FCC HAC (T-Coil) Compliance Test Report

Project Name: HSDPA/UMTS/GPRS/GSM/EDGE Mobile Phone with Bluetooth

Model : HUAWEI U8651S, U8651S, Summit

FCC ID : OISU8651S

Report No. : SYBH (Z-SAR)006082012-H2

	APPROVED (Manager)	CHECKED	PREPARED
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DATE	2012-08-10	2012-08-10	2012-08-10

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※ ※ Modified History ※ ※

REV.	DESCRIPTION	ISSUED DATE	REMARK
Rev. 1.0	Initial Test Report Release	2012-08-10	Yang Hang

1 General Information

1.1 Statement of Compliance

The T-rating of Hear-Aid Compatibility (HAC) found during testing for HUAWEI U8651S are as below Table 1. So the T-rating of HUAWEI U8651S is **T3**.

Band	T-rating
GSM850	T3
GSM1900	T3
WCDMA Band V	T4
WCDMA Band IV	T4
WCDMA Band II	T4

Table 1: Summary of test result

Note: This portable wireless equipment has been shown to be hearing-aid compatible under the above rated category, specified in ANSI/IEEE Std.C63.19-2007 and had been tested in accordance with the specified measurement procedures, Hear-Aid Compatibility is based on the assumption that all production units will be designed electrically identical to the device tested in this report. Test results reported herein relate only to the item(s) tested and are for North American Bands only.

1.2 EUT Description

Device Information:			
DUT Name:	HUAWEI U8651S, U8651S, Summit		
Type Identification:	HSDPA/UMTS/GPRS/GSM/EDGE Mobile Phone with Bluetooth;		
FCC ID :	QISU8651S		
IMEI No:	004401720393285		
Device Type :	portable device		
Exposure Category:	uncontrolled environment / general population		
Hardware Version :	HD4U865M		
Software Version :	U8651S100R001USAC85B29		
Antenna Type :	Internal		
Device Operating Configurations:			
Supporting Mode(s)	GSM850/1900,WCDMA Band II/IV/V,(Tested);WiFi,BT(Untested)		
Test Modulation	GMSK(GSM),QPSK(WCDMA)		
Device Class	B		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	GSM850	824-849	869 - 894
	GSM1900	1850-1910	1930-1990
	WCDMA Band V	827-847	872- 892
	WCDMA Band IV	1710-1755	2110-2155
	WCDMA Band II	1853-1908	1933-1988
Power Class :	4,tested with power level 5(GSM850)		
	1,tested with power level 0(GSM1900)		
	3, tested with power control “all 1”(WCDMA Band V)		
	3, tested with power control “all 1”(WCDMA Band IV)		
	3, tested with power control “all 1”(WCDMA Band II)		
Test Channels (low-mid-high) :	128-190-251 (GSM850)		
	512-661-810 (GSM1900)		
	4132-4183-4233(WCDMA Band V)		
	1312-1413-1513 (WCDMA Band IV)		
	9262-9400-9538 (WCDMA Band II)		

Table 2: Device information and operating configuration

1.2.1 General Description

HUAWEI U8651S, U8651S, U8651, Astro subscriber equipment in the WCDMA/GSM system. The HSDPA/UMTS frequency band is Band IV and Band II and Band V. The GSM/GPRS/EDGE frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900, but only GSM850 and PCS1900 test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, HSDPA/UMTS and GSM/GPRS/EDGE protocol processing, voice, video, MMS service, GPS,AGPS and WIFI etc. Externally it provides micro SD card interface, earphone port (to provide voice service) and USIM card interface. It also provides Bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other Bluetooth devices.

The mobile phone U8651S is a HSDPA/UMTS/GPRS/GSM/EDGE mobile phone with Bluetooth, which supports GMS850/900/1800/1900 and WCDMA850/AWS/1900
The mobile phone U8651T is a HSDPA/UMTS/GPRS/GSM/EDGE mobile phone with Bluetooth, which supports GMS850/900/1800/1900 and WCDMA/850/AWS/1900
The PCB of them is the same.
The difference between U8651S and U8651T is showed in the following table.

	U8651S	U8651T
GSM four bands	the same	the same
WCDMA bands	WCDMA1900/AWS/850	WCDMA1900/AWS/850
FLASH	the same	the same
PCB	the same	the same
Appearance	the difference	the difference
Bluetooth mode	the same	the same
WLAN mode	the same	the same
BT/ WLAN antenna	the same	the same
GSM/ WCDMA antenna	the same	the same
External camera	the same	the same
internal camera	the same	the same
Adapter	the same	the same
Battery	the same	the same
Chipset	the same	the same
Memory	the same	the same
Form factor	Bar type, Internal antenna	Bar type, Internal antenna
RF Parameter	The same RF Parameter in the same band	The same RF Parameter in the same band
BT RF Parameter	the same	the same
Dimension	the same	the same
Weight	the same	the same
Bluetooth	the same	the same
External camera	the same	the same
Main Frequency NV	The same NV in the same band	The same NV in the same band
BT conducted power	the same	the same
WIFI conducted power	the same	the same

