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Hearing Aid Compatibility
T-Coil Test Report

Model: RM-927
FCC ID: QMND
Intertek Report Number: 101237626LEX-002

Tested in accordance with:

ANSI C63.19-2011
FCC Rule Parts: §20.19(b), §6.3(v), §7.3(v)

Testing Performed By:	**Testing Authorized By:**
Intertek	Nokia
731 Enterprise Drive	16620 West Bernardo Drive
Lexington, KY 40510	San Diego, CA 92127

Prepared By: ______________________ **Date:** 8/19/13
Jason Centers, Senior Project Engineer

Approved By: ______________________ **Date:** 8/19/13
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SECTION 1: INTRODUCTION

The RM-927 was evaluated to the requirements for T-Coil audio band magnetic compliance testing defined in ANSI C63.19-2011. Testing was performed at the Intertek facility in Lexington, Kentucky.

For this evaluation, the SPEAG DASY52 HAC extension was used. This near-field measurement system is comprised of a high-precision robot, HAC Test Arch and Helmholtz coil, magnetic field probe (AM1D), EUT holder and DASY52 software with SEMCAD post-processor for generating test plots. The specially designed Test Arch allows a high precision positioning of the device.

This report demonstrates compliance for T-Coil HAC performance only and not near-field emissions.

SECTION 2: SUMMARY OF TEST RESULTS

This report contains data for the RM-927 in CDMA mode only. The minimum HAC T-Coil (“T”) ratings that were obtained for the RM-927 are summarized below:

Table 1: Summary of Test Results

Reference (C63.19-2011)	Description	Result
8.3.1	Axial Field Intensity	Pass
8.3.1	Radial Field Intensity	Pass
8.3.2	Frequency Response	Pass
8.3.4	Signal Quality	T4

Table 2: Summary of Signal Quality Classification

Mode	Minimum Limit (dB)				Minimum Result (dB)	Category Assessment
	T1	T2	T3	T4		
CDMA Cell	0	10	20	30	35.28	T4
CDMA PCS	0	10	20	30	45.28	T4

Table 3: Summary T-Coil Coupling Field Intensity

Mode	Field Component	Minimum Limit (dB A/m)	Minimum Measured (dB A/m)	Result
CDMA Cell	Axial (Z)	-18	-14.62	Pass
	Radial(Y)	-18	-11.60	Pass
CDMA PCS	Axial (Z)	-18	-5.02	Pass
	Radial(Y)	-18	-5.24	Pass

Table 4: Summary of HAC Rating for Device

Mode	RF Emissions Category at T-Coil Measurement Point	Category Assessment of T-Coil Signal Quality	Category Assessment
CDMA Cell	M4	T4	**M4/T4**
CDMA PCS	M4	T4	
T-Coil Measurement Points were not located in excluded grids in the RF Emissions scans. RF Near field emissions evaluation is provided in a separate report.			

SECTION 3: EQUIPMENT UNDER TEST

3.1 Test Sample Photographs

Photographs of the RM-927 can be found in a separate exhibit.

3.2 Test Sample Description

TEST SAMPLE			
NAME/MODEL	RM-927		
FCC ID	**QMND**		
MEID	355906050012334		
HW ID	0160		
SW VERSION	1028.0305.1329.2000		
SAMPLE TYPE	Prototype		
MODE(S) OF OPERATION	GSM, WCDMA, CDMA, LTE		
FREQUENCY RANGE	GSM 850 – 824.2 – 848.6 MHz GSM 1900 – 1850.2 – 1909.8 MHz WCDMA Band V – 826.4 – 846.6 MHz WCDMA Band V – 1852.4 – 1907.6 MHz CDMA Cell – 824.7 – 848.31 MHz CDMA PCS – 1851.2 – 1908.75 MHz LTE Band 4 – 1710-1750 MHz LTE Band 13 – 777-787 MHz		
ANTENNA DESCRIPTION			
TYPE	Internal fixed antenna		
TEST SAMPLE ACCESSORIES			
BATTERY TYPE	Internal Battery		
OTHER ACCESSORIES	None		
JOB DESCRIPTION			
MANUFACTURER Nokia, 16620 West Bernardo Drive, San Diego, CA, 92127			
CONTACT PERSON Victoria Abadilla	**PHONE** (858) 831-5000		**FAX** NA
EUT RECEIVE DATE 7/25/13	**TEST START DATE** 8/4/13		**TEST END DATE** 8/5/13
EUT CONDITION Good condition		**EUT TESTED BY** Jason Centers, Senior Project Engineer	

Table 5: Summary of Air Interfaces & Bands Supported

Air-Interface	Band (MHz)	Type Transport	HAC Tested	Simultaneous Transmissions But Not Tested	Voice Over Digital Transport OTT Capability	WIFI Low Power	Additional GSM Power Reduction
GSM	850	VO	Yes	Yes BT,WLAN,LTE	NA	NA	NA
	1900	VO	Yes		NA		
	GPRS/EDGE	DT	No	Yes BT,WLAN,LTE	Yes	NA	
WCDMA	850	VO/DT	Yes	Yes BT,WLAN,LTE	Yes	NA	NA
	1900	VO/DT	Yes		Yes		
CDMA	800	VO	Yes	Yes BT,WLAN,LTE	NA	NA	NA
	1900	VO	Yes		NA		
	EVDO	DT	No		Yes		
LTE	700 (Band 13)	DT	No	Yes BT, WLAN,CDMA	Yes	No	NA
LTE	1700 (Band 4)	DT	No	Yes BT, WLAN,GSM, CDMA	Yes	No	NA
BT	2450	DT	No	Yes GSM, GPRS/EDGE, WCDMA, LTE	NA	NA	NA
WLAN	2450	DT	No	Yes GSM, GPRS/EDGE, WCDMA, LTE	Yes	No	NA
WLAN	5GHz Bands	DT	No	Yes GSM, GPRS/EDGE, WCDMA, LTE	Yes	No	NA

Type of Transport
VO = Voice Only
DT = Digital Data Transport
VD = CMRS and Data Transport

Note: this report only contains data for CDMA modes.

3.3 Sample Modification

No modifications were made to the test sample during this evaluation.

SECTION 4: TEST SITE DESCRIPTION

The Intertek HAC test site is located at 731 Enterprise Drive, Lexington, KY 40510, USA.

The HAC T-Coil Setup is comprised of the SPEAG DASY 52 Hearing Aid Compatibility extension, which is used to perform the audio band magnetic performance tests in accordance with ANSI C63.19.

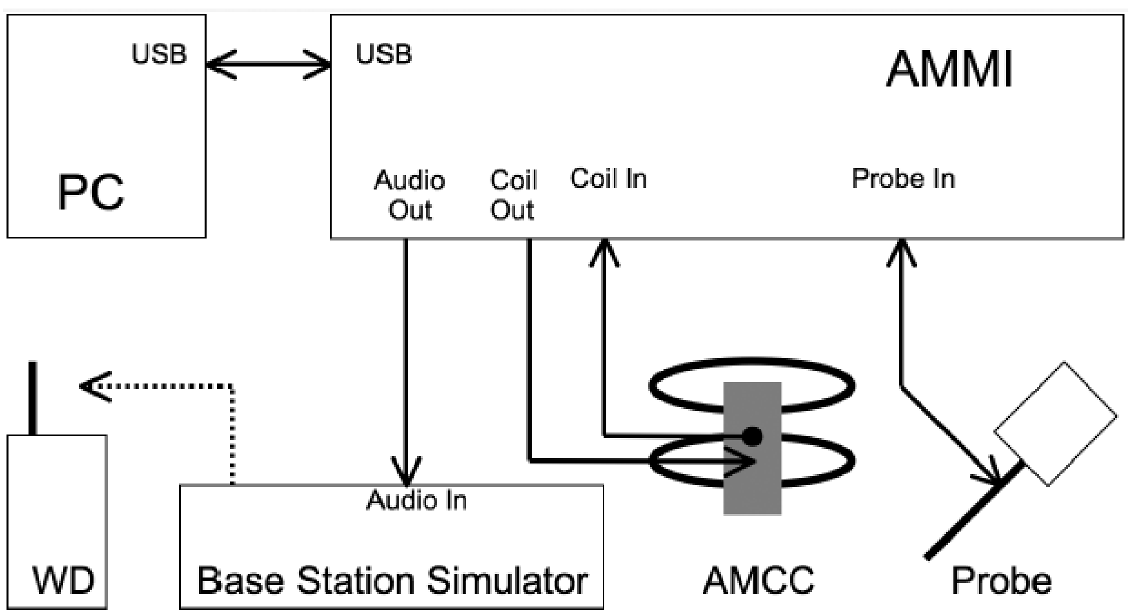
This system is installed in a shielded chamber. During each day of testing, the ambient temperature was verified to be 22.0 $\pm 2^{O}$C.

Figure 1: Intertek HAC T-Coil Test Site

4.1 Description of the Test Equipment

The measurements were performed using an automated near-field scanning system, DASY52 manufactured by Schmid and Partner AG (SPEAG) in Switzerland.

