

Terminal support interface for harmonized analogue PSTN terminals



Reference

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Foreword

This ETSI Guide (EG) has been produced by ETSI Project Analogue Terminals and Access (ATA).

Introduction

The present process of harmonization of the 2-wire analogue voice band switched interface (traditionally PSTN) has focussed on harmonization of the terminal equipment. Now that the terminal harmonization process is nearing completion, it becomes feasible to move towards harmonization of the network interface itself. This is particularly true for new local access delivery systems which tend to provide service via short local loops. Defining a short loop interface specifically for interworking with harmonized terminals provides the opportunity for better echo control by optimizing the 2 to 4 wire hybrid balance, and permits significant cost reduction of the line interface by minimizing the d.c. and a.c. power requirements.

1 Scope

The present document is applicable to apparatus intended for use in a private network and which incorporates an interface for the connection of harmonized terminal equipment intended for connection to the PSTN, and gives guidance on the performance of the interface so as to make it appear to the attached terminal equipment that it is inter-working with a 2-wire analogue interface of the PSTN.

The electrical conditions recommended for the apparatus at the terminal support interface are sufficient to ensure satisfactory operation of some or all of the following basic functions of approved terminal equipment:

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

Guidance is also given on the requirements for some additional features and services.

The present document applies to apparatus where the loop current provided to terminal equipment is not directly derived from a PSTN connection, and includes apparatus where the "internal" connection between the terminal support interface and the NCP uses digital radio communication means such as CT2, DECT and PCN. The present document is not intended to apply to apparatus which intentionally and substantially modifies the voice band transmission characteristics e.g. devices providing speech encryption, where it may not be possible to achieve the proposed requirements for parameters such as delay and distortion.

The present document applies to apparatus where any terminal equipment connected to the terminal support interface is connected via a cable with a maximum loop resistance of 100 Ω .

NOTE: This is equivalent to approximately 500 metres of cable with 0,5 mm diameter copper conductors.

The apparatus, which may be terminal apparatus, is intended for private network use but may be connected to the NTP of a public network. It does not apply to network terminating units installed by operators in the access network.

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, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] TBR 21: "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".

[2] EN 301 437: "Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE supporting the voice telephony service in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signalling".

- [3] TBR 38: "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".
- [4] ETS 300 659: "Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display and related services".
- [5] ETS 300 778: "Public Switched Telephone Network (PSTN); Protocol over the local loop for display and related services; Terminal Equipment requirements".
- [6] ITU-T Recommendation P.53: "Psophometer for use on telephone-type circuits".
- [7] TR 101 183: "Public Switched Telephone Network (PSTN); Analogue ringing signals".
- [8] ES 201 235-2: "Specification of Dual Tone Multi-Frequency (DTMF) Transmitters and Receivers; Part 2: Receivers for use in Public Exchanges (and PABXs)".
- [9] ETR 206: "Public Switched Telephone Network (PSTN); Multifrequency signalling system to be used for push-button telephones [CEPT Recommendation T/CS 46-02 E (1985)]".
- [10] Miniature 6 position plug as described in FCC 47, CFR 68.500: "Code of Federal Regulations (USA); Title 47 Telecommunications, Part 68 Connection of terminal equipment to the telephone network. Subpart F, Connectors; Section 68.500 Specification".
- [11] ETR 201: "Public Switched Telephone Network (PSTN); Register-recall [CEPT Recommendation T/CS 20-09 E (1980)]".
- [12] ITU-T Recommendation E.180 (1988): "Technical characteristics of tones for the telephone service".
- [13] TR 101 041-1: "Human Factors (HF); European harmonization of network generated tones; Part 1: A review and recommendations".
- [14] ES 201 168: "Corporate telecommunication Networks (CN); Transmission characteristics of digital Private Branch eXchanges (PBXs)".
- [15] ES 201 187: "2-wire analogue voice band interfaces; Public Switched Telephone Network (PSTN); Loop Disconnect Signalling Specific Requirements; Terminal Equipment (TE)".
- [16] ITU-T Recommendation V.23: "600/1200-baud modem standardized for use in the general switched telephone network".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

2-wire apparatus: apparatus which when providing a transmission path between the interface port and the network connection point uses the same path for each direction of transmission.

4-wire apparatus: apparatus which when providing a transmission path between the interface port and the network connection point uses separate paths for each direction of transmission.

answer signal: an indication that a terminal wishes to answer an incoming call.

apparatus type: a classification dependent on the apparatus internal transmission path and network connection as defined in table 1.

called party answer signal: a signal which may be provided at the call originating NTP by the network to indicate that the called party has answered the call. It is often used for call charging purposes.

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

clear signal: an indication that a terminal is attempting to release a connection.

disconnect signal: a break of duration 90 to 110 ms in the loop current presented at the TSI by the apparatus in response to an end-of-call signal received at the NCP.

end-of-call signal: a signal usually provided at the called analogue NTP by the network to indicate when a calling TE has resumed the quiescent state. The end-of-call signal may consist of a polarity reversal or a "K-break".

harmonized terminal equipment: for the purpose of the present document, terminal equipment conforming to the PSTN access requirements of TBR 21, or EN 301 437 (ex-TBR 37). The impedances and losses defined in the present document should ensure that handset telephones meeting the requirements of TBR 38 are consistent with national transmission plans.