1.3 Test specification(s)

ANSI C63.19-2007	American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices
KDB 285076 D01	HAC Guidance v02v01

1.4 Testing laboratory

Test Site	Reliability Laboratory of Huawei Technologies Co., Ltd.
Test Location	Zone K3,Huawei Industrial Base, Bantian Industry Area, Longgang District, Shenzhen, Guangdong, China
Telephone	+86-755-28785513
Fax	+86-755-36834474
State of accreditation	The Test laboratory (area of testing) is accredited according to ISO/IEC 17025. A2LA Registration number: 2174.01

1.5 Applicant and Manufacturer

Company Name	HUAWEI TECHNOLOGIES CO., LTD
Address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C

1.6 Application details

Start Date of test	2012-01-18
End Date of test	2012-01-19

1.7 Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

2 HAC(T-Coil) Measurement System

2.1 T-Coil 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.

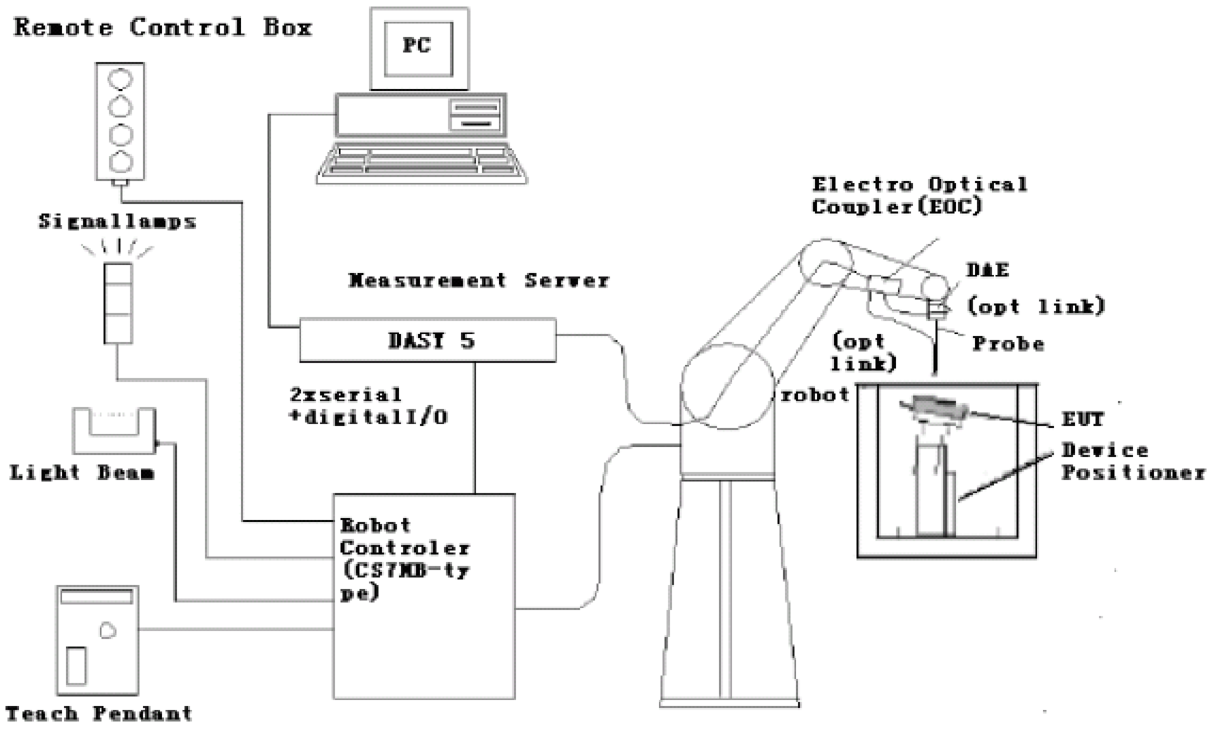
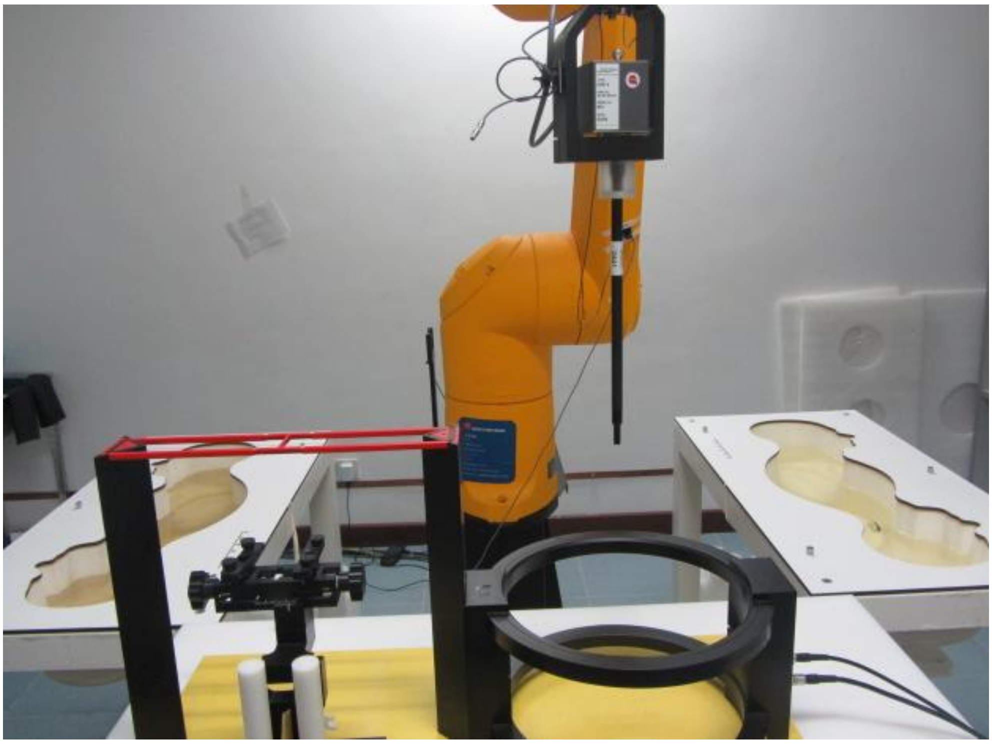


