

# Recommendation

## **ITU-T P.383 (03/2023)**

SERIES P: Telephone transmission quality, telephone installations, local line networks

Voice terminal characteristics

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**Technical requirements and test methods for digital headsets or headphones and corresponding interfaces of terminals**

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# Recommendation ITU-T P.383

## Technical requirements and test methods for digital headsets or headphones and corresponding interfaces of terminals

### Summary

Recommendation ITU-T P.383 specifies requirements and provides corresponding test methods for headsets and headphones, as well as terminals when tested separately. Headsets and headphones equipped with wired or wireless digital interfaces have been widely used in digital mobile terminals in recent years. The consumer is free to choose either the headset or the headphone originally provided with the terminal or other headsets or headphones that are offered separately. However, the quality of service or quality of experience perceived by users is influenced by both the electrical performance of the interface and the compatibility between the terminal and the headset or headphone.

### History

| Edition | Recommendation | Approval   | Study Group | Unique ID*                                                                |
|---------|----------------|------------|-------------|---------------------------------------------------------------------------|
| 1.0     | ITU-T P.383    | 2021-06-13 | 12          | <a href="http://handle.itu.int/11.1002/1000/14691">11.1002/1000/14691</a> |
| 2.0     | ITU-T P.383    | 2023-03-01 | 12          | <a href="http://handle.itu.int/11.1002/1000/15466">11.1002/1000/15466</a> |

### Keywords

Digital headset interface, headphones, headsets, terminals, wireless digital interface.

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# Recommendation ITU-T P.383

## Technical requirements and test methods for digital headsets or headphones and corresponding interfaces of terminals

### 1 Scope

This Recommendation specifies technical requirements and test methods for wired or wireless headsets and corresponding digital interfaces. See Figure 1.

This Recommendation aims to ensure adequate user experience when wired or wireless digital headsets are connected over the digital headset interface with digital terminals.

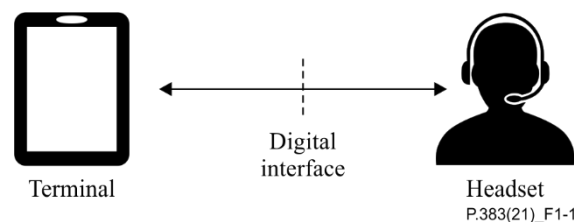


**Figure 1 – This Recommendation specifies performance parameters separately for terminals and headsets**

Terminals in the context of this Recommendation may be mobile terminals, portable players, information and communication technology terminals, Internet of things devices and augmented reality or /virtual reality devices for communication and multi-media application.

Specifying the performance requirements of the digital interface separately for the headset or headphone on one hand and the terminal on the other enables the consumer to combine commercially available hardware of both types without losing adequate user experience.

This Recommendation applies to digital audio output or input interfaces that wish to support wired or wireless headsets.

This Recommendation does not apply to terminals designed solely for analogue headset or headphone usage.

### 2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T G.122] Recommendation ITU-T G.122 (1993), *Influence of national systems on stability and talker echo in international connections.*
- [ITU-T O.41] Recommendation ITU-T O.41 (1994), *Psophometer for use on telephone-type circuits.*
- [ITU-T P.56] Recommendation ITU-T P.56 (2011), *Objective measurement of active speech level.*
- [ITU-T P.57] Recommendation ITU-T P.57 (2021), *Artificial ears.*