K-break: an optional end-of-call signal consisting of a reduction in the PSTN loop current to below 1 ma for a period normally in the range 90 to 130 ms. There are some NTPs in existence which provide break periods in the range 20 to 128 ms, but 90 to 110 ms is the preferred range for new installations

mean one-way transmission time: half the sum of the one-way transmission times in both directions of transmission between the interface port and the network connection point.

network connection point: the point provided by the apparatus intended for connection to a network. The NCP may be intended for connection to a Network Termination Point.

network termination point: the point where the local subscriber line is terminated, the network standard interface is presented, and the TE is connected.

off-line idle state: a condition of the apparatus where no seize signal is applied at the TSI, nor a network ringing indication is applied at the NCP, it has applied a release condition at the NCP, and where no transmission path is provided between the NCP and the TSI.

off-line signalling state: an optional condition of the apparatus during which it is capable of speechband signalling with a terminal connected to the TSI without entering the on-line transmission state.

on-line signalling state: a condition of the apparatus where a terminal seize or answer signal has been applied at the TSI, it has applied a seize indication to the NCP, and is capable of transmitting to the NCP any network address signalling applied at the TSI.

on-line transmission state: a condition of the apparatus where it has a loop condition applied at the TSI, it has applied a seize or answer signal to the NTP, and where it provides a voice band transmission path between the NCP and the TSI.

ringing state: a condition of the apparatus where a ringing/alerting indication has been applied at the NCP and it has applied ringing signal to the TSI.

ring trip: the removal of the ringing signal at the TSI in response to a valid answer signal applied to the TSI

seize signal: an indication that a terminal is attempting to establish a connection.

terminal support interface: a port provided by the apparatus for connection of terminal equipment intended for connection to the analogue PSTN, and which supports certain terminal equipment functions.

transparent signalling: a facility whereby network address information and supervisory signals are conveyed between the TSI and the PSTN connection point without regeneration within the apparatus.

3.2 Symbols

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

a.c.	alternating current
dBm0	the absolute power level in dB referred to a point of zero relative level
dBm0p	the absolute psophometric power level in dB referred to a point of zero relative level
dBr	the relative level of a signal in a transmission path referred to the level at a reference point on the path
dBV	the absolute voltage level expressed as dB relative to 1 V
dBVp	the absolute psophometric voltage level relative to 1 V expressed in dB
d.c.	direct current
r.m.s.	root mean square

3.3 Abbreviations

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

ALASS	Analogue Local Access Signalling Services
CPA	Called Party Answer
CT2	Second Generation Cordless Telephone
DECT	Digital Enhanced Cordless Telecommunications
DTMF	Dual Tone Multi Frequency
LD	Loop Disconnect
NCP	Network Connection Point
NTP	Network Termination Point
PCN	Personal Communication Network
PSTN	Public Switched Telephone Network
TE	Terminal Equipment
TSI	Terminal Support Interface

4 General

4.1 Apparatus types

The apparatus considered in the present document is divided into three distinct types. These are defined in table 1 and shown in figure 1.

Table 1: Apparatus types

Apparatus type	Apparatus internal transmission path	Network connection
A	2-wire	2-wire analogue
B	4-wire (see note)	2-wire analogue
C	4-wire	4-wire digital

NOTE: The internal 4-wire transmission path may be analogue or digital.

