T-Coil HAC TEST REPORT

ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

TD LTE digital mobile phone

ISSUED TO
Lemobile Information Technology (Beijing) Co., Ltd.

WENHUAYING NORTH (NO.1, LINKONG 2ND ST), GAOLIYING, SHUNYI DISTRICT, BEIJING, CHINA

Tested by: Tu Lang
Tu Lang
(Engineer)
Date: Nov. 9, 2015

Approved by: Wei Yanquan
Wei Yanquan
(Chief Engineer)
Date: Nov. 19, 2015

Report No.:	BL-SZ1590187-702
EUT Type:	TD LTE digital mobile phone
Model Name:	Le Max
Brand Name:	Letv
FCC ID:	2AFWMLEMAX
Test Standard:	FCC 47 CFR Part 20.19
	ANSI C63.19: 2011
	KDB 285076 D01 HAC Guidance v04
T-Rating:	T-Coil: T3
Test conclusion:	Pass
Test Date:	Nov. 8, 2015
Date of Issue:	Nov. 19, 2015

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Revision History

Version	Issue Date	Revisions
Rev. 01	Nov. 16, 2015	Initial Issue
Rev. 02	Nov. 19, 2015	Second Issue

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1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are 832625. The laboratory has met the requirements of the IAS Accreditation Criteria for Testing Laboratories (AC89), has demonstrated compliance with ISO/IEC Standard 17025:2005. The accreditation certificate number is TL-588. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Test Environment Condition

Ambient Temperature	21 to 23 ℃
Ambient Relative Humidity	40 to 50%
Ambient Pressure	100 to 102 KPa

1.4 Announce

(1) The test report reference to the report template version v1.0.

(2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(3) The test report is invalid if there is any evidence and/or falsification.

(4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant

Applicant	Lemobile Information Technology (Beijing) Co., Ltd.
Address	WENHUAYING NORTH (NO.1, LINKONG 2ND ST), GAOLIYING, SHUNYI DISTRICT, BEIJING, CHINA

2.2 Manufacturer

Manufacturer	Lemobile Information Technology (Beijing) Co., Ltd.
Address	WENHUAYING NORTH (NO.1, LINKONG 2ND ST), GAOLIYING, SHUNYI DISTRICT, BEIJING.

2.3 Factory Information

Factory	Lemobile Information Technology (Beijing) Co., Ltd.
Address	WENHUAYING NORTH (NO.1, LINKONG 2ND ST), GAOLIYING, SHUNYI DISTRICT, BEIJING.

2.4 General Description for Equipment under Test (EUT)

EUT Type	TD LTE digital mobile phone
Model Name Under Test	Le Max
Series Model Name	N/A
Description of Model Name Differentiation	N/A
Hardware Version	N/A
Software Version	N/A
Dimensions	83×165×6 mm
Weight	202.8 g(with battery)
Network and Wireless connectivity	2G Network GSM 850/ 900/ 1800/ 1900, GPRS, EGPRS; 3G Network WCDMA Band 2/ 5, HSDPA, HSUPA; 4G Network LTE FDD Band 1/ 3/ 7; LTE TDD Band 38/ 39/ 40/ 41; WLAN; Bluetooth; GPS

2.5 Technical Information

The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	GSM; WCDMA; LTE; WLAN; Bluetooth		
Frequency Range	GSM 850	TX: 824 MHz ~849 MHz	RX: 869 MHz ~ 894 MHz
	GSM 1900	TX: 1850 MHz ~ 1910 MHz	RX: 1930 MHz ~ 1990 MHz
	WCDMA Band 2	TX: 1850 MHz ~ 1910 MHz	RX: 1930 MHz ~ 1990 MHz
	WCDMA Band 5	TX: 824 MHz ~ 849 MHz	RX: 869 MHz ~ 894 MHz
	LTE Band 7	TX: 2500 MHz ~ 2570 MHz	RX: 2620 MHz ~ 2690 MHz
	LTE Band 41	TX: 2469 MHz ~ 2690 MHz	RX: 2469 MHz ~ 2690 MHz
	802.11b/g	2400 MHz ~ 2483.5 MHz	
	802.11 n(HT20/HT40)	2400 MHz ~ 2483.5 MHz	
	802.11a	5150 MHz ~ 5250 MHz	
		5725 MHz ~ 5850 MHz	
	802.11 n(HT20/HT40)	5150 MHz ~ 5250 MHz	
		5725 MHz ~ 5850 MHz	
	802.11ac(HT20 /HT40/HT80)	5150 MHz ~ 5250 MHz	
		5725 MHz ~ 5850 MHz	
	Bluetooth	2400 MHz ~ 2483.5 MHz	
Antenna Type	WWAN: PIFA Antenna WLAN: PIFA Antenna Bluetooth: PIFA Antenna		
DTM	Not Support		
Hotspot Function	Support		
Exposure Category	General Population/Uncontrolled exposure		
EUT Stage	Portable Device		

2.6 EUT Air Interface Description

Air Interface	Band	Type	C63.19 Tested	Simultaneous Transmitter	OTT	Power Reduction
GSM	GSM850	Voice	Yes	Bluetooth/WLAN	N/A	Not Support
	GSM1900	Voice	Yes	Bluetooth/WLAN	N/A	Not Support
WCDMA	Band 2	RMC	Yes	Bluetooth/WLAN	N/A	Not Support
	Band 5	RMC	Yes	Bluetooth/WLAN	N/A	Not Support
LTE	FDD B7	VOIP	Yes[Note]	Bluetooth/WLAN	N/A	Not Support
	TDD B41	VOIP	Yes[Note]	Bluetooth/WLAN	N/A	Not Support
Note: Testing the T-coil for LTE VOIP is not required according with KDB 285076 D02 T Coil testing for CMRS IP v01r01.						

2.7 Ancillary Equipment

Ancillary Equipment 1	Battery	
	Brand Name	LeTV
	Model No.	LT633
	Serial No.	N/A
	Capacitance	3400 mAh
	Rated Voltage	3.8 V
	Extreme Voltage	4.35 V
Ancillary Equipment 2	AC Adapter (Charger for Battery)	
	Brand Name	CHENYANG
	Model Number	LSUUL050200-A00
	Rated Input	100-240 V~, 50/60 Hz, 0.5 A
	Rated Output	5 V⎓, 2000 mA

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	FCC 47 CFR Part 20.19	Hearing aid-compatible mobile handsets.
2	ANSI C 63.19:2011	American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids
3	KDB 285076 D01 HAC Guidance v04	Provides equipment authorization guidance for mobile handsets subject to the requirements of Section 20.19 for hearing aid compatibility

3.2 HAC Test Configuration and Setting

For HAC T-Coil testing, the EUT was linked and controlled by wireless communication test set. Communication between the EUT and the wireless communication test set was established by coaxial connection. The EUT was set from the wireless communication test set to radiate maximum output power during HAC testing.

3.3 Summary Of HAC T-Rating

Band	T-Rating	Frequency response
GSM 850	T3	PASS
GSM 1900	T3	PASS
WCDMA Band 2	T4	PASS
WCDMA Band 5	T4	PASS

3.4 ANSI C63.19 HAC T-Coil Categories

3.4.1 T-Coil Field Intensity

When measured as specified in this standard, the T-Coil signal shall be ≥ - 18 dB (A/m) at 1 kHz, in a 1/3 octave band filter for all orientations.

3.4.2 T-Coil Signal Quality

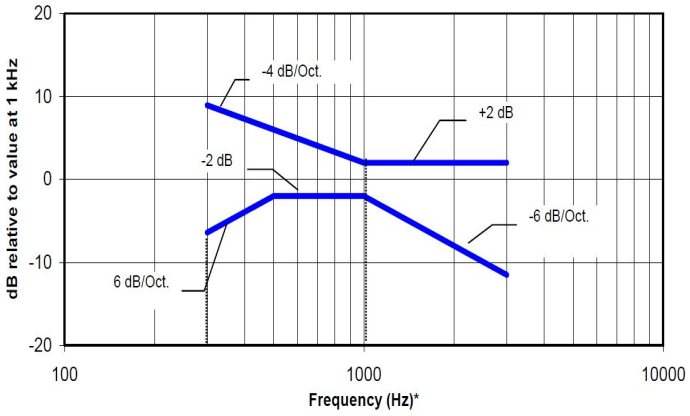
The table below provides the signal quality requirement for the intended audio magnetic signal from a wireless device. Only the RF immunity of the hearing aid is measured in T-coil mode. It is assumed that a hearing aid can have no immunity to an interference signal in the audio band, which is the intended reception band for this mode. The only criterion that can be measured is the RF immunity in T-coil mode. This is measured using the same procedure as the audio coupling mode at the same levels. The signal quality of the axial and radial components of the magnetic field was used to determine the T-coil mode category.

Category	Wireless Device Signal Quality (Signal + Noise-to-noise ratio in dB)
T1	0 to 10 dB
T2	10 to 20 dB
T3	20 to 30 dB
T4	＞30 dB
Magnetic Coupling Parameters	

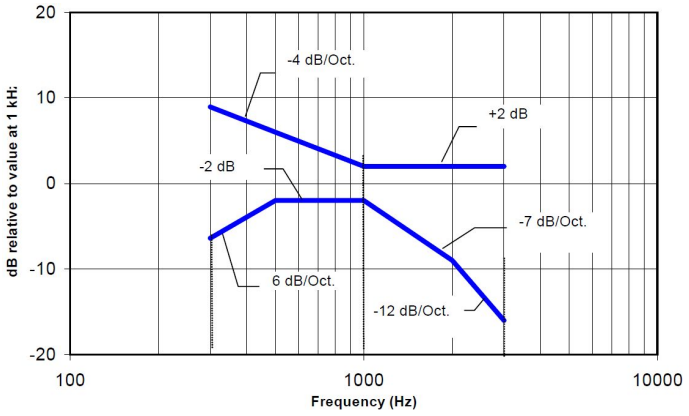
3.4.3 Frequency Response

The frequency response of the axial component of the magnetic field, measured in 1/3 octave bands, shall follow the below response curve, over the frequency range 300 Hz to 3000 Hz. Following Figures provide the boundaries for the specified frequency. These response curves are for true field strength measurements of the T-Coil signal. Thus the 6 dB/octave probe response has been corrected from the raw readings.

≤ - 15 dB (A/m) at 1 kHz



> –15 dB(A/m) at 1 kHz



Note: Frequency response is between 300 Hz and 3000 Hz.

3.4.4 Articulation Weighing Factor (AWF)

Standard	Technology	AWF
T1/T1P1/3GPP	UMTS(WCDMA)	0
IS-95	CDMA	0
iden	GSM(22and 11Hz)	0
J-STD-007	GSM(217Hz)	-5
Note1: AWF has been developed from information presented to the committee regarding the interference potential of the various modulation types according to ANSI PC 63.19		

3.5 HAC Test Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in ANSI C 63.19:2011.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Uncertainty Component	Uncertainty Value	Prob. Dist.	Div.	Ci (E)	Ci (H)	Std. Unc. (+/- %)	
						E	H
Measurement System							
Probe calibration	6.00	N	1.000	1	1	6.00	6.00
Axial Isotropy	2.02	R	1.732	1	1	1.17	1.17
Sensor Displacement	14.30	R	1.732	1	0.217	8.26	1.79
Boundary effect	2.50	R	1.732	1	1	0.87	0.87
Phantom Boundary Effect	6.89	R	1.732	1	0	3.52	0.00
Linearity	2.58	R	1.732	1	1	1.49	1.49
Scaling tp PMR Calibration	9.02	N	1.000	1	1	9.02	9.02
System detection limits	1.30	R	1.732	1	1	0.75	0.75
Readout Electronics	0.25	R	1.732	1	1	0.14	0.14
Reponse Time	1.23	R	1.732	1	1	0.71	0.71
Integration Time	2.15	R	1.732	1	1	1.24	1.24
RF ambient Conditions	2.03	R	1.732	1	1	1.17	1.17
RF Reflections	9.09	R	1.732	1	1	5.25	5.25
Probe positioner	0.63	N	1.000	1	0.71	0.63	0.45
Probe positioning	3.12	N	1.000	1	0.71	3.12	2.22
Extrapolation and Interpolation	1.18	R	1.732	1	1	0.68	0.68
Test sample Related							
Test sample positioning Vertical	2.73	R	1.732	1	0.71	1.58	1.12
Test sample positioning Lateral	1.19	R	1.732	1	1	0.69	0.69
Device holder and Phantom	2.20	N	1.000	1	1	2.20	2.20
Power drift	4.08	R	1.732	1	1	2.36	2.36
Phantom and Setup Related							
Phantom Thickness	2.00	N	1.000	1	0.6	2.00	1,20
Combined Std. Uncertainty(k=1)						16.18	13.25
Expanded Uncertainty on Power						32.35	26.50
Expanded Uncertainty on Field						16.18	13.25

4 SATIMO HSC MEASUREMENT SYSTEM

4.1 Definition of Hearing Aid Compatibility (HAC)

On July 10.2003.the Federal Communications Commission (FCC) adopted new rules requiring wireless manufacturers and service providers to provide digital wireless phones that are compatible with hearing aids. The FCC has modified the exemption for wireless phones under the Hearing Aid Compatibility Act of 1998 (HAC Act) in WT Docket 01-309 RM-8658 to extend the benefits of wireless telecommunications to individuals with hearing disabilities. These benefits encompass business, social and emergency communications, which increase the value of the wireless network for everyone. An estimated more than 10% of the population in the United States show signs of hearing impairment and of that fraction, almost 80% use hearing aids. Approximately 500 million people worldwide suffer from hearing loss.

