HEAD acoustics

APPLICATION EXAMPLES INCLUDED

Code 60069

TS 103 640

Tests for active noise cancellation headsets and other earphones

OVERVIEW

TS 103 640

Code 60069

Tests for active noise cancellation headsets and other earphones

TS 103 640 is an ACQUA standard containing the specified measurements and requirements from ETSI TS 103 640. It is ideally suited for testing the performance of headphones and headsets with and without active noise cancellation. TS 103 640 is applicable for many consumer and commercial devices. It supports various types of connectivity – analog (TRS), digital (USB), and Bluetooth® wireless technology.

In addition to assessing elemental properties like audio playback quality, TS 103 640 also covers advanced features such as active and passive environmental noise isolation, intelligibility of external speech, or acoustic leak robustness. The ACQUA standard also includes tests for evaluating voice call communication by applying internationally standardized telecommunication metrics such as 3QUEST, POLQA, and ABLE (listening effort).

KEY FEATURES

Comprehensive automated test suite

Supporting all types of headsets or earphones:
› Over-ear (circumaural)
› On-ear (supra-aural)
› In-ear (intra-concha and insert)

Supporting several interfaces
› Bluetooth® wireless technology
› Digital (USB)
› Analog (TRS)

Testing of device behavior for different types of external noise/speech with full repeatability

Testing of general audio and voice call communication quality

APPLICATIONS

Testing, comparison, and experimental optimization of active noise cancellation (ANC) and passive noise isolation of systems and devices

Measuring general audio quality for all types of earphones

Testing professional headsets (e.g., commercial aviation)

Testing voice call communication quality (narrowband, wideband, super-wideband, fullband) of headsets

DETAILS

The technical complexity of active noise cancellation (ANC) in headsets and earphones generates strong variations in day-to-day efficiency. Available devices already have convincing noise suppression in some acoustic scenarios while they still struggle in other acoustic situations. As a result, thorough testing of ANC headsets and earphones requires a broad range of test scenarios. The ACQUA standard TS 103 640 provides comprehensive assessment for ANC headsets and traditional earphones according to ETSI TS 103 640. In addition to testing fundamentally important metrics like audio and communication quality of the device under test (DUT), it consists of tests with background noise, concurrent talker, and wind noise. Applying TS 103 640 in a laboratory environment allows tests with full repeatability for convenient experimental optimization and meaningful comparison of active noise cancellation headsets and other earphones.

DESCRIPTION

ETSI TS 103 640 specifies precise requirements for test rooms, testing equipment, and measurement results. Furthermore, it describes the procedure and required equipment for each measurement. HEAD acoustics provides software and hardware for all specified measurements and analyses.

Comprehensive equipment package

The test suite TS 103 640 is applied in the ACQUA and provides measurements and analyses according to the ETSI specification.

The test suite consists of measurements requiring very low sound pressure levels, e.g., for determining idle noise of ANC headsets. For that purpose, there are the HMS II.3 LN and HMS II.3 LN HEC artificial heads containing ear simulators with a low inherent noise floor. HMS II.3 LN HEC has the additional feature of human-like ear canals. It especially supports the application of in-ear headsets.

3PASS *lab* background noise simulation software generates realistic background noise for challenging the ANC performance or the performance of voice call communication of the device under test. A second artificial head or an external loudspeaker can play back speech signals as concurrent talker with or without the presence of background noise.

The susceptibility of headset microphones for wind noise is another assessment factor. Hence, there is the HRT I motorized turntable for automatic and repeatable positioning of head and torso simulator (HATS) wearing the headset into different angles of the wind flow.

Structure

If ANC functionality is available, most of the measurements are executed with and without activated ANC at the device under test. The test suite is divided into three different scenarios including measurements and analyses:

› Scenario A: Isolation from ambient noise and external speech
› Scenario B: Audio playback
› Scenario C: Voice call communication

Depending on the type of device and the required assessment, measurements of one or several scenarios are necessary.

