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TELEPHONE TRANSMISSION QUALITY
SUBSCRIBERS' LINES AND SETS

COUPLING HEARING AIDS TO TELEPHONE SET

ITU-T Recommendation P.37

(Previously "CCITT Recommendation")

FOREWORD

The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the International Telecommunication Union. The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, established the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

ITU-T Recommendation P.37 was revised by the ITU-T Study Group XII (1988-1993) and was approved by the WTSC (Helsinki, March 1-12, 1993).

NOTES

1 As a consequence of a reform process within the International Telecommunication Union (ITU), the CCITT ceased to exist as of 28 February 1993. In its place, the ITU Telecommunication Standardization Sector (ITU-T) was created as of 1 March 1993. Similarly, in this reform process, the CCIR and the IFRB have been replaced by the Radiocommunication Sector.

In order not to delay publication of this Recommendation, no change has been made in the text to references containing the acronyms "CCITT, CCIR or IFRB" or their associated entities such as Plenary Assembly, Secretariat, etc. Future editions of this Recommendation will contain the proper terminology related to the new ITU structure.

2 In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

CONTENTS

INTRODUCTION

It is recognized that there is a sizeable proportion of telephone users that have difficulty in conversing over a telephone connection due to hearing loss. To alleviate these difficulties special means have been provided in many national systems to enable hearing impaired users to couple their hearing aids inductively to the telephone receiver, and a number of national/international specifications define characteristics for this form of coupling. Clause 1 addresses the requirements for successful inductive coupling of hearing aids to telephone sets.

Furthermore, it is also recognized that many hearing impaired users are able to have satisfactory telephone conversations while coupling their hearing aids acoustically to the telephone receiver, or even using the telephone handset without a hearing aid. This latter situation is possible due to the fact that under good conditions a telephone connection can be louder than a face to face conversation over a 1 metre air path by up to 30 dB. Provision of additional amplification in the mouth to ear path can greatly increase the proportion of telephone conversations involving hearing impaired users that are rated "good". Clause 2 addresses this form of coupling.

Certain national standards also exist to enable direct electrical connection of hearing aids to telephone apparatus. It is hoped that this form of coupling will be covered in a future version of this Recommendation.

COUPLING HEARING AIDS TO TELEPHONE SETS

(Malaga-Torremolinos, 1984; amended at Melbourne, 1988 and at Helsinki, l993)

1 Magnetic field strength around the earcap of telephone handsets which provide for coupling to hearing aids

1.1 Introduction

Magnetic induction systems incorporated in telephone handsets generate an alternating magnetic field with spatial characteristics which make the field detectable by hearing aids equipped with induction pick-up coils.

Reception of an audio-frequency signal via an induction pick-up coil can often allow an acceptable signal-to-noise ratio to be achieved in cases where the acoustical reception would otherwise be degraded by reverberation and background noise.

The magnetic field strength which enables induction pick-up coils in hearing aids to function effectively must be high enough to produce an acceptable signal-to-noise ratio but not so high as to cause overloading of the hearing aid.

The value of magnetic field strength recommended in this standard has been chosen so that these requirements are met as far as possible.

1.2 Scope

This Recommendation applies to telephone handsets which provide a magnetic field for coupling to hearing aids. It specifies the level, linearity and frequency dependence of the magnetic field strength produced by the handset and characteristics for a calibrated probe coil.

1.3 Explanation of terms

1.3.1 Level of magnetic field strength

The maximum value of the magnetic field strength is measured in accordance with 4.2.

1.3.2 Plane of measurement

A plane parallel to the earcap plane at a distance of 10 mm.

1.4 Magnetic field strength measurements and recommended values

1.4.1 Calibration of acoustic receive level

Using the measurement configuration shown in Figure 3/P.64, for analogue telephones, Figure 6/P.66 for digital telephones, the drive level of the oscillator shall be adjusted to produce a sound pressure level of 80 dB at 1000 Hz. This drive level shall be used for measuring the level and frequency characteristics of the magnetic field strength.

