HAC RF TEST REPORT

No. I16Z41389-SEM03

For

TCL Communication Ltd.

LTE / UMTS / GSM mobile phone

Model name: 5045I

With

Hardware Version: PIO

Software Version: 7EDF

FCC ID: 2ACCJH056

Results Summary: M Category = M4

Issued Date: 2016-8-1

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Note:

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Test Laboratory:

CTTL, Telecommunication Technology Labs, Academy of Telecommunication Research, MIIT

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REPORT HISTORY

Report Number	Revision	Issue Date	Description
I16Z41389-SEM03	Rev.0	2016-7-14	Initial creation of test report
I16Z41389-SEM03	Rev.1	2016-7-19	Update the table 3.4
I16Z41389-SEM03	Rev.2	2016-7-22	Add note for table 3.4
I16Z41389-SEM03	Rev.3	2016-7-27	Add MIF evaluation of VoLTE
I16Z41389-SEM03	Rev.4	2016-8-1	Add MIF evaluation of VoLTE 16-QAM

TABLE OF CONTENT

1 Test Laboratory

3.1 Testing Location

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

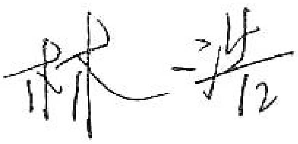
1.2 Testing Environment

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

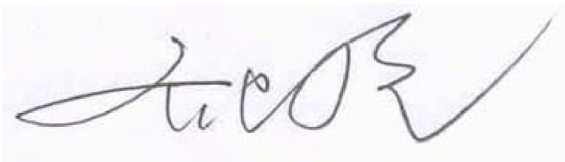
Project Leader:	Qi Dianyuan
Test Engineer:	Lin Hao
Testing Start Date:	July 4, 2016
Testing End Date:	July 4, 2016

1.4 Signature



Lin Hao

(Prepared this test report)



Qi Dianyuan

(Reviewed this test report)

Xiao Li

Deputy Director of the laboratory

(Approved this test report)

2 Client Information

2.1 Applicant Information

Company Name:	TCL Communication Ltd.
Address /Post:	5F, C building, No. 232, Liang Jing Road ZhangJiang High-Tech Park, Pudong Area Shanghai, P.R. China. 201203
City:	Shanghai
Postal Code:	201203
Country:	China
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Telephone:	0086-21-31363544
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2.2 Manufacturer Information

Company Name:	TCL Communication Ltd.
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City:	Shanghai
Postal Code:	201203
Country:	China
Contact Person:	Gong Zhizhou
Email:	zhizhou.gong@tcl.com
Telephone:	0086-21-31363544
Fax:	0086-21-61460602

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

3.1 About EUT

Description:	LTE / UMTS / GSM mobile phone
Model name:	5045I
Operating mode(s):	GSM 850/900/1800/1900, WCDMA 850/1700/1900 BT, Wi-Fi, LTE Band 2/4/5/7/12/17

3.2 Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version
EUT1	351666080300513 351666080300505	PIO	7EDF
EUT2	351666080300430 351666080300448	PIO	7EDF

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

Note: It is performed to test HAC with the EUT1 and conducted power with the EUT2.

3.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery	CAB2000059C2	/	SCUD
AE2	Battery	CAB2000010C1	/	BYD

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

Note: It is performed to test HAC with the AE2.

3.4 Air Interfaces / Bands Indicating Operating Modes

Air-interface	Band(MHz)	Type	C63.19/tested	Simultaneous Transmissions	OTT	Power Reduction
GSM	850	VO	Yes	BT, WLAN	NA	NA
	1900					
GPRS/EDGE	850	DT	NA			No
	1900					
WCDMA (UMTS)	850	VO	Yes	BT, WLAN	NA	NA
	1900					
	1700					
	HSPA	DT	NA			
LTE	Band 2/4/7/12/17	VD1.	NA	BT, WLAN	NA	NA
BT	2450	DT	NA	GSM, WCDMA, LTE	NA	NA
WLAN	2450	DT	NA	GSM, WCDMA, LTE	NA	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

