

ETSI TS 103 738 V1.3.1 (2018-10)



**Speech and multimedia Transmission Quality (STQ);
Transmission requirements for
narrowband wireless terminals (handsfree)
from a QoS perspective as perceived by the user**

Full Standard Preview
iTech Standards (standards.iteh.ai)
<https://standards.iteh.ai/catalog/standards/sls/etsi/103-738-2018-10>
40d1-95c5-f710110958a9/etsi/103-738-2018-10

Reference

RTS/STQ-272-2

Keywords

speech, terminal

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Speech and multimedia Transmission Quality (STQ).

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

The present document covers wireless speech terminals. It aims to enhance the interoperability and end-to-end quality with all other types of terminals.

The advanced signal processing of terminals is targeted to speech signals. Therefore, wherever possible speech signals are used for testing in order to achieve mostly realistic test conditions and meaningful results.

1 Scope

The present document provides speech transmission performance requirements for wireless terminals; it addresses all types of wireless terminals, including softphones. This part addresses handsfree function of narrowband wireless terminals.

In contrast to other standards which define minimum performance requirements it is the intention of the present document to specify terminal equipment requirements which enable manufacturers and service providers to enable good quality end-to-end speech performance as perceived by the user, whatever be the radio link (terminals may implement different radio links with the access network).

When an additional radio link between the terminal and external electroacoustical devices is used (e.g. Bluetooth® link), the standard will address the overall quality.

In the present document, objective measurement methodologies and requirements for wireless speech terminals are given.

In addition to basic testing procedures, the present document describes advanced testing procedures taking into account further quality parameters as perceived by the user.

The requirements available in the present document will ensure a high compatibility across access networks with all types of terminals.

It is the aim to optimize the listening and talking quality, conversational performance, as well as the use in noisy environment. Related requirements and test methods will be defined in the present document.

For all the functions, the standard will consider the limitations in audio performance due to different form factors (e.g. size, shape).

Terminals which are not intended to be connected to public networks are outside the scope of the present document.

2 References

2.1 Normative 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 necessary for the application of the present document.

- [1] ETSI TS 126 171 (V6.0.0): "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); AMR speech codec, wideband; General description (3GPP TS 26.171 version 6.0.0 Release 6)".
- [2] Recommendation ITU-T G.122: "Influence of national systems on stability and talker echo in international connections".
- [3] Void.
- [4] Recommendation ITU-T G.711: "Pulse code modulation (PCM) of voice frequencies".
- [5] Recommendation ITU-T G.726: "40, 32, 24, 16 kbit/s Adaptive Differential Pulse Code Modulation (ADPCM)".

- [6] Recommendation ITU-T G.729: "Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited linear prediction (CS-ACELP)".
- [7] Recommendation ITU-T G.729.1: "G.729 based embedded variable bit-rate coder: An 8-32 kbit/s scalable wideband coder bitstream interoperable with G.729".
- [8] Void.
- [9] Recommendation ITU-T P.56: "Objective measurement of active speech level".
- [10] Recommendation ITU-T P.58: "Head and torso simulator for telephony".
- [11] Recommendation ITU-T P.79: "Calculation of loudness ratings for telephone sets".
- [12] Recommendation ITU-T P.340: "Transmission characteristics and speech quality parameters of hands-free terminals".
- [13] Recommendation ITU-T P.342: "Transmission characteristics for narrow-band digital loudspeaking and hands-free telephony terminals".
- [14] Recommendation ITU-T P.501: "Test signals for use in telephony".
- [15] Recommendation ITU-T P.502: "Objective test methods for speech communication systems using complex test signals".
- [16] Recommendation ITU-T P.581: "Use of head and torso simulator (HATS) for hands-free terminal testing".
- [17] Recommendation ITU-T O.41: "Psophometer for use on telephone-type circuits".
- [18] IEC 61260-1: "Electroacoustics - Octave-band and fractional-octave-band filters - Part 1: Specifications".
- [19] ETSI TS 146 010: "Digital cellular telecommunications system (Phase 2+); Full-rate speech; Transcoding (3GPP TS 46.010 Release 9)".
- [20] ETSI TS 146 060: "Digital cellular telecommunications system (Phase 2+); Enhanced Full Rate (EFR) speech transcoding (3GPP TS 46.060 Release 9)".
- [21] ETSI TS 103 106 (03-2013) (V1.2.1): "Speech and multimedia Transmission Quality (STQ); Speech quality performance in the presence of background noise: Background noise transmission for mobile terminals-objective test methods".
- [22] Recommendation ITU-T P.863: "Perceptual objective listening quality prediction".
- [23] Recommendation ITU-T P.863.1: "Application guide for Recommendation ITU-T P.863".
- [24] ETSI TS 126 441 (V12.0.0): "Universal Mobile Telecommunications System (UMTS); LTE; EVS Codec General Overview (3GPP TS 26.441 version 12.0.0 Release 12)".
- [25] ETSI TS 103 224: "Speech and multimedia Transmission Quality (STQ); A sound field reproduction method for terminal testing including a background noise database".