1.4.2 Magnetic field strength level

Place (per clause 5) the centre of the calibrated probe coil in the plane of measurement and circuit orientate it for maximum coupling. Determine the magnetic field strength at 1000 Hz using the drive level as per 4.1.

Recommended range of values for the magnetic field strength is

–17 to –30 dB relative to 1 A/m

NOTE – Hearing aids with magnetic pick-up coils primarily intended for coupling to magnetic loops in auditoria in accordance with IEC Publication 118-4 are likely to have a sensitivity that corresponds to a field strength in the upper end of the range recommended for coupling to telephones.

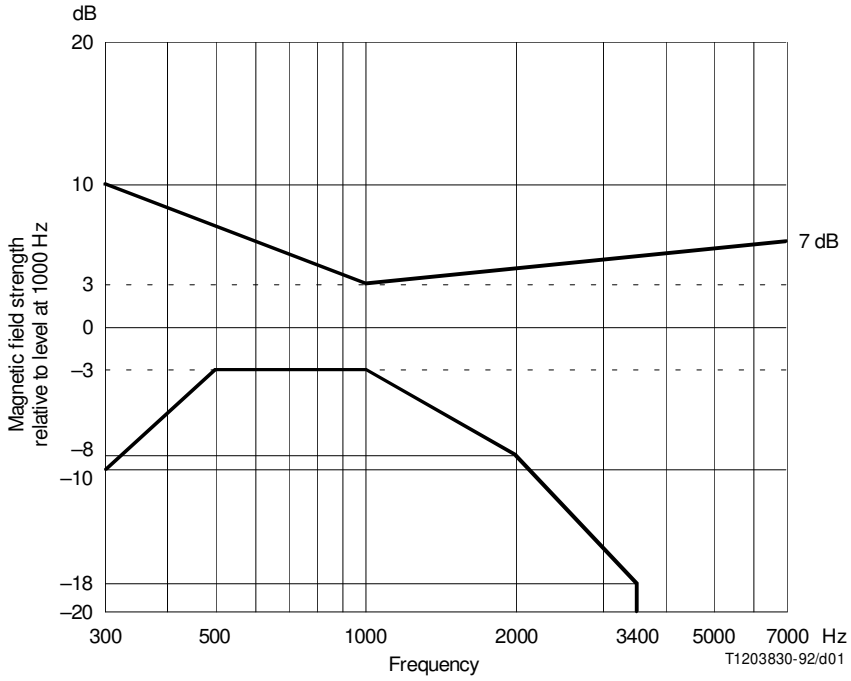
1.4.3 Linearity of the magnetic field strength

With the probe coil positioned as in 4.2, increase the 1000 Hz drive level specified in 4.1 by 20 dB and measure the resulting magnetic field strength.

The field strength should increase by 20 dB ± 1 dB.

1.4.4 Measurement of frequency characteristics

With the probe coil positioned as in 4.2 and the drive level as in 4.1, vary the frequency from 300 Hz to 5000 Hz for analogue telephones and to the upper frequency limit for digital telephones (4000 or 7000 Hz) as appropriate and measure the resulting field strength. The magnetic field strength frequency characteristics shall fit within the template shown in Figure 1.



NOTE – Preferred frequency characteristics are within the dotted lines (± 3 dB). Range of acceptable characteristics is within the solid lines.

FIGURE 1/P.37

Magnetic field strength frequency characteristics

1.5 Probe coil

1.5.1 Dimensions

For measuring the magnetic field strength, a calibrated probe coil having the following dimensions is recommended:

Core: length (12.5 ± 1 mm)
cross section (1 mm ± 0.5 mm) × (2 mm ± 0.5 mm)

Winding: length (10 mm ± 1 mm)
cross section (2 mm ± 0.5 mm) × (3 mm ± 0.5 mm)

The winding shall be shorter than the core.