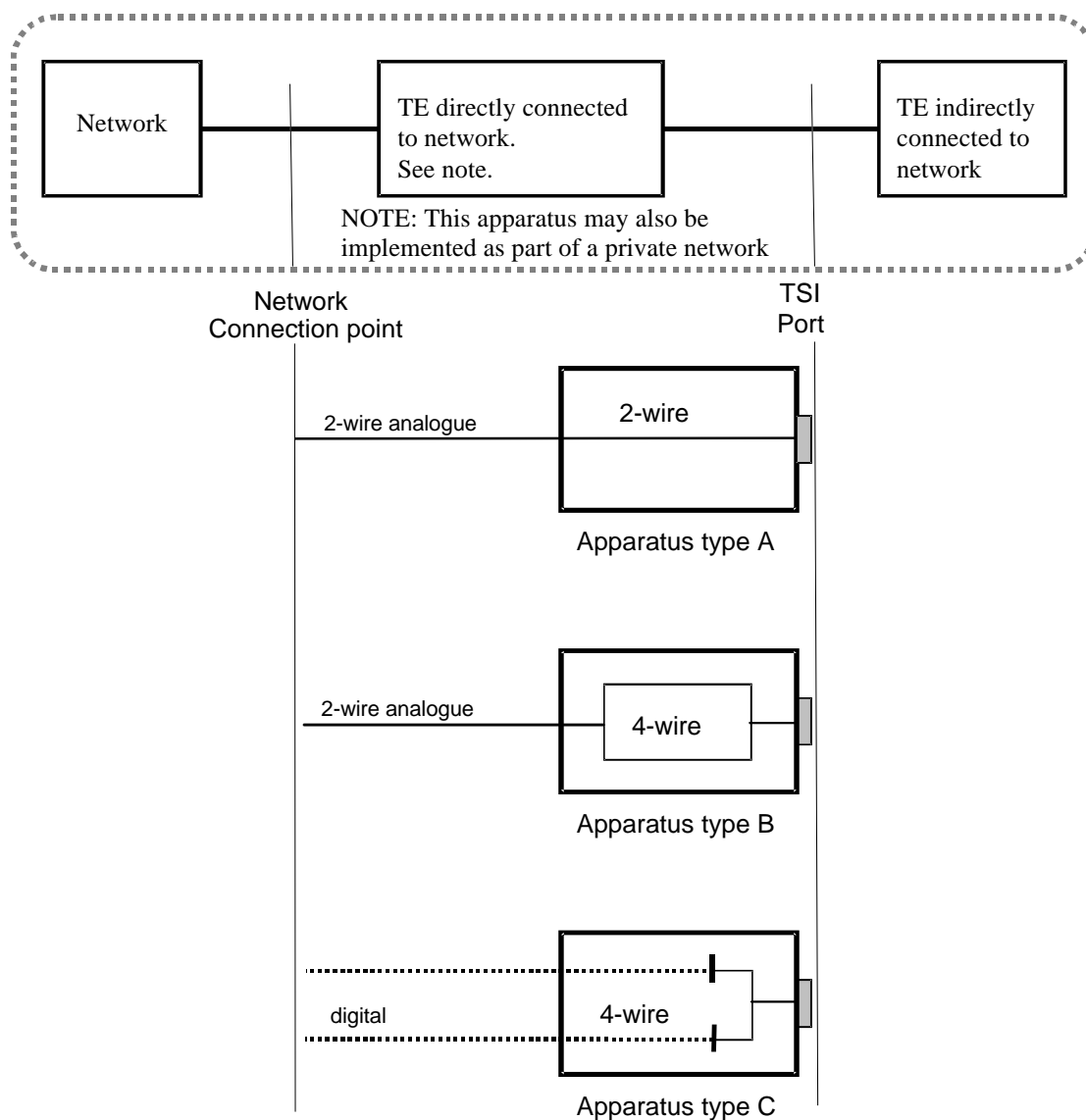


Figure 1: Apparatus types

4.2 States of the Apparatus

The possible states of the apparatus at the terminal support interface, and the transitions between states are shown in figure 2.

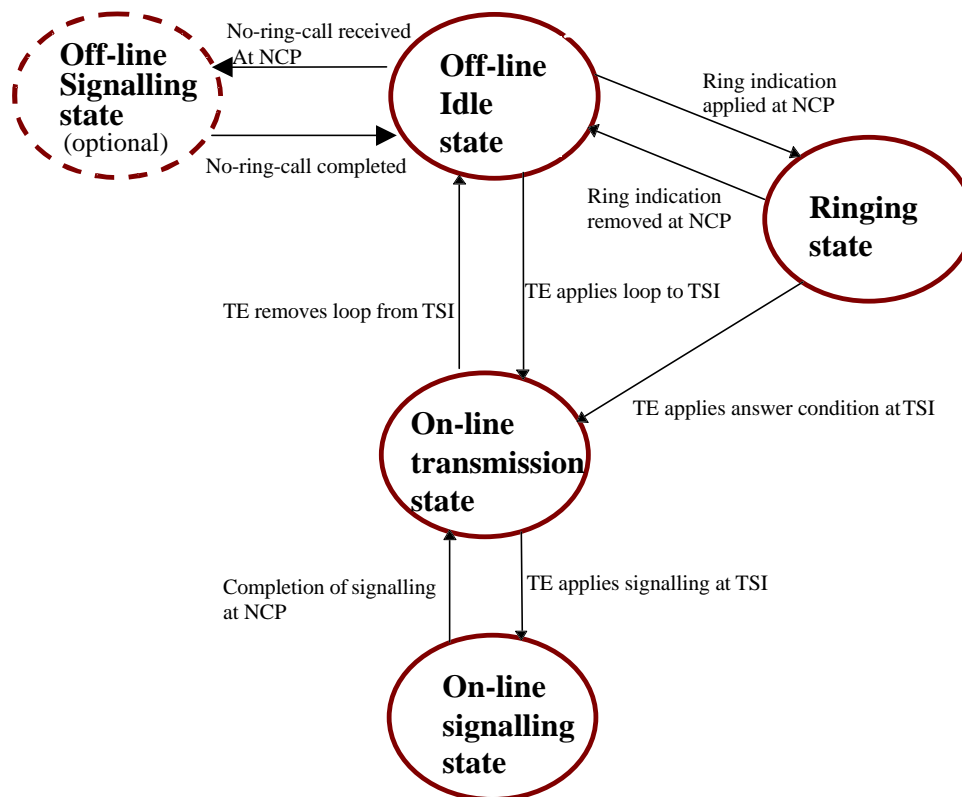


Figure 2: Apparatus state transition diagram

4.3 Call handling signalling messages

Figure 3 shows the call handling signalling messages at the NCP and the associated stimuli at the TSI. The right hand side shows the stimuli received or applied at the TSI for various phases of a call. The left hand side shows the corresponding signals present at the NCP for both 2-wire and 4-wire network connections. The 2-wire signals are physical in nature and in general match the stimuli at the TSI. The 4-wire signals are specific signalling messages appropriate for the type of 4-wire interface and are identified by angled brackets thus; <message type>. A separate message is identified for each call phase. In some applications some of these messages may be identical e.g. <release> and <clear>.

The 2-wire signals and 4-wire call handling signalling messages at the NCP are intended to be generic in nature. In the present document the descriptions are based upon the NCPs of the PSTN. Where the apparatus is intended for use in private networks which use different call handling messages, appropriate changes to the existing clauses may be required.

