Office of the Director of
Telecommunications
Regulation

Important Note:
This document is now obsolete and is for information purposes only. For updated information, please refer to ODTR documents 00/61 and 00/62R.

TTE 10

ATTACHMENT REQUIREMENTS FOR TERMINAL EQUIPMENT INTENDED FOR 2-WIRE CONNECTION TO THE IRISH ANALOGUE PSTN

Document No. ODTR 98/29 **August 1998**

Issue No. 2

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1 Scope

This specification has been produced by the Office of the Director of Telecommunications Regulation (O.D.T.R.). The O.D.T.R. is the national regulatory body for type approval of telecommunications terminal equipment in Ireland.

This specification details the technical characteristics (electrical and mechanical interface requirements and access control protocol) under Articles 5(d) and 5(f) of Directive 98/13/EC, which shall be satisfied by Terminal Equipment (TE) for which national approval is sought for connection to the Irish PSTN using 2-wire access. Directive 98/13/EC combines the terminal equipment directive 91/263/EEC and the satellite earth station equipment directive 93/97/EC into one directive.

The objective of this specification is to ensure that no harm occurs to the public network, and to ensure interworking between the network and terminal so that calls can be routed successfully through the network, but without any guarantee of terminal to terminal interoperability.

This specification details the access requirements for both voice and non-voice terminals. For the purposes of this specification a voice terminal is one that sends an unmodulated, acoustically stimulated signal to line. Where a terminal has both voice and non-voice functions (e.g. fax machine with a handset), it shall for the purposes of requirement 4.7.2 be deemed to be a voice terminal.

The specification was notified to the EU under Directive 83/189/EEC.

2 Safety / EMC / Radio

2.1 Safety

There are no safety requirements under this specification. Terminal equipment shall comply with the requirements of the Low Voltage Directive 73/23/EEC.

2.2 EMC

There are no EMC requirements under this specification. Terminal equipment shall comply with the requirements of the EMC directive 89/336/EEC.

2.3 Radio Frequency Transmissions

Terminal equipment designed to transmit radio signals under normal or fault conditions comes within the definition of apparatus for wireless telegraphy as defined in the Wireless Telegraphy Act 1926, as amended. Type approvals and licensing requirements in addition to those contained in this specification shall be met in respect of the radio elements of such equipment. Details of such requirements can be obtained from the Office of the Director of Telecommunication Regulation. Applicants are requested to enquire about radio approval before the equipment starts type testing to this specification.

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this specification, the following definitions apply:

3.1.1 General terms

automatic repeat call attempts: An automatic repeat call attempt made by the TE to the same network address as the result of the failure of the previous call attempt and not as a result of an external stimulus to the TE.

call attempt: The process by which the TE seizes the PSTN line and sends signalling characters of the network address with which the TE wishes to communicate.

connection to earth: Connection to earth means that all the following points, as applicable are connected to the earth point during measurement:

- a point in the TE which is intended to be connected to mains earth. (In practice this might be carried out by connecting to the earth of the mains source which is supplying the TE);
- connector points which are intended to be connected to earth during the normal operation of the apparatus

dBV: Absolute voltage level expressed in decibels with respect to 1 volt,

Handsfree Reference Point (HFRP): A point located on the axis of the artificial mouth, at 50 cm from the lip ring, where the level calibration is made, in free field. It corresponds to the measurement point no. 11, as defined in ITU-T Recommendation P.51.

Longitudinal Conversion Loss: As described in CCITT Recommendation G.117 [1990] subclause 4.1.3.

Mouth Reference Point (MRP): Generally the appropriate Mouth Reference Point from ITU Recommendation P.34, P.56 etc., shall be used. Where a supplier has declared that the ITU MRP would be inappropriate for the intended use of the TE, then the MRP described by the supplier shall be used.

Network Termination Point: The physical point at the boundary of the PSTN intended to accept the connection of a TE.

Nominal acoustic excitation: The application of an acoustic level of:

-4,7 dBPa to the MRP for handset measurements or;

-28,7 dBPa to the HFRP for handsfree measurements.

Peak to peak voltage: Peak to peak voltage in this document is the difference between the maximum and minimum voltage during any 10 ms window.

Public Switched Telephone Network: The term is used to describe the ordinary telephone system including subscriber lines, local exchanges and the complete system of trunks and the exchange hierarchy which makes up the network.

reference impedance Z_R: A complex impedance made up of 270 ohms in series with a parallel combination of 750 ohms and 150 nF.

repeat call attempt: A further call attempt to the same network address resulting from a failure to establish connection during the previous call attempt.

repeat call attempt sequence: A series of internally generated automatic repeat call attempts made in response to an initial call attempt.

Note Additional, but separate, call requests are permitted to initiate separate repeat attempt sequences.

Return Loss: As described in ITU-T Recommendation G.100 [1993] subclause 1.5.

Series connected TE: Series connected TE is defined as TE intended to be attached to a network termination point and which in addition provides a second connection point to which a second TE may be attached, so as to permit this second TE to be excited solely by loop current derived from the PSTN connection.

Terminal Equipment (TE): Equipment intended to be connected to the public telecommunication network; i.e.:

- to be connected directly to the termination of a public telecommunication network; or
- to interwork with a public telecommunication network being connected directly or indirectly to the termination of a public telecommunication network,

in order to send, process or receive information. The system of connection may be wire, radio, optical or other electromagnetic system.

3.1.2 States

loop state: The state where the TE draws sufficient DC current to activate the exchange.

loop steady state: A loop state excluding the transitions from and to quiescent state.

quiescent state: The state where the TE draws insufficient DC current to activate the exchange.

3.2 Abbreviations

For the purposes of this specification, the following abbreviations apply:

AC	Alternating Current
DC	Direct Current
DTMF	Dual Tone Multi-Frequency
LCL	Longitudinal Conversion Loss
NTP	Network Termination Point
PSTN	Public Switched Telephone Network
rms	root mean square
TTE 10 RT	TTE 10 Requirements Table
TE	Terminal Equipment
Vpp	Peak to Peak voltage

4 Requirements

The TE shall comply with the provisions of this specification when tested via contact pins 3 and 4 as shown in table 1.

4.1 General requirement

Requirement: Where the origination or reception of calls by the TE is invoked, or otherwise controlled by other equipment external to the TE, the manufacturer or supplier of the TE shall declare the conditions that need to be met by such external devices so as to enable the user to ensure that their use does not cause the TE to fail to meet the essential requirements.
Test: By confirming the presence of such declaration.

4.2 Physical characteristics of the connection to the PSTN

Requirement: The TE connector shall be a miniature 6-position plug as specified in FCC 47, CFR 68.500 clause (a).

NOTE 1: This connector is often referred to as RJ 11/12.

Table 1: Contact assignments

Contact number	Contact function
1	Unspecified
2	Unspecified
3/4	NTP
5	Unspecified
6	Unspecified

If contacts 2 and 5 are used to provide a port for series connection then these wires shall not be connected to the NTP.
Test: By visual inspection. The interworking capability shall be verified through the tests in annex A.

4.3 REQUIREMENTS UNDER ALL CONDITIONS

4.3.1 Polarity

Requirement: The TE shall conform to the requirements of this specification for both polarities of line feeding voltage.

Test: Where tests with both polarities are needed this is indicated in relevant clauses in annex A.

4.4 GENERAL REQUIREMENTS IN QUIESCENT STATE

4.4.1 DC resistance

Requirement: The current drawn by the TE when connected to a source of:

a) 100 V DC
b) 50 V DC
c) 25 V DC

shall not exceed that which would be drawn by a 5 MΩ resistor replacing the TE. This requirement applies 30 seconds after the voltage has been applied.

Test: This test shall be conducted according to annex A, subclause A.4.4.1.

4.4.2 Characteristics of TE for ringing signals

4.4.2.1 Impedance

Requirement: The impedance of the TE at a frequency of 25 Hz shall not be less than 8 kΩ when tested at 30 V rms applied at the TE terminals. The source shall have an output impedance of 2050 Ω and a sinusoidal open-circuit waveform. For the purpose of this requirement the impedance is deemed to be the ratio of the RMS voltage to the RMS current.

Test: This test shall be conducted according to annex A, subclause A.4.4.2.1.

4.4.2.2 Transient response

Requirement: When ringing signals are applied to the terminal equipment in the quiescent state, the resulting current shall not cause the public exchange to detect a loop state. This shall be verified by a DC excitation of 60 V with a source resistance of 200 Ω applied to the TE in quiescent state. The current shall be equal to or less than 25 mA 1 ms after commencement of the excitation, and equal to or less than 10 mA 6 ms after commencement.

Test: This test shall be conducted according to annex A, subclause A.4.4.2.2.

4.4.3 Impedance unbalance about earth

Requirement: Where the supplier's instructions state that a connection to earth is intended, the Longitudinal Conversion Loss when the AC termination of the TE is 600 Ω shall be at least the values given in table 2.

Table 2: Longitudinal Conversion Loss, minimum values

Frequency range	Minimum value
50 Hz to 600 Hz	40 dB
600 Hz to 3 400 Hz	46 dB

Test: This test shall be conducted according to annex A, subclause A.4.4.3

4.4.4 Resistance to earth

Requirement: Where the supplier's instructions state that a connection to earth is intended, the DC resistance between each line terminal of the TE and earth in quiescent states when tested at 100 V DC shall be not less than 10 MΩ.

Test: This test shall be conducted according to annex A, subclause A.4.4.4

4.4.5 Voice Band Impedance

Requirement: The impedance of the TE between 200 - 4 000 Hz shall not be less than 20 kΩ when a signal of 1 V rms is applied.

Test: This test shall be conducted according to annex A, subclause A.4.4.5

4.5 RINGING SIGNAL DETECTOR SENSITIVITY

Requirement: If a ring detect function is provided and enabled, the TE shall be able to respond to ringing signals of 30 Vrms at 25 Hz with a cadence of 0.4 s ON, 0.2 s OFF, 0.4 s ON, 2.0 s OFF, superimposed on a 50 VDC feeding voltage.
The response shall be as stated by the supplier.

Test: This test shall be conducted according to annex A, subclause A.4.5.

NOTE 1: A TE designer should be aware that some PBXs output ringing at 50 Hz and at different cadences to the above cadence.

4.6 BLANK

4.7 GENERAL LOOP STEADY STATE REQUIREMENTS

The requirements during the loop state apply when the TE has been in the loop state for a minimum of 1,2 s with a line feeding current which can be obtained when the TE is connected to a source of 50 VDC in series with a resistor within the range of 2300 Ω to 360 Ω.

4.7.1 DC characteristics

Requirement: The DC voltage/current characteristics of the TE within the operating range as stated in clause 4.7 shall not exceed the limits given in table 3 and shown in figure 1, after the TE has been in the loop state for 1,2 s.

Table 3: TE voltage/current characteristics

Point	Voltage (V)	Current (mA)
A	9,0	0
B	9,0	20,0
C	14,5	42,0
D	40,0	50,0
NOTE: Limits for intermediate currents can be found by drawing a straight line between the break points on a linear voltage/current scale.		

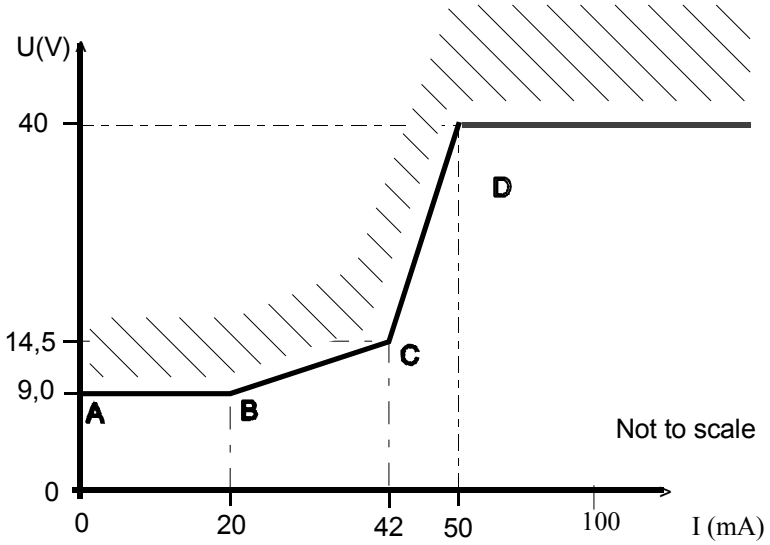

Figure 1: TE voltage/current characteristics

Test: This test shall be conducted according to annex A, subclause A.4.7.1

4.7.2 Impedance

Requirement: The TE shall meet the following requirements:

- at frequencies greater than 300 Hz, but less than or equal to 4 000 Hz, the return loss calculated with respect to the reference impedance Z_R (at the same frequency) shall not be less than

  (i) 8 dB for non-voice terminals; and
  (ii) 14 dB for voice terminals; and

- at frequencies that are greater than or equal to 200 Hz and less than or equal to 300 Hz
  a) the return loss calculated with respect to the reference impedance Z_R (at the same frequency) shall not be less than 6 dB; and
  b) the reactive component of the impedance shall not be greater than 500 Ω inductive (+j 500)

Test: This test shall be conducted according to annex A, subclause A.4.7.2

4.7.3 Sending level limitations

Voice terminals are not subject to sections 4.7.3.1, 4.7.3.2 and 4.7.3.3.