NOTES

1 The magnetic field may be inhomogeneous within distances comparable to the length of the probe coil. The introduction of a magnetic core material may also redirect the magnetic field contours, therefore the magnetic material of the core may be of importance.

2 The probe coil may be combined with frequency correcting elements to obtain a flat frequency response in the range of 300 Hz to 7000 Hz.

3 The North American Standard EIA/TIA RS 504, as included in the FCC Rules Part 68.316, refers to a commercially available probe coil of slightly smaller dimensions which nevertheless meets the requirements to this Recommendation.

1.5.2 Calibration of probe coil

In order to calibrate the probe a homogeneous magnetic field of known intensity must be available. The magnetic field strength at the centre of a square loop of one turn with a side of "a" metres and carrying a current of "i" amperes is given by:

$$H = \frac{2\sqrt{2}}{\pi} \cdot \frac{i}{a} \qquad A/m$$

The dimension "a" should be 0.5 m or more to ensure that the field at the centre is sufficiently well defined in magnitude and direction.

In practice it may be advantageous to construct the loop having several turns to reduce the current from the source. Essentially constant current conditions should be maintained over the test frequency range, for example driving the coil from a low impedance generator through a series resistor having at least 100 times the impedance of the coil over the frequency range of interest. If the current drive is monitored during the calibration process any variations can be taken into account when deriving the probe coil sensitivity.

The test space must be remote from any field disturbing magnetic material or other material in which eddy currents can be induced, so causing a field disturbance.

The sensitivity as a function of frequency of the probe coil shall be measured with an accuracy of ± 0.5 dB.

The harmonic distortion of the magnetic field shall be less than 1%.

NOTE – Further helpful information is given in IEC Publication 118-1.

1.5.3 Distortion

The distortion of the probe coil shall be less than 2%, when measuring field strength up to +2 dB relative to 1 A/m.

2 Characteristics of telephone sets that provide additional amplification for the benefit of hearing impaired users

2.1 Introduction

This clause recommends the requirements for telephones with receive amplification intended to aid the hearing impaired. A significant proportion of the population is disabled by varying degrees of hearing loss, often associated with a reduction of speech discrimination ability. Amplification can only replace the lost sensitivity.

The group most likely to receive the greatest benefit from use of a telephone with additional receive amplification are those with moderate to severe hearing losses in the range 35 dB to 80 dB.

In setting the numerical values in this Recommendation, consideration has been given to the fact that the sound pressure levels at the ear during a telephone conversation can be up to 30 dB above those occuring in normal face to face conversation (at 1 metre distance). As hearing impaired people do not necessarily have elevated thresholds of loudness discomfort, some form of output limitation will be required. Recent work has indicated that Automatic Gain Control (AGC) may provide a better automatic means of limitation than peak clipping. In addition, it is recognized that the frequency response to give maximum intelligibility to some hearing impaired people may require shaping.

It is recommended that the receive amplification, the level of which is selected by means of a volume control, is brought into use by operation of a latching switch that automatically resets the gain to nominal level when the handset is replaced in its rest position. This ensures that the normal receive sensitivity is always available to the non-impaired user. The use of voice switched attenuation, perhaps 10-12 dB, may be necessary to provide protection against instability, and could also improve the discrimination against the ambient noise received through the sidetone path.

It is estimated that with the provision of additional amplification to the levels recommended below, possibly up to 80% of hearing impaired users would benefit even when not using their hearing aids to couple to the telephone set. If a hearing is worn in addition and inductive coupling is also provided, then the proportion of hearing impaired who will be able to have satisfactory telephone conversations will increase further. It is however pointed out that with a high gain setting selected, the sound level and/or inductive field at the earphone can be expected to be considerably higher than normally experienced by hearing aid microphones and/or inductive pick-up coils and, on short telephone connections particularly, there is a very real danger of overloading input stages.