2.2 Informative references

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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] Void.
- [i.2] Recommendation ITU-T P.1100: "Narrowband hands-free communication in motor vehicles".
- [i.3] IEC 61672 (Edition 1.0): "Electroacoustics - Sound level meters".
- [i.4] Void.
- [i.5] Void.
- [i.6] ETSI EG 201 377-1: "Speech and multimedia Transmission Quality (STQ); Specification and measurement of speech transmission quality; Part 1: Introduction to objective comparison measurement methods for one-way speech quality across networks".
- [i.7] Recommendation ITU-T P.1010: "Fundamental voice transmission objectives for VoIP terminals and gateways".

3 Definitions of terms and abbreviations

3.1 Terms

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

artificial ear: device for the calibration of earphones incorporating an acoustic coupler and a calibrated microphone for the measurement of the sound pressure and having an overall acoustic impedance similar to that of the median adult human ear over a given frequency band

codec: combination of an analogue-to-digital encoder and a digital-to-analogue decoder operating in opposite directions of transmission in the same equipment

ear-Drum Reference Point (DRP): point located at the end of the ear canal, corresponding to the ear-drum position

freefield equalization: artificial head equalized flat for frontal sound incidence in anechoic conditions

group audio terminal: handsfree telephony terminal primarily designed for use by several users which will not be equipped with a handset.

handsfree telephony terminal: telephony terminal using a loudspeaker associated with an amplifier as a telephone receiver and which can be used without a handset

HATS Hands-Free Reference Point (HATS HFRP): reference point "n" from Recommendation ITU-T P.58 [10]: "n" is one of the points numbered from 11 to 17 and defined in table 6a of Recommendation ITU-T P.58 [10] (coordinates of far field front point)

NOTE: The HATS HFRP depends on the location(s) of the microphones of the terminal under test: the appropriate axis lip-ring/HATS HFRP is to be as close as possible to the axis lip-ring/HFT microphone under test.

Head And Torso Simulator (HATS) for telephonometry: manikin extending downward from the top of the head to the waist, designed to simulate the sound pick-up characteristics and the acoustic diffraction produced by a median human adult and to reproduce the acoustic field generated by the human mouth

loudspeaking function: function of a handset telephone using an external loudspeaker associated with an amplifier as a telephone receiver

Mouth Reference Point (MRP): point located on axis and 25 mm in front of the lip plane of a mouth simulator

nominal setting of the volume control: volume control setting which yields the RLR value closest to the nominal RLR

NOTE: If no user operable volume control is available, this should be noted in the test report.

