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**Terminal Equipment (TE);
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Electrical coupling of telephone sets to hearing aids**

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Foreword

This European Telecommunication Standard (ETS) has been produced by the Terminal Equipment (TE) Technical Committee of the European Telecommunications Standards Institute (ETSI).

Transposition dates	
Date of adoption of this ETS:	23 August 1996
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Introduction

This ETS is the third in a series developed especially to meet the needs of people with hearing impairments who want to use the telephone. The first, ETS 300 381, covers inductive coupling and the second, ETS 300 488, covers additional amplification. This ETS covers the possibility of electrical coupling from a telephone set to a hearing aid, and all three ETSs are in general accordance with ITU-T Recommendation P.37. This ETS is intended to be compatible with the IEC Publication 118, Part 6, which covers the characteristics of electrical input ports for hearing aids. It is anticipated that electrical coupling would benefit a limited number of users and should be regarded as an additional method and not a replacement for inductive coupling.

It is envisaged that direct electrical connection between a hearing aid and a telephone set could be used in other applications that require electrical connection to the Public Switched Telephone Network (PSTN), for example to couple into other non-telephony amplification systems such as public address, or recording systems. Another alternative would be the direct electrical connection to a hearing aid transducer or headset, given that the device had sufficient sensitivity.

Some of the applications envisaged would need to address safety and/or protection issues and, although these and the applications themselves do not come within the scope of ETSI standards, attention is drawn to them here for information.

I-ETS 300 245-4 (covering the Additional Equipment Interface standard) could find application for coupling to the receive path of a telephone into a hearing aid.

NOTE: It is possible that the system described could enable hearing aid users to use low-powered GSM (Group Special Mobile) telephones or DECT (Digital Enhanced Cordless Telephone). In this case some attention would need to be paid to ensure that disturbing signals are controlled sufficiently to prevent modulated carrier signals from interfering with the hearing aid. It is not possible to be more specific at this stage.

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1 Scope

This European Telecommunication Standard (ETS) specifies the electrical characteristics for the electrical coupling of the telephony function implemented in Terminal Equipment (TE) to hearing aids. It specifies the level and frequency response relative to the acoustic output at the earphone, and also the noise and maximum level.

This ETS applies to all apparatus that is capable of supporting telephony and can be connected to the Public Switched Telephone Network (PSTN) or Integrated Services Digital Network (ISDN), which are intended for direct application to the ear, using for example traditional handsets or operator's headsets, and which provide an electrical output port for the prime purpose of coupling electrically to a hearing aid. This ETS may also be invoked for mobile apparatus and apparatus having cordless handsets that provide the facility for electrical coupling to hearing aids.

Although handsfree and loudspeaking devices are outside the scope of this ETS, if such apparatus also supports handset telephony as a separate function, this ETS may be invoked as part of that function.

2 Normative references

This ETS incorporates by dated and undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this ETS only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

- [1] ITU-T Recommendation P.57 (1994): "Artificial ears".
- [2] IEC Publication 268-11 (1987): "Sound System Equipment Part 11: Application of Connectors for the Interconnection of Sound System Components".
- [3] CCITT Handbook on Telephony, ITU (1992).
- [4] ITU-T Recommendation P.64 (1994): "Determination of sensitivity/frequency characteristics of local telephone systems".
- [5] CCITT Recommendation P.53 (1988): "Psophometers (apparatus for the objective measurement of circuit noise)".

3 Abbreviations

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

dBVp	Decibels relative to 1 Volt, psophometrically weighted
ERP	Ear Reference Point
ISDN	Integrated Services Digital Network
PSTN	Public Switched Telephone Network
TE	Terminal Equipment

4 Electrical characteristics

The bandwidth assumed for the requirements listed below is 315 Hz to 4 000 Hz. If the bandwidth is different from this, e.g. as for wideband telephony, then the extremes of the test frequencies shall be changed accordingly to accommodate the nominal bandwidth of such terminals.

The following requirements and associated test methods assume the use of sine waves in one third octave sequences, or as appropriate for the equipment under test. For some apparatus it may be more appropriate to use other types of signal if it can be shown that such signals yield equivalent results.