2.2 Sending characteristics

2.2.1 Sensitivity

It is recommended that when the user is talking, the Send Loudness Rating (SLR) remains at a constant value set by the requirements of the national system, irrespective of any receive amplification selected.

If voice switching is used in the interests of preserving stability margins and/or Terminal Coupling Loss (TCL) under difficult operating conditions, it is recommended that the switched attenuation be the minimum required for the purpose, e.g. approximately equal to that required to offset any increased receiving amplification selected.

2.2.2 Frequency response

It is recommended that the sending frequency response is maintained according to the requirements of the national system irrespective of any increased receiving gain selected.

2.3 Receiving characteristics

2.3.1 Sensitivity

In respect of the receive sensitivity it is recommended that when no additional receive amplification is selected the Receive Loudness Rating (RLR) requirements of the national system are met.

With additional receive amplification selected it is recommended that it should not be possible to set the RLR 20 dB more negative (louder) than the nominal requirements of the national system.

With any amplifier volume control set to its minimum position it is recommended that it should not be possible to set the RLR 10 dB more positive (quieter) than the nominal requirements of the national system.

If additional amplification is provided in association with voice switching functions then the principles outlined in 5/P.34 are recommended. The depth of switched attenuation should be kept to a minimum in the interests of good speech quality but should be sufficient to maintain stability, return loss and TCL requirements.

2.3.2 Frequency response

When no additional amplification is selected it is recommended that the receive frequency response meets the requirements of the national system.

With additional amplification selected, under some conditions and for particular hearing impaired users it may be appropriate to provide special frequency shaping. In particular, shaping could be provided to compensate for the loss of low frequencies caused by earcap leakage effects that occur with most types of telephone earphone.

2.4 Sidetone

It is recommended that sidetone levels (STMR, LSTR) indicated in Recommendation G.121 be provided when additional amplification is not in use.

With additional amplification selected it will normally only be possible to maintain recommended sidetone levels if voice switching functions are used.

Annex A

Measurement of an acousto-magnetic adapter generating a magnetic field

(This annex forms an integral part of this Recommendation)

A.1 Scope

This annex specifies the measuring method for an acousto-magnetic adapter that converts the acoustic output of an associated telephone receiver to a magnetic field, in accordance with 4.1 and 4.2, that can be received by the magnetic pick-up coil in a hearing aid.

A.2 Definition of the adapter plane

The **adapter plane** is defined as the plane formed by the contacting points of a flat surface against the surface of the acousto-magnetic adapter opposite the earcap connection.

A.3 Definition of the plane of measurement

The **plane of measurement** is defined as a plane parallel to the adapter plane at a distance of 10 mm.

A.4 Measurement procedures

Measurements are made in accordance with this Recommendation.

The output sound pressure level of the telephone receiver is measured against the artificial ear without the acousto-magnetic adapter being mounted.

The characteristics of the magnetic field of the acousto-magnetic adapter are measured when mounted on the actual telephone receiver.

NOTE – In reporting results, the type of telephone set used should be specified.

A.5 Magnetic field requirements

The magnetic field produced by the adapter when fitted to a handset should meet the level and frequency characteristic requirements given in 4.2 and 4.4.

A.6 Physical properties

Desirable physical properties of the acousto-magnetic adapter are:

- easy to place on the earcap and remove again;
- a firm contact to the earcap so that the acousto-magnetic adapter and the telephone handset can be used as an integrated unit;
- forming a good and well-defined acoustic coupling to the earcap (see Note);
- the surface of the acousto-magnetic adapter defining the adapter plane should be flat or should have a shape easily defining the adapter plane;
- the adapter plane should be approximately parallel to the earcap plane;
- the magnetic field produced by the adapter should be orientated so that the magnetic coupling to the hearing aid is only to a small extent dependent on the position of the hearing aid.

NOTE – The inner diameter of an acoustic seal is recommended to be equal to the edge diameter of the IEC 318 artificial ear.

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