softphone: speech communication system based upon a computer

3.2 Abbreviations

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

a.c.	alternative current
$A_{H,S,dt}$	attenuation range in send direction during double talk
AM-FM	Amplitude Modulation Frequency Modulation
AMR	Adaptive Multi-Rate codec
CDMA	Code Division Multiple Access
CS	Composite Source
CSS	Composite Source Signal
DECT	Digital Enhanced Cordless Telecommunications
DFT	Discrete Fourier Transform
DRP	Drum Reference Point
DUT	Device Under Test
EC	Echo Cancellation
EFR	Enhanced Full Rate
EL	Echo loss
EVS-NB	Enhanced Voice Services - Narrowband
FFT	Fast Fourier Transform
G-MOS-LQOn	Overall transmission quality narrowband
GSM	Global System for Mobile communication
HATS	Head And Torso Simulator
HF	Handsfree
HFRP	Handsfree Reference Point
HFT	Handsfree Telephone
IEC	International Electrotechnical Commission
ITU-T	International Telecommunication Union - Telecommunication standardization sector
LE	Earcap Leakage/Coupling Loss
LQO	Listening Quality Objective
LTE	Long Term Evolution (3GPP)
MOS	Mean Opinion Score
MRP	Mouth Reference Point
NB	Narrow Band
NLP	Non Linear Processing
N-MOS-LQOn	Transmission quality of the background noise narrowband
PDA	Personal Data Analyser
PLC	Packet Loss Concealment
PMRP	Sound Pressure at MRP
PN	Pseudo random Noise
POI	Point Of Interconnect
QoS	Quality of Service
RF	Radio Frequency
RLR max	Receive Loudness Rating corresponding to the maximum setting of the volume control
RLR min	Receive Loudness Rating corresponding to the minimum setting of the volume control
RLR	Receive Loudness Rating
RMS	Root Mean Square
SLR	Send Loudness Rating
S-MOS-LQOn	Transmission quality of the speech narrowband
TCL_w	Terminal Coupling Loss (weighted)
$TELR_{dt}$	Talker Echo Loudness Rating
TOSQA	Telecommunication Objective Speech Quality Assessment
UE	User Equipment
UMTS	Universal Mobil Telecommunications System
VAD	Voice Activity Detector
VoLTE	Voice over LTE
WIFI	Wireless Fidelity
WIMAX™	Worldwide Interoperability for Microwave ACCESS

4 Configurations and interfaces

4.0 Introduction

The present document is intended to be applicable for different wireless access networks and for additional radio links.

4.1 Access networks

The present document applies to any wireless terminal whatever the access network, e.g. GSM, UMTS, VoLTE, DECT, Bluetooth®, WIFI, WIMAX™, CDMA, etc.

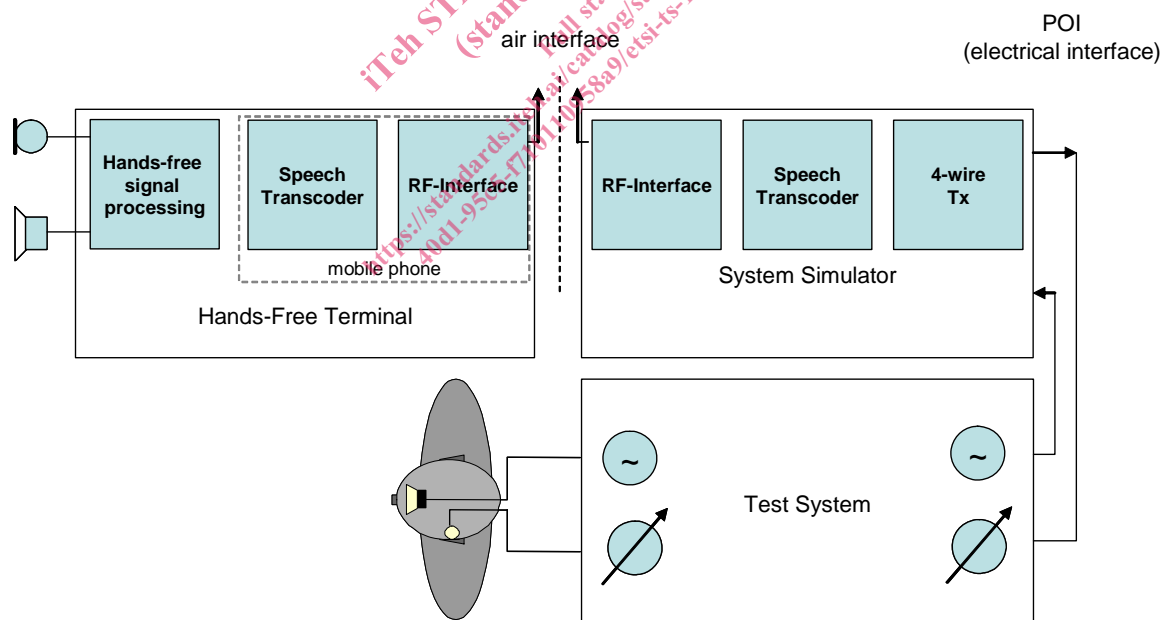
4.2 Additional (radio) links between the terminal and external electroacoustical devices