4.7.3.1 Mean sending levels

Requirement: The mean sending level in the frequency range 200 Hz to 3 800 Hz over a one-minute period shall not be greater than - 9,7 dBV when the TE interface is terminated with the reference impedance Z_R. This requirement does not apply to DTMF signals.

Test: This test shall be conducted according to annex A, subclause A.4.7.3.1.

4.7.3.2 Instantaneous voltage

Requirement: The peak to peak voltage shall not exceed 5,0 volts when the TE interface is terminated with the reference impedance Z_R.

Test: This test shall be conducted according to annex A, subclause A.4.7.3.2.

4.7.3.3 Voltage level in a 10 Hz bandwidth

Requirement: The voltage within a 10 Hz bandwidth centred at any point in the frequency band 30 Hz to 4 300 Hz, and wholly contained within that frequency band, shall not exceed the limits given in table 4 and figure 2 when the TE interface is terminated with the reference impedance Z_R. This requirement does not apply to DTMF signals.

Table 4: Voltage in a 10 Hz bandwidth

Points	Frequency kHz	Sending level dBV
A	0,03	- 33,7
B	0,1	- 10,7
C	0,2	- 6,7
D	3,8	- 6,7
E	3,9	- 10,7
F	4,0	- 16,7
G	4,3	- 44,7
NOTE:	Limits for intermediate frequencies can be found by drawing a straight line between the break points on a logarithmic (Hz) - linear (dB) scale.	

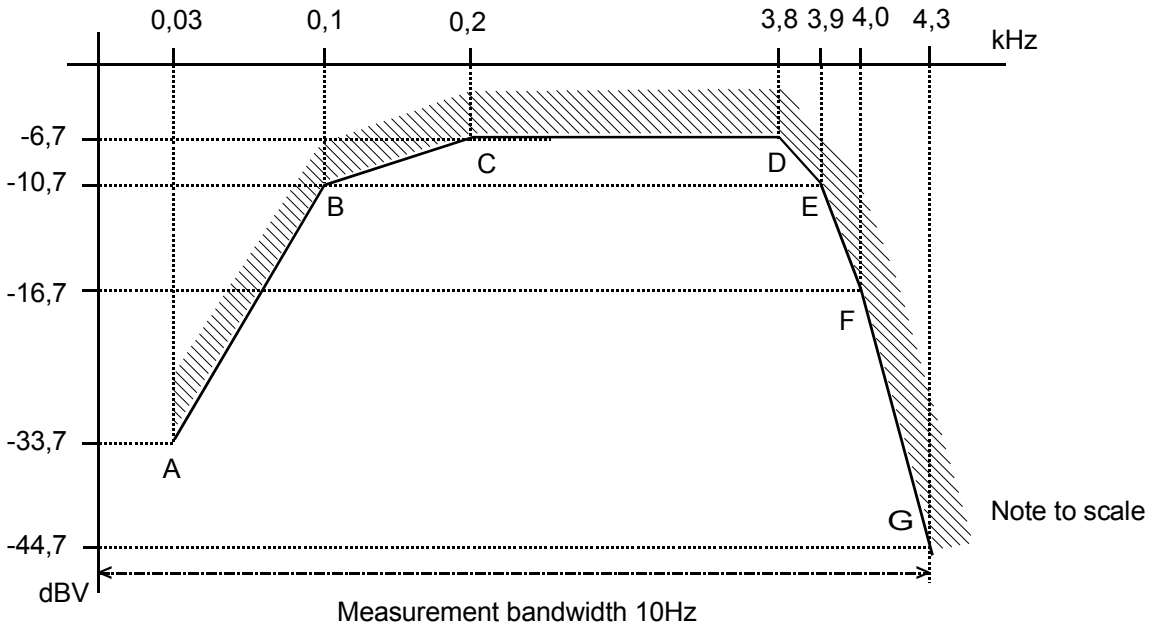

Figure 2: Voltage level in a 10 Hz bandwidth

Test: This test shall be conducted according to annex A, subclause A.4.7.3.3.

4.7.3.4 Sending levels above 4,3 kHz

Requirement: The total voltage level in a bandwidth, defined in table 5, wholly contained within the frequency range 4,3 kHz to 100 kHz, arising from normal operation of the TE when in an on-line, non-dialling state, and when terminated with reference impedance Z_R, shall not exceed the limits shown in table 5 and figure 3, unless the limits are exceeded as a result of one or more single frequency components which comply with the following requirements:

(i) In the range 4.3 kHz to 20 kHz, the level of any single frequency component shall not exceed -35.7 dBV per component.

(i) In the range 20 kHz to 100 kHz, the level of any single frequency component shall not exceed -40.7 dBV per component.

NOTE: "Normal operation of the TE" is defined in the test, see annex A, subclause A.1.3.

Table 5: Sending level above 4,3 kHz

Points	Frequency range kHz	Sending level in a specified bandwidth dBV	Measurement bandwidth
G to H	4,3 to 5,1	- 40 decreasing to - 44	300 Hz
H to I	5,1 to 8,9	- 44	300 Hz
I to J	8,9 to 11	- 44 decreasing to - 58,5	300 Hz
J to K	11 to 100	- 58,5	1 kHz
NOTE: Limits for intermediate frequencies can be found by drawing a straight line between the break points on a logarithmic (Hz) - linear (dB) scale.			

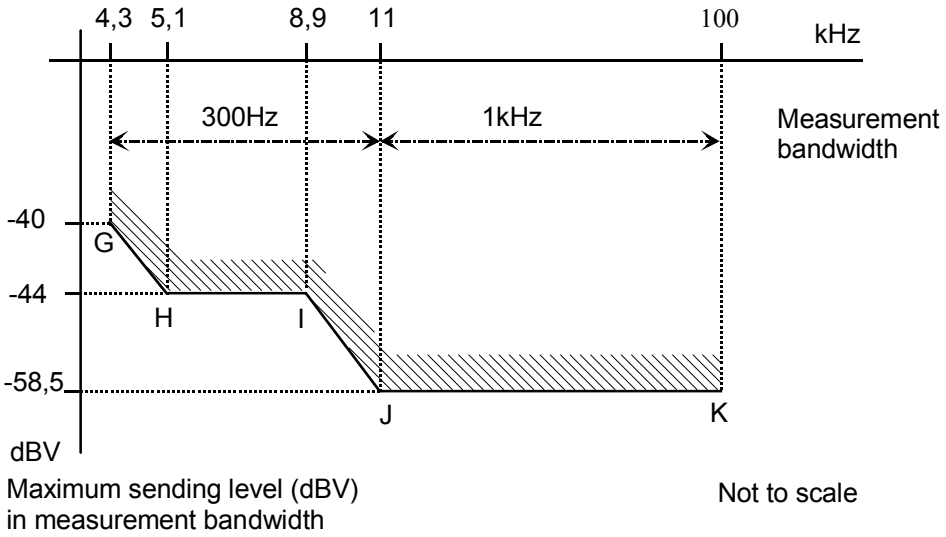

Figure 3: Sending level above 4,3 kHz

Test: This test shall be conducted according to annex A, subclause A.4.7.3.4.

4.7.4 Impedance unbalance about earth

4.7.4.1 Longitudinal Conversion Loss

Requirement: Where the supplier's instructions state that a connection to earth is intended, the Longitudinal Conversion Loss when the AC termination of the TE is 600 Ω shall be at least the values given in table 6.

Table 6: Longitudinal Conversion Loss, minimum values

Frequency range	Minimum value
50 Hz to 600 Hz	40 dB
600 Hz to 3 400 Hz	46 dB
3 400 Hz to 3 800 Hz	40 dB

Test: This test shall be conducted according to annex A, subclause A.4.7.4.1.

4.7.5 Resistance to earth

Requirement: Where the supplier's instructions state that a connection to earth is intended, the DC current in the earth connection shall not exceed 0.1 mA when a voltage of 100 V DC is applied between each line terminal of the TE and the earth connection.

Test: This test shall be conducted according to annex A, subclause A.4.7.5.

4.8 CALL ATTEMPT

All requirements in clause 4.7 will also apply during a call attempt.
This clause only applies for terminals intended for outgoing calls.

4.8.1 Automatic dialling

This requirement applies only to a TE with an automatic seizing and dialling function. It applies when the TE is in automatic dialling mode.

4.8.1.1 Dialling without dial tone detection

Requirement: The TE shall start dialling not earlier than 2,7 s but shall commence dialling before 5 s has elapsed after the loop state is established.

Test: This test shall be conducted according to annex A, subclause A.4.8.1.1.

4.8.1.2 Dialling with dial tone detection

Requirement: If the TE is intended for automatic dialling with an automatic dial tone detection, and this facility is enabled in accordance with the supplier's instruction, it shall start dialling within 5 s of the start of the application of continuous dial tone in the frequency band 400 - 450 Hz and at a level of -12 dBV to -28 dBV from a generator with a source impedance equal to Z_R.

Test: This test shall be conducted according to annex A, subclause A.4.8.1.2.

4.8.1.3 Call progress monitoring

Requirement: The TE shall not prematurely abort the call attempt in the presence of each of the following:

(i) progress tone at a frequency of 425 Hz, level of -12 dBV to -28 dBV and a cadence of 60 ms ON, 60 ms OFF); and

(ii) ringback tone at a frequency of (400 + 450) Hz, level of - 12 dBV to - 28 dBV and a cadence of 0.4 s ON, 0.2 s OFF, 0.4 s ON, 2.0 s OFF, repeated.

Test: This test shall be conducted according to annex A, subclause A.4.8.1.3.

4.8.2 DTMF signalling

4.8.2.1 Frequency combinations

Requirement: The TE shall use DTMF signalling characters according to table 7. However, the number of characters supported by the TE can be restricted, in which case only those frequencies assigned to the supported characters shall be used. The tolerances on the frequencies for the characters supported shall be ±1,5 %.

Table 7: DTMF signalling frequency combinations

Low group Hz	High group Hz			
	1 209	1 336	1 477	1 633
697	1	2	3	A
770	4	5	6	B
852	7	8	9	C
941	*	0	#	D

Test: This test shall be conducted according to annex A, subclause A.4.8.2.1.

4.8.2.2 Signalling levels

4.8.2.2.1 Absolute levels

Requirement: The level of any tone in the DTMF high frequency group shall be -9,0 dBV +2,0/-2,5 dB and the level of any tone in the low frequency group shall be -11,0 dBV +2,5/-2,0 dB when the TE interface is terminated with the reference impedance Z_R.

Test: This test shall be conducted according to annex A, subclause A.4.8.2.2

4.8.2.2.2 Level difference

Requirement: During sending of any DTMF frequency combination, the level of the tone in the high frequency group shall be 1 dB to 4 dB higher than the level of the tone in the low frequency group.

Test: This test shall be conducted according to annex A, subclause A.4.8.2.2.

4.8.2.3 Unwanted frequency components

Requirement: When transmitting any DTMF tone combination during a call attempt, the total sending level of all unwanted frequency components in the frequency range 250 Hz to 4 300 Hz shall be at least 20 dB below the low group frequency component.

In the case of voice terminals the acoustic input shall be stimulated in sequence by three sinewaves (500 Hz, 1000 Hz and 1500 Hz) at the nominal acoustic excitation level for handset and handsfree measurements.

Test: This test shall be conducted according to annex A, subclause A.4.8.2.3.

4.8.2.4 Tone duration

This requirement applies where the DTMF signalling tone duration is controlled automatically by the TE.

Requirement: The TE shall provide a setting whereby the duration for which any individual DTMF tone combination sent is not less than 65 ms. The time shall be measured from the time when the tone reaches 90 % of its steady-state value, until it has dropped to 90 % of its steady-state value.

Test: This test shall be conducted according to annex A, subclause A.4.8.2.4.

4.8.2.5 Pause duration

This requirement applies where the DTMF signalling pause duration is controlled automatically by the TE.

Requirement: The TE shall provide a setting whereby the duration of the pause between any individual DTMF tone combination is not less than 65 ms. The time shall be measured from the time when the tone has dropped to 10 % of its steady-state value, until it has risen to 10 % of its steady-state value.

Test: This test shall be conducted according to annex A, subclause A.4.8.2.5.

4.8.3 Automatically repeated call attempts

Requirement: The TE shall not automatically initiate an internally generated repeat call attempt less than 5 s after the termination of the previous call attempt in the same repeat attempt sequence. The previous call is considered to be terminated when the TE returns to the quiescent state.

NOTE Although this specification permits repeat call attempts to be made after an interval of 5 seconds, the interval between repeat call attempts, in most practical applications, will usually be set to be considerably greater than this so as to provide an appropriate compromise between the rate of redialling and the likelihood of the repeat call attempt being successful. Where this interval is user adjustable, TE supplier's are recommended to provide guidance to users on how to select a setting that would best suit the types of applications for which the TE is intended (e.g. taking into account the typical holding times for calls).

