

# ETSI TS 101 909-18 V1.3.1 (2004-05)

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*Technical Specification*

**Digital Broadband Cable access to the  
Public Telecommunications Network;  
IP Multimedia Time Critical Services;  
Part 18: Embedded Media Terminal Adapter (e-MTA) offering  
an interface to analogue terminals and Cable Modem**

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Reference

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## Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Access and Terminals (AT).

The present document is part 18 of a multi-part deliverable covering Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services. Full details of the entire series can be found in TS 101 909-1 [22].

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## Introduction

The cable industry in Europe and across other Global regions has already deployed broadband cable television Hybrid Fibre Coax (HFC) data networks running the DOCSIS or EuroDOCSIS Cable Modem Protocol. The Cable Industry is in the rapid stages of deploying IP Voice and other time critical multimedia services over these broadband cable television networks.

The cable Industry has recognized the urgent need to develop ETSI Technical Specifications aimed at developing interoperable interface specifications and mechanisms for the delivery of end to end advanced real time IP multimedia time critical services over bi-directional broadband cable networks.

IPCablecom is a set of protocols and associated element functional requirements developed to deliver Quality of Service (QoS) enhanced secure IP multimedia time critical communications services using packetized data transmission technology to a consumer's home over the broadband cable television Hybrid Fibre/Coaxial (HFC) data network running the Cable Modem protocol. IPCablecom utilizes a network superstructure that overlays the two-way data-ready cable television network. While the initial service offerings in the IPCablecom product line are anticipated to be Packet Voice, the long-term project vision encompasses packet video and a large family of other packet-based services.

The Cable Industry is a global market and therefore the ETSI standards are developed to align with standards either already developed or under development in other regions. The ETSI Specifications are consistent with the CableLabs/PacketCable set of specifications as published by the SCTE. An agreement has been established between ETSI and SCTE in the US to ensure, where appropriate, that the release of PacketCable and IPCablecom set of specifications are aligned and to avoid unnecessary duplication. The set of IPCablecom ETSI specifications also refers to ITU-SG9 draft and published recommendations relating to IP Cable Communication.

The whole set of multi-part ETSI deliverables to which the present document belongs specify a Cable Communication Service for the delivery of IP Multimedia Time Critical Services over a HFC Broadband Cable Network to the consumers home cable telecom terminal. 'IPCablecom' also refers to the ETSI working group program that must define and develop these ETSI deliverables.

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# 1 Scope

IPCablecom has defined a set of protocols and associated element functional requirements in the TS 101 909 series of documents. These have been developed to deliver Quality of Service (QoS), enhanced secure IP multimedia time critical communication services, using packetized data transmission technology to a consumer's home over a cable television Hybrid Fibre/Coaxial (HFC) data network.

To facilitate maintenance and future enhancements to support other real-time multimedia services the TS 101 909 document series consist of multi-parts as detailed in TS 101 909-1 [22].

The present document is part 18 of the IPCablecom TS 101 909 series. The present document defines an analogue POTS presentation of an IPCablecom Termination Point (E-MTA) intended to deliver 3,1 kHz voiceband services equivalent to a Public Switched Telephone Network (PSTN) or equivalent network with short length 2-wire local loop.

NOTE: To be clear throughout the present document, the term "*CM/MTA*" will be used to denote an E-MTA.

The objective of the present document is to specify the physical and electrical characteristics of the CM/MTA interfaces that are part of an analogue POTS presentation of an IPCablecom CM/MTA particularly suitable for use by new network operators, or by operators operating in several European countries. The present document specifies characteristics of the CM/MTA to enable it to operate with most existing national PSTN Terminal Equipment (TE), and especially with PSTN TE designed according to the European standards for analogue presented TEs.

The electrical conditions specified at the CM/MTA are sufficient to ensure satisfactory operation of the following functions of TE:

- a) call control;
- b) transmission;
- c) dialling;
- d) ringing.

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <http://docbox.etsi.org/Reference>.

- [1] ETSI EN 300 001: "Attachments to the Public Switched Telephone Network (PSTN); General technical requirements for equipment connected to an analogue subscriber interface in the PSTN".
- [2] ETSI EN 300 659 (all parts): "Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services".
- [3] ETSI EG 201 050: "Speech Processing, Transmission and Quality Aspects (STQ); Overall Transmission Plan Aspects for Telephony in a Private Network".
- [4] ETSI EG 201 120: "Public Switched Telephone Network (PSTN); Method of rating terminal equipment so that it can be connected in series and/or in parallel to a Network Termination Point (NTP)".

- [5] ETSI ES 200 778 (all parts): "Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Protocol over the local loop for display and related services; Terminal equipment requirements".
- [6] ETSI ES 201 071: "Public Switched Telephone Network (PSTN); Protocol over the local loop for display services; Server Display and Script Services (SDSS)".
- [7] ETSI ES 201 187: "2-wire analogue voice band interfaces; Loop Disconnect (LD) dialling specific requirements".
- [8] ETSI ES 201 235-2: "Access and Terminals (AT); Specification of Dual-Tone Multi-Frequency (DTMF) Transmitters and Receivers; Part 2: Transmitters".
- [9] ETSI ES 201 235-1: "Specification of Dual Tone Multi-Frequency (DTMF) Transmitters and Receivers; Part 1: General".
- [10] ETSI ES 201 235-3: "Access and Terminals (AT); Specification of Dual-Tone Multi-Frequency (DTMF) Transmitters and Receivers; Part 3: Receivers".
- [11] ETSI ES 201 729: "Public Switched Telephone Network (PSTN); 2-wire analogue voice band switched interfaces; Timed break recall (register recall); Specific requirements for terminals".
- [12] ETSI ES 201 912: "Access and Terminals (AT); Short Message Service (SMS) for PSTN/ISDN; Short Message Communication between a fixed network Short Message Terminal Equipment and a Short Message Service Centre".
- [13] ETSI ES 201 970: "Access and Terminals (AT); Public Switched Telephone Network (PSTN); Harmonized specification of physical and electrical characteristics at a 2-wire analogue presented Network Termination Point (NTP)".
- [14] ETSI ETR 344: "Terminal Equipment (TE); The technical feasibility of a harmonized plug and socket standard for European Public Switched Telephone Network (PSTN) access".
- [15] ETSI TBR 021: "Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling".
- [16] ETSI TBR 038: "Public Switched Telephone Network (PSTN); Attachment requirements for a terminal equipment incorporating an analogue handset function capable of supporting the justified case service when connected to the analogue interface of the PSTN in Europe".
- [17] ETSI TR 101 041-1: "Human Factors (HF); European harmonization of network generated tones; Part 1: A review and recommendations".
- [18] ETSI TR 101 182: "Analogue Terminals and Access (ATA); Definitions, abbreviations and symbols".
- [19] ETSI TR 101 183: "Public Switched Telephone Network (PSTN); Analogue ringing signals".
- [20] ETSI TR 101 768: "Public Switched Telephone Network (PSTN); Study on the generation of analogue ringing signals".
- [21] ETSI TR 101 959: "Access and Terminals (AT); Ringing without DC for Terminal Equipment (TE), Terminal Support Interfaces (TSI) and Local Exchange Interfaces (LEI)".
- [22] ETSI TS 101 909-1: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 1: General".
- [23] ETSI TS 101 909-2: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 2: Architectural framework for the delivery of time critical services over cable Television networks using cable modems".



- [24] ETSI TS 101 909-3: "Access and Terminals (AT); Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 3: Audio Codec Requirements for the Provision of Bi-Directional Audio Service over Cable Television Networks using Cable Modems".
- [25] ETSI TS 101 909-4: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 4: Network Call Signalling Protocol".
- [26] ETSI TS 101 909-5: "Access and Terminals (AT); Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 5: Dynamic Quality of Service for the Provision of Real Time Services over Cable Television Networks using Cable Modems".
- [27] ETSI TS 101 909-6: "Access and Terminals (AT); Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 6: Media Terminal Adapter (MTA) device provisioning".
- [28] ETSI TS 101 909-9: "Access and Terminals (AT); Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 9: Network Call Signalling (NCS) MIB Requirements".
- [29] ETSI TS 101 909-17: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 17: Inter-domain Quality of Service".
- [30] ETSI TS 101 909-22: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 22: Management Event Messages".
- [31] ETSI TS 101 909-23: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 23: Internet Protocol Access Terminal - Line Control Signalling (IPAT - LCS)".
- [32] ITU-T Recommendation G.100.1: "The use of the decibel and of relative levels in speechband telecommunications".
- [33] ITU-T Recommendation G.120: "Transmission characteristics of national networks".
- [34] ITU-T Recommendation G.122: "Influence of national systems on stability and talker echo in international connections".
- [35] ITU-T Recommendation G.711: "Pulse Code Modulation (PCM) of voice frequencies".
- [36] ITU-T Recommendation G.712: "Transmission performance characteristics of pulse code modulation channels".
- [37] ITU-T Recommendation J.112: "Transmission systems for interactive cable television services".
- [38] ITU-T Recommendation J.161: "Audio codec requirements for the provision of bidirectional audio service over cable television networks using cable modems". .
- [39] ITU-T Recommendation O.9: "Measuring arrangements to assess the degree of unbalance about earth".
- [40] ITU-T Recommendation O.41: "Psophometer for use on telephone-type circuits".
- [41] ITU-T Recommendation O.132: "Quantizing distortion measuring equipment using a sinusoidal test signal".
- [42] ITU-T Recommendation Q.35/E.180: "Technical characteristics of tones for the telephone service".
- [43] ITU-T Recommendation Q.551: "Transmission characteristics of digital exchanges".
- [44] ITU-T Recommendation Q.552: "Transmission characteristics at 2-wire analogue interfaces of digital exchanges".

- [45] ITU-T Recommendation V.90: " A digital modem and analogue modem pair for use on the Public Switched Telephone Network (PSTN) at data signalling rates of up to 56 000 bit/s downstream and up to 33 600 bit/s upstream".
- [46] ITU-T Recommendation V.92: "Enhancements to Recommendation V.90".
- [47] Code of Federal Regulations, Title 47, Volume 3, Parts 40 to 69 (revised as October 1998).
- NOTE: See <http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=199847>

## 3 Definitions, symbols and abbreviations

### 3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

NOTE 1: To be clear throughout the present document, the term "*CM/MTA*" will be used to denote an E-MTA.

NOTE 2: Also refer to TR 101 182 [18] for a collection of definitions used by analogue PSTN interfaces and terminals.

**access node:** layer two termination device that terminates the network end of the ITU-T Recommendation J.112 [37] connection

NOTE: It is technology specific. In ITU-T Recommendation J.112 [37], annex B it is the CMTS.

**analogue POTS termination point:** physical point at boundary of the IPCablecom System intended to accept the connection of a TE

NOTE: May or not coincide with the Network Termination Point as specified in EU regulatory frame documents.

**answer signal:** indication that a terminal is answering an incoming call

**cable modem:** device that terminates the IPCablecom Network and provides a data port to CPE devices

**called party answer signal:** signal, which may be provided at the call originating CM/MTA by the network to indicate that the called party, has answered the call

**clear indication:** indication that the network is attempting to release a connection

**clear signal:** signal indicating that a terminal is attempting to release a connection

**customer premises equipment:** devices that connect to the IPCablecom system that provide user interface to system services; equivalent to TE

NOTE: This includes devices that comply with specifications TBR 021 [15] and TBR 038 [16] but in general includes all User Telephony Devices (e.g. handsets, analogue modems, facsimile machines, Caller ID devices, etc.).

**embedded media terminal adapter:** MTA that is "embedded" (e.g. integrated) with a Cable Modem

**end-of-call signal:** signal provided at the CM/MTA by the network to indicate that the call has been released

**IPCablecom:** title of an ETSI working group project that has defined a system architecture and set of specifications that enable the delivery of real time services (such as telephony) over the cable television network

NOTE: Also refers to the specific System Architecture defined in TS 101 909 series of specifications.