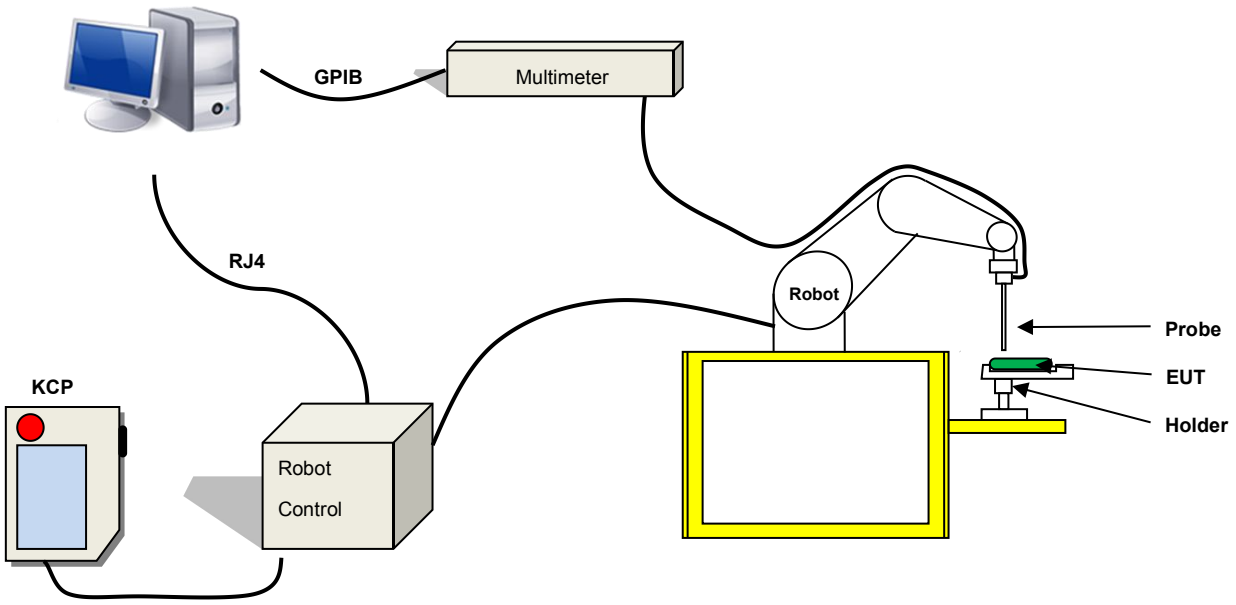
Compatibility Tests involved:

The standard calls for wireless communications devices to be measured for:
- RF Electric-field emissions.
- RF Magnetic- field emissions.
- T-coil mode, magnetic-signal strength in the audio band.
- T-coil mode, magnetic-signal frequency response through the audio band.
- T-coil mode, magnetic-signal and noise articulation index.

The hearing aid must be measured for:
- RF immunity in microphone mode
- RF immunity in T-coil mode

4.2 SATIMO HAC System

SATIMO HAC System Diagram:



4.2.1 Robot

The SATIMO HAC system uses the high precision robots from KUKA. For the 6-axis controller system, the robot controller version (KUKA) from KUKA is used. The KUKA robot series have many features that are important for our application:

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

4.2.2 HAC T-Coil Probe

Serial Number:	SN 22/12 TCP26
Frequency:	200Hz – 5000Hz
Probe length:	220mm
Length of Coil:	6.55mm
Diameter of Coil:	2.29mm
Resistance:	860.6
Wire size:	51 AWG
Inductance at 1 KHz:	132.1 mH at 1 KHz

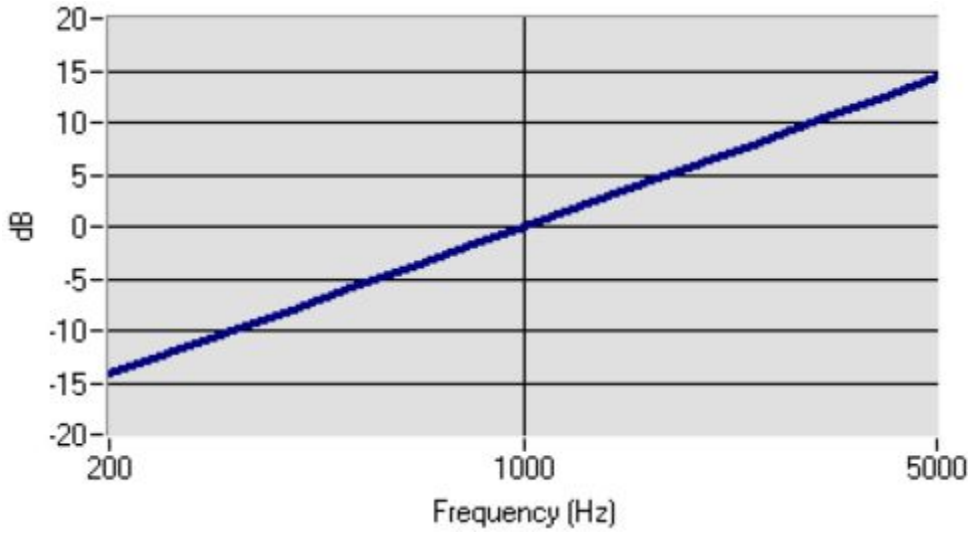
T-Coil Probe Calibration Process

All methods used to perform the measurements and calibrations comply with the ANSI C63.19 and IEEE 1309 standards.

SENSITIVITY

The T-coil was positioned within the Helmholtz coil in axial orientation. Using an audio generator connected to the input of the Helmholtz coil, a known field (1 A/m) was generated within the coil and the T-coil probe reading recorded over the frequency range of 100 Hz to 1000 Hz.

Probe Coil sensitivity relative to sensitivity at 1000 Hz

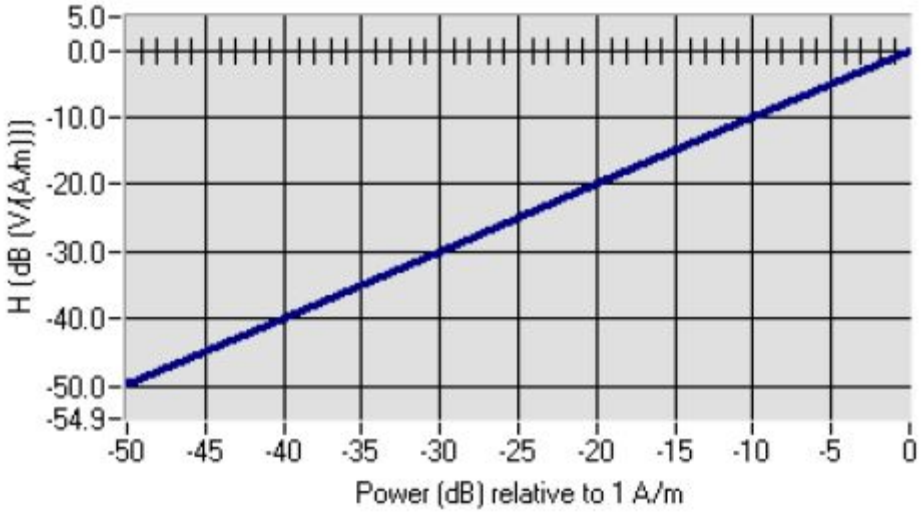


	Measured	Required
Sensitivity at 1 KHz	-60.22 dB (V/A/m)	- 60.5 +/- 0.5 dB (V/A/m)
Max. deviation from Sensitivity	0.43 dB	+/- 0.5 dB

LINEARITY

The T-coil probe was positioned within the Helmholtz coil in axial orientation. The audio generator connected to the input of the Helmholtz coil was adjusted to obtain a field within the coil from 0 dB A/m to -50 dB A/m and the T-coil reading recorded at each power level (10 dB steps).

Linearity



	Measured	Required
Linearity Slope	0.09 dB	+/ 0.5 dB

SIGNAL TO NOISE MEASUREMENT OF THE CALIBRATION SYSTEM

The T-coil probe was positioned within the Helmholtz coil in axial orientation. The audio generator connected to the input of the Helmholtz coil was adjusted to obtain a field of -50 dB A/m. The T-coil reading was recorded. The audio generator is then turned off and the T-coil reading recorded.

	Measured	Required
Signal to Noise	-78.99 dB A/m	'Reading with -50 dB A/m in coil' – 'no signal applied' > 10 dB

5 T-Coil AUDIO VALIDATION

5.1 System Audio Validation

Put the phone on call and select the CMU decoder cal. When the decoder cal is selected, a full sacle(3.14 dBm) signal is provided to the speech port. Measure the voltage form the speech connector using the provided CMU speech cable. For this connect the GSM/WCMDA out connector (or CDMA2K OUT connector) to the front panel of the keithley and read the AC voltage. With the speech cable provided by satiom, the GSM/WCDMA OUT connector 2 and the CDMA2K OUT connector is the connector 4.

Put the phone on call and select the CMU encoder cal. And send a signal to the CMU and check to avoid influencing the calibration. An RMS voltmeter would indicate 100 mV RMS during the first phase and 10 mV RMS during the second phase. After the first two phases, the two input channels are both calibrated for absolute measurements of voltages. The resulting factors are displayed above the multi-meter window.

After phases 1 and 2, the input channels are calibrated to measure exact voltages. This is required to use the inputs for measuring voltages with their peak and RMS value.

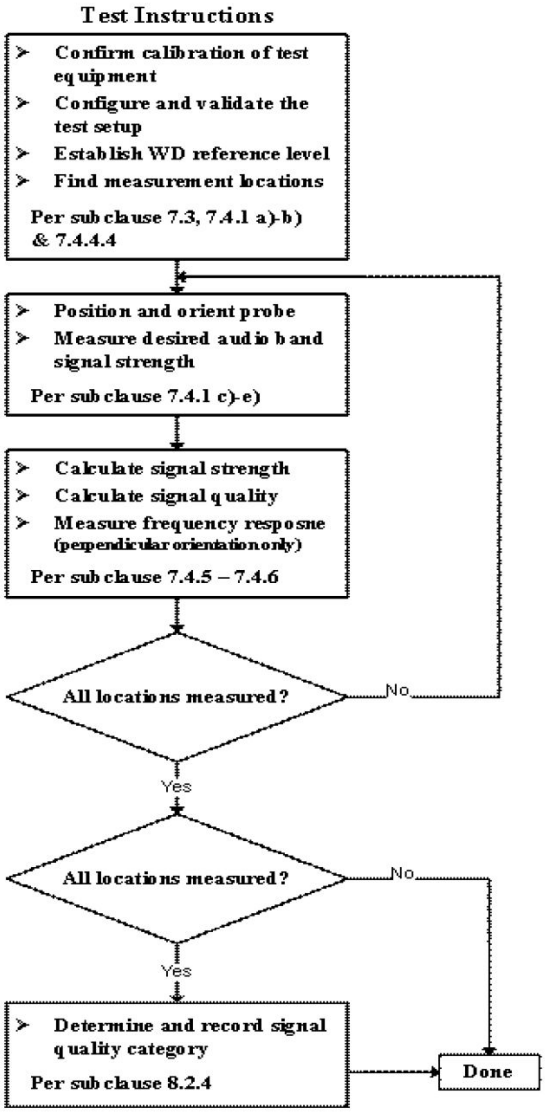
In phase 3, a multi-sine signal covering each third-octave band from 50 Hz to 10 kHz is generated and applied to both audio outputs. The probe should be positioned in the center of the AMCC and aligned in the z-direction, the field orientation of the AMCC. The “Coil In” channel is measuring the voltage over the AMCC internal shunt, which is proportional to the magnetic field in the AMCC. At the same time, the “Probe In" channel samples the amplified signal picked up by the probe coil and provides it to a numerical integrator. The ratio of the two voltages in each third-octave filter leads to the spectral representation over the frequency band of interest. The Coil signal is scaled in dBV, and the Probe signal is first integrated and normalized to show dB A/m. The ratio probe-to-coil at the frequency of 1 kHz is the sensitivity which will be used in the consecutive T-Coil jobs.

