T-Coil HAC Test Report

FOR:

Manufacturer: Unimax Communications
Model Name: U307TG, MXG308
FCC ID: P46-UMX35INT

Test Report #: HAC_INTEL_096_15001_T-Coil_Rev1

Date of Report: June 23, 2016

***CETECOM* Inc.**
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1. Assessment

The following device was tested against the applicable criteria specified in FCC 20.19 and ANSI C63.19 – 2011 and no deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Unimax Communications	Mobile Phone	U307TG, MXG308

Responsible for Testing Laboratory:

Date	Section	Name	Signature
June 23, 2016	Compliance	Josie Sabado (Test Lab Manager)	

Responsible for the Report:

Date	Section	Name	Signature
June 23, 2016	Compliance	James Donnellan (Sr. EMC engineer)	James Donnellan Digitally signed by James Donnellan DN: cn=James Donnellan, c=US, o=Cetecom Inc., ou=Compliance, email=james.donnellan@cetecom.com Date: 2016.06.24 11:27:10 -07'00'

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2. Administrative Data

2.1. Identification of the Testing Laboratory Issuing the HAC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
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Test Lab Manager	Josie Sabado
Responsible Project Manager	Rami Saman

2.2. Identification of the Client and Manufacturer

	Client	**Manufacturer**
Company	Intel Inc.	Unimax Communications
Street Address	12220 Scripps Summit Drive	18201 McDurmott Street W. Suite E
City/Zip Code	San Diego, CA 92131	Irvine, CA 92614
Country	USA	USA

3. Equipment under Test (EUT)

3.1. Specification of the Equipment under Test

Model No	U307TG, MXG308
FCC ID	P46-UMX35INT
Prototype/Production	Pre-Production
Supported Radios	GSM/GPRS /EGPRS MS Class 12, Power Class 4/1, Mobile Class B WCDMA/ HSUPA/HSPA+, Power Class 3 Bluetooth v4.0 802.11 b/g/n, HT20 GPS receiver
Date of Testing	June 1, 2016 to June 2, 2016
HAC Rated Category	T3

3.2. Antenna Information

Antenna	Type	Internal / External	Frequency (MHz)	Manufacturer Stated Max Peak Gain (dBi)
WWAN	IFA	Internal	800 – 1915	1.2
Bluetooth / WLAN	IFA	Internal	2400 – 2485	1.5

3.3. Technical Specification of Supported Radio

Technology	Type(s) of Modulation	Band	Transmit Frequency Range (MHz)	Declared Maximum Output Power Including Tolerance
GSM	GMSK	GSM 850	824.2 – 848.8	33
		PCS 1900	1850.2 – 1909.8	30
(E)GPRS	GMSK, 8PSK	GSM 850	824.2 – 848.8	33
		PCS 1900	1850.2 – 1909.8	30
WCDMA	QPSK, 16 QAM	FDD II	1852.4 – 1907.6	23.8
		FDD V	826.4 – 846.6	23.8
Bluetooth	GFSK	N/A	2402 – 2480	5.5
802.11 b/g/n	BPSK, QPSK, 16-QAM, 64-QAM	N/A	2412 – 2462	16

3.4. Supported Air Interfaces

Air Interface	Band	Transport Type[1]	C63.19 Tested	Over the Top Voice Mode	Simultaneous Transmission[2]	Wi-Fi Low Power	GSM Power Reduction
GSM	GSM 850 PCS 1900	VO	Yes	N/A	Yes; WiFi or Bluetooth	N/A	N/A
(E)GPRS	GSM 850 PCS 1900	DT	N/A	No	Yes; WiFi or Bluetooth	N/A	N/A
WCDMA	FDD II FDD V	VO	Yes	N/A	Yes; WiFi or Bluetooth	N/A	N/A
Bluetooth	N/A	DT	N/A	No	Yes; GSM, (E)GPRS, WCDMA	N/A	N/A
802.11 b/g/n	N/A	DT	No	Yes	Yes; GSM, (E)GPRS, WCDMA	N/A	N/A