**loop state:** state where the TE draws sufficient DC current that represents the Seize Signal

NOTE: The Loop state is also known as the on-line state or the off-hook state (see TBR 021 [15]).

**media terminal adapter:** device that provides an interface between the IPcablecom network and customer premises equipment

NOTE: In theory a MTA may provide any one of a number of services to premises equipment. In the context of the present document the MTA provides an Analogue Telephony (POTS) termination point.

**network call signalling:** IPcablecom MGCP profile used for controlling calls

**network termination point:** physical point of connection that delineates (demarks) the end of the IPcablecom System and the start of the Customer Premises (network or equipment)

**off-hook:** See loop state.

**on-hook:** See quiescent state.

**quiescent state:** state where the TE draws insufficient DC current to represent the Seize Signal

NOTE: The Quiescent state is also known as the idle state, off-line state or the on-hook state (see TBR 021 [15]).

**ring burst:** single, short period signal capable of ringing the TE ring circuit

**ring splash:** equivalent to ring burst

**ringing state:** condition of the network where a ringing/alerting signal has been applied at the CM/MTA

**ring trip:** removal of the ringing signal at the CM/MTA in response to a valid answer signal applied to the CM/MTA

**seize signal:** signal indicating that a terminal is attempting to establish a connection by means of applying a loop condition

**stand-alone MTA:** device that provides an interface between the IPcablecom Network and customer premises equipment

NOTE: In the context of the present document the S-MTA is not "embedded" (e.g. integrated) with a Cable Modem, usually relying on the data port of a Cable Modem for Network connection. Specifications for the S-MTA are outside of the scope of the present document.

**terminal equipment:** devices that connect to the IPcablecom system that provide user interface to system services; equivalent to CPE

NOTE: This includes devices that comply with TBR 021 [15] and TBR 038 [16] but in general includes all User Telephony Devices (e.g. handsets, analogue modems, facsimile machines, Caller ID devices, etc.).

**uninterruptible power source:** primary power source (AC Power Supply) with a backup power source (battery) for when the primary input power fails

NOTE: The UPS provides a switchover to the backup source without disruption of power to the device being supplied.

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

dBV	absolute voltage level expressed as dB relative to 1 V
dBm	relative level of a signal in a transmission path referenced to 1 mW across the reference (characteristic) impedance of the path
dBm0	absolute power level in dBm referred to a point of zero relative level
dBm0p	absolute power level in dBm referred to a point of zero relative level, psophometric weighting
dBmp	absolute power level in dBm, psophometric weighting
dBr	relative level of a signal in a transmission path referred to the level at a reference point on the path
pWp	power in picowatt, psophometric weighting
pW0p	power in picowatt, referred to a point of zero relative level, psophometric weighting,

### 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
AGC	Automatic Gain Control
ALASS	Analogue Local Access Signalling Services
CLID	Calling Line IDentification
CM	Cable Modem
CM/MTA	Cable Modem with Embedded Media Terminal Adapter (E-MTA)
CMS	Call Management Server
CPE	Customer Premise Equipment
CRCX	CReate ConneXion
DC	Direct Current
DTMF	Dual Tone Multi Frequency
E-MTA	Embedded-Media Terminal Adapter
FEXT	Far-End crossTalk
HFC	Hybrid Fibre/Coaxial
IDC	Insulation Displacement Connector
IPAT	Internet Protocol Access Terminal
LCL	Longitudinal Conversion Loss
LD	Loop Disconnect
LE	Local Exchange
LF	Loading Factor
LU	Loading Unit
MDCX	MoDify Connexion
MTA	Media Terminal Adapter
NCS	Network Call Signalling
NEXT	Near End crossTalk
NID	Network Interface Device
NIU	Network Interface Unit
NTP	Network Termination Point
OSS	Operations System Support
PICS	Protocol Implementation Conformance Statement
PL-EV	Primary Line-EVent
POTS	Plain Old Telephone Service
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RLR	Receiving Loudness Rating
SDSS	Server Display and Script Service
SLR	Sending Loudness Rating
SMS	Short Message Service
S-MTA	Stand-alone MTA
SNMP	Simple Network Management Protocol
TBRL	Terminal Balance Return Loss
TE	Terminal Equipment
UBS	User Based Solution
UPS	Uninterruptible Power Source

---

## 4 Overview

The present document covers requirements for the E-MTA Analogue Telephony Interface. It is the intention of the present document to address requirements only for the E-MTA. The service referred to in the present document is voice-grade communications, including communications with stations on the Public Switched Telephone Network (PSTN).

Two CM/MTA interfaces have been identified and will be defined in the present document:

- 1) CM/MTA Powering; and
- 2) the Analogue POTS interface.

A third CM/MTA interface, the HFC interface connection, is defined in ITU-T Recommendation J.112 [37].

The CM provides a high speed "data port" that may be of a type Ethernet and/or USB. The choice of which type is offered in a given CM is market driven. The present document does not cover the high speed "data ports".

The analogue POTS interface requirements ensure that CPE that meets telephone industry interoperability requirements (normal telephones, answering machines, etc.) will also operate in the IPCablecom environment. Note that the voice-grade analogue transmission requirements are dependent on the compression algorithm utilized to transport the packetized voice signal in the IPCablecom architecture. These requirements are derived from existing PSTN requirements that are based on a full 64 kbit/s voice channel. Therefore, the requirements specified are relevant only for ITU-T Recommendation G.711 [35] audio codec. Other audio codec compression algorithms specified by ITU-T Recommendation J.161 [38] are not currently addressed in the present document.

The performance at the CM/MTA is intended to ensure that:

- the interface presented by the CM/MTA will interwork successfully with TE compliant with PSTN TE TBRs (TBR 021 [15] and TBR 038 [16]) and will support voice band services accessible across the interface;
- the network being presented at the CM/MTA will not suffer harm as a result of signals normally appearing at such an interface, when used under real-life conditions, including when TE compliant with PSTN TBRs (TBR 021 [15] and TBR 038 [16]) are connected via the CM/MTA.

NOTE: The CM/MTA performance specified in the present document is similar to the one of ES 201 970 [13], which is also intended to ensure above conditions. IPCablecom allows a number of programmable values for many parameters and this facilitates the usage of the present standard not only for situations covered by ES 201 970 [13] but also in a wider range of applications. Annex A informs with more detail.

Should there be any conflicts between the present document and any reference document, the specifications in the present document take precedence and shall be followed.

The vendor must describe any functions that are provided at the CM/MTA such as protection or line test, insofar as these influence the behaviour at the CM/MTA.

Refer to TS 101 909-2 [23] for an overview of the System Architecture and clause 5.1 specifically for a description of a reference MTA architecture.

Vendors must provide a CM/MTA PICS declaration of the specific features and services that are supported in any CM/MTA model.

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## 5 CM/MTA power

The CM/MTA may have two sources of input power; the HFC Network and the local premises AC Utility.

### 5.1 HFC network powering

The HFC Network is typically powered by distributed power nodes.

Powering of the CM/MTA by the HFC Network is for further study. In all the cases the powering shall comply with the appropriate harmonized safety standards or appropriate national safety standards.

### 5.2 Premises powering

This is the method of providing local AC utility power directly to the CM/MTA from a receptacle at the premises.

## 5.2.1 Mechanical interface

The vendor must supply an appropriate AC mains line cord compliant with the appropriate harmonized safety standards or appropriate national safety standards.

## 5.2.2 Input voltage

The device should operate at the normal AC Supply voltage tolerance ranges.

## 5.2.3 Telephony service availability considerations

The delivery of a highly available Telephony service to the users is directly impacted by the reliability of the local AC utility provider. Some administrations and/or network operators require to provide alternate power to bridge across AC utility power loss.

The most common method of providing alternate power for the AC utility over relatively short periods of time is to provide a battery backup system.

The following requirements assume a battery backup system is employed. These requirements are not intended to dictate any specific implementation architecture or method as long as the functional goal of the backup system is achieved.

The implementation of a battery backup system is not required by the present document but may be subject to national regulation.

### 5.2.3.1 Back up power interruptions

#### 5.2.3.1.1 AC utility to back up supply

The CM/MTA transition from AC utility power (power loss) to a Back Up power source (battery) must maintain all established voice and data connections.

#### 5.2.3.1.2 Back up supply to ac utility

The CM/MTA transition from a Back Up power source (battery) to the AC utility power (power restoration) must maintain all established voice and data connections.

### 5.2.3.2 Automatic operation

The switching from AC utility power to battery back up must operate without service personnel or user intervention.

The switching from battery back up to AC utility power must operate without service personnel or user intervention.

If the battery is capable of being re-charged (e.g. secondary cell type), the battery charger operation (e.g. starting battery charge, ending battery charge, etc.) must operate without service personnel or user intervention.

### 5.2.3.3 Operation without battery

The CM/MTA must maintain all connection services if the battery is removed for service or replacement.

The CM/MTA must maintain all connection services if the battery is determined as requiring replacement, see clause 5.2.3.7.2.2.

### 5.2.3.4 Service limitations

During operation on backup power, data connections may optionally be disabled.

Upon return of AC utility power, data connections must be enabled.

### 5.2.3.5 Battery run time

Battery run time is dependent on the CM/MTA design, the back up system efficiency and the size and type of back up battery. These parameters represent various trade off considerations to meet specific run time goals per local administration requirements and product costs.

It is not possible to define any specific run times across all administrations therefore; the present document leaves specific run time goals to national regulation.

The vendor must specify the expected run time of the CM/MTA assuming a battery in good condition with a full charge for a representative sample of modes of CM/MTA operation in accordance with national regulations or based on Operators specification where there is no national regulation. Since vendor equipment may be configured with different types and quantities of interfaces, it is the vendor obligation to provide the appropriate combinations of port states and modes as appropriate for the equipment being offered.

The minimum modes that must be specified:

- 1) Idle Run Time - the CM/MTA is supporting the required protocol overhead, one telephony port is provisioned, all other telephone and data ports are disabled (not provisioned) and there is no active telephony connection on the provisioned telephony port. At the end of the Idle Run Time the CM/MTA must still originate a single, three minute Telephony Connection without any other connection activity.
- 2) Provisioned Run Time - the CM/MTA is supporting the required protocol overhead, all telephony and data ports are provisioned, and there are no active telephony or data connections. At the end of the Provisioned Run Time the CM/MTA must still originate a single, three minute Telephony Connection without any other connection activity.
- 3) Data Run Time - the CM/MTA is supporting protocol overhead, all telephony ports are disabled (not provisioned), all data ports are provisioned, and with a full data rate connection active, unless disabled per clause 5.2.3.4.5.
- 4) Talk Run Time - the time the CM/MTA can support the required protocol overhead, all telephony and data ports are provisioned, and there is one continuous telephony connection and no data connections.
- 5) Full Load Run Time - the time the CM/MTA can support the required protocol overhead with all of the Telephony connections active and a full rate data connection, unless disabled per clause 5.2.3.4.

### 5.2.3.6 Battery recharge time

If the battery is capable of being re-charged (e.g. secondary cell type), the vendor must specify the time to recharge the back up battery to at least 80 % of its capacity after the return of the AC utility power assuming the battery was fully discharged.

### 5.2.3.7 Back up telemetry

In order to maintain the high availability provided by the back up battery the CM/MTA must monitor various AC utility and battery states and report them to the OSS system so that the operator can replace aged or defective back up systems.

#### 5.2.3.7.1 Operations System Support (OSS) event reporting

The CM/MTA **MUST** support the event and alarm reporting mechanism as defined in TS 101 909-22 [30]. This mechanism is used to configure the Line Events on the CM/MTA. This mechanism is also used to report the Line Events in a local log or to send these events to an OSS back office system via SNMP or SYSLOG.