5.2 System Validation Results

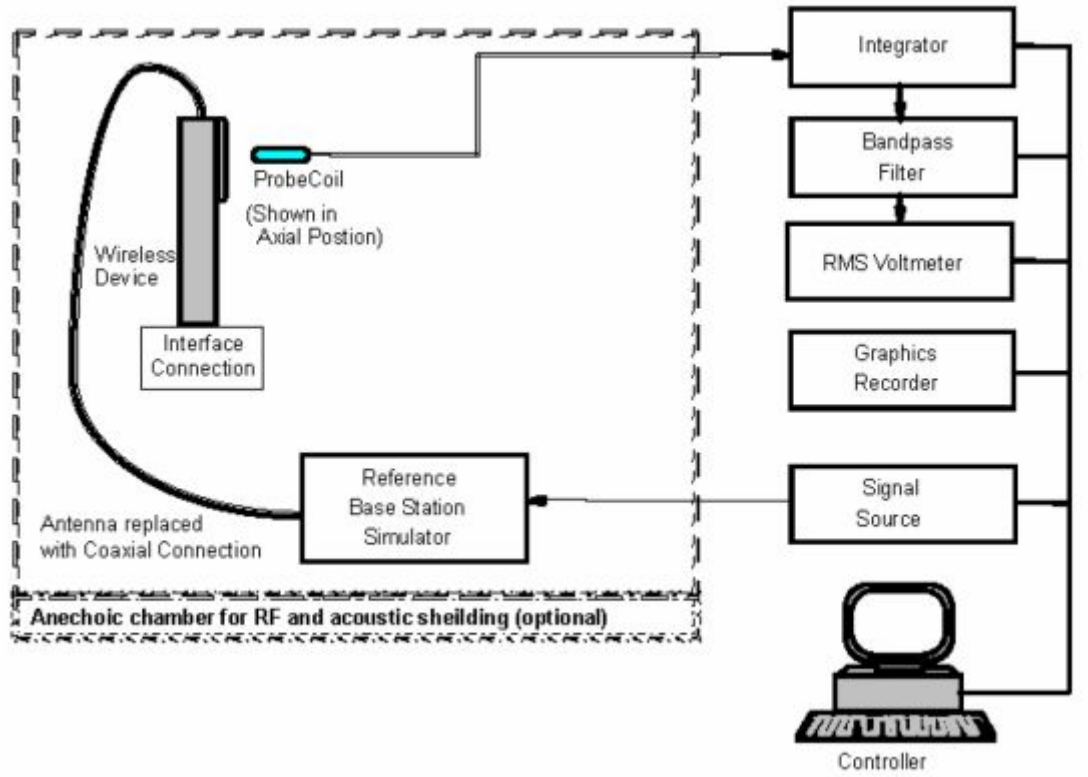
Date	Frequency	Input Level (mV)	Axial Description	Location	Magnetic Field (dB A/m)	Target Field (dB A/m)	Tolerance (%)
2015/11/08	1025 Hz	500.0	Axial	Max	-14.35	-13.68	4.90
			Radial H	Right side	-19.61	-20.68	-5.17
				Left side	-19.50	-20.85	-6.47
			Radial V	Upper side	-19.27	-19.92	-3.26
				Lower side	-19.10	-20.34	-6.10
Note1: The tolerance limit of System validation ±10%.							

6 HAC MEASUREMENT PROCEDURES

6.1 HAC Measurement Process Diagram



6.2 HAC T-Coil Test Setup



T-Coil measurement test setup.

6.3 T-Coil Measurement Procedure

The following illustrate a typical T-Coil signal test scan over a wireless communications device:

a. Confirm that the equipment that requires calibration has a current calibration.
b. Set up the WD to output a broadband signal, such as in IEEE Std 269-2010 or the ITU Recommendation P.50 artificial voice signal referenced in ANSI C63.19-2011 section 7.4.2.
c. Determine the acoustic reference point for the WD device. Set the drive level per ANSI C63.19-2011 section 7.4.2.1. Set the WD volume control so that the handset produces a broadband signal that is within the normal acoustic output range of the WD. The maximum setting that satisfies this criterion and avoids clipping may be used.
d. Measure the audio power spectral density of the broadband signal input to the WD. Perform a frequency domain analysis, such as an FFT, of the broadband signal and record the level at each frequency in the corresponding 1/3 octave BW in the frequency range specified in ANSI C63.19-2011 section 8.3.2. If the input signal cannot be measured directly, other means to determine the frequency response may be used such as calculation from a digital input or extrapolation from a measurement of the acoustic output. However, these steps must be fully justified.
e. Orient the magnetic probe in the perpendicular orientation.
f. Locate the desired perpendicular measurement position as shown in ANSI C63.19-2011 Figure A.4. It has proven helpful to perform a field map of the T-Coil signal not only to locate the best position for the measurement but also to provide insight into the size and shape of the T-Coil signal.
g. Measure the broadband audio-band magnetic signal, ABM1. Perform a frequency-domain analysis, over the frequency range specified in ANSI C63.19-2011 section 8.3.2, such as a fast Fourier transform, of the broadband magnetic signal as represented by the integrated probe coil output and record the level in decibels (A/m) for each 1/3 octave frequency band.
h. Turn OFF the audio reference input signal and measure the half-band integrated, per D.9, A-weighted undesired audio-band magnetic signal, ABM2.
i. Repeat step f) through step h) for the transverse position.
j. Correct the reading for the spectrum of the broadband input by subtracting the input signal spectrum, found in step d), from the magnetic field spectrum, found in step g). (Delta T-Coil to input decibels = measured T-Coil signal-measured input signal.) Record results for use in the T-Coil assessment of the signal magnitude and signal quality at each probe orientation.

7 CONDUCTED RF OUPUT POWER

7.1 GSM

Test Band	Test Mode	Test Channel	Measured (dBm)
850	GSM	LCH	33.69
		MCH	33.47
		HCH	33.37
	GSM/GPRS	LCH_Slot1	33.61
		LCH_Slot2	31.98
		LCH_Slot3	31.10
		LCH_Slot4	29.36
		MCH_Slot1	33.44
		MCH_Slot2	32.27
		MCH_Slot3	30.98
		MCH_Slot4	29.82
		HCH_Slot1	33.33
		HCH_Slot2	31.96
		HCH_Slot3	30.57
		HCH_Slot4	29.47
	GSM/EDGE	LCH_Slot1	27.91
		LCH_Slot2	25.72
		LCH_Slot3	24.01
		LCH_Slot4	23.34
		MCH_Slot1	27.69
		MCH_Slot2	25.57
		MCH_Slot3	23.91
		MCH_Slot4	23.25
		HCH_Slot1	27.37
		HCH_Slot2	25.21
		HCH_Slot3	23.59
		HCH_Slot4	22.95

Test Band	Test Mode	Test Channel	Measured (dBm)
1900	GSM/TM1	LCH	30.13
		MCH	30.54
		HCH	30.61
	GSM/TM2	LCH_Slot1	30.63
		LCH_Slot2	29.48
		LCH_Slot3	27.15
		LCH_Slot4	25.90
		MCH_Slot1	30.93
		MCH_Slot2	29.53
		MCH_Slot3	27.38
		MCH_Slot4	26.12
		HCH_Slot1	30.85
		HCH_Slot2	29.44
		HCH_Slot3	27.78
		HCH_Slot4	25.96
	GSM/TM3	LCH_Slot1	25.67
		LCH_Slot2	24.25
		LCH_Slot3	22.86
		LCH_Slot4	20.83
		MCH_Slot1	26.07
		MCH_Slot2	24.73
		MCH_Slot3	23.37
		MCH_Slot4	21.43
		HCH_Slot1	26.22
		HCH_Slot2	24.94
		HCH_Slot3	23.58
		HCH_Slot4	21.57

7.2 WCDMA

Test Band	Test Mode	Test Channel	Measured (dBm)
WCDMA850	UMTS/TM1	LCH_RMC12	24.15
		MCH_ RMC12	24.95
		HCH_ RMC12	24.69
WCDMA850	UMTS/HSDPA	LCH_Case1	23.12
		LCH_Case2	22.36
		LCH_Case3	22.31
		LCH_Case4	22.22
		MCH_Case1	23.92
		MCH_Case2	23.06
		MCH_Case3	23.03
		MCH_Case4	23.01
		HCH_Case1	23.62
		HCH_Case2	22.84
		HCH_Case3	22.80
		HCH_Case4	22.79
WCDMA850	UMTS/HSUPA	LCH_Case1	22.70
		LCH_Case2	21.69
		LCH_Case3	21.68
		LCH_Case4	22.23
		LCH_Case5	22.36
		MCH_Case1	23.70
		MCH_Case2	22.15
		MCH_Case3	21.82
		MCH_Case4	23.16
		MCH_Case5	22.45
		HCH_Case1	23.27
		HCH_Case2	21.87
		HCH_Case3	21.60
		HCH_Case4	22.95
		HCH_Case5	22.26

Test Band	Test Mode	Test Channel	Measured (dBm)
WCDMA1900	UMTS/TM1	LCH_RMC12	23.44
		MCH_ RMC12	23.60
		HCH_ RMC12	23.23
WCDMA1900	UMTS/TM2	LCH_Case1	22.62
		LCH_Case2	21.89
		LCH_Case3	22.18
		LCH_Case4	22.17
		MCH_Case1	23.19
		MCH_Case2	22.45
		MCH_Case3	22.39
		MCH_Case4	22.36
		HCH_Case1	22.67
		HCH_Case2	21.89
		HCH_Case3	21.84
		HCH_Case4	21.82
WCDMA1900	UMTS/TM3	LCH_Case1	22.63
		LCH_Case2	21.70
		LCH_Case3	21.68
		LCH_Case4	21.86
		LCH_Case5	21.84
		MCH_Case1	22.83
		MCH_Case2	21.95
		MCH_Case3	21.93
		MCH_Case4	22.12
		MCH_Case5	21.86
		HCH_Case1	22.35
		HCH_Case2	20.91
		HCH_Case3	20.97
		HCH_Case4	21.63
		HCH_Case5	21.62

7.3 LTE

Channel Bandwidth: 5 MHz

Modulation	Channel	RB Configuration		Average Power [dBm]	Verdict
		Size	Offset		
QPSK	LCH	1	0	21.57	PASS
		1	12	21.64	PASS
		1	24	21.65	PASS
		12	0	20.52	PASS
		12	6	20.57	PASS
		12	13	20.57	PASS
		25	0	20.54	PASS
	MCH	1	0	23.95	PASS
		1	12	23.73	PASS
		1	24	24.04	PASS
		12	0	22.97	PASS
		12	6	23.06	PASS
		12	13	23.01	PASS
		25	0	23.00	PASS
	HCH	1	0	23.04	PASS
		1	12	22.83	PASS
		1	24	22.59	PASS
		12	0	22.15	PASS
		12	6	22.09	PASS
		12	13	21.93	PASS
		25	0	22.04	PASS
16QAM	LCH	1	0	20.81	PASS
		1	12	20.90	PASS
		1	24	20.92	PASS
		12	0	19.61	PASS
		12	6	19.67	PASS
		12	13	19.65	PASS
		25	0	19.52	PASS
	MCH	1	0	23.20	PASS
		1	12	23.51	PASS
		1	24	23.47	PASS
		12	0	22.04	PASS
		12	6	22.13	PASS
		12	13	22.09	PASS
		25	0	22.05	PASS
	HCH	1	0	22.05	PASS
		1	12	21.84	PASS
		1	24	21.59	PASS
		12	0	21.18	PASS
		12	6	21.13	PASS
		12	13	20.96	PASS

		25	0	21.09	PASS

Channel Bandwidth: 10 MHz

Modulation	Channel	RB Configuration		Average Power [dBm]	Verdict
		Size	Offset		
QPSK	LCH	1	0	21.67	PASS
		1	24	21.95	PASS
		1	49	21.91	PASS
		25	0	20.88	PASS
		25	12	21.02	PASS
		25	25	20.91	PASS
		50	0	20.94	PASS
	MCH	1	0	24.03	PASS
		1	24	24.21	PASS
		1	49	24.00	PASS
		25	0	22.95	PASS
		25	12	22.94	PASS
		25	25	22.89	PASS
		50	0	23.00	PASS
	HCH	1	0	23.05	PASS
		1	24	22.99	PASS
		1	49	22.43	PASS
		25	0	22.45	PASS
		25	12	22.38	PASS
		25	25	22.03	PASS
		50	0	22.20	PASS
16QAM	LCH	1	0	20.85	PASS
		1	24	21.15	PASS
		1	49	21.10	PASS
		25	0	19.84	PASS
		25	12	20.00	PASS
		25	25	19.88	PASS
		50	0	19.89	PASS
	MCH	1	0	23.40	PASS
		1	24	23.54	PASS
		1	49	23.40	PASS
		25	0	21.94	PASS
		25	12	22.03	PASS
		25	25	21.88	PASS
		50	0	21.92	PASS
	HCH	1	0	22.36	PASS
		1	24	22.33	PASS
		1	49	21.74	PASS
		25	0	21.46	PASS

		25	12	21.41	PASS
		25	25	21.06	PASS
		50	0	21.21	PASS

Channel Bandwidth: 15 MHz

Modulation	Channel	RB Configuration		Average Power [dBm]	Verdict
		Size	Offset		
QPSK	LCH	1	0	22.02	PASS
		1	37	21.99	PASS
		1	74	22.36	PASS
		37	0	21.13	PASS
		37	18	21.06	PASS
		37	38	21.26	PASS
		75	0	21.22	PASS
	MCH	1	0	23.84	PASS
		1	37	23.88	PASS
		1	74	24.09	PASS
		37	0	23.02	PASS
		37	18	23.01	PASS
		37	38	22.88	PASS
		75	0	23.02	PASS
	HCH	1	0	23.50	PASS
		1	37	23.06	PASS
		1	74	22.69	PASS
		37	0	22.53	PASS
		37	18	22.50	PASS
		37	38	22.27	PASS
		75	0	22.48	PASS
16QAM	LCH	1	0	21.26	PASS
		1	37	21.18	PASS
		1	74	21.58	PASS
		37	0	20.12	PASS
		37	18	20.02	PASS
		37	38	20.23	PASS
		75	0	20.20	PASS
	MCH	1	0	23.23	PASS
		1	37	23.39	PASS
		1	74	23.37	PASS
		37	0	21.99	PASS
		37	18	22.03	PASS
		37	38	21.88	PASS
		75	0	22.00	PASS
	HCH	1	0	22.91	PASS
		1	37	22.46	PASS
		1	74	22.05	PASS