NOTES:
1. VO = CMRS Voice Service; DT = Digital Transport only (no voice); VD = CMRS IP Voice Service and Digital Transport
2. Simultaneous transmission mode is not tested

3.5. Identification of the Equipment Under Test (EUT)

EUT #	Serial Number	HW Version	SW Version
1	U307TG6303000222	B1.2	SOF35AU_L_3G_MRD5_ES21_Main_B1.1_01.35.ww39_p3.2016_20160512_eng_PTCRB

3.6. Identification of Accessory equipment

No accessory equipment

3.7. Miscellaneous Information

1. The U307TG and the MXG308 are electrically identical. The purpose of the models is because of the exterior appearance and for marketing purposes.
2. All tests in this test report was performed with HAC mode enabled. HAC Audio mode was enabled through the EUT user interface. The option to enable this mode is found under Phone > Settings > Calls > Hearing Aids.
3. HAC mode enabled makes the following changes:
    a. Enhanced audio frequency response
    b. Additional 3 dB digital gain in the downlink path

4. Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to determine the HAC rating of the EUT according to requirements in ANSI C63.19 – 2011. The examinations were carried out with the DASY 52 system described in Section 6.

4.1. FCC rules and ANSI Measurement Methods

Chapter 47 of Code of Federal Regulations, Part 20.19 specify criteria for Hearing aid-compatible mobile handsets and ANSI C63.19-2011: American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids establish categories for hearing aids and methods of measurement.

4.2. HAC performance and Equipment categorization Requirements

4.3. Categories of Hearing Aid Compatibility for wireless devices

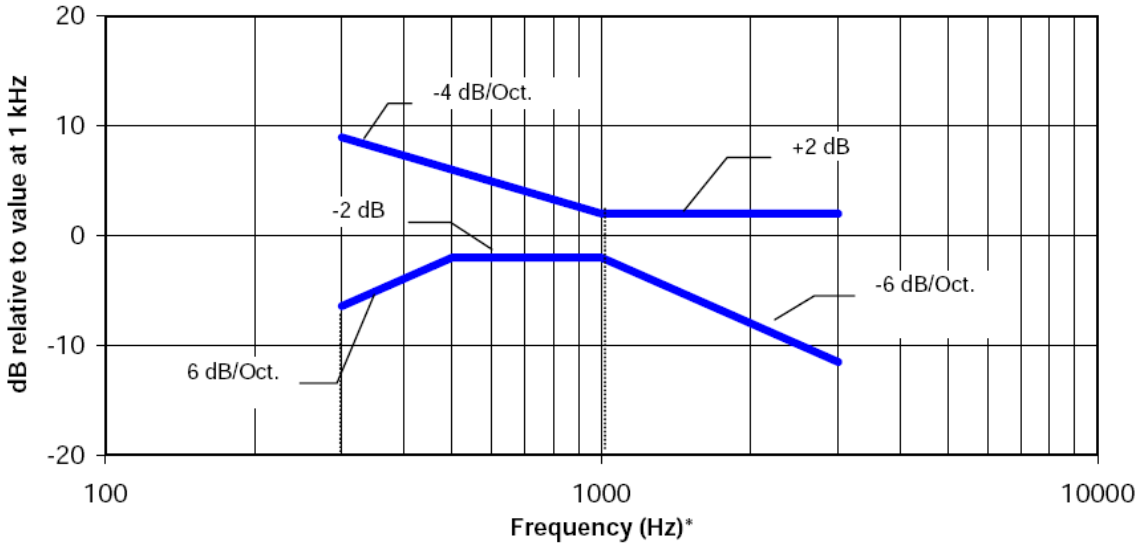
Category	Telephone parameters WD signal quality [(signal + noise)-to-noise ratio in decibels]
Category T1	0 dB to 10 dB
Category T2	10 dB to 20 dB
Category T3	20 dB to 30 dB
Category T4	>30 dB