All Line Events **MUST** be defined as a matched pair of "set" and "cleared" events. Eight Line Events are programmable events and therefore **MAY** be redefined to support a meaning other than the battery-related meanings defined in the present document. If these Line Events are redefined, then the definition of the new meaning and any coordination between systems to support this new meaning is out of the scope of IPCablecom.

The "set" and "clear" events for the four alarm signals are defined in clause 5.2.3.7.2.

### 5.2.3.7.2 Telemetry Signals

#### 5.2.3.7.2.1 Telemetry Signal 1 - AC Fail

The active alarm state of this signal indicates an "AC Fail" condition, which means the Back Up Supply, has detected a failure of the utility AC power and is operating off its battery.

The inactive alarm state of this signal indicates an "AC Restored" condition that means the Back Up Supply has detected the presence of utility AC power and is no longer operating off its battery.

- PL-EV-1: active alarm state of telemetry signal 1; default meaning "AC Fail" and default severity MINOR.
- PL-EV-2: inactive alarm state of telemetry signal 1, default meaning "AC Restored"; PL-EV-2 always clears PL-EV-1.

#### 5.2.3.7.2.2 Telemetry Signal 2 - Replace battery

The active alarm state of this signal indicates a "Replace Battery" condition which means the Back Up Supply, via internal test mechanisms outside the scope of the present document, has determined that the battery can no longer maintain a charge sufficient enough to provide the designed amount of battery run time and thus is failing and must be replaced with a new battery.

The inactive alarm state of this signal indicates a "Battery Good" condition.

- PL-EV-3: active alarm state of telemetry signal 2; default meaning "Replace Battery" and default severity MINOR.
- PL-EV-4: inactive alarm state of telemetry signal 2; default meaning "Battery Good"; PL-EV-4 always clears PL-EV-3.

#### 5.2.3.7.2.3 Telemetry Signal 3 - Battery missing

The active alarm state of this signal indicates a "Battery Missing" condition, which means the Back Up Supply has detected that a battery is not present and a battery must be installed to support the Back Up Supply.

The inactive alarm state of this signal indicates a "Battery Present" condition.

- PL-EV-5: active alarm state of telemetry signal 3; default meaning "Battery Missing" and default severity MINOR.
- PL-EV-6: inactive alarm state of telemetry signal 3; default meaning "Battery Present"; PL-EV-6 always clears PL-EV-5.

#### 5.2.3.7.2.4 Telemetry Signal 4 - Battery low

The active alarm state of this signal indicates a "Battery Low" condition. This condition is defined to mean that battery has sufficiently discharged (e.g. approximately 75 % to 80 % discharged) to the point where a power source can only be maintained for a short while longer.

The inactive alarm state of this signal indicates a "Battery Not Low" condition. This condition means that the battery has a charge capacity above the "battery low" threshold (e.g. at least 20 % to 25 % of full capacity).

- PL-EV-7: active alarm state of telemetry signal 4; default meaning "Battery Low" and default severity MINOR.
- PL-EV-8: inactive alarm state of telemetry signal 4; default meaning "Battery Not Low"; PL-EV-8 always clears PL-EV-7.



## 6 Analogue POTS interface

The CM/MTA analogue port represents an interface between the IP-Cablecom Network and Customer Premises Equipment (Telephony) designed to function when connected to the PSTN using standard PSTN interfaces. The subscriber side of this interface is an analogue interface consistent with the PSTN and the network side of this interface is a digital interface to the IP-based IP-Cablecom network, which rides on top of the ITU-T Recommendation J.112 [37] transport. In this architecture, the CM/MTA will reside at the subscriber premises, either inside or outside. The CM/MTA will, in the context of the IP-Cablecom network, be analogous with a PSTN NIU or NID offering a NTP. Finally, because the network side of the port interface is digital, and the device resides close to the subscriber, the analogue subscriber side of the port interface will only be required to support relatively short metallic (copper twisted pair) drops (i.e. 150 m or less).

In the IP-Cablecom System there are a number of system characteristics that are managed to achieve "telephony quality" voice services. Reference is offered to TS 101 909-5 [26] and TS 101 909-17 [29] for technical details of these characteristics.

### 6.1 Mechanical aspects

The physical Analogue POTS line presentation shall be specified in such a way that a terminal manufacturer can supply a suitable terminal connector. The connection arrangements shall be according to the arrangement described below or by established practice (optional).

#### 6.1.1 Harmonized arrangement

Where the CM/MTA is presented as a socket it shall be a socket capable of connecting with a miniature 6-position plug as specified in FCC 47 [47], 68.502 clause (a.1) with contact assignments as specified in table 1. This connector is often referred to as RJ11.

**Table 1: Contact assignment**

Pin-nr.	ES 201 970 [13], table 1
1	Unspec.
2	Unspec.
3/4	Pair (a and b wire)
5	Unspec.
6	Unspec.

#### 6.1.2 Other arrangements

##### 6.1.2.1 Arrangement 1

It is acceptable to provide two pair terminations presentation by the CM/MTA as a socket that must be capable of connecting with a miniature 6-position plug as specified in FCC 47 [47], CFR 68.502 clause (c1) with contact assignments as specified in table 2. This connector is often referred to as RJ14.

**Table 2: Arrangement 1**

Pin-nr.	RJ 14
1	Unspec.
2	a2
3	b1
4	a1
5	b2
6	Unspec.
NOTE: Use of this option must be carefully considered with respect to EN 300 001 [1] which does not consistently define the two pair configurations across different networks and as a result, some conflicts between the RJ14 connections appear to exist when considering wiring plans with primary and secondary sockets, series terminals, earthing leads and 50 Hz metering leads. ETR 344 [14] gives further guidance on this subject.	

### 6.1.2.2 Arrangement 2

Where the CM/MTA is presented as a wire termination point the physical presentation may (optional) be realized as a set of connection contacts (e.g. a screw terminal block, IDC) compatible with common telephony premises wiring (e.g. 0,4 mm to 0,6 mm) is required.

### 6.1.2.3 Further established practice

Existing installations may determine other connection arrangements.

## 6.2 Support of more than one TE

A CM/MTA line presentation at a and b terminals (termination point) may support one or more TE. The number of physical TE(s) is dependent on the LF the CM/MTA can support and the LF of each TE(s) offer to the CM/MTA.

The vendor must specify the CM/MTA LF capability in the PICs declaration as described in the following clauses.

Should the CM/MTA support the presentation of more than one line, the vendor must also specify how many lines are offered and the LF for each line.

### 6.2.1 Wiring arrangement

The vendor must describe the wiring arrangements for the connection of additional terminals for each single a-b termination. The instructions must be expressed in a way that makes it straight forward for an operator to add additional points for connection of terminals on the POTS interface premises wiring.

The vendor must describe any functions that are provided at the CM/MTA such as protection or line test, insofar as these influence the behaviour at the CM/MTA.

Also refer to EG 201 120 [4] for further detailed information.

### 6.2.2 Loading Factors (LF)

The vendor must declare in the PICS declaration the maximum numbers of terminals per line that can be supported at the CM/MTA. This information must be supplied in terms of a Loading Factor (LF), as defined in EG 201 120 [4].

The LF specified must be the lowest of the LFs for the individual parameters of table 3, rounded down to the nearest whole number.

NOTE 1: In addition to the LF-value discussed above, the vendor is invited to also give the applicable values of each individual parameter. This more detailed information would enable an operator to take full advantage of the available resources at the CM/MTA.

NOTE 2: Per ES 201 970 [13] a minimum LF of 100 LU per line is recommended.

**Table 3: Calculation of Loading Factors (table 2 of ES 201 970 [13])**

Operating state of TE	Parameter	Test Method	Value for 100LU	Formula for calculation of LF and unit for input data
Quiescent	Resistance to earth	TBR 021 [15], A.4.4.4	$R = 10 \text{ M}\Omega$	$1\ 000/R[\text{M}\Omega]$
Quiescent	DC resistance	TBR 021 [15], A.4.4.1	$R = 1 \text{ M}\Omega$	$100/R[\text{M}\Omega]$
Ringing	Lowest impedance at 25 Hz	TBR 021 [15], A.4.4.2.1	$Z = 4 \text{ k}\Omega$	$400/Z [\text{k}\Omega]$
Ringing	DC current during ringing	TBR 021 [15], A.4.4.2.3	$I = 0,6 \text{ mA}$	$100 \times I / 0,6 [\text{mA}]$

NOTE 3: For a consistence application of the present requirement and to prevent misleading declarations in PICS it is recommended to carefully study the information supplied with the example described in annex B.

## 6.3 D.C. feed conditions

### 6.3.1 Polarity

The polarity of the d.c. voltage presented by the CM/MTA is arbitrary with respect to the CM/MTA a-b terminals.

NOTE: For polarity reversal refer to clause 6.14.5.

### 6.3.2 Quiescent state

#### 6.3.2.1 Maximum voltage

The maximum open circuit d.c. voltage presented between the a-b terminals of the CM/MTA must not exceed 78 V.

#### 6.3.2.2 Minimum voltage

When a resistor with a value of  $100/LF \text{ M}\Omega$ , where LF is the Vendor declared LF arising from clause 6.2.2 is connected between the a and b terminals of the CM/MTA, the continuous d.c. voltage appearing at the CM/MTA must not be less than 38 V.

#### 6.3.2.3 TE supply interruption

Many types of TE rely on the continuous application of exchange battery voltage for the correct functioning of features.

During the quiescent state the network feed voltage applied by the CM/MTA must not be removed for periods longer than 10 s for maintenance or other purposes (refer to clause 6.14.6).

## 6.3.3 Loop current

### 6.3.3.1 Loop current range

When a resistor with a value in the range  $0 \text{ }\Omega$  to  $500 \text{ }\Omega$  is connected between the a and b terminals at the CM/MTA, a minimum d.c. current of 18 mA must flow but must never exceed 70 mA.

NOTE 1: 18 mA is the minimum current required to match the TE access requirements for interworking with the network.

NOTE 2: The resistance range represents the resistance of the internal wiring between CM/MTA and the sockets for TE connections and all TEs including one TE in the on line (off hook) state.

NOTE 3: Per ES 201 970 [13] a DC current in the range of 25 mA to 40 mA per line is recommended.

### 6.3.3.2 Loop current interruptions caused by the terminal

Brief loop current interruptions (where the current is no more than 1,0 mA) of 20 ms between the a and b terminals must not cause any change of condition at the CM/MTA.

## 6.4 Seize signal

### 6.4.1 Must not seize condition

When a resistor with a value such as to cause a loop current not greater than 3,0 mA d.c. to flow is connected at the a and b terminals of the CM/MTA, it must not be recognized by the network as a seize signal.

The CM/MTA must not recognize a seize condition when the loop current changes from quiescent to the Seized Loop Levels of clause 6.4.2 for a period of less than a value stated by the vendor. This value must not be less than 10 ms.

### 6.4.2 Must seize condition

When applied to a line that is in the Quiescent State (see relationship between seize and clear signals in clause 6.5.1), a resistor with a value such as to cause a loop current not less than 10,0 mA d.c. to flow is connected for a period as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28] at the a and b terminals of the CM/MTA, it must be correctly accepted by the CM/MTA as a seize signal.

Upon the detection of a Seize Condition, the CM/MTA must send the appropriate NCS message per TS 101 909-4 [25].

## 6.5 Clear signal

### 6.5.1 Clear signal generated by TE

In order to ensure satisfactory operation of the seize/clear function, hysteresis must be provided between the seize and clear current. The Clear Signal Threshold current must be at least 0,5 mA lower than the seize signal threshold current of clause 6.4.2.

