

Specification of Terminal Equipment Interconnected to the
Analog Public Telephone Network
Requirements for Type Approval

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Introduction

The ever growing use of analog terminals, especially terminals offering non-voice services such as modems and facsimile machines, in the Israeli network, constitute an indication of the demand of this equipment by the business sector in Israel. Such equipment, and sophisticated voice telephony equipment of different types is undergoing a continuous and swift evolution. The Ministry of Communications recognizes its obligation to reduce to the minimum the delay and cost involved in the process of introducing these products in the market, those caused by type approval procedures. This in order to prevent a situation where new and innovative products will be available to the Israeli market later than in other countries in the world.

Generally, terminal equipment is required, amongst others, to comply with the following requirements:

- Not to cause any harm to the network
- Be able to internal work with the network in order to set up, hold, modify, charge for and clear down a connection
- Internal work with the TE at the other end of the network.

In this specification the Ministry of Communications defines the requirements with which the TE has to comply in order to be type approved. The main and only meaning of the type approval is that it is allowed to connect the TE to the PSTN without causing any harm to the network.

In this specification harm to the network is defined as:

- Electrical hazard to BEZEQ's or any other network operator's employees
- Damage to BEZEQ's or any other network operator's equipment
- To disturb the operation of the network operator's billing equipment
- To harm the quality of service offered to the network users, excluding the owner of the TE and parties to his calls

All other requirements mentioned above, those pertaining to the interactivity with the network and with the TE at the other end of the network, constitute conditions for adequate operation of the equipment when it is used in order to obtain network services. The responsibility for this lies on the equipment provider. The buyer of the TE has to verify that the equipment really meets the requirements of the applications for which he buys it.

All the technical requirements with which the different TE's have to comply are given in detail in the different relevant Israeli and international standards. These standards are created amongst others in order to serve the equipment buyers and sellers as test and reference standards in the buyer seller relations.

1. Scope

This document specifies the technical characteristics with which a TE has to comply if it is:

1. Intended to be connected to the analog PSTN
2. Able to interconnect with a two wire (2W) extension line of the PSTN at the network termination point (NTP) without causing harm to the network.

The objective of this specification is to define conditions, which will guarantee that no harm will be caused to the network by connecting a type approved TE, as defined in the introduction. This specification relates to TE, which is able to initiate and receive calls in the Israeli analog PSTN by using either tone or pulse dialing.

To each requirement in the specification there is given a test definition, including test method. Testing the compliance with the requirements is defined at the interface point where the TE is connected directly (in a galvanic connection) to the PSTN via the NTP.

In order to perform the tests the TE has in some cases to be excited by additional external equipment, which does not constitute part of the TE. When initiation or acceptance of a call by the TE is dependent or controlled by another equipment, external to the TE, the TE must still comply with the requirements of this specification at the interface point to the PSTN. This specification requires the manufacturer or provider of the TE to define the conditions with which such external equipment have to comply, so that their use will not cause the TE not to comply with the requirements of this specification.

2. Reference Documents

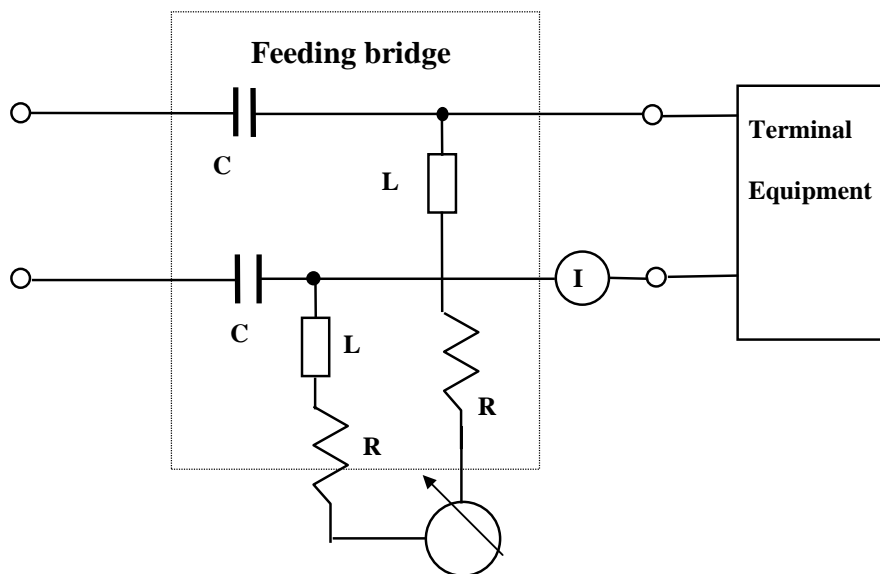
1. Israeli Standard IS 1121 - Safety of Information Technology Equipment, including Electrical Office Equipment.
2. Israeli Standard 961 Part 6 - Electromagnetic interference: Limits and test methods of interference from Information Technology Equipment.

3. Definitions and abbreviations

3.1 Definitions

- **Apparent power:** The value of power obtained when the square of the measured voltage is divided by the apparent value of the reference impedance at 1020 Hz.
- **Automatic repeat attempts:** A repeat attempt made by the TE to the same network address without manual intervention.
- **Call attempt:** The process by which the TE seizes the PSTN line and sends signaling characters of the network address with which the TE wishes to communicate.
- **Communication condition:** The condition where a connection to the remote terminal is established, and communication between terminals can take place.
- **Connection to earth:** Connection to earth means that all the following are connected to the earth point during measurement:

- A point in the TE which is 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 likely to be connected to earth during the normal operation of the apparatus, e.g. the earth connection on Data Terminal Equipment (DTE) ports.
- **dBm**: Absolute power level with respect to 1 milliwatt, expressed in decibels.
- **dBV**: Absolute voltage level with respect to 1 volt, expressed in decibels.
- **Feeding Bridge**: An electric circuit which enables simulation of connecting TE to an exchange for the purpose of testing as described in Figure 1.



$$C \geq 1 \mu\text{F} \pm 5\% \text{ 250 V}$$

$$L \geq 15 \text{ H} \pm 5\%$$

$$R = 200 \Omega \pm 5\%$$

Power supply
DC

Figure 1: Feeding Bridge

- **loop condition**: The condition where the terminal presents a low DC resistance, and draws power from the PSTN.
- **Public Switched Telephone Network (PSTN)**: The term is used describe the ordinary telephone system including subscriber lines, local exchanges and the complete system of trunks and exchange hierarchy which makes up the network.
- **quiescent condition**: The condition where the terminal presents a high DC resistance to the PSTN so as not to activate the exchange.

- **reference impedance Z_R :** A complex impedance made up of a resistance of 270Ω in series with a parallel combination of 750Ω and 150 nF , as shown in Figure 2.

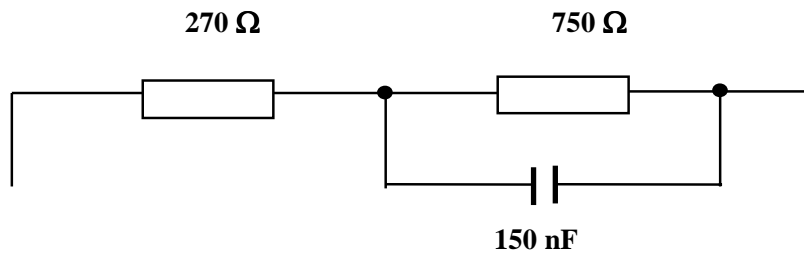


Figure 2: Z_R

- **Terminal Equipment (TE):** Equipment intended to be connected to the public telecommunication network; i.e.;
 - a) It should be connected directly to the termination of a public telecommunication network, or
 - b) to internal work 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.

