HAC RF TESTREPORT

No. I18Z60272-SEM03

For

TCL Communication Ltd.

GSM Quad-band/HSPA-UMTS Six-band/LTE 18-bands mobile phone

Model Name: BBE100-2

With

Hardware Version: 04

Software Version: V6R13-6

FCC ID: 2ACCJN024

Results Summary: M Category = M4

Issued Date: 2018-7-2

TESTING
NVLAP LAB CODE 600118-0

Note:

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Test Laboratory:

CTTL, Telecommunication Technology Labs, CAICT

No. 51, Xueyuan Road, Haidian District, Beijing, P. R. China 100191.

Tel:+86(0)10-62304633-2512, Fax:+86(0)10-62304633-2504

Email: cttl_terminals@caict.ac.cn, website: www.caict.ac.cn

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REPORT HISTORY

Report Number	Revision	Issue Date	Description
I18Z60272-SEM03	Rev.0	2018-7-2	Initial creation of test report

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1 Test Laboratory

1.1 Testing Location

CompanyName:	CTTL(Shouxiang)
Address:	No. 51 Shouxiang Science Building, Xueyuan Road, Haidian District, Beijing, P. R. China100191

1.2 Testing Environment

Temperature:	18°C~25°C,
Relative humidity:	30%~ 70%
Ground system resistance:	< 0.5 Ω
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

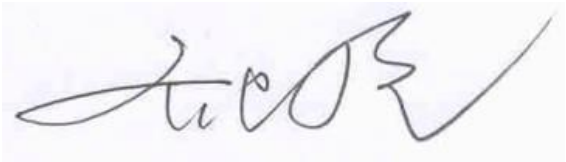
1.3 Project Data

Project Leader:	Qi Dianyuan
Test Engineer:	Lin Hao
Testing Start Date:	2018-6-25
Testing End Date:	2018-6-26

1.4 Signature

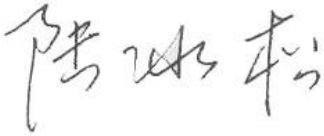
Lin Xiaojun

(Prepared this test report)



Qi Dianyuan

(Reviewed this test report)



Lu Bingsong

Deputy Director of the laboratory

(Approved this test report)

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2 Client Information

2.1 Applicant Information

Company Name:	TCL Communication Ltd.
Address/Post:	7/F, Block F4, TCL International E City, Zhong Shan Yuan Road, Nanshan District, Shenzhen, Guangdong, P.R. China 518052 Shenzhen, Guangdong
City:	Shenzhen
Country:	China
Contact Person:	Gong Zhizhou
E-mail:	zhizhou.gong@tcl.com
Telephone:	0086-755-36611722
Fax:	0086-75536612000-81722

2.2 Manufacturer Information

Company Name:	TCL Communication Ltd.
Address/Post:	7/F, Block F4, TCL International E City, Zhong Shan Yuan Road, Nanshan District, Shenzhen, Guangdong, P.R. China 518052 Shenzhen, Guangdong
City:	Shenzhen
Country:	China
Contact Person:	Gong Zhizhou
E-mail:	zhizhou.gong@tcl.com
Telephone:	0086-755-36611722
Fax:	0086-75536612000-81722

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3 Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1 About EUT

Description:	GSM Quad-band/HSPA-UMTS Six-band/LTE 18-bands mobile phone
Model name:	BBE100-2
Operating mode(s):	GSM 850/900/1800/1900 WCDMA850/900/1700/1900/2100 LTE B1/2/3/4/5/7/8/12/13/17/20/28/29/38/39/40/41/66, BT, WLAN

3.2 Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version
EUT1	015138000010588	04	V6R13-6
EUT2	015138000009671	04	V6R13-6
EUT3	015138000200049	04	V6R13-6

*EUT ID: is used to identify the test sample in the lab internally.

3.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	TLp029C1	/	BYD

*AE ID: is used to identify the test sample in the lab internally.

