# TEST REPORT

## No.I21N04037-HAC RF

**For**

**HMD Global Oy**

**Smart Phone**

**Model Name: TA-1339**

**With**

**Hardware Version: V01B**

**Software Version: 000T_0_513**

**FCC ID: 2AJOTTA-1339**

**Results Summary: M Category = M4**

**Issued Date: 2022-02-12**

**Designation Number: CN1210**

**Note:**

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of SAICT.

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## REPORT HISTORY

| Report Number | Revision | Description | Issue Date |
|---|---|---|---|
| I21N04037-HAC RF | Rev.0 | 1st edition | 2022-02-12 |

**This EUT is a variant product and the report of original sample is No.I21N00548-HAC RF. According to "Justification Letter" provided by applicant, we quote the test results of original sample and spot check the worst case in annex G.**

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# 1. Summary of Test Report

## 1.1. Test Items

| | |
|---|---|
| Description: | Smart Phone |
| Model Name: | TA-1339 |
| Applicant's Name: | HMD Global Oy |
| Manufacturer's Name: | HMD Global Oy |

## 1.2. Test Standards

ANSI C63.19-2011

## 1.3. Test Result

Pass

## 1.4. Testing Location

Address: Building G, Shenzhen International Innovation Center, No.1006 Shennan Road, Futian District, Shenzhen, Guangdong, P. R. China

## 1.5. Project Data

Testing Start Date: 2021-03-02 Testing End Date: 2022-01-16

## 1.6. Signature

Li Yongfu
**(Prepared this test report)**

Zhang Yunzhuan
**(Reviewed this test report)**

Cao Junfei
**(Approved this test report)**

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# 2. Client Information

## 2.1. Applicant Information

| | |
|---|---|
| Company Name: | HMD Global Oy |
| Address: | Bertel Jungin aukio 902600 Espoo，Finland |
| City: | / |
| Country: | / |
| Telephone: | +393 31 6272922 |

## 2.2. Manufacturer Information

| | |
|---|---|
| Company Name: | HMD Global Oy |
| Address: | Bertel Jungin aukio 902600 Espoo，Finland |
| City: | / |
| Country: | / |
| Telephone: | +393 31 6272922 |

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# 3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

## 3.1. About EUT

| | |
|---|---|
| Description: | Smart Phone |
| Mode Name: | TA-1339 |
| Condition of EUT as received: | No obvious damage in appearance |
| Operating mode(s) : | GSM 850/1900, WCDMA Band 2/4/5<br>LTE Band 2/4/5/7/12/17/28/66, Bluetooth, WLAN 2.4G |

## 3.2. Internal Identification of EUT used during the test

| EUT ID* | IMEI | HW Version | SW Version | Receipt Date |
|---|---|---|---|---|
| UT05aa | 357321210003827 | V01 | 00WW_0_070 | 2021-03-01 |
| UT01aa | 357321211569966 | V01B | 000T_0_513 | 2022-01-05 |

*EUT ID: is used to identify the test sample in the lab internally.

**Note:** It is performed to test HAC with the UT05aa.

## 3.3. Internal Identification of AE used during the test

| AE ID* | Description | Model | Manufacturer |
|---|---|---|---|
| AE1 | Battery | BL-29CI | Fenghua Battery Co., Ltd. |
| AE2 | Headset | JWEP1199-M01H(178210504) | JUWEI ELECTRONICS CO.,LTD |

*AE ID: is used to identify the test sample in the lab internally.

## 3.4. Air Interfaces and Operating Modes

| **Air-interface** | **Band(MHz)** | **Type** | **C63.19 / tested** | **Simultaneous Transmissions** | **Name of Voice Service** | **Power Reduction** |
|---|---|---|---|---|---|---|
| GSM | 850 /1900 | VO | Yes | BT,WLAN | CMRS Voice | No |
| EDGE | 850 /1900 | DT | No | BT,WLAN | NA | |
| WCDMA | B2 / B4/ B5 | VO | Yes | BT,WLAN | CMRS Voice | No |
| | HSPA | DT | No | BT,WLAN | NA | |
| LTE (FDD) | 2/4/5/7/12/17/28/66 | VD | Yes | BT,WLAN | VoLTE | No |
| WLAN | 2.4G | VD | Yes | WWAN | VoWIFI | No |
| Bluetooth | 2.4G | DT | No | WWAN | NA | No |

VO: Voice Only

VD: CMRS and IP Voice Service over Digital Transport

DT: Digital Transport only (no voice)

* HAC Rating was not based on concurrent voice and data modes; Non-current mode was found to represent worst case rating for both M and T rating

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# 4. Reference Documents

The following document listed in this section is referred for testing.

| Reference | Title | Version |
|---|---|---|
| ANSI C63.19-2011 | American National Standard for Methods of Measurement of Compatibility between Wireless Communication Devices and Hearing Aids | 2011 |
| KDB 285076 D01 | Equipment Authorization Guidance for Hearing Aid Compatibility | v05 |
| KDB 285076 D02 | Guidance for performing T-Coil tests for air interfaces supporting voice over IP (e.g., LTE and WiFi) to support CMRS based telephone services | v03 |

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# 5. Operational Conditions During Test

## 5.1. HAC 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.

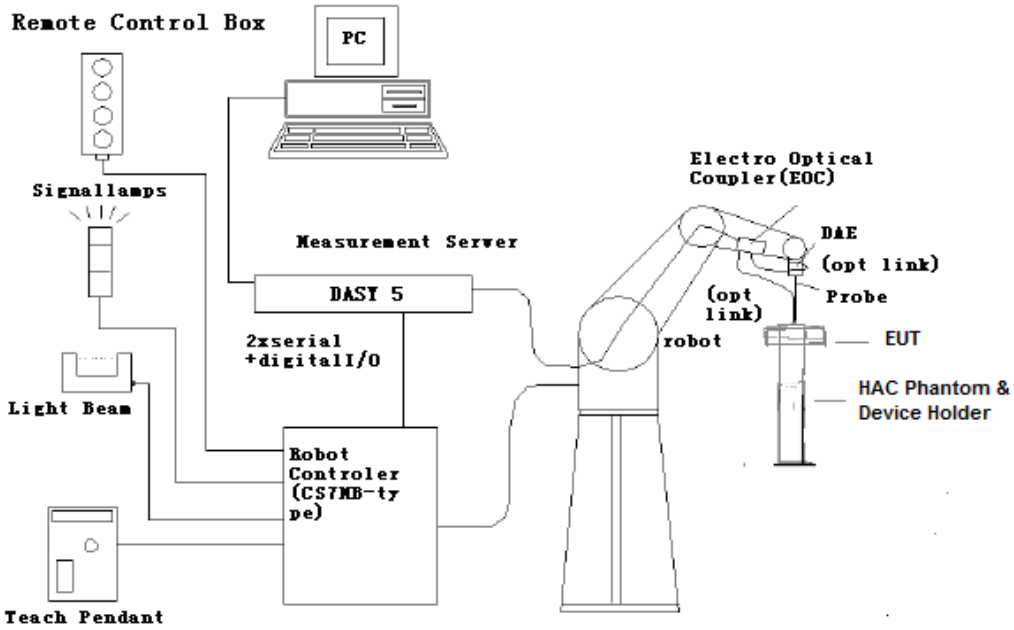


**Fig. 1 HAC Test Measurement Set-up**

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.

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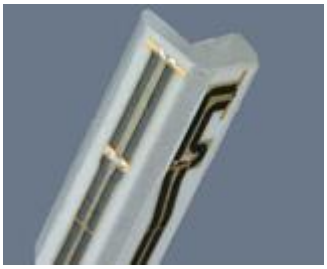
## 5.2. Probe Specification

E-Field Probe Description



**[ER3DV6]**

| | |
|---|---|
| Construction | One dipole parallel, two dipoles normal to probe axis<br>Built-in shielding against static charges<br>PEEK enclosure material |
| Calibration | In air from 100 MHz to 3.0 GHz (absolute accuracy ±6.0%, k=2) |
| Frequency | 40 MHz to > 6 GHz (can be extended to < 20 MHz)<br>Linearity: ± 0.2 dB (100 MHz to 3 GHz) |
| Directivity | ± 0.2 dB in air (rotation around probe axis)<br>± 0.4 dB in air (rotation normal to probe axis) |
| Dynamic Range | 2 V/m to > 1000 V/m; Linearity: ± 0.2 dB |
| Dimensions | Overall length: 330 mm (Tip: 16 mm)<br>Tip diameter: 8 mm (Body: 12 mm)<br>Distance from probe tip to dipole centers: 2.5 mm |
| Application | General near-field measurements up to 6 GHz<br>Field component measurements<br>Fast automatic scanning in phantoms |

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## 5.3. 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.

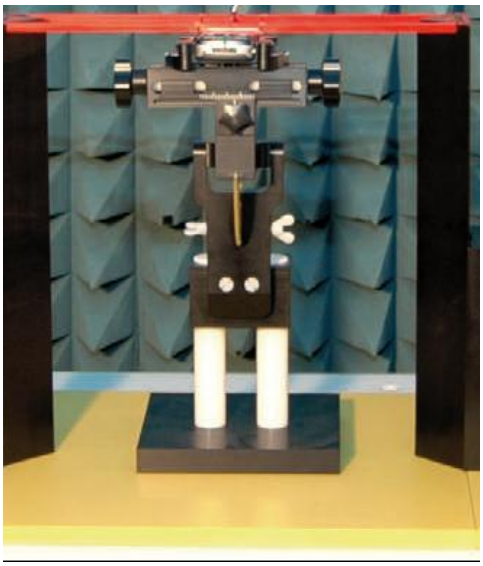

**Fig. 2 HAC Phantom & Device Holder**

## 5.4. Robotic System Specifications

### Specifications

**Positioner:** Stäubli Unimation Corp. Robot Model: RX160XL
**Repeatability:** ±0.02 mm
**No. of Axis:** 6

### Data Acquisition Electronic (DAE) System

**Cell Controller**
**Processor:** Intel Core2
**Clock Speed:** 1.86 GHz
**Operating System:** Windows XP
**Data Converter**
**Features:**Signal Amplifier, multiplexer, A/D converter, and control logic
**Software:** DASY5 software
**Connecting Lines:** Optical downlink for data and status info.
Optical uplink for commands and clock

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# 6. EUT Arrangement

## 6.1. WD RF Emission Measurements Reference and Plane

Figure 4 illustrates the references and reference plane that shall be used in the WD emissions measurement.

• The grid is 5 cm by 5 cm area that is divided into 9 evenly sized blocks or sub-grids.

• The grid is centered on the audio frequency output transducer of the WD (speaker or T-coil).

• The grid is located by reference to a reference plane. This 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 located parallel to the reference plane and 15 mm from it, out from the phone. The grid is located in the measurement plane.