3.2 Abbreviations

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

AC	Alternative Current
DC	Direct Current
DTE	Data Terminal equipment
DTMF	Dual Tone Multi-Frequency (MFPB or MF)
EMC	Electromagnetic Compatibility
TE	Terminal Equipment
RMS	Effective value

4. Requirements

4.1 Requirements in quiescent condition

4.1.1 DC resistance in quiescent condition

Justification: Internal working with the PSTN is assured by requiring the TE to present a sufficiently high DC resistance in quiescent condition to enable testing of the line by the public network operator.

Requirement: The resistance in quiescent condition shall be tested at 50 and 100 V DC, and shall not be less than $1 \text{ M}\Omega$.

Test: The test shall be conducted according to annex A, subclause A.4.1.1.

4.1.2 Characteristics of TE for ringing signals

4.1.2.1 Minimum impedance for ringing signals

Justification: If the impedance is too low it may cause a drop in the output voltage of the ringer in the exchange and disturb other call attempts.

Requirement: When tested at 30 V, the impedance of the TE at frequencies of 25 Hz and 50 Hz shall not be less than 3 K Ω .

Test: The test shall be conducted according to annex A, subclause A.1.2.1.

4.1.2.2 Maximum impedance for ringing signals

Justification: impedance above maximum may not allow the network operator to test the line in case of failure.

Requirement: When tested at 30 V, the impedance of the TE at frequencies of 25 Hz and 50 Hz shall not be more than 40 k Ω .

Test: The test shall be conducted according to annex A, subclause A.4.1.2.1.

4.1.2.3 DC-current during ringing

Justification: DC during ringing which exceeds the rated value may cause a false ring tipping, which will stop the ringing and cause charging of calling party when a call has not been established.

Requirement: The resulting DC current during the ringing signal, tested with a 25 Hz and 50 Hz AC signal at a voltage of 90 Vrms superimposed on a DC voltage of 60 V, shall be less than 1,5 mA.

Test: The test shall be conducted according to annex A, subclause A.4.1.2.3.

4.1.3 Impedance unbalance about earth in quiescent condition

Justification; Unbalance may possibly cause crosstalk of sufficient severity to cause disturbance to other users of the network.

The impedance unbalance about earth is expressed as the Longitudinal Conversion Loss.

Requirement: Where the manufacturer's instructions state that a connection to earth is intended, the Longitudinal Conversion Loss shall be at least the values given in the table1.

Table 1: Longitudinal Conversion Loss, minimum values

Frequency range	Minimum value
50 Hz ÷ 600 Hz	40 dB
600 Hz ÷ 3400 Hz	46 dB

Test: The test shall be conducted according to annex A, subclause A.4.1.3

4.2 Sending power limitations

Justification (for all subclauses of this clause): Protection of the PSTN from harm is assured by limiting the signal sent into the PSTN by the TE so that the interfering effects of the signal with the remainder of the network can be predicted and avoided.

4.2.1 Maximum mean sending levels

Requirement: The mean sending level in the frequency range 200 Hz ÷ 3800 Hz in every one-minute period shall not be greater than - 9,7 dBV when the TE interface is terminated with the reference impedance Z_R .

Test: The test shall be conducted according to annex A, subclause A.4.2.1.

4.2.2 Maximum instantaneous voltage

Requirement: Except for transients during DTMF tone bursts, the peak voltage in the frequency range 200 Hz ÷ 3800 Hz shall not exceed 2,0 Volts when the TE interface is terminated with the reference impedance Z_R .

Test: The test shall be conducted according to annex A, subclause A.4.2.2.

4.2.3 Maximum voltage in a 10 Hz bandwidth

Requirement: The maximum apparent power level within a 10 Hz bandwidth centered at any frequency band 30 Hz to 3400 Hz, and wholly contained within that frequency band, shall not exceed the limits given in table 2 and figure 3 when the TE interface is terminated with the reference impedance Z_R .

The requirement does not apply during sending of DTMF signals.

Table 2: Maximum voltage in a 10 Hz bandwidth

Points	Frequency range kHz	Maximum sending level dBV
A	0.03	- 33.7
B	0.1	- 16.7
C	0.3	- 6.7
D	3.8	- 6.7
E	4.0	- 10.7
F	4.3	- 44.7