TEST SCENARIOS

Scenario A: Isolation from ambient noise and external speech

Performance evaluation of ANC, passive noise isolation, and the ANC idle noise of headsets or traditional earphones:

› Assessments with background noise simulation (Insertion loss, Noise loudness level reduction, Speech intelligibility index)
› Self noise of ANC headset
› Wind noise insertion gain
› Automatic ANC activation
› Acoustic overload point and undesirable distortion level
› Self speech transmission
› External speech
› Pass-through mode

Scenario B: Audio playback

Assessment of the impact by ANC on parameters of audio playback:

› Output level range
› Frequency response
› Loudness level change
› Listening effort according to ETSI TS 103 558
› Frequency response left and right
› Crosstalk
› Sound leakage

Scenario C: Voice call communication

Measurements and analyses for assessing telecommunication capabilities of headsets:

› Frequency response
› Speech quality according to recommendation ITU-T P.863
› Listening effort according to ETSI TS 103 558

GENERAL REQUIREMENTS

Scenarios A, B, and C

Hardware platform

*lab*CORE (Code 7700)
› Modular multi-channel hardware platform
*core*BUS (Code 7710)
› I/O bus mainboard
*core*OUT-Amp2 (Code 7720)[1]
› *lab*CORE power amplifier board
*core*IN-Mic4 (Code 7730)
› *lab*CORE microphone input board

HEAD measurement system

One of the following HEAD measurement systems:

HMS II.3
› HMS II.3 (Code 1703)
  » HEAD measurement system, basic version with right ear simulator, 3.3 pinna and artificial mouth
› HIS L (Code 1701)
  » HEAD impedance simulator, left
HMS II.3 LN
› HMS II.3 LN (Code 1703.1)
  » HEAD measurement system, low-noise version with right ear simulator, 3.3 pinna and artificial mouth
› HIS L LN (Code 1701.1)
  » HEAD impedance simulator, left, low-noise version
HMS II.3 LN HEC
› HMS II.3 LN HEC (Code 1703.2)
  » HEAD measurement system, low-noise version with human-like ear canal simulator right and artificial mouth
› HIS L LN HEC (Code 1701.2)
  » HEAD impedance simulator, left, low noise, human-like ear canal version
HMS II.3 ViBRIDGE[1]
› HMS II.3 ViBRIDGE (Code 1703.3)
  » HEAD measurement system, low-noise, with human-like ViBRIDGE (bone conduction simulation) ear simulators (left and right) and artificial mouth
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- › Sidetone masking
- › Echo cancellation
- › Double Talk
- › Speech quality in the presence of background noise (according to ETSI TS 103 106, ETSI TS 103 281 (Model A))

HEADSET FIT

Online analysis

Online analysis is available with ACOPT 19 in ACQUA. It provides the feature to display an FFT of the live recording from sensors connected to *lab*CORE. The FFT live view of the ear microphones supports finding the ideal headset position for sealing the ear canal and synchronizing the input level of left and right ear.

OPTIONS

ACOPT 19 (Code 6842)
- › Option Online analysis

ACOPT 36 (Code 6867)
- › Option MDAQS – Multi-Dimensional Audio Quality Score

RELEASE NOTES

Database revision and specification version		
Database revision	**Based on specification**	**ACQUA version**
Revision 01	ETSI TS 103 640 V1.2.1 (2022-03)	at least 6.0.200

SCOPE OF DELIVERY

TS 103 640 (Code 60069)
- › delivered as ACQUA database backup

V2C file
- › License file for ACQUA dongle

Revision history
- › PDF file

GENERAL REQUIREMENTS

Headset interface

One of the following access interfaces for the device under test:

Analog (TRS)
- › HIB I (Code 6002)
  - » Headset interface box

USB
- › Included in *lab*CORE (Code 7700)

Bluetooth
- › *core*BT2 (Code 7782)
  - » *lab*CORE I/O module, Bluetooth reference access point, version 2

Measurement and analysis software

One of the following software applications:

ACQUA (Code 6810)
- › Advanced Communication Quality Analysis Software, full license version

ACQUA Compact (Code 6860)
- › Compact test system

ACQUA options

ACOPT 25 (Code 6852)
- › Option Psychoacoustics

ACOPT 26 (Code 6853)
- › Option Room acoustics

ACOPT 37 (Code 6869)
- › Option ABLE – Assessment of Binaural Listening Effort according to ETSI TS 103 558