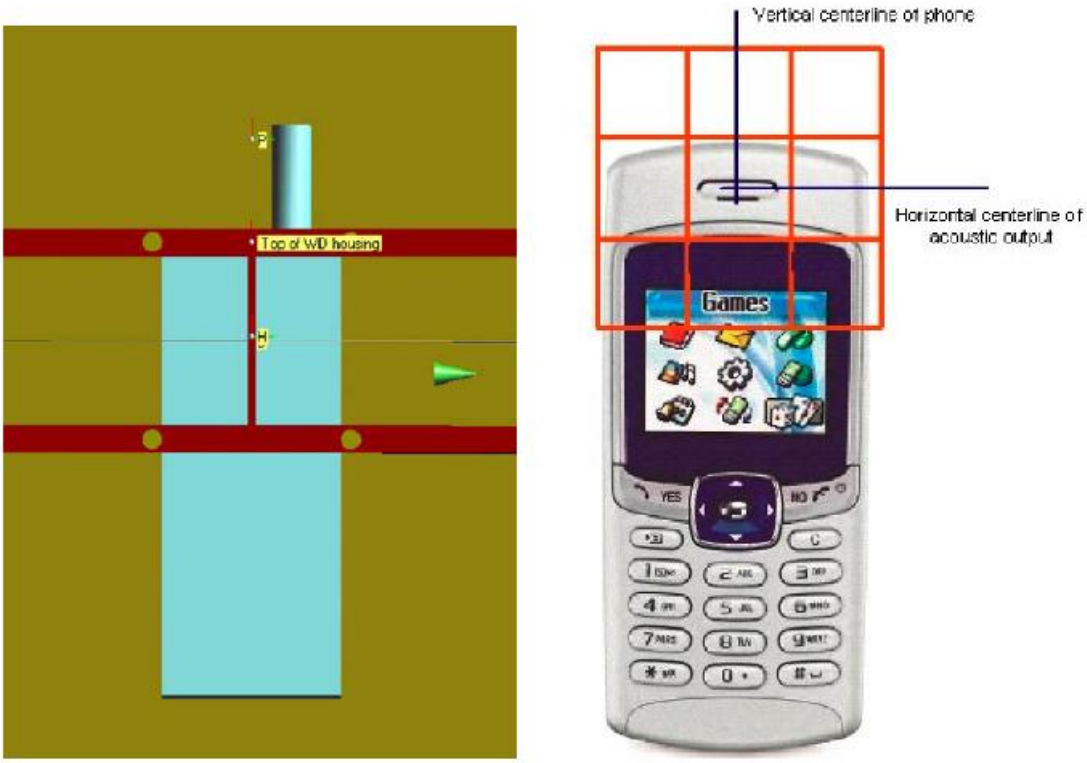


**Fig. 3 WD reference and plane for RF emission measurements**

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# 7. System Validation

## 7.1. Validation Procedure

Place a dipole antenna meeting the requirements given in ANSI C63.19 in the position normally occupied by the WD. The dipole antenna serves as a known source for an electrical output. Position the E-field probes so that:

• The probes and their cables are parallel to the coaxial feed of the dipole antenna

• The probe cables and the coaxial feed of the dipole antenna approach the measurement area from opposite directions

• The center point of the probe element(s) are 15 mm from the closest surface of the dipole elements.

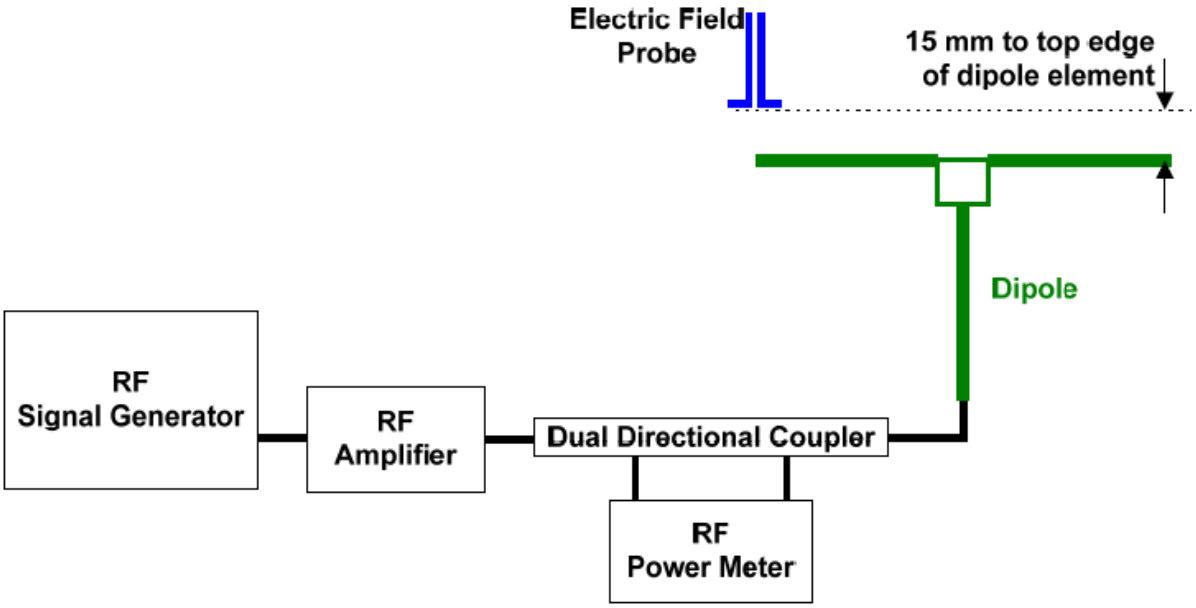


**Fig. 4 Dipole Validation Setup**

## 7.2. Validation Result

| E-Field Scan | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Measurement Date** | **Mode** | **Frequency (MHz)** | **Input Power (mW)** | **Measured[1] Value (dBV/m)** | **Target[2] Value (dBV/m)** | **Deviation[3] (%)** | **Limit[4] (%)** |
| 2021-03-02 | CW | 835 | 100 | 44.38 | 40.72 | 9.0 | ±25 |
| 2021-03-02 | CW | 1880 | 100 | 39.89 | 39.06 | 2.1 | ±25 |
| 2022-01-16 | CW | 835 | 100 | 43.64 | 41.15 | 6.1 | ±25 |

Notes:

1. Please refer to the attachment for detailed measurement data and plot.

2. Target value is provided by SPEAD in the calibration certificate of specific dipoles.

3. Deviation (%) = 100 * (Measured value minus Target value) divided by Target value.

4. ANSI C63.19 requires values within ± 25% are acceptable, of which 12% is deviation and 13% is measurement uncertainty. Values independently validated for the dipole actually used in the measurements should be used, when available.

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# 8. Modulation Interference Factor (MIF)

The HAC Standard ANSI C63.19-2011 defines a new scaling using the Modulation Interference Factor (MIF) which replaces the need for the Articulation Weighting Factor (AWF) during the evaluation and is applicable to any modulation scheme.

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 repetition rates of few 100 Hz have high MIF values and give similar classifications as ANSI C63-2007.

**Definitions**

ER3D, E-field probes have a bandwidth <10 kHz 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. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by probe modulation response (PMR) calibration in order to not overestimate the field reading.

The evaluation method or the 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 these filtering is called to a 1 kHz 80% AM signal as 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.

MIF values were not tested by a probe or as specified in the standards but are based on analysis provided by SPEAG for all the air interfaces (GSM, WCDMA, CDMA, LTE). The data included in this report are for the worst case operating modes. The UIDs used are listed below:

| UID | Communication System Name | MIF (dB) |
|---|---|---|
| 10021 | GSM-FDD (TDMA, GMSK) | 3.63 |
| 10011 | UMTS-FDD (WCDMA) | -27.23 |
| 10170 | LTE-FDD(SC-FDMA, 1RB, 20MHz, 16-QAM ) | -9.76 |
| 10176 | LTE-FDD(SC-FDMA, 1RB, 10MHz, 16-QAM ) | -9.76 |
| 10061 | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps) | -2.02 |

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A PMR calibrated probe is linearized for the selected waveform over the full dynamic range within the uncertainty specified in its calibration certificate. ER3D, EF3D and EU2D E-field probes have a bandwidth <10 kHz 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. These near field probes read the averaged E-field measurement. Especially for the new high peak-to-average (PAR) signal types, the probes shall be linearized by PMR calibration in order to not overestimate the field reading.

The MIF measurement uncertainty is estimated as follows, for modulation frequencies from slotted waveforms with fundamental frequency and at least 2 harmonics within 10 kHz:

0.2 dB for MIF -7 to +5 dB,
0.5 dB for MIF -13 to +11 dB
1 dB for MIF > -20 dB

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# 9. Evaluation for low-power exemption

## 9.1. Product testing threshold

There are two methods for exempting an RF air interface technology from testing. The first method requires evaluation of the MIF for the worst-case operating mode. An RF air interface technology of a device is exempt from testing when its average antenna input power plus its MIF is ≤17 dBm for any of its operating modes. The second method does not require determination of the MIF. The RF emissions testing exemption shall be applied to an RF air interface technology in a device whose peak antenna input power, averaged over intervals ≤50 μs20, is ≤23 dBm. An RF air interface technology that is exempted from testing by either method shall be rated as M4.
The first method is used to be exempt from testing for the RF air interface technology in this report.

## 9.2. Conducted power

| Band | power (dBm) | MIF (dB) | Sum (dBm) | HAC Test |
|---|---|---|---|---|
| GSM 850 | 33.0 | 3.63 | 36.63 | Yes |
| GSM 1900 | 30.0 | 3.63 | 33.63 | Yes |
| WCDMA B2 | 24.5 | -27.23 | -2.73 | No |
| WCDMA B4 | 25.0 | -27.23 | -2.23 | No |
| WCDMA B5 | 24.5 | -27.23 | -2.73 | No |
| LTE Band 2 | 24.0 | -9.76 | 14.24 | No |
| LTE Band 4 | 24.0 | -9.76 | 14.24 | No |
| LTE Band 5 | 24.0 | -9.76 | 14.24 | No |
| LTE Band 7 | 22.5 | -9.76 | 12.74 | No |
| LTE Band 12 | 24.0 | -9.76 | 14.24 | No |
| LTE Band 17 | 24.0 | -9.76 | 14.24 | No |
| LTE Band 28 | 24.0 | -9.76 | 14.24 | No |
| LTE Band 66 | 24.0 | -9.76 | 14.24 | No |
| WLAN 2.4G | 18.5 | -2.02 | 16.48 | No |

**Note:**

1. Power = Max tune-up limit

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## 10. RF Test Procedures

**The evaluation was performed with the following procedure:**

1) Confirm proper operation of the field probe, probe measurement system and other instrumentation and the positioning system.