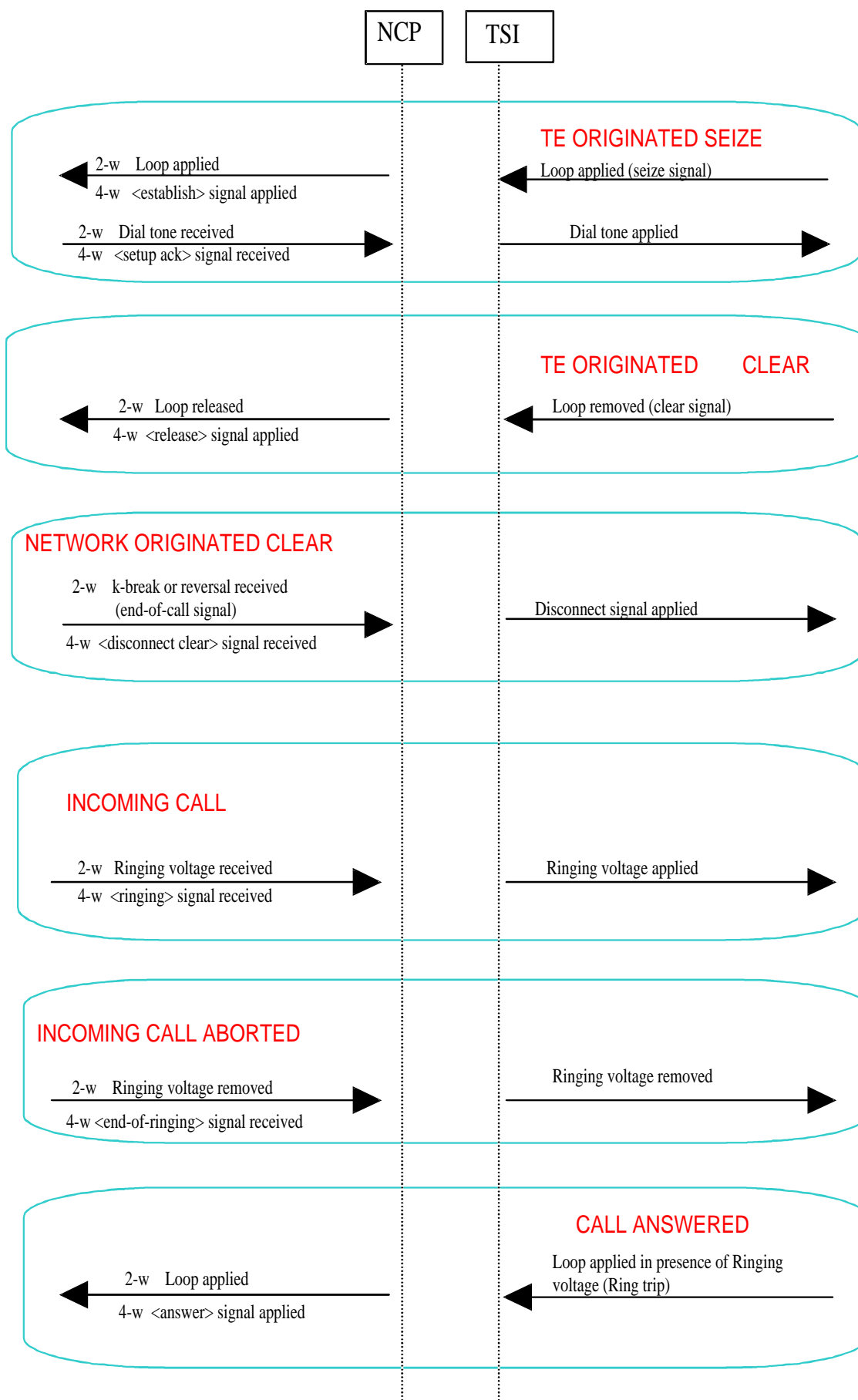


Figure 3: Call handling signalling messages

5 Physical connections

5.1 Mechanical Aspects

The terminal support interface (TSI) should normally be presented at an adequately protected termination block.

If feasible for the intended application of the apparatus, i.e. to allow direct connection of TE, the TSI may be presented at a socket capable of connecting with a miniature 6-position plug as specified in FCC47, CFR 68.500 Clause (a) [10] (often referred to as RJ11/12).

5.2 Loop presentation

Connections equivalent to the A- and B-wires of the 2-wire analogue PSTN connection should be presented at the TSI. Where the miniature 6-position socket is used, the A-wire and B-wire should be presented at contacts numbered 3 and 4 respectively.

6 D.C. feed conditions

6.1 Loop current - on line state

When a resistor with a value in the range $0\ \Omega$ to $600\ \Omega$ is connected between the A- and B-wires at the TSI, a minimum d.c. current of 18 mA should flow. It is recommended that a d.c. current within the range $32\ \text{mA} \pm 7\ \text{mA}$ should be provided.

NOTE 1: 18 mA is the minimum current required to meet the access requirements for interworking with the network. The current range $32\ \text{mA} \pm 7\ \text{mA}$ is typical of that provided by many modern networks during normal operating conditions, (particularly those with current sourced line feeds) and provides sufficient current for operating most types of terminal equipment including line powered handsfree telephones. It is recommended that a minimum loop current of 18 mA is provided during power fail conditions.

NOTE 2: $600\ \Omega$ is derived from $500\ \Omega$ maximum TE resistance (9 V, 18 mA) plus $100\ \Omega$ maximum loop resistance.

6.2 Voltage

6.2.1 Polarity

The polarity of the d.c. voltage presented at the TSI during the off-line-idle state, should be such that the B-wire is normally negative with respect to the A-wire.

6.2.2 Off-line idle state

NOTE: No unwanted a.c. components should be presented at the TSI during the off-line idle state.

6.2.2.1 Maximum voltage

The maximum open circuit d.c. voltage presented between the A- and B-wires of the TSI should not exceed 78 V.

6.2.2.2 Minimum voltage

When a resistor of 100 k Ω is connected between the A- and B-wires of the TSI, the continuous d.c. voltage appearing at the TSI should not be less than 38 V.

NOTE: Some existing designs of terminal require a minimum effective exchange battery voltage of 38 volts in order to function correctly. There are some pressures to reduce the power consumption further for short loop line interfaces. It is recommended that future designs of terminal equipment should assume that a minimum battery voltage of 24 volts will be available.

6.2.3 Polarity reversal

Apparatus with a 2-wire network connection should be as transparent as possible in order not to disturb the dynamic signalling procedures on analogue subscriber lines.

For apparatus types A and B, any polarity reversal applied at the NCP during the on line, ringing, and off-line idle states should cause a polarity reversal to be applied at the TSI within 50 ms.

NOTE: For those networks providing ALASS services (see subclause 14.4), and which use a polarity reversal followed by a Dual Tone Alerting Signal (DT-AS) to wake up any Calling Line Identity receivers, the 50 ms period should be minimized so as to avoid possible overlap of the reversal and the DT-AS at the TSI.