When the load applied between the a and b terminals of the CM/MTA is such as to reduce the loop current below the Clear Signal Threshold current for a period greater than the maximum line break time of a Register Recall (Hook Flash) signal (see clause 6.14.2) provisioned value as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28], then the CM/MTA must accept this as a clear signal and signal the CMS per the appropriate TS 101 909-4 [25] NCS message.

### 6.5.2 Clear indication from the network

Depending upon the network characteristics, a connection may be cleared:

- a) as a result of either the calling party or the called party TE providing a clear signal to the network; or
- b) at the instigation of the network itself, independently of the state of the calling party or the called party.

Depending on the Network implementation architecture, a PSTN end-of-call signal may be generated by a Network element (e.g. the LE Switch or an Announcement Server) or by the CM/MTA when directed by the CMS. This end-of-call signal must be given as a release tone as specified in clause 6.13.1.

If the CM/MTA is capable of providing other end-of-call signals in addition to the release tone, e.g. polarity reversal (see clause 6.14.5) or K-break (see clause 6.14.6), the vendor must declare this capability in the CM/MTA PICS document.

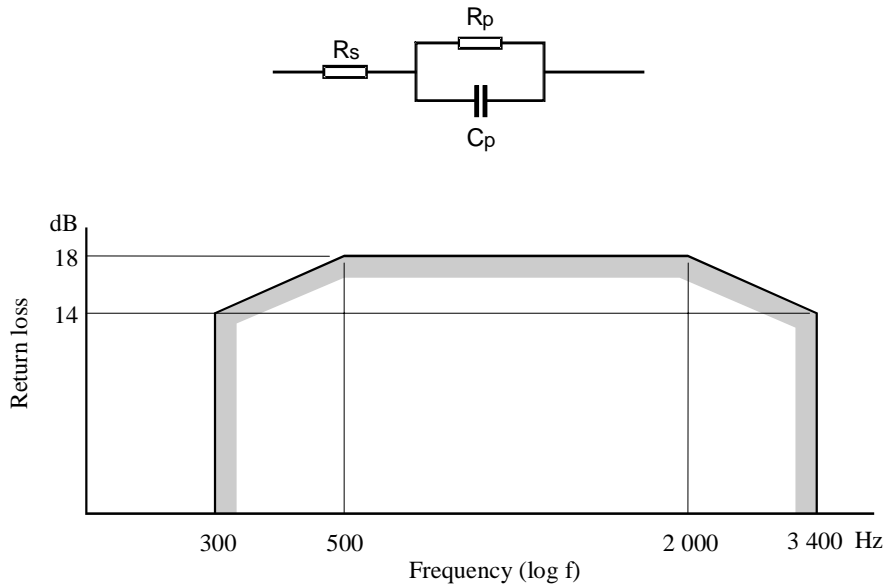
## 6.6 Seizing the line for a new call

After the network has recognized the call clear signal from the TE (see clause 6.5.1), the CM/MTA must allow the TE to seize the line for a new call according to clause 6.4. In particular, an event indicating that the TE has applied a new seizure condition must not be ignored whenever it occurs following recognition by the CM/MTA of a call clear signal.

## 6.7 POTS interface impedance

The impedance presented by the network between the a and b terminals of the CM/MTA when in the loop state (Seized line) must have a return loss as shown in figure 1 with respect to the reference impedance:

$$Z_{\text{ref}} = (R_s = 270 \Omega \text{ in series with } (R_p = 750 \Omega \text{ in parallel with } C_p = 150 \text{ nF})).$$



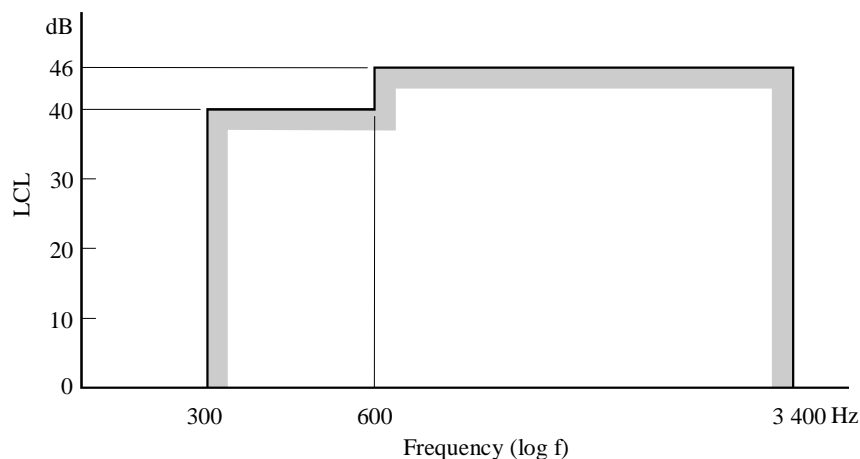
NOTE: See clause 2.2.1 of ITU-T Recommendation Q.552 [44].

**Figure 1: Minimum value of return loss against the reference impedance (figure 1/Q.552)**

OPTIONAL: The  $Z_{\text{ref}}$  may be modified per established network specific needs.

## 6.8 Balance about earth

A CM/MTA line Termination in the off hook State (i.e. loop state, "on line", "Seized", "talk mode"), must meet the balance about earth measured as Longitudinal Conversion Loss (LCL) in figure 2.



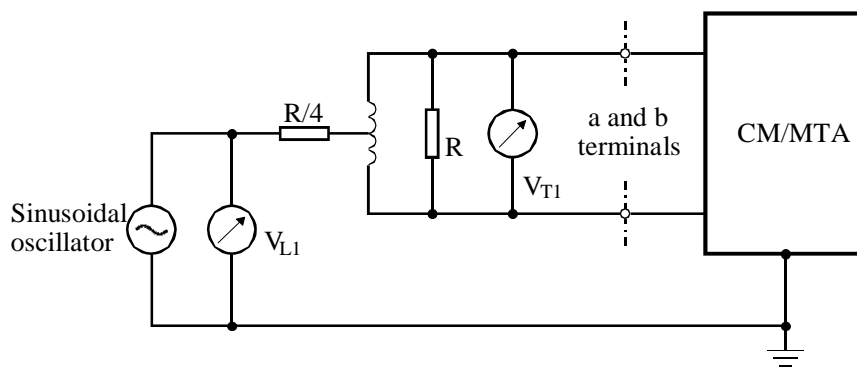
NOTE: See clause 2.2.2 of ITU-T Recommendation Q.552 [44].

**Figure 2: Minimum values of LCL measured in the arrangement shown in figure 3 (figure 2/Q.552)**

## Test Method

Longitudinal conversion loss at the a-b terminal should be measured in accordance with the principles given in clause 4.1/ITU-T Recommendation O.9 [39]. Figure 3 shows an example of the basic measuring arrangement for digital exchanges. Arrangements containing two resistors each of value  $R/2$  may also be used (see clause 5.1/ITU-T Recommendation O.9 [39]).

Measurements of the longitudinal and transverse voltages should preferably be done with a frequency-selective level meter.



$R$  should be in the range of  $600\ \Omega$  to  $900\ \Omega$

$$\text{Longitudinal Conversion Loss (LCL)} = 20 \log_{10} \left| \frac{V_{LI}}{V_{TI}} \right| \text{ dB}$$

NOTE 1: Provisions should be made for representative DC currents to be present.

NOTE 2: Special care must be taken in those applications using active hybrids.

**Figure 3: Arrangement for measuring LCL (figure 3/Q.552)**

## 6.9 Analogue transmission

The transmission performance aspects are given at the CM/MTA since the CM/MTA provides the digital network to analogue line interface conversion. It is advised that the design of such interface is based on ITU-T Recommendation Q.552 [44]. Interfaces complying with ITU-T Recommendation Q.552 [44] will meet the requirements of this clause (note that Q.552 does not specify the exact value of relative levels).

NOTE: EG 201 050 [3] help specifying the transmission aspects and evaluating the corresponding Quality of Service impact.

Due to the fact that this is a specification of the CM/MTA that provides the digital network to analogue line interface, one observation point is available. Thus in principle it is not possible to state performance between two points. However, a fictitious point in the transmit and receive digital path (ITU-T Recommendation G.711 [35] A-law PCM, 0 dBr) is established for reference purposes. The following clauses are based on the existence of this fictitious point.

An input connection is a unidirectional path from CM/MTA a and b terminals to the fictitious point.

An output connection is a unidirectional path from the fictitious point to the CM/MTA a and b terminals.

A half connection is a bidirectional path comprised of an input connection and an output connection, both having the same interfaces.

While the CM/MTA must comply with TS 101 909-3 [24] that may include low rate (compressed) codec support, the clauses that follow assume a ITU-T Recommendation G.711 [35] A-law PCM codec is being used.

The IPCablecom protocol allows the use of different size voice packets. The timings included in the clauses that follow assume a 10 ms packet size.

The use of low rate codecs or different packet sizes may influence the following clauses and these influences are subject to further study.

### 6.9.1 Transmission path establishment

Upon receiving a MDCX or CRCX NCS message per TS 101 909-4 [25] (in either on-hook and off-hook state), the CM/MTA must establish a transmission path in less than 200 ms from the fictitious digital reference point to the analogue line.

### 6.9.2 Transmission delay and other quality parameters

NOTE: This is for further study for future release of the present document. EG 201 050 [3] give guidance in this area.

### 6.9.3 Echo performance

The CM/MTA must implement Echo canceller devices per TS 101 909-3 [24] and the guidance on QoS in EG 201 050 [3].

### 6.9.4 Relative levels

To enable full signal handling capacity, the nominal relative levels (at 1 020 Hz) at the a and b terminals of the CM/MTA must be:

$L_i$  = Input relative level = +4 dBr  $\pm$ 2 dB;

$L_o$  = Output relative level = -11 dBr  $\pm$ 2 dB.

NOTE 1: The concept of relative levels is described in ITU-T Recommendation G.100.1 [32].

NOTE 2: These relative levels are chosen to obtain optimum performance for a speech telephony terminal in accordance with TBR 038 [16] having nominal SLR = +3 dB and RLR = -8 dB.

NOTE 3: Some types of CM/MTA that provides a constant d.c. current feeding with a low loop current setting may false the Automatic Gain Control (AGC) function of existing TEs. Therefore it is recommended that such CM/MTAs provide a method or function in order to provide acceptable TE performance under these conditions, especially on short line lengths.

NOTE 4: The levels at the CM/MTA a-b analogue connection point should be considered at the a and b terminals of the CM/MTA, i.e. as near as possible to the CM/MTA. This is to ensure the reproducibility of the measurement results.

OPTIONAL: The relative levels may be modified per established network specific practice. Alternate values must be declared in the CM/MTA PICS.

The relative level is assumed to be 0 dBr on the digital side of the analogue/digital conversion point in the local network. See figure 4.

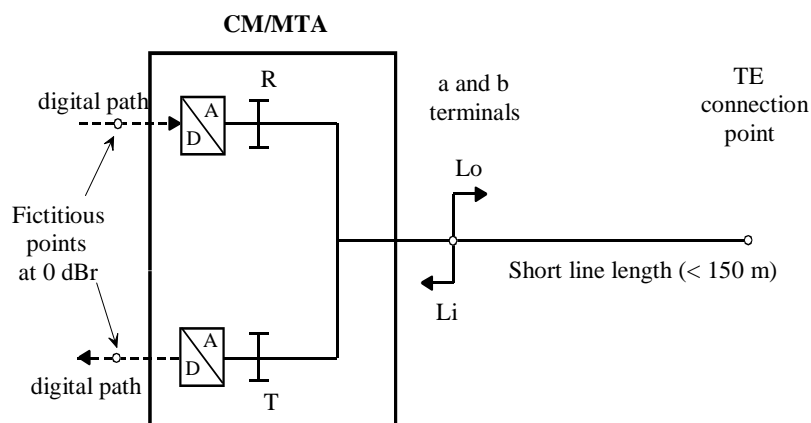


Figure 4: Relative levels

## 6.9.5 Variation of gain with input level

With a sine wave test signal applied to the 2-wire analogue interface of any input connection at the reference frequency 1 020 Hz and at a level between -55 dBm0 and +3 dBm0, the gain variation of that connection, relative to the gain at an input level of -10 dBm0, shall lie within the limits given in figure 5. The measurement shall be made with a frequency selective level meter to reduce the effect of the environmental noise. This requires a sinusoidal test signal.

