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P.381 (Code 60005)
ITU-T P.381, headset/headphone interface of mobile terminals

Overview

Most wired analog headphones and headsets use the widespread 3.5 mm plug for audio transmission. The corresponding 3.5 mm jack is a built-in feature of many digital mobile devices, e.g. smartphones. Mutual compatibility across this connection allows users to combine arbitrary analog headphones and headsets with digital mobile devices for telephony and media playback.

To ensure compatibility, Recommendation ITU-T P.381 specifies physical & electrical and acoustic requirements as well as test methods for both device groups with this connector. Complying with P.381 therefore attests interoperability and also good performance across this connection.

HEAD acoustics implemented all tests specified in the ITU-T Recommendation in the automated test suite P.381 for ACQUA. The test suite can be used by manufacturers of digital terminal devices as well as by manufacturers of wired analog headphones or headsets to ensure universal compatibility and to test electro-acoustic performance.

Description

The 3.5 mm audio connector, commonly known as the "headphone jack", is a very popular feature found on all kinds of audio and communication devices. On digital mobile terminal devices like smartphones, it connects to analog wired headphones and headsets with the corresponding 3,5 mm plug.

While headphones are limited to media playback, headsets additionally support telephony. This introduces the challenges typically associated with telecommunication such as delay, echo and double talk issues.

From the user's perspective, a mobile terminal device should be compatible with any suitable headphone and headset. Together they should offer decent signal quality in send and receive direction. This allows universal combination possibilities of mobile terminal devices with headphones/headsets, which is convenient for the user and reduces electronic waste.

Recommendation ITU-T P.381 specifies test methods for communication and media playback across an analog (2.5 mm/3.5 mm) audio connection. The document entails:

- Physical requirements for jack & plug
- Electrical tests for digital mobile terminal devices
- Acoustic tests for wired headphones/headsets.

HEAD acoustics has implemented all tests laid out in the ITU-T recommendation into the test suite P.381 for the advanced communication quality analysis system ACQUA. For electrical tests of terminal devices as well as acoustic tests of headphones/headsets, measurements are separated for communication and media playback. The version in force of Recommendation ITU-T P.381 describes tests for all frequency ranges from narrowband to fullband that are common for the respective application.

Key Features

- Complete implementation of latest version of Recommendation ITU-T P.381 (10/2020) as automated test suite for ACQUA
- Supports analog headphones/headsets with 2.5 mm and 3.5 mm plug
- Supports terminal devices with inbuilt or adapted 2.5 mm/ 3.5 mm jack
- Supports GSM/3G/VoLTE measurements in NB/WB/SWB/FB
- ITU-T provides speech recordings with background noise

Applications

- Automated analysis, experimental development and optimization of the following device types according to Recommendation ITU-T P.381 (10/2020):
  - The analog audio connection of digital mobile terminal devices
  - Wired analog headphones & headsets

Overview of database revisions and specification versions		
Database Revision	Based on Specification Version	Min. ACQUA Version
03	ITU-T P.381 10/2020	4.0.200