The present document also applies when an additional radio link exists between the wireless terminal and external electro acoustic devices, e.g. Bluetooth®.

5 Test Configurations

5.1 Set-up interface

The generic schematic as defined in figure 5.1-1 is applicable to any wireless link.



NOTE: The "whole" terminal includes all the components from "RF interface" to the transducers and may include an additional (radio) link. The air interface considered in figure 5.1-1 is not the additional radio link.

Figure 5.1-1: Set-up interface

5.2 Set-up for terminals

5.2.0 General

For electroacoustical testing, HATS as described in Recommendation ITU-T P.58 [10] shall be used.

The preferred way of testing a terminal is to connect it to a network simulator with exact defined settings and access points. The test sequences are fed in either electrically, using a reference codec or using the direct signal processing approach or acoustically using ITU-T specified devices.

When a coder with variable bit rate is used for testing terminal electroacoustical parameters, the bit rate giving the best characteristics or the most commonly used should be selected, e.g.:

- AMR-NB (ETSI TS 126 171 [1]): 12,2 kbit/s
- Recommendation ITU-T G.729.1 [7]: 32 kbit/s

5.2.1 Handheld terminal

HATS measurement equipment shall be configured to the handheld hands-free UE according to figure 5.2-1. The HATS should be positioned so that the HATS Reference Point is at a distance d_{HF} from the centre point of the visual display of the Mobile Station. The distance d_{HF} is specified by the manufacturer. A vertical angle θ_{HF} may be specified by the manufacturer. In case it is not specified the distance d_{HF} shall be 42 cm and θ_{HF} shall be 0.

NOTE: The nominal distance of 42 cm corresponds to lip plane-HATS reference point distance (12 cm) with an additional 30 cm giving a realistic figure as a reference usage of handheld terminals.

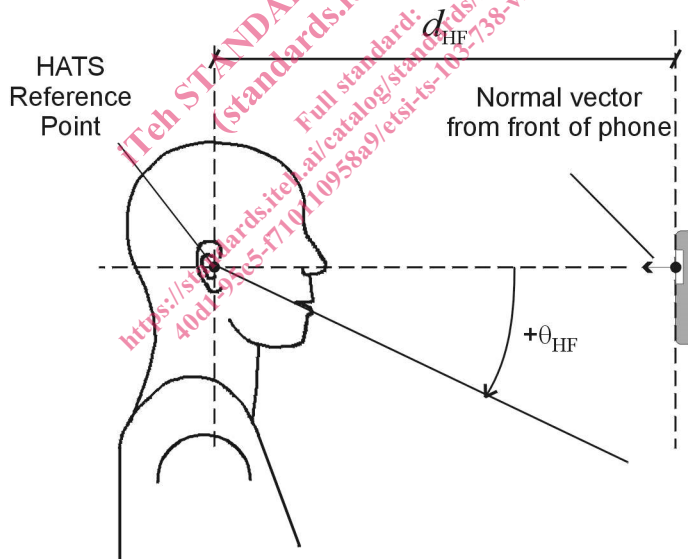


Figure 5.2-1: Configuration of handheld hands-free UE relative to the HATS

5.2.2 Vehicle mounted hands-free

Test arrangement, test methods and performance requirements are according to Recommendation ITU-T P.1100 [i.2].

Figure 5.2.2-1: Void.

