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# Hearing Aid Compatibility
# RF Near Field Emissions Test Report

**Model:** RM-927
**FCC ID:** QMND
**Intertek Report Number:** 101237626LEX-001

**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
**Bryan Taylor, Team Leader – Engineering**

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## SECTION 1: INTRODUCTION

The RM-927 was evaluated for HAC RF (E Field Emissions) in accordance with the requirements for RF Near Field Emissions compliance testing defined in ANSI C63.19-2011. Testing was performed at the Intertek facility in Lexington, Kentucky.

Per ANSI C63.19, testing that is performed on a wireless device establishes categories, which, when coupled with those of a hearing aid, can indicate to healthcare practitioners and hearing aid users which hearing aids are compatible with which wireless devices. The ANSI standard provides tests that can be used to assess the electromagnetic characteristics of hearing aids and wireless devices, and assigns them to these categories.

The aim of this report, therefore, is to provide RF measurements of the near-field electric emitted by a wireless device to categorize these emissions for correlation with the RF immunity of a hearing aid.

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, calibration dipoles, electric field probes (ER3DV4R), dipole holder, EUT holder and DASY52 software with SEMCAD post-processor for generating test plots.

Electric fields of a wireless device are scanned with the free-space probes in a 5 x 5 cm area located 15 mm above its acoustic or T-Coil output. The maximum field values in 9 sub-grids of the electric field scans are evaluated automatically according to the rules defined in the standard and assigned a classification.

The specially designed Test Arch allows a high precision positioning of both the device and any of the calibration dipoles. The broadband dipoles are calibrated at a single frequency and are used for system performance checks.

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

## SECTION 2: SUMMARY OF TEST RESULTS

This report contains data for the RM-927 in CDMA mode only. The minimum HAC RF ("M") ratings that were obtained for the RM-927 are summarized below:

**Table 1: Summary of Test Results with Overall Rating**

| RF Test | Band | Call Mode | Channel | RF Audio Interference Level (V/m) | M-Rating |
|---|---|---|---|---|---|
| E-Field | CDMA Cell | 1/8th Rate | 777 | 28.15 | M4 |
| | CDMA PCS | 1/8th Rate | 600 | 21.57 | M4 |
| | | | | **Overall M Rating** | M4 |

# 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<br>GSM 1900 – 1850.2 – 1909.8 MHz<br>WCDMA Band V – 826.4 – 846.6 MHz<br>WCDMA Band V – 1852.4 – 1907.6 MHz<br>CDMA Cell – 824.7 – 848.31 MHz<br>CDMA PCS – 1851.2 – 1908.75 MHz<br>LTE Band 4 – 1710-1750 MHz<br>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**<br>Nokia, 16620 West Bernardo Drive, San Diego, CA, 92127 | | |
| **CONTACT PERSON**<br>Victoria Abadilla | **PHONE**<br>(858) 831-5000 | **FAX**<br>NA |
| **EUT RECEIVE DATE**<br>7/25/13 | **TEST START DATE**<br>8/2/13 | **TEST END DATE**<br>8/4/13 |
| **EUT CONDITION**<br>Good condition | **EUT TESTED BY**<br>Jason Centers, Senior Project Engineer | |