Figure 2: Diagram of T-Coil Measurement Setup



AMMI (Audio Magnetic Measurement Instrument) is a desktop unit containing a sampling unit, a waveform generator for test, calibration signals and a USB interface. Front connectors include: Audio Out – predefined or user definable audio signals for injection into the WD; Probe In – the probe signal is evaluated by AMMI; Coil Out – test and calibration signal to the AMCC; Coil In – monitor signal from the AMCC

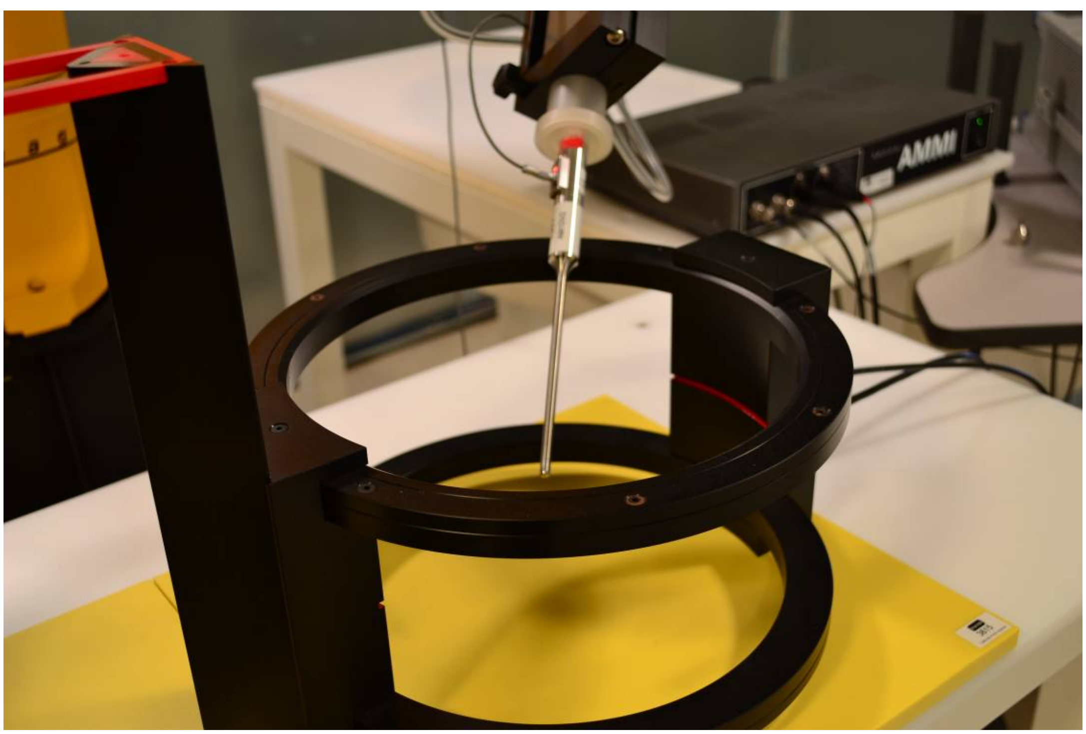
Figure 3: Photographs of AMMI

Audio Magnetic Probe (AM1DV2) is an active probe with a single sensor. The probe is fully RF shielded. The same probe coil is used to measure three orthogonal field components (axial, radial x, radial y). The probe is rotated to properly orient the coil for each field component.

Figure 4: AM1D Probe with probe cable

AMCC (Audio Magnetic Calibration Coil) is a Helmholtz coil for calibration of the AM1D probe. The two horizontal coils create a homogeneous magnetic field in the z direction. The coil is ANSI C63.19 compliant.

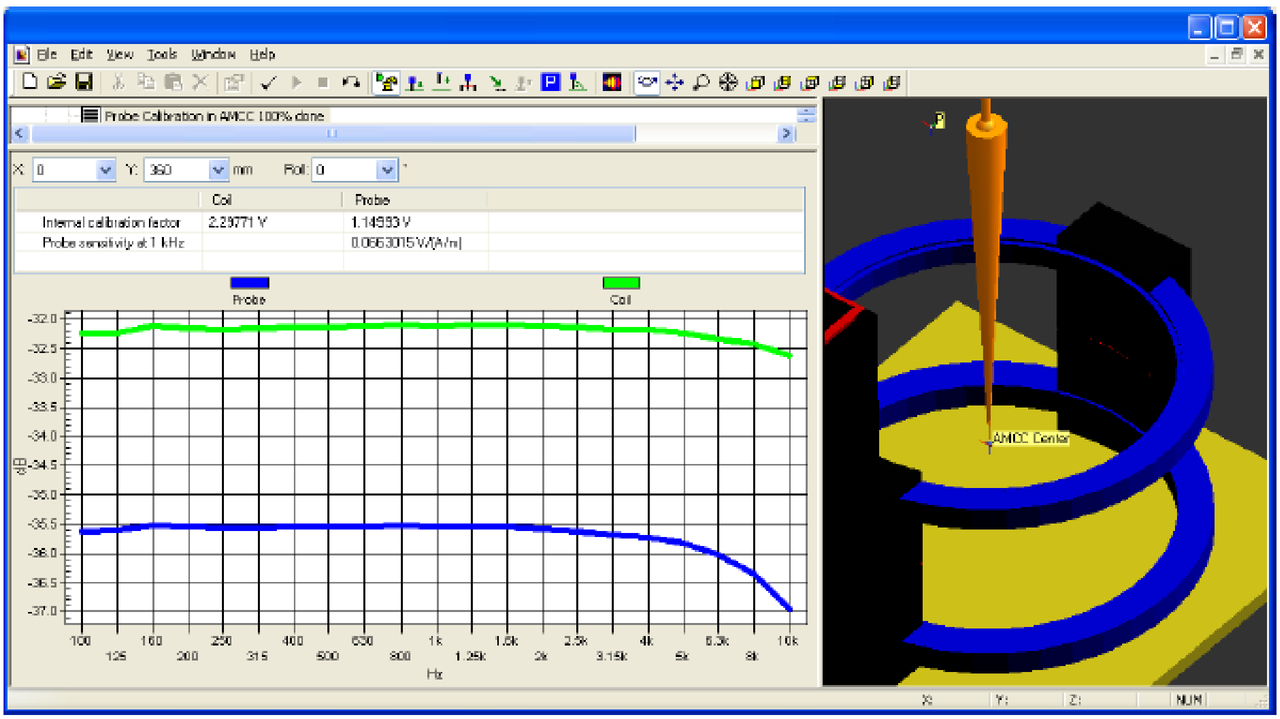
Figure 5: AMCC



4.2 Verification of the System

The Audio Magnetic Probe AM1D is calibrated in the AMCC Helmholtz Audio Magnetic Calibration Coil before each measurement procedure using calibration and reference signals. The frequency response and sensitivity are measured and stored. The sensitivity is for a 1kHz sine signal. The sensitivity includes both probe sensitivity and pre-amplifier sensitivity. The evaluated probe sensitivity was compared to the calibration of the AM1D probe.

Figure 6: Frequency Response and Sensitivity measured in AMCC



The R&S CMU200 base station audio codec and SPEAG AMMI audio paths (gain) were calibrated according to the manufacture instructions and described in Section 5.

4.3 Test Signals

Narrowband voice-like signals are used during the scans to determine the optimum location for the T-Coil assessment. A broadband voice-like signal (300 Hz – 3kHz) is used for the frequency response measurements. These signals are calibrated by the system in AMCC prior to starting a measurement procedure. The DASY52 software compensates for the spectral response of these signals.

Figure 7: Audio Signal Spectrum of the Narrowband Signal

	Signal (File 48k_voice_1kHz_1s.wav)	Noise	Coil signal	Coil noise
ABM	0.174567 dB A/m	-56.9262 dB A/m		
Peak	-7.38562 dB V	-57.998 dB V	-4.00569 dB V	-76.2446 dB V
RMS	-23.1739 dB V	-70.0197 dB V	-19.8179 dB V	-89.5859 dB V

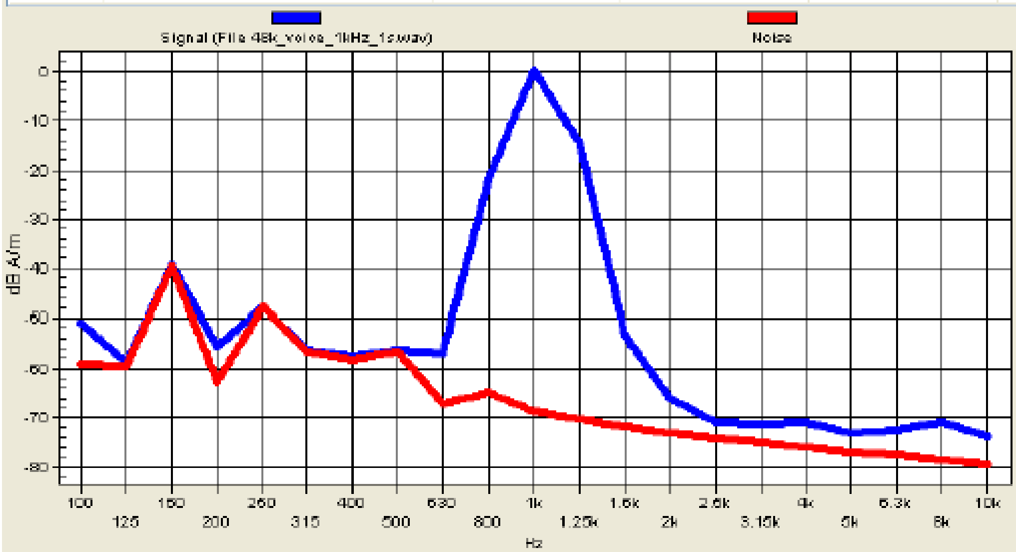
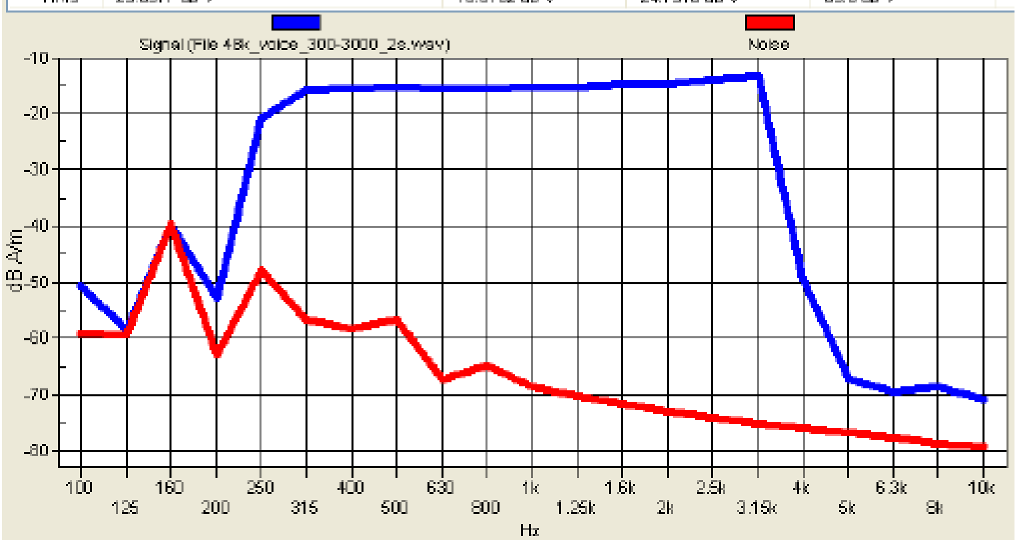