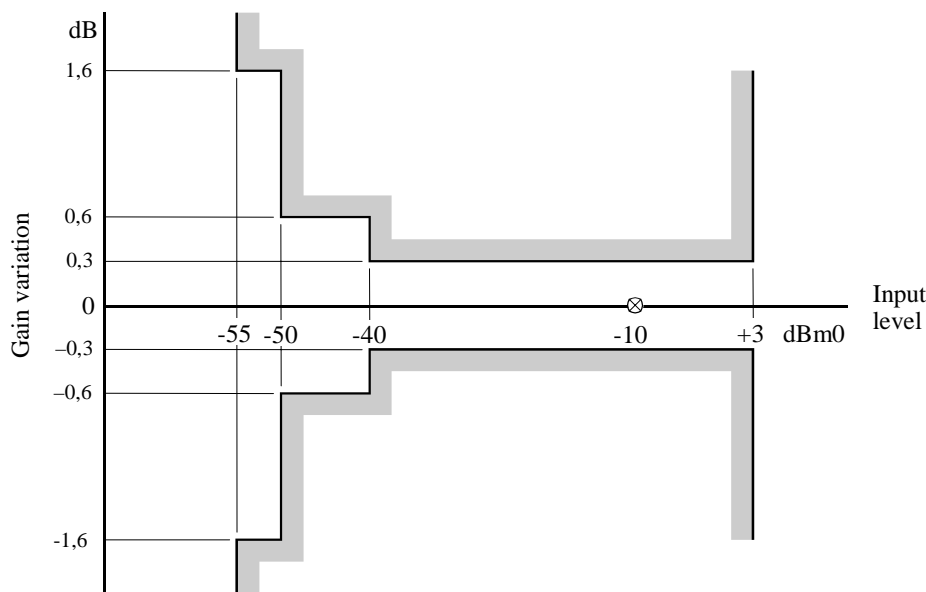


Figure 5: Variation of gain with input level (figure 4/Q.552)

Per network specific needs the  $L_1$  value may be different and care should be exercised to coordinate any changes in  $L_1$  with regards to system performance and test conditions across the Input levels, noise and stability specifications.

## 6.9.6 Loss distortion with frequency

The loss distortion with frequency, defined in clause 1.2.5 of ITU-T Recommendation Q.551 [43] of any input or output connection shall lie within the limits (most stringent limits of ITU-T Recommendation Q.552 [44] since only short lines are in the scope of the present document) shown in the mask of figure 6 using an input level of -10 dBm0.

NOTE: Attention is drawn to the need to accommodate voice band data applications that require a greater bandwidth for optimum operation (e.g. ITU-T Recommendations V.90 [45] and V.92 [46] modems). It is recommended that the bandwidth available be as wide as is practicable in order to accommodate such applications.



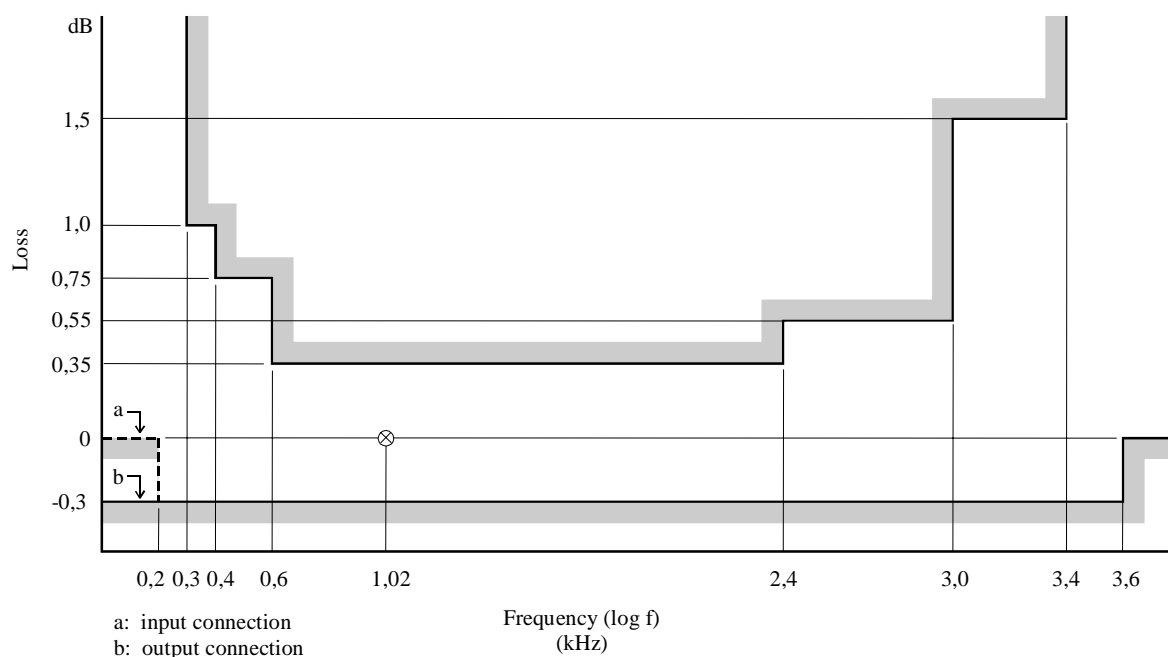


Figure 6: Loss distortion with frequency (figure 5/Q.552)

## 6.9.7 Audio coding law

The CM/MTA must support the Codec plan as defined in TS 101 909-3 [24] and as directed in NCS messages per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

## 6.9.8 Noise

### 6.9.8.1 Weighted noise

#### 6.9.8.1.1 Output connection per ITU-T Recommendation Q.552, clause 3.3.2.1.1

For an output relative level of  $L_O = -11,0$  dBBr the resulting maximum total noise level  $L_{TNO}$  for the output connection is:

$L_O$ (dBBr)	$L_{INO}$ (dBm0p)	$P_{AN}$ (pWp)	$P_{TNO}$ (pWp)	$L_{TNO}$ (dBmp)
-11	-70	200	207,94	-66, 82

Per network specific needs, if the  $L_O$  plan is different from -11 dBBr (see clause 6.9.4), then the noise specification will need to be re-stated per guidance of ITU-T Recommendation Q.552 [44].

#### 6.9.8.1.2 Input connection per ITU-T Recommendation Q.552, clause 3.3.2.1.2

The total maximum psophometric power  $L_{TNI}$  allowed at the fictitious test point (see clause 6.9) with an input relative level of  $L_i = +4,0$  dBBr is:

$L_i$ (dBBr)	$L_{INI}$ (dBm0p)	$P_{AN}$ (pWp)	$P_{TNI}$ (pW0p)	$L_{TNI}$ (dBm0p)
+4	-67	200	279,15	-65,54

Per network specific needs, if the  $L_i$  plan is different from +4 dBBr (clause 6.9.4), then the noise specification will need to be re-stated per guidance of ITU-T Recommendation Q.552 [44].

### 6.9.8.2 Single frequency noise

The level of any single frequency (in particular the sampling frequency and its multiples), measured selectively at the interface of an output connection, shall not exceed -50 dBm0.

Between 300 Hz and 3 400 Hz, the level of any single frequency measured selectively and corrected by the psophometric weighting factor (see table 1 of ITU-T Recommendation O.41 [40]) shall not exceed -73 dBm0p (provisional value).

NOTE: See clause 1.2.3.1/ITU-T Recommendation Q.551 [43] with regard to common measurement conditions.

### 6.9.9 Crosstalk

Only applicable for CM/MTA that provides more than one analogue Telephony interface.

For crosstalk measurements, auxiliary signals are injected as indicated in figures 7 and 8.

NOTE: A CM/MTA that only supports two analogue Telephony interfaces must test for NEXT and FEXT separately since only two analogue interfaces are available for signal application and measurement.

These signals are:

- the quiet code (see clause 1.2.3.1 of ITU-T Recommendation Q.551 [43]);
- a low level activating signal, e.g. a sine wave at a level in the range from -33 dBm0 to -40 dBm0. Care must be taken in the choice of frequency and the filtering characteristics of the measuring apparatus in order that the activating signal does not significantly affect the accuracy of the crosstalk measurement.

#### 6.9.9.1 Far-End and Near-End crossTalk measured with analogue test signal

A sine wave test signal at the reference frequency of 1 020 Hz and at a level of 0 dBm0, applied between the a and b terminals of a CM/MTA, shall not produce a level in any other half-connection exceeding -73 dBm0 for Near-End CrossTalk (NEXT) and -70 dBm0 for Far-End CrossTalk (FEXT) (see figure 7).

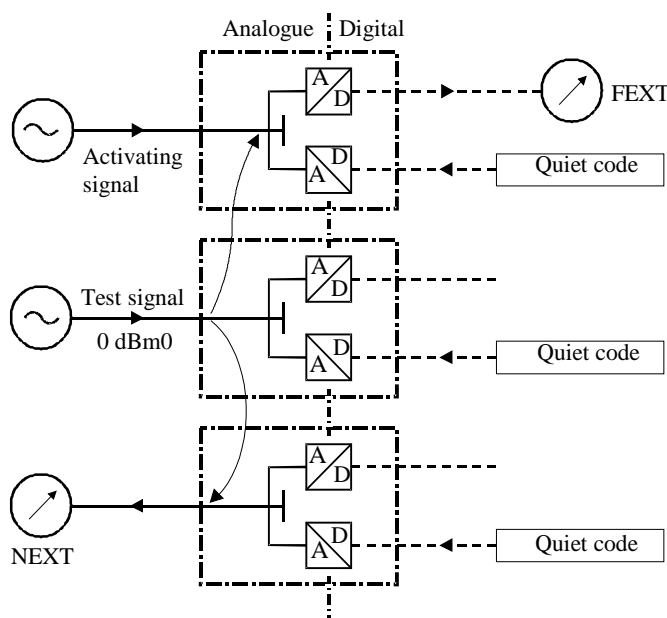
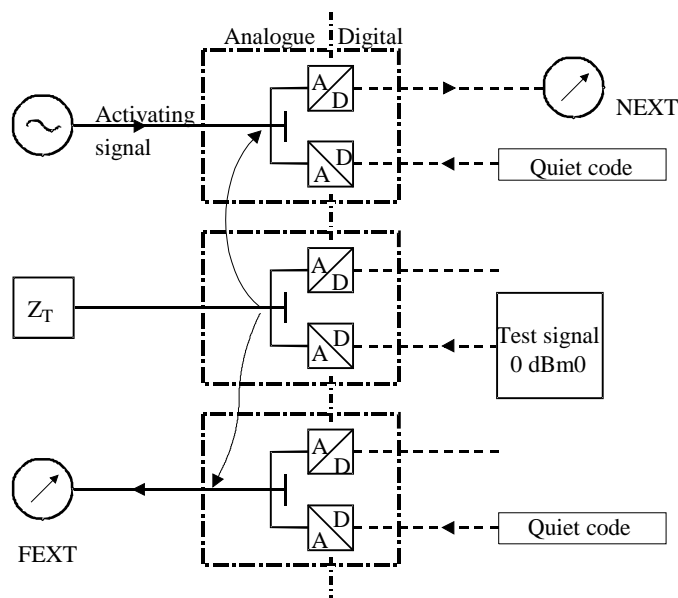


Figure 7: FEXT and NEXT measurements with analogue test signal (figure 7/Q.552)

### 6.9.9.2 Far-end and near-end crosstalk measured with digital test signal

A digitally simulated sine wave test signal at the reference frequency of 1 020 Hz applied at a level of 0 dBm0 to the fictitious test point (see clause 6.9), shall not produce a level in any other half-connection exceeding -70 dBm0 for Near-End crossTalk (NEXT) and -73 dBm0 for Far-End crossTalk (FEXT) (see figure 8).



