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**Induction loop systems
intended to assist the hearing impaired
in the frequency range 10 Hz to 9 kHz;
Harmonised Standard covering the essential requirements
of article 3.2 of Directive 2014/53/EU**

Reference

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Contents

Intellectual Property Rights 5
Foreword 5
Modal verbs terminology 5
Introduction 5
1 Scope 7
2 References 7
2.1 Normative references 7
2.2 Informative references 7
3 Definitions, symbols and abbreviations 8
3.1 Definitions 8
3.2 Symbols 10
3.3 Abbreviations 10
4 Technical requirements specifications 11
4.1 Environmental conditions 11
4.1.1 Environmental profile 11
4.2 General requirements 11
4.2.1 Presentation of induction loop amplifier equipment for testing purposes 11
4.2.2 Choice of model for testing 11
4.2.3 Controls 11
4.2.4 Amplifier shut-off facility 12
4.2.5 Declarations by the manufacturer 12
4.2.6 Auxiliary test equipment 12
5 Testing for compliance with technical requirements 12
5.1 Environmental conditions for testing 12
5.1.1 General requirements 12
5.1.2 Normal temperature and humidity 12
5.1.3 Test power source 12
5.1.3.1 General requirements 12
5.1.3.2 External test power source 13
5.1.3.3 Internal test power source 13
5.1.3.3.1 General 13
5.1.3.3.2 Mains voltage 13
5.1.3.3.3 Valve-regulated lead-acid battery power sources 13
5.1.3.3.4 Other power sources 13
5.2 General conditions 13
5.2.1 Normal test signals 13
5.2.1.1 Signal input for testing 14
5.2.2 Loop connections 14
5.2.2.1 General 14
5.2.2.2 Artificial loop 14
5.2.3 Measuring receiver 14
5.3 Induction loop amplifier 15
5.3.1 General 15
5.3.2 Induction loop amplifier definitions 15
5.3.2.1 General 15
5.3.2.2 Product Classes 15
5.3.3 Audio frequency in band and out of band emission limits 16
5.3.3.1 Definition 16
5.3.3.2 Methods of measurement 16
5.3.3.3 Limits 17
5.3.4 Spurious domain emission limits 17
5.3.4.1 Definition 17
5.3.4.2 Methods of measurement 17

5.3.4.3 Limits 17
5.4 Induction loop receiver 18
5.4.1 General 18
5.4.2 Headphone output 18
5.4.3 Induction loop receiver definitions 18
5.4.4 Methods of measurement 18
5.4.5 Limits 18
5.5 Interpretation of the measurement results 19

Annex A (informative): Relationship between the present document and the essential requirements of Directive 2014/53/EU 20

Annex B (informative): Technical overview 21

B.1 Induction loop amplifiers 21
B.1.1 General 21
B.1.2 Frequency response 21
B.1.3 Field strength 21
B.1.4 General performance criteria 21

B.2 Induction loop receivers and test equipment 21
B.2.1 General 21
B.2.2 Sensitivity 22

Annex C (normative): Measurement 23

C.1 Standard test position to be used with internal loop equipment or equipment having a loop connector 23

Annex D (normative): The relationship between loop current and H-Field strength 24

Annex E (informative): Artificial loop 26

Annex F (normative): Induction loop amplifier emission levels and spectrum mask measurements 28

Annex G (informative): Determination and use of the measurement bandwidth 29

Annex H (informative): Bibliography 30

Annex I (informative): Change history 31

History 32

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Foreword

This final draft Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Vote phase of the ETSI standards EN Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.8] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.1].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive, and associated EFTA regulations.

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	18 months after doa

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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Introduction

Audio Frequency Induction Loop Systems (AFILS) have been on the market since the middle of the twentieth century, with the first recognizable patents appearing circa 1938. AFILS are primarily used to facilitate improved communication to people with impaired hearing and are an important tool in the reduction of discrimination against disabled people.

The present document represents the performance of equipment which is currently on the market, which has not previously been subjected to compliance to a "radio" directive.

AFILS are installed in places of worship, places of entertainment, places of education, ticket booths and service counters, etc., as well as in domestic situations, providing huge benefits to users with impaired hearing.

AFILS provide an audio frequency magnetic field that couples with a receiving coil (Telecoil) fitted in hearing aids, cochlear implants, loop listeners and testing devices. This magnetic field is generated in a wire loop that is fed by an audio frequency amplifier which is capable of driving current through the "induction loop" which, in turn, is fed from external signals such as those generated by microphones, audio-visual equipment and musical instruments.

AFILS operate below 9 kHz and have a very limited range (some few metres) and there is no known evidence of interference with radio equipment.

The market for AFILS is relatively small compared with technologies such as RFID, and is physically separated from most radio systems, so the opportunity for mutual interference problems is reduced compared to other users of the spectrum in this frequency range.

The present document has been developed in response to Directive 2014/53/EU [i.1], which is the first radio standard that has been produced for AFILS equipment and has been prepared to allow the assessment of audio frequency induction loop amplifiers and receivers for compliance with Directive 2014/53/EU [i.1].

