Telecom

FIGURES **Section/Page**

RELATED TELECOM DOCUMENTS

PTC 100	Permit to connect (Telepermit): General conditons
PTC 101	Telepermit Requirements for Electrical Safety
PTC 103	Code of Practice for the Installation of Telecommunications Wiring
PTC 105	Code of Practice for Cabling of Commercial Premises
TNA 118	Telecom DDI Interfaces
PTC 200	Requirements for Connection of Equipment to Analogue Lines
PTC 200/- Series	Technical Requirements for specific types of CPE

REFERENCE DOCUMENTS (including later amendments)

AS/NZS 3080:1996 (IEC 11801:1995)	Telecommunications installations - Integrated telecommunications cabling systems for commercial premises
AS/NZS 308x:1996	Telecommunications installations - Integrated telecommunications cabling systems for small office/home office premises
AS/NZS 3260:1993 (IEC 950:1991)	Approval & test specification - Safety of information technology equipment including electrical business equipment
Bellcore TR-NWT-000030:1992	Voiceband data transmission interface: Generic requirements
Bellcore TR-NWT-000031:1992	LATA switching systems: Generic requirements

British Standards:-

BS 6305:1992	General requirements for connection to public switched networks
BS 6312:1985	Specification for plugs to be used with British Telecom line jack units

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FOREWORD

This Document describes the nominal characteristics existing at the service delivery point in a customer's premises on analogue lines connected to the Telecom Public Switched Telephone Network (PSTN) and Telecom Centrex system.

With the exception of some equipment provided by Telecom as an inherent part of its network service and classed as ‘network equipment’, all wiring and equipment within a customer's premises (CPE) are open to competitive supply. It is therefore necessary for the nominal technical characteristics of PSTN lines to be clearly specified so that CPE suppliers are aware of the electrical conditions their equipment will encounter. This is necessary in order to preserve the network integrity and the quality of service to other customers.

The first issue of this document, published as "Specification PTC 102" in 1988, included some CPE requirements in addition to describing the PSTN line conditions. CPE requirements have since been fully incorporated into Specification PTC 200 and the various other 'PTC' specifications applicable to the specific types of equipment.

Since 1988 there have been substantial changes in Telecom's network. Virtually all electro-mechanical switching equipment has been replaced by Stored Programme Control digital electronic equipment. There has also been an increase in the use of electronic equipment in the local loop and additional services are being continually introduced. These changes are reflected in this technical document which now replaces Specification PTC 102.

This document does not include CPE requirements and is therefore being released as "TNA 102". ('TNA' documents are intended to describe technical conditions supplied by the Telecom network at a given interface, whereas 'PTC' specifications describe the technical requirements for the connection of CPE to the Telecom network.)

By the very nature of the analogue network, the conditions described in this technical document are nominal and cannot always be closely defined. However, they can usually be described as ranging between specified limits. These limits are specified in this document wherever possible.

TELECOM DISCLAIMER

Telecom makes no representation or warranty, express or implied, with respect to the sufficiency, accuracy, or utility of any information or opinion contained in this Specification. Telecom expressly advises that any use of or reliance on such information is at the risk of the person concerned.

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This document describes the conditions encountered on the great majority of Telecom lines. It does not cover the extreme conditions that may arise on a small proportion of the total lines in the network. As an example, service in some rural areas may be provided by a combination of cable, line transmission and radio systems which may not support all Telecom services or terminal equipment functions.

Additionally, it must be stressed that Telecom's network is primarily designed for telephony. While it supports basic data and facsimile transmission functions, it is not always possible to accommodate the higher data rates claimed by equipment suppliers.

Telecom

1
SCOPE

1.1
Telecom Public Switched Telephone Network

(1) This document describes the nominal conditions on a Telecom Public Switched Telephone Network (PSTN) analogue line at the point of interface with customer premises equipment (CPE). Unless otherwise stated, the conditions described also apply to Telecom Centrex lines.

• *This does not necessarily include lines connecting Centrex Consoles which may involve the use of digital interfaces and proprietary signalling.*

(2) The conditions described in this document relate to the network services currently available to customers, although some of the interface procedures will also support future services.

(3) The Telecom network consists of a range of switching and transmission equipment types, purchased from different sources and covering a variety of technologies. This variability of the network equipment, coupled with variations in the local cable network, are such that the conditions applying at a particular customers line can only be defined in broad terms.

1.2
Customer premises equipment

(1) All products intended for connection as customer premises equipment (CPE) to the Telecom PSTN must have been granted a Telepermit, unless a specific dispensation has been given by Telecom. The requirements for obtaining a Telepermit are covered in Specification PTC 100, PTC 200 and other PTC specifications which are issued to cover the technical requirements for specific classes of equipment.

• *Commercial building cabling components are an example of product types granted a dispensation from Telepermit requirements. See PTC 100:1996 for further details.*

(2) This technical document complements those PTC specifications applicable to products intended for connection to an analogue PSTN line. It provides for a more complete understanding of the Telepermit requirements .

(3) While equipment complying with the requirements of PTC specifications can be connected with a high degree of assurance that it will be compatible with the network in most situations, there may be some exceptions. Experience to date indicates that such exceptions occur relatively rarely. Extreme exceptions are being dealt with progressively by the upgrading of network equipment.

(4) While this Specification relates primarily to the Telecom PSTN interface, many products such as PABX systems and series-connected devices need to present a similar interface if they are to support CPE intended for direct connection to the network. Such equipment, although having a similar interface to that described in this document, cannot be regarded as a direct equivalent and may not support all PSTN services and interface arrangements.

(5) This document should be read in conjunction with the PTC Specification(s) applicable to the particular CPE functions concerned.

1.3
Legal requirements

(1) To comply with Section 6 of the Telecommunications Act 1987 and gain Telecom's agreement for connection to the Telecom network, CPE shall comply with Telecom's requirements. Only devices that comply with those requirements for connection are granted a Telepermit and they are to be labelled accordingly.

• *See Specification PTC 100.*

• *Exceptions are those items supplied or Type Approved by Telecom or NZ Post Office prior to 1 May 1988, or before 'Telepermit' came into force. Such items complied with the network interface requirements applicable at the time they entered service. Other classes of equipment excluded from Telepermit are listed in PTC 100.*

(2) This document is intended to assist Telepermit applicants to comply with Telecom's requirements and to more fully understand their purpose.

1.4
Compliance with International standards

(1) As far as is practicable, the Telecom PSTN is compliant with ITU-T (formerly CCITT) Recommendations. Reference is made as appropriate to specific Recommendations throughout this Specification. For convenience, such references indicate the Recommendation current at the date of issue, e.g. 'CCITT Blue Book Rec. xxx' is stated where there is no more recent ITU-T Recommendation.

(2) Wherever practicable, Telecom endeavours to harmonise Telepermit requirements with equivalent overseas specifications. This particularly applies to Austel requirements.

• *Issue 1 of this Specification was harmonised with British Standards as far as possible, owing to the fact that the Telecom network design was originally close to that of British Telecom. It is now New Zealand Government policy to align Australian and New Zealand Standards wherever possible. However, complete alignment is not realistic due to fundamental network differences which evolved during many years of separate development.*

2
GENERAL

2.1
Mode of presentation

Statements which form the main text of this document are printed in plain type with each paragraph formally numbered. Comments and recommendations which are added only as explanations, or as indications of the means of compliance with PTC Specifications, are shown in *italics*. Smaller type is used and each paragraph is preceded with a "•" symbol instead of a number.

2.2
Network demarcation

(1) For most residential customers connected to the PSTN via individual lines, the physical demarcation point between the Telecom network and customer wiring will be one of the following:-

> (a) The External Test Point (ETP) mounted on the outside of the customer's building in cases where one has been installed by Telecom.

• *An External Test Point (ETP) is a small weatherproof box mounted on the outside of a building where the network lead-in cable enters the building. It provides a suitable point at which to joint the grease-filled lead-in cable to the building cabling.*

> (b) Where no ETP has been installed, the demarcation point becomes the first point within the customer's premises at which the incoming line terminates. This is usually a telecommunications outlet (TO), such as a jackpoint, socket or equivalent item of hardware (see also Section 9).

(2) There are some exceptions to the position outlined in (1) above in that the "first termination" in residential premises may be derived in an item of Telecom-owned network equipment. As the customer's individual voice frequency service is only available on the customer's side of such equipment, its output termination is regarded as the demarcation point.

• *To avoid the necessity of installing new cabling to meet rising demand, there is growing use of derived circuits in Telecom's local network reticulation. These may in some cases require the installation of Telecom-owned network equipment within the customer's premises.*

• *Included in this category are lines derived from various types of 'pair gain devices', multiplex equipment, multi-access radio, etc.*

(3) Commercial premises can be divided broadly into two categories as follows:-

> (a) Those with only a few network lines where each line is separately terminated on a jackpoint in a similar manner as outlined above for residential customers.

> (b) In larger installations, service is usually provided by means of either a multi-pair network lead-in cable or derived circuit equipment. In both cases, the individual lines are usually terminated on a frame or block providing cross connection with internal

building cabling. The actual network terminations are deemed to be part of the network (and may be secured by Telecom). The physical network demarcation point is then at the first terminations which are accessible to the customer.

• *The physical location of the network demarcation point is not defined in New Zealand legislation. It may be sited at any point agreed by Telecom and the customer or building owner. In some commercial buildings and sites, one or more demarcation points may be sited on upper floors or within outlying buildings remote from the lead-in cable entry point. These are termed “Telecom Network Terminations” or “TNT’s”.*

2.3
Service Delivery Points (SDP)

Commercial building telecommunications cabling has been open to competition and private ownership since 1988. As a result, cabling belonging to a third party may be interposed between the Telecom network demarcation point and the point at which a Telecom service is delivered to a customer. In such cases, the electrical characteristics of the interface at the service delivery point will be nominally the same as those at the network demarcation point.

• *The cabling and connection arrangements for commercial buildings are covered in Specification PTC 105.*

2.4
Responsibilities

(1) Telecom owns and is responsible for the maintenance and correct operation of all components of its network. These include the lead-in cable and pipe on the customer's land, the ETP on the building if provided, and any network equipment or network cabling within the customer's premises required to derive the customer's individual line.

(2) Wiring and termination hardware within the premises and on the customer's side of the network demarcation point is the customer's responsibility, other than where a third party, typically the owner of the building, may own part of the building cabling and be responsible for its maintenance.

• *See Section 9 for details of Telecom standard customer interfaces and Specification PTC 103 for details of residential customer wiring.*

(3) Apart from certain exceptions specifically stated in this document or in relevant PTC specifications (e.g. for PABX’s), Telecom does not undertake to adjust or modify the network to fit different types of CPE. It is the responsibility of suppliers to arrange for any necessary modifications to their products to meet the interface requirements of the Telecom network.

2.5
Network interface characteristics

The electrical characteristics at the network interface cannot be precisely defined in every installation for reasons of variations in line characteristics, length of line, differences in delivery technology and the need to allow for future developments. However, this document defines the range of conditions that can be encountered on the great majority of PSTN lines by anyone dealing with the design and installation of CPE.

2.6
Protection from line interference

2.6.1
Electrical safety

(1) The very nature of a PSTN line renders it liable to power surges caused by lightning strikes or power supply faults. It is almost impossible to protect against lightning directly striking the line. However, the most common problem is a strike from either lightning or power in the vicinity of the line, causing very high changes in earth potential and high transient earth currents. A Telecom line can become an ideal conductor for such currents, and both longitudinal and transverse transient voltages may result.