Fig. 1 HAC Test Measurement Set-up

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.



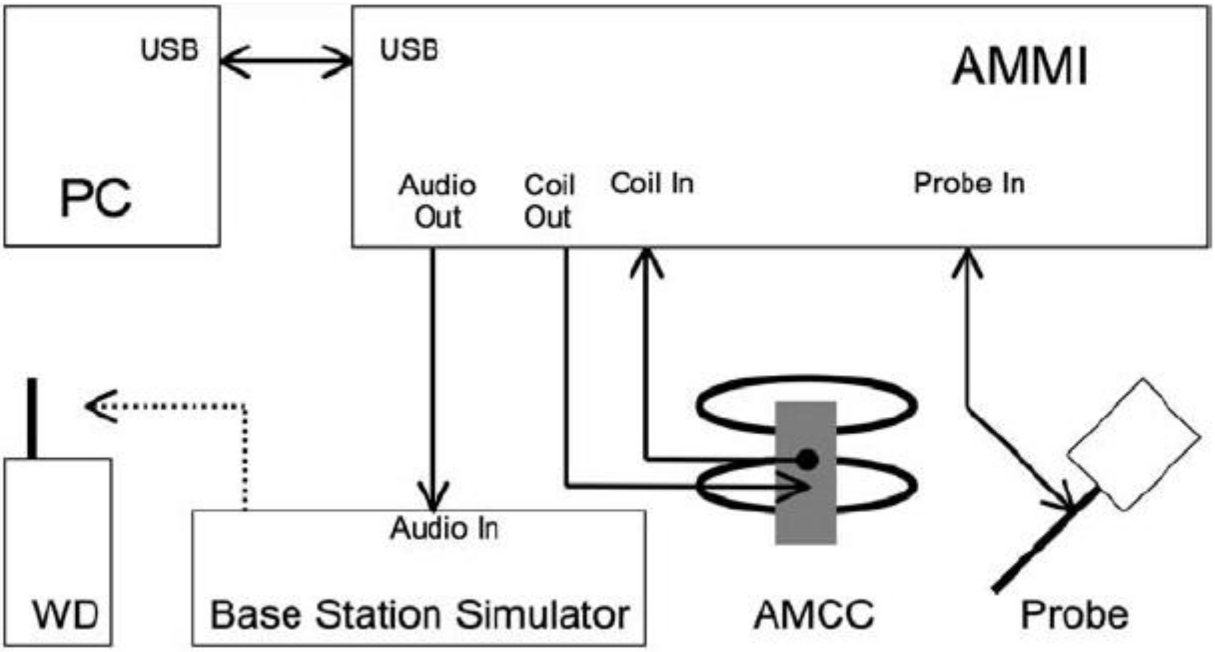


Fig. 2 T-Coil setup with HAC Test Arch and AMCC

2.2 Probe description

AM1D probe Description

The AM1D probe is an active probe with a single sensor. It is fully RF-shielded and has a rounded tip 6mm in diameter incorporating a pickup coil with its center offset 3mm from the tip and the sides. The symmetric signal preamplifier in the probe is fed via the shielded symmetric output cable from the AMMI with a 48V "phantom" voltage supply. The 7-pin connector on the back in the axis of the probe does not carry any signals. It is mounted to the DAE for the correct orientation of the sensor. If the probe axis is tilted 54.7 degree from the vertical, the sensor is approximately vertical when the signal connector is at the underside of the probe (cable hanging downwards).