4.4. T-Coil Coupling field intensity

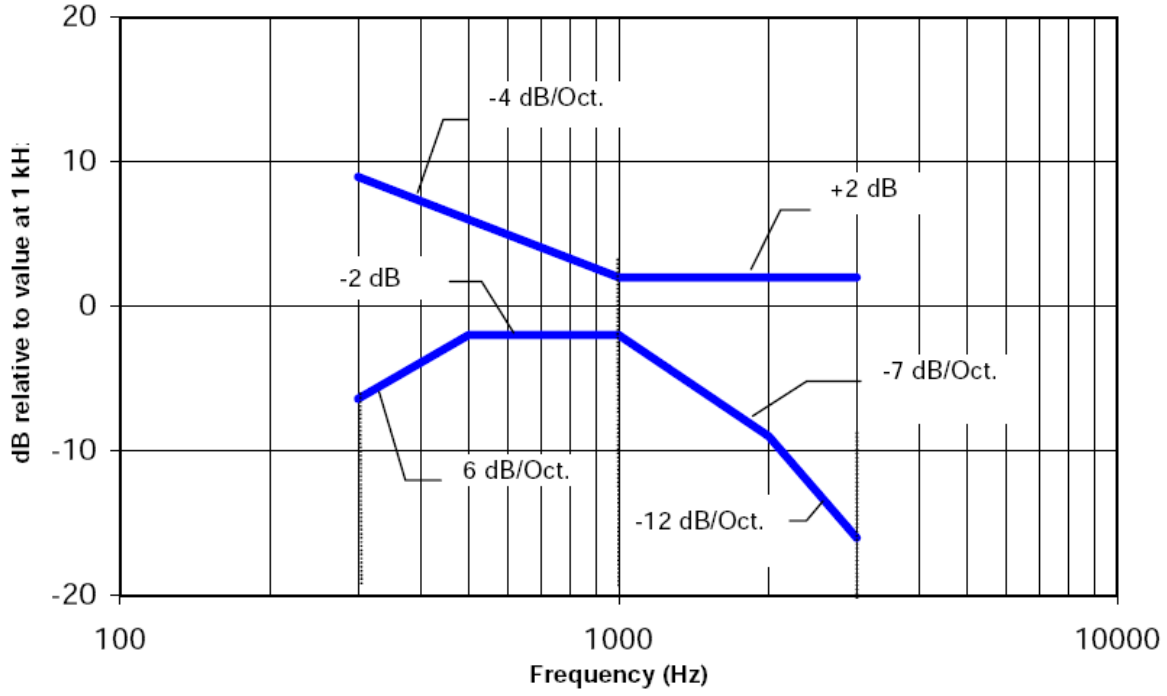
The T-Coil signal shall be ≥ -18 dB (A/m) at 1 kHz for all probe orientations while the wireless device is operating at reference input levels as specified in section 5.4 of this test report.

4.5. Magnetic Field Frequency Response

The magnetic field response for wireless devices with a field strength ≤ -15 dB (A/m) at 1 kHz shall be within the constraints of the following plot:



The magnetic field response for wireless devices with a field strength > -15 dB (A/m) at 1 kHz shall be within the constraints of the following plot:



5. Measurement Procedure

ANSI has published an American National Standard on May 2011 (C63.19), which establishes categories for hearing aids and for wireless devices, and provide tests that can be used to assess the electromagnetic characteristics of hearing aids and for wireless devices and assign them to these categories.

