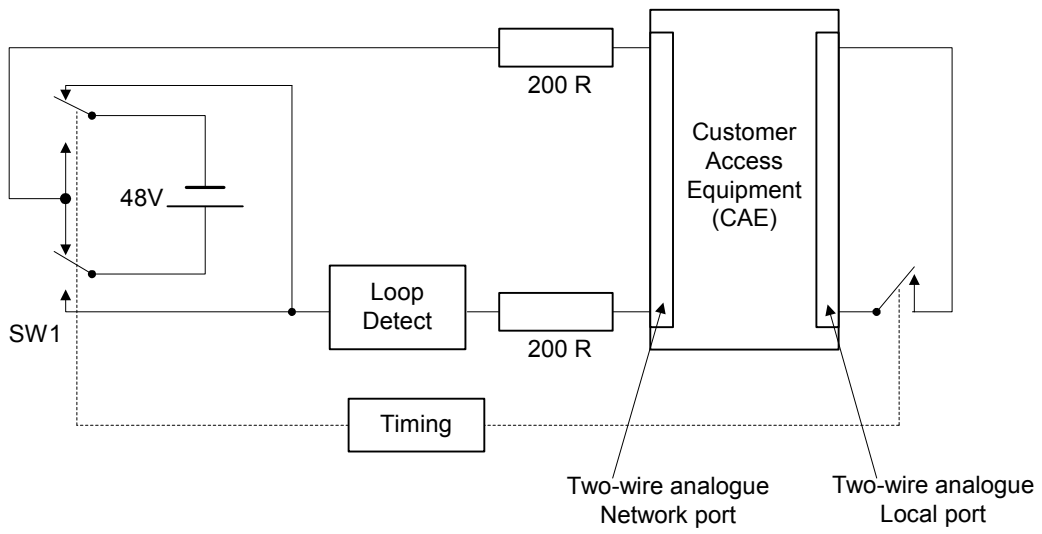


FIGURE 8

Early Guard (polarity reversal) and release blocking

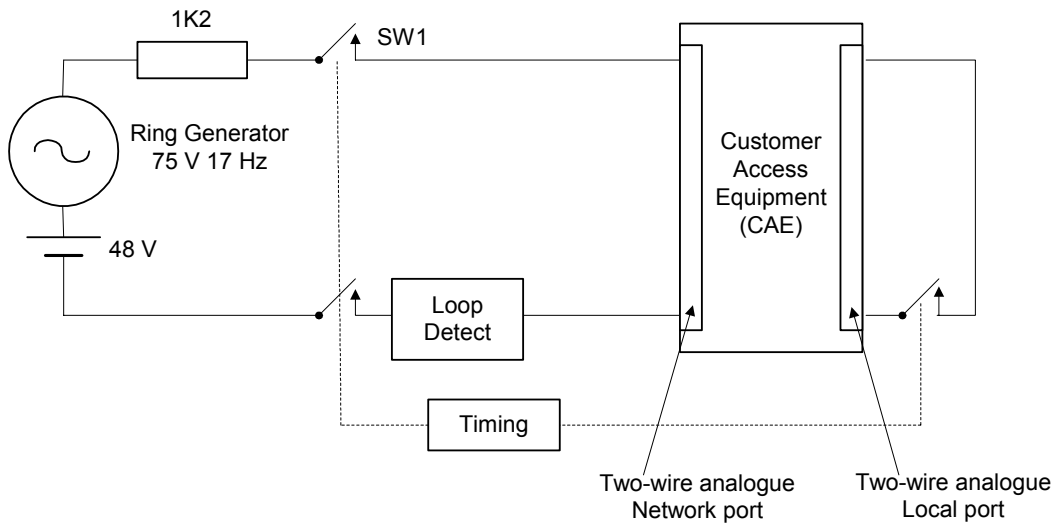


FIGURE 9

Early Guard (immediate ring)

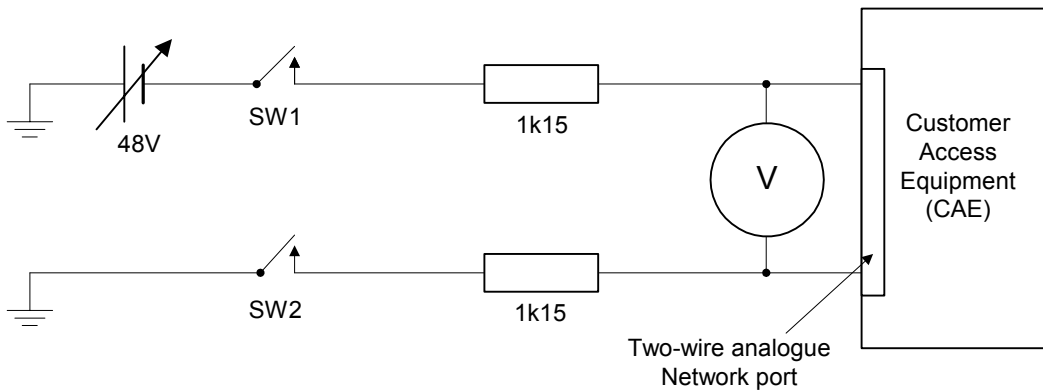


FIGURE 10

Automatic Guard

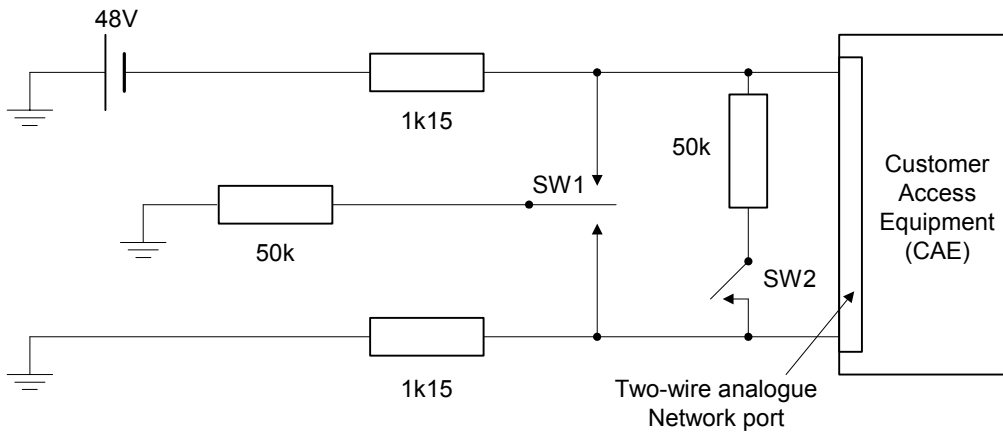
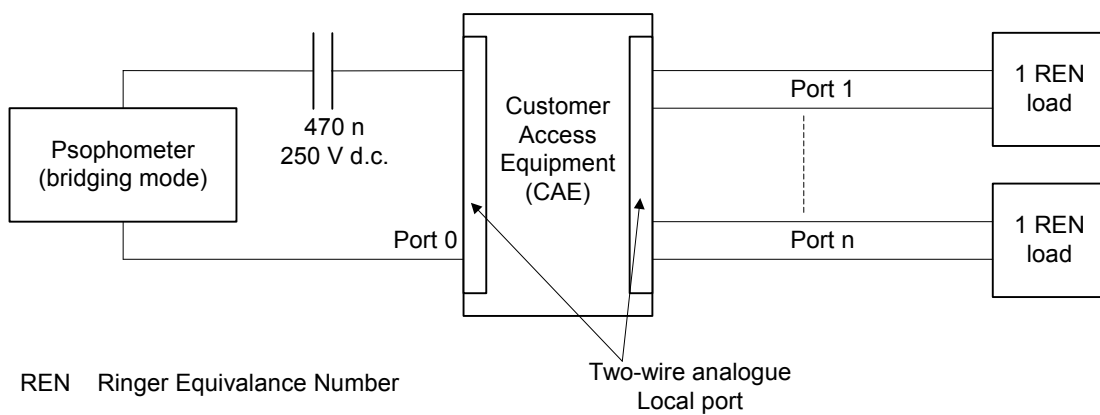