		37	0	21.46	PASS
		37	18	21.49	PASS
		37	38	21.32	PASS
		75	0	21.55	PASS

Channel Bandwidth: 20 MHz

Modulation	Channel	RB Configuration		Average Power [dBm]	Verdict
		Size	Offset		
QPSK	LCH	1	0	22.12	PASS
		1	49	22.35	PASS
		1	99	22.57	PASS
		50	0	21.28	PASS
		50	25	21.36	PASS
		50	50	21.37	PASS
		100	0	21.29	PASS
	MCH	1	0	23.85	PASS
		1	49	24.11	PASS
		1	99	23.79	PASS
		50	0	22.98	PASS
		50	25	23.23	PASS
		50	50	23.01	PASS
		100	0	22.99	PASS
	HCH	1	0	23.38	PASS
		1	49	23.31	PASS
		1	99	22.87	PASS
		50	0	22.68	PASS
		50	25	22.64	PASS
		50	50	22.34	PASS
		100	0	22.51	PASS
16QAM	LCH	1	0	21.34	PASS
		1	49	21.58	PASS
		1	99	21.80	PASS
		50	0	20.42	PASS
		50	25	20.31	PASS
		50	50	20.33	PASS
		100	0	20.39	PASS
	MCH	1	0	23.57	PASS
		1	49	23.64	PASS
		1	99	23.71	PASS
		50	0	22.02	PASS
		50	25	22.18	PASS
		50	50	21.97	PASS
		100	0	22.01	PASS
	HCH	1	0	22.91	PASS

		1	49	22.78	PASS
		1	99	22.29	PASS
		50	0	21.73	PASS
		50	25	21.64	PASS
		50	50	21.33	PASS
		100	0	21.54	PASS

8 HAC T-Coil Test Results

Band	Ch.	Mode	Signal to noise (dB)	T-Rating	Frequency Response	Meas.No.
GSM850	128	Axial	28.86	T4	PASS	1#
		Radial H	21.65	T4		
	190	Axial	28.75	T3	PASS	2#
		Radial H	23.68	T3		
	251	Axial	28.65	T3	PASS	3#
		Radial H	23.59	T3		
GSM1900	512	Axial	33.78	T4	PASS	4#
		Radial H	26.27	T3		
	661	Axial	32.86	T4	PASS	5#
		Radial H	25.38	T3		
	810	Axial	33.86	T4	PASS	6#
		Radial H	24.84	T3		
WCDMA Band 2	9263	Axial	33.28	T4	PASS	7#
		Radial H	31.33	T4		
	9400	Axial	36.39	T4	PASS	8#
		Radial H	32.92	T4		
	9537	Axial	34.80	T4	PASS	9#
		Radial H	33.04	T4		
WCDMA Band 5	4133	Axial	35.43	T4	PASS	10#
		Radial H	34.32	T4		
	4175	Axial	36.75	T4	PASS	11#
		Radial H	32.24	T4		
	4232	Axial	41.05	T4	PASS	12#
		Radial H	38.95	T4		

9 TEST EQUIPMENTS LIST

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
PC	Dell	N/A	N/A	N/A	N/A
TMFS	SATIMO	STMFS	SN 22/12 TMFS18	2015/03/30	2016/03/29
T-coil Probe	SATIMO	STCOIL	SN 22/12 TCP26	2015/03/16	2016/03/15
RF coaxial Cable	SATIMO	N/A	N/A	N/A	N/A
MultiMeter	Keithley	MultiMeter 2000	4024022	2014/12/13	2015/12/12
Signal Generator	R&S	SMBV100A	260592	2015/07/16	2016/07/15
Power Meter	Agilent	E4419B	GB40201833	2015/10/14	2016/10/13
Power Sensor	R&S	NRP-Z21	103971	2015/07/16	2016/07/15
Power Amplifier	SATIMO	6552B	22374	N/A	N/A
Wireless Communication Test Set	R&S	CMU 200	123666	2015/10/15	2016/10/14

ANNEX A HAC TEST RESULT OF SYSTEM VERIFICAION

T-coil System Check Data

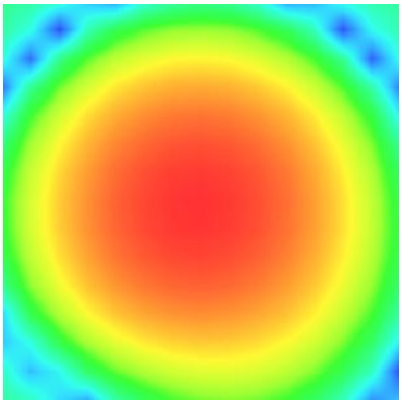
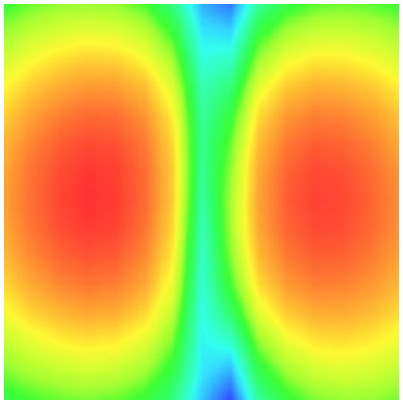
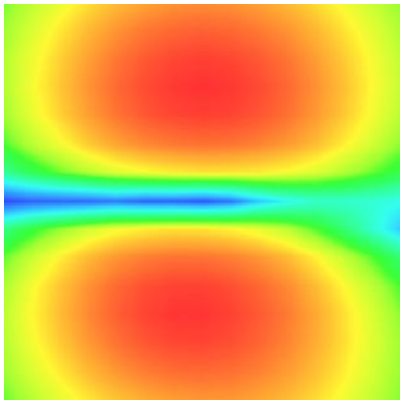
Experimental conditions

Grid size (mm x mm)	70.0, 70.0
Step (mm)	5
Band	-
Channel	-
Signal	Audio
Date of measurement	2015-11-08

HAC Measurement Results

Test Description	Minimum Limit	Location	Measured
	dBA/m	-	dBA/m
Intensity, Axial	-18	Max	-14.35
Intensity, RadialH	-18	Right side	-19.61
	-18	Left side	-19.50
Intensity, RadialV	-18	Upper side	-19.27
	-18	Lower side	-19.10

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H	RADIAL V
		

ANNEX B HAC RF MEASUREMENT RESULT

TABLE OF MEASUREMENT RESULT LIST

Band	Mode	PARAMETERS
GSM 850	T-Coil	Measurement 1: Low Channel
		Measurement 2: Middle Channel
		Measurement 3: High Channel
GSM 1900	T-Coil	Measurement 4: Low Channel
		Measurement 5: Middle Channel
		Measurement 6: High Channel
WCDMA Band 2	T-Coil	Measurement 7: Low Channel
		Measurement 8: Middle Channel
		Measurement 9: High Channel
WCDMA Band 5	T-Coil	Measurement 10: Low Channel
		Measurement 11: Middle Channel
		Measurement 12: High Channel

MEASUREMENT 1

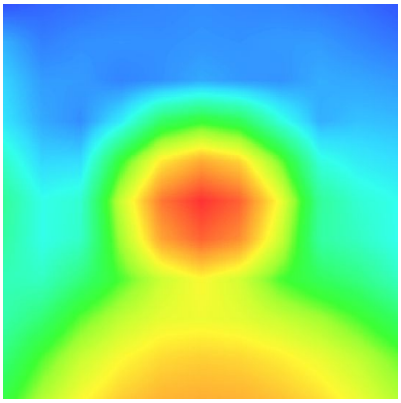
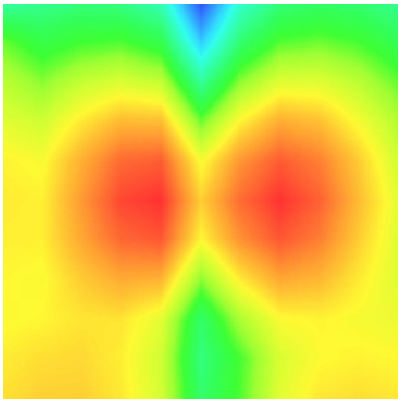
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	GSM 850
Channel	Low
Signal	GSM
Date of measurement	2015-11-08

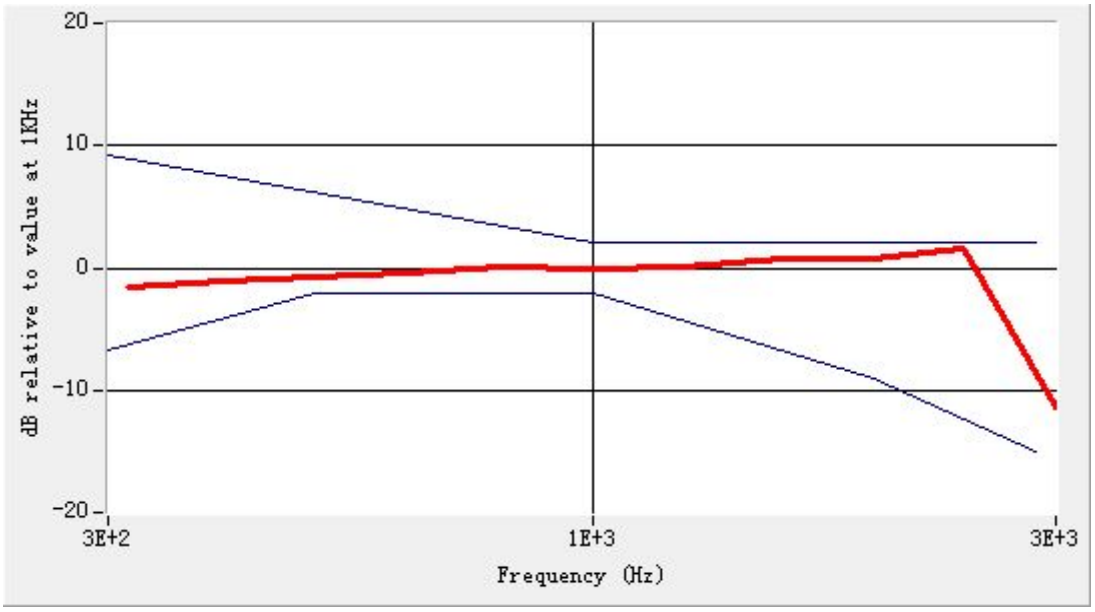
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	GSM	GSM850	Intensity, Axial	-18	Max	-1.50	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-3.80	-	PASS
				dB		dB		
7.3.3			Signal to noise/noise, Axial	20	Max	28.86	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	21.65	T4	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 2

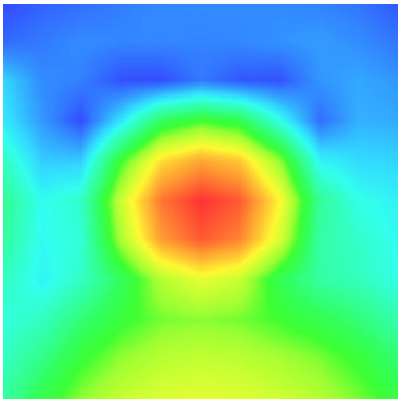
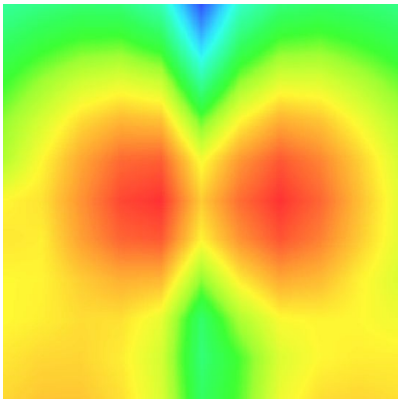
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	GSM
Channel	Middle
Signal	GSM 850
Date of measurement	2015-11-08

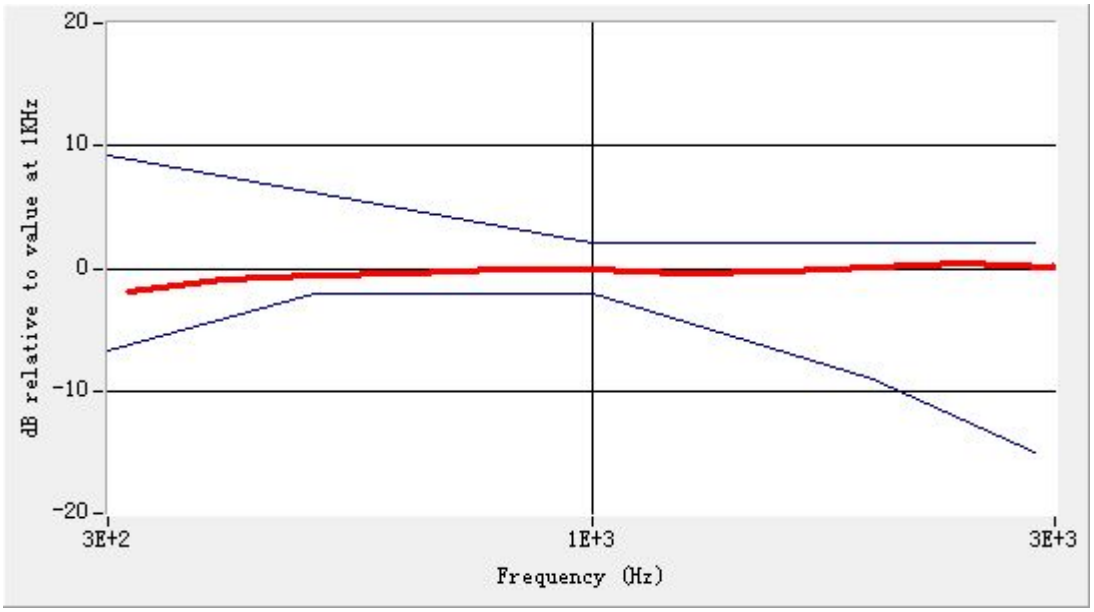
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	GSM	GSM850	Intensity, Axial	-18	Max	4.18	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-4.07	-	PASS
				dB		dB		
7.3.3			Signal to noise/noise, Axial	20	Max	28.75	T3	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	23.68	T3	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 3