Figure 8: Audio Signal Spectrum of the Broadband Signal

	Signal (File 48k_voice_300-3000_2s.wav)	Noise	Coil signal	Coil noise
ABM	-15.4015 dB A/m	-56.9512 dB A/m		
Peak	-1.36333 dB V	-57.6443 dB V	-3.17397 dB V	-76.4804 dB V
RMS	-23.6377 dB V	-70.0102 dB V	-24.7518 dB V	-89.6 dB V



SECTION 5: MEASUREMENT PROCEDURES

5.1 Wireless Device – Positioning and Call Setup

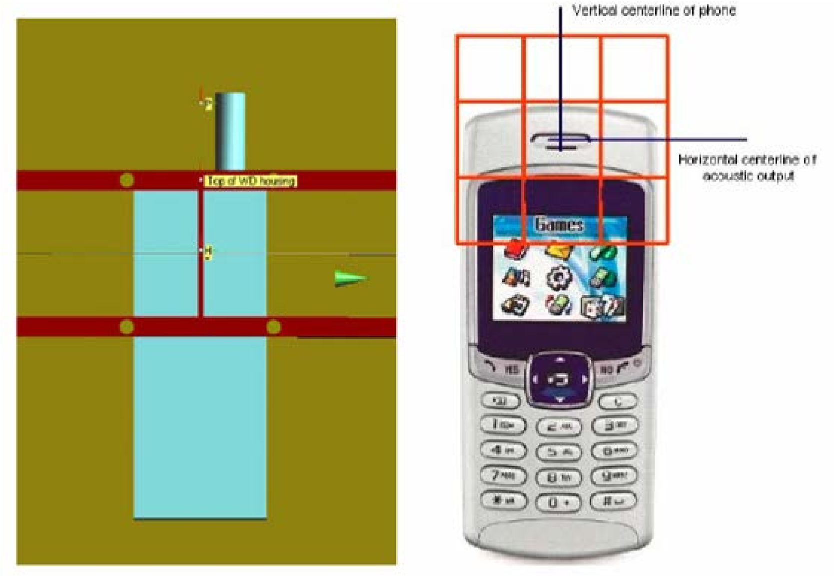
5.1.1 Device Positioning

a. The DASY52 HAC RF test arch was installed on the phantom cover.
b. The correct position of the test arch was verified by moving the free-space probe to its 4 reference points using the DASY52 software. If any variations were seen, the reference points were re-taught.
c. The wireless device was mounted in the device holder shown in Figure 9.

Figure 9: Device Holder

d. The wireless device was then centered under the test arch as shown in Figure 10. The acoustic output of the WD coincided with the center point of the area formed by the dielectric wire and the middle bar of the arch's top frame.

Figure 10: Centering the WD under the Test Arch



e. The reference plane of the wireless device was then positioned as follows: After the phone was centered, it was adjusted until the reference plane was parallel to, and touching the bottom of the test arch. The reference plane is the planar area that contains the highest point in the area of the WD that normally rests against the user's ear. The measurement plane is 10 mm parallel to, and above the reference plane, and contains the nearest point on the probe sensor per ANSI C63.19-2011.

5.2 Audio Signal Level Setting

According to ANSI C63.19:2011, the normal speech input level for HAC T-coil tests shall be set to -16dBm0 for GSM and UMTS (WCDMA) and -18dBm0 for CDMA.

The required speech input levels were determined as follows using a CMU200 base station and a DASY52 T-Coil measurement job:

Calculate the internal reference level of the CMU200 (in dBm0)
a. Perform the internal calibration sequence of the AMMI. After the calibration, the Coil In port can be used as a calibrated audio voltmeter.
b. Select “Decoder Cal” to obtain 1kHz signal from internal generator with a level of 3.14 dBm0.
c. Run a T-Coil measurement job to read the RMS voltage level corresponding to 3.14 dBm0.
d. Calculate the desired signal levels of -16dBm0 or -18dBm0.

Determine the 1kHz Gain level to generate the desired signal level of -16dBm0 or -18dBm0
a. Select “Encoder Cal” with the WD in a call.
b. Run a measurement job with a 1kHz sine signal applied at a gain level of 10.
c. Record the RMS voltage level.
d. Using the measured level, calculate the required gain setting for the desired level.
e. Run the measurement job again with this gain level and verify the result.

Calculate and Verify the Gain levels for the signals to be used during the test
a. Select Handset Low with the WD in a voice call.
b. Run a measurement job with selected signal at an estimated gain level.
c. Measure level and compaire to the desired level of -16dBm0 or -18dBm0.
d. Adjust gain and repeat until the desired level is measured.

The gain determined for each signal to achieve a speech level -16dBm0 or -18dBm0 will be used during the t-coil measurements.

5.3 Wireless Device (WD) Setup & Call Procedure

a. A fully charged battery was installed in the phone.
b. The backlight was turned on and the contrast setting was adjusted to maximum unless otherwise noted in this report.
c. The WD was placed into a call using a base station simulator.
d. The microphone was muted and the audio volume was set to maximum.
e. The WD was configured for normal operation at maximum rated output power. The device was tested in a voice call. In CDMA mode, the device was tested in RC1/SO3 mode. Speech coding was processed with EFR speech codec for GSM and with AMR 12.2kbps for WCDMA.
f. Unless otherwise noted, the Bluetooth and WLAN radios were disabled.

5.4 T-Coil Measurement Test Procedure

5.4.1 T-Coil Scans

The following explains a typical test procedure for a device:

a. The geometry and reference signals are checked. The probe is aligned.
b. A surface calibration was performed before each setup change to ensure repeatable spacing and proper maintenance of the measurement plane using the test arch.
c. The reference drive level of voice signal defined in C63.19 per 7.4.2.1 was calibrated as described in previous section. Gain levels for signals used were determined and entered into the measurement software.
d. The ambient 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 category limit of C63.19 per 7.3.1. Background noise is shown in Table 9 and noise spectrum plots are shown at this end of this report.
e. The DUT was positioned under the test arch centered on the acoustic output point of the device.
f. The device was placed in a call. In each operating band, a measurement of ABM2 was made at the low, middle, and high channels to determine the worse case channel. The channel with the highest ABM2 measurement was selected to perform a scan to find the optimal measurement points.
g. The optimal measurement points were selected from the scan based on the signal quality measurement. At each measurement locations, samples in the measurement window duration were evaluated to get ABM1. The noise measurement was performed after the scan with the signal removed. The ABM2 was calculated from this second scan. Scans were performed over a 50 x 50 mm grid with a 1kHz voice like signal for the ABM1 measurement.
h. A point measurement for ABM1 and ABM2 in axial and radial y was made at a point based on optimal SNR of the scan. The SNR was calculated for axial and radial y orientation.
i. A point measurement for frequency response (300Hz to 3 kHz signal) was made in the axial orientation. The position was selected based on optimal SNR of the axial scan.
j. At an optimal point measurement, the SNR (ABM1/ABM2) was calculated for axial and radial y orientation, and the frequency response was measured in axial axis.
k. In SEMCAD post-processing, the spectral points are 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.
l. The signal quality was classified based on the values listed in Table 7.
m. Measurements at the two remaining channels were made at the same location as the channel that was scanned. A scan was only performed again if it were necessary to obtain a better classification.

SECTION 6: ANSI C63.19-2011 REQUIREMENTS

T-Coil measurements were taken by following the procedures outlined below. A complete evaluation was performed per the guidelines provided by ANSI C63.19-2011.

6.1 ANSI Near-Field Categories

The procedures outlined in ANSI C63.19 for measuring near-field RF Emissions from a wireless device (WD) were followed. The test criteria (categories) to be met are stated in Table 8-3 of ANSI C63.19-2011 (see Table 6, below). This table was used to assign the wireless device's "M" rating.

Table 6: ANSI Near-Field Categories in Linear Units

Emission categories	**<960 MHz**	
	E-field emissions	
Category M1	50 to 55	dB (V/m)
Category M2	45 to 50	dB (V/m)
Category M3	40 to 45	dB (V/m)
Category M4	<40	dB (V/m)

Emission categories	**>960 MHz**	
	E-field emissions	
Category M1	40 to 45	dB (V/m)
Category M2	35 to 40	dB (V/m)
Category M3	30 to 35	dB (V/m)
Category M4	<30	dB (V/m)

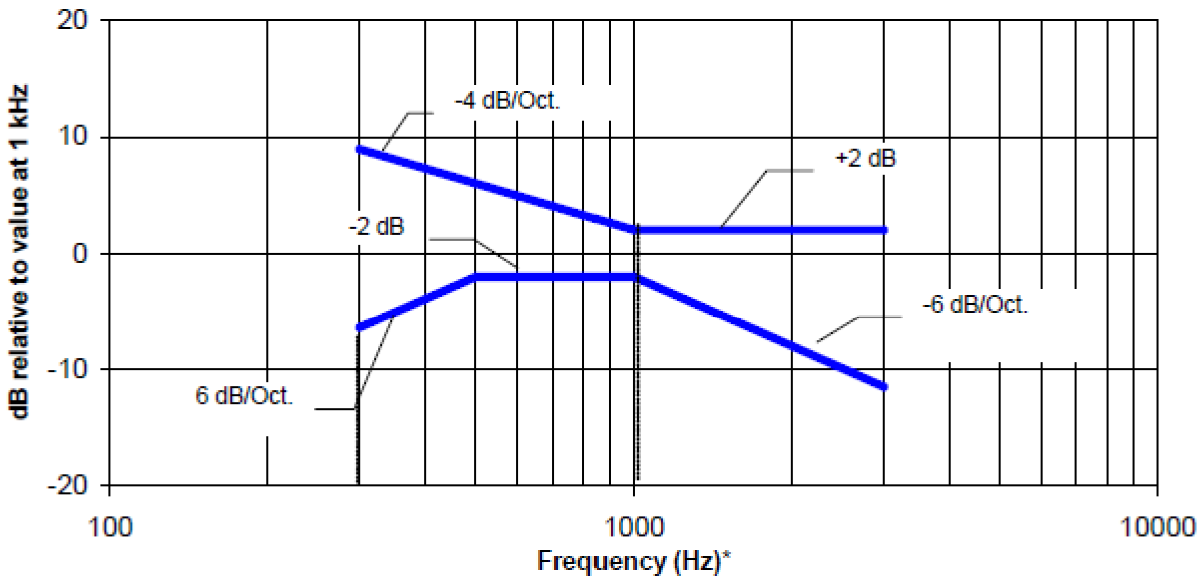
6.2 Axial and Radial Field Intensity

All orientations of the magnetic field, in the axial and radial orientation (y) along in the measurement plane shall be ≥ -18 dB(A/m) at 1kHz in 1/3 octave band filter per 8.3.1.