7 Seize signal

7.1 Non seizure

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-wires of the TSI, it should not be recognized by the apparatus as a seize signal.

7.2 Seize condition

When a resistor with a value such as to cause a loop current not less than 6,0 mA d.c. to flow is connected at the A- and B-wires of the TSI, it should be correctly accepted by the apparatus as a seize signal, and:

- i) For apparatus types A and B, the apparatus should, within 150 ms, present a loop condition at the NCP and provide a transmission path between the network connection point and the TSI so as to present any voice band supervisory signals applied at the network connection point to the terminal equipment.
- ii) For apparatus Type C, the apparatus should apply an <establish> signal to the network connection point and either present internally generated dial tone to the TSI within 2,0 seconds from the application of the seize condition at the TSI, or provide a transmission path between NCP and the TSI so as to present any voice band supervisory signals applied at the NCP to the TSI.

NOTE 1: The 2 second period allows time for the network to set up the link and receive a <setup acknowledge> signal at the NCP before activating the internal tone generator of the TE.

If the apparatus is unable to meet the above recommendations in response to a valid seize condition, it is recommended that a "connection not admitted" supervisory tone is presented at the TSI.

NOTE 2: Some designs of line interface, particularly those with constant current feed, use a high impedance monitoring facility with a reduced current drive capability to check for a seize condition before applying the normal steady-state on-line loop current drive capability. For example, 50 V may be applied via a 10 k Ω resistor (i.e. a maximum current of 5 mA) with a seize current threshold of 4 mA. Similarly, some designs of terminal equipment, particularly line powered TE using solid state hookswitches, may assume the instant availability of a minimum loop current of say 18 mA. Such designs of terminal may not achieve the steady state d.c. on-line condition if only 5 mA is available due to insufficient current to fully operate the electronic hookswitch. While in this partial on-line condition, TE may present an equivalent resistance up to 5 k Ω instead of the 300 Ω or less of the normal on-line condition. Care needs to be taken to ensure that proper startup occurs when such terminals and line interfaces are inter-working. This may best be achieved by meeting the following additional transient seize condition.

It is recommended that during the transition from quiescent state to loop state, the TSI should be capable of supplying a minimum current of 4 mA into a load of 5 k Ω for a minimum period of 20 ms.

8 Clear signal

8.1 Clear signal generated by TE

When the load presented by terminal equipment connected at the A- and B-wires of the TSI is such as to reduce the loop current to less than 1,0 mA for a period:

- a) less than 350 ms, the apparatus should not accept this as a clear signal; and
- b) greater than 500 ms, the apparatus should accept this as a clear signal and should terminate the transmission path between the NCP and the TSI, and either release the loop condition applied at the NCP for apparatus types A and B, or transmit a <release> message to the NTP for apparatus type C.

NOTE: For deviation from this requirement in support of the optional hook switch flash facility, see subclause 14.2.

In order to ensure satisfactory operation of the seize/clear function, hysteresis of the seize and clear current should normally be provided. It is recommended that the clear signal threshold current should be at least 2,0 mA lower than the seize signal threshold current.

8.2 Clear indication received from the network

8.2.1 2-wire network connection

Two types of network clear indication are currently in use; a break pulse, and a polarity reversal.

When type A or type B apparatus receives a PSTN K-break end-of-call signal at the NCP, it should remove the transmission path between the NCP and the TSI, and apply a disconnect signal at the TSI.

When type A or type B apparatus receives a PSTN polarity reversal end-of-call signal at the NCP, a reversal should be applied at the TSI in accordance with subclause 6.2.3. The transmission path between the NCP and TSI should be maintained for a period of 5 s in order to transparently pass any network provided release tone to the TE.

NOTE: The break pulse network clear indication is normally only provided where the calling TE is the one initiating the clear. Networks using polarity reversals as a network clear indication typically provide the reversal for both called and calling TE initiating the clear. The polarity reversal initiated by clearing at the called TE is normally accompanied by a burst of release tone.

8.2.2 4-wire network connection

When type C apparatus receives a <disconnect clear> indication at the NCP, it should, as a network option, either:

- terminate the transmission path between the NCP and the TSI, and apply a disconnect signal to the terminal equipment; or
- maintain the transmission path between the NCP and the TSI for a period of 5 s in order to transparently pass any network provided release tone to the TE.

NOTE: The <disconnect clear> indication may also be known as the release or clear-request message.

9 Impedance

9.1 Input impedance

The impedance presented by the apparatus between the A- and B-wires of the TSI when in the on-line state should have a return loss with respect to the reference impedance Z_{ref} shown in figure 4, not less than 18 dB in the frequency range 500 Hz to 2 000 Hz, and not less than values located on straight line intersecting 14 dB at 200 Hz and 18 dB at 500 Hz, and not less than values located on straight line intersecting 18 dB at 2 000 Hz and 14 dB at 3 800 Hz (lines plotted on linear dB - logarithmic frequency scale).

NOTE: For apparatus types A and B, the NCP shall be terminated with the reference impedance Z_{ref} .

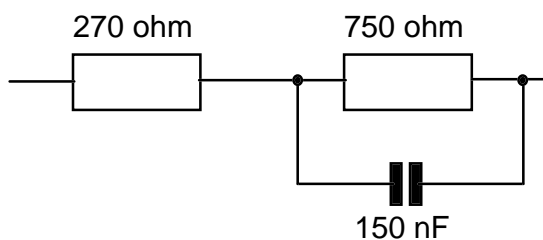


Figure 4: Reference impedance Z_{ref}

9.2 Apparatus balance return loss

For apparatus type C, the apparatus balance return loss when in the on-line state, and with the TSI terminated by the reference impedance Z_{ref} shown in figure 4 should be not less than 20 dB over the frequency range 500 Hz to 2 500 Hz, and not less than values located on a straight line intersecting 16 dB at 200 Hz and 20 dB at 500 Hz, and not less than values located on a straight line intersecting 20 dB at 2 500 Hz and 16 dB at 3 800 Hz (lines plotted on linear dB - logarithmic frequency scale).