2) Position the WD in its intended test position. The gauge block can simplify this positioning.

3) Configure the WD normal operation for maximum rated RF output power, at the desired channel and other operating parameters (e.g., test mode), as intended for the test.

4) The center sub-grid shall centered on the center of the T-Coil mode axial measurement point or the acoustic output, as appropriate. Locate the field probe at the initial test position in the 50 mm by 50 mm grid, which is contained in the measurement plane. If the field alignment method is used, align the probe for maximum field reception.

5) Record the reading.

6) Scan the entire 50 mm by 50 mm region in equally spaced increments and record the reading at each measurement point. The distance between measurement points shall be sufficient to assure the identification of the maximum reading.

7) Identify the five contiguous sub-grids around the center sub-grid whose maximum reading is the lowest of all available choices. This eliminates the three sub-grids with the maximum readings. Thus, the six areas to be used to determine the WD's highest emissions are identified.

8) Identify the maximum field reading within the non-excluded sub-grids identified in Step 7)

9) Evaluate the MIF and add to the maximum steady-state rms field-strength reading to obtain the RF audio interference level..

10) Compare this RF audio interference level with the categories and record the resulting WD category rating.

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## 11. Measurement Results (E-Field)

| Frequency | | Measured Value (dBV/m) | Power Drift (dB) | Category |
|---|---|---|---|---|
| MHz | Channel | | | |
| **GSM 850** | | | | |
| 848.8 | 251 | 35.45 | 0.06 | **M4** (see Fig A.1) |
| 836.6 | 190 | 35.86 | 0.02 | **M4** (see Fig A.2) |
| 824.2 | 128 | 35.87 | 0.05 | **M4** (see Fig A.3) |
| **GSM 1900** | | | | |
| 1909.8 | 810 | 23.30 | 0.09 | **M4** (see Fig A.4) |
| 1880.0 | 661 | 22.76 | 0.05 | **M4** (see Fig A.5) |
| 1850.2 | 512 | 24.13 | 0.10 | **M4** (see Fig A.6) |

## 12. ANSI C 63.19-2011 Limits

**WD RF audio interference level categories in logarithmic 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) |

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## 13. Measurement Uncertainty

| No. | Error source | Type | Uncertainty Value (%) | Prob. Dist. | k | $c_i$ E | Standard Uncertainty (%) $u_i^{'}$ (%) E | Degree of freedom $V_{eff}$ or $v_i$ | source |
|---|---|---|---|---|---|---|---|---|---|
| 1 | System repeatability | A | 0.24 | N | 1 | 1 | 0.24 | 9 | Measurement |
| **Measurement System** | | | | | | | | | |
| 2 | Probe Calibration | B | 10.1 | N | 1 | 1 | 10.1 | ∞ | Manufacturer |
| 3 | Axial Isotropy | B | 0.5 | R | $\sqrt{3}$ | 1 | 0.5 | ∞ | Cal report |
| 4 | Sensor Displacement | B | 16.5 | R | $\sqrt{3}$ | 1 | 9.5 | ∞ | Manufacturer |
| 5 | Boundary Effects | B | 2.4 | R | $\sqrt{3}$ | 1 | 1.4 | ∞ | Manufacturer |
| 6 | Linearity | B | 0.6 | R | $\sqrt{3}$ | 1 | 0.35 | ∞ | Cal report |
| 7 | Scaling to Peak Envolope Power | B | 2.0 | R | $\sqrt{3}$ | 1 | 1.2 | ∞ | Standard |
| 8 | System Detection Limit | B | 1.0 | R | $\sqrt{3}$ | 1 | 0.6 | ∞ | Manufacturer |
| 9 | Readout Electronics | B | 0.3 | N | 1 | 1 | 0.3 | ∞ | Manufacturer |
| 10 | Response Time | B | 0.8 | R | $\sqrt{3}$ | 1 | 0.5 | ∞ | Manufacturer |
| 11 | Integration Time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1.5 | ∞ | Manufacturer |
| 12 | RF Ambient Conditions | B | 3.0 | R | $\sqrt{3}$ | 1 | 1.7 | ∞ | Measurement |
| 13 | RF Reflections | B | 12.0 | R | $\sqrt{3}$ | 1 | 6.9 | ∞ | Measurement |
| 14 | Probe Positioner | A | 1.2 | R | $\sqrt{3}$ | 1 | 0.7 | ∞ | Manufacturer |
| 15 | Probe Positioning | A | 4.7 | R | $\sqrt{3}$ | 1 | 2.7 | ∞ | Manufacturer |
| 16 | Extra. And Interpolation | B | 1.0 | R | $\sqrt{3}$ | 1 | 0.6 | ∞ | Manufacturer |
| **Test Sample Related** | | | | | | | | | |
| 17 | Device Positioning Vertical | B | 4.7 | R | $\sqrt{3}$ | 1 | 2.7 | ∞ | Manufacturer |
| 18 | Device Positioning Lateral | B | 1.0 | R | $\sqrt{3}$ | 1 | 0.6 | ∞ | Manufacturer |
| 19 | Device Holder and Phantom | B | 2.4 | R | $\sqrt{3}$ | 1 | 1.4 | ∞ | Manufacturer |
| 20 | Power Drift | B | 5.0 | R | $\sqrt{3}$ | 1 | 2.9 | ∞ | Measurement |
| **Phantom and Setup related** | | | | | | | | | |
| 21 | Phantom Thickness | B | 2.4 | R | $\sqrt{3}$ | 1 | 1.4 | ∞ | Manufacturer |
| **PMF related** | | | | | | | | | |
| 22 | Monitor amplitude | B | 3.5 | R | $\sqrt{3}$ | 1 | 2.02 | ∞ | Manufacturer |
| 23 | Setup repeatability | A | 2.3 | N | 1 | 1 | 2.3 | 9 | Manufacturer |
| 24 | Sensor amplitude | B | 12 | R | $\sqrt{3}$ | 1 | 6.93 | ∞ | Manufacturer |
| | Combined standard uncertainty (%) | | | | | | 18.3 | | |
| | Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | N | k=2 | | 36.6 | | |

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## 14. Main Test Instruments

**Table 14-1: List of Main Instruments**

| No. | Name | Type | Serial Number | Calibration Date | Valid Period |
|---|---|---|---|---|---|
| 01 | Signal Generator | E8257D | MY47461211 | 2022-01-15 | One year |
| 02 | Power meter | E4418B | MY50000366 | 2021-12-13 | One year |
| 03 | Power sensor | E9304A | MY50000188 | | |
| 04 | Amplifier | VTL5400 | 0404 | / | |
| 05 | HAC Test Arch | N/A | 1150 | / | |
| 06 | E-Field Probe | ER3DV6 | 2302 | 2020-06-19 | Three year |
| 07 | DAE | DAE4 | 1527 | 2020-11-06 | One year |
| 08 | E-Field Probe | ER3DV6 | 2424 | 2021-03-04 | Three year |
| 09 | DAE | DAE4 | 786 | 2021-04-09 | One year |
| 10 | HAC Dipole | CD835V3 | 1165 | 2018-07-19 & 2021-05-18 | Three year |
| 11 | HAC Dipole | CD1880V3 | 1149 | 2018-07-19 | Three year |
| 12 | BTS | CMW500 | 152499 | 2021-07-16 | One year |
| 13 | Software | DASY5 | / | / | / |

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# ANNEX A: RF Emission Test Plot

**HAC RF E-Field GSM 850 High**

Date: 2021-3-2

Electronics: DAE4 Sn1527

Medium: Air

Medium parameters used: $\sigma$ = 0 S/m, $\varepsilon_r$ = 1; $\rho$ = 1000 kg/m$^3$

Communication System: UID 0, GSM Frequency: 848.8 MHz Duty Cycle: 1:8.3

Probe: ER3DV6 - SN2302 ConvF (1, 1, 1);

**E Scan - ER3DV6 - 2011: 15 mm from Probe Center to the Device/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 = 49.96 V/m; Power Drift = 0.06 dB

Applied MIF = 3.63 dB

RF audio interference level = 35.45 dBV/m

**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4**<br>**34.65 dBV/m** | Grid 2 **M4**<br>**35.21 dBV/m** | Grid 3 **M4**<br>**34.69 dBV/m** |
| Grid 4 **M4**<br>**34.84 dBV/m** | Grid 5 **M4**<br>**35.45 dBV/m** | Grid 6 **M4**<br>**35.1 dBV/m** |
| Grid 7 **M4**<br>**34.79 dBV/m** | Grid 8 **M4**<br>**35.66 dBV/m** | Grid 9 **M4**<br>**35.33 dBV/m** |

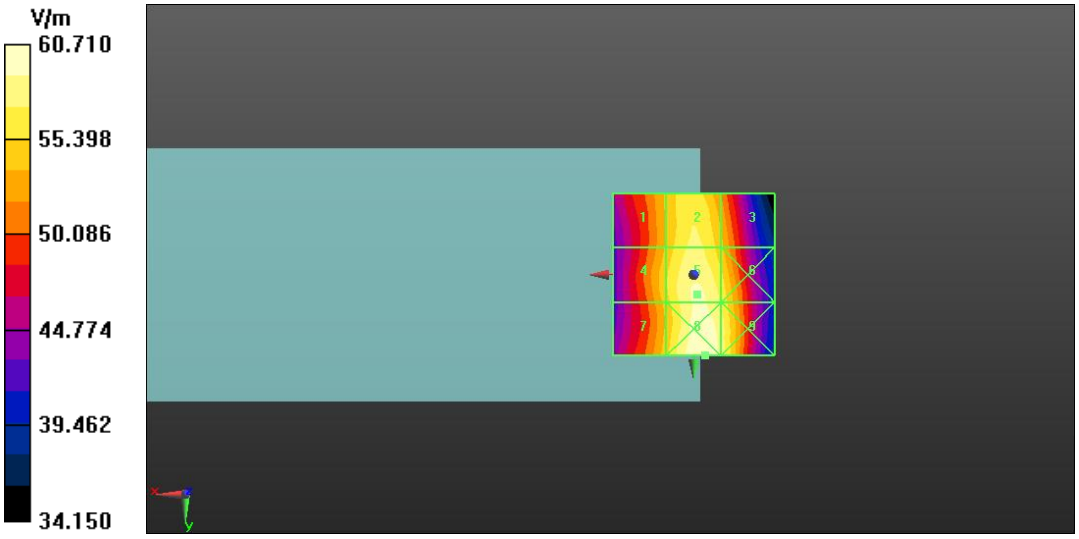


**Fig A.1 HAC RF E-Field GSM850**

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**HAC RF E-Field GSM 850 Middle**

Date: 2021-3-2

Electronics: DAE4 Sn1527

Medium: Air

Medium parameters used: $\sigma$ = 0 S/m, $\varepsilon_r$ = 1; $\rho$ = 1000 kg/m$^3$