Frequency	0.1~20kHz (RF sensitivity < -100dB, fully RF shielded)	
Sensitivity	< -50dB A/m @ 1kHz	
Dynamic range	2 V/m to > 1000 V/m; Linearity: ± 0.2 dB	
Pre-amplifier	40dB, symmetric	
Dimensions	Tip diameter/length: 6/290mm, sensor according to ANSI-C63.19	

2.3 AMCC

The Audio Magnetic Calibration coil is a Helmholtz Coil designed for calibration of the AM1D probe. The two horizontal coils generate a homogeneous magnetic field in the z direction. The DC input resistance is adjusted by a series resistor to approximately 50Ohm, and a shunt resistor of 10Ohm permits monitoring the current with a scale of 1:10。

Port description:

Signal	**Connector**	**Resistance**
Coil In	BNC	Typically 50Ohm
Coil Monitor	BNO	10Ohm±1% (100mV corresponding to 1 A/m)

Specification:

Dimensions	370 x 370 x 196 mm, according to ANSI-C63.19

2.4 AMMI

Figure 3 AMMI front panel

The Audio Magnetic Measuring Instrument (AMMI) is a desktop 19-inch unit containing a sampling unit, a waveform generator for test and calibration signals, and a USB interface.

Sampling rate	48 kHz / 24 bit
Dynamic range	85 dB
Test signal generation	User selectable and predefined (vis PC)
Calibration	Auto-calibration / full system calibration using AMCC with monitor output
Dimensions	482 x 65 x 270 mm

2.5 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.

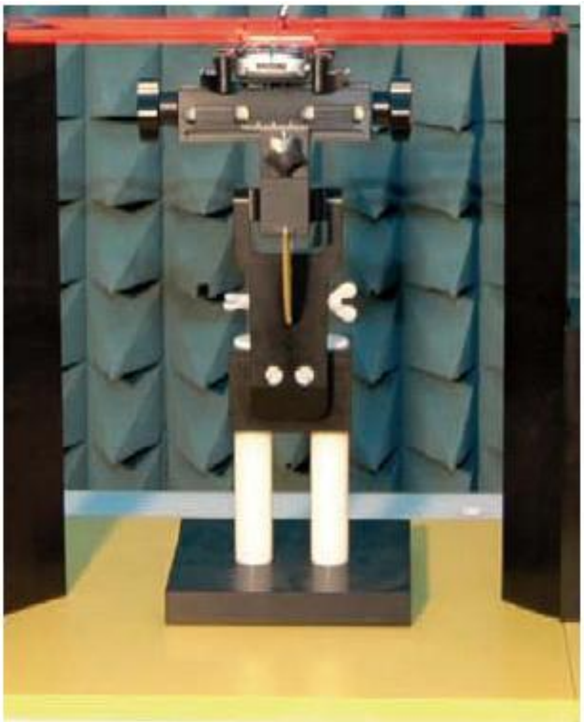


Fig. 2 HAC Phantom & Device Holder

2.6 Test Equipment List

This table gives a complete overview of the HAC measurement equipment

Devices used during the test described are marked ☒

No.	Manufacturer	Device	Type	Serial number	Date of last calibration)*
☐	SPEAG	Audio Magnetic Field Probe	AM1DV2	1068	2011-11-17
☐	SPEAG	Audio Magnetic Calibration Coil	AMCC	1053	NCR
☐	SPEAG	Audio Magnetic Measuring Instrument	AMMI	1065	NCR
☐	SPEAG	HAC Test Arch	N/A	1102	NCR
☐	SPEAG	Data acquisition electronics	DAE4	851	2011-06-30
☐	SPEAG	Data acquisition electronics	DAE4	852	2011-11-26
☐	SPEAG	Software	DASY5	N/A	N/A
☐	SPEAG	Telephone Magnetic Field Simulator	TMFS	1030	2011-11-07
☐	R & S	Universal Radio Communication Tester	CMU200	117057	2011-09-04
☐	R & S	Universal Radio Communication Tester	CMU200	111379	2011-08-06

Note: 1) The calibration interval of Audio Magnetic Field Probe is three years;
2) The calibration interval of DAE and CMU is one year.

2.7 Measurement Uncertainty Evaluation

Error Description	Uncertainty Value	Probability Distribution	Divi-sor	ci ABM1	ci ABM2	Standard Uncertainty ABM1	Standard Uncertainty ABM2
Probe Sensitivity							
Reference Level	±3.0%	N	1	1	1	±3.0%	±3.0%
AMCC Geometry	±0.4%	R	√3	1	1	± 0.2%	± 0.2%
AMCC Current	±1.0%	R	√3	1	1	± 0.6%	± 0.6%
Probe Positioning during Calibr.	± 0.1%	R	√3	1	1	± 0.1%	± 0.1%
Noise Contribution	± 0.7%	R	√3	0.0143	1	± 0.0%	± 0.4%
Frequency Slope	± 5.9%	R	√3	0.1	1	± 0.3%	± 3.5%
Probe System							
Repeatability / Drift	± 1.0%	R	√3	1	1	± 0.6%	± 0.6%
Linearity / Dynamic Range	± 0.6%	R	√3	1	1	± 0.4%	± 0.4%
Acoustic Noise	± 1.0%	R	√3	0.1	1	± 0.1%	± 0.6%
Probe Angle	± 2.3%	R	√3	1	1	±1.4%	± 1.4%
Spectral Processing	± 0.9%	R	√3	1	1	±0.5%	± 0.5%
Integration Time	± 0.6%	N	1	1	5	±0.6%	± 3.0%
Field Disturbation	± 0.2%	R	√3	0	1	±0.1%	± 0.1%
Test Signal							
Ref. Signal Spectral Response	± 0.6%	R	√3	1	1	±0.1%	± 0.4%
Positioning							
Probe Positioning	± 1.9%	R	√3	1	1	±1.1%	± 1.1%
Phantom Thickness	± 0.9%	R	√3	1	1	±0.5%	± 0.5%
DUT Positioning	± 1.9%	R	√3	1	1	±1.1%	± 1.1%
External Contributions							
RF Interference	± 0.0%	R	√3	1	0.3	±0.0%	± 0.0%
Test Signal Variation	± 2.0%	R	√3	1	1	±1.2%	± 1.2%
Combined Uncertainty							
Combined Std. Uncertainty (ABM Field)						**±4.1%**	**±6.1%**
Expanded Std. Uncertainty						**±8.1%**	**±12.3%**