- [ITU-T P.79] Recommendation ITU-T P.79 (2007), *Calculation of loudness ratings for telephone sets.*
- [ITU-T P.340] Recommendation ITU-T P.340 (2000), *Transmission characteristics and speech quality parameters of hands-free terminals.*
- [ITU-T P.381] Recommendation ITU-T P.381 (2023), *Technical requirements and test methods for analogue wired headsets or headphones and corresponding universal interface of terminals.*
- [ITU-T P.382] Recommendation ITU-T P.382 (2023), *Technical requirements and test methods for analogue wired multi-microphone headsets or headphones and corresponding universal interface of terminals.*
- [ITU-T P.501] Recommendation ITU-T P.501 (2020), *Test signals for use in telephony and other speech-based applications.*
- [ITU-T P.502] Recommendation ITU-T P.502 (2000), *Objective test methods for speech communication systems using complex test signals.*
- [ITU-T P.700] Recommendation ITU-T P.700 (2021), *Calculation of loudness for speech communication.*
- [ITU-T P.863] Recommendation ITU-T P.863 (2018), *Perceptual objective listening quality prediction.*
- [EN 50332-1] European Standard EN 50332-1:2013, *Sound system equipment: Headphones and earphones associated with personal music players – Maximum sound pressure level measurement methodology – Part 1: General method for "one package equipment".*
- [ETSI TS 103 106] Technical Specification ETSI TS 103 106 V1.6.1 (2021), *Speech and multimedia transmission quality (STQ); Speech quality performance in the presence of background noise: Background noise transmission for mobile terminals – Objective test methods.*
- [ETSI TS 103 224] Technical Specification ETSI TS 103 224 V1.6.1 (2022), *Speech and multimedia transmission quality (STQ); A sound field reproduction method for terminal testing including a background noise database.*
- [ETSI TS 103 281] Technical Specification ETSI TS 103 281 V1.3.1 (2019), *Speech and multimedia transmission quality (STQ); Speech quality in the presence of background noise: Objective test methods for super-wideband and fullband terminals.*
- [IEC 61260-1] International Standard IEC 61260-1:2014, *Electroacoustics – Octave-band and fractional-octave-band filters – Part 1: Specifications.*
- [IEC 61672-1] International Standard IEC 61672-1:2013, *Electroacoustics – Sound level meters – Part 1: Specifications.*

### 3 Definitions

#### 3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

**3.1.1 artificial ear** [ITU-T P.381]: A device that incorporates an acoustic coupler and a calibrated microphone for measuring sound pressure, and which has an overall acoustic impedance similar to that of the average adult ear over a given frequency band.

NOTE – Definition based on that in [b-ITU-T P.10].

**3.1.2 codec** [ITU-T P.381]: Combination of an analogue-to-digital encoder and a digital-to-analogue decoder operating in opposite directions of transmission in the same equipment.

**3.1.3 composite source signal (CSS)** [b-ITU-T P.10]: A signal composed in time by various signal elements.

**3.1.4 eardrum reference point (DRP)** [b-ITU-T P.10]: A point located at the end of the ear canal, corresponding to the eardrum position.

**3.1.5 earphone** [b-IEC 60268-7]: Electroacoustic transducer by which acoustic oscillations are obtained from electric signals and intended to be closely coupled acoustically to the ear.

**3.1.6 head and torso simulator (HATS) for telephonometry** [ITU-T P.381]: A manikin that extends downwards from the top of the head to the waist. It is designed to simulate the sound pick-up characteristics and the acoustic diffraction produced by the average adult, and to reproduce the acoustic field generated by the human mouth

NOTE – Definition based on that in [b-ITU-T P.10].

**3.1.7 headphone (HP)** [ITU-T P.381]: An object based on the assembly of one or two earphones on a headband or chinband, the use of which may be optional (e.g., with intra-concha earphones).

NOTE – Definition based on that in [b-IEC 60268-7].

**3.1.8 headset** [b-ITU-T P.10]: A device which includes a telephone receiver and transmitter which is typically secured to the head or the ear of the wearer.

**3.1.9 mean opinion score – listening-only quality objective (MOS-LQO)** [ITU-T P.381]: A score calculated by means of an objective model that aims to predict the quality for a listening-only test situation.

NOTE – Objective measurements made using the model given in [ITU-T P.863] give results in terms of MOS-LQO.

**3.1.10 mouth reference point (MRP)** [b-ITU-T P.10]: Point 25 mm in front of and on the axis of the lip plane of the artificial mouth or a typical human mouth (see Figure A.1 of [b-ITU-T P.64]).

**3.1.11 Receive** [ITU-T P.381]: The receiving direction of the signal transmission, usually from the measurement system to the device under test.

**3.1.12 Send** [ITU-T P.381]: The sending direction of the signal transmission, usually from the device under test to the measurement system.

## **3.2 Terms defined in this Recommendation**

None.