NOTE: Apparatus balance return loss is the receive to transmit loss of the port (return loss) less the sum of the nominal TSI to 4-wire Tx point and 4-wire Rx point to TSI connection losses.

9.3 Balance about earth

The following recommendations of this subclause only apply to apparatus provided with an earth connection.

9.3.1 Impedance balance

The impedance balance at the TSI should be not less than 46 dB over the frequency range 200 Hz to 3 800 Hz.

9.3.2 Signal balance

The signal balance at the TSI should be not less than 46 dB over the frequency range 200 Hz to 3 800 Hz.

9.4 Stability

For apparatus type B in the on-line transmission state, on-line DTMF signalling state, or off-line signalling states and with the NCP terminated by the reference impedance Z_{ref} shown in figure 4, the apparatus should not exhibit instability, i.e. sustained self oscillation when the TSI is terminated in turn by:

- a) a short circuit;
- b) a 600 Ω resistor in parallel with 1,8 μF .

10 Transmission

NOTE 1: The transmission requirements of this clause are based upon those in ETSI standard ES 201 168 which is in turn aligned with ITU-T Recommendations.

Unless stated otherwise, the requirements of this clause apply when the apparatus is in the on-line transmission state and the on-line transparent DTMF signalling state.

NOTE 2: In the present clause the most common situations are described. In some circumstances (e.g. leased lines of private networks or public networks planned for higher level transmission or situations where the line impedance is mismatched) special transmission plans may have to be used.

10.1 Loss

10.1.1 2-wire network connection

For apparatus types A and B the loss at 1 020 Hz in both directions of transmission between the TSI and the analogue NCP (terminated with the reference impedance Z_{ref} shown in figure 4, and with a PSTN loop current of value within the range 32 mA \pm 7 mA) should be less than 2,0 dB.

NOTE 1: For apparatus type B using a digital internal 4-wire path, the digital path is assumed to be at the 0 dBr level reference point.

NOTE 2: The restriction of the interface loop current to below 40 mA ensures that any speech regulation within TE is disabled. By restricting the connection between the interface and the TE to short loops only, it is not necessary for the apparatus to provide regulation at the interface port. By setting the PSTN loop current to 32 mA, any speech regulation provided by the apparatus at the NCP is disabled.

10.1.2 4-wire network connection

For apparatus type C intended for connection to the PSTN, the relative levels at the TSI at 1 020 Hz should be as given below.

Direction	Relative level
TSI to NCP	+4 dB \pm 1 dBr
NCP to TSI	-11 dBr \pm 1 dBr

NOTE: The 4-wire digital path at the NCP is assumed to be at the 0 dBr level reference point.

10.2 Attenuation / frequency response

NOTE: Unless otherwise stated, the attenuation/frequency response requirements apply to both directions of transmission between the TSI and the NCP.

10.2.1 Apparatus types A and B

The relative loss variations with frequency should be within the upper and lower limits given in table 2.

Table 2: Co-ordinates of attenuation / frequency response limits

Frequency Hz	Lower limit dB rel. arbitrary level	Upper limit dB rel. arbitrary level
200	-0,6	
300	-0,6	+2,0
400	-0,6	+1,5
600	-0,6	+0,7
1 020	-0,6	+0,7
2 000	-0,6	+0,7
2 400	-0,6	+0,9
3 000	-0,6	+1,4
3 400	-0,6	+3,4
3 600	-0,6	-

10.2.2 Apparatus type C

The sending and receiving attenuation/frequency responses should be within the upper and lower limits given in table 3.

Table 3: Co-ordinates of attenuation/frequency response limits

Frequency Hz	Lower limit dB rel. arbitrary level	Upper limit dB rel. arbitrary level
0	0,0 (see note)	
200	0,00 (see note)	
300	-0,3	+1,0
400	-0,3	+0,75
600	-0,3	+0,35
1 020	-0,3	+0,35
2 000	-0,3	+0,35
2 400	-0,3	+0,45
3 000	-0,3	+0,7
3 400	-0,3	+1,7
3 600	0,0	

NOTE: For the receive direction (NCP to TSI) the value 0,0 dB is replaced by -0,3 dB.

10.3 Distortion

Apparatus type A and apparatus type B using analogue internal 4-wire paths should not cause more than 2 % total harmonic distortion to any input sine wave signals at a level of -10 dBV r.m.s. for all frequencies between 300 Hz and 3 400 Hz for both directions of transmission.

For apparatus type B using digital internal 4-wire paths, the requirements of ES 201 168 subclauses 5.6.1 and 5.6.2 should be met.

Apparatus type C should meet the requirements of subclause 5.6.2 of ES 201 168.

10.4 Signal handling

For both directions of transmission, apparatus type A and apparatus type B using analogue internal 4-wire paths, should have a signal to total distortion ratio not less than 24 dB for input sine wave signals at a level of 1,0 V r.m.s. for all frequencies between 300 Hz and 3 400 Hz.

NOTE 1: It is recommended that the apparatus type A and apparatus type B using analogue internal 4-wire paths has sufficient headroom to accommodate signals of 2,5 V peak applied at the TSI without significant clipping.

NOTE 2: For apparatus type B using digital internal 4-wire paths, and apparatus type C, the signal handling requirements are implicit in the digital reference levels defined in subclause 10.1.2.

NOTE 3: The maximum signals to the PSTN are outside the scope of the present document. For apparatus intended for connection to a PSTN, existing approval requirements will apply.