Note: 1.= No Associated T-Coil measurement has been made in accordance with 285076 D02 T-Coil testing for CMRS IP

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)**
	32.67	32.70	32.67
GSM 1900MHz	**Conducted Power (dBm)**		
	Channel 810(1909.8MHz)	**Channel 661(1880MHz)**	**Channel 512(1850.2MHz)**
	29.86	29.48	29.38
WCDMA 850MHz	**Conducted Power (dBm)**		
	Channel 4233(846.6MHz)	**Channel 4182(836.4MHz)**	**Channel 4132(826.4MHz)**
	23.80	23.78	23.88
WCDMA 1900MHz	**Conducted Power (dBm)**		
	Channel 9538(1907.6MHz)	**Channel 9400(1880MHz)**	**Channel 9262(1852.4MHz)**
	23.54	23.34	23.82
WCDMA 1700MHz	**Conducted Power (dBm)**		
	Channel 1513(1752.6MHz)	**Channel 1412(1732.4MHz)**	**Channel 1312(1712.4MHz)**
	23.01	23.27	23.87
LTE Band2	**Conducted Power (dBm)**		
	Channel 19100(1900MHz)	**Channel 18900(1880MHz)**	**Channel 18700(1860MHz)**
	22.48	22.63	22.49
LTE Band4	**Conducted Power (dBm)**		
	Channel 20300(1745MHz)	**Channel 20175(1732.5MHz)**	**Channel 20050(1720MHz)**
	21.38	21.49	21.70
LTE Band5	**Conducted Power (dBm)**		
	Channel 20600(844MHz)	**Channel 20525(836.5MHz)**	**Channel 20450(829MHz)**
	21.80	21.95	22.15
LTE Band7	**Conducted Power (dBm)**		
	Channel 21350(2560MHz)	**Channel 21100(2535MHz)**	**Channel 20850(2510MHz)**
	22.08	22.38	22.16
LTE Band12	**Conducted Power (dBm)**		
	Channel 23130(711MHz)	**Channel 23095(707.5MHz)**	**Channel 23060(704MHz)**
	21.81	21.81	21.81
LTE Band17	**Conducted Power (dBm)**		
	Channel 23800(711MHz)	**Channel 23790(710MHz)**	**Channel 23780(709MHz)**
	21.87	21.81	21.75

LTE 16-QAM Band2	Conducted Power (dBm)		
	Channel 19100(1900MHz)	Channel 18900(1880MHz)	Channel 18700(1860MHz)
	21.47	21.6	21.46
LTE 16-QAM Band4	Conducted Power (dBm)		
	Channel 20300(1745MHz)	Channel 20175(1732.5MHz)	Channel 20050(1720MHz)
	20.37	20.47	20.69
LTE 16-QAM Band5	Conducted Power (dBm)		
	Channel 20600(844MHz)	Channel 20525(836.5MHz)	Channel 20450(829MHz)
	20.81	20.97	21.17
LTE 16-QAM Band7	Conducted Power (dBm)		
	Channel 21350(2560MHz)	Channel 21100(2535MHz)	Channel 20850(2510MHz)
	21.05	21.34	21.08
LTE 16-QAM Band12	Conducted Power (dBm)		
	Channel 23130(711MHz)	Channel 23095(707.5MHz)	Channel 23060(704MHz)
	20.90	20.86	20.88
LTE 16-QAM Band17	Conducted Power (dBm)		
	Channel 23800(711MHz)	Channel 23790(710MHz)	Channel 23780(709MHz)
	21	20.96	20.89

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	/
KDB 285076 D01	Equipment Authorization Guidance for Hearing Aid Compatibility	v04

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 Core2 1.86 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.