(2) Telecom's standard 'Master' sockets incorporate a British Telecom Type 11A gas type surge suppressor, which provides some protection against line to line transients. This was originally regarded as the primary protection stage for many line-powered telephones as it absorbed inductive surges from network equipment. Telecom’s transmission bridges are now non-inductive and the need for such suppressors no longer applies.

• *Telecommunications administrations in most countries do not provide such suppression devices.*

(3) As a result of extensive network changes, Telecom is has reviewed its practices and the BT Type 11A suppressor will no longer be fitted to new or re-wired installations. In view of this change, it is essential that customer equipment satisfies the requirements of Section 6 of AS/NZS 3260:1993 without placing any reliance on the presence of surge suppressors.

• *It is expected that a higher grade of surge protection may be installed as appropriate by Telecom on lines in those locations with a known history of lightning damage or high risk of a rise in earth potential.*

• *AS/NZS 3260:1993 is the joint Australian and New Zealand Standard for electrical safety of information technology equipment. The New Zealand version is directly equivalent to the international standard IEC 950:1991.*

2.6.2
Line faults

On short lines connected to earlier types of telephone exchange, an earth contact on the line can result in a current of up to 125 mA flowing through customer equipment in the off-hook condition. It is strongly recommended that equipment be capable of withstanding such current flow for a lengthy period without damage.

• *In most cases, Telecom’s digital exchange and transmission system line feeds are current limited to 80 mA or less.*

2.7
Network numbering

2.7.1
International obligations

(1) Registers in Telecom’s electronic exchanges are capable of storing a total of at least 20 digits. This provides for call prefixes and satisfies the ITU requirement that all

networks provide for 15 digit international numbers by time ‘T’, as specified in CCITT Rec. E. 165 and ITU-T Rec. E. 164: 1991.

- *Time ‘T’ is specified in CCITT Rec. E. 165 as being 2359 hrs on 31 Dec. 1996.*

(2) In order to comply with the requirements of ITU-T Rec. E. 164, at time ‘T’ all Telecom’s crossbar exchanges are being progressively phased out. These currently support only 15 digits, including the ‘0’ national or ‘00’ international call prefix.

2.7.2
Telecom numbering scheme

(1) The general principles of the Telecom network numbering scheme are published in document TNA 150.

(2) Details of the number groups allocated in each area and the numbers allocated to network and special services are published in a document entitled "Call Charging Steps and Network Numbering".

- *This document is published quarterly and subscriptions may be registered with Access Standards.*

2.8
Supplementary services and Centrex

The technical details of the line interface for supplementary services and for Centrex are the same as stated in this Document. However, the necessary codes etc. for accessing and controlling these services are not included in this Specification.

- *Refer to Telecom’s User Instructions and Telephone Books for such information*

3 DEFINITIONS

3.1
In general, definitions set by the International Telecommunications Union and published in the ITU-T (formerly CCITT) Recommendations apply throughout this Specification. Nevertheless, some ITU-T definitions are not particularly informative for those unfamiliar with telephone engineering and therefore the following definitions are provided. Where necessary, these are supplemented by explanatory notes which elaborate on the formal wording.

3.2
Additional definitions are provided in all PTC Specifications. Nevertheless, some definitions are repeated in this document for ease of use and for explanatory purposes:-

Called party: is the person or device receiving a call via the PSTN.

Calling party: is the person or device initiating a call via the PSTN.

Convergence: is a term used in connection with echo cancellation and is the process of developing a model of the echo path which will be used to estimate the circuit echo.

- *See also "echo control device".*

Crosstalk: is any unwanted signal introduced into a line or equipment through coupling between one or more other lines or items of equipment not electrically connected.

dBm: is the absolute power level in decibels (dB's) relative to 1 mW.

dBm0: is the absolute power level in decibels referred to a point of zero relative level (0 dBr).

dBr: is the nominal relative power level in decibels referred to a point of zero relative level (0 dBr).

Decadic: is the form of call initiation signalling which makes use of one or more timed disconnections of the line current.

- *Otherwise referred to as "loop-disconnect" signalling or "pulse" signalling. It is the form of signals sent by an ordinary rotary telephone dial. It is now largely superseded by "tone" signalling (DTMF).*

- *At present all Telecom exchanges are capable of responding to decadic signalling. However, this may not always be the case in future as DTMF signalling is generally preferred by both suppliers and customers.*

Derived circuit: is a circuit which is provided by means other than a physical pair of wires from the telephone exchange to the customer's premises.

- *Typical examples of this are circuits over PCM and fibre optic systems.*

Direct dialling-in (DDI): is the facility to allow incoming calls from the PSTN to be switched directly to a specified station (e.g. PABX extension) without operator assistance.

• *Also known as "Direct in-dial", or "DID" overseas. Refer to Document TNA 118 for details.*

Distinctive Alerts (DA): are the four different ringing cadences (DA1 to DA4) used on PSTN lines, any one of which may be applied to the same line from time to time.

• *Typically used as a means of indicating the specific person or function required by the caller (e.g., facsimile, answerphone, modem or telephone), or the nature of the call (on Centrex).*

Double talk: relates to echo control and describes the condition whereby signals are present in both directions of a 4-wire circuit at the same time.

• *This occurs when both parties in a telephone conversation are speaking at once and the situation requires special treatment by any echo control device present in the circuit.*

DTMF (Dual Tone Multi-Frequency): is a signalling system used over PSTN customer lines whereby two tones are sent simultaneously to line for each digit.

• *It is used both for call initiation and for the accessing or controlling of other services, often between customers, following connection of a call.*

• *The system is referred to in North America as 'Touch-Tone' signalling.*

• *The system used by Telecom is to the current world standard described in the CCITT Blue Book Recommendation Q 23.*

Echo: is an unwanted signal reflection delayed to such a degree that it is perceived as distinct from the signal directly transmitted.

• *In telecommunication networks, there is a distinction made between "talker echo" and "listener echo" as follows:-*

(a) "Talker echo" is the reflected signal experienced at the terminal sending the original signal. This is particularly disturbing to the person speaking in a telephone conversation who hears their own voice returning, but delayed enough to disrupt their flow of speech.

(b) "Listener echo" is the reflected signal experienced at the terminal receiving the original signal. This can be a problem for data transmission since the receive terminal is likely to receive the same signal twice, the second being sufficiently delayed, but of high enough power level to be interpreted as another valid signal.

Echo control device: is a device, operated by voice signals, which is used in telecommunication networks to reduce the effect of echo by either suppressing or cancelling the echo signal.

• *The "Echo suppressor" was the earlier form of echo control used internationally. This device reduced the effect of echo by introducing additional loss in the echo path.*

• *Later technology developments introduced the "echo canceller" which is a more effective method of controlling echo. This estimates the echo signal from an examination of the original signal and subtracts that estimated signal from the actual echo signal without affecting the transmission path.*

External Test Point (ETP): is the terminal box, fitted at the customer’s end of a Telecom lead-in, in which the lead-in cable is connected to the building cabling.

• *The ETP may also be used to house a simple electrical termination which allows remote testing of the line from the exchange through to the customer’s premises when no terminal equipment has been connected.*

Full current: is the current drawn by any item of terminal equipment when connected directly to a 50 V, 400 ? source in the off-hook condition.

• *"Full current" is used for test purposes and defines the maximum current that can be drawn under zero line conditions.*

• *On some exchanges operated by Telecom, the line current 'limits' at 80 mA maximum.*

Individual line: is any PSTN line serving a single Telecom customer.

• *An individual line may have one or more extension devices within that customer premises.*

Inter-digital pause: is the interval between successive DTMF tone bursts (or decadic pulse trains) in a series of digits.

Key telephone system (KTS): is a small telecommunications system designed for use in customer's premises which provides switching facilities between individual extension devices and the Telecom PSTN.

• *Simple KTS's often have a nominal 0 dB (i.e. =1 dB) transmission loss between ports.*

• *See also "PABX" for further details.*

• *For the purposes of this and other TNA documents, and PTC Specifications, the term "PABX" embraces all Private Automatic Branch Exchange (PABX), Key Telephone System (KTS), Small Business Exchange (SBX) and other equipment intended for installation in a customer's premises to switch calls between separate telephone lines and extensions.*

• *For the purposes of defining interface requirements a key telephone system may be considered to provide a similar range of conditions to that of a public exchange line.*

Line impedance: is the terminating impedance presented to a line by any equipment to which it is connected.

Loop current: is the standing d.c. current drawn by any equipment in the off-hook condition.

• *The loop current is dependent upon the resistance of the equipment, the line length and any current limiting by the exchange line feed equipment.*

Loudness Rating (LR): is a measure, expressed in decibels, for characterising the loudness performance of complete telephone connections, or parts thereof, such as the sending system, line, or receiving system.

• *Reference ITU-T Rec. P. 64:1993, P. 65:1993, and CCITT Blue Book, Rec. P. 76.*

• *Loudness rating is an internationally accepted method of objectively measuring the performance of telephones from the mouthpiece to a given point on the line, and vice versa to the earpiece. The approach enables computer-controlled measuring equipment to be used for making quick, accurate and, above all, repeatable tests.*

• *A loudness value is the result of a calculation based on fourteen separate measurements made at pre-determined frequencies within the normal telephony frequency range, each measurement being "weighted" according to its effect as perceived by the human ear when listening to normal spoken words.*

• *The loudness measurement value is actually the loss involved in the circuit under test, relative to an internationally accepted reference standard. Thus the higher the loudness value the quieter the perceived signal volume. A negative value occurs when the loss is actually less than that of the reference standard.*

• *Overall loudness rating (OLR) is the sum of the send loudness rating (SLR) of the telephone at one end of a telephone connection, the receive loudness rating (RLR) of the telephone at the other end, and the loudness ratings of each section of line in between. In other words it is a measure of the overall electro-acoustic performance between mouthpiece at one end and earpiece at the other.*

Master jackpoint: is a telecommunications outlet which provides the 'on-hook' line termination for a Telecom PSTN line and derives the 'shunt' wire for 3-wire connection.

Off-hook: is the condition where the equipment is connected to line and is used to initiate or take part in a call.

On-hook: is the condition where the equipment is connected to line in the idle state awaiting receipt of an incoming call or available to initiate a call.

• *The above terms are derived from the term "hookswitch", which is used to describe any device which changes the status of the equipment from "on-hook" to "off-hook" or vice versa.*

On-hook data transmission: is the transmission of information in the form of data signals over a PSTN line while the terminating CPE is in the on-hook condition.

• *This data is normally transmitted during the first ringing cycle of a call incoming to the CPE.*

PABX: is a form of telecommunications system designed for use in a customer's premises which provides full switching facilities between individual extension devices and the Telecom PSTN.

• *See also "Key Telephone Systems".*

• *For the purposes of this and other TNA documents, and PTC Specifications, the term "PABX" embraces all Private Automatic Branch Exchange (PABX), Key Telephone System (KTS), Small Business Exchange (SBX) and other equipment intended for installation in a customer's premises to switch calls between separate telephone lines.*

• *For Telepermit purposes, it is necessary to divide PABX's/KTS's into two defined categories as follows:-*

> *(a) Type 1: 4-wire switching devices (digital or analogue) which, by their very nature are designed to have an inherent 2 - 3 dB transmission loss between extension and 2-wire analogue trunk ports (ref. Specification PTC 109).*
>
> *(b) Type 2: 2-wire analogue switching devices without networking facilities and which have a nominal 0 dB (=1 dB) transmission loss between extension and trunk ports.*

• *Most KTS's can be categorised as Type 2 and most large PABX's as Type 1, but this is not always the case.*

• *For the purposes of defining interface requirements a PABX system may be considered to provide a similar range of conditions to that of a public exchange line.*

Private ringing: is a Telecom service providing for up to four Distinctive Alert ringing cadences, each with a separate directory number, to be used on the same PSTN line.