Communication System: UID 0, GSM Frequency: 836.6 MHz Duty Cycle: 1:8.3

Probe: ER3DV6 - SN2302 ConvF (1, 1, 1);

**E Scan - ER3DV6 - 2011: 15 mm from Probe Center to the Device /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 = 52.39 V/m; Power Drift = 0.02 dB

Applied MIF = 3.63 dB

RF audio interference level = 35.86 dBV/m

**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4**<br>**34.98 dBV/m** | Grid 2 **M4**<br>**35.57 dBV/m** | Grid 3 **M4**<br>**35.05 dBV/m** |
| Grid 4 **M4**<br>**35.24 dBV/m** | Grid 5 **M4**<br>**35.86 dBV/m** | Grid 6 **M4**<br>**35.51 dBV/m** |
| Grid 7 **M4**<br>**35.22 dBV/m** | Grid 8 **M4**<br>**36.09 dBV/m** | Grid 9 **M4**<br>**35.74 dBV/m** |

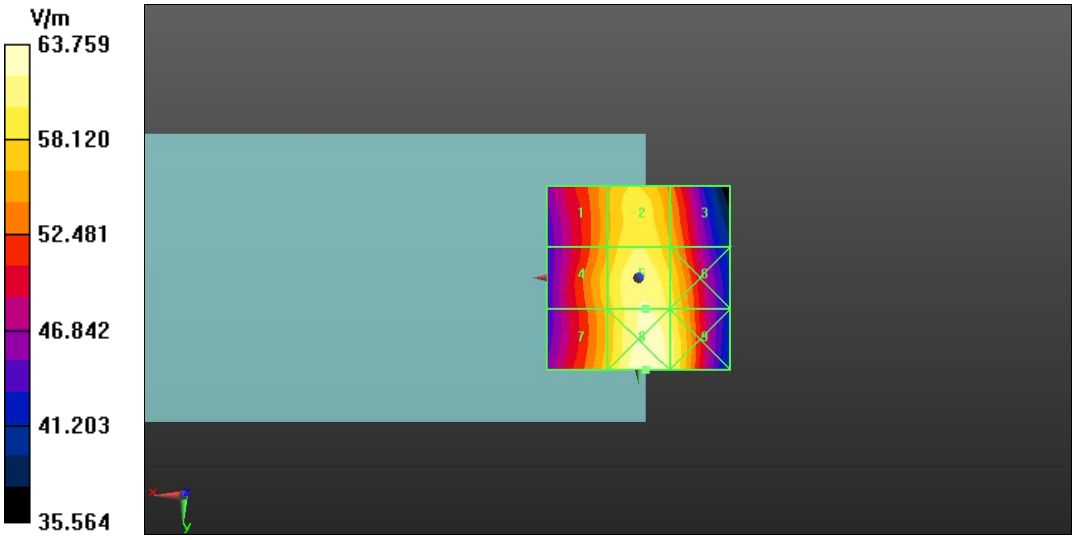


**Fig A.2 HAC RF E-Field GSM850**

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**HAC RF E-Field GSM 850 Low**

Date: 2021-3-2

Electronics: DAE4 Sn1527

Medium: Air

Medium parameters used: $\sigma$ = 0 S/m, $\varepsilon_r$ = 1; $\rho$ = 1000 kg/m$^3$

Communication System: UID 0, GSM Frequency: 824.2 MHz Duty Cycle: 1:8.3

Probe: ER3DV6 - SN2302 ConvF (1, 1, 1);

**E Scan - ER3DV6 - 2011: 15 mm from Probe Center to the Device/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 = 52.13 V/m; Power Drift = 0.05 dB

Applied MIF = 3.63 dB

RF audio interference level = 35.87 dBV/m

**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4**<br>**34.96 dBV/m** | Grid 2 **M4**<br>**35.56 dBV/m** | Grid 3 **M4**<br>**35.04 dBV/m** |
| Grid 4 **M4**<br>**35.2 dBV/m** | Grid 5 **M4**<br>**35.87 dBV/m** | Grid 6 **M4**<br>**35.49 dBV/m** |
| Grid 7 **M4**<br>**35.22 dBV/m** | Grid 8 **M4**<br>**36.06 dBV/m** | Grid 9 **M4**<br>**35.67 dBV/m** |

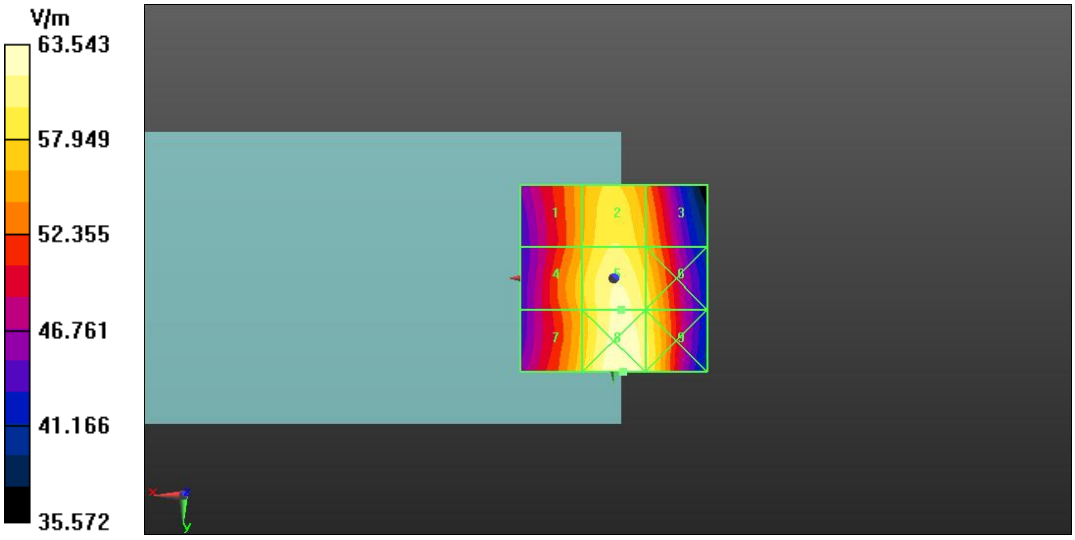


**Fig A.3 HAC RF E-Field GSM850**

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**HAC RF E-Field GSM 1900 High**

Date: 2021-3-2

Electronics: DAE4 Sn1527

Medium: Air

Medium parameters used: $\sigma$ = 0 S/m, $\varepsilon_r$ = 1; $\rho$ = 1000 kg/m$^3$

Communication System: UID 0, GSM Frequency: 1909.8 MHz Duty Cycle: 1:8.3

Probe: ER3DV6 - SN2302 ConvF (1, 1, 1);

**E Scan - ER3DV6 - 2011: 15 mm from Probe Center to the Device/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 = 11.72 V/m; Power Drift = 0.09 dB

Applied MIF = 3.63 dB

RF audio interference level = 23.30 dBV/m

**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4**<br>**27.49 dBV/m** | Grid 2 **M4**<br>**21.34 dBV/m** | Grid 3 **M4**<br>**21.34 dBV/m** |
| Grid 4 **M4**<br>**27.49 dBV/m** | Grid 5 **M4**<br>**22.85 dBV/m** | Grid 6 **M4**<br>**22.76 dBV/m** |
| Grid 7 **M4**<br>**26.99 dBV/m** | Grid 8 **M4**<br>**23.3 dBV/m** | Grid 9 **M4**<br>**23.23 dBV/m** |

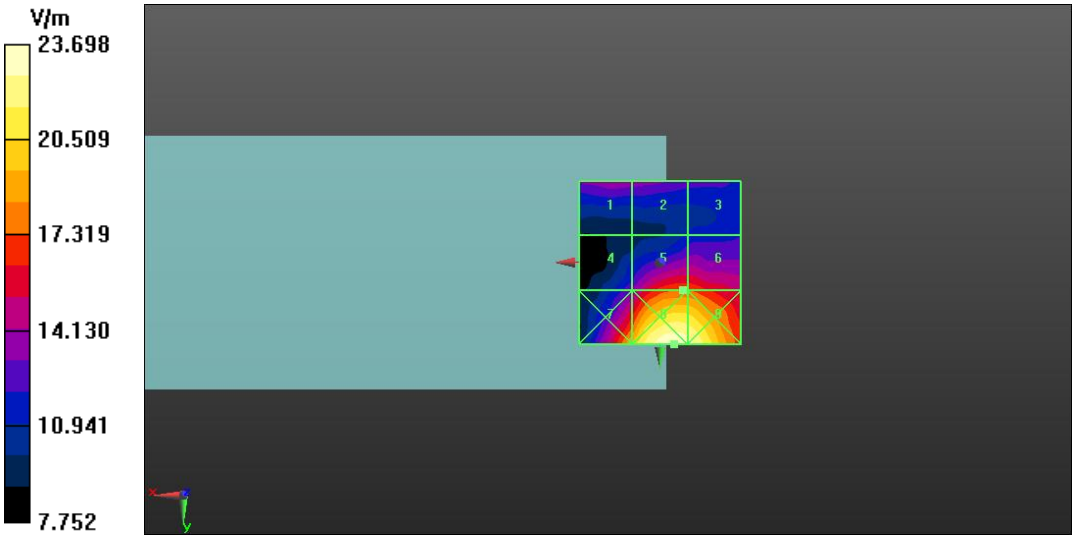


**Fig A.4 HAC RF E-Field GSM1900**

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**HAC RF E-Field GSM 1900 Middle**

Date: 2021-3-2

Electronics: DAE4 Sn1527

Medium: Air

Medium parameters used: $\sigma$ = 0 S/m, $\varepsilon_r$ = 1; $\rho$ = 1000 kg/m$^3$

Communication System: UID 0, GSM Frequency: 1880 MHz Duty Cycle: 1:8.3

Probe: ER3DV6 - SN2302 ConvF (1, 1, 1);

**E Scan - ER3DV6 - 2011: 15 mm from Probe Center to the Device/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 = 8.398 V/m; Power Drift = 0.05 dB

Applied MIF = 3.63 dB

RF audio interference level = 22.76 dBV/m

**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4**<br>**20.96 dBV/m** | Grid 2 **M4**<br>**20.83 dBV/m** | Grid 3 **M4**<br>**20.12 dBV/m** |
| Grid 4 **M4**<br>**20.47 dBV/m** | Grid 5 **M4**<br>**22.76 dBV/m** | Grid 6 **M4**<br>**22.75 dBV/m** |
| Grid 7 **M4**<br>**23.87 dBV/m** | Grid 8 **M4**<br>**25.45 dBV/m** | Grid 9 **M4**<br>**25.24 dBV/m** |