## **4 Abbreviations, acronyms and symbols**

### **4.1 Abbreviations and acronyms**

This Recommendation uses the following abbreviations and acronyms:

|     |                         |
|-----|-------------------------|
| AGC | Automatic Gain Control  |
| CSS | Composite Source Signal |
| DRP | eardrum Reference Point |
| EC  | Echo Cancellor          |
| EL  | Echo Loss               |
| FB  | Fullband                |

|        |                                                          |
|--------|----------------------------------------------------------|
| FFT    | Fast Fourier Transform                                   |
| HATS   | Head and Torso Simulator                                 |
| HTCL   | Headset Terminal Coupling Loss                           |
| JLR    | Junction Loudness Rating                                 |
| JLRr   | Junction Loudness Rating in the receive direction        |
| JLRs   | Junction Loudness Rating in the send direction           |
| L      | Left                                                     |
| LQO    | Listening-only Quality Objective                         |
| LQOf   | Listening-only Quality Objective, fullband               |
| LQOn   | Listening-only Quality Objective, narrowband             |
| LQOw   | Listening-only Quality Objective, wideband               |
| MOS    | Mean Opinion Score                                       |
| MRP    | Mouth Reference Point                                    |
| NB     | Narrowband transmission                                  |
| PN     | Pseudo-Noise                                             |
| POI    | Point of Interconnection                                 |
| R      | Right                                                    |
| RLL    | Receive Loudness Level                                   |
| RLR    | Receive Loudness Rating                                  |
| SLL    | Send Loudness Level                                      |
| SLR    | Send Loudness Rating                                     |
| SRW    | Short-Range Wireless                                     |
| STMR   | Sidetone Masking Rating                                  |
| SWB    | Super-Wideband                                           |
| TCL    | Terminal Coupling Loss                                   |
| TCLw   | weighted Terminal Coupling Loss                          |
| TELRdt | Talker Echo Loudness Rating under double talk conditions |
| UE     | User Equipment                                           |
| WB     | Wideband                                                 |

## 4.2 Symbols

|              |                                                                |
|--------------|----------------------------------------------------------------|
| $A_{H,R,DT}$ | attenuation range in the receive direction during double talk  |
| $A_{H,S,dt}$ | attenuation range in the send direction during double talk     |
| dBFS         | decibels relative to full scale                                |
| dBm0         | decibel milliwatts measured at a zero transmission level point |
| dBPa         | decibel sound pressure level relative to 1 Pa                  |
| dBV          | decibels relative to 1 V                                       |

|                                 |                                                                  |
|---------------------------------|------------------------------------------------------------------|
| dBVp                            | decibels relative to 1 V, psophometric noise weighting           |
| $f_s$                           | frequency of sine-wave signal                                    |
| $L_{\text{meST}}$               | sidetone path loss                                               |
| $T_r$                           | delay in the receive direction                                   |
| $T_{r,S,\text{min}}$            | minimum built-up time in Send                                    |
| $T_{\text{rd}}$                 | round trip delay                                                 |
| $T_s$                           | delay in the send direction                                      |
| $T_{\text{wireless},R}$         | Receive delay of terminal with short-range wireless interface    |
| $T_{\text{wireless},\text{rd}}$ | round trip delay of terminal with short-range wireless interface |
| $T_{\text{wireless},S}$         | Send delay of terminal with short-range wireless interface       |

## 5 Conventions

None.

## 6 General description

[ITU-T P.381] and [ITU-T P.382] specify performance requirements and corresponding test methods for standardized analogue headset or headphone interfaces used in digital mobile terminals. These Recommendations do not cover digital headset interfaces. Mobile terminals and other devices provided only with digital headset interfaces are becoming available. These digital headset interfaces may provide multiple functionalities including:

- personal hearing preference adjustment;
- application control, motion detection.

From the communication and multi-media perspectives, specifying performance requirements and standardizing a digital interface increases the possibilities of providing adequate user experience when different headsets are used with different devices, which consequently helps in reducing e-waste in the future.

## 7 Options of possible physical interfaces

This Recommendation does not specify the specific physical form or dimensions of digital headset interfaces; only the electro-acoustic performance at the digital interface and the digital headsets are specified, so that adequate user experience can be achieved.