FIGURE 11

Line leakage resistance



REN Ringer Equivalence Number

FIGURE 12

Harmonic content of ring signal

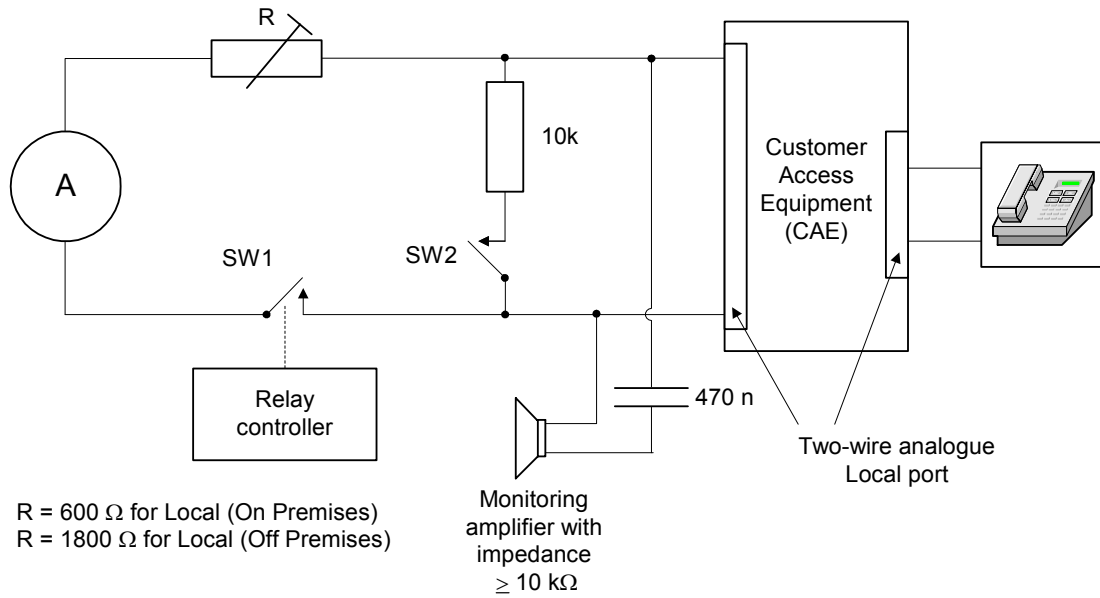


FIGURE 13

Answer/Seizure/Hold/Idle/Release/Facility signals

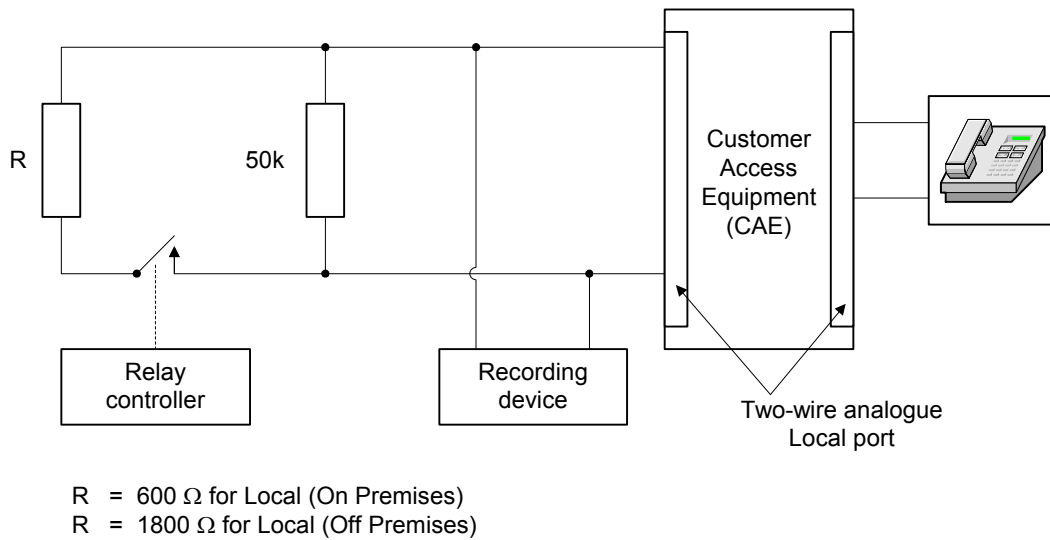
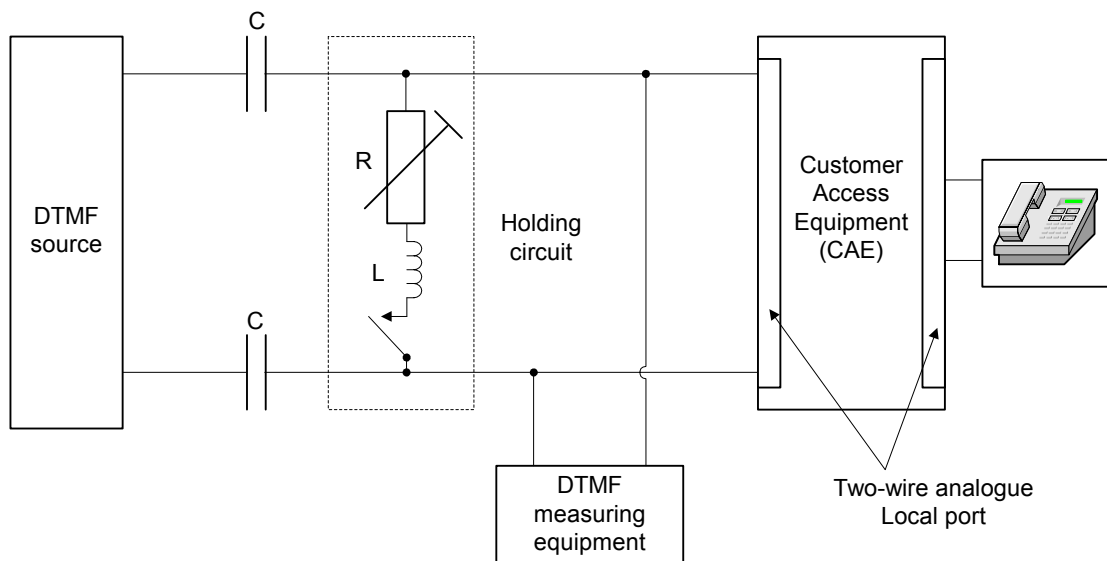