Table 3: Measurement uncertainties for T-Coil

3 HAC(T-Coil) Measurement

3.1 T-Coil measurement points and reference plane

Figure 3 illustrates the three standard probe orientations. Position 1 is the axial orientation of the probe coil; orientation 2 and orientation 3 are radial orientations. The space between the measurement positions is not fixed. It is recommended that a scan of the WD be done for each probe coil orientation and that the maximum level recorded be used as the reading for that orientation of the probe coil.

1) The reference plane is the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the WD handset, which, in normal handset use, rest against the ear.

2) The measurement plane is parallel to, and 10 mm in front of, the reference plane.

3) The reference axis is normal to the reference plane and passes through the center of the receiver speaker section (or the center of the hole array); or may be centered on a secondary inductive source. The actual location of the measurement point shall be noted in the test report as the measurement reference point.

4) The measurement points may be located where the axial and radial field intensity measurements are optimum with regard to the requirements. However, the measurement points should be near the acoustic output of the WD and shall be located in the same half of the phone as the WD receiver. In a WD handset with a centered receiver and a circularly symmetrical magnetic field, the measurement axis and the reference axis would coincide.

5) The relative spacing of each measurement orientation is not fixed. The axial and two radial orientations should be chosen to select the optimal position.

6) The measurement point for the axial position is located 10 mm from the reference plane on the measurement axis. The actual location of the measurement point shall be noted in test reports and designated as the measurement reference point.

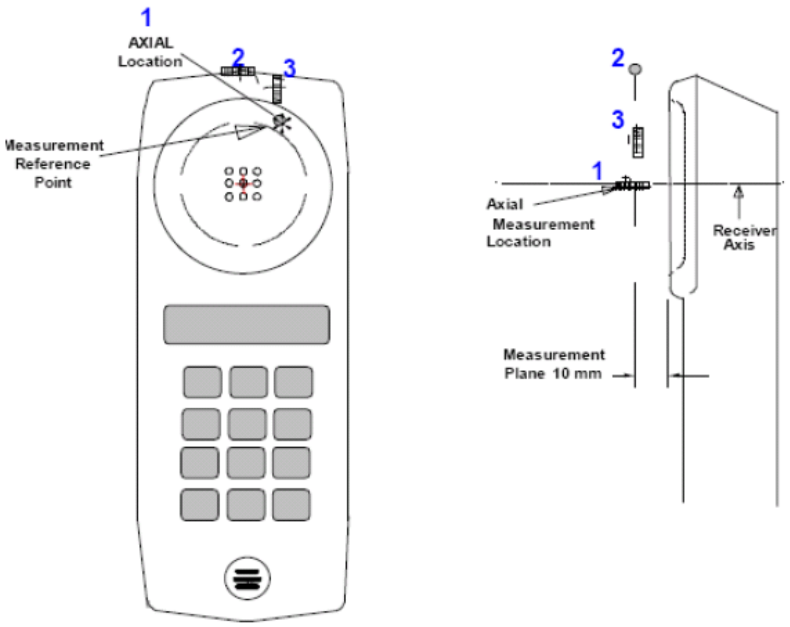


Figure 3 Axis and planes for WD audio frequency magnetic field measurements

3.2 T-Coil Measurement Procedure

The following illustrate a typical test scan over a wireless communications device:

1) Geometry and signal check: system probe alignment, proper operation of the field probe, probe measurement system, other instrumentation, and the positioning system was confirmed. A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the test Arch.

2) Set the reference drive level of signal voice defined in C63.19 per 6.3.2.1.

3) The ambient and test system background noise (dB A/m) was measured as well as ABM2 over the full measurement. The maximum noise level must be at least 10dB below the limit of C63.19 per 7.3.2.

4) The DUT was positioned in its intended test position, acoustic output point of the device perpendicular to the field probe.