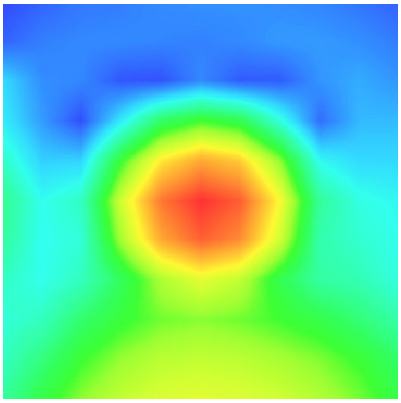
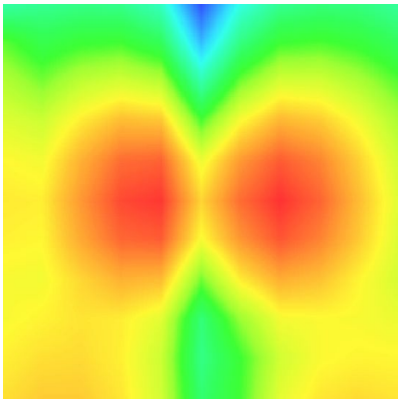
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	GSM 850
Channel	High
Signal	GSM
Date of measurement	2015-11-08

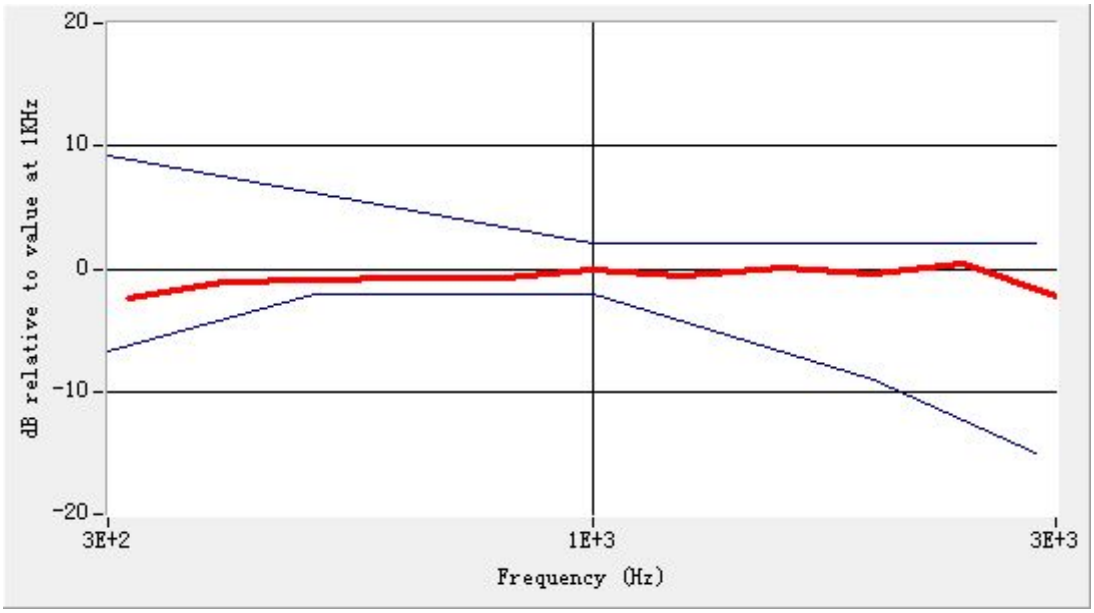
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	GSM	GSM850	Intensity, Axial	-18	Max	4.42	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-4.55	-	PASS
				dB		dB		
7.3.3			Signal to noise/noise, Axial	20	Max	28.65	T3	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	23.59	T3	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 4

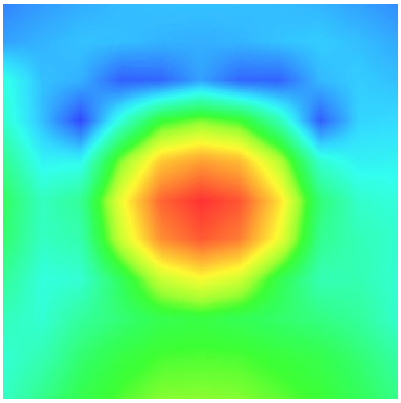
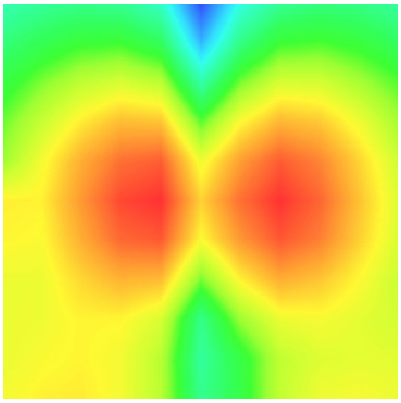
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	GSM1900
Channel	Low
Signal	GSM
Date of measurement	2015-11-08

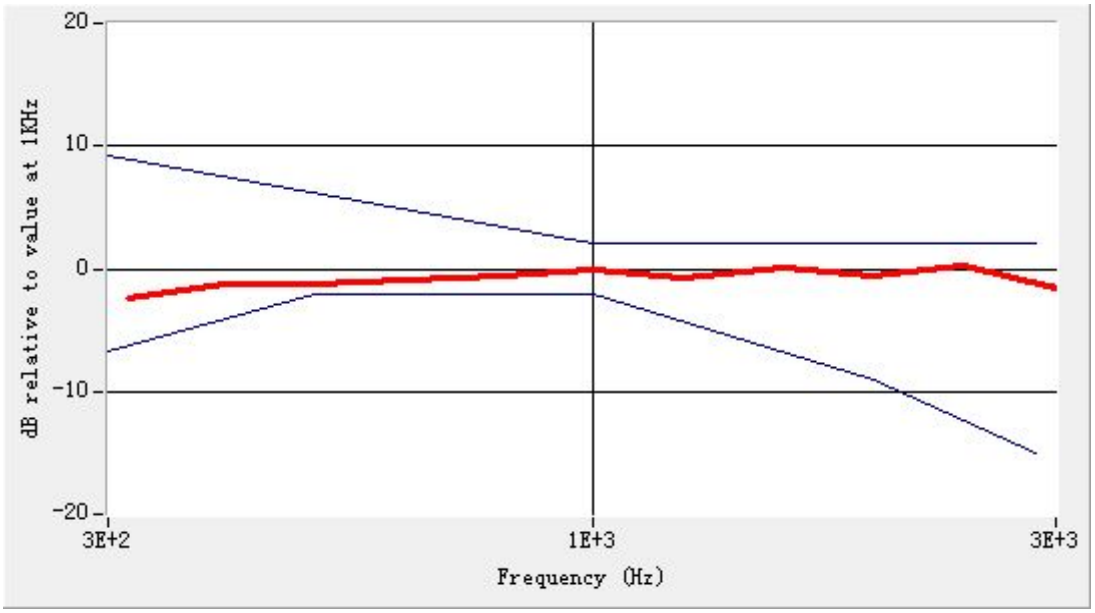
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	GSM	GSM1900	Intensity, Axial	-18	Max	3.93	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-8.44	-	PASS
				dB		dB		
7.3.3			Signal to noise/noise, Axial	20	Max	33.78	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	26.27	T3	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 5

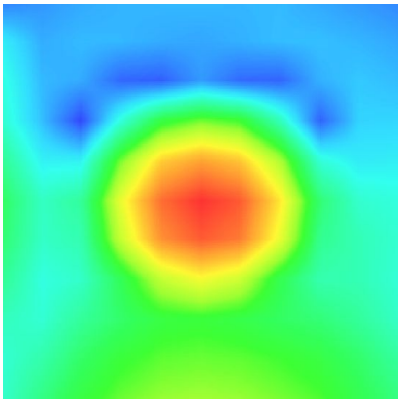
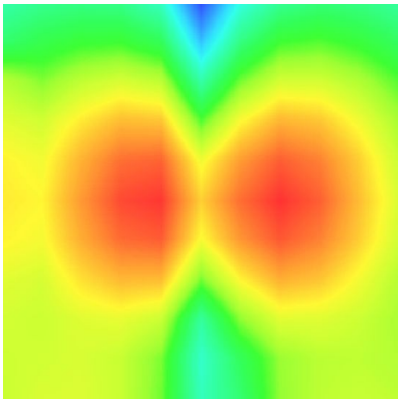
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	GSM1900
Channel	Middle
Signal	GSM
Date of measurement	2015-11-08

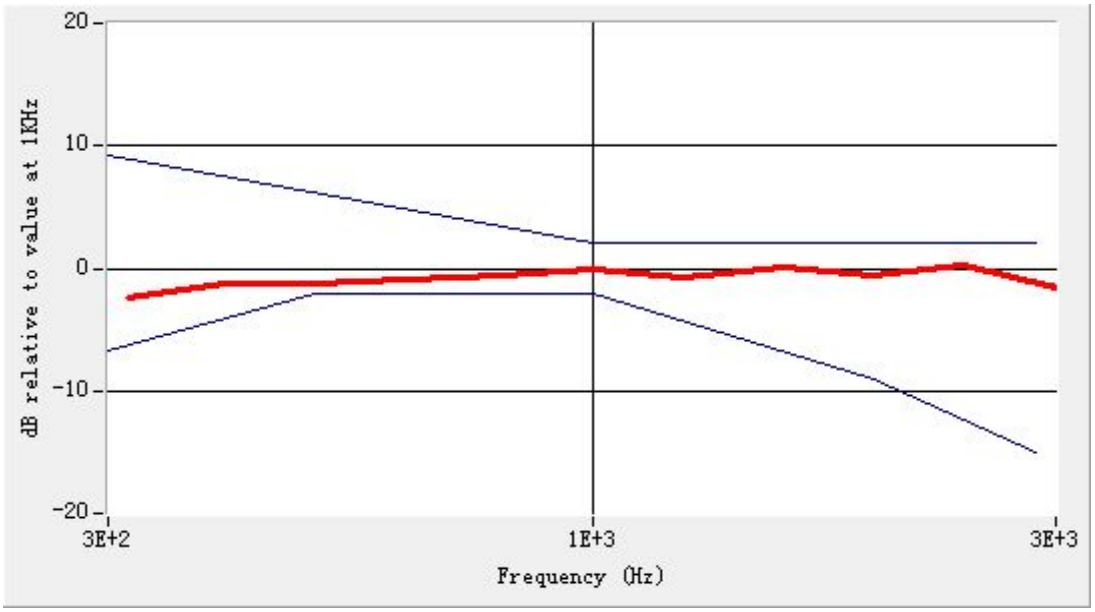
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	GSM	GSM1900	Intensity, Axial	-18	Max	4.21	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-4.33	-	PASS
				dB		dB		
7.3.3			Signal to noise/noise, Axial	20	Max	32.86	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	25.38	T3	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 6

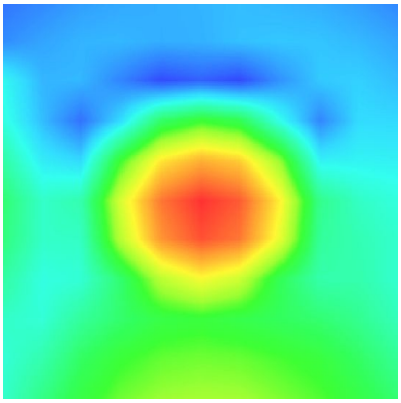
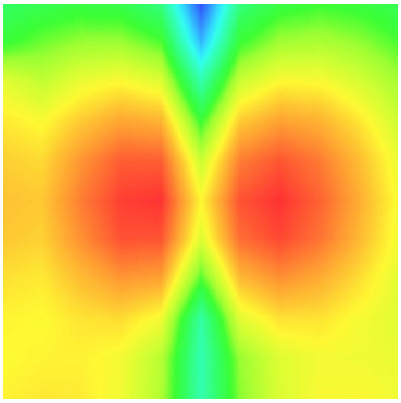
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	GSM1900
Channel	High
Signal	GSM
Date of measurement	2015-11-08