3.4 Air Interfaces / Bands Indicating Operating Modes

Air-interface	Band(MHz)	Type	C63.19/tested	Simultaneous Transmissions	OTT
GSM	850	VO	Yes	BT, WLAN	NA
	1900				
GPRS/EDGE	850	DT	NA		
	1900				
WCDMA (UMTS)	850	VO	Yes	BT, WLAN	NA
	1700				
	1900				
	HSPA	DT	NA		
LTE	Band 2/5/7/12/13/41/66	V/D	Yes	BT, WLAN	NA
BT	2450	DT	NA	GSM, WCDMA, LTE	NA
WLAN	2450	V/D	Yes	GSM, WCDMA, LTE	NA
WLAN	5G	V/D	Yes	GSM, WCDMA, LTE	NA

VO: Voice CMRS/PSTN Service Only V/D: Voice CMRS/PSTN and Data Service DT: Digital Transport

* HAC Rating was not based on concurrent voice and data modes, Non current mode was found to represent worst case rating for both M and T rating

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4 CONDUCTED OUTPUT POWER MEASUREMENT

4.1 Summary

During the process of testing, the EUT was controlled via Agilent Digital Radio Communication tester (E5515C) to ensure the maximum power transmission and proper modulation. This result contains conducted output power for the EUT. In all cases, the measured output power should be greater and within 5% than EMI measurement.

4.2 Conducted Power

GSM 850MHz	**Conducted Power (dBm)**		
	Channel 251(848.8MHz)	**Channel 190(836.6MHz)**	**Channel 128(824.2MHz)**
	32.38	32.41	32.28
GSM 1900MHz	**Conducted Power(dBm)**		
	Channel 810(1909.8MHz)	**Channel 661(1880MHz)**	**Channel 512(1850.2MHz)**
	29.26	29.08	28.96
WCDMA 850MHz	**Conducted Power (dBm)**		
	Channel 4233(846.6MHz)	**Channel 4182(836.4MHz)**	**Channel 4132(826.4MHz)**
	23.44	23.48	23.52
WCDMA 1700MHz	**Conducted Power (dBm)**		
	Channel 1513 (1752.6MHz)	**Channel 1412 (1732.4MHz)**	**Channel 1312 (1712.4MHz)**
	23.72	23.85	23.86
WCDMA 1900MHz	**Conducted Power (dBm)**		
	Channel 9538(1907.6MHz)	**Channel 9400(1880MHz)**	**Channel 9262(1852.4MHz)**
	23.75	23.70	23.74
LTE Band2 QPSK	**Conducted Power (dBm)**		
	Channel 19100(1900MHz)	**Channel18900(1880MHz)**	**Channel 18700(1860MHz)**
	23.45	23.40	23.37
LTE Band5 QPSK	**Conducted Power (dBm)**		
	Channel 20600(844MHz)	**Channel 20525(836.5MHz)**	**Channel20450(829MHz)**
	23.08	23.13	23.15
LTE Band7 QPSK	**Conducted Power (dBm)**		
	Channel 21350(2560MHz)	**Channel21100(2535MHz)**	**Channel 20850(2510MHz)**
	23.41	23.53	23.42
LTE Band12 QPSK	**Conducted Power (dBm)**		
	Channel 23130(711MHz)	**Channel 23095(707.5MHz)**	**Channel23060(704MHz)**
	23.12	23.07	23.10
LTE Band13 QPSK	**Conducted Power (dBm)**		
	Channel 23230(782MHz)		
	23.02		
LTE	**Conducted Power (dBm)**		

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Band41 QPSK	**Channel 41490(2680MHz)**	**Channel 41055(2636.5MHz)**	**Channel 40620(2593MHz)**	**Channel 40185(2549.5MHz)**	**Channel 39750(2506MHz)**
	23.84	23.78	23.62	23.70	23.65

LTE Band66 QPSK	**Conducted Power (dBm)**		
	Channel 132572(1770MHz)	**Channel 132322(1745MHz)**	**Channel 132072(1720MHz)**
	23.30	23.44	23.52
LTE Band2 16-QAM	**Conducted Power (dBm)**		
	Channel 19100(1900MHz)	**Channel18900(1880MHz)**	**Channel 18700(1860MHz)**
	22.80	22.85	22.97
LTE Band5 16-QAM	**Conducted Power (dBm)**		
	Channel 20600(844MHz)	**Channel 20525(836.5MHz)**	**Channel20450(829MHz)**
	22.54	22.25	22.12
LTE Band7 16-QAM	**Conducted Power (dBm)**		
	Channel 21350(2560MHz)	**Channel21100(2535MHz)**	**Channel 20850(2510MHz)**
	22.85	22.87	23.03
LTE Band12 16-QAM	**Conducted Power (dBm)**		
	Channel 23130(711MHz)	**Channel 23095(707.5MHz)**	**Channel23060(704MHz)**
	22.37	21.97	21.94
LTE Band13 16-QAM	**Conducted Power (dBm)**		
	Channel 23230(782MHz)		
	22.08		