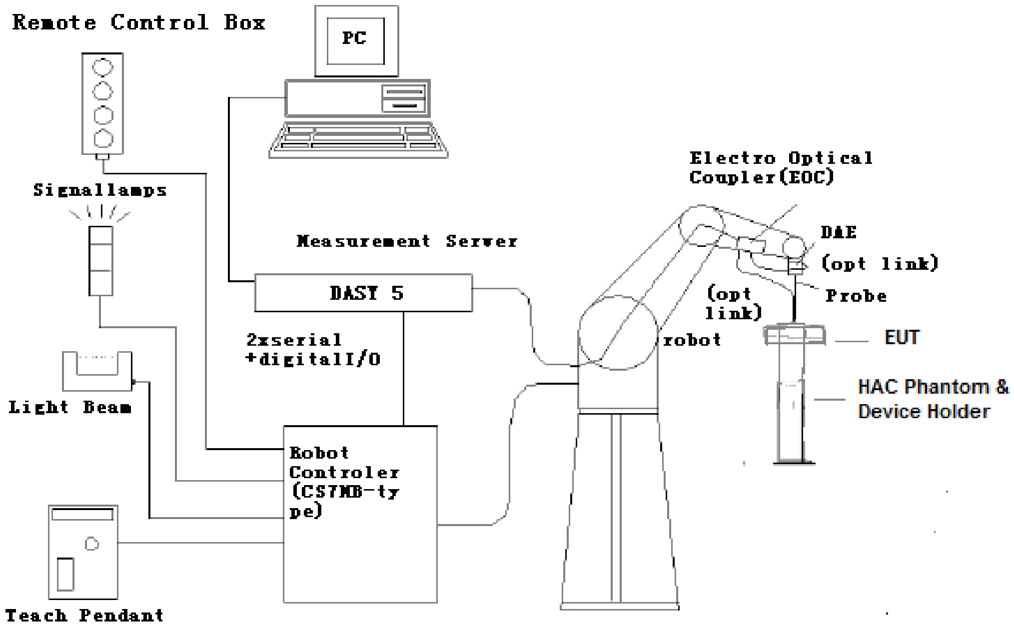

Fig. 1 HAC Test Measurement Set-up

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.

6.2 Probe Specification

E-Field Probe Description

[ER3DV6]

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

6.3 Test 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.

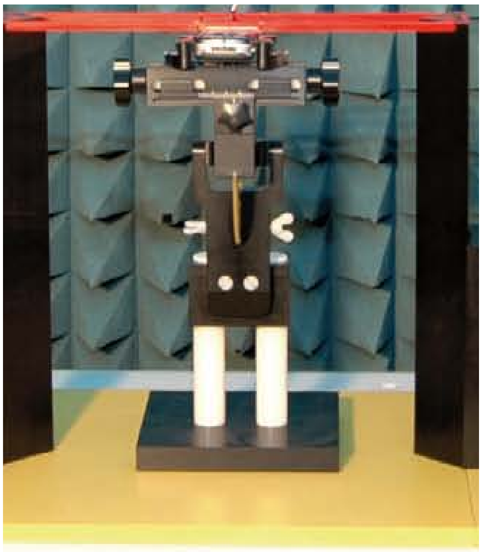

Fig. 2 HAC Phantom & Device Holder

6.4 Robotic 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: 1.86 GHz
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

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.