• *Private ringing can be used simply as a means of defining the wanted party, or with suitable decoders to provide selective ringing of individual CPE items.*

Psophometric: is the term used to describe a method of measuring noise within the speech band while weighting the value of each frequency component present in accordance with its relative effect on the human ear.

• *Such measurements are normally made with a psophometer, which is a voltmeter fitted with a standardised frequency weighting network and calibrated to indicate noise power or voltage in psophometric units (dBmp or mV psophometric).*

• *The weighting coefficients defined in CCITT Blue Book, Rec. O. 41 for telephone circuits and weighted to a reference tone of 800 Hz are used by Telecom for telephony purposes.*

PSTN: is the Public Switched Telephone Network.

• *New Zealand PSTN services may be provided by a number of different Network Operators, each of which can set different network interface requirements should they choose to do so.*

Recall: is the procedure used to re-connect the register function of a switching system to enable additional features of that system to be used while a call is in progress.

Ringer (or ringing detector): is any device which responds to the alternating voltage applied to indicate an incoming call.

Secondary jackpoint: is a telecommunications outlet which provides an additional connection point to a Telecom PSTN line which is also equipped with a Master jackpoint.

• *This jackpoint provides only a CPE connection facility and is wired in parallel to a Master jackpoint.*

Service Delivery Point (SDP): is the defined electrical interface point provided at an agreed physical location to which Telecom will deliver service to a customer.

• *In commercial premises, the SDP may or may not be the same as the network demarcation point. Cable owned by a third party, such as the building owner, may be used to serve the SDP.*

Signalling: is the exchange of information (other than by speech) which is specifically concerned with the establishment, release and other control of calls over the PSTN.

• *The term "signal" can also be used in connection with other types of transfer of information, but only if suitably qualified, e.g. "data signal", "voice signal".*

Telecom PSTN: is the Public Switched Telephone Network provided and operated by Telecom New Zealand Ltd.

Telecommunications outlet (TO): is any jackpoint forming part of the fixed wiring in a customer's premises at which CPE may be connected to a telecommunications network.

- *This is a generic term which, for PSTN applications, is independent of a network demarcation point, although it can perform that function where required.*

- *The term includes Telecom Master, Secondary and Two-wire jackpoints, as well as those equipped with 6-way or 8-way North American style sockets.*

Telepermit: is the Registered Trade Mark used to indicate Telecom's agreement to the connection of equipment to its network.

Two-wire jackpoint: is the current standard Telecom jackpoint, as used in the 2-wire system of premises wiring.

4
D.C. LINE CONDITIONS

4.1 General

The d.c. conditions at customers' demarcation points on PSTN lines vary depending on the following:-

(a) The type of line feed equipment used by Telecom, and

(b) The length of the line and type of cable used.

4.2
Exchange line feed equipment

(1) The nominal supply voltage used in local exchanges to feed Telecom PSTN lines is in the range 50 V to 90 V. However, for the majority of lines a nominal 50 V power supply is used, having a tolerance range of 44 V to 56 V. The positive pole of the power supply is connected to earth (see Fig. 1).

• *The exchange supply may be boosted to 90 V between the line wires on some long rural lines, but the voltage on each conductor will not normally exceed ± 52 V with respect to earth.*

(2) The line current supplied by a nominal 50 V power supply will normally range between 20 mA and 80 mA depending on the type and length of line. The source resistance is 400 ?.

• *Most exchanges current limit at around 80 mA, but on others the current can rise above 80 mA on very short lines.*

(3) Ripple components up to 2 mV psophometric may be present.

(4) Under normal network switching conditions step changes in the open-circuit voltage may occur within the limits stated.

• *A typical case of this is the "reversal on answer" supervisory signal. Other network conditions also result in short breaks in line current during the setting up of a call.*

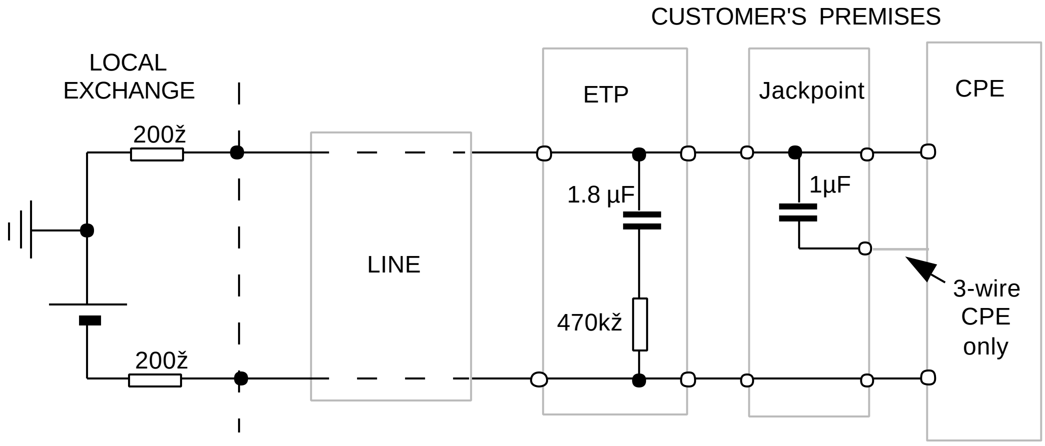


FIG. 1 EXCHANGE LINE FEED

• *Although the CPE connection is shown as 2-wire, the earlier 3-wire connection is still acceptable (see Section 9 for details).*

4.3
Derived circuits

(1) Use of derived circuit equipment by Telecom, for all or part of the line between the local exchange and the customer, is widespread and on the increase. In such cases, the line feed current is produced by the equipment terminal nearest the customer and frequently has a steady current output which is fairly constant in the range 20 - 25 mA, independent of line length. This may reduce to 18 mA during power failure conditions.

(2) Such systems frequently provide only 24 Vdc in the on-hook condition.

• *Typically, derived circuit equipment may consist of PCM systems, fibre optic systems, pair gain devices, multi-access radio systems, country sets, etc.*

4.4
Line polarity

(1) Normal conditions are negative battery relative to earth on one wire, and earth on the other. The particular line polarity at the customer's premises is not normally standardised and may be subject to reversals as the result of activities within the network.

• *Service restoration following a cable fault is a typical cause of such a change.*

(2) On some PSTN lines, a reversal of polarity is available as an indication to the calling party that the called party has answered the call. This facility is designed for PABX use.

• *Detailed information on conditions applicable to PABX's and the associated requirements are given in Specifications PTC 107, PTC 108 and PTC 109.*

(3) For party line operation, different line conditions exist and customer products complying with PTC Specifications will not normally be suitable.

• *Multi-party lines represented less than 0.1 % of the total Telecom PSTN lines in 1996.*

4.5
Answer supervision

(1) Answer supervision is provided on originated calls by means of a reversal of the line polarity when the called line is answered. The line polarity is again reversed should the called party be the first to release the call.

(2) Answer supervision is NOT part of the standard PSTN service. It is currently available only on business lines which serve a PABX system or payphone.

(3) Line polarity reversal for answer supervision does not apply on the called party’s line should the calling party release first. In this case, the only indication given to the called party is disconnect tone.

4.6
Voltage transients

(1) Changes to line conditions of up to 50 ms duration (for example, polarity, voltage, and feeding resistances) may occur during processing of a call by the network or by PABX's.

(2) Also, high voltages may occur in the event of power system faults or lightning strikes.

- *See clause 2.3.1 and Specification PTC 101 for further details on power faults and lightning strikes.*

4.7
Telecom Tests

Telecom staff may employ the following when testing lines connected to the PSTN:-

(a) 500 V insulation resistance measuring equipment.

(b) ± 80 V line test equipment.

4.8
Requirements for terminal equipment

The d.c. requirements applicable to CPE are covered in the 200 series PTC specifications relevant to the products concerned. This includes details of the following:-

(a) Line seizure: d.c. loop condition

(b) Answer: d.c. loop condition

(c) Hold: Low d.c. resistance loop condition

(d) Release of call: Disconnection of d.c. loop condition

(e) Timed break recall: Brief break in d.c.loop condition

(f) On-hook condition: High d.c. loop resistance resulting in low line current

5
SIGNALLING

5.1
Signalling types

(1) The standard method of signalling between customer premises equipment and Telecom telephone exchanges is dual tone multi-frequency (DTMF) signalling. This method is also widely used for signalling from customer to customer after a call has been established.

- *Reference CCITT Blue Book, Recommendation Q. 23.*

(2) (a) Historically, the standard method of signalling was decadic, consisting of trains of break pulses to indicate the digits signalled. The version of this system developed for use in New Zealand was unique in that the coding was the reverse of that used generally around the world.

(b) The use of NZ-type decadic signalling on new customer products is being strongly discouraged by Telecom.

- *All existing exchanges currently support NZ-type decadic signalling, but this may not always be so in future.*

(3) Direct Dial-in (or 'DDI') operation is a particular type of signalling used between the exchange and the customer's equipment whereby the final 1 - 4 digits of the called number are sent from the exchange. DDI operation can use decadic or DTMF signalling, as required by the customer's equipment.

- *Information and requirements for DDI operation, including DTMF signalling received from the local exchange, are covered separately in Technical Document TNA 118.*

(4) For alpha-numeric signalling, the allocation of letters to digits adopted by Telecom is in accordance with the standard agreed internationally at the World Telecommunications Standardisation Conference, March 1993. In this respect it is important to note that the letters 'Q' and 'Z' correspond with digits '7' and '9' respectively.

- *Ref. ITU-T Rec. E. 161 and International Standard ISO/IEC 9995-8:1994.*

5.2
DTMF signalling

5.2.1
DTMF tones

(1) The allocation of DTMF signalling frequencies necessary to signal information to the Telecom network is as follows:-

Low Group (Hz)	High Group (Hz) 1209	1336	1477	1633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

Telecom

• *The 'A', 'B', 'C' and 'D' signals are rarely used at the date of issue of this document.*

(2) The tone duration required is at least 60 ms for each digit, with at least 60 ms between digits.

• *The network equipment is generally capable of responding correctly to signals keyed at such a rate that the minimum duration of any signal or inter-digital pause does not fall below about 50 ms*

(3) Details of required DTMF send levels are given in the relevant PTC 200 series Specifications.

5.2.2
DTMF signalling between customers

The received level of DTMF tones at the customer's premises when transmitted from a distant point in the Telecom PSTN, will on average be in the order of -20 dBm, but may be as low as -40 dBm depending on actual transmit level and length of line. If transmitted from other networks, it may in some extreme cases be even lower.

• *See also clause 8.4 for "Network and local circuit losses".*

5.3
Decadic (loop-disconnect) signalling

5.3.1
Coding

The Telecom decadic pulsing allocation to keypad or dial numbers is as follows:-

Number:	0	1	2	3	4	5	6	7	8	9
No. of 'Break' Pulses:	10	9	8	7	6	5	4	3	2	1

• *This was the New Zealand Post Office standard and is the reverse of that used in most other countries. This leads to the need for rotary dials used in New Zealand to be numbered 0, 1, ...9 clockwise.*

• *The reversal does not affect the layout of decadic signalling keypads.*

5.3.2
Pulse rate and timing

(1) For decadic signalling, the customer equipment is required to interrupt the basic network loop current so as to change it to its 'off' value in the following way:-

Pulse rate: The rate of pulsing is nominally 10 pulses per second.

Pulse ratio: The break (or 'off') period is nominally 67 % of the total pulse period for each and every pulse in the pulse train for any digit dialled.

(2) The pause between each digit, known as the inter-digital pause, should be between 240 ms and 1000 ms, with an objective of 800 ms.