**Table 2: 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.

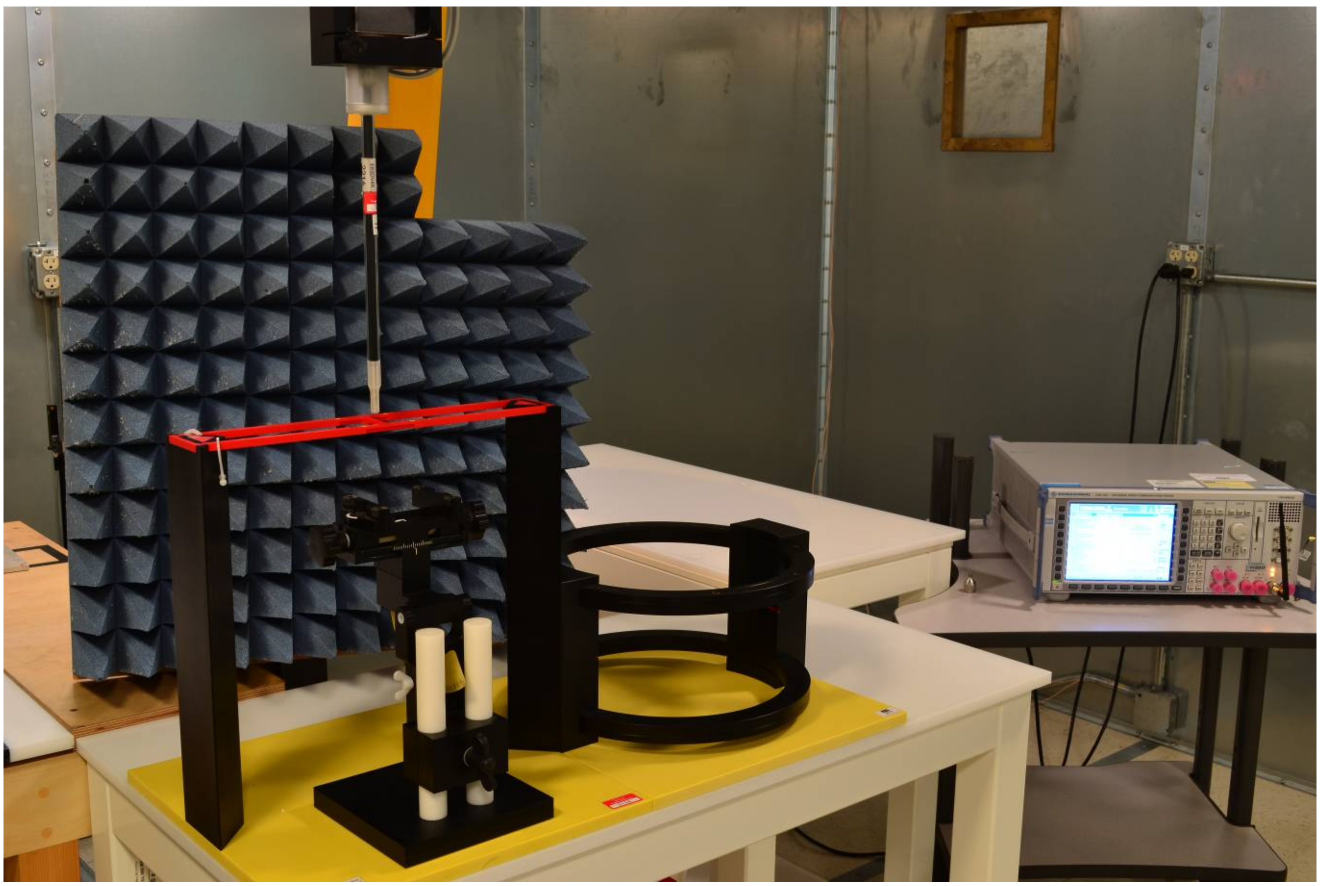
## SECTION 4: TEST SITE DESCRIPTION

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

The HAC RF Setup is comprised of the SPEAG DASY 52 Hearing Aid Compatibility extension, which is used to measure electric and magnetic fields generated by wireless communication devices in the region controlled for use by a hearing aid in accordance with ANSI C63.19.

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

**Figure 1: Intertek HAC RF Test Site**



# SECTION 5: VALIDATION PROCEDURES

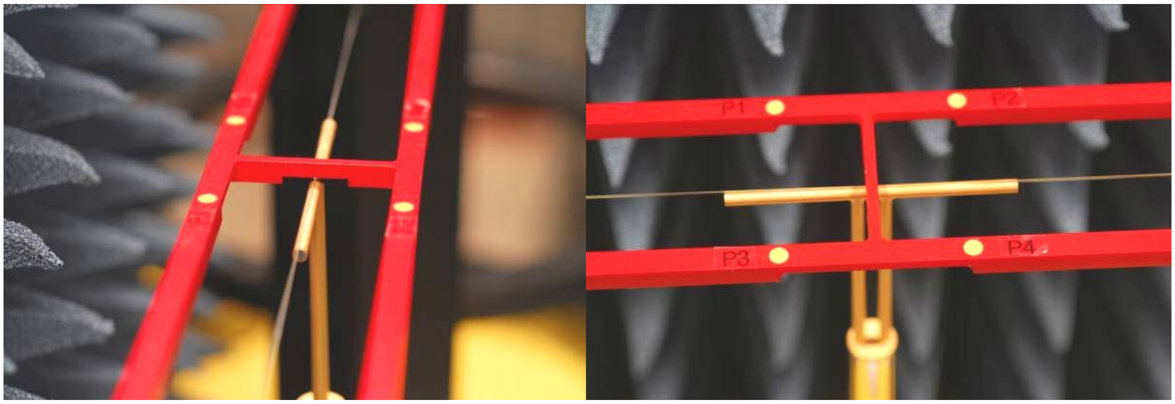
## 5.1 System Validation with Calibration Dipole

As part of the SPEAG HAC extension, calibration dipoles (CD835V3 and CD1880V3) are provided to validate the test setup prior to any measurements at the frequency of interest. The dipoles are calibrated to a known electric and magnetic field at a specified forward power.

An E-field calibration was performed on each day prior to the start of testing to verify the correct operation of the setup.

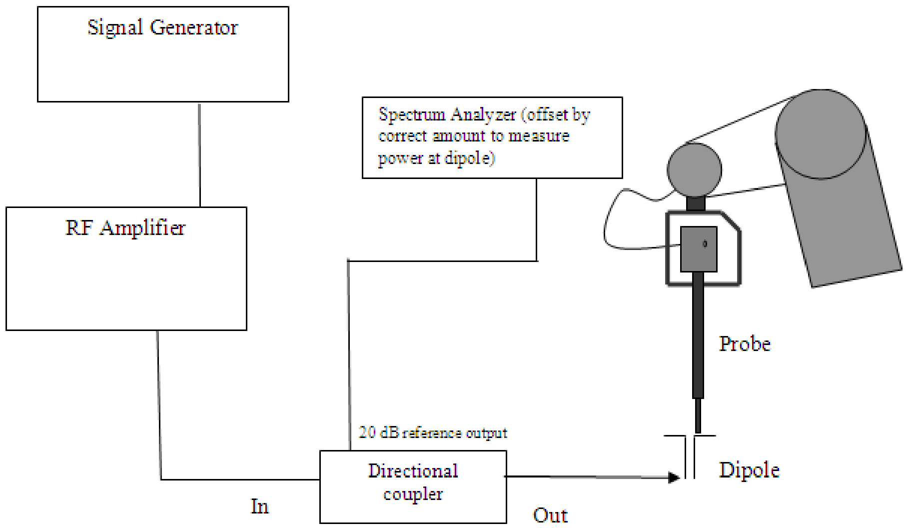
a. The SPEAG e-field probe (ER3DV4R) was installed into the DAE.
b. The correct position of the HAC Test Arch's four reference points was verified using the DASY52 software.
c. The appropriate dipole (CD835V3 or CD1880V3) was selected, depending on the desired frequency range to be validated.
d. The calibration dipole was placed in the position that is normally occupied by the wireless device, as shown below.