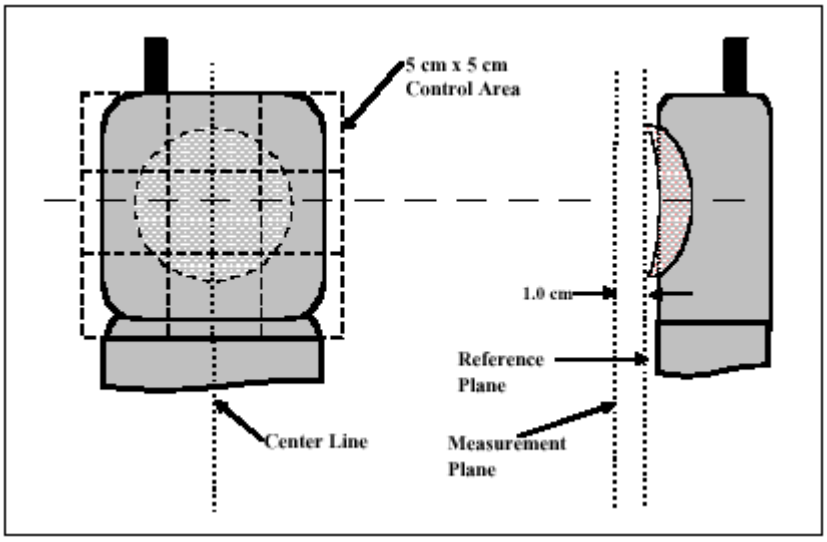
5.1. General Requirements

The test was performed in a laboratory with an environment which avoids influence on HAC measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature shall be in the range of 20°C to 26°C and 30-70% humidity.

5.2. Configurations

Device holder and positioning description
The SPEAG Test Arch is placed on a flat, stable surface. The Test Arch was designed to allow high precision positioning of the EUT and dipole. The center of the Test Arch is the point where the dielectric wire and the middle bar of the arch's top frame cross. To minimize interferences between the device holder and the EUT, a foam block is attached to the back of the EUT and used with the device holder. The distance between the EUT and the top of the HAC test arch is 6.3 mm.

Test positions of device
The HAC measurements are perform according to the requirements of ANSI C63.19. It allows centering the wireless device inside a 5 x 5 cm control area marked with 4 points for position adjustment. SPEAG's robot arm allows an exact adjustment of the measurement distance from the DUT.
The measurement probe is centered above the mobile phone speaker inside the control area.



Radio Exercising

The cellular radio of the EUT was exercised via a wireless connection to a base station simulator. The base station simulator was used to set the EUT to transmit at maximum power at the specified air interface, channel, and operating mode.

5.3. Audio Signal Preparation

Normal speech input levels are as follows:

Standard	Technology	Input (dBm0)
TIA/EIA/IS-2000	CDMA	-18
TIA/EIA-136	TDMA (50 Hz)	-18
T1/T1P1/3GPP	UMTS (WCDMA)	-16
iDEN	TDMA (22 Hz and 11 Hz)	-18
J-STD-007	GSM (217 Hz)	-16

5.4. GSM/WCDMA

1. Establish a call between the base station simulator and the EUT via a radiated link.
2. The speech port of the base station simulator is directly connected to the AMMI.
3. Set the voice coder on the base station simulator to “Decoder Cal”. This represents 3.14 dBm0. Use the AMMI to measure the voltage.
4. Calculate the RMS value of the desired input level using the equation
   Audio Input Level = Reference Input Level – 3.14 dBm0 + Decoder Cal RMS Coil Signal
5. Change the voice coder to “Encoder Cal”. Use the AMMI to measure the voltage from the base station simulator speech port.
6. Adjust the level of the 1 kHz test signal to match the desired input level calculated in step 4.
7. When using an audio signal other than the 1 kHz test tone, the level of the audio signal should also be adjusted to match the desired audio input level calculated in step 4.

5.5. EUT Scanning Procedure

All tests are performed with the same configuration of test steps and in accordance with the requirements described in C63.19-2011 Chapter 5.