5.4
Timeout

(1) Following seizure of a line by application of the off-hook condition, there are time limits automatically applied for the commencement and completion of dialling. If the correct dialling signals have not been received by the time these periods have

elapsed, then the line is released at the exchange and disconnect tone is applied. These ‘timeout’ periods will vary depending on the traffic activity at the time.

(2) Under light traffic conditions, the maximum timeout periods are as follows:-

(a) Time to dial first digit is 16 seconds.

(b) Time between digits from the first to the eighth digit is 11 seconds.

(c) Time between remaining digits is 5 seconds.

(3) Under heavy traffic conditions, the above timeout periods are halved.

(4) The above timeout periods apply to both DTMF and decadic dialling.

(5) PABX timeout periods are likely to vary from those stated above.

5.5
Recall

(1) There are two alternative methods commonly used to activate the recall facility on a PSTN line. They are as follows:-

(a) "Hookswitch flash", which involves manual operation of the hookswitch to provide a brief break in the d.c. loop conditon during a call.

(b) "Timed break recall (TBR)", which is the preferred method, breaks the d.c. loop for a pre-determined duration on operation of a recall button.

(2) To ensure the highest probability of correct operation of the recall facility on all types of Telecom exchanges, and also the full range of PABX's currently installed, the duration of the recall break in the d.c. loop is required to be in the range 500 - 800 ms. However, some parts of the network and also many PABX’s will operate satisfactorily to a wider range.

• *Most exchanges will operate satisfactorily down to 120 ms, but on some earlier equipment there is a possibility of non-operation below 500 ms.*

(3) For Centrex operation, the optimum break is 350 ms. However, a wider range of 200 - 800 ms is acceptable.

(4) Requirements for Telepermit purposes are given in the PTC 200 series Specifications.

6
RINGING CHARACTERISTICS

6.1
Ringing frequency

The standard ringing frequency applied to Telecom PSTN lines is 25 Hz.

• *Some older Telecom exchanges use 16 $^{2}/_{3}$ Hz ringing but these are being progressively replaced by later technology equipment which uses 25 Hz ringing.*

• *The proportion of Telecom customer lines operating with 16 $^{2}/_{3}$ Hz ringing is now less than 1% of total lines, and is reducing progressively.*

6.2
Ringing voltage

(1) For individual Telecom PSTN lines without derived circuit equipment, the conditions are as follows (see also Fig. 2):-

(a) The open circuit ringing voltage applied to line at the exchange is nominally 90 V_{rms}, dropping to 75 V_{rms} under the maximum rated load of the ringing generator.

(b) Under normal operating conditions using a single 2-wire connected CPE device (ref. Fig. 2 (a)), the ringing voltage across the ringing detector can, in most cases, be expected to lie within the range of 30 to 80 V_{rms}. It may not necessarily have a sinusoidal waveform.

• *The precise voltage across the ringing detector of 2-wire connected CPE will also depend on the internal circuitry of the device used.*

(c) Under normal operating conditions using a single 3-wire connected CPE device (ref. Fig. 2 (b)), the ringing voltage on the customer's side of the Master Socket can also be expected to lie within the range of 30 to 80 V_{rms}. Again, it may not necessarily have a sinusoidal waveform.

(d) One side of the ringing generator is normally connected to earth at the exchange, and the other applied to one conductor of the line. The return path is via the other conductor to the exchange -50 V supply, the positive side of which is also connected to earth (see Fig. 2).

(2) For Telecom PSTN lines using derived circuit equipment, the conditions are:-

(a) On some derived circuits the ringing voltage may be somewhat less than in sub-clause (1) above, and the current available may be limited.

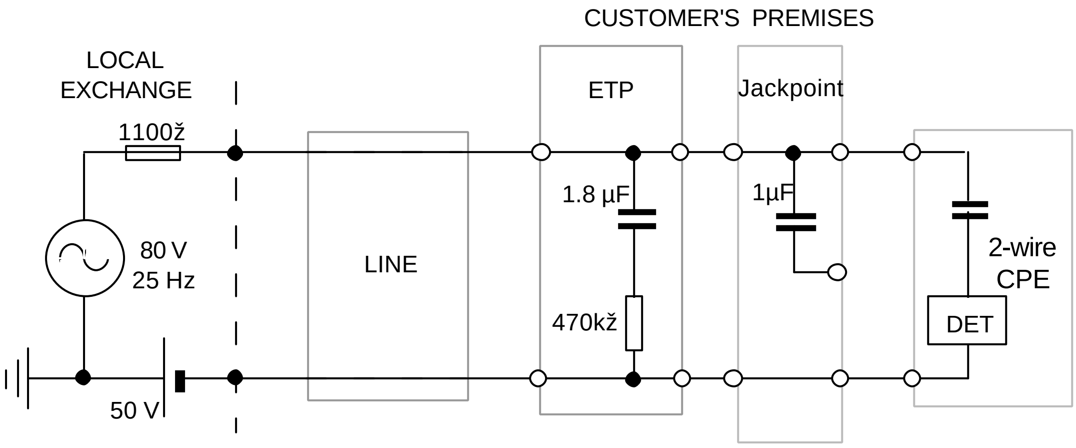
(b) The ringing voltage at the customer's premises should still be at least 10 V_{rms}.

- *For derived circuit terminal equipment, the maximum distance between the ringing supply and the customer is normally less than in (1) above, so the higher source voltage is not necessary.*

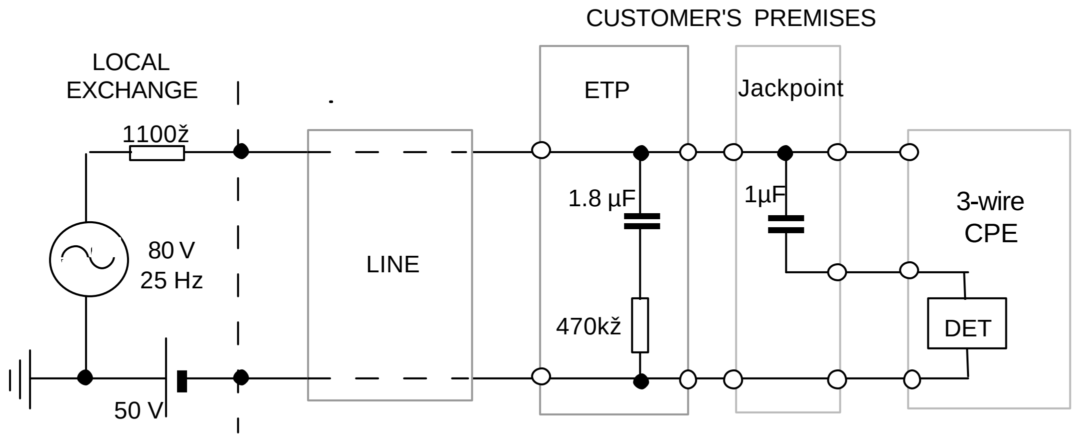
6.3 Ringing current

The ringing current available at the customer's premises is limited by the source impedance, the line impedance and the series capacitor at the line interface. To ensure reasonable ringing performance, the total ringing load connected to a line should not exceed a RAL of 5.

- *See Specification PTC 200 for details.*



(a) 2-WIRE CUSTOMER PREMISES DEVICES



(b) 3-WIRE CUSTOMER PREMISES DEVICES

FIG. 2 RINGING CONNECTIONS

6.4
Ringing cadences

(1) There are four distinctive cadences available for use on individual customers lines, and these are designated as Distinctive Alerts 1 - 4 (DA 1 - 4). The purpose of using different cadences is to enable an individual line to be used for up to four separate functions (e.g. telephone, fax, modem and answerphone, can all be supported by the one line). Use of suitable decoding arrangements associated with the CPE allows the nature of the incoming call to be determined before it is answered and avoids the ringing of all devices unnecessarily.

• *These ringing cadences are available only from NEAX 61E exchanges. Earlier switches support only DA 1 which is regarded as the standard cadence.*

• *These cadences are not connected in any way with multi-party ringing which is referred to below in clause 6.8.*

(2) The specification of this facility does not constitute a guarantee that all four cadences will be available in all circumstances. The only cadence which is always available is DA 1, which is the traditional Telecom standard.

(3) The nominal cadences designated DA 1-4 are as follows, each cadence being repeated until the call is answered or abandoned:-

DA 1 (normal ringing cadence):
400 ms on, 200 ms off,
400 ms on, 2000 ms off,
and repeated.

DA 2 : 400 ms on, 2600 ms off,
and repeated.

DA 3 : 400 ms on, 200 ms off,
400 ms on, 200 ms off,
400 ms on, 1400 ms off,
and repeated.

DA 4 : 400 ms on, 800 ms off,
400 ms on, 1400 ms off,
and repeated.

(4) The calling party will hear the standard ringing tone (ref. clause 7.1 (1)) in each case.

(5) Ringing will time-out after 4 minutes if the call remains unanswered.

6.5
Tolerances on cadences

In most cases, the cadence ‘on’ periods can be expected to fall within ± 10 % of the nominal figures stated above in clause 6.4(3). However, in certain cases this can increase to ± 20 %.

• *The cadences generated at the exchange are accurate, but subject to a ± 10 % variation in the typical PCM systems used on local lines. However, some earlier radio and transmission systems, especially when* *used in combination, cause distortions to rise to ± 20 % or more. Telecom will not usually make the service available in such cases.*

6.6
Allocation of cadences

(1) Each ringing cadence may be assigned a separate directory number so that either the nature of the call or the intended destination facility can be determined before the call is answered.

• *For example, a facsimile machine could be set to only respond to DA-4, a modem to DA-3, an answerphone to DA-2 and a telephone to DA-1. Otherwise, the service can be used without decoders and operate on a simple "code ringing" basis. For Centrex use, the codes differentiate incoming network calls, group calls, recalls, etc.*

(2) DA 4 is the cadence normally allocated for use with data services, in particular facsimile devices.

• *DA 4 is arranged to disable 'call waiting', the warning tone for which could otherwise disrupt the transmission of data.*

• *DA 4 is currently used in conjunction with Telecom's "Faxability" service.*

(3) DA 2 and DA 3 are currently used on Centrex lines, and are expected to be introduced shortly in the PSTN. DA 1 to DA 3, when all are available, may be allocated as required. Since DA 1 is the 'standard' ringing cadence, it is expected that this will usually be allocated to the 'main' telephone.

6.7
PABX ringing

(1) While it is recommended that ringing cadences used in PABX's are the same as those used in the PSTN, this is not a mandatory requirement. This particularly applies to internal ringing which is not normally heard outside the particular PABX network in which it is generated.

(2) PABX ringing cadences can vary typically as listed below:-

Internal ringing:	700 to 1500 ms on, 700 to 3300 ms off, repeated
External ringing:	400 to 600 ms on, 200 to 300 ms off, 400 to 600 ms on, 2000 to 3000 ms off, all repeated
Recall ringing	400 to 600 ms on, 200 to 300 ms off, 400 to 600 ms on, 200 to 300 ms off, 400 to 600 ms on, 2000 to 3000 ms off, all repeated

6.8
Multi-party ringing

A small and rapidly decreasing proportion of rural lines connected to the Telecom PSTN are multi-party and use a system of code ringing based on the morse code. This type of line is being progressively phased out by Telecom and replaced by individual lines.