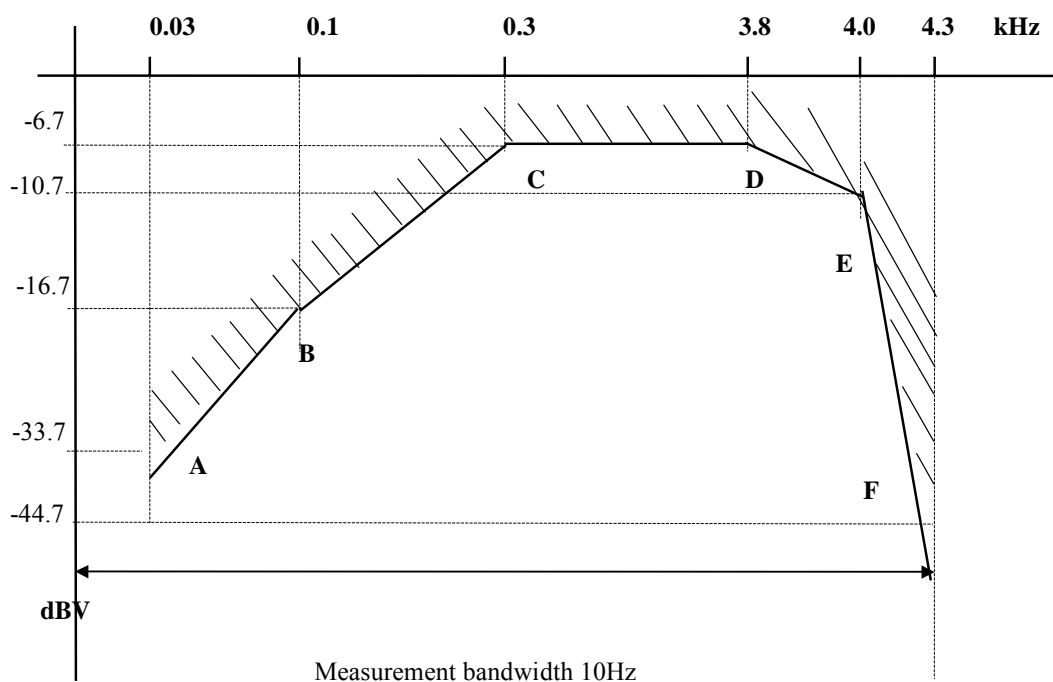


Figure 3: Maximum voltage in a 10 Hz bandwidth

Test: The test shall be conducted according to annex A, subclause A.4.2.3

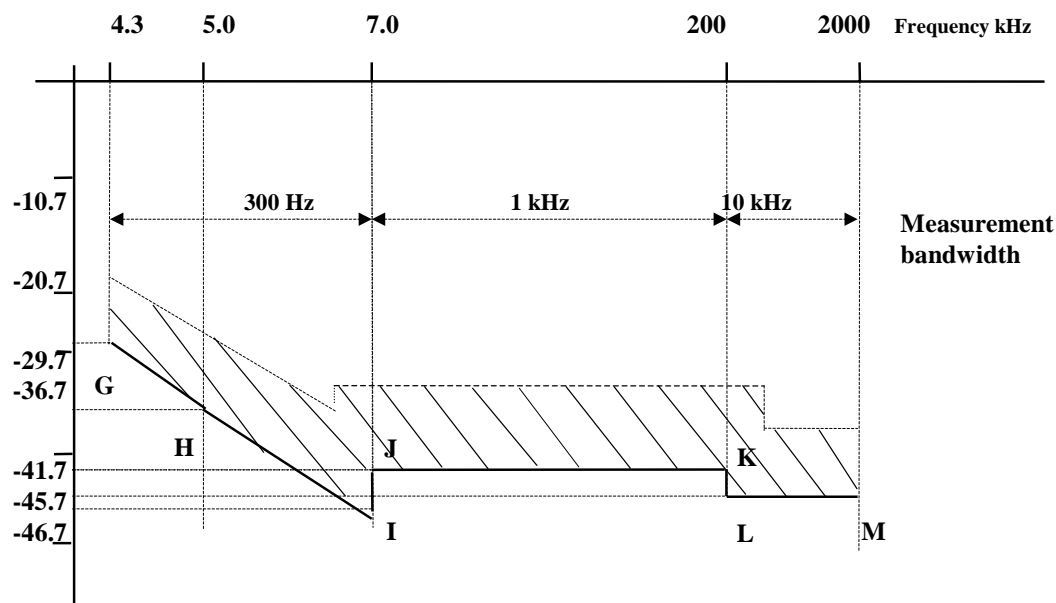
4.2.4 Maximum sending levels above 4.3 kHz

Requirement: The power spectral density in a bandwidth, defined in table 3, wholly contained within the frequency range 4,3 kHz ÷ 2 MHz, arising from normal operation of the TE when in on-line, non-signaling state, and when sending DTMF digits, and when terminated with 120 Ω, shall not exceed the limits shown in table 3 and figure 4.

Exceptionally, (e.g. during the sending of DTMF signals) the level of single frequency components in the output spectrum may exceed the limits given in table 3 and figure 4 but shall not exceed - 35 dBm per component.

Table 3: Maximum sending power outside the voice bandwidth

Points	Frequency range kHz	Maximum sending level in a specified bandwidth dBV	Measurement bandwidth
G to H	4,3 to 5	- 29.7 decreasing to - 36.7	300 Hz
H to I	5 to 7	- 36.7 decreasing to - 46.7	300 Hz
J to K	7 to 200	- 41.7	1 kHz
L to M	200 to 2000	- 45.7	10 kHz



Maximum sending level (dBV)
in measurement bandwidth

Not to scale

Figure 4: Maximum sending power outside the voice bandwidth

Test: The test shall be conducted according to annex A, subclause A.4.2.4

4.3 Automatically repeated call attempts

Justification: Many concurrent automatically repeated calls to a blocked line by a large number of TE may cause blocking of routes in the PSTN and damage the quality of service offered to other users of the PSTN.

Requirement: The TE shall not automatically initiate an internally generated repeat call attempt less than 30 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 condition.

Alternately a TE shall not initiate automatically more than 15 consecutive call attempts in the same repeat attempt sequence.

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

4.4 Communication condition

4.4.1 Impedance unbalance about earth

Justification: protection of the PSTN from harm. Unbalance may possibly cause crosstalk of sufficient severity to disturb other users of the PSTN.

The impedance unbalance about earth is expressed as the Longitudinal Conversion Loss (used for measurement of TE without internal generator) and output signal balance (used for measurement of TE with internal generator)

Requirement: The Longitudinal Conversion Loss and the output signal balance shall be at least the values given in table 1 and subclause 4.1.3.

Test: The test of TE without internal generator shall be conducted according to annex A subclause A.4.4.1.1 and the test of TE with internal generator shall be conducted according to annex A subclause A.4.4.1.2.

4.5 General requirements

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 provide information regarding 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 investigation of the information available to the user.

4.6 Safety

TE shall comply with IS 1121 - Safety of information technology equipment, including electrical office equipment.

4.7 EMC

The TE shall comply with IS 961 part 6.1. Electromagnetic interference: "limits and measurement methods of interference from information technology equipment", for "Classification Class B ITE" equipment.

A.1. General

This annex describes the test principles to determine the compliance of a TE with the requirements of this document.

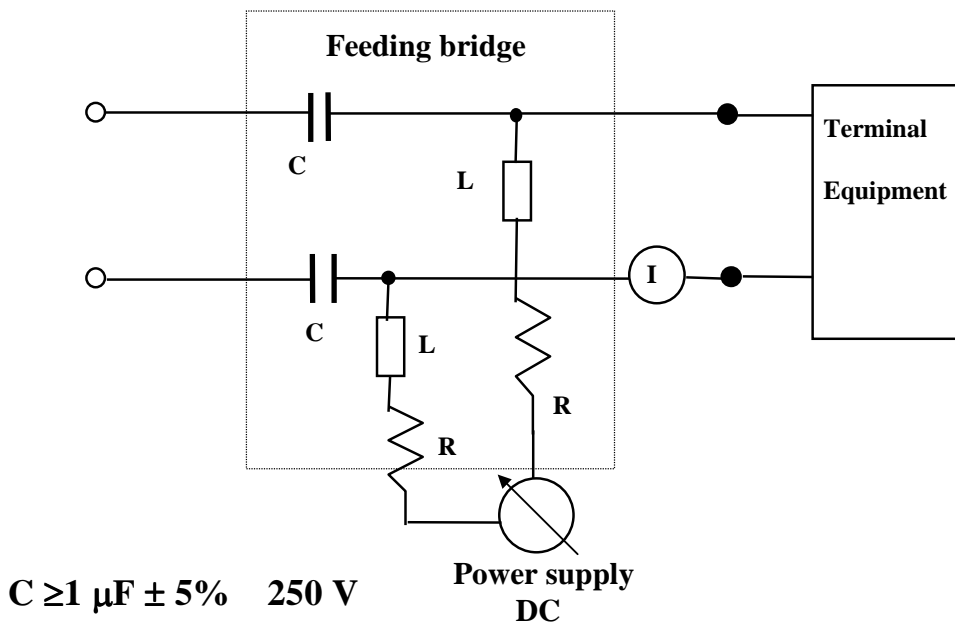
A TE may require the provision of external termination or stimuli in order to assess its conformity with the requirements of this document. In this case, such termination or stimuli shall need to be provided in order for the tests to be carried out. In order to do this, it may be necessary for the supplier to provide additional equipment or information for the purpose of test.

The test configurations given do not imply a specific realization of test equipment or arrangement or use of specific test devices for conformance testing.

The test equipment shall be a device, or a group of devices, generating a stimulus signal conforming to this annex and capable of monitoring the receive signal from the interface.

A.1.1 Equipment connection

The tests shall be applied at the terminal connection point (see figure A1).

**Figure A1**

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

A.1.2 Test environment

All tests shall be performed at:

an ambient temperature in the range from + 15 C to + 35 C;

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

For TE, which is not designed to operate within the 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 with + 5 % of the rated voltage of that supply. If the equipment is powered by other means and those means are not supplied as part of the apparatus (e.g., batteries, stabilized 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.

A.1.3 Powered state

Tests should be carried out with the TE powered on under normal operating conditions defined by the supplier, unless otherwise stated.

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 should be connected to the earth point:

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

connector points which are likely to be connected to earth during the normal operation of the apparatus, e.g. the earth connection on DTE ports.

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.

A.1.6 Reference levels

Unless otherwise stated, test signal levels are defined into the reference impedance.

A.2 Test impedance

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 a resistance of 270Ω in series with a parallel combination of 750Ω and 150 nF . This is shown, and the values of the components are defined in figure A2.