FIGURE 14

Decadic signals



$C \geq 100 \mu\text{F}$

$L \geq 10 \text{ H}$ up to 125 mA d.c. over the range 100 to 4000 Hz

$R = 600 \Omega$ for Local (On Premises) includes resistance of L

$R = 1800 \Omega$ for Local (Off Premises) includes resistance of L

FIGURE 15

DTMF signals

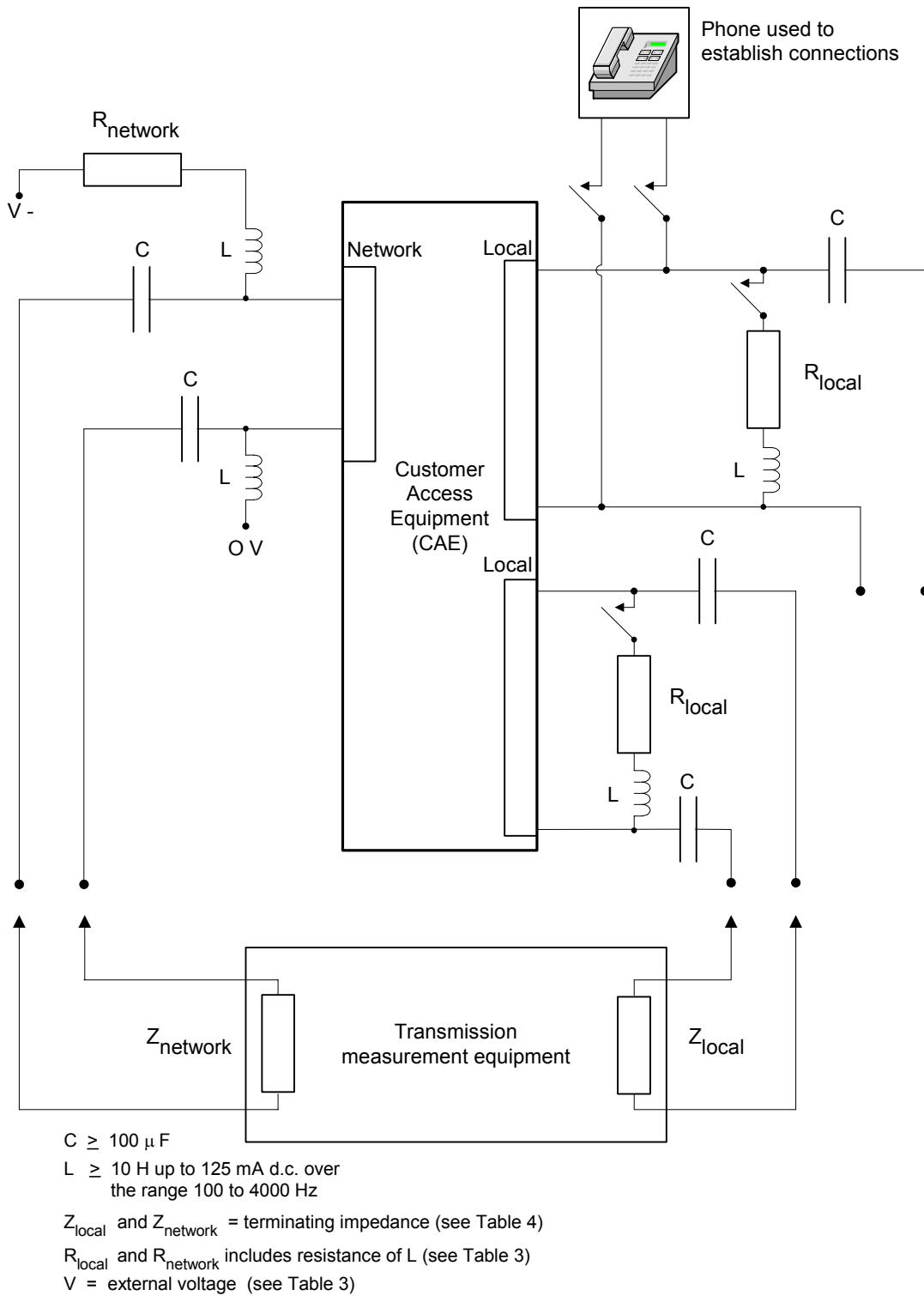
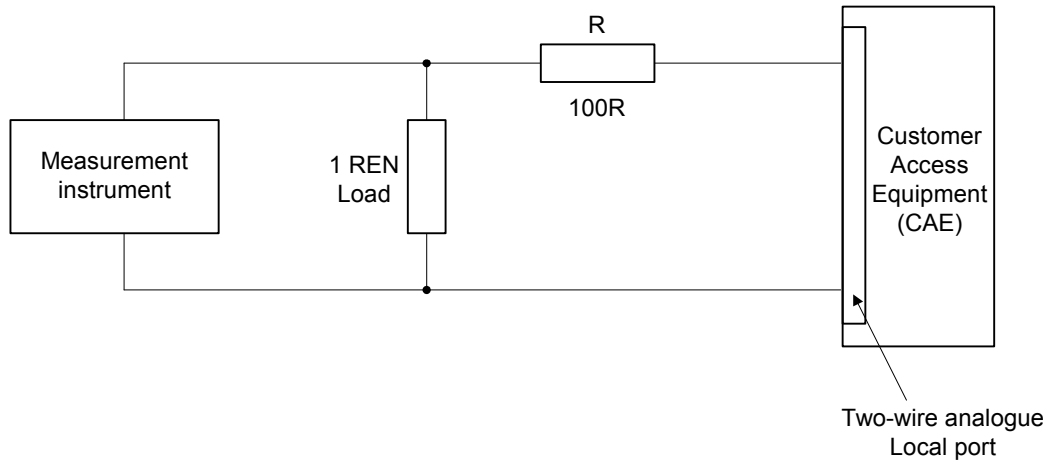
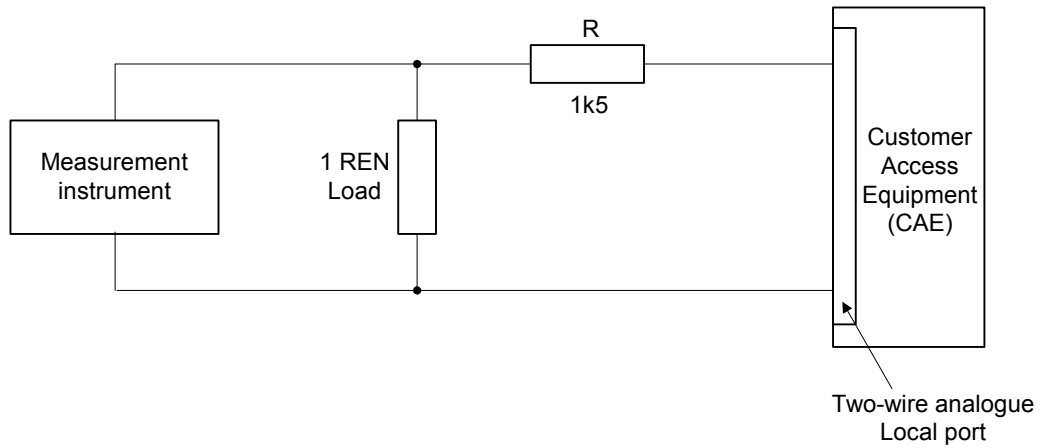


FIGURE 16

Analogue transmission measurement configuration



(a) Local Port (On Premises)



(b) Local Port (Off Premises)

FIGURE 17

Measurement of ring signals

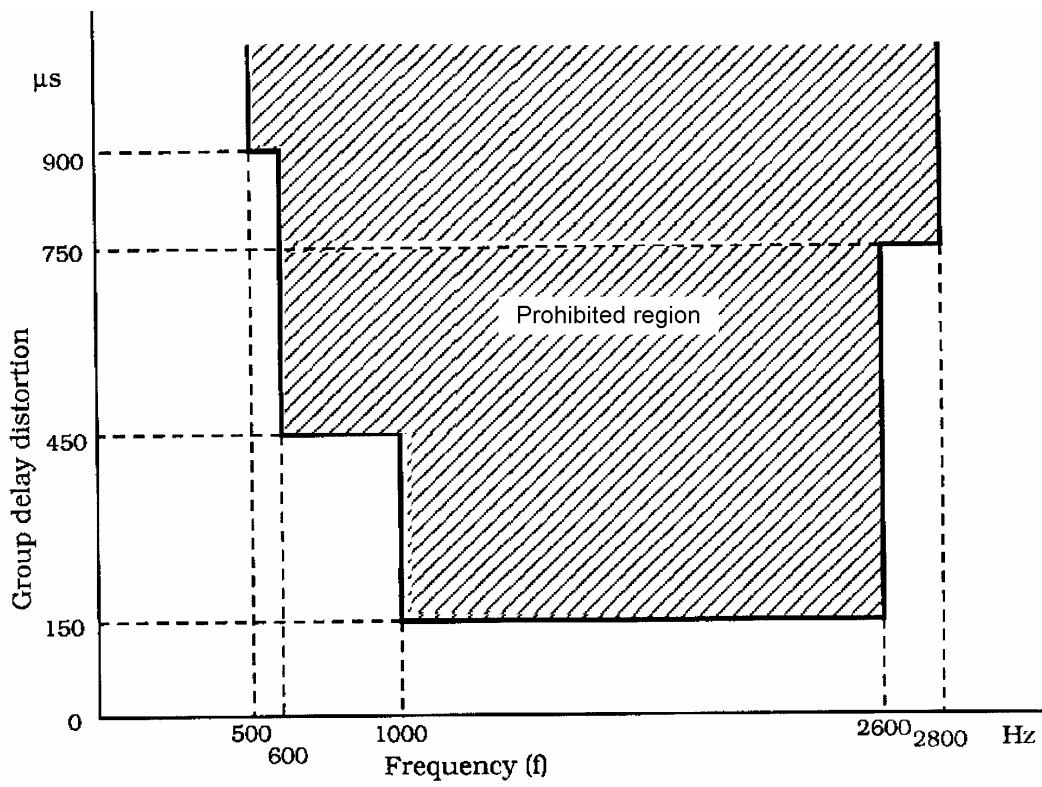


FIGURE 18

Group delay distortion limits with frequency

APPENDIX A

FOUR-WIRE VOICE FREQUENCY INTERFACES

A1 General

- A1.1 The availability of this facility is subject to negotiation with the carrier or carriage service provider. Four-wire VF interfaces employ signalling transfer by means of separate E & M signalling leads. These interfaces may be used to provide access to PSTN and tie-lines. A1.2 Signal transfer is by application of an earth potential on the M-Lead and reception of an earth potential on the E-Lead for forward and backward signal transmission respectively.
- A1.3 Figure A1 illustrates the interconnection.
- A1.4 For PSTN E & M access lines, the signal durations and tolerances when transferred by E and M leads **shall** be identical with signals specified in AS/ACIF S002 [5] for 2 wire loop interface (ring-in/loop-out or loop-in). For tie-lines, the signal durations and tolerances **shall** be as specified in Clause 5.6 of this Standard.
- A1.5 Relative levels for PSTN four-wire voice frequency interfaces are specified in Table 5 of this Standard.