5.2.3 Desktop hands-free terminal

Definition of hands-free terminals and setup for desktop hands-free terminals are based on in Recommendation ITU-T P.581 [16].

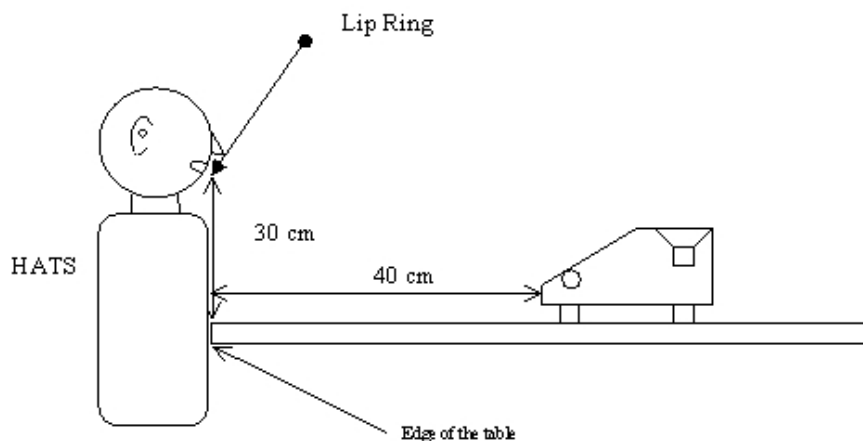


Figure 5.2.3-1: Position for test of desktop hands-free terminal side view

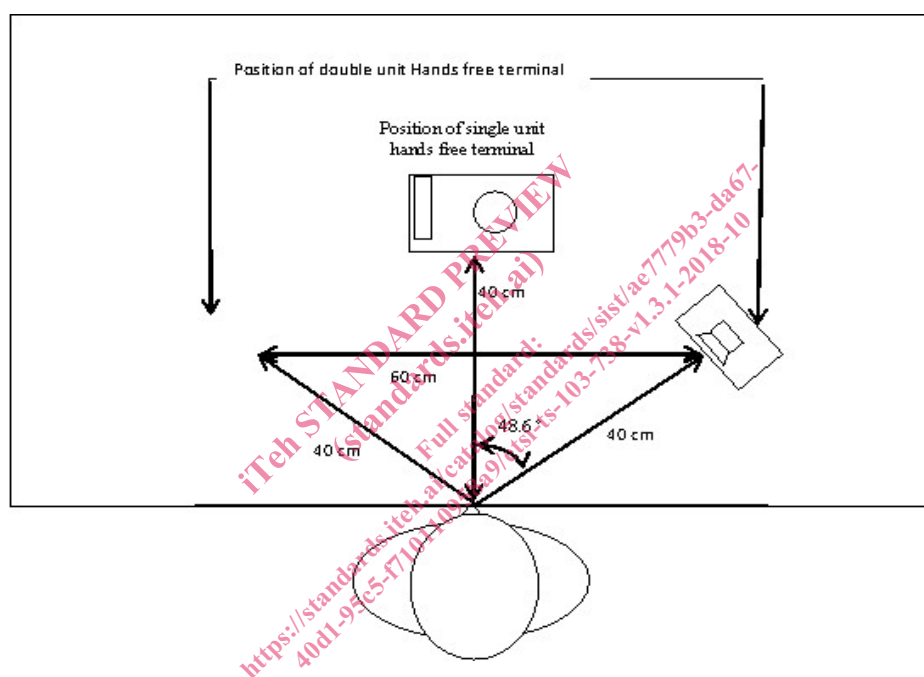


Figure 5.2.3-2: Position for test of desktop hands-free terminal top sight

5.2.4 Additional test setup for hands-free function with softphone

5.2.4.0 General

Two types of softphones are to be considered:

- Type 1 is to be used as a desktop type (e.g. notebook).
- Type 2 is to be used as a handheld type (e.g. PDA).

When manufacturer gives conditions of use, they will apply for test. If no other requirement is given by manufacturer softphone will be positioned according the following conditions.