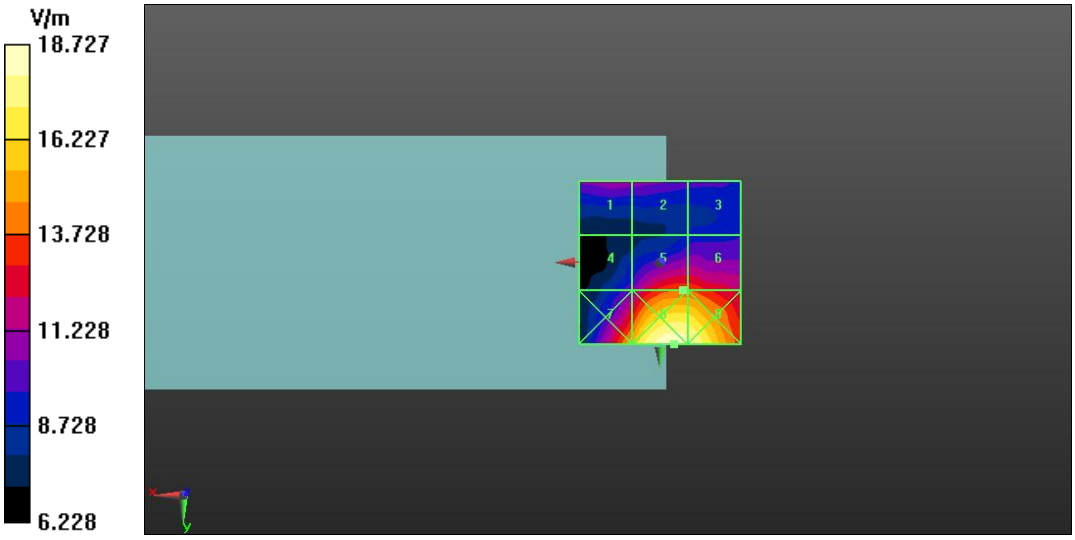


**Fig A.5 HAC RF E-Field GSM1900**

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**HAC RF E-Field GSM 1900 Low**

Date: 2021-3-2

Electronics: DAE4 Sn1527

Medium: Air

Medium parameters used: $\sigma$ = 0 S/m, $\varepsilon_r$ = 1; $\rho$ = 1000 kg/m$^3$

Communication System: UID 0, GSM Frequency: 1850.2 MHz Duty Cycle: 1:8.3

Probe: ER3DV6 - SN2302 ConvF (1, 1, 1);

**E Scan - ER3DV6 - 2011: 15 mm from Probe Center to the Device /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 = 6.095 V/m; Power Drift = 0.10 dB

Applied MIF = 3.63 dB

RF audio interference level = 24.13 dBV/m

**Emission category: M4**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M4**<br>**23.99 dBV/m** | Grid 2 **M4**<br>**24.13 dBV/m** | Grid 3 **M4**<br>**23.33 dBV/m** |
| Grid 4 **M4**<br>**20.97 dBV/m** | Grid 5 **M4**<br>**23.02 dBV/m** | Grid 6 **M4**<br>**22.99 dBV/m** |
| Grid 7 **M4**<br>**26.68 dBV/m** | Grid 8 **M4**<br>**27.86 dBV/m** | Grid 9 **M4**<br>**27.56 dBV/m** |

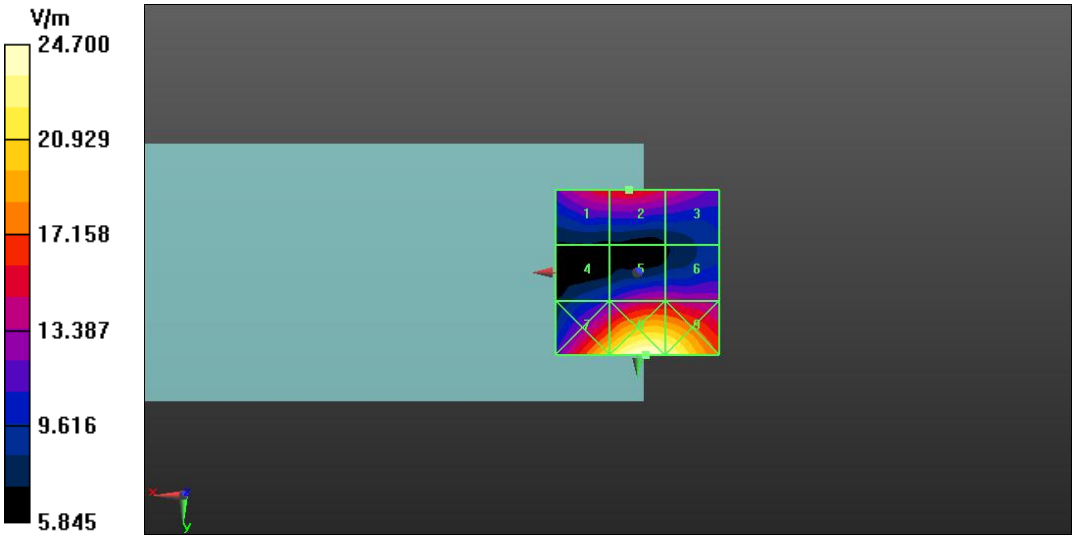


**Fig A.6 HAC RF E-Field GSM1900**

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# ANNEX B: System Validation Result

**835 MHz**

Date: 2021-3-2

Electronics: DAE4 Sn1527

Medium: Air

Medium parameters used: σ = 0 mho/m, εr = 1; ρ = 1000 kg/m3

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Probe: ER3DV6 - SN2302; ConvF (1, 1, 1)

**E Scan - measurement distance from the probe sensor center to CD835 Dipole = 15mm /Hearing Aid Compatibility Test (41x361x1):** Interpolated grid: dx=0.5000 mm, dy=0.5000 mm

Device Reference Point: 0, 0, -6.3 mm

Reference Value = 122.5 V/m; Power Drift = 0.09 dB

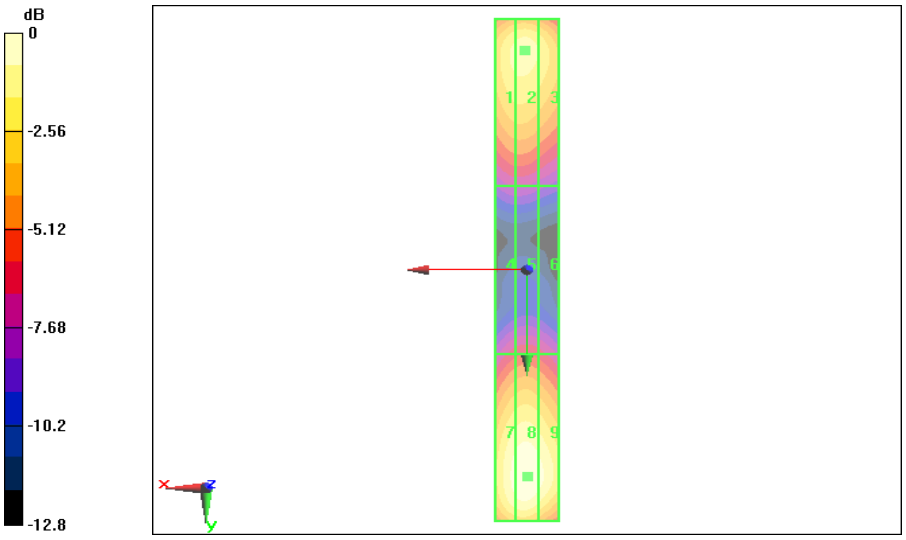
Applied MIF = 0.00 dB

RF audio interference level = 44.38 dBV/m

**Emission category: M3**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M3**<br>**43.74 dBV/m** | Grid 2 **M3**<br>**44.29 dBV/m** | Grid 3 **M3**<br>**44.15 dBV/m** |
| Grid 4 **M4**<br>**39.29 dBV/m** | Grid 5 **M4**<br>**39.64 dBV/m** | Grid 6 **M4**<br>**39.58 dBV/m** |
| Grid 7 **M3**<br>**43.81 dBV/m** | Grid 8 **M3**<br>**44.38 dBV/m** | Grid 9 **M3**<br>**44.22 dBV/m** |




0 dB = 44.38 dBV/m

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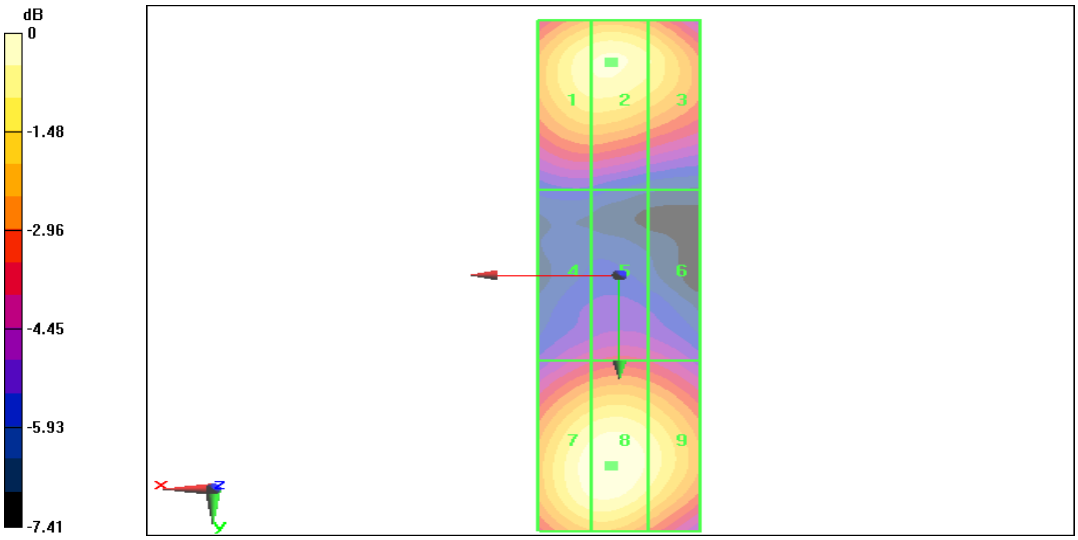
**1880 MHz**
Date: 2021-3-2
Electronics: DAE4 Sn1527
Medium: Air
Medium parameters used: σ = 0 mho/m, $\varepsilon_r$ = 1; ρ = 1000 kg/m$^3$
Communication System: CW; Frequency: 1880 MHz; Duty Cycle: 1:1
Probe: ER3DV6 - SN2302; ConvF (1, 1, 1)

**E Scan - measurement distance from the probe sensor center to CD1880 Dipole = 15mm /Hearing Aid Compatibility Test (41x181x1):** Interpolated grid: dx=0.5000 mm, dy=0.5000 mm
Device Reference Point: 0, 0, -6.3 mm
Reference Value = 137.4 V/m; Power Drift = 0.10 dB
Applied MIF = 0.00 dB
RF audio interference level = 39.89 dBV/m
**Emission category: M2**