LTE Band41 16-QAM	**Conducted Power (dBm)**				
	Channel 41490(2680MHz)	**Channel 41055(2636.5MHz)**	**Channel 40620(2593MHz)**	**Channel 40185(2549.5MHz)**	**Channel 39750(2506MHz)**
	22.99	23.02	23.19	22.95	22.78

LTE Band66 16-QAM	**Conducted Power (dBm)**		
	Channel 132572(1770MHz)	**Channel 132322(1745MHz)**	**Channel 132072(1720MHz)**
	22.86	23.07	23.15
LTE Band2 64-QAM	**Conducted Power (dBm)**		
	Channel 19100(1900MHz)	**Channel18900(1880MHz)**	**Channel 18700(1860MHz)**
	21.40	21.43	21.44
LTE Band5 64-QAM	**Conducted Power (dBm)**		
	Channel 20600(844MHz)	**Channel 20525(836.5MHz)**	**Channel20450(829MHz)**
	21.46	21.46	21.45
LTE Band7 64-QAM	**Conducted Power (dBm)**		
	Channel 21350(2560MHz)	**Channel21100(2535MHz)**	**Channel 20850(2510MHz)**
	21.12	21.09	20.82
LTE Band12 64-QAM	**Conducted Power (dBm)**		
	Channel 23130(711MHz)	**Channel 23095(707.5MHz)**	**Channel23060(704MHz)**
	21.11	21.16	21.14

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LTE Band13 64-QAM	**Conducted Power (dBm)**				
	Channel 23230(782MHz)				
	21.46				
LTE Band41 64-QAM	**Conducted Power (dBm)**				
	Channel 41490(2680MHz)	**Channel 41055(2636.5MHz)**	**Channel 40620(2593MHz)**	**Channel 40185(2549.5MHz)**	**Channel 39750(2506MHz)**
	21.76	21.33	21.08	21.07	20.56
LTE Band66 64-QAM	**Conducted Power (dBm)**				
	Channel 132572(1770MHz)	**Channel 132322(1745MHz)**	**Channel 132072(1720MHz)**		
	21.23	21.38	21.66		
2.4GHz 802.11b 1M	**Conducted Power (dBm)**				
	Channel 11 (2462MHz)	**Channel 6 (2437MHz)**	**Channel 1 (2412MHz)**		
	19.16	19.23	19.47		
5GHz 802.11a 18M	**Conducted Power (dBm)**				
	Channel 165 (5825MHz)				
	17.37				

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5 Reference Documents

5.1 Reference Documents for testing

The following document listed in this section is referred for testing.

Reference	Title	Version
ANSI C63.19-2011	American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids	2011 Edition
FCC 47 CFR §20.19	Hearing Aid Compatible Mobile Headsets	2015 Edition
KDB 285076 D01	Equipment Authorization Guidance for Hearing Aid Compatibility	v05

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6 OPERATIONAL CONDITIONS DURING TEST

6.1 HAC MEASUREMENT SET-UP

These measurements are performed using the DASY5 NEO automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Stäubli), robot controller, Intel Core2 computer, near-field probe, probe alignment sensor. The robot is a six-axis industrial robot performing precise movements. A cell controller system contains the power supply, robot controller, teach pendant (Joystick),and remote control, is used to drive the robot motors. The PC consists of the HP Intel Core21.86 GHz computer with Windows XP system and HAC Measurement Software DASY5 NEO, A/D interface card, monitor, mouse, and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE)circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