Terminals providing digital headset interface and digital headsets using any digital audio input/output interfaces or utilizing various wireless access technologies as input/output interfaces to transmit audio or speech, are recommended to meet the requirements specified in clauses 8 and 9.

Two generic configurations are considered in this Recommendation:

- 1) Digital headsets and terminals, where the speech signal processing such as equalization, automatic gain control (AGC), noise cancellation and echo cancellation is performed in the headset. Test methods for this case are described in clause 8 (digital interface) and in clause 9 (digital headsets). These types of headsets are often equipped with higher signal processing capabilities, while terminals providing such headset interfaces are used for audio gateway functionality e.g., in vehicle hands-free systems. These connection types are typically wireless.
- 2) Digital headsets and terminals, where the speech signal processing such as equalization, AGC, noise cancellation and echo cancellation is performed in the terminal. Test methods

for this case are described in clause 8 (digital interface) and in clause 9 (digital headsets). These types of headsets are typically equipped with very low or no signal processing capabilities, the terminal connected via this headset interface is required to perform it. These connection types are typically wired but can also be wireless.

## 8 Terminal digital interface specification (speech signal processing in headset)

### 8.1 Communication mode

The digital headset interface shall meet corresponding requirements listed for the supported speech bandwidth including narrowband (NB), wideband (WB), super-wideband (SWB), and fullband (FB), depending on the speech communication modes the terminal supports.

Wireless digital headsets perform their own signal processing. Whatever wireless interface is used, a signalling mechanism shall be provided, ensuring unambiguously the deactivation of any signal processing in the terminal. Only access technology-related signal processing such as jitter buffer and packet loss concealment of packet-switched transmission networks shall be performed in the terminal. Specific protocols used for the digital headset interface are not covered by this Recommendation.

NOTE – Any signal processing in the terminal such as noise reduction and echo cancellation when connected to a digital wireless headset that has already performed signal processing should be avoided. Cascaded signal processing may degrade speech and conversation quality significantly.

#### 8.1.1 Test set-up

##### 8.1.1.1 Test configuration and test system

When testing wireless digital headset interfaces in terminals, a wireless reference interface as shown in Figure 8-1 is used to establish the audio transmission between the test system and the headset interface. It shall be able to simulate the essential functionalities of a wireless digital headset including necessary protocol handling to set up an audio link between the reference interface and the terminal. The wireless digital headset reference interface shall not introduce any amplification or attenuation in the audio stream from or to the headset interface. No additional signal processing except the audio or speech coding, or transcoding shall be active. The reference interface shall provide a signalling mechanism that is intended to deactivate any signal processing in the terminal.

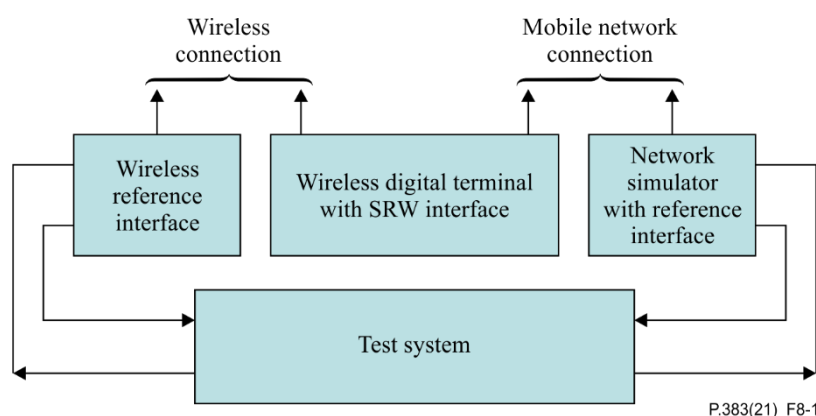


**Figure 8-1 – Test set-up for testing the digital headset interface**

For testing echo and double talk scenarios, an artificial feedback of the received signal into the Send path as shown in Figure 8-2 shall be used. This echo path shall be realized as part of the test system. The received and decoded signal from the user equipment (UE) is fed back into the sending direction, in advance to the encoding/protocol/hardware layer. For measurements without artificial echo loss (EL), the feedback path is disabled.

NOTE – Evaluation boards from digital headset chipset vendors may be used for the implementation of the digital headset reference interface.