**Figure 8: FEXT and NEXT measurements with digital test signal (figure 8/Q.552)**

### 6.9.10 Total distortion including quantizing distortion

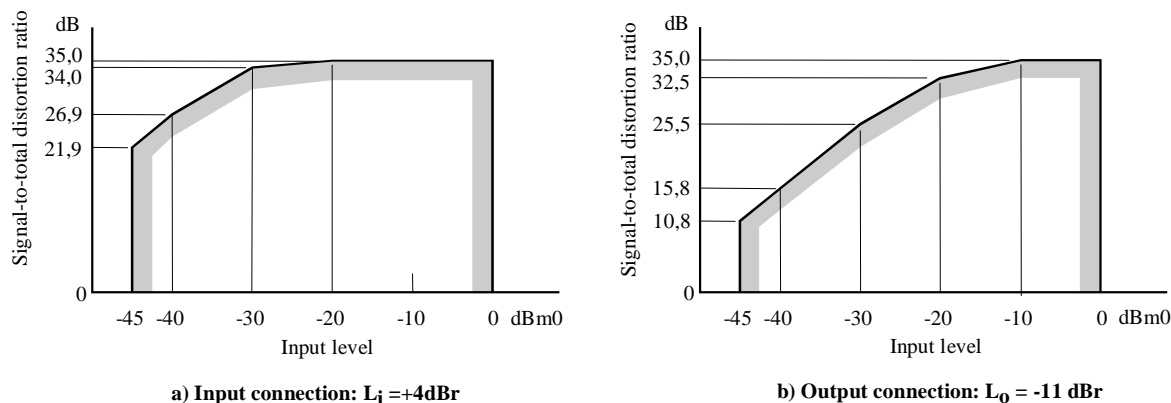
With a sine wave test signal at the reference frequency of 1020 Hz (see ITU-T Recommendation O.132 [41]) applied to the 2-wire interface of an input connection, or with a digitally simulated sine wave signal of the same characteristic applied to the fictitious digital reference point defined in clause 6.9 of an output connection, the signal-to-total-distortion ratio, measured at the corresponding outputs of the half-connection with a proper noise weighting (see table 1 of ITU-T Recommendation O.41 [40]) shall lie above the limits given in figure 9.

NOTE 1: The sinusoidal test signal is chosen to obtain results independent of the spectral content of the noise.

Resulting templates for the signal-to-total distortion ratio of input and output connections in a CM/MTA are shown in figure 9 per clause 6.9.4 where  $L_i = +4$  dBr and  $L_o = -11$  dBr are defined.

The signal-to-total distortion ratio for other relative levels as defined by the Network Operator can be calculated by using the formula given in clause 3.4.2 of ITU-T Recommendation Q.551 [43]. If the Network Operator specifies alternate levels the Vendor should state in the PICS declaration the calculated values based on the alternate levels.

NOTE 2: The values of figure 9 include the limits for the coding process given in figure 12 of ITU-T Recommendation G.712 [36] and the allowance for the noise contributed via signalling circuits from the power supply and other analogue sources, which is limited to -67 dBmp for an a-b (Z) interface (with feeding) by annex A of ITU-T Recommendation G.120 [33].



**Figure 9: Limits for signal-to total distortion ratio as a function of input level**

NOTE 3: On horizontal axis is given the input test level. In figure a) this is an analogue input signal and in b) it is a digital input signal.

NOTE 4: The levels shown in figures 9a and 9b are not the same as figure 14 of ITU-T Recommendation Q.552 [44] because Q.552 assumes values of  $L_i = 0 \text{ dBr}$  and  $L_o = -7 \text{ dBr}$  and in the present document  $L_i = +4 \text{ dBr}$  and  $L_o = -11 \text{ dBr}$ .

### 6.9.11 Discrimination against out-of-band signals applied to the input interface

This clause is only applicable to input connections.

#### 6.9.11.1 Input signals above 4,6 kHz

With a sine-wave signal in the range from 4,6 kHz to 72 kHz applied to the 2-wire interface of an input connection at a level of  $-25 \text{ dBm0}$ , the level of any image frequency produced at the fictitious digital reference point defined in clause 6.9 corresponding to the input connection shall be at least 25 dB below the level of the test signal.

#### 6.9.11.2 Overall requirement

Under the most adverse conditions encountered in a national network, the half-connection should not contribute more than  $100 \text{ pW0p}$  of additional noise in the band 10 Hz to 4 kHz at the output of the input connection, as a result of the presence of out-of-band signals at the 2-wire interface of the input connection.

### 6.9.12 Spurious out-of-band signals received at the output interface

This clause is only applicable to output connections.

#### 6.9.12.1 Level of individual components

With a digitally simulated sine wave signal in the frequency range 300 Hz to 3 400 Hz and at a level of  $0 \text{ dBm0}$  applied to the fictitious digital reference point of a half-connection defined in clause 6.9, the level of spurious out-of-band image signals measured selectively at the 2-wire interface of the output connection shall be lower than  $-25 \text{ dBm0}$ .

#### 6.9.12.2 Overall requirement

Spurious out-of-band signals should not give rise to unacceptable interference in equipment connected to the IPCablecom network. In particular, the intelligible and unintelligible crosstalk in a connected channel should not exceed a level of  $-65 \text{ dBm0}$  as a consequence of spurious out-of-band signals at the half-connections.

## 6.9.13 Echo and stability

Terminal Balance Return Loss (TBRL) as defined in ITU-T Recommendation Q.552 [44] clause 3.1.8.1 is introduced in order to characterize the CM/MTA performance required to comply with the network performance objective of ITU-T Recommendation G.122 [34] with respect to echo and stability.

NOTE: According to clause 6.9.3, the CM/MTA must have echo cancellation. An echo cancellor according to ITU-T Recommendation G.168 (see bibliography) will provide a much higher TBRL than required in this clause and shown in figure 11.

The TBRL of an interface is measured in the talking state as in an established connection through the fictitious digital reference point defined in clause 6.9.

The parameter "Stability Loss", as defined in Recommendation G.122 [34], applies to the worst terminating conditions encountered at a 2-wire interface in normal operation.

Using the arrangement of figure 10 (figure 9 of ITU-T Recommendation Q.552 [44]) and sinusoidal test signals, the measured TBRL should exceed the limits shown in figure 11. The Balance Test Network reference impedance is the network given in clause 6.7. Optionally, in special cases, the reference impedance may be modified according specific network practice.

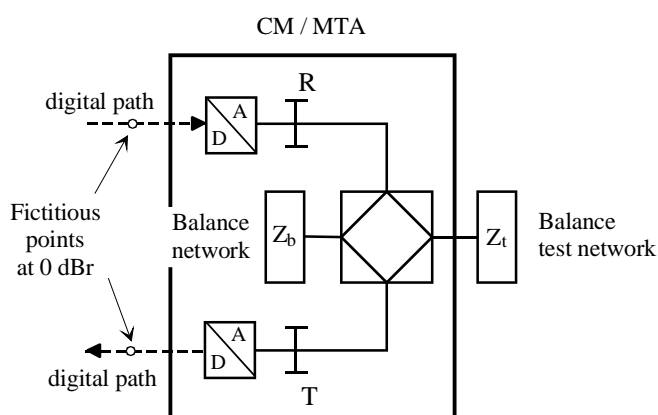


Figure 10: Arrangement for measuring of TBRL (figure 9/Q.552)

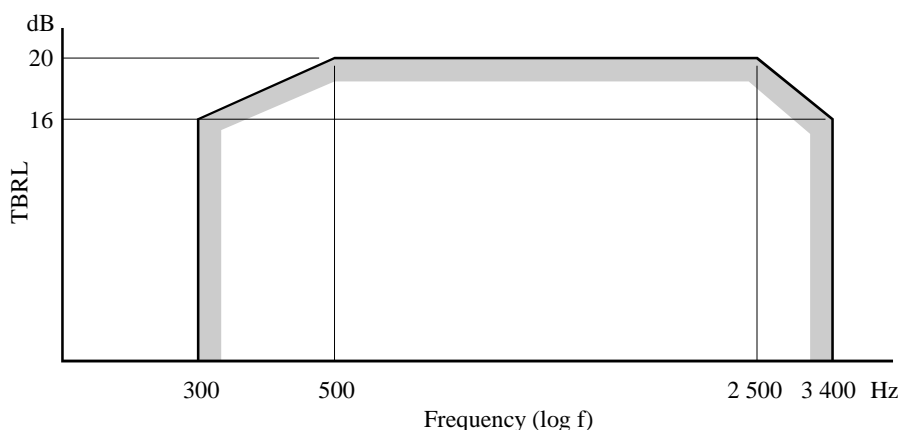


Figure 11: Limits for TBRL (figure 10/Q.552)

## 6.10 Dialling

### 6.10.1 DTMF dialling

Support of Dual Tone Multi Frequency (DTMF) dialling is required for signals from -15,0 dBV to -3,0 dBV corresponding to specification in ES 201 235-1 [9] and ES 201 235-3 [10].

Depending on the Network implementation architecture (e.g. LE Switch per TS 101 909-23 [31]), the CM/MTA may be required to pass the DTMF signalling from the analogue POTS interface to any network element (e.g. LE Switch) or in a non-switch architecture the CM/MTA may be required to detect and decode the DTMF Signals according to ES 201 235-2 [8] (see note 1), and signal the decoded digits to the CMS per the appropriate TS 101 909-4 [25] NCS message as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

NOTE 1: In deviation to ES 201 235-3 [10], it is enough to decode DTMF digits across the range of -3,0 dBV to -15,0 dBV, i.e. levels taken from the DTMF transmit level of TBR 021 [15] plus a small margin. The levels are not the same as in the DTMF receiver standard ES 201 235-3 [10], which specifies a reception range between -3 dBV to -28 dBV. The reason for this deviation is that this present document specifies requirements at the CM/MTA where the line length to the terminal is very short (150 m or less). This means that the levels appearing at the CM/MTA will be approximately the same as the levels transmitted from the terminal.

NOTE 2: See ES 201 235-1 [9] and ES 201 235-3 [10] for more information on DTMF receivers.

## 6.10.2 Loop disconnect dialling

OPTIONAL: Loop Disconnect dialling (Pulse Dialling) see clause 6.14.1.

## 6.11 Dial tone

### 6.11.1 Delay

Depending on the Network implementation architecture, e.g. LE Switch per TS 101 909-23 [31], the CM/MTA may be required to pass the dial tone to the analogue POTS interface or the CM/MTA may be required to generate the Dial Tone per the appropriate NCS message per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

In the TS 101 909-23 [31] architecture, the CM/MTA adds transmission delay per clause 6.9.1 to the overall network element signalling and transmission delays to make up the Dial Tone delay time.

When directed to generate dial tone per TS 101 909-4 [25], the CM/MTA must generate dial tone within 250 ms of the detection of a valid seize signal per clause 6.4.

### 6.11.2 Removal

Depending on the Network implementation architecture, e.g. LE Switch per TS 101 909-23 [31], the CM/MTA may be required to pass dialling signals from the analogue POTS interface or the CM/MTA may be required to disable dial tone signals per the appropriate NCS message per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

In the TS 101 909-23 [31] architecture, the CM/MTA must pass DTMF signals per clause 6.10 or decode loop disconnect dialling signals per clause 6.14.1. In this architecture, the delay in dial tone removal is dependent on the overall network element signalling, transmission and device (LE Switch) delays in addition to the delays encountered in either clauses 6.10 or 6.14.1.