There shall be no more than 15 repeated call attempts in an hour in a repeated call attempt sequence.

Test: This test shall be conducted according to annex A, subclause A.4.8.3.

4.8.4 Loop disconnect signalling

TE supporting loop disconnect signalling shall meet the following requirements.

4.8.4.1 Timing

Requirement: The TE shall meet the following requirements:

(i) The break duration, as defined in figure 4, shall be in the range 60 - 70 ms.
(ii) The make duration, as defined in figure 4, shall be in the range 30 - 44 ms.
(iii) The number of impulses per second shall be 10 +/- 1.
(iv) The interdigit pause shall be 720 - 2,000 ms for electronically generated pulses.

Note: Interdigit Pause
This is the period from the rear of the last break pulse for any digit to the front edge of the first break pulse for the following digit. The preferred range for electronically generated pulses is 800 ms +/- 10%. However, the interdigit pause of manually operated electronic phones is fully under operator control and can be > 1000 ms.

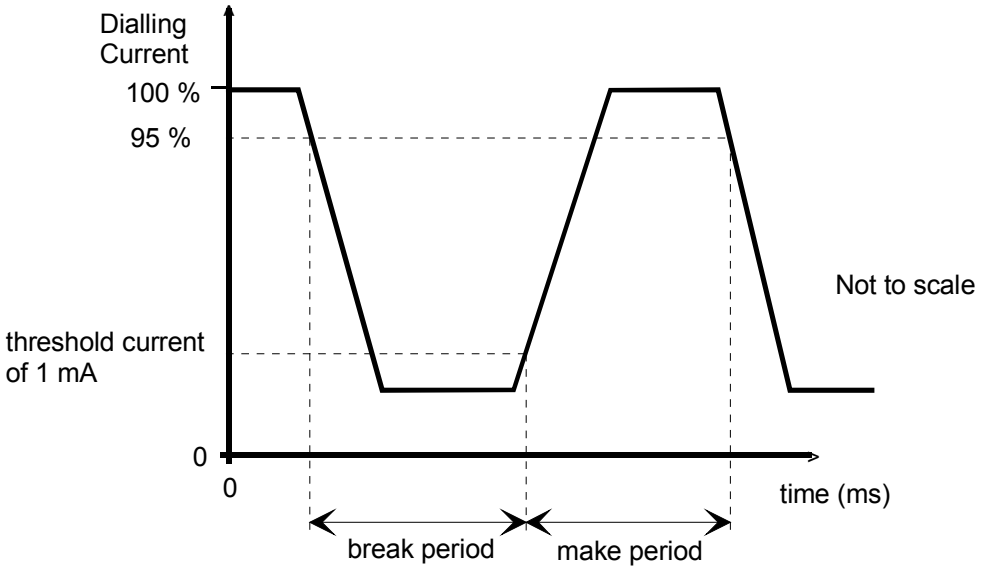

Figure 4: Break and Make Period

Test: This test shall be conducted according to annex A, subclause A.4.8.4.1.

4.8.4.2 Resistance during the make period

Requirement: During a continuous period of at least 30 ms between break pulses and for 25 ms after the last break pulse for each digit, the dialling circuit shall be a continuous loop which meets the characteristics of figure 5.

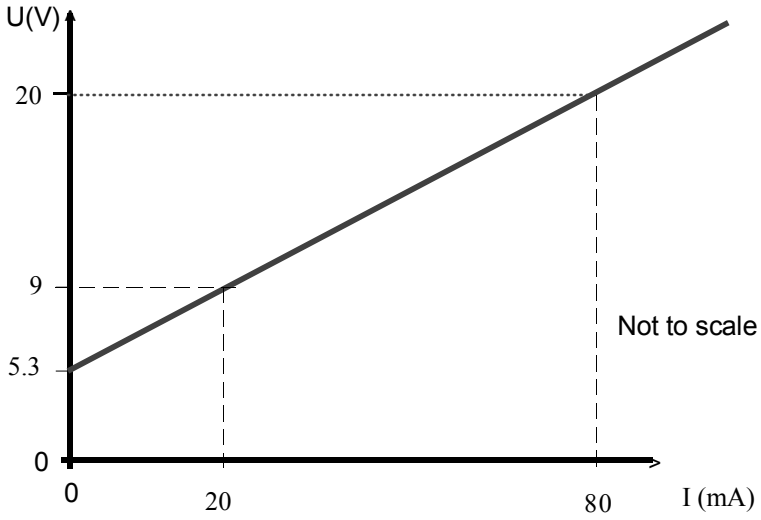

Figure 5: Resistance during the make period

Test: This test shall be conducted according to annex A, subclause A.4.8.4.2.

4.8.4.3 Residual current during the break period

Requirement: For a continuous period of at least 50 ms during the break period the current shall not exceed 0.5 mA.
Test: This test shall be conducted according to annex A, subclause A.4.8.4.3.

4.8.4.4 Pulse distortion

Requirement: In the transition from make to break the current shall reach 7 mA within 1 ms of the start of the transition (i.e. when the pulse falls to 95% of its value). In the transition from break to make the current shall reach 16 mA within 1 ms of the time that it first reaches and remains at 1 mA. In the case where the break period is between 64 ms and 70 ms the transition shall be <= 2 ms.

During the make period the current shall remain above 16 mA from the time it first reaches that value until the end of the period.

During the break period the current shall remain below 7 mA from the time it first reaches that value until the end of the period.

Test: This test shall be conducted according to annex A, subclause A.4.8.4.4.

4.9 BLANK

4.10 CALL CLEARDOWN

Requirement: TE which use the presence of busy tone to return to the quiescent state at the end of a call, shall do so when busy tone in the frequency range 400 - 450 Hz, at a level of -12 dBV and -28 dBV, and with a cadence of 0.75 s ON, 0.75 s OFF or 0.375 s ON, 0.375 s OFF is applied for 20 s.

Test: This test shall be conducted according to annex A, subclause A.4.10.

4.11 SERIES CONNECTION

4.11.1 DC in-line resistance

Requirement: Series connected TE shall not have an in-line series resistance greater than 75 Ω.

Test: This test shall be conducted according to annex A, subclause A.4.11.1.

4.11.2 Ringing frequency insertion loss

Requirement: Series connected TE shall not have an insertion loss greater than 1 dB with an input voltage of 75 V rms at a frequency of 25 Hz with a load of 8 kΩ.

Test: This test shall be conducted according to annex A, subclause A.4.11.2.

4.11.3 Voice frequency band insertion loss

Requirement: Series connected TE shall not introduce an insertion loss greater than 1 dB over the frequency band 300 - 3,400 Hz with a load of 600 Ω.

Test: This test shall be conducted according to annex A, subclause A.4.11.3.

4.12 SUPPLEMENTARY SERVICES

4.12.1 Register recall

Requirement: A TE with the register recall facility shall meet the following requirements:

(i) The timed register recall signal to the public exchange shall have a duration not less than 80 ms and not greater than 250 ms.

(ii) During a continuous period of at least 80 ms the current shall not exceed 1 mA during the register recall period.

Test: This test shall be conducted according to annex A, subclause A.4.12.1.

Annex A (Normative): Test Methods

A.1 General

This annex describes the test principles to determine the compliance of a TE against the requirements of TTE 10.

TE may require the provision of external termination or stimuli in order to assess its conformity with TTE 10. In this case, such termination or stimuli shall need to be provided in order for the tests to be carried out but shall not influence the results of measurements which shall be obtained under the normal operating condition of the TE. In order to do this, it may be necessary for the supplier to provide additional equipment or information for the purpose of test.

The test configurations given do not imply a specific realisation of test equipment or arrangement or use of specific test devices for conformance testing. The test parameters defined in this annex are "ideal" parameters. Equipment accuracies or component tolerances are not prescribed for test implementations, with the exception of guidance and information notes. Any deviations from the ideal which are present when using real test implementations shall be taken into account in calculating measurement uncertainty. Correction of systematic effects may be used to reduce measurement uncertainty.

The test equipment shall be a device, or group of devices, generating a stimulus signal and providing the test conditions (e.g. feeding conditions) conforming to this annex and capable of monitoring the received signal from the interface.

If inconsistencies are discovered between the test annex and the requirements then the requirements shall take precedence in problem resolution.

A.1.1 Equipment connection

The tests shall be applied at the NTP.

Contact number	Test socket connected to
1	Unconnected
2	Unconnected
3/4	NTP
5	Unconnected
6	Unconnected

NOTE 1: See subclause A.1.4 for additional connections for performing measurements to earth.

A.1.2 Test environment

All tests shall be performed under non-condensing conditions at:

- an ambient temperature in the range from + 15 ºC to + 35 ºC.

- a relative humidity in the range from 5 % to 85 %.

- an air pressure in the range 86 kPa to 106 kPa.

For TE which is not designed to operate over the entire specified environmental range, all tests shall be performed at any point within the operational range specified by the supplier.

For TE which is directly powered (either wholly or partly) from the mains supply, all tests shall be carried out within ± 5 % of the rated voltage of the TE. If the equipment is powered by other means and those means are not supplied as part of the apparatus (e.g., batteries, stabilised AC supplies, DC) all tests shall be carried out within the power supply limit declared by the supplier. If the power supply is AC, the test shall be conducted within ± 4 % of the rated frequency limit.

There is no requirement to control or monitor air pressure except for acoustic measurements.

A.1.3 Powered state

Tests shall be carried out with the TE powered on under normal operating conditions defined by the supplier.

A.1.4 Measurements to earth

Where a measurement to earth is defined and the supplier's instructions state that a connection to earth is intended, then all the following points, as applicable, shall be connected to the earth point:

- a point in the TE which is intended to be connected to mains earth. (In practice this might be carried out by connecting to the earth of the mains source which is supplying the TE);

- connector points which are intended to be connected to earth during the normal operation of the apparatus.

Where the TE has no facility for connection to earth, for example by one of the above points, then the test does not apply.

A.1.5 Equivalent test methods

Laboratories may use other test methods provided they are electrically equivalent to those specified.

Where test methods other than those specified are used the test report shall include statements that uniquely identify the selected test methods. However full technical details of the test methods need not be included in the test report.

NOTE: This is intended to allow traceability where alternative test methods are used

A.1.6 Additional information to support the test

It is necessary for the supplier to provide facilities to allow all tests to be carried out. Examples of these facilities could be the following:

1) a facility to remain in the loop state without transmitting signals; and

2) a facility to transmit all types of signal (e.g. all data rates) that the TE transmits while not receiving any signal.

NOTE: The special test facilities such as those in 1) and 2) above need not to be provided in the product finally marketed, but provided by the supplier when needed.

However if alternative methods are feasible these are also acceptable.

A.2 Test Impedances

A.2.1 Reference impedance

Where the test defines the use of the reference impedance then this shall be as follows:

Reference impedance Z_R: This is a complex impedance made up of 270 Ω in series with a parallel combination of 750 Ω and 150 nF as shown in figure A.1.

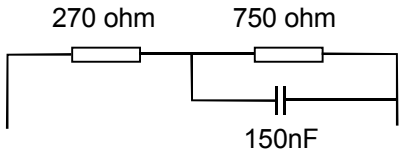

Figure A.1: Reference impedance

A.2.2 Non-reactive line termination

NOTE : All resistors specified in this annex for testing should be nominally non-reactive, such that any resistor or group of resistors should have a reactive impedance at any frequency in the range to be measured, not exceeding 0,5 % of the nominal impedance.

A.3 Feeding bridge

The feeding bridge specified in this annex is a configuration of test equipment used to:

- apply to the TE terminals electrical conditions consistent with those defined in the test
- suitably couple measurement equipment to the TE terminals

The feeding bridge is assumed to be ideal, so that

- DC feeding and AC termination of the TE are as defined in the test
- All measurements are referenced to the TE terminals (e.g. the feeding bridge does not cause an attenuation or delay, in the parameter to be measured, between the TE terminals and the measuring equipment)

If requested by the supplier (e.g. for TE with an adaptive filter) the TE shall be reset before repeating a test with a different feeding condition.

Within individual test cases, “AC termination of TE” defines the total AC impedance to be seen by the TE including all test equipment (feeding bridge, measuring equipment, reference impedance fixtures, etc.).

A.4 Test methods

One test may cover more than one requirement. The scope of each test is defined under the heading "purpose".

A.4.1 General requirement

By confirming the presence of a declaration from the manufacturer or supplier of the TE.

A.4.2 Physical characteristics of connection to the PSTN

Test by visual inspection

A.4.3 Requirements in all conditions

A.4.3.1 Polarity

Where tests with both polarities are needed this is indicated in relevant clauses in this annex.

A.4.4 General requirements in quiescent state

A.4.4.1 DC Resistance

Requirement: Subclause 4.4.1.

Measurement principle:

Preamble: Set the TE in quiescent state.

Test state: Quiescent state.