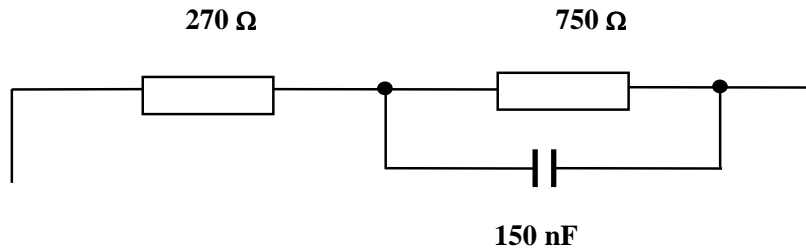


Figure A2: Reference impedance

NOTE: At 1020 Hz, this results in an impedance of 842Ω and a phase angle of $-25,0$ degrees.

Specific realizations for the reference impedance required for the performance of the tests shall have a return loss against Z_R better than 40 dB over the range 300 Hz ÷ 4000 Hz.

A.2.2 Non-reactive line termination

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

A.3 Feeding conditions

A.3.1 DC feeding conditions

The following categories of feed condition are defined:

Maximum: Feed voltage: 50 V, Line resistance: 230Ω

Normal: Feed voltage: 50 V, Line resistance: 1600Ω

Minimum: Feed voltage: 50 V, Line resistance: 3800Ω

Some tests may need to be repeated for different feed conditions. The main combinations of feed condition are the following:

- Feeding condition no.1:** Nominal.
- Feeding condition no.2:** Minimum, Maximum.
- Feeding condition no.3:** Minimum, Nominal, Maximum.
- Feeding condition no.4:** All specified conditions (Feeding voltage: 50 V, Line resistance: each of the following: 230 Ω , 400 Ω , 700 Ω , 1000 Ω , 1600 Ω , 2000 Ω , 2500 Ω , 3000 Ω , 3800 Ω).

Individual test cases refer to these feeding conditions.

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

A.3.2 AC feeding conditions

The test circuit shall have the following characteristics:

- > 40 dB return loss against the measurement AC load over the relevant frequency band.

A.4 Test methods

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

A.4.1.1 DC Resistance in quiescent condition

Requirement: Subclause 4.1.

Purpose: To check whether the TE presents a resistance of at least 1M Ω when tested at 50 and 100 volts DC in the quiescent condition.

Measurement principle:

Preamble: Set TE to quiescent condition

Test configuration:

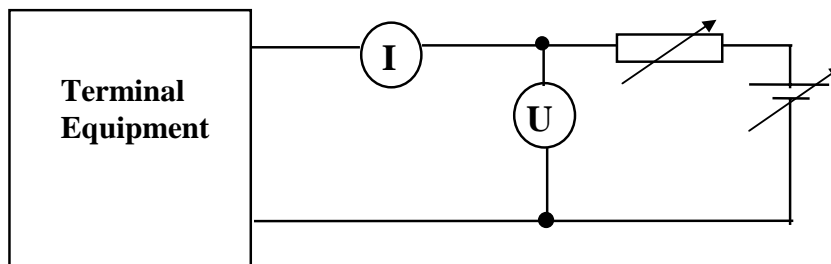


Figure A3

Measurement points: $U = 50$ and 100 volts DC.

Measurement execution:

Apply test voltage U between the TE (line terminal and earth for at least 5 s before measuring DC current I . The test shall be carried out for both polarities of the applied voltage.

Postamble: None.

Formal processing: Insulation resistance $R = U/I$.

Verdict: If R is greater than or equal to $1\text{ M}\Omega$ then Pass; else Fail.

Guidance: None.

A.4.1.2 Characteristics of TE for ringing signals

Requirement: Subclause 4.1.2.1 and 4.1.2.2.

Purpose: To determine whether the TE presents an impedance in the quiescent condition during ringing within the specified range.

Measurement principle:

Preamble: Place the TE in quiescent condition with any auto answering facility disabled. Powered TE should be placed in the powered condition.

Test state: Powered, quiescent condition.

Test configuration:

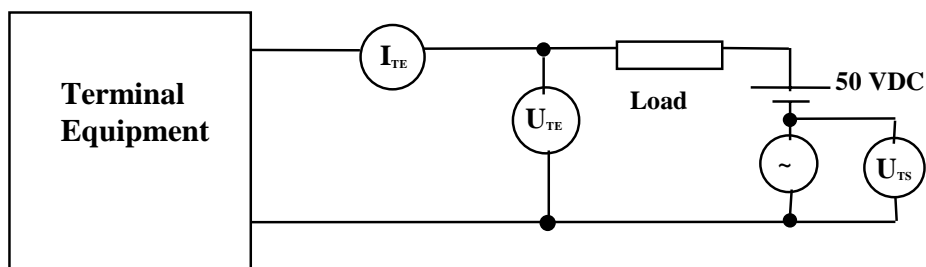


Figure A4

DC feeding arrangement: 50 V DC.

AC feeding arrangement:

Sinusoidal 25 Hz and 50 Hz \pm 1 Hz at 30 V rms (U_{TE} measured across the TE.)

Load resistor: Value not critical but shall remain constant throughout the test.

Measurement points: Voltage measurement for U_{TE} and current I_{TE} to be recorded for frequencies of 25 Hz and 50 Hz.

Measurement Execution:

Using the test configuration shown, apply the ringing signal continuously to the TE. Record the voltage measured across the TE (U_{TE}), the current flowing in the circuit (I_{TE}). Having obtained these results apply them to the mathematical formula given under formal processing. Testing to be performed at ringing frequencies of both 25 Hz and 50 Hz.

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

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

$$|Z_{Ri}| = U_{TE} / I_{TE}$$

Verdict: If $Z_{Ri} = U_{TE} / I_{TE}$ is equal to or greater than 3 K Ω and not greater than 40 K Ω then Pass, else Fail.

Guidance: None.

A.4.1.2.3 DC-current during ringing

Requirement: Subclause 4.1.2.3.

Purpose: To determine whether the DC component of the ringing current exceeds 1,5 mA.

Measurement principle:

Preamble: Place the TE in quiescent condition with any auto answer facility disabled. Powered TE should be place in the powered condition.

Test State: Powered, quiescent condition.

Test configuration:

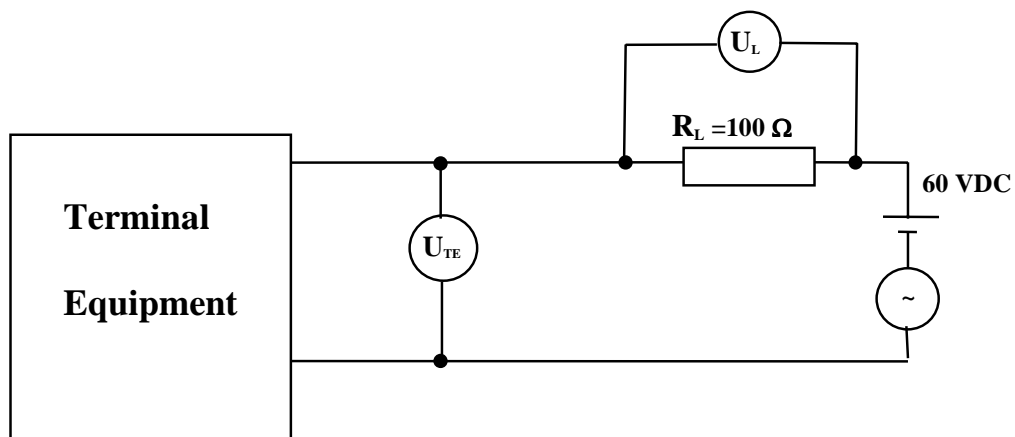


Figure A5

DC feeding arrangement: Feed Voltage = 60V DC.