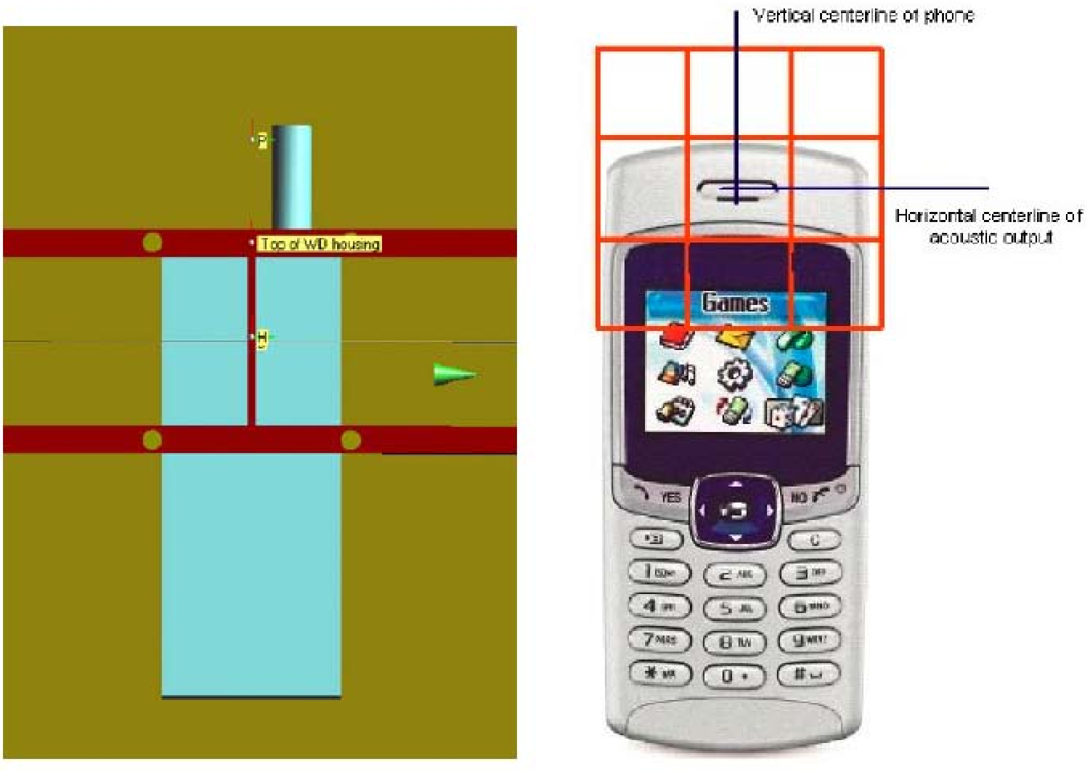

Fig. 3 WD reference and plane for RF emission measurements

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.