1 Scope

The present document specifies technical characteristics and methods of measurements for audio frequency induction loop amplifiers and receivers operating from 10 Hz to 9 kHz used in audio frequency induction loop systems (AFILS).

NOTE: The object of an AFILS is to transmit an audio signal to people with hearing difficulties. The receiver in this case is normally a hearing aid with a built in telecoil.

These radio equipment types are capable of operating in the frequency band within the 10 Hz to 9 kHz range:

- either with an output connection(s) and dedicated loop(s) or with an internal loop(s);
- for audio frequency baseband transmission (un-modulated and without the use of a carrier);

The present document covers fixed induction loop amplifiers, mobile induction loop amplifiers and portable induction loop amplifiers.

The present document covers the essential requirements of article 3.2 of Directive 2014/53/EU [i.1] under the conditions identified in annex A.

2 References

2.1 Normative references

References are specific, identified by date of publication and/or edition number or version number. Only the cited version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at https://docbox.etsi.org/Reference/.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

[1] Void.

[2] CEPT/ERC/Recommendation 74-01E (Siófok 98, Nice 99, Sesimbra 02, Hradec Kralove 05, Cardiff 11): "Unwanted Emissions in the Spurious Domain".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.

[i.2] CEPT/ERC/REC 70-03: "Relating to the use of Short Range Devices (SRD)".

[i.3] CISPR 16-2-3: "Specification for radio disturbance and immunity measuring apparatus and methods - Part 2-3: Methods of measurement of disturbances and immunity - Radiated disturbance measurements".

[i.4] IEC 60118-4: "Electroacoustics - Hearing aids - Part 4: Induction loop systems for hearing aid purposes - Magnetic field strength".

[i.5] IEC 62489-1 + Amd 1: "Electroacoustics - Audio-frequency induction loop systems for assisted hearing - Part 1: Methods of measuring and specifying the performance of system components".

[i.6] IEC 61672-1: "Electroacoustics. Sound level meters. Specifications".

[i.7] IEC 60268-10: "Sound system equipment. Methods for specifying and measuring the characteristics of peak programme level meters".

[i.8] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.

[i.9] ETSI TR 100 028 (all parts) (V1.4.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[i.10] ETSI TR 100 028-2 (V1.4.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in Directive 2014/53/EU [i.1] and the following apply:

artificial loop: reduced size radiating dummy load equal to the nominal impedance of the loop specified by the manufacturer

Audio-Frequency Induction-Loop System (AFILS): system including induction loop amplifier(s), microphones and/or other signal sources, in which a magnetic field is created by the flow of audio-frequency current in a conductor arranged in the form of a loop or coil

conducted measurements: measurements that are made using a direct connection to the equipment under test

customized loop: loop built according to manufacturers' loop design rules inside tested limits

dedicated loop: removable loop supplied and type tested with the AFILS equipment, designed as an indispensable part of the equipment

NOTE: The loop has been designed or developed for one or more specific types of equipment. It is the combination of dedicated loop and induction loop amplifier that is expected to be compliant with the regulations.

hearing aid: personal amplification system, worn entirely on the listener, which is designed to enable a person with impaired hearing to hear more easily

hearing instrument: hearing aid or cochlear implant

hearing loop system: See AFILS.

in band emissions: emissions on a frequency or frequencies which are inside the occupied bandwidth (10 Hz to 9 kHz)

induction loop: current carrying loop or coil of an AFILS used to create the magnetic field

NOTE: This is equivalent to the term "antenna" used in other ETSI documents and is used in the present document as it is the term commonly understood by the AFILS industry.

induction loop amplifier: audio amplifier designed to drive an induction loop

NOTE: This is equivalent to the term "transmitter" used in other ETSI documents and is used in the present document as it is the term commonly understood by the AFILS industry.

induction loop listener: portable listening device that is designed to give an audible output in response to signals produced by an AFILS

induction loop monitor receiver: equipment designed to verify the performance of an AFILS by audio and visual means:

a) providing visible indication that it is powered and indicating when the strength of the magnetic field produced by the loop falls within a specified range; and

b) providing an audio-frequency output by which the sound quality of the AFILS transmissions can be assessed

induction-loop system: See AFILS.

internal loop: loop designed as a fixed part of the equipment, without the use of an external connector and as such which cannot be disconnected from the equipment by the user

loop: See induction loop.

loop listener: See induction-loop listener.

magnetic dipole moment: product of (Number of loop turns) × (loop area) × (loop current)

NOTE: Air loops only.

magnetic field strength level meter: instrument designed to measure magnetic field strength of audio frequency magnetic fields

NOTE: Two types are in common use; a peak-programme meter (PPM) type having dynamic characteristics similar to those of the Type II meter as specified in IEC 60268-10 [i.7], and a true rms meter type that incorporates a true rms rectifier, and meets the relevant requirements for a Class 2 sound level meter as specified in IEC 61672-1 [i.6]. Full functional specifications for both types of meter can be found in IEC 60118-4 [i.4].