A2 CE Interface with E & M Signalling (including C2)

- A2.1 CE Interface E & M Signalling leads are to comply with the following:
- (a) When the M-Lead is extending earth the maximum voltage drop between FE terminal and the M-Lead terminal **shall** be 1 V for all M-Lead currents up to 25 mA.
 - (b) When the M-Lead presents an open-circuit and -65 V is applied between the M-Lead terminal and the FE terminal, the leakage current **shall not** exceed $150 \mu\text{A}$.
 - (c) The M-Lead switching device **shall** be rated for a continuous M-Lead current of 60 mA.
 - (d) The E-Lead **shall** recognise the following conditions as earth:
 - (i) Any voltage between 0 and -4.5 V applied between the E-Lead terminal and FE terminal.
 - (ii) Any resistance less than 50Ω connected between the E-Lead terminal and FE terminal.
 - (e) The E-Lead current **shall** be between 1 and 25 mA when earth as in A2.1(a) is applied to the E-Lead terminals.
 - (f) The E-Lead **shall** recognise an open-circuit condition when the resistance between the E-Lead terminal and FE terminal exceeds $20 \text{ k}\Omega$.
 - (g) Under open-circuit conditions the E-Lead terminal voltage **shall** be less than -10 V (i.e. at least 10 V negative) to ensure that the earth and open-circuit states can readily be distinguished under test conditions.
- A2.2 Where the CE interfaces directly to PCM multiplex equipment, the CE interface E & M leads **shall** be connected to the PCM multiplexer E & M leads respectively.

Note: The PSTN interface provides the following conditions on the E & M leads of a PCM multiplexer with which the E & M leads of the CE is to interwork:

- (a) The M-Lead provides a contact wetting DC potential of at least -10 V (open-circuit) and between 1 and 25 mA (short-circuit to earth).
- (b) An earth is defined as existing when a resistance between 0 and $50\ \Omega$ is applied between the FE terminal and the M-Lead. An open circuit is defined as existing when a resistance exceeding $20\ \text{k}\Omega$ is connected between FE terminal and the M-Lead.
- (c) When the E-Lead is in the short circuit (extending earth) condition and the E-Lead current is 60 mA, the voltage drop between the E-Lead terminal and the FE terminal is less than 4 V.
- (d) When the E-Lead is in the open circuit (not extending earth) condition and -52 V is applied to the E-Lead terminal, the leakage current will not exceed $150\ \mu\text{A}$.
- (e) The E-Lead switching device is rated for a continuous E-Lead current of 60 mA.

TABLE A1

E & M Signalling states – CE to PSTN

CE condition	Resulting E & M lead state M
On-hook	Open-circuit
Off-hook	Earth

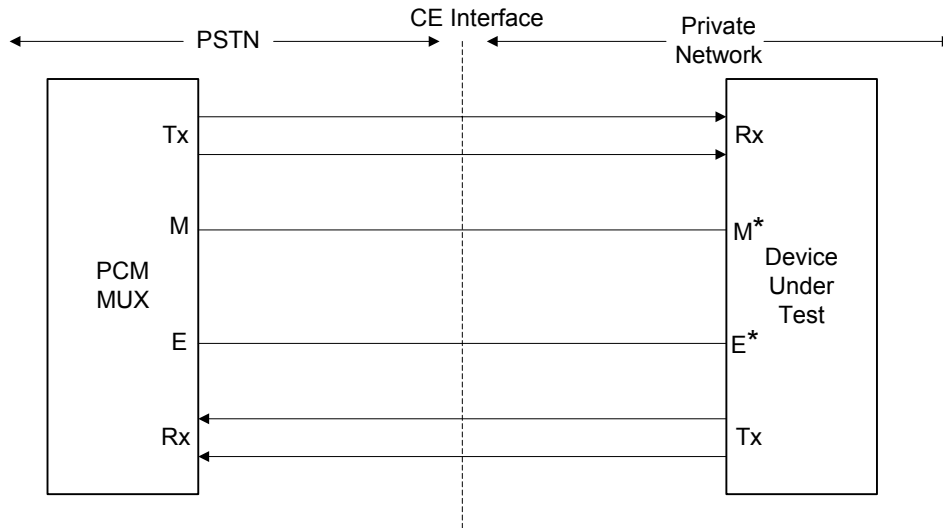
TABLE A2

E & M Signalling states – PSTN to CE

State of E & M lead E	Resulting CE signal
Open-circuit	No ring
Earth	Ring

A3 Proceed to send – Wink Start (outgoing call to PSTN)

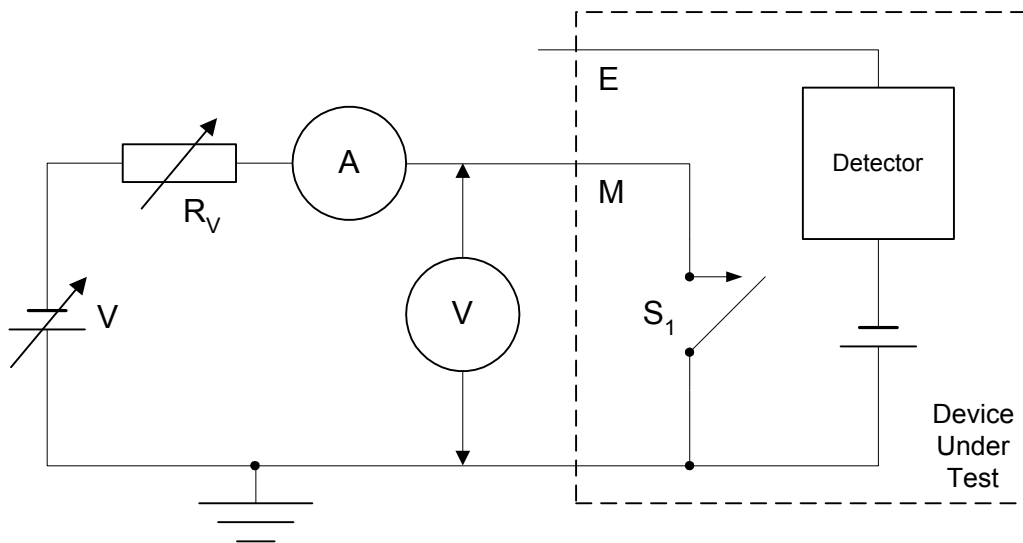
Where a CE has the capability to receive a Wink Start from the PSTN, it **shall** recognise a pulsed earth applied to the E-Lead with a duration in the range 135 ms to 165 ms inclusive, occurring 90 ms and later after the CE Network Port has applied a continuous earth to the M-Lead.



Note: Connections shown with an asterisk (*) assume that CE is a terminating device, i.e. a CAE. If CE is transmission equipment, the signalling connections are to be transposed, i.e. M to E and vice versa.

FIGURE A1

Four-wire CE interface with E & M Signalling



Note: All measurements to accuracy better than:
 ± 2% voltage and current
 ± 0.5% time
 ± 0.25% frequency
 ± 0.2% dB power level

M-Lead earthed for voltage drop and continuous current test
 M-Lead open for leakage current test
 Set voltage and resistance as required
 $V = -4$ to -65 V

FIGURE A2

Test circuit for E & M Signalling – M-Lead voltage drop; M-Lead continuous current and M-Lead leakage current tests

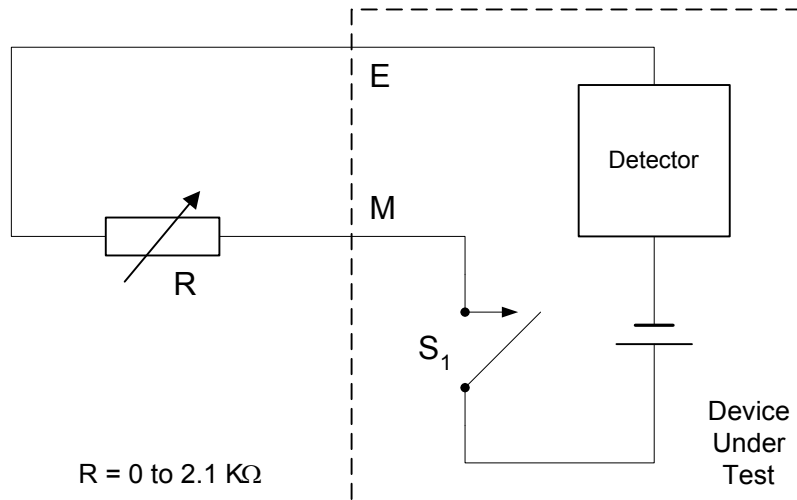
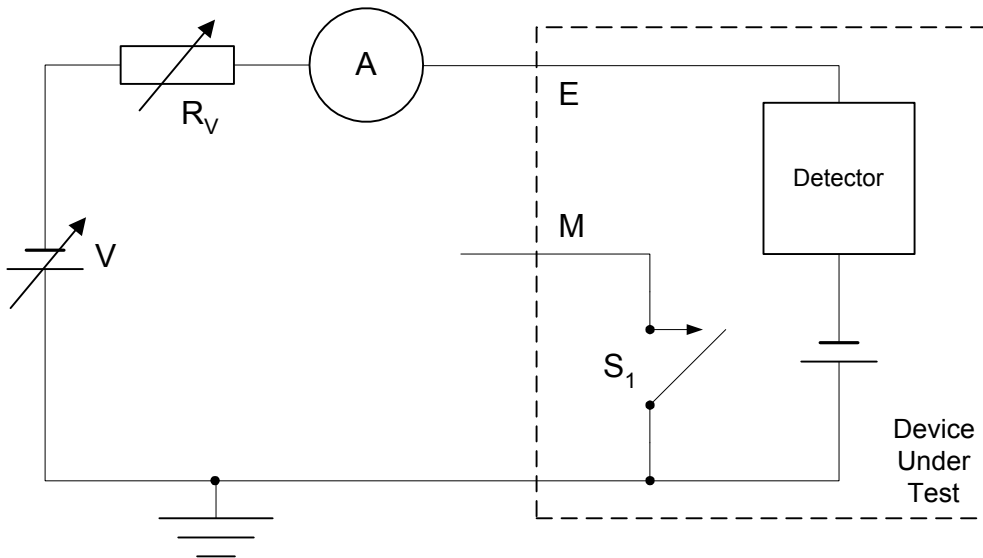