Test configuration:

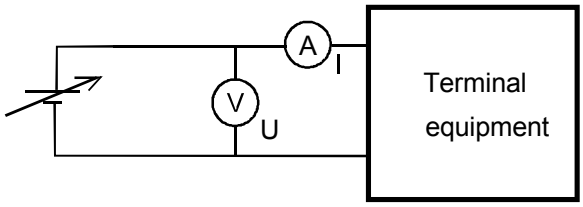

Figure A.2

Measurement points: U = 25 VDC, 50 VDC and 100 VDC.

Measurement execution:

Apply the test voltage U between the line terminals of the TE for at least 30 s before measuring DC current I. The test shall be carried out for both polarities of the applied voltage.

Formal processing: None

Verdict: When tested at U the current I shall be less than or equal to the values of I_{max} in table A.1:

Table A.1

U (VDC)	I_{max} (μA)
25	5
50	10
100	20

if yes then Pass; else Fail.

Guidance: None.

A.4.4.2Characteristics of TE for ringing signals

A.4.4.2.1 Impedance

Requirement: Subclause 4.4.2.1.

Measurement principle:

Preamble: Set the TE in quiescent state with any auto answering facility disabled.

Test state: Quiescent state.

Test configuration:

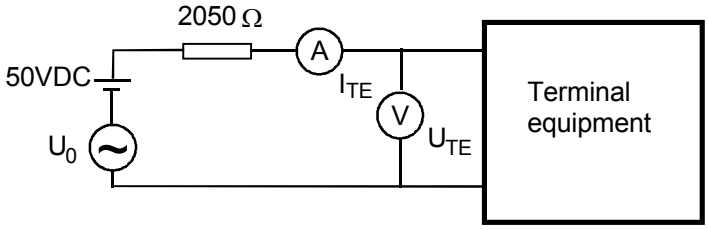

Figure A.3

DC feeding arrangement: Feed Voltage = 50 V DC.
AC feeding arrangement: Sinusoidal source U_0 25 Hz

30 V rms U_{TE} measured across the TE.

Measurement points: Voltage U_{TE} and current I_{TE} measured for the frequency of 25 Hz.

Safety Warning: This test presents the potential for a shock hazard. Ensure satisfactory safety precautions are implemented to reduce the risk of electric shock.

Measurement execution:

Using the test configuration shown, apply the ringing signal continuously to the TE. Adjust the source voltage (U_0) to set the voltage across the TE (U_{TE}) to 30 V rms. However, if U_{TE} is less than 30 V rms for a source voltage of 90 V rms then the source voltage is not increased further and the test is deemed completed. Otherwise, measure the current flowing in the circuit(I_{TE}).

Formal processing: The impedance of the TE during ringing can be calculated using the following formula:

$$|Z_{Ri}| = \frac{U_{TE}}{I_{TE}}$$

Verdict: If it is possible to apply 30 V rms at the TE terminals with a source voltage of less than or equal to 90 V rms and if $|Z_{Ri}|$ is equal to or greater than 8 kΩ then Pass; else Fail.

Guidance: True rms reading instruments should be used because voltages and currents across the TE may not be sinusoidal.

A.4.4.2.2 Transient response

Requirement: Subclause 4.4.2.2.

Measurement principle:

Preamble: Set the TE in quiescent state with the line terminals shorted together.

Test state: Quiescent state. The TE shall have been in the quiescent state for not less than 1 minute.

Test configuration:

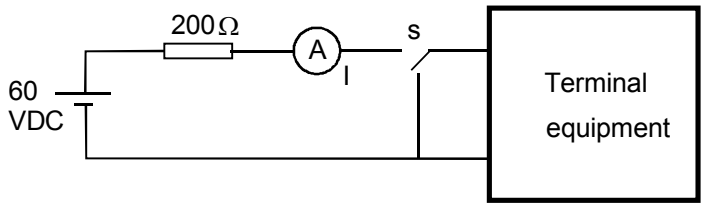

Figure A.4

DC feeding arrangement: Feed Voltage = 60 V DC.
Measurement points: Measure current 1 ms and 6 ms after the connection of the voltage source.

Measurement execution:

Connect the voltage source to the TE with the switch S and monitor the line current.

Verdict: If the line current is less or equal to 25 mA 1 ms after the connection and less or equal to 10 mA 6 ms after the connection then Pass; else Fail.

Guidance: None.

A.4.4.3 Impedance unbalance about earth

Requirement: Subclause 4.4.3.

Measurement principle:

Preamble: Set the TE in quiescent state.

Test state: Quiescent state.

Test configuration:

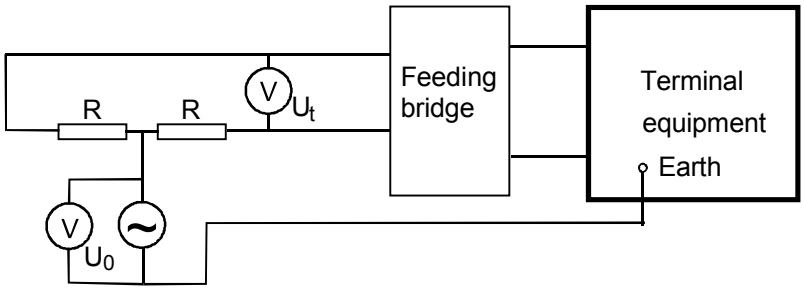

Figure A.5

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 360 Ω. The test shall be made with both polarities.

Measurement points:

The resistors R shall be 300 Ω.
U_O shall be a sinusoidal signal with a constant voltage of 0,775 V rms throughout the specified frequency range (50 Hz to 3 400 Hz in not greater than one octave steps). Measurement of the transverse voltage U_t shall be performed with a suitable frequency selective level measuring instrument.

Measurement execution:

Measure the voltage U_t across the specified frequency range. The test shall also be carried out for both polarities of feeding.

Formal processing: The measured value of U_t is used to calculate the Longitudinal Conversion Loss by using the following equation at all the measurement points:

$$\text{Longitudinal Conversion Loss} = 20\log_{10}\left|\frac{U_o}{U_t}\right| \text{ dB}$$

Verdict: If the Longitudinal Conversion Loss is greater than or equal to the specified limits in table 2 then Pass; else Fail.

Guidance: The test sender output impedance should be less than 500 Ω. The voltmeter input impedance should be greater than

100 kΩ.

A.4.4.4Resistance to earth

Requirement: Subclause 4.4.4

Measurement principle:

Preamble: Connect the TE in accordance with figure A.

Test state: Quiescent state.

Test configuration:

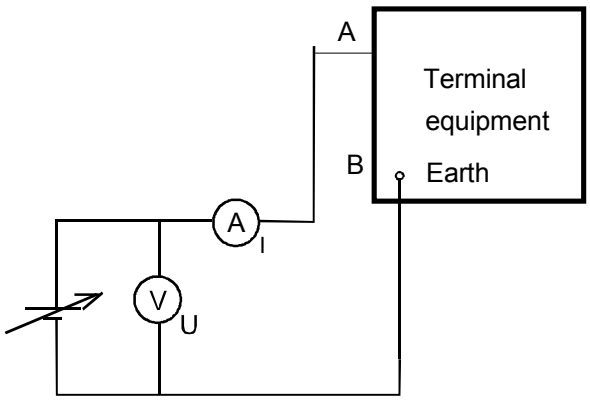

Figure A.6

Measurement points: U = 100 volts DC.

Measurement execution:

Apply test voltage U between one of the line terminals and the earth connection point or points specified by the supplier's instructions for at least 30 s before measuring current I. The test shall be carried out both line terminals and for both polarities of the applied test voltage and applied feeding voltage.

Formal processing: Resistance to earth (R) = U/I.

Verdict: If R is greater than or equal to 10 MΩ then Pass; else Fail.

Guidance: None.

A.4.4.5Voice band impedance

Requirement: Subclause 4.4.5

Measurement principle:

Preamble: Connect the TE in accordance with figure A.

Test state: Quiescent state.

Test configuration:

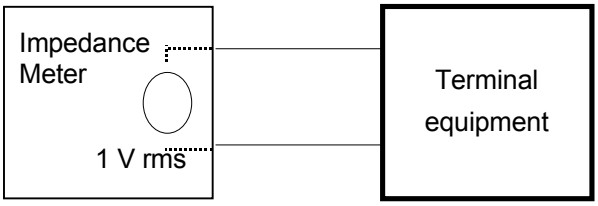

Figure A.7

Measurement points: The test signal from the Impedance Meter shall be a sinusoidal signal of amplitude 1 V rms.

f_{min} = 200 Hz, f_{max} = 4 000 Hz with step intervals of not more than one of an octave.

Measurement execution:

Apply test signal from the Impedance meter to the TE and measure the impedance Z at the frequencies in "Measurement points"

Formal processing: None

Verdict: If Z is greater than or equal to 20 kΩ for all frequencies then Pass; else Fail.

Guidance: None.

A.4.5 Ringing signal detector sensitivity

Requirement: Subclause 4.5

Measurement principle:

Preamble: Set the TE in quiescent state with answering facility enabled.

Test state: Quiescent state.

Test configuration:

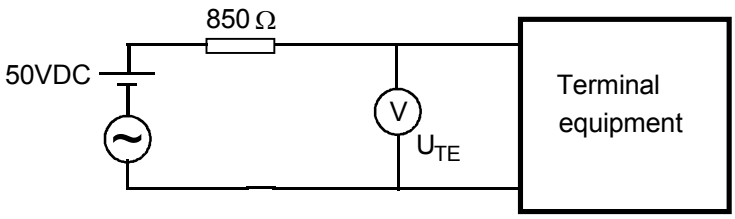

Figure A.8

DC feeding arrangement: Feed Voltage = 50 V DC.

Measurement points: The ringing signal has a sinusoidal source of 25 Hz and has a cadence of 0.4 s on, 0.2 s off, 0.4 s on 2.0 s off.

U_{TE} = 30 Vrms

Safety Warning: This test presents the potential for a shock hazard. Ensure satisfactory safety precautions are implemented to reduce the risk of electric shock.

Measurement execution:

Using the test configuration shown in figure A.8, apply the ringing signals described in "Measurement points" to the circuit to determine whether they are detected by the TE as stated by the supplier.

Formal processing: None.

Verdict: If TE detects all the ringing signals above described in "Measurement points" then Pass; else Fail.

Guidance: None

A.4.7 General loop state requirements

A.4.7.1DC characteristics

Requirement: Subclause 4.7.1.

Measurement principle:

Preamble: Set the TE in quiescent state.

Test state: Loop state.

Test configuration:

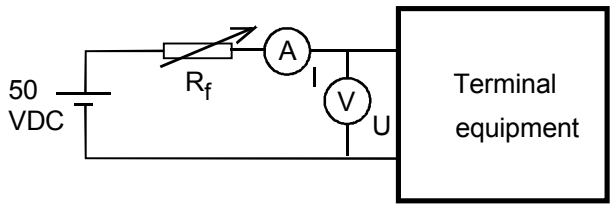

Figure A.9

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω, 850 Ω, 1600 Ω, and 2300 Ω. Polarity shall be switched between each feed resistance.

Measurement execution:

Select a feed resistance value according to the DC feeding arrangement and then cause the TE to enter the loop state after making sure that the TE has been held at least one minute in quiescent state. When the terminal has been in the loop state for at least 1,2 s, measure the DC current drawn by the TE and the DC voltage across the TE for each of the feed conditions. Then repeat the sequence after each feed resistor change.

Formal processing: None.

Verdict: If the DC voltage/current characteristics are within the limits as given in table 3, and shown in figure 1 then Pass; else Fail.

Guidance: Allowing "sufficient settling time", to a maximum of 3 s, to ensure that the measured value is stable.

A.4.7.2Impedance

Requirement: Subclause 4.7.2.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: Loop state.

Test configuration:

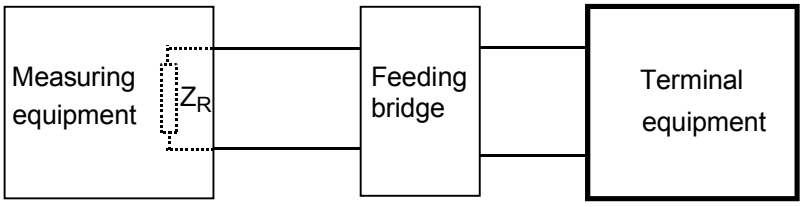

Figure A.10

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω, 850 Ω, 1600 Ω, and 2300 Ω. Polarity shall be switched between each feed resistance.

AC termination of TE: Z_R

Measurement points:

The test signal shall be sinusoidal with a constant voltage, whose level shall be pre-set to that required to achieve a level of - 10 dBV at the TE terminals.

f_{min} = 200 Hz, f_{max} = 4 000 Hz with step intervals of not more than one octave.

Measurement execution:

When the TE has been in the loop state for at least 1,2 s, measure the voltage and current flowing at the measurement frequency. Derive the modulus and phase of the signals which gives Z_i.