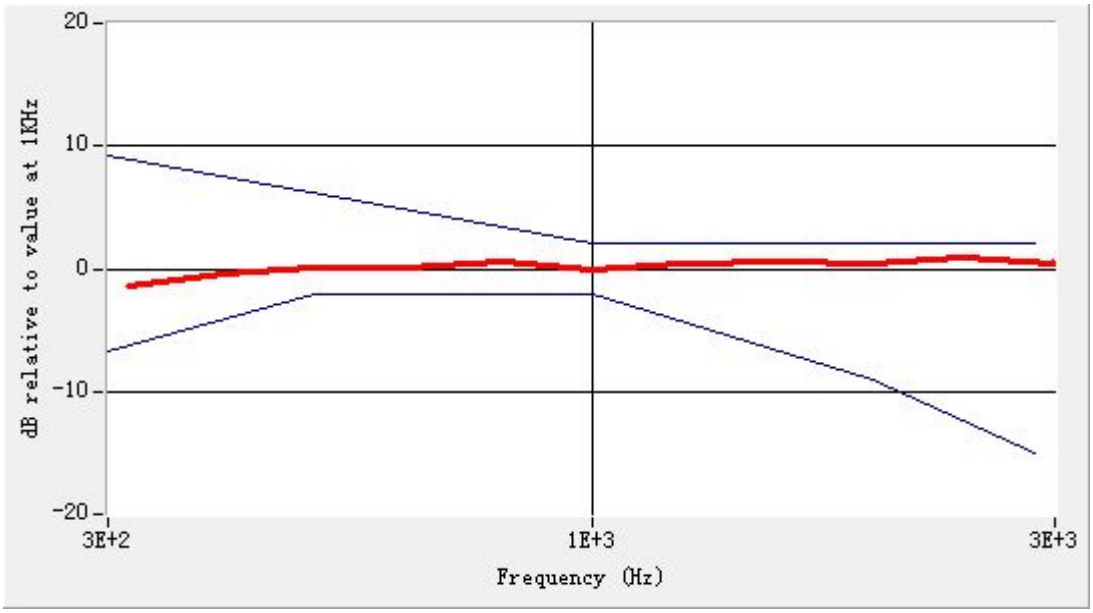
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	GSM	GSM1900	Intensity, Axial	-18	Max	4.70	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-4.35	-	PASS
				dB		dB		
7.3.3			Signal to noise/noise, Axial	20	Max	33.86	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	24.84	T3	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 7

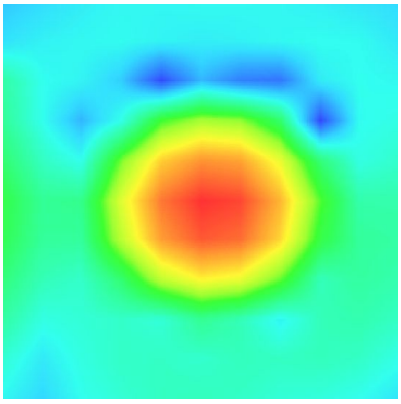
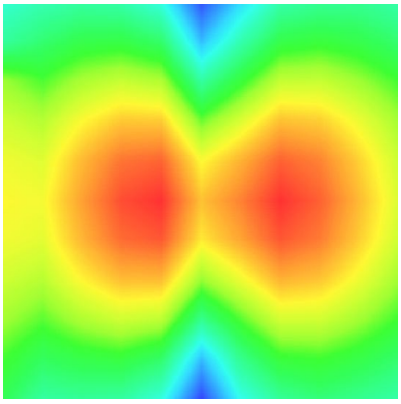
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	WCDMA 1900
Channel	Low
Signal	WCDMA
Date of measurement	2015-11-08

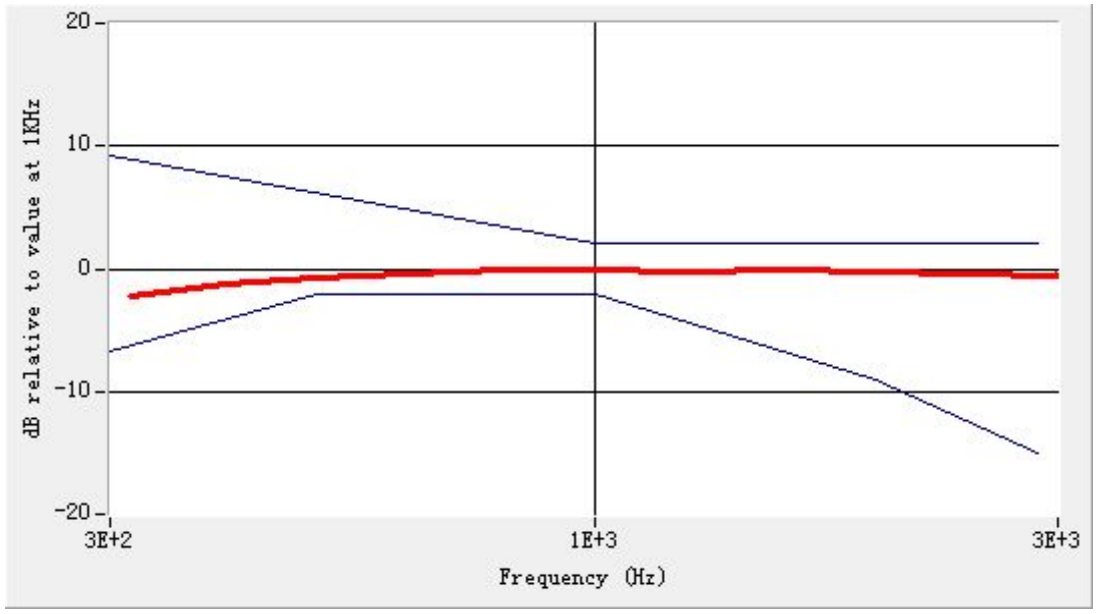
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	WCDMA	Band 2	Intensity, Axial	-18	Max	-3.43	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-11.67	-	PASS
						dB		
7.3.3			Signal to noise/noise, Axial	20	Max	33.28	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	31.33	T4	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 8

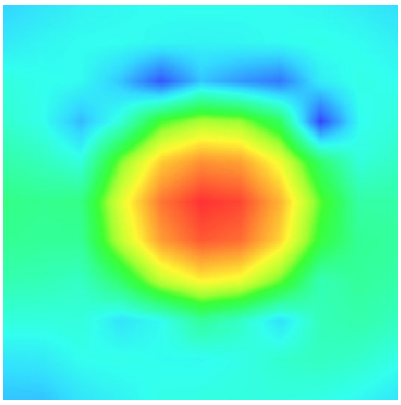
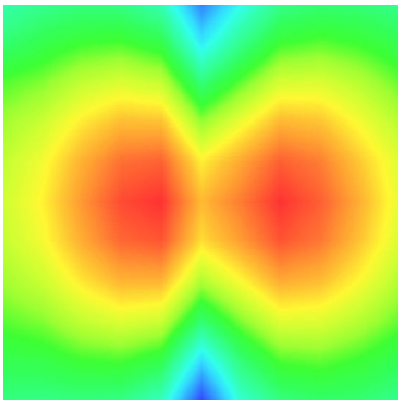
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	WCDMA 1900
Channel	Middle
Signal	WCDMA
Date of measurement	2015-11-08

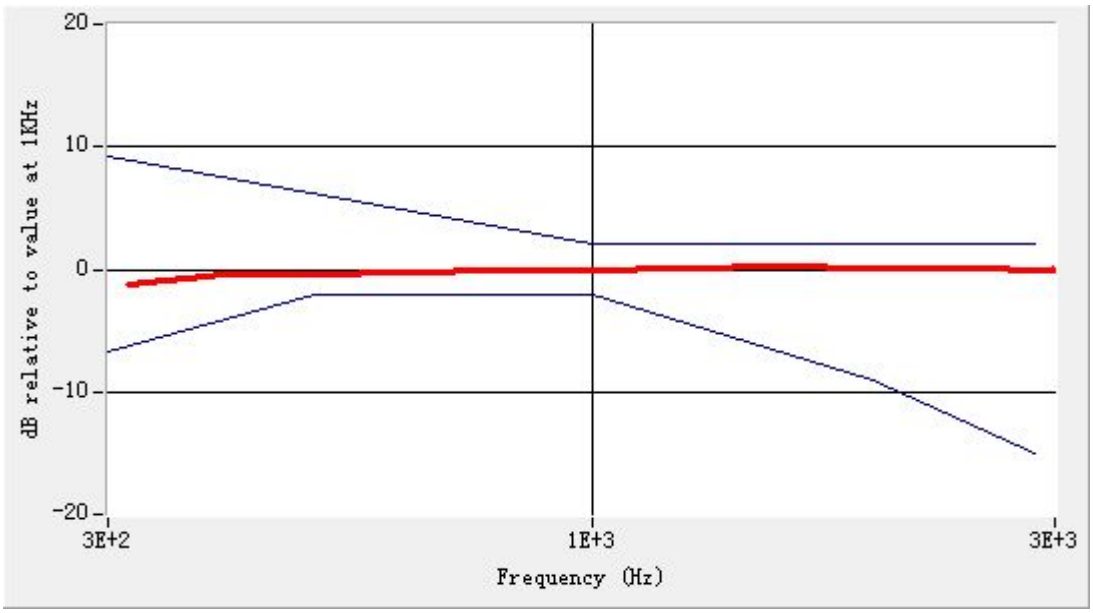
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	WCDMA	Band 2	Intensity, Axial	-18	Max	3.56	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-4.78	-	PASS
						dB		
7.3.3			Signal to noise/noise, Axial	20	Max	36.39	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	32.92	T4	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency reponse



MEASUREMENT 9

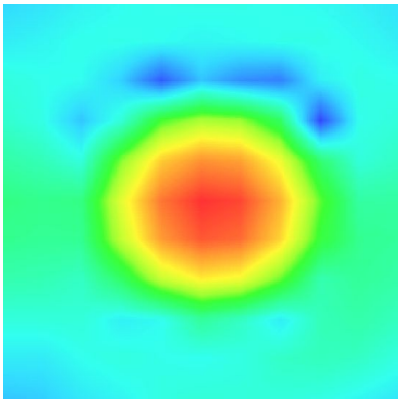
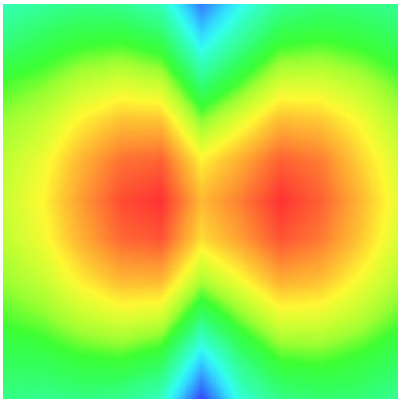
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	WCDMA 1900
Channel	High
Signal	WCDMA
Date of measurement	2015-11-08

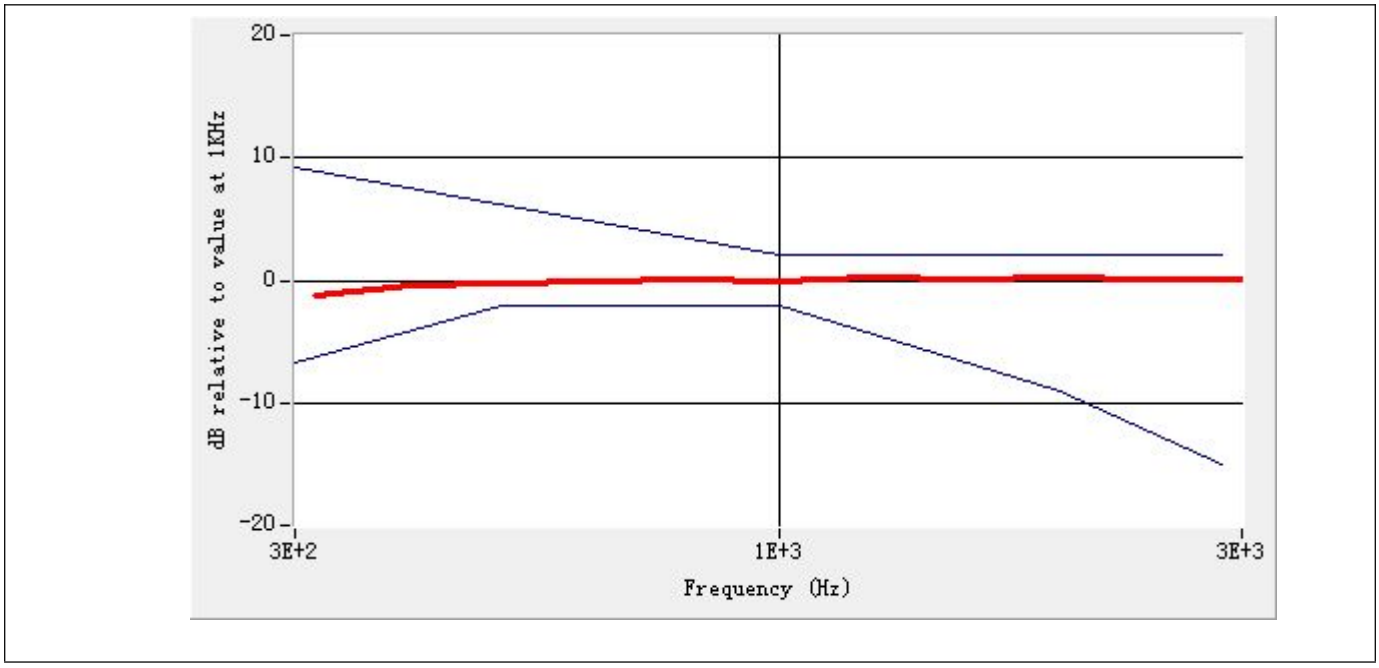
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	WCDMA	Band 2	Intensity, Axial	-18	Max	3.57	-	PASS
7.3.1.2			Intensity, RadialH	-18	Max	-4.72	-	PASS
						dB		
7.3.3			Signal to noise/noise, Axial	20	Max	34.80	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	33.04	T4	PASS
7.3.2			Frequency reponse, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency reponse