6.3 Frequency Response

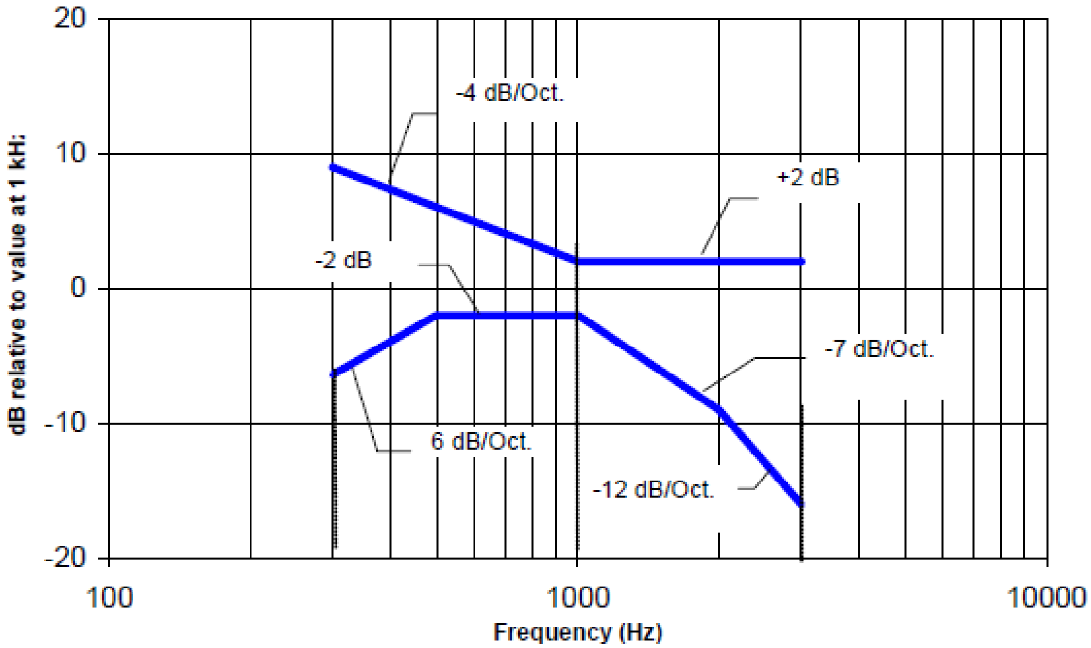
The frequency response over the range of 300 Hz – 3 kHz of the axial component of the magnetic field must be within the limits show in response curves below per 8.3.2.

Figure 11: Magnetic Field Frequency Response for WD with an Axial Field ≤ -15 dB (A/m) at 1 kHz



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

Figure 12: Magnetic Field Frequency Response for WD with an Axial Field > -15 dB (A/m) at 1 kHz



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

6.4 Signal Quality

The table below provides the signal quality requirement for the intended audio magnetic signal from the 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 signal quality of the axial and radial component of the magnetic field was used to determine the T-coil mode category.

Table 7: T-Coil Signal Quality Categories

Category	Telephone Parameters WD 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

SECTION 7: TABULAR OUTPUT POWER TEST DATA

7.1 Conducted Output Power

The conducted output power of the RM-927 was measured and summarized in Table 8. Conducted power measurements were taken with a base station simulator. Cable loss was accounted for within the test set by offsetting the readings by the appropriate amounts. Readings were taken at the RF port that was present on the RM-927.

Table 8: Conducted Output Power – CDMA

Band	Channel	Frequency (MHz)	RC1/SO2	RC3/SO55	RC1/SO3
Cellular	1013	824.7	25.08	25.11	25.1
	384	836.52	25.11	25.11	25.1
	777	848.31	25.1	25.1	25.08
PCS	25	1851.25	25.05	25.09	25.01
	600	1880	24.96	24.94	24.96
	1175	1908.75	25.1	25.09	24.98

SECTION 8: T-COIL TABULAR TEST DATA

The results in the tables below summarize the data obtained when the device was tested in the operating conditions described previously. Detailed measurement data and plots are shown in Section 13: of this report for the worse case measurement channels in each band. Frequency response plots for the axial position are shown in Figure 13 through Figure 18.

Table 9: T-Coil Test Data

T-Coil Measurement Results									
Band	Channel	Probe Position	Measured Point Coordinates (x mm, y mm)	Frequency Response Margin (dB)	Ambient Noise (dB A/m)	ABM2 (dB A/m)	ABM1 (dB A/m)	SNR (dB)	T-Rating
CDMA Cell	1013	Axial	4.2, -4.2	0.98	-57.56	-51.47	-5.74	45.73	T4
		Radial (Y)	4.2, -12.5		-51.54	-48.17	-11.6	36.57	T4
CDMA Cell	384	Axial	0, -4.2	0.42	-57.56	-52.67	0.86	53.53	T4
		Radial (Y)	4.2, -12.5		-51.54	-49.52	-4.03	45.49	T4
CDMA Cell	777	Axial	0, 4.2	1.20	-57.56	-49.9	-14.62	35.28	T4
		Radial (Y)	4.2, 0		-51.54	-44.49	-3.98	40.51	T4
CDMA PCS	25	Axial	4.2, -4.2	0.27	-57.56	-50.04	2.22	52.26	T4
		Radial (Y)	0, -16.7		-51.54	-50.67	-5.24	45.43	T4
CDMA PCS	600	Axial	4.2, -4.2	0.16	-57.56	-50.37	2.47	52.84	T4
		Radial (Y)	4.2, -16.7		-51.54	-50.66	-3.67	46.99	T4
CDMA PCS	1175	Axial	0, 0	0.21	-57.56	-50.3	-5.02	45.28	T4
		Radial (Y)	4.2, -16.7		-51.54	-50.08	-3.51	46.57	T4

Note: Backlight On, Volume = Max, Microphone muted, BT Off, WLAN Off.