Formal processing: Return loss $\alpha = 20\log_{10}\left|\frac{Z_R + Z_i}{Z_R - Z_i}\right|$ where Z_R is the reference impedance and Z_I is the impedance of the TE.

Verdict: If for frequencies that are above 300 Hz and not greater than 4 000 Hz, the return loss is greater than or equal to

(i) 8 dB for non-voice terminals;

(ii) 14 dB for voice terminals;

and for frequencies that are not less than 200 Hz but are not greater than 300 Hz the return loss is greater than or equal to 6 dB;

and for frequencies that are not less than 200 Hz but are not greater than 300 Hz the inductive (reactive) component of impedance is less than 500 Ω (+j 500 Ω)

then Pass; else Fail.

Guidance: None.

A.4.7.3Sending level limitations

A.4.7.3.1 Mean sending levels

Requirement: Subclause 4.7.3.1.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: The TE shall be in loop state and will be sending representative signals continuously.

Test configuration:

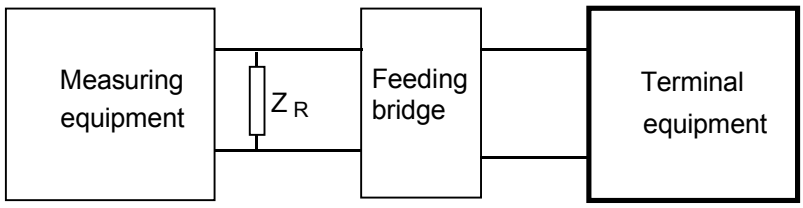

Figure A.11

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω, and 2300 Ω. Polarity shall be switched between each feed resistance.

AC termination of TE: Z_R

Measurement points: The TE is exercised to send to line representative combinations of its declared output capabilities.

Measurement execution:

The TE shall be set in loop state, transmitting representative signals continuously. The mean sending level in the frequency range 200 Hz to 3 800 Hz transmitted across the termination points of the TE shall be determined over a one-minute period.

Formal processing: None.

Verdict: If the mean level over a one-minute period is less than or equal to - 9,7 dBV then Pass; else Fail.

Guidance: Terminal equipment with adjustable output level is set up in accordance with the supplier's instructions for intended use, or in the absence of instructions, is set to send at its maximum level. The terminal equipment is then operated in accordance with its intended use. For data equipment (e.g. modems), any output signal may be a test message consisting of a representative bit pattern or a scrambled signal. For answering machines or similar equipment where the output is derived from recorded speech, any recorded signal shall have been prepared in accordance with the supplier's instruction for intended use.

A.4.7.3.2 Instantaneous voltage

Requirement: Subclause 4.7.3.2.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: The TE shall be in loop state and will be sending representative signals continuously.

Test configuration:

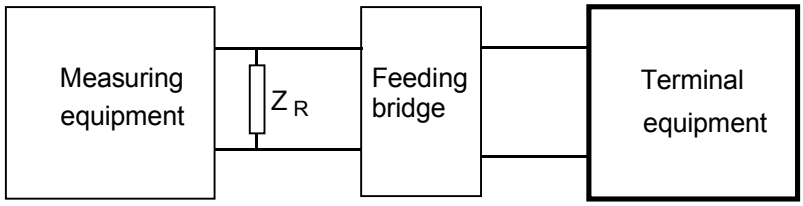

Figure A.12

DC feeding arrangement:

Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω, and 2300 Ω. Polarity shall be switched between each feed resistance.

AC termination of TE: Z_R

Measurement points: The TE is exercised to send to the line:

a) representative combinations of its declared output capabilities;

b) DTMF signals.

Measurement execution:

The TE shall be set in the loop state, transmitting representative signals. The peak to peak voltage transmitted across the termination points of the TE, shall be measured.

Formal processing: None.

Verdict: If the peak to peak voltage is not higher than 5,0 V then Pass; else Fail.

Guidance: TE with adjustable output level is set up in accordance with supplier's instructions to send at its maximum intended level.

A.4.7.3.3 Voltage level in a 10 Hz bandwidth

Requirement: Subclause 4.7.3.3.

Purpose: To check that the TE complies with subclause 4.7.3.3.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: The TE shall be in loop state and will be sending representative signals continuously.

Test configuration:

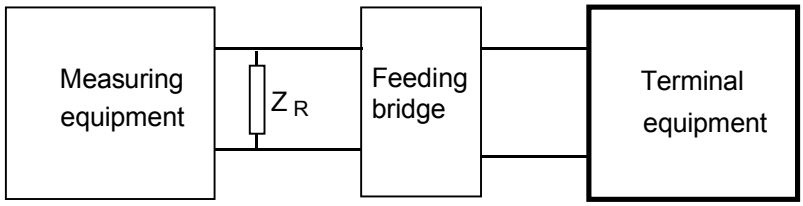

Figure A.13

DC feeding arrangement:

Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω, and 2300 Ω. Polarity shall be switched between each feed resistance.

AC termination of TE: Z_R

Measurement points: The TE is exercised to send to line representative combinations of its declared output capabilities.

Measurement execution:

The TE shall be set in loop state, transmitting representative signals continuously. The voltage level transmitted across the NTP shall be measured. It shall be determined whether the level within every 10 Hz bandwidth wholly contained in the frequency range 30 Hz to 4 300 Hz is less than or equal to the limits given in table 4 and figure 2. In the case of data equipment (e.g. modems) the level shall only be measured during the data transfer phase

Formal processing: None.

Verdict: If the levels are according to table 4 and figure 2 then Pass; else Fail.

Guidance: TE with adjustable output level is set up in accordance with the supplier's instructions to send at its maximum intended level.

A.4.7.3.4 Sending levels above 4,3 kHz

A.4.7.3.4.1 Sending levels above 4,3 kHz during DTMF dialling

Requirement: Subclause 4.7.3.4.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: DTMF dialling.

Test configuration:

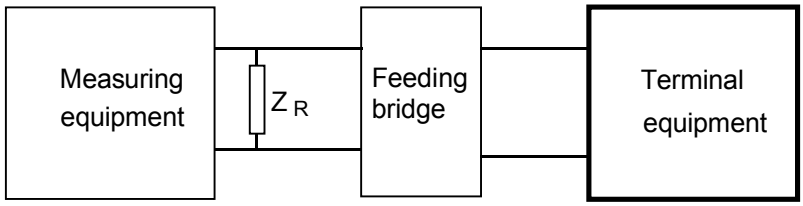

Figure A.14

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω, and 2300 Ω. Polarity shall be switched between each feed resistance.

AC termination of TE: Z_R

Measurement points: Where all characters of table 9 are available, select digits A, 6, 8, *. Else if all numerals are available, select digits 3, 5, 7 and 0, else select all available digits.

Measurement execution:

The TE shall be set in the loop state, transmitting DTMF characters to line.

Measurement shall be made during the tone duration as defined in subclause 4.7.2.4 (minimum duration 65 ms).

It shall be determined whether all single frequency components individually have a sending level less than or equal to - 35,7 dBV in the range 4.3 kHz to 20 kHz and -40.7 dBV in the range 20 kHz to 100 kHz.

Formal processing: None.

Verdict: If the voltage level of each single frequency component is less than or equal to - 35,7 dBV in the range 4.3 kHz to 20 kHz and -40.7 dBV in the range 20 kHz to 100 kHz then Pass; else Fail.

Guidance: All characteristics of the TE are captured for practical purposes when the diagonal in table 9 is used, going from the digit with the largest frequency difference in its combination (highest/lowest frequency) up to the digit with the smallest frequency difference..

A.4.7.3.4.2 Sending levels above 4,3 kHz during communication

Requirement: Subclause 4.7.3.4.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: The TE shall be in loop state and will be sending representative signals continuously.

Test configuration:

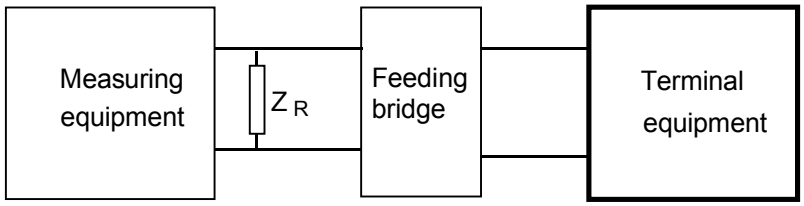

Figure A.15

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω, and 2300 Ω. Polarity shall be switched between each feed resistance.

AC termination of TE: Z_R

Measurement points: The TE is exercised to send to line representative combinations of its declared output capabilities.

Measurement execution:

The TE is set in loop state, transmitting representative signals continuously. The sending level across the termination points of the TE shall be measured. It is determined whether the level in a bandwidth defined in table 5, wholly contained in the frequency range 4,3 kHz to 100 kHz, is less than or equal to the limits of table 5 and figure 3, Where these limits are exceeded it is determined whether exceeding the limits is caused by one or more single frequency component whose individual voltage level is less than or equal to - 35,7 dBV in the range 4.3 kHz to 20 kHz and -40.7 dBV in the range 20 kHz to 100 kHz.

Formal processing: None.

Verdict: If the sending level complies with table 5 and figure 3 then Pass.

If the only non-compliance with table 5 and figure 3 is due to one or more single frequency components whose individual levels are less than or equal to 35.7 dBV in the range 4.3 kHz to 20 kHz and - 40.7 dBV in the range 20 kHz to 100 kHz then Pass; else, Fail.

Guidance: TE with adjustable output level is set up in accordance with supplier's instructions to send at its maximum level.

A.4.7.4Impedance unbalance about earth

A.4.7.4.1 Longitudinal Conversion Loss

Requirement: Subclause 4.7.4.1.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: Loop state.

Test configuration:

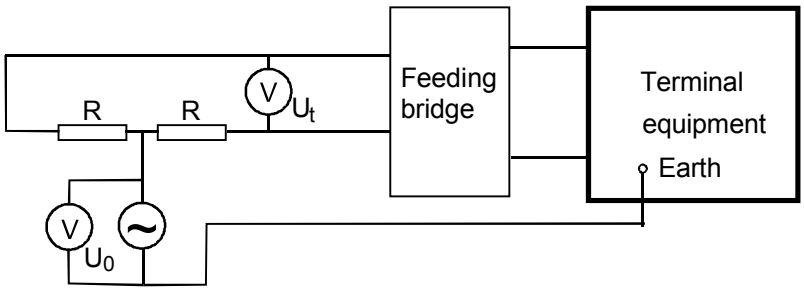

Figure A.16

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω, 850 Ω, 1600 Ω and 2300 Ω. Polarity shall be switched between each feed resistance.

Measurement points: The resistors R shall be 300 Ω
U_O shall be a sinusoidal signal with a constant voltage of 0.775 V throughout the specified frequency range (50 Hz to 3 800 Hz in steps not greater that one octave). Measurement of the transverse voltage U_t shall be performed with a suitable frequency selective voltage measuring instrument.

Measurement execution:

Measure the longitudinal voltage U_t across the specified frequency range for each of the feed conditions. Allow sufficient settling time at each feed condition to ensure that the measured value is stable to within ± 0.5 % for at least 0.2 s.

Formal processing: The measured value of U_t is used to calculate the Longitudinal Conversion Loss by using the following equation:

$$\text{Longitudinal Conversion Loss} = 20\log_{10}\left|\frac{U_o}{U_t}\right| \text{ dB}$$

Verdict: If the Longitudinal Conversion Loss is greater than the specified limit in table 6 then Pass; else Fail.

Guidance: The test sender output impedance should be less than 500 Ω.
The voltmeter input impedance should be greater than 100 kΩ.

A.4.7.5Resistance to earth

Requirement: Subclause 4.7.5

Measurement principle:

Preamble: Set the TE in loop state.

Test state: Loop state.

Test configuration:

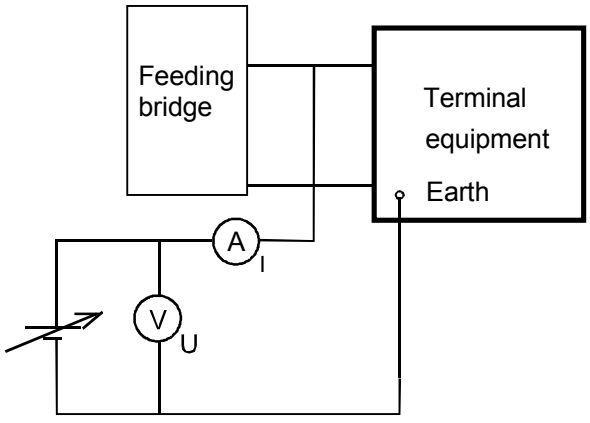

Figure A.17

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 360 Ω.

Measurement points: U = 100 VDC.

Measurement execution:

Apply test voltage U between one of the line terminals and the earth connection point or points specified by the supplier's instructions for at least 30 s before measuring current I. The test shall be carried out for both polarities of the applied test voltage and applied feeding voltage.

Formal processing: None

Verdict: If I is less than or equal to 0.1 mA then Pass; else Fail.

Guidance: None.