MIF scaled E-field

| | | |
|---|---|---|
| Grid 1 **M2**<br>**39.43 dBV/m** | Grid 2 **M2**<br>**39.89 dBV/m** | Grid 3 **M2**<br>**39.78 dBV/m** |
| Grid 4 **M2**<br>**37.81 dBV/m** | Grid 5 **M2**<br>**37.95 dBV/m** | Grid 6 **M2**<br>**37.89 dBV/m** |
| Grid 7 **M2**<br>**39.37 dBV/m** | Grid 8 **M2**<br>**39.83 dB V/m** | Grid 9 **M2**<br>**39.72 dBV/m** |




0 dB = 39.89 dBV/m

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# ANNEX C: Probe Calibration Certificate

## ER3DV6-SN: 2302 Calibration Certificate (2020)

**Calibration Laboratory of**
Schmid & Partner
Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
Servizio svizzero di taratura
**S** Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

**Accreditation No.: SCS 0108**

**Client** **Auden**

**Certificate No: ER3-2302_Jun20**

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | ER3DV6- SN:2302 |
| Calibration procedure(s) | QA CAL-02.v9, QA CAL-25.v7<br>Calibration procedure for E-field probes optimized for close near field evaluations in air |
| Calibration date: | June 19, 2020 |

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter NRP | SN: 104778 | 01-Apr-20 (No. 217-03100/03101) | Apr-21 |
| Power sensor NRP-Z91 | SN: 103244 | 01-Apr-20 (No. 217-03100) | Apr-21 |
| Power sensor NRP-Z91 | SN: 103245 | 01-Apr-20 (No. 217-03101) | Apr-21 |
| Reference 20 dB Attenuator | SN: CC2552 (20x) | 31-Mar-20 (No. 217-03106) | Apr-21 |
| DAE4 | SN: 789 | 18-Jun-20 (No. DAE4-789_Jun20) | Jun-21 |
| Reference Probe ER3DV6 | SN: 2328 | 05-Oct-19 (No. ER3-2328_Oct19) | Oct-20 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| Power meter E4419B | SN: GB41293874 | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A | SN: MY41498087 | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| Power sensor E4412A | SN: 000110210 | 06-Apr-16 (in house check Jun-18) | In house check: Jun-20 |
| RF generator HP 8648C | SN: US3642U01700 | 04-Aug-99 (in house check Jun-18) | In house check: Jun-20 |
| Network Analyzer E8358A | SN: US41080477 | 31-Mar-14 (in house check Oct-19) | In house check: Oct-20 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Jeffrey Katzman | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: June 25, 2020

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: ER3-2302_Jun20 Page 1 of 21

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**Calibration Laboratory of**
Schmid & Partner
Engineering AG
**Zeughausstrasse 43, 8004 Zurich, Switzerland**

**S** Schweizerischer Kalibrierdienst
**C** Service suisse d'étalonnage
**S** Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
**The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates**

**Accreditation No.: SCS 0108**

## Glossary:

| | |
|---|---|
| NORMx,y,z | sensitivity in free space |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A, B, C, D | modulation dependent linearization parameters |
| En | incident E-field orientation normal to probe axis |
| Ep | incident E-field orientation parallel to probe axis |
| Polarization φ | φ rotation around probe axis |
| Polarization ϑ | ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1309-2005, " IEEE Standard for calibration of electromagnetic field sensors and probes, excluding antennas, from 9 kHz to 40 GHz", December 2005
b) CTIA Test Plan for Hearing Aid Compatibility, Rev 3.1.1, May 2017

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 for XY sensors and ϑ = 90 for Z sensor (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart).
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *Spherical isotropy (3D deviation from isotropy)*: in a locally homogeneous field realized using an open waveguide setup.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).



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# DASY/EASY - Parameters of Probe: ER3DV6 - SN:2302

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm (μV/(V/m)$^2$) | 1.49 | 1.35 | 1.40 | ± 10.1 % |
| DCP (mV)[B] | 99.1 | 99.4 | 104.0 | |

## Calibration results for Frequency Response (30 MHz – 3 GHz)

| Frequency MHz | Target E-Field V/m | Measured E-field (En) V/m | Deviation E-normal in % | Measured E-field (Ep) V/m | Deviation E-normal in % | Unc (k=2) % |
|---|---|---|---|---|---|---|
| 30 | 77.2 | 76.8 | -0.6% | 77.5 | 0.4% | ± 5.1% |
| 100 | 77.4 | 78.7 | 1.7% | 78.1 | 0.9% | ± 5.1% |
| 450 | 77.1 | 78.5 | 1.8% | 77.7 | 0.8% | ± 5.1 % |
| 600 | 77.1 | 78.1 | 1.2% | 77.5 | 0.5% | ± 5.1 % |
| 750 | 77.1 | 77.9 | 1.0% | 77.5 | 0.4% | ± 5.1 % |
| | | | | | | |
| 1800 | 143.0 | 141.7 | -1.0% | 140.8 | -1.6% | ± 5.1 % |
| 2000 | 135.0 | 134.3 | -0.5% | 133.4 | -1.2% | ± 5.1 % |
| 2200 | 127.5 | 125.9 | -1.2% | 127.4 | -0.1% | ± 5.1 % |
| 2500 | 125.6 | 126.0 | 0.3% | 127.2 | 1.3% | ± 5.1 % |
| 3000 | 79.5 | 78.4 | -1.4% | 81.3 | 2.3% | ± 5.1 % |

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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# DASY/EASY - Parameters of Probe: ER3DV6 - SN:2302

## Calibration Results for Modulation Response

| UID | Communication System Name | | A dB | B dB√μV | C | D dB | VR mV | Max dev. | Max Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.00 | 0.00 | 1.00 | 0.00 | 155.0 | ± 2.2 % | ± 4.7 % |
| | | Y | 0.00 | 0.00 | 1.00 | | 135.4 | | |
| | | Z | 0.00 | 0.00 | 1.00 | | 179.2 | | |
| 10352-AAA | Pulse Waveform (200Hz, 10%) | X | 12.46 | 86.55 | 21.46 | 10.00 | 60.0 | ± 1.8 % | ± 9.6 % |
| | | Y | 14.84 | 89.50 | 22.33 | | 60.0 | | |
| | | Z | 16.90 | 92.38 | 23.74 | | 60.0 | | |
| 10353-AAA | Pulse Waveform (200Hz, 20%) | X | 19.62 | 92.77 | 22.05 | 6.99 | 80.0 | ± 1.0 % | ± 9.6 % |
| | | Y | 20.00 | 93.24 | 22.09 | | 80.0 | | |
| | | Z | 20.00 | 94.16 | 22.81 | | 80.0 | | |
| 10354-AAA | Pulse Waveform (200Hz, 40%) | X | 20.00 | 92.96 | 20.47 | 3.98 | 95.0 | ± 0.9 % | ± 9.6 % |
| | | Y | 20.00 | 93.40 | 20.60 | | 95.0 | | |
| | | Z | 20.00 | 94.94 | 21.61 | | 95.0 | | |
| 10355-AAA | Pulse Waveform (200Hz, 60%) | X | 20.00 | 91.16 | 18.11 | 2.22 | 120.0 | ± 0.9 % | ± 9.6 % |
| | | Y | 20.00 | 90.60 | 17.76 | | 120.0 | | |
| | | Z | 20.00 | 94.14 | 19.77 | | 120.0 | | |
| 10387-AAA | QPSK Waveform, 1 MHz | X | 1.95 | 67.16 | 15.70 | 1.00 | 150.0 | ± 1.8 % | ± 9.6 % |
| | | Y | 1.97 | 67.59 | 15.99 | | 150.0 | | |
| | | Z | 1.89 | 68.38 | 16.15 | | 150.0 | | |
| 10388-AAA | QPSK Waveform, 10 MHz | X | 2.46 | 68.81 | 15.86 | 0.00 | 150.0 | ± 1.1 % | ± 9.6 % |
| | | Y | 2.52 | 69.39 | 16.26 | | 150.0 | | |
| | | Z | 2.41 | 69.51 | 16.53 | | 150.0 | | |
| 10396-AAA | 64-QAM Waveform, 100 kHz | X | 5.03 | 80.38 | 23.79 | 3.01 | 150.0 | ± 0.7 % | ± 9.6 % |
| | | Y | 3.87 | 74.73 | 21.01 | | 150.0 | | |
| | | Z | 4.29 | 76.86 | 21.62 | | 150.0 | | |
| 10399-AAA | 64-QAM Waveform, 40 MHz | X | 3.56 | 67.03 | 15.65 | 0.00 | 150.0 | ± 1.3 % | ± 9.6 % |
| | | Y | 3.59 | 67.29 | 15.84 | | 150.0 | | |
| | | Z | 3.51 | 67.31 | 15.92 | | 150.0 | | |
| 10414-AAA | WLAN CCDF, 64-QAM, 40MHz | X | 4.99 | 65.56 | 15.47 | 0.00 | 150.0 | ± 3.0 % | ± 9.6 % |
| | | Y | 5.01 | 65.71 | 15.57 | | 150.0 | | |
| | | Z | 4.83 | 65.68 | 15.56 | | 150.0 | | |

Note: For details on UID parameters see Appendix

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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# DASY/EASY - Parameters of Probe: ER3DV6 - SN:2302

## Sensor Frequency Model Parameters

| | Sensor X | Sensor Y | Sensor Z |
|---|---|---|---|
| Frequency Corr. (LF) | -1.43 | -1.13 | 0.41 |
| Frequency Corr. (HF) | 0.00 | 0.00 | 0.00 |

## Sensor Model Parameters

| | C1 fF | C2 fF | α $V^{-1}$ | T1 $ms.V^{-2}$ | T2 $ms.V^{-1}$ | T3 ms | T4 $V^{-2}$ | T5 $V^{-1}$ | T6 |
|---|---|---|---|---|---|---|---|---|---|
| X | 89.6 | 427.93 | 36.17 | 25.21 | 1.13 | 5.10 | 0.00 | 0.51 | 1.02 |
| Y | 87.2 | 413.40 | 35.84 | 24.12 | 0.97 | 5.10 | 0.41 | 0.48 | 1.01 |
| Z | 65.7 | 304.60 | 34.59 | 23.50 | 1.08 | 5.10 | 1.21 | 0.34 | 1.01 |

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Rectangular |
| Connector Angle (°) | -178.6 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 10 mm |
| Tip Diameter | 8 mm |
| Probe Tip to Sensor X Calibration Point | 2.5 mm |
| Probe Tip to Sensor Y Calibration Point | 2.5 mm |
| Probe Tip to Sensor Z Calibration Point | 2.5 mm |