Figure 13: Frequency Response CDMA Cell – Channel 1013

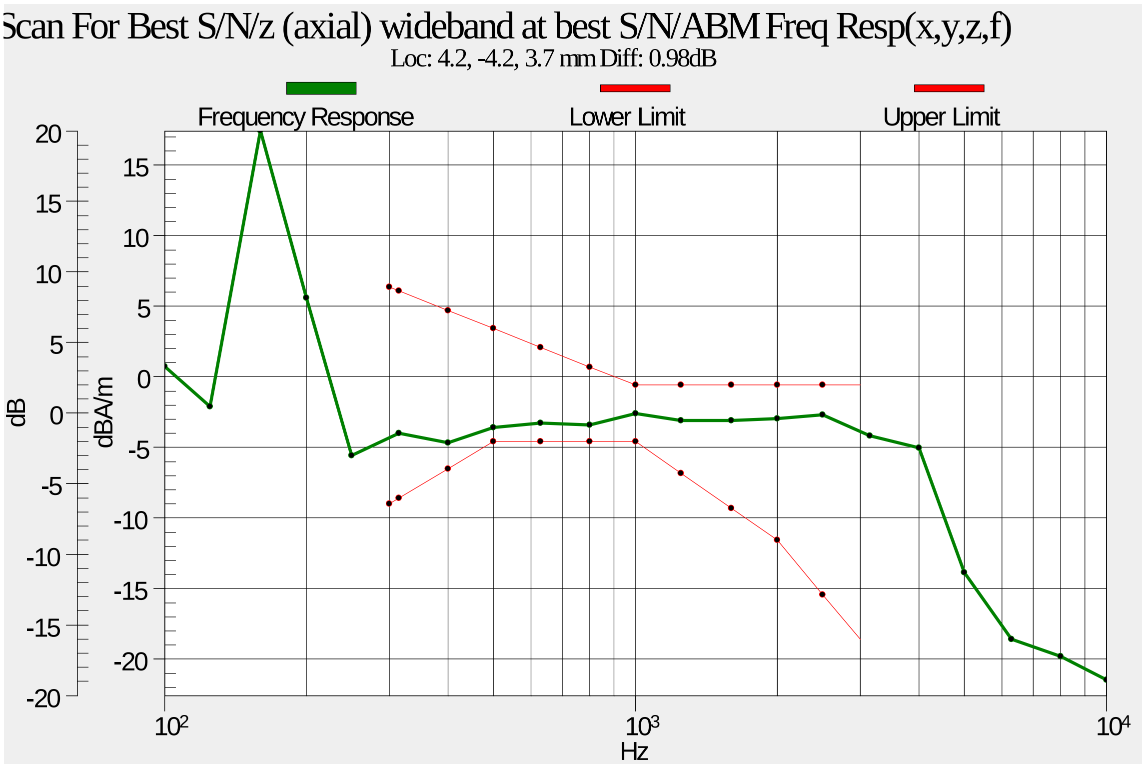


Figure 14: Frequency Response CDMA Cell – Channel 384

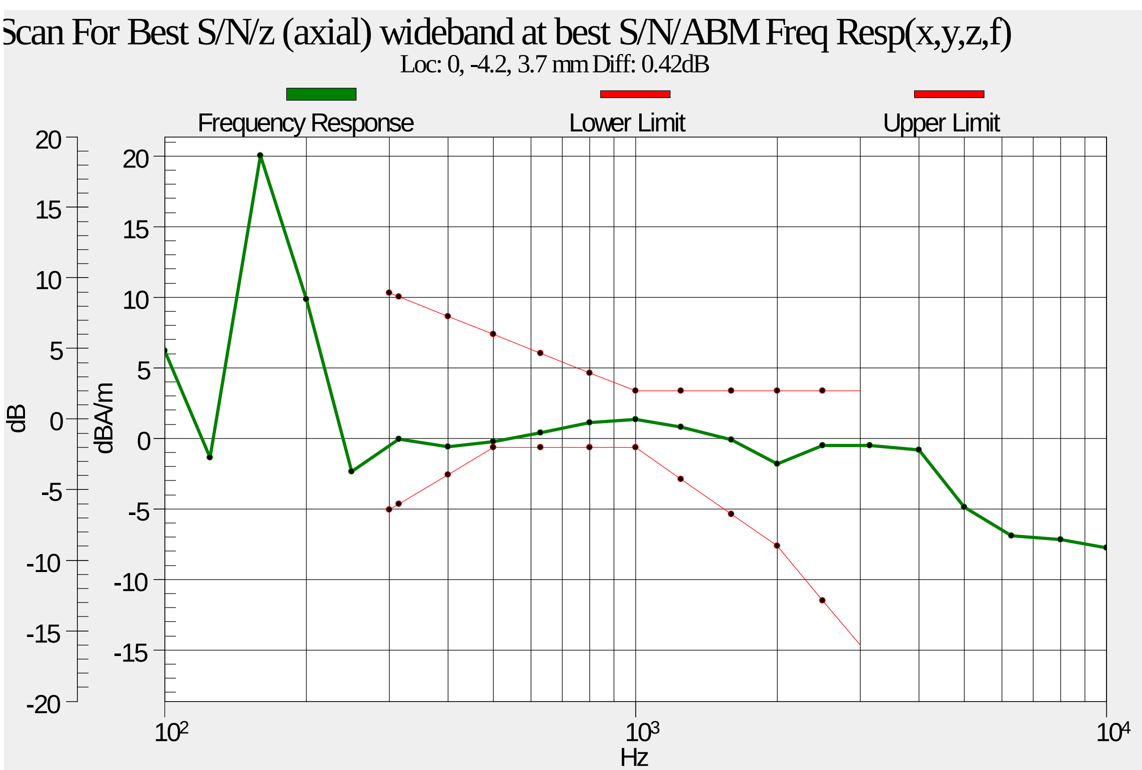


Figure 15: Frequency Response CDMA Cell – Channel 777

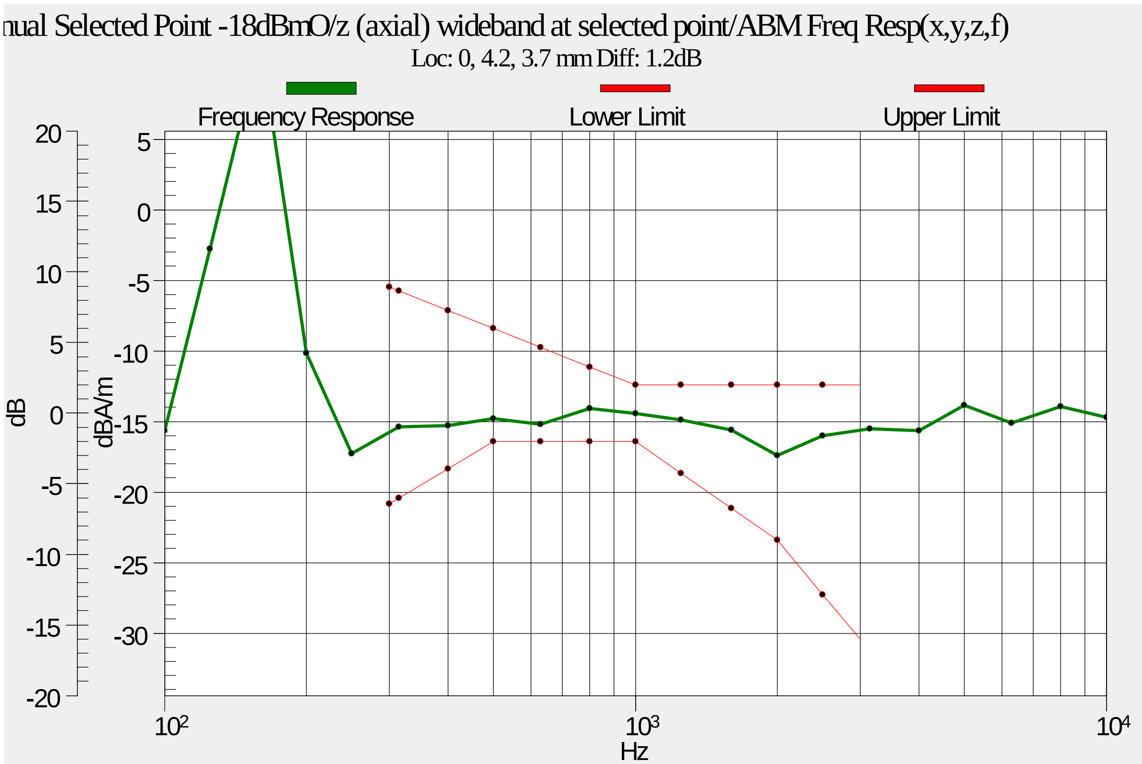


Figure 16: Frequency Response CDMA PCS – Channel 25

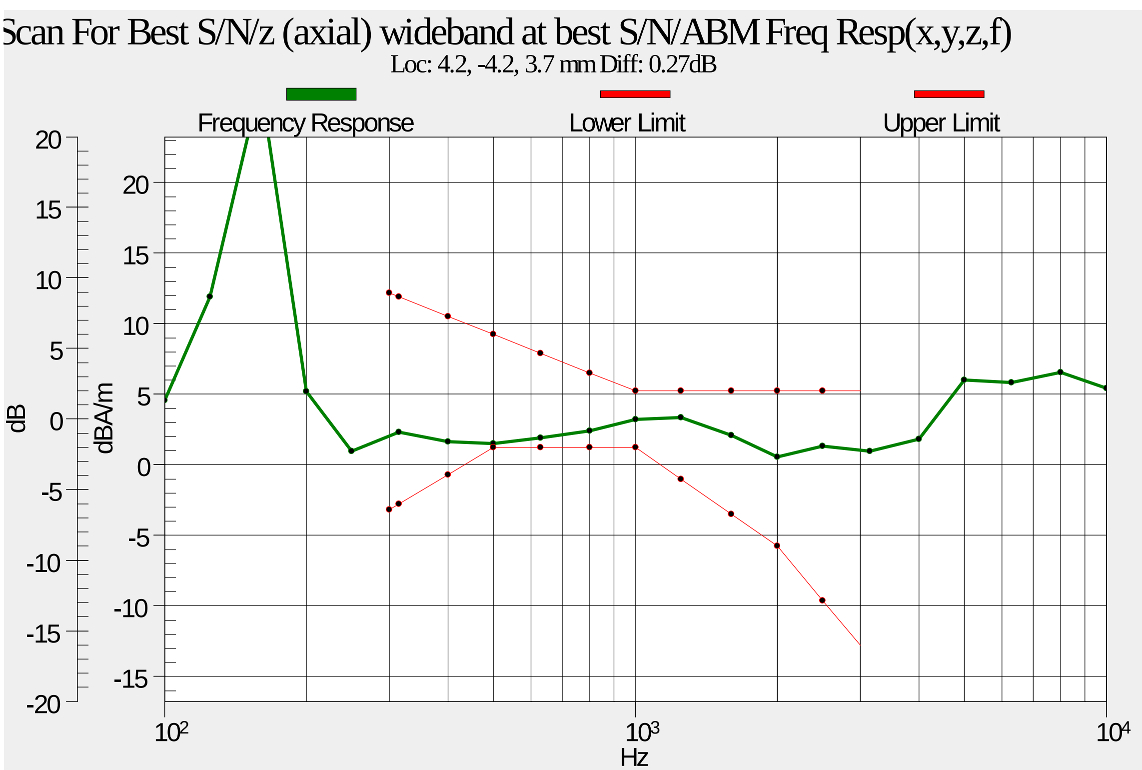


Figure 17: Frequency Response CDMA PCS – Channel 600

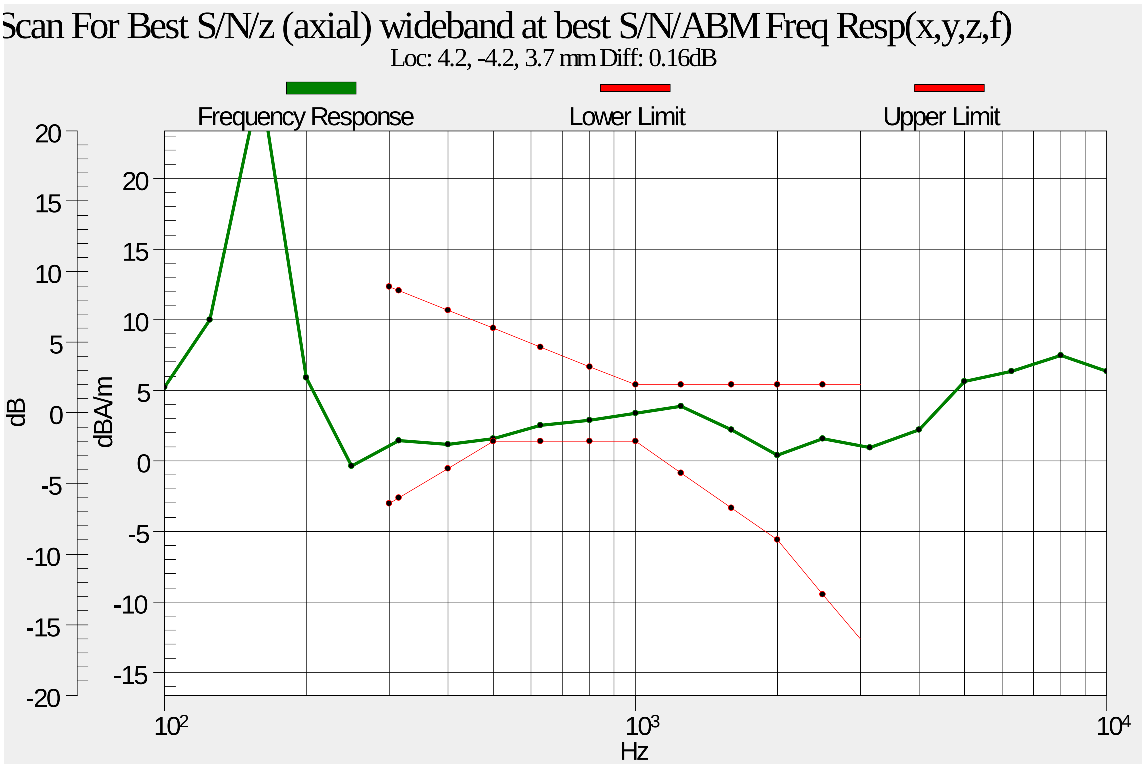
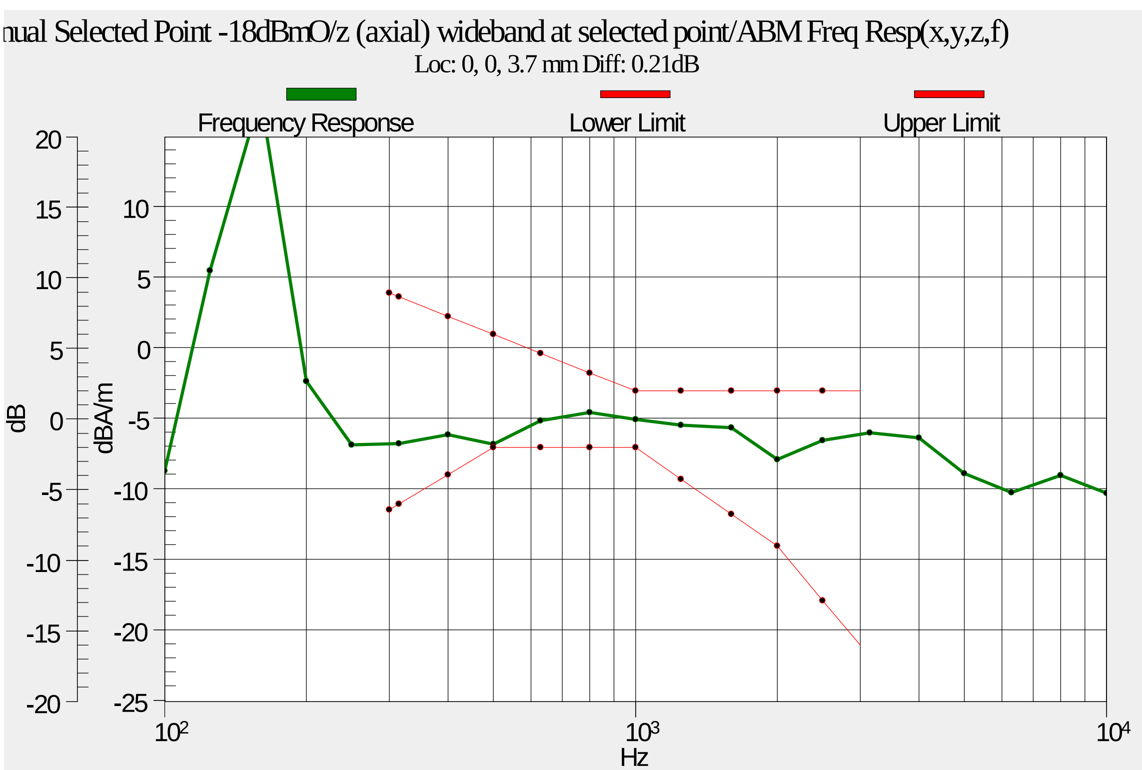


Figure 18: Frequency Response CDMA PCS – Channel 1175



SECTION 9: TEST EQUIPMENT

The following major equipment/components were used for the HAC RF evaluation:

9.1 HAC RF Measurement System

Table 10: HAC Measurement Equipment

Model	Manufacturer	Type of Equipment	Serial Number	Calibration Date	Calibration Due
RX-90	Stäubli	Robot	F11/5H1YA/A/01	N/A	N/A
AM1DV2	SPEAG	Shielded T-Coil Probe	1047	9/20/2012	9/20/2013
DAE4	SPEAG	Data Acquisition Electronics	258	9/11/2012	9/11/2013
SE UMS 010 AC	SPEAG	AMMI	1043	N/A	N/A
SD HC P01BA	SPEAG	HAC RF Test Arch	1046	N/A	N/A
SD HAC P02 AB	SPEAG	AMCC Helmholtz Calibration Coil	1041	N/A	N/A

9.2 Support Equipment

Table 11: Test Support Equipment

Model	Manufacturer	Type of Equipment	Serial Number	Calibration Date	Calibration Due
CMU200	Rohde and Schwarz	Wireless Communications Test Set	119978	9/17/2012	9/17/2013
ZHL-4240	Mini-Circuits	Amplifier	012012	N/A	N/A
SMBV100A	Rohde & Schwarz	Vector Signal Generator	257708	5/30/2013	5/30/2014
8651A	Gigatronics	Power Meter	8650456	7/18/2013	7/18/2014
80701A	Gigatronics	Power Sensor	1834169	7/18/2013	7/18/2014