**Figure 2: Dipole Mounted under Test Arch**




e. The test bed shown in Figure 3 was used to illuminate the CD835V3 or CD1880V3 validation dipole with 20 dBm (100 mW) of forward power. This is the same input power used during the manufacturer's calibration of the dipole. The CW input signal was set to the appropriate frequency.

**Figure 3: Setup for Dipole Validation**




f. The DASY52 profile was used to measure the maximum field strength along the length of the dipole arm. A separation distance of 15 mm was maintained between the center of the probe sensor and the top of the dipole. Note: This is how the manufacturer's dipole calibration was performed.

g. Once the scan was complete, the E-field results were verified to be within 10% of the calibration lab's result.

h. Dipole validation plots are shown in a appendix at the end of this report. Results from the dipole validation performed prior to testing are shown in Table 3 and Table 4.

**Table 3: Dipole Validation Results – 835 MHz**

| CD835V3 Dipole Validation Results | | | |
|---|---|---|---|
| Date | Input Power (mW) with f = 835 MHz | Ave. Maximum E-field (V/m) | E-field Deviation From Calibration (%) |
| 8/2/2013 | 100 | 107.5 | 0.19 |

**Table 4: Dipole Validation Results – 1880 MHz**

| CD1880V3 Dipole Validation Results | | | |
|---|---|---|---|
| Date | Input Power (mW) with f = 1880 MHz | Ave. Maximum E-field (V/m) | E-field Deviation From Calibration (%) |
| 8/4/2013 | 100 | 87.25 | 3.06 |

## SECTION 6: MODULATION INTERFERENCE FACTOR

The Modulation Interference Factor (MIF, in dB) is added to the measured average E-field (in dBV/m) and converts it to the RF Audio Interference level (in dBV/m). This level considers the audible amplitude modulation components in the RF E-field. CW fields without amplitude modulation are assumed to not interfere with the hearing aid electronics. Modulations without time slots and low fluctuations at low frequencies have low MIF values, TDMA modulations with narrow transmission and low repetition rates have high MIF values.

The ER3D E-field probes have a bandwidth <10kHz and can therefore not evaluate the RF envelope in the full audio band. DASY52 is therefore using the “indirect” measurement method according to ANSI C63.19-2011 which is the primary method. This method reads the average E-field. According to the equipment manufacture, the probes shall be linearized by PMR calibration in order to not overestimate the field reading.

The evaluation method or MIF is defined in ANSI C63.19-2011 section D.7. An RMS demodulated RF signal is fed to a spectral filter (similar to an A weighting filter) and forwarded to a temporal filter acting as a quasi-peak detector. The averaged output of this filtering is called to a 1kHz 80% AM modulated signal as a reference. MIF measurement requires additional instrumentation and is not well suited for evaluation by the end user with reasonable uncertainty. It may alternatively be determined through analysis and simulation, because it is constraint and characteristic for a communication signal. DASY52 uses well defined signals for PMR calibration. The MIF of these signals has been determined by simulation and is automatically applied in post processing.

MIF values were not tested as specified in the standards but are based on analysis provided by SPEAG for the following User Identifiers and air interfaces. Detailed information on the UID is provided as a separate exhibit.

| UID | Version Date | Communication System Name | MIF (dB) |
|---|---|---|---|
| 10276-CAA | 2/28/13 | CDMA(1xRTT, RC1, 1/8 Rate) | 0.74 |

A PMR calibrated probe is linearized for the selected waveform over the full dynamic range within the uncertainty specified in its calibration certificate. The MIF measurement uncertainty listed in the following table is estimated by SPEAG.

| MIF (dB) | MIF Measurement Uncertainty (dB) |
|---|---|
| -7 to +5 | 0.2 |
| -13 to +11 | 0.5 |
| >-20 | 1.0 |

# SECTION 7: MEASUREMENT PROCEDURES

Near-field E emissions measurements were taken by following the procedures outlined below. A complete evaluation was performed per the guidelines provided by ANSI C63.19.

## 7.1 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 5, below). This table was used to assign the wireless device's "M" rating.

**Table 5: ANSI Near-Field Categories**

| 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) |

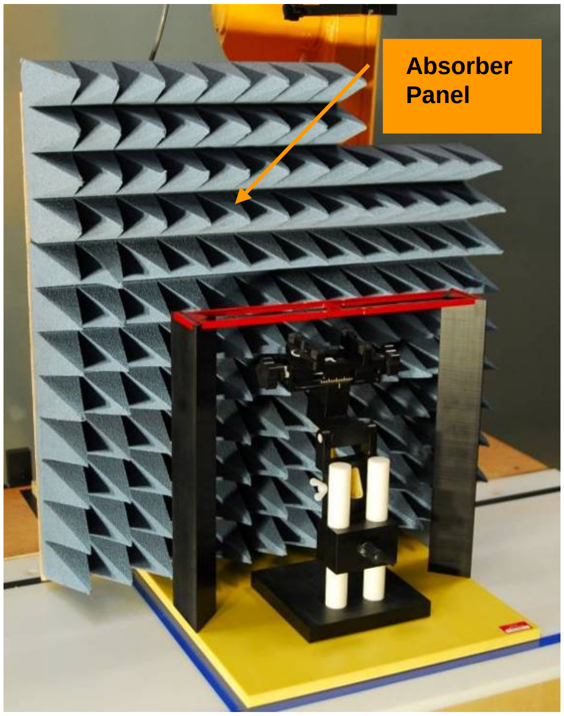
| Emission categories | >960 MHz | |
| --- | --- | --- |
| | E-field emissions | |
| Category M1 | 40 to 45 | dB (V/m) |
| Category M2 | 35 to 40 | dB (V/m) |
| Category M3 | 30 to 35 | dB (V/m) |
| Category M4 | <30 | dB (V/m) |