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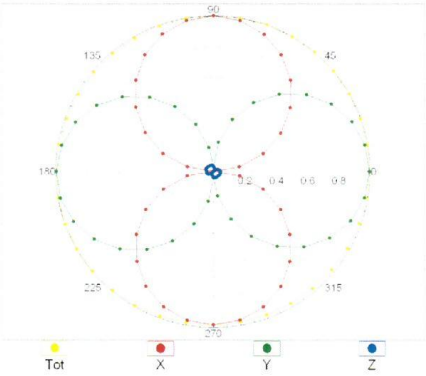
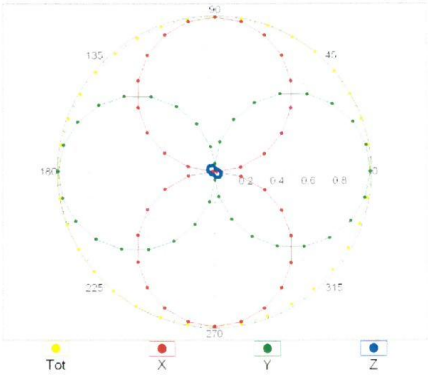
## Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM,0°

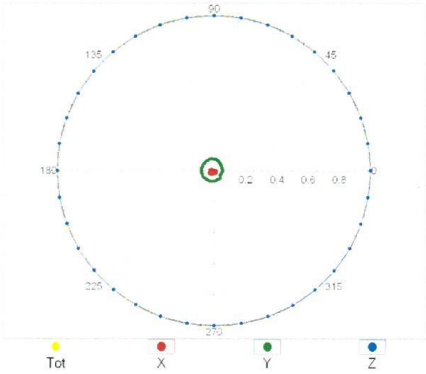



f=2500 MHz,R22,0°

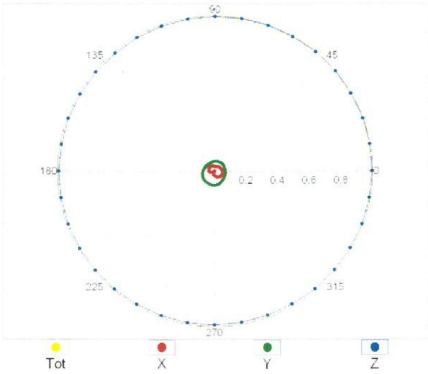



## Receiving Pattern (ϕ), ϑ = 90°

f=600 MHz,TEM,90°




f=2500 MHz,R22,90°



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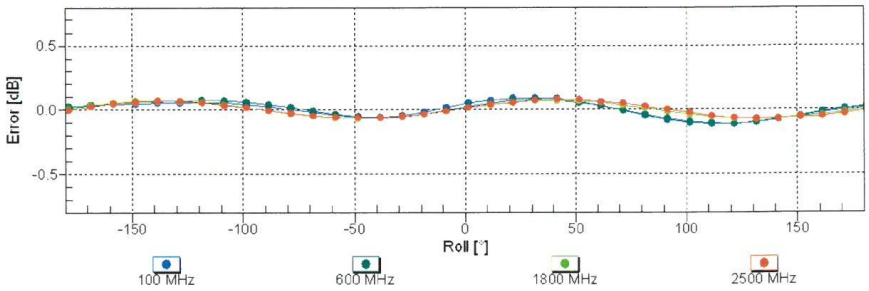
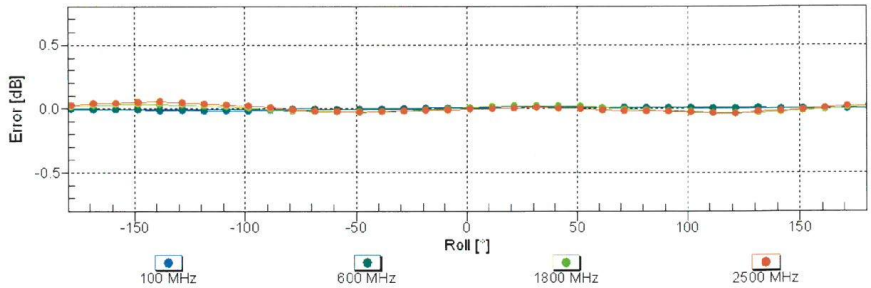
## Receiving Pattern (ϕ), ϑ = 0°




**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

## Receiving Pattern (ϕ), ϑ = 90°




**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**



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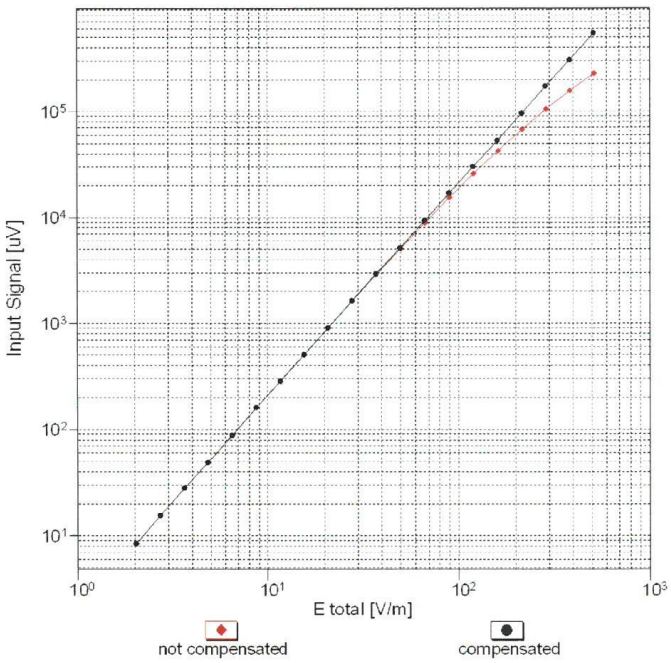
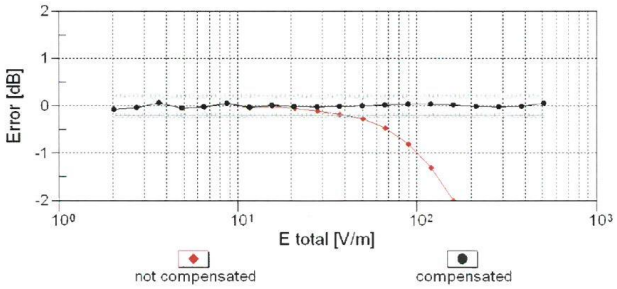
## Dynamic Range f(E-field)
**(TEM cell, f = 900 MHz)**




**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**



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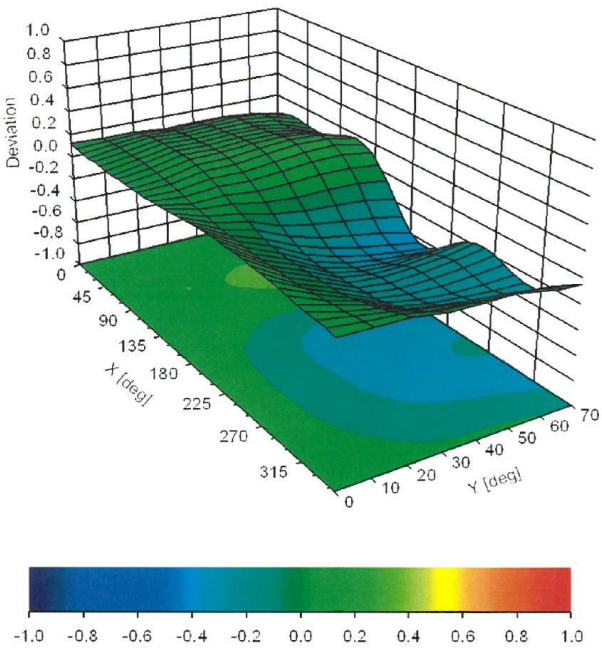
ER3DV6 – SN:2302 June 19, 2020

## Deviation from Isotropy in Air

**Error (ϕ, ϑ), f = 900 MHz**




**Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)**



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## Appendix: Modulation Calibration Parameters