• *Multi-party lines represent less than 0.1 % of the total Telecom PSTN lines in 1996.*

7 SUPERVISORY SIGNALS

7.1 Supervisory tones

(1) The following are the standard supervisory tones generated by equipment within the Telecom PSTN:-

Dial tone:		400 Hz continuous
Dial tone, with message waiting: (Note 1)		400 Hz interrupted, 100 ms on, 100 ms off, repeated for 2.5 secs then continuous until it times out
Busy tone:		400 Hz interrupted, 500 ms on, 500 ms off, repeated
Number unobtainable tone:		400 Hz interrupted, 75 ms on, 100 ms off, 75 ms on, 100 ms off, 75 ms on, 100 ms off, 75 ms on, 400 ms off, all repeated
Ringing tone:	Either	400 Hz plus 450 Hz interrupted,
	or	400 Hz, modulated at 16 $^2/_3$ Hz, interrupted, 400 ms on, 200 ms off, 400 ms on, 2 sec.off, all repeated
Disconnect tone:		400 or 900 Hz interrupted, 250 ms on, 250 ms off, repeated
Switching complete tone: (Note 2)		400 Hz plus 450 Hz interrupted, 200 ms on, 400 ms off, 2 sec. on, 400 ms off, all repeated
Call waiting tone:		400 Hz interrupted, 200 ms on, 3 sec. off, 200 ms on, 3 sec. off, 200 ms on, 3 sec. off, 200 ms on, not repeated
Call holding tone:		400 Hz interrupted, 500 ms on, 500 ms off, then 400 Hz plus 450 Hz interrupted, 500 ms on, 2.5 sec. off, all repeated
Network differential signal (NDS):		1000 Hz interrupted, 100 ms on, 100 ms off, 100 ms on, 100 ms off, 100 ms on, not repeated

Note 1: "Message waiting" is for users of the public voice mail system indicating that a message is waiting.

Note 2: In addition to indicating "switching complete", this tone is used for the following:-

(a) In place of conventional dial tone to warn a customer that the line has been set up either to divert incoming calls or for "do not disturb".

(b) On calls to some Telepaging applications, to indicate that a call has been registered.

• *CCITT Blue Book Rec. E.180 recommends use of 425 Hz instead of 400 Hz for the above tones when using a single frequency signal in newly established networks. However, Telecom has no plans at this stage to change from use of 400 Hz in the existing PSTN.*

(2) On PABX's connected to the Telecom PSTN, the following tones may be generated in addition to those in (1) above:-

• *Those public exchange tones specified in (1) above as "400 Hz" may be generated at frequencies between 340 Hz and 500 Hz in some PABX systems. However, the preferred range is 400 Hz to 450 Hz (see CCITT Rec. E.180).*

Transfer dial tone:	Either	425 Hz modulated at 25 Hz,
	or	400 Hz, or 425 Hz, interrupted, 0.1 sec. on, 0.1 sec. off, 0.1 sec. on, 0.1 sec. off, 0.1 sec. on, 0.1 sec. off, then continuous
Camp-on tone:		400 Hz interrupted, 0.2 sec. on, 0.2 sec. off, repeated
Feature acceptance confirmation tone:		1400 Hz continuous
Intrusion tone:		1400 Hz interrupted, 0.3-0.6 sec. on, 4-6 sec. off, repeated
Message notification tone:		425 Hz modulated at 25 Hz and interrupted, 0.75 sec. on, 0.75 sec. off, 0.75 sec. on, 0.75 sec. off, 0.2 sec. on, followed by 'switching complete' tone
Special information tone:		1400 Hz interrupted as required

7.2
Tolerances on frequencies and cadences

In the Telecom PSTN, maintenance limits for supervisory tones are as follows:-

(a) Frequencies are maintained within ± 5% of the nominal values quoted in clause 7.1(1) above.

(b) Cadences are maintained within ±10% of the nominal values quoted in clause 7.1(1) above.

7.3
Received levels of supervisory tones

The received level of these tones at the customer end of a PSTN line or PABX extension will vary between -15 dBm and -25 dBm, depending on the length of the line.

- *On some very long rural lines, the received level of tones may be somewhat lower than -25 dBm. However, these represent considerably less than 2 % of the total customer lines, and the number is being progressively reduced.*

8
TRANSMISSION CHARACTERISTICS

• *The general transmission characteristics of the Telecom network are given in Technical Document TNA 151.*

8.1
Frequency range

(1) Frequencies in the range 300 - 3400 Hz are normally available on the Telecom PSTN for speech transmission purposes. The frequency response across this band is not necessarily linear because of cable and equipment characteristics.

• *These frequencies and their level variations are internationally recognised for telephony use.*

(2) No guarantee can be made for the passage of signals outside this range or for a direct current path to exist for the full distance between the exchange and the customer's premises.

• *A Telecom line connected to the PSTN will normally arrive at the customer's premises in the form of a pair of wires. Between the customer and the local exchange these pairs were traditionally "hard-wire" connections, but the increasing use of pair gain devices, PCM and fibre-optic systems means that customer lines are often over derived circuits for at least part of the way.*

(3) Any Telecom customer will generally be able to communicate with any other Telecom customer using this full frequency band. However, in some circumstances, such as on some international calls or where a call is routed via other networks, there may be restrictions on the bandwidth available.

(4) Where calls are routed partially through some private networks, there is the possibility of distortion and signal delay being introduced by various commonly used digital compression processes. Telecom cannot accept responsibility for such degradation of signals.

• *The Telecom network uses 64 kbit/s digital transmission between all of its telephone exchanges and for almost all of its digital subscriber transmission systems. See also clause 8.8.1(3).*

(5) The Telecom PSTN is optimised for telephony. As such, there are some situations where data transmission may not be available at the full rated speed of the customer’s equipment.

• *See also clause 8.6*

8.2
Network impedence

(1) The nominal terminating impedance required on PSTN lines connected to the Telecom network is represented by a network of 370 ? in series with a parallel combination of 620 ? and 310 nF as shown in Fig 3. This impedance network is generally referred to in Telecom documents as "BT3".

• *Impedance network 'BT 3' is the same as that specified by British Telecom and is published in British Standard BS 6305.*

(2) It is important from a performance viewpoint that the impedance of any device connected to a Telecom line has a value that is nominally equal to BT3. Failure to do so may cause an unacceptable level of "echo" to be produced back into the network (see also clause 8.8). This can have a considerable nuisance value to customers.

- *Ref. ITU-T Rec. G. 122:1993.*

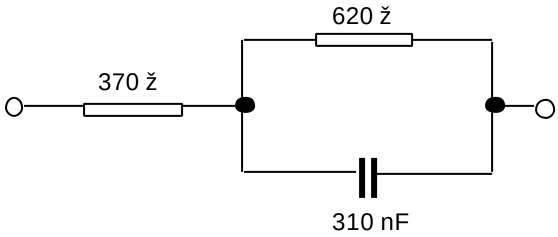


FIG. 3 NETWORK TERMINATING IMPEDANCE

8.3
Impedance balance about earth

It is important that a good impedance balance is maintained about earth on PSTN lines, primarily for noise and cross-talk reasons. Limits are stated for customer terminal devices in the relevant PTC specifications applicable to particular products.

- *There are many noise sources outside Telecom’s control such as electric fences, faulty power systems, etc. Imbalance about earth allows these to cause noise interference on telephone lines.*

8.4
Limits for transmitted speech and data

(1) It is necessary to limit the power levels transmitted into a PSTN line in order to avoid unnecessary signal distortion and also interference to other customers. Any signals, if transmitted too high, will distort when encoded by the exchange equipment due to the design 'ceiling'. Also, if data signals are transmitted at too high a level, they can overload some analogue network systems and, in some cases, cause the system to shut down.

- *The Telecom network is mainly digital and is not likely to suffer from overloading, but overseas networks may still be using older design analogue systems. Telecom has a responsibility to comply with the ITU-T standards in order to protect such networks.*

(2) The detailed limits are stated in the PTC 200/- series Specifications relevant to the CPE concerned.

8.5
Network and local circuit losses

(1) Speech performance for telephony is normally expressed in terms of loudness rating. The overall loudness rating (OLR) on most calls (approx. 95%) made over the Telecom PSTN can be expected to be between 8 and 22 dB.

- *A high proportion of PSTN calls will have an OLR between 8 and 12 dB.*

- *This level of performance is in line with ITU-T recommendations, ref. Rec. G. 121:1993.*

• *Expressions such as "preferred ranges" and "design targets" in PTC specifications, and "short term/long term objectives" found in ITU-T recommendations, are all used with the intent of ensuring that performance for most PSTN connections falls within the customer preferred ranges or near to optimum conditions. The success of network transmission plans rely on there being only a small proportion of calls at or near the "limits". (See Technical Document TNA 151 for the Telecom Transmission Plan.)*

(2) A small percentage of calls must be expected to have an OLR greater than 20 dB due to the existence of some longer lengths of cable reticulation serving customers, particularly in rural areas. This is inevitable, but the proportion can be expected to reduce with time as the number of derived circuits increases.

(3) Most medium and large business PABX's are Type 1 and introduce an additional 2 - 3 dB loss between extension telephones and the local exchange. This is inevitable where 2-wire trunks are used for connection to the network. If such a PABX is sited some distance from the local exchange, this additional loss may become a problem to the customer concerned.

(4) Wherever possible, Telecom will give consideration to providing lower loss circuits for such PABX's and, depending on the circumstances, may require the PABX customer to bear all or part of the cost of doing so.

(5) Consideration will not normally be given to provide amplification or to upgrade the line for the purpose of residential or small business customers installing key telephone systems (normally Type 2 anyway).

• *See Section 3 for definitions of "PABX" and "Key Telephone Systems", together with the categories "Type 1" and "Type 2".*

8.6
Performance of facsimile and data modems

(1) The connection of facsimile and data modems to the PSTN continues to increase, and they can be expected to perform satisfactorily on the greater proportion of customer lines.

(2) Performance at the data rates often claimed by modem suppliers cannot always be guaranteed. This is particularly so where a customer attempts to use high data rates when connected to a longer line. Telecom will accept no responsibility for poor performance of facsimile or modem products over any lines where normal telephone performance is considered satisfactory.

• *Many modems available on the market are designed for satisfactory operation on short to average length lines only and will not perform to specification on longer lines.*

• *It is not possible to state a specific line length over which satisfactory performance can be expected due to the number of variables involved in the characteristics of both line and fax or modem.*

• *Successful data transmission at rated speed is dependent on the line characteristics and the equipment used by each of the parties involved in a call. There is no assurance that both customers will have equipment or lines with the same transmission speed capabilities.*

8.7 Received speech levels

(1) The level of mean active speech on calls via the Telecom PSTN can normally be expected to be in the range -15 dBm0 to -25 dBm0, depending on the speech source and the transmission characteristics of the local lines used by the parties concerned.

• *The source of speech on telephone calls may be anywhere in the world and the whole range has to be taken into consideration.*

• *In the Blue Book and earlier CCITT publications, the nominal mean speech power at a 0 dBr point in the international network was assumed to be -15 dBm (i.e. -15 dBm0). However, more recent studies by the ITU-T have indicated that there is disparity in the mean active speech power between different countries and it appears that -19 dBm0 or lower may be a more realistic recommended level.*

(2) Allowing for the variations in local line losses and possible ranges of levels from other networks, the mean speech power received at a customer's premises is likely to be in the range -21 dBm to -39 dBm.

• *Lower speech levels may be experienced by customers on some extremely long rural copper lines. However, these represent considerably less than 2 % of the total customer lines, and the number is being progressively reduced.*

8.8 Echo

8.8.1 Causes of echo

(1) The total control of echo by means impedance matching alone (ref. clause 8.2) is not practicable due to component tolerances and other variables. There is always a certain amount of signal reflection occurring whenever there is a 2-wire/4-wire transition. This particularly becomes a problem when signal delay is introduced in the transmission path, e.g. on long distance or international calls. This delay causes the signal reflection to become noticeable as 'talker echo' which can make telephone conversation extremely difficult. Further 'near end' reflections produce 'listener echo' which is often an additional problem for the transmission of data.