When directed to remove dial tone per TS 101 909-4 [25], the CM/MTA must remove the dial tone within 250 ms of the detection of the first valid digit by either clauses 6.10 or 6.14.1.

### 6.11.3 Signal characteristics

See in clause 6.13 the signal characteristics.

## 6.12 Ringing

### 6.12.1 Waveshape

The CM/MTA must provide a ringing supply with a nominal frequency per the appropriate NCS message per TS 101 909-4 [25] as defined by provisioning or configuration per TS 101 909-6 [27] and TS 101 909-9 [28], within a tolerance of  $\pm 1$  Hz.

NOTE: The harmonized frequency value according ES 201 970 [13] is 25 Hz; other ring frequencies are 20 Hz and 50 Hz. However, 20 Hz is not widely used in Europe and some TE do not respond to 20 Hz signals in some countries probably due to the fact that it represents harmonic values of the loop disconnect dialling. There are also European networks using 50 Hz signals for meter pulse signalling.

It is recommended that the ringing signal is balanced with respect to earth and applied to the a and b terminals with a phase difference of  $180^\circ$ .

OPTIONAL: The a.c. ringing signal may be superimposed on a d.c. voltage as specified in clause 6.3.2.

In any case, where the ringing signal is not superimposed on a d.c. voltage, a d.c. voltage must be presented during the off (silent) parts of the ring cadence.

#### 6.12.1.1 Option 1 sinusoidal waveshape

A sinusoidal waveshape must be essentially symmetrical with an even order harmonic content not exceeding 5 %.

#### 6.12.1.2 Option 2 non-sinusoidal waveshape

A non-sinusoidal waveshape must be essentially symmetrical with a peak to rms voltage ratio in the range 1,2 to 1,6.

### 6.12.2 Ringing drive capability per line

The open circuit a.c. voltage must not exceed 100  $V_{rms}$  at the CM/MTA interface.

The CM/MTA must provide sufficient ringing current so as to produce a voltage not less than 35 V rms across an a.c. load of  $400/LF$  k $\Omega$ , where LF is the stated LF arising from clause 6.2.2.

OPTIONAL: A lower capability may be provided with the network operator agreement.

NOTE 1: A single TE may present a load of 4 k $\Omega$  at the CM/MTA. However, most recent TE normally present considerably higher impedance at the CM/MTA.

NOTE 2: Caution must be observed so as not to exceed specific requirements for duration-limited source safety.

NOTE 3: Additional guidance is offered in TR 101 768 [20] and TR 101 959 [21] on overlap feeding (DC) and ringing (AC) voltages.

### 6.12.3 Ring generator capacity

A CM/MTA that supports more than one Telephony interface must have sufficient ringing capacity to ring at least two interfaces simultaneously with the full line load as defined in clause 6.12.2.

NOTE 1: In an IPAT/LE architecture using the TS 101 909-4 [25] "L" line package, the CM/MTA operates as a "slave" to the V5 ring cadence in order to meet timing requirements for the LE generated "On Hook" data (e.g. CLID) transmission. To meet the LE timing requirements, the Ring Cadence Delay per clause 6.12.4.1 and the Ring Burst Delay per clause 6.12.5.1 must be met. In this architecture, the capability to ring all available lines with the full line load as defined in clause 6.12.2 must be met.

NOTE 2: In the Softswitch architecture the CM/MTA rings the lines autonomously and locally times and generates "On Hook" data (e.g. CLID) transmission. In this mode Network Operators may allow delayed (e.g. staggered) ringing across multiple lines to load share the ringer capacity.

NOTE 3: In an IPAT/LE architecture using the TS 101 909-4 [25] "E" line package, the CM/MTA has the capability to signal the end of the first ring burst (e.g. operation complete) so that the IPAT/LE can then generate the "On Hook" data (e.g. CLID) transmission. This enables the CM/MTA to delay (e.g. stagger) ring cadences across multiple lines so as to load share the ringer capacity in a manner similar to the Softswitch architecture.

OPTIONAL: A lower capacity may be provided per Network Operator agreement.

## 6.12.4 Ring cadence

Ring cadence is defined in the appropriate NCS message per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

### 6.12.4.1 Ring cadence delay

The CM/MTA must apply the appropriate ring cadence within 50 ms of the receipt of the NCS ring cadence message.

NOTE 1: In an IPAT/LE architecture using the TS 101 909-4 [25] "L" line package, the CM/MTA operates as a "slave" to the V5 ring cadence in order to meet timing requirements for the LE generated "On Hook" data (e.g. CLID) transmission. To meet the LE timing requirements, the Ring Cadence Delay per this clause and the Ring Burst Delay per clause 6.12.5.1 must be met. In this architecture, the capability to ring all available lines with the full line load as defined in clause 6.12.2 must be met.

NOTE 2: In the Softswitch architecture the CM/MTA rings the lines autonomously and locally times and generates "On Hook" data (e.g. CLID) transmission. In this mode the local administration may allow delayed (e.g. staggered) ringing across multiple lines to load share the ringer capacity. In this architecture the staggered ringing algorithms in the CM/MTA supersede the Ring Cadence Delay per this clause and the Ring Burst Delay as defined in clause 6.12.5.1.

NOTE 3: In an IPAT/LE architecture using the TS 101 909-4 [25] "E" line package, the CM/MTA has the capability to signal the end of the first ring burst (e.g. operation complete) so that the IPAT/LE can then generate the "On Hook" data (e.g. CLID) transmission. This enables the CM/MTA to delay (e.g. stagger) ring cadences across multiple lines so as to load share the ringer capacity in a manner similar to the Softswitch architecture. In this architecture the staggered ringing algorithms in the CM/MTA supersede the ring cadence delay per this clause and the ring burst delay as defined in clause 6.12.5.1.

### 6.12.4.2 Ring cadence timing distortion

The ring cadence timing distortion must be within  $\pm 50$  ms of the defined ring cadence timing.

## 6.12.5 Ring burst (Ring Splash)

Ring burst (Ring Splash) is defined in the appropriate NCS message per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

### 6.12.5.1 Ring burst delay

The CM/MTA must apply the appropriate ring burst within 50 ms of the receipt of the NCS ring cadence message.

NOTE 1: In an IPAT/LE architecture using the TS 101 909-4 [25] "L" line package, the CM/MTA operates as a "slave" to the V5 ring cadence in order to meet timing requirements for the LE generated on hook data (CLID) transmission. To meet the LE timing requirements, the Ring Cadence Delay per clause 6.12.4.1 and the Ring Burst Delay per this clause must be met. In this architecture, the capability to ring all available lines with the full line load as defined in clause 6.12.2 must be met.

NOTE 2: In the Softswitch architecture the CM/MTA rings the lines autonomously and locally times and generates on hook data (e.g. CLID) transmission. In this mode the local administration may allow delayed (e.g. staggered) ringing across multiple lines to load share the ringer capacity. In this architecture the staggered ringing algorithms in the CM/MTA supersede the Ring Cadence Delay per clause 6.12.4.1 and the Ring Burst Delay per this clause.



NOTE 3: In an IPAT/LE architecture using the TS 101 909-4 [25] "E" line package, the CM/MTA has the capability to signal the end of the first ring burst (e.g. operation complete) so that the IPAT/LE can then generate the on hook Data (e.g. CLID) transmission. This enables the CM/MTA to delay (e.g. stagger) ring cadences across multiple lines so as to load share the ringer capacity in a manner similar to the Softswitch architecture. In this architecture the staggered ringing algorithms in the CM/MTA supersede the Ring Cadence Delay per clause 6.12.4.1 and the Ring Burst Delay per this clause.

### 6.12.5.2 Ring burst timing distortion

The ring burst timing distortion must be within  $\pm 50$  ms of the defined ring burst timing.

### 6.12.6 Ring trip

Any ringing signal presented by the CM/MTA must be removed within 200 ms of a call answer (similar to seizure) signal consisting of a d.c. condition as defined in clause 6.4 being applied to the CM/MTA.

Upon detection of the Ring Trip, the CM/MTA must transmit the appropriate NCS message per TS 101 909-4 [25].

## 6.13 Supervisory signals

NOTE 1: Further information on tones generated by the network may be found in TR 101 041-1 [17].

NOTE 2: The tones specified in this clause are in accordance with ITU-T Recommendation Q.35/E.180 [42].

Depending on the Network implementation architecture, the CM/MTA may be required to pass the supervisory signals (e.g. LE Switch per TS 101 909-23 [31]) to the analogue POTS interface or the CM/MTA may be required to generate the Supervisory Signals per the appropriate NCS message per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

### 6.13.1 Supervisory tones

The following types of supervisory tones must be provided:

- a) dial tone;
- b) number unobtainable tone;
- c) ring tone;
- d) busy tone.

When directed to generate tones per the appropriate NCS message per TS 101 909-4 [25], the frequency and amplitude of the tones must be as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

It is recommended that the following additional supervisory tones are also provided:

- e) release tone (if such a tone is used as specified in clause 6.5.2);
- f) special dial tone (often used to indicate the presence of messages waiting, or call forward activated);
- g) special information tone;
- h) release tone (if not provided as e) above);
- i) call waiting tone;
- j) congestion tone.

### 6.13.2 Tone levels

The level of supervisory tones applied by the CM/MTA across the reference impedance load  $Z_{ref}$ , should be within the range of  $-18$  dBV  $\pm 6$  dBV.

Depending on Network implementation architecture, this level may be a function of the LE Switch generated level less the CM/MTA " $L_o$ " loss (clause 6.9.4) or the level may be per the appropriate NCS message per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

### 6.13.3 Cadences and frequencies

Depending on the Network implementation, cadences and frequencies may be supplied by another network element (e.g. LE Switch or Announcement Server) or they may be generated by the CM/MTA per the appropriate NCS message per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

## 6.14 Optional functions

Each of the functions listed in this clause are to be considered independent options unless specified otherwise. The Vendor must declare in the CM/MTA PICS document which of these options is supported.

### 6.14.1 Loop Disconnect dialling

The CM/MTA must recognize breaks in the loop current below the Clear Signal Threshold current of clause 6.5 and correctly interpret them in time as Loop Disconnect (LD) signals as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28] and must send the appropriate NCS message per TS 101 909-4 [25].

NOTE 1: TE with automatic LD signalling will normally generate pulse trains with a maximum InterDigits Pause of 920 ms. It is possible for terminals with manual LD signalling to exceed this limit.

NOTE 2: Information on the requirements for TE with LD signalling capability may be found in ES 201 187 [7].

### 6.14.2 Register recall (hook flash)

The CM/MTA shall recognize breaks in the loop current below the Clear Signal Threshold current of clause 6.5 and as defined in time by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28] applied at the CM/MTA as a Register Recall signal. In response to a Register Recall signal the CM/MTA must send the appropriate NCS message per TS 101 909-4 [25].

NOTE: Information on the requirements for TE with Register Recall signalling capability may be found in ES 201 729 [11].

### 6.14.3 Metering

The CM/MTA must apply to the Analogue Line the appropriate meter pulse in response to NCS message directives per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28].

The most common signalization to be used in Europe is specified in ES 201 970 [13], clause 14.3. The Network Operator may specify other signalization.

### 6.14.4 ALASS and other enhanced services

In order to support the provision of ALASS services to the TE, the CM/MTA shall apply to the Analogue line signals selected from the list below, according to TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28] for the implemented options:

- a) a single burst of ringing current with or without polarity reversal;
- b) provision of loop current up to 2,5 mA at a voltage greater than 32 V without it being treated as a seize signal;
- c) ignore on-line value dc current pulses not exceeding 25 ms duration, i.e. do not treat as a seize signal.