## 7.2 Wireless Device – Positioning and Call Setup

### 7.2.1 Device Positioning

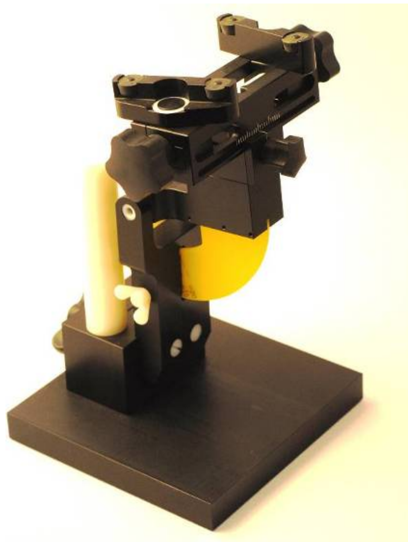
a. The DASY52 HAC RF test arch was installed on the phantom cover.
b. A foam absorber panel, shown in Figure 4, was placed between the robot and the test arch in order to mitigate RF reflections from the robot during E-Field measurements.

**Figure 4: Absorber Panel**



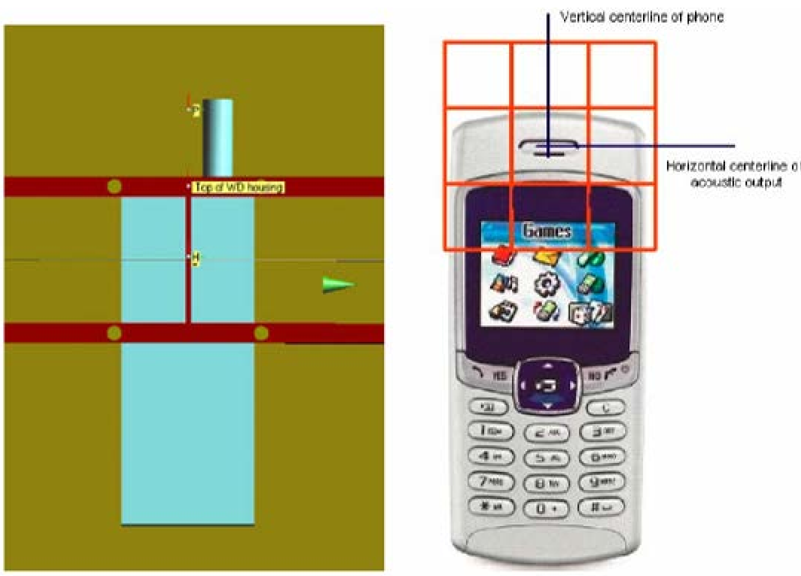

c. The correct position of the test arch was verified by moving the free-space probe to its 4 reference points using the DASY52 software. If any variations were seen, the reference points were re-taught.
d. The wireless device was mounted in the device holder shown in Figure 5.

**Figure 5: Device Holder**



e. The wireless device was then centered under the test arch as shown in Figure 6. The acoustic output (or T-Coil location, as required) 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 6: Centering the WD under the Test Arch**




f. 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 15 mm parallel to, and above the reference plane, and is measured to the center of the probe sensor per ANSI C63.19-2011.

## 7.3 Wireless Device (WD) Call Procedure

a. A fully charged battery was installed in the phone.
b. The WD was placed into a call using a base station simulator.
c. CDMA devices were tested in RC1/SO2 (Full Rate) & RC1/SO3 (1/8$^{th}$ Rate) configurations unless otherwise noted.
d. The WD was configured for normal operation at maximum rated output power.
e. Since the presence of wires or conductors close to the WD will disturb the RF field, the WD was operated under its own power source, with no external connections.

## 7.4 Near-Field RF Emissions Procedure

a. All system parameters in the DASY52 software (phantom section, communication system, crest factor, type of probe, etc) were verified to be correct.
b. The Phantom adjustment and Verification steps were run to guarantee the proper placement and separation of the test arch in relation to the RF probe.
c. The scan height of the free-space probe was verified. Different gauge blocks were used to verify the gap between the probe and the top of the test arch. This guaranteed a proper 15 mm separation between the device reference plane and the probe's measurement plane.
d. The Hearing Aid Compatibility test was then run. A 5 cm x 5 cm area, divided into 9 sub-grids and centered on the device acoustic (or T-coil) output was evaluated with a 5 mm resolution (step size).
e. The HAC procedure calculates power drift from the field strength at a reference point before and after each scan. If the power drift was greater than ± 0.20 dB, then the scan was repeated.

## 7.5 Interpretation and Post-Processing of Data

a. The "M" rating of the wireless device was determined once a complete set of E-field scans was collected.
b. Per ANSI C63.19, three contiguous blocks containing the highest field values may be excluded. The center sub-grid cannot be excluded.
c. The SEMCAD post-processor uses the pre-determined MIF values to convert the average probe readings to RF Audio Interference Level.
d. The "M" rating for the scan was assigned based on the criteria shown in Table 5.

# SECTION 8: TABULAR TEST DATA

## 8.1 Conducted Output Power

The conducted output power of the RM-927 was measured and summarized in Table 6. 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 internal radio.

**Table 6: 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 |

## 8.2 Low Power Exemption

An air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤ 17dBm. Interfaces that are exempt from testing are assumed to have a M4 category rating. See Table 7 for analysis of the air interfaces required for testing.