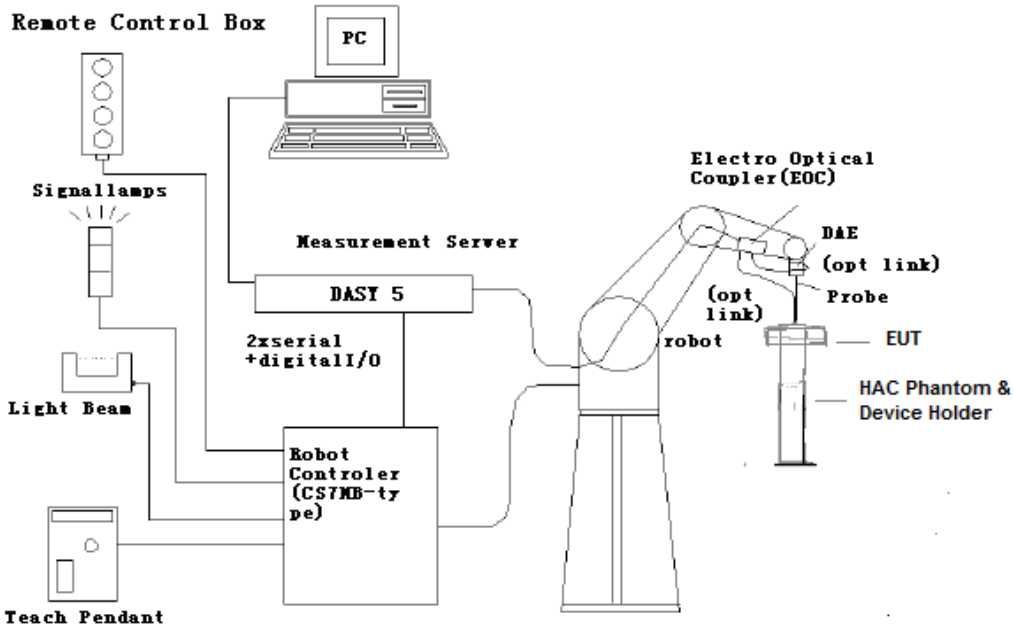

Fig. 1 HAC Test Measurement Set-up

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

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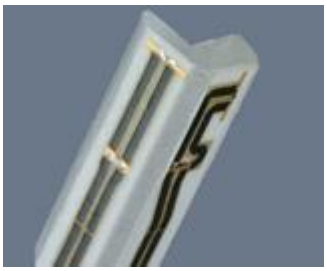
6.2 Probe Specification

E-Field Probe Description

Construction	One dipole parallel, two dipoles normal to probe axis Built-in shielding against static charges PEEK enclosure material
Calibration	In air from 100 MHz to 3.0 GHz (absolute accuracy ±6.0%, k=2)
Frequency	40 MHz to > 6 GHz (can be extended to < 20 MHz) Linearity: ± 0.2 dB (100 MHz to 3 GHz)
Directivity	± 0.2 dB in air (rotation around probe axis) ± 0.4 dB in air (rotation normal to probe axis)
Dynamic Range	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.5 mm
Application	General near-field measurements up to 6 GHz Field component measurements Fast automatic scanning in phantoms



[ER3DV6]

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6.3Test Arch Phantom &Phone Positioner

The Test Arch phantom should be positioned horizontally on a stable surface. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. It enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot (Dimensions: 370 x 370 x 370 mm).

The Phone Positioner supports accurate and reliable positioning of any phone with effect on near field <±0.5 dB.

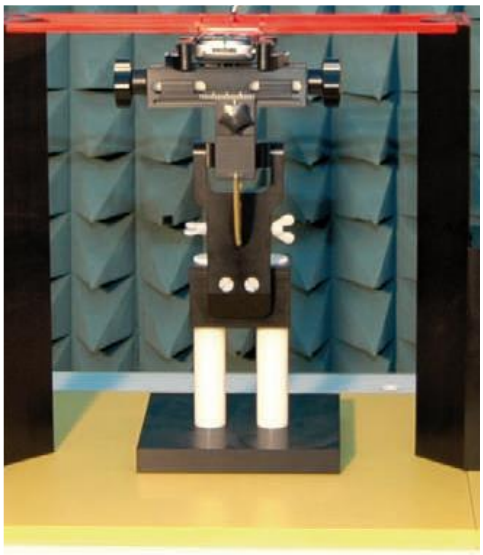

Fig. 2 HAC Phantom & Device Holder

6.4Robotic System Specifications

Specifications

Positioner: Stäubli Unimation Corp. Robot Model: RX160L
Repeatability: ±0.02 mm
No. of Axis: 6

Data Acquisition Electronic (DAE) System

Cell Controller
Processor: Intel Core2
Clock Speed: 1.86GHz
Operating System: Windows XP
Data Converter
Features: Signal Amplifier, multiplexer, A/D converter, and control logic
Software: DASY5 software
Connecting Lines: Optical downlink for data and status info.
Optical uplink for commands and clock

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7 EUT ARRANGEMENT

7.1 WD RF Emission Measurements Reference and Plane

Figure 4 illustrates the references and reference plane that shall be used in the WD emissions measurement.