AC feeding arrangement: $U_{TE} = 90V$ rms, sinusoidal 25 Hz and 50 Hz ± 1 Hz.

Measurement execution:

Using the test configuration shown, apply the ringing signal. After 400 ms measure the voltage U_L across resistor R_L for one or more complete cycles. The test shall be carried out for both polarities of the feeding voltage.

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

Formal processing: Calculate the average value (U_{DC}) of U_L over one or more complete cycles. Calculate the DC current from the formula $I_{DC} = U_{DC} / R_L$.

Verdict: If I_{DC} is less than or equal to 1,5 mA then Pass; else Fail.

Guidance: It is recommended that the source of 50V DC is shunted by a capacitor. The sampling rate should be chosen to give an even integer of samples in one cycle.

A.4.1.3 Impedance unbalance about earth in quiescent condition

Requirement: Subclause 4.1.3

Purpose: To ensure that the impedance unbalance about earth expressed as Longitudinal Conversion Loss meets the requirements specified in subclause 4.1.3..

Measurement principle:

Preamble: Ensure that the TE is powered and operational.

Test state: Powered and in the quiescent state.

Test configuration:

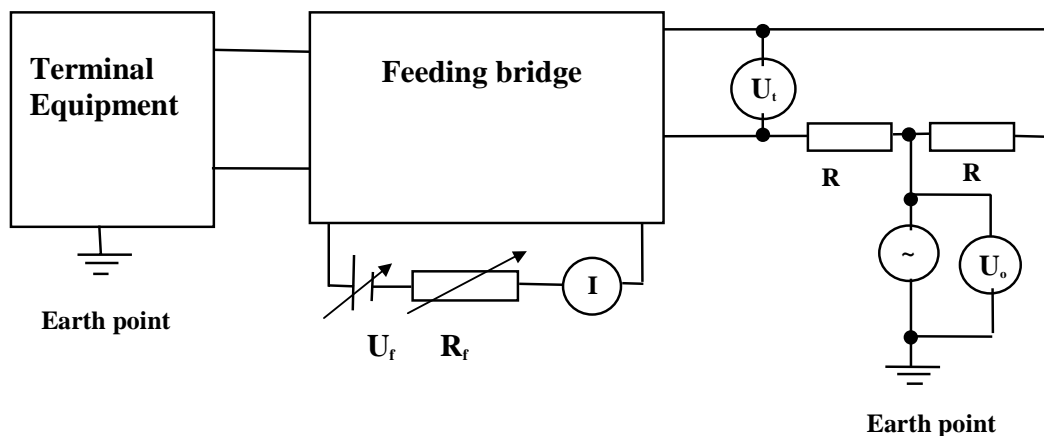


Figure A6

DC feeding arrangement: Feeding condition 1.

Measurement points:

The resistors R shall be $300 \Omega \pm 1\%$ and matched to better than 0,2 %.

The test sender output impedance is not critical.

The voltmeter input impedance shall be greater than $100 K\Omega$.

V_o shall be a sinusoidal signal with a constant level of 0,775 V throughout the specified frequency range (50 Hz ÷ 3400 Hz in 12th octave steps). Measurement of the longitudinal voltage U_t shall be performed with a suitable frequency selective level measuring instrument.

Measurement execution:

Measure the longitudinal voltage U_t across the specified frequency range for each of the feed conditions listed in the “Measurement points” section. The test shall also be carried out for both polarities of feeding voltage.

Postamble: None.

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

$$\text{Longitudinal Conversion Loss} = 20 \lg |V_o / V_t| \text{ dB}$$

Verdict: If the Longitudinal Conversion Loss is greater than or equal to the specified limits in table 1 of the specification then Pass; else Fail.

Guidance: None.

A 4.2 Sending Power Limitations.

A 4.2.1 Maximum mean sending levels.

Requirements: Subclause 4.2.1

Purpose: To check the mean apparent power level in the frequency range 200 Hz to 3800 Hz in every one minute period shall not be greater than -9.7 dBV when the TE interface is terminated with the reference impedance Z_R .

Measurement Principle:

Preamble: Set the TE in loop condition.

Test state: The TE shall be in loop condition and sending random data continuously.

Test configuration: Figure A7

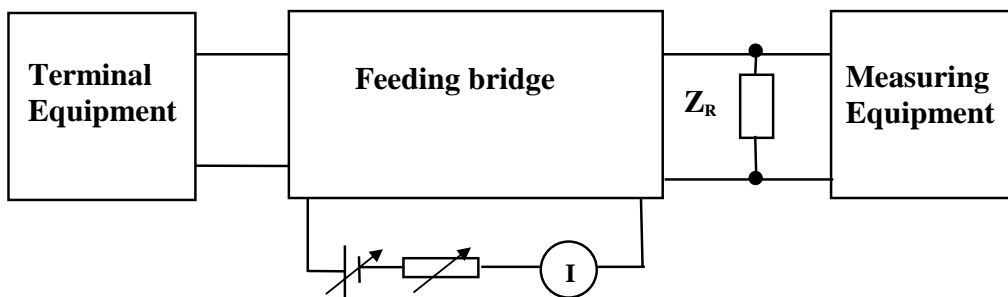


Figure A7

AC termination of TE: Z_R = Reference impedance.

Measurement points: Feeding condition no.2. The TE is exercised to send to line representative combinations of its declared output capabilities.

Measurement execution:

The TE shall be set in loop condition, transmitting random data continuously. The mean power in the frequency range 200 Hz ÷ 3800 Hz transmitted across the termination points of the TE shall be determined over a one-minute period.

Postamble: None.

Formal processing: None.

Verdict: If the maximum level is less than or equal to - 9,7 dBV 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.4.2.2 Maximum instantaneous voltage

Requirement: Subclause 4.2.2.

Purpose: To check that the peak voltage of the TE complies with subclause 4.2.2.

Measurement principle:

Preamble: Set the TE in loop condition.

Test state: The TE shall be in loop condition and sending random data continuously.

Test configuration:

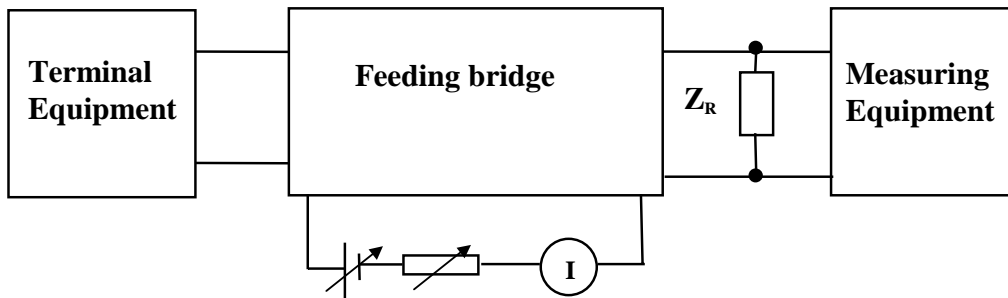


Figure A8

AC termination or TE: Z_R = Reference impedance.

Measurement points: Feeding condition no.2. The TE is exercised to send to line representative combinations of its declared output capabilities.

Measurement execution:

The TE shall be set in loop condition, transmitting random data continuously. The peak voltage, totaled over the frequency range 200 Hz ÷ 3800 Hz, transmitted across the termination points of the TE, shall be measured.

Formal processing: None.

Verdict: If the peak voltage is not higher than 2,0 V then Pass; else Fail.