**Table 7: Lower Power Exemptions**

| Air Interface | Max. Average Power (dBm) | Worst Case MIF (dB) | Total (Cond. Pwr+MIF, dBm) | C63.19 Test Required |
|---|---|---|---|---|
| CDMA RC1/SO2 (Full Frame) | 25.11 | -19.77 | 5.34 | No |
| CDMA RC3/SO55 (Full Frame) | 25.11 | -19.71 | 5.4 | No |
| CDMA RC1/SO3 (1/8$^{th}$ Rate) | 25.1 | 0.74 | 25.84 | Yes |

**Note: Only CDMA modes are considered in this report.**

## SECTION 9: RF EMISSIONS TEST DATA

The results in the tables below summarize the data obtained when the device was tested in the operating conditions described previously. Plots of the measured near field emissions are shown in Section 14: of this report for the worse case measured channels in each band.

**Table 8: E-Field Test Data**

| E-Field Emissions Data | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Band | Call Mode | Channel | Backlight | Measurement Plane Center (Acoustic/T-Coil) | Modulation Interference Factor | Drift (dB) | Excluded Cells | RF Audio Interference Level [dB(V/m)] | Margin to Next Lower Category Rating (dB) | M-Rating |
| CDMA Cell | 1/8th Rate | 1013 | On | Acoustic | 0.74 | -0.02 | None | 25.35 | 15.39 | M4 |
| CDMA Cell | 1/8th Rate | 384 | On | Acoustic | 0.74 | -0.06 | None | 25.68 | 15.06 | M4 |
| CDMA Cell | 1/8th Rate | 777 | On | Acoustic | 0.74 | 0.19 | None | 28.15 | 12.59 | M4 |
| CDMA PCS | 1/8th Rate | 25 | On | Acoustic | 0.74 | -0.03 | None | 20.84 | 9.9 | M4 |
| CDMA PCS | 1/8th Rate | 600 | On | Acoustic | 0.74 | -0.16 | None | 21.57 | 9.17 | M4 |
| CDMA PCS | 1/8th Rate | 1175 | On | Acoustic | 0.74 | 0.09 | None | 19.82 | 10.92 | M4 |

# SECTION 10: TEST EQUIPMENT

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

## 10.1 HAC RF Measurement System

**Table 9: 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 |
| ER3DV4R | SPEAG | Free-space E-field probe | 2216 | 9/21/2012 | 9/21/2013 |
| CD835V3 | SPEAG | Validation Dipole | 1049 | 9/19/2012 | 9/19/2013 |
| CD1880V3 | SPEAG | Validation Dipole | 1042 | 9/19/2012 | 9/19/2013 |
| DAE4 | SPEAG | Data Acquisition Electronics | 258 | 9/12/2012 | 9/12/2013 |
| SD HC P01BA | SPEAG | HAC RF Test Arch | 1046 | N/A | N/A |

## 10.2 Support Equipment

**Table 10: 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 11: MEASUREMENT UNCERTAINTY

## 11.1 Equipment Uncertainty

Table 11 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 11: SPEAG HAC Uncertainty Budget**

| Error Description | Uncertainty Value | Prob. Dist. | Div. | ($c_i$) E | Std.Unc. E |
|---|---|---|---|---|---|
| **Measurement System** | | | | | |
| Probe Calibration | ±5.1% | N | 1 | 1 | ±5.1% |
| Axial Isotropy | ±4.7% | R | √3 | 1 | ±2.7% |
| Sensor Displacement | ±16.5% | R | √3 | 1 | ±9.5% |
| Boundary Effects | ±2.4% | R | √3 | 1 | ±1.4% |
| Phantom Boundary Effects | ±7.2% | R | √3 | 1 | ±4.1% |
| Linearity | ±4.7% | R | √3 | 1 | ±2.7% |
| Scaling to with PMR Calibration | ±10.0% | R | √3 | 1 | ±5.8% |
| System Detection Limit | ±1.0% | R | √3 | 1 | ±0.6% |
| Readout Electronics | ±0.3% | N | 1 | 1 | ±0.3% |
| Response Time | ±0.8% | R | √3 | 1 | ±0.5% |
| Integration Time | ±2.6% | R | √3 | 1 | ±1.5% |
| RF Ambient Conditions | ±3.0% | R | √3 | 1 | ±1.7% |
| RF Reflections | ±12.0% | R | √3 | 1 | ±6.9% |
| Probe Positioner | ±1.2% | R | √3 | 1 | ±0.7% |
| Probe Positioning | ±4.7% | R | √3 | 1 | ±2.7% |
| Extrapolation and Interpolation | ±1.0% | R | √3 | 1 | ±0.6% |
| **Test Sample Related** | | | | | |
| Device Positioning Vertical | ±4.7% | R | √3 | 1 | ±2.7% |
| Device Positioning Lateral | ±1.0% | R | √3 | 1 | ±0.6% |
| Device Holder & Test Arch | ±2.4% | R | √3 | 1 | ±1.4% |
| Power Drift | ±5.0% | R | √3 | 1 | ±2.9% |
| **Phantom and Setup Related** | | | | | |
| Test Arch Thickness | ±2.4% | R | √3 | 1 | ±1.4% |
| | | | | Combined Standard Uncertainty | ±16.3% |
| | | | | Expanded Standard Uncertainty on Power | ±32.6% |
| | | | | Expanded Standard Uncertainty on Field | ±16.3% |

## SECTION 12: DOCUMENT HISTORY

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

## SECTION 13: 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 14: HAC RF EMISSIONS TEST PLOTS

Date/Time: 8/2/2013 3:00:35 PM

Test Laboratory: Intertek
File Name: HAC RF Cell Band CDMA RC1SO3_C63.19-2011.da52:2

**HAC RF Cell Band CDMA RC1SO3_C63.19-2011**

**DUT: Nokia RM-927; Serial: 2160022522**

Communication System: CDMA2000 (1xRTT, RC1, 1/8 Rate); Communication System Band: Band Class 0 (824.0 - 849.0 MHz); Frequency: 848.31 MHz;Duty Cycle: 1:19.8153

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

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

DASY5 Configuration:

- Probe: ER3DV4R - SN2216; ConvF(1, 1, 1); Calibrated: 9/21/2012;
- Sensor-Surface: (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)

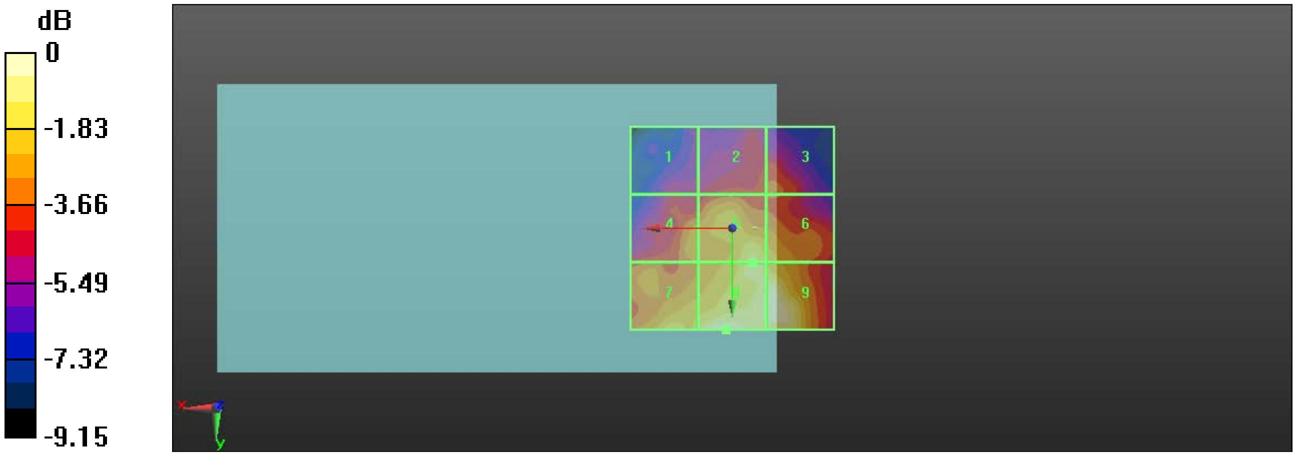
**CDMA 1_8th Rate HAC E-Field Measurement/E Scan - ER3D: 15 mm from Probe Center to the Device - High Channel/Hearing Aid Compatibility Test (101x101x1):** Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 20.19 V/m; Power Drift = 0.19 dB
Applied MIF = 0.74 dB
RF audio interference level = 28.15 dBV/m
**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **23.32 dBV/m** | Grid 2 **M4** **24.63 dBV/m** | Grid 3 **M4** **24.74 dBV/m** |
| Grid 4 **M4** **25.72 dBV/m** | Grid 5 **M4** **27.17 dBV/m** | Grid 6 **M4** **26.36 dBV/m** |
| Grid 7 **M4** **26.94 dBV/m** | Grid 8 **M4** **28.15 dBV/m** | Grid 9 **M4** **27.98 dBV/m** |

| Category | Limits for E-Field Emissions < 960MHz | Limits for E-Field Emissions > 960MHz |
|---|---|---|
| M1 | 50 dBV/m - 55 dB V/m | 40 dBV/m - 45 dB V/m |
| M2 | 45 dBV/m - 50 dB V/m | 35 dBV/m - 40 dB V/m |
| M3 | 40 dBV/m - 45 dB V/m | 30 dBV/m - 35 dB V/m |
| M4 | <40 dBV/m | <30 dBV/m |

**Cursor:**
Total = 28.15 dBV/m
E Category: M4
Location: 1.5, 25, 8.7 mm




0 dB = 25.56 V/m = 28.15 dBV/m

Date/Time: 8/4/2013 10:49:03 AM

Test Laboratory: Intertek
File Name: HAC RF PCS Band CDMA RC1SO3_C63.19-2011.da52:2

**HAC RF PCS Band CDMA RC1SO3_C63.19-2011**

**DUT: Nokia RM-927; Serial: 2160022522**

Communication System: CDMA2000 (1xRTT, RC1, 1/8 Rate); Communication System Band: Band Class 1 (1850.0 - 1910.0 MHz); Frequency: 1880 MHz;Duty Cycle: 1:19.8153

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

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

DASY5 Configuration:

- Probe: ER3DV4R - SN2216; ConvF(1, 1, 1); Calibrated: 9/21/2012;
- Sensor-Surface: (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)