- The grid is 5 cm by 5 cm area that is divided into 9 evenly sized blocks or sub-grids.
- The grid is centered on the audio frequency output transducer of the WD (speaker or T-coil).
- The grid is located by reference to a reference plane. This reference plane is the planar area that contains the highest point in the area of the WD that normally rests against the user's ear
- The measurement plane is located parallel to the reference plane and 15 mm from it, out from the phone. The grid is located in the measurement plane.

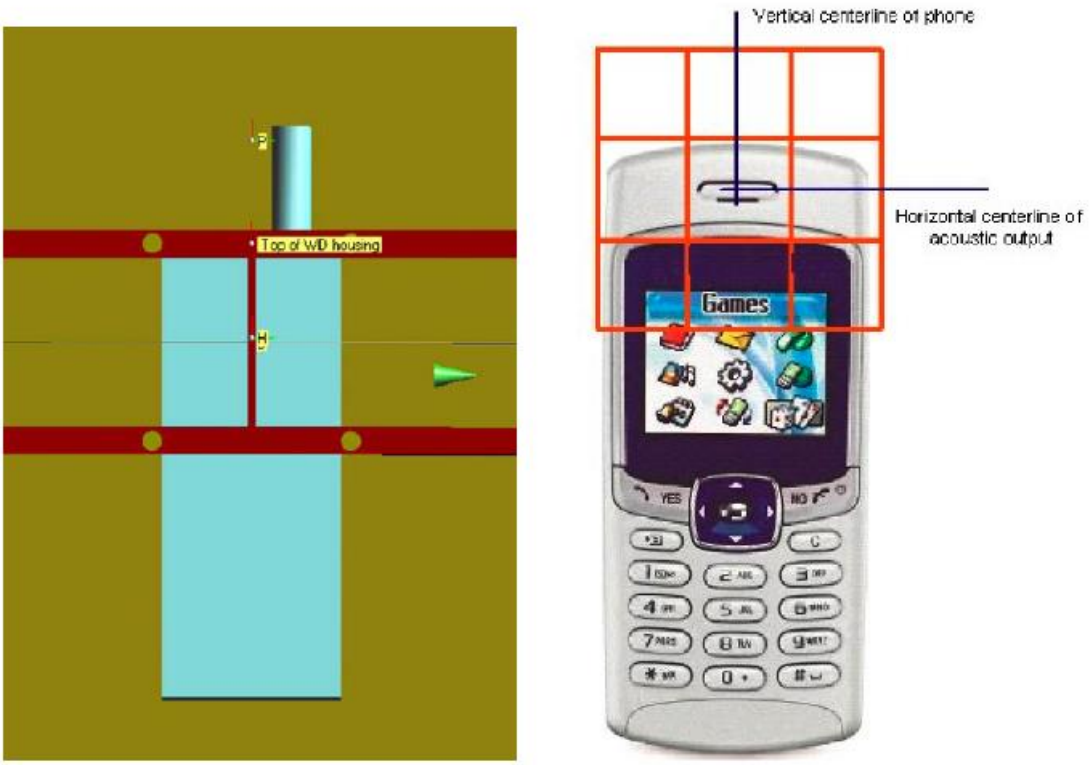

Fig. 3 WD reference and plane for RF emission measurements

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8 SYSTEM VALIDATION

8.1 Validation Procedure

Place a dipole antenna meeting the requirements given in ANSI C63.19 in the position normally occupied by the WD. The dipole antenna serves as a known source for an electrical output. Position the E-field probes so that:

•The probes and their cables are parallel to the coaxial feed of the dipole antenna

•The probe cables and the coaxial feed of the dipole antenna approach the measurement area from opposite directions

• The center point of the probe element(s) are 15 mm from the closest surface of the dipole elements.