MEASUREMENT 10

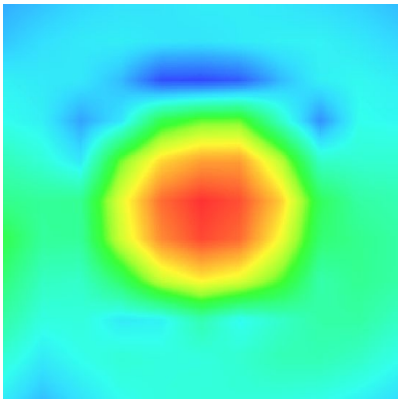
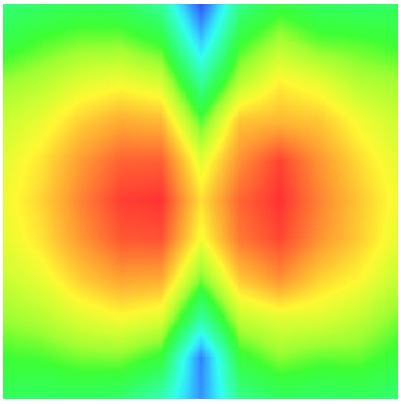
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	WCDMA 850
Channel	Low
Signal	WCDMA
Date of measurement	2015-11-08

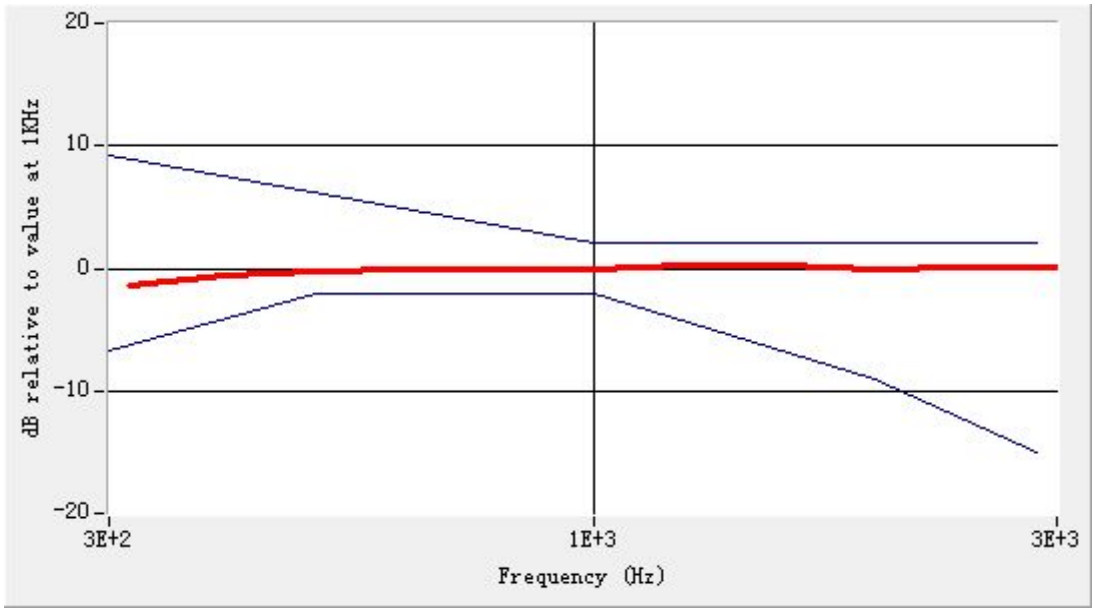
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	WCDMA	Band 5	Intensity, Axial	-18	Max	4.10	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-4.76	-	PASS
						dB		
7.3.3			Signal to noise/noise, Axial	20	Max	35.43	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	34.32	T4	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 11

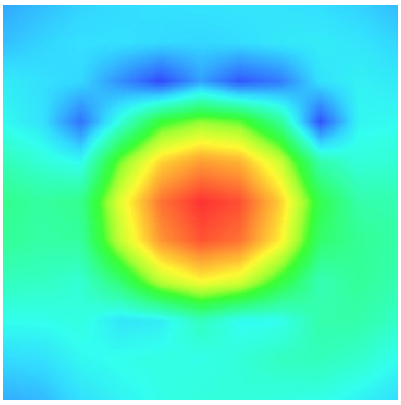
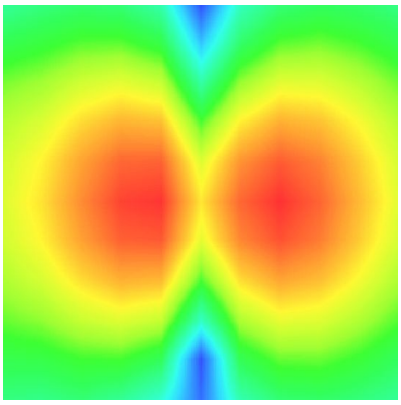
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	WCDMA 850
Channel	Middle
Signal	WCDMA
Date of measurement	2015-11-08

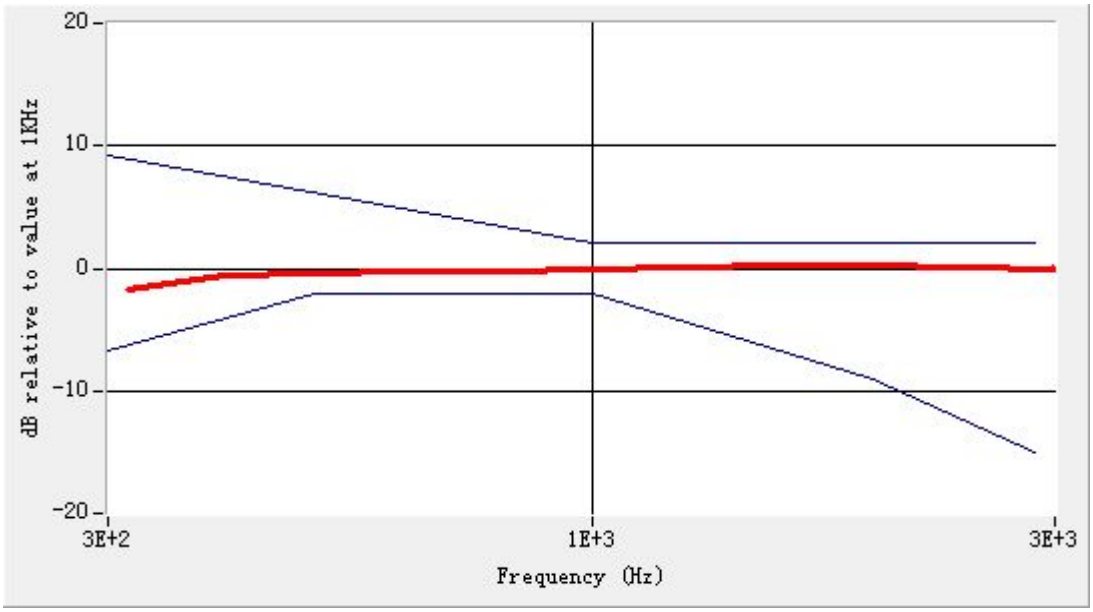
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	WCDMA	Band 5	Intensity, Axial	-18	Max	3.87	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-4.87	-	PASS
						dB	-	
7.3.3			Signal to noise/noise, Axial	20	Max	36.75	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	32.24	T4	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



MEASUREMENT 12

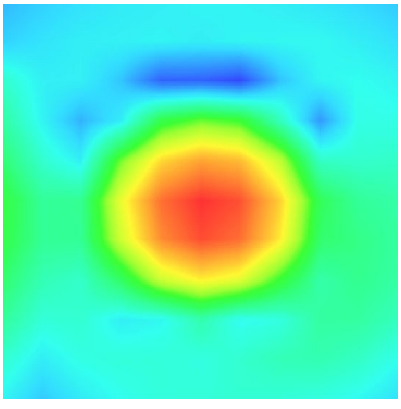
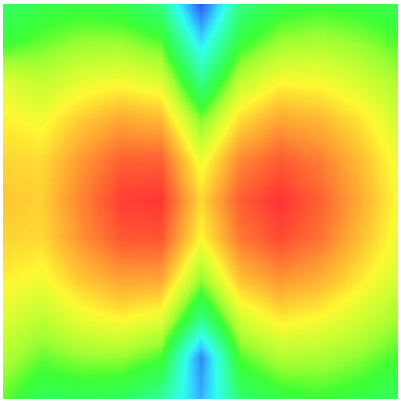
Experimental conditions

Grid size (mm x mm)	50.0, 50.0
Step (mm)	5
Band	WCDMA 850
Channel	High
Signal	WCDMA
Date of measurement	2015-11-08

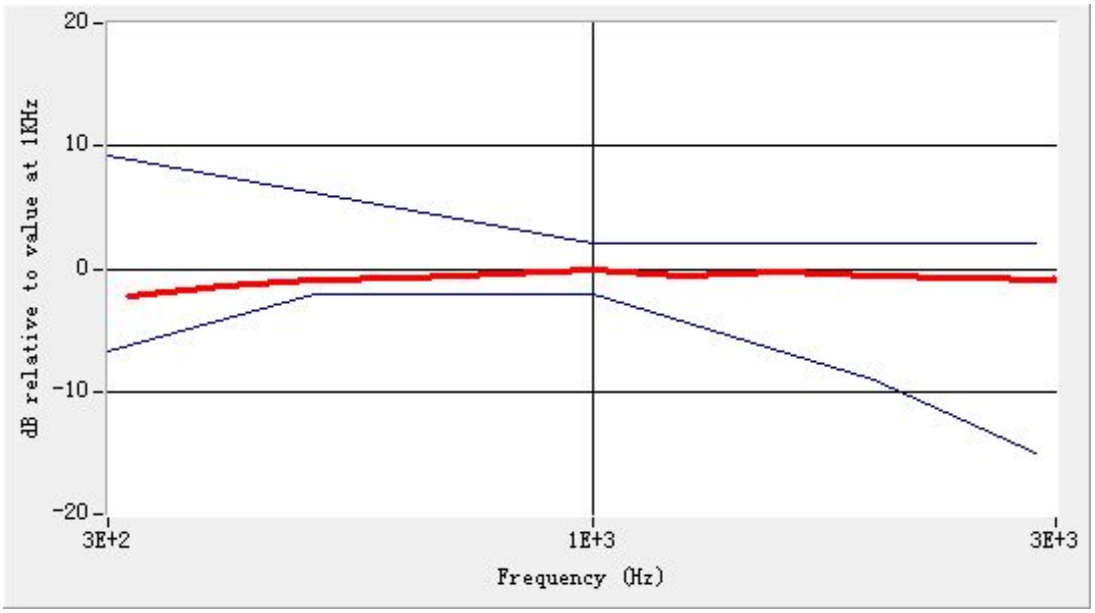
HAC Measurement Results

C63.19	Mode	Band	Test Description	Minimum Limit	Location	Measured	Category	Verdict
				dBA/m	-	dBA/m	-	Pass/Fail
7.3.1.1	WCDMA	Band 5	Intensity, Axial	-18	Max	4.38	-	PASS
7.3.1.2			Intensity, Radial H	-18	Max	-4.50	-	PASS
						dB	-	
7.3.3			Signal to noise/noise, Axial	20	Max	41.05	T4	PASS
7.3.3			Signal to noise/noise, Radial H	20	Max	38.95	T4	PASS
7.3.2			Frequency response, Axial	PASS				