NRP-Z51	Rohde and Schwarz	Thermal Power Sensor	100705	9/14/2012	9/14/2013

SECTION 10: MEASUREMENT UNCERTAINTY

10.1 Equipment Uncertainty

Table 12 shows the uncertainty budget provided by SPEAG for the HAC RF extension. The budget is valid for the frequency range 800 MHz – 3 GHz and represents a worst-case analysis.

Table 12: SPEAG HAC Uncertainty Budget

Error Description	Uncertainty Value	Prob. Dist.	Div.	(c_i) ABM1	(c_i) 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	0.145	±0.6%	±0.6%
Probe Positioning during Calibration	±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 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 Standard Uncertainty						±4.1%	±6.1%
Expanded Std. Uncertainty						±8.1%	±12.3%

SECTION 11: DOCUMENT HISTORY

Revision/ Project Number	Writer Initials	Date	Change
1.0 /G101237626	JC	8/19/13	Original document

SECTION 12: REFERENCES

[1] *ANSI/IEEE C63.19-2011: American National Standard Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids.*

[2] *SPEAG DASY5 V5.2 User Manual, August 2010*

SECTION 13: HAC T-COIL TEST PLOTS

Date/Time: 8/4/2013 2:58:27 PM

Test Laboratory: Intertek
File Name: HAC-T-Coil-CDMA Cell Band Channel 1013.da52:0

HAC-T-Coil-CDMA Cell Band Channel 1013

DUT: Nokia RM-927; Serial: 355906050012334

Communication System: Generic CDMA RC1_SO3; Communication System Band: Cell Band; Frequency: 824.7 MHz;Duty Cycle: 1:8.01678

Medium parameters used: σ = 0 S/m, ε_r = 1; ρ = 0 kg/m^3

Phantom section: TCoil Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

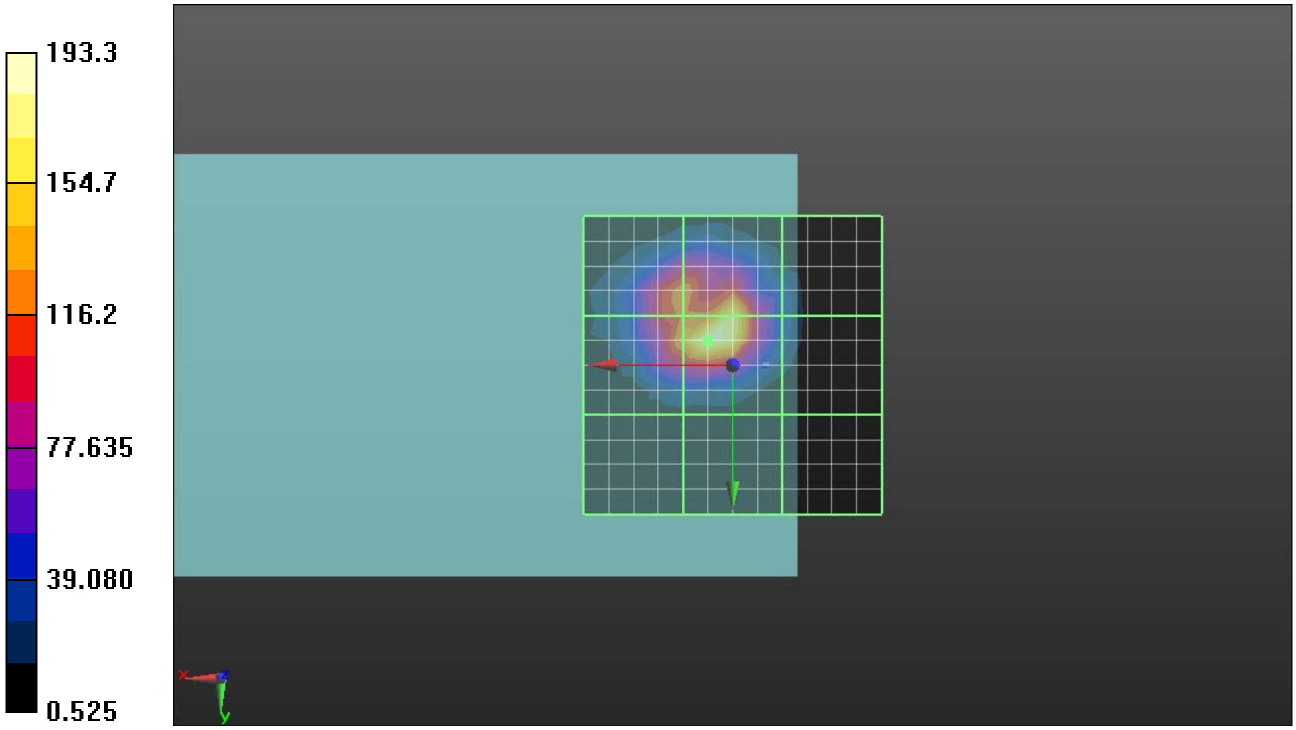
DASY5 Configuration:

- Probe: AM1DV2 - 1047; ; Calibrated: 9/20/2012
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn358; Calibrated: 9/11/2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.8(7028)

T-Coil scan (scan for ANSI C63.19-2007 & 2011 compliance)/Scan For Best S/N/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 32.8
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

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

Cursor:
ABM1/ABM2 = 45.73 dB
ABM1 comp = -5.74 dBA/m
BWC Factor = 0.15 dB
Location: 4.2, -4.2, 3.7 mm



Date/Time: 8/4/2013 3:14:20 PM

Test Laboratory: Intertek
File Name: HAC-T-Coil-CDMA Cell Band Channel 1013.da52:0

HAC-T-Coil-CDMA Cell Band Channel 1013

DUT: Nokia RM-927; Serial: 355906050012334

Communication System: Generic CDMA RC1_SO3; Communication System Band: Cell Band; Frequency: 824.7 MHz;Duty Cycle: 1:8.01678

Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Phantom section: TCoil Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

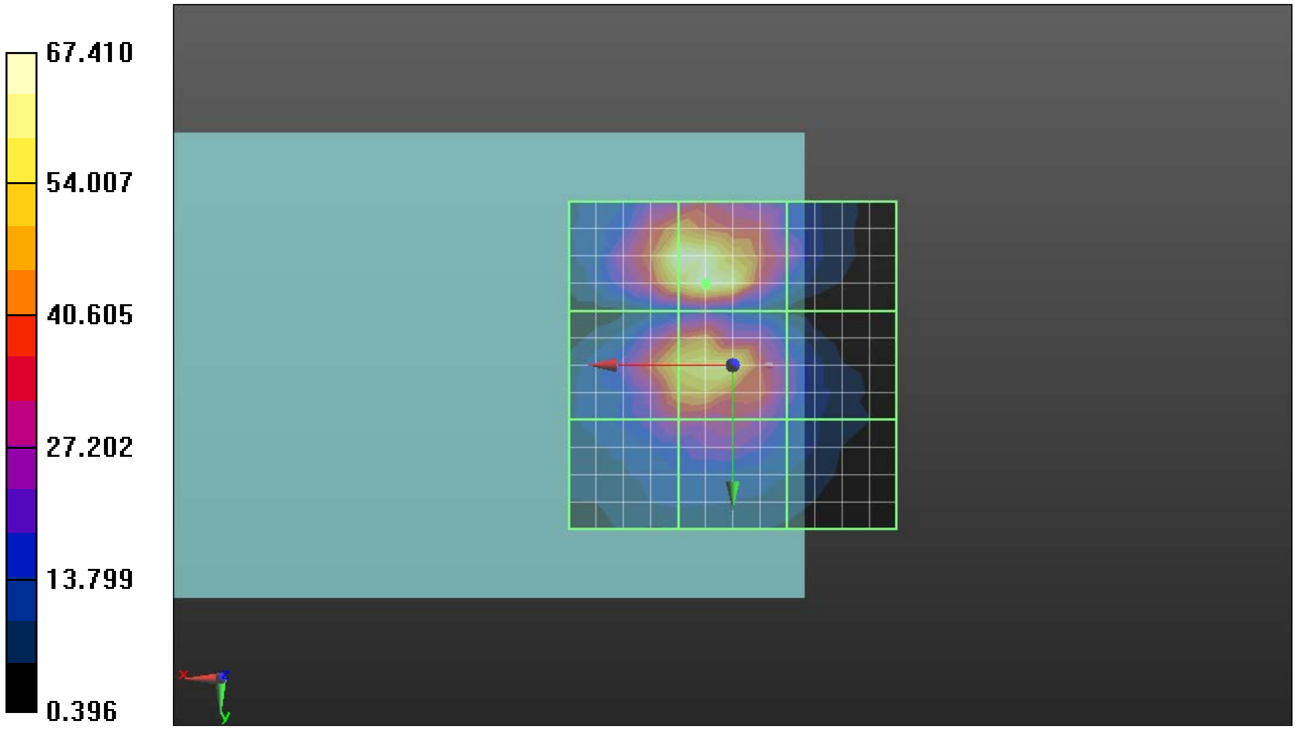
DASY5 Configuration:

- Probe: AM1DV2 - 1047; ; Calibrated: 9/20/2012
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn358; Calibrated: 9/11/2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.8(7028)

T-Coil scan (scan for ANSI C63.19-2007 & 2011 compliance)/Scan For Best S/N/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 32.8
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

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

Cursor:
ABM1/ABM2 = 36.57 dB
ABM1 comp = -11.60 dBA/m
BWC Factor = 0.15 dB
Location: 4.2, -12.5, 3.7 mm



Date/Time: 8/5/2013 3:12:57 PM

Test Laboratory: Intertek
File Name: HAC-T-Coil-CDMA PCS Band Channel 1175.da52:0

HAC-T-Coil-CDMA PCS Band Channel 1175

DUT: Nokia RM-927; Serial: 355906050012334

Communication System: Generic CDMA RC1_SO3 (0); Communication System Band: PCS Band; Frequency: 1908.75 MHz;Duty Cycle: 1:8.01678

Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Phantom section: TCoil Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

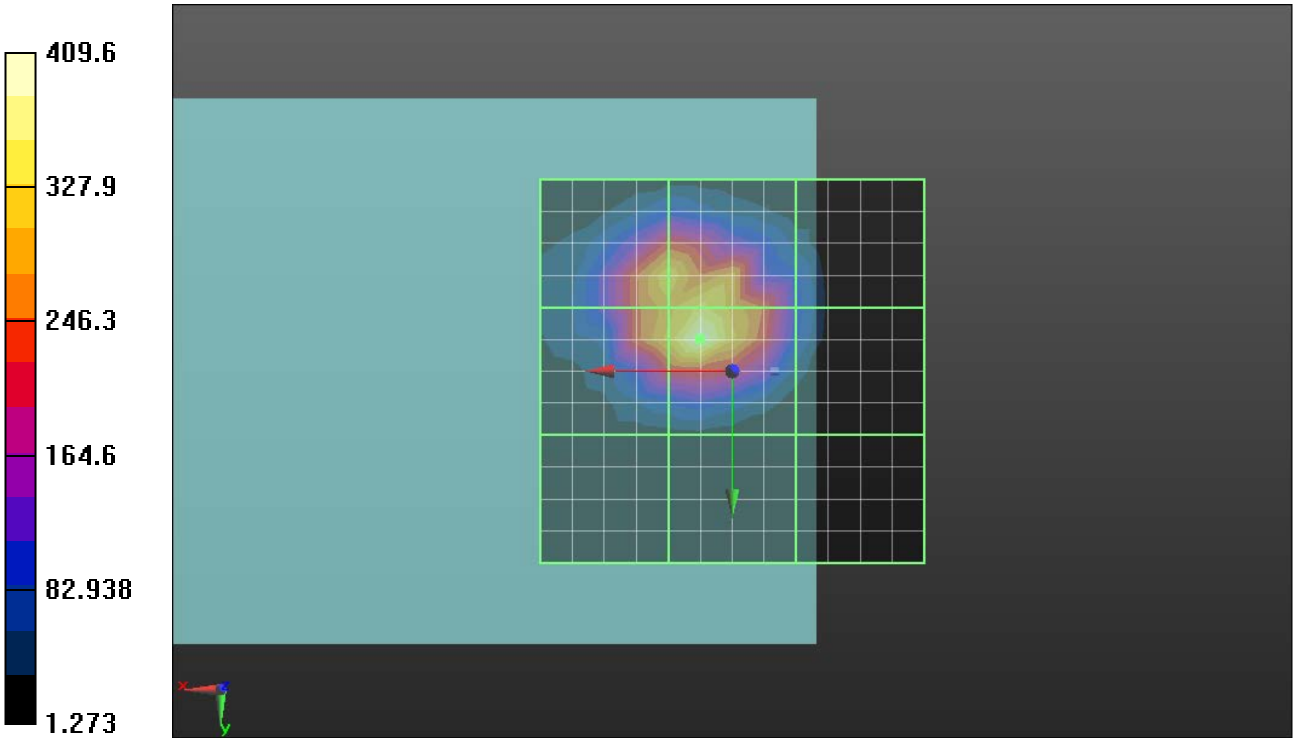
DASY5 Configuration:

- Probe: AM1DV2 - 1047; ; Calibrated: 9/20/2012
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn358; Calibrated: 9/11/2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.8(7028)

T-Coil scan (scan for ANSI C63.19-2007 & 2011 compliance)/Scan For Best S/N/z (axial) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 32.8
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

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

Cursor:
ABM1/ABM2 = 52.25 dB
ABM1 comp = 2.46 dBA/m
BWC Factor = 0.15 dB
Location: 4.2, -4.2, 3.7 mm



Date/Time: 8/5/2013 3:28:51 PM

Test Laboratory: Intertek
File Name: HAC-T-Coil-CDMA PCS Band Channel 1175.da52:0

HAC-T-Coil-CDMA PCS Band Channel 1175

DUT: Nokia RM-927; Serial: 355906050012334

Communication System: Generic CDMA RC1_SO3 (0); Communication System Band: PCS Band; Frequency: 1908.75 MHz;Duty Cycle: 1:8.01678