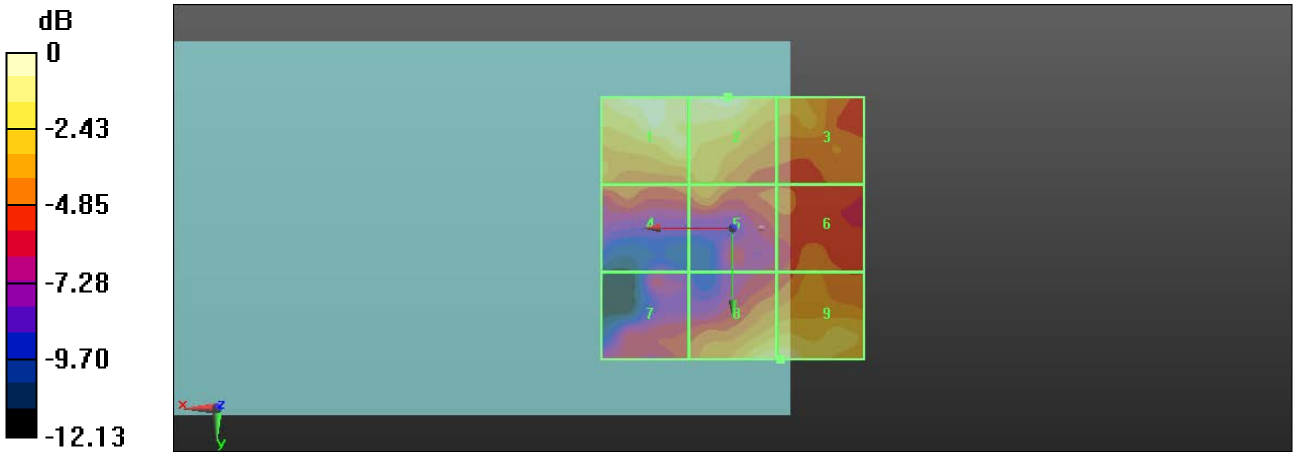
**CDMA 1_8th Rate HAC E-Field Measurement/E Scan - ER3D: 15 mm from Probe Center to the Device - Mid Channel/Hearing Aid Compatibility Test (101x101x1):** Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 5.319 V/m; Power Drift = -0.16 dB
Applied MIF = 0.74 dB
RF audio interference level = 21.57 dBV/m
**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **21.11 dBV/m** | Grid 2 **M4** **21.57 dBV/m** | Grid 3 **M4** **19.15 dBV/m** |
| Grid 4 **M4** **17.68 dBV/m** | Grid 5 **M4** **18.26 dBV/m** | Grid 6 **M4** **17.67 dBV/m** |
| Grid 7 **M4** **16.77 dBV/m** | Grid 8 **M4** **20.95 dBV/m** | Grid 9 **M4** **20.97 dBV/m** |

| Category | Limits for E-Field Emissions < 960MHz | Limits for E-Field Emissions > 960MHz |
|---|---|---|
| M1 | 50 dBV/m - 55 dB V/m | 40 dBV/m - 45 dB V/m |
| M2 | 45 dBV/m - 50 dB V/m | 35 dBV/m - 40 dB V/m |
| M3 | 40 dBV/m - 45 dB V/m | 30 dBV/m - 35 dB V/m |
| M4 | <40 dBV/m | <30 dBV/m |

**Cursor:**
Total = 21.57 dBV/m
E Category: M4
Location: 1, -25, 8.7 mm




0 dB = 11.98 V/m = 21.57 dBV/m

## SECTION 15: HAC RF EMISSIONS SYSTEM VALIDATION PLOTS

Date/Time: 8/2/2013 1:42:58 PM

**HAC-ANSI C63.19-2011 Dipole Validation**

**DUT: HAC-Dipole 835 MHz; Serial: 1049**

Communication System: CW; Communication System Band: ITD835 (835.0 MHz); Frequency: 835 MHz;Duty Cycle: 1:1

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

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

DASY5 Configuration:

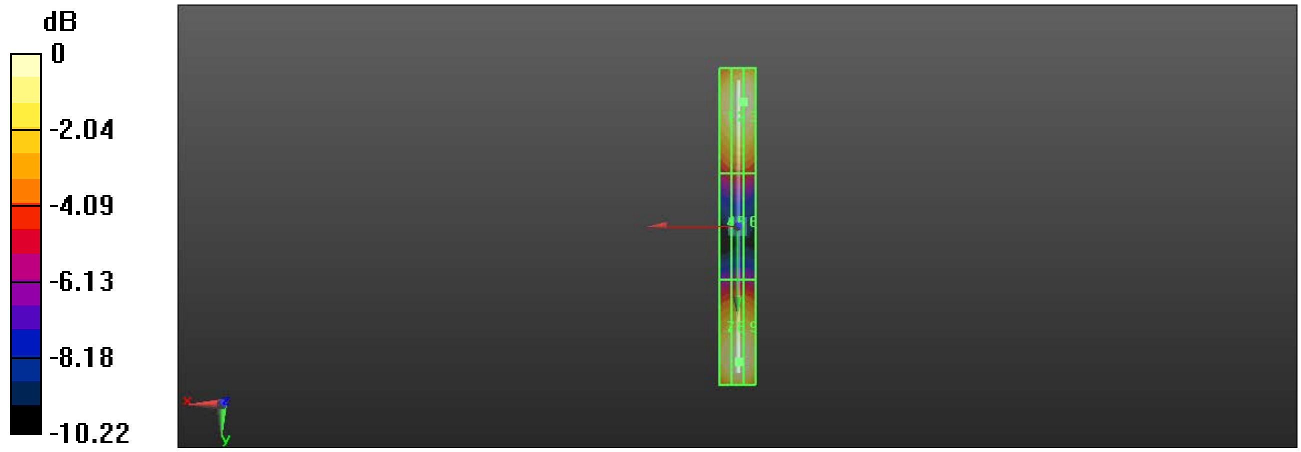
- Probe: ER3DV4R - SN2216; ConvF(1, 1, 1); Calibrated: 9/21/2012;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn358; Calibrated: 9/11/2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1046
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

**Dipole E-Field measurement (E-field scan for ANSI C63.19-2007 & -2011 compliance)/E Scan - measurement distance from the probe sensor center to CD835 = 10mm & 15mm/Hearing Aid Compatibility Test at 15mm distance (41x361x1):** Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 106.6 V/m; Power Drift = 0.08 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 107.7 V/m
**Near-field category: M4 (AWF 0 dB)**

PMF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4** **101.9 V/m** | Grid 2 **M4** **107.3 V/m** | Grid 3 **M4** **107.3 V/m** |
| Grid 4 **M4** **62.83 V/m** | Grid 5 **M4** **64.82 V/m** | Grid 6 **M4** **64.42 V/m** |
| Grid 7 **M4** **103.0 V/m** | Grid 8 **M4** **107.7 V/m** | Grid 9 **M4** **105.7 V/m** |