FIGURE A3

Test circuit for E & M Signalling limits

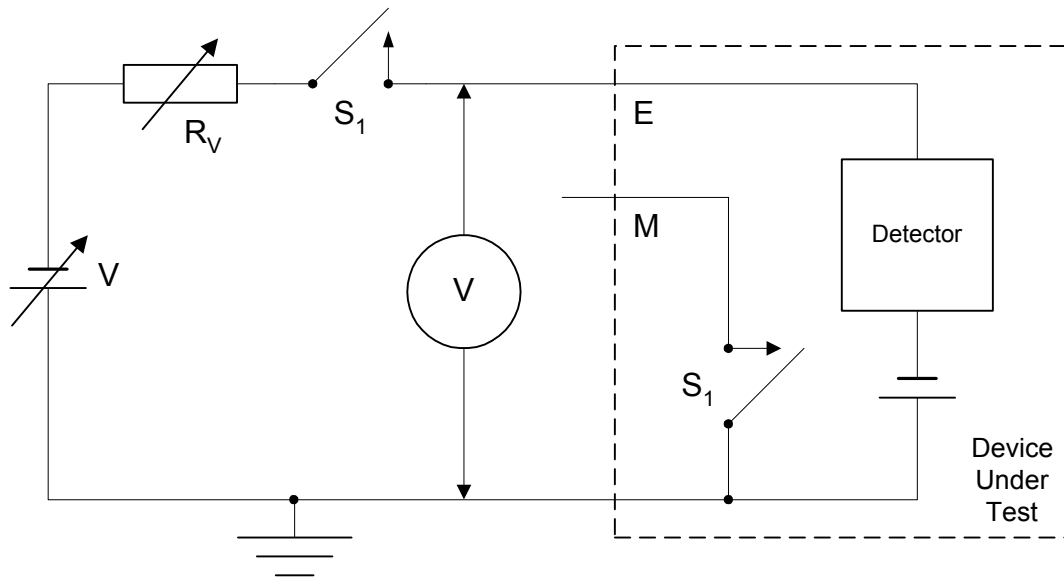


Note: All measurements to accuracy better than:
 $\pm 2\%$ voltage and current
 $\pm 0.5\%$ time
 $\pm 0.25\%$ frequency
 $\pm 0.2\%$ dB power level

$R_v = 0 \text{ to } 2.1 \text{ k}\Omega$
 $V = 0 \text{ to } -4.5 \text{ V}$

FIGURE A4

Test circuit for E & M Signalling limits E-Lead sensitivity test



Note: All measurements to accuracy better than:
 $\pm 2\%$ voltage and current
 $\pm 0.5\%$ time
 $\pm 0.25\%$ frequency
 $\pm 0.2\%$ dB power level

$R_v = 0$ to $24 \pm 1\%$ k Ω
 $V = 0$ to -4.5 V

FIGURE A5

Test circuit for E & M Signalling – E-Lead open circuit and leakage test

APPENDIX B

2048 KBIT/S PSTN INTERFACE – CAS PROTOCOL

B1 General

- B1.1 This Appendix specifies the signalling requirements for the digital connection of a CE to the PSTN for unidirectional or bothway operation. The signalling scheme uses CAS in timeslot 16 for line signals. Information signals are sent as either line signals (Decadic Pulses) or in-band tones (DTMF or MFC).
- B1.2 Figure B1 and Figure B2 describe the signalling states and transitions for the signalling protocol for outgoing and incoming calls.

B2 Signalling

- B2.1 The timeslot 16 signal is a two bit protocol and **shall** be as defined in Table B1 for calls outgoing from CE and Table B2 for calls incoming to CE.
- B2.2 Faults detected at the CE in the PCM equipment may be indicated by a Service Alarm as defined in Tables B1 and B2. Such faults **shall** initiate the sending of the PCM Fault signal, on idle channels. When the fault conditions are cleared the channel shall return to the idle state.
- B2.3 The Seize Acknowledge signal as defined in Tables B1 and B2 **shall** not be returned in response to a Seize Forward on decadic or DTMF signalling inlets until the CE is ready to receive decadic or DTMF signals.
- B2.4 The bits 'a' and 'b' in Tables B1 and B2 are as defined in ITU-T Recommendation G.704 [15]. The bits 'c' and 'd' are not used in this scheme and **shall** be set in accordance with ITU-T Recommendation G.704 [15] Table 9/704 Note 3 to be 'c'= 0 and 'd'= 1.

TABLE B1

Signalling codes – Outgoing call

Forward		State	Backward	
a_f	b_f		a_b	b_b
1	0	Idle	1	0
0	0	Seize Forward		
		Seize Acknowledge	1	1
		Answer	0	1
1	0	Clear Forward		
		Release Guard (Note)	1	0
		Line lockout	1	1
		Blocking	1	1
1	0	Dial Break		
0	0	Dial Make		
		Meter Pulse	1	1
1	0	Timed Loop Break	1	1
1	1	PCM Fault	1	1

Note: Release Guard is defined as the transition to idle in response to a Clear Forward signal.

TABLE B2

Signalling codes – Incoming call

Forward		State	Backward	
a _f	b _f		a _b	b _b
1	0	Idle	1	0
0	0	Seize Forward		
		Seize Acknowledge (Note)	1	1
		Answer/Re-answer	0	1
1	0	Clear Forward		
		Clear Back	1	1
		Release Guard	1	0
		Blocking	1	1
1	0	Dial Break		
0	0	Dial Make		
1	0	Timed Loop Break	1	1
1	1	PCM Fault	1	1

Note: Release Guard is defined as the transition to idle in response to a Clear Forward signal.

B3 Timing

B3.1 Signalling state transition times

B3.1.1 A signalling state **shall** only be accepted as valid if it is observed in at least 5 consecutive multiframes.

B3.1.2 If a change in signalling states requires a change in both bits, then these bits **shall** both change in the same multiframe (2 ms).

B3.2 State and signal limits

B3.2.1 General

Signals are continuous except for those described in Tables B3 and B4, for which the indicated timing requirements **shall** apply.

TABLE B3

Timing limits – Outgoing call

Description	Timers	Value (ms)
Dial Make		30 to 50
Dial Break		50 to 70
Meter Pulse (Note 1)	T2 and T7	90 to 190
Release Guard	T5	80 to 120
Interdigital Pause		400 to 1600
Timed Loop Break (facility request) (Note 2)	T6	80 to 100

Note 1: Timer values include signal validation time, refer Clause B3.1.1.

Note 2: Recognition of the Timed Loop Break (facility request) signal may not be provided by a carrier or carriage service provider.

Note 3: A meter pulse is optionally available as a signal from the PSTN for outgoing calls.

TABLE B4

Timing limits – Incoming call

Description	Timers	Value (ms)
Dial Make		30 to 50
Dial Break		50 to 70
Timed Loop Break (facility request) Note 1	T6	80 to 100
Release Guard	T5	80 to 120
Interdigital Pause		400 and greater

Note 1: Timed Loop Break (facility request) recognition may be optionally available from a carrier or carriage service provider.

Note 2: Timer values include signal validation time, refer Clause C3.1.1.

B3.2.2 Outgoing calls

B3.2.2.1 The time supervision period for receipt of the Seize Acknowledge signal when an outgoing call is attempted **shall** be in the range 810 ms to 2000 ms inclusive from the instant of application of the Seize signal.

B3.2.2.2 The timing, level and frequency requirements for the sending of DTMF in-band signals **shall** comply with the ring-in/loop-out requirements in AS/ACIF S002 [5].

Note: No absolute level adjustment is required to compensate for the difference in relative level between the analogue interface in AS/ACIF S002 [5], and the digital interface in this Standard.