The Recommendation also supports testing across the less common, but electrically identical 2.5 mm audio connection. Terminal devices without a headphone jack can be tested with the help of an adapter that provides an analog headphone jack, e.g. a "USB-C to headphone" cable. For testing, terminal device and adapter are treated as one joint device. Devices that have neither of these connections, e.g. headsets with a USB connector, are not part of Recommendation ITU-T P.381.
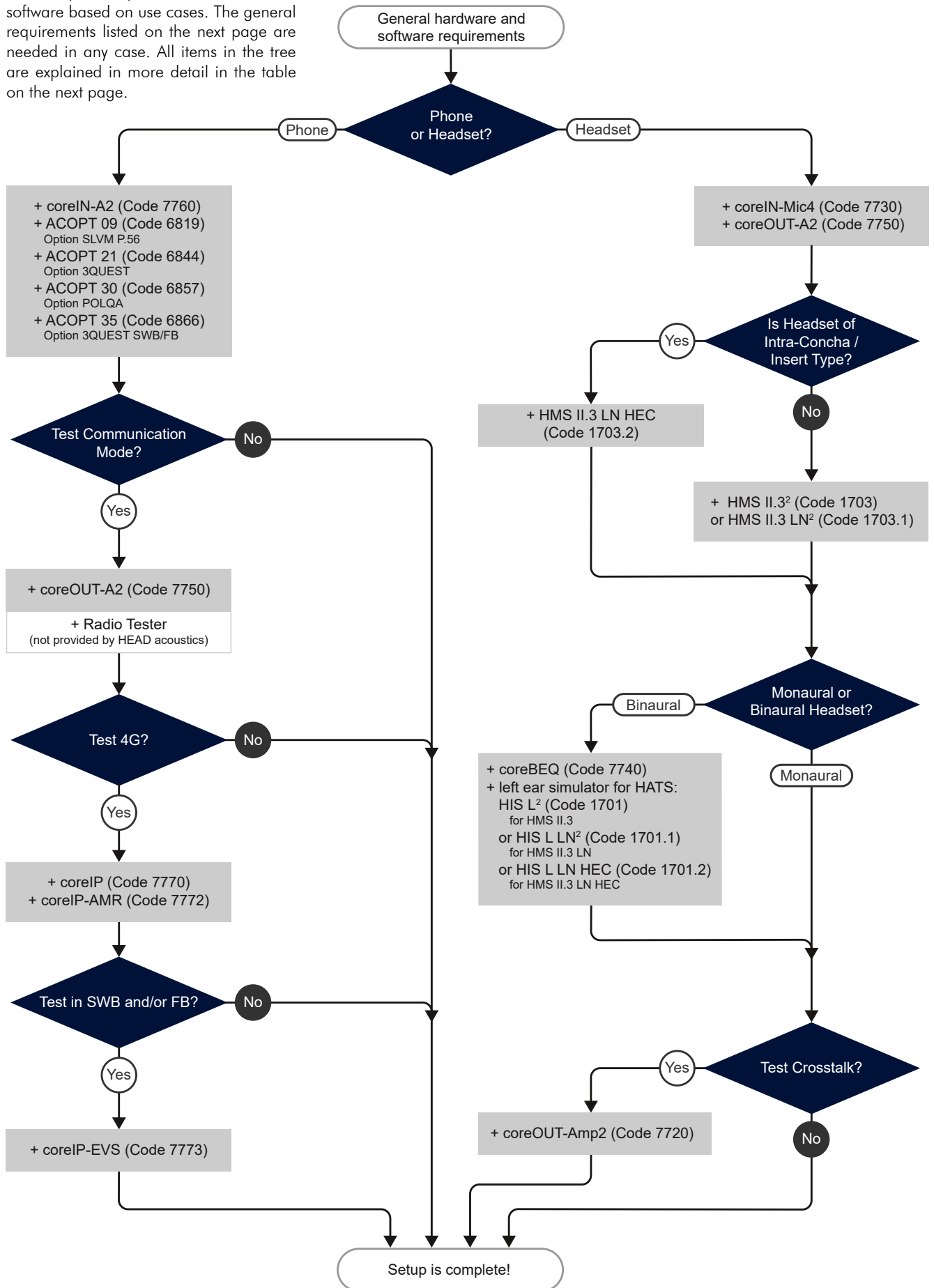
For testing terminal devices, the ITU-T provides speech recordings with background noise. Making own recordings as described in previous versions of P.381 is still possible with this test suite, but not part of P.381 anymore.

In conjunction with the analysis system ACQUA and various other HEAD acoustics components (cf. system requirements), the P.381 test suite with its predefined measurement descriptors (see table below) and automated test sequences allows the fast and easy acquisition, analysis and documentation of measurement data.