5) The DUT operation for maximum rated RF output power was configured and connected by using of coaxial cable connection to the base station simulator at the test channel and other normal operating parameters as intended for the test. The battery was ensured to be fully charged before each test. The center sub-grid was centered over the center of the acoustic output (also audio band magnetic output, if applicable). The DUT audio output was positioned tangent (as physically possible) to the measurement plane.

6) The DUT's RF emission field was eliminated from T-coil results by using a well RF-shielding of the probe, AM1D, and by using of coaxial cable connection to a Base Station Simulator. One test channel was pre-measurement to avoid this possibility.

7) Determined the optimal measurement locations for the DUT by following the three steps, coarse resolution scan, fine resolution scans, and point measurement, as described in C63.19 per 6.3.4.4. At each measurement locations, samples in the measurement window duration were evaluated to get ABM1 and the signal spectrum. The noise measurement was performed after the scan with the signal, the same happened, just with the voice signal switched off. The ABM2 was calculated from this second scan.

8) All results resulting from a measurement point in a T-Coil job were calculated from the signal samples during this window interval. ABM values were averaged over the sequence of there samples.

9) At an optimal point measurement, the SNR (ABM1/ABM2) was calculated for axial,radial transverse and radial longitudinal orientation, and the frequency response was measured in axial axis.

10) Corrected for the frequency response after the DUT measurement since the DASY5 system had known the spectrum of the input signal by using a reference job.

11) In SEMCAD postprocessing, the spectral points are in addition scaled with the high-pass (half-band) and the A-weighting, bandwidth compensated factor (BWC) and those results are final as shown in this report.

3.3 T-Coil Performance Requirements

In order to be rated for T-Coil use, a WD shall meet the requirements for signal level and signal quality contained in this part.

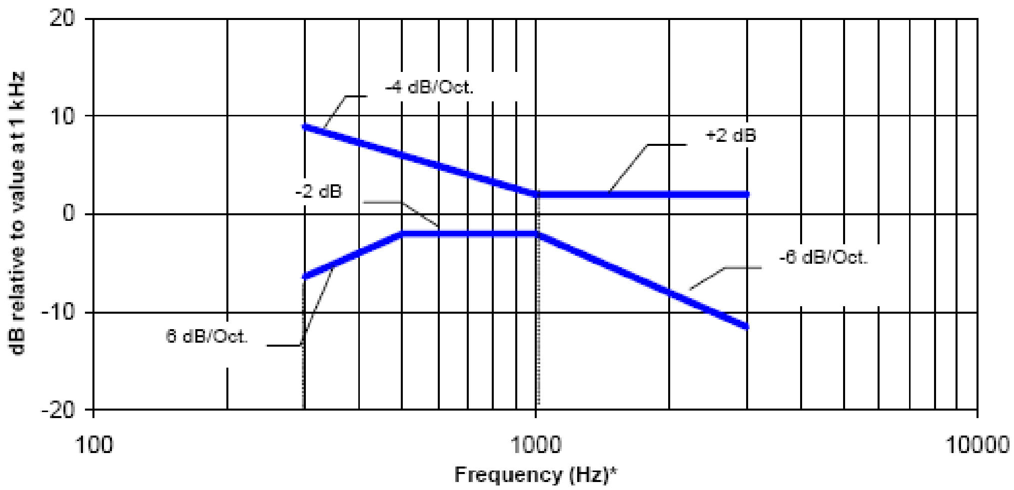
1) T-Coil coupling field intensity

When measured as specified in ANSI C63.19, the T-Coil signal shall be ≥ –18 dB (A/m) at 1 kHz, in a 1/3 octave band filter for all orientations.

2) Frequency response

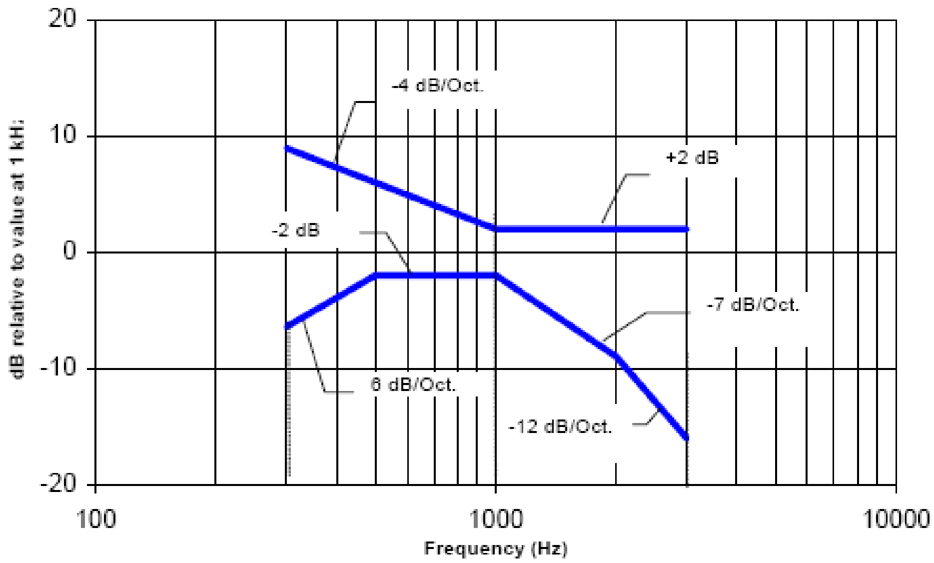
The frequency response of the axial component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve specified in this sub-clause, over the frequency range 300 Hz to 3000 Hz. Figure 7.1 and Figure 4 provide the boundaries for the specified frequency.