- B3.2.3 Incoming calls
- B3.2.3.1 A valid Seize Acknowledge signal **shall** be returned within 810 ms of the instant of application of the Seize signal (subject to the availability of digit address receivers, etc.).
- B3.2.3.2 The timing, level and frequency requirements for the reception of MFC and DTMF signals **shall** comply with the loop-in line requirements in AS/ACIF S002 [5].
- Note: No absolute level adjustment is required to compensate for the difference in relative level between the analogue interface in AS/ACIF S002 [5] and the digital interface in this Standard

B4 Action on faults and transmission degradation

- B4.1 A link may fail to perform satisfactorily due to equipment failures in transmission or switching equipment, or due to transmission path degradation. The Service Alarm (SA) indicates that the transmission link has failed. This alarm when provided **shall** operate within 2 ms of transmission errors being detected to avoid recognition of corrupted signals. The SA **shall** operate at the remote end within 10 ms of activation of the Remote Alarm Signal.
- Note: For further information relating to Service Alarms, refer to ITU-T Recommendation G.732 [17] §§ 4.2.
- B4.2 Equipment failures or transmission path degradation should not cause wrong number, false answer or unnecessary call clear down during transient degradations. To achieve this protection, the following action **shall** be taken on the occurrence of a fault or degradation:
- (a) During idle the link **shall** be blocked to calls.
 - (b) During call set-up the call **shall** be cleared immediately, independent of the duration of the fault or degradation (to prevent wrong numbers that may occur due to lost or split digit signals).
 - (c) During call answer or clear back states, the call **shall** be held for a nominal 6 s before being cleared. This avoids clearing a call during transient degradations. False answering or metering is avoided by freezing the state of the line signals in those states that existed at the time of the fault, and by clearing the call when 6 s (T3) has expired. At the incoming end, timer T4 is set to 7 s to ensure that the outgoing end is released first.

B5 Summary of actions appropriate to various signals

Tables B5 and B6 together with the associated notes summarise the actions appropriate to the various signal combinations.

TABLE B5

Signalling conditions – originating call from the CE

State	Code sent from CE	Code received from PSTN			
		$a_b = 0 \ b_b = 0$	$a_b = 0 \ b_b = 1$	$a_b = 1 \ b_b = 0$	$a_b = 1 \ b_b = 1$
Idle	$a_f = 1 \ b_f = 0$	Incoming Seizure or Abnormal (Note 1)	Abnormal (Note 2)	Idle	Blocking
Seizure	$a_f = 0 \ b_f = 0$	Double Seizure or Abnormal (Note 3)	Abnormal (Note 2)	Outgoing Seizure (Note 4)	Seizure Acknowledge
Seized Outgoing Note 5	$a_f = 0 \ b_f = 0$	Abnormal (Note 6)	Answer (Note 7)	Abnormal (Note 8)	Seizure Acknowledge (Note 10)
Answered	$a_f = 0 \ b_f = 0$	Abnormal (Note 6)	Answer	Abnormal (Note 9)	Meter Signal (Note 10)
Meter	$a_f = 0 \ b_f = 0$	Abnormal (Note 6)	Answer	Abnormal (Note 9)	Meter Signal (Note 10)
Clear Forward	$a_f = 1 \ b_f = 0$	Abnormal (Note 2)	Clear Forward	Release Guard Idle	Clear Forward
Release Guard/Idle	$a_f = 1 \ b_f = 0$	Seizure or Abnormal (Note 1)	Abnormal (Note 2)	Idle	Blocking
Blocking	$a_f = 1 \ b_f = 0$	Abnormal (Note 2)	Abnormal (Note 2)	Idle	Blocking

Note 1: When the channel is operating in a bothway mode and is idle, receipt of this signal constitutes a seizure from the other end which then assumes the status of the outgoing end.

When the channel is operating in a one-way mode, this signal is abnormal and action should be taken in accordance with Note 2.

Note 2: In these abnormal conditions the CE should prevent outgoing seizures of the channel.

Note 3: On recognition of double seizure, the CE should reject or re-route the CE outgoing call attempt, prevent further seizures and accept the incoming PSTN call.

The PSTN will continue to send a seize and wait for a seizure acknowledge signal from the CE. Non recognition of the seizure acknowledge signal will result in PSTN action equivalent to that described in Note 4.

Note 4: If the seizure acknowledge signal is not recognised within a time supervision period of 810 to 2000 ms after sending the seizure signal, a maintenance alarm should be operated and either a busy signal sent to the CE extension or a repeat attempt made to set up the call on another channel. The CE should continue to send the seizure signal and prevent outgoing seizures of the channel. If the seizure acknowledge signal is recognised after the time supervision period has elapsed, a clear forward signal should be sent.

Note 5: For Decadic Signalling the Dial Break is equivalent to a timed Clear Forward during the seized outgoing state after receipt of a seizure acknowledge.

Note 6: In these circumstances the CE should respond by sending a clear forward, prevent outgoing seizure, and await an idle condition from the PSTN.

- Note 7: If an answer signal is recognised prematurely, i.e. before the completed address has been sent, the call should be released by the CE and a busy signal sent to the CE extension.
- Note 8: On receipt of $a_b = 1$ and $b_b = 0$ by the CE after recognition of the seizure acknowledge and prior to recognition of the answer signal a clear forward signal should be sent.
- Note 9: In the case of recognition $a_b = 1$ and $b_b = 0$, whilst in receipt of answer or meter pulse, the CE should force release the call. Also see Note 6.
- Note 10: LINE LOCKOUT is defined as a state in which only the individual channel equipment is occupied. There is no occupancy of common exchange resources. Busy Tone or Congestion Tone may be applied for a period prior to setting an individual channel in the LINE LOCKOUT.

LINE LOCKOUT may occur before or after reception of an Answer signal (i.e. in the SEIZED OUTGOING or in the ANSWER states). An identifiable signal transition to indicate that an individual channel has entered the LINE LOCKOUT state will not occur during the SEIZED OUTGOING state, as the signal code for Seize Acknowledge and Line Lockout are identical. An identifiable signal transition to indicate that an individual channel has entered the LINE LOCKOUT state will occur when the individual channel is in the ANSWER state; LINE LOCKOUT can be recognised by the expiration of timer T7 following reception of $a_b b_b = 1, 1$.

TABLE B6

Signalling conditions – incoming call to the CE

State	Code sent from CE	Code received from PSTN			
		$a_f = 0 \ b_f = 0$	$a_f = 0 \ b_f = 1$	$a_f = 1 \ b_f = 0$	$a_f = 1 \ b_f = 1$
Idle Released	$a_b = 1 \ b_b = 0$	Seizure	Fault (Note 1)	Idle	Fault (Note 1)
Seizure Acknowledge Seized Incoming (Note 2)	$a_b = 1 \ b_b = 1$	Seizure Acknowledge	Fault (Note 3)	Clear Forward	Fault (Note 3)
Answer	$a_b = 0 \ b_b = 1$	Answer Re-answer	Fault (Note 4)	Clear Forward (Note 5)	Fault (Note 4)
Clear Back	$a_b = 1 \ b_b = 1$	Clear Back	Fault (Note 4)	Clear Forward (Note 5)	Fault (Note 4)
Blocking	$a_b = 1 \ b_b = 1$	Fault (Note 6)	Fault (Note 7)	Blocking	Fault (Note 7)
Invalid Code (Note 2)	$a_b = 0 \ b_b = 0$	Fault (Note 6)	Fault (Note 7)	Abnormal (Clear Forward See Note 8)	Fault (Note 9)

Note 1: When idle, if b_f changes to 1, then b_b should also be changed to 1 to indicate a fault. For a bothway channel if $a_b = 1$ and $b_b = 1$ in either direction, this will constitute a blocking signal.

- Note 2: (a) On recognition of double seize, the PSTN will wait for a seizure acknowledge signal from the CE. The CE should reject or re-route the outgoing CE call attempt.
- (b) If the channel is operating in a one-way mode, the Seizure Acknowledge signal should be recognised as abnormal and action taken at the CE to prevent new seizures of the channel.

Note 3: On receipt of a fault signal (and service alarm signal) any equipment seized in the forward direction should be released. $a_b = 1$ and $b_b = 1$ should be maintained until the service alarm is removed and a clear forward is received.

While the backward signal remains unchanged the channel can change from seizure acknowledge to fault and possibly to blocking before it returns to idle.

Note 4: No action should be taken to clear down the call connection until the expiry of a time supervision period of 6 ± 1 s, to guard against loss of calls due to short transmission impairments.

Within the time supervision period, the channel should remain in the answer state subject to A and B party's control of the channel.

At the expiry of the time supervision period the channel should be force released and marked as faulty/blocked until the service alarm is removed.

Note 5: After clear forward is recognised and until the release guard time expires, all transitions in the forward direction should be ignored.

Note 6: In this case immediate action is not necessary. However, rapid release of the channel by the PSTN should occur if the CE simulates the answer condition by sending $a_b = 0$ and $b_b = 1$.