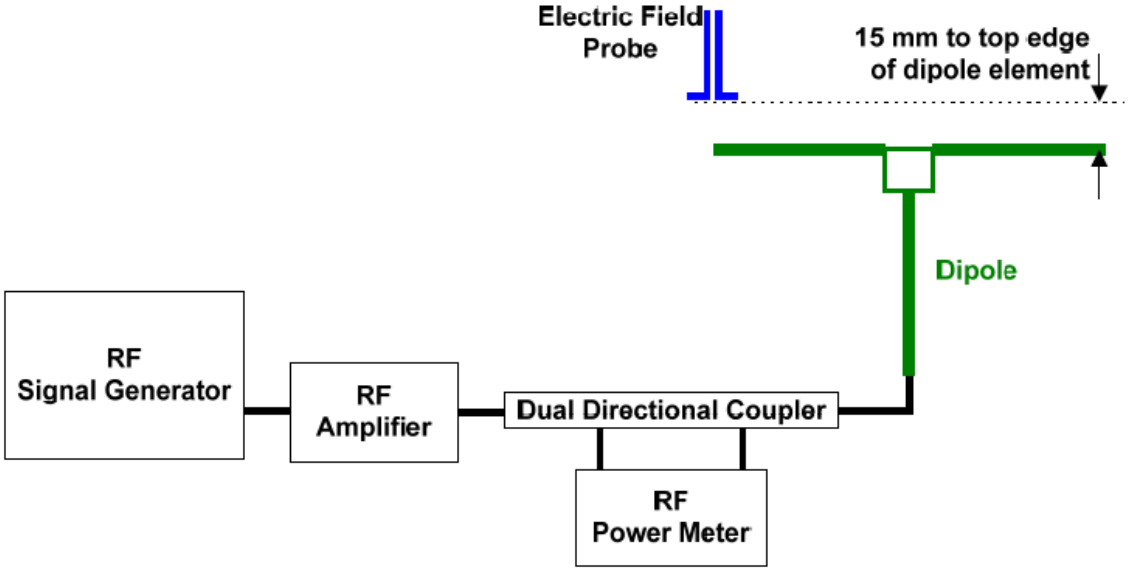

Fig. 4 Dipole Validation Setup

8.2 Validation Result

E-Field Scan						
Mode	**Frequency (MHz)**	**Input Power (mW)**	**Measured[1] Value(dBV/m)**	**Target[2] Value(dBV/m)**	**Deviation[3] (%)**	**Limit[4] (%)**
CW	835	100	40.61	40.67	-0.69	±25
CW	1880	100	39.32	39.24	0.93	±25
CW	2600	100	38.89	38.74	-0.57	±25

Notes:

1. Please refer to the attachment for detailed measurement data and plot.
2. Target value is provided by SPEAD in the calibration certificate of specific dipoles.
3. Deviation (%) = 100 * (Measured value minus Target value) divided by Target value.
4. ANSI C63.19 requires values within ± 25% are acceptable, of which 12% is deviation and 13% is measurement uncertainty. Values independently validated for the dipole actually used in the measurements should be used, when available.

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9 Evaluation of MIF

9.1 Introduction

The MIF (Modulation Interference Factor) is used to classify E-field emission to determine Hearing Aid Compatibility (HAC). It scales the power-averaged signal to the RF audio interference level and is characteristic to a modulation scheme. The HAC standard preferred "indirect" measurement method is based on average field measurement with separate scaling by the MIF. With an Audio Interference Analyzer (AIA) designed by SPEAG specifically for the MIF measurement, these values have been verified by practical measurements on an RF signal modulated with each of the waveforms. The resulting deviations from the simulated values are within the requirements
of the HAC standard.

The AIA (Audio Interference Analyzer) is an USB powered electronic sensor to evaluate signals in the frequency range 698MHz - 6 GHz. It contains RMS detector and audio frequency circuits for sampling of the RF envelope.