	Overview of SMDs in P.381								
	Electrical Interface (EI) Measurements					**Acoustic Headset (HE) Measurements**			
	Communication			MM Playback		Communication		MM Playback	
	EINB	**EIWB**	**EISB**	**EIFB**		**HEWB**	**HESB**	**HEFB**	
Delay in SND	•	•	•	•	-	•	•	•	-
Sensitivity SND	-	-	-	-	-	•	•	•	-
Level (ASL) SND NOM. IN	•	•	•	•	-	-	-	-	-
Level (ASL) SND -10 dB	•	•	•	•	-	-	-	-	-
Level rel. to target Level -10dB	•	•	•	•	-	-	-	-	-
Level (ASL) SND +5dB	•	•	•	•	-	-	-	-	-
Level rel. to target Level +5dB	•	•	•	•	-	-	-	-	-
Frequency Response SND	•	•	•	•	-	•	•	•	-
Idle channel noise SND	•	•	•	•	-	•	•	•	-
Speech Level SND S/N Cal.	•	•	•	•	-	-	-	-	-
Distortion SND	•	•	•	•	-	•	•	•	-
Speech Quality SND	•	•	•	•	-	•	•	•	-
Activation Sensitivity SND	•	•	•	•	-	-	-	-	-
Sensitivity RCV	-	-	-	-	-	-	-	-	•
Frequency Response RCV	•	•	•	•	•	-	-	-	-
Level (ASL) NOM. IN	•	•	•	•	-	-	-	-	-
Idle channel Noise RCV	•	•	•	•	•	-	-	-	-
Speech Level RCV S/N Cal.	•	•	•	•	-	-	-	-	-
Distortion RCV	•	•	•	•	•	-	-	-	•
Speech Quality RCV	•	•	•	•	-	-	-	-	-
STMR Real Speech	•	•	•	•	-	-	-	-	-
BGN Measurement	•	•	•	•	-	-	-	-	-
TCLw	•	•	•	•	-	•	•	•	-
Temporal Echo Effects[1]	•	•	•	•	-	-	-	-	-
Att. Range dur. Double Talk SND	•	•	•	•	-	-	-	-	-
Att. Range dur. Double Talk RCV	•	•	•	•	-	-	-	-	-
Echo Attenuation during Double Talk	•	•	•	•	-	-	-	-	-
Crosstalk	-	-	-	-	•	-	-	-	•
U – Speech Level SND S/N Cal.	-	-	-	-	-	•	•	•	-
U – Idle channel Noise SND Peak	-	-	-	-	-	•	•	•	-
U – Clock Drift Measurement	•	•	•	•	-	-	-	-	-

Hardware & software

This tree serves as a decision-making tool to identify the required hardware and/or software based on use cases. The general requirements listed on the next page are needed in any case. All items in the tree are explained in more detail in the table on the next page.

```
                        ( General hardware and
                          software requirements )
                                    |
                                    v
              Phone         < Phone or Headset? >        Headset
         +----------------                        --------------------+
         |                                                            |
         v                                                            v
+---------------------------+              +---------------------------+
| + coreIN-A2 (Code 7760)   |              | + coreIN-Mic4 (Code 7730) |
| + ACOPT 09 (Code 6819)    |              | + coreOUT-A2 (Code 7750)  |
|    Option SLVM P.56       |              +---------------------------+
| + ACOPT 21 (Code 6844)    |                           |
|    Option 3QUEST          |                           v
| + ACOPT 30 (Code 6857)    |              Yes   < Is Headset of        >
|    Option POLQA           |          +-------    Intra-Concha /
| + ACOPT 35 (Code 6866)    |          |           Insert Type?         >
|    Option 3QUEST SWB/FB   |          |                  | No
+---------------------------+          v                  v
         |                   +------------------+   +---------------------------+
         v                   | + HMS II.3 LN HEC|   | + HMS II.3² (Code 1703)   |
   < Test Communication >  No| (Code 1703.2)    |   |  or HMS II.3 LN² (Code    |
     Mode?            -------+------------------+   |  1703.1)                  |
         | Yes                                      +---------------------------+
         v                                                        |
+---------------------------+                                     v
| + coreOUT-A2 (Code 7750)  |                        Binaural  < Monaural or      >
+---------------------------+                    +-------------  Binaural Headset?  >
| + Radio Tester            |                    |                    | Monaural
| (not provided by HEAD     |                    v                    v
|  acoustics)               |      +---------------------------+
+---------------------------+      | + coreBEQ (Code 7740)     |
         |                         | + left ear simulator for  |
         v                         |   HATS:                   |
   < Test 4G? >         No         |   HIS L² (Code 1701)      |
         |         ----------+     |     for HMS II.3          |
         | Yes              |      |   or HIS L LN² (Code      |
         v                  |      |   1701.1)                 |
+---------------------------+      |     for HMS II.3 LN       |
| + coreIP (Code 7770)      |      |   or HIS L LN HEC (Code   |
| + coreIP-AMR (Code 7772)  |      |   1701.2)                 |
+---------------------------+      |     for HMS II.3 LN HEC   |
         |                         +---------------------------+
         v                                     |
   < Test in SWB and/or FB? > No               |              < Test Crosstalk? >
         |            --------+                 |        Yes  +------         | No
         | Yes               |                  v        v    |              |
         v                   |      +---------------------------+           |
+---------------------------+|      | + coreOUT-Amp2 (Code 7720)|           |
| + coreIP-EVS (Code 7773)  ||      +---------------------------+           |
+---------------------------+|                                              |
         |                   v                                              |
         +------------> ( Setup is complete! ) <-------------------------+
```