**Cursor:**
Total = 107.7 V/m
E Category: M4
Location: -1, 77, 9.7 mm




0 dB = 107.7 V/m = 40.64 dBV/m

Date/Time: 8/4/2013 9:27:37 AM

HAC-ANSI C63.19-2011 Dipole Validation

**DUT: HAC Dipole 1880 MHz; Serial: 1042**

Communication System: CW; Communication System Band: CD1880 (1880.0 MHz); Frequency: 1880 MHz;Duty Cycle: 1:1

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

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

DASY5 Configuration:

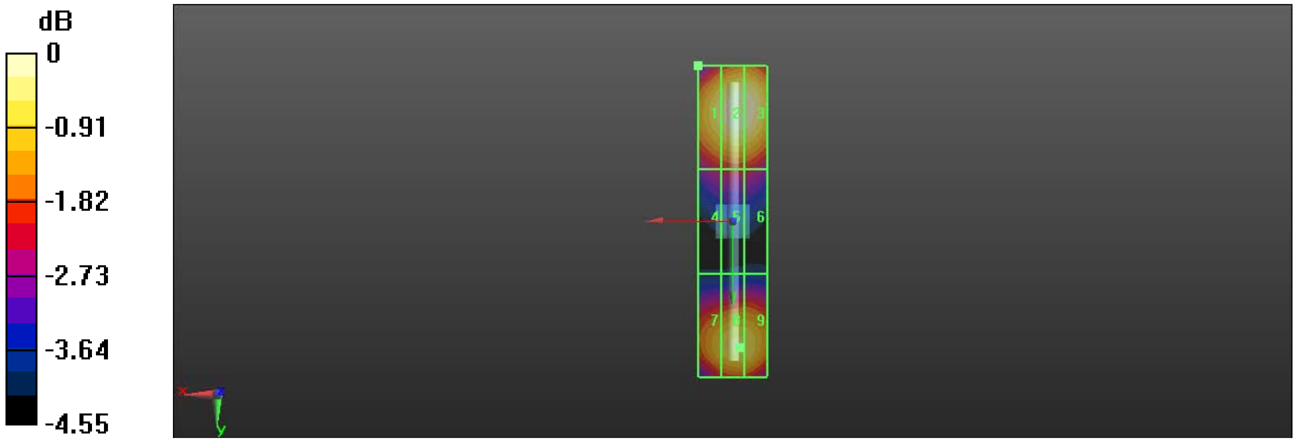
- Probe: ER3DV4R - SN2216; ConvF(1, 1, 1); Calibrated: 9/21/2012;
- Sensor-Surface: (Fix Surface)
- Electronics: DAE4 Sn358; Calibrated: 9/11/2012
- Phantom: HAC Test Arch with AMCC; Type: SD HAC P01 BA; Serial: 1046
- DASY52 52.8.7(1137); SEMCAD X 14.6.8(7028)

**Dipole E-Field measurement (E-field scan for ANSI C63.19-2007 & -2011 compliance)/E Scan - measurement distance from the probe sensor center to CD1880 = 10mm & 15mm/Hearing Aid Compatibility Test at 15mm distance (41x181x1):** Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 147.5 V/m; Power Drift = -0.02 dB
PMR not calibrated. PMF = 1.000 is applied.
E-field emissions = 89.91 V/m
**Near-field category: M3 (AWF 0 dB)**

PMF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M3** **86.03 V/m** | Grid 2 **M3** **89.91 V/m** | Grid 3 **M3** **89.72 V/m** |
| Grid 4 **M3** **69.02 V/m** | Grid 5 **M3** **70.39 V/m** | Grid 6 **M3** **69.89 V/m** |
| Grid 7 **M3** **81.48 V/m** | Grid 8 **M3** **84.62 V/m** | Grid 9 **M3** **84.15 V/m** |

**Cursor:**
Total = 61.17 V/m
E Category: M4
Location: 10, -45, 9.7 mm




0 dB = 89.91 V/m = 39.08 dBV/m

# SECTION 16: SPEAG PROVIDED MIF VALUES

| UID | CDMA2000 | PAR (dB) | MIF (dB) |
| --- | --- | --- | --- |
| 10039−CAA | CDMA2000 (1xRTT, RC1) | 4.57 | -19.77 |
| 10080−CAA | CDMA2000 (1xEV-DO, 153.6 kbps) | 4.22 | -19.54 |
| 10081−CAA | CDMA2000 (1xRTT, RC3) | 3.97 | -19.71 |
| 10273−CAA | CDMA2000 (1xEV-DO Rev A, 1.8Mbps) | 10.07 | -3.78 |
| 10276−CAA | CDMA2000 (1xRTT, RC1, 1/8 Rate) | 12.97 | 0.74 |
| UID | iDEN | PAR (dB) | MIF (dB) |
| 10041−CAA | iDEN 2:6 | 7.59 | -3.43 |
| UID | TD-SCDMA | PAR (dB) | MIF (dB) |
| 10056−CAA | UMTS-TDD (TD-SCDMA, 1.28 Mcps) | 11.01 | 3.10 |
| UID | WCDMA | PAR (dB) | MIF (dB) |
| 10011−CAA | UMTS-FDD (WCDMA) | 2.91 | -27.23 |
| 10097−CAA | UMTS-FDD (HSDPA) | 3.98 | -20.75 |
| 10098−CAA | UMTS-FDD (HSUPA, Subtest 2) | 3.98 | -20.75 |
| 10225−CAA | UMTS-FDD (HSPA+) | 5.97 | -20.39 |
| 10274−CAA | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10) | 4.87 | -24.48 |
| 10275−CAA | UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4) | 3.96 | -26.26 |

## SECTION 17: CALIBRATION DOCUMENTS

Calibration documents are provided in a separate exhibit.