Note 7: Under these conditions no action is to be taken.

Note 8: The PSTN may respond to $a_b = 0$, $b_b = 0$ with a clear forward signal.

Note 9: On receipt of a fault signal, any equipment seized in the forward direction should be released. $a_b = 1$ and $b_b = 1$ should be sent until the fault is cleared and a clear forward received.

Note 1: For CAE originating calls a Facility Request Signal is sent to the PSTN exchange as a Timed Clear Forward Signal of duration T6.
 Note 2: When dual seizure occurs the CAE allows the incoming call to terminate and reselects another idle channel for the outgoing call.

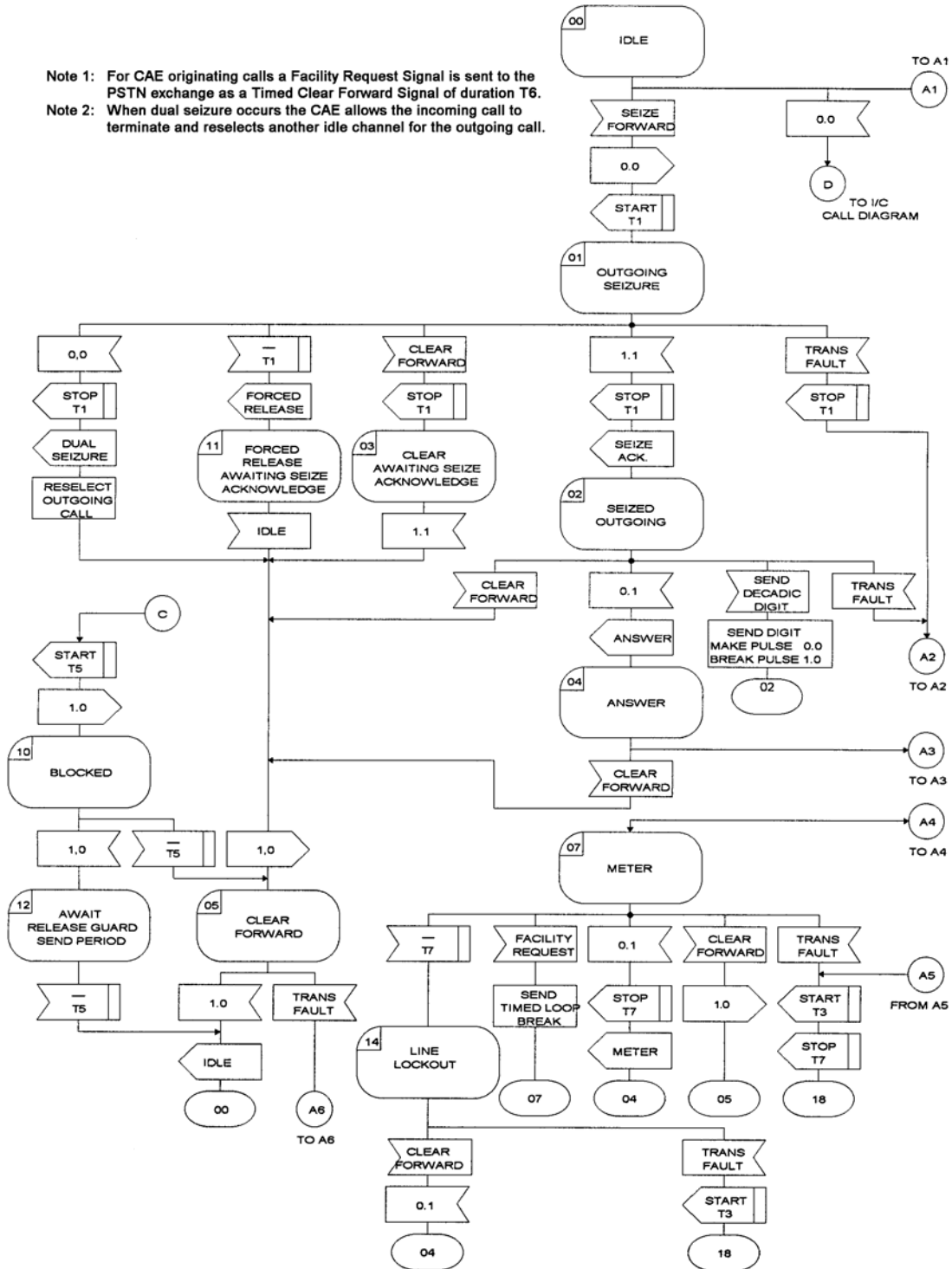


FIGURE B1

CAS Line signalling functions – outgoing calls
 (a) State and transition diagram (Sheet 1 of 2)

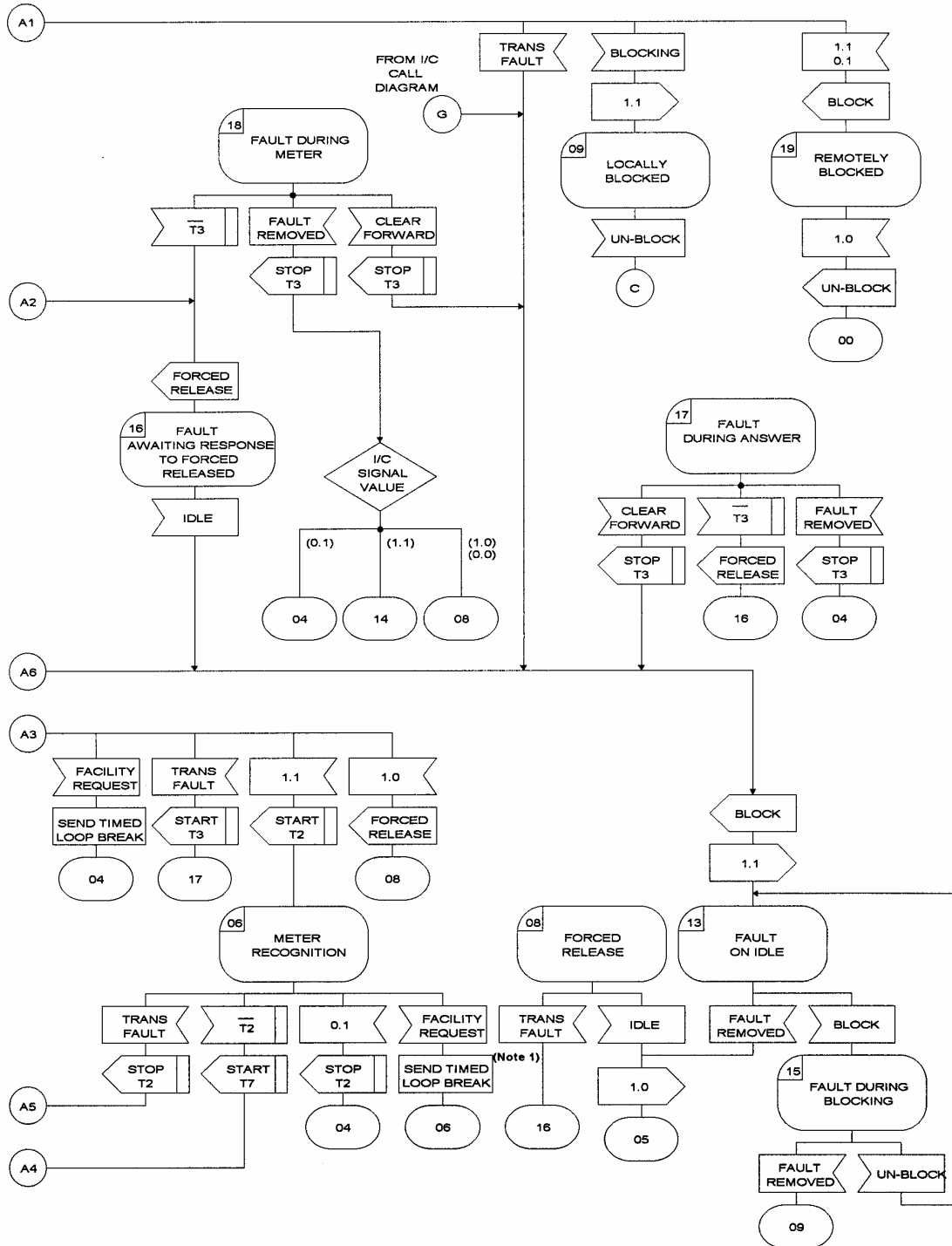
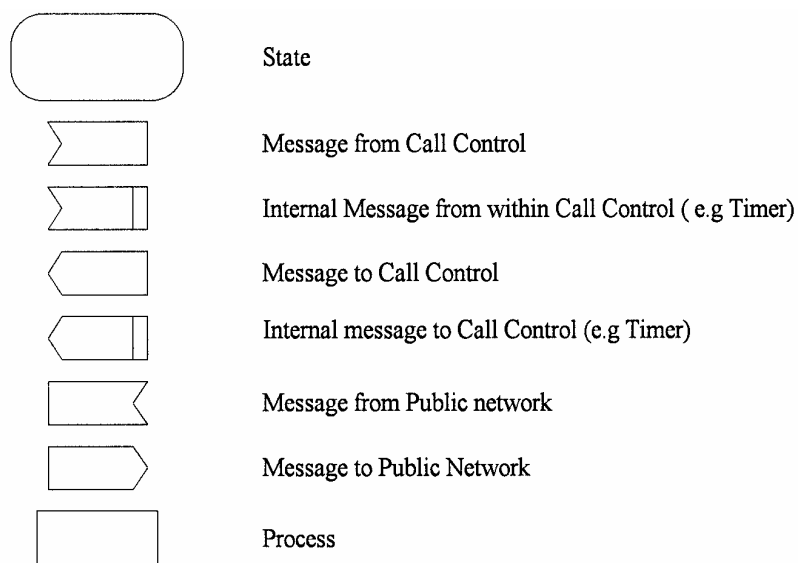