(2) The increase in use of digital technology throughout the Telecom PSTN, and also in other networks around the world, has further compounded the problem by introducing additional processing delays into transmission paths. Thus, echo is now evident on routes that did not previously have a problem because circuit length alone was not significant.

(3) The Telecom network uses 64 kbit/s digital transmission between all of its telephone exchanges and for almost all of its digital subscriber transmission systems. However, customers with private networks are commonly using digital processing equipment to increase the traffic capacity of their circuits. Such equipment commonly introduces transmission delays. Calls to or from the public network passing over such private networks may experience degraded echo performance.

8.8.2 Control of echo

(1) There are two types of echo control devices commonly used on circuits where echo is likely to result on PSTN calls. These are as follows:-

(a) Echo suppressors: These control echo by inserting a loss of at least

30 dB in the transmission path in the direction opposite to that of the original signal. This loss is removed after a period of 100 ms of quiet time. When signals are present simultaneously in both directions for a period of 50 ms, the echo suppressors enter the "double talk" state in which 6 to 15 dB of loss is added to both directions of transmission.

(b) Echo cancellers: These control echo by adding loss to the echo signal only, without affecting the transmission path. After a training (converging) period of approximately 500 ms, the echo canceller will assure an echo loss of at least 40 dB. During the "double talk" state the degree of echo cancellation may diminish slightly, but the transmission path is again not affected.

(2) Such echo control devices are particularly suitable for telephone conversations. However, on some data services, they can cause greater problems than echo itself. It is therefore necessary that echo control devices are capable of being disabled when required. For this reason they are equipped with tone operated disablers designed to respond to a frequency of 2100 Hz as described in clause 8.8.4 below.

8.8.3
Characteristics of echo control devices

- *Ref. CCITT Blue Book, Rec. G.164, ITU-T Rec. G.165:1993 and ANSI EIA/TIA-496-A.*

(1) To avoid the unintentional disabling of echo suppressors during transmission of data, the 100 ms average signal power in the 1900 - 2350 Hz band shall not exceed, at any time, the 100 ms average power in the rest of the voice frequency band (300 -1900 Hz and 2350 - 3000 Hz), when the power is weighted in accordance with a function which lies in the acceptable region shown in Fig. 4.

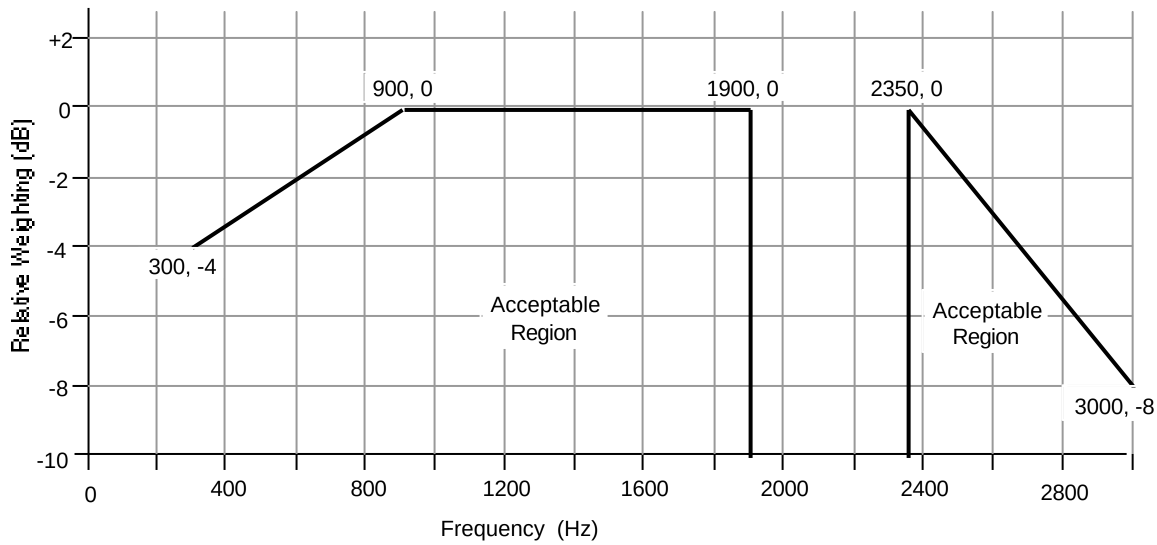


FIG. 4 ECHO SUPPRESSOR DISABLING PREVENTION WEIGHTING FUNCTION

(2) To ensure that any echo cancellers present on a network connection are properly converged, data terminal equipment should transmit a signal having the full frequency spectrum of the line signals to be transmitted. This should be transmitted as a part of initial handshaking procedures for at least 500 ms in each direction, one direction at a time. Alternatively, this can take the form of noise having a flat spectrum over the 300 - 3000 Hz band transmitted at the data signal level.

(3) It should be noted that even a properly converged echo canceller will begin to diverge when a narrow band signal is applied for a sustained period of time. Significant divergence may begin within 1 minute. Therefore, half duplex data connections, which send data interspersed with single frequency idle tones, may encounter initial echoes when switching to the data mode after a period of several minutes in the idling state.

- *"Data" services include any non-voice services such as facsimile, data modems etc.*

8.8.4
Disabling of echo control devices

(1) Echo control devices are equipped with tone operated disablers. Because of the different approaches to echo control used by echo suppressors and cancellers, it has been recognised that some types of data communications (e.g. frequency division duplex working) which require echo suppressors to be disabled, may benefit from the operation of an active echo canceller.

(2) As a result of this, a selective disabling process has been specified with two options as follows:-

(a) Echo suppressors only: Echo suppressor disabling signal is transmitted.

(b) All echo control devices: Echo canceller disabling signal is transmitted.

(3) <u>Echo suppressor disabling signal</u>:-

(a) To disable echo suppressors, either terminal shall transmit a signal at data level at a frequency of 2100 ± 15 Hz for at least 400 ms. If the signal is transmitted by the answering terminal (called party) the duration shall be extended to at least 2.4 seconds to ensure that the originating terminal (calling party) receives at least 400 ms of disabling tone.

(b) During this transmission the signal power outside of this band shall be at least 15 dB below that in the band.

(4) <u>Echo canceller disabling signal</u>:-

(a) If both echo cancellers and echo suppressors are to be disabled, either terminal shall transmit a signal at its normal data level consisting of a 2100 ± 15 Hz tone with a reversal of 180° in its phase every 450 ± 25 ms, for a period of 3.3 ± 0.7 seconds. The reversals in phase shall be accomplished such that the phase is changed by 180° ± 10° within a 1 ms period and that the amplitude of the 2100 Hz tone is not more than 3 dB below its steady state value for more than 400 ms.

(b) During this transmission the signal power outside of this band shall be at least 15 dB below that in the band.

(5) The terminal not transmitting the echo suppressor/canceller disabling signal shall not transmit any signals above -46 dBm in the 200 - 4000 Hz band.

8.8.5

Holding disabled condition

After the echo control device (suppressor or canceller) has been disabled, signal power in the 300 - 3000 Hz band in either direction of transmission will keep it disabled, provided the following requirements are met:-

(a) The power of the signal in the 300 - 3000 Hz band, when weighted in accordance with a function in the appropriate acceptable region in Fig. 5, and averaged over any 100 ms, is not lower than the minimum acceptable tone power specified above in clause 8.8.4 (3) and (4).

(b) If the signal spectra from both terminals can consist of a single frequency being transmitted simultaneously for more than 100 ms, the difference between the two frequencies shall be greater than 5Hz.

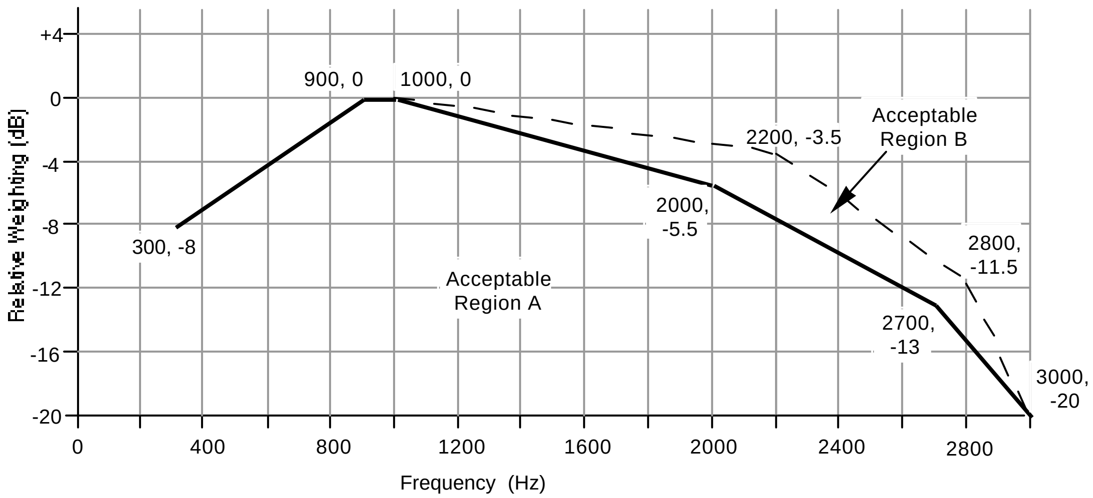


FIG. 5 HOLDING OF ECHO SUPPRESSOR/CANCELLER DISABLING STATE: WEIGHTING FUNCTION

9
CUSTOMER INTERFACE ARRANGEMENTS

9.1
General

(1) The line interface in residential installations and most commercial installations at which analogue CPE is to be connected will normally be the 6-way "BT" jackpoint. However, there is also growing use being made of the 8-way modular jack for "generic" cabling installations in commercial premises and in a few residential installations (see clause 9.2 (3)). This document assumes the existence of a telecommunications outlet suitable for both 2-wire and 3-wire connected CPE.

(2) The preferred method of connecting CPE to the Telecom network is now 2-wire and customer equipment suppliers are encouraged to comply with this for the future.

• *The previous Telecom preference was for 3-wire connection of CPE. The change to 2-wire brings New Zealand into line with most overseas practices.*

(3) Although 2-wire connection is now preferred, the 3-wire method still applies to the vast majority of telephones currently in use in 1996. For this reason 3-wire operation will still be available and both are referred to in this Section (see Fig. 6).

9.2
Telecom standard

(1) The Telecom standard wiring and connection arrangement, introduced in 1983, was a 3-wire parallel arrangement capable of accommodating both 2-wire and 3-wire CPE devices. This included provision of a 1.8 µF "ringer" capacitor, a surge suppressor and a 470 k? "out-of-service" resistor in, typically, a Master jackpoint. This derives a third wire, known as the shunt wire, for 3-wire ringing purposes (see Fig. 6(a) and 6(b)).