Unless otherwise stated all the requirements given below are for the volume control (if present) set to give maximum output.

4.1 Point of connection in the telephone set

The interconnection to the hearing aid shall be taken from the electrical path to the handset earphone so that the sidetone path is coupled into the hearing aid. Also, it shall not be possible to inject a signal into the telecommunication network from this point. Compliance shall be tested by inspection.

4.2 Electrical characteristics at interconnection point

This ETS assumes that the load normally applied by a hearing aid input circuit will be 2 000 ohms resistive, as specified in IEC 118, Part 6 (see annex D).

4.2.1 Setting the acoustic receive and signal generator reference drive levels

The signal generator reference drive level that produces a sound pressure level of - 14 dBPa at 1 000 Hz at the ERP (Ear Reference Point) shall be determined in accordance with subclause 6.1. This reference drive level shall be used for measuring the impedance, sensitivity and frequency characteristics specified in subclauses 4.2.2, 4.2.3 and 4.2.4.

4.2.2 Impedance

The modulus of the electrical source impedance between the frequencies of 315 Hz and 4 000 Hz, or over the nominal bandwidth of the telephone set if greater than this, shall be less than 1 000 ohms for all settings of the volume control (if present). Conformance shall be checked using the test described in subclause 6.2.

4.2.3 Sensitivity

With the reference drive level of the oscillator set to produce - 14 dBPa at the artificial ear, with the choice and use of the artificial ear in accordance with ITU-T Recommendation P.57 [1] (see subclause 6.1), the electrical output at 1 000 Hz shall be - 35 dBV \pm 5 dBV. With the volume control (if present) set to minimum, the electrical output shall be between 15 dB and 30 dB lower than the output at the maximum setting. Conformance shall be checked using the test described in subclause 6.3.

4.2.4 Frequency characteristic

The frequency response at the telephone electrical interconnection point when loaded with 2 kohms shall be equal to the sensitivity at 1 000 Hz \pm 3 dB over the range 315 Hz to 4 000 Hz and \pm 5 dB over the range 100 Hz to 315 Hz, for all settings of the volume control (if present). Conformance shall be checked using the test described in subclause 6.4.

4.2.5 Maximum output

With the reference drive level increased by 50 dB (see subclause 6.1) the maximum output at the electrical interconnection point shall be limited to 3 Volts peak-to-peak over the frequency range 315 Hz to 4 000 Hz. Conformance shall be checked using the test described in subclause 6.5.

4.2.6 Noise

With the signal generator in subclause 6.1 replaced by a 600 ohms resistor, the noise level at the electrical interconnection point shall be less than - 70 dBVp. Conformance shall be checked using the test described in subclause 6.6.

4.2.7 Linearity check

The linearity shall be such that an increase of the reference drive level by 20 dB shall result in an increase in the electrical output voltage of 20 dB \pm 1 dB. Conformance shall be checked using the test described in subclause 6.1.

4.3 Safety

Safety issues are generally covered by the Low Voltage Directive (73/23/EEC). However in order to prevent direct electrical connection with the network interconnection point should be electrically isolated, for example, by use of a transformer.

5 Interconnection with the telephone set

The connection shall be by means of a socket which is compatible with a miniature coaxial, stereo jack plug, type 130-8 IEC-pp, conforming to IEC 268-11 [2]. Normally the socket shall be of 3,5 mm diameter. Alternatively, for compact telephone sets such as cordless or mobile telephones, the socket may be of 2,5 mm diameter.

The electrical connection shall be made using the tip and ring terminals of the plug and mating socket. Connection to the sleeve (screen) of the plug is optional. Compliance shall be tested by inspection.

NOTE: Annex C gives further information concerning the connector position on the telephone and the interconnecting lead.

6 Test procedures

The test methods described below shall be consistent with ITU-T practices as documented in the CCITT Handbook on Telephonometry [3] and in ITU-T Recommendation P.64 [4]. The choice of artificial ear shall be appropriate for the equipment under test. ITU-T Recommendation P.57 [1] gives guidance on this subject.