FIGURE B1

**CAS Line signalling functions – outgoing calls
(b) State and transition diagram (Sheet 2 of 2)**



VALUES

T1	Seize ack time supervision	800 to 2000 ms
T2	Meter recognition – lower limit	90 +0/–10 ms
T3	Delay before clear-down on fault (after answer outgoing end)	6 +/-1 s
T5	Bothway release guard send time	100 +/-20 ms
T6	Send time for timed loop break / facility request	90 +/-10 ms
T7	Meter recognition – upper limit	190 +10/–0 ms

Note: Values include signal validation time, refer C3.1.1.

FIGURE B1

**CAS Line signalling functions – outgoing calls
(c) Legend**

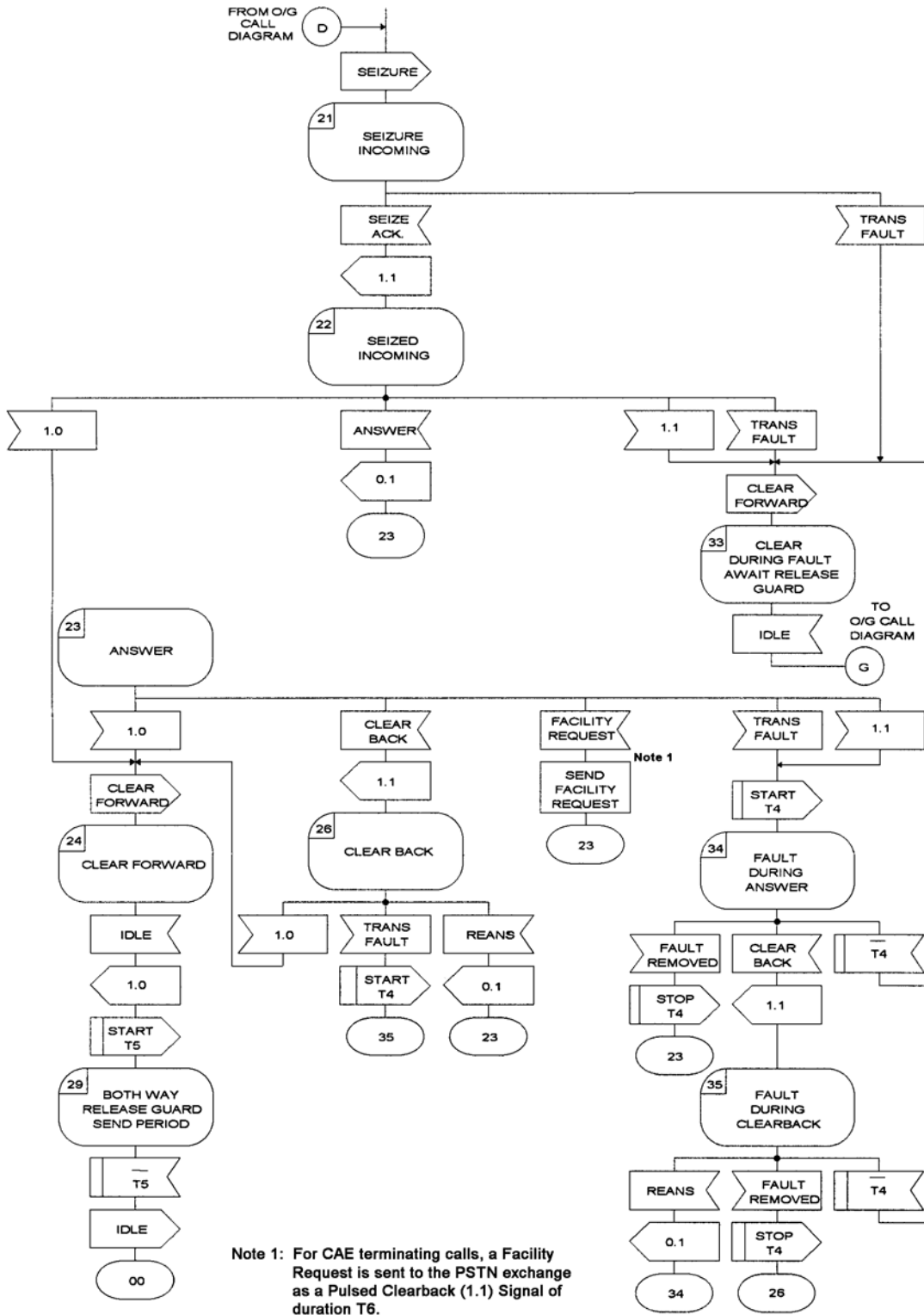
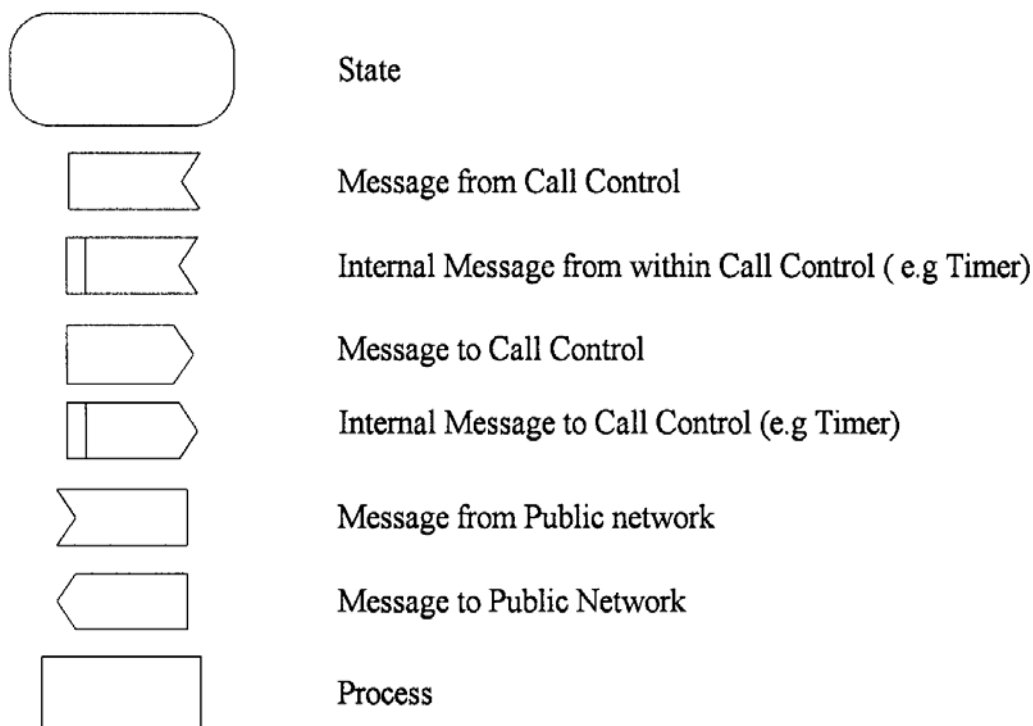


FIGURE B2

CAS Line signalling functions – incoming calls
(a) State and transition diagram



VALUE

T4	Delay before Cleardown on Fault (After Answer Outgoing End)	7 ± 1 (s)
T5	Bothway Release Guard Send Time	100 ± 20 (ms)
T6	Send Time for Timed Loop break/ Facility Request	90 ± 10 (ms)

- Note 1: Values include Signal Validation Time, refer C3.1.1.
 Note 2: For CAE terminating calls a Facility Request is sent to the PSTN Exchange as a pulsed Clearback (1.1) Signal of duration of T6

FIGURE B2

**CAS Line signalling functions – incoming calls
(b) Legend**

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.

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