• *The purpose of the 3-wire ringing arrangement was to eliminate bell-tinkle during decadic dialling. With greater use of DTMF, the incidence of this problem has now been significantly reduced.*

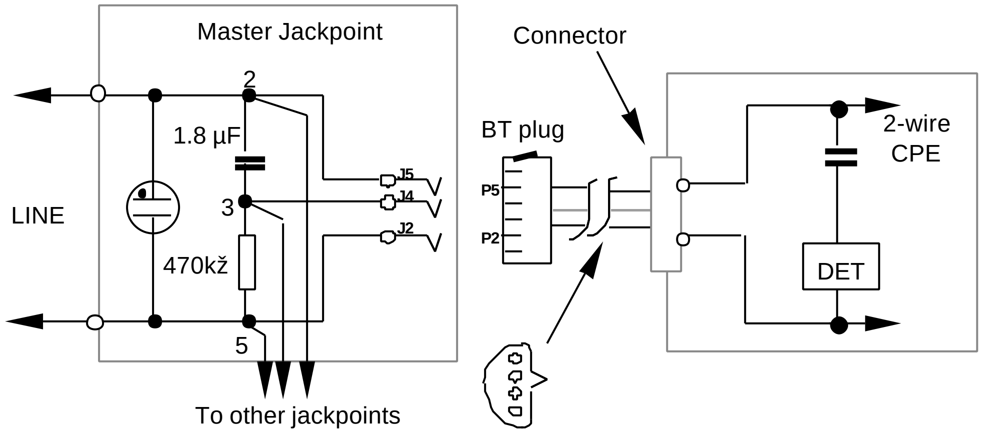
• *The wiring of residential premises and interconnection of Master and Secondary Sockets is described in Specification PTC 103. Any changes will accommodate CPE compatible with current requirements.*

(2) From 1996, customer premises wiring will be progressively converted to a "2-wiring" arrangement. This replaces the separate "Master" and "Secondary" jackpoints shown in Figs 6(a) and 6(b) with a single type of jackpoint incorporating a 1 µF capacitor to support 3-wire connected CPE. Socket pin connections are the same as for the 3-wire jackpoint.

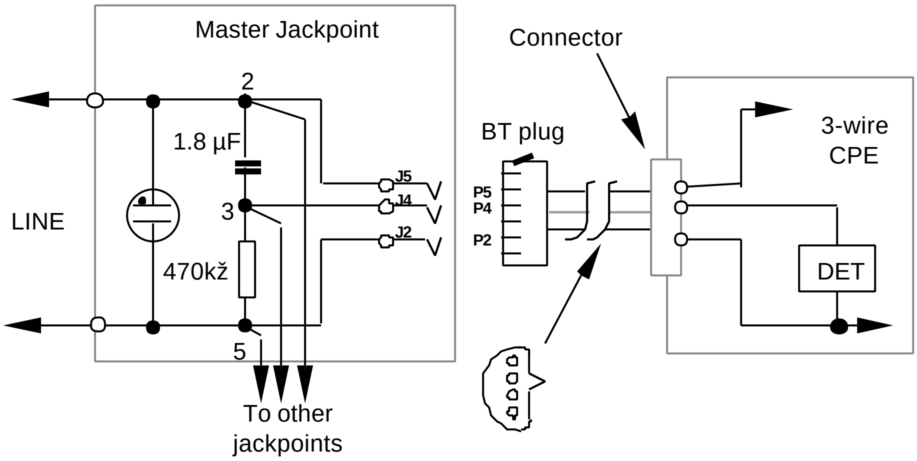
(3) This arrangement, which is shown in Fig 6(c), will be used for new installations. The original 1.8 µF capacitor and 470 k? resistor will be re-located within the ETP or mounted with the jackpoint closest to the lead-in cable. These components will continue to be used for remote testing purposes when no CPE is connected. The surge suppressor is no longer equipped. As shown in Fig 6(c), this arrangement supports both 2-wire and 3-wire connected CPE.

• *By removing the "ringing" wire, this arrangement improves line balance to earth, especially for installations with long wiring runs.*

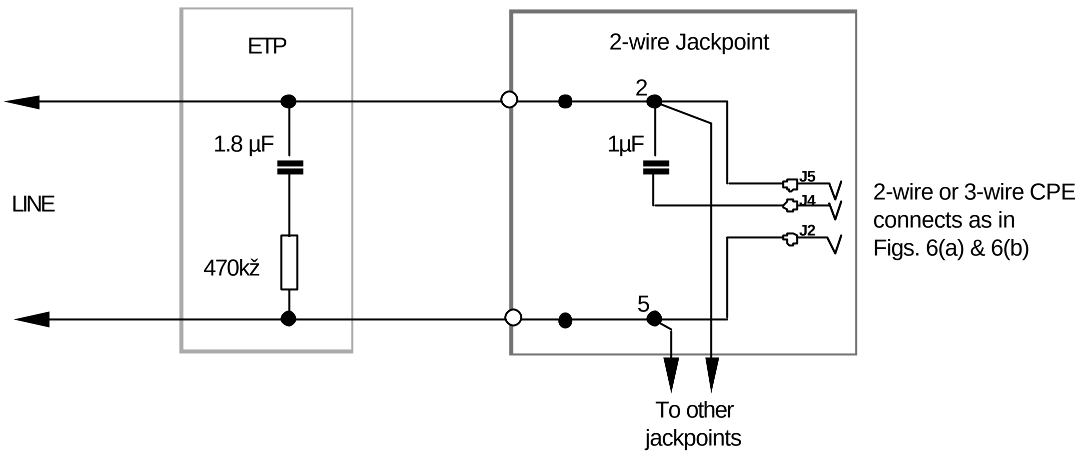
• *PTC 103 covers these wiring arrangements and other options in more detail.*



(a) 2-WIRE CUSTOMER PREMISES DEVICES



(b) 3-WIRE CUSTOMER PREMISES DEVICES



(c) 2-WIRE ARRANGEMENT OF PREMISES WIRING

FIG. 6 CONNECTION OF 2-WIRE & 3-WIRE CUSTOMER EQUIPMENT

Telecom

9.3
Physical network connection methods

(1) The primary method of connection of terminal equipment to the customer's premises wiring is via a standard Telecom socket which mates with a plug to BS 6312:1985. This method of connection accommodates both 2-wire and 3-wire terminal equipment.

• *The plug to BS 6312:1985 is commonly known as a "BT" plug.*

(2) (a) The plug and socket pin numbering for 3-wire jackpoints is as shown below, indicating the connections to the wiring terminals. The numbering reversal should be noted (ref. Fig. 6):-

Socket/Plug Pin Numbering		Wiring Terminal Numbering
Pin 1	not used	6
Pin 2	A-wire	5
Pin 3	earth (when provided)	4
Pin 4	shunt-wire (used for 3-wire CPE only)	3
Pin 5	B-wire	2
Pin 6	not used	1

• *Pin 6 on the plug is adjacent to the latch.*

(b) The plug and socket pin numbering for 2-wire jackpoints is as shown below, indicating the connections to the wiring terminals:-

Socket/Plug Pin Numbering		Wiring Terminal Numbering
Pin 1	not used	not used
Pin 2	A-wire	A1, A2 or A3
Pin 3	not used	not used
Pin 4	Shunt-wire (used for 3-wireCPE only)	not used
Pin 5	B-wire	B1, B2 or B3
Pin 6	not used	not used

• *The actual Wiring Terminal Numbers and/or "A" and "B" may not be marked on all 2-wire jack terminal strips. Each 3-way IDC terminal strip supports one line connection. The same polarity is not necessarily carried through between jackpoints.*

(c) The A & B wires referred to in (a) and (b) above are the two wires of the line to the Telecom local exchange and they form the basis of the 2-wire connection method. The shunt wire is only used for 3-wire connection.

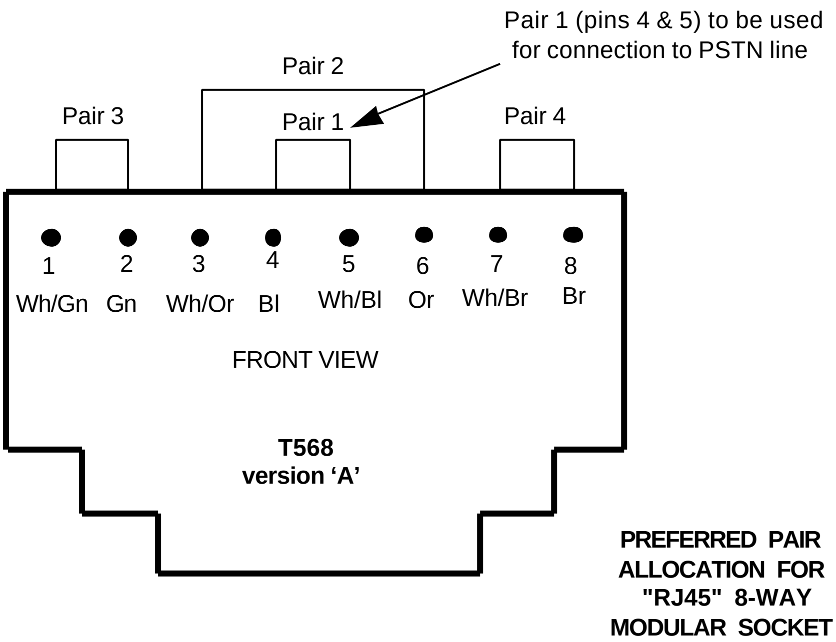
• *The reference to 'A' & 'B' wires are used here for convenience. They do not relate to any particular polarity connection at the local exchange since this is always subject to the possibility of line reversals occurring (ref. clause 4.4).*

(3) An acceptable alternative plug and socket arrangement for 2-wire connection in business premises is the 8-way modular connector specified in IEC 603-7, and also in EIA/TIA-568 and EIA/TIA-570. The preferred pin-out designation is T568A, using pins 4 & 5 (pair 1) as shown in the attached Fig. 7.

- *This modular connector is also specified in AS 3080:1996 and IS 11801:1995.*

- *This 8-way plug and socket is commonly known as "RJ45" in New Zealand. However, this is not strictly the correct designation.*

- *This connector will generally be used with 4-pair cable in cabling systems designed for generic application. Telephony is just one of the many sevices supported.*



References:-
AS/NZS 3080:1996
EIA/TIA-568A
IEC 603-7

FIG. 7 ALTERNATIVE 2-WIRE CONNECTION ARRANGEMENT FOR COMMERCIAL PREMISES

10
ANALOGUE ON-HOOK DATA TRANSMISSION

10.1
Introduction

(1) Analogue on-hook data transmission is a technique which enables information to be transmitted to the called party from the exchange during the ringing cycle, without that party going off-hook. The information is transmitted to the called party during the long silent period between the first and second ringing cadences (ref. clause 6.3).

- *A typical application of this facility is for the called party to receive information about the incoming call, such as calling party number (see Section 11).*

- *Ref. Bellcore TR-NWT-000030*

(2) This facility is supplementary to standard Telecom telephone service. It is restricted to describing interfaces requiring connection of specialist CPE, and does not include services which use standard techniques such as DTMF tones for data transfer.

(3) The specification of this facility does not constitute a guarantee that it will be available in all circumstances.

10.2
Timing

The timing of the data transmission signal relative to the ringing cadence is as follows:-

(a) The signal starts not less than 500 ms after the first ringing cadence has ended, and,

(b) ends at least 200 ms before the start of the second ringing cadence.

10.3
Physical Layer

The physical make-up of the signal transmitted from the exchange is as follows:-

Modulation Type:	Frequency shift keying
Mark (logic 1):	1200 ± 12 Hz
Space (logic 0):	2200 ± 22 Hz
Transmission level:	-13.5 dBm ±1.5 dBm at the exchange into a standard BT3 termination
Transmission rate:	1200 ± 12 bits per second
Word format:	Each data word shall be preceded by a start bit (space) and followed by a stop bit (mark)
Word length:	8 bits
Bit order:	The least significant bit of each data byte shall be transmitted first

10.4
Data Link Layer

(1) In the data link layer, the Data Message Frame comprises the following (see Fig. 8):-

(a) Wake-up signal to alert receiver of impending transmission.

(b) Message.

(c) A checksum for error detection purposes.