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.



NOTE—Frequency response is between 300 Hz and 3000 Hz.

Figure 4—Magnetic field frequency response for WDs with a field ≤ –15 dB (A/m) at 1 kHz



NOTE—Frequency response is between 300 Hz and 3000 Hz.

Figure 5 —Magnetic field frequency response for WDs with a field that exceeds –15dB(A/m) at 1 kHz

3) Signal quality

This part provides the signal quality requirement for the intended T-Coil signal from a WD. 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. So, the only criteria that can be measured is the RF immunity in T-Coil mode. This is measured using the same procedure as for the audio coupling mode and at the same levels.

The worst signal quality of the three T-Coil signal measurements shall be used to determine the T-Coil mode category per Table 1

Category	Telephone parameters WD signal quality [(signal + noise) – to – noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	> 30 dB

Table 1: T-Coil signal quality categories

4 HAC(T-Coil) Test Configuration

4.1 General Description

The phone was tested in all normal configurations for the ear use. The EUT is mounted in the device holder equivalent as for classic dosimeter measurements. The acoustic output of the EUT shall coincide with the center point of the area formed by the dielectric wire and the middle bar of the arch's top frame. The EUT shall be moved vertically upwards until it touches the frame. The fine adjustment is possible by sliding the complete. The EUT holder is on the yellow base plate of the Test Arch phantom. These test configurations are tested at the middle frequency channels of each applicable operating mode; for example, GSM, WCDMA(UMTS),CDMA and TDMA.

4.2 GSM Test Configuration

A communication link is set up with a System Simulator (SS) by RF cable,and a call is established. The Absolute Radio Frequency Channel Number(ARFCN) are allocated to 190 respectively in the case of GSM850, allocated to 661 respectively in the case of GSM1900. T-Coil configurations is measured in Speechcod/Handset Low using System Simulator (SS) of CMU200, at the same time the EUT shall be operated at its maximum RF output power setting.

4.3 WCDMA Test Configuration

A communication link is set up with a System Simulator (SS) by RF cable,and a call is established. The Absolute Radio Frequency Channel Number(ARFCN) are allocated to 9400 respectively in the case of WCDMA Band II, allocated to 1413 respectively in the case of WCDMA Band IV, allocated to 4183 respectively in the case of WCDMA Band V. T-Coil configurations is measured in voice mode with 12.2kbps RMC using System Simulator (SS) of CMU200, at the same time the EUT shall be operated at its maximum RF output power setting.

5 HAC(T-Coil) Measurement Results

Band	Test channel /Frequency	Test Result				Frequency Response	Category
		Location (x,y)[mm]	ABM1≥-18 (dB A/m)	SNR(dB)	Probe Orientation		
Test data from report NO.: RZA1201-0064HAC01R1							
GSM850	190/836.6	(-7.8, -8.3)	8.71	**22.1**	Radial1(x)	/	T3
		(1.2, 0.7)	4.93	39.1	Radial2(y)		T4
		(0.2, -10.3)	19.2	30.5	Z-axial	PASS	T4
GSM1900	661/1880	(-7.8, -8.3)	8.75	**27.4**	Radial1(x)	/	T3
		(1.2, -14.3)	18.7	41.3	Radial2(y)		T4
		(0.2, -10.3)	19.1	35.5	Z-axial	PASS	T4
WCDMA Band II	9400/1880	(-7.8, -8.3)	8.83	**48.6**	Radial1(x)	/	T4
		(1.2, -17.3)	18.9	59.8	Radial2(y)		T4
		(2.2, -10.3)	19.8	65.6	Z-axial	PASS	T4
WCDMA Band IV	1413/1732.6	(-4.8, -28)	5.16	**56.0**	Radial1(x)	/	T4
		(1.2, -19)	17.1	62.1	Radial2(y)		T4
		(2.2, -25)	18.7	64.9	Z-axial	PASS	T4
WCDMA Band V	4183/836.6	(-7.8, -28)	6.61	**56.4**	Radial1(x)	/	T4
		(1.2, -16)	18.4	62.2	Radial2(y)		T4
		(2.2, -23)	18.6	63.7	Z-axial	PASS	T4