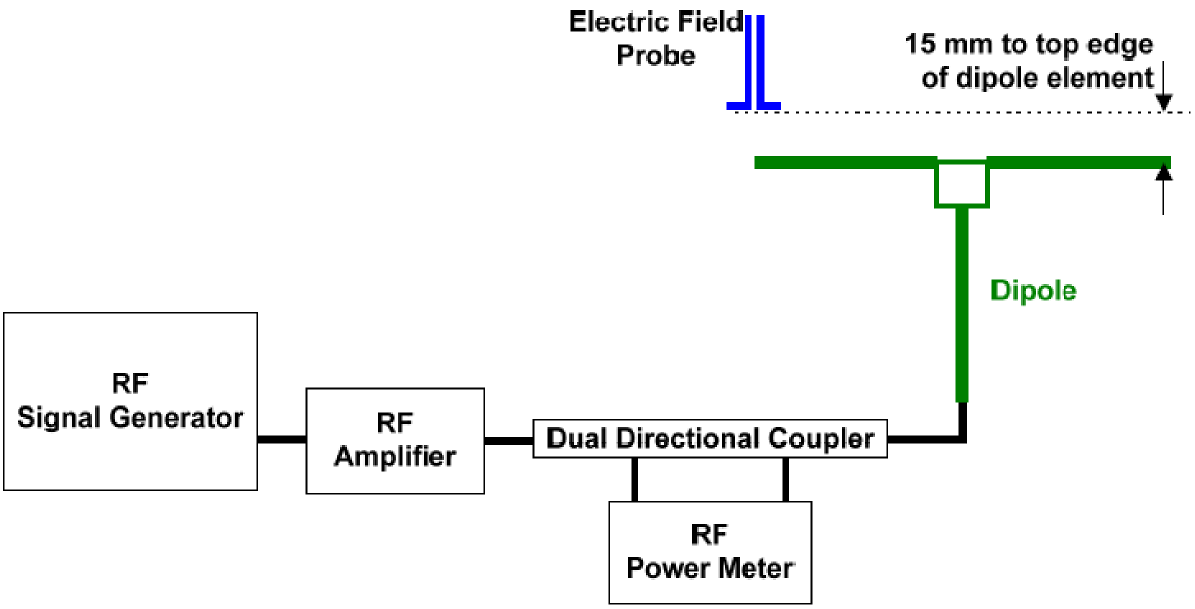

Fig. 4 Dipole Validation Setup

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	40.48	40.42	0.69	±25
CW	1880	100	39.12	39.08	0.46	±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.

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 698 MHz - 6 GHz. It contains RMS detector and audio frequency circuits for sampling of the RF envelope.

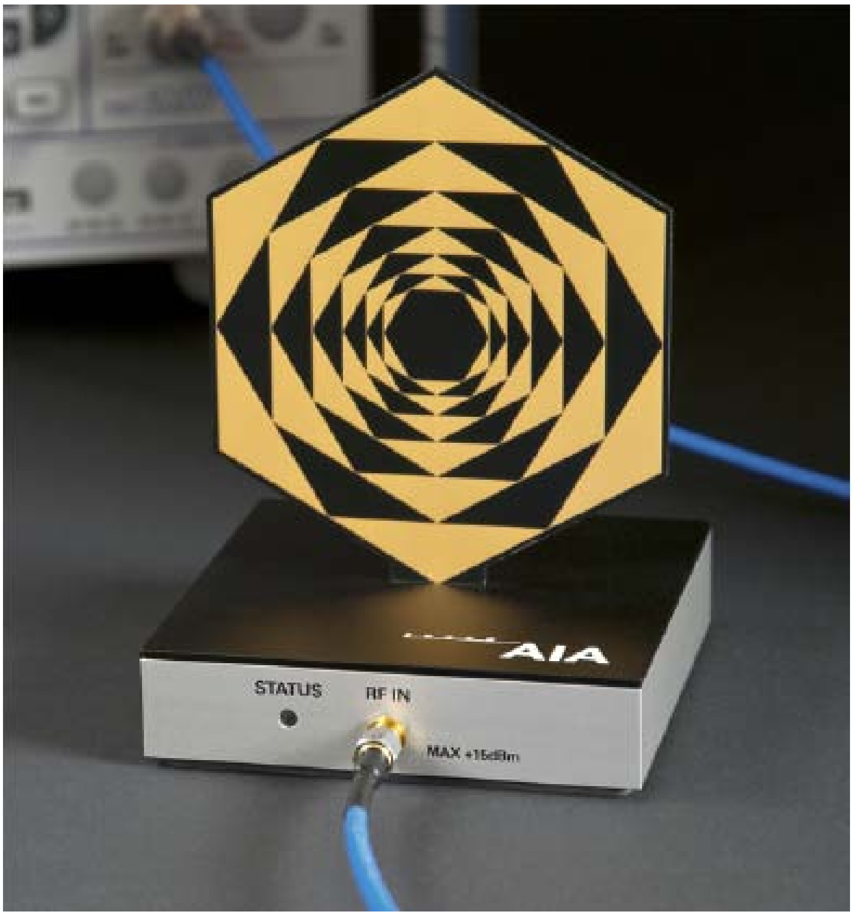

Fig. 5 AIA Front View

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

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,100%RB,20MHz,QPSK）	-23.48 dB
LTE-FDD（SC-FDMA,100%RB,20MHz,16-QAM）	-17.86 dB
LTE-FDD（SC-FDMA,100%RB,10MHz,QPSK）	-21.57 dB
LTE-FDD（SC-FDMA,100%RB,10MHz, 16-QAM）	-16.87 dB