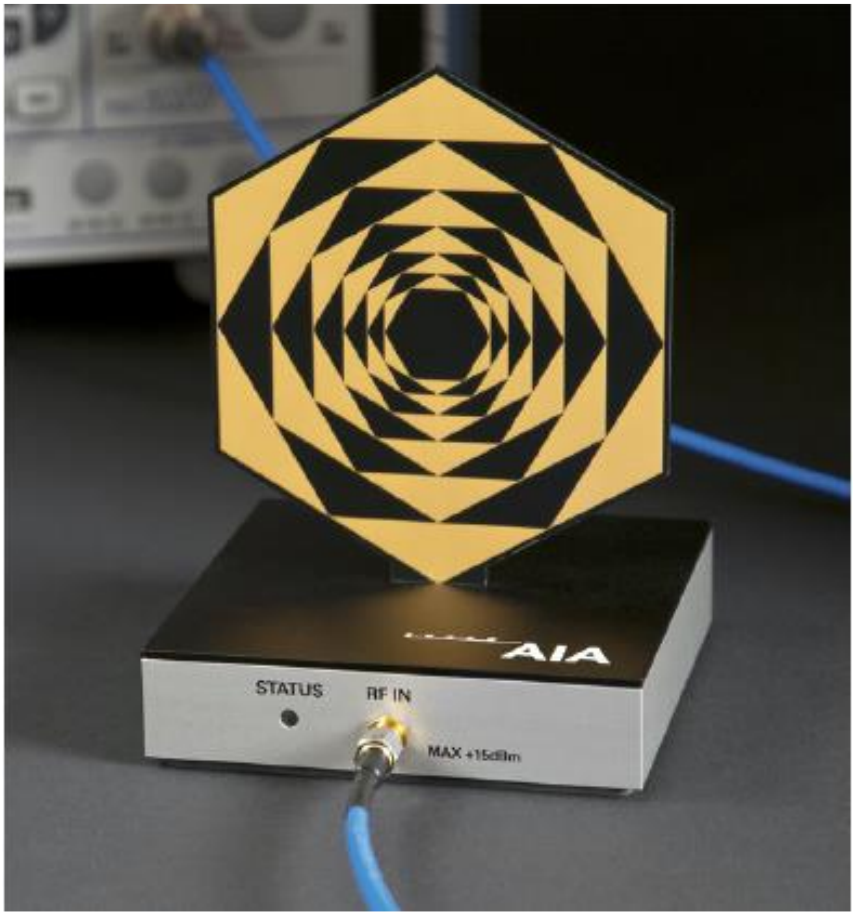

Fig. 5 AIA Front View

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9.2 MIF measurement with the AIA

The MIF is measured with the AIA as follows:

1. Connect the AIA via USB to the DASY5 PC and verify the configuration settings.
2. Couple the RF signal to be evaluated to an AIA via cable or antenna.
3. Generate a MIF measurement job for the unknown signal and select the measurement port and timing settings.
4. Document the results via the post processor in a report.

9.3 Test equipment for the MIF measurement

No.	Name	Type	Serial Number	Manufacturer
01	Signal Generator	E4438C	MY49071430	Agilent
02	AIA	SE UMS 170 CB	1029	SPEAG
03	BTS	E5515C	MY50263375	Agilent

9.4 Test signal validation

The signal generator (E4438C) is used to generate a 1GHz signal with different modulation in the below table based on the ANSI C63.19-2011. The measured MIF with AIA are compared with the target values given in ANSI C63.19-2011 table D.3, D.4 and D5.

Pulse modulation	**Target MIF**	**Measured MIF**	**Deviation**
0.5ms pulse, 1000Hz repetition rate	-0.9 dB	-0.9 dB	0 dB
1ms pulse, 100Hz repetition rate	+3.9 dB	+3.7 dB	0.2 dB
0.1ms pulse, 100Hz repetition rate	+10.1 dB	+10.0 dB	0.1 dB
10ms pulse, 10Hz repetition rate	+1.6 dB	+1.7 dB	0.1 dB
Sine-wave modulation	**Target MIF**	**Measured MIF**	**Deviation**
1 kHz, 80% AM	-1.2 dB	-1.3 dB	0.1 dB
1 kHz, 10% AM	-9.1 dB	-9.0 dB	0.1 dB
1 kHz, 1% AM	-19.1 dB	-18.9 dB	0.2 dB
100 Hz, 10% AM	-16.1 dB	-16.0 dB	0.1 dB
10 kHz, 10% AM	-21.5 dB	-21.6 dB	0.1 dB
Transmission protocol	**Target MIF**	**Measured MIF**	**Deviation**
GSM; full-rate version 2; speech codec/handset low	+3.5 dB	+3.47 dB	0.03 dB
WCDMA; speech; speech codec low; AMR 12.2 kb/s	-20.0 dB	-19.8 dB	0.2 dB
CDMA; speech; SO3; RC3; full frame rate; 8kEVRC	-19.0 dB	-19.1 dB	0.1 dB
CDMA; speech; SO3; RC1; 1/8th frame rate; 8kEVRC	+3.3 dB	+3.44 dB	0.14 dB

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9.5 DUT MIF results

Typical MIF levels in ANSI C63.19-2011	
Transmission protocol	Modulation interference factor
GSM; full-rate version 2; speech codec/handset low	+3.5 dB
WCDMA; speech; speech codec low; AMR 12.2 kb/s	-20.0 dB
LTE-FDD (SC-FDMA, 1RB, 20MHz, QPSK)	-15.63 dB
LTE-FDD (SC-FDMA, 1RB, 20MHz, 16QAM)	-9.76 dB
LTE-FDD (SC-FDMA, 1RB, 20MHz, 64QAM)	-9.93 dB
LTE-TDD (SC-FDMA, 1RB, 20MHz, QPSK)	-1.62 dB
LTE-TDD (SC-FDMA, 1RB, 20MHz, 16QAM)	-1.44 dB
LTE-TDD (SC-FDMA, 1RB, 20MHz, 64QAM)	-1.54 dB