1. A test arch adjustment and verification is performed, which allows checking the borders and center position of the 5 x 5 cm² control area. The probe tip touches down on center of the test arch
2. The HAC test setup is placed at the pre-defined position under the SPEAG test arch phantom.
3. The wireless device (WD) is oriented in its intended test position (see photo documentation) with the reference plane in the horizontal plane and secured by the device holder. The acoustical output is placed in the centre of the test arch.
4. The EUT is set to transmit at maximum output power at the desired test channel(s).
5. The “area scan” measures the magnetic field strength above the WD on a parallel plane to the surroundings of the control area at the upper end of the HAC test arch. It is used to locate the approximate location of the peak field strength. The robot performs a stepped movement along one grid axis while the local magnetic field strength is measured by the probe. This area scan is done with the probe coil oriented in the axial and transverse orientations relative to the WD.
6. After the transverse probe orientation area scan is complete, the probe returns to the interpolated magnetic field maximum to measure the frequency response from 300 Hz to 3 kHz.
7. SEMCAD is used to perform the evaluation in respect of the requirements of the test standard. The maximum interpolated magnetic field is taken to represent the maximum field intensity and to determine the T-rating.

6. The Measurement System

6.1. Robot system specification

The HAC measurement system being used is the SPEAG DASY52 system, which consists of a Stäubli TX90XL 6-axis robot arm and CS8c controller, SPEAG HAC Probes, Data Acquisition Electronics, and SPEAG Test Arch. The robot is used to articulate the probe to programmed positions over the test arch to obtain the E-field readings from the EUT.

The system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

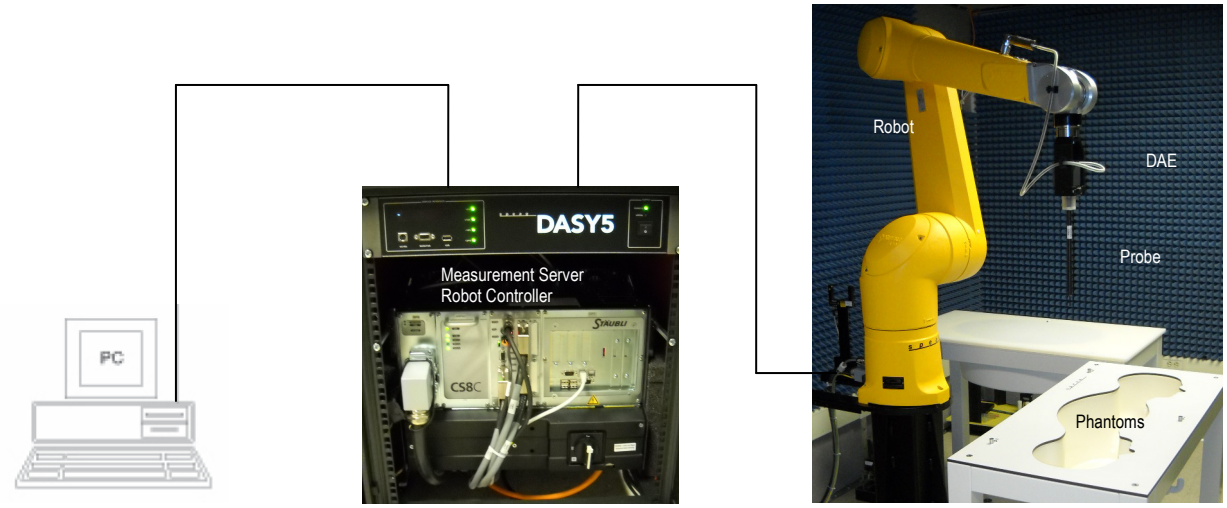


Figure 5: Schematic diagram of the SAR measurement system

In operation, the system first does an area (2D) scan at a fixed distance from the EUT.