Scenario A

Testing active noise cancellation and pass-through mode with external speaker

Equipment option 1:
- › HMS II.5 (Code 1705)[1]
  - » HEAD measurement system, with 3.3 pinna and artificial mouth (without ear simulators)

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GENERAL REQUIREMENTS

Equipment option 2:
›   Loudspeaker
    »   Complying with requirements from ETSI TS 103 640, chapter 4.2.5.2
Power amplifier
›   *core*OUT-A2 (Code 7720)
    »   *lab*CORE output module, analog balanced/unbalanced (2 channels)

High level external sound/speech signal

Loudspeaker
›   Complying with requirements from ETSI TS 103 640, chapter 4.2.5.2
Power amplifier
*core*OUT-A2 (Code 7720)
›   *lab*CORE output module, analog balanced/unbalanced (2 channels)

Pass-through mode tests with external speaker

›   ACOPT 09 (Code 6819)
    »   Option SLVM P.56

Background noise simulation

3PASS *lab* (Code 6990)
›   Advanced background noise simulation system with automated equalization – lab version

Noise cancellation tests

ACOPT 34 (Code 6865)
›   Option Speech intelligibility index according to ANSI S3.5-1997

Wind noise tests and pass-through mode tests

HRT I (Code 6498)
›   HEAD acoustics remote-operated turntable

Scenario C

Speech quality in receiving direction

ACOPT 30 (Code 6857)
›   Option POLQA

Double Talk tests

ACOPT 32 (Code 6859)
›   Option Speech-based Double Talk analysis

Speech quality in sending direction in the presence of background noise

3PASS *lab* (Code 6990)
›   Advanced background noise simulation system with automated equalization – lab version
Narrowband and wideband voice call
›   ACOPT 21 (Code 6844)
    »   Option 3QUEST - 3fold Quality Evaluation of Speech in Telecommunication (narrowband/ wideband)
Super-wideband and fullband voice call
›   ACOPT 09 (Code 6819)
    »   Option SLVM P.56
›   ACOPT 35 (Code 6866)
    »   Option 3QUEST super-wideband/fullband according to ETSI TS 103 281, Model A

IN PRACTICE

APPLICATION EXAMPLES

ANC functionality in the presence of an external speaker (exemplary)

This configuration presents testing a wireless in-ear ANC headset with HMS II.3 LN HEC. A second HATS –HMS II.5 – simulates an external talker to test the headset's active noise cancellation performance with external speech. Measurements are executed with activated and deactivated ANC functionality.

*lab*CORE connects to the headset via Bluetooth. The two artificial heads are connected to *lab*CORE for recording (ears of HMS II.3 LN HEC) and playback (mouth loudspeakers of HMS II.3 LN HEC and HMS II.5). Background noise is simulated by 3PASS *lab*. For full repeatability of measurements, background noise playback is synchronized by *lab*CORE through a pulse connection to *lab*BGN. ACQUA is the control software for generating, recording, and analyzing signals.

Speech quality in the presence of background noise (exemplary)

This configuration presents the assessment of speech signal processing by a wireless over-ear ANC headset in the presence of background noise. The headset is mounted on HMS II.3 LN HEC. Measurements are executed with activated and deactivated ANC functionality.

*lab*CORE connects to the headset via Bluetooth. The head and torso simulator (HATS) is connected to *lab*CORE for playback. Background noise is simulated by 3PASS *lab*. For full repeatability of measurements, background noise playback is synchronized by *lab*CORE through a pulse connection to *lab*BGN. ACQUA is the control software for generating, recording, and analyzing signals. The recorded signal is analyzed by the 3QUEST (3-fold Quality Evaluation of Speech in Telecommunications) algorithm according to ETSI TS 103 106.

Listening effort during voice call in the presence of background noise (exemplary)

This configuration presents the assessment of listening effort during a voice call with an analog wired over-ear ANC headset. The headset is mounted on HMS II.3 LN HEC. Background noise simulated by 3PASS *lab* challenges the voice call communication performance of the headset. Measurements are executed with activated and deactivated ANC functionality.