When measuring sampled systems, measuring at submultiples of the sampling frequency should be avoided. There is a tolerance of \pm 2 % on the generated frequencies, which may be used to avoid this problem.

6.1 Setting the reference drive level

Using the measurement configuration shown in figure 1 for analogue telephones and figure 2 for digital telephones, or an equivalent arrangement for cordless or mobile telephones, the drive level of the oscillator or signal generator shall be adjusted to produce a sound level of - 14 dBPa at 1 000 Hz at the ERP. This drive level shall be used for measuring the impedance, sensitivity and frequency characteristics specified in clause 4.

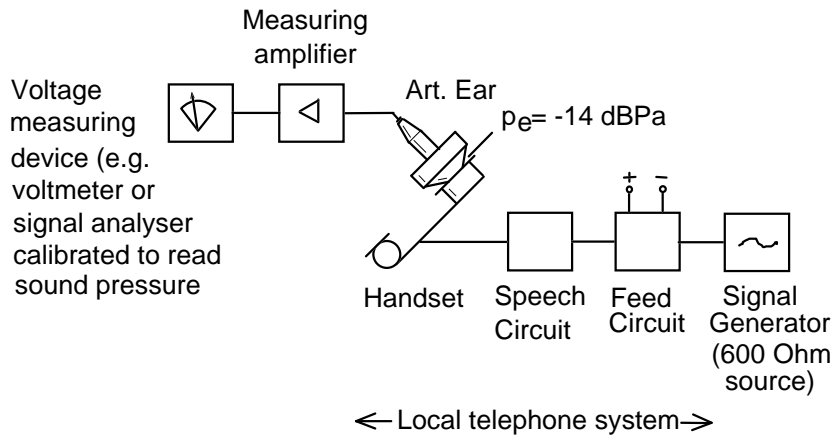
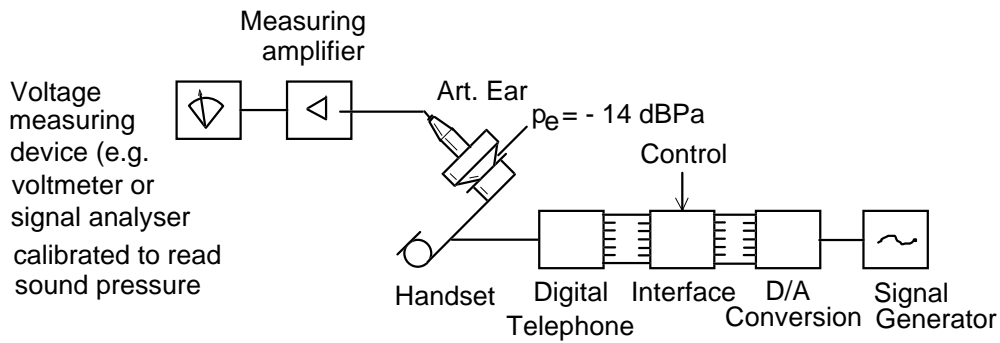
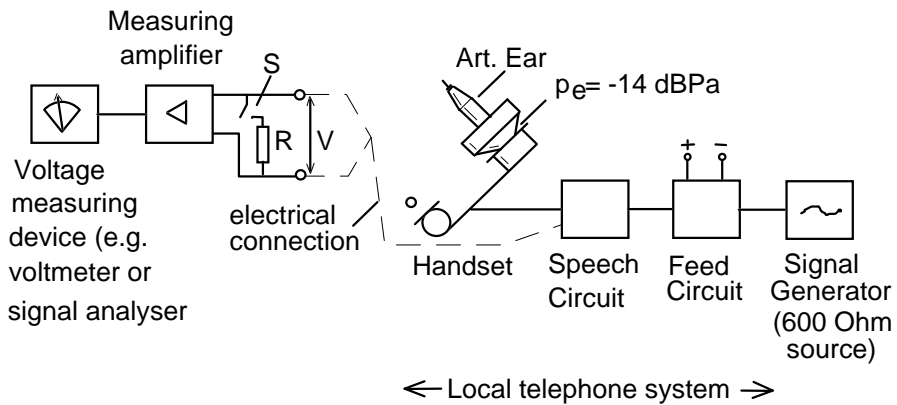


Figure 1: Setting the sound pressure level p_e in the artificial ear for an analogue telephone set



NOTE: Instead of the D/A conversion, the direct digital signal generation may be used.