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

A.4.2.3 Maximum voltage in a 10 Hz bandwidth

Requirement: Subclause 4.2.3.

Purpose: To check the TE complies with subclause 4.2.3.

Measurement principle:

Preamble: Set the TE in loop condition.

Test state: The TE shall be in loop condition and sending random data continuously.

Test configuration:

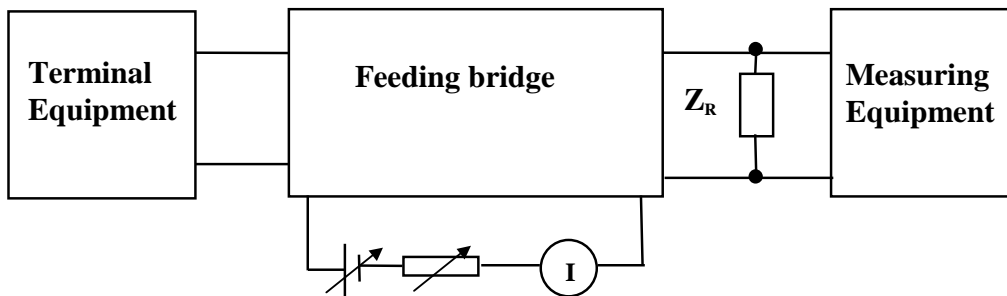


Figure A9

AC termination of TE: Z_R = Reference impedance.

Measurement points: Feeding condition no.2. The TE is exercised to send to line representative combinations of its declared output capabilities.

Measurement execution: The TE shall be set in loop condition, transmitting random data continuously. The maximum voltage level transmitted across the termination points of the TE shall be measured. It shall be determined whether the level within every 10 Hz bandwidth wholly contained in the frequency range 30 Hz ÷ 4300 Hz is less than or equal to the limits given in table 2 and figure 3 of the specification.

Postamble: None.

Formal processing: None.

Verdict: If the levels are according to table 2 and figure 3 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.4.2.4 Maximum sending levels above 4,3 kHz

Requirement: Subclause 4.2.4.

Purpose: To check that the TE complies with subclause 4.2.4.

A.4.2.4.1 Maximum sending levels above 4,3 kHz during DTMF signaling

Requirement: Subclause 4.2.4.

Purpose: To check that the TE complies with subclause 4.2.4 when transmitting any DTMF tone combination during call set-up.

Measurement principle:

Preamble: The TE shall be in loop condition.

Test state: DTMF dialing state.

Test configuration:

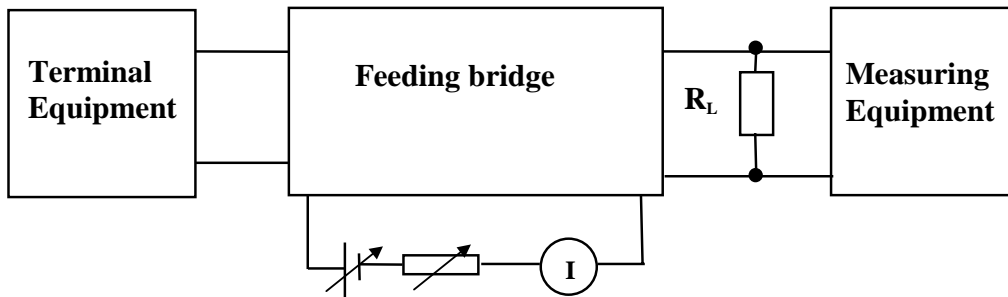


Figure A10

DC feeding arrangement: Feeding condition no.2.

AC termination of TE: 120 Ω (R_L)

Measurement points: Where all 16 standard characters (0-9, A-D, *,#) are available, select digits A, 6, 8, *. Else if all numerals are available, select digits 3, 6, 7 and 0, else select all available digits.

Measurement execution:

The TE shall be set in the loop condition, transmitting DTMF characters to line. Measurement should be taken during the tone duration , minimum duration 65 ms (between the two 90% points of stable tone voltage).

The power spectral density transmitted across the termination points of the TE shall be measured. It shall be determined whether the level in any bandwidth defined in table 3, wholly contained in the frequency range 4,3 kHz ÷ 2 MHz, is less than or equal to the limits of table 3 and figure 4. If these limits are exceeded it shall be determined whether exceeding the limits is caused by a single frequency signal whose power level is less than or equal to - 35 dBm.

Postamble: None.

Formal processing: None.

Verdict: Pass: if the power spectral density complies with table 3 and figure 4.

If the only non-compliance with table 3, and figure 4 is due to a single frequency signal whose power level is less than or equal to - 35 dBm then Pass; else Fail.

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

A.4.2.4.2 Maximum sending levels above 4,3 kHz in loop condition

Requirement: Subclause 4.2.4.

Purpose: To check that the TE complies subclause 4.2.4 in loop condition.

Measurement principle:

Preamble: Set the TE in loop condition

Test state: The TE shall be in loop condition and sending random data continuously.

Test configuration:

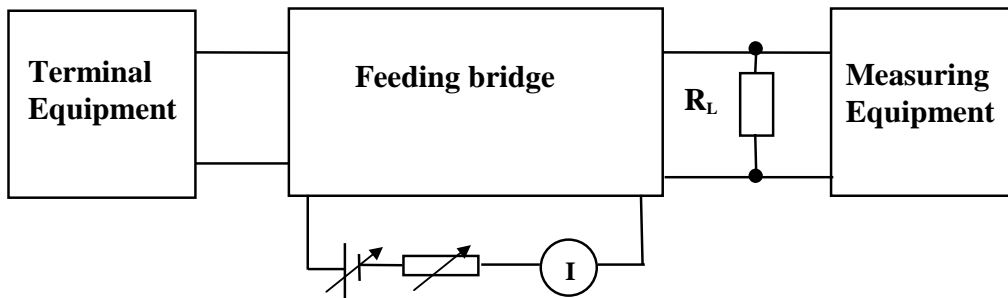


Figure A11

AC termination of TE: 120Ω (R_L).

Measurement points: Feeding condition no.2. The TE is exercised to send to line representative combinations of its declared output capabilities.

Measurement execution:

The TE is set in loop condition, transmitting random data continuously. The power spectral density transmitted across the termination points of the TE shall be measured. It is determined whether the level in a bandwidth defined in table 3, wholly contained in the frequency range $4,3 \text{ kHz} \div 2 \text{ MHz}$, is less than or equal to the limits of table 3 and figure 4. Where these limits are exceeded it is determined whether exceeding the limits is caused by a single frequency signal whose power level is less than or equal to -35 dBm .

Postamble: None.

Formal processing: None.

Verdict: If the power spectral complies with table 3 and figure 4 then Pass.

If the only non-compliance with table 3 and figure 4 is due to a single frequency signal whose power level is less than or equal to -35 dBm then Pass.

Else, Fail.

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

A.4.3 Automatically repeats call attempts.

Requirement: Subclause 4.3

Purpose: To check that the TE complies with subclause 4.3

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 condition.

Test state: Alternates between DTMF dialing, loop condition and quiescent condition.