A.4.8 Call attempt

A.4.8.1 Automatic dialling

A.4.8.1.1 Dialling without dial tone detection

Requirement: Subclause 4.8.1.1.

Measurement principle:

Preamble: Set the TE in quiescent state, tone-detector, if any, disabled. If the pause before dialling is adjustable by the user set it in accordance with the supplier's instructions to the closest available value to the midpoint between 3 and 5 s. If two values are equally close to the mid point, then use the lower value.

Test state: Automatic DTMF dialling.

Test configuration:

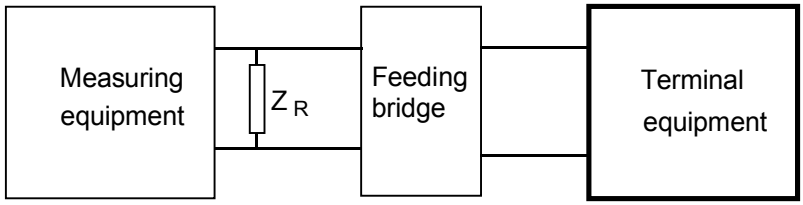

Figure A.18

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.

AC termination of TE: Z_R.

Measurement execution:

The TE is set in the loop state, transmitting signalling characters to line. The time shall be measured from seizure up to the start of the first digit.

Formal processing: None.

Verdict: If the time delay is equal to or greater than 2,7 s and dialling has started within 5 s then Pass; else Fail.

Guidance: None.

A.4.8.1.2 Dialling with a dial tone detection

Requirement: Subclause 4.8.1.2.

Measurement principle:

Preamble: Set the TE in quiescent state with dial tone detector enabled.

Test state: Automatic DTMF dialling.

Test configuration:

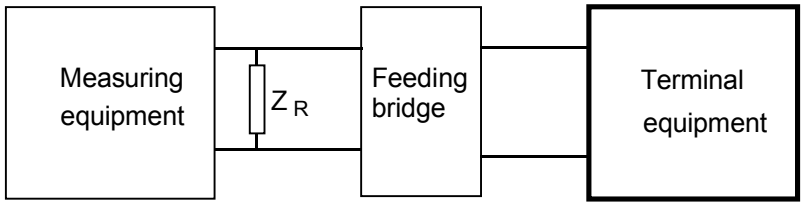

Figure A.19

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.

AC termination of TE: Z_R.

Measurement points: The detection range that shall be tested is limited by the frequencies and voltage levels given in the table below. The levels are defined across the reference impedance Z_R

Detection range, frequencies:

Frequency (Hz)	Level (dBV)
400	- 12
400	- 28
450	- 12
450	- 28

Measurement execution:

The TE is set in the loop state, ready for transmitting signalling tones to the line.

The dial tone is activated 3 s after having established the loop state.

Send continuous dial tone. Time is measured from the start of the dial tone.

Formal processing: None.

Verdict: If the TE has started dialling before 5 s, measured from the start of the dial tone, then Pass; else Fail.

Guidance: The level is supplied from a generator such that the total impedance of the generating and feeding circuitry is Z_R. The TE is replaced by a matching impedance Z_R for the purpose of level measurement. The TE is in-circuit for the purpose of timing measurement.

A.4.8.1.3 Call progress monitoring

Requirement: Subclause 4.8.1.3.

Measurement principle:

Preamble: Set the TE in the quiescent state, initiate a call from the TE which will enter the loop state.

Test state: Loop state for an outgoing call, without communication having been established with a remote TE.

Test configuration:

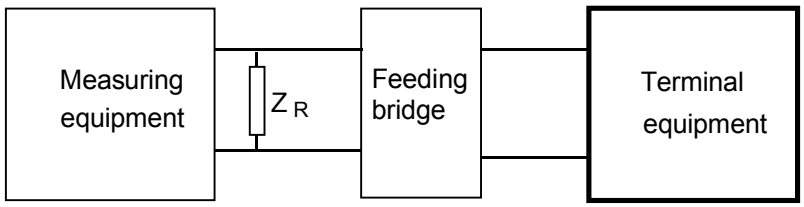

Figure A.20

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.

AC termination of TE: Z_R.

Measurement points: The detection range that shall be tested is limited by the frequencies, voltage levels, cadences and the duration of the applied signal given in the table below. The levels are defined across the reference impedance Z_R

Detection range table:

Frequency (Hz)	Level (dBV)	Cadences (s)	Time duration (s)
425	-12.7	0.06 on, 0.06 off	10
425	-28.7	0.06 on, 0.06 off	10
400 + 450	-12.7	0.4 on, 0.2 off, 0.4 on, 2.0 off	10
400 + 450	-28.7	0.4 on, 0.2 off, 0.4 on, 2.0 off	10

NOTE 1: The (400 + 450 Hz) signals are applied simultaneously.

Measurement execution:

When the TE has entered the loop state and dialling is completed, apply a signal from the detection range table. Repeat the sequence for the other signals in the table.

Formal processing: None.

Verdict: If the TE has not aborted the call attempt for all cases, then Pass; else Fail.

Guidance: None

A.4.8.2DTMF signalling

Guidance: Dial tone may be necessary to activate dialling.

A.4.8.2.1 Frequency combinations

Requirement: Subclause 4.8.2.1.

Measurement principle:

Preamble: Set the TE in loop state

Test state: Dialling.

Test configuration:

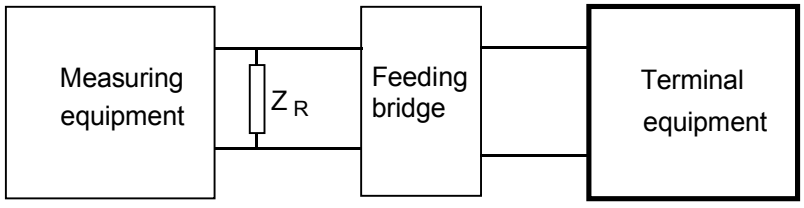

Figure A.21

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.
AC termination of TE: Z_R.

Measurement points: All supported characters shall be verified. The tolerances on the available frequencies shall be not more than ±1,5 %.

Measurement execution:

The TE is set in the loop state, transmitting DTMF signals to line.

Measurement shall be made during the tone duration as defined in subclause 4.8.2.4 (minimum duration 65 ms).

Formal processing: None.

Verdict: If all available frequencies are according to table *7*, with a tolerance of ±1,5 %, then Pass; else Fail.

Guidance: None.

A.4.8.2.2 Signalling levels

Requirement: Subclause 4.8.2.2.1

Measurement principle:

Preamble Set the TE in loop state. Maximum duration of tone burst setting.

Test state: Dialling.

Test configuration:

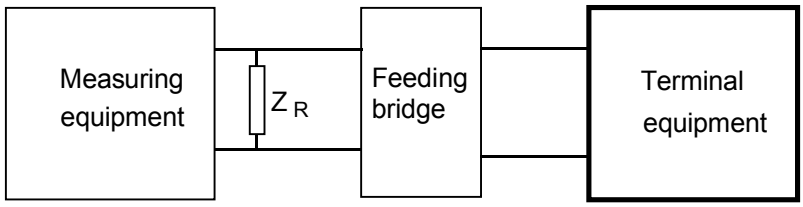

Figure A.22

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω and 2300 Ω. Polarity shall be switched between each feed resistance.

AC termination of TE: Z_R.

Measurement points: All supported characters shall be verified.

Measurement execution:

The TE is set in the loop state, transmitting DTMF signals to line.

Measurement shall be made during the tone duration as defined in subclause 4.8.2.4. (minimum duration 65 ms).

Formal processing: None.

Verdict: If the tone in the high frequency group has a level between -7,0 dBV and -11,5 dBV and if the tone in the low frequency group has a level between -8,5 dBV and -13,0 dBV and if the difference between the levels is between 1 and 4 dB then Pass: else Fail.

Guidance: None.

A.4.8.2.3 Unwanted frequency components

Requirement: Subclause 4.8.2.3.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: Dialling.

Test configuration:

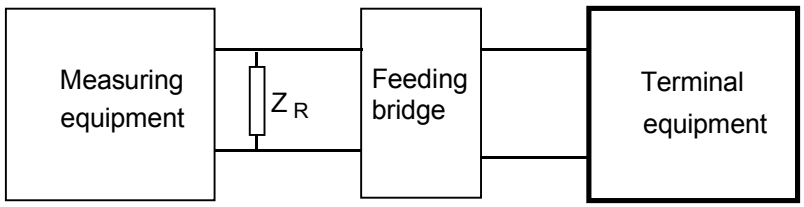

Figure A.23

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω and 2300 Ω. Polarity shall be switched between each feed resistance.

AC termination of TE: Z_R.

Measurement points: Where all characters of table 9 are available, select digits A, 6, 8, *. Else if all numerals are available, select digits 3, 5, 7 and 0, else select all available digits.

In addition, in the case of voice terminals, while the TE is transmitting DTMF characters to line, an acoustic signal consisting of three sinewaves at frequencies of 500 Hz, 1,000 Hz and 1,500 Hz shall be applied in sequence at the nominal acoustic excitation levels for handset and handsfree measurements. Only the digit 5 is transmitted for this acoustic test.

Measurement execution:

The TE is set in the loop state, transmitting DTMF characters to the line.

In addition, in the case of voice terminals, with the TE set in the loop state, apply one of the signals in the "Measurements points" section to the TE, while the TE is transmitting DTMF characters to the line.

Measurement shall be made during the sending period as defined in subclause 4.8.2.4 (minimum duration 65 ms).

Formal processing: Integration of all signal levels is divided in 3 parts,

a) from 250 Hz up to the lower DTMF component,

b) from the lower DTMF component up to the higher DTMF component,

c) from the higher DTMF component up to 4 300 Hz.

Summation of all three parts gives the total unwanted sending level result. Frequencies up to 50 Hz on either side of the DTMF components shall be excluded from the summation. This result is compared with the level of the lower DTMF component.

Verdict: If the total unwanted signal level is at least 20 dB below the level of the lower DTMF component for all available digits then Pass; else Fail.

Guidance The total unwanted sending level is calculated from the following formula:

$$\Sigma = \sqrt{a^2 + b^2 + c^2}$$

A.4.8.2.4 Tone duration

Requirement: Subclause 4.8.2.4.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: Automatic dialling. Tone signal duration according to supplier's instructions.

Test configuration:

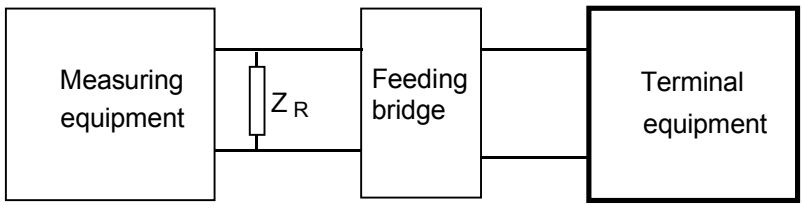

Figure A.24

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.

AC termination of TE: Z_R.

Measurement points: Where all characters of table 9 are available, select digits A, 6, 8, *. Else if all numerals are available, select digits 3, 5, 7 and 0, else select all available digits.

Measurement execution:

Set tone signalling duration according to supplier's instructions.

The TE is set in the loop state, transmitting DTMF signals to the line. Capture the waveform of the DTMF signal.

Formal processing: In this formal processing three waveforms derived from the measured waveform are used. These are referred to as waveforms A, B and C.

Determine waveform A such that at any time the instantaneous value of waveform A is equal to the absolute value of difference between the value of the measured waveform at that time and the mean value of the measured waveform over a period of 10 ms centred on that time.

Determine waveform B such that at any time its value is the greater of: the linear interpolation of the maxima of waveform A, and waveform A.

Determine waveform C such that at any time its value is the greater of: the linear interpolation of the maxima of waveform B, and waveform B.

Determine the reference level such that it is 90% of the highest level which waveform C exceeds for 20 ms during the burst.

The duration of the burst is the duration of the greatest period of time for which waveform C exceeds the reference level.

Verdict: If all bursts have a duration greater than or equal to 70 ms then Pass;

If any burst has a duration of less than 60 ms then Fail;

The test shall be repeated ten times for any burst for which the duration is between 60 and 70 ms and the mean duration calculated. If the mean duration for all such bursts is greater than or equal to 65 ms then Pass; else Fail.

Guidance: The repeatability of this test is intrinsically poor because the measured duration of the burst depends on the phase relationship of the tones. Therefore averaging is needed for borderline cases.

The relationship between the measured waveform and waveforms A, B and C is shown in figure A. 25.