*lab*CORE connects to the headset via HIB I. HMS II.3 LN HEC is connected to *lab*CORE for recording. ACQUA is the control software for generating, recording, and analyzing signals. Background noise is simulated by 3PASS *lab*. For full repeatability of measurements, background noise playback is synchronized by *lab*CORE through a pulse connection to *lab*BGN. The recorded signal is analyzed by the ABLE (Assessment of Binaural Listening Effort) algorithm according to ETSI TS 103 558.
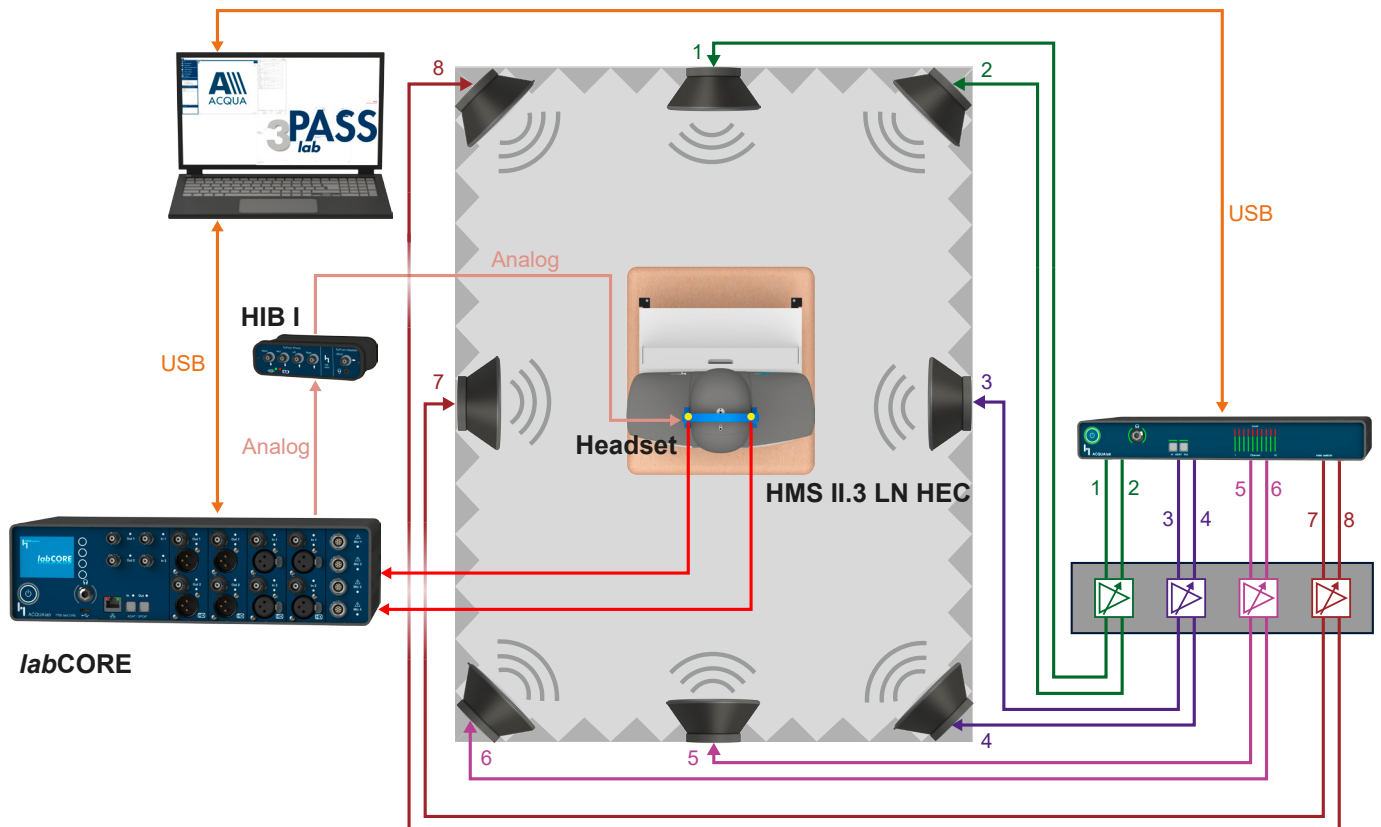
1. The application of ViBRIDGE requires both channels of the *core*OUT-Amp2 board. Hence, a second *core*OUT-Amp2 board is required for the operation of HMS II.5 as external speaker.

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