Figure 2: Setting the sound pressure level p_e in the artificial ear for a digital telephone set



NOTE: The feed circuit arrangement is shown for an analogue set. For a digital set this should be replaced by that of figure 2.

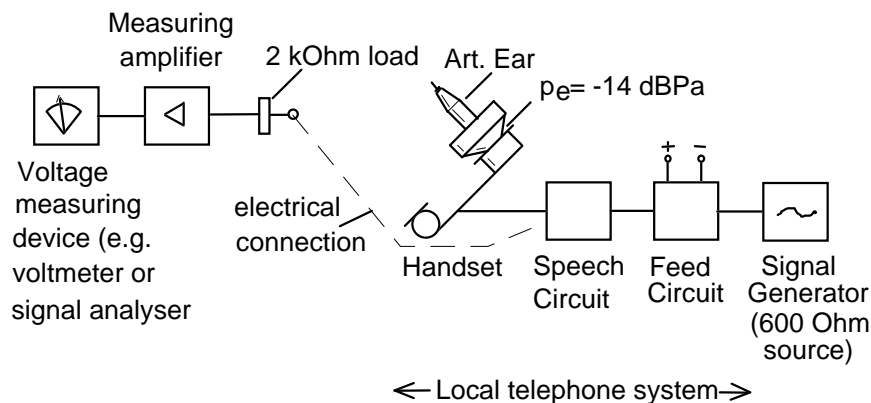
Figure 3: Determining conformance with the impedance requirements

6.2 Determining the electrical impedance at the interconnection point

Using the test arrangement of figure 3 and with the drive voltage set as described in subclause 6.1, set the termination R to be 1 000 ohms. On opening and closing switch S the change in voltage V shall be less than 6 dB for any frequency in the range 300 Hz to 4 000 Hz.

6.3 Measurement of the sensitivity

Using the test arrangement of figure 4 and with the drive voltage set as described in subclause 6.1, for a frequency of 1 000 Hz, measure the output voltage at the interconnection point when loaded with a 2 kohms resistor.



NOTE: The feed circuit arrangement is shown for an analogue set. For a digital set this should be replaced by that of figure 2.

Figure 4: Measuring the electrical output from the telephone set

6.4 Determining the frequency characteristic

Using the test arrangement of figure 4 and with the drive voltage set as described in subclause 6.1, the output voltage shall be measured at the interconnection point when loaded with a 2 kohms resistor over the frequency range 100 Hz to 4 000 Hz (or as appropriate for the apparatus under test).

6.5 Determining the maximum output level

Using the test arrangement of figure 4, increase the reference drive level by 50 dB. The output level across the 2 kohms termination shall be measured over the frequency range 315 Hz to 4 000 Hz (or as appropriate).

6.6 Determining the electrical noise level

Using the test arrangement of figure 4 but with the signal generator replaced by a 600 ohms resistor and the voltmeter replaced by a psophometer as specified in CCITT Recommendation P.53 [5], the electrical noise level across the 2 kohms termination shall be measured.

6.7 Checking the input/output linearity

Using the test arrangement of figure 4, the electrical output across the 2 kohms termination shall be determined for an input at the reference drive level and with the drive level increased by 20 dB.

Annex A (normative): Packaging, labelling and user instructions

A.1 Packaging and labelling

Where the telephone instruments are suitable for use by hearing impaired people this shall be indicated by the inclusion of an agreed international symbol on the telephone sets themselves, the packaging, brochures and instruction leaflets as public signs that such facilities are available and conform to this standard. A general symbol for this purpose is shown in figure A.1 below. A special symbol for electrical coupling is being developed by ETSI TC-HF.