6.2. Audio Magnetic Field Probe

The AM1D probe is an active probe with a single sensor according to ANSI C63.19-2011 Section D.8. 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° from the vertical, the sensor is approximately vertical when the signal connector is at the underside of the probe (cable hanging downwards). The sensor axis is indicated by a dot at the probe tip.

6.3. Data Acquisition Electronics

The DAE contains a signal amplifier, multiplexer, 16bit A/D converter and control logic. It uses an optical link for communication with the DASY5 system. The DAE has a dynamic range of -100 to 300 mV. It also contains a two-step probe touch detector for mechanical surface detection and emergency robot stop. For the purposes of T-Coil measurements, the DAE does not influence the outcome of the results. The purpose of the DAE is to provide surface detection and emergency stop functionality.

6.4. AMCC Helmholtz Coil

The Audio Magnetic Calibration Coil is a Helmholtz Coil designed according to ANSI C63.19-2011, Section D.10 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 50 Ohm, and a shunt resistor of 10 Ohm permits monitoring the current with a scale of 1:10.

6.5. AMMI

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. The AMMI provides the test signal for the WD, drives the AMCC during calibration or reference measurement, supplies the AM1D probe with a phantom supply, and analyzes the probe measurement results.

7. Uncertainty Assessment

Measurement uncertainty values were evaluated for HAC measurements. The uncertainty values for components were evaluated according to the procedures given in ANSI C63.19.

7.1. Measurement Uncertainty Budget

Error Contribution	Uncertainty (+/- %)	Distribution	Div.	C ABM1	C ABM2	Std Unc. ABM1 (+/- %)	Std Unc. 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 Calibration	0.1	R	√3	1	1	0.1	0.1
Noise Contribution	0.7	R	√3	1	1	0.1	0.1
Frequency Slope	5.9	R	√3	0.1	1.0	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	0.1	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 Distribution	0.2	R	√3	1	1	0.1	0.1
Test Signal							
Ref. Signal Spectral Response	0.6	R	√3	0	1	0.0	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

8. Test results summary

HAC Audio mode was enabled through the EUT user interface. The option to enable this mode is found under Phone > Settings > Calls > Hearing Aids. The volume was set to maximum and the screen was off.

8.1. HAC Results

Air Interface / Band	Voice Codec	Probe Position	Frequency Response	ABM 1 (dB A/m)	ABM 1 / ABM 2 (dB)	Category	Results (Appendix A)
GSM 850	Speechcodec Low	Axial	Pass	4.37	25.35	T3	Plot 1 & 2
		Transverse		-14.42	25.22	T3	Plots 3
GSM 1900	Speechcodec Low	Axial	Pass	4.40	29.64	T3	Plot 4 & 5
		Transverse		-6.72	25.44	T3	Plots 6
WCDMA FDD II	Speechcodec Low	Axial	Pass	0.25	49.56	T4	Plot 7 & 8
		Transverse		-8.07	42.27	T4	Plots 9
WCDMA FDD V	Speechcodec Low	Axial	Pass	-0.33	45.49	T4	Plot 10 & 11
		Transverse		-8.81	38.31	T4	Plots 12

9. References

1. FCC 47 CFR 20 Article 19 – Hearing aid-compatible mobile handsets

2. FCC KDB 285076 D01 V04R01, Equipment Authorization Guidance for Hearing Aid Compatibility

3. FCC KDB 285076 D02 V02, Guidance for Performing T-Coil Tests for Air Interfaces Supporting Voice Over IP to support CMRS Based Telephone Services

4. ANSI C63.19-2011, American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids

5. Schmid & Partner Engineering AG, DASY5 Manual V52, April 2014

10. Report History

Date	Report Name – Changes to Report	Report prepared by
June 7, 2016	**HAC_INTEL_096_15001_TCoil** 1. First Version	J. Sabado
June 23, 2016	**HAC_INTEL_096_15001_TCoil_Rev1** 1. Updated according to TCB comments received June 13, 2016 2. Replaces previous test report number.	J. Donnellan