(2) Details of the frame are as follows:-

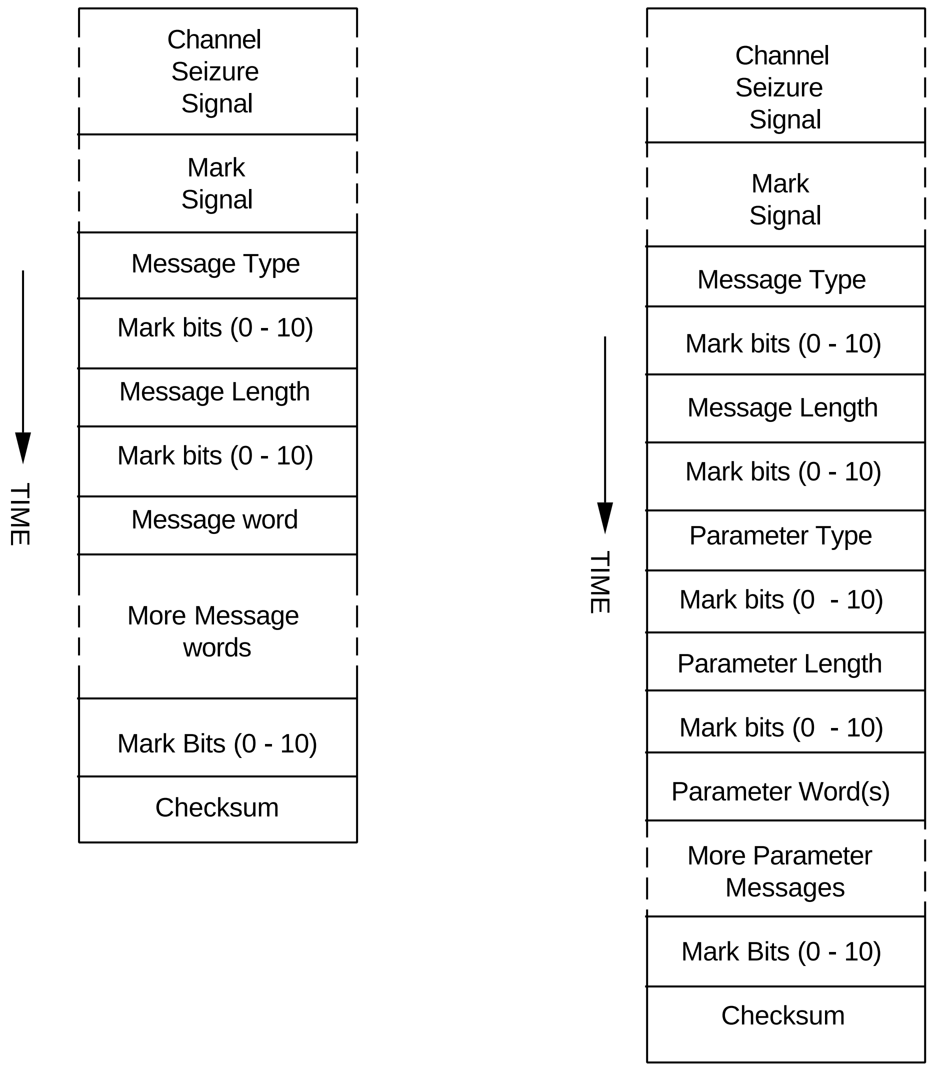
(a) Each frame commences with a Channel Seize Signal (CSS) and a Mark Signal.

(b) The CSS consists of a block of 300 continuous bits of alternating "0"s and "1"s. The first bit transmitted is a "0" and the last bit a "1".

(c) The Mark Signal consists of 180 mark bits.

(d) The format of the Message portion of the frame is shown in Figs. 9 & 10.

(e) The checksum is the last word of the frame. It is the 2's complement of the modulo 256 sum of each bit in the other words within the message.



(a) Single Data Message Format (SDMF)

(b) Multiple Data Message Format (MDMF)

FIG. 8 SINGLE AND MULTIPLE DATA MESSAGE FRAME FORMATS

Telecom

10.5
Message Assembly Layer

10.5.1
Types of message

There are two message types as follows (see Figs. 9 and 10):-

(a) The Single Data Message Format (SDMF) which defines a message consisting of a message header and a message body.

(b) The Multiple Data Message Format (MDMF) which defines a sequence of messages, each consisting of a message header and a message body. The message body may contain several smaller messages called parameter messages, each of which has a header and a body.

10.5.2
Single Data Message Format (SDMF)

The Single Data Message Format (SDMF) is as follows (see Fig. 9):-

(1) Header, consisting of:-

(a) The 'Message Type', which is an 8-bit word identifying the feature generating the message.

(b) The 'Message Length', which is an 8-bit word indicating the number of message words following in the message body (1 - 255).

(2) Message Body

The message body contains up to 255 8-bit words.

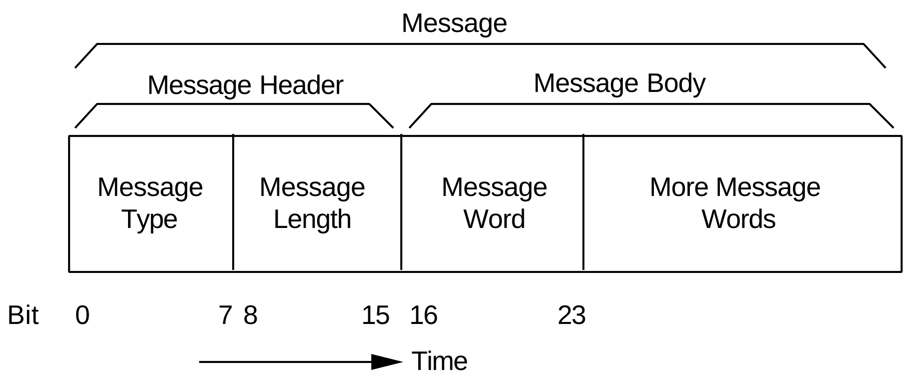


FIG. 9 SINGLE DATA MESSAGE FORMAT (SDMF)

- *In practice the message body may be limited by the ringing cadence used.*

10.5.3
Multiple Data Message Format (MDMF)
The Multiple Data Message Format (MDMF) is as follows (see Fig. 10):-

(1) Header, consisting of:-

(a) The 'Message Type', which is an 8-bit word identifying the feature generating the message.

(b) The 'Message Length', which is an 8-bit word indicating the number of message words following (1 - 255). This includes the parameter message headers as well as the parameter message bodies.

(2) Message body:-

(a) Parameter Message Header, consisting of:-

(i) The 'Parameter Message Type', which is an 8-bit word identifying the feature generating the parameter message.

(ii) The 'Parameter Message Length', which is an 8-bit word indicating the length of the parameter message.

(b) Parameter Message Body containing a series of 8-bit words.

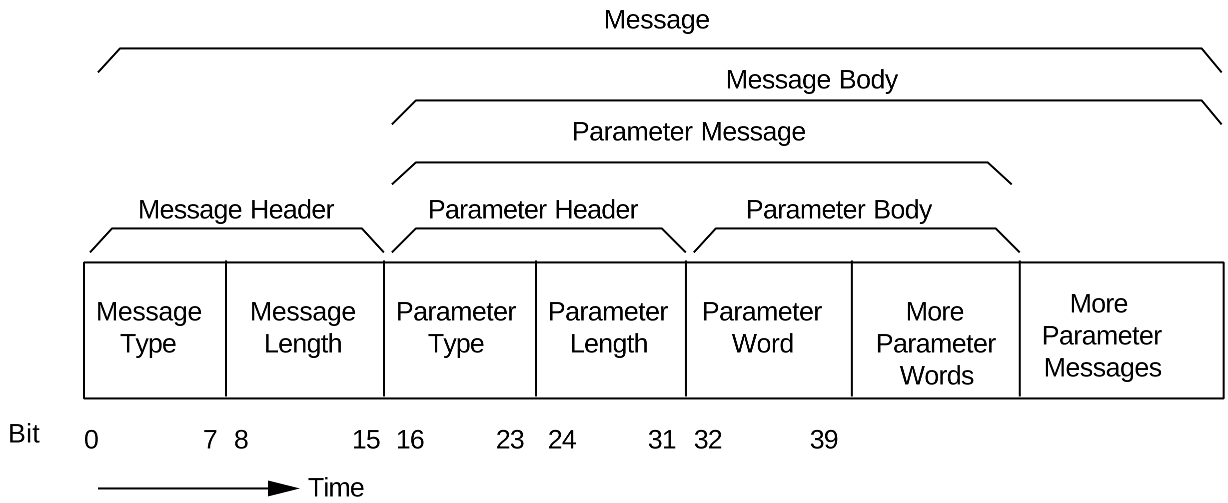


FIG. 10 MULTIPLE DATA MESSAGE FORMAT

11
ANALOGUE CALLING LINE IDENTIFICATION PRESENTATION

11.1
Introduction

Analogue Calling Line Identification Presentation (Analogue CLIP) is a technique which enables the directory number of the calling party to be transmitted to the called party during the ringing cycle. This enables CPE to receive the calling party number without going off-hook. The information is transmitted to the called party during the long silent period between the first and second ringing cadences using the analogue on-hook data transmission facility described in Section 10.

11.2
Information Format

(1) The PSTN will normally deliver the date and time of the call and the directory number of the calling party. The SDMF is normally used to carry the information, but where additional information is necessary, the MDMF is used. The formats of SDMF and MDMF are described in Section 10.

(2) In some instances, information can be conveyed by means of a coded "calling number" in place of the actual calling party identity (see Specification PTC 200, clause 11.4.5).

• *An example of this is used for international calls received via Telecom's Gateway exchange. On all such calls, a calling number identity of "0000" is delivered, rather than use the "number unknown" or "not available" information category.*

11.3
Calling Number Delivery (CND)

11.3.1
Using SDMF

(1) The message type is as follows:-

Message type	Service
00000100	Calling Number Identity

(2) Message Length:-

8-bit word with a binary value between 9 and 18.

(3) Message Body:-

(a) Date and Time of message: 8 words coded in IA5, with no parity.

(b) Calling line directory number (if available and able to be displayed):-

(i) Up to 10 digits coded in IA5 with no parity, **or**

(ii) IA5 character "P" if an anonymous indication is to be delivered in lieu of the calling line directory number as reason for absence of directory number, **or**

(iii) IA5 character "O" if an out-of-area/unavailable indication is to be delivered in lieu of the calling line directory number as reason for absence of directory number.

- *For the purposes of this Document, IA5 is the same as ASCII*

11.3.2
Using MDMF

(1) The message type is as follows:-

Message type word	Service
10000000	Call Setup

(2) Message Length:-

8-bit word with a binary value between a minimum of 13 and up to a number dependent upon the number of messages.

- *The absolute maximum binary value is 255 (ref. clause 10.5.2)*

(3) Message Body
The message body is made up of the following parameter messages:-

(a) Date and Time, and

(b) Directory number, **or** reason for absence of directory number.

(4) The Parameter Type Values are as follows:-

Parameter type Value	Value Parameter
00000001	Date/Time
00000010	Calling Line Directory Number
00000100	Reason for absence of Directory Number

(5) Parameter Message Format

There are 3 parameter message formats, as follows:-

(a) Time and Date Message Format:-

1	Date and Time parameter type code (00000001)
2	Parameter Length (8)
3 4	Month (01 - 12)
5 6	Day (01 - 31)
7 8	Hour (00 - 23)
9 10	Minute (00 - 59)

(b) Calling Line Directory Number Parameter:-

1	Calling line Directory Number parameter type code (00000010)
2	Parameter Length (up to 10)
3 4 Up to 10	Digit 1 Digit 2 . . . Digit 10

(c) Reason for absence of Calling Directory Number Parameter:-

1	Reason for absence of Directory Number; parameter type code (00000100)
2	Parameter Length (1)
3	Reason (P or O)