Measured MIF levels		
Band	Channel	Modulation interference factor
GSM 850	251	+3.49 dB
	190	+3.46 dB
	128	+3.44 dB
GSM 1900	810	+3.5 dB
	661	+3.45 dB
	512	+3.43 dB
WCDMA 850	4233	-19.82 dB
	4182	-19.79 dB
	4132	-19.77 dB
WCDMA 1900	9538	-19.76 dB
	9400	-19.72 dB
	9262	-19.74 dB
WCDMA 1700	1513	-19.75 dB
	1412	-19.68 dB
	1312	-19.73 dB
LTE Band2	19100	-21.13 dB
	18900	-22.27 dB
	18700	-22.75 dB
LTE Band4	20300	-22.07 dB
	20175	-23.80 dB
	20050	-23.01 dB
LTE Band5	20600	-20.84 dB
	20525	-21.67 dB
	20450	-20.85 dB
LTE Band7	21350	-22.69 dB
	21100	-22.22 dB
	20850	-21.41 dB
LTE Band12	23130	-20.87 dB
	23095	-20.97 dB
	23060	-21.53 dB

LTE Band17	23800	-20.90 dB
	23790	-20.97 dB
	23780	-20.84 dB
LTE 16-QAM Band2	19100	-17.89 dB
	18900	-17.17 dB
	18700	-17.70 dB
LTE 16-QAM Band4	20300	-17.87 dB
	20175	-17.83 dB
	20050	-17.53 dB
LTE 16-QAM Band5	20600	-16.06 dB
	20525	-16.33 dB
	20450	-16.48 dB
LTE 16-QAM Band7	21350	-17.94 dB
	21100	-17.14 dB
	20850	-17.15 dB
LTE 16-QAM Band12	23130	-16.66 dB
	23095	-16.20 dB
	23060	-16.61 dB
LTE 16-QAM Band17	23800	-16.20 dB
	23790	-16.74 dB
	23780	-17.25 dB

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	32.7	3.46	36.16
GSM 1900	29.86	3.5	33.36
WCDMA 850	23.88	-19.77	4.11
WCDMA 1900	23.82	-19.74	4.08
WCDMA 1700	23.87	-19.73	4.14
LTE Band2	22.63	-22.27	0.36
LTE Band4	21.7	-23.01	-1.31
LTE Band5	22.15	-20.85	1.3
LTE Band7	22.38	-22.22	0.16
LTE Band12	21.81	-20.87	0.94
LTE Band17	21.87	-20.9	0.97
LTE 16-QAM Band2	21.6	-17.17	4.43
LTE 16-QAM Band4	20.69	-17.53	3.16
LTE 16-QAM Band5	21.17	-16.48	4.69
LTE 16-QAM Band7	21.34	-17.15	4.19
LTE 16-QAM Band12	20.9	-16.66	4.24
LTE 16-QAM Band17	21	-16.2	4.8

10.3 Conclusion

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

11 RF TEST PROCEDUERES

The evaluation was performed with the following procedure:

1) Confirm proper operation of the field probe, probe measurement system and other instrumentation and the positioning system.

2) Position the WD in its intended test position. The gauge block can simplify this positioning.

3) Configure the WD normal operation for maximum rated RF output power, at the desired channel and other operating parameters (e.g., test mode), as intended for the test.

4) The center sub-grid shall centered on the center of the T-Coil mode axial measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane. If the field alignment method is used, align the probe for maximum field reception.

5) Record the reading.

6) Scan the entire 50 mm by 50 mm region in equally spaced increments and record the reading at each measurement point. The distance between measurement points shall be sufficient to assure the identification of the maximum reading.

7) Identify the five contiguous sub-grids around the center sub-grid whose maximum reading is the lowest of all available choices. This eliminates the three sub-grids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.

8) Identify the maximum field reading within the non-excluded sub-grids identified in Step 7)

9) Evaluate the MIF and add to the maximum steady-state rms field-strength reading to obtain the RF audio interference level..

10) Compare this RF audio interference level with the categories and record the resulting WD category rating.