| UID | Rev | Communication System Name | Group | PAR (dB) | Unc[E] (k=2) |
|---|---|---|---|---|---|
| 0 | | CW | CW | 0.00 | ± 4.7 % |
| 10010 | CAA | SAR Validation (Square, 100ms, 10ms) | Test | 10.00 | ± 9.6 % |
| 10011 | CAB | UMTS-FDD (WCDMA) | WCDMA | 2.91 | ± 9.6 % |
| 10012 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps) | WLAN | 1.87 | ± 9.6 % |
| 10013 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS-OFDM, 6 Mbps) | WLAN | 9.46 | ± 9.6 % |
| 10021 | DAC | GSM-FDD (TDMA, GMSK) | GSM | 9.39 | ± 9.6 % |
| 10023 | DAC | GPRS-FDD (TDMA, GMSK, TN 0) | GSM | 9.57 | ± 9.6 % |
| 10024 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1) | GSM | 6.56 | ± 9.6 % |
| 10025 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0) | GSM | 12.62 | ± 9.6 % |
| 10026 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1) | GSM | 9.55 | ± 9.6 % |
| 10027 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1-2) | GSM | 4.80 | ± 9.6 % |
| 10028 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-1-2-3) | GSM | 3.55 | ± 9.6 % |
| 10029 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1-2) | GSM | 7.78 | ± 9.6 % |
| 10030 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH1) | Bluetooth | 5.30 | ± 9.6 % |
| 10031 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH3) | Bluetooth | 1.87 | ± 9.6 % |
| 10032 | CAA | IEEE 802.15.1 Bluetooth (GFSK, DH5) | Bluetooth | 1.16 | ± 9.6 % |
| 10033 | CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH1) | Bluetooth | 7.74 | ± 9.6 % |
| 10034 | CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH3) | Bluetooth | 4.53 | ± 9.6 % |
| 10035 | CAA | IEEE 802.15.1 Bluetooth (PI/4-DQPSK, DH5) | Bluetooth | 3.83 | ± 9.6 % |
| 10036 | CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH1) | Bluetooth | 8.01 | ± 9.6 % |
| 10037 | CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH3) | Bluetooth | 4.77 | ± 9.6 % |
| 10038 | CAA | IEEE 802.15.1 Bluetooth (8-DPSK, DH5) | Bluetooth | 4.10 | ± 9.6 % |
| 10039 | CAB | CDMA2000 (1xRTT, RC1) | CDMA2000 | 4.57 | ± 9.6 % |
| 10042 | CAB | IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Halfrate) | AMPS | 7.78 | ± 9.6 % |
| 10044 | CAA | IS-91/EIA/TIA-553 FDD (FDMA, FM) | AMPS | 0.00 | ± 9.6 % |
| 10048 | CAA | DECT (TDD, TDMA/FDM, GFSK, Full Slot, 24) | DECT | 13.80 | ± 9.6 % |
| 10049 | CAA | DECT (TDD, TDMA/FDM, GFSK, Double Slot, 12) | DECT | 10.79 | ± 9.6 % |
| 10056 | CAA | UMTS-TDD (TD-SCDMA, 1.28 Mcps) | TD-SCDMA | 11.01 | ± 9.6 % |
| 10058 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-1-2-3) | GSM | 6.52 | ± 9.6 % |
| 10059 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 2 Mbps) | WLAN | 2.12 | ± 9.6 % |
| 10060 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 5.5 Mbps) | WLAN | 2.83 | ± 9.6 % |
| 10061 | CAB | IEEE 802.11b WiFi 2.4 GHz (DSSS, 11 Mbps) | WLAN | 3.60 | ± 9.6 % |
| 10062 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 6 Mbps) | WLAN | 8.68 | ± 9.6 % |
| 10063 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 9 Mbps) | WLAN | 8.63 | ± 9.6 % |
| 10064 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 12 Mbps) | WLAN | 9.09 | ± 9.6 % |
| 10065 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 18 Mbps) | WLAN | 9.00 | ± 9.6 % |
| 10066 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 24 Mbps) | WLAN | 9.38 | ± 9.6 % |
| 10067 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 36 Mbps) | WLAN | 10.12 | ± 9.6 % |
| 10068 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 48 Mbps) | WLAN | 10.24 | ± 9.6 % |
| 10069 | CAC | IEEE 802.11a/h WiFi 5 GHz (OFDM, 54 Mbps) | WLAN | 10.56 | ± 9.6 % |
| 10071 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 9 Mbps) | WLAN | 9.83 | ± 9.6 % |
| 10072 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 12 Mbps) | WLAN | 9.62 | ± 9.6 % |
| 10073 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 18 Mbps) | WLAN | 9.94 | ± 9.6 % |
| 10074 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 24 Mbps) | WLAN | 10.30 | ± 9.6 % |
| 10075 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 36 Mbps) | WLAN | 10.77 | ± 9.6 % |
| 10076 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 48 Mbps) | WLAN | 10.94 | ± 9.6 % |
| 10077 | CAB | IEEE 802.11g WiFi 2.4 GHz (DSSS/OFDM, 54 Mbps) | WLAN | 11.00 | ± 9.6 % |
| 10081 | CAB | CDMA2000 (1xRTT, RC3) | CDMA2000 | 3.97 | ± 9.6 % |
| 10082 | CAB | IS-54 / IS-136 FDD (TDMA/FDM, PI/4-DQPSK, Fullrate) | AMPS | 4.77 | ± 9.6 % |
| 10090 | DAC | GPRS-FDD (TDMA, GMSK, TN 0-4) | GSM | 6.56 | ± 9.6 % |
| 10097 | CAB | UMTS-FDD (HSDPA) | WCDMA | 3.98 | ± 9.6 % |
| 10098 | CAB | UMTS-FDD (HSUPA, Subtest 2) | WCDMA | 3.98 | ± 9.6 % |
| 10099 | DAC | EDGE-FDD (TDMA, 8PSK, TN 0-4) | GSM | 9.55 | ± 9.6 % |
| 10100 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK) | LTE-FDD | 5.67 | ± 9.6 % |
| 10101 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) | LTE-FDD | 6.42 | ± 9.6 % |
| 10102 | CAE | LTE-FDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) | LTE-FDD | 6.60 | ± 9.6 % |
| 10103 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, QPSK) | LTE-TDD | 9.29 | ± 9.6 % |
| 10104 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 16-QAM) | LTE-TDD | 9.97 | ± 9.6 % |
| 10105 | CAG | LTE-TDD (SC-FDMA, 100% RB, 20 MHz, 64-QAM) | LTE-TDD | 10.01 | ± 9.6 % |
| 10108 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK) | LTE-FDD | 5.80 | ± 9.6 % |



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| | | | | | |
|---|---|---|---|---|---|
| 10109 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 16-QAM) | LTE-FDD | 6.43 | ± 9.6 % |
| 10110 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK) | LTE-FDD | 5.75 | ± 9.6 % |
| 10111 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 16-QAM) | LTE-FDD | 6.44 | ± 9.6 % |
| 10112 | CAG | LTE-FDD (SC-FDMA, 100% RB, 10 MHz, 64-QAM) | LTE-FDD | 6.59 | ± 9.6 % |
| 10113 | CAG | LTE-FDD (SC-FDMA, 100% RB, 5 MHz, 64-QAM) | LTE-FDD | 6.62 | ± 9.6 % |
| 10114 | CAC | IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK) | WLAN | 8.10 | ± 9.6 % |
| 10115 | CAC | IEEE 802.11n (HT Greenfield, 81 Mbps, 16-QAM) | WLAN | 8.46 | ± 9.6 % |
| 10116 | CAC | IEEE 802.11n (HT Greenfield, 135 Mbps, 64-QAM) | WLAN | 8.15 | ± 9.6 % |
| 10117 | CAC | IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK) | WLAN | 8.07 | ± 9.6 % |
| 10118 | CAC | IEEE 802.11n (HT Mixed, 81 Mbps, 16-QAM) | WLAN | 8.59 | ± 9.6 % |
| 10119 | CAC | IEEE 802.11n (HT Mixed, 135 Mbps, 64-QAM) | WLAN | 8.13 | ± 9.6 % |
| 10140 | CAE | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 16-QAM) | LTE-FDD | 6.49 | ± 9.6 % |
| 10141 | CAE | LTE-FDD (SC-FDMA, 100% RB, 15 MHz, 64-QAM) | LTE-FDD | 6.53 | ± 9.6 % |
| 10142 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10143 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 16-QAM) | LTE-FDD | 6.35 | ± 9.6 % |
| 10144 | CAE | LTE-FDD (SC-FDMA, 100% RB, 3 MHz, 64-QAM) | LTE-FDD | 6.65 | ± 9.6 % |
| 10145 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, QPSK) | LTE-FDD | 5.76 | ± 9.6 % |
| 10146 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 16-QAM) | LTE-FDD | 6.41 | ± 9.6 % |
| 10147 | CAF | LTE-FDD (SC-FDMA, 100% RB, 1.4 MHz, 64-QAM) | LTE-FDD | 6.72 | ± 9.6 % |
| 10149 | CAE | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM) | LTE-FDD | 6.42 | ± 9.6 % |
| 10150 | CAE | LTE-FDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM) | LTE-FDD | 6.60 | ± 9.6 % |
| 10151 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK) | LTE-TDD | 9.28 | ± 9.6 % |
| 10152 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 16-QAM) | LTE-TDD | 9.92 | ± 9.6 % |
| 10153 | CAG | LTE-TDD (SC-FDMA, 50% RB, 20 MHz, 64-QAM) | LTE-TDD | 10.05 | ± 9.6 % |
| 10154 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK) | LTE-FDD | 5.75 | ± 9.6 % |
| 10155 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 16-QAM) | LTE-FDD | 6.43 | ± 9.6 % |
| 10156 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, QPSK) | LTE-FDD | 5.79 | ± 9.6 % |
| 10157 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 16-QAM) | LTE-FDD | 6.49 | ± 9.6 % |
| 10158 | CAG | LTE-FDD (SC-FDMA, 50% RB, 10 MHz, 64-QAM) | LTE-FDD | 6.62 | ± 9.6 % |
| 10159 | CAG | LTE-FDD (SC-FDMA, 50% RB, 5 MHz, 64-QAM) | LTE-FDD | 6.56 | ± 9.6 % |
| 10160 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK) | LTE-FDD | 5.82 | ± 9.6 % |
| 10161 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 16-QAM) | LTE-FDD | 6.43 | ± 9.6 % |
| 10162 | CAE | LTE-FDD (SC-FDMA, 50% RB, 15 MHz, 64-QAM) | LTE-FDD | 6.58 | ± 9.6 % |
| 10166 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, QPSK) | LTE-FDD | 5.46 | ± 9.6 % |
| 10167 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 16-QAM) | LTE-FDD | 6.21 | ± 9.6 % |
| 10168 | CAF | LTE-FDD (SC-FDMA, 50% RB, 1.4 MHz, 64-QAM) | LTE-FDD | 6.79 | ± 9.6 % |
| 10169 | CAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10170 | CAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10171 | AAE | LTE-FDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM) | LTE-FDD | 6.49 | ± 9.6 % |
| 10172 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK) | LTE-TDD | 9.21 | ± 9.6 % |
| 10173 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 16-QAM) | LTE-TDD | 9.48 | ± 9.6 % |
| 10174 | CAG | LTE-TDD (SC-FDMA, 1 RB, 20 MHz, 64-QAM) | LTE-TDD | 10.25 | ± 9.6 % |
| 10175 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK) | LTE-FDD | 5.72 | ± 9.6 % |
| 10176 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10177 | CAI | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10178 | CAG | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10179 | CAG | LTE-FDD (SC-FDMA, 1 RB, 10 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10180 | CAG | LTE-FDD (SC-FDMA, 1 RB, 5 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10181 | CAE | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK) | LTE-FDD | 5.72 | ± 9.6 % |
| 10182 | CAE | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10183 | AAD | LTE-FDD (SC-FDMA, 1 RB, 15 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10184 | CAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10185 | CAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 16-QAM) | LTE-FDD | 6.51 | ± 9.6 % |
| 10186 | AAE | LTE-FDD (SC-FDMA, 1 RB, 3 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10187 | CAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, QPSK) | LTE-FDD | 5.73 | ± 9.6 % |
| 10188 | CAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 16-QAM) | LTE-FDD | 6.52 | ± 9.6 % |
| 10189 | AAF | LTE-FDD (SC-FDMA, 1 RB, 1.4 MHz, 64-QAM) | LTE-FDD | 6.50 | ± 9.6 % |
| 10193 | CAC | IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK) | WLAN | 8.09 | ± 9.6 % |
| 10194 | CAC | IEEE 802.11n (HT Greenfield, 39 Mbps, 16-QAM) | WLAN | 8.12 | ± 9.6 % |
| 10195 | CAC | IEEE 802.11n (HT Greenfield, 65 Mbps, 64-QAM) | WLAN | 8.21 | ± 9.6 % |
| 10196 | CAC | IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK) | WLAN | 8.10 | ± 9.6 % |
| 10197 | CAC | IEEE 802.11n (HT Mixed, 39 Mbps, 16-QAM) | WLAN | 8.13 | ± 9.6 % |
| 10198 | CAC | IEEE 802.11n (HT Mixed, 65 Mbps, 64-QAM) | WLAN | 8.27 | ± 9.6 % |
| 10219 | CAC | IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK) | WLAN | 8.03 | ± 9.6 % |



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