T.Coil Scan Overlay Magnetic Field Distributions

AXIAL	RADIAL H
	

Frequency response



ANNEX C EUT EXTERNAL PHOTOS

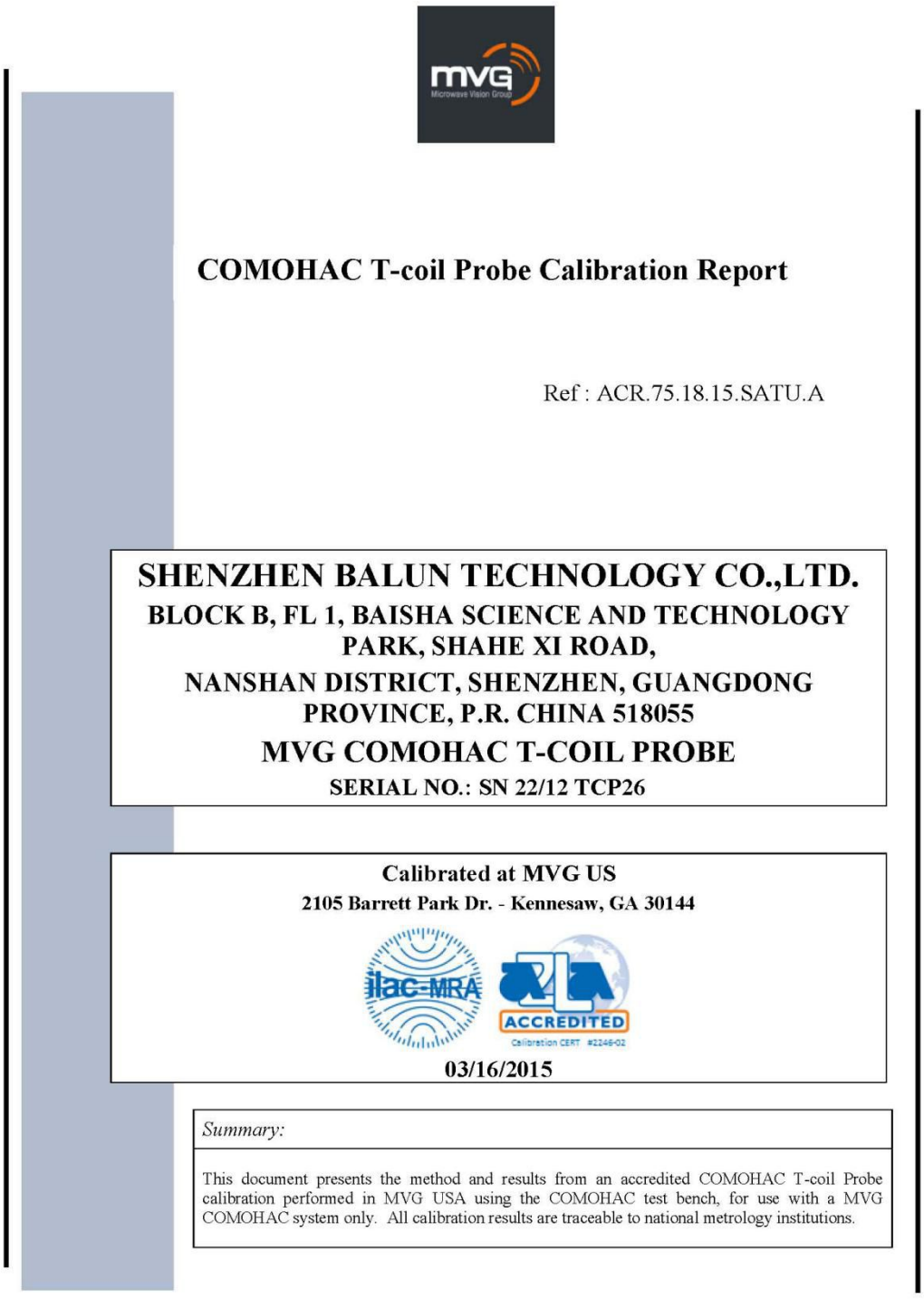
Please refer the document " BL-SZ1590187-AW. PDF".

ANNEX D HAC T-Coil TEST SETUP PHOTOS

Please refer the document " BL-SZ1590187-T-Coil. PDF".

ANNEX E CALIBRATION REPORT

F.1 T-coil Probe Calibration Report



COMOHAC T-coil Probe Calibration Report

Ref : ACR.75.18.15.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055
MVG COMOHAC T-COIL PROBE
SERIAL NO.: SN 22/12 TCP26

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144

ilac-MRA A2LA ACCREDITED Calibration CERT #2246-02

03/16/2015

Summary:

This document presents the method and results from an accredited COMOHAC T-coil Probe calibration performed in MVG USA using the COMOHAC test bench, for use with a MVG COMOHAC system only. All calibration results are traceable to national metrology institutions.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	3/16/2015	
Checked by :	Jérôme LUC	Product Manager	3/16/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	3/16/2015	

	Customer Name
Distribution :	SHENZHEN BALUN TECHNOLOGY Co.,Ltd.

Issue	Date	Modifications
A	3/16/2015	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOHAC T-COIL PROBE
Manufacturer	MVG
Model	STCOIL
Serial Number	SN 22/12 TCP26
Product Condition (new / used)	Used
Frequency Range of Probe	200-5000 Hz

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOHAC T-coil Probes are built in accordance to the ANSI C63.19 and IEEE 1027 standards.

Figure 1 – *MVG COMOHAC T-coil Probe*

Coil Dimension	6.55 mm length * 2.29 mm diameter
DC resistance	860.6 Ω
Wire size	51AWG
Inductance at 1 kHz	132.1 mH at 1 kHz

3 MEASUREMENT METHOD

All methods used to perform the measurements and calibrations comply with the ANSI C63.19 and IEEE 1027 standards. All measurements were performed using a Helmholtz coil built according to the specifications outlined in ANSI C63.19 and IEEE 1027.

3.1 SENSITIVITY

The T-coil was positioned within the Helmholtz coil in axial orientation. Using an audio generator connected to the input of the Helmholtz coil, a known field (1 A/m) was generated within the coil and the T-coil probe reading recorded over the frequency range of 100 Hz to 1000 Hz.

3.2 LINEARITY

The T-coil probe was positioned within the Helmholtz coil in axial orientation. The audio generator connected to the input of the Helmholtz coil was adjusted to obtain a field within the coil from 0 dB A/m to -50 dB A/m and the T-coil reading recorded at each power level (10 dB steps).

3.3 SIGNAL TO NOISE MEASUREMENT OF THE CALIBRATION SYSTEM

The T-coil probe was positioned within the Helmholtz coil in axial orientation. The audio generator connected to the input of the Helmholtz coil was adjusted to obtain a field of -50 dB A/m. The T-coil reading was recorded. The audio generator is then turned off and the T-coil reading recorded.

4 MEASUREMENT UNCERTAINTY

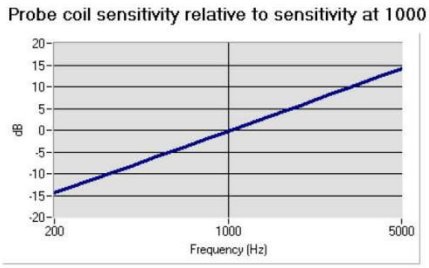
The guideline outlined in the IEEE ANSI C63.19 standard was followed to generate the measurement uncertainty for validation measurements. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the T-coil probe calibration					
Uncertainty Component	Tol. (± dB)	Prob. Dist.	Div.	Uncertainty (dB)	Uncertainty (%)
Current/Volage Accuracy	0.224	R	√3	0.13	
Acoustic/ Signal Source drift	0.008	R	√3	0.00	
Probe coil sensitivity	0.2	R	√3	0.12	
Positioning accuracy	0.4	R	√3	0.23	
Acoustic Signal Receive Accuracy	0.03	R	√3	0.02	
Acoustic Signal Receive Linearity	0.006	R	√3	0.00	
System repeatability	0.4	N	1	0.40	
Combined Standard Uncertainty		N	1	0.49	
Expanded uncertainty (confidence level of 95%, k = 2)		N	k=2	1.00	12.0

5 CALIBRATION MEASUREMENT RESULTS

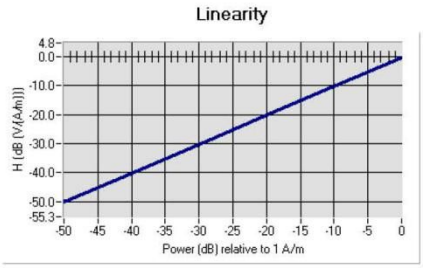
Calibration Parameters	
Lab Temperature	21°C
Lab Humidity	45%

5.1 SENSITIVITY



	Measured	Required
Sensitivity at 1 kHz	-60.04 dB (V/A/m)	–60.5 +/- 0.5 dB (V/A/m)
Max. deviation from Sensitivity	0.46 dB	+/- 0.5 dB

5.2 LINEARITY



	Measured	Required
Linearity Slope	0.10 dB	+/ 0.5 dB

5.3 SIGNAL TO NOISE MEASUREMENT OF THE CALIBRATION SYSTEM

	Measured	Required
Signal to Noise	-72.92 dB A/m	'Reading with -50 dB A/m in coil' – 'no signal applied' > 10 dB

6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
COMOHAC Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
Audio Generator	National Instruments	15222AE	01/2014	01/2017
Reference Probe	MVG	TCP 18 SN 47/10	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Helmholtz Coil	MVG	HC07 SN47/10	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

F.2 TMFS Calibration Report

COMOHAC TMFS Calibration Report

Ref : ACR.91.15.1.SATU.A

SHENZHEN BALUN TECHNOLOGY CO.,LTD.
BLOCK B, FL 1, BAISHA SCIENCE AND TECHNOLOGY PARK, SHAHE XI ROAD,
NANSHAN DISTRICT, SHENZHEN, GUANGDONG PROVINCE, P.R. CHINA 518055

MVG COMOHAC MAGNETIC FIELD SIMULATOR

SERIAL NO.: SN 22/12 TMFS18

Calibrated at MVG US
2105 Barrett Park Dr. - Kennesaw, GA 30144

ACCREDITED
Calibration CERT #2246-02

03/30/2015

Summary:

This document presents the method and results from an accredited COMOHAC TMFS calibration performed in MVG USA using the COMOHAC test bench, for use with a MVG COMOHAC system only. All calibration results are traceable to national metrology institutions.

	Name	*Function*	*Date*	*Signature*
Prepared by :	Jérôme LUC	Product Manager	4/1/2015	
Checked by :	Jérôme LUC	Product Manager	4/1/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	4/1/2015	

	Customer Name
Distribution :	SHENZHEN BALUN TECHNOLOGY Co.,Ltd.

Issue	*Date*	*Modifications*
A	4/1/2015	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOHAC Magnetic Field Simulator
Manufacturer	MVG
Model	STMFS
Serial Number	SN 22/12 TMFS18
Product Condition (new / used)	Used
Frequency Range	200-5000 Hz

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

MVG's COMOHAC T-coil Probes are built in accordance to the ANSI C63.19 and ANSI S3.22-2003 standards.

Figure 1 – *MVG COMOHAC Magnetic Field Simulator*

3 MEASUREMENT METHOD

All methods used to perform the measurements and calibrations comply with the ANSI C63.19. All measurements were performed with the TMFS in the standard device test configuration, with the TMFS in free space, 10 mm below the coil center.

3.1 MAXIMUM AXIAL AND RADIAL MAGNETIC FIELD VALUES

An audio signal was fed into the TMFS and the magnetic field measured and recorded over an area scan with the T-coil probe in three orientations; axial and two radial. The maximum magnetic field is recorded for all three T-coil orientations.

4 MEASUREMENT UNCERTAINTY

The guideline outlined in the IEEE ANSI C63.19 standard was followed to generate the measurement uncertainty for validation measurements. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

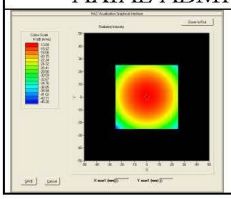
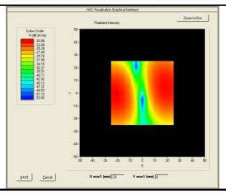
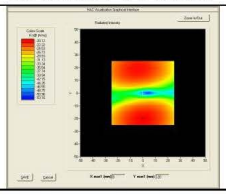
Uncertainty analysis of the probe calibration in Helmholtz Coil					
Uncertainty Component	Tol. (± dB)	Prob. Dist.	Div.	Uncertainty (dB)	Uncertainty (%)
Reflections	0.1	R	$\sqrt{3}$	0.06	
Acoustic noise	0.1	R	$\sqrt{3}$	0.06	
Probe coil sensitivity	0.49	R	$\sqrt{3}$	0.28	
Reference signal level	0.25	R	$\sqrt{3}$	0.14	
Positioning accuracy	0.2	R	$\sqrt{3}$	0.12	
Cable loss	0.1	N	1	0.05	
Frequency analyzer	0.15	R	$\sqrt{3}$	0.09	
System repeatability	0.2	N	1	0.20	
Repeatability of the WD	0.1	N	1	0.10	
Combined standard uncertainty		N	1	0.43	
Expanded uncertainty 95 % confidence level k = 2		N	2	0.85	10.3%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Software	OpenHAC V2
HAC positioning ruler	SN 42/09 TABH12
T-Coil probe	SN 47/10 TCP18
Distance between TMFS and coil center	10 mm
Frequency	1025 Hz
Scan Size	X=70mm/Y=70mm
Scan Resolution	dx=5mm/dy=5mm
Output level	0.5 VAC
Lab Temperature	21°C
Lab Humidity	45%

5.1 MAXIMUM AXIAL AND RADIAL MAGNETIC FIELD VALUES

Test Description	Measured Magnetic Field	
	Location	Intensity (dB A/m)
Axial	Max	-13.68
Radial H	Right side	-20.68
	Left side	-20.85
Radial V	Upper side	-19.92
	Lower side	-20.34

AXIAL ABM1	RADIAL H ABM1	RADIAL V ABM1
		

6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
COMOHAC Test Bench	Version 2	NA	Validated. No cal required.	Validated. No cal required.
HAC positioning ruler	MVG	TABH12 SN 42/09	Validated. No cal required.	Validated. No cal required.
Audio Generator	National Instruments	15222AE	01/2014	01/2017
Reference Probe	MVG	TCP 18 SN 47/10	10/2014	10/2015
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Temperature / Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

--END OF REPORT--