Test configuration:

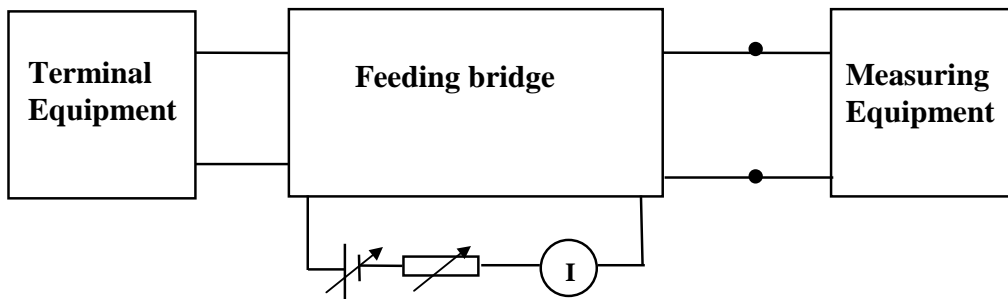


Figure A12

Measurement points: Perform measurement at minimum DC feeding conditions.

Measurement execution:

Cause TE to dial out without subsequent successful connection. Monitor TE line terminals for 10 minutes after TE assumes loop condition of first dialing attempt. Record the duration of the shortest interval (t) between transition to the quiescent condition and assuming the loop condition for the next automatically initiated, internally generated call attempt. Count the number of call attempts, including the first one.

Postamble: None.

Formal processing: None.

Verdict: If the shortest interval is greater than or equal to 30s or the number of repeated call attempts did not exceed 15 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.

A.4.4 Impedance unbalance about earth - Communication condition

A.4.4.1 TE without internal generator

Requirement: Subclause 4.4.1.

Purpose: To ensure that the impedance unbalance about earth, expressed as Longitudinal Conversion Loss, meets the requirements specified in table 1.

Measurement principle:

Preamble: Ensure that the TE is powered and operational.

Test state: Powered and in the loop state.

Test configuration:

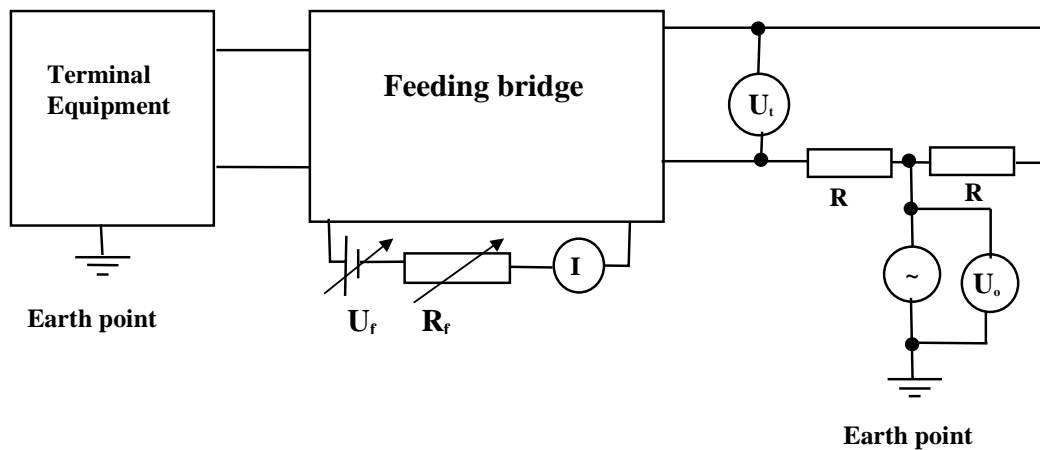


Figure A13

DC feeding arrangement: Feeding condition 4.

Measurement points: The resistors R shall be $300 \Omega \pm 1\%$ and matched to better than $0,2 \%$. The task sender output impedance is not critical. The voltmeter Input impedance shall be greater than $100 \text{ K}\Omega$. U_o shall be a sinusoidal signal with a constant level of $0,775 \text{ V}$ throughout the specified frequency range ($50 \text{ Hz} \div 3400 \text{ Hz}$ in 12th octave steps). Measurement of the longitudinal voltage U_t shall be performed with a suitable frequency selective level measuring instrument.

Measurement execution:

Measure the longitudinal voltage U_t across the specified frequency range for each of the feed conditions listed in the “Measurement points” statement above. Allow sufficient settling time at each feed condition to ensure that the measured value is stable to within $\pm 0,5\%$ for at least 2 s. The test shall be carried out for both polarities of feeding voltage.

Postamble: None.

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

$$\text{Longitudinal Conversion Loss} = 20\lg \left| \mathbf{V}_o / \mathbf{V}_t \right| \text{ dB}$$

Verdict: If the Longitudinal Conversion Loss is greater than the limit specified in table 1 then Pass; else Fail.

Guidance: None.

A.4.4.2 TE with internal generator

Requirement: Subclause 4.4.2.

Purpose: To ensure that the impedance about earth, expressed as output signal balance, meets the requirements specified in table 1.

Measurement principle:

Preamble: Ensure that the TE is powered and operational.

Test state: Powered and in the loop state.

Test configuration:

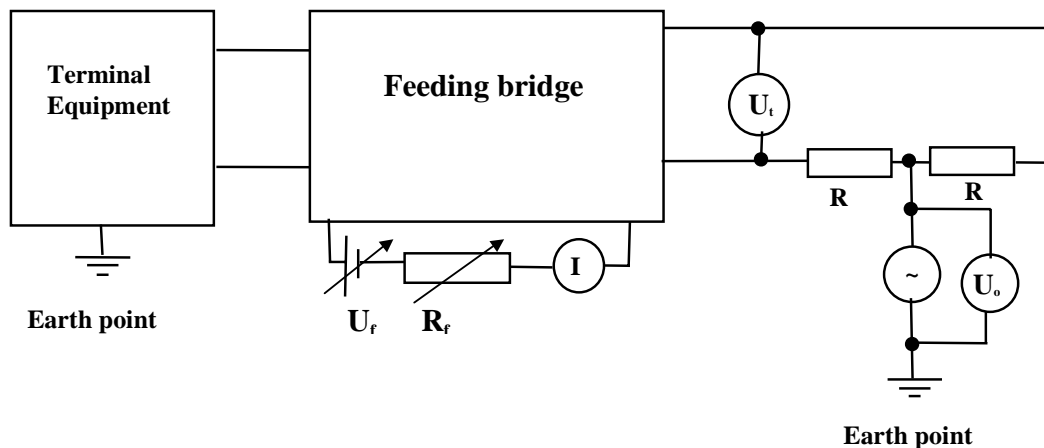


Figure A14

DC feeding arrangement: Feeding condition 4.

Measurement points: The resistors **R** shall be $300 \Omega \pm 1\%$ and matched to better than 0,2 %.
The voltmeter Input impedance shall be greater than $100 K\Omega$.
Measurement of voltages **U_t** shall be performed with a suitable frequency selective level measuring instrument.

Measurement execution:

The **TE** is set in the loop condition transmitting DTMF characters to line.
The test shall be carried out for both polarities of feeding voltage.

Postamble: None.

Formal processing: The measured value of **U₁** and **U₂** are used to calculate the output signal balance by using the following equation:

$$\text{Output signal balance} = 20 \lg \left| \frac{U_1}{U_2} \right| \text{ dB}$$

Verdict: If the output signal balance is greater than the limit specified in table 1, then Pass; else Fail.

Guidance: None.

Annex B: Additional Test Methods

Tests performed according to the requirements specifications of Part 68 of FCC

The Ministry of Communications recognizes tests performed by test laboratories which are recognized by authorized international approval bodies, such as FCC, BABT, BZT and ART.

This annex refers to equipment, which was type approved in the US after passing successfully the tests required by Part 68 of FCC requirements.