Medium parameters used: $\sigma = 0$ S/m, $\varepsilon_r = 1$; $\rho = 0$ kg/m^3

Phantom section: TCoil Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

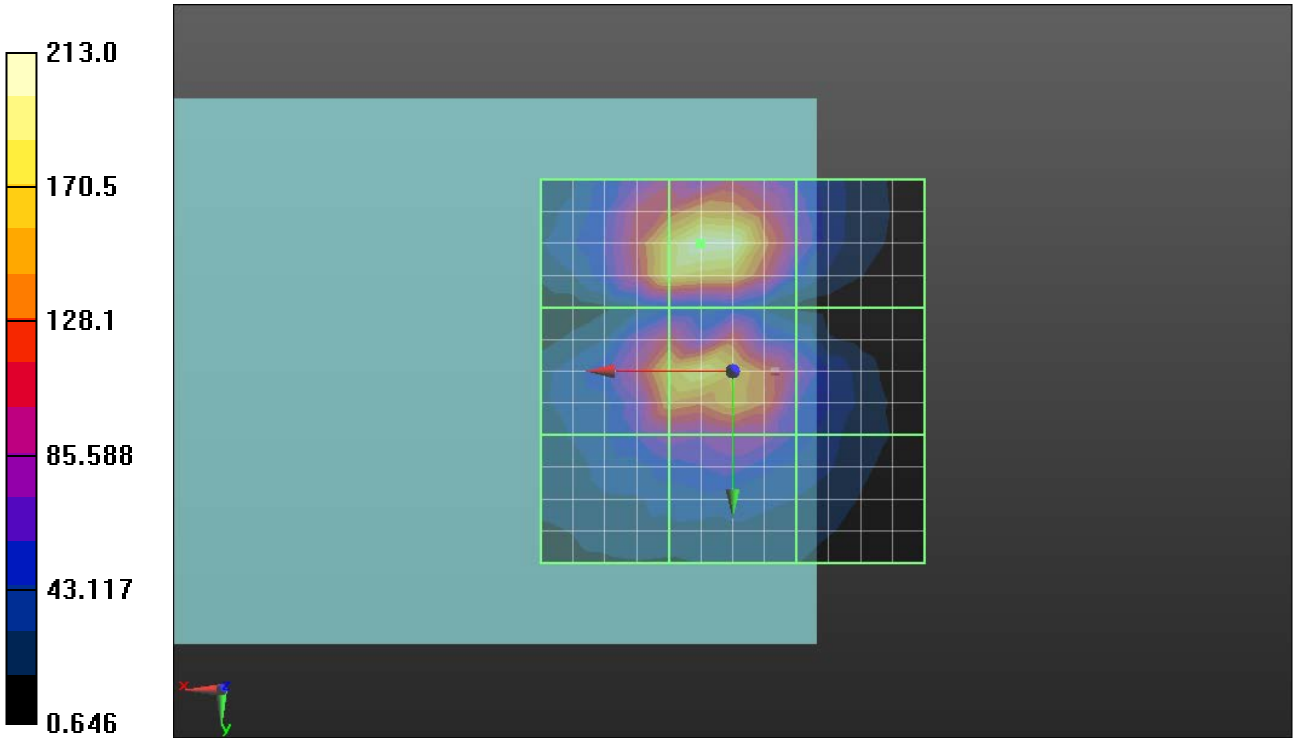
DASY5 Configuration:

- Probe: AM1DV2 - 1047; ; Calibrated: 9/20/2012
- Sensor-Surface: 0mm (Fix Surface)
- Electronics: DAE4 Sn358; Calibrated: 9/11/2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.8(7028)

T-Coil scan (scan for ANSI C63.19-2007 & 2011 compliance)/Scan For Best S/N/y (transversal) 4.2mm 50 x 50/ABM SNR(x,y,z) (13x13x1): Measurement grid: dx=10mm, dy=10mm
Signal Type: Audio File (.wav) 48k_voice_1kHz_1s.wav
Output Gain: 32.8
Measure Window Start: 300ms
Measure Window Length: 1000ms
BWC applied: 0.15 dB
Device Reference Point: 0, 0, -6.3 mm

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

Cursor:
ABM1/ABM2 = 46.57 dB
ABM1 comp = -3.51 dBA/m
BWC Factor = 0.15 dB
Location: 4.2, -16.7, 3.7 mm



SECTION 14: BACKGROUND ABM2 NOISE PLOTS

Figure 19: Ambient Background Noise Spectrum Plot – Axial Orientation

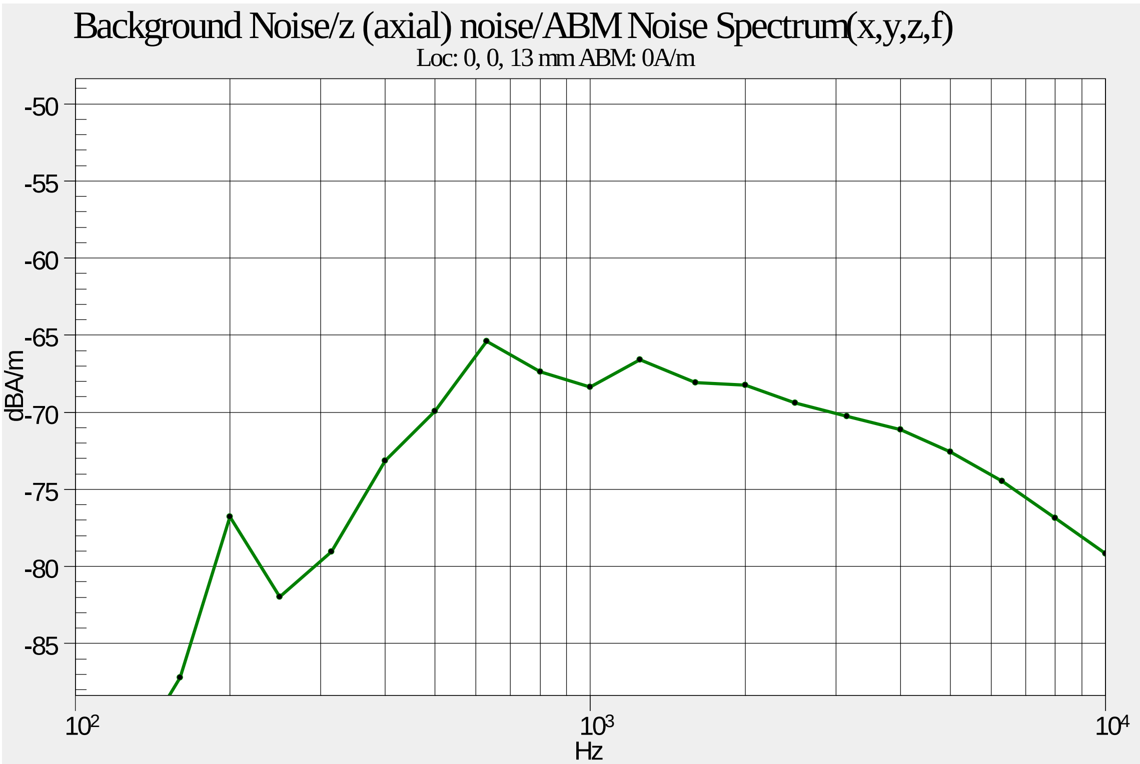
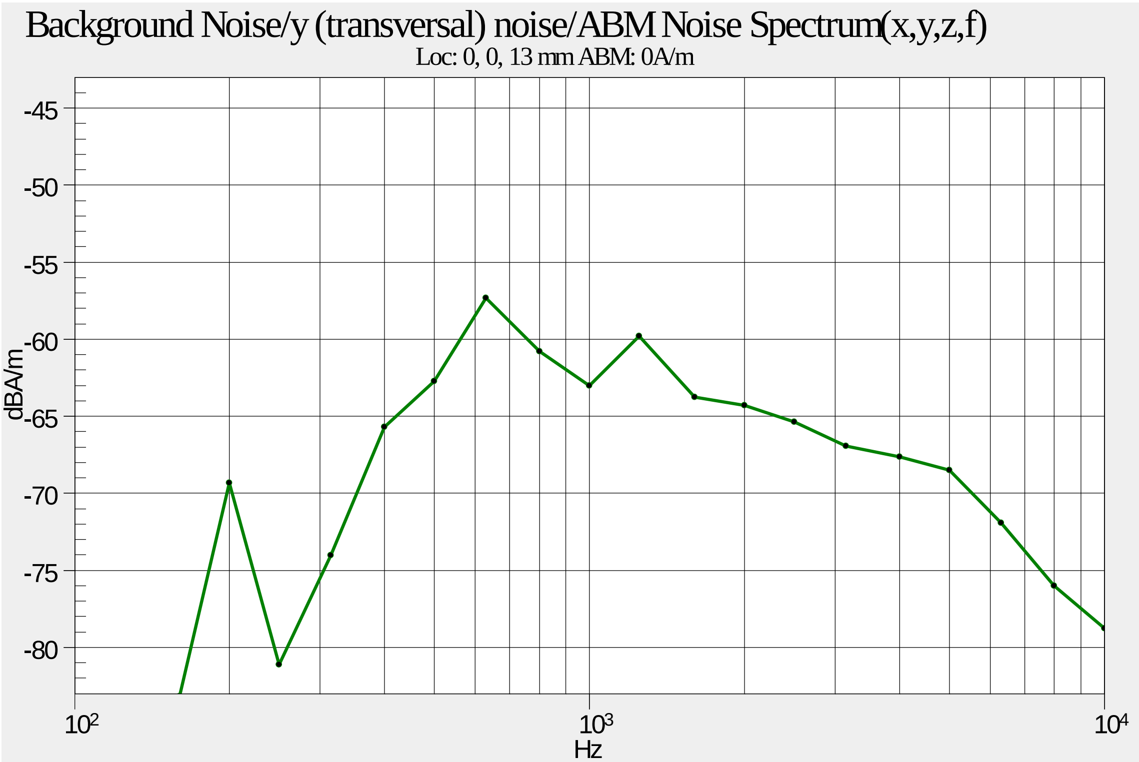


Figure 20: Ambient Background Noise Spectrum Plot – Radial Y Orientation



SECTION 15: CALIBRATION DOCUMENTS

Calibration documents are provided in a separate exhibit.