10.5 Variation of loss with signal level

Apparatus types A and B:

With a sine wave test signal at a frequency of 1 020 Hz and at the input levels defined in table 4, the loss variation between the TSI and the NCP relative to the loss at the reference input level should not exceed the limits given in table 4.

Table 4: Variation of loss with signal level

Range of input levels in dBV	Maximum variation of loss in dB	
	App. Type A and Type B with analogue 4-w path	Apparatus type B with digital 4-w path
+3 to -10	± 0,3	± 0,6
-10 to -40	± 0,3	± 0,6
-40 to -50	± 0,6	± 0,6
-50 to -55	± 1,6	± 3,2

Apparatus type C should meet the requirements of subclause 5.2.2 of ES 201 168.

10.6 Outband signal to inband signal translation

For apparatus types A and B with any sine wave signal at any frequency between 4,6 kHz and 40 kHz at a level of -30 dBV applied at the TSI, the output signals at the NCP should not contain signals in the frequency range 300 Hz to 3 400 Hz at a level greater than -55 dBV.

For apparatus type C the requirements of subclause 5.7.1 of ES 201 168 should apply.

NOTE: The out-of-band signals to PSTN are outside the scope of the present document.

10.7 Noise

10.7.1 Receiving noise

With a transmission path set up between the NCP and the TSI, the noise generated within the apparatus and presented at the TSI terminated with the reference impedance shown in figure 4 should not exceed -67 dBVp when measured using a psophometer incorporating a weighting function conforming to ITU-T Recommendation P.53.

10.7.2 Sending noise

With a transmission path set up between the TSI and the NCP, the noise generated within the apparatus and presented at the NCP when measured using a psophometer incorporating a weighting function conforming to ITU-T Recommendation P.53, should not exceed -64 dBVp for apparatus types A and B, and -64 dBm0p for apparatus type C. For apparatus types A and B, the NCP should be terminated in the reference impedance of figure 4.

10.8 Delay

The mean one way transmission time of a transmission path between the TSI and the NCP should not exceed:

- a) 2,0 ms for apparatus not employing radio communication means; or
- b) the delay value stated by the supplier for apparatus employing radio communication means.

NOTE: It is recommended that with the minimum mean one-way transmission time in the frequency band 300 Hz to 3 400 Hz taken as a reference, the maximum delay at other in-band frequencies should not exceed the values given in table 5. Failure to comply with this recommendation may result in the interface port being unsuitable for transmission of voiceband data signals.

Table 5: Recommended relative delay limits

Frequency range Hz	Maximum relative delay ms
500 to 600	1,8
600 to 1 000	0,9
1 000 to 2 600	0,3
2 600 to 2 800	1,5

11 Dialling

For apparatus providing transparent DTMF signalling, any MF tones applied at the TSI should appear at the NCP within 5 ms of the tones being applied at the TSI.

For apparatus not providing transparent DTMF signalling, the apparatus should correctly interpret DTMF tone signals of pulse duration greater than 40 ms and an inter-digital pause of not less than 40 ms applied at the TSI, and should:

- a) for apparatus types A and B, correctly regenerate the DTMF pulses or generate signals in a format declared by the supplier, and apply them at the NCP; or
- b) for apparatus type C, convert the DTMF pulses and apply them at the NCP in a format declared by the supplier.

The apparatus should correctly interpret the tones when received at the TSI at a level within the range -5,0 dBV to -15,0 dBV and with a maximum difference in level between the high and low group tones of 4,0 dB, and with frequencies within $\pm (1,5 \% + 2 \text{ Hz})$ of the nominal values.

NOTE 1: DTMF tones received at the TSI should be correctly interpreted even if 425 Hz dial tone at levels up to -10 dBV at the TSI is generated by the apparatus.

NOTE 2: MF levels taken from TBR 21 plus a small margin.

NOTE 3: Where the apparatus is placed in a mode of operation where interworking with the network is not intended (e.g. to programme a call barring device), the above requirement does not apply.

Further information on the performance of DTMF receivers can be found in ETR 206, and ES 201 235-2.

12 Ringing

The apparatus should present a ringing signal at the TSI within 100 ms in response to the arrival of appropriate ringing information received from the network.

12.1 Ringing drive capability

The TSI should provide a ringing supply with a nominal frequency of either $25 \text{ Hz} \pm 5 \text{ Hz}$ or $50 \text{ Hz} \pm 5 \text{ Hz}$, and with a peak to r.m.s. voltage ratio in the range 1,2 to 1,6. The waveform should be essentially symmetrical with an even order harmonic content not exceeding 5 %.

The a.c. ringing signal may be superimposed on a d.c. voltage within the range 38 V to 78 V. Where the ringing signal is not superimposed on a d.c. voltage, a d.c. voltage should be presented during the off (silent) parts of the ring cadence.

The TSI should provide sufficient ringing current so as to produce a voltage not less than 35 V r.m.s. across an a.c. load of 4,0 k Ω . However it should be noted that a single terminal equipment may present a load of 4 k Ω at the TSI and thus utilize the full ringing drive capability. It is recommended that the TSI provide a drive capability of not less than 35 V r.m.s. across an a.c. load of 2 k Ω .

12.2 Ring cadence

The cadence of ringing signals presented at the TSI should either:

- a) follow the cadence signalled to the apparatus from the network; or
- b) for apparatus with internally generated cadences, comply with the information stated by the supplier.

NOTE: Information of cadences frequently used in public networks is given in TR 101 183.

12.3 Ring trip

Any ringing signal presented at the TSI should be removed within 100 ms of an answer signal consisting of a d.c. seize condition as defined in clause 7 being applied to the TSI.

As an additional option, an impedance not exceeding 700 Ω at 25 Hz or 50 Hz applied at the TSI may also be regarded as an answer signal.