Overview of Hardware & Software Items in Decision Tree		
Code	Type	Description
Hardware		
1701	HIS L	HEAD Impedance Simulator, Left, for HMS II.3/4/5, Version 2021
1701.1	HIS L LN	HEAD Impedance Simulator, Left, Low-Noise Version, for HMS II.3/4/5, Version 2021
1701.2	HIS L LN HEC	HEAD Impedance Simulator, Left, Low Noise, for HMS II.3/4/5, Human-like Ear Canal Version
1703	HMS II.3	HEAD Measurement System, Basic Version with Right Ear Simulator, 3.3 Pinna & Artificial Mouth
1703.1	HMS II.3 LN	HEAD Meas. System, Low-Noise (LN) Version with Right Ear Simulator, 3.3 Pinna & Artificial Mouth
1703.2	HMS II.3 LN HEC	HEAD Meas. System, LN Version with Human-like Ear Canal Simulator Right & Artificial Mouth
7720	coreOUT-Amp2	labCORE Output Module, Power Amplifier (2 Channels)
7730	coreIN-Mic4	labCORE Input Module, Microphone (4 Channels)
7750	coreOUT-A2	labCORE Output Module, Analog Balanced/Unbalanced (2 Channels)
7760	coreIN-A2	labCORE Input Module, Analog Balanced/Unbalanced (2 Channels)
Software		
6819	ACOPT 09	Option SLVM P.56
6844	ACOPT 21	Option 3QUEST - 3fold Quality Evaluation of Speech in Telecommunication (NB/WB)
6857	ACOPT 30	Option POLQA - Perceptual Objective Listening Quality Analysis
6866	ACOPT 35	Option 3QUEST Super-wideband/Fullband according to ETSI TS 103 281, Model A
7740	coreBEQ	labCORE Binaural Equalization, incl. Filter Set for One Artificial Head
7770	coreIP	labCORE I/O Module, Voice over IP Reference Gateway
7772	coreIP-AMR	labCORE VoIP AMR Codec Option (coreIP Module Required)
7773	coreIP-EVS	labCORE VoIP EVS Codec Option (coreIP Module Required)

General Requirements

The following items are generally required independently of the use case. Please note that further components are necessary to use this test suite. They can be identified via the decision tree on the previous page.

Hardware

- *lab*CORE (Code 7700), Modular multi-channel hardware platform **with**
  - *core*BUS (Code 7710), I/O bus mainboard
- HIB I (Code 6002), Headset interface box

Software

- ACQUA (Code 6810 etc.), Advanced Communication Analysis System, Version 4.3.100 or later

Options

Please see the decision tree to determine hardware and software needed for your individual application.

Delivery Items

- P.381 (Code 60005), delivered as ACQUA database
- V2C file
- Documentation as PDF

1) This measurement requires *lab*CORE as a hardware platform and ACQUA in version 4.3.100 or newer.

2) Where applicable, a HMS model of the previous generation (Codes 12xx and 13xx) can also be used. Please note that HMS II.3 LN HEC as well as HMS II.7 do not have predecessors.