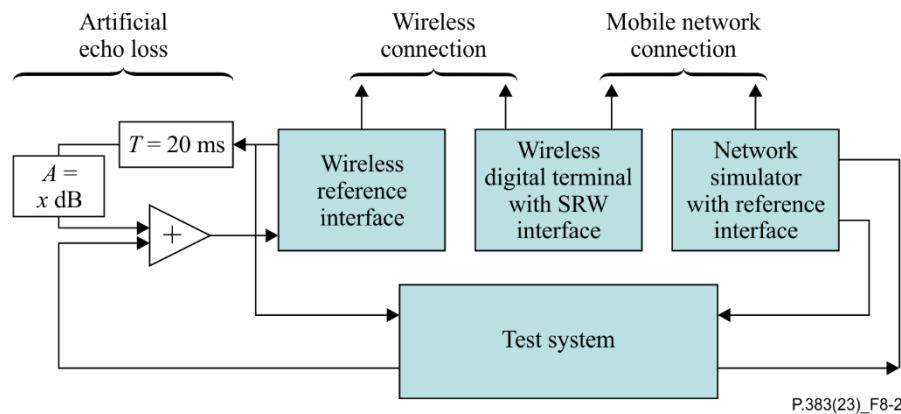


**Figure 8-2 – Test set-up with artificial echo loss for echo and double talk testing**

### 8.1.1.2 Test signals and test signal levels

Unless otherwise specified, FB real speech signals, which can be found in [ITU-T P.501], are used for measurements. Detailed information about the test signal used can be found in the corresponding clause of [ITU-T P.501]. For test cases where composite source signals (CSSs) are specified, the speech spectrum-shaped CSSs specified in [ITU-T P.501] shall be used.

All test signals used in the Receive tests must be band limited using a bandpass filter with a roll-off of more than 24 dB/octave. In NB mode, the signal shall be band limited between 100 Hz and 4 kHz. In WB mode, the signal shall be band limited between 100 Hz and 8 kHz. In SWB mode, the frequency range shall be band limited between 50 Hz and 16 kHz. In FB mode, the signal shall be band limited between 20 Hz and 20 kHz.

In Send, the test signals are used without band limitation, other than what is inherent in the digital interface.

For real speech, the test signal levels are referred to the [ITU-T P.56] active speech level of the (band-limited in receiving direction) test signal, calculated over the complete test sequence, unless described otherwise. For other test signals, the test signal levels are referred to the average level of the (band limited in the receiving direction) test signals, averaged over the complete test sequence length.

Unless stated otherwise, the nominal average signal level for the measurements is  $-16$  dBm0 at the electrical interfaces (includes digital headset reference interface and the system simulator), for Send and Receive.

Some tests require the exact synchronization of test signals in the time domain. Therefore, consideration is required of the delays of the terminals. When analysing signals, any delay introduced by the test system, codecs and terminals must be taken into account accordingly.

## 8.1.2 Delay for the communication mode (terminal)

### 8.1.2.1 Requirements

The delay in the send direction is measured from the wireless reference interface to the point of interconnection (POI; speech codec of the system simulator output), and in the receive direction from the POI to the wireless reference interface and it is corrected for test equipment delays. See Figure 8-3.

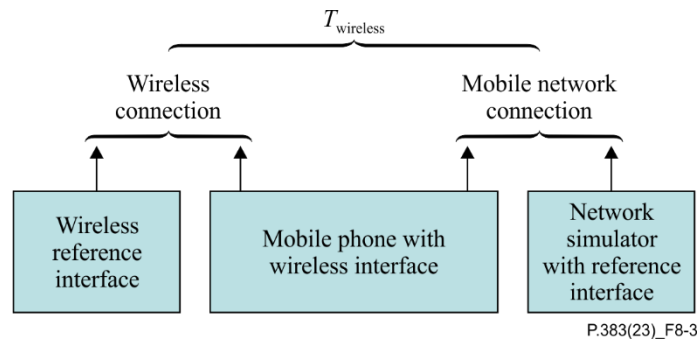


**Figure 8-3 – Delay in wireless headset connections**

Definitions:

- The mobile phone delay in the send (uplink) direction  $T_{\text{wireless,S}}$  is the delay between the first bit of a wireless speech frame at the wireless antenna to the last bit of the corresponding speech frame at the mobile network antenna.
- The mobile phone delay in the receive (downlink) direction with short-range wireless (SRW) interface  $T_{\text{wireless,R}}$  is the delay between the first bit of a speech frame at the mobile network antenna and the first bit of a wireless speech frame at the wireless antenna corresponding to that speech frame.