NOTE 1: More details may be found in EN 300 659 [2] for the NTP and ES 200 778 [5] for the TE. For the implementation of ALASS services these standards should be followed. By fulfilling the signalling requirements established in EN 300 659 [2], parts 1 and 2, the interface may support enhanced services based on protocols specified in EN 300 659 [2] or other standards.

NOTE 2: ES 201 912 [12] standardizes the Short Message Service (SMS) for the User Based Solution (UBS), protocols for analogue TE of the PSTN/ISDN to communicate with the appropriate service centre. To implement such services no specific additional requirement is necessary in the present document, it is enough to fulfil the requirements of EN 300 659 [2], parts 1 and 2.

NOTE 3: ES 201 071 [6] standardizes the Server Display and Script Services protocol (SDSS), which is also a protocol supporting enhanced services based on interfaces considered in the scope of the present document. To implement such services no specific additional requirement is necessary in the present document, it is enough to fulfil the requirements of EN 300 659 [2], parts 1 and 2.

NOTE 4: A signal similar to "k-break" may be used to start and stop services based on the "on-hook" transmission. A "Open Switch Interval" signal, interrupting the voltage offered to the TE for an time interval of e.g. 900 ms, may be used to start and stop a certain service.

### 6.14.5 Polarity reversal

The CM/MTA must apply the appropriate line polarity reversal to the Analogue Line in response to NCS message directives per TS 101 909-4 [25].

NOTE 1: In order to ensure compatibility with the installed base of terminals in certain European States it may be necessary to use polarity reversals to indicate start and end of ringing signal. In these cases, compatibility must be adequately ensured if the normal d.c. polarity is reversed when the first ringing voltage is applied. The polarity must revert to the normal polarity when the line is seized or cleared. The CM/MTA must not autonomously apply polarity reversal. The CM/MTA must provide polarity reversal in response to NCS message directives per TS 101 909-4 [25].

NOTE 2: Polarity reversal can be used to indicate called party answer and end-of-call.

NOTE 3: Polarity reversal can also be used for other signalling purposes (e.g. as given in EN 300 659 [2]).

### 6.14.6 End of call signal ("K-break")

An end-of-call signal consisting of a reduction in the a-b terminal interface loop current to below 1 mA for a certain period is referred to as K-break. The CM/MTA must apply the "K-break" signal to the Analogue Line in response to a NCS message directive per TS 101 909-4 [25] as defined by Provisioning or Configuration per TS 101 909-6 [27] and TS 101 909-9 [28]. The CM/MTA must apply the signals with timing distortion within  $\pm 25$  ms.

During the K-break, the CM/MTA must maintain a loop closure state (Line Seizure State) towards the network.

### 6.14.7 Payphones

Many Payphones operate by using a combination of polarity reversal, meter pulse or "K-break" signals. Due to the wide range of payphone variations the specifics of this operation require further study. As defined in the above clauses, CM/MTAs that support these optional features must be capable of supporting Payphone services under the appropriate CMS control using the defined NCS message set of TS 101 909-4 [25].

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## Annex A (informative): Most important references for analogue PSTN interfaces

The present document covers requirements for the E-MTA Analogue Telephony Interface. This annex gives guidance on the use of most relevant standards normally used as reference for analogue PSTN public interfaces. There is a large consistence between such reference documents and the present one, but the difference in the architectures of the legacy PSTN systems and IPCablecom justify different organizations for the corresponding standards. Also the fact that IPCablecom is based on most recent technologies allow a level of flexibility not common to earlier networks.

It is the intention of the present document to address requirements only for the E-MTA. This implies that a certain number of parameters identified in standards normally used as reference for analogue PSTN interfaces have to be placed in other parts of the TS 101 909 series of standards. This is particularly applicable for time parameters specified in the MIBs parts of this series of documents to allow a more flexible deployment of IPCable systems.

The use of European harmonized values is recommended as default values for programmable parameters in the IPCablecom.

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### A.1 Characteristics of analogue port

The analogue port specification of the CM/MTA was derived from EG 201 188 (see bibliography). More recently ES 201 970 [13] was adopted and is being recommended by several regulating authorities in Europe.

The use of values respecting ES 201 970 [13] limits and others widely harmonized in Europe as default for the programmed parameters in the IPCablecom system will facilitate a wider and quicker deployment of the system. For example the information of cadences frequently used in public networks is given in TR 101 183 [19] and this information may be obtained via ES 201 970 [13]. In special cases the network operator may nevertheless, for special reasons, require values deviating from ES 201 970 [13] or not specified in the document.

The ES 201 970 [13] requirements largely ensure the correct interoperation between the CM/MTA and the analogue TE in Europe and other regions following European Standards. It is based on TBR 021 [15], a standard harmonizing the European TE, but it covers the large majority of legacy terminals, including the most relevant national specific variations, some of them tending at present to disappear in the normal process of network maintenance and renewal.

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### A.2 Voice transmission for analogue connected TE

The transmission characteristics in general are based on ITU-T Recommendations Q.551 [43] and Q.552 [44]. Echo canceller devices should be designed according to ITU-T Recommendation G.168 (see bibliography).

QoS information in EG 201 050 [3] help to understand the relationship between transmission parameters and the performance evaluated in terms of Quality of Service. ES 201 168 (see bibliography) is also an important base to understand European transmission aspects of voice signals.

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## Annex B (informative): Loading Factor (LF) interpretation

This annex is of informative nature.

The LFs being defined are based on TE performance characterizations. The intent of using these LFs in the present document is to define how much of a load each CM/MTA interface can support. Therefore the CM/MTA statement of LF relates to the magnitude of the load that can be supported, where as the TBR 021 [15] LF relates to the load of an individual TE (e.g. source capacity verses sink characteristics).

These views are intended to allow the connection of multiple terminals in combinations of parallel and series connections as long as the LF of the CM/MTA is not exceeded. The CM/MTA Vendor is required to state the lowest of the LFs calculated for each of the four parameters in table 3, thus determining the maximum TE load that can be attached to the CM/MTA and still maintain proper operation.

As such it is necessary to extrapolate the TBR 021 [15] LF definitions to the CM/MTA and to clearly interpret the meaning of the Vendor declaration of CM/MTA LFs (capacity).

**NOTE:** Caution must be exercised so as not to confuse LU and LF with the number of Terminals being connected. Any Terminal will offer some number of LU to contribute to the total Loading Factor. If wiring or other installation devices do not introduce significant impairments, the total LF of a home installation is the sum of the LF of all the TE connected to the CM/MTA interface. An CM/MTA should offer a higher value for LF in order to ensure appropriate level of service.

There are four loading factors identified in table 3.

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### B.1 Resistance to earth

This parameter may not be relevant for many implementations of MTAs, i.e. the sensitivity of CM/MTA to low values of resistance between the interface metallic points and the earth may not influence the correct behaviour of the system.

TBR 021 [15], clause A.4.4.4 defines this as the resistance that exists from either the "a" or "b" terminal to the TE earthing point. From a CM/MTA perspective this could cause the CM/MTA to incorrectly detect an off-hook condition, to be unable to generate ringing voltages or present another inappropriate behaviour.

From an CM/MTA perspective, this means that if an excessive number of TE and/or an inappropriate installation allow excessive current to flow from the loop to Earth, then the CM/MTA would not be able to detect when the line was being released (on-hook), or to be unable to generate ringing voltages or have another inappropriate behaviour.

Assuming that a CM/MTA can only ensure a correct operation when the resistance to earth is  $> 10 \text{ k}\Omega = 0,01 \text{ M}\Omega$ .

Using the table 3 formula of  $1\ 000/R \text{ [M}\Omega]$  provides:

$$\text{LF} = (1\ 000/0,01) \text{ LU} = 100\ 000 \text{ LU}$$

This means that the CM/MTA would be able to support Terminals with a combined LF of 100 000 LU and still operate correctly.

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### B.2 DC resistance

The CM/MTA LF is linked to the on-line release threshold (current or resistance criteria) so that when loaded with the maximum LF, the CM/MTA will still detect the loop as being in or going to the off-line state.

Assuming the same "line release" condition on the loop as a loop resistance of  $> 10 \text{ k}\Omega = 0,01 \text{ M}\Omega$ .

Using the table 3 formula of  $100/R \text{ [M}\Omega]$  provides:

$$\text{LF} = (100/0,01) = 10\ 000 \text{ LU}$$

This means that the CM/MTA would be able to support TE with a combined LF of 10 000 LU and still detect an off-line (on-hook) state or a transition to it.

NOTE: Clause A.4.4.1 of TBR 021 [15] defines this as the resistance that exists between the "a" and "b" terminals of a TE in the off-line (on-hook) state. From a CM/MTA perspective, this would represent a maximal load (minimal resistance of the loop) presented to CM/MTA interface wires to which the CM/MTA could still ensure to release the line and go to off-hook condition. From a CM/MTA perspective, if an excessive number of TE or/and an inappropriate installation combined to represent an excessive low resistance, then the CM/MTA would not be able to detect when the line was being released (on-hook).

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## B.3 Lowest impedance at 25 Hz

Since the CM/MTA is providing the ring voltage/current source the capability of the CM/MTA generator is converted into equivalent load impedance and then applied to the LF formula. Assuming a CM/MTA that can provide the specified minimum ring voltage across a  $1\,400\ \Omega = 1,4\ \text{k}\Omega$  total ringer load on the a and b terminals (including loop resistance) then the LF for that CM/MTA would be:

Using the table 3 formula of  $400/Z$  [k $\Omega$ ]:

$$\text{LF} = (400/1,4)\ \text{LU} = 285\ \text{LU}$$

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## B.4 DC current during ringing

The CM/MTA LF is linked to the ring trip detection current so that when loaded with the maximum LF, the CM/MTA will still maintain ringing voltage on the a and b terminals.

This also equates Ring Trip to the "Must not Seize line state" of clause 6.4.1 (e.g.  $< 3\ \text{mA}$ )

Using the table 3 formula:

$$\text{LF} = 100 \times 3 / 0,6 = 500\ \text{LU}$$

NOTE: Clause A.4.4.2.3 of TBR 021 [15] defines this as the DC current that flows from a 60 VDC source superimposed on a 25 Hz ring signal applied to the Terminal Equipment in the off-line (on-hook) state. Under these conditions the maximum current that is to flow to a single terminal is 0,6 mA.

From a CM/MTA perspective this would represent a current that must not be detected as a ring trip condition. Again, from a CM/MTA perspective, if a sufficient number of terminals combined to represent a high enough DC current during ringing then the CM/MTA would detect ring trip and essentially no ringing or inappropriate ringing characteristics (e.g. shorter ring bursts) would be supplied to TE.

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## B.5 PICS declaration

Comparing the four parameter calculations for the above example CM/MTA, the LF is determined by the capability of the CM/MTA to interpret characteristics at 25 Hz presented to the interface. The LF value to be declared is 285 LU and this would be the value stated in the PICS declaration by the vendor.

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## Annex C (informative): Bibliography

- ETSI EG 201 188 (V1.2.1): "Public Switched Telephone Network (PSTN); Network Termination Point (NTP) analogue interface; Specification of physical and electrical characteristics at a 2-wire analogue presented NTP for short to medium length loop applications".
- ETSI ES 201 168 (V1.2.1): "Speech processing, Transmission and Quality aspects (STQ); Transmission characteristics of digital Private Branch eXchanges (PBXs) for interconnection to private networks, to the public switched network or to IP gateways".
- ETSI TS 101 909-8: "Access and Terminals (AT); Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 8: Media Terminal Adapter (MTA) Management Information Base (MIB)".
- ITU-T Recommendation G.117 (1996): "Transmission aspects of unbalance about earth".
- ITU-T Recommendation G.168: "Digital network echo cancellers".

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## History

<b>Document history</b>		
V1.1.1	August 2002	Publication
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