Measured MIF levels		
Band	Channel	Modulation interference factor (dB)
GSM 850	251	3.42
	190	3.51
	128	3.52
GSM 1900	810	3.51
	661	3.53
	512	3.50
WCDMA 850	4458	-23.87
	4407	-22.66
	4357	-24.8
WCDMA 1700	1738	-24.26
	1637	-24.18
	1537	-22.28
WCDMA 1900	9938	-24.35
	9800	-24.42
	9662	-23.07
LTE Band2 QPSK	19100	-14.39
	18900	-14.51
	18700	-13.83
LTE Band5 QPSK	20600	-14.38
	20525	-14.47
	20450	-14.73
LTE Band7 QPSK	21350	-14.56
	21100	-14.15
	20850	-14.26
LTE Band12 QPSK	23130	-14.68
	23095	-14.66
	23060	-15.12

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LTE Band13 QPSK	23230	-14.79
LTE Band66 QPSK	132572	-14.64
	132322	-14.25
	132072	-14.32
LTE Band41 QPSK	41490	-1.79
	41055	-1.82
	40620	-1.74
	40185	-1.74
	39750	-1.69
LTE Band2 16QAM	19100	-9.78
	18900	-10.24
	18700	-10.93
LTE Band5 16QAM	20600	-9.9
	20525	-10.96
	20450	-9.41
LTE Band7 16QAM	21350	-10.62
	21100	-10.08
	20850	-10.54
LTE Band12 16QAM	23130	-11.65
	23095	-10.74
	23060	-10.55
LTE Band13 16QAM	23230	-9.49
LTE Band66 16QAM	132572	-10.49
	132322	-10.31
	132072	-9.58
LTE Band41 16QAM	41490	-1.85
	41055	-1.72
	40620	-1.7
	40185	-1.55
	39750	-1.74
LTE Band2 64QAM	19100	-10.73
	18900	-10.33
	18700	-9.59
LTE Band5 64QAM	20600	-10.16
	20525	-9.52
	20450	-10.97
LTE Band7 64QAM	21350	-10.52
	21100	-10.45
	20850	-9.95
LTE Band12 64QAM	23130	-10.74
	23095	-10.54
	23060	-11.51
LTE Band13 64QAM	23230	-11.06

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LTE Band66 64QAM	132572	-10.38
	132322	-10.34
	132072	-9.71
LTE Band41 64QAM	41490	-1.85
	41055	-1.94
	40620	-1.63
	40185	-1.61
	39750	-1.76
2.4GHz 802.11b 5.5M	11	-8.76
	6	-7.68
	1	-8.93
5GHz 802.11a 18M	165	-9.04

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10 Evaluation for low-power exemption

10.1 Product testing threshold

There are two methods for exempting an RF air interface technology from testing. The first method requires evaluation of the MIF for the worst-case operating mode. An RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is≤17 dBm for any of its operating modes. The second method does not require determination of the MIF. The RF emissions testing exemption shall be applied to an RF air interface technology in a device whose peak antenna input power, averaged over intervals ≤50 μs20, is ≤23 dBm. An RF air interface technology that is exempted from testing by either method shall be rated as M4.
The first method is used to be exempt from testing for the RF air interface technology in this report.

10.2 Conducted power

Band	Average power (dBm)	MIF (dB)	Sum (dBm)
GSM 850	32.41	3.52	35.93
GSM 1900	29.26	3.53	32.79
WCDMA 850	23.52	-22.66	0.86
WCDMA 1700	23.86	-22.28	1.58
WCDMA 1900	23.75	-23.07	0.68
LTE B2	23.45	-9.29	14.16
LTE B5	23.15	-9.41	13.74
LTE B7	23.53	-9.95	13.58
LTE B12	23.12	-10.54	12.58
LTE B13	23.02	-9.49	13.53
LTE B66	23.84	-9.58	14.26
LTE B41	23.52	-1.55	21.97
WiFi-2.4G	19.47	-7.68	11.79
WiFi-5G	17.37	-9.04	8.33

10.3 Conclusion

According to the above table, the sums of average power and MIF for UMTS, WiFi and LTE bands except B41 are less than 17dBm. So it is only measured for GSM bands and LTE B41. The others are exempt from testing and rated as M4.

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