Figure A.1: Internationally agreed symbol to indicate availability of facilities for hearing impaired people

A.2 User instructions

Instructions which clearly describe the manner in which the instrument to be used in conjunction with hearing aids shall be provided with each instrument. The instructions shall show how, if provided, the volume and any other controls on the telephone are to be used for maximum efficiency and make reference to the use of the controls on the hearing aid particularly the switch position necessary to enable the electrical coupling feature to be used. If electrical coupling can be used in addition to the increased receiving amplification this should be stated. If undesirable effects can occur, for example acoustic feedback, adequate warnings of the combination of conditions under which such effects can occur shall be given together with the appropriate remedial actions necessary.

A.3 Product Suppliers Information

If the complexity of the terminal demands the use of special testing techniques in order to assess performance this shall be clearly stated together with information to enable a test house to carry out a meaningful evaluation of the product.

Annex B (informative): Rationale for electrical output sensitivity chosen

The IEC Publication 118, Part 6 (see annex D) calls for hearing aids to have an electrical input sensitivity (if provided) such that the sound pressure generated in the earphone from a microphone input of 70 dBSPL equates to an electrical input of 0,5 mV to 10 mV. The test frequency chosen is 1 600 Hz or 2 500 Hz. As there is sufficient signal at the telephone line to satisfy the 10 mV level (- 40 dBV) we can equate this figure to the 70 dBSPL (- 24 dBPa) microphone input, based on the assumption of the need to give equality of output to the aided ear for acoustic and electrical coupling to the telephone. For other related standards the sound pressure at the ear is set at - 14 dBPa, thus equating to an electrical output of - 30 dBV. Allowing a tolerance of ± 5 dB this results in a requirement of - 35 dBV ± 5 so as to avoid exceeding the hearing aid input requirement (maximum 10 mV for 70 dBSPL or - 30 dBV for - 14 dBPa). The fact that the frequency response is normally sensibly flat in receiving allows the use of 1 000 Hz for telephony purposes and gives consistency in the ETSI standards.

Annex C (informative): Coupling to the hearing aid

C.1 Connector position

It is recommended that the connector socket should be positioned on the telephone for high visibility and ease of inserting the plug. This means that the socket should be placed on the front edge, front top side or on the front sides of the subset housing. The socket should be placed so that the plug and lead does not interfere with the normal operation of the telephone, i.e. lifting/replacing the handset, dialling, inserting coins or cards, or any other functions. On public telephones it is important that the socket is not positioned on a horizontal surface making it susceptible to the ingress of fluids or other contaminants.

For one-piece telephones, cordless phones and mobile phones the socket should be positioned so that the plug and the lead do not interfere with the normal operation of the instrument, i.e. holding it, dialling, charging batteries, or any other function.

C.2 Interconnecting lead

Although outside the scope of this ETS the design of the interconnecting lead needs careful consideration as an integral part of the coupling from the telephone set to the hearing aid. For example;

- The flexible cord should be very lightweight but robust.
- Consideration should be given to the provision of a purpose designed receptacle to enable the cord to be carried about and to reduce the risk of it becoming tangled so increasing the fault liability.
- Cords that might be used to couple GSM or DECT telephone handsets to a hearing aid may need to be screened to reduce interference from the radio frequency signals in the aid.
- Attention needs to be paid to the connection at the hearing aid, bearing in mind that some hearing aid users, particularly elderly users, may have lost some dexterity and find it difficult to make the connection into the aid itself.

Annex D (informative): Bibliography

For the purposes of this ETS, the following references have been given for information:

- ETS 300 381 (1994): "Telephony for hearing impaired people; Inductive coupling of telephone earphones to hearing aids".
- ETS 300 488 (1996): "Terminal Equipment (TE); Telephony for hearing impaired people; Characteristics of telephone sets that provide additional receiving amplification for the benefit of hearing impaired".
- I-ETS 300 245-4 (1995): "Integrated Services Digital Network (ISDN); Technical characteristics of telephony terminals; Part 4: Additional Equipment Interface (AEI)".
- ITU-T Recommendation P.37 (1994): "Coupling hearing aids to telephone sets".
- IEC Publication 118-6 (1984): "Characteristics of electrical input circuits for hearing aids".
- 73/23/EEC: "Council Directive of 19 February 1973 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits".

NOTE: Commonly referred to as the Low Voltage Directive.

History

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