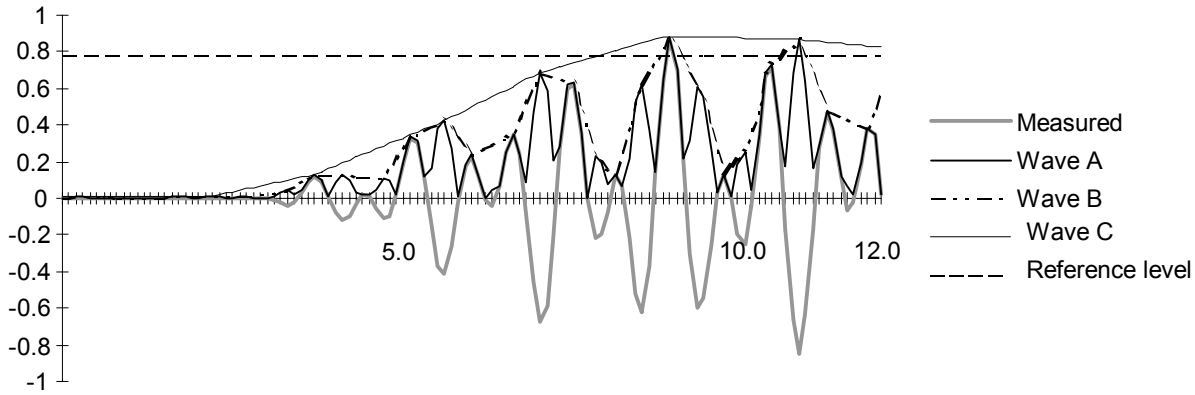

Figure A.25

A.4.8.2.5 Pause duration

Requirement: Subclause 4.8.2.5.

Measurement principle:

Preamble: Set the TE in loop state.

Test state: Automatic dialling.

Test configuration:

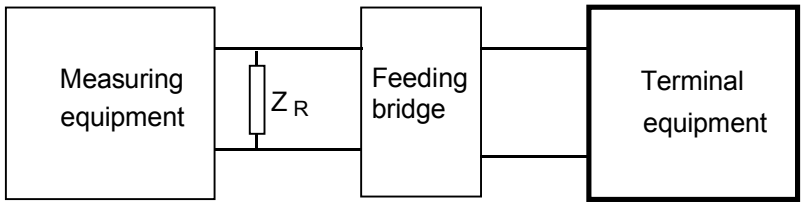

Figure A.26

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.

AC termination of TE: Z_R.

Measurement points: Where all characters of table 9 are available, select digits A, 6, 8, *. Else if all numerals are available, select digits 3, 5, 7 and 0, else select all available digits.

Measurement execution:

The TE is set in the loop condition, transmitting DTMF signals to line. Set pause duration in accordance with the supplier's instructions. Capture the waveform of the sequence of bursts.

Formal processing: In this formal processing a number of waveforms derived from the measured waveform are used. These shall be calculated independently for each burst These are referred to as waveforms A, B, C etc.

Determine waveform A such that at any time the instantaneous value of waveform A is equal to the absolute value of difference between the value of the measured waveform at that time and the mean value of the measured waveform over a period of 10 ms centred on that time.

Determine waveform B such that at any time its value is the greater of the linear interpolation of the maxima of waveform A, and waveform A.

Determine waveform C such that at any time its value is the greater of the linear interpolation of the maxima of waveform B, and waveform B.

Determine the reference level such that it is 10% of the highest level which waveform C exceeds for 20 ms during the burst.

The pause between two bursts is the time between the last instant that waveform C is greater than the reference level for the first burst and the first instant that waveform C is greater than the reference level for the second burst.

Verdict: If all pauses have a duration greater than or equal to 70 ms then Pass;

If any pause has a duration of less than 60 ms then Fail;

If any pause has a duration of between 60 ms and 70 ms then the test shall be repeated 10 times, and the mean duration of the pause between each of the pairs on characters calculated. If each mean duration is greater than 65 ms then Pass; otherwise Fail.

Guidance: The repeatability of this test is intrinsically poor because the measured duration of the burst depends on the phase relationship of the tones. Therefore averaging is needed for borderline cases

A.4.8.3 Automatically repeated call attempts

Requirement: Subclause 4.8.3.

Measurement principle:

Preamble: Set TE for automatic repeat call attempts to the same number. Set number of repeat call attempts to the maximum. Put TE in quiescent state.

Test state: Alternates between DTMF dialling, loop state and quiescent state.

Test configuration:

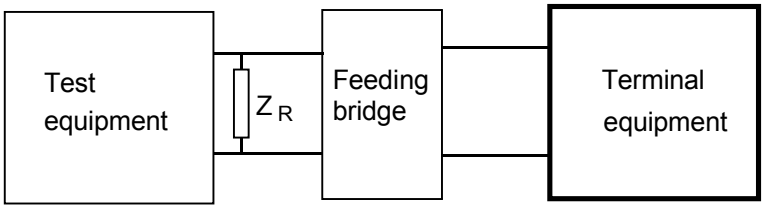

Figure A. 27

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.
AC termination of TE: Z_R.

Measurement execution:

Cause TE to dial out without subsequent successful connection. Monitor TE line terminals. Measure the duration of the shortest interval (t) between transition to the quiescent state and the loop state for the next automatically initiated, internally generated call attempt. Record the number of repeated call attempts in one hour.

Formal processing: None.

Verdict: If the interval (t) is greater than or equal to 5 s and if there is no more than 15 repeated call attempts in one hour in a call attempt sequence or if the TE does not make any repeated call attempt in the duration of the test then Pass; else Fail.

Guidance: If the interval between call attempts is user adjustable then it shall be set to the minimum interval in accordance with supplier's instructions.

This test may be terminated if the TE indicates that the repeat call attempt sequence has finished.

A.4.8.4Loop disconnect dialling

Guidance: Dial tone may be necessary to activate dialling

A.4.8.4.1 Timing

Requirement: Subclause 4.8.4.1

Measurement principle:
Preamble: Set the TE in loop state

Test state: Loop disconnect dialling

Test configuration:

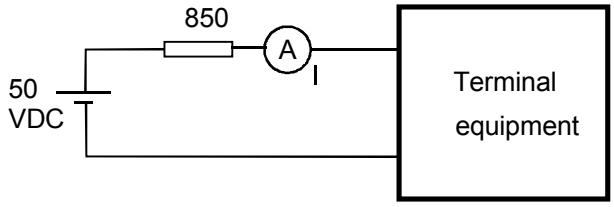

Figure A. 28

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.

Measurement execution:
Initiate dialling and capture the waveform. Measure the following items:

(i) Break duration

(ii) Make duration

(iii) Number of pulses per second

(iv) Interdigit pause for electronically generated pulses

Formal processing: None.

Verdict: If the break duration is within the range 60 to 70 ms, the make duration is within range 30 - 44 ms, the number of pulses per second are 10 +/- 1 and the interdigit pause for electronically generated pulses is in the range 700 - 2000 ms then Pass; else Fail.

Guidance: None

A.4.8.4.2 Resistance during the make period

Requirement: Subclause 4.8.4.2

Measurement principle:

Preamble: Set the TE in loop state

Test state: Loop disconnect dialling

Test configuration:

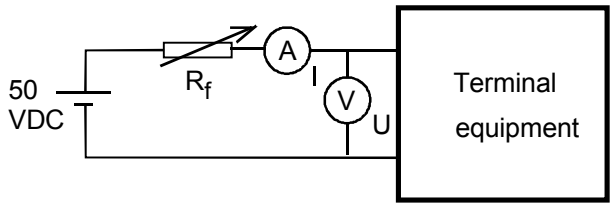

Figure A. 29

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360Ω, 850 Ω, 1600Ω and 2300Ω.

Measurement execution:

In sequence select a feed resistance value from the DC feeding arrangements. Initiate dialling and measure the voltage U across the TE and measure the current I. Then repeat the sequence for other measurement points.

Formal processing: None.

Verdict: If the voltage current characteristics are within the limits given in figure 4 for a continuous period of at least 30 ms between break pulses and for 25 ms after the last break pulse for each digit then Pass; else Fail.

Guidance: None

A.4.8.4.3 Residual current during the break period

Requirement: Subclause 4.8.4.3

Measurement principle:

Preamble: Set the TE in loop state.

Test state: Loop disconnect dialling

Test configuration:

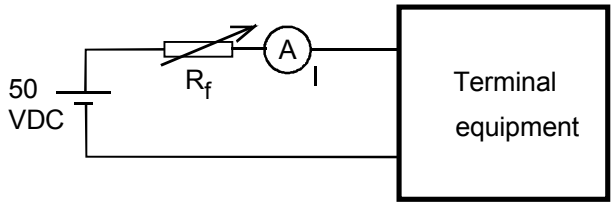

Figure A. 30

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω and 2300 Ω.

Measurement execution:

In sequence select a feed resistance value from the DC feeding arrangements. Initiate dialling and capture the waveform. Measure the current I. Then repeat the sequence for other measurement points.

Formal processing: None.

Verdict: If I is less than or equal to 0.5 mA for a continuous period of at least 50 ms then Pass; else Fail.

Guidance: None

A.4.8.4.4 Pulse distortion

Requirement: Subclause 4.8.4.4

Measurement principle:

Preamble: Set the TE in loop state.

Test state: Loop disconnect dialling

Test configuration:

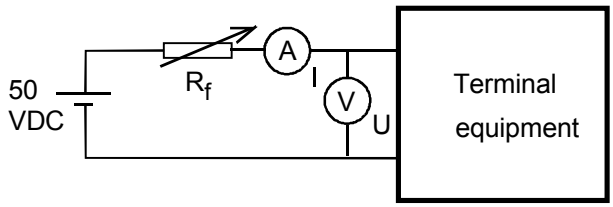

Figure A. 31

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following : 850 Ω and 2300 Ω.

Measurement execution:

In sequence select a feed resistance value from the DC feeding arrangements. Initiate dialling and capture the waveform.

Formal processing: None.

Verdict: If all the following requirements are met:

(i) the current in the transition from make to break has reached 7 mA within 1 ms of the start of the transition;

(ii) the current in the transition from break to make has reached 16 mA within 1 ms of the time that it first reaches and remains at 1 mA;

(iii) where the break period is between 64 and 70 ms the transition shall be <= 2 ms;

(iv) that during the make period the current remained above 16 mA from the time it first reached that value until the end of the period;

(v) that during the break period the current remained below 7 mA from the time it first reached that value until the end of the period;

then Pass; else Fail.

Guidance: None

A.4.10 Call cleardown

Requirement: Subclause 4.10

Measurement principle:

Preamble: Cause TE to auto answer a call and enter into communication condition.

Test state: Loop state

Test configuration:

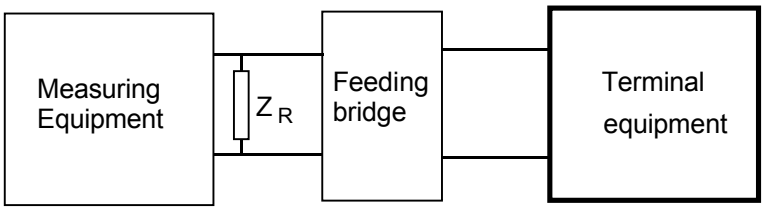

Figure A. 32

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: 850 Ω.

AC termination of TE: Z_R.

Measurement points: The detection range that shall be tested is limited by the frequencies, voltages levels and cadences given in the table below. The levels are defined across the reference impedance Z_R.

Detection table:

Frequency (Hz)	Levels (dBV)	Cadences
425	-12	0.75 s on, 0.75 s off
425	-28	0.75 s on, 0.75 s off
425	-12	0.375 s on, 0.375 s off
425	-28	0.375 s on, 0.375 s off

Measurement execution:

When the TE has been in the loop state for at least 1.2 s apply a test signal from the detection table for 20 s. Observe whether the TE goes into the quiescent state during the 20 s period. Repeat the sequence for each of the test signals in the table, repeating the preamble each time.

Formal processing: None.

Verdict: If the TE goes in to the quiescent state for each of the four cases within 20 s then Pass; else Fail.

Guidance: It may be necessary to apply a stimulating signal to cause the TE to enter the communication state.

A.4.11 Series connection

A.4.11.1 DC in-line resistance

Requirement: Subclause 4.11.1

Measurement principle:

Preamble: Connect TE in accordance with figure A 33.

Test configuration:

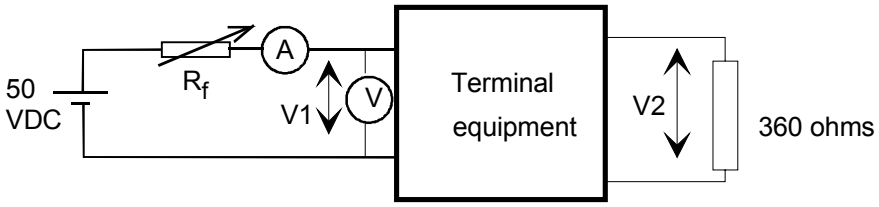

Figure A. 33

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω and 2300 Ω.

Measurement execution:

In sequence select a feed resistance value according to the DC feeding arrangements and measure the current I and the voltage V1 and V2.

Formal processing: DC in-line resistance (R) = (V1 - V2)/I

Verdict: If R for both feed resistance settings is less than or equal to 75 Ω then Pass; else Fail.

Guidance: None

A.4.11.2 Ringing frequency insertion loss

Requirement: Subclause 4.11.2

Measurement principle:

Preamble: Connect TE in accordance with figure A 34.