1. The test in clause 312(b)(1)(i) of Part 68 is equivalent to testing according to clause 4.1.1 of this specification. Compliance with the FCC requirement exempts from the need to test according to this specification.
2. The test in clause 312(b)(1)(iv) of Part 68 is equivalent to testing according to clause 4.1.2.1/2 of this specification. It is required to comply with the parameter requirements of this specification, which are different from the FCC requirements.
3. The test in clause 312(b)(1)(iii) of Part 68 is equivalent to testing according to clause 4.1.2.3 of this specification. It is required to comply with the parameter requirements of this specification, which are different from the FCC requirements.
4. The test in clause 310(A) of Part 68 is equivalent to testing according to clause 4.1.3 of this specification. It is required to comply with the parameter requirements of this specification, which are different from the FCC requirements.
5. Compliance with requirement of clause 308(b)(i) of Part 68 exempts from testing according to clause 4.2.1 (Maximum mean sending level) of this specification.
6. Equipment, which has passed successfully all tests, required by Part 68 will be exempt from testing according to clause 4.2.2 (Maximum instantaneous voltage) of this specification.
7. Compliance with clause 308(c)(1) of Part 68 exempts from testing according to clause 4.2.3 of this specification.
8. Compliance with clause 308(e)(1) of Part 68 exempts from testing according to clause 4.2.4 of this specification.
9. The test in clause 318(c) of Part 68 is equivalent to testing according to clause 4.3 of this specification. Compliance with this FCC requirement exempts from the need to test according to clause 4.3 of this specification.

Annex C: Table of Technical specifications of terminal equipment

File No.
Name of Company

Type of Equipment
Model No.....

Clause According to MOC specifications	Name of test	Requirements in MOC specifications	Given in Tech. Specification of TE	page No.	Given in Manufacturer's lab report	page No.
4.1.1	DC resistance in quiescent condition	$R \geq 1 \text{ } \square \Omega$ at 50 and 100 VDC				
4.1.2.2	Impedance for ringing signals	$40\text{K}\Omega > Z > 3\text{K}\Omega$ at 30 VAC and 25/50 Hz				
4.1.2.3	DC current during ringing	$I \leq 1.5 \text{ mA}$ at 90 VAC 25/50 Hz + 60 VDC				
4.1.3	Impedance unbalance about earth in quiescent condition	$LB \geq 40 \text{ dB}$ in the range 50 ÷ 600 Hz $LB \geq 46 \text{ dB}$ in the range 600 ÷ 3800 Hz				
4.2.1	Maximum mean sending level	$SL \leq -9.7 \text{ dBV}$ on Z_R in the range 200 ÷ 3800 Hz measured one minute				
4.2.2	Maximum instantaneous voltage	$V \leq 2\text{V}$ on Z_R in the range 200 ÷ 3800 Hz				
4.2.3	Maximum voltage in a 10Hz bandwidth	-33.7 dBV at 0.03 kHz -16.7 dBV at 0.1 kHz -6.7 dBV at 0.3 kHz -6.7 dBV at 3.8 kHz -10.7 dBV at 4.0 kHz -44.7 dBV at 4.3 kHz				
4.2.4	Maximum sending levels above 4.3 kHz	-29.7- -36.7 dBV in the range 4.3 - 5 kHz measured at 300 Hz BW -36.7 ÷ -46.7 dBV in the range 5 ÷ 7 kHz measure at 300 Hz BW -41.1 dBV in the range 7 ÷ 200 kHz measured at 1 kHz BW -45.7 dBV in the range 200 ÷ 2000 kHz measure at 10 kHz BW				
4.3	Automatically repeated call attempts	# of attempts < 15 or delay after each attempt > 30 Sec.				
4.4	Impedance unbalance around earth - communication condition	$LC \geq 40 \text{ dB}$ in the range 50 ÷ 600 Hz $LC \geq 46 \text{ dB}$ in the range 600 ÷ 3400 Hz				
4.5	General Requirement	According to data provided by the manufacturer				
4.6	Safety	The TE shall comply with IS 1121				
4.7	EMC	The TE shall comply with IS 961 part 6				

Annex D

Test Report

File No.	Type of Equipment:	Model:	Date:
Name of Tester:		Signature:	
Approved by:		Signature:	

Test Report

File No.:	Type of Equipment:	Model:	Date:
Clause in TE specification	Name of Test	Requirements in specifications	Results
4.1.1	DC resistance in Quiesc. condition	The resistance in quiescent condition shall be tested at 50 and 100 VDC and shall not be less than 1 MΩ	
4.1.2.1	Min. impedance for ringing signals	Testing at 30 VAC and at 25/50 Hz the TE impedance shall not be less than 3 kΩ	
4.1.2.2	Max. impedance for ringing signals	Testing at 30 VAC and at 25/50 Hz the TE impedance shall not be more than 40 kΩ	
4.1.2.3	DC current during ringing	The DC curr. while applying a ring signal of 90 VAC at 25/50 Hz with 60 VDC, shall not exceed 1.5 mA .	
4.1.3	Impedance unbalance about earth in quiescent condition	When manufacturer's instructions indicate need or possibility of grounding TE, longitudinal conversion loss shall be according to following: Min. 40 dB at 50 ÷ 600 Hz Min. 46 dB at 600÷3400 Hz	
4.2.1	Maximum mean sending level	The mean sending level in the range 200÷ 3800 Hz in any 1 minute period shall not exceed -9.7 dBV when the TE interface is terminated by Z_R .	
4.2.2	Maximum instantaneous voltage	Excluding transients during signaling, the maximum voltage in the range 200÷3800 Hz shall not exceed 2 V when the TE is terminated by Z_R .	
4.2.3	Maximum voltage in a 10 Hz bandwidth	The max apparent power in a bandwidth of 10 Hz centered around any frequency in the range 30 ÷ 4300 Hz shall not exceed the following given limits while the TE is terminated by Z_R . Except during signaling. Point Frequency (kHz) Max. Sending level (dBV) A 0.03 -33.7 B 0.1 -16.7 C 0.3 - 6.7 D 3.8 - 6.7 E 4.0 - 10.7 F 4.3 - 44.7	
4.2.4	Maximum sending levels above 4.3 kHz	The power spectral density in a given bandwidth, wholly contained within the freq. range 4.3 kHz to 2 MHz, arising from normal operation of the TE when in on-line, non signaling state, and when sending DTMF digits, while terminated with 120 Ω, shall not exceed the limits defined : Frequency Max Sending Level Measurement Range (kHz) (dBV) bandwidth 4.3 to 5 -29.7 dec to -36.7 300 Hz 5 to 7 -36.7 dec to -46.7 300 Hz 7 to 200 -41.7 1 kHz 200 to 2000 -45.7 10 kHz	
Name of Tester:		Signature:	

Approved by:		Signature:	
File No.:	Type of Equipment:	Model:	Date:
Clause in TE specification	Name of Test	Requirements in specifications	Results
4.3	Automatically repeated call attempts	The TE shall not automatically initiate an internally generated repeat call attempt less than 30 s after the termination of the previous call attain the same repeat attempt sequence. The previous call is considered to be terminated when the TE returns to the quiescent condition. Alternately, a TE shall not initiate automatically more than 15 consecutive call attempts in the same repeat attempt sequence.	
4.4.1	Impedance unbalance about earth	The longitudinal conversion loss and the output signal unbalance shall be at least the values: 40 dB in the range 50 ÷ 600 Hz 46 dB in the range 600 ÷ 3400 Hz	
4.5	General 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 provide information regarding 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.	
4.6	Safety	The TE shall comply with IS 1121 - Safety of information technology equipment, including electrical office equipment	
4.7	EMC	The TE shall comply with IS 961 Part 6 – Electromagnetic interference: Limits and measurement methods of interference from information technology equipment.	
Name of Tester:		Signature:	
Approved by:		Signature:	