mobile amplifier: equipment normally installed in a vehicle

out of band emissions: emissions on a frequency or frequencies which are outside the occupied bandwidth (10 Hz to 9 kHz), but for which the levels are in transition to a frequency where the level may be reduced without affecting the corresponding transmission of information

phased loop array: system of overlapping loops in which the currents are out of phase with each other

portable amplifier: amplifier intended to be carried or attached

radiated measurements: measurements which involve the absolute measurement of a radiated field

rated load: the load, stated by the manufacturer, to which the amplifier output is connected for measurement purposes

reference magnetic field strength level: 0 dB reference for magnetic field strength levels, which is 400 mAm^{-1}

spurious emissions: emissions on a frequency or frequencies which are outside the occupied bandwidth (10 Hz to 9 kHz) and the level of which may be reduced without affecting the corresponding transmission of information

telecoil: magnetic pickup coil intended to receive signals from an audio-frequency induction-loop system

NOTE: A telecoil can be part of a hearing aid, cochlear implant, or of any other device for receiving signals from an audio-frequency induction-loop system in accordance with IEC 60118-4 [i.4].

type designation: manufacturers' marking of the equipment

useful magnetic field volume: volume within which the AFILS provides a hearing-aid user with a signal of acceptable quality

NOTE: See IEC 60118-4 [i.4].

3.2 Symbols

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

Ω	ohm
A	loop area
C	correction factor
E	electrical field strength
f	frequency
f_C	centre frequency in Hz
H	magnetic field strength
Hf	H-field-strength limit
H_C	H-field strength at the centre of the frequency of interest
H_S	H-field-strength limit for radiated spurious emissions
I_C	audio frequency baseband output current
I_S	spurious output current
λ	wavelength
m	magnetic dipole moment
N	number of turns for a loop
P	power
t	time

3.3 Abbreviations

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

AFILS	Audio Frequency Induction Loop System, also known as a Hearing Loop
AMN	Artificial Mains Network
CDN	Coupling/Decoupling Network
CEPT	Conférence Européenne des Postes et Télécommunications
CISPR	Comité International Spécial des Perturbations Radioélectriques
EC	European Community
EFTA	European Free Trade Area
EMC	ElectroMagnetic Compatibility
ERC	European Radiocommunications Committee
EU	European Union
HF	High Frequency (range)
ISN	Impedance Stabilization Network
LISN	Line Impedance Stabilization Network
OOB	Out Of Band
RF	Radio Frequency
RFID	Radio Frequency Identification Device
rms	root mean square
SRD	Short Range Device
THD	Total Harmonic Distortion
TR	Technical Report

4 Technical requirements specifications

4.1 Environmental conditions

4.1.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the manufacturer. The equipment shall comply with all the technical requirements of the present document which are identified as applicable in annex A at all times when operating within the boundary limits of the declared operational environmental profile.

4.2 General requirements

4.2.1 Presentation of induction loop amplifier equipment for testing purposes

Each equipment submitted for testing shall fulfil the requirements of the present document when operated as intended.

The manufacturer shall declare the range of operating conditions and power requirements to establish the appropriate test conditions.

Additionally, technical documentation and operating manuals sufficient to make the test shall be supplied.

For equipment supplied without an internal induction loop, i.e. Product Class 2 defined in clause 5.3.2.2, the manufacturer shall supply an artificial loop as defined in clause 5.2.2.1.

In the case of equipment supplied with an internal induction loop, i.e. Product Class 1 equipment as defined in clause 5.3.2.2, it is permissible to supply a sample of the equipment with a temporary connector to facilitate testing. This shall be used to provide a method to monitor the loop current, or at the manufacturer's discretion, to use an artificial loop.

The means to access and/or implement the internal permanent or temporary loop connector shall be stated by the manufacturer with the aid of a diagram. The fact that use has been made of the internal loop connection, or of a temporary connection to facilitate measurements, shall be recorded in the test report. Such ports shall not affect the performance of the equipment.

If equipment is designed to operate with different radiated field strengths or power levels, measurement of each parameter shall be performed on samples of equipment as defined in clause 4.2.2.

4.2.2 Choice of model for testing

Stand-alone equipment shall be supplied by the manufacturer complete with any ancillary equipment needed for testing.

If an equipment has optional features, considered not to affect the RF parameters, then the tests need only to be performed on the equipment configured with that combination of features considered to be the most complex, as declared by the manufacturer.

Equipment offered for test shall provide an output connector for conducted RF measurements. For equipment with an internal loop, this can be a modification for the tests.

The performance of the equipment submitted for testing shall be representative of the performance of the corresponding production model.

4.2.3 Controls

Controls that may need to be adjusted after installation such as input gain, loop drive, bass, treble, tone or "metal compensation" may be provided. However, any controls that might increase the interfering potential of the equipment, if misadjusted, shall not be easily accessible to the user.