Test configuration:

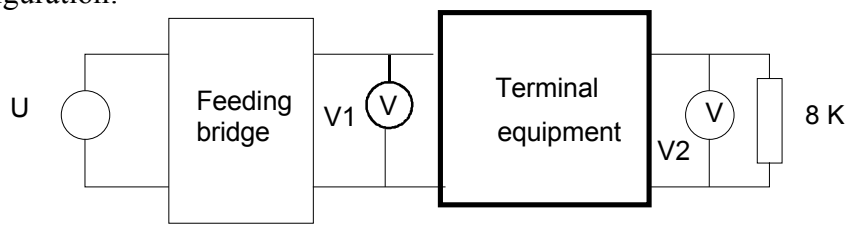

Figure A. 34

DC feeding arrangement: Feed voltage: 50 V. Feed resistance of 850 Ω.

Measurement points: The test signal shall be sinusoidal at a frequency of 25 Hz and with a constant voltage, whose level shall be pre-set to that required to achieve a level of 75 V rms at the TE line terminals.

Measurement execution:

Apply the input signal to the TE and measure V_1 and V_2.

Formal processing: Ringing frequency insertion loss (A) = $20*\log_{10} (V_2 / V_1)$.

Verdict: If A is less than or equal to 1 dB then Pass; else Fail.

Guidance: None

A.4.11.3 Voice frequency band insertion loss

Requirement: Subclause 4.11.3

Measurement principle:

Preamble: Connect TE in accord0ance with figure A 35.

Test configuration:

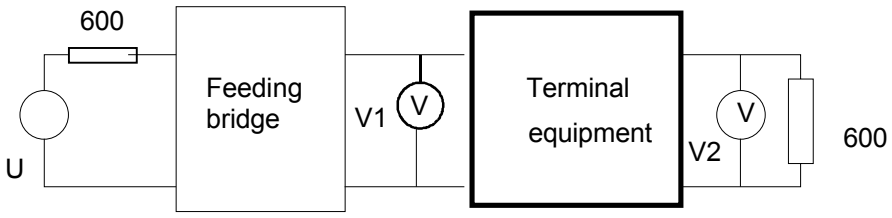

Figure A. 35

DC feeding arrangement: Feed voltage: 50 V. Feed resistance of 850Ω.

Measurement points: The test signal shall be sinusoidal with a constant voltage, whose level shall be pre-set to that required to achieve a level of 1 V rms at the TE line terminals. The signal frequency shall be in the range

f_{min} = 300 Hz, f_{max} = 3 400 Hz with step intervals of not more than one octave.

Measurement execution:

In sequence apply the signals in the "Measurement points" to the TE and measure V_1 and V_2.

Formal processing: Voice frequency band insertion loss (A) = $20*\log_{10}$ (V_2 / V_1).

Verdict: If A is less than or equal to 1 dB for all frequency settings then Pass; else Fail.

Guidance: None

A.4.12 Supplementary Services

A.4.12.1 Register recall

Requirement: Subclause 4.12.1

Measurement principle:

Preamble: Set TE in loop state

Test state: Loop state

Test configuration:

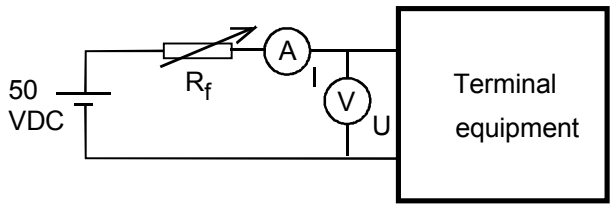

Figure A. 36

DC feeding arrangement: Feed voltage: 50 V. Feed resistance: each of the following: 360 Ω and 2300 Ω.

Measurement execution:

The TE is exercised to invoke the register recall facility. Capture the waveform of the register recall signal.

Measure (i) the break duration;

(ii) the current I.

Formal processing: None.

Verdict: If the following requirements are met:

(i) break period is not less than 80 ms and not greater than 250 ms

(ii) the break current is less than or equal to 1.0 mA

then Pass; else Fail.

Guidance: None

Annex B (normative): TTE 10 Requirements Table (TTE 10-RT)

B.1 Guidance for completion of the TTE 10-RT

B.1.1 Tables of conditions

For the requirements, there is a table of condition questions.

The Reference column contains references in the form C.x where:

C means Condition;

x uniquely identifies the element of the table.

The Condition column contains a question, the answer to which determines whether the corresponding requirement(s) in the Requirements Table shall be mandatory.

The Status column identifies whether a "Yes" or "No" answer causes relevant requirements to be mandatory for the TE. The following codes are used:

M means that the relevant requirements are mandatory;

N means that the relevant requirements are not applicable.

The Support column is blank for the user to complete.

B.1.2 Table of requirements

The Number column provides an unique identifier to each requirement.

The Reference column lists the subclause reference in TTE 10 where the requirement may be found.

The TTE 10 Requirement column gives the clause title of the relevant clause, supplemented by any additional information necessary to identify the requirement.

The Status column contains on of the following items:

M means that the requirement is mandatory;

C.x means that the requirement is mandatory if the relevant condition is met.

In some cases, two or more Conditions are included in the status column. The requirement shall be mandatory if the boolean combination of them is true.

The Support column is blank for the user to complete.

Table B.1: Condition table

Reference	Condition	Status	Support (Y/N)	Comment
C.1.	Is the TE controlled by an external device for the origination and/or the reception of a call?	If YES then M else N		
C.2.	Is the TE intended to have a connection to earth?	If YES then M else N		
C.3.	Is the TE intended to be in loop state	If YES then M else N		
C.4.	Is the TE intended for call answer?	If YES then M else N		
C.5.	Is the TE intended for call set-up?	If YES then M else N		
C.6.	Is the TE intended for dialling with DTMF?	If YES then M else N		
C.7.	Is the TE intended for automatic dialling without dial tone detection?	If YES then M else N		
C.8.	Is the TE intended for automatic dialling with a dial tone detection?	If YES then M else N		
C.9.	Is the TE intended for use in receiving mode?	If YES then M else N		
C.10.	Is the TE intended for use in transmitting mode?	If YES then M else N		
C.11.	Is the TE intended for making internally generated automatically repeated call attempt?	If YES then M else N		
C.12.	Is the TE intended for automatically controlled signalling tone duration	If YES then M else N		
C.13.	Is the TE intended for automatically controlled signalling pause duration	If YES then M else N		
C.14.	Is the TE intended for dialling with loop disconnect dialling ?	If YES then M else N		
C.15.	Is the TE intended to supply the register recall facility ?	If YES then M else N		
C.16.	Is the TE a series connected TE ?	If YES then M else N		
C.17.	Does the TE rely on the presence of busy tone to return to the quiescent state at the end of a call ?	If YES then M else N		

Table B.2: Requirements table

Reference	TTE 10 Requirement	Status (see Note 1)	Support (Y/N)
4.1	General requirement	C.1	
4.2	Physical characteristics of connection to the PSTN	M	
4.3.1	Polarity	M	
4.4.1	DC resistance	M	
4.4.2.1	Impedance	M	
4.4.2.2	Transient response	M	
4.4.3	Impedance unbalance about earth	C.2	
4.4.4	Resistance to earth	C.2	
4.4.5	Voice band impedance	M	
4.5	Ringing signal detector sensitivity	C.4	
4.7.1	DC characteristics	C.3	
4.7.2	Impedance	C.3	
4.7.3.1	Mean sending levels	C.3	
4.7.3.2	Instantaneous voltage	C.3	
4.7.3.3	Voltage levels in a 10 Hz bandwidth	C.3	
4.7.3.4.1	Sending levels above 4,3 kHz during DTMF dialling	C.3	
4.7.3.4.2	Sending levels above 4,3 kHz during communication	C.3	
4.7.4.1	Longitudinal Conversion Loss	C.2 and C.3 and C.9	
4.7.5	Resistance to earth	C.2 and (C.4 or C.5)	
4.8.1.1	Dialling without dial tone detection	C.7	
4.8.1.2	Dialling with dial tone detection	C.8	
4.8.1.3	Call progress monitoring	C.7 or C.8	
4.8.2.1	Frequency combinations	C.6	
4.8.2.2 1	Absolute levels	C.6	
4.8.2.2.2	Level difference	C.6	
4.8.2.3	Unwanted frequency components	C.6	
4.8.2.4	Tone duration	C.6 and C .12	
4.8.2.5	Pause duration	C.6 and C.13	
4.8.3	Automatically repeated call attempts	C.11	
4.8.4.1	Timing (loop disconnect dialling)	C.14	
4.8.4.2	Resistance during the make period	C.14	
4.8.4.3	Residual current during the break period	C.14	
4.8.4.4	Pulse distortion	C.14	
4.10	Call cleardown	C.17	
4.11.1	DC in-line resistance	C.16	
4.11.2	Ringing frequency insertion loss	C.16	
4.11.3	Voice frequency band insertion loss	C.16	
4.12.1	Register recall	C.15	

ANNEX C

PSTN SYSTEM INFORMATION

Dial Tone

Frequency	400 - 450 Hz [Nominally 425 Hz]
Cadence	Continuous
Level	-12 to -28 dBm depending on exchange type and line length

Call Diversion Dial Tone

Frequency	400 - 450 Hz
Cadence	400 Hz for 400 ms, 440 Hz for 400 ms, repeated [E10 Exchange]; or 400 Hz for 400 ms, 425 Hz for 400 ms, repeated [AXE Exchange] These tones are replacing the following tones on the network 410 ms ON, 50 ms OFF [AXE Exchange] 200 ms ON, 200 ms OFF [E10 Exchange] There may be silent pauses or gaps of up to 4 ms in duration at the point where the tone changes
Level	-12 to -28 dBm depending on exchange type and line length

Message Waiting Dial Tone

Frequency	400 - 450 Hz
Cadence	400 Hz for 320 ms, 440 Hz for 40 ms, repeated [E10 Exchange]; or 400 Hz for 320 ms, 425 Hz for 40 ms, repeated [AXE Exchange] There may be silent pauses or gaps of up to 4 ms in duration at the point where the tone changes
Level	-12 to -28 dBm depending on exchange type and line length

Call Waiting Tone

Frequency 400 - 450 Hz

Cadence 200 ms ON, 200 ms OFF, 200 ms ON, 4s OFF, repeated

Level -10 to -36 dBm depending on exchange type and length.

Progress Tone

Frequency 425 +/- 5 Hz [E10 Exchange]
Spike Type Pulses [Ericsson Crossbar]

Cadence 60 ms ON, 60 ms OFF [E10 Exchange]
0.5 s repeated [Ericsson Crossbar]

Level -12 to -28 dBm depending on line length [E10 Exchange]
5 V pk. [Ericsson Crossbar]

Busy Tone

Frequency 400 - 450 Hz

Cadence Varies with exchange type and call routing. It will be between
0.375s ON, 0.375 s OFF and
0.75 s ON, 0.75 s OFF

Level -12 to -28 dBm depending on exchange type and line length

Ringing Signal

Frequency 25 Hz

Cadence 0.4 s ON, 0.2s OFF, 0.4 s ON, 2.0 s OFF repeated.

Level 75 V rms on AXE and Crossbar exchanges
40 V rms on each leg, out of phase on E10B exchanges

Note: In some areas local loop carrier systems are in use which have ringing voltages as low as 45 V. The voltage presented to the terminal equipment may be as low as 30 V depending on line length and ringing impedance of the terminal equipment.

Ringback Tone

Frequency	400 + 450 Hz for AXE and E10B 425 +/- 5 Hz modulated with 50 Hz for Ericsson Crossbar
Cadence	0.4 s ON, 0.2s OFF, 0.4 s ON, 2.0 s OFF repeated. 0.4 s ON, 0.2s OFF, 0.4 s ON, 2.4 +/- 0.2s OFF repeated in some crossbar exchanges
Level	-12 to -28 dBm depending on exchange type and line length

Special Information Tone

Frequency	950 +/- 5 Hz, 1400 +/- 5 Hz, 1800 +/- 5 Hz
Cadence	Silent period of 1000 s +/- 250 ms followed by 3 tones on increasing frequency, each of 330 +/- 70 ms duration repeated.
Level	-12 to -28 dBm depending on exchange type and line length

Meter Pulses

Frequency	12 kHz +/- 1%
Pulse Length	120 +/- 20 ms
Level	45 mV rms (minimum) 2.6 V rms (maximum)

DC Feeding Conditions

Exchange Voltage	44 - 56 V DC
Feed Bridges	2 X 400 ohm for AXE and some E10B exchanges 2 X 200 ohm for electromechanical exchanges and the remainder of the E10 lines
Line Current	19 - 60 mA for AXE and E10B exchanges 19 - 100 mA for electromechanical exchanges

Note: In some areas local loop carrier systems are in use. The line voltage on these vary between 6 V and 48 V depending on the type.

Note: Some E10B lines are fed using a 40 mA constant current feed.

ANNEX D

WIRING DIAGRAM CONNECTION TO THE PSTN

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Installation using Modular RJ11 type socket