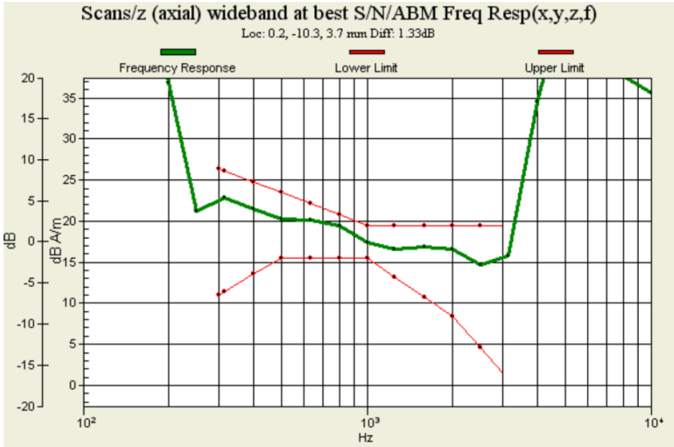
Table 4: Test Result of T-Coil

Note:

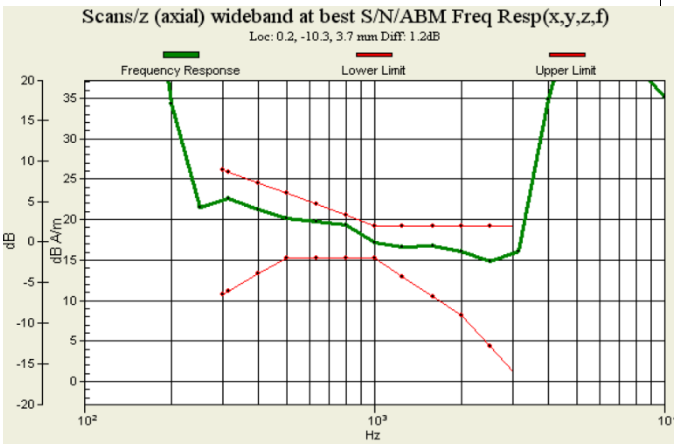
1. The maximum value of each band is marked with bold letters.
2. T-coil test doesn't need to do for the differences between U8651T and U8651S.

Plots from report NO.: RZA1201-0064HAC01R1

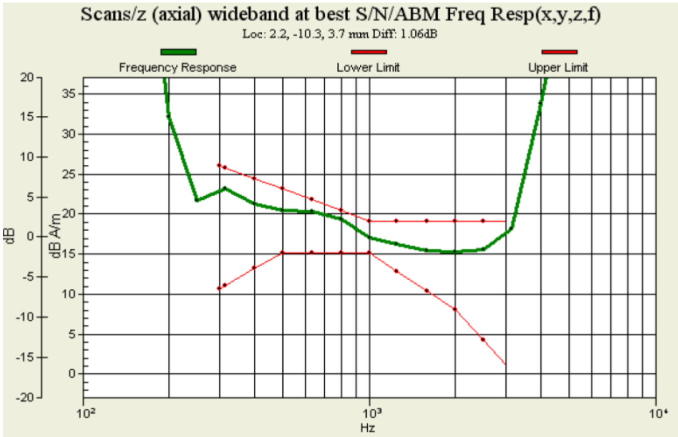
GSM850/190CH



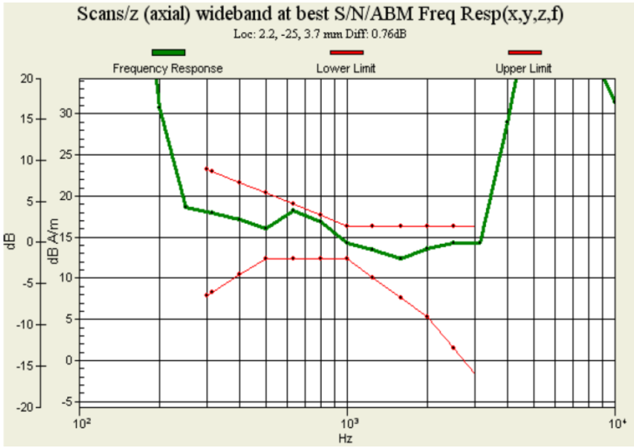
GSM1900/661CH



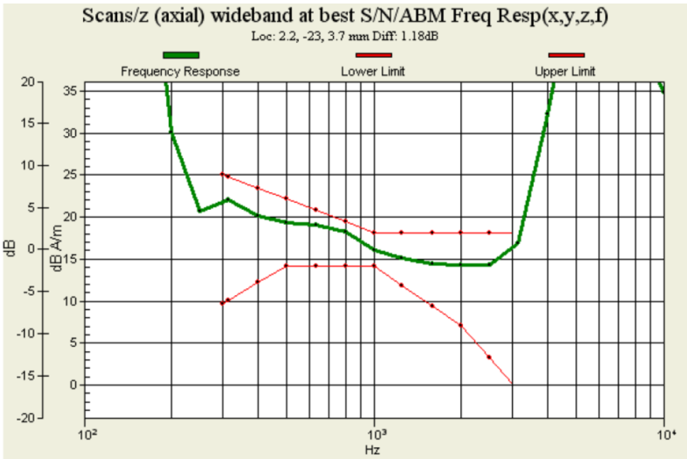
WCDMA Band II/661CH



WCDMA Band IV/1413CH



WCDMA Band V/4183CH



NA

NA

Table 5: Frequency response plots of T-Coil

6 Test photos

HAC T-Coil test photo

End Of Report