According to these definitions and for error-free radio conditions, the round trip delay of terminal with SRW interface,

$$T_{\text{wireless,rtt}} = T_{\text{wireless,S}} + T_{\text{wireless,R}}$$

where

$T_{\text{wireless,S}}$  is the Send delay of terminal with SRW interface;

$T_{\text{wireless,R}}$  is the Receive delay of terminal with SRW interface,

shall be less than 150 ms.

NOTE 1 – The delay  $T_{\text{wireless,rtt}}$  should be minimized.

NOTE 2 – The system delay  $T_{\text{sys}}$  depends on the transmission method used and the network simulator. The delay  $T_{\text{sys}}$  must be known.

NOTE 3 – For 3GPP UMTS circuit-switched speech and 3GPP LTE MTSI-based speech, definitions, test methods, performance objectives, and requirements are found in [b-3GPP TS 26.131] and [b-3GPP TS 26.132].

## 8.1.2.2 Test

### 8.1.2.2.1 Test of overall delay in Send

- 1) The test signal to be used for the measurements is a CSS, as described in [ITU-T P.501]. The test signal consists of the voiced part followed by a pseudo-random noise sequence with a minimum periodicity of 500 ms.
- 2) The test signal level is  $-16 \text{ dBm}_0$ , measured at the Send input of the digital headset reference interface.
- 3) The delay is calculated using the cross-correlation function between the signal at the Send input of digital headset reference interface and the signal at the system simulator output.
- 4) The measurement is corrected by the delay in the sending direction introduced by the test equipment ( $T_{\text{S,sys}}$ ). The sending delay ( $T_{\text{S,wdt}}$ ), expressed in milliseconds, is determined from the maximum of the cross-correlation function.

#### 8.1.2.2.2 Test of overall delay in Receive

- 1) The test signal to be used for the measurements is a CSS, as described in [ITU-T P.501]. The test signal consists of the voiced part followed by a pseudo-random noise sequence with a minimum periodicity of 500 ms.
- 2) The test signal level is  $-16 \text{ dBm}_0$ , measured at the output of the system simulator.
- 3) The delay is calculated using the cross-correlation function between the signal at the system simulator and the signal at the Receive output of the digital headset reference interface.
- 4) The measurement is corrected by the delay in the receive direction introduced by the test equipment ( $T_{R,\text{sys}}$ ). The Receive delay ( $T_{R,\text{wdt}}$ ), expressed in milliseconds, is determined from the maximum of the cross-correlation function.

#### 8.1.3 Junction loudness rating in Send for the communication mode (terminal)

##### 8.1.3.1 Requirements

The nominal values of the junction loudness rating in the send direction (JLRs) should be:

$$\text{JLRs} = 0 \pm 2 \text{ dB}.$$

##### 8.1.3.2 Test

- 1) The test set-up is according to clause 8.1.1, Figure 8-1.
- 2) The test signal used for the measurements is the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level is the active speech level according to [ITU-T P.56], adjusted as described in clause 8.1.1.2. The power density spectrum at the sending input of the headset reference interface is used as the reference power density spectrum for determining the sending sensitivity.
- 3) For NB, the Send sensitivity is calculated from each band of the frequencies given in Table 1 of [ITU-T P.79], bands 4 to 17. For WB, SWB and FB, the Send sensitivity is calculated from each band of the frequencies given in Table A.2 of [ITU-T P.79], bands 1 to 20. For the calculation, the average measured level at the output of the system simulator for each frequency band is referred to the reference signal.
- 4) The sensitivity is expressed in decibels. For NB, the junction loudness rating (JLR) is calculated according to Equation A-23d of [ITU-T P.79], bands 4 to 17,  $m = 0.175$  and the weighting factors ( $W_j$ ) for JLR according to Table A.2 of [ITU-T P.79]. For WB, SWB and FB, the JLR is calculated according to Equation A-23d of [ITU-T P.79], bands 1 to 20.