In addition to removal of the ringing signal in response to a valid answer signal applied at the TSI, the apparatus should meet the following requirements:

- a) For apparatus types A and B, the apparatus should, within 150 ms, present a loop condition at the NCP and provide a transmission path between the network connection point and the TSI.
- b) For apparatus Type C, the apparatus should apply an <answer> signal at the NCP and provide a transmission path between NCP and the TSI.

12.4 Ring clear

Any ringing signal presented at the TSI should be removed in response to the appropriate condition applied at the NCP.

12.4.1 Apparatus types A and B

Unless the apparatus has presented a loop condition at the NCP, any ringing signal presented at the TSI should be removed within 100 ms of the detection of the removal of the ringing signal at the NCP.

12.4.2 Apparatus type C

Any ringing signal presented at the TSI should be removed within 100 ms of receipt of an <end-of-ringing> message from the network, and additionally for apparatus type C, loss of data communication with the network.

13 Supervisory signals

The requirements of this clause apply only to apparatus with internally generated supervisory tones.

13.1 Supervisory tones

The following types of supervisory tone should be provided:

- a) proceed indication (dial tone);
- b) connection not admitted indication (number unobtainable tone);
- c) ring tone;
- d) busy tone.

The frequency and tolerance of the tones should be in accordance with ITU-T Recommendation E.180.

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

- e) special dial tone (often used to indicate the presence of messages waiting, or call forward activated);
- f) special information tone;
- g) release tone;
- h) call waiting tone;
- i) congestion tone.

13.2 Tone levels

The level of supervisory tones applied at the TSI into a reference impedance load Z_{ref} as shown in figure 4, should be within the range $-18 \text{ dBV} \pm 6 \text{ dB}$.

13.3 Timing

- a) Supervisory tones should be applied at the TSI within 100 ms of the appropriate stimulus.
- b) Supervisory tones should be removed from the TSI within 100 ms of the appropriate stimulus.
- c) Dial tone should also be removed on receipt of a first dialled digit received at the TSI.

Further information on network generated tones may be found in TR 101 041-1.

14 Optional functions

14.1 Loop Disconnect dialling

The apparatus should correctly interpret Loop Disconnect (LD) signals applied at the TSI within the following limits:

- a) Pulsing rate: 8 to 12 pulses per second.
- b) Make to break ratio: break = 50 % to 70 % of the total pulse period.
- c) Break current: loop current not exceeding 1,0 mA.
- d) Inter-digital pause: 240 ms minimum (see note).

and should:

- for apparatus types A and B, generate the corresponding digit at the NCP in LD or DTMF format;
- for apparatus type C, convert them and generate an appropriate message at the NCP in a format declared by the supplier.

NOTE 1: Terminals with automatic LD signalling will normally generate pulse trains with a maximum inter digital 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.

14.2 Register recall

The apparatus should recognize breaks in the loop current applied at the TSI as a register recall signal.

NOTE: The break period is the time for which the loop current is below 1,0 mA.

The following network options are identified:

- i) The timed break recall; breaks in loop current within the range 50 ms to 130 ms.
- ii) The hook-switch flash: breaks in loop current within the range 75 ms to 850 ms.

Apparatus types A and B, should apply a break equivalent to the received break to the loop current at the NCP.

Apparatus type C, should apply an indication appropriate for the network service at the NCP in a format declared by the supplier.

Further information on timed break recall can be found in ETR 201.

It is recommended that new networks should adopt type i) TBR.

NOTE 1: For apparatus providing the type ii) hook-switch flash option, the requirements of subclause 8.1 Clear signal generated by TE should be modified as follows:

- replace 350 ms by 950 ms;
- replace 0,5 seconds by 1 050 ms.

NOTE 2: Terminal equipment providing timed breaks in the range 75 ms to 130 ms can interwork with apparatus meeting the requirements of both options i) and ii).

14.3 Metering

Most established networks provide some form of metering pulses to enable terminal equipment to estimate the cost of calls. Meter pulses consist of signals outside the normal voice band and fall into two categories.

- a) Low frequencies - these are typically 25 Hz to 50 Hz signals of approximately 30 V to 40 V r.m.s. applied longitudinally to the A- and B-wires.
- b) High frequency - these are typically 12 kHz or 16 kHz signals of approximately 500 mV r.m.s. applied transversely between the A- and B-wires.

Both types of meter pulses are difficult (or impossible) to provide via modern access technology such as radio local loop or fibre to the curb. Some network operators are considering replacing their meter pulse signals by a Called Party Answer (CPA) signal and letting the TE calculate the call costs in accordance with a publicly available charging algorithm. A polarity reversal or short tone burst are possibilities for the CPA signal.

14.4 ALASS services

ALASS services are services delivered to the terminal equipment using voice-band data, usually during incoming call setup while the terminal is still in the quiescent state. Common ALASS services include provision of Calling Line Identity (CLI) and message waiting indication.

It is recommended that in order to support the provision of ALASS services to the TE, the apparatus should be capable of entering the off-line signalling state in response to an appropriate network message or stimulus applied at the NCP, and providing the TSI features selected from the list below, according to the implemented options:

- a) control of polarity reversal;
- b) a single burst of ringing current with or without polarity reversal;
- c) on-off control of the transmission path (NCP to TSI);
- d) provision of loop current up to 2,5 mA at a voltage greater than 32 V without it being treated as a seize signal;
- e) ignore on-line value d.c. current pulses not exceeding 25 ms duration, i.e. do not treat as a seize signal;
- f) transmission path between the NCP and TSI may be established when the TE connected to the TSI is off-line i.e. apparatus is in the off-line signalling state;
- g) transmission path (NCP to TSI) should be transparent to ITU-T Recommendation V.23 data transmission and DTMF signals.

More details may be found in ETS 300 659 and ETS 300 778.

History

Document history		
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