#### 8.1.4 Junction loudness rating in Receive for the communication mode (terminal)

##### 8.1.4.1 Requirements

The nominal values of the junction loudness rating in the receive direction (JLRr) should be:

$$\text{JLRr} = 0 \pm 2 \text{ dB}.$$

It is recommended that the terminal with digital headset interfaces transmit the audio signals in the sending and receiving directions in a transparent and neutral way when connecting digital headsets. The digital headset interfaces should not add gains or attenuate the transmitted signal regardless of the volume setting of the terminal.

##### 8.1.4.2 Test

- 1) The test set-up is according to clause 8.1.1, Figure 8-1.
- 2) The test signal used for the measurements is the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level is the active speech level according to [ITU-T P.56], adjusted as described in clause 7.1.1.2. The measured power

density spectrum at the receiving input of the system simulator is used as the reference power density spectrum for determining the Receive sensitivity.

- 3) For NB, the Send sensitivity is calculated from each band of the frequencies given in Table 1 of [ITU-T P.79], bands 4 to 17. For WB, SWB and FB, the Send sensitivity is calculated from each band of the frequencies given in Table A.2 of [ITU-T P.79], bands 1 to 20. For the calculation, the average measured level at the receiving output of the digital headset reference interface for each frequency band is referred to the reference signal.
- 4) The sensitivity is expressed in decibels. For NB, the JLR is calculated according to Equation A-23d of [ITU-T P.79], bands 4 to 17,  $m = 0.175$  and the weighting factors ( $W_J$ ) for JLR according to Table A.2 of [ITU-T P.79]. For WB, SWB and FB, the JLR is calculated according to Equation A-23d of [ITU-T P.79], bands 1 to 20.

### **8.1.5 Linearity in Send for the communication mode (terminal)**

#### **8.1.5.1 Requirements**

For acoustical signal level variation in the range  $-30$  dB to  $0$  dB from the nominal signal level, the measured JLRs shall not deviate by more than  $\pm 2$  dB from the JLRs measured with the nominal signal level.

#### **8.1.5.2 Test**

- 1) The test set-up is according to clause 8.1.1, Figure 8-1.
- 2) The test signal used for the measurements is the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level shall be the active speech level according to [ITU-T P.56]. The test signals are in the range  $-30$  dB to  $0$  dB in steps of  $10$  dB relative to the nominal signal level  $-16$  dBm<sub>0</sub>, measured at the sending input of the digital headset reference interface.
- 3) JLRs is calculated according to clause 8.1.3.1 at each test signal level.

### **8.1.6 Linearity in Receive for the communication mode (terminal)**

#### **8.1.6.1 Requirements**

For acoustical signal level variation in the range  $-30$  dB to  $0$  dB from the nominal signal level, the measured JLRr shall not deviate by more than  $\pm 2$  dB from the JLRr measured with the nominal signal level.

#### **8.1.6.2 Test**

- 1) The test set-up is according to clause 8.1.1, Figure 8-1.
- 2) The test signal used for the measurements is the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level shall be the active speech level according to [ITU-T P.56]. The test signals are in the range  $-30$  dB to  $0$  dB in steps of  $10$  dB relative to the nominal signal level  $-16$  dBm<sub>0</sub>, measured at the input of the system simulator.
- 3) JLRr is calculated according to clause 8.1.4.1 at each test signal level.

### **8.1.7 Send sensitivity/frequency response for the communication mode (terminal)**

#### **8.1.7.1 Requirements**

The Send sensitivity frequency response is measured from the sending input of digital headset reference interface to the output of the system simulator.

The tolerance mask for the Send sensitivity frequency response is shown in Tables 8-1, 8-2, 8-3 and 8-4.

**Table 8-1 – Tolerance mask for the narrowband sending frequency response**

| Frequency (Hz) | Upper limit | Lower limit | Target |
|----------------|-------------|-------------|--------|
| 100            | 0           | $-\infty$   | 0      |
| 200            | 0           | $-\infty$   | 0      |
| 300            | 0           | -3          | 0      |
| 1 000          | 0           | -3          | 0      |
| 3 100          | 0           | -4          | 0      |
| 3 400          | 0           | -4          | 0      |
| 4 000          | 0           | $-\infty$   | 0      |

NOTE 1 – All sensitivity values are expressed in db on an arbitrary scale.

NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (db) scale.

**Table 8-2 – Tolerance mask for the wideband sending frequency response**

| Frequency (Hz) | Upper limit | Lower limit | Target |
|----------------|-------------|-------------|--------|
| 100            | 0           | -3          | 0      |
| 200            | 0           | -3          | 0      |
| 1 000          | 0           | -3          | 0      |
| 3 000          | 0           | -4          | 0      |
| 5 000          | 0           | -4          | 0      |
| 6 300          | 0           | -4          | 0      |
| 8 000          | 0           | $-\infty$   | 0      |

NOTE 1 – All sensitivity values are expressed in db on an arbitrary scale.

NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (dB) scale.

**Table 8-3 – Tolerance mask for the super-wideband sending frequency response**

| Frequency (Hz) | Upper limit | Lower limit | Target |
|----------------|-------------|-------------|--------|
| 100            | 0           | -3          | 0      |
| 200            | 0           | -3          | 0      |
| 1 000          | 0           | -3          | 0      |
| 3 000          | 0           | -4          | 0      |
| 5 000          | 0           | -4          | 0      |
| 8 000          | 0           | -4          | 0      |
| 12 500         | 0           | -4          | 0      |
| 16 000         | 0           | -4          | 0      |

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale.

NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (db) scale.

**Table 8-4 – Tolerance mask for the fullband sending frequency response**

| Frequency (Hz) | Upper limit | Lower limit | Target |
|----------------|-------------|-------------|--------|
| 100            | 0           | –3          | 0      |
| 200            | 0           | –3          | 0      |
| 1 000          | 0           | –3          | 0      |
| 3 000          | 0           | –4          | 0      |
| 5 000          | 0           | –4          | 0      |
| 8 000          | 0           | –4          | 0      |
| 12 500         | 0           | –4          | 0      |
| 20 000         | 0           | –4          | 0      |

NOTE 1 – All sensitivity values are expressed in dB on an arbitrary scale.  
NOTE 2 – The limits for intermediate frequencies lie on a straight line drawn between the given values on a logarithmic (frequency) – linear (dB) scale.

**8.1.7.2 Test**

- 1) The test set-up is according to clause 8.1.1, Figure 8-1.
- 2) The test signal used for the measurements is the British-English single talk sequence described in clause 7.3.2 of [ITU-T P.501]. The test signal level is the active speech level according to [ITU-T P.56], adjusted as described in clause 7.1.1.2. The power density spectrum at the sending input of the headset reference interface is used as the reference power density spectrum for determining the sending sensitivity.
- 3) In FB, the sending sensitivity is determined in one-12th octave bands, as given by [IEC 61260-1] for frequencies from 100 Hz to 20 kHz inclusive, measured at the output of the system simulator. In SWB, it is determined for frequencies from 100 Hz to 16 kHz. In WB, it is determined for frequencies from 100 Hz to 8 kHz. In NB, it is determined for frequencies from 100 Hz to 4 kHz. In each one-third octave band, the level of the measured signal is referred to the level of the reference signal.
- 4) The sensitivity is determined in decibels.

**8.1.8 Receive sensitivity and frequency response for the communication mode (terminal)****8.1.8.1 Requirements**

The Receive sensitivity and frequency response is measured from the input of the system simulators to the receiving output of the digital headset reference interface.

The tolerance mask for the Send sensitivity frequency response is shown in Tables 8-5, 8-6, 8-7, and 8-8.

**Table 8-5 – Tolerance mask for the narrowband receiving frequency response**

| Frequency (Hz) | Upper limit | Lower limit | Target |
|----------------|-------------|-------------|--------|
| 100            | 0           | –∞          | 0      |
| 200            | 0           | –∞          | 0      |
| 300            | 0           | –3          | 0      |
| 1 000          | 0           | –3          | 0      |
| 3 100          | 0           | –4          | 0      |
| 3 400          | 0           | –4          | 0      |